2010P037

Power Road
Pecos Road to Santan Freeway

FINAL DRAINAGE REPORT

City of Mesa

December 2011

Prepared by

JACOBS

101 N. First Avenue

Phoenix, Az 85003

REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO.
11963
George A.
Lopez-Cepero
Date Signed 12/7/11
ARIZONA, U.S.A.

George Lopez Cepero

Expires Jan 6, 2012

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I. PROJECT DESCRIPTION

The project involves widening Power Road from Pecos Road north to SR202L, a distance of approximately 2.9 miles, Figure I.A through I.E. The project has a section, approximately 4700 feet where the northbound and southbound roadways are on separate alignment as they cross the East Maricopa Floodway (EMF) and the Roosevelt Water Conservation District (RWCD) Canal. The southbound will be along the existing alignment, the northbound will be on new alignment and will require new bridges across the EMF and the RWCD. South of Pecos Road, the project will reconstruct the roadway with new roadway profile. North of Pecos Road the project will widen the existing roadway, therefore the roadway profile is controlled by the existing roadway.

The drainage tasks on the project are to design the collection and conveyance system for the off-site flows, to evaluate the impact to the EMF by the new crossing for the northbound roadway and the widening of the existing Williams Field Road bridge, and to design the drainage features to manage the on-site pavement drainage.

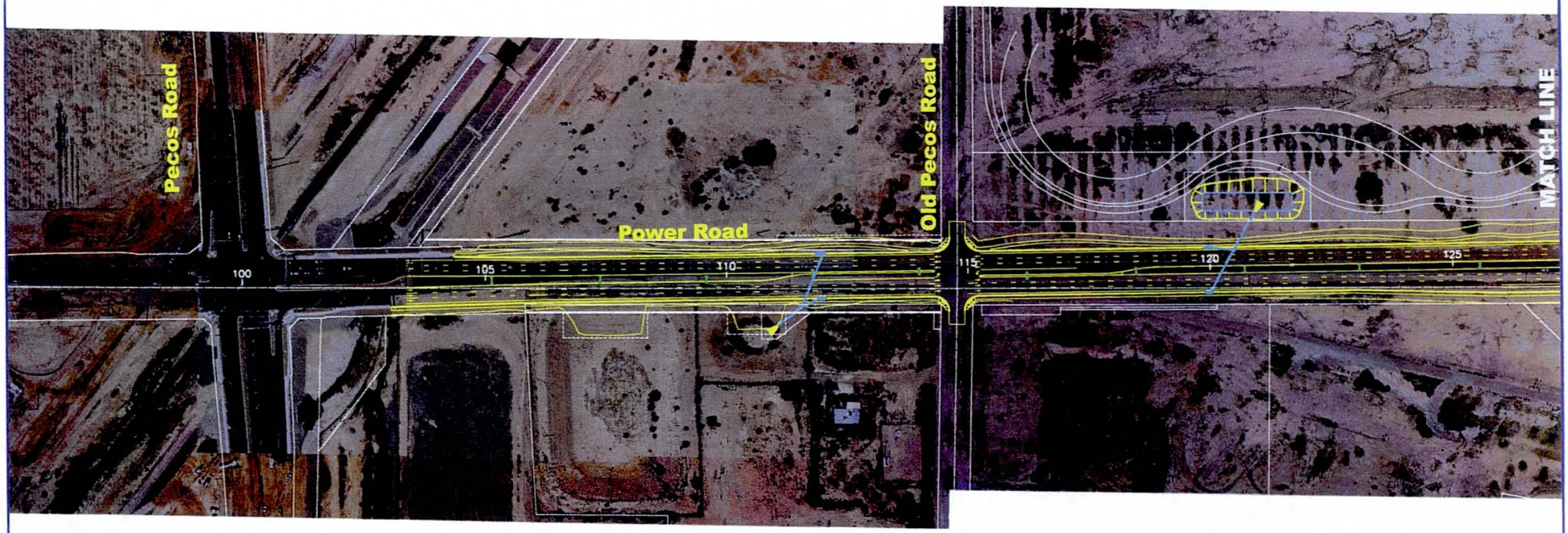
City of Mesa design criteria requires that off-site drainage facilities be adequate to pass the 50-year peak discharge under Power Road. The pavement drainage criteria are for the 10-year storm spread not to exceed the width of a travel lane and for the 100-year flow depth not to exceed curb height. South of Williams Field Road, the collected pavement drainage is discharged to either the Baysavers and then the EMF or new small on-site retention basins. North of Williams Field Road the discharge is to new detention basins.

The existing FIRM shows no floodway or floodplain along Power Road, the only floodplain shown is along the east side of the East Maricopa Floodway. See Appendix A.

II. OFF-SITE FLOWS DRAINAGE SYSTEM

A major task for the project is to manage the off-site flows that come to the project east of the EMF, especially between Pecos Road and Williams Field Road. The flow patterns that exist today are for flows to approach the existing Power Road from the east then flow north parallel with Power Road some distance to either flow overland to the northwest and spill into the EMF or continue north to the existing channel approximately 300 feet south of Williams Field Road.

The project proposes to collect the offsite flows that come to the east side of Power Road between Pecos Road and 1000 feet north of Verona Avenue in channels and convey them to EMF by a proposed box culvert under Power Road and channel. North of this location to Williams Field Road, the offsite flows will be collected and discharged to the existing lined channel south of Williams Field Road. North of Williams Field Road, there is a small area that is part of the Toka Sticks Golf Course that will be conveyed by culverts under the NB Power Road to the EMF, as it does today.



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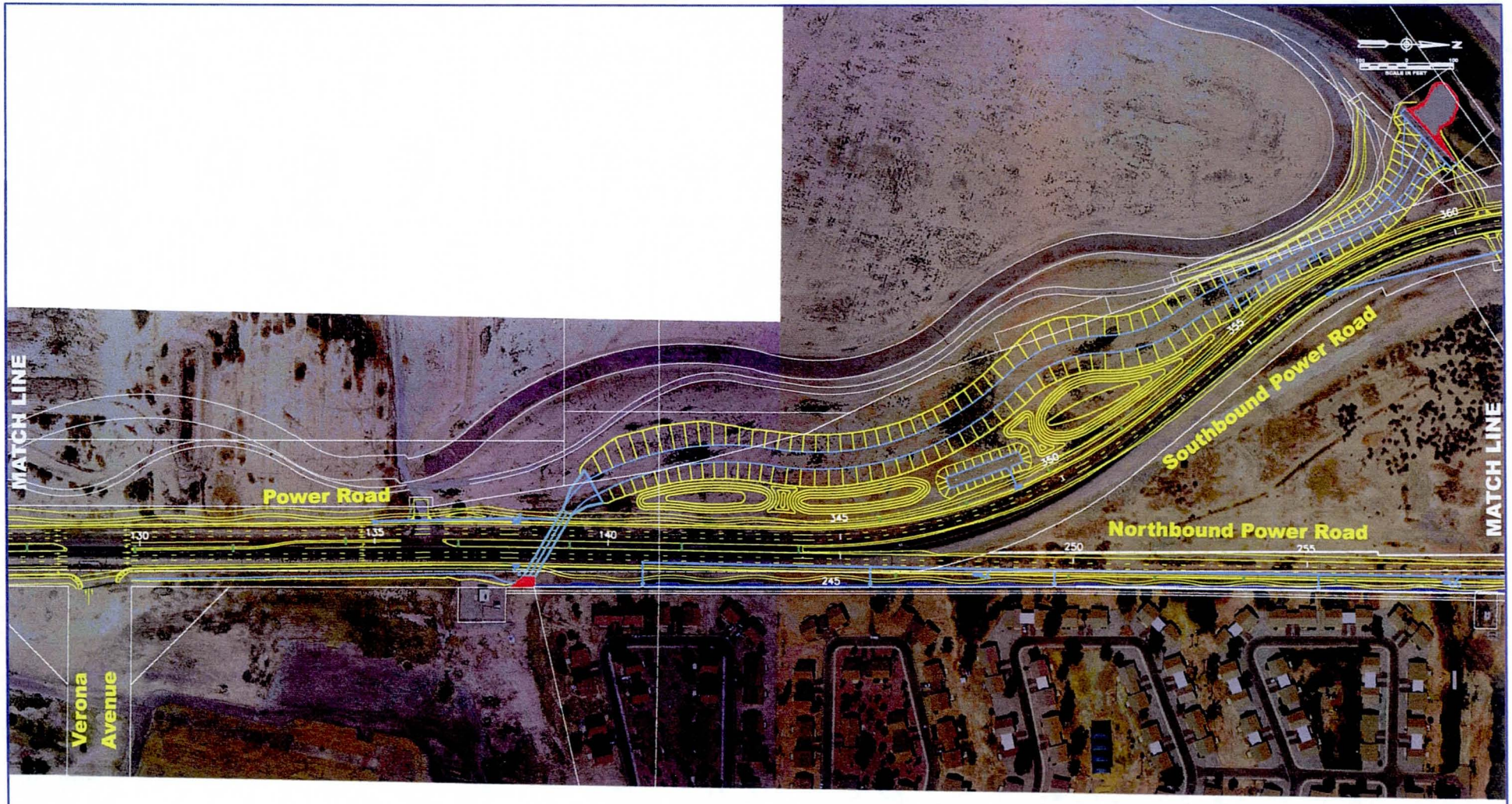
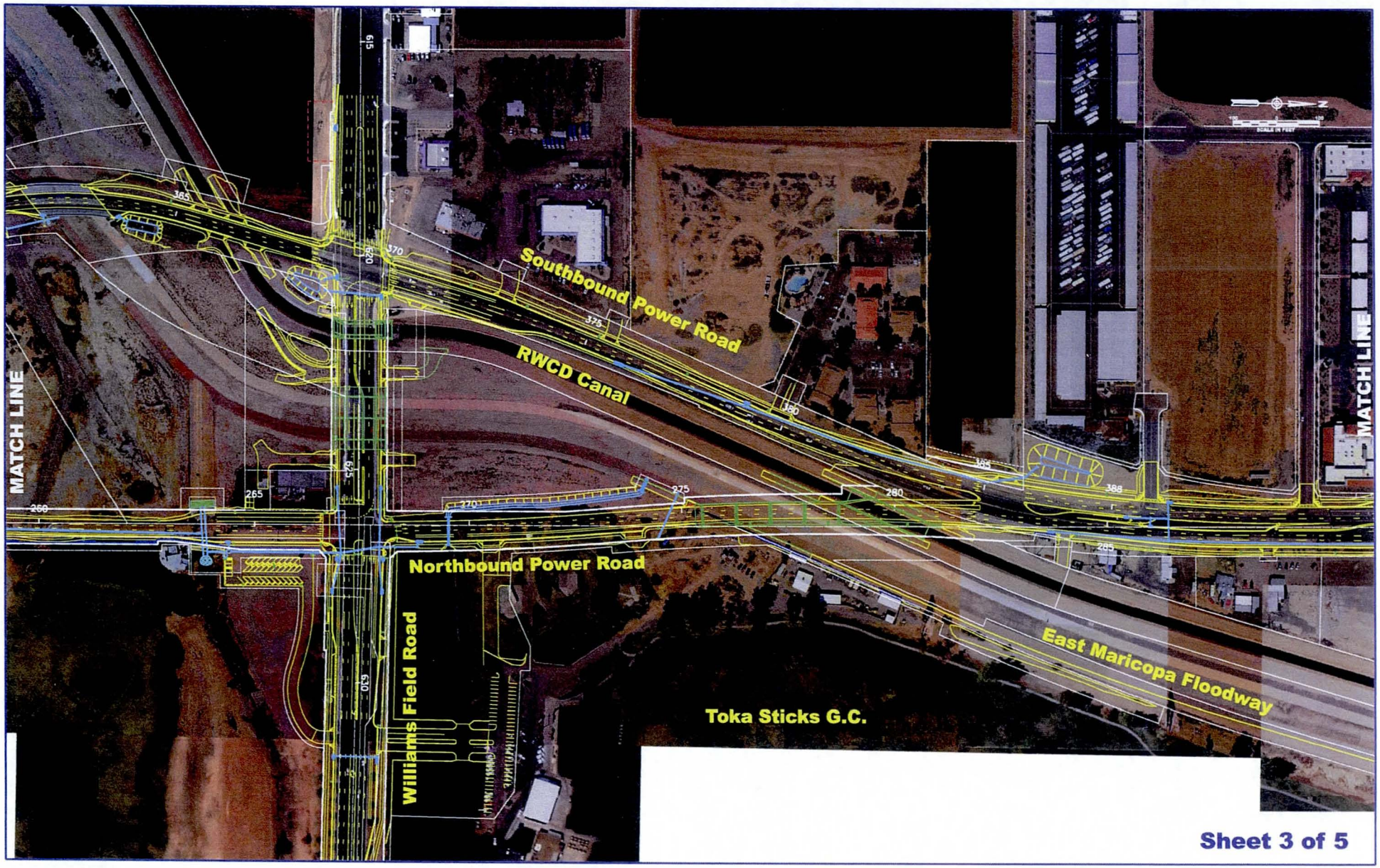
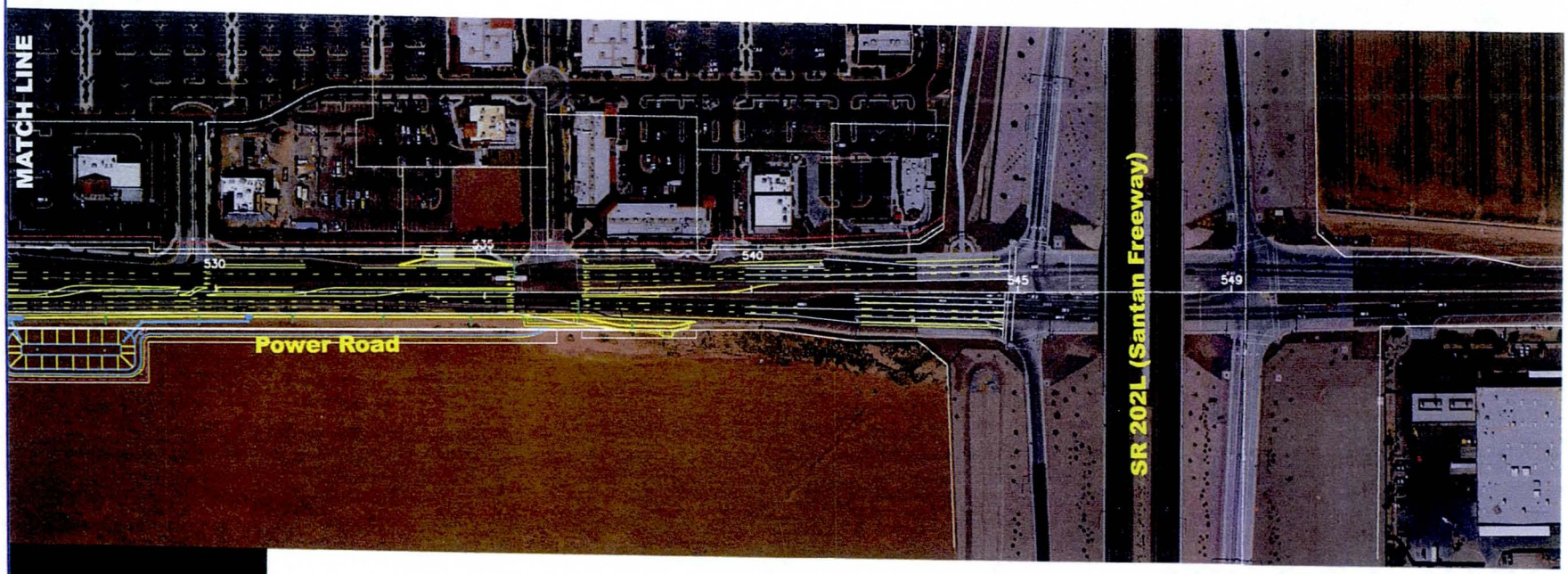

MATCH LINE
Verona Avenue
Power Road
130
135
140
245
250
255
345
350
355
360
Northbound Power Road
Southbound Power Road
MATCH LINE

Sheet 2 of 5


MATCH LINE
Southbound Power Road
RWCD Canal
Northbound Power Road
Williams Field Road
Toka Sticks G.C.
East Maricopa Floodway
MATCH LINE

Sheet 3 of 5

MATCH LINE
Galveston Street
Power Road
495
500
505
510
515
520
525
725
730
735
Ray Road
MATCH LINE
Sheet 4 of 5


MATCH LINE
530
535
540
545
549
Power Road
SR 202L (Santan Freeway)

The off-site drainage in the Pecos Road to Williams Field Road area was developed initially using the data presented in the DCR and then modified based on the new hydrology prepared by the Flood Control District of Maricopa County. Major features that impact the area include Phoenix Gateway airport (the former Williams Field AFB), and the developed and undeveloped areas to the east of Power Road. To the west of Power Road lies the Rittenhouse Detention Basin and immediately to the west of the basin is the East Maricopa Floodway (EMF). Future developments in the area are also considered in the final design. Revised drainage concepts were identified and evaluated for final design. Items considered in selecting the proposed solution include cost, right-of-way and easement requirements, utilities including an existing 24" water transmission main in Power Road, adjoining proposed improvements, and City of Mesa design criteria.

The off-site flow drainage system is presented in four sections: A. DCR Recommendations, B. Off-Site Hydrology, C. Off-Site Drainage Collection System, and D. Off-Site Drainage Conveyance.

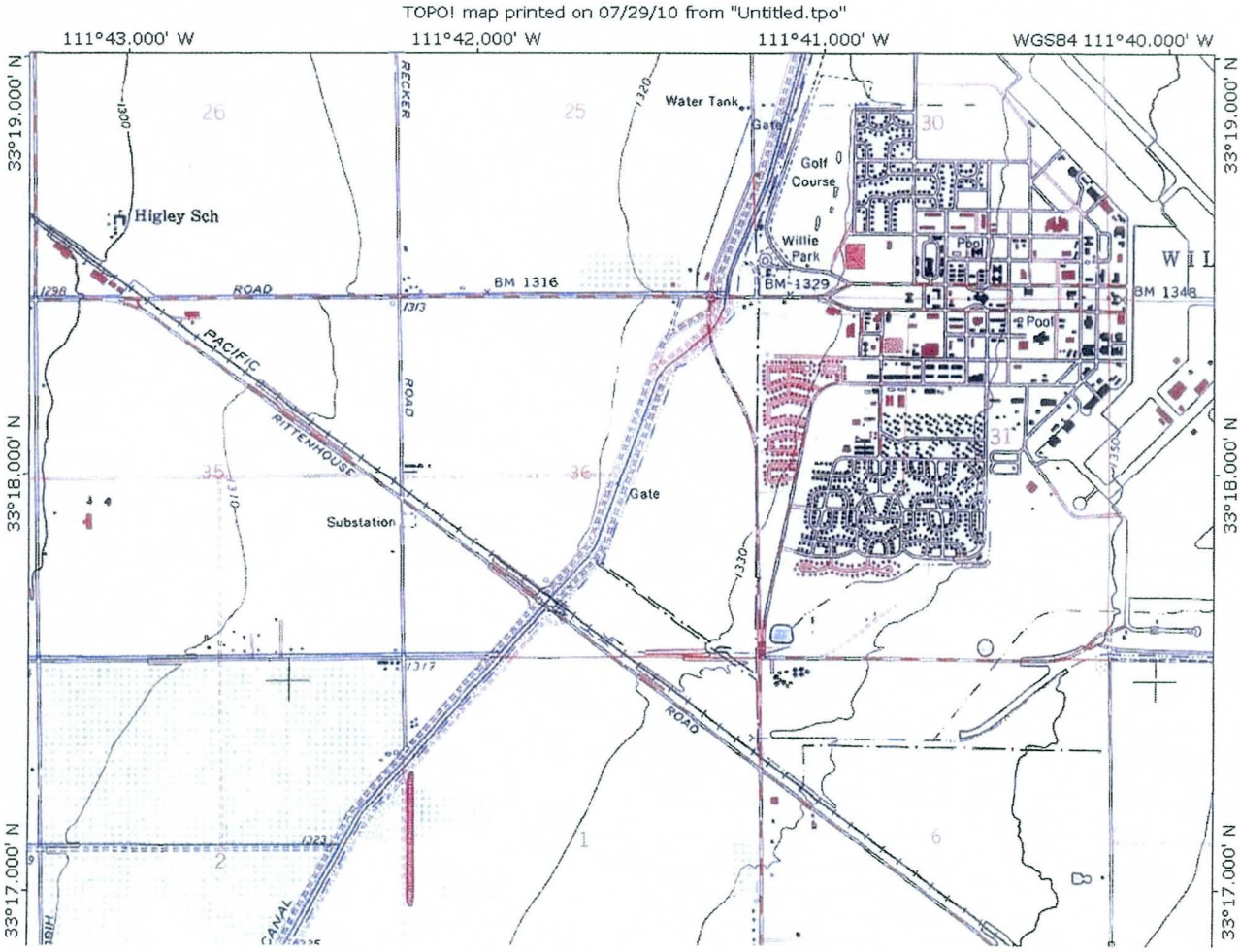


Figure II.A

II.A DCR Recommendations:

The Final Design Concept Report was prepared by Entranco in June, 2004. The off-site drainage concepts were based on hydrology from the East Mesa ADMP that had been modified for the DCR. Existing drainage patterns, Figure II.A, indicate runoff is conveyed east to west by sheet flow. In the DCR, Basin 81, east of Power Road, was subdivided and Sub-basins 81B1 and 81B2, as modified combine to produce a 100-year peak discharge of 350 cubic feet per second (cfs). This flow was to be collected along the Power Road east right-of-way and conveyed north to the EMF. In the DCR, Power Road was to follow the existing curvilinear alignment. After the DCR, it was decided to construct a section of northbound Power Road along the Section line. A review of the EMF design calculations indicated the existing concrete channel located just south of Williams Field Road has a capacity of 350 cfs. This channel conveys runoff from the northern portion of the off-site sub-basin to the EMF.

II.B Updated Off-Site Hydrology:

The Flood Control District recently obtained more accurate mapping of the area and has revised the hydrology. The revised HEC-1 model has a larger sub-basin draining to the west toward Power Road between Pecos Road and Williams Field Road, EMF3. See the attached aerial photograph Figure II.B. District staff has indicated that the larger sub-basin has a 100-year peak discharge rate of 1,226 cfs for the present conditions.

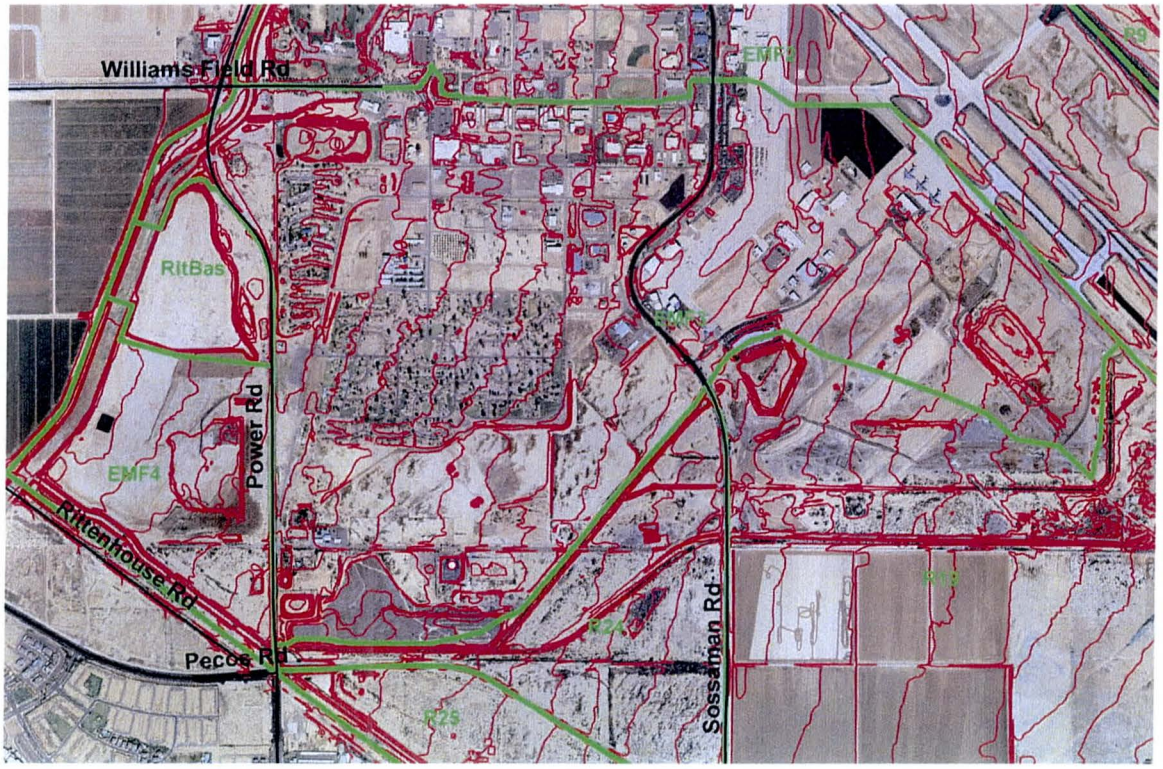


Figure II.B
Subbasin EMF3

In a meeting with the District, Jacobs was provided with a copy of the Williams Gateway Airport Master Drainage Plan developed by Dibble & Associates. In that study the existing condition 100-year peak discharge is 1,002 cfs. The study has a very detailed breakdown within subbasin EMF3. The study has two outfalls where the 100-year discharge is identified. At the north, aligned with the existing EMF unlined spillway, the 100-year discharge is 667 cfs. The south concentration point is at Old Pecos Road and the 100-year discharge is 335 cfs. There are many concentration points within the model that display the 10-year flow. The one of interest is a concentration point south of the existing housing with a 10-year discharge of 188 cfs. See Appendix B for exhibits from the Dibble & Associates study.

After consulting with the District, Jacobs used these three concentration points for identifying flow concentrations along the east side of Power Road. At the central concentration point the 100-year peak flow is estimated by multiplying the 10-year flow of 188 cfs by the ratio of 100-year/10-year flows at the northern concentration point. This results in a 100-year flow at central concentration point of

$$Qp = 188 \times (667/316) = 397 \text{ cfs.}$$

Since the flow at the central concentration point is routed to the northern concentration point in the Dibble hydrology, this flow of 397 cfs was subtracted from the total 667 cfs flow to give a flow of 269 cfs at the northern concentration point. The remainder, 733 cfs, being concentrated at the southern end of the existing housing.

These flows are based on a total flow of 1002 cfs. To use the District peak discharge from EMF3 subbasin of 1226 cfs, the flows are multiplied by 1,226/1002 = 1.226 to determine the flows used in the subsequent analyses.

Therefore, the 100-year peak flow directly to EMF at northern concentration point = 1.226 x 269 cfs = 330 cfs.

And the 100-year peak flow at the southern end of existing housing = 1226 cfs - 330 cfs = 896 cfs.

II.C Off-Site Drainage Collection System:

Currently off-site flows drain to Power Road from the east. At Old Pecos Road, there is a crest in the lands on the eastside of Power Road. The runoff enters the existing depressions between Stations 110+00 and 114+50.

North of Old Pecos Road, at Station 116+00, runoff flows north and eventually either overtops Power Road or enters the existing lined channel at Station 264+00.

The project will essentially match the existing drainage patterns: south of Old Pecos Road, the flows will drain south to the existing depressions and north of Old Pecos Road the flows will drain north and eventually discharge into the EMF. From north of Station 129+85, a V-ditch will collect and convey off-site flows north to the proposed box culvert at Station 138+75. The flows

will combine with other runoff and be conveyed under Power Road and discharged into a new channel which outlets at the EMF.

North of Station 139+00 there is a screen wall that will provide privacy to the residences east of Power Road. The ground along the east face of the wall will be graded so that off-site flows are directed to four catch basins that will collect the flows. The catch basins discharge to a storm drain system that eventually discharges at the proposed box culvert at Station 263+75. This is a new box culvert to convey the off-site flows that currently cross the northbound Power Road alignment and discharge into the existing lined channel.

The pavement drainage along this segment of Power Road will be discharged to these proposed box culverts. All pavement drainage that discharges to these culverts will be passed through "Baysaver" water quality treatment facilities. The pavement drainage that is not discharged to the box culverts will be conveyed to on-site retention basins.

The open channel that collects off-site flows is sized to convey the 50-year storm. To estimate the 50-year peak discharge rates for the sub-basins flowing toward Power Road, the 100-year peak discharge rates were first estimated based new District hydrology. These values were converted to 50-year peak discharge rates by the ratio 50-yr/100yr NOAA 14 precipitation values for this area, 0.89.

Station 129+85 to Station 138+75

Channel Design

Station 129+85 to Station 138+25

An unlined channel is proposed, it will be a Vee-ditch with 4:1 sideslope on the sidewalk side and 4:1 sideslope up to existing ground on the right-of-way side. This will provide for a safe and aesthetically pleasing facility.

Using a Manning's n value of 0.030 for the unlined channel, the computed velocities range from 1.2 feet per second (fps) to 3.6 fps. Therefore the channels will not require any lining or bank protection for the soils identified in the project geotechnical report. See Appendix C for the summary of channel results.

Box Culvert - Station 138+75

The box culvert at Station 138+75 conveys the flows that concentrate along Power Road south of the existing housing. This culvert is designed to convey the 50-year discharge of 797 cfs (Q50 = 0.89*896 cfs= 797 cfs). Flows in excess of 797 cfs that do not enter the box culvert will flow north along Power Road to the channel at Station 263+83, as they do today. Due to limited clearance available under the 24" water line in Power Road a double box culvert was evaluated. There is little fall from the box culvert to the EMF outfall, a slope of 0.0015 is used. Tailwater used in the analysis is the 50-year normal flow depth in the proposed channel of 4.0 ft. The tailwater due to the 100-year flow in the EMF is much less. Allowable headwater is the ground line at the R/W, 1326.4 east of the box culvert. The initial design of the box culvert was

will combine with other runoff and be conveyed under Power Road and discharged into a new channel which outlets at the EMF.

North of Station 139+00 there is a screen wall that will provide privacy to the residences east of Power Road. The ground along the east face of the wall will be graded so that off-site flows are directed to four catch basins that will collect the flows. The catch basins discharge to a storm drain system that eventually discharges at the proposed box culvert at Station 263+75. This is a new box culvert to convey the off-site flows that currently cross the northbound Power Road alignment and discharge into the existing lined channel.

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performed using the *ADOT Box Culvert Calculations, Version 3.01.* The required size is a 2-10x4 CBC. A HEC-RAS model of the channel and culvert was used for final design. The results are in Appendix D.

Location	Q_{50} (cfs)	Box Culvert Size (ft)	Length (ft)
Station 138+75	797	2-10' x 4'	162

Station 138+75 to Station 263+80

North of Station 139+00 there will be a screen wall that will provide privacy to the residences east of Power Road. The ground along the east face of the wall will be graded to that off-site flows are directed to four catch basins that will collect the flows. The catch basins discharge to a storm drain system that eventually discharges to the box culvert at Station 263+75. This is a new box culvert that will convey the off-site flows that currently cross the NB Power Road alignment and discharge to the existing lined channel.

Box Culvert - Station 263+83

At this location an existing unlined ditch drains both the on-site Williams Field Road runoff and the off-site runoff from properties to the east of Power Road. The existing corrugated metal pipe arches convey a portion of this flow under the Power Road alignment with the excess passing over the culverts in a grouted riprap swale. Since these culverts do not have the capacity to convey the 50-year storm water under new northbound Power Road, a new structure will be required. In addition to the runoff in the existing ditch, on-site storm drain pipes will discharge into the new culvert. The design discharge for the cross-culvert is the 50-yr flow of 294 cfs (89% of 330 cfs). Analysis of this crossing was performed using the *ADOT Box Culvert Calculations, Version 3.01.* Tailwater depth was the computed normal depth for the existing lined channel between Power Road and the EMF. Allowable head water was set at the elevation of the inlet. A summary of proposed concrete box culvert follows with the design calculations in Appendix D.

Location	Q_{50} (cfs)	Box Culvert Size (ft)	Length (ft)
Station 263+83	294.0	1-8' x 8'	92

II.D Off-Site Drainage Conveyance:

Power Road West Channel Design

At the southern concentration point, the 50-year flows will be collected and conveyed west under Power Road by the box culvert at Station 138+75 to a channel to be constructed between Southbound Power Road and the Rittenhouse Basin. This channel will discharge into the EMF south of the southbound Power Road bridge.

The Power Road West Channel is a trapezoidal channel beginning at the west side of Power Road at Station 130+85 and ending at the EMF. The channel was designed using a combination of sections: shotcrete sections with 2:1 sideslopes for the flow depth plus freeboard. Above the lined

section is a 3:1 earth section up to the existing ground. Where there is available ROW, an unlined section with 4:1 sideslopes up to existing ground. A shotcrete section flaring from 2:1 to 10:1 is used adjacent to the discharge point into the EMF where the east side EMF maintenance access road crosses the channel. Transition sections are required between these different sections.

The vertical alignment of the channel was determined by the available clearance under Power Road and the available space between Power Road and the Rittenhouse Basin. This resulted in a bed slope of 0.0015 ft/ft.

The channel is divided into five segments, four of the segments are shotcrete lined. At the southern end from the box culvert outlet to the end of the first transition is Channel Section 1. It is shotcrete lined with side slopes extending to a vertical retaining wall. The central segment is unlined with 4:1 side slopes. The second transition is Channel Section 2; it is a shotcrete lined transition with varying side slopes. The next segment is where the limited ROW required a narrower channel, Channel Section 3; it is shotcrete lined with 2:1 side slopes. Channel Section 4 is the transition at the outlet to the EMF, it transitions from the 2:1 side slopes to 10:1 side slopes. The 10:1 side slopes accommodate the maintenance road by having the road ramp down to the channel invert. The ramps are at a 10% grade (10:1) requiring the channel sideslopes being transitioned to 10:1. At the outfall into the EMF, a stilling basin is provided. See Appendix D for design calculations.

Channel Design Parameters:

Design flow = 797 cfs
Bottom width, ft – varies from 20.92 ft to 37.0 ft
Side slopes – varies from vertical at the culvert outlet to 2:1 or 4:1 and 10:1 at the EMF outlet
Freeboard: 25% of energy head = $0.25*(y+V^2/2g)$
Manning's n – shotcrete – 0.018, unlined – 0.022 and 0.032

The unlined channel was evaluated for the conditions with or without landscaping. The landscaped condition is used to determine the maximum flow depth and required channel depth. The without landscaping condition is used to determine the maximum velocities.

Without Landscaping:	With landscaping
Side Slope – 4:1	Side Slope – 4:1
n = 0.022	n = 0.032
Normal depth, ft, 3.26	Normal depth, ft = 4.00
Normal Velocity, fps, 4.89	Normal velocity, fps, 3.76
Freeboard required, ft 0.91 ft	Freeboard required, ft, 1.05

The permissible velocity is based on the project geotechnical data and using District criteria of 5.0 fps.

The channel was evaluated using HEC-RAS. HEC-RAS Standard Table 1 and the water surface profile are below:

section is a 3:1 earth section up to the existing ground. Where there is available ROW, an unlined section with 4:1 sideslopes up to existing ground. A shotcrete section flaring from 2:1 to 10:1 is used adjacent to the discharge point into the EMF where the east side EMF maintenance access road crosses the channel. Transition sections are required between these different sections.

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Normal depth, ft, 3.26	Normal depth, ft = 4.00
Normal Velocity, fps, 4.89	Normal velocity, fps, 3.76
Freeboard required, ft 0.91 ft	Freeboard required, ft, 1.05

The permissible velocity is based on the project geotechnical data and using District criteria of 5.0 fps.

The channel was evaluated using HEC-RAS. HEC-RAS Standard Table 1 and the water surface profile are below:

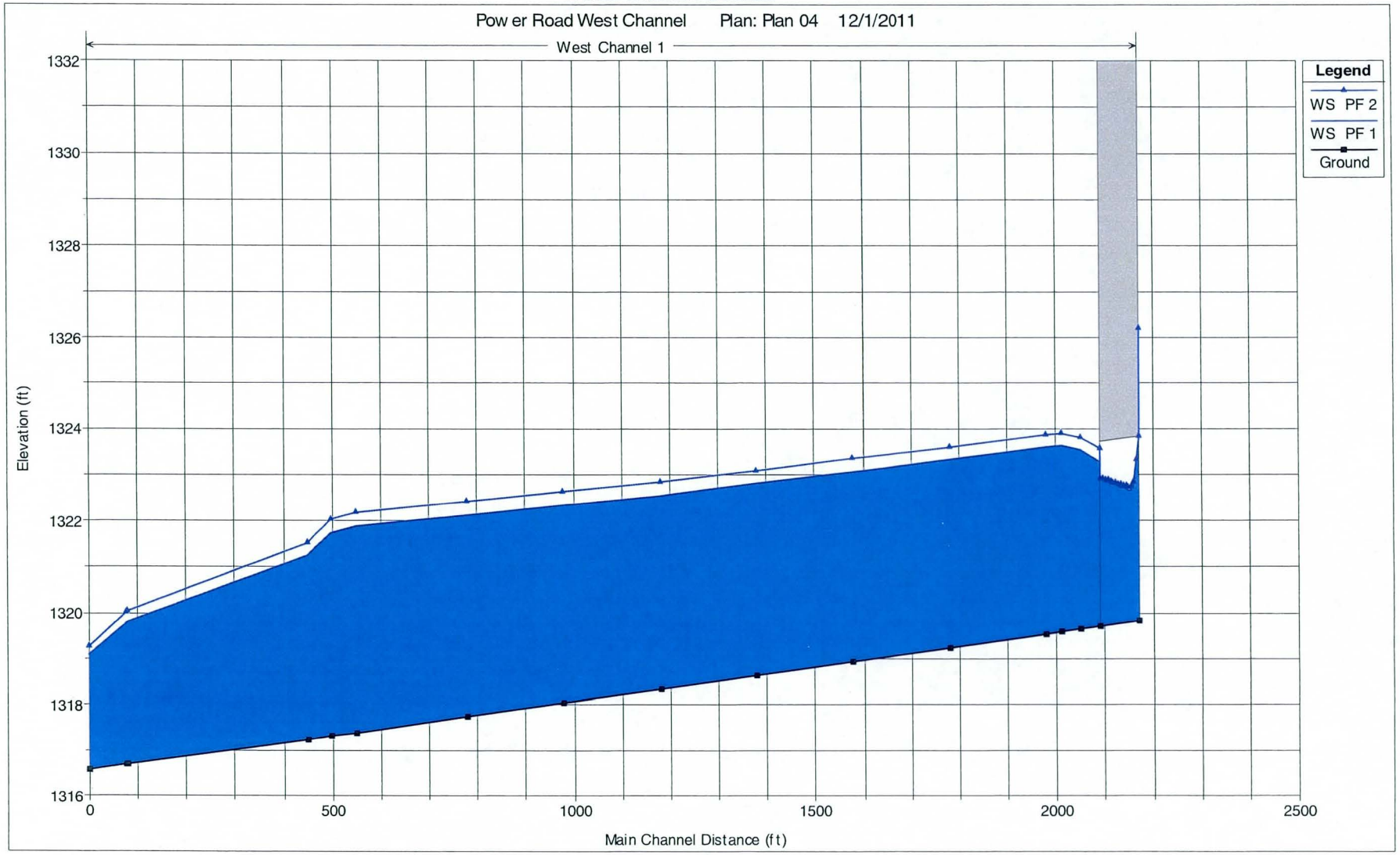
Table II.1

HEC-RAS Version 4.1

Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	-1000	1	797	1319.83	1325.35	1323.89	1326.10	0.001277	6.94	114.90	20.82	0.52
Reach 1	-1001	1	797	Culvert								
Reach 1	-1080.8	1	797	1319.71	1323.27	1323.27	1325.07	0.004628	10.76	74.08	20.82	1.01
Reach 1	-1140/8	1	797	1319.65	1323.55		1323.90	0.000727	4.77	166.94	50.00	0.46
Reach 1	-1160.8	1	797	1319.59	1323.62		1323.84	0.000461	3.73	213.90	69.17	0.37
Reach 1	-1161	1	797	1319.59	1323.62		1323.84	0.000461	3.73	213.90	69.17	0.37
Reach 1	-1200	1	797	1319.53	1323.60		1323.81	0.001402	3.68	216.77	69.50	0.37
Reach 1	-1400	1	797	1319.23	1323.33		1323.53	0.001370	3.65	218.54	69.70	0.36
Reach 1	-1600	1	797	1318.93	1323.06		1323.26	0.001330	3.61	220.86	69.97	0.36
Reach 1	-1800	1	797	1318.63	1322.80		1323.00	0.001279	3.56	223.88	70.31	0.35
Reach 1	-2000	1	797	1318.33	1322.56		1322.75	0.001218	3.50	227.76	70.75	0.34
Reach 1	-2200	1	797	1318.03	1322.33		1322.51	0.001147	3.43	232.68	71.31	0.33
Reach 1	-2400	1	797	1317.73	1322.11		1322.29	0.001065	3.34	238.80	70.75	0.32
Reach 1	-2629.5	1	797	1317.39	1321.89		1323.43	0.000966	3.22	247.29	71.31	0.31
Reach 1	-2630	1	797	1317.39	1321.89		1322.05	0.000306	3.22	247.28	71.99	0.31
Reach 1	-2680	1	797	1317.31	1321.75		1322.02	0.000523	4.17	191.30	82.98	0.40
Reach 1	-2730	1	797	1317.24	1321.26		1321.94	0.001466	6.60	120.69	38.07	0.65
Reach 1	-3100	1	797	1316.68	1319.81	1319.78	1321.07	0.003576	9.00	88.60	34.54	0.99
Reach 1	-3101	1	797	1316.68	1319.78	1319.78	1321.07	0.003708	9.11	87.50	34.41	1.01
Reach 1	-3179	1	797	1316.56	1318.43	1319.10	1320.53	0.010787	13.01	73.25	56.40	1.68

Figure II.C
Water Surface Profile



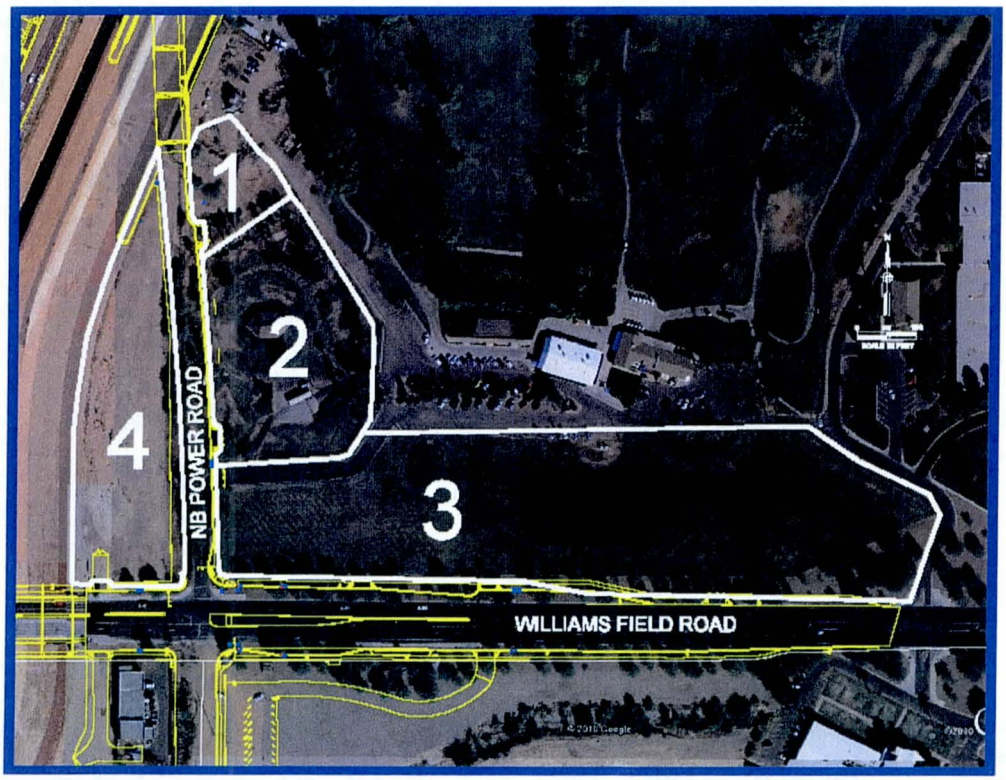
TOKA STICKS DRAINAGE

North of Williams Field Road, northbound Power Road crosses an existing off-site outfall into the EMF. This drains an area of the TOKA STICKS golf course, see below. The project will install pipe culverts to convey the flow discharges to the EMF. The system has two parts. Areas 1, 2 and 3 that are east of northbound Power Road and Area 4 that is west of Power Road. Area 1 will be drained to the west by a small culvert under northbound Power Road that discharges adjacent to the pipes for Areas 3 and 4. Area 2 is a self-contained basin that does not drain to the EMF. For Area 3 two concrete elliptical pipes will convey the flows under the northbound Power Road to a channel on the west side of Power Road. This channel will also collect flows from Area 4. The channel conveys the flows north to a new pair of pipes under the maintenance access road ramp that then discharge to the EMF. The design flow for these structures is the 100-year peak discharge determined by use of the Rational Method.

The hydraulic data is

Element	Size	Subbasin Area, Acre	Peak Q, cfs	Headwater Ft.
Pipe 1	1-18"	0.56	2.4	0.84
Pipe 3	2-19x30	6.1	30.0	2.0
Pipe 4	2-19x30	2.3	1.61	2.58

The HY-8 pipe culvert computations are in Appendix E.



III. EAST MARICOPA FLOODWAY

The East Maricopa Floodway (EMF) is a flood control channel that conveys storm water runoff from the east Mesa area to the Gila River. The Power Road project will construct a new bridge for the northbound Power Road and widen the existing Williams Field Road across the EMF. Jacobs obtained the existing HEC-2 water surface profile model from the District. As HEC-RAS uses a slightly different bridge modeling procedure than HEC-2, Jacobs needed to modify the model by narrowing the bridge definition and creating additional cross-sections immediately upstream and downstream of the proposed bridge. Jacobs was also provided with a graphic of the 1990 capacity study by HNTB. This was a set of plan sheets showing the HEC-2 cross-sections and the resultant water surface elevations in the area of interest. The information shown was for three conditions; the design condition, Q = 6,500 cfs, the existing condition (1990), Q = 11,900 cfs, and the future condition, Q = 8,500 cfs. The District stated that Jacobs should use the design condition to evaluate the impacts of the project.

IV.A BRIDGE HYDRAULIC MODELING

Widened Williams Field Road Bridge

The existing bridge superstructure is supported with concrete girders, the proposed widening will be by use of concrete box beams. The concrete box beams are used so that the low chord of the widened bridge is higher than the existing low chord resulting in no reduction in bridge freeboard. In the HEC-RAS model, the widened Williams Field Road bridge was modeled by adding additional length to the pier to represent the widened bridge. Excerpts of the bridge plans are included in Appendix F.

Northbound Power Road Bridge

The proposed northbound bridge is a 4-span girder bridge using AASTHO Type III girders with each span being 80 feet. The bridge is at a skew of 65 degrees. The layout of the piers results in four columns in the bottom of the EMF with pairs of columns generally aligned with the flow. Although the highway alignment is skewed in relation to the EMF, the piers are set to be in-line with the flow. The arrangement is a pier cap and two piers per cap. This arrangement results in piers of different frames being aligned with the flow, i.e, the south pier of frame 1 is aligned with the north pier of frame 2. The pier columns are 4-foot diameter. Excerpts of the bridge plans are included in Appendix F.

The existing HEC-RAS model was first modified by the addition of new cross-sections located at the proposed bridge location. The proposed bridge was modeled using the Bridge/Culvert Data Table in HEC-RAS. The bridge was described as having 2 piers in the flow with the abutments on the bank, out of the flow. HEC-RAS cross-section plots are in Appendix F.

IV.B FREEBOARD

An analysis of the impact of widening Williams Field Road Bridge and constructing a new northbound Power Road bridge was performed. The analysis shows a rise in the water surface of a maximum of 0.59 feet for the sections upstream of the bridge. Since the EMF has limited freeboard, the District requested that the freeboard be evaluated. The desired freeboard is 20% of

the energy head, $0.2*(H+V^2/2g)$. The critical freeboard is for the east bank (left looking downstream). Since the Roosevelt Water Conservation District canal lies to the west, right looking downstream, the freeboard on the west bank is not an issue.

Water surface relation to adjacent ground

When the EMF freeboard was being evaluated, it was determined that at a few locations the calculated water surface was slightly higher than the natural ground east of the maintenance road. Since the elevations used in the model were from a surface model contour map determined from aerial photography with contour intervals of 2 ft, Jacobs had ground survey performed at five cross-sections of interest; channel stations 17.480, 17.571, 17.672, 17.802, and 17.898.

DATUM adjustment

In a meeting in July 2011 with the District, Jacobs was directed to use the datum difference between the project datum and District datum to adjust the surveyed cross-sections. These adjusted cross-sections were used to replace the existing aerial mapping cross-sections in the HEC-RAS model.

Jacobs used the county benchmark at the section corner at the intersection of Power Road and Williams Field Road. This benchmark is near the future bridge location. The NAVD elevation for this benchmark is 1326.93. From the District web site, a correction of +1.66 feet is shown to adjust the 1929 NAVD elevations to 1988 NGVD elevations. In addition the project survey used a base elevation of 1327.09 for the section corner brass cap. Therefore the elevation adjustment is -1.82 feet to adjust any project elevation (NGVD1988) to the 1929 NAVD elevations used in the HEC-RAS models. The results of the HEC-RAS with the datum adjusted cross-sections are attached in Appendix F.

Results:

Freeboard

Exhibit IV.3 shows the freeboard for both the existing condition and the "with project" condition. It is determined that the freeboard for the existing condition is deficient at certain cross-sections. The maximum deficiency is 1.39 ft approximately 540 feet upstream of the future northbound Power Road bridge. The project raises the water 0.56 feet at Section 17.480 which results in a maximum increase of 0.67 feet of freeboard deficiency.. The results are shown in Exhibit IV.3 and Figure IV.4. Jacobs proposed and the District agreed that this deficiency in freeboard could be mitigated by construction of a 8" concrete curb along the east side of the existing maintenance road. This curb will extend from the northside of the new northbound bridge to the location of the existing swale that allows off-site flows to enter the EMF.

Water surface relation to adjacent ground

The table below provides a comparison between the 100-year water surface devaiation in the EMF and the low existing ground east of the EMF.

Section ID	Water Surface Elev.	Ground Surface Elev.	Difference
17.898	1323.88	1324.21	0.33
17.803	1323.49	1324.24	0.75
17.672	1323.12	1323.32	0.20
17.571	1322.81	1322.59	-0.22
17.480	1322.56	1322.67	0.11

Since the low area at River Station 17.571 is a small local depression, the project will fill the area to an elevation above the water surface in the EMF.

Exhibit IV.1

Existing with project bridge cross-sections and survey cross-sections

HEC-RAS Version 4.0

Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 4	18.345	Design	6500	1317.07	1326.63	1321.26	1326.87	0.000425	4.00	1624.83	206.88	0.25
Reach 4	18.237	Design	6500	1317.30	1326.48	1321.19	1326.76	0.000115	4.23	1536.33	189.74	0.26
Reach 4	18.193	Design	6500	1315.38	1325.31	1322.18	1326.45	0.000506	8.57	782.77	147.37	0.54
Reach 4	18.087	Design	6500	1315.14	1324.47	1322.46	1326.06	0.000785	10.1	643.49	88.51	0.66
Reach 4	17.898	Design	6500	1314.28	1323.68	1321.63	1325.27	0.000782	10.14	640.94	87.12	0.66
Reach 4	17.803	Design	6500	1313.90	1323.21	1321.27	1324.87	0.000821	10.32	629.80	86.55	0.67
Reach 4	17.672	Design	6500	1313.23	1322.76	1320.56	1324.29	0.000735	9.91	656.23	88.19	0.64
Reach 4	17.571	Design	6500	1312.67	1322.39	1320.09	1323.90	0.000718	9.86	659.56	87.60	0.63
Reach 4	17.480	Design	6500	1312.34	1322.08	1319.72	1323.55	0.000692	9.71	669.37	88.52	0.62
Reach 4	17.469	Design	6500	1312.26	1322.03	1319.83	1323.50	0.000729	9.74	667.05	91.86	0.64
Reach 4	17.468	Design	6500	1312.26	1322.03	1319.82	1323.50	0.000728	9.74	667.29	91.88	0.64
Reach 4	17.467	Design	6500	1312.26	1322.02	1319.82	1323.50	0.000729	9.75	667.01	91.84	0.64
Reach 4	17.453	Design	6500	1312.16	1321.99	1319.71	1323.43	0.000705	9.63	674.79	92.16	0.63
Reach 4	17.452	Design	6500	1312.16	1321.99	1319.71	1323.43	0.000706	9.64	674.41	92.14	0.63
Reach 4	17.451	Design	6500	1312.16	1321.98	1319.70	1323.43	0.000709	9.65	673.36	92.09	0.63
Reach 4	17.437	Design	6500	1312.05	1321.95	1319.59	1323.36	0.000682	9.53	682.39	92.46	0.62
Reach 4	17.436	Design	6500	1312.05	1321.95	1319.57	1323.36	0.000682	9.53	682.33	92.45	0.62
Reach 4	17.435	Design	6500	1312.05	1321.95	1319.58	1323.36	0.000682	9.53	682.31	92.45	0.62
Reach 4	17.339	Design	6500	1311.41	1321.77	1318.83	1322.99	0.000550	8.85	734.82	94.43	0.56
Reach 4	17.288	Design	6500	1311.13	1321.68	1318.55	1322.82	0.000515	8.59	756.28	96.76	0.54
Reach 4	17.269	Design	6500	1311.04	1321.64	1318.36	1322.77	0.000492	8.53	761.85	94.99	0.53
Reach 4	17.261		Bridge	Williams Field Road								
Reach 4	17.254	Design	6500	1310.98	1321.4	1318.38	1322.63	0.000544	8.87	732.44	92.72	0.56

Exhibit IV.2

Project with Bridge

HEC-RAS Version 4.0

Table1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 4	18.345	Design	6500	1317.07	1326.69	1321.26	1326.94	0.000414	3.97	1638.81	207.32	0.25
Reach 4	18.237	Design	6500	1317.30	1326.55	1321.19	1326.82	0.000112	4.19	1549.85	190.1	0.26
Reach 4	18.193	Design	6500	1315.38	1325.42	1322.18	1326.53	0.000486	8.45	799.00	149.8	0.53
Reach 4	18.087	Design	6500	1315.14	1324.64	1322.46	1326.16	0.000735	9.87	659.41	100.16	0.64
Reach 4	17.898	Design	6500	1314.28	1323.94	1321.63	1325.43	0.000707	9.79	664.08	88.18	0.63
Reach 4	17.803	Design	6500	1313.90	1323.56	1321.27	1325.07	0.000717	9.84	660.54	87.95	0.63
Reach 4	17.672	Design	6500	1313.23	1323.20	1320.56	1324.56	0.000623	9.35	695.35	89.95	0.59
Reach 4	17.571	Design	6500	1312.67	1322.91	1320.09	1324.23	0.000593	9.21	705.38	89.67	0.58
Reach 4	17.480	Design	6500	1312.34	1322.67	1319.72	1323.93	0.000557	9.00	722.42	90.89	0.56
Reach 4	17.469	Design	6500	1311.84	1322.76	1319.39	1323.85	0.000476	8.38	776.05	97.24	0.52
Reach 4	17.468		Bridge	Northbound Power Road								
Reach 4	17.453	Design	6500	1311.79	1322.13	1319.34	1323.39	0.000582	9.00	722.05	94.51	0.57
Reach 4	17.435	Design	6500	1311.73	1322.08	1319.26	1323.33	0.000576	8.97	724.38	94.48	0.57
Reach 4	17.339	Design	6500	1311.41	1321.83	1318.83	1323.03	0.000538	8.78	740.49	94.7	0.55
Reach 4	17.288	Design	6500	1311.13	1321.74	1318.55	1322.87	0.000503	8.53	762.37	97.04	0.54
Reach 4	17.269	Design	6500	1311.04	1321.71	1318.36	1322.82	0.000479	8.45	769.36	95.33	0.52
Reach 4	17.261		Bridge	Williams Field Road								
Reach 4	17.250	Design	6500	1311.10	1321.39	1318.44	1322.60	0.000546	8.83	736.52	94.6	0.56

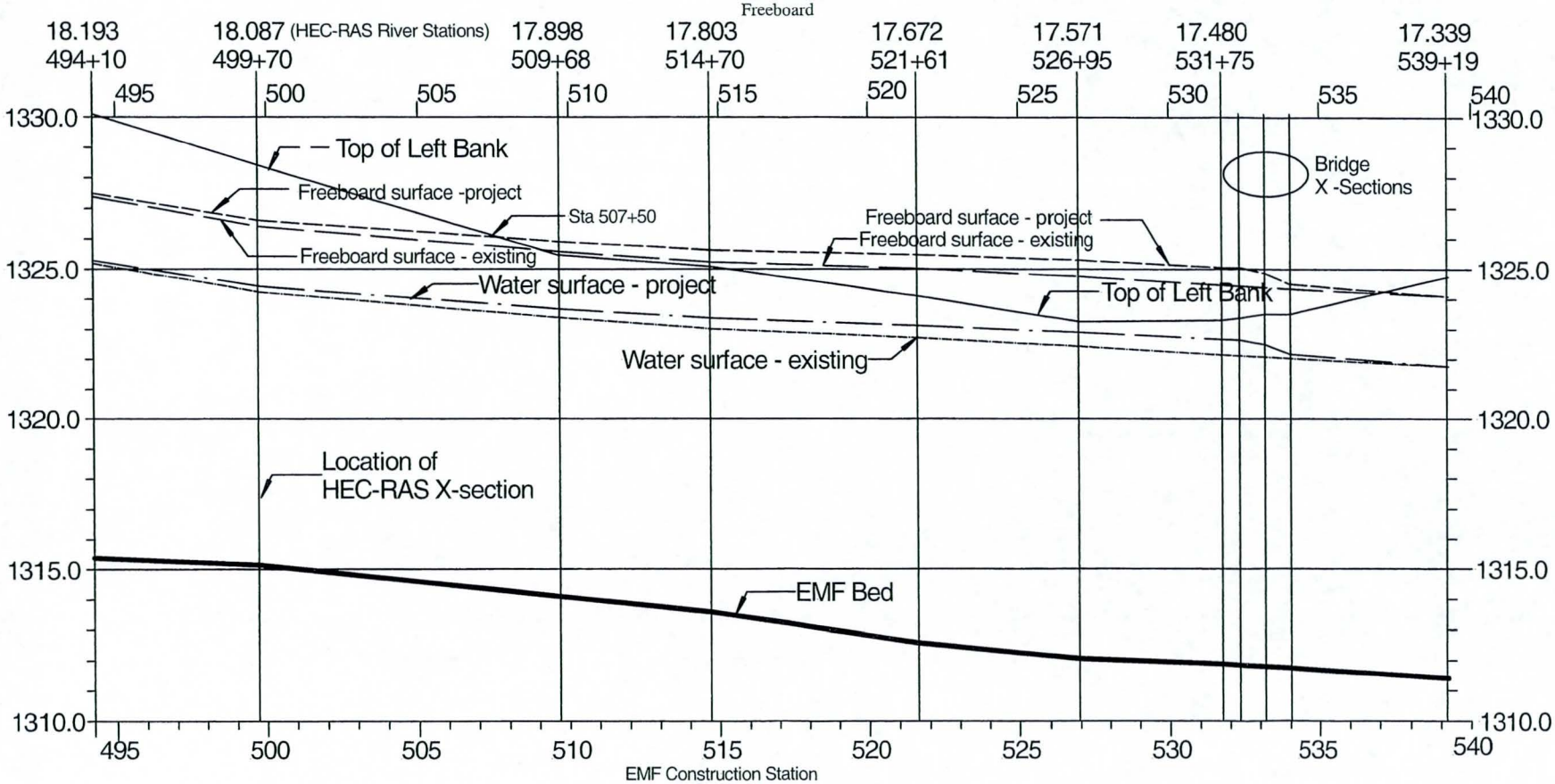
Exhibit IV.3
Freeboard

HEC-RAS Version 4.0

1	2	3	4	5	6	7	8	9	10	11	12
		Existing Condition					**With Project Condition - NB Bridge**				
X-Sec	Min Ch El	W.S. Elev	FB req	FB Elev	ToB - FBE	Top of Bank	W.S. Elev	FB req	FB Elev	ToB - FBE	Change in Freeboard
		HEC-RAS	FB=0.2xEH	FB+WSEL	Left	left	HEC-RAS	FB=0.2xEH	FB+WSEL	Left	
--	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
18.237	1317.30	1326.48	1.89	1328.37	0.03	1328.40	1326.55	1.90	1328.45	-0.05	-0.08
18.193	1315.38	1325.31	2.21	1327.52	2.58	1330.10	1325.42	2.23	1327.65	2.45	-0.13
18.087	1315.14	1324.47	2.18	1326.65	1.75	1328.40	1324.64	2.20	1326.84	1.56	-0.19
17.898	1314.10	1323.68	2.20	1325.88	**-0.27**	1325.61	1323.94	2.23	1326.17	**-0.56**	**-0.29**
17.803	1313.58	1323.21	2.19	1325.40	**-0.08**	1325.32	1323.56	2.23	1325.79	**-0.47**	**-0.39**
17.672	1312.57	1322.76	2.21	1324.97	**-0.34**	1324.63	1323.20	2.27	1325.47	**-0.84**	**-0.49**
17.571	1312.05	1322.39	2.25	1324.64	**-0.81**	1323.83	1322.91	2.31	1325.22	**-1.39**	**-0.59**
17.480	1311.88	1322.08	2.24	1324.32	**-0.92**	1323.40	1322.67	2.32	1324.99	**-1.59**	**-0.67**
17.469	1311.84	1322.03	2.25	1324.43	**-1.08**	1323.35	1322.76	2.32	1325.08	**-1.73**	**-0.65**
17.453	1311.79	1321.99	2.25	1324.39	**-0.95**	1323.44	1322.13	2.25	1324.38	**-0.94**	**0.02**
17.437	1311.73	1321.95	2.26	1324.34	**-0.83**	1323.51	1322.08	2.26	1324.34	**-0.83**	**0.01**
17.339	1311.41	1321.77	2.32	1324.09	0.61	1324.70	1321.83	2.32	1324.15	0.55	-0.07
17.288	1311.13	1321.68	2.34	1324.02	1.39	1325.41	1321.74	2.35	1324.09	1.32	-0.07
17.269	1311.04	1321.64	2.35	1323.99	1.72	1325.71	1321.71	2.36	1324.07	1.64	-0.08
17.261	Williams Field Road Bridge										

Area in yellow is location of Power Road columns.

Figure IV.4
Freeboard



V. PAVEMENT DRAINAGE

Concept

The Power Road project is a Capital Improvement Project, therefore the pavement drainage is managed by the use of storm drain system. Due the relative flatness of area, several systems will be necessary.

The pavement runoff from the area south of the EMF and RWCD will discharge to either the EMF or to small on-site retention basins. The pavement runoff from north of the EMF and RWCD and south of Ray Road will be managed by discharging to several local retention basins. Although gravity discharge to the EMF for this area would be the desired, it is not possible. In many locations, the 100-year water surface in the EMF is higher than the Power Road gutter elevations. This would result in water escaping from the EMF. Also, to connect to the EMF would require going under the RWCD canal. The clearance between the bottom of the RWCD and the EMF is approximately 4.0 ft. This is insufficient to provide sufficient clearance from the bottom of the RWCD to the top of a pipe.

North of Ray Road the drainage will either go to a basin in northeast of the corner of Ray Road and Power Road or north of the crest at Station 536+00 go to the ADOT drainage system.

Peak Discharge

As the pavement runoff areas are relatively small, less than 160 acres, the runoff is calculated using the Rational Method. The inputs for calculating the peak runoff using the Rational Method are the contributing drainage area, A; the coefficient of runoff, C; and the rainfall intensity based on the time of concentration, i.

The runoff coefficients used are:

0.95 for concrete
0.85 for asphalt, and
0.70 for landscaped areas.

The time of concentration for overland flow is determined using the Papadakis & Kazan equation as described in the Maricopa County Flood Control District Hydrology Manual. A minimum time of concentration of 10 minutes is specified. For the pavement drainage, the distance to inlets is short so that the computed time of concentration would be less than the minimum. Therefore a time of concentration of ten minutes is used for inlet analysis. The analysis of flow in storm drains is performed step-wise, at each inlet the additional contributing area is added and the rainfall intensity is adjusted based on the travel time from the next upstream inlet.

The rainfall used for analysis of pavement follows the procedures from the Maricopa County Flood Control District. The rainfall intensity used is by application of the PREFRE computer program. The program uses 4 rainfall amounts determined from

Rainfall Maps in the County Manual as input and determines the rainfall amount for a full range of duration and frequency. See Appendix G for the rainfall maps and PREFRE output

The rainfall inputs are:

	Duration	
Frequency	6 hr	24 hr
2-yr	1.1 in	1.35 in
100-yr	3.0 in	3.7 in

The results for the 10-yr and 100-yr rainfall are

	Duration	
Frequency	5 min	15 min
10-yr	0.455 in	0.874 in
100-yr	0.699 in	1.375 in

The rainfall intensity for the 10-minute duration is determined by multiplying the rainfall amount by the number of time increments in one hour to get the intensities then averaging the 5 and 15 minute intensities to get the rainfall intensity in inches/hour.

The resulting intensities are:

10-year: i = (0.455*12+0.874*4)/2 = 4.48 in/hr
100-yr: i = (0.699*12+1.375*4)/2 = 6.94 in/hr

Retention

The required retention volume is based on the runoff from the 100-year 2-hour storm. For the project area this is 2.70 inches of rainfall. See Appendix H for the 100-year 2-hour rainfall map.

Required Volume of Retention:

Vr = (CA)*D/12
Vr = (0.85*A1+0.95*A2+0.70*A3)*2.7/12 cubic feet

Inlet interception

The inlet spacing is based on meeting the spread criteria. The City of Mesa and the Town of Gilbert require that for the 10-year storm the spread be limited to one traffic lane. For the project, the right most traffic lane is 11.0 feet wide with an adjacent bicycle lane, 6.0 feet in Mesa and 5.5 feet in Gilbert. In summary, the allowable spread is

Mesa - 17.0 feet
Gilbert - 16.5 feet

Inlets are analyzed using the commonly accepted procedure presented in FHWA HEC-12 manual. The inlets used for this project are MAG 533 with wing length varying as needed to accomplish the required interception. See Appendix I for MAG 533 Details. This inlet includes a 1" local depression. The roadway profile is generally very mild, with much of the roadway gradient at the minimum desired of 0.4%. This flat grade increases the efficiency of inlets to capture flow while at the same time making the spread criteria more critical.

The cross-slope is generally 2%, the exceptions are the areas where the roadways are on curvilinear alignment and at major intersections. At the north end of the project the project will only widen the existing roadway, this will result in matching the longitudinal profiles along the existing edge. There are several existing roadway sections where the longitudinal is very flat, in those sections the cross-slope will be slightly steeper.

Inlet location is determined based on the spread criterion for the 10-year event. Once the inlet location is determined, the inlet is sized considering the 100-year event. For inlets on grade, generally the inlet is sized to capture from 70% to 90%. Inlets at sumps are sized so that the depth at the sump is less than the curb height.

There are several locations where the MAG 533 curb opening inlet is not used. North of Ray Road, the inlets are located at the valley gutter, at these locations a combination of inlet and slotted drain is used. Also the inlets on Ray Road are special situations; on the north side of Ray Road, an irrigation pipe is situated under the sidewalk. This irrigation pipe interferes with the installation of any inlet that extends beyond the curb line. For these inlets ACO was contacted for use of their TD100 trench drain system. The final design uses a MAG 533 curb opening inlet at the east end, then three locations of the ACO trench drain. The ACO trench drain system was evaluated using the procedures in HEC-22 for slotted drain. The clogging factor used in 0.8 in accordance with MCFCD procedures.

The results of the analyses are presented in Table IV.A. See Appendix J for the Drainage Area delineation, Appendix K for Inlet computations and computer output.

Table V.A

Power Road				INLET SUMMARY							
Pecos Road to Santan Fwy											
Precipitation	10 Min. Intensity					**10-yr**	**4.48**		**100-yr**	**6.94**	
Roadway	Station	***CA***	slope	Cross-slope	Wing	**Q10**	Spread, ft	depth, inches	**Q100**	Spread, ft	depth, inches
NB Power Rd	112+00	1.016	-0.47	0.02		4.55	14.5	3.86	7.06	17.2	4.49
		0.269	+0.4	0.02		1.20	9.0	2.52	1.87	10.7	2.93
		1.285	0	0.02	6	5.75	11.4	5.11	8.92	17.7	6.62
SB Power Rd	112+00	0.900	-0.36	0.02		4.03	14.6	3.87	6.25	17.3	4.51
		0.253	+0.40	0.02		1.13	8.8	2.47	1.76	10.4	2.87
		1.153	0	0.02	10	5.17	6.7	3.97	8.01	11.8	5.20
NB Power Rd	120+00	0.482	-0.68	0.02		2.16	10.2	2.81	3.35	12.0	3.26
		0.638	+0.4	0.02		2.86	12.6	3.38	4.43	14.8	3.93
		1.120	0	0.02	6	5.02	9.8	4.71	7.78	15.6	6.10
SB Power Rd	120+00	0.587	-0.68	0.02		2.63	11.0	3.00	4.08	13.0	3.49
		0.695	+0.40	0.02		3.11	13.0	3.48	4.83	15.3	4.05
		1.282	0	0.02	6	5.74	11.4	5.10	8.90	17.7	6.61
						Check spread at Verona					
NB Power Rd	128+80	0.309	-0.21	0.02	Spread	1.38	10.7				
SB Power Rd	135+00	1.056	-0.40	0.02	3	4.73	15.2	4.02	7.33	18.0	4.68
NB Power Rd	138+00	0.887	-0.4	0.02		3.97	14.2	3.78	6.16	16.8	4.40
		0.424	+0.4	0.02		1.90	10.7	2.99	2.92	12.7	3.41
		1.311	0	0.02	6	5.87	11.7	5.17	9.10	18.1	6.70

Table V.A

Power Road											
Pecos Road to Santan Fwy											
Roadway	Station	***CA***	slope	Cross-slope	Wing	**Q10**	Spread, ft	depth, inches	**Q100**	Spread, ft	Depth, inches
SB Power Rd	138+00	0.375	-0.34	0.02		2.59	12.5	3.36	4.96	16.0	4.20
		0.336	+0.40	0.02		1.51	9.8	2.72	2.33	11.6	3.15
		0.711	0	0.02	6	4.10	7.5	4.18	7.30	14.6	5.88
NB Power Rd	248+00	0.959	-0.52	0.02		4.29	13.9	3.71	6.66	16.5	4.38
		0.568	+0.4	0.02		2.54	12.0	3.25	3.94	14.2	3.77
		1.527	0	0.02	6	6.84	13.7	6.56	10.6	20.7	7.34
NB Power Rd	258+00	0.636	.-0.40	0.02		2.85	12.5	3.38	4.42	14.8	3.93
		0.331	+0.40	0.02		1.48	9.7	2.70	2.30	11.5	3.14
		0.967	0	0.02	6	4.33	8.1	4.32	6.71	13.4	5.59
NB Power Rd	264+40	0.400	-0.33	0.02		1.79	10.9	2.98	2.78	12.9	3.46
		0.382	+0.40	0.02		1.71	10.3	2.84	2.65	12.2	3.29
		0.782	0	0.02	3	3.50	9.2	4.59	5.43	14.7	5.89
NB Power Rd	268+78	0.934	-0.62	0.02	6	4.18	13.4	3.57	6.49	15.8	4.10
NB Power Rd	283+74	0.830	-1.19	0.02		3.72	11.3	3.07	5.76	13.3	3.56
		0.139	+0.11	0.02		0.62	8.9	2.51	0.97	10.6	2.92
		0.969	0	0.02	6	4.34	8.1	4.32	6.73	13.5	5.60
NB Power Rd	285+44.26	0.111	-1.10	0.01739	3	0.50	5.6	1.57	0.77	6.7	1.80

Table V.A

Power Road											
Pecos Road to Santan Fwy											
Roadway	Station	***CA***	slope	Cross-slope	Wing	**Q10**	Spread, ft	depth, inches	**Q100**	Spread, ft	depth, inches
NB Power Rd	286+00	0.259	-.37	0.0270		1.16	7.4	2.63	1.80	8.7	3.07
			n/a		3	1.16	1.2	2.27	1.80	2.8	3.05
SB Power Rd	349+00	0.889	-0.20	0.0355		3.98	11.4	4.96	6.17	13.5	5.84
		0.625	+0.40	0.0355		2.80	8.8	3.84	4.34	10.3	4.51
		1.514	0	0.0355	6	6.78	8.3	5.63	10.51	12.2	7.31
SB Power Rd	357+00	0.235	-0.40	0.0373		1.05	5.9	2.70	1.63	6.9	3.18
		0.425	+0.45	0.0373		1.90	7.2	3.29	2.95	8.5	3.87
		0.660	0	0.0373	3	2.96	4.7	4.17	4.58	7.3	5.35
SB Power Rd	361+89.94	0.381	-1.44	0.08*[1]		1.71	1.7	3.32	2.65	4.0	3.92
		0.381	0	0.08	3*[2]	1.71	3.5	3.35	2.65	4.4	4.28
	363+60	0.167	-1.94	0.08	3	0.75	2.4	2.31	1.16	2.8	2.72
SB Power Rd	368+33	0.334	-0.84	0.02	Spread	1.50	8.5	2.40	2.32	10.0	2.78
SB Power Rd	376+00	0.740	-0.40	0.0206	10.0	3.31	13.0	358	5.14	15.4	4.17

NOTES: 1. Gutter cross-slope =0.08 at SB 361+89.94
2. Inlet on bridge, local depression = 0.0 inches

Table V.A

Power Road											
Pecos Road to Santan Fwy											
Roadway	Station	***CA***	Slope	Cross-slope	Wing	**Q10**	Spread, ft	depth, inches	**Q100**	Spread, ft	depth, inches
SB Power Rd	379+00	0.372	-0.80	0.02		1.67	8.8	2.52	2.59	10.4	2.92
		0.681	+0.40	0.02		3.05	12.9	3.46	4.73	15.2	4.02
		1.053	0.00	0.02	6	4.72	9.1	4.55	7.31	14.7	5.89
SB Power Rd	389+30	0.683	-0.98	0.0215		3.06	10.4	3.02	4.74	12.3	3.51
		0.506	+1.04	0.0215		2.27	9.1	2.70	3.51	10.8	3.13
		1.189	0.00	0.0215	6	5.32	9.8	4.88	8.26	15.4	6.33
NB Power Rd	495+90	0.617	0.26	0.02		2.76	11.2	3.87	4.28	13.2	4.53
		0.243	+0.18	0.02		1.09	8.4	2.97	2.02	10.6	3.70
		0.860	0	0.02	3	3.86	10.3	4.85	6.31	16.9	6.42
SB Power Rd	496+00	0.601	-0.14	0.02		2.69	13.9	3.70	4.17	16.4	4.30
			-0.21	0.02		2.69	12.3	3.31	4.17	14.5	3.85
		0.228	1.09	0.02		1.61	8.3	2.35	2.83	10.3	2.84
		0.829	0	0.02	3	4.3	11.6	5.16	7.01	18.9	6.91
SB Power Rd	497+40	0.506	+0.22	0.02	20' SD	2.26	16.5	2.42	3.52	19.5	2.86
NB Power Rd	497+45	0.653	+0.18	0.02	6	3.23	12.7	4.37	5.64	15.7	5.34
SB Power Rd	501+00	0.401	-0.14/0.26	Treat as on grade	6	1.80	11.4	3.11	3.07	14.0	3.73
			+0.19	0.02							

Table V.A

Power Road											
Pecos Road to Santan Fwy											
Roadway	Station	***CA***	slope	Cross-slope	Wing	**Q10**	Spread, ft	depth, inches	**Q100**	Spread, ft	depth, inches
NB Power Rd	502+10	0.804	+0.20	0.02	3	3.60	13.0	4.46	5.58	15.3	5.22
SB Power Rd	504+00	0.697	+0.19	0.02	6	3.12	15.0	3.96	4.84	17.7	4.6
NB Power Rd	513+00	0.669	-0.21	0.02	3	3.00	14.5	3.84	4.65	16.7	4.37
NB Power Rd	516+60	0.484	-0.20	0.02	3	2.38	13.4	3.57	4.25	16.7	4.37
NB Power Rd	518+69.17	0.299	-0.40	0.02	3	1.42	9.6	2.67	2.77	12.4	3.34
NB Power Rd	522+10	0.538	0.218	0.02		2.41	13.2	3.54	3.88	15.8	4.17
		0.152	1.40	0.02		0.70	5.6	1.71	1.96	8.5	2.41
		0.690	0	0.02	3	3.11	8.0	4.29	5.69	15.4	6.05
NB Power Rd	523+92.23	0.166	-1.47	0.02		1.13	6.8	1.99	2.91	15.4	4.06
		0.259	+0.09	0.02		1.19	11.9	3.23	2.31	15.4	4.06
		0.425	0	0.02	3	2.32	5.1	3.60	5.22	14.1	5.76
NB Power Rd	526+25	0.475	+0.19	0.02	3	2.21	13.1	3.52	3.79	16.1	4.23
NB Power Rd	530+60	0.540	+0.19	0.02	3	2.42	13.6	3.63	3.75	16.0	4.22

Table V.A
Ray Road

Power Road											
Pecos Road to Santan Fwy											
Roadway	Station	***CA***	slope	Cross-slope	Wing	**Q10**	Spread, ft	depth, inches	**Q100**	Spread, ft	depth, inches
WB Ray Rd	726+98	0.126	+0.74	0.0064	Slotted Drain 15.0	0.56	11.7	1.50	0.98	14.8	1.73
WB Ray Rd	727+80	0.222	+0.74	0.0130	Slotted Drain 20.0	1.00	9.6	1.98	1.78	12.1	2.37
WB Ray Rd	729+20	0.362	+0.36	0.0118	Slotted Drain 20.0	1.62	14.3	2.53	2.65	17.3	2.95
WB Ray Rd	732+46	0.595	+0.28	0.02	MAG 533 10	2.66	13.1	3.50	4.13	15.5	4.08
EB Ray Rd	727+15	0.264	+0.77	0.0186	3	2.25	12.8	2.56	4.51	16.7	3.21
EB Ray Rd	729+50	0.350	+0.42	0.02	3	5.06	15.5	4.08	7.85	18.3	4.75
EB Ray Rd	732+46	0.780	+0.18	0.02	Spread	3.49	15.8	4.15	5.42	18.6	4.84

* for westbound Ray Road, the slotted drain inlet dimensions are based on HEC-22 procedures using a clogging factor of 0.8. It is expected that ACO TS100 trench drain will be used.

Table V.A
Williams Field Road - Westbound

Power Road											
Pecos Road to Santan Fwy											
Roadway	Station	***CA***	Slope	Cross-slope	Wing	**Q10**	Spread, ft	depth, inches	**Q100**	Spread, ft	Depth, inches
WB WF Rd	617+00	0.600	1.3919	0.0158	3	2.69	11.1	2.55	4.17	13.2	2.94
WB WF Rd	621+00	0.125	0.80	0.0049	3	0.56	13.6	1.42	0.87	16.4	1.59
WB WF Rd	625+45	0.394	0.51	0.010147	3	1.76	15.1	2.37	2.74	17.9	2.76
WB WF Rd	627+10W	0.273	-0.93	0.0077		1.37	14.4	1.91	3.10	9.9	2.42
	627+10E	0.100	0.20	0.0077		0.45	12.5	1.73	0.77	15.6	2.01
	627+10	0.373	0	0.0077	3	1.81	5.2	3.06	3.87	24.7	4.86
WB WF Rd	627+82	0.535	0.20	0.0`754	6	2.40	14.5	3.47	3.72	17.2	4.03
WB WF Rd	631+70	0.708	0.20	0.015758	10	3.`7	17.3	3.71	4.92	20.4	4.30

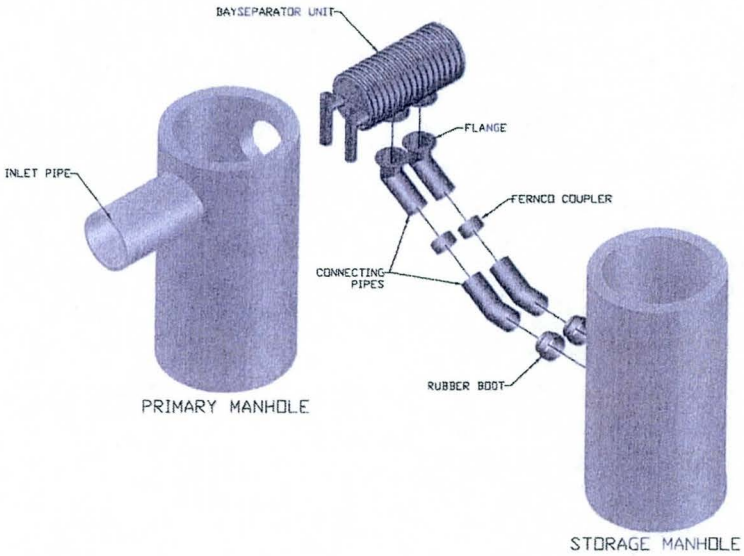
Table V.A
Williams Field Road - Eastbound

Power Road											
Pecos Road to Santan Fwy											
Roadway	Station	***CA***	Slope	Cross-slope	Wing	**Q10**	Spread, ft	depth, inches	**Q100**	Spread, ft	Depth, inches
EB WF Rd	617+00	0.778	1.2891	0.0188	6	3.48	11.2	2.92	5.40	13.3	3.39
EB WF Rd	620+50	0.140	0.82	0.0091	3	0.63	9.7	1.61	0.97	11.6	1.82
EB WF Rd	625+45	0.439	0.61	0.0100	3	1.97	15.4	2.38	3.05	18.2	2.73
EB WF Rd	627+10W	0.235	-0.59	0.0080		1.05	13.8	1.90	1.97	17.8	2.28
	627+10E	0.102	0.20	0.0080		0.46	12.3	1.76	1.14	17.7	2.28
	627+10	0.337	0	0.0080	3	1.51	1.7	2.49	3.11	11.0	3.86
EB WF Rd	627+82	0.475	0.20	0.01755	6	2.60	14.8	3.70	4.74	18.7	4.52
EB WF Rd	631+70	0.793	0.20	0.01727	3	3.55	17.0	3.95	5.51	20.1	4.59

Water Quality Treatment - "First Flush" - BaySaver Design:

To meet the Flood Control District of Maricopa County requirements for discharge of storm water to the EMF, the "first flush" of the on-site runoff must be collected and treated. This is generally accomplished by the use of retention basins. In the Power Road project where discharge is to the EMF, land is not available for the storage required to provide treatment. Therefore a treatment system produced by BaySaver Technologies, Inc. has been selected to provide treatment for on-site runoff prior to discharge. At most discharge locations, only the on-site runoff is treated, at one location it is practical to combine the off-site runoff with the on-site runoff and treat the total volume of storm water.

The BaySeparator system begins operating as soon as runoff enters the system. During a storm event, flow enters a Primary Manhole for initial separation. The flow is then conveyed to an offline Storage Manhole where oils, fine suspended solids and floatables are collected. Since the water flow is regulated into the Storage Manhole, re-suspension is eliminated during higher flows. In addition, the system's chambers are fully accessible for inspection and maintenance from the surface without entry to the system. The layout of the BaySeparator is shown below.



The BaySeparator system has two characteristic flow rates: the maximum treatment rate (MTR) and the maximum hydraulic rate (MHR). The MTR is the maximum flow rate that can be fully treated by the BaySeparator unit without any bypass. The MHR is the maximum flow rate that can be conveyed through the BaySeparator. The MHR, or bypass flow capacity, allows the BaySeparator system to be installed online, without the need for a separate diversion structure.

Standard BaySeparator Model Designation	BaySeparator Nominal Diameter (in)	Maximum Treatment Rate (MTR) (cfs)	Maximum Hydraulic Rate (MHR) (cfs)	Manhole Diameter/ Length (in)	Manhole/ Vault Depth (ft)
1/2K	24	1.1	8.5	48	6
1K	24	2.4	10	48	8
3K	36	7.8	30	60	8
5K	48	11.1	50	72	8
10K	60	21.8	100	120	8
SV	24	5.3-23.1	16.0-101.8	48-96	4-6
SV-FS	24	5.3-23.1	16.0-101.8	48-96	4-6
TT-5	24	2.8/0.33	16.0	48	4
TT-8	24	2.9/0.53	16.0	48	4

To size the BaySeparator unit, the design maximum flow through the storm drain must first be calculated. In this project, this is the 100-year peak discharge rate. For units that will receive both on-site and off-site runoff, the peak rate for each was computed. Since the time of concentration and time to peak flow varies greatly, the higher value of on-site vs. off-site was used for the MHR.

Since the "first flush" design criteria requires the treatment of the first ½" of rainfall, it was necessary to determine the rainfall intensity at the time of ½" rainfall. Using NOAA 14 data, it was computed to be approximately 4.6 in/hr, very close to the 10-year peak discharge. With this data the BaySeparator model was selected. A summary of the results follow with the computations in Appendix L.

Station, Offset	Model No.	Nominal Diameter (in)	Q_{10} (cfs)	MTR (cfs)	Q_{100} (cfs)	MHR (cfs)	Manhole Diameter (in)	Manhole Depth (ft)
119+80, 72' Lt	10K	60	11.8	21.8	18.3	100	120	8
120+05, 58' Rt	10K	60	11.8	21.8	24.0	100	120	8
135+76, 72' Lt	5K	48	9.9	11.1	15.3	50	72	8
135+76, 67' Rt	5K	48	9.6	11.1	15.0	50	72	8
248+42, 33' Rt	10K	60	13.0	21.8	20.2	100	120	8
257+76, 20' Rt	3K	36	5.2	7.8	8.1	30	60	8
264+43, 76' Rt	10K	60	15.8	21.8	24.5	100	120	8
361+93, 48' Rt	3K	36	5.7	7.8	8.9	30	60	8

Retention Basin Design:

8 locations where identified for retention basins. In accordance with City of Mesa regulations, the required retention storage volume is for the 100-year, 2-hour storm event. The rainfall depth was determined in accordance with the isopluvial map, Figure 3.3 of the *Drainage Design Manual for Maricopa County, Volume 1, Hydrology*. For the Power Road project vicinity, the 100-year, 2-hour rainfall depth is 2.7". Appendix H.

Design criteria for retention basins that are accessible by the public include side slopes of 4:1 and maximum storage depth of 3.5 feet. Several basins are deeper than 3.5 feet, these basins are designed with steeper side slopes and will require fencing or other means to limit access. Storm water disposal will be accomplished by the use of drywells. As specified by City of Mesa regulations, each drywell will be limited to draining 9,300 cubic feet of stored water. A summary of the results follow with the computations in Appendix M.

Location	Required Storage Volume (cu ft)	Number of Drywells
SB 349+00	14,836	2
SB 363+60	1,030	1
SB 386+70	17,573	2
NB 510+40	110,810	12
NB 526+25	14,113	2
EB WFR 617+00	4,352	1
EB WFR 620+50	2,597	1
WB WFR 617+00	5,881	1

Power Road
Pecos Road to 202L
Final Drainage Report

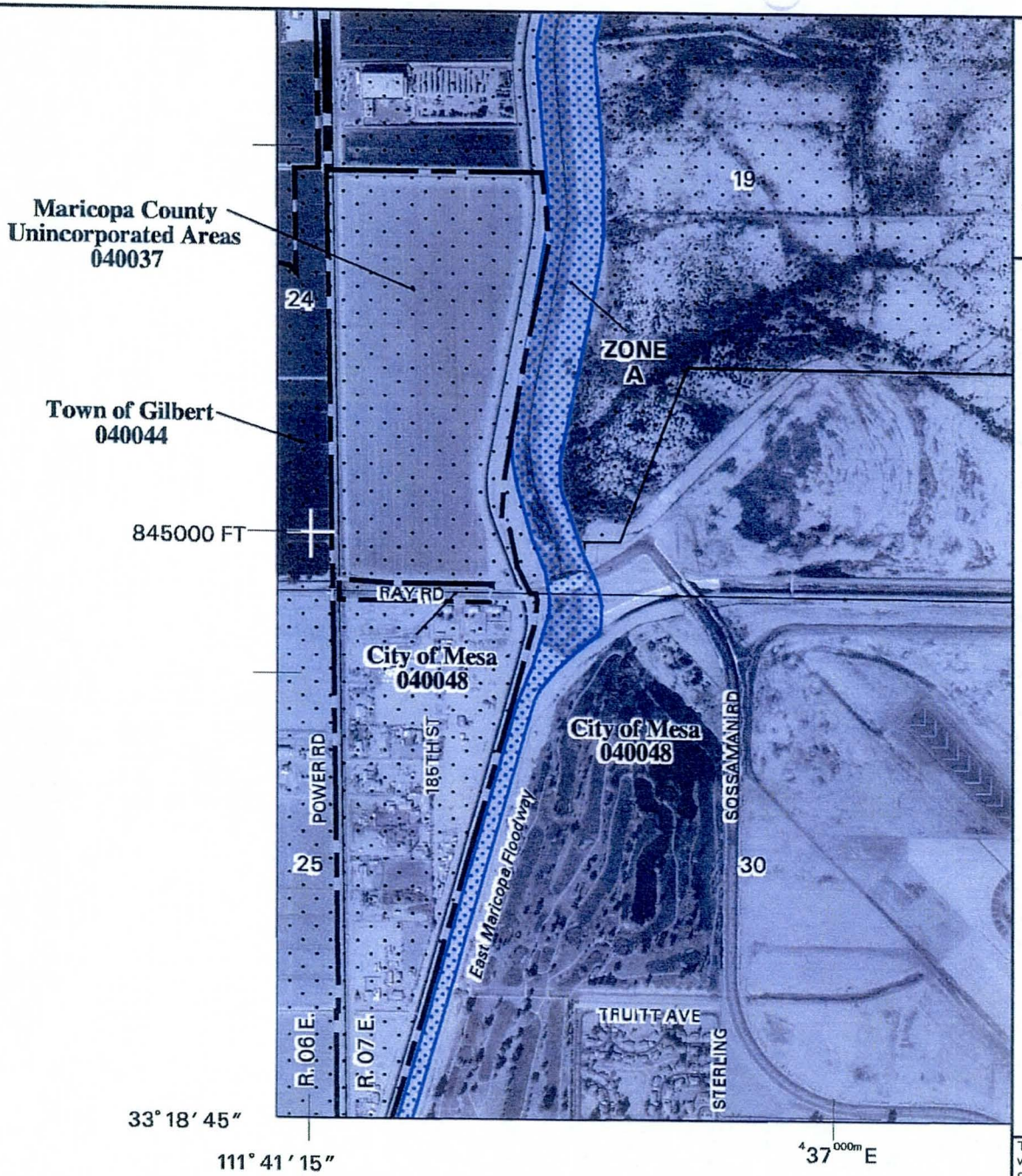
Appendices

Appendix A	FEMA FIRM
Appendix B	Dibble & Associates Study Plans
Appendix C	Power Road West Channel
Appendix D	Culvert Analyses
Appendix E	Toka Sticks Drainage
Appendix F	Bridge HEC-RAS analysis
Appendix G	Rainfall Maps
Appendix H	100-yr 2-Hr Precipitation Map
Appendix I	MAG 533 Inlet
Appendix J	Contributing Drainage Area Map
Appendix K	Inlet Analyses
Appendix L	BaySaver Data
Appendix M	Retention Basins

Power Road
Pecos Road to 202L
Final Drainage Report

Appendix A

FEMA FIRM



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2685H

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 2685 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GILBERT, TOWN OF	040044	2685	H
MARICOPA COUNTY	040037	2685	H
MESA, CITY OF	040048	2685	H

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
04013C2685H

MAP REVISED
SEPTEMBER 30, 2005

Federal Emergency Management Agency

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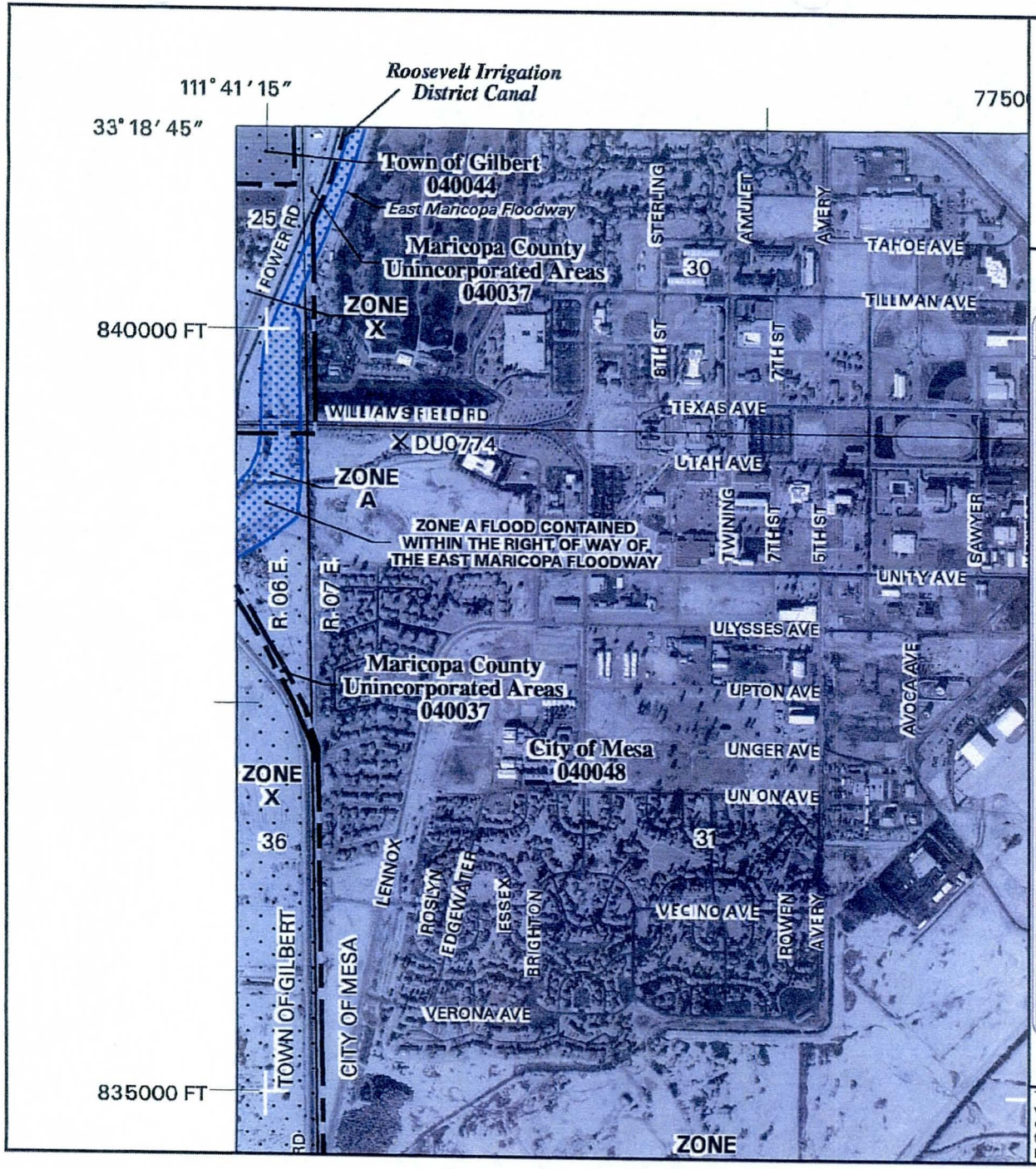

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2695H

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 2695 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GILBERT, TOWN OF	040044	2695	H
MARICOPA COUNTY	040037	2695	H
MESA, CITY OF	040048	2695	H
QUEEN CREEK, TOWN OF	040132	2695	H

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MAP NUMBER
04013C2695H

MAP REVISED
SEPTEMBER 30, 2005

Federal Emergency Management Agency

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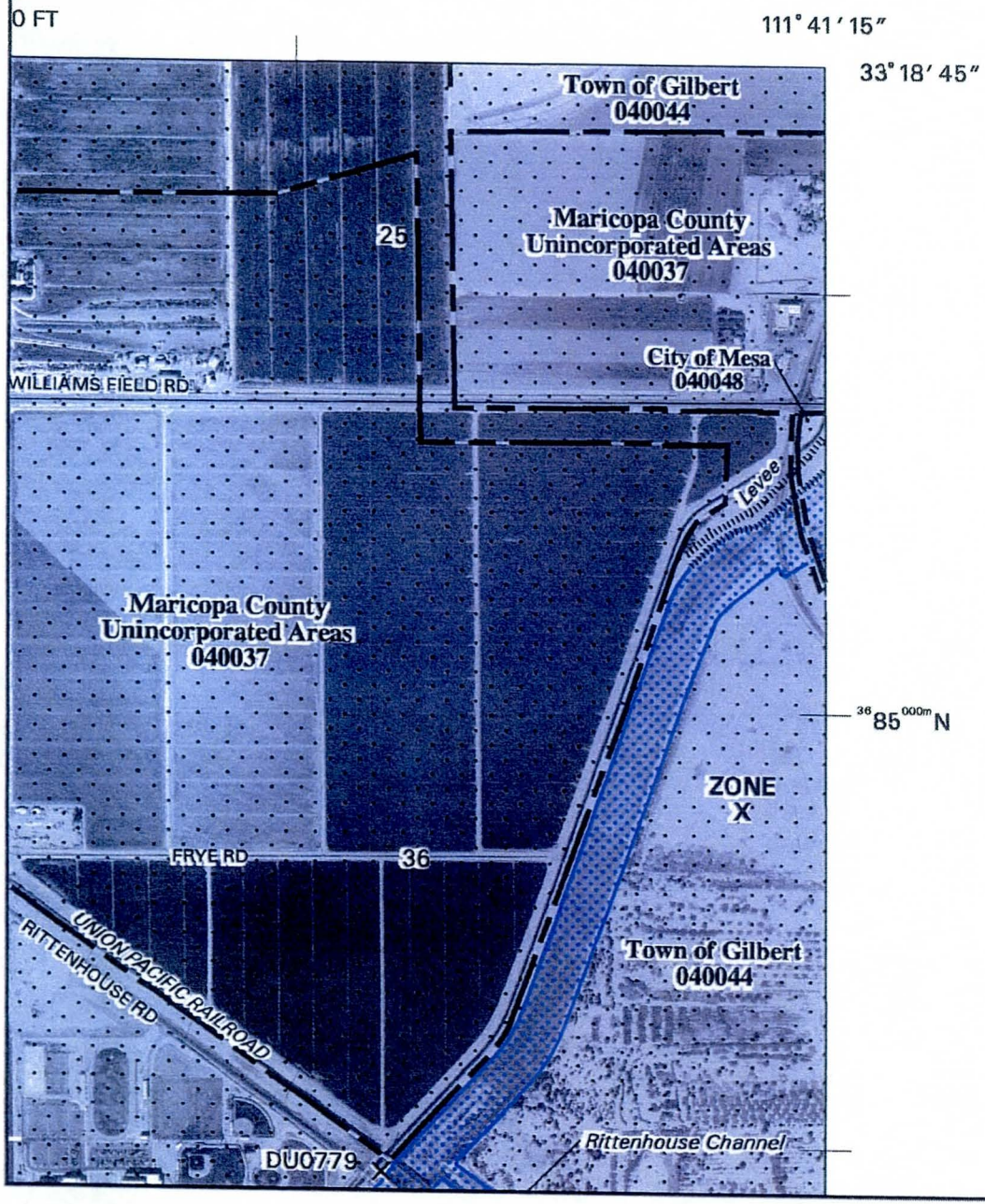
PE 605



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2690H

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 2690 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GILBERT, TOWN OF	040044	2690	H
MARICOPA COUNTY	040037	2690	H
MESA, CITY OF	040048	2690	H

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MAP NUMBER
04013C2690H

MAP REVISED
SEPTEMBER 30, 2005

Federal Emergency Management Agency

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PG 105

Power Road
Pecos Road to 202L
Final Drainage Report

Appendix B

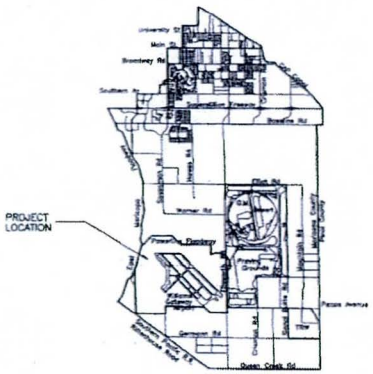
Dibble & Associates
Hydrology Study

WILLIAMS GATEWAY AIRPORT

MASTER DRAINAGE PLAN
EXHIBITS

MASTER DRAINAGE PLAN PARTICIPANTS

WILLIAMS GATEWAY AIRPORT AUTHORITY
MARICOPA COUNTY COMMUNITY COLLEGE DISTRICT
NATIONAL WEATHER SERVICE
MARICOPA COUNTY REGIONAL SCHOOL DISTRICT
ARIZONA STATE UNIVERSITY EAST
CITY OF MESA
GILA RIVER INDIAN COMMUNITY
COMMUNITY HOUSING PARTNERSHIP
HOUSE OF REFUGE
DEPARTMENT OF THE ARMY
USAF ARMSTRONG LABORATORIES
MARICOPA COUNTY FLOOD CONTROL DISTRICT
SALT RIVER PROJECT

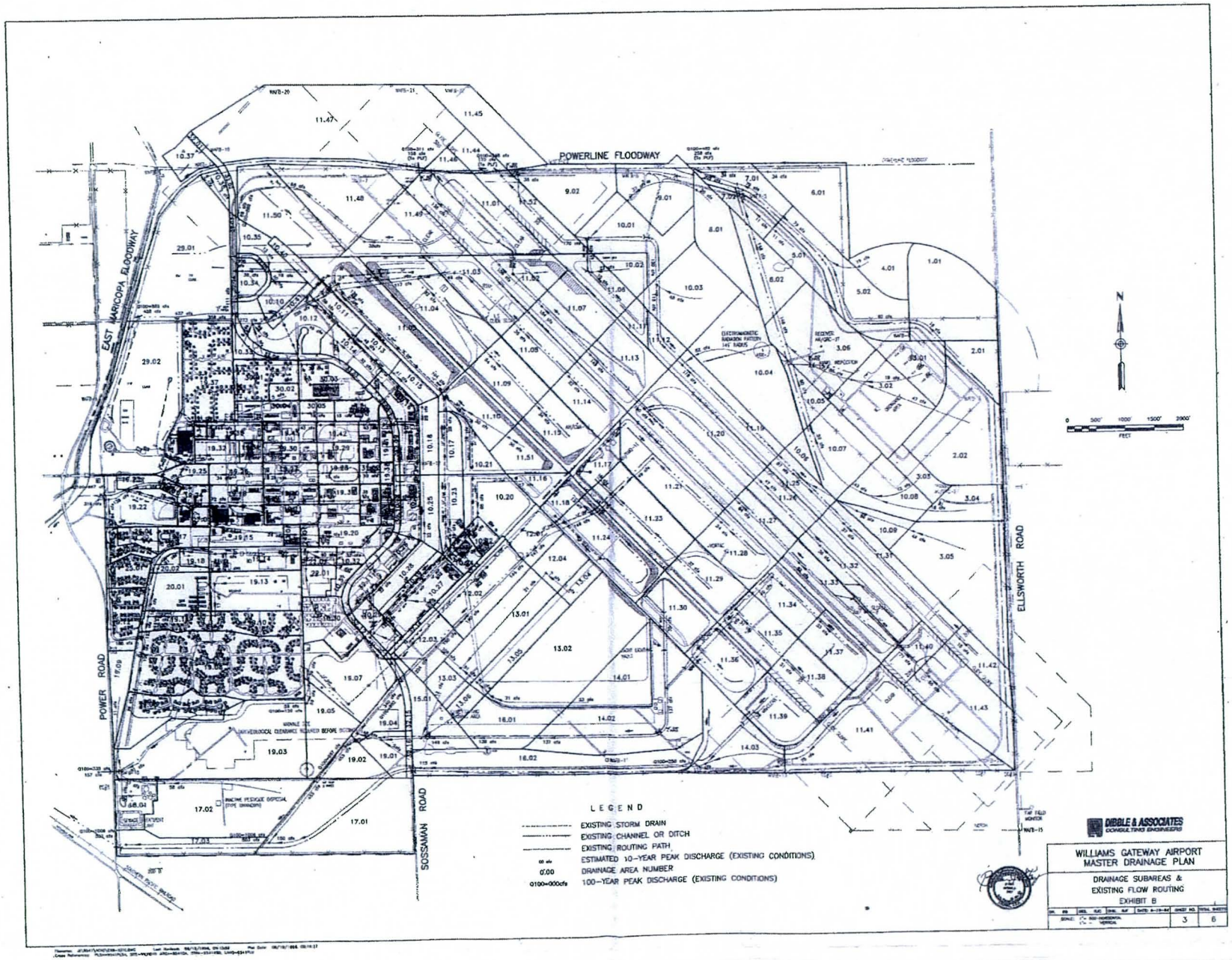


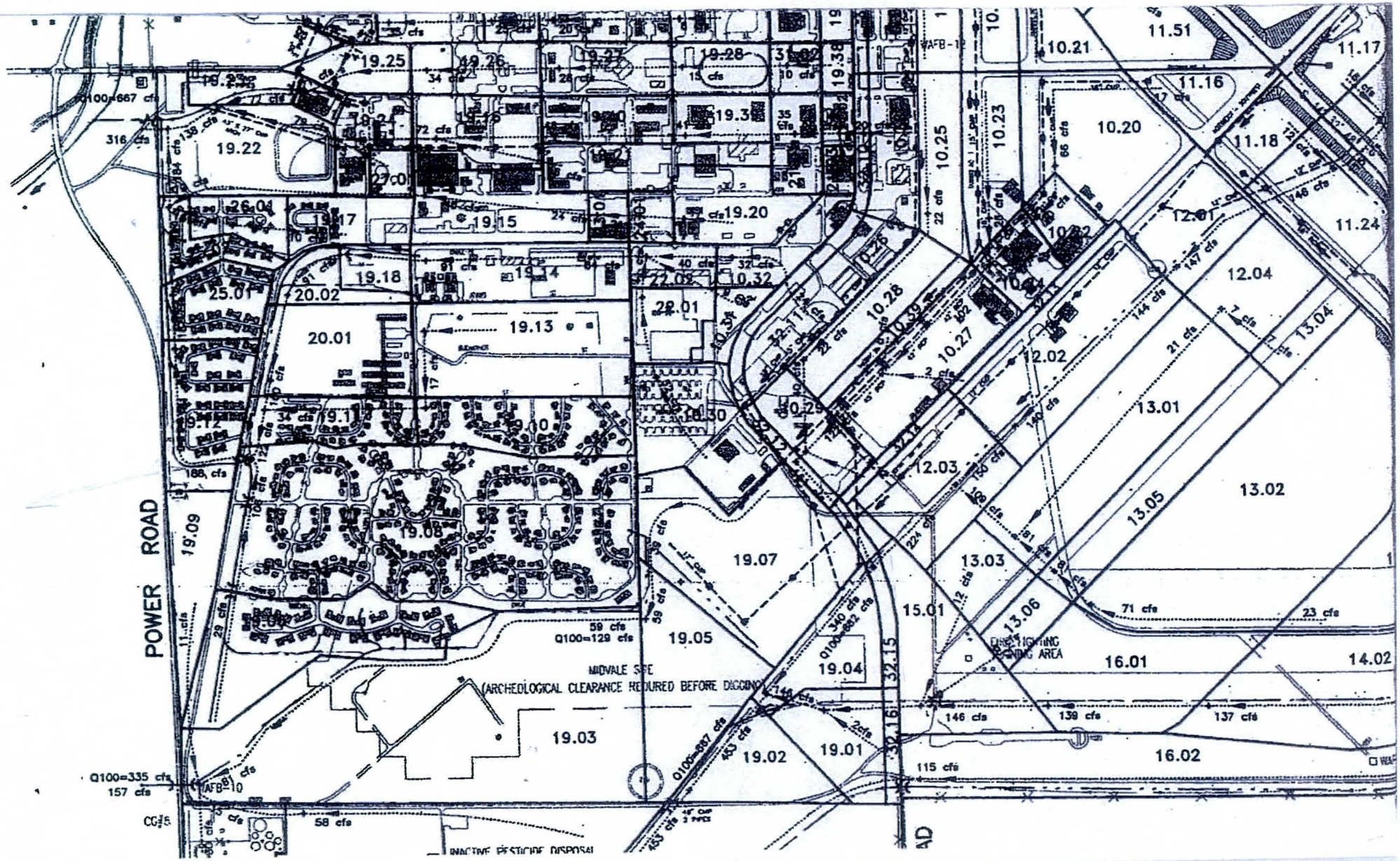
VICINITY MAP

INDEX

EXHIBIT A: PLANNED LAND USE
EXHIBIT B: DRAINAGE SUBAREAS & EXISTING FLOW ROUTING
EXHIBIT C: EXISTING DRAINAGE FACILITIES
EXHIBIT D: RECOMMENDED IMPROVEMENTS
EXHIBIT E: DRAINAGE SUBAREAS & PROPOSED FLOW ROUTING

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS


POWERLINE FLOODWAY
EAST MARICOPA FLOODWAY
POWER ROAD
SOSSAMAN ROAD
ELLSWORTH ROAD
N
0 500' 1000' 1500' 2000'
FEET
LEGEND
EXISTING STORM DRAIN
EXISTING CHANNEL OR DITCH
EXISTING ROUTING PATH
ESTIMATED 10-YEAR PEAK DISCHARGE (EXISTING CONDITIONS)
DRAINAGE AREA NUMBER
Q100=000cfs 100-YEAR PEAK DISCHARGE (EXISTING CONDITIONS)
DIBBLE & ASSOCIATES
CONSULTING ENGINEERS
WILLIAMS GATEWAY AIRPORT
MASTER DRAINAGE PLAN
DRAINAGE SUBAREAS &
EXISTING FLOW ROUTING
EXHIBIT B
3
6


POWER ROAD
MIDVALE SITE
(ARCHEOLOGICAL CLEARANCE REQUIRED BEFORE DIGGING)
INACTIVE PESTICIDE DISPOSAL
Q100=667 cfs
316 cfs
Q100=335 cfs
157 cfs
Q100=129 cfs
Q100=887 cfs
19.22
19.25
19.26
19.27
19.28
19.38
19.39
19.20
19.15
19.17
19.18
19.14
19.13
19.12
19.11
19.10
19.09
19.08
19.07
19.05
19.04
19.03
19.02
19.01
20.01
20.02
25.01
26.04
27.00
22.01
10.21
10.20
10.25
10.23
10.28
10.27
10.29
10.30
10.32
11.51
11.17
11.16
11.18
11.24
12.01
12.02
12.03
12.04
13.01
13.02
13.03
13.04
13.05
13.06
15.01
16.01
16.02
14.02
32.15
32.16
58 cfs
59 cfs
146 cfs
139 cfs
137 cfs
115 cfs
71 cfs
23 cfs

Power Road
Pecos Road to 202L
Final Drainage Report

Appendix C

Channel Analyses
On-site Channels
Power Road West Channel

Jacobs

Hydraulics

Project:	**Power Road**	By:	**JPF**
Subject:	**Open Channel Design**	Date:	**4/11/2011**
	Pecos Road to Williams Field Road	Checked:	
		Jacobs Project No.:	**W7X77901**

Remarks:

Sub-Basin C extends from Sta 138+00 to Sta 260+50 with Q_{100} = 24 cfs — L = 2,250' — Outlets Sta 143+50, 247+50, Sta 252+50 and 263+75

Sub-Basin D extends from Sta 116+00 to Sta 121+00 — L = 500' — Outlets Sta 119+50

and from Sta 129+00 to Sta 138+00 with Q_{50} = 21 cfs — L = 900' — Outlets Sta 138+00

Unlined V-Ditch n = 0.030

From Station	To Station	Segment Q_{50} (cfs)	Total Q_{50} (cfs)	S (ft/ft)	Yn (ft)	Channel Depth (ft)	Z left	Z right	TW (ft)	Flowline Elevation (ft)	Sidewalk Elevation (ft)	R/W Elevation (ft)
11600	11650	0.8	0.8	0.0100	0.36	1.63	4	4	23.4	1330.40	1333.21	1332.03
11650	11700	0.8	1.5	0.0100	0.46	0.98	4	4	21.8	1329.90	1332.88	1330.88
11700	11750	0.8	2.3	0.0060	0.59	1.21	4	4	22.5	1329.60	1332.55	1330.81
11750	11800	0.8	3.0	0.0060	0.65	1.27	4	4	22.5	1329.30	1332.21	1330.57
11800	11850	0.8	3.8	0.0060	0.71	1.53	4	4	22.3	1329.00	1331.69	1330.53
11850	11900	0.8	4.5	0.0060	0.76	1.55	4	4	22.1	1328.70	1331.35	1330.25
11900	11950	0.8	7.5	0.0060	0.92	1.45	4	4	21.5	1328.40	1331.01	1329.85
11950	12000	0.8	2.3	0.0060	0.59	0.65	4	4	14.4	1328.70	1330.67	1329.35
12000	12050	0.8	1.5	0.0020	0.62	0.65	4	4	15.0	1328.80	1330.86	1329.45
12050	12100	0.8	0.8	0.0020	0.49	0.62	4	4	15.4	1328.90	1331.06	1329.52
12100	12650											
12650	12900											
12900	12950	0.8	0.8	0.0030	0.45	0.69	4	4	26.2	1327.85	1331.76	1328.54
12950	13000	0.8	1.5	0.0030	0.57	0.81	4	4	27.0	1327.70	1331.66	1328.51
13000	13050	0.8	2.3	0.0030	0.67	0.85	4	4	26.8	1327.55	1331.45	1328.40
13050	13100	0.8	3.0	0.0030	0.74	0.85	4	4	26.5	1327.40	1331.25	1328.25
13100	13150	0.8	3.8	0.0030	0.81	0.93	4	4	26.5	1327.25	1331.05	1328.18
13150	13200	0.8	4.5	0.0030	0.86	1.01	4	4	26.5	1327.10	1330.85	1328.11
13200	13250	0.8	5.3	0.0030	0.92	1.08	4	4	26.0	1326.95	1330.57	1328.03
13250	13300	0.8	6.0	0.0030	0.96	1.15	4	4	25.5	1326.80	1330.28	1327.95
13300	13350	0.8	6.8	0.0030	1.01	1.14	4	4	25.1	1326.65	1330.07	1327.79
13350	13400	0.8	7.5	0.0030	1.04	1.13	4	4	24.7	1326.50	1329.87	1327.63
13400	13450	0.8	8.3	0.0030	1.08	1.17	4	4	24.6	1326.35	1329.67	1327.52
13450	13500	0.8	9.0	0.0030	1.12	1.27	4	4	24.7	1326.20	1329.47	1327.47
13500	13550	0.8	9.8	0.0030	1.15	1.32	4	4	24.6	1326.05	1329.27	1327.37
13550	13600	0.8	10.5	0.0015	1.35	1.37	4	4	24.0	1325.98	1329.07	1327.34
13600	13650	0.8	11.3	0.0015	1.39	2.06	4	4	26.0	1325.90	1328.86	1327.96
13650	13700	0.8	12.0	0.0015	1.42	2.84	4	4	30.2	1325.83	1328.66	1329.12
13700	13750	0.8	12.8	0.0015	1.45	2.70	4	4	30.4	1325.75	1328.45	1329.30
13750	13800	0.8	13.5	0.0015	1.48	2.35	4	4	24.8	1325.68	1328.25	1328.02

Jacobs

Hydraulics

Project:	**Power Road**	By:	**JPF**
Subject:	**Open Channel Design**	Date:	**4/11/2011**
	Pecos Road to Williams Field Road	Checked:	
		Jacobs Project No.:	**W7X77901**

Remarks:

Sub-Basin C extends from Sta 138+00 to Sta 260+50 with Q_{100} = 24 cfs	L = 2,250'	Outlets Sta 143+50, 247+50, Sta 252+50 and 263+75
Sub-Basin D extends from Sta 116+00 to Sta 121+00	L = 500'	Outlets Sta 119+50
and from Sta 129+00 to Sta 138+00 with Q_{50} = 21 cfs	L = 900'	Outlets Sta 138+00

Unlined V-Ditch n = 0.030

From Station	To Station	Segment Q_{50} (cfs)	Total Q_{50} (cfs)	S (ft/ft)	Yn (ft)	Channel Depth (ft)	Z left	Z right	TW (ft)	Flowline Elevation (ft)	Sidewalk Elevation (ft)	R/W Elevation (ft)
11600	11650	0.8	0.8	0.0100	0.36	1.63	4	4	23.4	1330.40	1333.21	1332.03
11650	11700	0.8	1.5	0.0100	0.46	0.98	4	4	21.8	1329.90	1332.88	1330.88
11700	11750	0.8	2.3	0.0060	0.59	1.21	4	4	22.5	1329.60	1332.55	1330.81
11750	11800	0.8	3.0	0.0060	0.65	1.27	4	4	22.5	1329.30	1332.21	1330.57
11800	11850	0.8	3.8	0.0060	0.71	1.53	4	4	22.3	1329.00	1331.69	1330.53
11850	11900	0.8	4.5	0.0060	0.76	1.55	4	4	22.1	1328.70	1331.35	1330.25
11900	11950	0.8	7.5	0.0060	0.92	1.45	4	4	21.5	1328.40	1331.01	1329.85
11950	12000	0.8	2.3	0.0060	0.59	0.65	4	4	14.4	1328.70	1330.67	1329.35
12000	12050	0.8	1.5	0.0020	0.62	0.65	4	4	15.0	1328.80	1330.86	1329.45
12050	12100	0.8	0.8	0.0020	0.49	0.62	4	4	15.4	1328.90	1331.06	1329.52
12100	12650											
12650	12900											
12900	12950	0.8	0.8	0.0030	0.45	0.69	4	4	26.2	1327.85	1331.76	1328.54
12950	13000	0.8	1.5	0.0030	0.57	0.81	4	4	27.0	1327.70	1331.66	1328.51
13000	13050	0.8	2.3	0.0030	0.67	0.85	4	4	26.8	1327.55	1331.45	1328.40
13050	13100	0.8	3.0	0.0030	0.74	0.85	4	4	26.5	1327.40	1331.25	1328.25
13100	13150	0.8	3.8	0.0030	0.81	0.93	4	4	26.5	1327.25	1331.05	1328.18
13150	13200	0.8	4.5	0.0030	0.86	1.01	4	4	26.5	1327.10	1330.85	1328.11
13200	13250	0.8	5.3	0.0030	0.92	1.08	4	4	26.0	1326.95	1330.57	1328.03
13250	13300	0.8	6.0	0.0030	0.96	1.15	4	4	25.5	1326.80	1330.28	1327.95
13300	13350	0.8	6.8	0.0030	1.01	1.14	4	4	25.1	1326.65	1330.07	1327.79
13350	13400	0.8	7.5	0.0030	1.04	1.13	4	4	24.7	1326.50	1329.87	1327.63
13400	13450	0.8	8.3	0.0030	1.08	1.17	4	4	24.6	1326.35	1329.67	1327.52
13450	13500	0.8	9.0	0.0030	1.12	1.27	4	4	24.7	1326.20	1329.47	1327.47
13500	13550	0.8	9.8	0.0030	1.15	1.32	4	4	24.6	1326.05	1329.27	1327.37
13550	13600	0.8	10.5	0.0015	1.35	1.37	4	4	24.0	1325.98	1329.07	1327.34
13600	13650	0.8	11.3	0.0015	1.39	2.06	4	4	26.0	1325.90	1328.86	1327.96
13650	13700	0.8	12.0	0.0015	1.42	2.84	4	4	30.2	1325.83	1328.66	1329.12
13700	13750	0.8	12.8	0.0015	1.45	2.70	4	4	30.4	1325.75	1328.45	1329.30
13750	13800	0.8	13.5	0.0015	1.48	2.35	4	4	24.8	1325.68	1328.25	1328.02

BASE Model

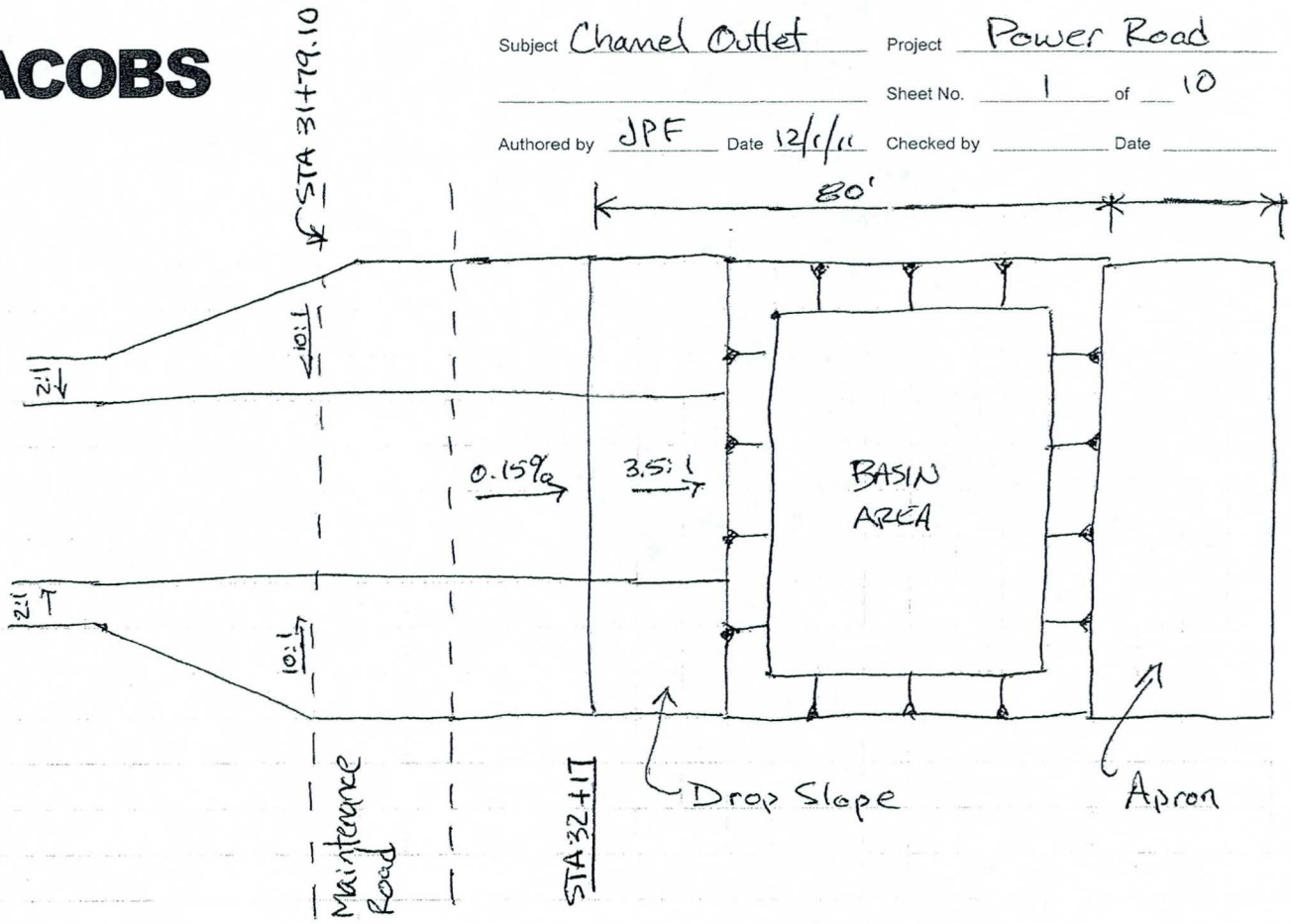
Project:	Power Rd West Channel	\PowerRdWestCha.prj
Plan:	Plan 01	\ PowerRdWestCha.p01
Geometry:	West Channel	\ PowerRdWestCha.g01
Steady Flow:	West Channel	\ PowerRdWestCha.f01

JACOBS

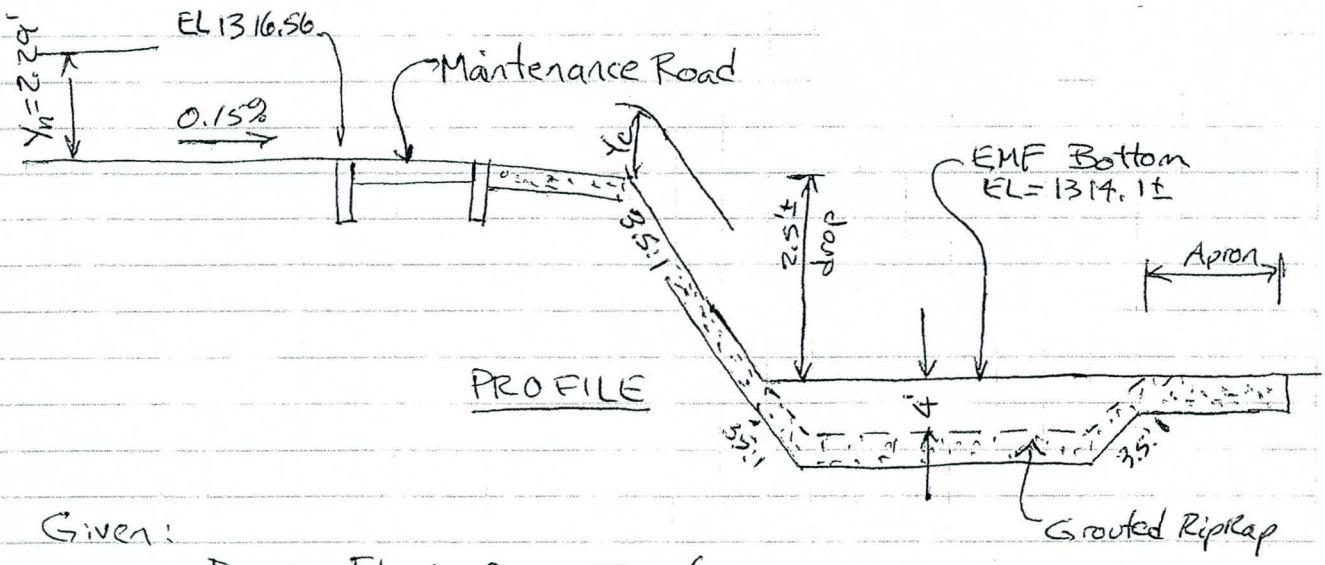
Subject Channel Outlet Project Power Road

Sheet No. 1 of 10

Authored by JPF Date 12/1/11 Checked by _____ Date _____



PLAN



PROFILE

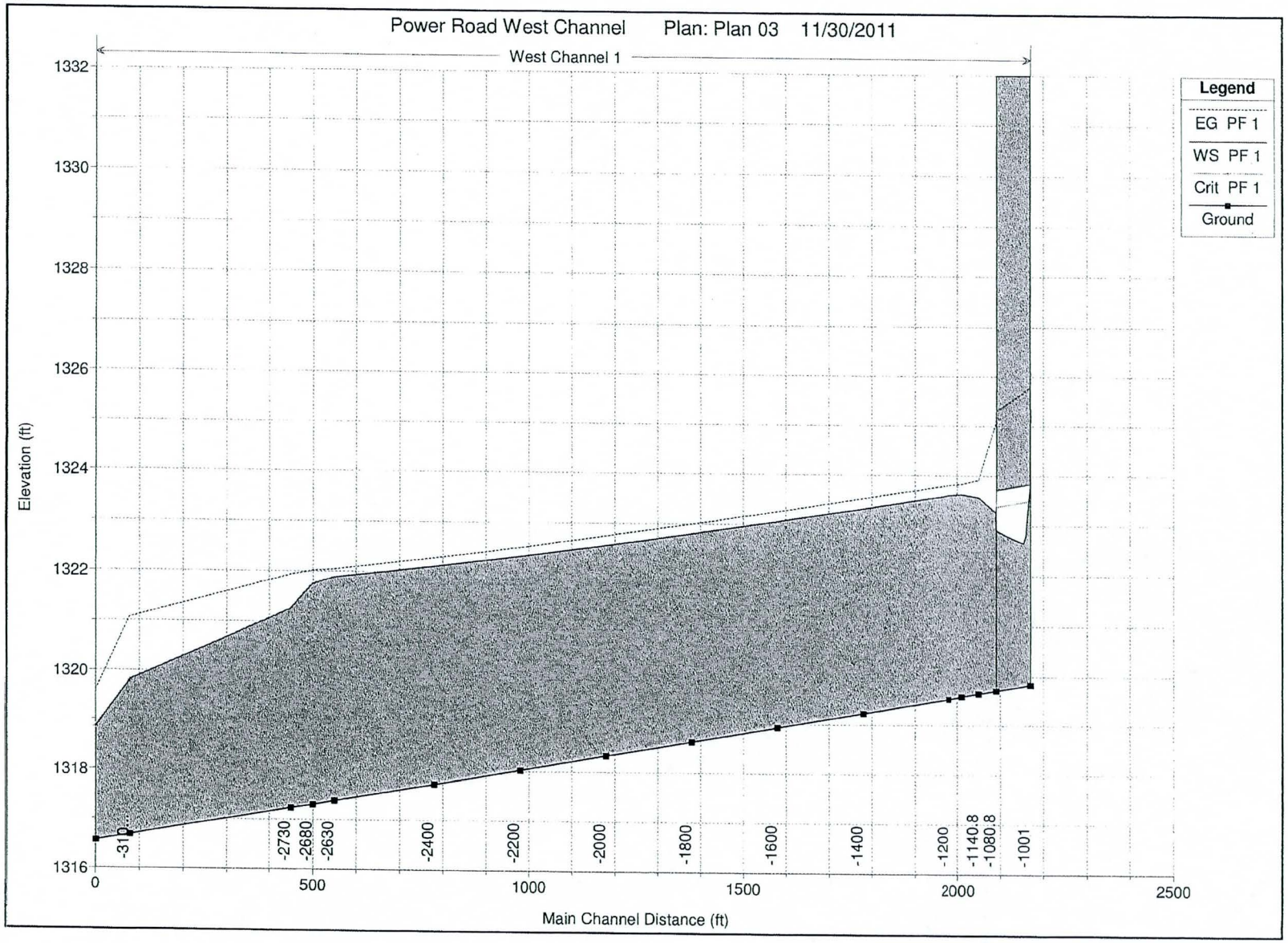
Given:

Design Flow = Q_{50} = 797 cfs

Channel at Maintenance Road: BW=22', Z=10, n=0.013

Design per FCD Drainage Design Manual

Normal depth per channel HEC-RAS


Power Road West Channel Plan: Plan 03 11/30/2011
West Channel 1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1332
1330
1328
1326
1324
1322
1320
1318
1316
0
500
1000
1500
2000
2500
Main Channel Distance (ft)
-310
-2730
-2680
-2630
-2400
-2200
-2000
-1800
-1600
-1400
-1200
-1140.8
-1080.8
-1001

HEC-RAS Plan: Plan 01 River: West Channel Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Head	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft)	(sq ft)	(ft)	
1	-1000	PF 1	797.00	1319.83	1325.35	5.52	1323.39	1326.10	0.001277	6.94	0.75	114.90	20.82	0.52
1	-1000	PF 2	896.00	1319.83	1326.20	6.37	1323.68	1326.91	0.001074	6.76	0.71	132.54	20.82	0.47
1	-1001		Culvert											
1	-1080.8	PF 1	797.00	1319.71	1322.91	3.20	1323.27	1325.13	0.006367	11.96	2.22	66.62	20.82	1.18
1	-1080.8	PF 2	896.00	1319.71	1322.92	3.21	1323.56	1325.71	0.007966	13.40	2.79	66.84	20.82	1.32
1	-1140.8	PF 1	797.00	1319.65	1323.55	3.90	1322.18	1323.90	0.000727	4.77	0.35	166.94	50.00	0.46
1	-1140.8	PF 2	896.00	1319.65	1321.26	1.61	1322.35	1325.09	0.024179	15.70	3.83	57.08	41.81	2.37
1	-1160.8	PF 1	797.00	1319.59	1323.62	4.03		1323.84	0.000461	3.73	0.22	213.90	69.17	0.37
1	-1160.8	PF 2	896.00	1319.59	1323.90	4.31	1321.98	1324.13	0.000455	3.84	0.23	233.31	71.38	0.37
1	-1161	PF 1	797.00	1319.59	1323.62	4.03		1323.84	0.000461	3.73	0.22	213.90	69.17	0.37
1	-1161	PF 2	896.00	1319.59	1323.90	4.31		1324.13	0.000455	3.84	0.23	233.31	71.38	0.37
1	-1200	PF 1	797.00	1319.53	1323.60	4.07		1323.81	0.001402	3.68	0.21	216.77	69.50	0.37
1	-1200	PF 2	896.00	1319.53	1323.88	4.35		1324.10	0.001387	3.79	0.22	236.30	71.71	0.37
1	-1400	PF 1	797.00	1319.23	1323.33	4.10		1323.53	0.001370	3.65	0.21	218.54	69.70	0.36
1	-1400	PF 2	896.00	1319.23	1323.61	4.38		1323.83	0.001353	3.76	0.22	238.39	71.94	0.36
1	-1600	PF 1	797.00	1318.93	1323.06	4.13		1323.26	0.001330	3.61	0.20	220.86	69.97	0.36
1	-1600	PF 2	896.00	1318.93	1323.34	4.41		1323.56	0.001311	3.72	0.21	241.06	72.24	0.36
1	-1800	PF 1	797.00	1318.63	1322.80	4.17		1323.00	0.001279	3.56	0.20	223.88	70.31	0.35
1	-1800	PF 2	896.00	1318.63	1323.09	4.46		1323.30	0.001259	3.66	0.21	244.49	72.62	0.35
1	-2000	PF 1	797.00	1318.33	1322.56	4.23		1322.75	0.001218	3.50	0.19	227.76	70.75	0.34
1	-2000	PF 2	896.00	1318.33	1322.85	4.52		1323.05	0.001198	3.60	0.20	248.81	73.09	0.34
1	-2200	PF 1	797.00	1318.03	1322.33	4.30		1322.51	0.001147	3.43	0.18	232.68	71.31	0.33
1	-2200	PF 2	896.00	1318.03	1322.62	4.59		1322.82	0.001128	3.52	0.19	254.19	73.68	0.33
1	-2400	PF 1	797.00	1317.73	1322.11	4.38		1322.29	0.001065	3.34	0.17	238.80	71.99	0.32
1	-2400	PF 2	896.00	1317.73	1322.41	4.68		1322.60	0.001049	3.44	0.18	260.80	74.39	0.32
1	-2629.5	PF 1	797.00	1317.39	1321.89	4.50		1322.05	0.000966	3.22	0.16	247.29	72.98	0.31
1	-2629.5	PF 2	896.00	1317.39	1322.19	4.80		1322.36	0.000954	3.32	0.17	269.84	75.41	0.31
1	-2630	PF 1	797.00	1317.39	1321.89	4.50		1322.05	0.000306	3.22	0.16	247.28	72.98	0.31
1	-2630	PF 2	896.00	1317.39	1322.19	4.80		1322.36	0.000302	3.32	0.17	269.82	75.41	0.31
1	-2680	PF 1	797.00	1317.31	1321.75	4.44		1322.02	0.000523	4.17	0.27	191.30	56.96	0.40
1	-2680	PF 2	896.00	1317.31	1322.04	4.73		1322.33	0.000519	4.30	0.29	208.42	58.80	0.40

HEC-RAS Plan: Plan 01 River: West Channel Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Vel Head	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(ft)	(sq ft)	(ft)	
1	-2730	PF 1	797.00	1317.24	1321.26	4.02		1321.94	0.001466	6.60	0.68	120.69	38.07	0.65
1	-2730	PF 2	896.00	1317.24	1321.51	4.27		1322.25	0.001482	6.87	0.73	130.52	39.09	0.66
1	-3100	PF 1	797.00	1316.68	1319.81	3.13	1319.78	1321.07	0.003576	9.00	1.26	88.60	34.54	0.99
1	-3100	PF 2	896.00	1316.68	1320.05	3.37	1320.01	1321.38	0.003505	9.27	1.33	96.71	35.46	0.99
1	-3101	PF 1	797.00	1316.68	1319.78	3.10	1319.78	1321.07	0.003708	9.11	1.29	87.50	34.41	1.01
1	-3101	PF 2	896.00	1316.68	1320.01	3.33	1320.01	1321.38	0.003641	9.39	1.37	95.45	35.32	1.01
1	-3179	PF 1	797.00	1316.56	1318.43	1.87	1319.10	1320.53	0.010787	13.01	2.10	73.25	56.40	1.68
1	-3179	PF 2	896.00	1316.56	1318.53	1.97	1319.26	1320.83	0.011134	13.67	2.30	78.80	58.19	1.72

TRAP. CHANNEL CALCULATIONS

11-30-2011

PROJECT NAME - Power Road PROJECT NO. - W7X77901
HIGHWAY NAME - DESIGNER - JPF
LOCATION - Drop Slope Channel Outlet at EMF CHECKER - PAGE 5 of 10
VBVer 1.3: January 2011

Channel Bottom Width (Ft.) =20.00
Lt. side slope (Horiz. to 1) =10.00
Rt. side slope (Horiz. to 1) =10.00
Channel Slope,(Ft./Ft.) =0.285000
Manning's 'n' =0.025

Discharge (CFS) =797.00

Normal Depth (Ft.) =1.01
Area of Normal Depth (Sq. Ft.) =30.36
Normal Depth Velocity (Ft./Sec.) =26.25

Critical Depth (Ft.) =2.48
Critical Depth Velocity (Ft./Sec.) =7.17
Critical Slope (Ft./Ft.) =0.007844

Sequent Depth-Ft. =4.81
Froude Number =5.32

CHAPTER 8: STILLING BASINS

Stilling basins are external energy dissipators placed at the outlet of a culvert, chute, or rundown. These basins are characterized by some combination of chute blocks, baffle blocks, and sills designed to trigger a hydraulic jump in combination with a required tailwater condition. With the required tailwater, velocity leaving a properly designed stilling basin is equal to the velocity in the receiving channel.

Depending on the specific design, they operate over a range of approach flow Froude numbers from 1.7 to 17 as summarized in Table 8.1. This chapter includes the following stilling basins: USBR Type III, USBR Type IV, and SAF. The United States Bureau of Reclamation (USBR) basins were developed based on model studies and evaluation of existing basins (USBR, 1987). The St. Anthony Falls (SAF) stilling basin is based on model studies conducted by the Soil Conservation Service at the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota (Blaisdell, 1959).

Table 8.1. Applicable Froude Number Ranges for Stilling Basins

Stilling Basin	Minimum Approach Froude Number	Maximum Approach Froude Number
USBR Type III	4.5	17
USBR Type IV	2.5	4.5
SAF	1.7	17

The selection of a stilling basin depends on several considerations including hydraulic limitations, constructibility, basin size, and cost. The design examples in this chapter all use the identical site conditions to provide a comparison between the size of basins and a free hydraulic jump basin for one case. Table 8.2 summarizes the results of these examples with the incoming Froude number, the required tailwater at the exit of the basin along with basin length and depth. For this example, the SAF stilling basin results in the shortest and shallowest basin. Details of the design procedures and this design example are found in the following sections.

Table 8.2. Example Comparison of Stilling Basin Dimensions

Basin Type[1]	Froude Number	Required Tailwater[3], m (ft)	Basin Length, m (ft)	Basin Depth, m (ft)
Free jump	7.6	3.1 (10.1)	33.7 (109.2)	4.8 (15.5)
USBR Type III	6.9	3.0 (9.6)	20.6 (67.3)	3.8 (12.5)
USBR Type IV[2]	8.0	3.5 (11.2)	38.1 (121.8)	5.5 (17.4)
SAF	6.1	2.4 (7.9)	12.4 (39.7)	2.7 (8.6)

[1]Based on a 3 m by 1.8 m (10 ft by 6 ft) box culvert at a design discharge of 11.8 m^3/s (417 ft^3/s). All basins have a constant width equal to the culvert width. Detailed description of the example is found in Section 8.1.

[2]The USBR Type IV approach Froude number is outside of the recommended range, but was included for comparison.

[3]Required tailwater influences basin depth. Velocity leaving each of these basins is the same and depends on the tailwater channel.

8.1 EXPANSION AND DEPRESSION FOR STILLING BASINS

As explained in Chapter 4, the higher the Froude number at the entrance to a basin, the more efficient the hydraulic jump and the shorter the resulting basin. To increase the Froude number as the water flows from the culvert to the basin, an expansion and depression is used as is shown in Figure 8.1. The expansion and depression converts depth, or potential energy, into kinetic energy by allowing the flow to expand, drop, or both. The result is that the depth decreases and the velocity and Froude number increase.

Assume Basin Bottom Elev = 1310.00

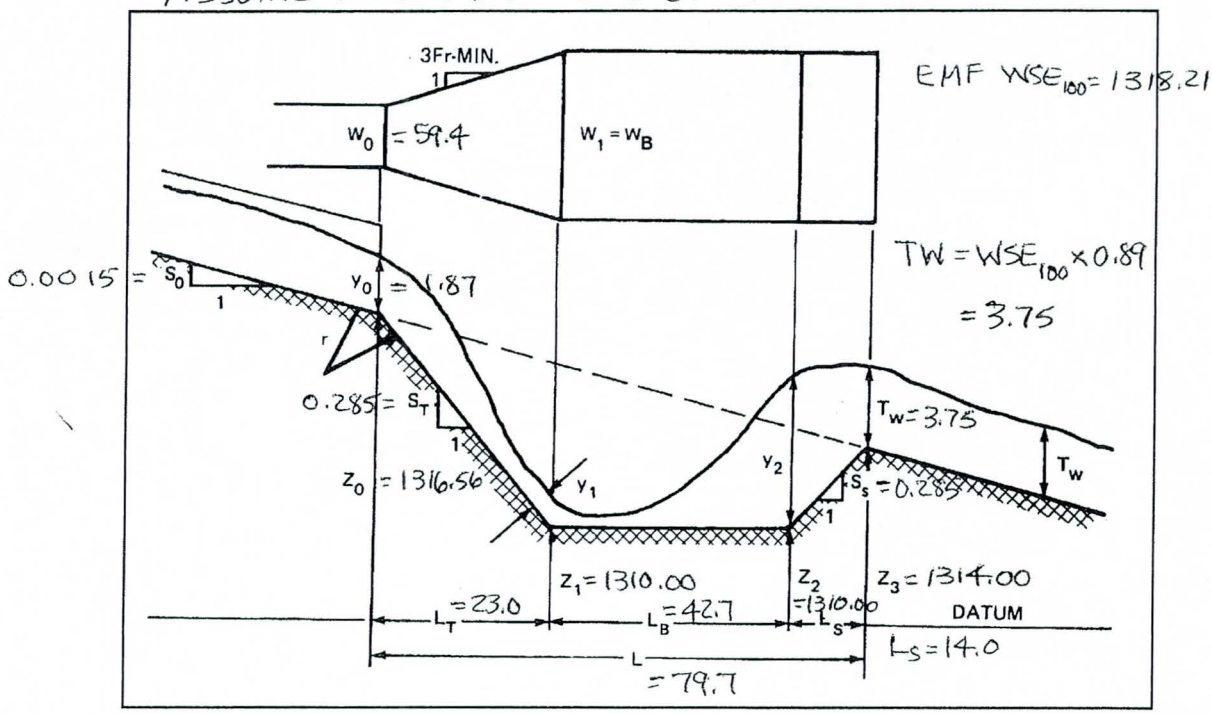


Figure 8.1. Definition Sketch for Stilling Basin

The Froude number used to determine jump efficiency and to evaluate the suitability of alternative stilling basins as described in Table 8.1 is defined in Equation 8.1.

$$Fr_1 = \frac{V_1}{\sqrt{gy_1}} \tag{8.1}$$

where,

Fr_1 = Froude number at the entrance to the basin = 5.32
V_1 = velocity entering the basin, m/s (ft/s) = 26.25
y_1 = depth entering the basin, m (ft) = 1.01
g = acceleration due to gravity, m/s^2 (ft/s^2)

} See ADOT Trap Channel Calcs

To solve for the velocity and depth entering the basin, the energy balance is written from the culvert outlet to the basin. Substituting $Q/(y_1W_B)$ for V_1 and solving for Q results in:

$$Q = y_1 W_B \left[2g(z_o - z_1 + y_o - y_1) + V_o^2\right]^{1/2} \tag{8.2}$$

where,

W_B = width of the basin, m/s (ft/s)
V_o = culvert outlet velocity, m/s (ft/s) = 13.01
y_1 = depth entering the basin, m (ft) = 1.01
y_o = culvert outlet depth, m (ft) = 1.87
z_1 = ground elevation at the basin entrance, m (ft) = 1310.00
z_o = ground elevation at the culvert outlet, m (ft) = 1316.56

Equation 8.2 has three unknowns y_1, W_B, and z_1. The depth y_1 can be determined by trial and error if W_B and z_1 are assumed. W_B should be limited to the width that a jet would flare naturally in the slope distance L.

$$W_B \le 59.4 + \frac{2 \times 23.0\sqrt{0.285^2+1}}{3 \times 1.68}$$

$$W_B \le W_o + \frac{2L_T\sqrt{S_T^2+1}}{3Fr_o} \tag{8.3}$$

≤ 68.9

where,

L_T = length of transition from culvert outlet to basin, m (ft)
S_T = slope of the transition, m/m (ft/ft)
Fr_o = outlet Froude number

Since the flow is supercritical, the trial y_1 value should start near zero and increase until the design Q is reached. This depth, y_1, is used to find the sequent (conjugate) depth, y_2, using the hydraulic jump equation:

Solve for Y_2

$$y_2 = \frac{Cy_1}{2}\left(\sqrt{1+8Fr_1^2} - 1\right) \tag{8.4}$$

$$Y_2 = \frac{1.0 \times 1.01}{2}\left(\sqrt{1+8 \times 5.32^2} - 1\right)$$

$= 7.11$

where,

y_2 = conjugate depth, m (ft) = 7.11
y_1 = depth approaching the jump, m (ft) = 1.01
C = ratio of tailwater to conjugate depth, TW/y_2 = 1.0
Fr_1 = approach Froude number = 5.32

For a free hydraulic jump, C = 1.0. Later sections on the individual stilling basin types provide guidance on the value of C for those basins. For the jump to occur, the value of $y_2 + z_2$ must be equal to or less than TW + z_3 as shown in Figure 8.1. If $z_2 + y_2$ is greater than z_3 +TW, the basin must be lowered and the trial and error process repeated until sufficient tailwater exists to force the jump.

In order to perform this check, z_3 and the basin lengths must be determined. The length of the transition is calculated from:

$$L_T = \frac{z_o - z_1}{S_T} \tag{8.5}$$

$Y_2 + Z_2 = 7.11 + 1310.00 = 1317.11$

$TW + Z_3 = 3.75 + 1314.00 = 1317.75$

OK

where,

L_T = length of the transition from the culvert outlet to the bottom of the basin, m (ft)

S_T = slope of the transition entering the basin, m/m (ft/ft)

The length of the basin, L_B, depends on the type of basin, the entrance flow depth, y_1, and the entrance Froude number, Fr_1. Figure 8.2 describes these relationships for the free hydraulic jump as well as several USBR stilling basins.

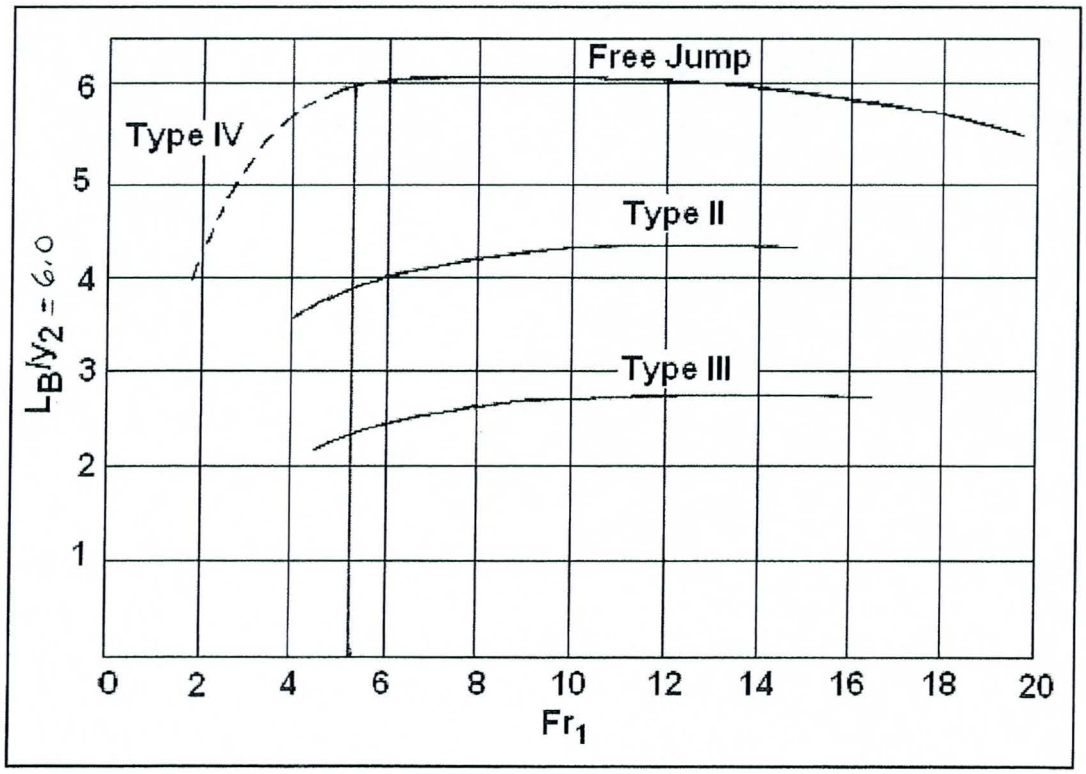


Figure 8.2. Length of Hydraulic Jump on a Horizontal Floor

The length of the basin from the floor to the sill is calculated from:

$$\frac{L_B}{Y_2} = 6.0$$

$$L_S = \frac{L_T(S_T - S_o) - L_B S_o}{S_S + S_o} \tag{8.6}$$

$$L_B = 6.0 \times 7.11 = 42.7$$

where,

L_S = length of the basin from the bottom of the basin to the basin exit (sill), m (ft)

S_S = slope leaving the basin, m/m (ft/ft)

The elevation at the entrance to the tailwater channel is then calculated from:

$$z_3 = L_S S_S + z_1 \tag{8.7}$$

where,

z_3 = elevation of basin at basin exit (sill), m (ft)

Figure 8.1 also illustrates a radius of curvature between the culvert outlet and the transition to the stilling basin. If the transition slope is 0.5V:1H or steeper, use a circular curve at the transition with a radius defined by Equation 8.8 (Meshgin and Moore, 1970). It is also advisable to use the same curved transition going from the transition slope to the stilling basin floor.

$$r = \frac{y}{e^{\frac{1.5}{Fr^2}} - 1} \tag{8.8}$$

where,

r = radius of the curved transition, m (ft)

Fr = Froude number

y = depth approaching the curvature, m (ft)

For the curvature between the culvert outlet and the transition, the Froude number and depth are taken at the culvert outlet. For the curvature between the transition and the stilling basin floor, the Froude number and depth are taken as Fr_1 and y_1.

8.2 GENERAL DESIGN PROCEDURE

The design procedure for all of these stilling basins may be summarized in the following steps. Basin specific variations to these steps are discussed in the following sections on each basin.

Step 1. Determine the velocity and depth at the culvert outlet. For the culvert outlet, calculate culvert brink depth, y_o, velocity, V_o, and Fr_o. For subcritical flow, use Figure 3.3 or Figure 3.4. For supercritical flow, use normal depth in the culvert for y_o. (See HDS 5 (Normann, et al., 2001) for additional information on culvert brink depths.)

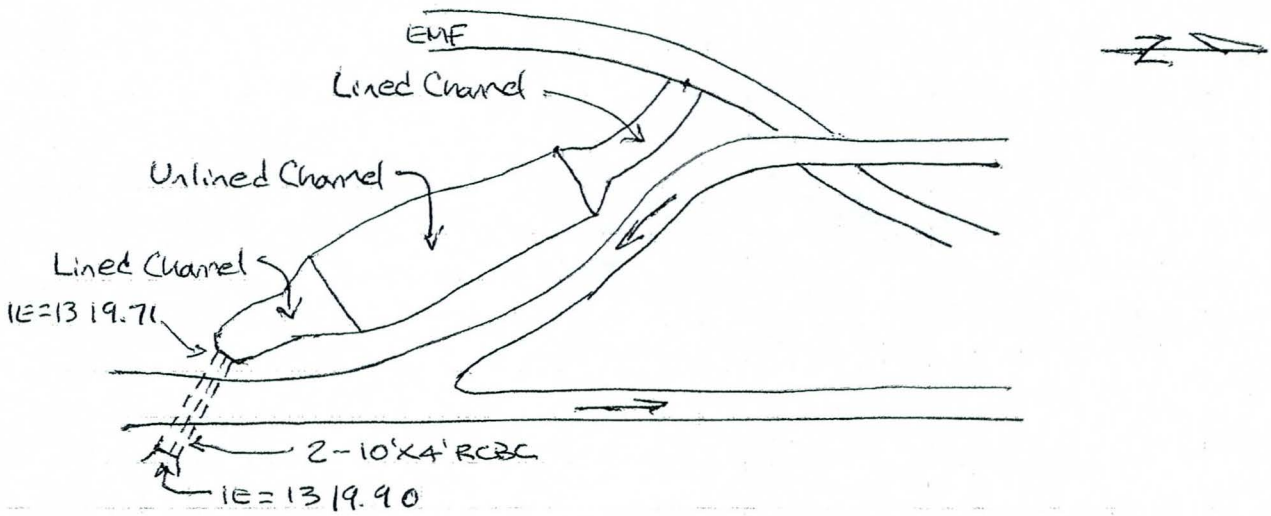
Step 2. Determine the velocity and TW depth in the receiving channel downstream of the basin. Normal depth may be determined using Table B.1 or other appropriate technique.

Step 3. Estimate the conjugate depth for the culvert outlet conditions using Equation 8.4 to determine if a basin is needed. Substitute y_o and Fr_o for y_1 and Fr_1, respectively. The value of C is dependent, in part, on the type of stilling basin to be designed. However, in this step the occurrence of a free hydraulic jump without a basin is considered so a value of 1.0 is used. Compare y_2 and TW. If $y_2 < TW$, there is sufficient tailwater and a jump will form without a basin. The remaining steps are unnecessary.

Step 4. If step 3 indicates a basin is needed ($y_2 > TW$), make a trial estimate of the basin bottom elevation, z_1, a basin width, W_B, and slopes S_T and S_S. A slope of 0.5 (0.5V:1H) or 0.33 (0.33V:1H) is satisfactory for both S_T and S_s. Confirm that W_B is within acceptable limits using Equation 8.3. Determine the velocity and depth conditions entering the basin and calculate the Froude number. Select candidate basins based on this Froude number.

JACOBS

Subject W7X77901 Project Power Road
Channel Design Sheet No. 1 of 13
Authored by JPF Date 11/9/11 Checked by _____ Date _____



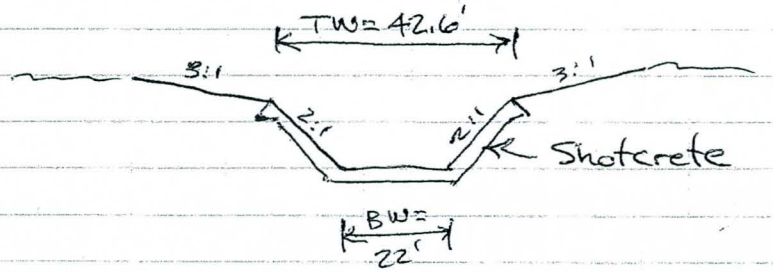
Given:

Q_{50} = 797 cfs
Shotcrete: n = 0.018
Landscape Channel: n = 0.032 check n = 0.022
RCBC: n = 0.013 L = 162' TW = 4' AHW = 1326.40
S = 0.0015 FT/FT

RCBC

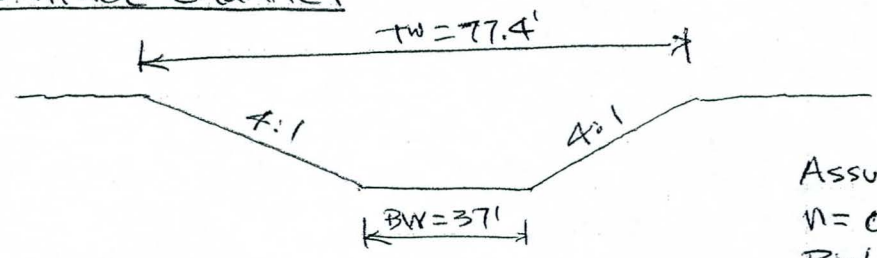
HW = 1326.31 ok Outlet Velocity = 9.96 fps
Ke = 0.20 STA 99+19 to STA 100+81 channel stations
S = 0.0012 FT/FT

Lined Channel



BW = 22'
S = 0.0015 FT/FT
Y_n = 3.99' V = 6.66 fps
Freeboard =
$0.25 \times \left(3.99 + \frac{6.66^2}{2g}\right) = 1.17'$

Unlined Channel



Assume future landscaping
$n = 0.032$ $S = 0.0015$ FT/FT
$BW = 37'$ $Y_n = 4.00'$
$V = 3.76$ fps

Freeboard =
$0.25 \times \left(4.00 + \frac{3.76^2}{2g}\right)$
$= 1.05'$
Total Depth $= 4.00' + 1.05' = 5.05'$

Check freeboard and velocity
with no landscaping $n = 0.022$
$Y_n = 3.26'$ $V = 4.89$ fps
Freeboard $= 0.25 \times \left(3.26 + \frac{4.89^2}{2g}\right)$
$= 0.91'$
Total Depth $= 3.26' + 0.91' = 4.17'$ ok

See Soil Borings R-7 and R-8
Soil is Clay
∴ per FCD Table 6.1 Permissible
Velocity for Clay is 5.0 fps ok

Low Flow Channel:
$\frac{37}{3.76 \times 4.00} = 2.46$
≥ 1.40 Low Flow recommended

Total Channel

Length = $(\cancel{121+81.62}\ 31+79) - (\cancel{100+81}\ 10+81) = \cancel{2100.62}\ 2098$

Outlet Elev = $1319.71 - (\cancel{2100.62}\ 2098 \times 0.0015) = \cancel{1316.56}\ 1316.55$

Channel Curvature

Lined $F = 0.66$ r_c / water surface width > 3.0 $r_c > 37.96 \times 3 = 114'$
Unlined $F = 0.38$ " $r_c > 69 \times 3 = 207'$

Box Culvert Calculations

11-09-2011

PROJECT NAME - Power Road
PROJECT NO. - W7X7790(
HIGHWAY NAME -
DESIGNER - JPF
LOCATION - STA 138+75 30° skew
CHECKER -
PAGE 3 of 13
VBVer 1.2: August 2008

***** INPUT DATA *****
4: BEVEL-EDGE CULVERT: HDS-5 CHART 9(1,2)
WINGWALL @ 18-37 Degrees
2- Barrel- 10.00 FT. Wide x 4.00 Ft. High

LENGTH =162.00 Ft.
SLOPE = 0.0012 Ft./Ft.
Length*Slope = 0.19Ft.
TOTAL DISCHARGE: 797 Cfs.
FREQUENCY = 50 Years

Entrance Co-eff. (Ke) =0.2
Inlet Invert Elev: 1,319.90 Ft.
Allowable Headwater Elev: 1,326.40 Ft.
Tailwater Depth = 4.00 Ft.
Calculated Tailwater Elev: 1,323.71 Ft.

---------- HYDRAULIC ANALYSIS ----------

INLET CONTROL DATA

Hw/D =1.60
Hw = 6.41 Ft.

OUTLET CONTROL DATA

Hw/D = 1.58 H = 2.50 Ft.
Hw = 6.31 Ft. Ho= 4.00 Ft.

** INLET CONTROL GOVERNS **
HEADWATER COMPUTATION

Controling Hw. = 6.41 Ft.
Design Hw/D = 1.60
Design HEADWATER Elev. 1,326.31 Ft.
Freeboard = 0.09 Ft.

Dn = 5.03 Ft.
Dc = 3.67 Ft.
(Dc+D)/2 = 3.84 Ft.

Outlet Velocity 9.96 Ft/Sec
based on depth = 4.00 Ft.
Tailwater.

*** Outlet Depth is limited to height of Box Culvert ***

TRAP. CHANNEL CALCULATIONS

11-09-2011

PROJECT NAME - Power Road PROJECT NO. - W7X77901
HIGHWAY NAME - DESIGNER - JPF
LOCATION - Shotcrete Lined Channel CHECKER - PAGE
VBVer 1.3: January 2011

Channel Bottom Width (Ft.) =22.00
Lt. side slope (Horiz. to 1) =2.00
Rt. side slope (Horiz. to 1) =2.00
Channel Slope,(Ft./Ft.) =0.001500
Manning's 'n' =0.018

Discharge (CFS) =797.00

Normal Depth (Ft.) =3.99
Area of Normal Depth (Sq. Ft.) =119.73
Normal Depth Velocity (Ft./Sec.) =6.66

Critical Depth (Ft.) =3.11
Critical Depth Velocity (Ft./Sec.) =9.07
Critical Slope (Ft./Ft.) =0.003659

Sequent Depth-Ft. =2.36
Froude Number =0.66

TRAP. CHANNEL CALCULATIONS

11-09-2011

PROJECT NAME - Power Road PROJECT NO. - W7X77901
HIGHWAY NAME - DESIGNER - JPF
LOCATION - Unlined Channel w/o Landscaping CHECKER - PAGE
VBVer 1.3: January 2011

Channel Bottom Width (Ft.) =37.00
Lt. side slope (Horiz. to 1) =4.00
Rt. side slope (Horiz. to 1) =4.00
Channel Slope,(Ft./Ft.) =0.001500
Manning's 'n' =0.022

Discharge (CFS) =797.00

Normal Depth (Ft.) =3.26
Area of Normal Depth (Sq. Ft.) =163.13
Normal Depth Velocity (Ft./Sec.) =4.89

Critical Depth (Ft.) =2.23
Critical Depth Velocity (Ft./Sec.) =7.77
Critical Slope (Ft./Ft.) =0.005815

Sequent Depth-Ft. =1.43
Froude Number =0.54

TRAP. CHANNEL CALCULATIONS

11-09-2011

PROJECT NAME - Power Road PROJECT NO. - W7X77901
HIGHWAY NAME - DESIGNER - JPF
LOCATION - Unlined Channel w/Landscaping CHECKER - PAGE
VBVer 1.3: January 2011

Channel Bottom Width (Ft.) =37.00
Lt. side slope (Horiz. to 1) =4.00
Rt. side slope (Horiz. to 1) =4.00
Channel Slope,(Ft./Ft.) =0.001500
Manning's 'n' =0.032

Discharge (CFS) =797.00

Normal Depth (Ft.) =4.00
Area of Normal Depth (Sq. Ft.) =211.79
Normal Depth Velocity (Ft./Sec.) =3.76

Critical Depth (Ft.) =2.23
Critical Depth Velocity (Ft./Sec.) =7.77
Critical Slope (Ft./Ft.) =0.012302

Sequent Depth-Ft. =1.06
Froude Number =0.38

JACOBS

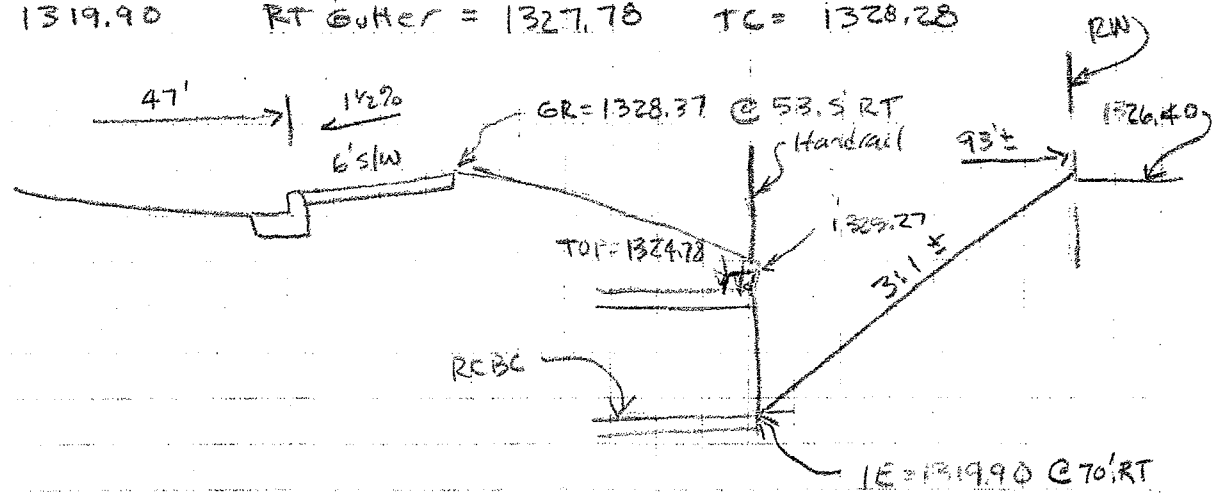
Subject RCBC Inlet Wings Project Power Road

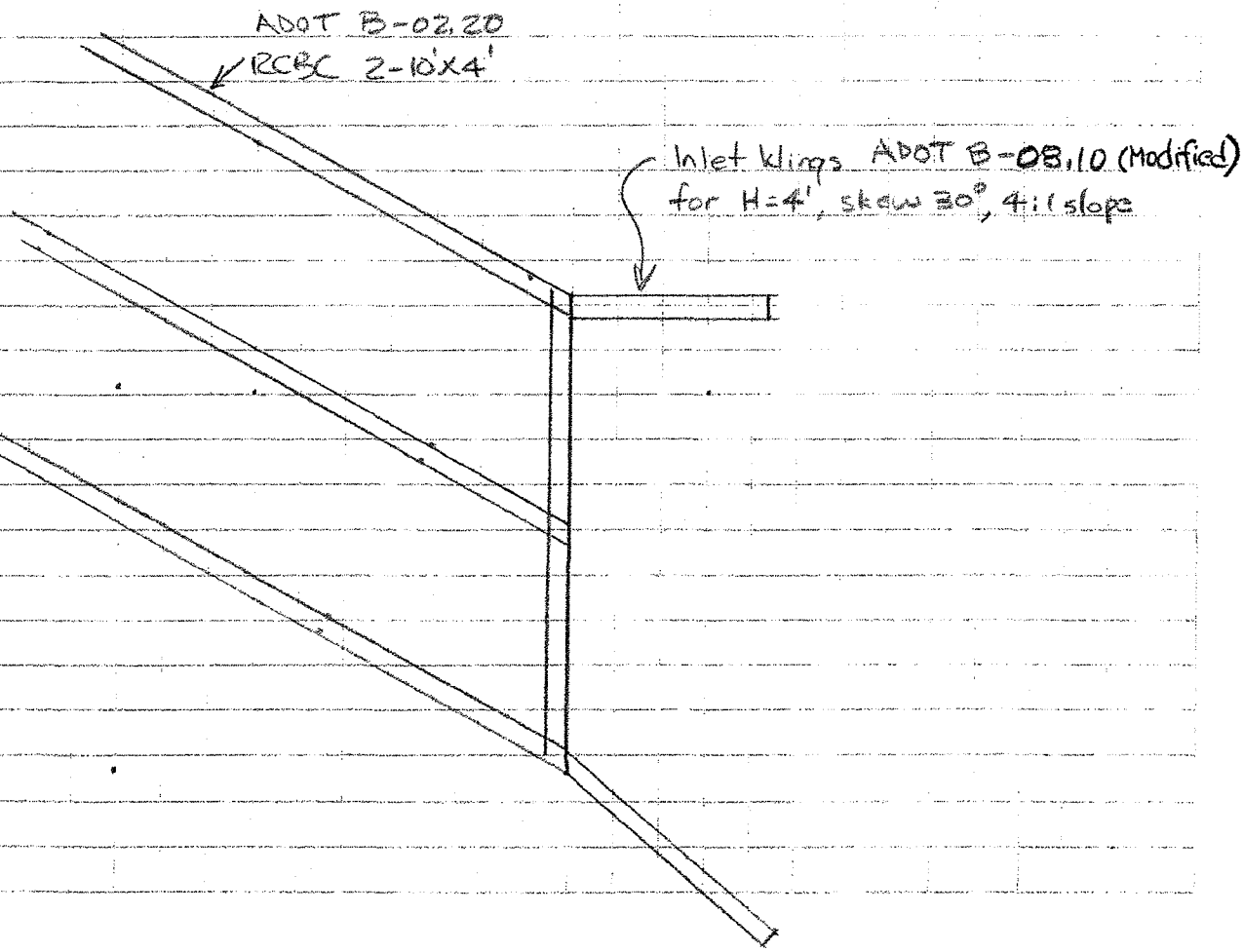
Sheet No. 7 of 13

Authored by _____ Date _____ Checked by _____ Date _____

RCBC Inlet 138+30 70' RT

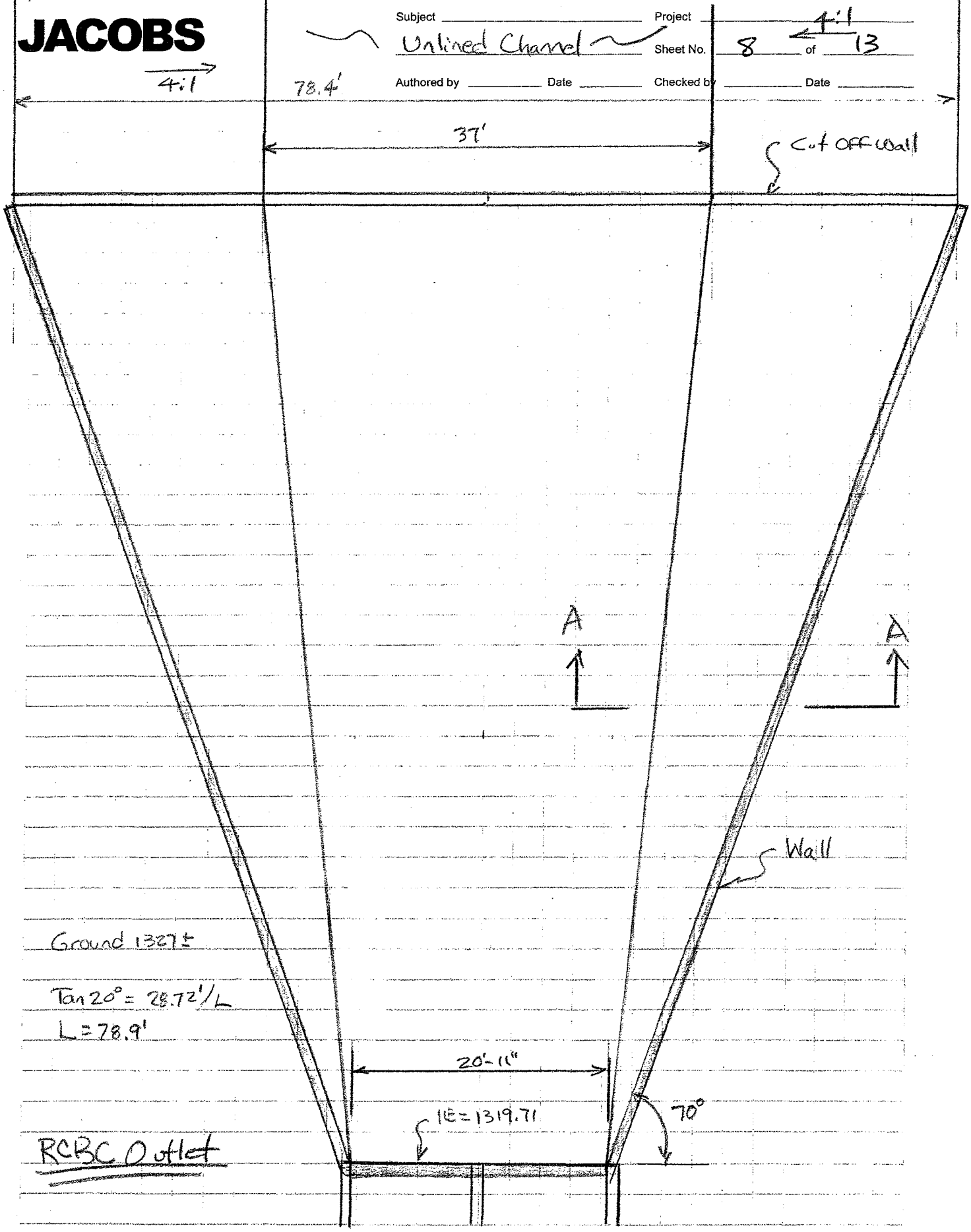
IE = 1319.90 RT Gutter = 1327.78 TC = 1328.28





JACOBS

Subject: Unlined Channel
Project:
Sheet No. 8 of 13
Authored by: Date:
Checked by: Date:

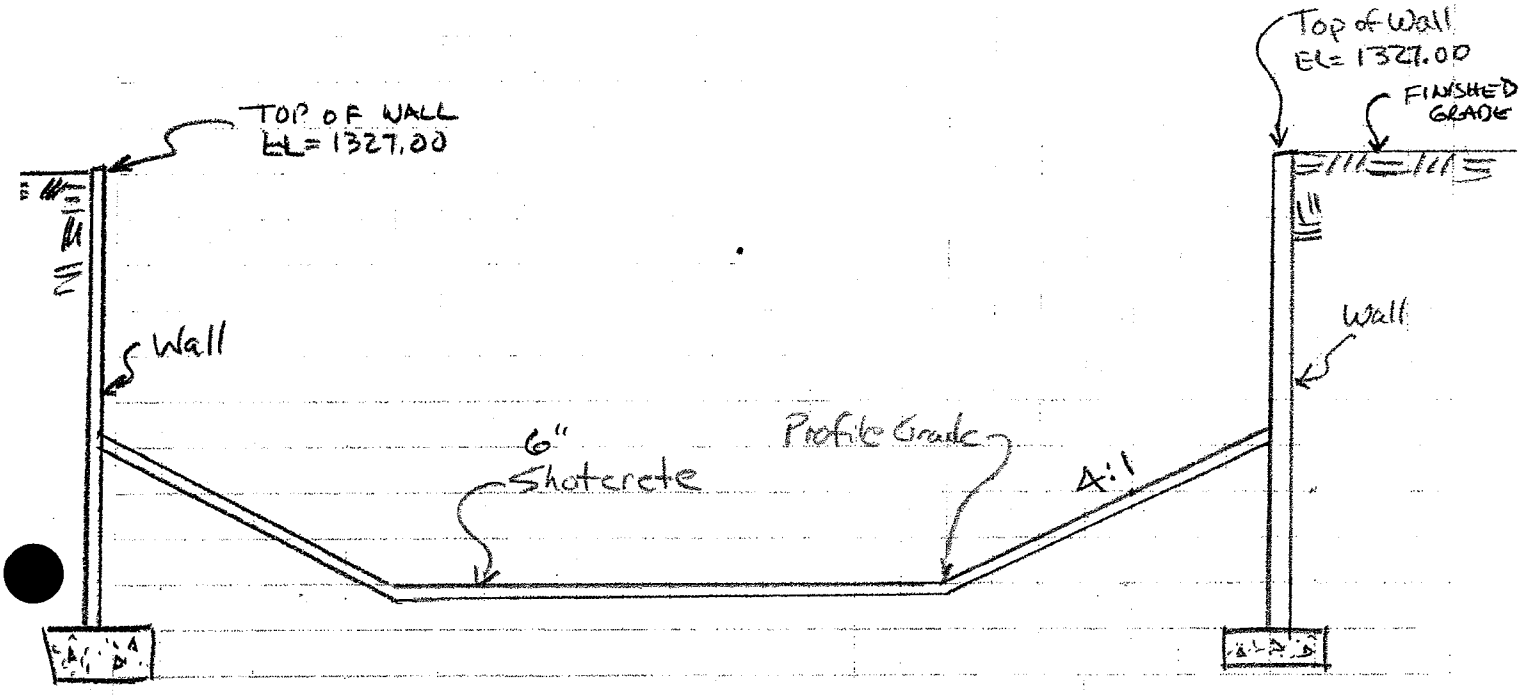


JACOBS

Subject _____ Project Power Road

Sheet No. 9 of 13

Authored by _____ Date _____ Checked by _____ Date _____

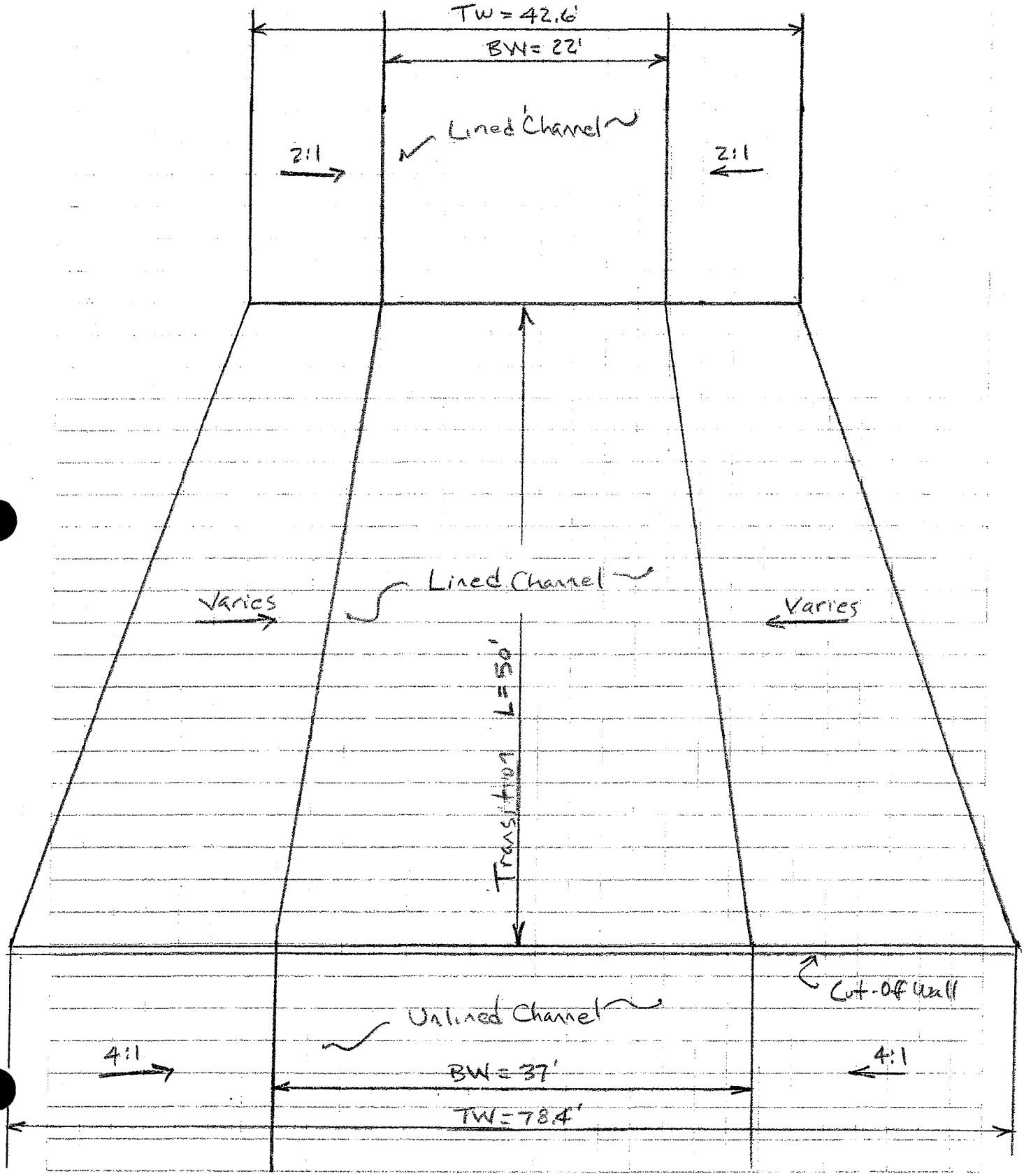


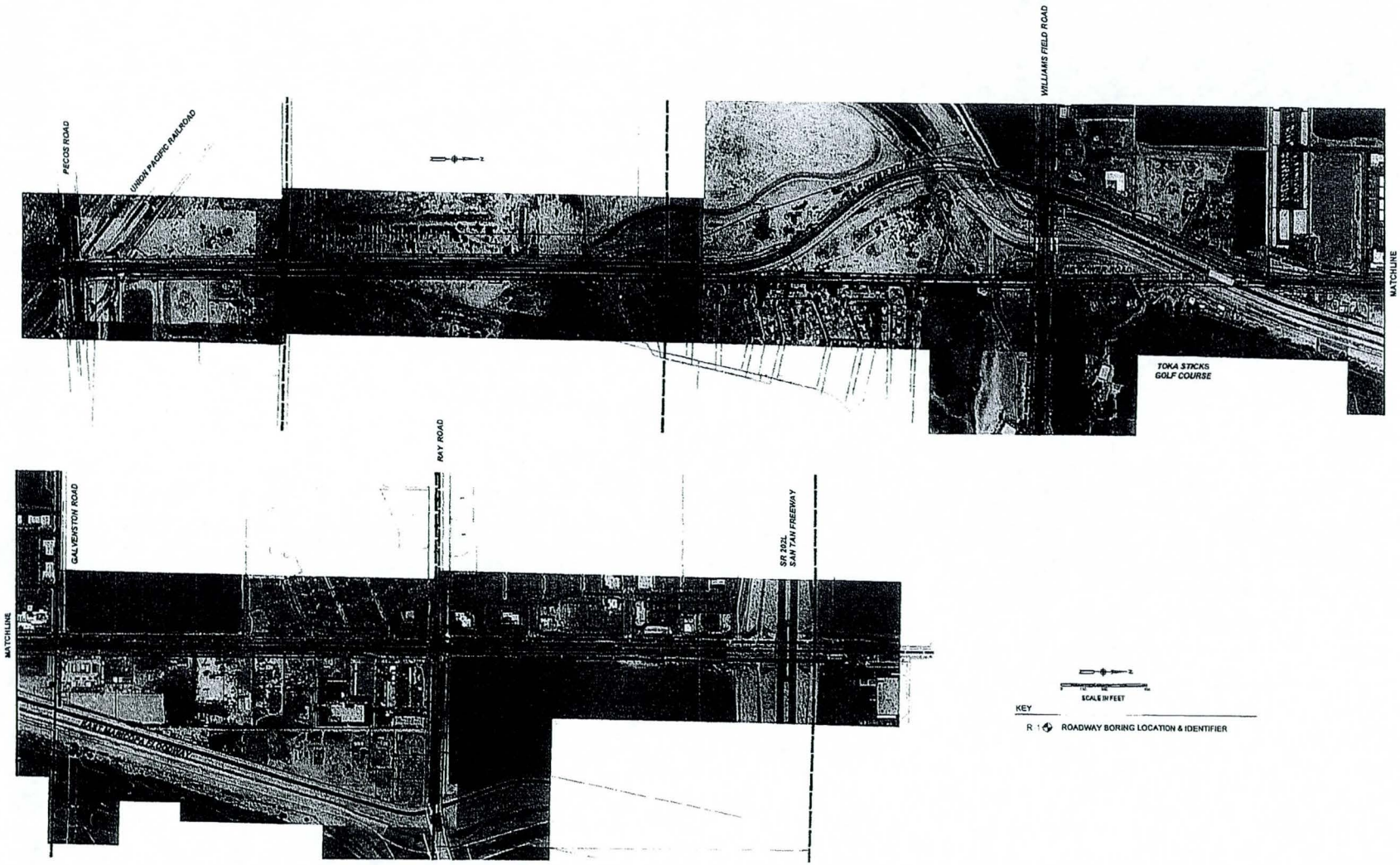
Section A-A

RCBC Outlet

JACOBS

Subject Unlined Channel to Lined Channel Transition
Project Power Road
Sheet No. 10 of 13
Authored by _____ Date _____ Checked by _____ Date _____





NO.	REVISION	MADE	CKD.	DATE	NO.	REVISION	MADE	CKD.	DATE	DWG. NO.	REFERENCES

SCALE 1" = 300'	JOB NO. 17-2010-4018	SITE PLAN	amec
DESIGNED RB	DATE 6/2011	POWER ROAD IMPROVEMENTS PECOS ROAD TO SR 202L (SANTAN FREEWAY) CITY OF MESA PROJECT NOS. 04-843-001 & 07-068-001 MARICOPA COUNTY, ARIZONA	SHEET 1
DRAWN GWH	DATE 6/2011		
CHECKED DNF	DATE 6/2011		
APPROVED	SIGNED		

amec

PROJECT Power Road Improvements
Pecos Road to SR 202L
Maricopa County, Arizona

JOB NO. 17-2010-4018 **DATE** 1/18/11

LOCATION

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	3-3-2		16.0	CL	moist to slightly moist	**CLAY,** trace silt, medium plasticity, dark brown
				A						note: very moist at ground surface
									soft to very firm	
				S	3-5-7					
				S	9-12-19					
5										
										Stopped Auger at 4'6"
										Stopped Sampler at 6'
										Backfilled boring with drill cuttings
10										
15										
20										
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE

A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
P - Pressuremeter Test
NR - No Recovery

LOG OF TEST BORING NO. R-7

amec

PROJECT Power Road Improvements
Pecos Road to SR 202L
Maricopa County, Arizona

JOB NO. 17-2010-4018 **DATE** 1/18/11

LOCATION

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	3-7-			CL	slightly moist	**CLAY WITH SILT,** medium plasticity, light brown
				A	11		7.2		firm to hard	
				S	17-33-					
					36					
										note: considerable calcium carbonate below 4'
				U	100/6"	96.0	6.7			
5										Stopped Auger at 4'6" Sampler refused at 5' Backfilled boring with drill cuttings
10										
15										
20										
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▽			

SAMPLE TYPE

A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
P - Pressuremeter Test
NR - No Recovery

LOG OF TEST BORING NO. R-8

Jacobs

Channel Freeboard

Project:	**Power Road**	By:	**JPF**
Subject:	**West Channel**	Date:	**11/30/2011**
	Freeboard and Channel Lining	Checked:	
		Jacobs Project No.:	**W7X77901**

Remarks:

Peak flow is 50-year discharge at Power Road.
3, 4 and 5 - Flow results from HEC-RAS analysis.
7 - Minimum Freeboard = 0.25 x ($v^2/2g + Y_n$)

Calculations:

Channel Station (ft) 1	Bottom Grade (ft) 2	WSE (ft) 3	Y_n (ft) 4	Velocity (fps) 5	Velocity Head (ft) 6	Minimum Freeboard (ft) 7	Channel Top (ft) 8	Freeboard Provided (ft) 8 - (2 +3)
1080.80	1319.71	1323.27	3.56	10.76	1.80	1.34	1327.00	3.73
1140.80	1319.62	1323.57	3.95	4.75	0.35	1.08	1327.00	3.43
1160.80	1319.59	1323.62	4.03	3.73	0.22	1.06	1327.00	3.38
1161.00	1319.59	1323.62	4.03	3.73	0.22	1.06	1327.00	3.38
1200.00	1319.53	1323.60	4.07	3.68	0.21	1.07	1327.20	3.60
1400.00	1319.23	1323.33	4.10	3.65	0.21	1.08	1327.90	4.57
1600.00	1318.93	1323.06	4.13	3.61	0.20	1.08	1328.20	5.14
1800.00	1318.63	1322.80	4.17	3.56	0.20	1.09	1327.70	4.90
2000.00	1318.33	1322.56	4.23	3.50	0.19	1.10	1326.70	4.14
2200.00	1318.03	1322.33	4.30	3.43	0.18	1.12	1327.30	4.97
2400.00	1317.73	1322.11	4.38	3.34	0.17	1.14	1327.10	4.99
2629.50	1317.39	1321.89	4.50	3.22	0.16	1.17	1326.70	4.81
2630.00	1317.39	1321.89	4.50	3.22	0.16	1.17	1323.14	1.25
2680.00	1317.31	1321.75	4.44	4.17	0.27	1.18	1323.06	1.31
2730.00	1317.24	1321.26	4.02	6.60	0.68	1.18	1322.99	1.73
3100.00	1316.68	1319.82	3.14	8.99	1.25	1.10	1322.43	2.61
3101.00	1316.68	1319.78	3.10	9.10	1.29	1.10	1322.43	2.65
3179.00	1316.56	1318.53	1.97	13.01	2.63	1.15	1322.31	3.78

Power Road
Pecos Road to 202L
Final Drainage Report

Appendix D

Culvert Analyses

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE SECTION
BOX CULVERT CALCULATIONS-Vers 3.01

10-28-2010

PROJECT NUMBER _____ TRACS NO. _____
PROJECT NAME Power Road DESIGNER JPF
HIGHWAY NAME _____ CHECKER _____
LOCATION/STATION Sta 263+75 PAGE _____

***** INPUT DATA *****

SQUARE EDGE CULVERT: HDS-5 CHART 8(2)
WINGWALL @ 15, 90 Degrees
1 Barrel- 8.0 FT. Wide x 8.0 Ft. High

LENGTH = 92.0 Ft.
SLOPE = 0.0050 Ft./Ft.
Length*Slope = 0.4600 Ft.
TOTAL DISCHARGE: 312 Cfs.
FREQUENCY = 50 Years

Entrance Co-eff. (Ke) = 0.5
Inlet Invert Elev: 1315.08 Ft.
Allowable Headwater Elev: 1323.00 Ft.
Tailwater Depth = 4.00 Ft.
Calculated Tailwater Elev: 1318.62 Ft.

---------- HYDRAULIC ANALYSIS ----------

INLET CONTROL DATA	OUTLET CONTROL DATA	
Hw/D = 0.76	Hw/D = 0.74	H = 0.61 Ft.
Hw = 6.12 Ft.	Hw = 5.95 Ft.	Ho= 5.81 Ft.

** INLET CONTROL GOVERNS **

HEADWATER COMPUTATION

Controling Hw. = 6.12 Ft.
Design Hw/D = 0.8
Design HEADWATER Elev. 1321.20 Ft.

Dn = 3.07 Ft.
Dc = 3.61 Ft.
(Dc+D)/2 = 5.81 Ft.

Outlet Velocity 9.73 Fps.
based on depth = 4.00 Ft.
Sequent depth <= Tailwater.

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE SECTION
BOX CULVERT CALCULATIONS-Vers 3.01

10-28-2010

PROJECT NUMBER _____ TRACS NO. _____
PROJECT NAME Power Road DESIGNER JPF
HIGHWAY NAME _____ CHECKER _____
LOCATION/STATION Sta 263+75 PAGE _____

BOX CULVERT-OPEN CHANNEL

CULVERT LENGTH = 92.0 Ft.
CULVERT SLOPE, S = 0.0050 Ft./Ft.

BARREL WIDTH = 8.00 Ft.
BARREL DEPTH = 8.00 Ft.
Manning's n = 0.012

DISCHARGE per Barrel, Q = 311.5 CFS

COMPUTATIONS:
****

CRITICAL SLOPE = 0.0032 Ft./Ft.

CRITICAL DEPTH = 3.61 Ft.
CRITICAL VELOCITY = 10.78 fps

NORMAL DEPTH = 3.07 Ft.
NORMAL VELOCITY = 12.67 Ft.

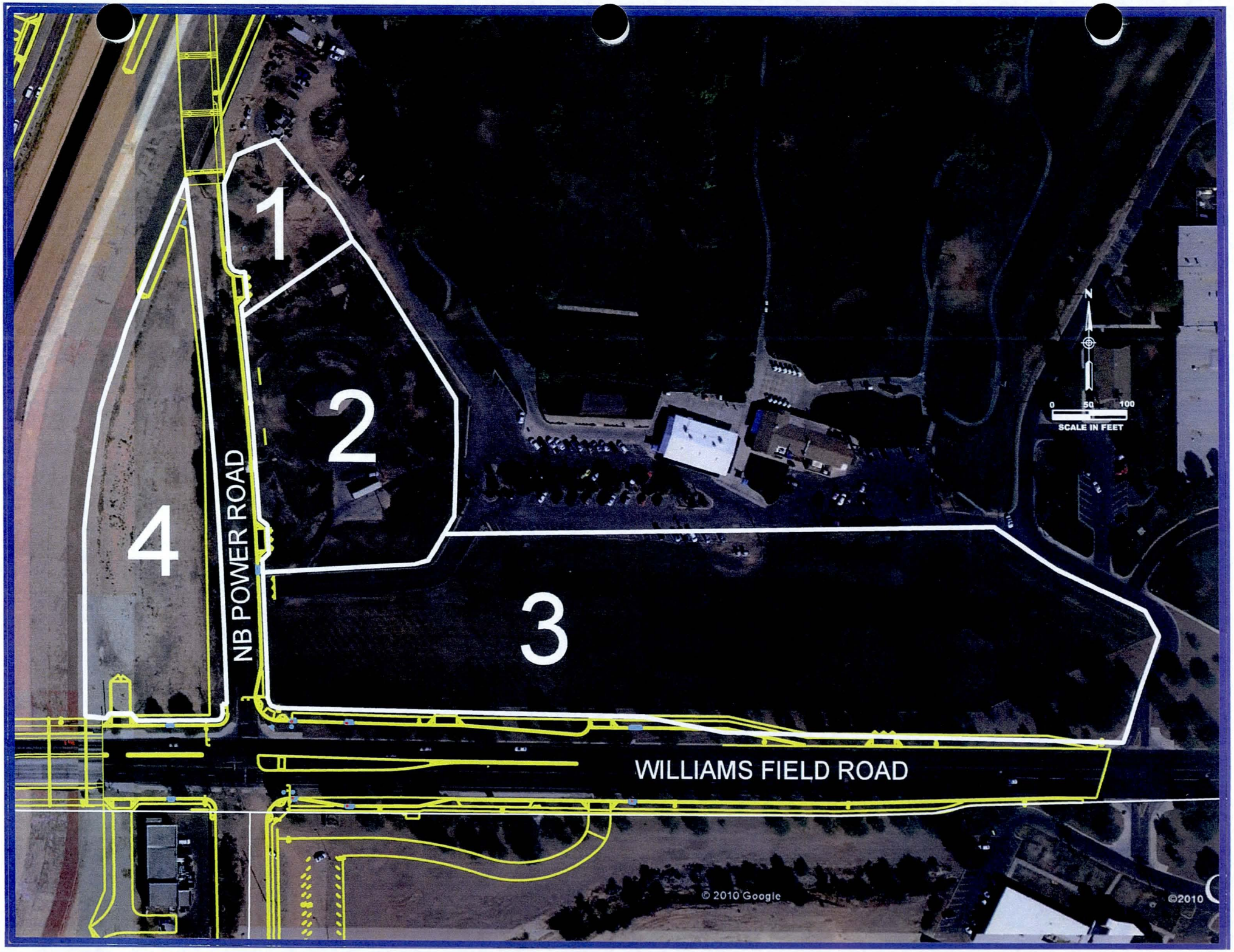
Dc to Dn Table: Supercritical flow

I	Y	V	E	Sf	DEL X	X	I
0	3.611	10.78	5.416	0.00321	0.00	0.00	0
1	3.584	10.86	5.417	0.00328	0.17	0.17	1
2	3.557	10.95	5.418	0.00334	0.54	0.71	2
3	3.530	11.03	5.419	0.00341	0.96	1.67	3
4	3.504	11.11	5.421	0.00348	1.42	3.10	4
5	3.477	11.20	5.424	0.00356	1.95	5.04	5
6	3.450	11.29	5.428	0.00363	2.55	7.59	6
7	3.423	11.37	5.432	0.00371	3.24	10.83	7
8	3.396	11.46	5.437	0.00379	4.03	14.86	8
9	3.369	11.56	5.443	0.00387	4.97	19.83	9
10	3.343	11.65	5.450	0.00396	6.08	25.91	10
11	3.316	11.74	5.457	0.00405	7.43	33.34	11
12	3.289	11.84	5.465	0.00414	9.09	42.43	12
13	3.262	11.94	5.474	0.00423	11.18	53.61	13
14	3.235	12.04	5.484	0.00433	13.91	67.52	14
15	3.208	12.14	5.495	0.00443	17.60	85.11	15
16	3.182	12.24	5.507	0.00453	22.87	107.98	16
17	3.155	12.34	5.520	0.00464	31.02	139.00	17
18	3.128	12.45	5.534	0.00475	45.28	184.28	18
19	3.101	12.56	5.549	0.00486	76.63	260.91	19
20	3.074	12.67	5.565	0.00498	201.45	462.36	20

Power Road
Pecos Road to 202L
Final Drainage Report

Appendix E

TOKA Sticks Drainage


1
2
3
4
NB POWER ROAD
WILLIAMS FIELD ROAD
N
0
50
100
SCALE IN FEET
© 2010 Google
©2010

Jacobs

Project:	**Power Road**	By:	**GLC**
Subject:	**Off-site Drainage**	Date:	**8/11/2011**
	Toka Sticks GC	Checked:	
		Jacobs Project No.:	**W7X77901**

There are three drainage subbasins that drain to the EMF outfall located north of Williams Field Road.

Rational Method

Rainfall Intensity

10-year i	4.48
50-year i	6.20
100-year i	6.94

Peak Discharge

ID	Area, sq.ft	Area, Acre	C	CA	Q10	Q50	Q100
1	24193	0.56	0.7	0.39	1.74	2.41	2.70
3	296502	6.81	0.7	4.76	21.35	29.54	33.07
4	100053	2.30	0.7	1.61	7.20	9.97	11.16
				Totals	30.29	41.92	46.92

Area 2 is self-contained, no discharge.

Pipe Analyses

Pipe 1 - Area 1 **Station 274+42**

Pipe to west under Power Road.

Q50=2.4 cfs

Pipe Invert Elevation =	1322.81	
Outfall elevation =	1321.68	
Length, ft =	122	
slope =	0.009262	
Tailwater for pipe 1 =	0	
Try 18" pipe		
Headwater ıtfall pipe =	1-18"	
Headwater at Headwall =	0.84	
Headwater Elevation =	1323.65	OK

Jacobs

Project:	**Power Road**	By:	**GLC**
Subject:	**Off-site Drainage**	Date:	**8/11/2011**
	Toka Sticks GC	Checked:	
		Jacobs Project No.:	**W7X77901**

Pipe 5 - Area 3 & 4	**Station 274+20**	
Q50 at outfall, cfs =	40	
Pipe Invert Elevation, ft =	1322.06	
Outfall elevation, ft =	1321.68	
Length, ft =	30	
slope =	0.0127	
Try 2- elliptical pipes		
Outfall pipe =	2-19x30	2-22x34
Headwater at Headwall =	2.58	2.11
Headwater Elevation =	1324.64	1324.17

Ditch betweem Pipe 4 and Pipe 3
Outfall station = 274+19
Outfall elevation = 1322.06
slope = 0.004
Begin Station = 269+50
Length = 469 ft
Begin elevation = 1322.06+0.004*469 = 1323.94

Earth lined - n=0.025 to 0.035
Flow varies from 30 cfs at southern end where pipes enter to 40 cfs at northern end where flow enters pipe for outfall to EMF.

Use 40 cfs to evaluate width necessary.
Allowable depth = 1
at a Mannings n of 0.025, B=9 ft
at a Mannings n of 0.030, B=11 ft
at a Mannings n of 0.035, B=13.25 ft
Allowable headwater depth = 2.57 ft

WS Elevation at Pipe 4= 1324.64

Jacobs

Project:	**Power Road**	By:	**GLC**
Subject:	**Off-site Drainage**	Date:	**8/11/2011**
	Toka Sticks GC	Checked:	
		Jacobs Project No.:	**W7X77901**

Pipe 3 - Area 3 **Station 269+50**

Q50, cfs =	30
Pipe Invert Elevation =	1324.04
Outfall elevation =	1323.94
Length, ft =	100
slope =	0.0010

Allowable Headwater Elevation = 1326.60 at Williams Field Road

With an 11 ft wide ditch at a Manning's n of 0.030, try 2-elliptical pipes to 30 cfs

Try	2-19x30	
Ditch Outfall pipe =	2-19x30	2-22x34
Tailwater Elevation	1324.64	1324.17
Headwater Elevation =	1326.04	1325.81
Headwater at Headwall =	2	1.77

OK, use 2-19x39 elliptical pipes at both Area 3 and at ditch outfall to EMF.

HY-8 Culvert Analysis Report

Pipe 1 – area 1

Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 1322.81 ft

Outlet Station: 122.00 ft

Outlet Elevation: 1321.68 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Concrete

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: None

Table 1 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	1322.81	0.000	0.000	0-NF	0.000	0.000	0.000	1321.680	0.000	0.000
0.40	0.40	1323.12	0.311	0.000	1-S2n	0.185	0.222	0.212	1321.680	2.535	0.000
0.80	0.80	1323.27	0.456	0.000	1-S2n	0.267	0.328	0.272	1321.680	3.609	0.000
1.20	1.20	1323.37	0.557	0.000	1-S2n	0.330	0.404	0.333	1321.680	4.184	0.000
1.60	1.60	1323.46	0.652	0.000	1-S2n	0.381	0.472	0.381	1321.680	4.483	0.000
2.00	2.00	1323.54	0.732	0.000	1-S2n	0.431	0.528	0.432	1321.680	4.727	0.000
2.40	2.40	1323.63	0.820	0.000	1-S2n	0.474	0.585	0.475	1321.680	5.024	0.000
2.80	2.80	1323.71	0.904	0.000	1-S2n	0.513	0.632	0.516	1321.680	5.177	0.000
3.20	3.20	1323.79	0.982	0.000	1-S2n	0.552	0.677	0.556	1321.680	5.354	0.000
3.60	3.60	1323.87	1.056	0.000	1-S2n	0.591	0.722	0.591	1321.680	5.560	0.000
4.00	4.00	1323.94	1.127	0.000	1-S2n	0.625	0.764	0.626	1321.680	5.735	0.000

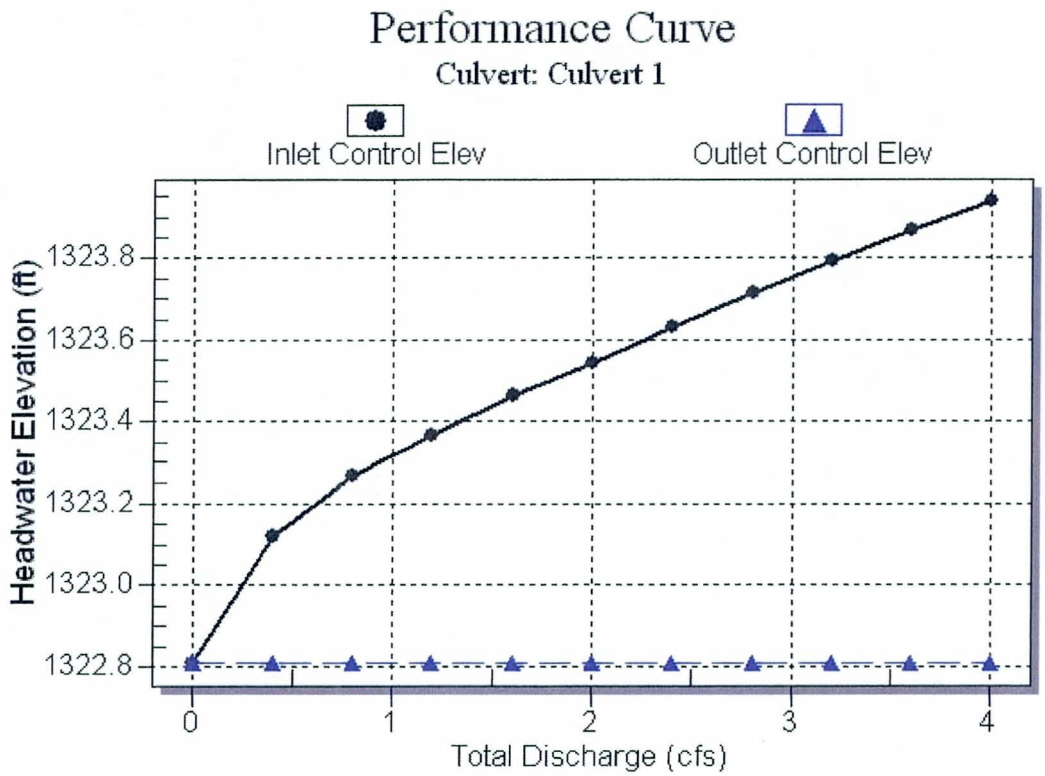
****

Inlet Elevation (invert): 1322.81 ft, Outlet Elevation (invert): 1321.68 ft

Culvert Length: 122.01 ft, Culvert Slope: 0.0093

****

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1

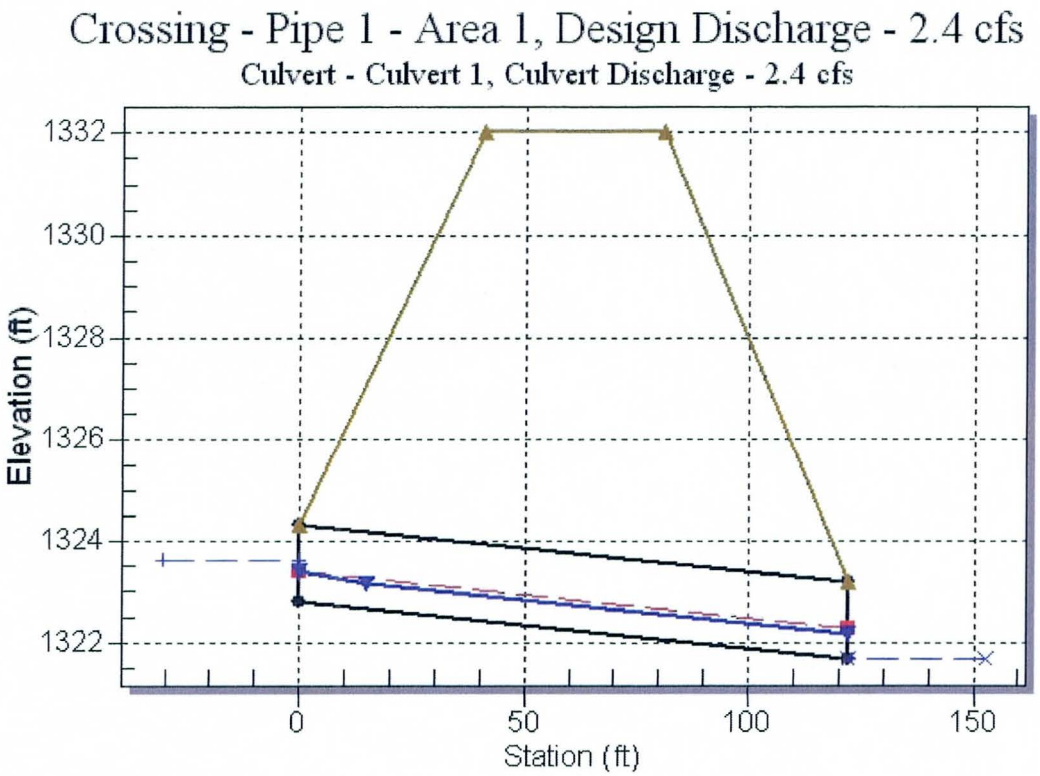


Table 2 - Downstream Channel Rating Curve (Crossing: Pipe 1 - Area 1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
0.00	1321.68	1321.68
0.40	1321.68	1321.68
0.80	1321.68	1321.68
1.20	1321.68	1321.68
1.60	1321.68	1321.68
2.00	1321.68	1321.68
2.40	1321.68	1321.68
2.80	1321.68	1321.68
3.20	1321.68	1321.68
3.60	1321.68	1321.68
4.00	1321.68	1321.68

Tailwater Channel Data - Pipe 1 - Area 1

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 1321.68 ft

Roadway Data for Crossing: Pipe 1 - Area 1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 1332.00 ft

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

Table 3 - Summary of Culvert Flows at Crossing: Pipe 1 - Area 1

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1322.81	0.00	0.00	0.00	1
1323.12	0.40	0.40	0.00	1
1323.27	0.80	0.80	0.00	1
1323.37	1.20	1.20	0.00	1
1323.46	1.60	1.60	0.00	1
1323.54	2.00	2.00	0.00	1
1323.63	2.40	2.40	0.00	1
1323.71	2.80	2.80	0.00	1
1323.79	3.20	3.20	0.00	1
1323.87	3.60	3.60	0.00	1
1323.94	4.00	4.00	0.00	1

Rating Curve Plot for Crossing: Pipe 1 - Area 1

HY-8 Culvert Analysis Report

Pipe 3 – Area 3

Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 1324.04 ft

Outlet Station: 90.00 ft

Outlet Elevation: 1323.94 ft

Number of Barrels: 2

Culvert Data Summary - Culvert 1

Barrel Shape: Elliptical

Barrel Span: 30.00 in

Barrel Rise: 19.00 in

Barrel Material: Concrete

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Grooved End with Headwall

Inlet Depression: None

Table 1 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	1324.17	0.000	0.130	0-NF	0.000	0.000	0.000	0.230	0.000	0.000
3.00	3.00	1324.55	0.477	0.511	2-M2c	0.451	0.339	0.339	0.230	2.829	0.000
6.00	6.00	1324.76	0.673	0.715	2-M2c	0.634	0.486	0.486	0.230	3.299	0.000
9.00	9.00	1324.91	0.829	0.872	2-M2c	0.770	0.595	0.595	0.230	3.657	0.000
12.00	12.00	1325.05	0.985	1.007	2-M2c	1.005	0.689	0.689	0.230	3.944	0.000
15.00	15.00	1325.26	1.128	1.223	2-M2c	1.154	0.774	0.774	0.230	4.172	0.000
18.00	18.00	1325.47	1.263	1.426	2-M2c	1.400	0.981	0.981	0.230	4.827	0.000
21.00	21.00	1325.58	1.393	1.545	2-M2c	1.583	1.041	1.041	0.230	4.935	0.000
24.00	24.00	1325.72	1.522	1.681	2-M2c	1.583	1.101	1.101	0.230	5.212	0.000
27.00	27.00	1325.85	1.652	1.815	2-M2c	1.583	1.153	1.153	0.230	5.506	0.000
30.00	30.00	1326.04	1.787	2.005	7-M2c	1.583	1.203	1.203	0.230	5.860	0.000

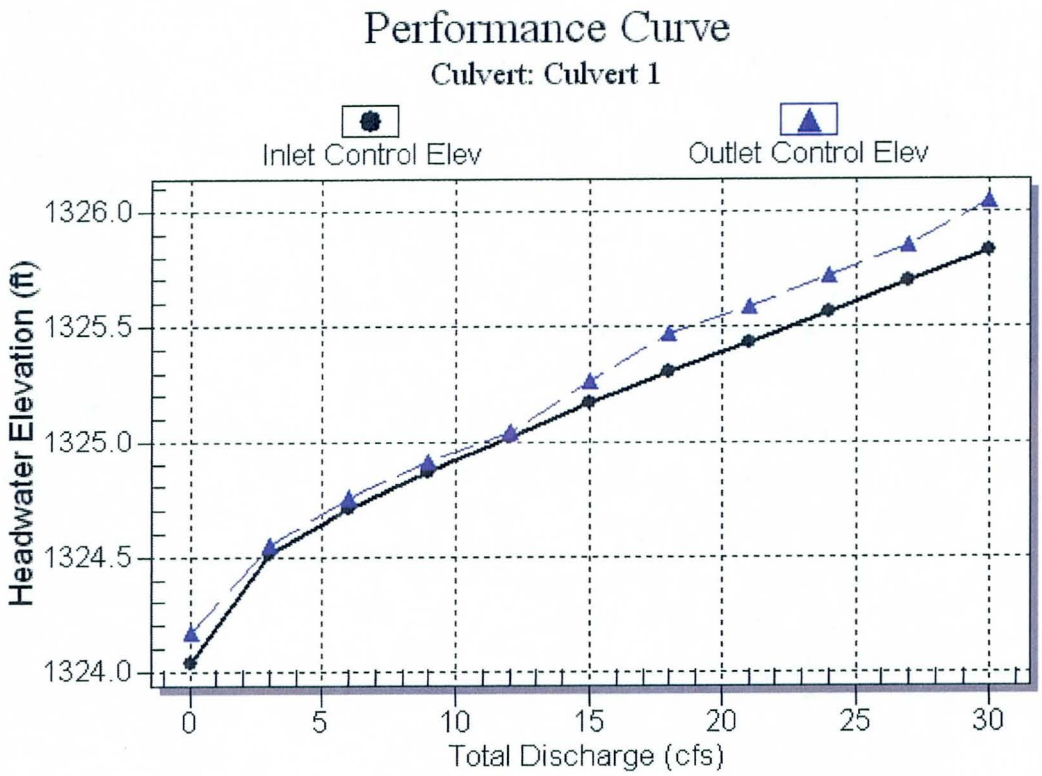
****

Inlet Elevation (invert): 1324.04 ft, Outlet Elevation (invert): 1323.94 ft

Culvert Length: 90.00 ft, Culvert Slope: 0.0011

****

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1

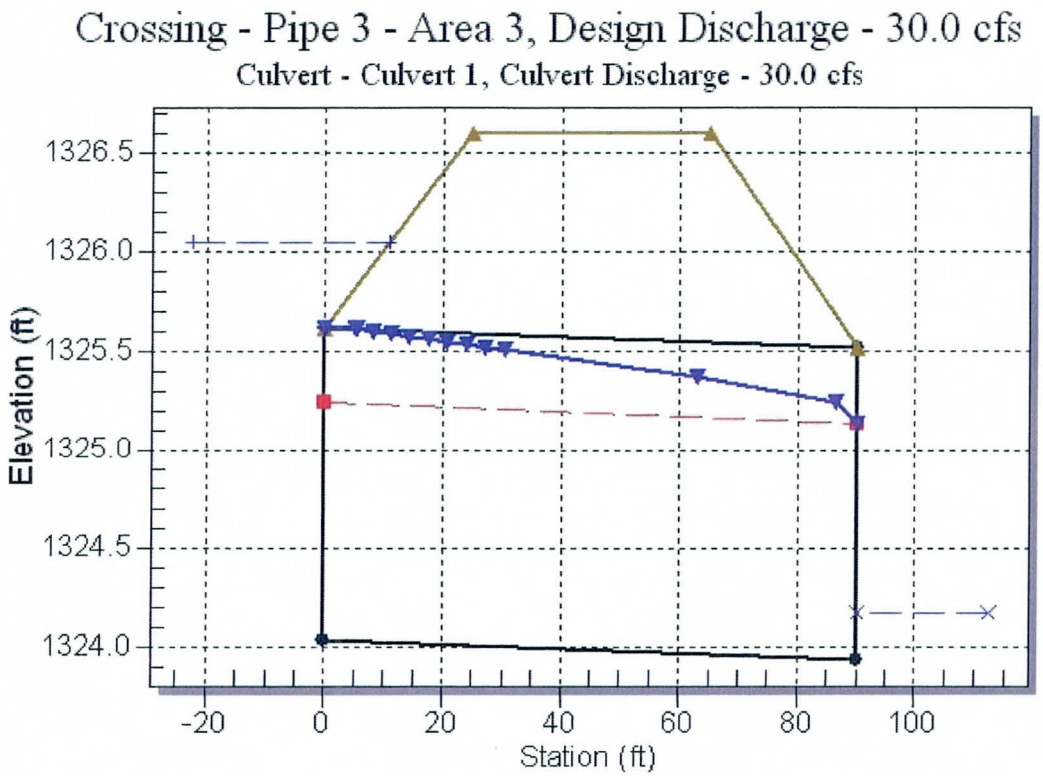


Table 2 - Downstream Channel Rating Curve (Crossing: Pipe 3 - Area 3)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
0.00	1324.17	0.23
3.00	1324.17	0.23
6.00	1324.17	0.23
9.00	1324.17	0.23
12.00	1324.17	0.23
15.00	1324.17	0.23
18.00	1324.17	0.23
21.00	1324.17	0.23
24.00	1324.17	0.23
27.00	1324.17	0.23
30.00	1324.17	0.23

Tailwater Channel Data - Pipe 3 - Area 3

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 1324.17 ft

Roadway Data for Crossing: Pipe 3 - Area 3

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 1326.60 ft

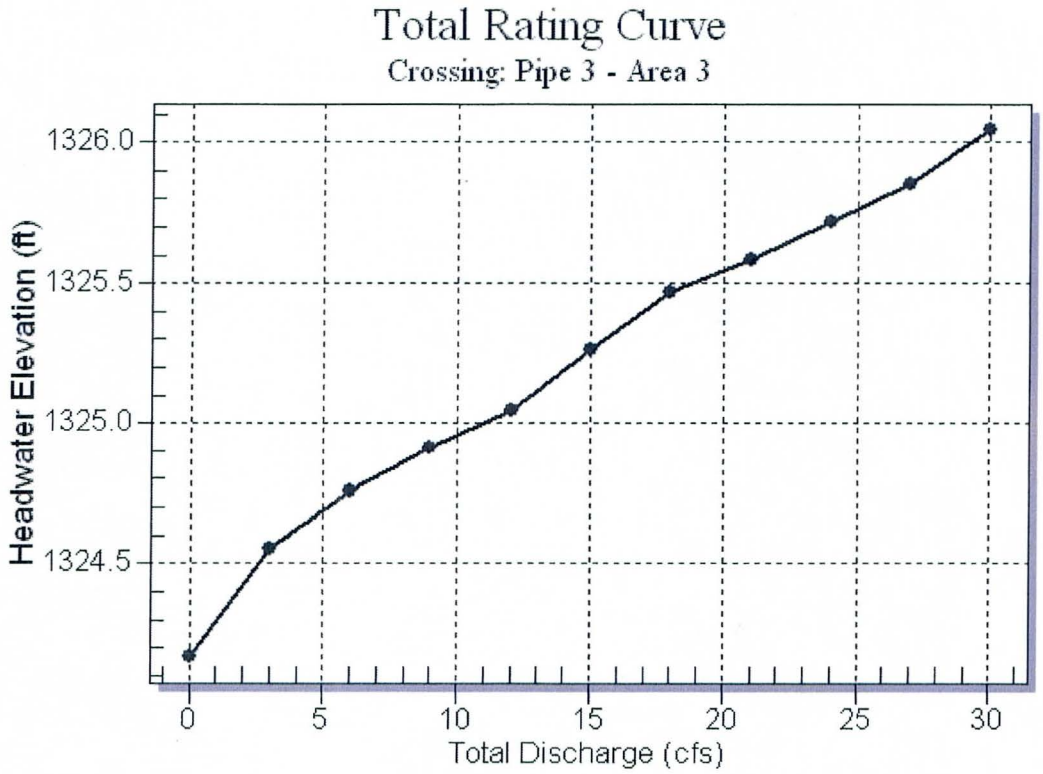
Roadway Surface: Paved

Roadway Top Width: 40.00 ft

Table 3 - Summary of Culvert Flows at Crossing: Pipe 3 - Area 3

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1324.17	0.00	0.00	0.00	1
1324.55	3.00	3.00	0.00	1
1324.76	6.00	6.00	0.00	1
1324.91	9.00	9.00	0.00	1
1325.05	12.00	12.00	0.00	1
1325.26	15.00	15.00	0.00	1
1325.47	18.00	18.00	0.00	1
1325.58	21.00	21.00	0.00	1
1325.72	24.00	24.00	0.00	1
1325.85	27.00	27.00	0.00	1
1326.04	30.00	30.00	0.00	1

Rating Curve Plot for Crossing: Pipe 3 - Area 3



HY-8 Culvert Analysis Report

Pipe 5 Area 4 & 5

Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 1322.06 ft

Outlet Station: 30.00 ft

Outlet Elevation: 1321.68 ft

Number of Barrels: 2

Culvert Data Summary - Culvert 1

Barrel Shape: Elliptical

Barrel Span: 30.00 in

Barrel Rise: 19.00 in

Barrel Material: Concrete

Barrel Manning's n: 0.0120

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: None

Table 1 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	1322.06	0.000	0.000	0-NF	0.000	0.000	0.000	1322.000	0.000	0.000
4.00	4.00	1322.61	0.549	0.549	1-S2n	0.286	0.389	0.288	1322.000	4.649	0.000
8.00	8.00	1322.84	0.784	0.000	1-S2n	0.399	0.558	0.407	1322.000	5.609	0.000
12.00	12.00	1323.07	1.006	0.000	1-S2n	0.491	0.689	0.498	1322.000	6.389	0.000
16.00	16.00	1323.27	1.207	0.000	1-S2n	0.561	0.866	0.592	1322.000	6.539	0.000
20.00	20.00	1323.46	1.401	0.000	1-S2n	0.631	1.021	0.635	1322.000	7.428	0.000
24.00	24.00	1323.66	1.598	0.000	5-S2n	0.686	1.101	0.714	1322.000	7.479	0.000
28.00	28.00	1323.87	1.808	0.000	5-S2n	0.740	1.169	0.742	1322.000	8.261	0.000
32.00	32.00	1324.10	2.039	0.000	5-S2n	0.797	1.236	1.000	1322.000	7.964	0.000
36.00	36.00	1324.35	2.295	0.000	5-S2n	0.938	1.293	1.062	1322.000	8.223	0.000
40.00	40.00	1324.64	2.580	0.000	5-S2n	1.001	1.342	1.114	1322.000	8.552	0.000

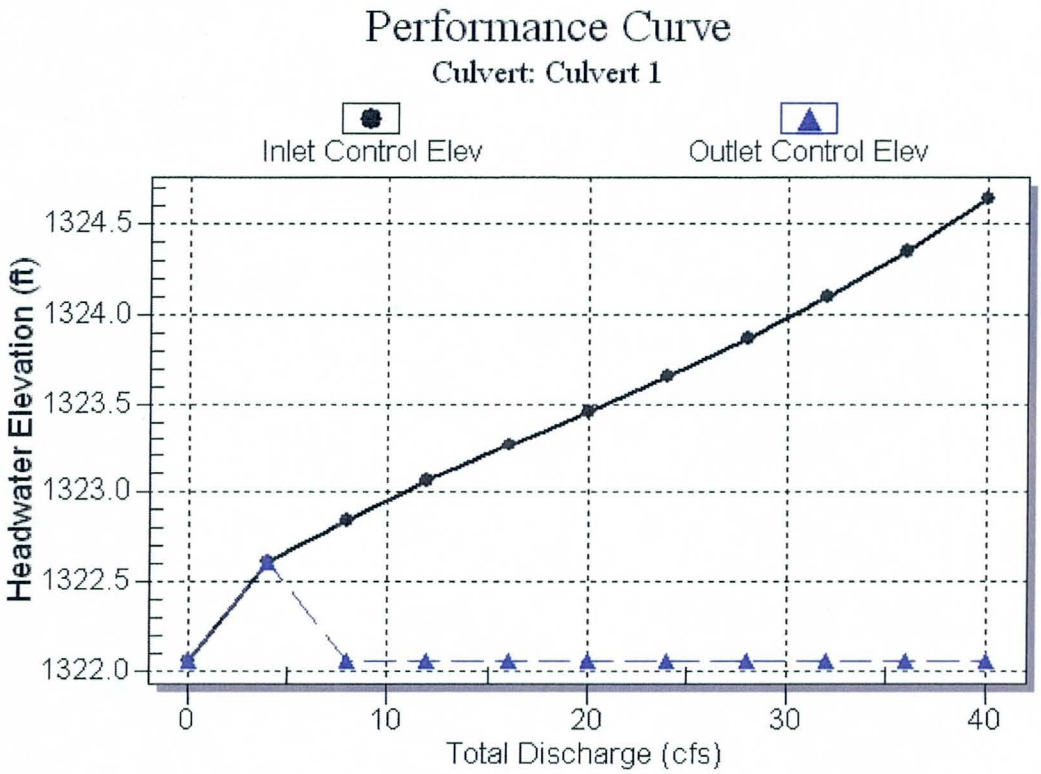
****

Inlet Elevation (invert): 1322.06 ft, Outlet Elevation (invert): 1321.68 ft

Culvert Length: 30.00 ft, Culvert Slope: 0.0127

****

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1

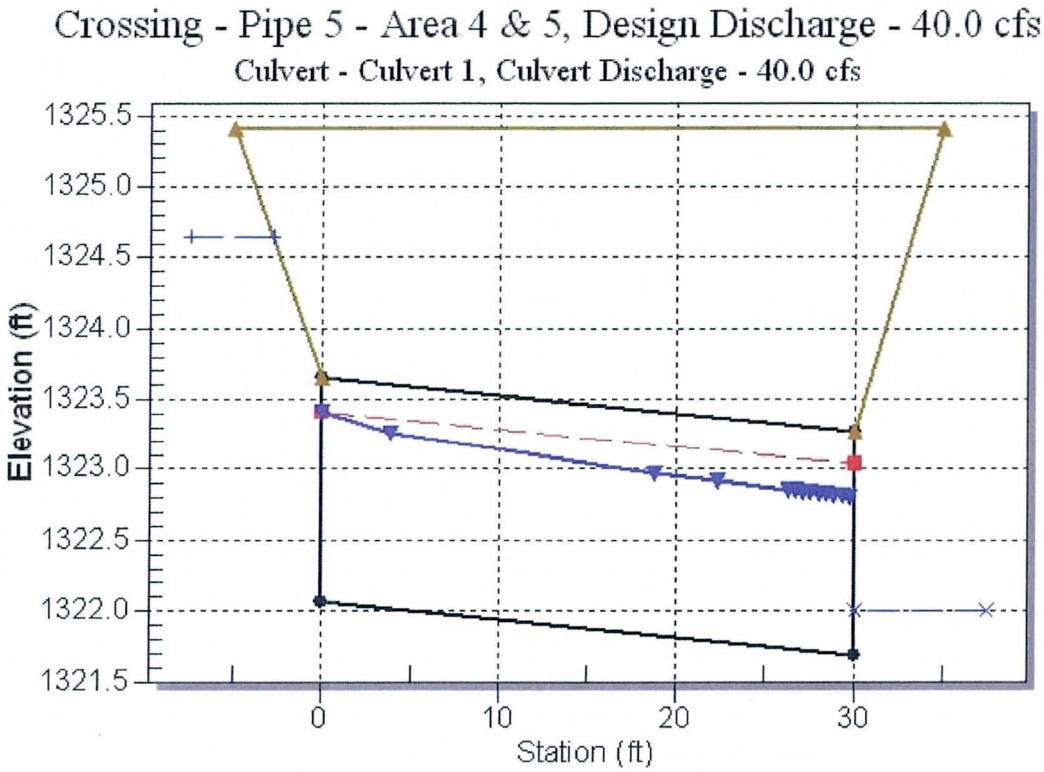


Table 2 - Downstream Channel Rating Curve (Crossing: Pipe 5 - Area 4 & 5)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
0.00	1322.00	1322.00
4.00	1322.00	1322.00
8.00	1322.00	1322.00
12.00	1322.00	1322.00
16.00	1322.00	1322.00
20.00	1322.00	1322.00
24.00	1322.00	1322.00
28.00	1322.00	1322.00
32.00	1322.00	1322.00
36.00	1322.00	1322.00
40.00	1322.00	1322.00

Tailwater Channel Data - Pipe 5 - Area 4 & 5

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 1322.00 ft

Roadway Data for Crossing: Pipe 5 - Area 4 & 5

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 1325.40 ft

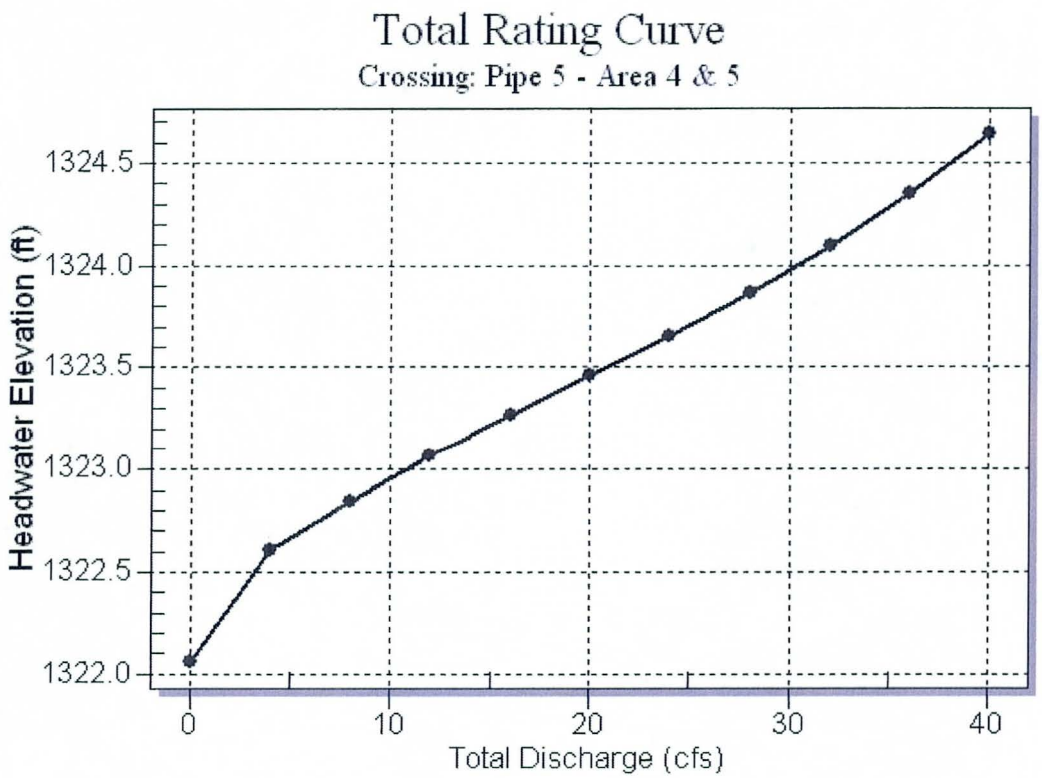
Roadway Surface: Paved

Roadway Top Width: 40.00 ft

Table 3 - Summary of Culvert Flows at Crossing: Pipe 5 - Area 4 & 5

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1322.06	0.00	0.00	0.00	1
1322.61	4.00	4.00	0.00	1
1322.84	8.00	8.00	0.00	1
1323.07	12.00	12.00	0.00	1
1323.27	16.00	16.00	0.00	1
1323.46	20.00	20.00	0.00	1
1323.66	24.00	24.00	0.00	1
1323.87	28.00	28.00	0.00	1
1324.10	32.00	32.00	0.00	1
1324.35	36.00	36.00	0.00	1
1324.64	40.00	40.00	0.00	1

Rating Curve Plot for Crossing: Pipe 5 - Area 4 & 5



Power Road
Pecos Road to 202L
Final Drainage Report

Appendix F

Bridge HEC-RAS Analysis

MEMO

TO: Jonathan Lesperance **DATE:** August 30, 2011

FROM: George Lopez-Cepero

SUBJECT: Power Road
EMF
HEC-RAS Model **PROJECT NO:** W7X77900

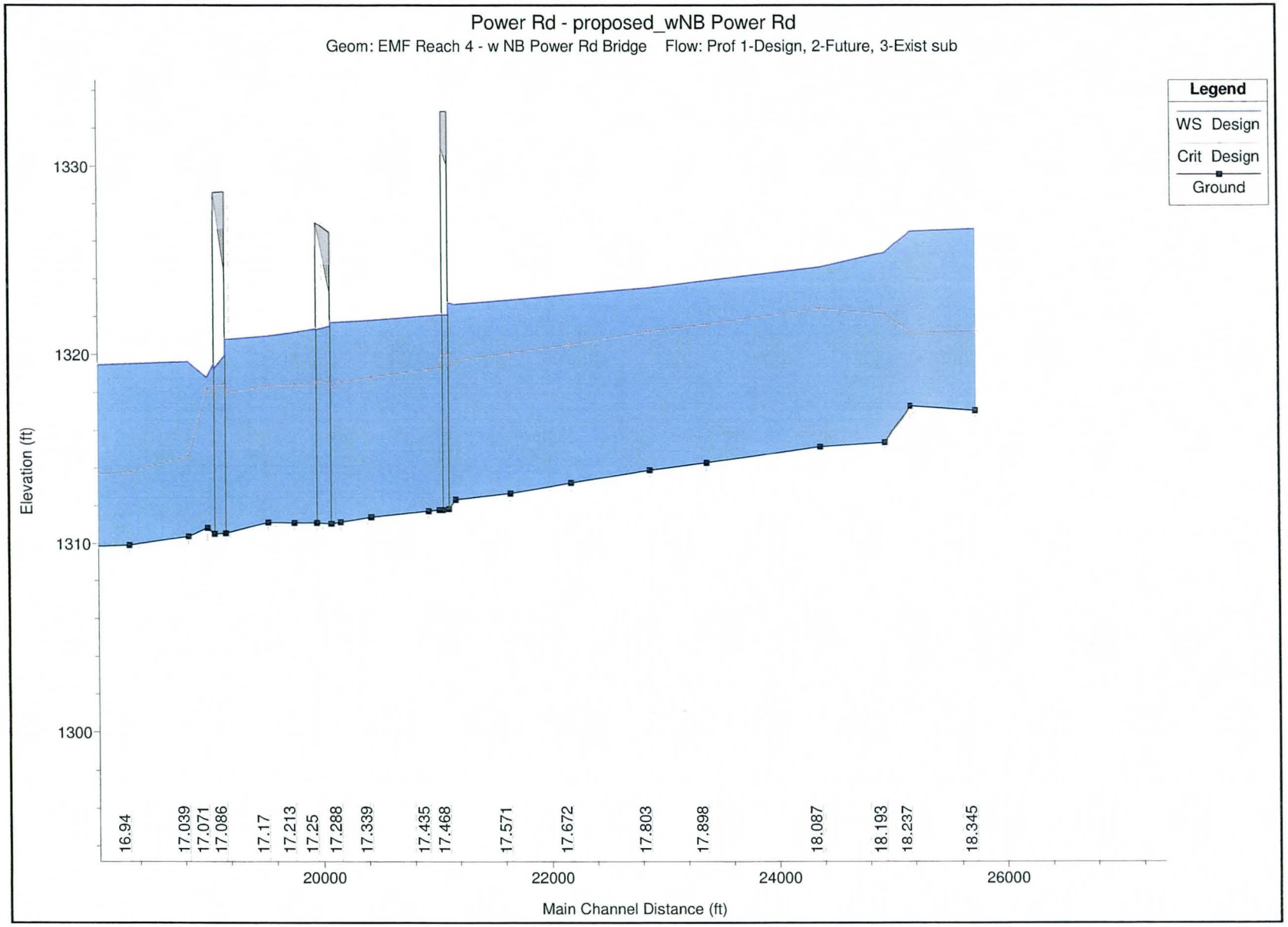
Mr. Lesperance, the following file structure is used in the HEC-RAS model for the NB Power Road Bridge.

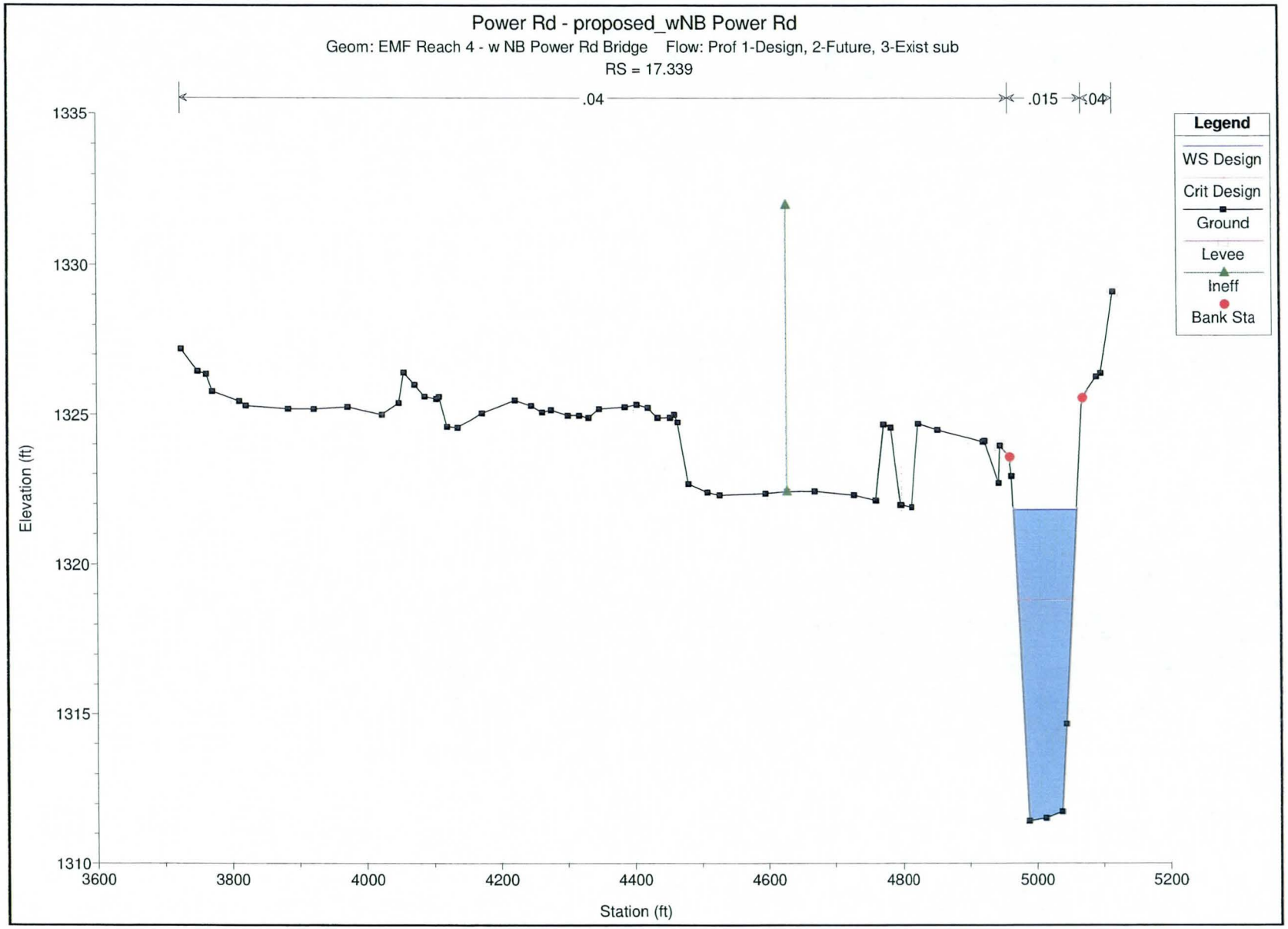
BASE Model

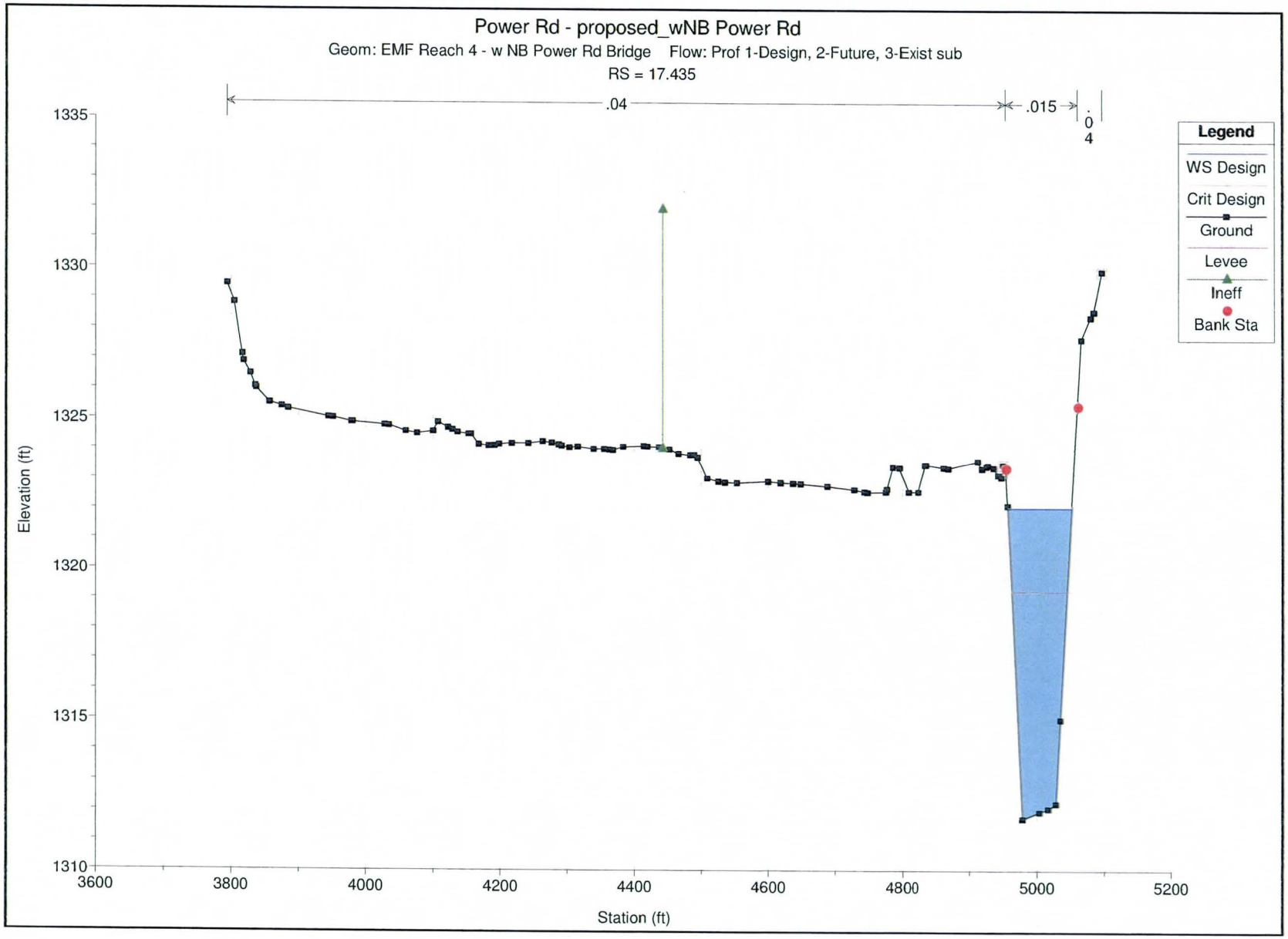
Project:	Power Rd – existing w added sections	\Power Rd-existing sects.prj
Plan:	Plan 01	\ Power Rd-existing sects.p01
Geometry:	EMF Reach 4 - wpier s-xecs, survey	\ Power Rd-existing sects.g01
Steady Flow:	Prof 1-Design, 2-Future, 2-Exist sub	\ Power Rd-existing sects.f01

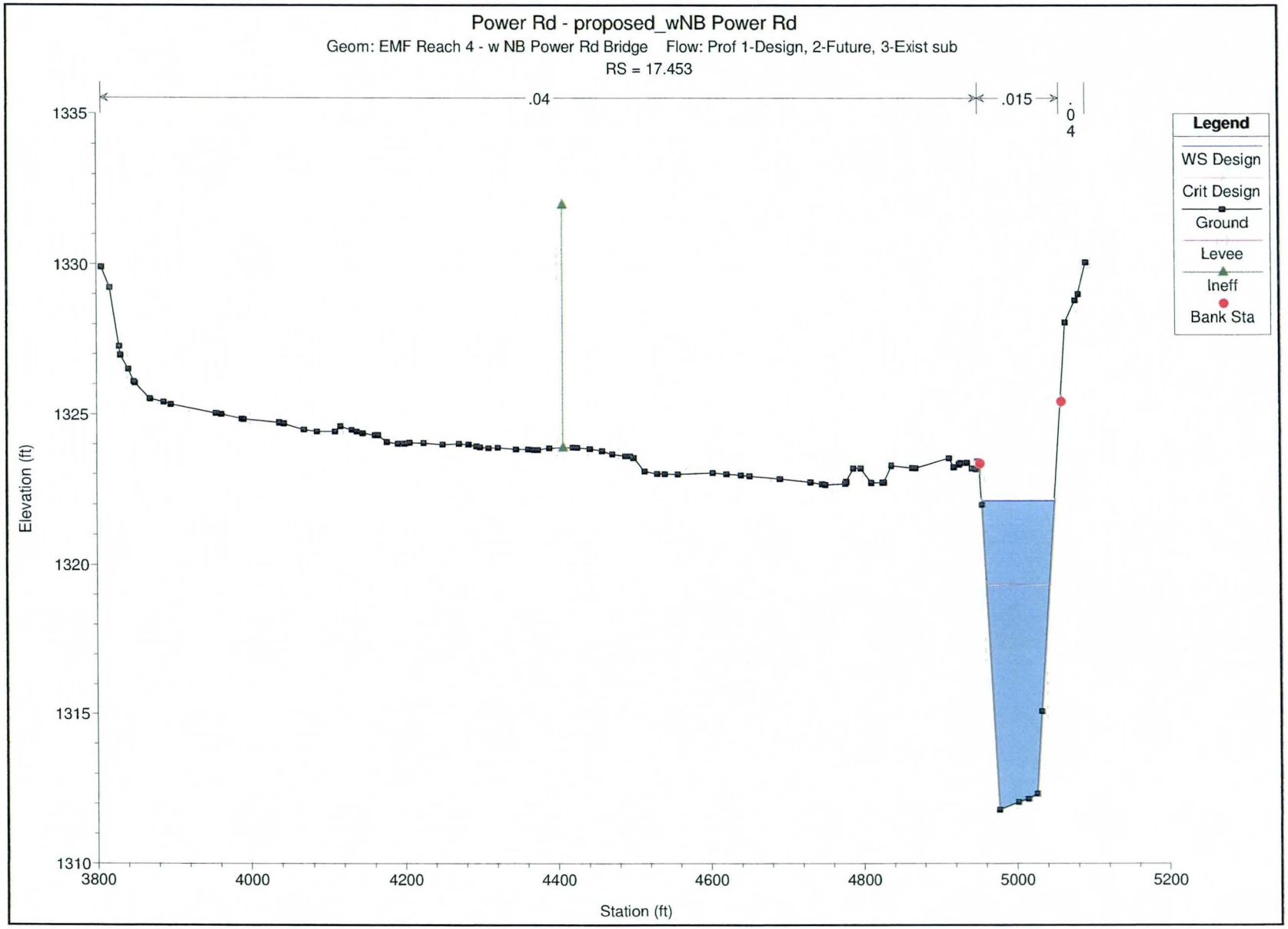
With Project Model

Project:	Power Rd – proposed_wNB Power Rd	\With Bridge_110830 \NBPower Rd.prj
Plan:	Plan 01	\With Bridge_110830 \NBPower Rd.p01
Geometry:	EMF Reach 4 - wNB Power Rd Bridge	\With Bridge_110830 \NBPower Rd.g01
Steady Flow:	Prof 1-Design, 2-Future, 2-Exist sub	\With Bridge_110830 \NBPower Rd.f01


Power Rd - proposed_wNB Power Rd
Geom: EMF Reach 4 - w NB Power Rd Bridge Flow: Prof 1-Design, 2-Future, 3-Exist sub
Legend
WS Design
Crit Design
Ground
Elevation (ft)
1330
1320
1310
1300
16.94
17.039
17.071
17.086
17.17
17.213
17.25
17.288
17.339
17.435
17.468
17.571
17.672
17.803
17.898
18.087
18.193
18.237
18.345
20000
22000
24000
26000
Main Channel Distance (ft)


Power Rd - proposed_wNB Power Rd
Geom: EMF Reach 4 - w NB Power Rd Bridge Flow: Prof 1-Design, 2-Future, 3-Exist sub
RS = 17.339
.04
.015
.04
Legend
WS Design
Crit Design
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1335
1330
1325
1320
1315
1310
3600
3800
4000
4200
4400
4600
4800
5000
5200
Station (ft)


Power Rd - proposed_wNB Power Rd
Geom: EMF Reach 4 - w NB Power Rd Bridge Flow: Prof 1-Design, 2-Future, 3-Exist sub
RS = 17.435
.04
.015
.04
Legend
WS Design
Crit Design
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1335
1330
1325
1320
1315
1310
3600
3800
4000
4200
4400
4600
4800
5000
5200
Station (ft)


Power Rd - proposed_wNB Power Rd
Geom: EMF Reach 4 - w NB Power Rd Bridge Flow: Prof 1-Design, 2-Future, 3-Exist sub
RS = 17.453
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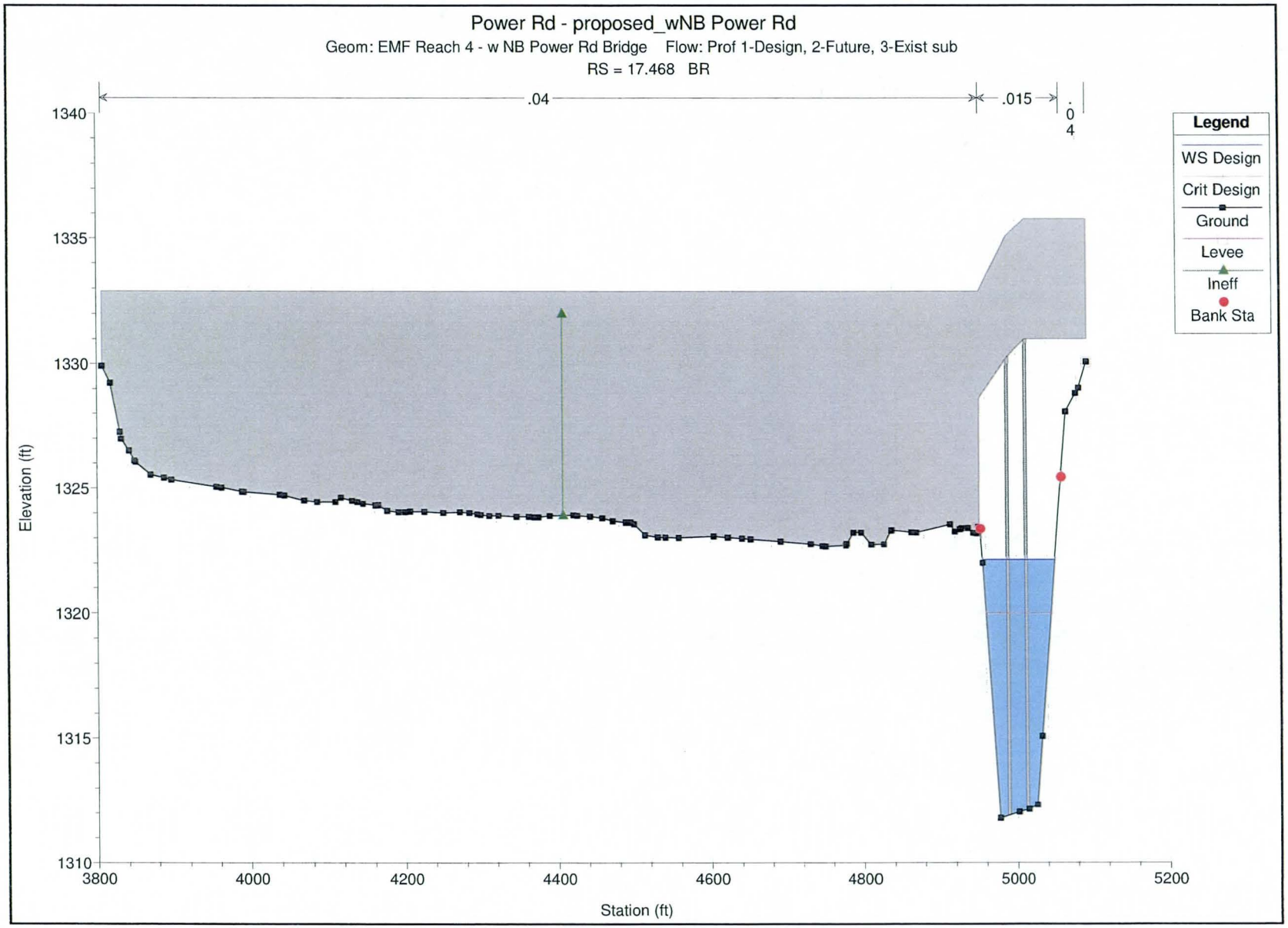
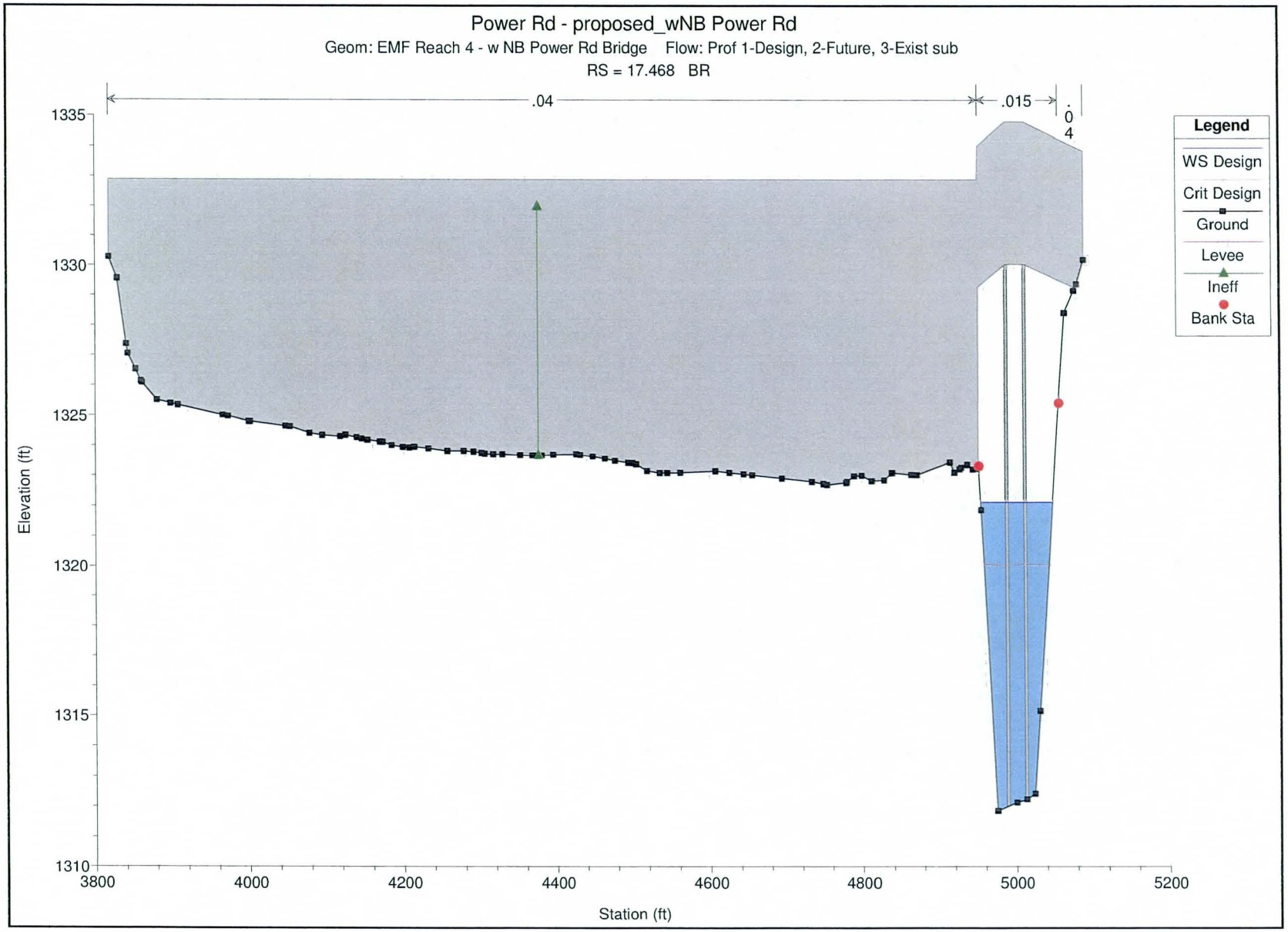
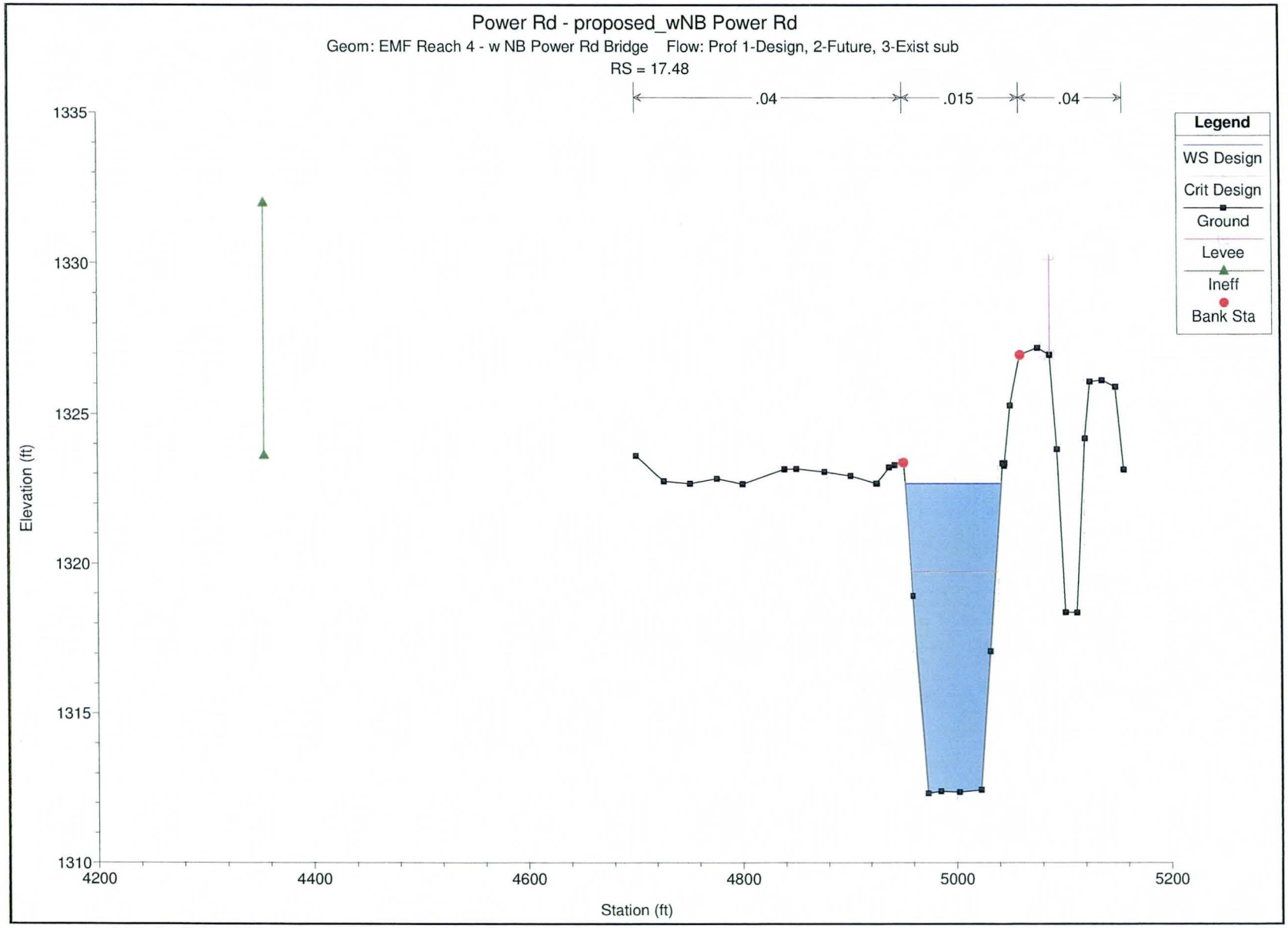
.015
.04
Legend
WS Design
Crit Design
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1335
1330
1325
1320
1315
1310
3800
4000
4200
4400
4600
4800
5000
5200
Station (ft)


Power Rd - proposed_wNB Power Rd
Geom: EMF Reach 4 - w NB Power Rd Bridge Flow: Prof 1-Design, 2-Future, 3-Exist sub
RS = 17.468 BR
.04
.015
.04
Legend
WS Design
Crit Design
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1340
1335
1330
1325
1320
1315
1310
3800
4000
4200
4400
4600
4800
5000
5200
Station (ft)


Power Rd - proposed_wNB Power Rd
Geom: EMF Reach 4 - w NB Power Rd Bridge Flow: Prof 1-Design, 2-Future, 3-Exist sub
RS = 17.468 BR
.04
.015
.04
Legend
WS Design
Crit Design
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1335
1330
1325
1320
1315
1310
3800
4000
4200
4400
4600
4800
5000
5200
Station (ft)


Power Rd - proposed_wNB Power Rd
Geom: EMF Reach 4 - w NB Power Rd Bridge Flow: Prof 1-Design, 2-Future, 3-Exist sub
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.04
.015
.04
Legend
WS Design
Crit Design
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
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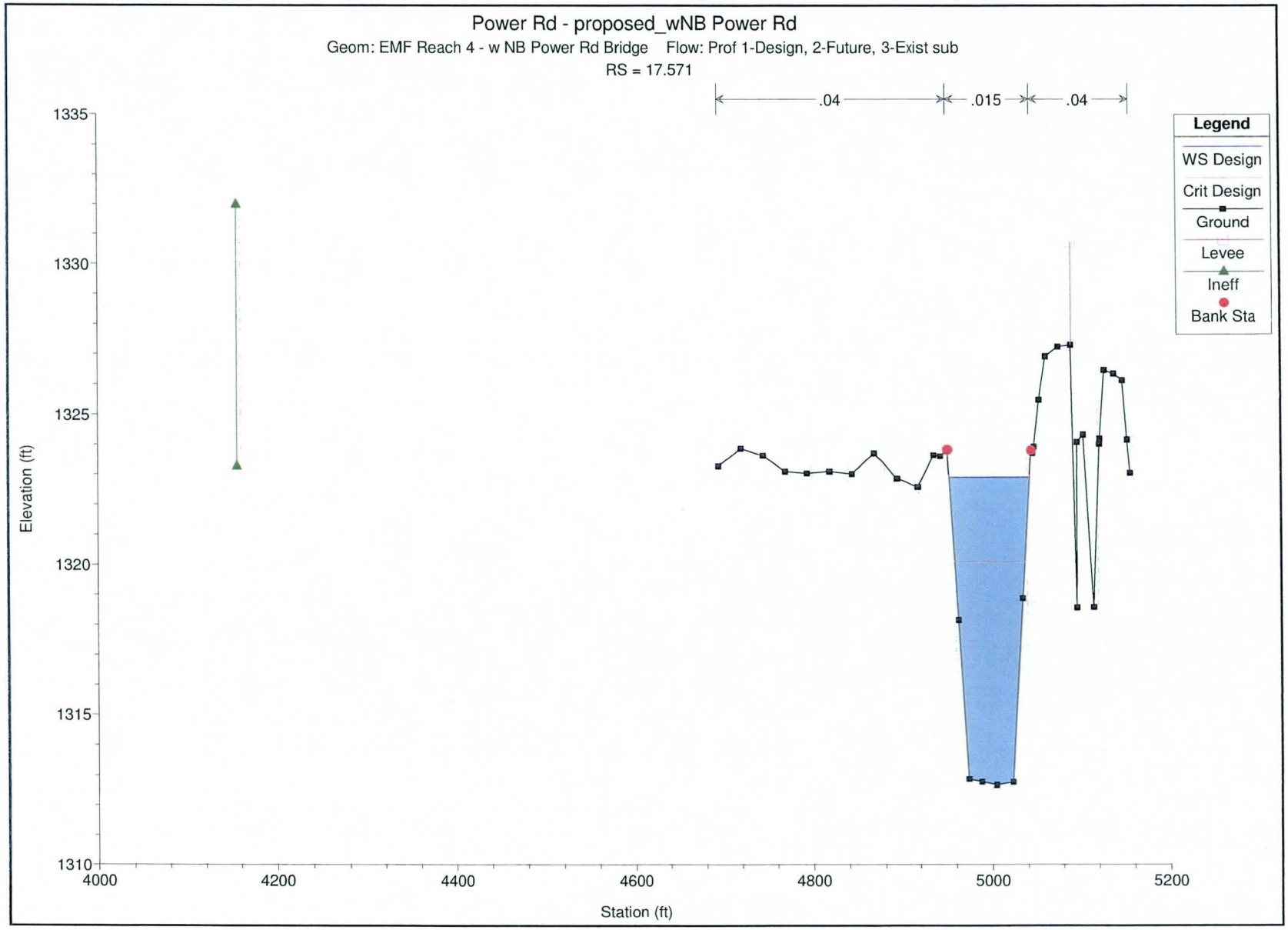
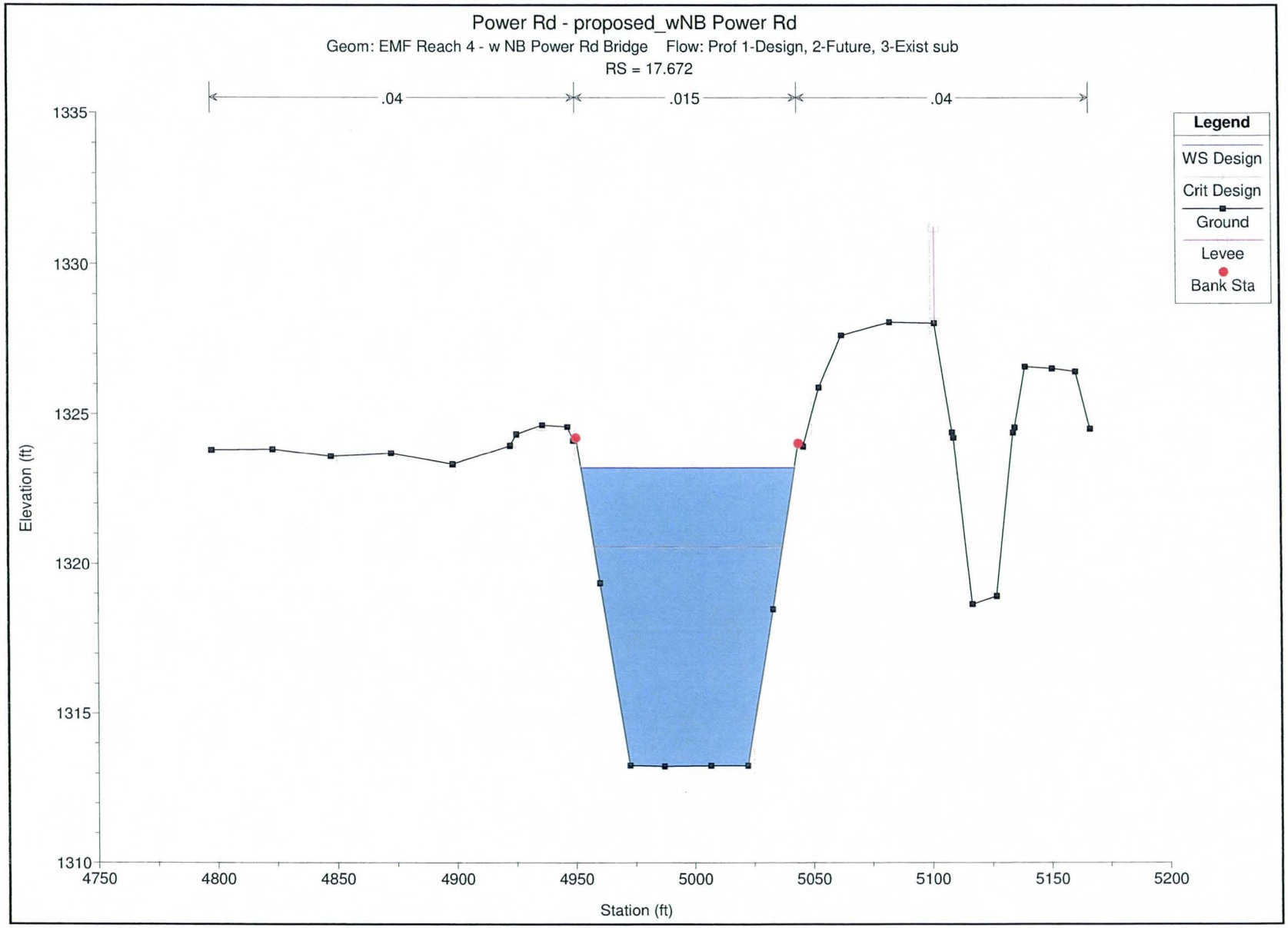
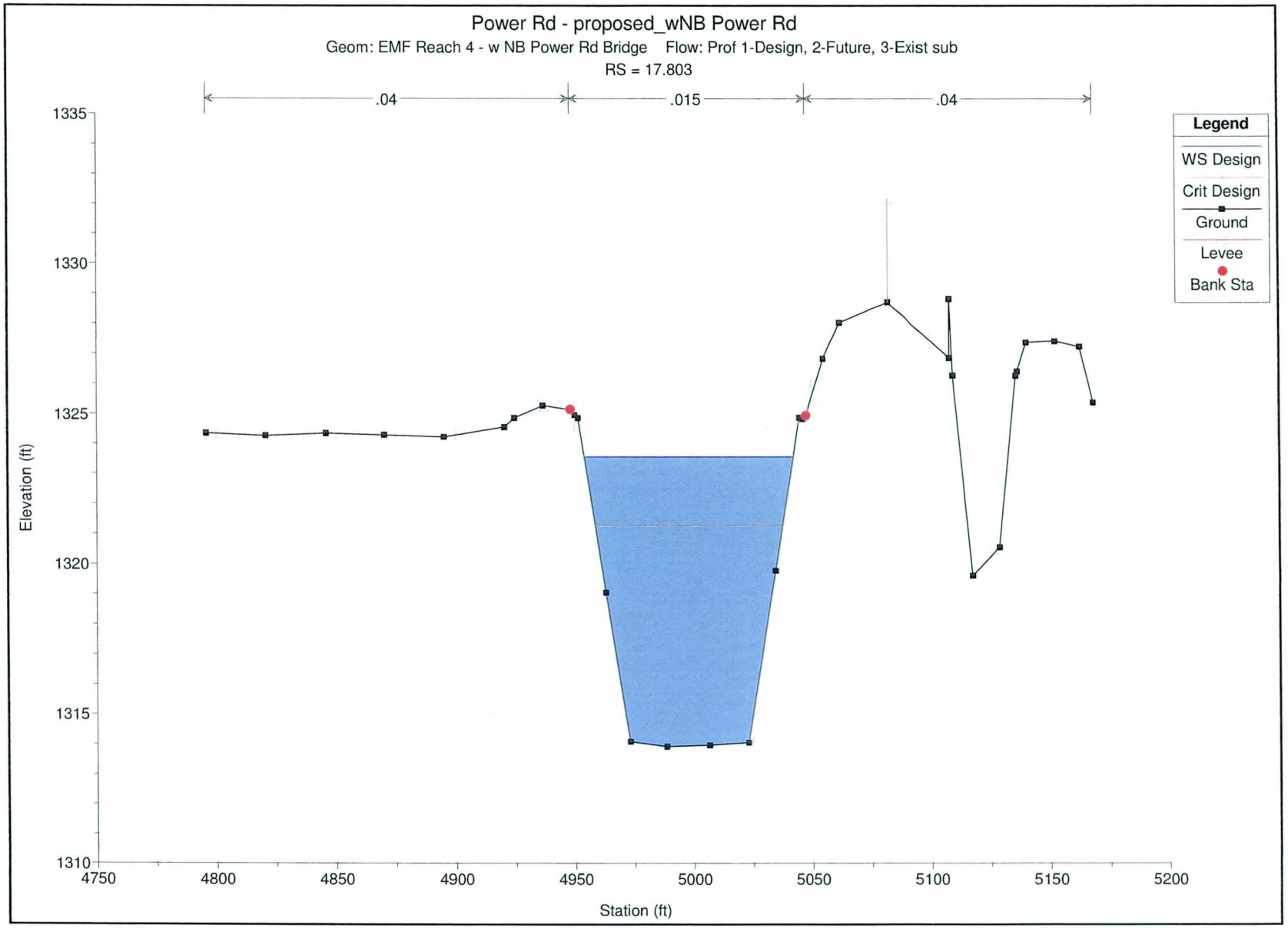
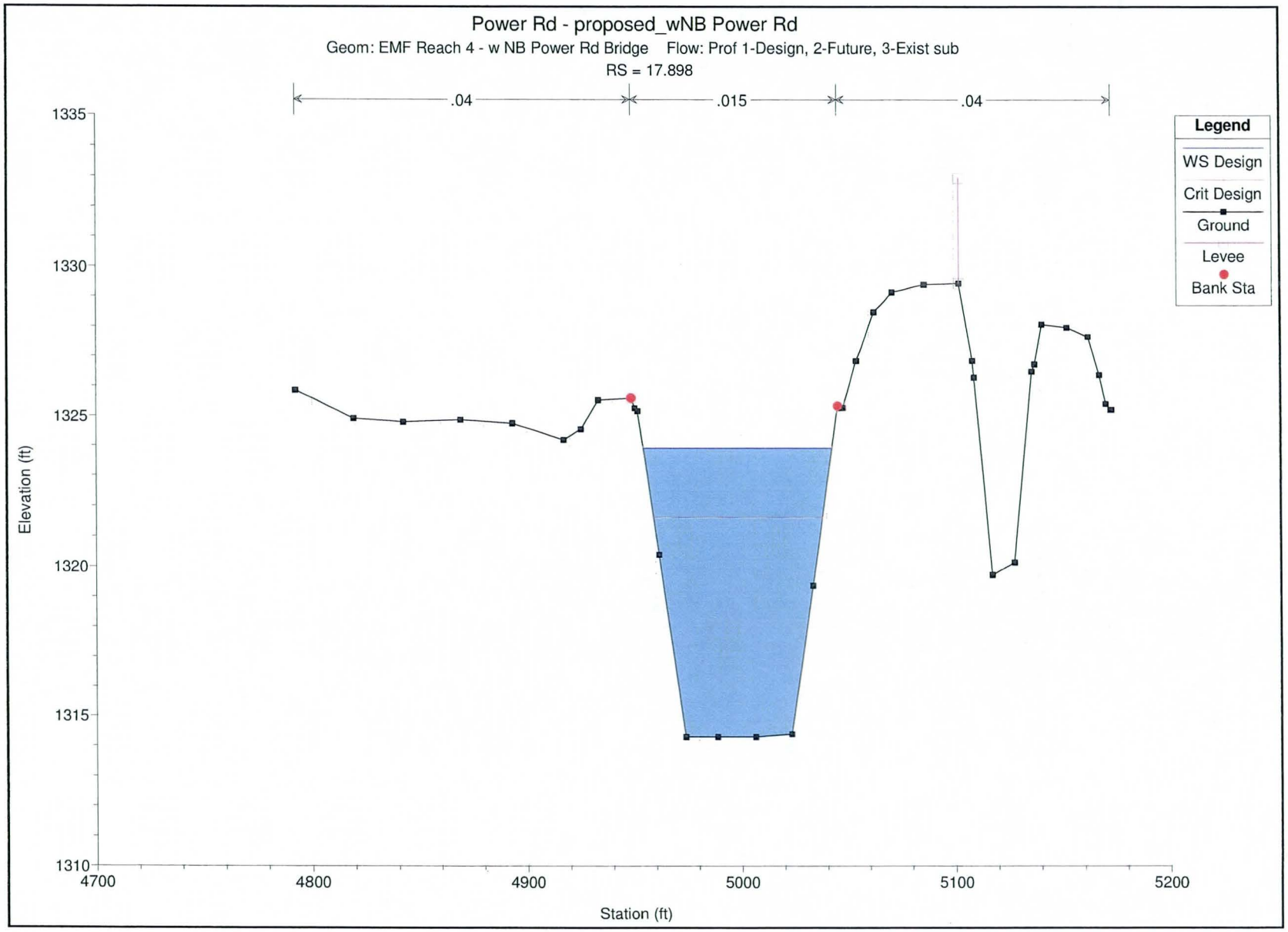
1330
1325
1320
1315
1310
4200
4400
4600
4800
5000
5200
Station (ft)


Power Rd - proposed_wNB Power Rd
Geom: EMF Reach 4 - w NB Power Rd Bridge Flow: Prof 1-Design, 2-Future, 3-Exist sub
RS = 17.571
.04
.015
.04
Legend
WS Design
Crit Design
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1335
1330
1325
1320
1315
1310
4000
4200
4400
4600
4800
5000
5200
Station (ft)


Power Rd - proposed_wNB Power Rd
Geom: EMF Reach 4 - w NB Power Rd Bridge Flow: Prof 1-Design, 2-Future, 3-Exist sub
RS = 17.672
.04
.015
.04
Legend
WS Design
Crit Design
Ground
Levee
Bank Sta
Elevation (ft)
1335
1330
1325
1320
1315
1310
4750
4800
4850
4900
4950
5000
5050
5100
5150
5200
Station (ft)


Power Rd - proposed_wNB Power Rd
Geom: EMF Reach 4 - w NB Power Rd Bridge Flow: Prof 1-Design, 2-Future, 3-Exist sub
RS = 17.803
.04
.015
.04
Legend
WS Design
Crit Design
Ground
Levee
Bank Sta
Elevation (ft)
1335
1330
1325
1320
1315
1310
4750
4800
4850
4900
4950
5000
5050
5100
5150
5200
Station (ft)


Power Rd - proposed_wNB Power Rd
Geom: EMF Reach 4 - w NB Power Rd Bridge Flow: Prof 1-Design, 2-Future, 3-Exist sub
RS = 17.898
.04
.015
.04
Legend
WS Design
Crit Design
Ground
Levee
Bank Sta
Elevation (ft)
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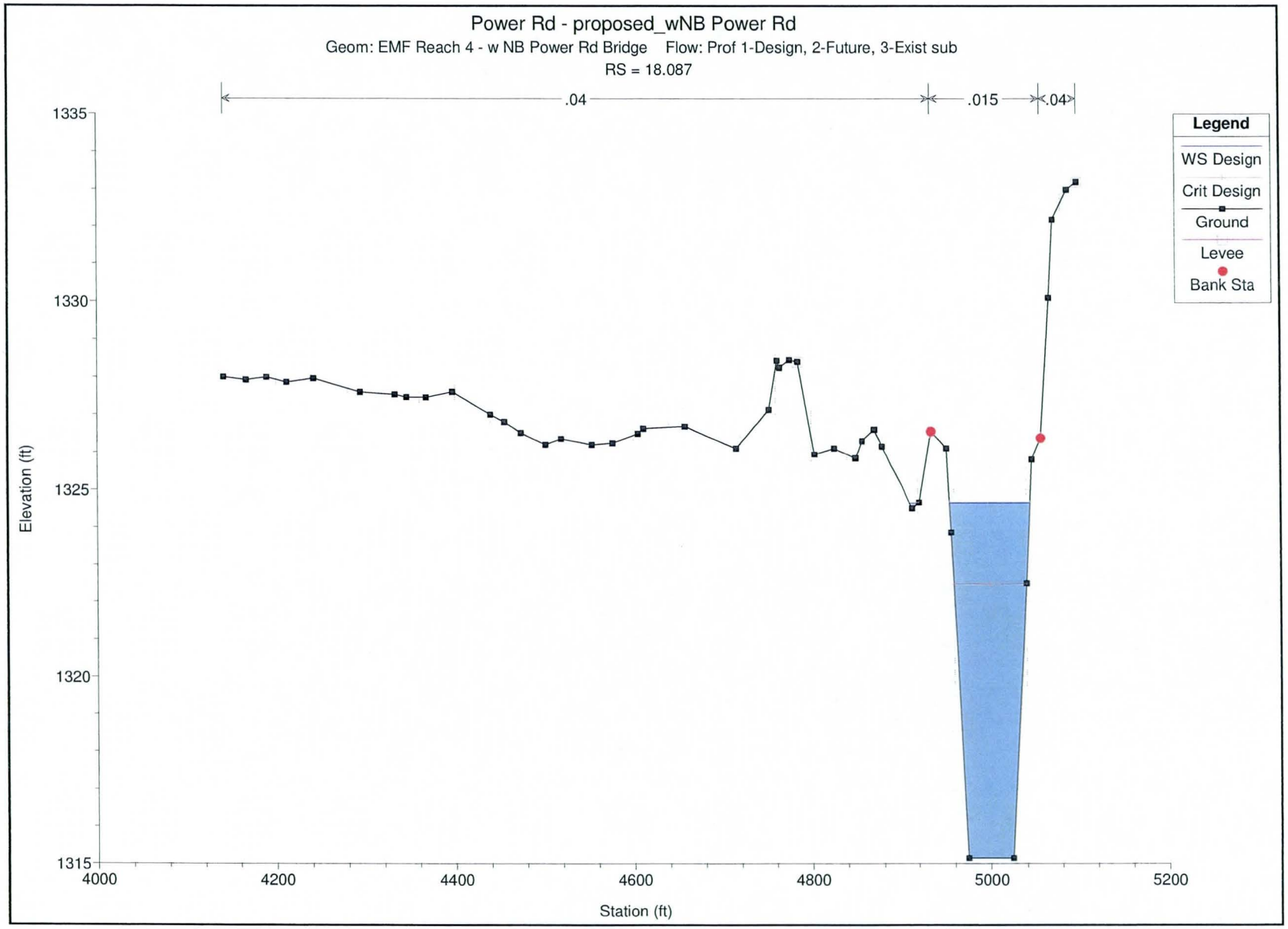
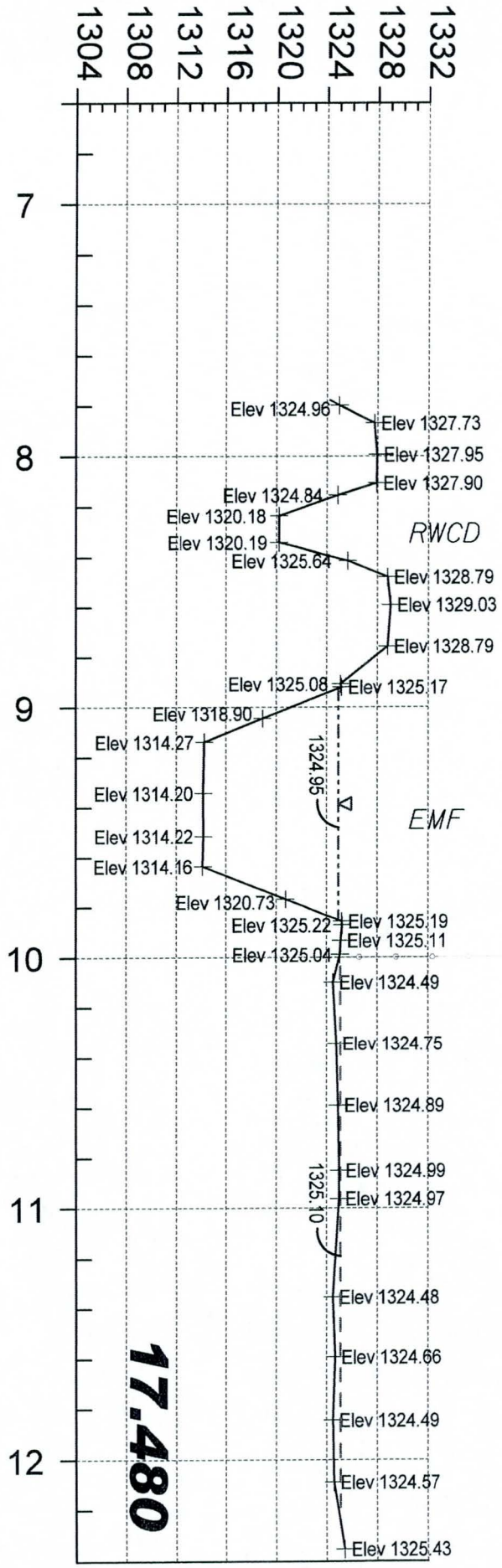
1330
1325
1320
1315
1310
4700
4800
4900
5000
5100
5200
Station (ft)


Power Rd - proposed_wNB Power Rd
Geom: EMF Reach 4 - w NB Power Rd Bridge Flow: Prof 1-Design, 2-Future, 3-Exist sub
RS = 18.087
.04
.015
.04
Legend
WS Design
Crit Design
Ground
Levee
Bank Sta
Elevation (ft)
1335
1330
1325
1320
1315
4000
4200
4400
4600
4800
5000
5200
Station (ft)

17.480
RWCD
EMF
N
SCALE IN FEET
10 0 20 40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1328
1324
1320
1316
1312
1308
1304
7
8
9
10
11
12
Elev 1324.96
Elev 1327.73
Elev 1327.95
Elev 1327.90
Elev 1324.84
Elev 1320.18
Elev 1320.19
RWCD
Elev 1325.64
Elev 1328.79
Elev 1329.03
Elev 1328.79
Elev 1325.08
Elev 1325.17
Elev 1318.90
Elev 1314.27
1324.95
Elev 1314.20
EMF
Elev 1314.22
Elev 1314.16
Elev 1320.73
Elev 1325.22
Elev 1325.19
Elev 1325.11
Elev 1325.04
Elev 1324.49
Elev 1324.75
Elev 1324.89
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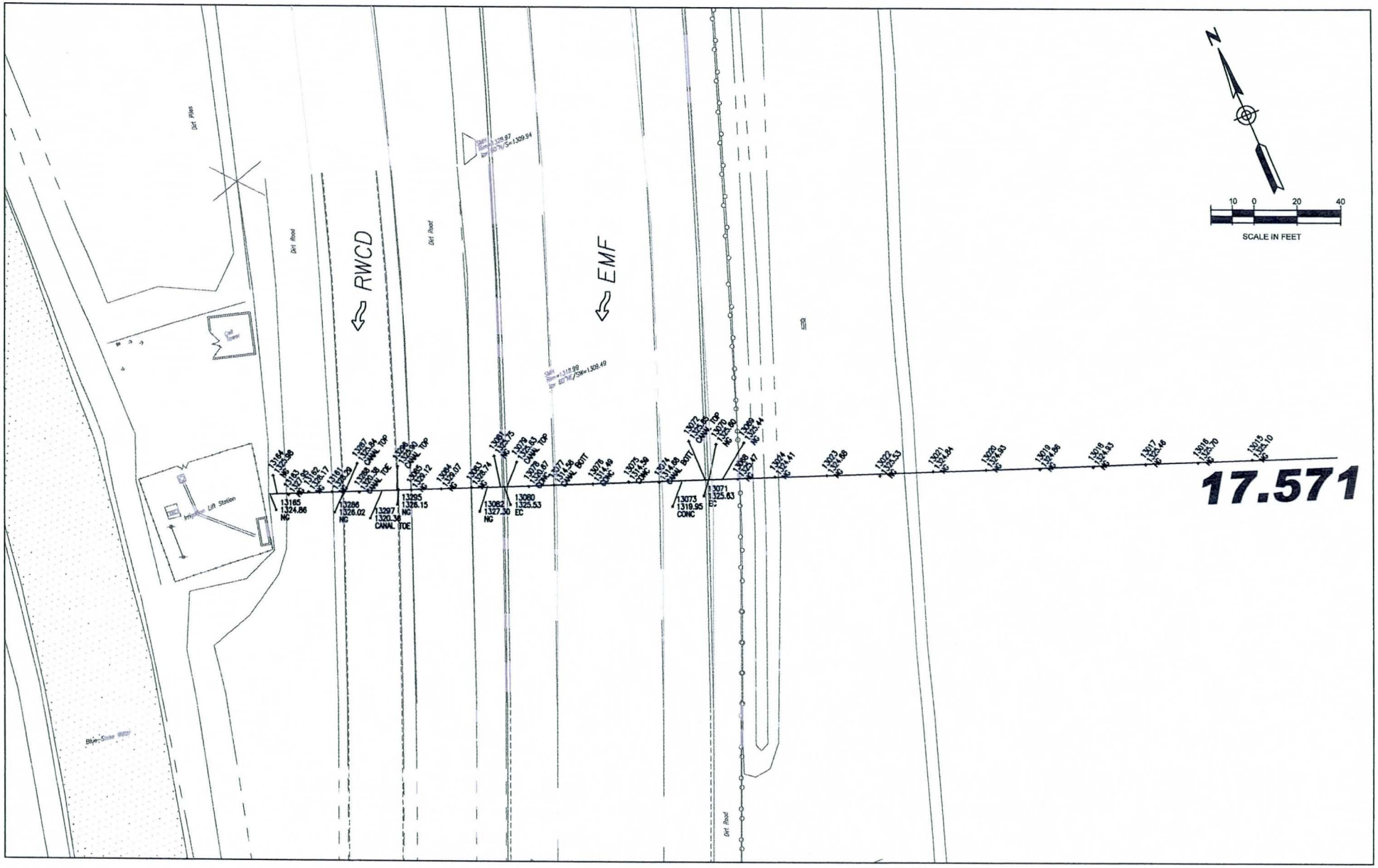
N
10 0 20 40
SCALE IN FEET
RWCD
EMF
Dirt Road
Dirt Piles
Irrigation Lift Station
Blue Stake Water
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13163 1325.15 NG
13162 1326.17 NG
13161 1325.29 NG
13297 1325.34 CANAL TOP
13289 1325.38 CANAL TOE
13288 1325.40 CANAL TOP
13285 1325.12 NG
13284 1325.07 NG
13283 1325.74 NG
13281 1325.75 NG
13279 1325.63 CANAL TOP
13276 1325.57 CONC
13277 1314.38 CANAL BOTT
13278 1314.49 CONC
13275 1314.50 CONC
13274 1314.68 CANAL BOTT
13272 1325.35 CANAL TOP
13270 1325.40 NG
13269 1325.44 NG
13268 1325.47 NG
13274 1324.41 NG
13273 1324.68 NG
13272 1324.53 NG
13271 1324.54 NG
13270 1324.65 NG
13319 1324.86 NG
13318 1324.93 NG
13317 1324.46 NG
13316 1325.70 NG
13315 1324.10 NG
13165 1324.86 NG
13286 1326.02 NG
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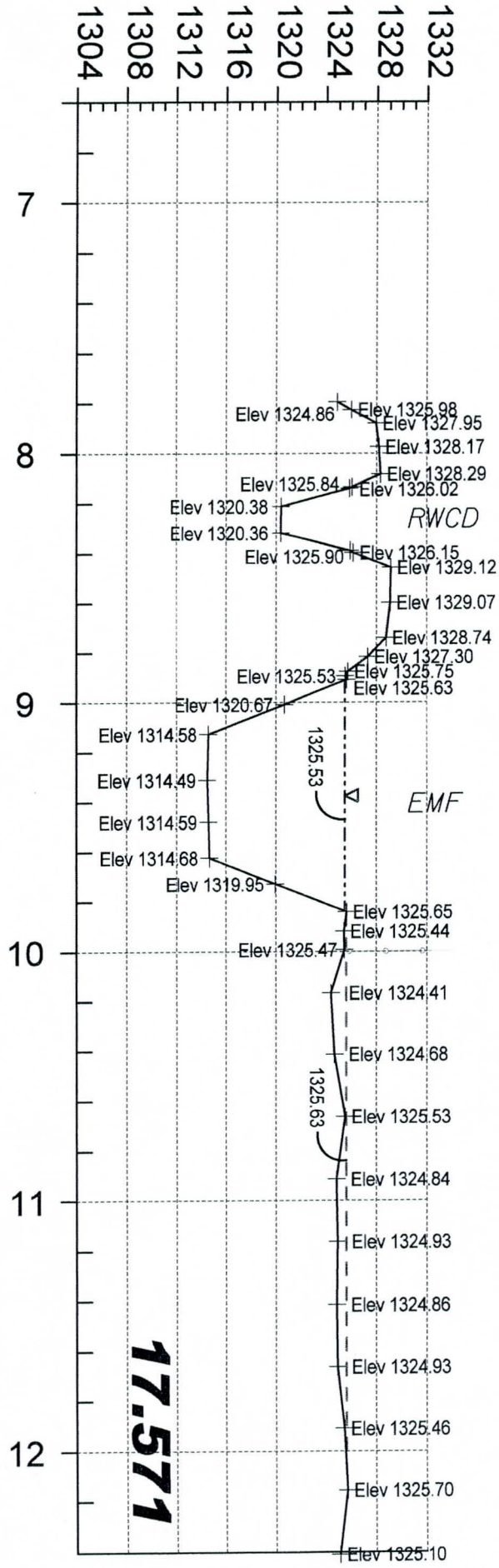
17.571


1332
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1324
1320
1316
1312
1308
1304
7
8
9
10
11
12
Elev 1324.86
Elev 1325.98
Elev 1327.95
Elev 1328.17
Elev 1328.29
Elev 1325.84
Elev 1326.02
Elev 1320.38
Elev 1320.36
RWCD
Elev 1325.90
Elev 1326.15
Elev 1329.12
Elev 1329.07
Elev 1328.74
Elev 1327.30
Elev 1325.53
Elev 1325.75
Elev 1325.63
Elev 1320.67
Elev 1314.58
1325.53
Elev 1314.49
EMF
Elev 1314.59
Elev 1314.68
Elev 1319.95
Elev 1325.65
Elev 1325.44
Elev 1325.47
Elev 1324.41
Elev 1324.68
1325.63
Elev 1325.53
Elev 1324.84
Elev 1324.93
Elev 1324.86
Elev 1324.93
Elev 1325.46
Elev 1325.70
Elev 1325.10
17.571

N
10 0 20 40
SCALE IN FEET
RWCD
EMF
17.672
13182
1326.32
NG
13284
1326.20
CANAL TOP
13293
1326.03
CANAL TOP
13090
1325.74
NG
13092
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CANAL TOP
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1325.93
EC
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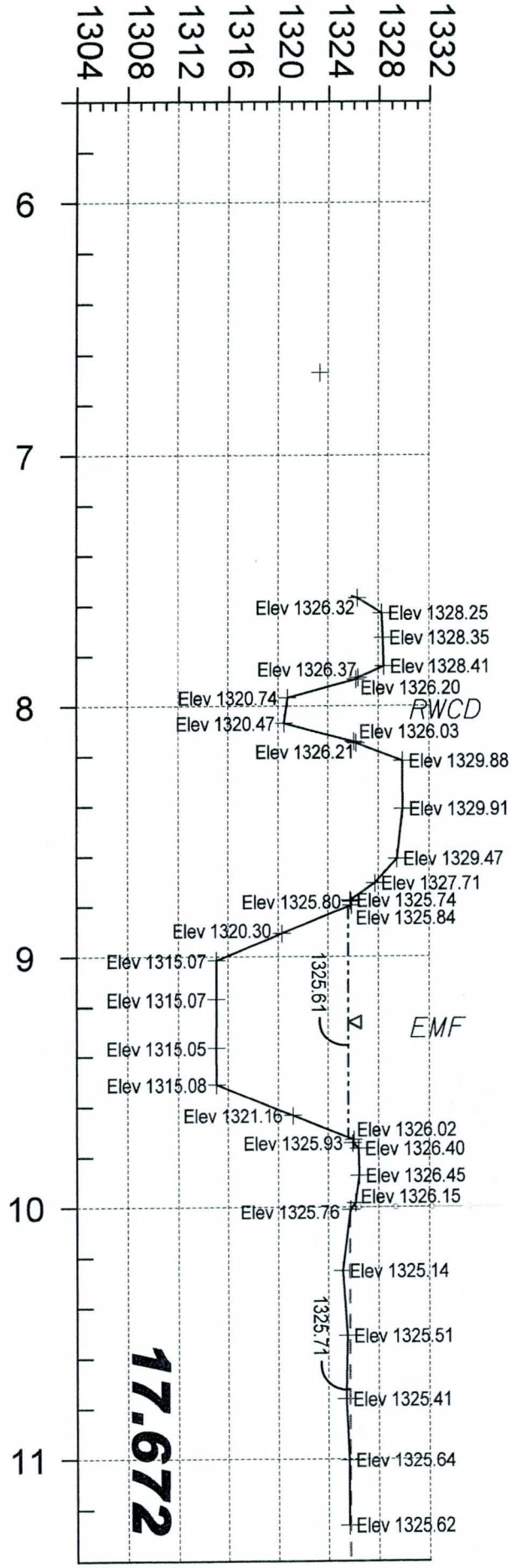
1326.40
NG
13103
1326.15
NG
Billboard


1332
1328
1324
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1304
6
7
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9
10
11
Elev 1326.32
Elev 1328.25
Elev 1328.35
Elev 1328.41
Elev 1326.37
Elev 1326.20
Elev 1320.74
RWCD
Elev 1320.47
Elev 1326.03
Elev 1326.21
Elev 1329.88
Elev 1329.91
Elev 1329.47
Elev 1327.71
Elev 1325.80
Elev 1325.74
Elev 1325.84
Elev 1320.30
Elev 1315.07
1325.61
Elev 1315.07
EMF
Elev 1315.05
Elev 1315.08
Elev 1321.16
Elev 1326.02
Elev 1325.93
Elev 1326.40
Elev 1326.45
Elev 1326.15
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1325.71
Elev 1325.51
Elev 1325.41
Elev 1325.64
Elev 1325.62
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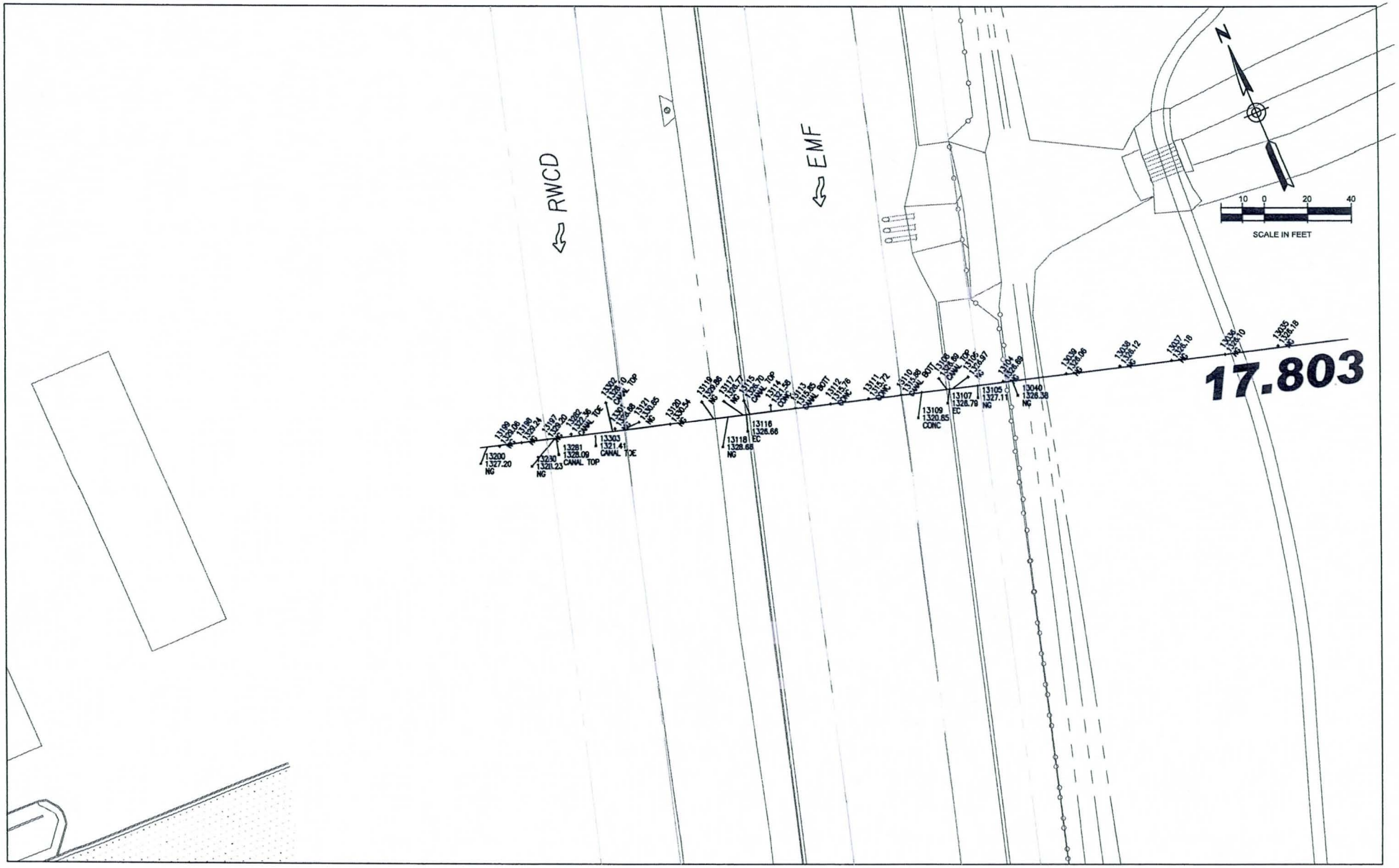
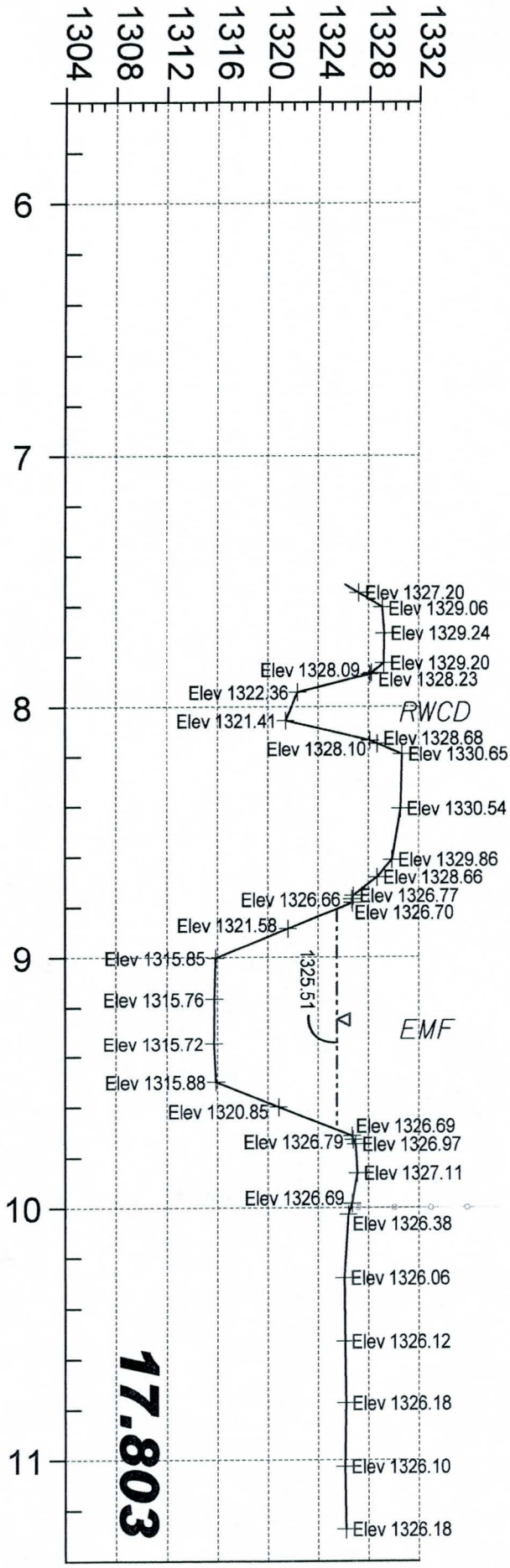

17.803
RWCD
EMF
N
10 0 20 40
SCALE IN FEET
13200
1327.20
NG
13230
1321.23
NG
13281
1328.09
CANAL TOP
13303
1321.41
CANAL TOE
13118
1328.68
NG
13116
1328.66
EC
13109
1320.85
CONC
13107
1328.79
EC
13105
1327.11
NG
13040
1326.38
NG


1332
1328
1324
1320
1316
1312
1308
1304
6
7
8
9
10
11
Elev 1327.20
Elev 1329.06
Elev 1329.24
Elev 1329.20
Elev 1328.23
Elev 1328.09
Elev 1322.36
Elev 1321.41
RWCD
Elev 1328.68
Elev 1328.10
Elev 1330.65
Elev 1330.54
Elev 1329.86
Elev 1328.66
Elev 1326.77
Elev 1326.66
Elev 1326.70
Elev 1321.58
Elev 1315.85
1325.51
Elev 1315.76
EMF
Elev 1315.72
Elev 1315.88
Elev 1320.85
Elev 1326.69
Elev 1326.79
Elev 1326.97
Elev 1327.11
Elev 1326.69
Elev 1326.38
Elev 1326.06
Elev 1326.12
Elev 1326.18
Elev 1326.10
Elev 1326.18
17.803

RWCD
EMF
17.898
N
10 0 20 40
SCALE IN FEET

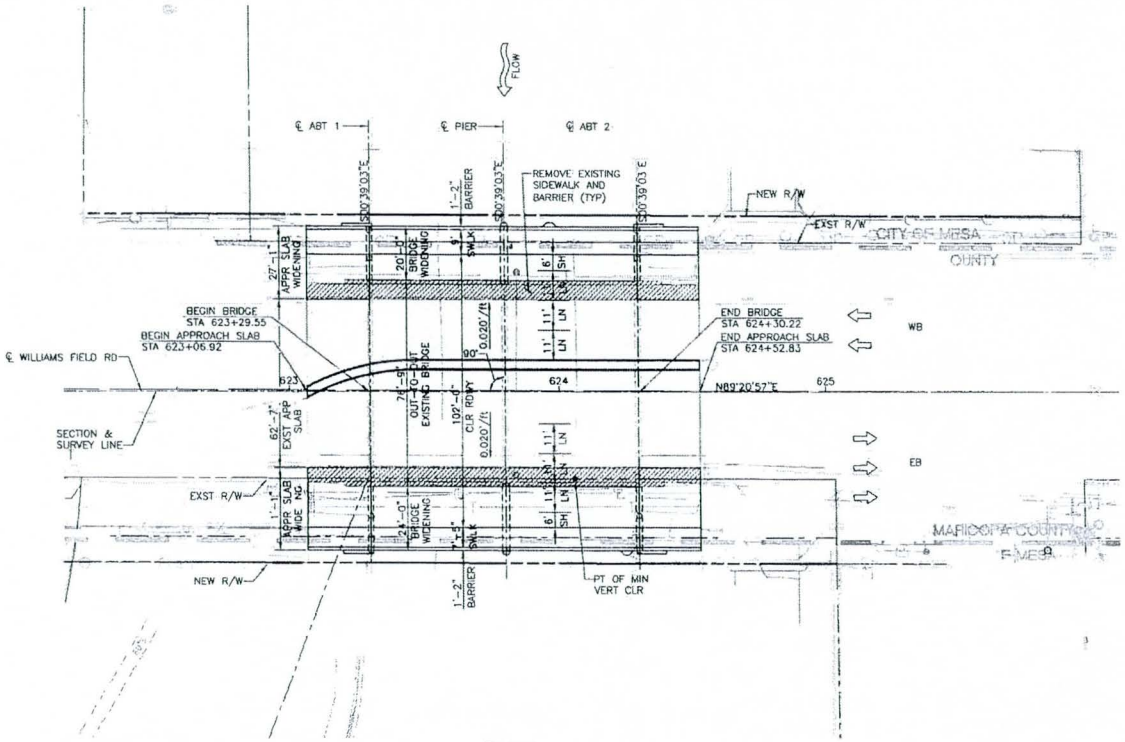
1332
1328
1324
1320
1316
1312
1308
1304
Elev 1327.04
Elev 1327.24
Elev 1328.21
Elev 1329.48
Elev 1329.80
Elev 1329.92
Elev 1328.32
Elev 1328.56
Elev 1321.96
PWCD
Elev 1321.54
Elev 1328.68
Elev 1328.12
Elev 1331.27
Elev 1331.23
Elev 1330.97
Elev 1330.31
Elev 1328.67
Elev 1327.11
Elev 1327.10
Elev 1327.17
Elev 1321.18
Elev 1316.20
Elev 1316.10
Elev 1316.10
Elev 1316.10
1325.68
EMF
Elev 1322.21
Elev 1327.00
Elev 1327.09
Elev 1327.43
Elev 1327.53
Elev 1327.37
Elev 1326.38
Elev 1326.03
Elev 1326.58
Elev 1326.70
Elev 1326.63
Elev 1326.71
Elev 1327.69
17.898
6
7
8
9
10
11

SCALE: AS NOTED

NORTH

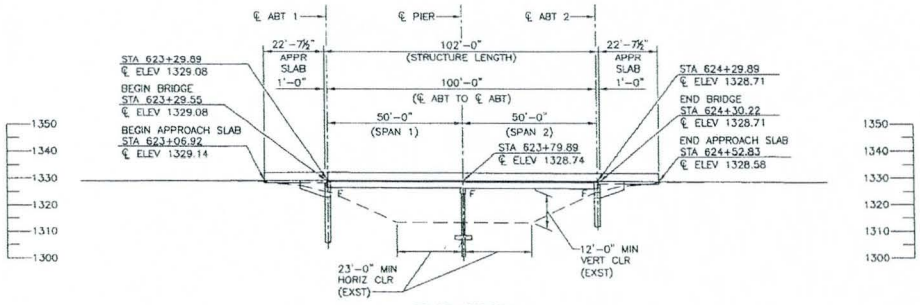
BENCHMARK:

ELEVATION= (CITY OF MESA DATUM)



PLAN

SCALE: 1"=20'-0"



ELEVATION

SCALE: 1"=20'-0"

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N.I. = NOT INCLUDED

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CITY OF MESA
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POWER RD
PECOS RD TO SANTAN FWY

WILLIAMS FIELD ROAD
EMF BRIDGE
GENERAL PLAN & ELEVATION

DRAWING: S-5.01

DRAWN BY: HRD
ENGINEER: BPD
APPROVED BY: DRS

240 N.G. 4357
PROJ. NO. 07-066-001

SHEET 249 OF 460

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SCALE: AS NOTED

BENCHMARK:
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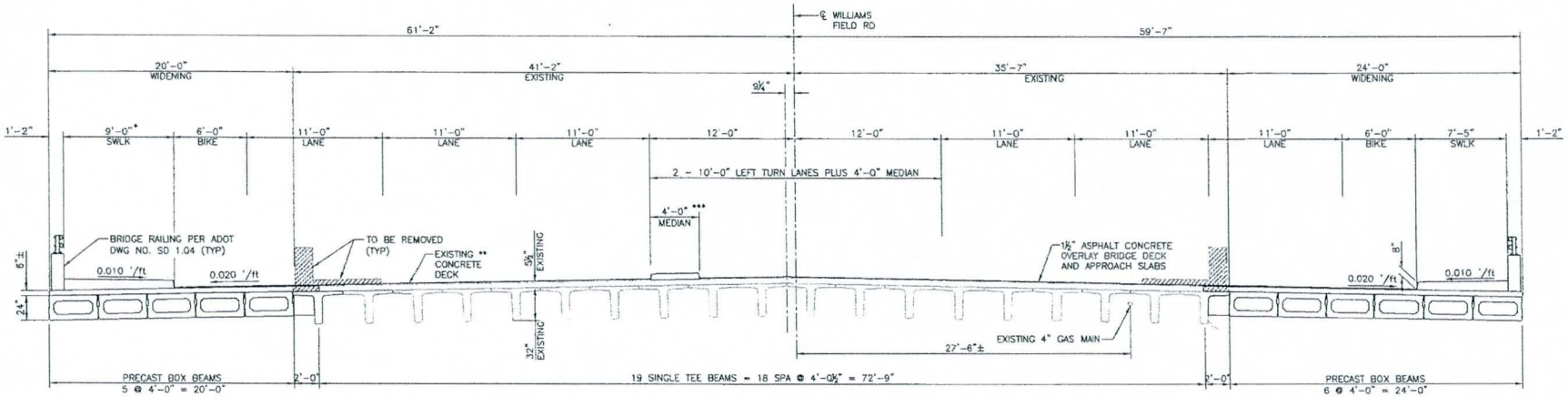
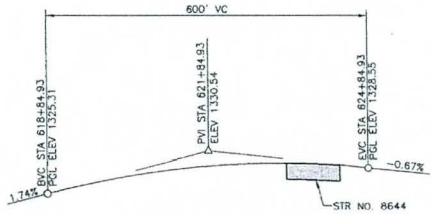


TYPICAL SECTION
SCALE: ¼"=1'-0"
(LOOKING AHEAD STATION)

* 8'-0 SIDEWALK PLUS 1'-0" SURPLUS DECK.

** EXISTING CONCRETE DECK TO BE SEALED AND OVERLAYED WITH ASPHALT CONCRETE.

*** LOCATION VARIES. SEE ROADWAY PLANS FOR DETAILED MEDIAN LAYOUT.



PROFILE GRADE - WILLIAMS FIELD RD
SCALE: NONE

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WILLIAMS FIELD ROAD
EMF BRIDGE
TYPICAL SECTION & GEOMETRICS

DRAWING: S-5.02

DRAWN BY: MRD
ENGINEER: BPG
APPROVED BY: DRS

340 W.O. 4337
PROJ. NO. 07-066-001

SHEET 250 OF 460

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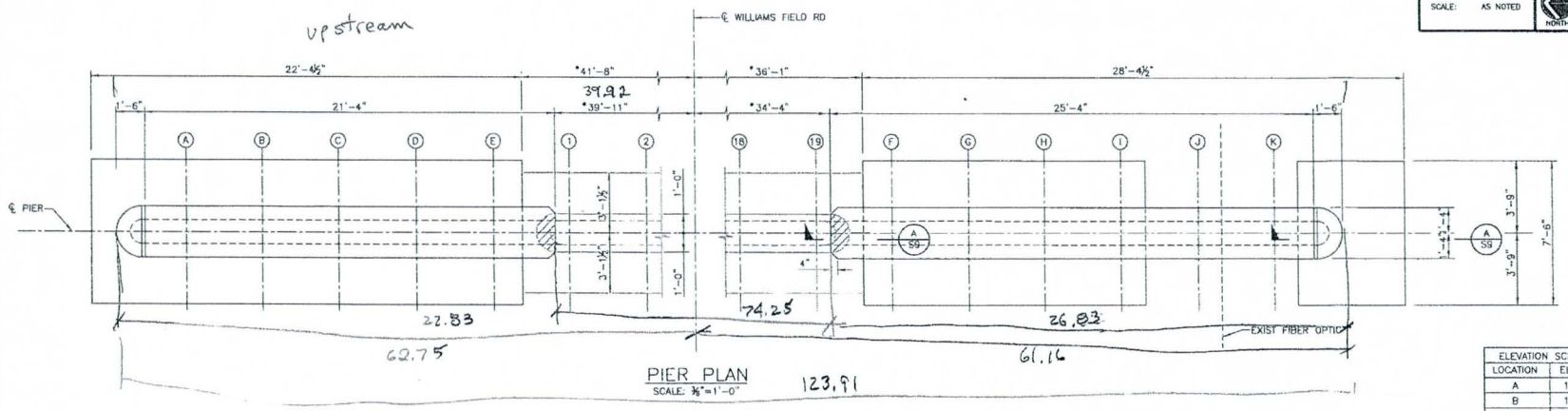


PIER PLAN
SCALE: ⅜"=1'-0"

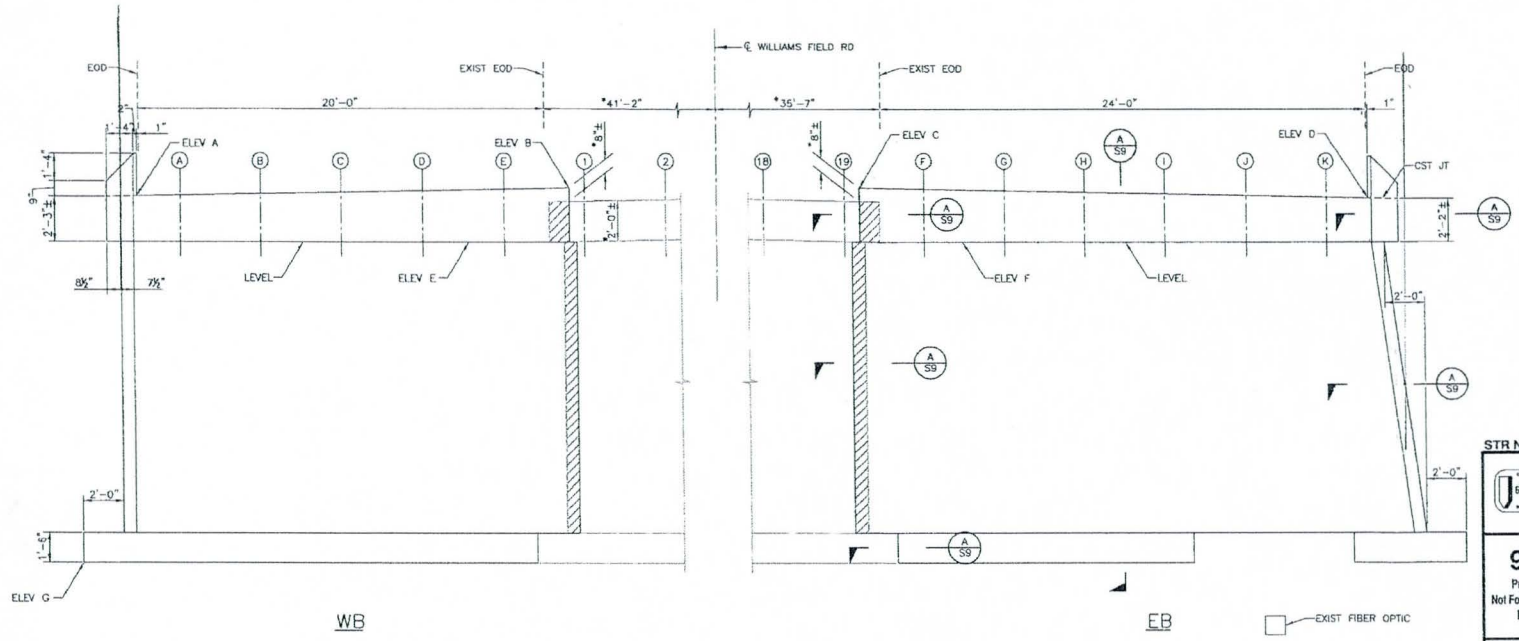
ELEVATION SCHEDULE	
LOCATION	ELEVATION
A	1325.24
B	1325.64
C	1325.80
D	1325.28
E	1322.97
F	1323.09
G	1308.18

EOD = EDGE OF DECK

LEGEND:

CONCRETE REMOVAL

* FIELD VERIFY ALL EXISTING DIMENSIONS AND ELEVATIONS



PIER ELEVATION
SCALE: ⅜"=1'-0"

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POWER RD
PECOS RD TO SANTAN FWY

WILLIAMS FIELD ROAD
EMF BRIDGE
PIER PLAN & ELEVATION

DRAWING S-5.11

DRAWN BY: MRD
ENGINEER: BPD
APPROVED BY: DRS

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PROJ. NO. 07-0XX-001

SHEET 259 OF 460

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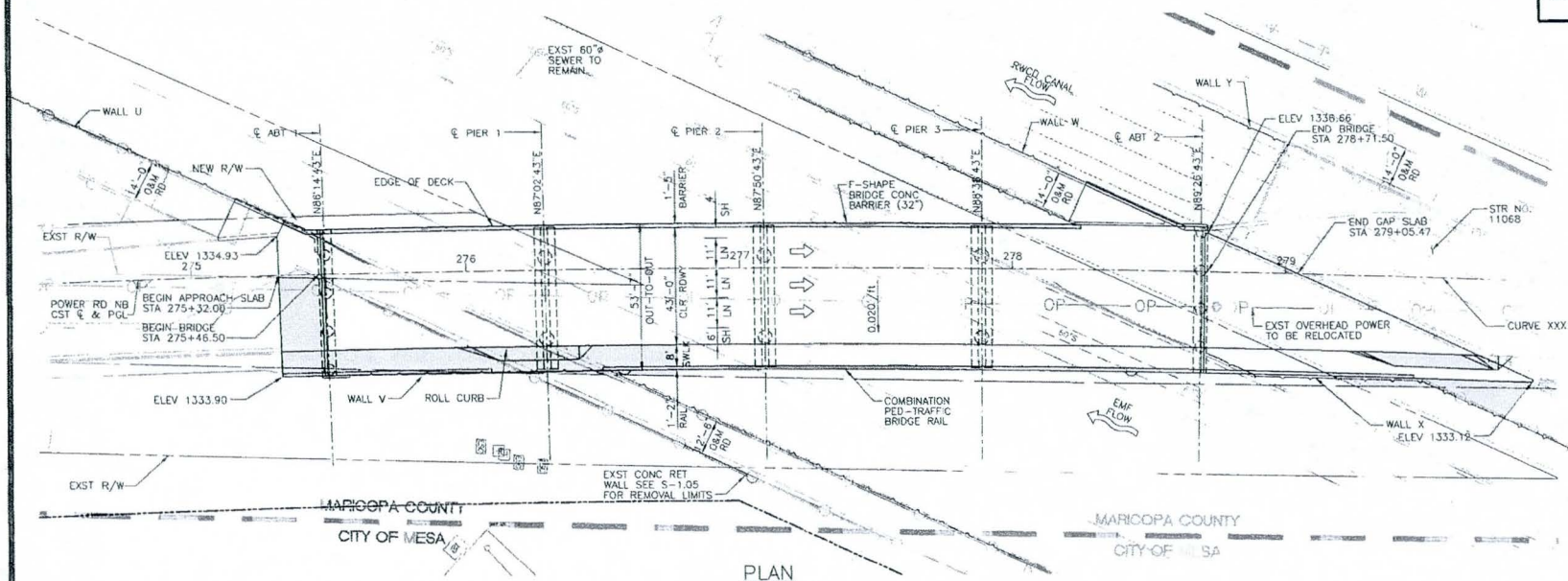
SCALE: 1"=20'-0"

NORTH

BENCHMARK:

ELEVATION= (CITY OF MESA DAT

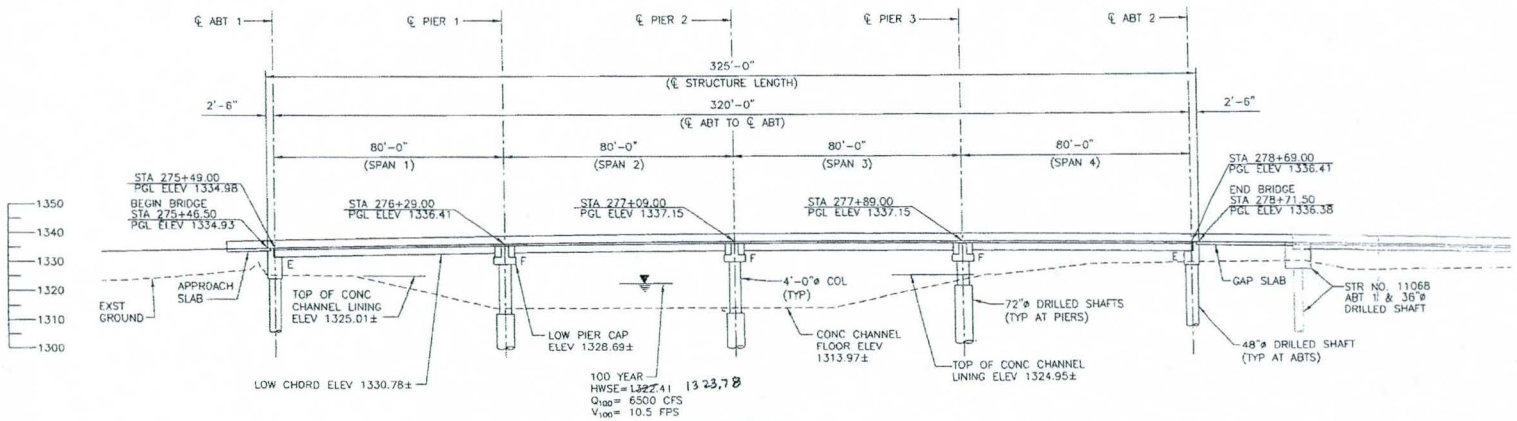


PLAN

SCALE: 1"=20'-0"

NEW 4-SPAN PRECAST PRESTRESSED AASHTO TYPE III CONCRETE GIRDER BRIDGE

SKEW = 0°00'00"



ELEVATION

SCALE: 1"=20'-0"

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CAMBER DETAILS	S-2.2
SCREED ELEVATIONS	S-2.2
BORING LOCATION PLAN (N.I.)	SF-2.
FOUNDATION DATA (N.I.)	SF-2.

N.I. = NOT INCLUDED

NOTES:

1. DIMENSIONS AND STATIONING SHOWN ARE MEASURED ALONG POWER RD NB CST ℄ UNO.
2. ELEVATIONS ARE MEASURED ALONG PROFILE GRADE LINE UNO.
3. ℄ OF ABUTMENTS AND DRILLED SHAFTS ARE OFFSET 1'-0" FROM ℄ BRG ABUTMENT.
4. EMF = EAST MARICOPA FLOODWAY.
5. RWCD = ROOSEVELT WATER CONSERVATION DISTRICT.

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POWER RD
PECOS RD TO SANTAN FW

POWER ROAD NB
EMF BRIDGE
GENERAL PLAN & ELEVATION

DRAWN BY: NWD
ENGINEER: DB
APPROVED BY: DRS

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PROJ. NO. 07-066-001

SHEET 188 OF 460

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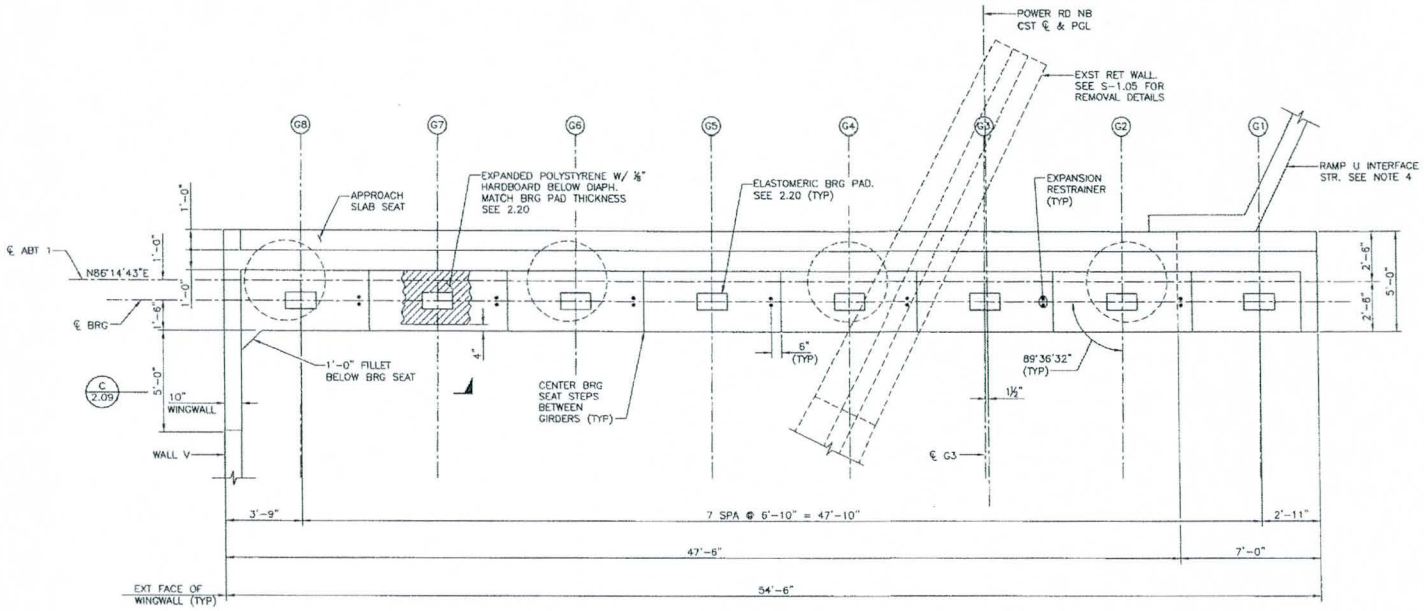
SCALE: AS NOTED

NORTH

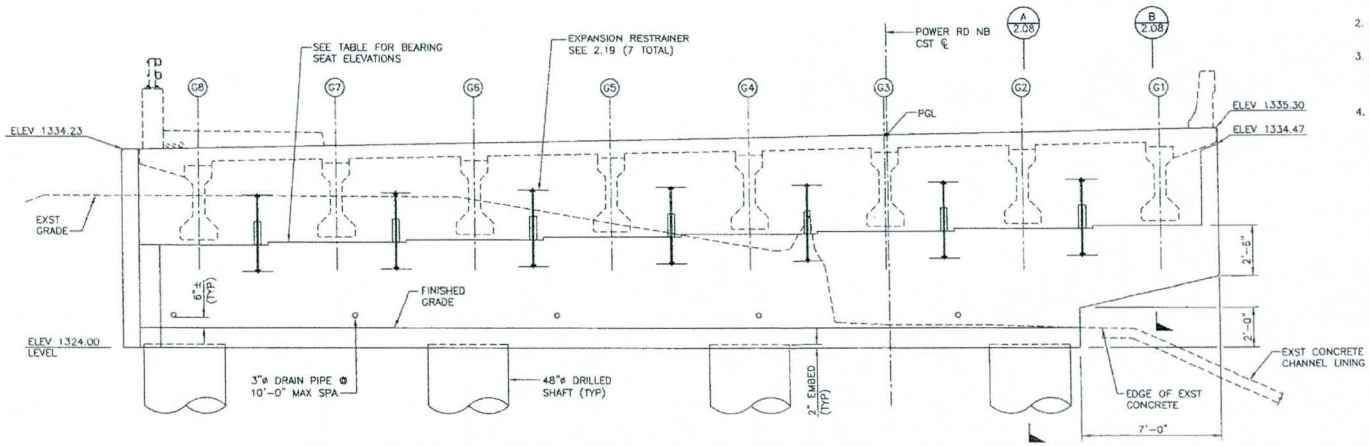
BENCHMARK:
ELEVATION= (CITY OF MESA DATUM)



ABUTMENT 1 PLAN

SCALE: ⅜"=1'-0"

ABT 1 BEARING SEAT ELEVATIONS	
LOCATION	ELEV
G1	1330.44
G2	1330.30
G3	1330.16
G4	1330.03
G5	1329.89
G6	1329.75
G7	1329.62
G8	1329.48



ABUTMENT 1 ELEVATION

(LOOKING BACK STATION)
SCALE: ⅜"=1'-0"

NOTES:

1. ALL DIMENSIONS SHOWN ARE NORMAL TO OR ALONG ℄ ABT, UNLESS NOTED OTHERWISE.
2. ELEVATIONS SHOWN ARE TAKEN AT FRONT FACE OF BACKWALL.
3. BEARING SEAT ELEVATIONS SHALL BE MEASURED IN THE FIELD BY THE CONTRACTOR AND SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL PRIOR TO GIRDER ERECTION.
4. SEE WALL PLANS FOR WALL AND INTERFACE STRUCTURE LAYOUTS AND DETAILS.

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CITY OF MESA
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POWER RD
PECOS RD TO SANTAN FWY

POWER ROAD NB
EMF BRIDGE
ABUTMENT 1 PLAN & ELEVATION

DRAWING: S-2.06

DRAWN BY: NRD
ENGINEER: DB
APPROVED BY: DRS

SHEET 193 OF 460

CATALOG NUMBER:

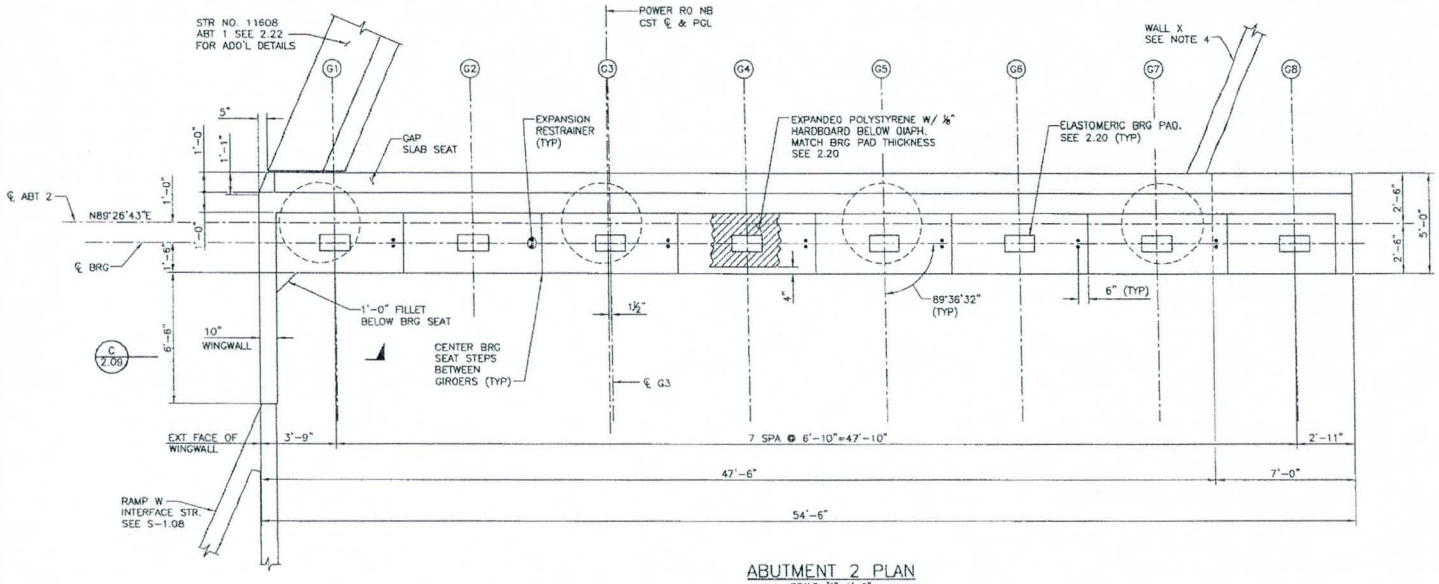
DATE SAVED: 5/3/11 O:\20928\11-CADD\05-STRCT\02-S11069\S11069_ABD1.DWG

SCALE: AS NOTED

NORTH

BENCHMARK:

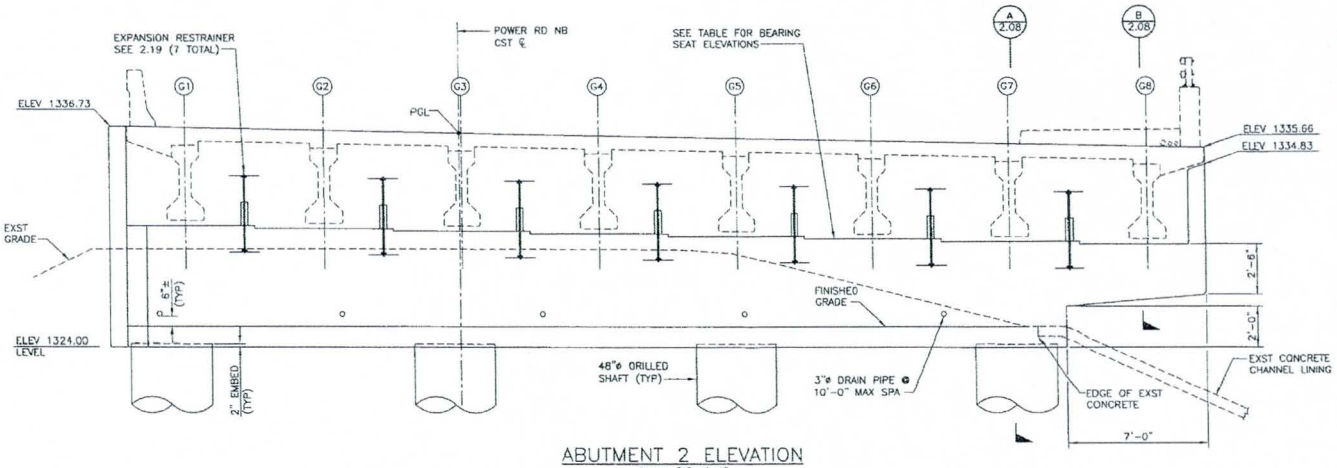
ELEVATION= (CITY OF MESA DATUM)



ABUTMENT 2 PLAN

SCALE: ⅜"=1'-0"

ABT 2 BEARING SEAT ELEVATIONS	
LOCATION	ELEV
G1	1331.87
G2	1331.73
G3	1331.59
G4	1331.46
G5	1331.32
G6	1331.18
G7	1331.05
G8	1330.91



ABUTMENT 2 ELEVATION

SCALE: ⅜"=1'-0"

NOTES:

1. ALL DIMENSIONS SHOWN ARE NORMAL TO OR ALONG ℄ ABT. UNLESS NOTED OTHERWISE.
2. ELEVATIONS SHOWN ARE TAKEN AT FRONT FACE OF BACKWALL.
3. BEARING SEAT ELEVATIONS SHALL BE MEASURED IN THE FIELD BY THE CONTRACTOR AND SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL PRIOR TO GIRDER ERECTION.
4. SEE WALL PLANS FOR WALL AND INTERFACE STRUCTURE LAYOUTS AND DETAILS.

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POWER RD
PECOS RD TO SANTAN FWY

POWER ROAD NB
EMF BRIDGE
ABUTMENT 2 PLAN & ELEVATION

DRAWING
S-2.07

DRAWN BY: NKD
ENGINEER: DB
APPROVED BY: DWS

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194 of 460

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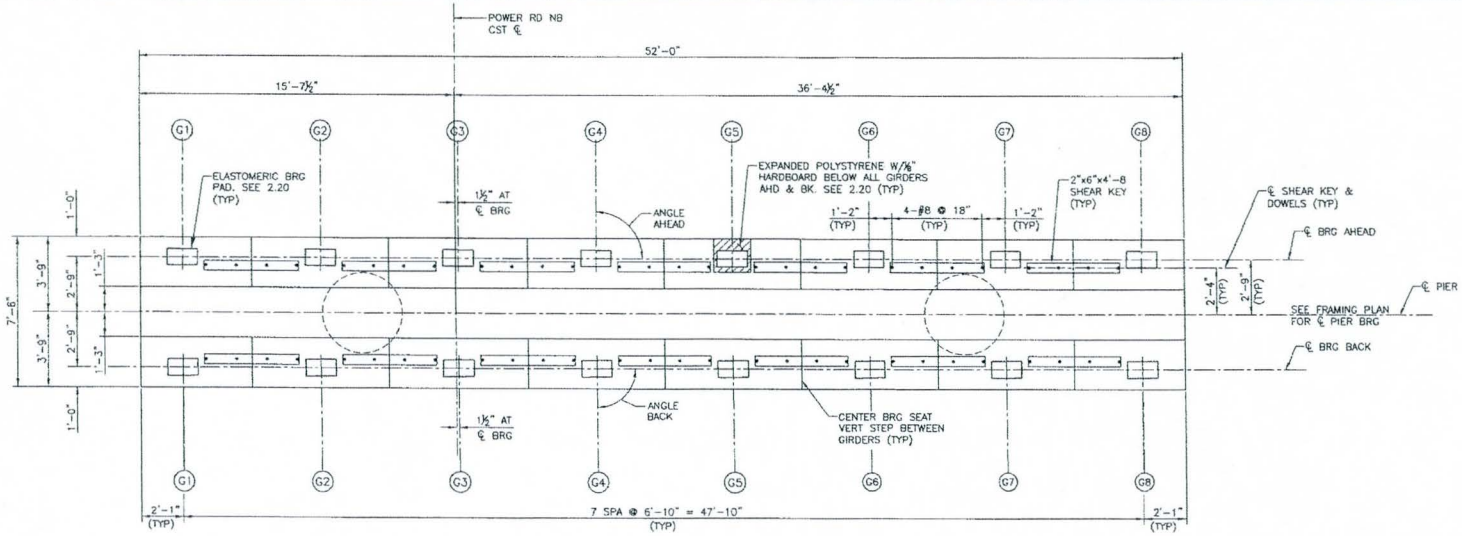
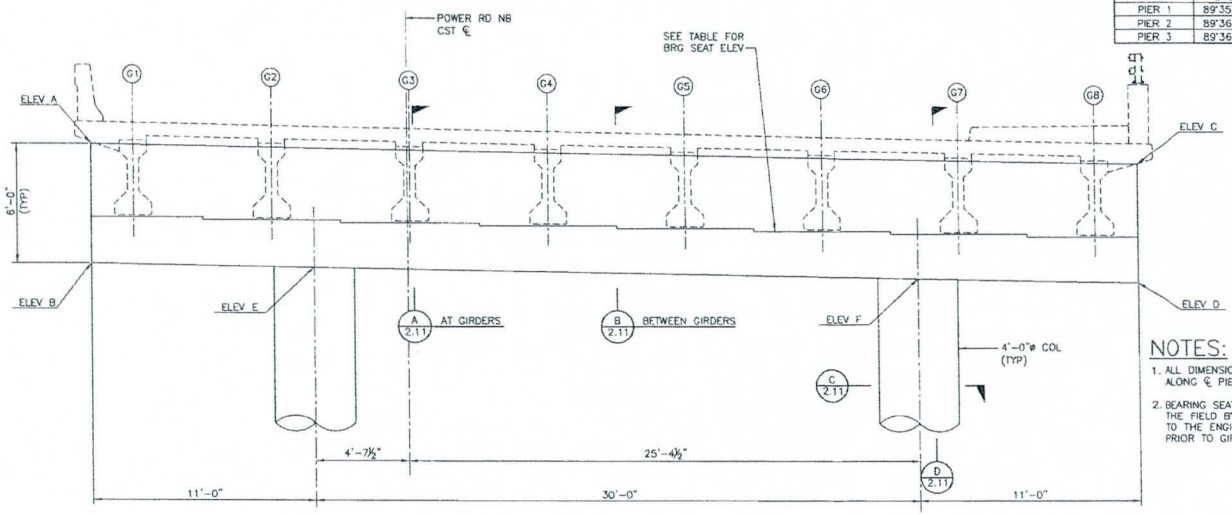
SCALE: AS NOTED

BENCHMARK:
ELEVATION= (CITY OF MESA DATUM)



PIER PLAN
SCALE: ⅜"=1'-0"

PIER DATA								
	FRAMING ANGLE		ELEVATIONS					
LOCATION	ANGLE BACK	ANGLE AHEAD	ELEV A	ELEV B	ELEV C	ELEV D	ELEV E	ELEV F
PIER 1	89°35'29"	89°36'00"	1335.64	1329.64	1334.69	1328.69	1329.44	1328.89
PIER 2	89°36'00"	89°36'00"	1336.41	1330.41	1335.45	1329.45	1330.20	1329.65
PIER 3	89°36'00"	89°35'29"	1336.41	1330.41	1335.45	1329.45	1330.20	1329.65



PIER ELEVATION
SCALE: ⅜"=1'-0"

BEARING SEAT ELEVATIONS						
	PIER 1		PIER 2		PIER 3	
GIRDER	BACK BRG	AHEAD BRG	BACK BRG	AHEAD BRG	BACK BRG	AHEAD BRG
G1	1332.06	1332.14	1332.82	1332.85	1332.85	1332.82
G2	1331.92	1332.00	1332.69	1332.71	1332.71	1332.69
G3	1331.79	1331.86	1332.55	1332.57	1332.57	1332.55
G4	1331.65	1331.73	1332.41	1332.44	1332.44	1332.41
G5	1331.51	1331.59	1332.28	1332.30	1332.30	1332.28
G6	1331.38	1331.45	1332.14	1332.16	1332.16	1332.14
G7	1331.24	1331.32	1332.00	1332.03	1332.03	1332.00
G8	1331.10	1331.18	1331.87	1331.89	1331.89	1331.87

NOTES:

1. ALL DIMENSIONS SHOWN ARE NORMAL TO OR ALONG ℄ PIER UNLESS NOTED OTHERWISE.
2. BEARING SEAT ELEVATIONS SHALL BE MEASURED IN THE FIELD BY THE CONTRACTOR AND SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL PRIOR TO GIRDER ERECTION.

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POWER ROAD NB
EMF BRIDGE
PIER PLAN & ELEVATION

DRAWING: S-2.10

DRAWN BY: NRD
ENGINEER: DB
APPROVED BY: DRS

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SCALE: AS NOTED

BENCHMARK:
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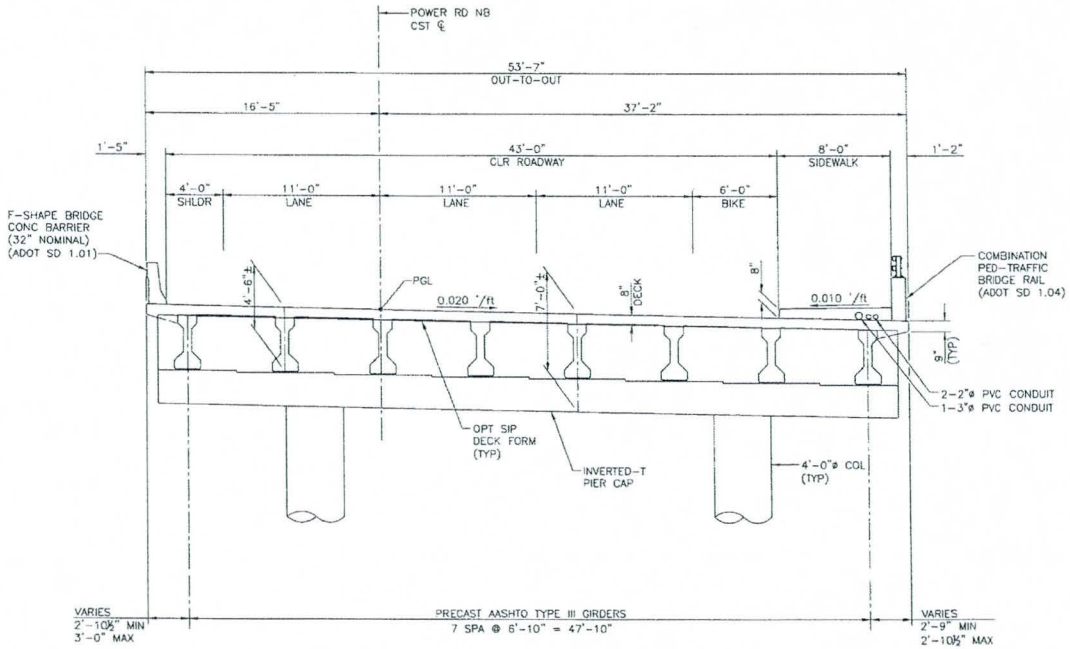
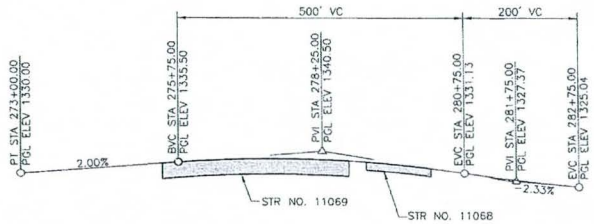


TYPICAL SECTION AT PIER

SCALE: ¼"=1'-0"

POWER RD NB
CURVE DATA

PRC = STA 273+28.31
PI = STA 279+40.21
PRC = STA 285+47.48
Δ=12°11'30" RT
D=1°00'00"
T=611.89'
L=1219.17'



PROFILE GRADE - POWER RD NB

SCALE: NONE

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PECOS RD TO SANTAN FW'

POWER ROAD NB
EMF BRIDGE
TYPICAL SECTION & GEOMETRICS

DRL
S-

DRAWN BY: MRD
ENGINEER: DB
APPROVED BY: DRS

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SHEET
189 of 460

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JACOBS

MEMO

TO: FILE **DATE:** Aug 8, 2011

FROM: George Lopez-Cepero

PROJECT NAME: Power Rd Pecos to San Tan Fwy **PROJECT NO:** W7X77900

SUBJECT: NB Power Road Bridge Elevation Adjustment NGVD 1988 to NAVD 1929

For the Section corner at Power Road and Williams Field Road, the JACOBS survey team has a project elevation of 1327.09 and a GDACS elevation of 1326.93 for a delta of +0.16. This is point number 125 in the Jacobs survey.

As determined from FCDMC web site the elevation difference between the 1929 NAVD and the 1988 NGVD is +1.66 ft. The 1988 datum is the higher of the two datum.

Therefore to adjust the Northbound Bridge elevations to the 1929 NAVD elevations in the HEC-RAS model, the bridge elevations must be lowered by 1.82 ft.(1.66+0.16).

The points of interest are at the most upstream, G8 and the most downstream girder, G1. As the bridge pier is skewed in relation to the bridge, the relevant points are on different substructure elements. For entry into HEC-RAS, the elevations at each element are as shown in the table below.

Bridge Deck and Low Chord

Element		Girder 1 - Downstream	Girder 8 – Upstream
Left Abutment		Abutment 1	Pier 1
	Bridge Deck	1335.30 – 1.82 = 1333.48	1335.85 – 1.82 = 1334.03
	Low chord	1330.44 – 1.82 = 1328.62	1331.10 – 1.82 = 13129.28
Pier 1		Pier 1	Pier 2
	Bridge Deck	1336.92 – 1.82 = 1335.10	1336.62 – 1.82 =1334.80
	Low chord	1332.06 – 1.82 = 1330.24	1331.87 – 1.82 = 1330.05
Pier 2		Pier 2	Pier 3
	Bridge Deck	1337.68 –1.82 = 1335.86	1336.62 – 1.82 =1334.80
	Low chord	1332.82 – 1.82 = 1331.00	1331.87 – 1.82 = 1330.05
Right Abutment		Pier 3	Abutment 2
	Bridge Deck	1337.68 – 1.82 = 1335.86	1335.66 – 1.82 = 1333.84
	Low chord	1332.82 – 1.82 = 1331.00	1330.91 – 1.82 = 1329.09

Power Road
Pecos Road to 202L
Final Drainage Report

Appendix G

Rainfall Maps
PREFRE output

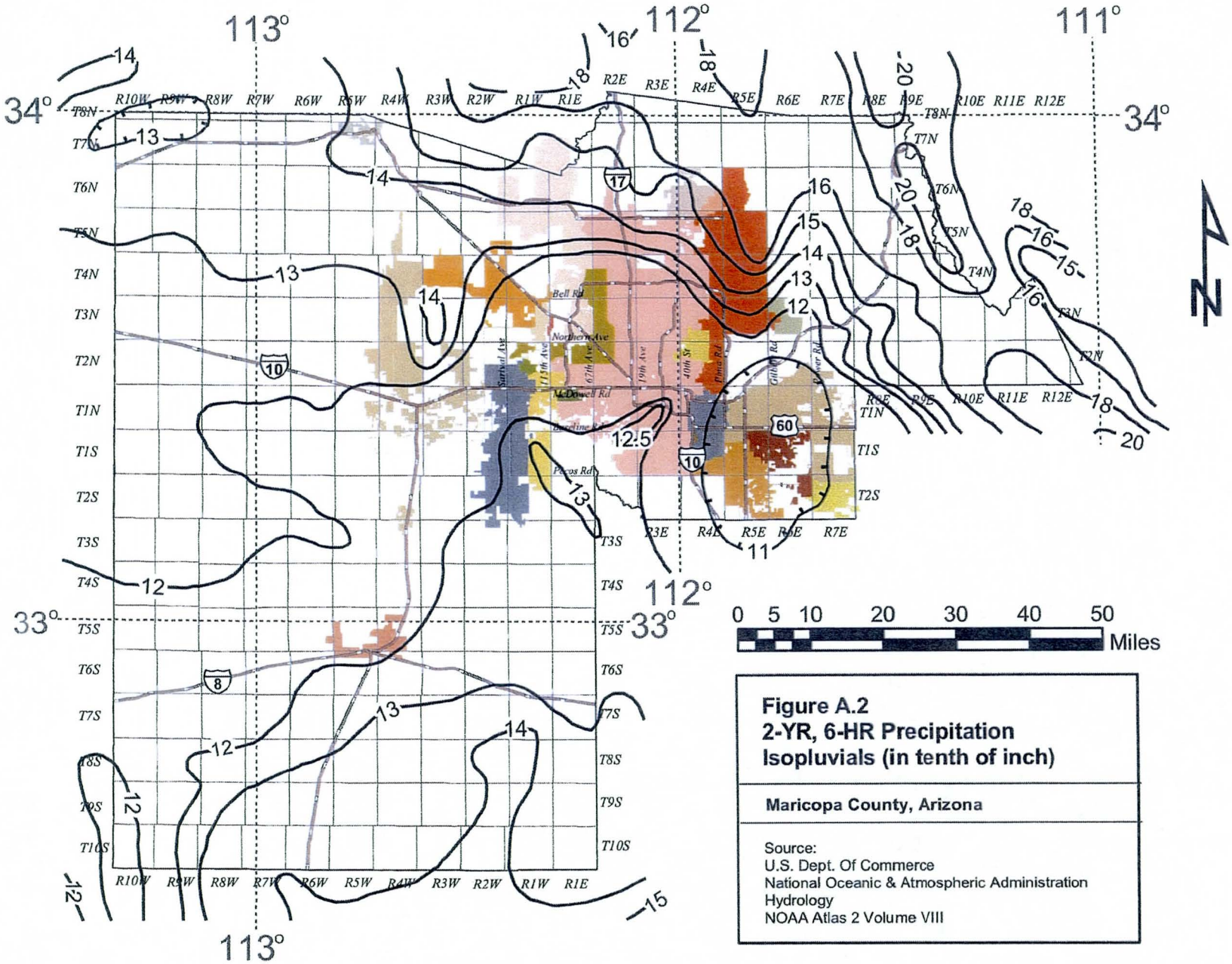


Figure A.2
2-YR, 6-HR Precipitation Isopluvials (in tenth of inch)

Maricopa County, Arizona

Source:
U.S. Dept. Of Commerce
National Oceanic & Atmospheric Administration
Hydrology
NOAA Atlas 2 Volume VIII

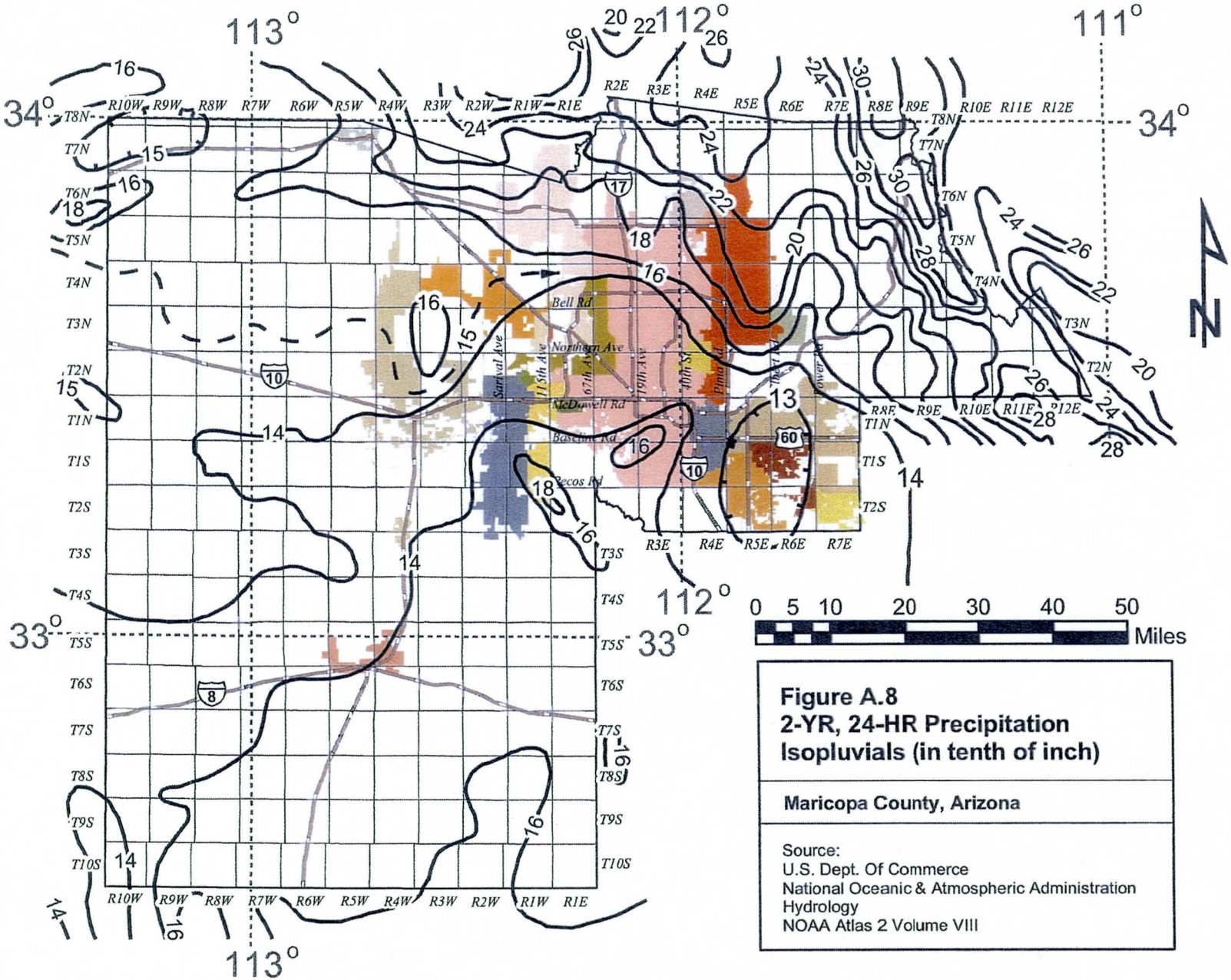


Figure A.8
2-YR, 24-HR Precipitation Isopluvials (in tenth of inch)

Maricopa County, Arizona

Source:
U.S. Dept. Of Commerce
National Oceanic & Atmospheric Administration
Hydrology
NOAA Atlas 2 Volume VIII

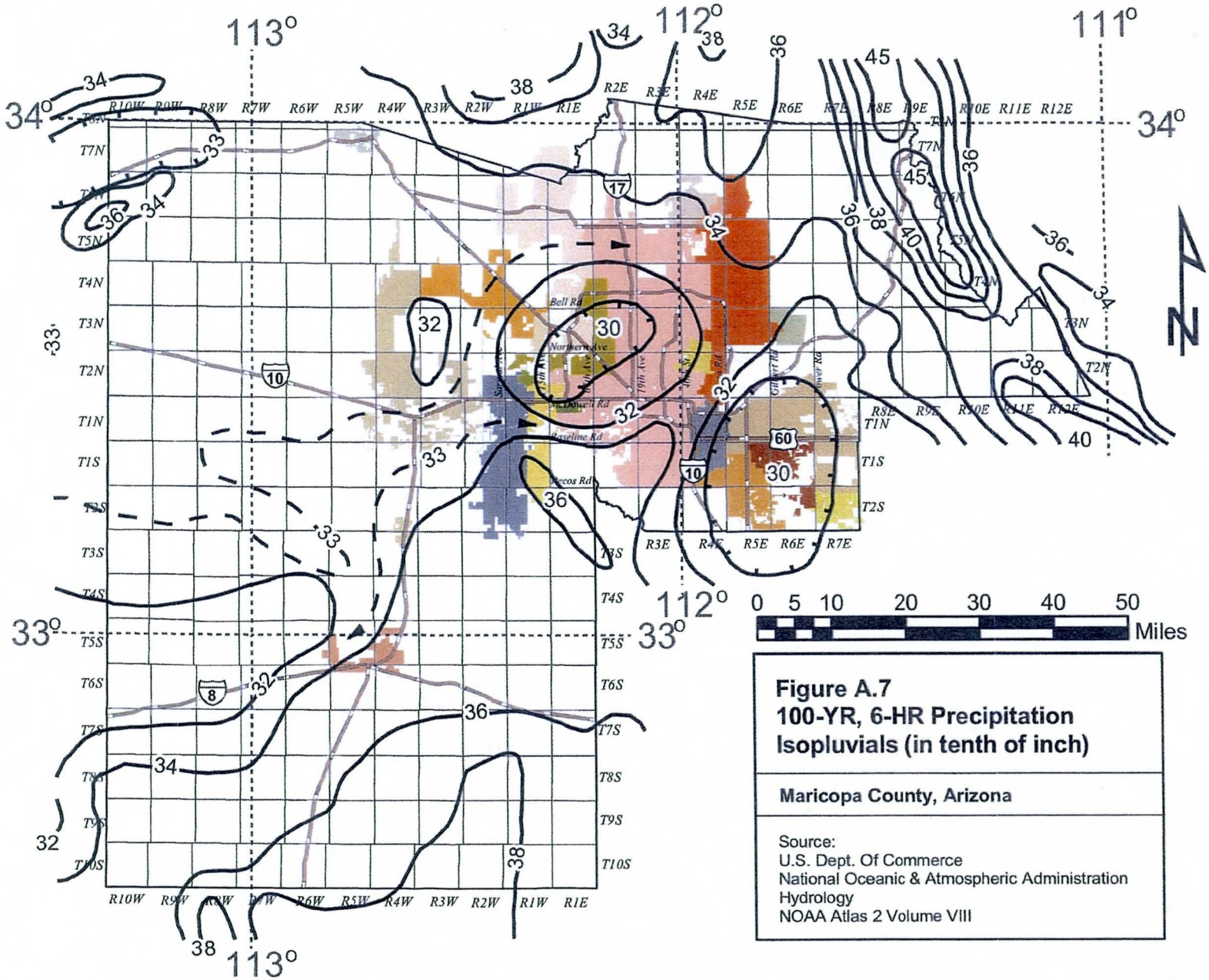


Figure A.7
100-YR, 6-HR Precipitation Isopluvials (in tenth of inch)

Maricopa County, Arizona

Source:
U.S. Dept. Of Commerce
National Oceanic & Atmospheric Administration
Hydrology
NOAA Atlas 2 Volume VIII

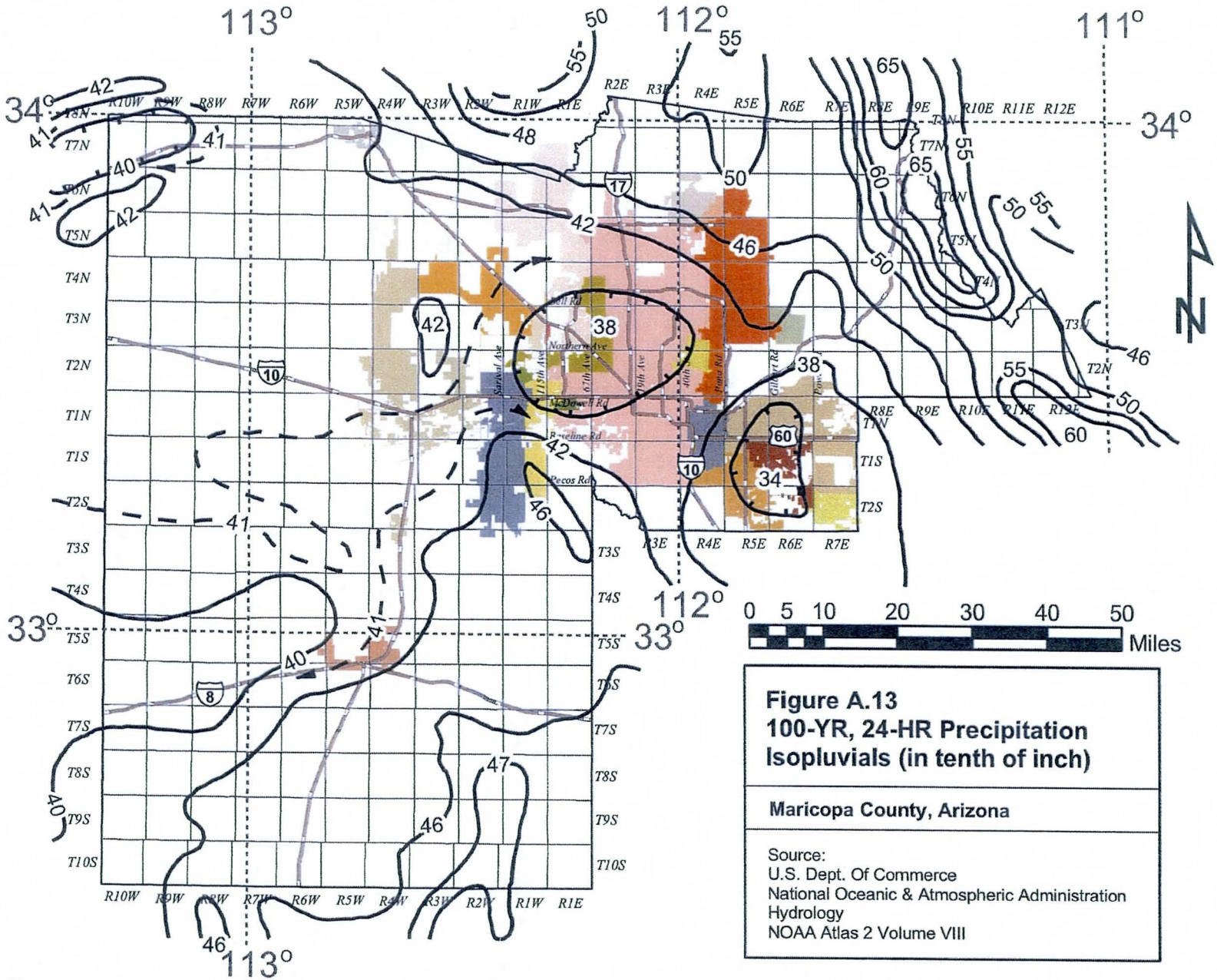


Figure A.13
100-YR, 24-HR Precipitation Isopluvials (in tenth of inch)

Maricopa County, Arizona

Source:
U.S. Dept. Of Commerce
National Oceanic & Atmospheric Administration
Hydrology
NOAA Atlas 2 Volume VIII

Precipitation Frequency

08-11-2011

PROJECT NUMBER_____ TRACS NO._____
PROJECT NAME_____ DESIGNER_____
HIGHWAY NAME_____ CHECK BY:_____
LOCATION/STATION_____ PAGE_____
Vers. VB 1.01

MAP RAINFALL VALUES

2 Yr.- 6 Hr. = 1.1 inches
2 Yr.-24 Hr. = 1.35 inches

100 Yr.- 6 Hr. = 3 inches
100 Yr.-24 Hr. = 3.7 inches

The Secondary Zone Number = 8

COMPUTED FREQUENCY-RAINFALL TABLE

	FREQUENCY						
TIME	2 Yr.	5 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.	500 Yr.
5 MIN.	0.283	0.386	0.455	0.551	0.625	0.699	0.870
15 MIN.	0.517	0.731	0.874	1.071	1.224	1.375	1.725
30 MIN.	0.683	0.980	1.177	1.447	1.657	1.864	2.344
1 HOUR	0.833	1.210	1.461	1.803	2.068	2.330	2.938
2 HOUR	0.924	1.335	1.608	1.982	2.272	2.559	3.222
3 HOUR	0.985	1.419	1.707	2.102	2.408	2.711	3.413
6 HOUR	1.100	1.577	1.894	2.329	2.666	3.000	3.772
12 HOUR	1.225	1.758	2.113	2.600	2.976	3.350	4.213
24 HOUR	1.350	1.940	2.333	2.871	3.287	3.700	4.655

Power Road
Pecos Road to 202L
Final Drainage Report

Appendix H

100-yr, 2-hr Precipitation Map

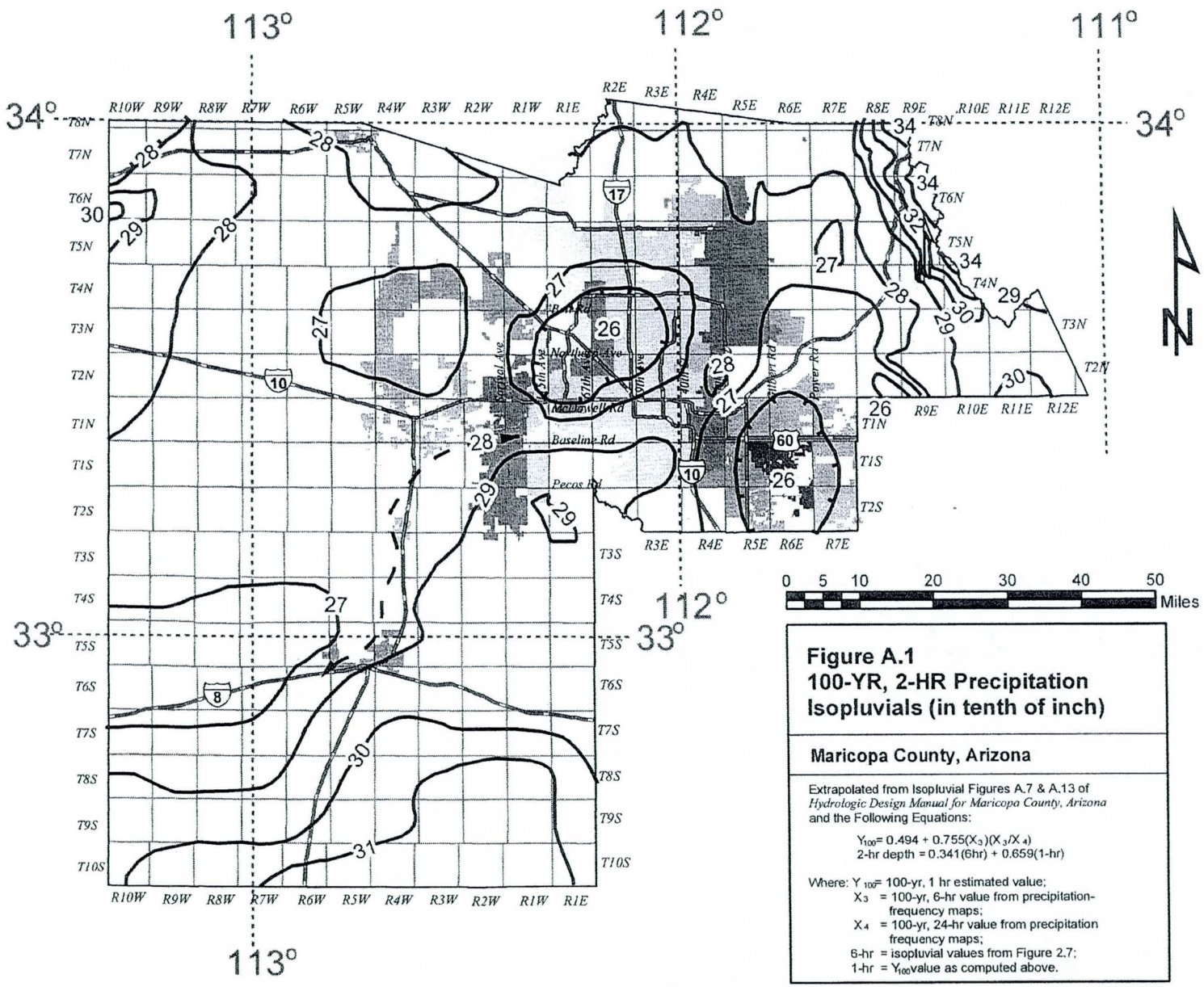


Figure A.1
100-YR, 2-HR Precipitation Isopluvials (in tenth of inch)

Maricopa County, Arizona

Extrapolated from Isopluvial Figures A.7 & A.13 of *Hydrologic Design Manual for Maricopa County, Arizona* and the Following Equations:

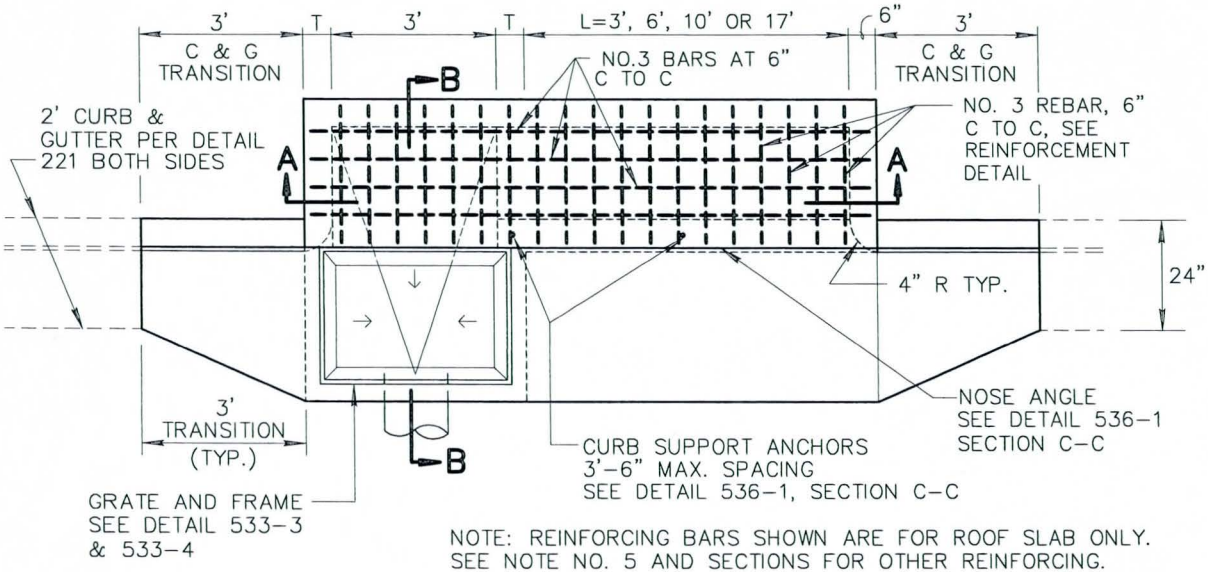
$$Y_{100} = 0.494 + 0.755(X_3)(X_3/X_4)$$
$$\text{2-hr depth} = 0.341(6\text{hr}) + 0.659(1\text{-hr})$$

Where: Y_{100} = 100-yr, 1 hr estimated value;
X_3 = 100-yr, 6-hr value from precipitation-frequency maps;
X_4 = 100-yr, 24-hr value from precipitation frequency maps;
6-hr = isopluvial values from Figure 2.7;
1-hr = Y_{100} value as computed above.

Power Road
Pecos Road to 202L
Final Drainage Report

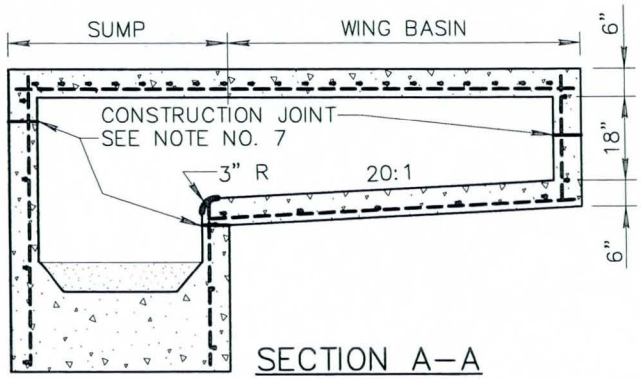
Appendix I

MAG 533 Inlet
Page 1 of 3



NOTE: REINFORCING BARS SHOWN ARE FOR ROOF SLAB ONLY. SEE NOTE NO. 5 AND SECTIONS FOR OTHER REINFORCING.

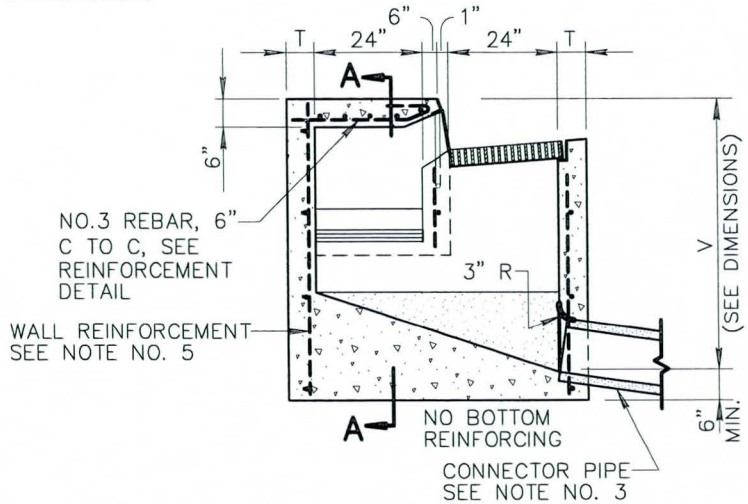
PLAN VIEW



SECTION A–A

NOTES:

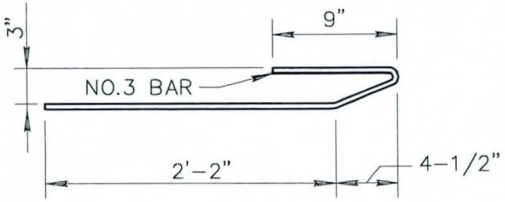
1. SINGLE C.B. (ILLUSTRATED), SUMP WITH WING BASIN UPSTREAM.
2. DOUBLE C.B. SUMP WITH SYMMETRICAL WING BASINS EACH SIDE.
3. PIPES CAN BE PLACED IN ANY WALL EXCEPT WALL ADJACENT TO A WING BASIN. PIPE SHALL BE TRIMMED TO FINAL SHAPE AND LENGTH BEFORE CONCRETE IS PLACED.
4. SUMP FLOOR SHALL HAVE A WOOD TROWEL FINISH AND A MIN. SLOPE OF 4:1 IN ALL DIRECTIONS TOWARD OUTLET PIPE.
5. ALL REFORCING BARS SHALL BE NO.4 18" C TO C BOTH WAYS AND 1-1/2" CLEAR TO INSIDE OF WALLS AND OUTSIDE WING BASIN FLOOR EXCEPT AS SHOWN. SEE SECT. 727.
6. ALL CONCRETE SHALL BE CLASS 'A', PER SECT. 725.
7. CONSTRUCTION JOINTS SHALL BE PLACED TO MEET FIELD CONDITIONS.
8. ALL EXPOSED STEEL SHALL BE GALVANIZED OR PAINTED WITH ONE SHOP COAT OF #1 PAINT AND TWO FIELD COATS OF #10 PAINT.



SECTION B–B

DIMENSIONS

V = 3'-3" MIN. WHEN L = 3'
V = 3'-5" MIN. WHEN L = 6'
V = 3'-7" MIN. WHEN L = 10'
V = 4'-0" MIN. WHEN L = 17'
T = 6" WHEN V IS LESS THAN 8'
T = 8" WHEN V IS EQUAL TO OR GREATER THAN 8'
H = CURB HEIGHT PRIOR TO THE TRANSITION



REINFORCEMENT DETAIL

DETAIL NO.				REVISED	DETAIL NO.
533-1	MARICOPA ASSOCIATION of GOVERNMENTS	STANDARD DETAIL ENGLISH	CATCH BASIN TYPE 'D		533-1

Power Road
Pecos Road to 202L
Final Drainage Report

Appendix J

Contributing Drainage Area Map

Power Road
Pecos Road to Santan Fwy

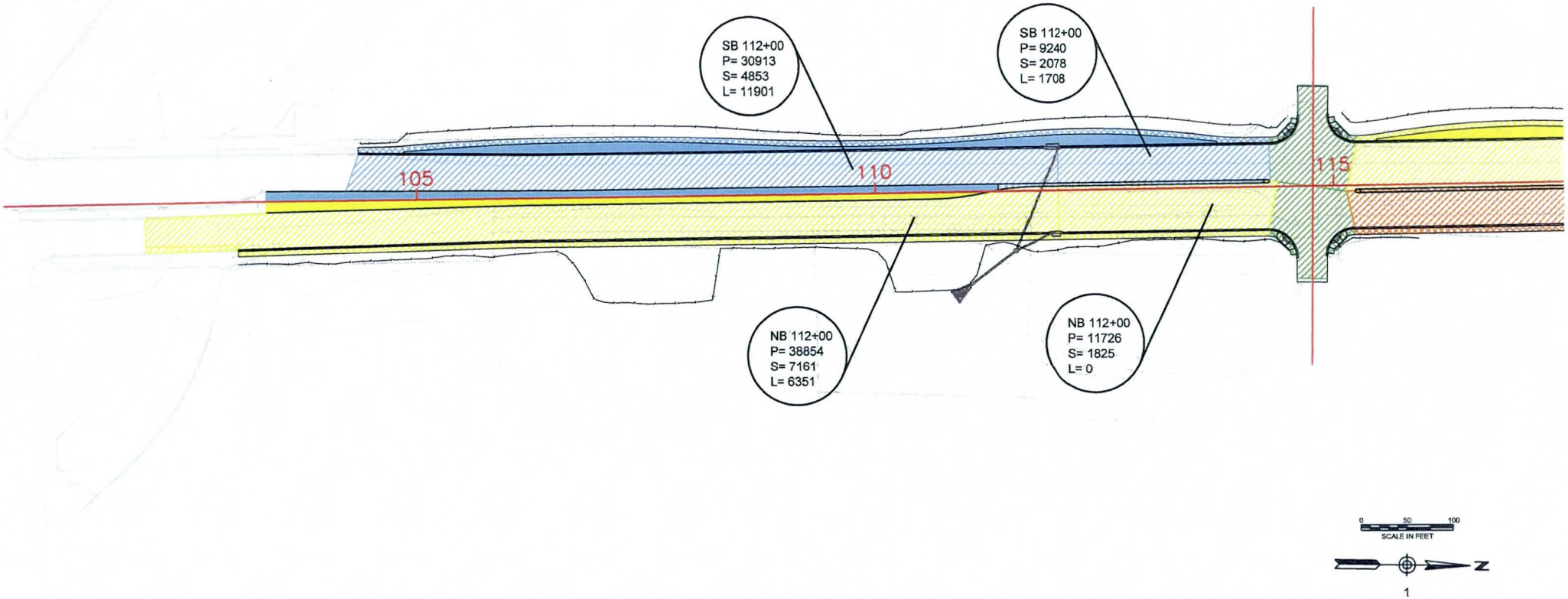
December 6, 2011
G. Lopez-Cepero

Roadway	Station	Contributing Area				CA
		Pavement Sq Ft	Concrete Sq Ft	Landscape Sq Ft	*Area Sq Feet*	
NB Power Rd	112+00N	11726	1825	0	13551	0.269
NB Power Rd	112+00S	38854	7161	6351	52366	1.016
NB Power Rd	112+00	50582	8987	6351	65920	1.285
SB Power Rd	112+00N	9240	2078	1708	13026	0.253
SB Power Rd	112+00S	30913	4853	11901	47667	0.900
SB Power Rd	112+00	40154	6021	13613	59788	1.134
NB Power Rd	120+00N	23454	4798	4685	32937	0.638
NB Power Rd	120+00S	18316	4726	1367	24409	0.482
NB Power Rd	120+00	41770	9523	6051	57344	1.120
SB Power Rd	120+00N	24051	3580	9195	36826	0.695
SB Power Rd	120+00S	23021	2842	4726	30589	0.587
SB Power Rd	120+00	47073	6422	13921	67416	1.282
NB Power Rd	128+80	12123	1992	1816	15931	0.309
NB Power Rd	135+00	22442	4239	911	27592	0.545
SB Power Rd	135+00	41879	5459	7443	54781	1.056
NB Power Rd	138+00N	12023	1800	9317	23140	0.424
NB Power Rd	138+00S	13801	2295	1418	17514	0.342
NB Power Rd	138+00	25824	4095	10735	40654	0.766
SB Power Rd	138+00N	12045	1810	3812	17667	0.336
SB Power Rd	138+00S	12924	2348	4461	19733	0.375
SB Power Rd	138+00	24969	4158	8273	37400	0.711
NB Power Rd	248+00N	20042	3000	6940	29982	0.568
NB Power Rd	248+00S	28058	4200	19909	52167	0.959
NB Power Rd	248+00	48100	7200	26849	82149	1.527
NB Power Rd	258+00N	11347	1832	4302	17481	0.331
NB Power Rd	258+00S	19042	6951	7045	33038	0.636
NB Power Rd	258+00	30389	8783	11347	50519	0.967
NB Power Rd	264+40N	16117	1763	1808	19688	0.382
NB Power Rd	264+40S	15633	2500	2507	20640	0.400
NB Power Rd	264+40	31750	4263	4315	40328	0.782
NB Power Rd	268+78	30591	15460	0	46051	0.934
NB Power Rd	283+74N	5310	1020	790	7120	0.139
NB Power Rd	283+74S	21197	17856	1655	40708	0.830
NB Power Rd	285+44.26	4376	732	631	5739	0.111
NB Power Rd	286+00	9786	1454	2253	13493	0.259
SB Power Rd	349+00N	23099	3400	6246	32745	0.625
SB Power Rd	349+00S	31996	4673	10097	46766	0.889
SB Power Rd	349+00	55095	8073	16343	79511	1.514
SB Power Rd	357+00N	15984	3239	2614	21837	0.425
SB Power Rd	357+00S	8484	1396	2442	12322	0.235
SB Power Rd	357+00	24468	4635	5056	34159	0.660
SB Power Rd	361+90	4588	12875	681	18144	0.381
SB Power Rd	363+68.91	5848	863	2133	8844	0.167
SB Power Rd	368+33	See Williams Field Road 617+00S				
SB Power Rd	376+00	29920	4082	4196	38198	0.740

Power Road
Pecos Road to Santan Fwy

December 6, 2011
G. Lopez-Cepero

Roadway	Station	Contributing Area				CA
		Pavement Sq Ft	Concrete Sq Ft	Landscape Sq Ft	*Area Sq Feet*	
SB Power Rd	379+00S	12024	1817	6077	19918	0.372
SB Power Rd	379+00N	22016	3877	10385	36278	0.681
SB Power Rd	389+31.95S	25749	3539	6426	35714	0.683
SB Power Rd	389+31.95N	12677	1549	13994	28220	0.506
SB Power Rd	496+00S	19908	7026	3715	30649	0.601
SB Power Rd	496+00N	8850	2318	318	11486	0.228
NB Power Rd	495+90S	21988	3490	6970	32448	0.617
NB Power Rd	495+90N	9314	2067	976	12357	0.243
SB Power Rd	497+40	17691	5693	2267	25651	0.506
NB Power Rd	497+45	19850	7494	6389	33733	0.653
SB Power Rd	501+00	14532	1777	4874	21183	0.401
NB Power Rd	502+10	28361	5322	8361	42044	0.804
SB Power Rd	504+00	24556	3331	9046	36933	0.697
NB Power Rd	513+00	23922	3522	7830	35274	0.669
NB Power Rd	516+49	16628	2755	6161	25544	0.484
NB Power Rd	518+69.17	9708	2021	4050	15779	0.299
NB Power Rd	522+10S	22285	3233	2023	27541	0.538
NB Power Rd	522+10N	7388	354	0	7742	0.152
NB Power Rd	523+90S	7954	177	422	8553	0.166
NB Power Rd	523+90N	9493	1008	3205	13706	0.259
NB Power Rd	526+25	19879	420	4861	25160	0.475
NB Power Rd	530+60	24514	541	3113	28168	0.540
EB WF Rd	617+00S	13717	2061	1308	17086	0.334
EB WF Rd	617+00W	19652	2768	0	22420	0.444
WB WF Rd	617+00	24029	3537	3365	30931	0.600
EB WF Rd	620+50	3393	3406	0	6799	0.140
WB WF Rd	621+00	1937	3877	189	6003	0.125
EB WF Rd	625+45	8909	12148	0	21057	0.439
WB WF Rd	625+45	9408	9650	0	19058	0.394
EB WF Rd	627+10W	10617	725	739	12081	0.235
EB WF Rd	627+10E	2746	976	1707	5429	0.102
WB WF Rd	627+10W	11265	1890	753	13908	0.273
WB WF Rd	627+10E	3550	459	1264	5273	0.100
EB WF Rd	627+82	17028	2687	5210	24925	0.475
WB WF Rd	627+82	20363	3372	4018	27753	0.535
EB WF Rd	631+70	27554	3730	10802	42086	0.793
WB WF Rd	631+70	27038	4365	5276	36679	0.708
EB Ray Rd	727+15	9428	3658	0	13086	0.264
EB Ray Rd	729+50	13289	3067	1487	17843	0.350
EB Ray Rd	732+46	23135	11473	4902	39510	0.780
WB Ray Rd	727+00	5597	0	1024	6621	0.126
WB Ray Rd	727+80	9835	0	1890	11725	0.222
WB Ray Rd	729+20	15802	0	3328	19130	0.362
WB Ray Rd	732+46	21189	8326	0	29515	0.595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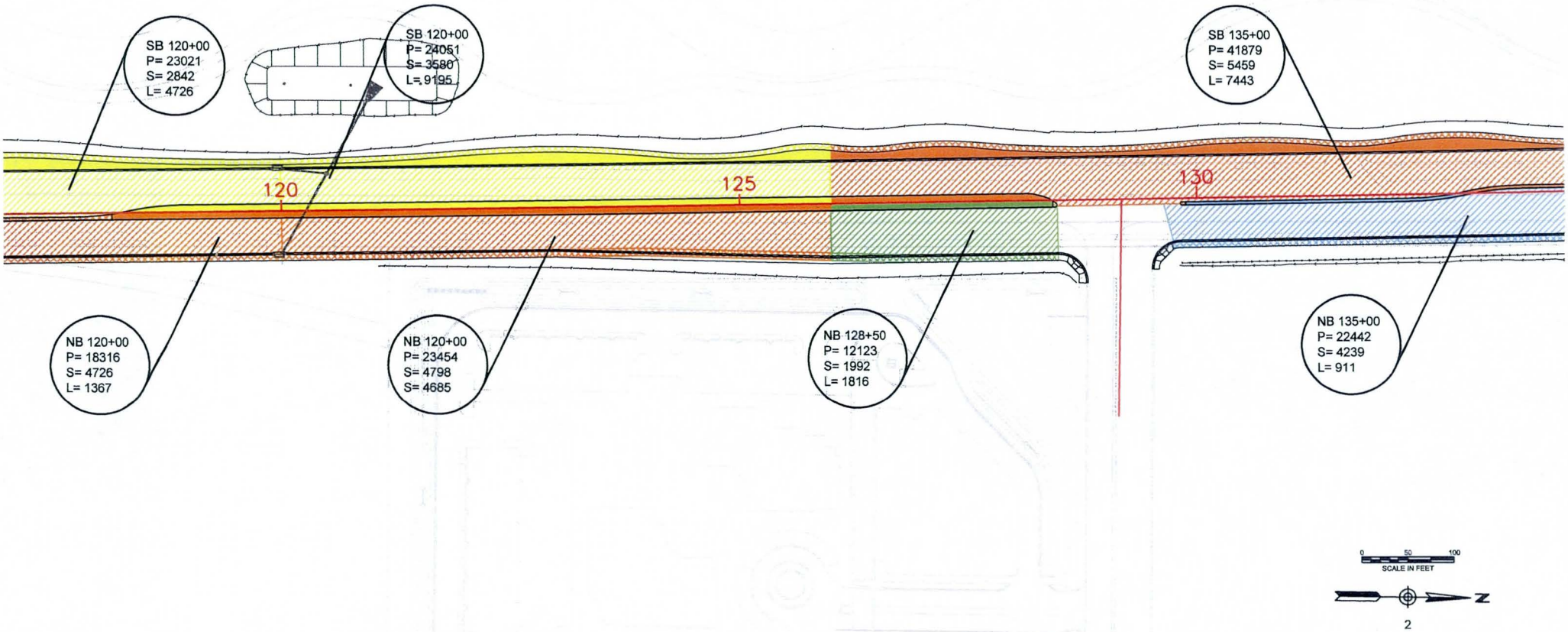
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SB 135+00
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S= 5459
L= 7443
120
125
130
NB 120+00
P= 18316
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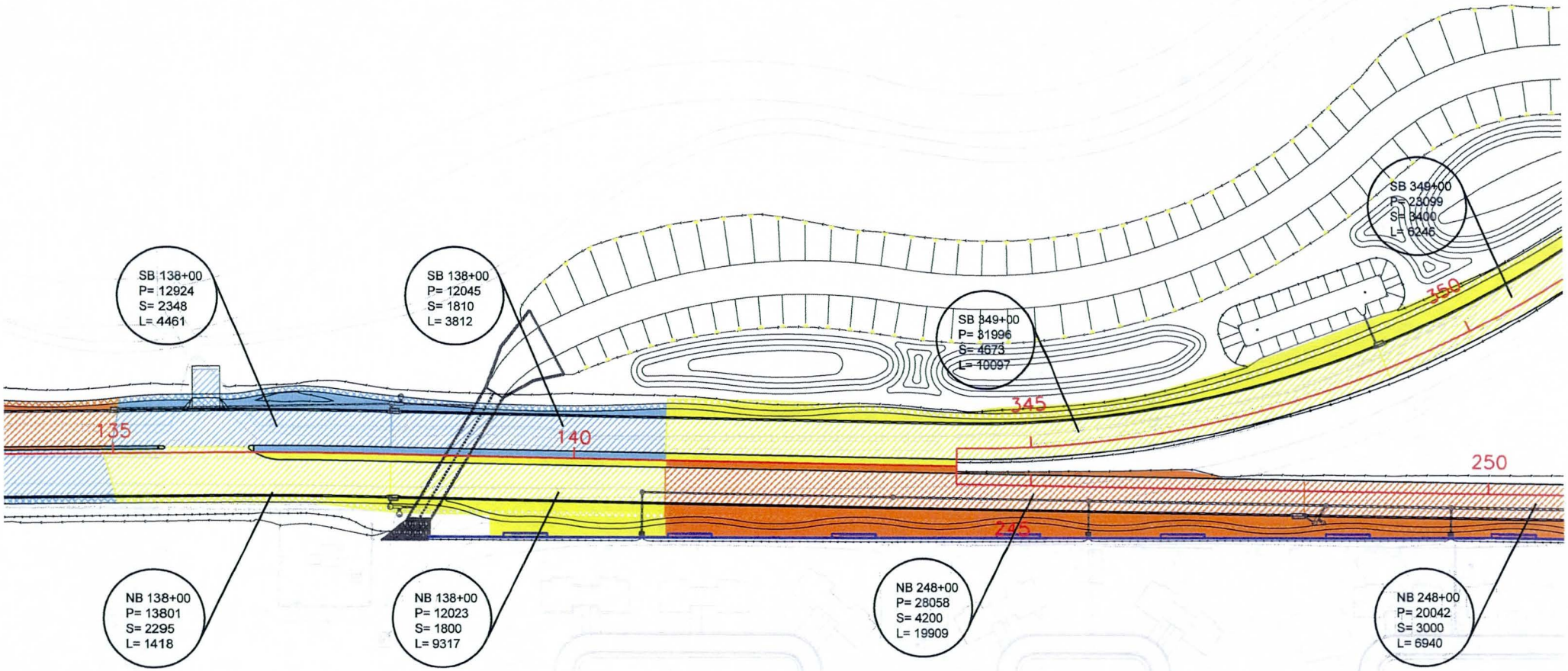
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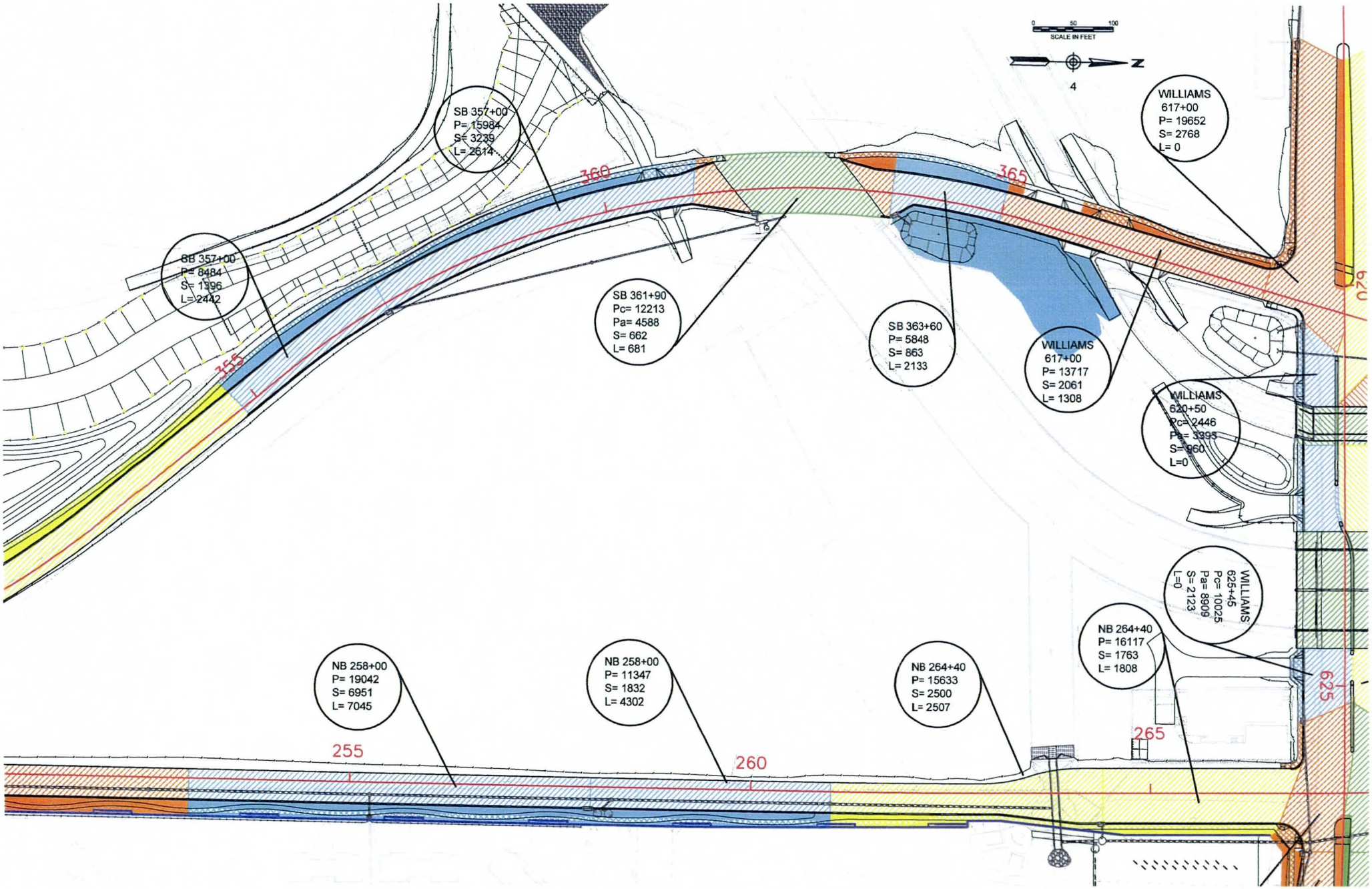
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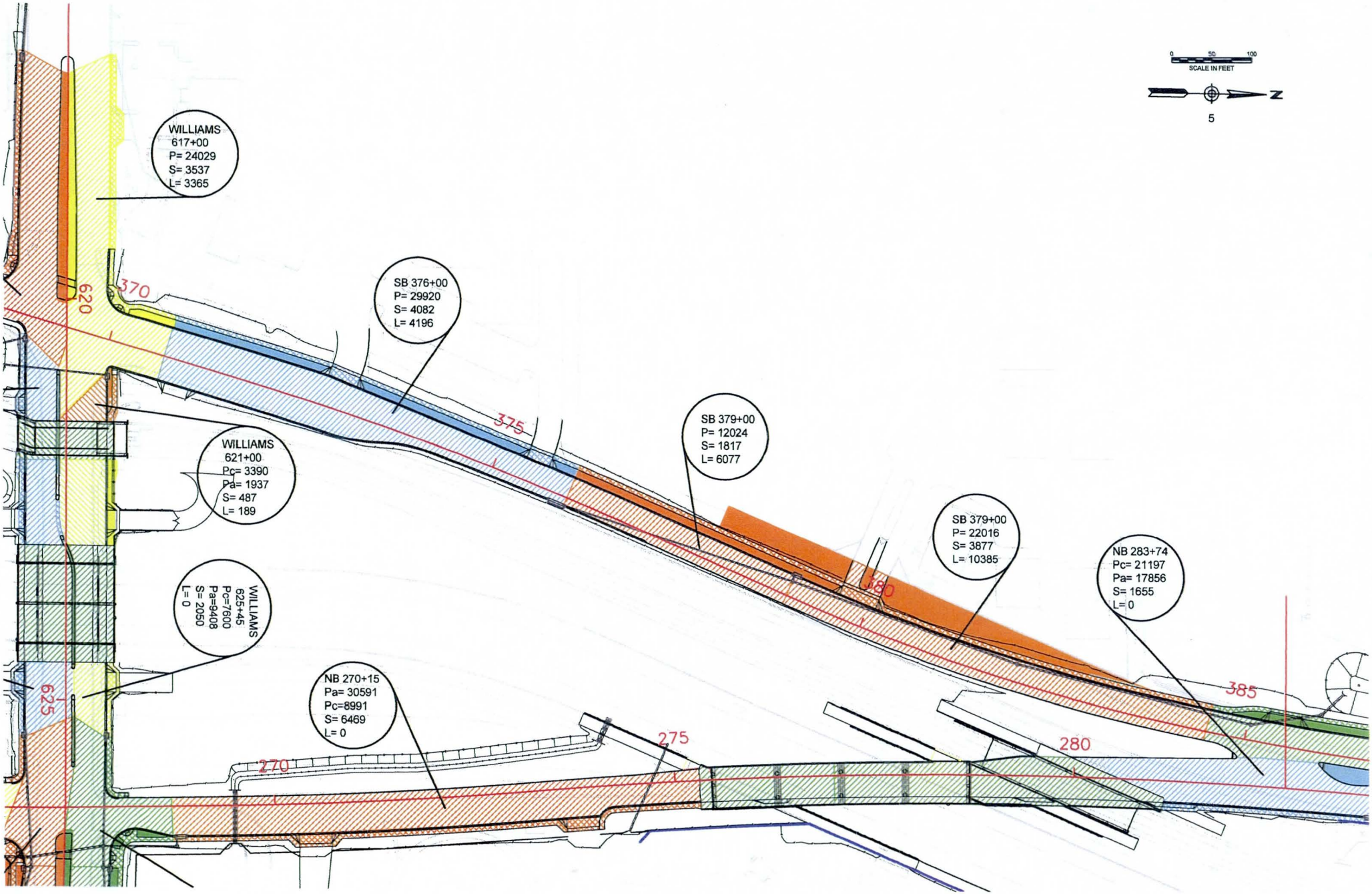
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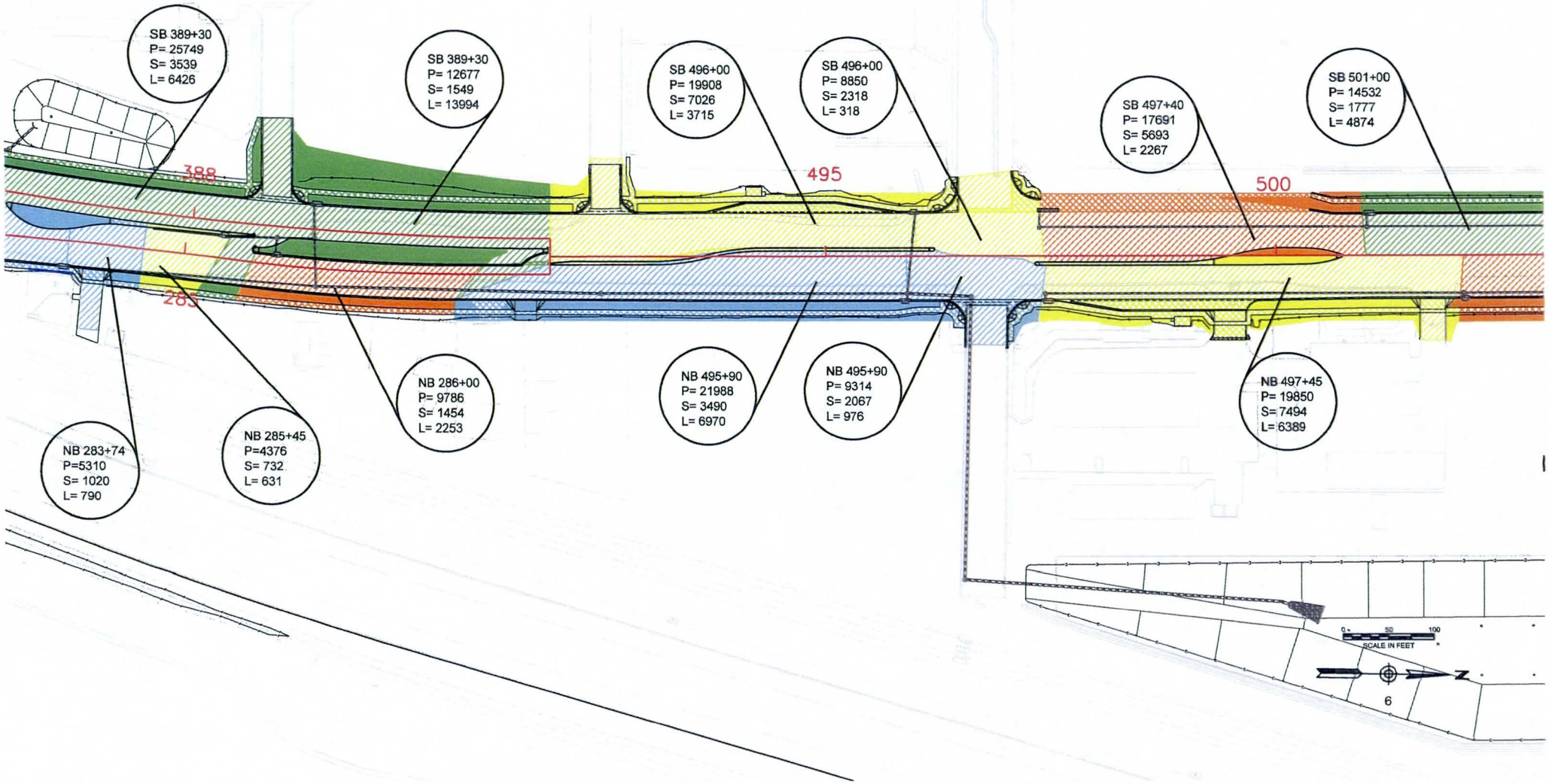
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P= 8850
S= 2318
L= 318
SB 497+40
P= 17691
S= 5693
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S= 1777
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388
495
500
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P= 9786
S= 1454
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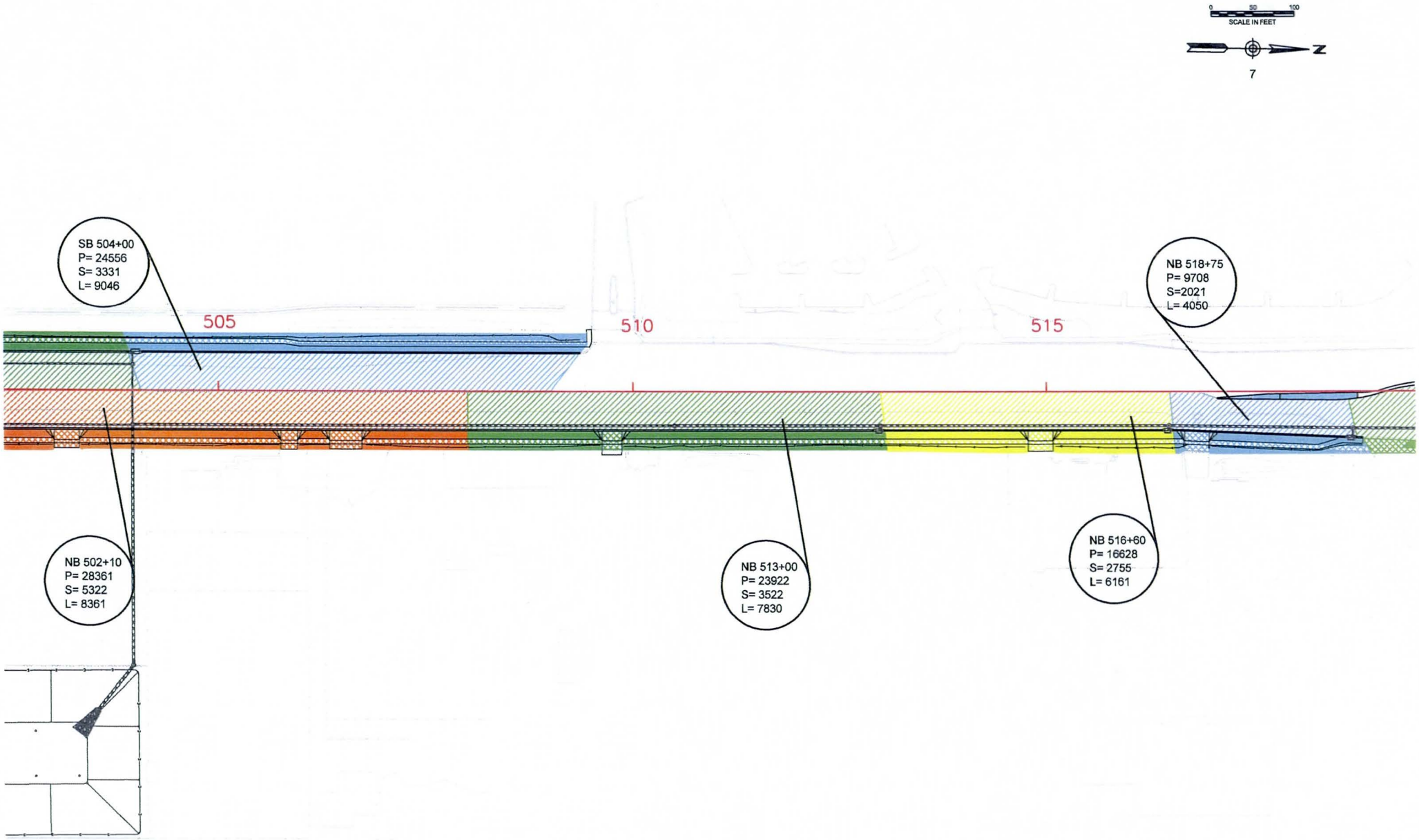
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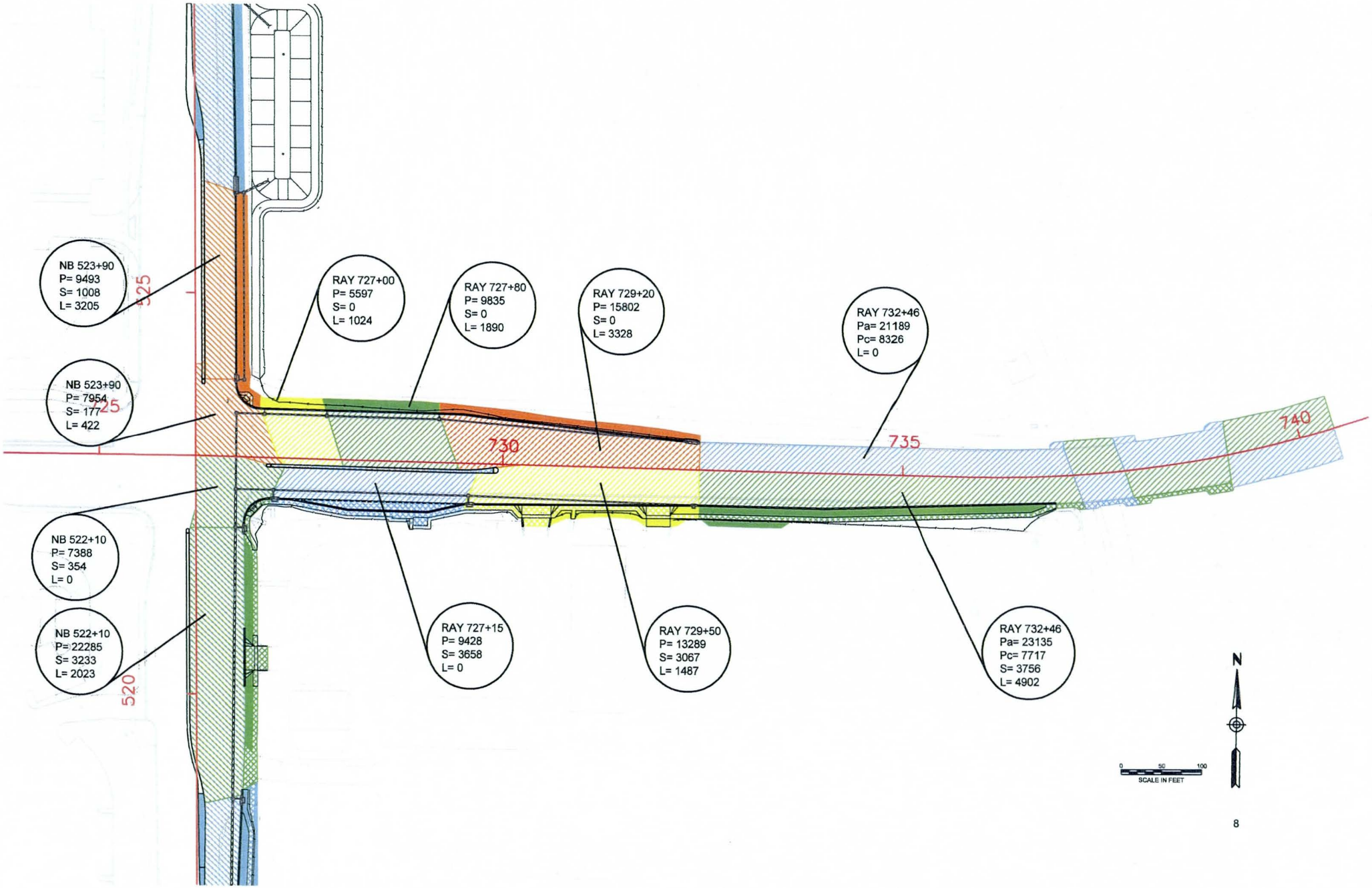
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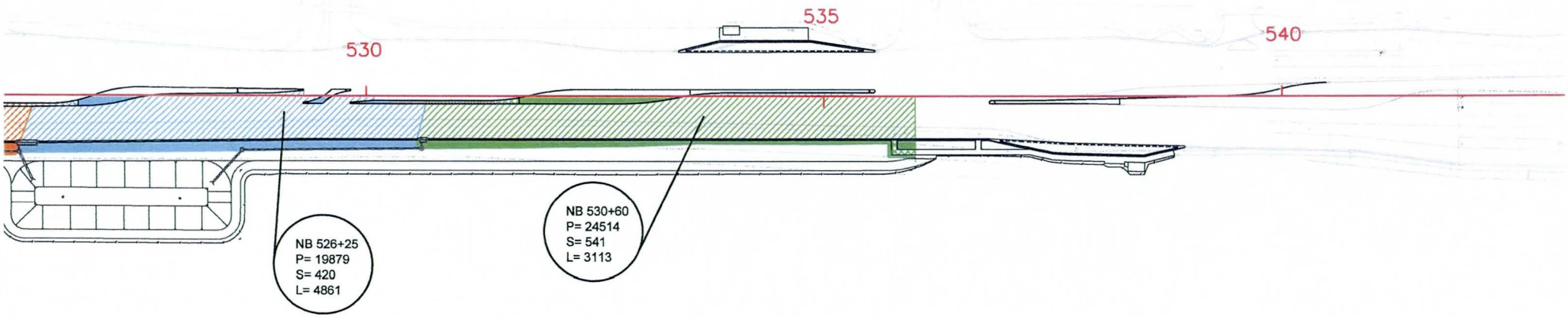
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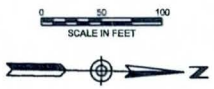
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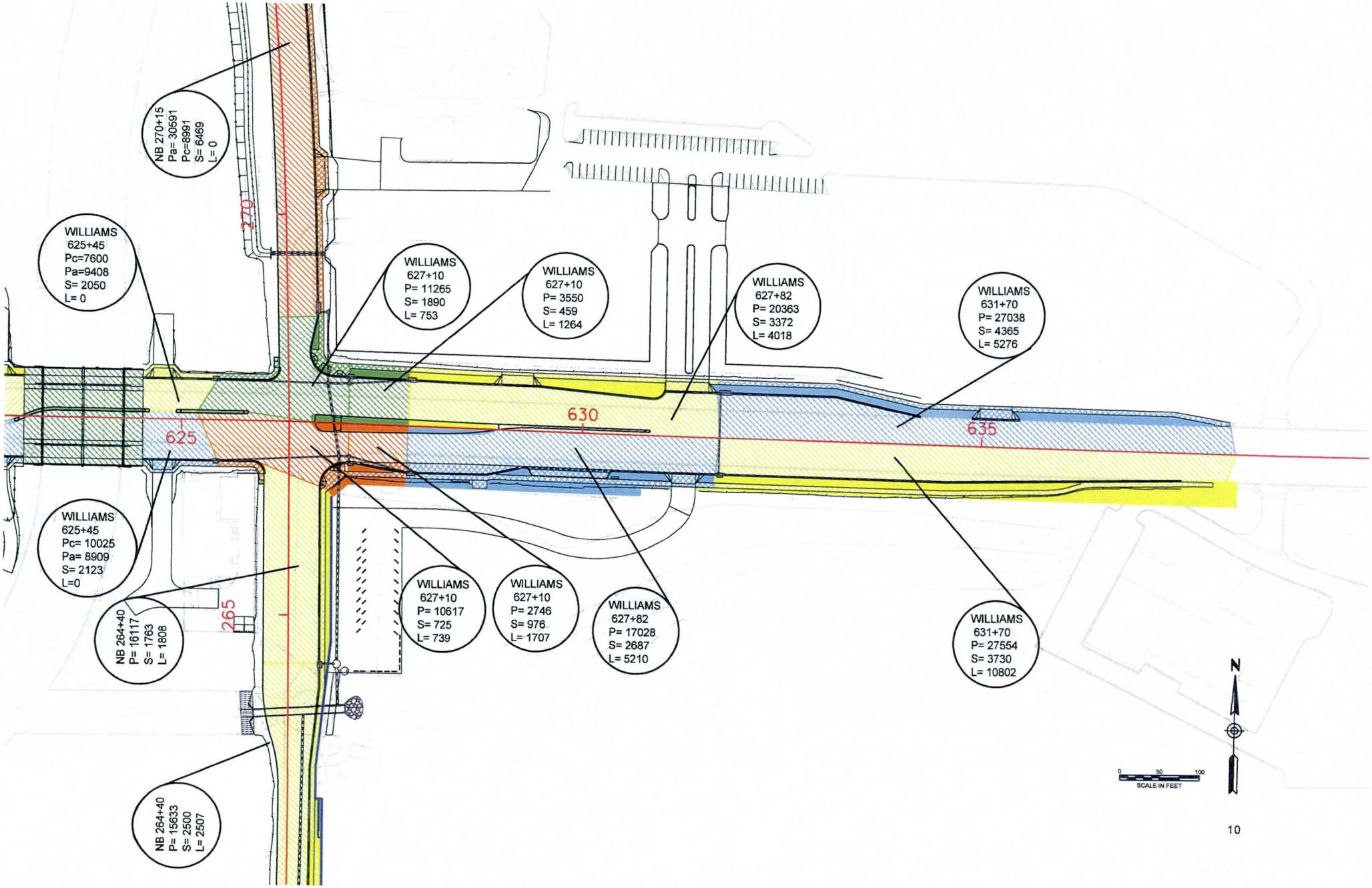
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Pc=7600
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WILLIAMS
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P= 11265
S= 1890
L= 753
WILLIAMS
627+10
P= 3550
S= 459
L= 1264
WILLIAMS
627+82
P= 20363
S= 3372
L= 4018
WILLIAMS
631+70
P= 27038
S= 4365
L= 5276
270
625
630
635
WILLIAMS
625+45
Pc= 10025
Pa= 8909
S= 2123
L=0
NB 264+40
P= 16117
S= 1763
L= 1808
265
WILLIAMS
627+10
P= 10617
S= 725
L= 739
WILLIAMS
627+10
P= 2746
S= 976
L= 1707
WILLIAMS
627+82
P= 17028
S= 2687
L= 5210
WILLIAMS
631+70
P= 27554
S= 3730
L= 10802
NB 264+40
P= 15633
S= 2500
L= 2507
N
0
50
100
SCALE IN FEET

Power Road
Pecos Road to 202L
Final Drainage Report

Appendix K

Inlet Analyses

Power Road
Pecos Road to Santan Freeway

Rainfall depth - PreFre

	5-min	15-min
10-yr	0.455	0.874
100-yr	0.699	1.375

Rainfall intensity
For rainfall intensity, multiply the rainfall depth by the number of increments in one hour (by 12 for the 5 minute rainfall)
The 10-minute intensity is the average of the 5 minute and 15 minute intensities.

	5-min	15-min	10-min
10-yr	5.46	3.496	4.48
100-yr	8.388	5.5	6.94

Station NB 104+00 to NB 277+00

From NB 104+00 to NB 112+00

Sta	CA
NB 112+00	1.106 Ac

G1	-0.47
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	4.95	15.0	3.97
100-yr	7.68	17.7	4.62

From NB 112+00 to NB 115+00

Sta	CA
NB 112+00	0.269 Ac

G1	-0.4
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	1.20	9.0	2.52
100-yr	1.87	10.7	2.93

Sta NB 112+00
At sump

Sta	CA
NB 112+00	1.106 Ac
NB 112+00	0.269 Ac
	1.375 Ac

Use 6.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	6.16	12.3	5.32
100-yr	9.55	18.9	6.90

From NB 115+00 to NB 126+00
From NB 115+00 to NB 120+00

Sta	CA
NB 120+00	0.482 Ac
G1	0.68
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	2.16	10.2	2.81
100-yr	3.35	12.0	3.26

From NB 120+00 to NB 126+00

Sta	CA
NB 120+00	0.638 Ac
G1	0.4
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	2.86	12.6	3.38
100-yr	4.43	14.8	3.93

Sta NB 120+00
At sump

Sta	CA
	0.482 Ac
	0.638
NB 120+00	1.120

Use 6.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	5.02	9.8	4.71
100-yr	7.78	15.6	6.10

From NB 126+00 to NB 141+00
At NB 128+80 Check spread at Verona

Sta	CA	
NB 128+80	0.309	Ac
G1	0.21	
Sx	0.02	

From NB 126+00 to NB 138+00

Sta	CA	
NB 135+00	0.545	
NB 138+00	0.342	Ac
	0.887	
G1	-0.4	
Sx	0.02	

	Q, cfs	Spread, ft	Depth,in
10-yr	3.97	14.2	3.78
100-yr	6.16	16.8	4.40

From NB 138+00 to NB 141+00

Sta	CA	
NB 138+00	0.424	Ac
G1	0.4	
Sx	0.02	

	Q, cfs	Spread, ft	Depth,in
10-yr	1.90	10.7	2.94
100-yr	2.94	12.7	3.41

Sta NB 138+00
At sump

Sta	CA	
	0.887	
	0.424	
NB 138+00	1.311	Ac

Use 6.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	5.87	11.7	5.17
100-yr	9.10	18.1	6.70

From NB 141+00 to NB 253+00
Sump at Sta NB 248+00
From NB 141+00 to NB 248+00

Sta	CA	
NB 248+00	0.959	Ac
	0.959	

G1	0.52
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	4.29	13.9	3.71
100-yr	6.66	16.5	4.32

From NB 248+00 to NB 253+00

Sta	AC	
NB 248+00	0.568	Ac

G1	0.4
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	2.54	12.0	3.25
100-yr	3.94	14.2	3.77

At sump

Sta	CA	
	0.959	
	0.568	
NB 248+00	1.527	Ac

Use 6.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	6.84	13.7	6.56
100-yr	10.60	20.7	7.34

From NB 253+00 to NB 261+00
Sump at Sta NB 257+77.73

From NB 253+00 to NB 258+00

Sta	AC
NB 258+00	0.636 Ac

G1	-0.4
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	2.85	12.5	3.38
100-yr	4.42	14.8	3.93

From NB 258+00 to NB 261+00

Sta	AC
NB 258+00	0.331 Ac

G1	0.4
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	1.48	9.7	2.70
100-yr	2.30	11.5	3.14

At sump

Sta	CA
	0.636
	0.331
NB 258+00	0.967 Ac

Use 6.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	4.33	8.1	4.32
100-yr	6.71	13.4	5.59

From NB 261+00 to NB 265+50
Sump at Sta NB 264+40

From NB 261+00 to NB 264+40

Sta	CA
NB 264+40	0.400 Ac

G1	0.33
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	1.79	10.9	2.98
100-yr	2.78	12.9	3.46

From NB 264+40 to NB 265+50

Sta	CA
NB 264+40	0.382 Ac

G1	0.4
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	1.71	10.3	2.84
100-yr	2.65	12.2	3.29

At sump

Sta	CA
	0.400
	0.382
NB 264+40	0.782 Ac

Use 3.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	3.50	9.2	4.59
100-yr	5.43	14.7	5.89

North of Williams Field Road
From NB 268+35 to NB 277+00

From NB 268+35 to NB 270+15

Sta	CA
NB 270+15	0.193 Ac

From NB 270+15 to NB 277+00

Sta	CA
NB 270+15	0.770 Ac
	0.963

G1	0.62
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	4.31	13.5	3.61
100-yr	6.69	16.0	4.20

Use 10.5 wing Depth includes 2" local depresion.

	Q, cfs	Qcap	Qby
10-yr	4.31	4.3	0.00
100-yr	6.69	6.7	0.00

Power Road
Pecos Road to Santan Freeway

Rainfall depth - PreFre

	5-min	15-min
10-yr	0.455	0.874
100-yr	0.699	1.375

Rainfall intensity
For rainfall intensity, multiply the rainfall depth by the number of increments in one hour (by 12 for the 5 minute rainfall)
The 10-minute intensity is the average of the 5 minute and 15 minute intensities.

	5-min	15-min	10-min
10-yr	5.46	3.496	4.48
100-yr	8.388	5.5	6.94

100-yr, 2-hr rainfall 2.70
Capacity of various pipes at 0.004

Dia	Q	V	A
	14.3	4.55	3.14
30	25.9	5.28	4.91
36	42.2	6	7.07

Station NB 277+00 to NB 508+00

From NB 277+00 to NB 283+74

Sta	CA
NB 283+74	0.830 Ac

G1	-1.19
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	3.72	11.3	3.07
100-yr	5.76	13.3	3.56

Sta	CA
NB 283+74	0.139 Ac

G1	0.11
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	0.62	8.9	2.51
100-yr	0.97	10.6	2.92

SUMP	CA
NB 283+74	0.830 Ac
NB 283+74	0.139 Ac
	0.969 Ac

Use 6.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	4.34	8.1	4.32
100-yr	6.73	13.5	5.60

From NB 285+00 to NB 285+45

Sta	CA
NB 285+45	0.111 Ac

G1	-1.1
Sx	0.0174

	Q, local	Qby	Qtotal
10-yr	0.50	0	0.50
100-yr	0.77	0.0	0.77

	Q, cfs	Spread, ft	Depth,in
10-yr	0.50	5.6	1.57
100-yr	0.77	6.7	1.80

Use 3.5 wing Depth includes 2" local depresion.

	Q, cfs	Qcap	Qby
10-yr	0.50	0.5	0.00
100-yr	0.77	0.8	0.00

There is no bypass that goes to SB 389+30

From NB 285+78 to NB 288+61
From NB 285+78 to NB 288+61

Sta	CA
NB 286+00	0.259 Ac

G1	0.41
Sx	0.027

	Q, cfs	Spread, ft	Depth,in
10-yr	1.16	7.4	2.63
100-yr	1.80	8.7	3.07

Sta NB 286+00
At sump

Sta	CA
NB 286+00	0.259

Use 3.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	1.16	1.2	2.27
100-yr	1.80	2.8	3.05

From NB 288+61 to NB 495+90

Sta	CA
NB 495+90	0.617 Ac

G1	0.26	Station NB495+00
Sx	0.02	

	Q, cfs	Spread, ft	Depth,in
10-yr	2.76	11.2	3.87
100-yr	4.28	13.2	4.53

From NB 495+90 to NB 508+00
From NB 508+00 to NB 502+07

Sta	CA
NB502+07	0.804 Ac

G1	0.2
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	3.60	13.0	4.46
100-yr	5.58	15.3	5.22

Use 3.5 wing Depth includes 2" local depresion.

	Q, cfs	Qcap	Qby
10-yr	3.60	3.29	0.31
100-yr	5.58	4.5	1.10

From NB 502+07 to NB 497+45

Sta	CA
NB 497+45	0.653 Ac

G1	0.18
Sx	0.02

	Q, local	Qby	Qtotal
10-yr	2.92	0.31	3.23
100-yr	4.53	1.10	5.64

	Q, cfs	Spread, ft	Depth,in
10-yr	3.23	12.7	4.37
100-yr	5.64	15.7	5.34

Use 6.5 wing Depth includes 2" local depresion.

	Q, cfs	Qcap	Qby
10-yr	3.23	3.23	0.00
100-yr	5.64	5.3	0.34

From NB 497+45 to NB 495+90

NB 495+90 0.243 Ac

G1	0.18
Sx	0.02

	Q, local	Qby	Qtotal
10-yr	1.09	0.00	1.09
100-yr	1.69	0.34	2.02

	Q, cfs	Spread, ft	Depth,in
10-yr	1.09	8.4	2.97
100-yr	2.02	10.6	3.70

From NB 497+45 to NB 495+90

Sump 0.617 Ac
0.243
0.860

	Q, local	Qby	Qtotal
10-yr	3.85	0.00	3.86
100-yr	5.97	0.34	6.31

Use 3.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	3.86	10.3	4.85
100-yr	6.31	16.9	6.42

Power Road
Pecos Road to Santan Freeway

Rainfall depth - PreFre

	5-min	15-min
10-yr	0.455	0.874
100-yr	0.699	1.375

Rainfall intensity
For rainfall intensity, multiply the rainfall depth by the number of increments in one hour (by 12 for the 5 minute rainfall)
The 10-minute intensity is the average of the 5 minute and 15 minute intensities.

	5-min	15-min	10-min
10-yr	5.46	3.496	4.48
100-yr	8.388	5.5	6.94

Station NB 508+00 to NB 523+00
South of Ray Road
Contributing Areas

513+00	0.669 Ac
516+49	0.484 Ac
518+69.17	0.299 Ac
522+00	0.690 Ac
	2.142

Crest is at 508+00
Sag is at 523+87

From NB 508+00 to NB 513+00

Sta	CA
NB 513+00	0.669 Ac

G1	-0.21
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	3.00	14.5	3.84
100-yr	4.65	17.1	4.47

Using 3.5 wing

	Q, local	Qcap	Qbypass
10-yr	3.00	2.78	0.22
100-yr	4.65	3.76	0.89

From NB 513+00 to NB 516+60

Sta	CA
NB 516+60	0.484 Ac

G1	-0.2
Sx	0.02

	Q, local	Qbypass	Q, cfs
10-yr	2.17	0.22	2.38
100-yr	3.36	0.89	4.25

	Q, cfs	Spread, ft	Depth,in
10-yr	2.38	13.4	3.57
100-yr	4.25	16.7	4.37

Using 3.5 wing

	Q, local	Qcap	Qbypass
10-yr	2.38	2.30	0.08
100-yr	4.25	3.55	0.70

From NB 516+60 to NB 518+69

Sta	CA
NB 518+69	0.299 Ac

G1	-0.4
Sx	0.02

	Q, local	Qbypass	Q, cfs
10-yr	1.34	0.08	1.42
100-yr	2.08	0.70	2.77

	Q, cfs	Spread, ft	Depth,in
10-yr	1.42	9.6	2.67
100-yr	2.77	12.4	3.34

Using 3.5 wing

	Q, local	Qcap	Qbypass
10-yr	1.42	1.42	0.00
100-yr	2.77	2.63	0.14

Sta NB 522+10
From NB 518+69.2 to NB 522+00

Sta	CA
NB 522+10	0.538 Ac

G1	0.218
Sx	0.02

	Q, local	Qbypass	Q, cfs
10-yr	2.41	0.00	2.41
100-yr	3.74	0.14	3.88

	Q, cfs	Spread, ft	Depth,in
10-yr	2.41	13.2	3.54
100-yr	3.88	15.8	4.17

From NB 522+10 to NB 522+97.7

Sta	CA
NB 522+10	0.152 Ac

G1	1.4
Sx	0.02

Bypass is from inlet on Ray Road 727+15 Rt

	Q, local	Qbypass	Q, cfs
10-yr	0.68	0.02	0.70
100-yr	1.06	0.90	1.96

	Q, cfs	Spread, ft	Depth,in
10-yr	0.70	5.6	1.71
100-yr	1.96	8.5	2.41

Sump

	CA
NB 522+10	0.538
NB 522+10	0.152
	0.690

Bypass is from inlet on Ray Road 727+15 Rt

	Q, local	Qbypass	Q, cfs
10-yr	3.09	0.02	3.11
100-yr	4.79	0.90	5.69

Use 3.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	3.11	8.0	4.29
100-yr	5.69	15.4	6.05

Power Road
Pecos Road to Santan Freeway

Rainfall depth - PreFre

	5-min	15-min
10-yr	0.455	0.874
100-yr	0.699	1.375

Rainfall intensity
For rainfall intensity, multiply the rainfall depth by the number of increments in one hour (by 12 for the 5 minute rainfall)
The 10-minute intensity is the average of the 5 minute and 15 minute intensities.

	5-min	15-min	10-min
10-yr	5.46	3.496	4.48
100-yr	8.388	5.5	6.94

Station NB 524+00 to NB 536+00
Contributing Areas

523+87	0.000	Ac.
525+00	0	Ac.
534+00	0	Ac.
	0	Ac.

Crest is at 536+00
Sag is at 523+87

From NB 536+00 to NB 530+60

Sta	CA	
NB 530+60	0.540	Ac

G1	0.19
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	2.42	13.6	3.63
100-yr	3.75	16.0	4.22

Using 3.5 wing

	Q, local	Qcap	Qbypass
10-yr	2.42	2.34	0.08
100-yr	3.75	3.26	0.49

From NB 530+60 to NB 526+25

Sta	CA	
NB 526+25	0.475	Ac

G1	0.19
Sx	0.02

	Q, local	Qbypass	Q, cfs
10-yr	2.13	0.08	2.21
100-yr	3.30	0.49	3.79

	Q, cfs	Spread, ft	Depth,in
10-yr	2.21	13.1	3.52
100-yr	3.79	16.1	4.23

Using 3.5 wing

	Q, local	Qcap	Qbypass
10-yr	2.21	2.17	0.04
100-yr	3.79	3.28	0.51

Station NB 523+90 At Sump

	CA		
523+90	0.259	Ac	North

G1	0.09
Sx	0.02

	Q, local	Qbypass	Q, cfs
10-yr	1.16	0.04	1.19
100-yr	1.80	0.51	2.31

	Q, cfs	Spread, ft	Depth,in
10-yr	1.19	11.9	3.23
100-yr	2.31	15.4	4.06

	CA		
523+90	0.166	Ac	South

G1	1.47
Sx	0.02

Bypass is from Ray Road WB 727+00

	Q, local	Qbypass	Q, cfs
10-yr	0.74	0.39	1.13
100-yr	1.15	1.76	2.91

	Q, cfs	Spread, ft	Depth,in
10-yr	1.13	6.8	1.99
100-yr	2.91	9.9	2.74

At sump

Sta	CA
NB 523+90	0.166 Ac
NB 523+90	0.259 Ac
	0.425 Ac

Bypass is from Ray Road WB 727+00

	Q, local	Qbypass	Qbypass	Q, cfs
10-yr	1.90	0.04	0.39	2.32
100-yr	2.95	0.51	1.76	5.22

Use 3.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	2.32	5.1	3.60
100-yr	5.22	14.1	5.76

Power Road
Pecos Road to Santan Freeway

Rainfall depth - PreFre

	5-min	15-min
10-yr	0.455	0.875
100-yr	0.699	1.375

Rainfall intensity
For rainfall intensity, multiply the rainfall depth by the number of increments in one hour (by 12 for the 5 minute rainfall)
The 10-minute intensity is the average of the 5 minute and 15 minute intensities.

	5-min	15-min	10-min
10-yr	5.46	3.5	4.48
100-yr	8.388	5.5	6.94

Station SB 104+00 to SB 368+00
Sump at SB 112+00

From SB 104+00 to SB 112+00

Sta	CA
SB 112+00	0.900 Ac

G1	-0.36
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	4.03	14.6	3.87
100-yr	6.25	17.3	4.51

From SB 112+00 to SB 115+00

Sta	CA
SB 112+00	0.253 Ac

G1	0.4
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	1.13	8.8	2.47
100-yr	1.76	10.4	2.87

Sta SB 112+00
At sump

Sta	CA
SB 112+00	0.900 Ac
SB 112+00	0.253 Ac
	1.153 Ac

Use 10.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	5.17	6.7	3.97
100-yr	8.01	11.8	5.20

From SB 115+00 to SB 126+00
Sump Station SB 120+00

From SB 115+00 to SB 120+00

Sta	CA
SB 120+00	0.587 Ac

G1	-0.68
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	2.63	11.0	3.00
100-yr	4.08	13.0	3.49

From SB 120+00 to SB 126+00

Sta	CA
SB 120+00	0.695 Ac

G1	0.4
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	3.11	13.0	3.48
100-yr	4.83	15.3	4.05

Sta SB 120+00
At sump

Sta	CA
	0.587 Ac
	0.695
SB 120+00	1.282

Use 6.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	5.74	11.4	5.10
100-yr	8.90	17.7	6.61

From SB 126+00 to SB 141+00
At SB 135+00

Sta	CA
SB 135+00	1.056 Ac

G1	-0.4
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	4.73	15.2	4.02
100-yr	7.33	18.0	4.68

Use 3.5 wing Depth includes 2" local depresion.

	Q, cfs	Qcap	Qby
10-yr	4.73	3.82	0.91
100-yr	7.33	4.97	2.36

From SB 126+00 to SB 138+00

Sta	CA
SB 138+00	0.375 Ac

G1	-0.34
Sx	0.02

	Q, local	Qby	Q, total
10-yr	1.68	0.91	2.59
100-yr	2.60	2.36	4.96

	Q, cfs	Spread, ft	Depth,in
10-yr	2.59	12.5	3.36
100-yr	4.96	16.0	4.20

From SB 138+00 to SB 141+00

Sta	CA
SB 138+00	0.336 Ac

G1	0.4
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	1.51	9.8	2.72
100-yr	2.33	0.0	0.00

Sta SB 138+00

At sump

Sta	CA	Qby
	0.375	
	0.336	
SB 138+00	0.711 Ac	

Use 6.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	4.10	7.5	4.18
100-yr	7.30	14.6	5.88

From SB 141+00 to SB 353+00
Sump at Sta SB 349+00
From SB 141+00 to SB 349+00

Sta	CA
SB 349+00	0.889 Ac

G1	0.2
Sx	0.0355

	Q, cfs	Spread, ft	Depth,in
10-yr	3.98	11.4	4.96
100-yr	6.17	13.5	5.84

From SB 349+00 to SB 353+00

Sta	CA	
SB 349+00	0.625	Ac

G1	0.4
Sx	0.0355

	Q, cfs	Spread, ft	Depth,in
10-yr	2.80	8.8	3.84
100-yr	4.34	10.3	4.51

At sump

Sta	CA	
	0.889	
	0.625	
SB 349+00	1.514	Ac
Sx	0.0355	

Use 6.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	6.78	8.3	5.63
100-yr	10.51	12.2	7.31

From SB 353+00 to SB 361+00
Sump at Sta SB 357+00
From SB 353+00 to SB 357+00

Sta	CA	
SB 357+00	0.235	Ac

G1	0.4
Sx	0.0373

	Q, cfs	Spread, ft	Depth,in
10-yr	1.05	5.9	2.70
100-yr	1.63	6.9	3.18

From SB 357+00 to SB 361+00

Sta	CA	
SB 357+00	0.425	Ac

G1	0.45
Sx	0.0373

	Q, cfs	Spread, ft	Depth,in
10-yr	1.90	7.2	3.29
100-yr	2.95	8.5	3.87

At sump

Sta	CA	
	0.235	
	0.425	
SB 357+00	0.660	Ac

Sx	0.0373

Use 3.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	2.96	4.7	4.17
100-yr	4.58	7.3	5.35

From SB 361+00 to SB 364+00
On-grade inlet at SB363+60
Sump at Sta SB 361+90

From SB 363+60 to SB 364+90

Sta	CA	
SB 363+60	0.106	Ac

G1	1.94
Sx	0.08

	Q, cfs	Spread, ft	Depth,in
10-yr	0.47	2.0	1.94
100-yr	0.74	2.4	2.30

Use 3.5 wing This inlet has 0" local depresion.

	Q, local	Qcap	Qby
10-yr	0.47	0.47	0.00
100-yr	0.74	0.74	0.00

From SB 361+60 to SB 363+90

Sta	AC	
SB 361+90	0.381	Ac

G1	1.44
Sx	0.08

	Q, cfs	Spread, ft	Depth,in
10-yr	1.71	1.7	3.32
100-yr	2.65	4.0	3.92

At sump

Sta	CA	
SB 361+90	0.381	Ac
Sx	0.08	

Use 3.5 wing This inlet has 0" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	1.71	3.5	3.35
100-yr	2.65	4.4	4.28

Flow north of Station SB 365+00 goes to Williams Field Road
Check Spread at 368+33, PC.

Sta	AC	
SB 368+33	0.334	Ac
G1	0.84	
Sx	0.02	

	Q, cfs	Spread, ft	Depth,in
10-yr	1.50	8.5	2.40
100-yr	2.32	10.0	2.78

Power Road
Pecos Road to Santan Freeway

Rainfall depth - PreFre

	5-min	15-min
10-yr	0.455	0.874
100-yr	0.699	1.375

Rainfall intensity
For rainfall intensity, multiply the rainfall depth by the number of increments in one hour (by 12 for the 5 minute rainfall)
The 10-minute intensity is the average of the 5 minute and 15 minute intensities.

	5-min	15-min	10-min
10-yr	5.46	3.496	4.48
100-yr	8.388	5.5	6.94

Rainfall Intensity

10-yr-10 min	4.48	in/hr
100-yr-10 min	6.94	in/hr

Southbound Roadway
Station SB 371+32 to SB 392+15

Due to curvature of road cross-slope goes from low on left to low on right to low on left.
Station SB 370+50 to SB 371+32
Cross-slope is to left; 0 cross-slope at SB 371+32

From Station SB 371+32 to SB 377+18
Cross-slope is to right; 0 cross-slope at SB 377+18

From Station SB 377+18 to SB 385+00
Cross-slope is to left; 0 cross-slope at SB 377+18

	Gutter Elevation:	
Station SB 371+32	Elev = 1326.63	Crest, point of 0 cross-slope
Station SB 379+00	Elev = 1322.25	Sump
Station SB 384+50	Elev = 1326.33	Crest

Due to cross-slope rollover

Place inlet at SB 376+00

	CA
SB 376+00	0.74

G1, %=	0.40
Sx	0.0206

	Q, cfs	Spread, ft	Depth,in
10-yr	3.31	13.0	3.58
100-yr	5.14	15.4	4.17

use 10.5 ft effective wing length for zero by-pass for Q10.

	Q, local	Qcap	Qbypass
10-yr	3.31	3.31	0.00
100-yr	5.14	5.13	0.01

From SB 376+00 to roll over at SB 377+12.4

Sta	CA
SB 377+12	0.14

	Q, local
10-yr	0.62
100-yr	0.96

From SB 376+00 to SB 384+50

Sta	CA
SB379+00	0.372 Ac

G1	-0.8
Sx	0.02

	Q, local	Qbypass	Qtotal
10-yr	1.67	0.00	1.67
100-yr	2.58	0.01	2.59

	Q, cfs	Spread, ft	Depth,in
10-yr	1.67	8.8	2.52
100-yr	2.59	10.4	2.92

From crest at SB 384+50 to sump at SB 379+00

Sta	CA
SB 379+00	0.681 Ac

G1	0.4
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	3.05	12.9	3.46
100-yr	4.73	15.2	4.02

SB 379+00 At Sump

Sta	CA	
SB 379+00	0.372	south
SB 379+00	0.681	north
	1.053	

Use 6.5 wing Depth includes 2" local depresion.

	Q, cfs	Spread, ft	Depth,in
10-yr	4.72	9.1	4.55
100-yr	7.31	14.7	5.89

From Sta SB 384+50 to SB391+94
includes NB 284+70 to NB 285+50
includes NB 285+50 to NB 288+95
Sump at SB 389+26.91

SB 389+30 Sump

Sta	CA		
SB 389+30	0.683	Ac	South

G1, %= -0.98
Sx 0.0215

	Q, cfs	Spread, ft	Depth,in
10-yr	3.06	10.4	3.02
100-yr	4.74	12.3	3.51

North

Sta	CA	
SB 389+30	0.506	Ac

G1, %= 1.04
Sx 0.0215

	Q, cfs	Spread, ft	Depth,in
10-yr	2.27	9.1	2.70
100-yr	3.51	10.8	3.13

SB 389+30		Sump inlet
south	0.683	
north	0.506	
	1.189	

Sx 0.0215

Use 6.5 wing

	Q, cfs	Spread, ft	Depth,in
10-yr	5.32	9.8	4.88
100-yr	8.26	15.4	6.33

Power Road
Pecos Road to Santan Freeway

Rainfall depth - PreFre

	5-min	15-min
10-yr	0.455	0.874
100-yr	0.699	1.375

Rainfall intensity
For rainfall intensity, multiply the rainfall depth by the number of increments in one hour (by 12 for the 5 minute rainfall)
The 10-minute intensity is the average of the 5 minute and 15 minute intensities.

	5-min	15-min	10-min
10-yr	5.46	3.496	4.48
100-yr	8.388	5.5	6.94

Rainfall Intensity

10-yr-10 min	4.48	in/hr
100-yr-10 mi	6.94	in/hr

Sta 491+93 to Sta 496+16.55

	CA	
SB 496+00	0.601	Ac

At SB 495+82.5

G1, %=	0.21
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	2.69	13.9	3.70
100-yr	4.17	16.4	4.30

At inlet

G1, %=	0.40
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	2.69	12.3	3.31
100-yr	4.17	14.5	3.85

See below for sump analysis

From SB 508+00 to SB 496+46
Inlet at SB 504+00

CA	0.697
G1, %=	0.19
Sx	0.02

	Q, cfs	Spread, ft	Depth,in
10-yr	3.12	15.0	3.96
100-yr	4.84	17.7	4.61

Use 6.5 ft effective wing length

	Q, cfs	Qcap	Qby
10-yr	3.12	3.12	0.00
100-yr	4.84	4.55	0.29

Sump at SB 501+00

G1=	-0.14
G2=	0.26

maximum depth before spillover is 0.09 ft = 1.8 inches
For flow analysis, assume inlet is on grade, G=0.26
Locate inlet at SB 501+00
As downstream of Sta SB 501+00 flow is in valley gutter to south side of Galveston Rd, try to capture 100% of Q100 at this location.

CA=	0.401	Ac
G1, %=	0.26	
Sx	0.02	

	Q, local	Qbypass	Qtotal
10-yr	1.80	0.00	1.80
100-yr	2.78	0.29	3.07

	Q, cfs	Spread, ft	Depth,in
10-yr	1.80	11.4	3.11
100-yr	3.07	14.0	3.73

Use 6.5 ft wing, 100% is captured

	Q, cfs	Qcap	Qby
10-yr	1.80	1.80	0.00
100-yr	3.07	3.07	0.01

Inlet at SB 497+57

CA= 0.506 Ac

cross-section is vee-shaped

Sta 497+35 Lt		G	Sx1	Sx2				
Slotted Drain		0.325	0.0298	0.0208				**Driveway**
	Q1	Qby	Q		Qcap	Qby	T, ft	d, in
10-year	2.27	0.00	2.26		1.68	0.59	6.8	2.42
100-year	3.51	0.01	3.52		2.27	1.25	8.0	2.86

Sx=2.98*2.08/(2.98+2.08)

Sx= 0.01225

T'=(Qn)/Kusx^1.67*Sl^0.5)^0.375

10-year T'=((2.26*0.016)/((0.56)*(0.01225^1.67)*(0.00325^0.5)))^0.375

T'= 16.50 Computer=16.4 OK

T1=T*(Sx2)/(Sx1+Sx2)

T1=x.x*(0.0208)/(0.0298+0.02081)

T1, ft.= 6.78

d1, in.= 2.42

Slotted Drain

Lt= =0.6*(Q^0.42)*(S^0.3)*(1/nSx)^0.6

Lt= =(0.6*(2.26^0.42)*(0.00325^0.3)*(1/((0.016)*(0.01225))^0.6)/0.67

Lt= 37.93

E= 1-1(-l/lt)^1.8

10-year Q= 2.26

Length	% capture	Qcap	Qby
10	0.424	0.96	1.31
15	0.596	1.35	0.92
20	0.740	1.68	0.59

Use 20 ft of slotted drain

100-year T'=((3.52*0.016)/((0.56)*(0.01225^1.67)*(0.00325^0.5)))^0.375

T'= 19.49

T1=T*(Sx2)/(Sx1+Sx2)

T1=19.49*(0.0208)/(0.0298+0.02081)

T1, ft.= 8.01

d1, in.= 2.86

Lt= =(0.6*(3.52^0.42)*(0.00325^0.3)*(1/((0.016)*(0.01225))^0.6)/0/67

Lt= 45.69

E= 1-1(-l/lt)^1.8

10-year Q= 3.52

Length	% capture	Qcap	Qby
10	0.359	1.26	2.26
15	0.511	1.80	1.72
20	0.645	2.27	1.25

Use 20 ft of slotted drain

Sump at Station SB 496+00

CA=	0.228	Ac

G1, %=	1.09
Sx	0.02

	Q, local	Qbypass	Qtotal
10-yr	1.02	0.59	1.61
100-yr	1.58	1.25	2.83

	Q, cfs	Spread, ft	Depth,in
10-yr	1.61	8.3	2.35
100-yr	2.83	10.3	2.84

At sump

	CA	
	0.228	From north
	0.601	from south
SB 496+00	0.829	

	Q, local	Qbypass	Qtotal
10-yr	3.71	0.59	4.30
100-yr	5.76	1.25	7.01

MAG 533 with 2" local depression

Using 3.5 effective wing length

	Q, cfs	Spread, ft	Depth,in
10-yr	4.30	11.6	5.16
100-yr	7.01	18.9	6.91

Power Road
Pecos Road to Santan Freeway
Williams Field Road

Station EB 617+00 to EB 635+00

Rainfall depth - PreFre

	5-min	15-min
10-yr	0.455	0.874
100-yr	0.699	1.375

Rainfall intensity

For rainfall intensity, multiply the rainfall depth by the number of increments in one hour (by 12 for the 5 minute rainfall)

The 10-minute intensity is the average of the 5 minute and 15 minute intensities.

	5-min	15-min	10-min
10-yr	5.46	3.496	4.48
100-yr	8.388	5.5	6.94

Station EB 617+00 to EB 623+00
Station EB 620+50 to EB 623+00

Sta	CA
EB 620+50	0.140 Ac

G1	0.82
Sx	0.0091

	Q, cfs	Spread, ft	Depth,in
10-yr	0.63	9.7	1.61
100-yr	0.97	11.6	1.82

MAG 533 w/ 2" local depresion
Use 3.5 effective wing

	Q	Qcap	Qby
10-yr	0.63	0.63	0.00
100-yr	0.97	0.97	0.00

Williams Field Road
Eastbound

Station EB 617+00 to EB 620+50

Sta	CA
EB 617+00	0.878 Ac

G1	1.2891
Sx	0.0188

	Qlocal	Qby	Qtotal
10-yr	3.93	0.00	3.93
100-yr	6.10	0.00	6.10

	Q, cfs	Spread, ft	Depth,in
10-yr	3.93	11.8	3.04
100-yr	6.10	13.9	3.53

MAG 533 w/ 2" local depresion
Use 6.5 effective wing

	Q	Qcap	Qby
10-yr	3.93	3.87	0.06
100-yr	6.10	5.35	0.75

Station EB 623+00 to EB 635+00
Station EB 623+00 to EB 625+85

Sta	CA
EB 625+45	0.455 Ac

G1	0.61
Sx	0.01

	Q, cfs	Spread, ft	Depth,in
10-yr	2.04	15.6	2.41
100-yr	3.16	18.5	2.76

MAG 533 w/ 2" local depresion
Use 3.5 effective wing

	Q	Qcap	Qby
10-yr	2.04	2.03	0.01
100-yr	3.16	2.77	0.39

Station EB 620+50 to EB 627+10

Sta	CA			Area	C	
EB 627+10	0.277 Ac			2400	0.85	2040
				4284	0.85	3641.4
G1	-0.59			4700	0.85	3995
Sx	0.008			1008	0.85	856.8
				581.25	0.85	494.0625
	Qlocal	Qby	Qtotal	1209	0.85	1027.65
10-yr	1.24	0.01	1.25			12054.9125
100-yr	1.92	0.39	2.31			0.277

	Q, cfs	Spread, ft	Depth,in
10-yr	1.25	14.9	2.00
100-yr	2.31	18.9	2.39

Station EB 623+00 to EB 635+00
Station EB 635+00 to EB 631+70

Sta	CA
EB 631+70	0.793 Ac
G1	0.2
Sx	0.01727

	Q, cfs	Spread, ft	Depth,in
10-yr	3.55	17.0	3.95
100-yr	5.51	20.1	4.59

MAG 533 w/ 2" local depresion
Use 3.5 effective wing

	Q	Qcap	Qby
10-yr	3.55	3.08	0.48
100-yr	5.51	4.90	0.61

Station EB 631+70 to EB 627+10

EB 627+82

Sta	CA	
EB 627+82	0.640	Ac

G1	0.2
Sx	0.02

	Qlocal	Qby	Qtotal
10-yr	2.87	0.48	3.34
100-yr	4.44	0.61	5.05

	Q, cfs	Spread, ft	Depth,in
10-yr	3.34	15.2	4.02
100-yr	5.05	17.8	4.64

MAG 533 w/ 2" local depresion
Use 6.5 effective wing

	Q	Qcap	Qbypass
10-yr	3.34	3.33	0.01
100-yr	5.05	4.69	0.36

EB 627+10

Sta	CA	
EB 627+10	0.153	Ac

G1	0.2
Sx	0.008

	Qlocal	Qby	Qtotal
10-yr	0.69	0.01	0.70
100-yr	1.06	0.36	1.42

	Q, cfs	Spread, ft	Depth,in
10-yr	0.70	14.6	1.98
100-yr	1.42	19.3	2.43

Area	C	
7848	0.85	6670.8
0	0.85	0
0	0.85	0
0	0.85	0
0	0.85	0
0	0.85	0
		6670.8
		0.153

Station EB 627+10
At Sump

Sta	CA	
EB 627+10	0.277	
EB 627+10	0.153	Ac
	0.430	

G1	0
Sx	0.008

	Qlocal	Qby	Qby	Qtotal
10-yr	1.92	0.01	0.01	1.95
100-yr	2.98	0.39	0.36	3.73

MAG 533 w/ 2" local depresion
Use 3.5 effective wing

	Q, cfs	Spread, ft	Depth,in
10-yr	1.95	6.7	3.22
100-yr	3.73	22.8	4.76

Power Road
Pecos Road to Santan Freeway
Williams Field Road

Station WB 617+00 to WB 635+00

Rainfall depth - PreFre

	5-min	15-min
10-yr	0.455	0.874
100-yr	0.699	1.375

Rainfall intensity

For rainfall intensity, multiply the rainfall depth by the number of increments in one hour (by 12 for the 5 minute rainfall)

The 10-minute intensity is the average of the 5 minute and 15 minute intensities.

	5-min	15-min	10-min
10-yr	5.46	3.496	4.48
100-yr	8.388	5.5	6.94

Station WB 617+00 to WB 623+00
Station EB 621+00 to WB 623+00

Sta	CA	
WB 621+00	0.125	Ac

G1	0.8
Sx	0.0049

	Q, cfs	Spread, ft	Depth,in
10-yr	0.56	13.6	1.42
100-yr	0.87	16.4	1.59

MAG 533 w/ 2" local depresion
Use 3.5 effective wing

	Q	Qcap	Qby
10-yr	0.56	0.56	0.00
100-yr	0.87	0.87	0.00

Williams Field Rd
Westbound

Station WB 617+00 to WB 620+50

Sta	CA
WB 617+00	0.600 Ac

G1	1.3919
Sx	0.0158

	Qlocal	Qby	Qtotal
10-yr	2.69	0.00	2.69
100-yr	4.17	0.00	4.17

	Q, cfs	Spread, ft	Depth,in
10-yr	2.69	11.1	2.55
100-yr	4.17	13.2	2.94

MAG 533 w/ 2" local depresion
Use 3.5 effective wing

	Q	Qcap	Qby
10-yr	2.69	2.66	0.03
100-yr	4.17	3.68	0.49

Station WB 623+00 to WB 635+00
Station WB 623+00 to WB 626+00

Sta	CA
WB 625+45	0.409 Ac

G1	0.51
Sx	0.010147

	Q, cfs	Spread, ft	Depth,in
10-yr	1.83	15.3	2.40
100-yr	2.84	18.2	2.75

MAG 533 w/ 2" local depresion
Use 3.5 effective wing

	Q	Qcap	Qby
10-yr	1.83	1.83	0.00
100-yr	2.84	2.57	0.27

Station WB 626+00 to WB 627+10

Sta	CA				
WB 627+10	0.237	Ac	Area	C	
			1620	0.85	1377
G1	-0.93		924	0.85	785.4
Sx	0.0077		9579	0.85	8142.15
					10304.55
					0.237

	Qlocal	Qby	Qtotal
10-yr	1.06	0.00	1.06
100-yr	1.65	0.27	1.92

	Q, cfs	Spread, ft	Depth,in
10-yr	1.06	13.0	1.78
100-yr	1.92	16.5	2.10

Station WB 623+00 to WB 635+00
Station WB 635+00 to WB 631+70

Sta	CA	
WB 631+70	0.722	Ac
G1	0.2	
Sx	0.01576	

	Q, cfs	Spread, ft	Depth,in
10-yr	3.23	17.4	3.73
100-yr	5.01	20.6	4.33

MAG 533 w/ 2" local depresion
Use 10.5 effective wing

	Q	Qcap	Qby
10-yr	3.23	3.23	0.00
100-yr	5.01	5.00	0.01

Station WB 631+70 to WB 627+10

Sta	CA	
EB 627+82	0.580	Ac

3528	0.85	2998.8	
Area Adjustment		0.069	

G1	0.2
Sx	0.02

	Qlocal	Qby	Qtotal
10-yr	2.60	0.00	2.60
100-yr	4.03	0.01	4.04

	Q, cfs	Spread, ft	Depth,in
10-yr	2.60	13.8	3.68
100-yr	4.04	16.3	4.29

MAG 533 w/ 2" local depresion
Use 6.5 effective wing

	Q	Qcap	Qbypass
10-yr	2.60	2.60	0.00
100-yr	4.04	3.94	0.11

Sta	CA	
EB 627+10	0.069	Ac

G1	0.2
Sx	0.0077

	Qlocal	Qby	Qtotal
10-yr	0.31	0.00	0.31
100-yr	0.48	0.11	0.59

	Q, cfs	Spread, ft	Depth,in
10-yr	0.31	10.7	1.56
100-yr	0.59	14.0	1.87

Station WB 627+10
At Sump

Sta	CA	
WB 627+10	0.237	
WB 627+10	0.069	Ac
	0.306	

G1	0
Sx	0.008

	Qlocal	Qby	Qby	Qtotal
10-yr	1.37	0.00	0.00	1.37
100-yr	2.12	0.27	0.11	2.50

Use MAG 533 w/ 2" local depresion
Use 3.5 effective wing

	Q, cfs	Spread, ft	Depth,in
10-yr	1.37	1.3	2.54
100-yr	2.50	12.9	3.77

Williams Field Rd
Westbound

Power Road
Pecos Road to Santan Freeway
Ray Road

Station EB 727+00 to EB 732+46

Rainfall depth - PreFre

	5-min	15-min
10-yr	0.455	0.874
100-yr	0.699	1.375

Rainfall intensity

For rainfall intensity, multiply the rainfall depth by the number of increments in one hour (by 12 for the 5 minute rainfall)

The 10-minute intensity is the average of the 5 minute and 15 minute intensities.

	5-min	15-min	10-min
10-yr	5.46	3.496	4.48
100-yr	8.388	5.5	6.94

100-yr, 2-hr rainfall 2.70

Capacity of various pipes at 0.004

Dia, in	Q, cfs	V, ft/sec	A, sq.ft.
24	14.3	4.55	3.14
30	25.9	5.28	4.91
36	42.2	6	7.07

Check 732+46

Contributing Areas

732+46 0.78 Ac.

G1= 0.18

Sx 0.02

	Q, cfs	Spread, ft	Depth, in
10-yr	3.49	15.8	4.15
100-yr	5.42	18.6	4.84

Power Road
Pecos Road to Santan Freeway
Ray Road

Inlet at EB 729+50

CA

729+50	0.350	Ac

G1=	0.42
Sx=	0.02

	Qlocal	Qby	Q
Q10	1.57	3.493	5.060
Q100	2.43	5.416	7.847

	Q, cfs	Spread, ft	Depth, in
10-yr	5.06	15.5	4.08
100-yr	7.85	18.3	4.75

Use MAG 533 w/ 2" local depresion
3.5 ft effective wing

	Q	Qcap	Qby
10-yr	5.060	3.990	1.070
100-yr	7.847	5.170	2.677

Inlet at EB 727+15

CA

727+15	0.264	Ac
	0.264	

G1=	0.77
Sx=	0.0136

	Qlocal	Qby	Q	
Q10	1.18	1.070	2.252	cfs
Q100	1.83	2.677	4.510	cfs

	Q, cfs	Spread, ft	Depth, in
10-yr	2.25	12.8	2.56
100-yr	4.51	16.7	3.21

Use MAG 533 w/ 2" local depresion
3.5 ft effective wing

	Q	Qcap	Qby
10-yr	2.252	2.234	0.018
100-yr	4.510	3.610	0.900

Bypass flow goes to Power Rd inlet at NB 522+10

Power Road
Pecos Road to Santan Freeway
Ray Road

Station WB 727+00 to WB 732+46

Rainfall depth - PreFre

	5-min	15-min
10-yr	0.455	0.874
100-yr	0.699	1.375

Rainfall intensity

For rainfall intensity, multiply the rainfall depth by the number of increments in one hour (by 12 for the 5 minute rainfall)

The 10-minute intensity is the average of the 5 minute and 15 minute intensities.

	5-min	15-min	10-min
10-yr	5.46	3.496	4.48
100-yr	8.388	5.5	6.94

Capacity of various pipes at 0.004

Dia, in	Q, cfs	V, ft/sec	A, sq.ft.
24	14.3	4.55	3.14
30	25.9	5.28	4.91
36	42.2	6	7.07

Contributing Areas

732+46	0.595	
729+20	0.362	Ac.
727+80	0.222	Ac.
727+00	0.126	Ac.
	1.305	Ac.

Check WB732+50

Sta.	CA	
732+50	0.595	
	0.595	Ac.

G1=	0.28
Sx=	0.02

Project will be using slotted drain west of this location.
Intent is to capture 100% using Curb opening at this location.
Use MAG 533 w/ 1" local depression

	Q, cfs	Spread, ft	Depth, in
10-yr	2.66	13.1	3.50
100-yr	4.13	15.5	4.08

Use 10.0 ft wing for 100% capture of 10-year flow.

	Q, cfs	Qcap	Qby
10-yr	2.66	2.66	0.00
100-yr	4.13	4.0	0.13

Power Road
Pecos Road to Santan Freeway
Ray Road

Check WB731+00

	CA	
731+00	0.162	Ac.
	0.162	

G1=	0.31
Sx=	0.016

	Q, cfs	Spread, ft	Depth, in
10-yr	0.73	8.9	2.14
100-yr	1.13	10.6	2.46

Check at WB 730+00

	CA	
730+00	0.273	
	0.273	Ac

G1=	0.36
Sx=	0.018

	Q, cfs	Spread, ft	Depth, in
10-yr	1.22	9.8	2.52
100-yr	1.90	11.7	2.92

Inlet at WB729+20

	CA	
729+20	0.362	
	0.362	Ac

G1=	0.36
Sx=	0.0118

	Qlocal	Qby	Q
Q10	1.62	0.00	1.62
Q100	2.51	0.13	2.65

	Q, cfs	Spread, ft	Depth, in
10-yr	1.62	14.3	2.53
100-yr	2.65	17.3	2.95

Inlet at WB729+20
Using slotted drain, local depression = 0"
Use 20.0 ft for 100% capture of 10-year flow.

	Q	Qcap	Qby
10-yr	1.62	1.62	0.00
100-yr	2.65	2.41	0.24

Power Road
Pecos Road to Santan Freeway
Ray Road

Inlet at Ray WB 727+80

	CA
727+80	0.222 Ac

G1=	0.74
Sx=	0.013

	Qlocal	Qby	Q
Q10	0.99	0.00	1.00 cfs
Q100	1.54	0.24	1.78 cfs

	Q, cfs	Spread, ft	Depth, in
10-yr	1.00	9.6	1.98
100-yr	1.78	12.1	2.37

Using slotted drain, local depression = 0"
Use 20.0 ft for 100% capture of 10-year flow.

	Q	Qcap	Qby
10-yr	1.00	1.00	0.00
100-yr	1.78	1.67	0.11

Inlet at WB726+98

	CA
727+00	0.126 Ac

G1=	0.74
Sx=	0.0064

	Qlocal	Qby	Q
Q10	0.56	0.00	0.56
Q100	0.87	0.11	0.98

	Q, cfs	Spread, ft	Depth, in
10-yr	0.56	11.7	1.50
100-yr	0.98	14.8	1.73

Using slotted drain, local depression = 0"
Use 15.0 ft for 100% capture of 10-year flow.

	Q	Qcap	Qby
10-yr	0.56	0.55	0.01
100-yr	0.98	0.83	0.15

Bypass flow goes to Power Rd inlet at NB523+90

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 112+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	7.320

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	4.326	3.013	6.942	23.226
6.500	5.355	1.997	5.632	17.767
10.500	5.943	1.389	4.730	14.009
17.500	6.502	0.838	3.772	10.016
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 112+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	11.390

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	5.656	5.787	9.904	35.566
6.500	8.029	3.381	7.378	25.041
10.500	8.993	2.446	6.235	20.276
17.500	9.863	1.549	4.980	15.048
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 120+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	6.140

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	3.843	2.314	6.062	19.556
6.500	4.565	1.604	5.063	15.397
10.500	5.054	1.097	4.246	11.991
17.500	5.514	0.645	3.379	8.380
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 120+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	9.550

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	5.108	4.478	8.587	30.079
6.500	6.837	2.756	6.629	21.918
10.500	7.631	1.966	5.588	17.583
17.500	8.350	1.221	4.457	12.868
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Road
HIGHWAY NAME - Pecos Road to Santan Freeway
LOCATION - NB Sta 133+50_10
VBVer 1.2: July 2010

PROJECT NO. - MESA
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.400
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.720
SPREAD-Ft.--T	=	16.35
Average Velocity-V-fps	=	2.12
FLOW in Gutter-CFS--Q	=	1.308
% Flow in Gutter-CFS	=	22.87
Velocity of Flow in Gutter-fps	=	2.810
Depth at Curb Line-Inches--d	=	4.292

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.214
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	23.87
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.248	1.420	2.174	3.594	2.126	62.840
6.500	0.436	2.492	1.831	4.323	1.397	75.580
10.500	0.648	3.705	1.369	5.075	0.645	88.720
17.500	0.907	5.190	0.519	5.708	0.012	99.800

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Road
HIGHWAY NAME - Pecos Road to Santan Freeway
LOCATION - NB Sta 133+50_100
VBVer 1.2: July 2010

PROJECT NO. - MESA
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.400
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.900
SPREAD-Ft.--T	=	19.34
Average Velocity-V-fps	=	2.37
FLOW in Gutter-CFS--Q	=	1.728
% Flow in Gutter-CFS	=	19.41
Velocity of Flow in Gutter-fps	=	3.140
Depth at Curb Line-Inches--d	=	5.009

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.943
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	30.39
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.198	1.759	2.930	4.689	4.211	52.680
6.500	0.352	3.129	2.586	5.715	3.185	64.220
10.500	0.534	4.750	2.128	6.879	2.021	77.290
17.500	0.786	6.999	1.320	8.319	0.581	93.470

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 138+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	4.440

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	2.930	1.516	4.929	14.835
6.500	3.399	1.048	4.160	11.631
10.500	3.756	0.694	3.484	8.814
17.500	4.068	0.391	2.759	5.796
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 138+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	8.290

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	4.682	3.626	7.658	26.208
6.500	6.001	2.326	6.077	19.619
10.500	6.669	1.634	5.108	15.582
17.500	7.308	1.002	4.078	11.290
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 248+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	7.730

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	4.481	3.268	7.246	24.491
6.500	5.629	2.136	5.823	18.559
10.500	6.250	1.492	4.892	14.682
17.500	6.843	0.907	3.903	10.561
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 248+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	12.030

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	5.827	6.246	10.341	37.387
6.500	8.454	3.607	7.637	26.118
10.500	9.464	2.615	6.451	21.177
17.500	10.387	1.665	5.155	15.777
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 257+75_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	5.220

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	3.385	1.851	5.426	16.905
6.500	3.930	1.297	4.583	13.393
10.500	4.355	0.876	3.845	10.319
17.500	4.735	0.503	3.053	7.021
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 257+75_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	8.120

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	4.622	3.516	7.533	25.688
6.500	5.888	2.268	6.000	19.300
10.500	6.542	1.591	5.043	15.311
17.500	7.167	0.973	4.025	11.071
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 264+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	4.040

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	2.698	1.347	4.664	13.732
6.500	3.124	0.922	3.932	10.683
10.500	3.446	0.604	3.289	8.003
17.500	3.721	0.337	2.600	5.133
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 264+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	6.280

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	3.904	2.394	6.167	19.993
6.500	4.659	1.651	5.133	15.685
10.500	5.160	1.131	4.305	12.237
17.500	5.631	0.668	3.427	8.579
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Road
HIGHWAY NAME - Pecos Road to Santan Freeway
LOCATION - NB Sta 270+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	5.150

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	3.343	1.820	5.381	16.722
6.500	3.882	1.274	4.546	13.238
10.500	4.301	0.859	3.813	10.187
17.500	4.676	0.493	3.028	6.914
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Road
HIGHWAY NAME - Pecos Road to Santan Freeway
LOCATION - NBSta 270+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	8.010

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	4.583	3.446	7.453	25.351
6.500	5.815	2.230	5.951	19.093
10.500	6.460	1.563	5.001	15.135
17.500	7.076	0.954	3.991	10.928
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 283+74_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	3.760

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	2.542	1.237	4.483	12.978
6.500	2.930	0.836	3.768	9.999
10.500	3.227	0.543	3.148	7.417
17.500	3.465	0.301	2.479	4.630
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

11-09-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 283+74_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	5.850

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	3.622	2.159	5.869	18.755
6.500	4.369	1.509	4.918	14.791
10.500	4.835	1.027	4.122	11.474
17.500	5.269	0.600	3.279	7.960
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

11-01-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 285+46_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.070
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.018
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.018
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.588
SPREAD-Ft.--T	=	5.90
Average Velocity-V-fps	=	1.76
FLOW in Gutter-CFS--Q	=	0.347
% Flow in Gutter-CFS	=	59.00
Velocity of Flow in Gutter-fps	=	2.240
Depth at Curb Line-Inches--d	=	1.667

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	2.413
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	8.04
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.642	0.378	0.210	0.588	0.000	100.000
6.500	0.949	0.558	0.030	0.588	0.000	100.000
10.500	1.000	0.588	0.000	0.588	0.000	100.000
17.500	1.000	0.588	0.000	0.588	0.000	100.000

11-01-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 285+46_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	1.070
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.018
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.018
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.915
SPREAD-Ft.--T	=	7.09
Average Velocity-V-fps	=	1.94
FLOW in Gutter-CFS--Q	=	0.464
% Flow in Gutter-CFS	=	50.72
Velocity of Flow in Gutter-fps	=	2.510
Depth at Curb Line-Inches--d	=	1.921

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	2.719
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	10.44
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.521	0.476	0.439	0.915	0.000	100.000
6.500	0.827	0.757	0.158	0.915	0.000	100.000
10.500	1.000	0.915	0.000	0.915	0.000	100.000
17.500	1.000	0.915	0.000	0.915	0.000	100.000

Pavement Drainage Analysis

11-01-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 285+88.5_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.870
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.028
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.028
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.610
SPREAD-Ft.--T	=	7.12
Average Velocity-V-fps	=	2.26
FLOW in Gutter-CFS--Q	=	0.757
% Flow in Gutter-CFS	=	47.01
Velocity of Flow in Gutter-fps	=	2.860
Depth at Curb Line-Inches--d	=	2.596

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	3.414
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.90
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.434	0.699	0.869	1.569	0.041	97.430
6.500	0.717	1.154	0.456	1.610	0.000	99.990
10.500	0.952	1.532	0.078	1.610	0.000	100.000
17.500	1.000	1.610	0.000	1.610	0.000	100.000

Pavement Drainage Analysis

11-01-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - NB Sta 285+88.5_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.870
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.028
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.028
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.505
SPREAD-Ft.--T	=	8.44
Average Velocity-V-fps	=	2.51
FLOW in Gutter-CFS--Q	=	1.017
% Flow in Gutter-CFS	=	40.61
Velocity of Flow in Gutter-fps	=	3.210
Depth at Curb Line-Inches--d	=	3.034

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	3.883
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.48
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.349	0.875	1.360	2.235	0.270	89.220
6.500	0.595	1.489	0.950	2.440	0.065	97.390
10.500	0.839	2.101	0.404	2.505	0.000	100.000
17.500	1.000	2.505	0.000	2.505	0.000	100.000

Pavement Drainage Analysis

11-10-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Freeway
LOCATION - NB Sta 496+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	3.740

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	2.530	1.228	4.469	12.921
6.500	2.916	0.830	3.756	9.949
10.500	3.211	0.538	3.138	7.374
17.500	3.447	0.298	2.471	4.595
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

11-10-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Freeway
LOCATION - NB Sta 496+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	6.490

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	3.993	2.515	6.324	20.648
6.500	4.799	1.720	5.236	16.114
10.500	5.319	1.183	4.393	12.603
17.500	5.808	0.701	3.499	8.876
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Road
HIGHWAY NAME - Pecos Road to Santan Freeway
LOCATION - NB Sta 497+70_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.170
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.170
SPREAD-Ft.--T	=	15.37
Average Velocity-V-fps	=	1.33
FLOW in Gutter-CFS--Q	=	0.770
% Flow in Gutter-CFS	=	24.29
Velocity of Flow in Gutter-fps	=	1.760
Depth at Curb Line-Inches--d	=	4.058

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.000
Depth at INLET Curb Line-Inches--d	=	4.97
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.83
Capture Ratio -- SLOTTED DRAIN	=	0.67
Capture Ratio -- GRATE	=	0.50

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
5.000	0.470	1.489	0.982	2.471	0.699	77.950
7.500	0.654	2.073	0.731	2.805	0.365	88.480
10.000	0.803	2.544	0.487	3.031	0.139	95.630
12.500	0.913	2.894	0.255	3.149	0.021	99.340
15.000	0.982	3.111	0.059	3.170	0.000	100.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Road
HIGHWAY NAME - Pecos Road to Santan Freeway
LOCATION - NB Sta 497+70_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.170
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.560
SPREAD-Ft.--T	=	19.03
Average Velocity-V-fps	=	1.53
FLOW in Gutter-CFS--Q	=	1.097
% Flow in Gutter-CFS	=	19.72
Velocity of Flow in Gutter-fps	=	2.030
Depth at Curb Line-Inches--d	=	4.935

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.000
Depth at INLET Curb Line-Inches--d	=	5.87
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	22.92
Capture Ratio -- SLOTTED DRAIN	=	0.67
Capture Ratio -- GRATE	=	0.50

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
5.000	0.358	1.990	1.618	3.607	1.953	64.880
7.500	0.510	2.836	1.356	4.191	1.369	75.390
10.000	0.644	3.579	1.097	4.676	0.884	84.100
12.500	0.758	4.215	0.843	5.058	0.502	90.970
15.000	0.852	4.739	0.595	5.334	0.226	95.930

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - NB Sta 502+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.200
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.750
SPREAD-Ft.--T	=	15.89
Average Velocity-V-fps	=	1.47
FLOW in Gutter-CFS--Q	=	0.882
% Flow in Gutter-CFS	=	23.52
Velocity of Flow in Gutter-fps	=	1.950
Depth at Curb Line-Inches--d	=	4.181

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.101
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.07
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.357	1.340	1.461	2.801	0.949	74.680
6.500	0.607	2.274	1.063	3.337	0.413	88.990
10.500	0.851	3.193	0.517	3.710	0.040	98.920
17.500	1.000	3.750	0.000	3.750	0.000	100.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - NB Sta 502+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.200
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.840
SPREAD-Ft.--T	=	18.80
Average Velocity-V-fps	=	1.64
FLOW in Gutter-CFS--Q	=	1.166
% Flow in Gutter-CFS	=	19.96
Velocity of Flow in Gutter-fps	=	2.180
Depth at Curb Line-Inches--d	=	4.879

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.812
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.49
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.286	1.671	2.051	3.722	2.118	63.740
6.500	0.497	2.901	1.654	4.555	1.285	78.000
10.500	0.725	4.237	1.123	5.360	0.480	91.770
17.500	0.969	5.657	0.183	5.840	0.000	100.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Freeway
LOCATION - NB Sta 513+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.210
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.100
SPREAD-Ft.--T	=	14.64
Average Velocity-V-fps	=	1.43
FLOW in Gutter-CFS--Q	=	0.789
% Flow in Gutter-CFS	=	25.46
Velocity of Flow in Gutter-fps	=	1.890
Depth at Curb Line-Inches--d	=	3.882

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	4.794
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.62
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.389	1.206	1.255	2.461	0.639	79.390
6.500	0.653	2.025	0.858	2.883	0.217	92.990
10.500	0.898	2.783	0.315	3.099	0.001	99.950
17.500	1.000	3.100	0.000	3.100	0.000	100.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Freeway
LOCATION - NB Sta 513+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.210
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.828
SPREAD-Ft.--T	=	17.33
Average Velocity-V-fps	=	1.60
FLOW in Gutter-CFS--Q	=	1.044
% Flow in Gutter-CFS	=	21.61
Velocity of Flow in Gutter-fps	=	2.120
Depth at Curb Line-Inches--d	=	4.527

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.453
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.69
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.311	1.504	1.788	3.292	1.536	68.180
6.500	0.537	2.591	1.396	3.987	0.841	82.590
10.500	0.774	3.735	0.868	4.603	0.225	95.340
17.500	0.993	4.794	0.034	4.828	0.000	100.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Freeway
LOCATION - NB Sta 516+56_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.200
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.197
SPREAD-Ft.--T	=	12.95
Average Velocity-V-fps	=	1.29
FLOW in Gutter-CFS--Q	=	0.629
% Flow in Gutter-CFS	=	28.63
Velocity of Flow in Gutter-fps	=	1.710
Depth at Curb Line-Inches--d	=	3.477

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	4.377
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	11.90
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.466	1.023	0.910	1.933	0.264	87.990
6.500	0.759	1.667	0.500	2.167	0.030	98.650
10.500	0.979	2.150	0.047	2.197	0.000	100.000
17.500	1.000	2.197	0.000	2.197	0.000	100.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Freeway
LOCATION - NB Sta 516+56_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.200
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.952
SPREAD-Ft.--T	=	16.21
Average Velocity-V-fps	=	1.49
FLOW in Gutter-CFS--Q	=	0.912
% Flow in Gutter-CFS	=	23.07
Velocity of Flow in Gutter-fps	=	1.980
Depth at Curb Line-Inches--d	=	4.258

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.179
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.55
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.348	1.375	1.524	2.899	1.053	73.350
6.500	0.593	2.342	1.126	3.468	0.484	87.750
10.500	0.837	3.306	0.582	3.889	0.063	98.400
17.500	1.000	3.952	0.000	3.952	0.000	100.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - NB Sta 523+87_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

GRATE INLET--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

GRATE INLET--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Local Gutter Depression-Inches	=	1.000
Depth at INLET Curb Line-Inches--d	=	3.868
Depth at C.G. of Grate Flow--In.	=	3.872
SPREAD-Ft.--T	=	14.581
Depth for WEIR FLOW, inches	=	4.868
Depth for ORIFICE FLOW, inches	=	0.054

Q(INLET) =1.476 cfs is Based on WEIR flow

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - NB Sta 523+87_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

GRATE INLET--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

GRATE INLET--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Local Gutter Depression-Inches	=	1.000
Depth at INLET Curb Line-Inches--d	=	5.037
Depth at C.G. of Grate Flow--In.	=	5.016
SPREAD-Ft.--T	=	19.453
Depth for WEIR FLOW, inches	=	6.037
Depth for ORIFICE FLOW, inches	=	0.130

Q(INLET) =2.296 cfs is Based on WEIR flow

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - NB Sta 525+60_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.190
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.855
SPREAD-Ft.--T	=	16.21
Average Velocity-V-fps	=	1.45
FLOW in Gutter-CFS--Q	=	0.889
% Flow in Gutter-CFS	=	23.06
Velocity of Flow in Gutter-fps	=	1.930
Depth at Curb Line-Inches--d	=	4.259

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.180
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	16.13
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.356	1.373	1.485	2.858	0.997	74.150
6.500	0.605	2.332	1.083	3.414	0.441	88.570
10.500	0.850	3.276	0.537	3.812	0.043	98.900
17.500	1.000	3.855	0.000	3.855	0.000	100.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - NB Sta 525+60_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.190
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.571
SPREAD-Ft.--T	=	19.85
Average Velocity-V-fps	=	1.66
FLOW in Gutter-CFS--Q	=	1.243
% Flow in Gutter-CFS	=	18.92
Velocity of Flow in Gutter-fps	=	2.200
Depth at Curb Line-Inches--d	=	5.132

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	6.068
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	21.57
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.273	1.793	2.227	4.020	2.551	61.170
6.500	0.475	3.124	1.823	4.948	1.623	75.290
10.500	0.699	4.593	1.285	5.878	0.693	89.450
17.500	0.950	6.244	0.325	6.569	0.002	99.970

11-10-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - NB Sta 526+25_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.190
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.451
SPREAD-Ft.--T	=	15.54
Average Velocity-V-fps	=	1.42
FLOW in Gutter-CFS--Q	=	0.829
% Flow in Gutter-CFS	=	24.02
Velocity of Flow in Gutter-fps	=	1.870
Depth at Curb Line-Inches--d	=	4.099

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.016
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	15.17
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.376	1.299	1.356	2.655	0.796	76.950
6.500	0.635	2.191	0.953	3.143	0.308	91.090
10.500	0.880	3.037	0.403	3.440	0.011	99.700
17.500	1.000	3.451	0.000	3.451	0.000	100.000

Pavement Drainage Analysis

11-10-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - NB Sta 526+25_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.190
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.943
SPREAD-Ft.--T	=	19.11
Average Velocity-V-fps	=	1.62
FLOW in Gutter-CFS--Q	=	1.167
% Flow in Gutter-CFS	=	19.64
Velocity of Flow in Gutter-fps	=	2.150
Depth at Curb Line-Inches--d	=	4.954

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.887
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.44
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.287	1.705	2.070	3.775	2.168	63.520
6.500	0.498	2.959	1.667	4.626	1.317	77.840
10.500	0.727	4.320	1.129	5.449	0.494	91.690
17.500	0.970	5.762	0.181	5.943	0.000	100.000

Pavement Drainage Analysis

11-10-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - NB Sta 530+60_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.190
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.357
SPREAD-Ft.--T	=	15.38
Average Velocity-V-fps	=	1.41
FLOW in Gutter-CFS--Q	=	0.815
% Flow in Gutter-CFS	=	24.27
Velocity of Flow in Gutter-fps	=	1.860
Depth at Curb Line-Inches--d	=	4.060

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	4.976
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.93
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.382	1.281	1.325	2.607	0.750	77.650
6.500	0.642	2.157	0.921	3.078	0.279	91.690
10.500	0.888	2.980	0.371	3.351	0.006	99.820
17.500	1.000	3.357	0.000	3.357	0.000	100.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - NB Sta 530+60_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.190
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.222
SPREAD-Ft.--T	=	18.19
Average Velocity-V-fps	=	1.57
FLOW in Gutter-CFS--Q	=	1.076
% Flow in Gutter-CFS	=	20.61
Velocity of Flow in Gutter-fps	=	2.080
Depth at Curb Line-Inches--d	=	4.734

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.664
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	19.05
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.306	1.598	1.880	3.479	1.743	66.610
6.500	0.528	2.758	1.478	4.237	0.985	81.130
10.500	0.764	3.987	0.940	4.927	0.295	94.340
17.500	0.989	5.165	0.057	5.222	0.000	100.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 112+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	6.550

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	4.018	2.550	6.369	20.835
6.500	4.840	1.740	5.265	16.236
10.500	5.364	1.198	4.418	12.706
17.500	5.858	0.711	3.519	8.960
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 112+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	10.190

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	5.304	4.918	9.043	31.977
6.500	7.260	2.977	6.899	23.046
10.500	8.106	2.132	5.818	18.538
17.500	8.877	1.334	4.642	13.642
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 120+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	9.330

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	5.038	4.329	8.429	29.421
6.500	6.691	2.681	6.534	21.525
10.500	7.468	1.909	5.508	17.249
17.500	8.169	1.182	4.392	12.598
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 120+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	14.510

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	6.433	8.093	12.000	44.299
6.500	9.758	4.804	8.926	31.490
10.500	11.286	3.275	7.254	24.523
17.500	12.411	2.122	5.804	18.483
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 135+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.400
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.920
SPREAD-Ft.--T	=	16.57
Average Velocity-V-fps	=	2.14
FLOW in Gutter-CFS--Q	=	1.337
% Flow in Gutter-CFS	=	22.58
Velocity of Flow in Gutter-fps	=	2.840
Depth at Curb Line-Inches--d	=	4.344

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.267
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	24.33
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.244	1.444	2.226	3.670	2.250	62.000
6.500	0.429	2.537	1.884	4.421	1.499	74.670
10.500	0.638	3.779	1.423	5.202	0.718	87.870
17.500	0.898	5.319	0.577	5.897	0.023	99.600

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 135+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.400
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	9.200
SPREAD-Ft.--T	=	19.58
Average Velocity-V-fps	=	2.39
FLOW in Gutter-CFS--Q	=	1.764
% Flow in Gutter-CFS	=	19.17
Velocity of Flow in Gutter-fps	=	3.170
Depth at Curb Line-Inches--d	=	5.067

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	6.003
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	30.94
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.194	1.788	2.994	4.782	4.418	51.980
6.500	0.346	3.182	2.651	5.833	3.367	63.400
10.500	0.526	4.838	2.193	7.031	2.169	76.420
17.500	0.777	7.149	1.385	8.534	0.666	92.760

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 138+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	6.190

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	3.865	2.342	6.099	19.712
6.500	4.598	1.621	5.088	15.500
10.500	5.092	1.109	4.267	12.079
17.500	5.556	0.653	3.397	8.451
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 138+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	10.560

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	5.413	5.177	9.304	33.065
6.500	7.504	3.105	7.053	23.687
10.500	8.379	2.228	5.948	19.081
17.500	9.182	1.400	4.748	14.081
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 349+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	5.270

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	3.416	1.874	5.459	17.043
6.500	3.964	1.313	4.609	13.502
10.500	4.393	0.888	3.867	10.412
17.500	4.778	0.511	3.072	7.097
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 349+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	8.190

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	4.647	3.561	7.585	25.902
6.500	5.935	2.292	6.032	19.432
10.500	6.594	1.609	5.070	15.423
17.500	7.226	0.985	4.047	11.161
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 357+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	3.410

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	2.335	1.092	4.237	11.951
6.500	2.686	0.729	3.556	9.115
10.500	2.951	0.468	2.966	6.659
17.500	3.155	0.261	2.329	4.004
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 357+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	5.300

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	3.435	1.888	5.479	17.128
6.500	3.984	1.323	4.625	13.568
10.500	4.416	0.895	3.881	10.468
17.500	4.803	0.515	3.083	7.143
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 362+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	2.290

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	1.654	0.639	3.366	8.322
6.500	1.887	0.409	2.809	6.005
10.500	2.035	0.258	2.316	3.947
17.500	2.126	0.172	1.790	1.758
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 362+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	5.50
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	3.560

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	2.424	1.154	4.343	12.396
6.500	2.791	0.775	3.648	9.498
10.500	3.070	0.500	3.045	6.987
17.500	3.289	0.278	2.395	4.276
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 376+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.400
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.178
SPREAD-Ft.--T	=	14.51
Average Velocity-V-fps	=	1.96
FLOW in Gutter-CFS--Q	=	1.073
% Flow in Gutter-CFS	=	25.68
Velocity of Flow in Gutter-fps	=	2.600
Depth at Curb Line-Inches--d	=	3.850

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	4.761
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	20.04
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.292	1.221	1.736	2.957	1.221	70.780
6.500	0.506	2.116	1.390	3.505	0.673	83.900
10.500	0.737	3.080	0.916	3.996	0.182	95.640
17.500	0.976	4.077	0.101	4.178	0.000	100.000

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 376+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.400
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	6.498
SPREAD-Ft.--T	=	17.16
Average Velocity-V-fps	=	2.19
FLOW in Gutter-CFS--Q	=	1.418
% Flow in Gutter-CFS	=	21.81
Velocity of Flow in Gutter-fps	=	2.900
Depth at Curb Line-Inches--d	=	4.487

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.413
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	25.61
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.232	1.511	2.373	3.884	2.614	59.770
6.500	0.410	2.662	2.031	4.693	1.805	72.220
10.500	0.613	3.985	1.572	5.557	0.941	85.510
17.500	0.874	5.678	0.741	6.419	0.079	98.780

Pavement Drainage Analysis

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 379+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	5.016

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	3.265	1.762	5.297	16.368
6.500	3.791	1.231	4.474	12.942
10.500	4.199	0.828	3.752	9.934
17.500	4.562	0.473	2.978	6.708
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 379+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	7.802

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	4.507	3.314	7.299	24.712
6.500	5.677	2.160	5.856	18.697
10.500	6.304	1.510	4.920	14.799
17.500	6.903	0.919	3.926	10.656
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

11-10-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 389+26.9_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	4.940

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	3.220	1.728	5.248	16.166
6.500	3.740	1.207	4.434	12.772
10.500	4.141	0.810	3.718	9.789
17.500	4.497	0.462	2.950	6.590
0.000	0.000	0.000	0.000	0.000

10-29-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 389+26.9_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	8.860

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	4.885	4.015	8.090	28.008
6.500	6.380	2.520	6.330	20.673
10.500	7.093	1.780	5.323	16.476
17.500	7.780	1.100	4.252	12.014
0.000	0.000	0.000	0.000	0.000

10-31-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 501+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	3.350

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	2.300	1.067	4.193	11.771
6.500	2.644	0.711	3.519	8.960
10.500	2.904	0.456	2.935	6.526
17.500	3.101	0.255	2.303	3.894
0.000	0.000	0.000	0.000	0.000

10-31-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 501+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--IN SUMP

GUTTER DESCRIPTION

Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.708

CURB OPENING W/ GRATE--IN SUMP

GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Effective Perimeter--Ft.	=	6.670
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80
Local Gutter Depression-Inches	=	1.000
Flow-CFS--Q	=	5.200

LENGTH	Q(Curb Op)	Q(Grate)	d(inches)	SPREAD, Ft.
3.500	3.373	1.842	5.413	16.853
6.500	3.916	1.291	4.572	13.349
10.500	4.340	0.871	3.836	10.281
17.500	4.718	0.500	3.046	6.991
0.000	0.000	0.000	0.000	0.000

Pavement Drainage Analysis

10-31-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 497+57_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.220
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.130
SPREAD-Ft.--T	=	9.84
Average Velocity-V-fps	=	1.14
FLOW in Gutter-CFS--Q	=	0.419
% Flow in Gutter-CFS	=	37.08
Velocity of Flow in Gutter-fps	=	1.490
Depth at Curb Line-Inches--d	=	2.730

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.000
Depth at INLET Curb Line-Inches--d	=	3.60
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	9.88
Capture Ratio -- SLOTTED DRAIN	=	0.67
Capture Ratio -- GRATE	=	0.50

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
5.000	0.719	0.812	0.290	1.102	0.028	97.530
7.500	0.923	1.043	0.087	1.130	0.000	100.000
10.000	1.000	1.130	0.000	1.130	0.000	100.000
12.500	1.000	1.130	0.000	1.130	0.000	100.000
15.000	1.000	1.130	0.000	1.130	0.000	100.000

Pavement Drainage Analysis

11-10-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 497+57_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.180
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.150
SPREAD-Ft.--T	=	15.17
Average Velocity-V-fps	=	1.36
FLOW in Gutter-CFS--Q	=	0.775
% Flow in Gutter-CFS	=	24.60
Velocity of Flow in Gutter-fps	=	1.800
Depth at Curb Line-Inches--d	=	4.009

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.000
Depth at INLET Curb Line-Inches--d	=	4.92
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.00
Capture Ratio -- SLOTTED DRAIN	=	0.67
Capture Ratio -- GRATE	=	0.50

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
5.000	0.466	1.467	0.982	2.450	0.700	77.770
7.500	0.649	2.045	0.735	2.780	0.370	88.260
10.000	0.798	2.513	0.495	3.007	0.143	95.460
12.500	0.909	2.862	0.265	3.127	0.023	99.270
15.000	0.979	3.083	0.067	3.150	0.000	100.000

Pavement Drainage Analysis

10-31-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 497+57_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.220
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.150
SPREAD-Ft.--T	=	14.60
Average Velocity-V-fps	=	1.46
FLOW in Gutter-CFS--Q	=	0.804
% Flow in Gutter-CFS	=	25.53
Velocity of Flow in Gutter-fps	=	1.940
Depth at Curb Line-Inches--d	=	3.872

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.000
Depth at INLET Curb Line-Inches--d	=	4.78
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.80
Capture Ratio -- SLOTTED DRAIN	=	0.67
Capture Ratio -- GRATE	=	0.50

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
5.000	0.448	1.410	1.006	2.416	0.734	76.710
7.500	0.626	1.973	0.771	2.744	0.406	87.120
10.000	0.774	2.437	0.541	2.977	0.173	94.520
12.500	0.887	2.794	0.318	3.112	0.038	98.800
15.000	0.964	3.037	0.113	3.150	0.000	100.000

Pavement Drainage Analysis

10-31-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 497+57_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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SLOTTED DRAIN W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.220
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.270
SPREAD-Ft.--T	=	12.88
Average Velocity-V-fps	=	1.35
FLOW in Gutter-CFS--Q	=	0.654
% Flow in Gutter-CFS	=	28.79
Velocity of Flow in Gutter-fps	=	1.780
Depth at Curb Line-Inches--d	=	3.460

SLOTTED DRAIN--ADOT STD.--C13.60
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.000
Depth at INLET Curb Line-Inches--d	=	4.36
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.79
Capture Ratio -- SLOTTED DRAIN	=	0.67
Capture Ratio -- GRATE	=	0.50

LENGTH	Efficiency	Q(S.D.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
5.000	0.524	1.190	0.727	1.916	0.354	84.420
7.500	0.720	1.635	0.497	2.131	0.139	93.890
10.000	0.869	1.972	0.275	2.247	0.023	98.970
12.500	0.965	2.191	0.079	2.270	0.000	100.000
15.000	1.000	2.270	0.000	2.270	0.000	100.000

Pavement Drainage Analysis

11-10-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 501+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.260
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.121
SPREAD-Ft.--T	=	12.15
Average Velocity-V-fps	=	1.42
FLOW in Gutter-CFS--Q	=	0.645
% Flow in Gutter-CFS	=	30.43
Velocity of Flow in Gutter-fps	=	1.860
Depth at Curb Line-Inches--d	=	3.285

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	4.178
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	12.37
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.450	0.955	0.921	1.876	0.245	88.460
6.500	0.739	1.567	0.526	2.093	0.028	98.680
10.500	0.967	2.050	0.071	2.121	0.000	100.000
17.500	1.000	2.121	0.000	2.121	0.000	100.000

Pavement Drainage Analysis

11-10-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 501+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.260
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.871
SPREAD-Ft.--T	=	15.30
Average Velocity-V-fps	=	1.64
FLOW in Gutter-CFS--Q	=	0.944
% Flow in Gutter-CFS	=	24.40
Velocity of Flow in Gutter-fps	=	2.170
Depth at Curb Line-Inches--d	=	4.040

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	4.956
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.39
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.333	1.288	1.546	2.834	1.037	73.210
6.500	0.569	2.204	1.170	3.375	0.496	87.180
10.500	0.811	3.140	0.651	3.792	0.079	97.950
17.500	1.000	3.871	0.000	3.871	0.000	100.000

11-10-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 504+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.150
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.548
SPREAD-Ft.--T	=	16.43
Average Velocity-V-fps	=	1.30
FLOW in Gutter-CFS--Q	=	0.808
% Flow in Gutter-CFS	=	22.76
Velocity of Flow in Gutter-fps	=	1.730
Depth at Curb Line-Inches--d	=	4.312

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.234
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.58
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.390	1.384	1.352	2.736	0.812	77.110
6.500	0.655	2.322	0.925	3.247	0.301	91.510
10.500	0.899	3.190	0.351	3.541	0.007	99.810
17.500	1.000	3.548	0.000	3.548	0.000	100.000

Pavement Drainage Analysis

11-10-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - SB Sta 504+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.150
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.518
SPREAD-Ft.--T	=	19.43
Average Velocity-V-fps	=	1.45
FLOW in Gutter-CFS--Q	=	1.066
% Flow in Gutter-CFS	=	19.32
Velocity of Flow in Gutter-fps	=	1.930
Depth at Curb Line-Inches--d	=	5.031

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	5.965
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.55
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	Capture
3.500	0.314	1.731	1.929	3.659	1.859	66.310
6.500	0.540	2.980	1.498	4.478	1.040	81.150
10.500	0.777	4.290	0.926	5.216	0.302	94.520
17.500	0.994	5.487	0.031	5.518	0.000	100.000

Pavement Drainage Analysis

12-07-2011

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - RAY Sta 726+98 North_10
VBVer 1.4: Aug 2011

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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SLOTTED DRAIN INLET--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.740
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.006
Shoulder Width-Ft.--	=	5.00
Shoulder Slope-Ft./Ft.--Ss	=	0.006
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.560
SPREAD-Ft.--T	=	11.68
Average Velocity-V-fps	=	1.19
FLOW in Gutter-CFS--Q	=	0.230
% Flow in Gutter-CFS	=	41.05
Velocity of Flow in Gutter-fps	=	1.700
Depth at Curb Line-Inches--d	=	1.497

SLOTTED DRAIN--ADOT STD.--C13.60

Flow-CFS--Q	=	0.56
Gutter Velocity at INLET-fps	=	1.700
Gutter Flow at Inlet-CFS--Q	=	0.230
Depth at INLET Curb Line-Inches--d	=	1.500
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	16.44
Capture Ratio -- SLOTTED DRAIN	=	0.80

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
15.000	0.988	0.553	0.007
17.500	1.000	0.560	0.000
20.000	1.000	0.560	0.000
22.500	1.000	0.560	0.000
25.000	1.000	0.560	0.000

Pavement Drainage Analysis

12-07-2011

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - RAY Sta 727+00 North_100
VBVer 1.4: Aug 2011

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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SLOTTED DRAIN INLET--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.740
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.006
Shoulder Width-Ft.--	=	5.00
Shoulder Slope-Ft./Ft.--Ss	=	0.006
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.980
SPREAD-Ft.--T	=	14.77
Average Velocity-V-fps	=	1.34
FLOW in Gutter-CFS--Q	=	0.313
% Flow in Gutter-CFS	=	31.96
Velocity of Flow in Gutter-fps	=	1.920
Depth at Curb Line-Inches--d	=	1.734

SLOTTED DRAIN--ADOT STD.--C13.60

Flow-CFS--Q	=	0.98
Gutter Velocity at INLET-fps	=	1.920
Gutter Flow at Inlet-CFS--Q	=	0.313
Depth at INLET Curb Line-Inches--d	=	1.730
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	22.98
Capture Ratio -- SLOTTED DRAIN	=	0.80

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
15.000	0.851	0.834	0.146
17.500	0.924	0.906	0.074
20.000	0.975	0.955	0.025
22.500	0.999	0.979	0.001
25.000	1.000	0.980	0.000

Pavement Drainage Analysis

12-07-2011

PROJECT NAME - Power Rd
PROJECT NO. - MESA: 07-066-001
HIGHWAY NAME - Pecos Rd to Santan Fwy
DESIGNER - G. Lopez-Cepero
LOCATION - RAY Sta 727+80 North_10_Slotted Drain
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VBVer 1.4: Aug 2011

SLOTTED DRAIN INLET--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.740
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.013
Shoulder Width-Ft.--	=	5.00
Shoulder Slope-Ft./Ft.--Ss	=	0.013
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.000
SPREAD-Ft.--T	=	9.60
Average Velocity-V-fps	=	1.59
FLOW in Gutter-CFS--Q	=	0.412
% Flow in Gutter-CFS	=	41.22
Velocity of Flow in Gutter-fps	=	2.140
Depth at Curb Line-Inches--d	=	1.985

SLOTTED DRAIN--ADOT STD.--C13.60

Flow-CFS--Q	=	1.00
Gutter Velocity at INLET-fps	=	2.140
Gutter Flow at Inlet-CFS--Q	=	0.412
Depth at INLET Curb Line-Inches--d	=	1.980
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	18.90
Capture Ratio -- SLOTTED DRAIN	=	0.80

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
15.000	0.942	0.942	0.058
17.500	0.991	0.991	0.009
20.000	1.000	1.000	0.000
22.500	1.000	1.000	0.000
25.000	1.000	1.000	0.000

Pavement Drainage Analysis

12-07-2011

PROJECT NAME - Power Rd
PROJECT NO. - MESA: 07-066-001
HIGHWAY NAME - Pecos Rd to Santan Fwy
DESIGNER - G. Lopez-Cepero
LOCATION - RAY Sta 727+80 North_100_Slotted Drain
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VBVer 1.4: Aug 2011

SLOTTED DRAIN INLET--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.740
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.013
Shoulder Width-Ft.--	=	5.00
Shoulder Slope-Ft./Ft.--Ss	=	0.013
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.780
SPREAD-Ft.--T	=	12.09
Average Velocity-V-fps	=	1.82
FLOW in Gutter-CFS--Q	=	0.587
% Flow in Gutter-CFS	=	32.96
Velocity of Flow in Gutter-fps	=	2.460
Depth at Curb Line-Inches--d	=	2.373

SLOTTED DRAIN--ADOT STD.--C13.60

Flow-CFS--Q	=	1.78
Gutter Velocity at INLET-fps	=	2.460
Gutter Flow at Inlet-CFS--Q	=	0.587
Depth at INLET Curb Line-Inches--d	=	2.370
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	25.57
Capture Ratio -- SLOTTED DRAIN	=	0.80

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
15.000	0.796	1.417	0.363
17.500	0.875	1.557	0.223
20.000	0.936	1.665	0.115
22.500	0.978	1.741	0.039
25.000	0.999	1.778	0.002

Pavement Drainage Analysis

12-07-2011

PROJECT NAME - Power Rd
PROJECT NO. - MESA: 07-066-001
HIGHWAY NAME - Pecos Rd to Santan Fwy
DESIGNER - G. Lopez-Cepero
LOCATION - RAY Sta 729+20 North_10_Slotted Drain
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SLOTTED DRAIN INLET--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.360
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.012
Shoulder Width-Ft.--	=	5.00
Shoulder Slope-Ft./Ft.--Ss	=	0.012
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.620
SPREAD-Ft.--T	=	14.25
Average Velocity-V-fps	=	1.32
FLOW in Gutter-CFS--Q	=	0.462
% Flow in Gutter-CFS	=	28.49
Velocity of Flow in Gutter-fps	=	1.800
Depth at Curb Line-Inches--d	=	2.525

SLOTTED DRAIN--ADOT STD.--C13.60

Flow-CFS--Q	=	1.62
Gutter Velocity at INLET-fps	=	1.800
Gutter Flow at Inlet-CFS--Q	=	0.461
Depth at INLET Curb Line-Inches--d	=	2.520
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	21.03
Capture Ratio -- SLOTTED DRAIN	=	0.80

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
15.000	0.894	1.449	0.171
17.500	0.960	1.555	0.065
20.000	0.996	1.613	0.007
22.500	1.000	1.620	0.000
25.000	1.000	1.620	0.000

Pavement Drainage Analysis

12-07-2011

PROJECT NAME - Power Rd
PROJECT NO. - MESA: 07-066-001
HIGHWAY NAME - Pecos Rd to Santan Fwy
DESIGNER - G. Lopez-Cepero
LOCATION - RAY Sta 729+20 North_100_Slotted Drain
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VBVer 1.4: Aug 2011

SLOTTED DRAIN INLET--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.360
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.012
Shoulder Width-Ft.--	=	5.00
Shoulder Slope-Ft./Ft.--Ss	=	0.012
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.650
SPREAD-Ft.--T	=	17.25
Average Velocity-V-fps	=	1.48
FLOW in Gutter-CFS--Q	=	0.621
% Flow in Gutter-CFS	=	23.43
Velocity of Flow in Gutter-fps	=	2.030
Depth at Curb Line-Inches--d	=	2.950

SLOTTED DRAIN--ADOT STD.--C13.60

Flow-CFS--Q	=	2.65
Gutter Velocity at INLET-fps	=	2.020
Gutter Flow at Inlet-CFS--Q	=	0.621
Depth at INLET Curb Line-Inches--d	=	2.950
Local Gutter Depression-Inches	=	0.000
Length of opening: TOTAL Intercept--Ft.	=	27.09
Capture Ratio -- SLOTTED DRAIN	=	0.80

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
15.000	0.766	2.030	0.620
17.500	0.846	2.241	0.409
20.000	0.910	2.413	0.237
22.500	0.959	2.541	0.109
25.000	0.990	2.624	0.026

Pavement Drainage Analysis

12-07-2011

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - RAY Sta 730+00 North_10
VBVer 1.4: Aug 2011

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.360
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.018
Shoulder Width-Ft.--	=	5.00
Shoulder Slope-Ft./Ft.--Ss	=	0.018
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.220
SPREAD-Ft.--T	=	9.83
Average Velocity-V-fps	=	1.37
FLOW in Gutter-CFS--Q	=	0.461
% Flow in Gutter-CFS	=	37.81
Velocity of Flow in Gutter-fps	=	1.800
Depth at Curb Line-Inches--d	=	2.525

Pavement Drainage Analysis

12-07-2011

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - RAY Sta 730+00 North_100
VBVer 1.4: Aug 2011

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.360
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.018
Shoulder Width-Ft.--	=	5.00
Shoulder Slope-Ft./Ft.--Ss	=	0.018
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.900
SPREAD-Ft.--T	=	11.67
Average Velocity-V-fps	=	1.52
FLOW in Gutter-CFS--Q	=	0.611
% Flow in Gutter-CFS	=	32.13
Velocity of Flow in Gutter-fps	=	2.010
Depth at Curb Line-Inches--d	=	2.924

Pavement Drainage Analysis

12-07-2011

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - RAY Sta 731+00 North_10
VBVer 1.4: Aug 2011

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.310
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.016
Shoulder Width-Ft.--	=	5.00
Shoulder Slope-Ft./Ft.--Ss	=	0.016
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	0.730
SPREAD-Ft.--T	=	8.87
Average Velocity-V-fps	=	1.11
FLOW in Gutter-CFS--Q	=	0.310
% Flow in Gutter-CFS	=	42.48
Velocity of Flow in Gutter-fps	=	1.470
Depth at Curb Line-Inches--d	=	2.140

Pavement Drainage Analysis

12-07-2011

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to Santan Fwy
LOCATION - RAY Sta 731+00 North_100
VBVer 1.4: Aug 2011

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
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GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.310
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.016
Shoulder Width-Ft.--	=	5.00
Shoulder Slope-Ft./Ft.--Ss	=	0.016
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	1.130
SPREAD-Ft.--T	=	10.55
Average Velocity-V-fps	=	1.23
FLOW in Gutter-CFS--Q	=	0.408
% Flow in Gutter-CFS	=	36.11
Velocity of Flow in Gutter-fps	=	1.640
Depth at Curb Line-Inches--d	=	2.463

Pavement Drainage Analysis

12-05-2011

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - Ray Rd Sta 732+50N_10
VBVer 1.4: Aug 2011

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.660
SPREAD-Ft.--T	=	13.07
Average Velocity-V-fps	=	1.54
FLOW in Gutter-CFS--Q	=	0.755
% Flow in Gutter-CFS	=	28.40
Velocity of Flow in Gutter-fps	=	2.030
Depth at Curb Line-Inches--d	=	3.505

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	4.406
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.31
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% Capture
3.50	0.396	1.054	1.148	2.202	0.458	82.77
6.50	0.664	1.765	0.768	2.533	0.127	95.23
10.50	0.908	2.414	0.246	2.660	0.000	99.99
17.50	1.000	2.660	0.000	2.660	0.000	100.00

Pavement Drainage Analysis

12-05-2011

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - Ray Rd Sta 732+50N_100
VBVer 1.4: Aug 2011

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING W/ GRATE--ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.280
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	2.00
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	1.00
Manning's 'N	=	0.016
Flow-CFS--Q	=	4.130
SPREAD-Ft.--T	=	15.46
Average Velocity-V-fps	=	1.71
FLOW in Gutter-CFS--Q	=	0.997
% Flow in Gutter-CFS	=	24.15
Velocity of Flow in Gutter-fps	=	2.270
Depth at Curb Line-Inches--d	=	4.079

CURB OPENING--MAG STD. 533-1
GRATE TYPE: MAG 533-3

Grate Length--Ft.	=	3.000
Grate Width---Ft.	=	1.830
Grate Area--Sq. Ft.	=	3.660
Splash-Over Velocity--FPS	=	7.00
Depth at INLET Curb Line-Inches--d	=	4.996
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	18.34
Capture Ratio -- GRATE	=	0.50
Capture Ratio -- CURB OPENING	=	0.80

CURB OPENING:

LENGTH	Efficiency	Q(C.O.)	Q(GRATE)	Q(INT.)	Q(By-Pass)	% Capture
3.50	0.317	1.309	1.639	2.948	1.182	71.38
6.50	0.545	2.252	1.270	3.522	0.608	85.28
10.50	0.784	3.236	0.768	4.003	0.127	96.94
17.50	0.996	4.114	0.015	4.130	0.000	99.99

Pavement Drainage Analysis

11-02-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - Ray Rd Sta 727+00_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING INLET -- ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.320
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	2.599
SPREAD-Ft.--T	=	12.63
Average Velocity-V-fps	=	1.61
FLOW in Gutter-CFS--Q	=	0.763
% Flow in Gutter-CFS	=	29.34
Velocity of Flow in Gutter-fps	=	2.120
Depth at Curb Line-Inches--d	=	3.399

Curb Opening MAG STD. 53x

Flow-CFS--Q	=	2.599
Gutter Velocity at INLET-fps	=	6.180
Gutter Flow at Inlet-CFS--Q	=	0.944
Depth at INLET Curb Line-Inches--d	=	0.358
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	14.556
Capture Ratio -- CURB OPENING	=	0.80

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.500	0.390	1.015	1.584
5.500	0.574	1.493	1.106
8.000	0.762	1.981	0.618

Pavement Drainage Analysis

11-02-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - Ray Rd Sta 727+00_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING INLET -- ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.320
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	3.740
SPREAD-Ft.--T	=	14.51
Average Velocity-V-fps	=	1.76
FLOW in Gutter-CFS--Q	=	0.960
% Flow in Gutter-CFS	=	25.67
Velocity of Flow in Gutter-fps	=	2.330
Depth at Curb Line-Inches--d	=	3.851

Curb Opening MAG STD. 53x

Flow-CFS--Q	=	3.740
Gutter Velocity at INLET-fps	=	6.450
Gutter Flow at Inlet-CFS--Q	=	1.164
Depth at INLET Curb Line-Inches--d	=	0.397
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	17.889
Capture Ratio -- CURB OPENING	=	0.80

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.500	0.324	1.213	2.527
5.500	0.484	1.809	1.931
8.000	0.656	2.453	1.287

Pavement Drainage Analysis

11-02-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - Ray Rd Sta 729+50_10
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING INLET -- ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.360
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	5.159
SPREAD-Ft.--T	=	16.04
Average Velocity-V-fps	=	1.99
FLOW in Gutter-CFS--Q	=	1.202
% Flow in Gutter-CFS	=	23.30
Velocity of Flow in Gutter-fps	=	2.630
Depth at Curb Line-Inches--d	=	4.218

Curb Opening MAG STD. 53x

Flow-CFS--Q	=	5.159
Gutter Velocity at INLET-fps	=	7.090
Gutter Flow at Inlet-CFS--Q	=	1.436
Depth at INLET Curb Line-Inches--d	=	0.428
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	21.996
Capture Ratio -- CURB OPENING	=	0.80

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.500	0.268	1.383	3.776
5.500	0.404	2.086	3.073
8.000	0.557	2.873	2.286

Pavement Drainage Analysis

11-02-2010

PROJECT NAME - Power Rd
HIGHWAY NAME - Pecos Rd to San Tan FWY
LOCATION - Ray Rd Sta 729+50_100
VBVer 1.2: July 2010

PROJECT NO. - MESA: 07-066-001
DESIGNER - G. Lopez-Cepero
CHECKER - _____PAGE_____

CURB OPENING INLET -- ON GRADE

GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.360
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.020
Shoulder Width-Ft.--	=	6.00
Shoulder Slope-Ft./Ft.--Ss	=	0.020
Gutter Width-Ft.--W	=	1.42
Gutter Slope-Ft./Ft.--Sw	=	0.042
Gutter Depression-Inches--	=	0.71
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.024
SPREAD-Ft.--T	=	18.97
Average Velocity-V-fps	=	2.22
FLOW in Gutter-CFS--Q	=	1.587
% Flow in Gutter-CFS	=	19.78
Velocity of Flow in Gutter-fps	=	2.940
Depth at Curb Line-Inches--d	=	4.920

Curb Opening MAG STD. 53x

Flow-CFS--Q	=	8.024
Gutter Velocity at INLET-fps	=	7.580
Gutter Flow at Inlet-CFS--Q	=	1.854
Depth at INLET Curb Line-Inches--d	=	0.488
Local Gutter Depression-Inches	=	1.000
Length of opening: TOTAL Intercept--Ft.	=	28.017
Capture Ratio -- CURB OPENING	=	0.80

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.500	0.214	1.713	6.311
5.500	0.325	2.610	5.414
8.000	0.454	3.643	4.381

Power Road
Pecos Road to 202L
Final Drainage Report

Appendix L

BaySaver Data

Jacobs

BaySaver Design

Project:	**Power Road**	By:	**JPF**
Subject:	**BaySaver No. 1**	Date:	**4/12/2011**
	Sta 112+00, 56' Lt	Checked:	
		Jacobs Project No.:	**W7X77901**

Remarks:

Hydrology in accordance with
City of Mesa Engineering Procedure Manual

Design calculations were prepared in accordance with
BaySeparator Technical and Design Manual
BaySaver Technologies, Inc.
1302 Rising Ridge Road, Unit One
Mount Airy, Maryland 21771

DRAINAGE CONDITIONS

Drainage Structure	Sub-Basin	Station	Offset	CA	i_{10} (in/hr)	Q_{10} (cfs)	i_{100} (in/hr)	Q_{100} (cfs)
CB	Pvmt *	112+00	47' Lt	1.153	4.48	5.2	6.94	8.0
						5.2		**8.0**

* It is assumed the time of concentration (T_c) is 10 minutes for on-site drainage.

PROPOSED BAYSAVER SYSTEM

Model No.	Nominal Diameter (in)	Q_{10} (cfs)	MTR (cfs)	Q_{100} (cfs)	MHR (cfs)	Manhole Diameter (in)	Manhole Vault Depth (ft)
3K	**36**	5.2	7.8	8.0	30	**60**	**8**

MTR - Maximum Treatment Rate is the flow rate that can be fully treated by the BaySeparator without bypass.

MHR - Maximum Hydraulic Rate is the flow rate that can be conveyed through the BaySeparator.

Jacobs

BaySaver Design

Project:	**Power Road**	By:	**JPF**
Subject:	**BaySaver No. 2**	Date:	**5/11/2011**
	Sta 112+00, 57' Rt	Checked:	
		Jacobs Project No.:	**W7X77901**

Remarks:

Hydrology in accordance with
City of Mesa Engineering Procedure Manual

Design calculations were prepared in accordance with
BaySeparator Technical and Design Manual
BaySaver Technologies, Inc.
1302 Rising Ridge Road, Unit One
Mount Airy, Maryland 21771

DRAINAGE CONDITIONS

Drainage Structure	Sub-Basin	Station	Offset	CA	i_{10} (in/hr)	Q_{10} (cfs)	i_{100} (in/hr)	Q_{100} (cfs)
CB	Pvmt *	112+00	47' Rt	1.375	4.48	6.2	6.94	9.5
						6.2		**9.5**

* It is assumed the time of concentration (T_c) is 10 minutes for on-site drainage.

PROPOSED BAYSAVER SYSTEM

Model No.	Nominal Diameter (in)	Q_{10} (cfs)	MTR (cfs)	Q_{100} (cfs)	MHR (cfs)	Manhole Diameter (in)	Manhole Vault Depth (ft)
3K	**36**	6.2	7.8	9.5	30	**60**	**8**

MTR - Maximum Treatment Rate is the flow rate that can be fully treated by the BaySeparator without bypass.

MHR - Maximum Hydraulic Rate is the flow rate that can be conveyed through the BaySeparator.

Jacobs

BaySaver Design

Project:	**Power Road**	By:	**JPF**
Subject:	**BaySaver No. 3**	Date:	**5/11/2011**
	Sta 120+00, 60' Lt	Checked:	
		Jacobs Project No.:	**W7X77901**

Remarks:

Hydrology in accordance with
City of Mesa Engineering Procedure Manual

Design calculations were prepared in accordance with
BaySeparator Technical and Design Manual
BaySaver Technologies, Inc.
1302 Rising Ridge Road, Unit One
Mount Airy, Maryland 21771

DRAINAGE CONDITIONS

Drainage Structure	Sub-Basin	Station	Offset	CA	i_{10} (in/hr)	Q_{10} (cfs)	i_{100} (in/hr)	Q_{100} (cfs)
CB	Pvmt *	120+00	47' Lt	1.282	4.48	5.7	6.94	8.9
						5.7		**8.9**

* It is assumed the time of concentration (T_c) is 10 minutes for on-site drainage.

PROPOSED BAYSAVER SYSTEM

Model No.	Nominal Diameter (in)	Q_{10} (cfs)	MTR (cfs)	Q_{100} (cfs)	MHR (cfs)	Manhole Diameter (in)	Manhole Vault Depth (ft)
3K	**36**	5.7	7.8	8.9	30	**60**	**8**

MTR - Maximum Treatment Rate is the flow rate that can be fully treated by the BaySeparator without bypass.

MHR - Maximum Hydraulic Rate is the flow rate that can be conveyed through the BaySeparator.

Jacobs

BaySaver Design

Project:	**Power Road**	By:	**JPF**
Subject:	**BaySaver No. 4**	Date:	**5/11/2011**
	Sta 120+00, 57' Rt	Checked:	
		Jacobs Project No.:	**W7X77901**

Remarks:

Hydrology in accordance with
City of Mesa Engineering Procedure Manual

Design calculations were prepared in accordance with
BaySeparator Technical and Design Manual
BaySaver Technologies, Inc.
1302 Rising Ridge Road, Unit One
Mount Airy, Maryland 21771

DRAINAGE CONDITIONS

Drainage Structure	Sub-Basin	Station	Offset	CA	i_{10} (in/hr)	Q_{10} (cfs)	i_{100} (in/hr)	Q_{100} (cfs)
CB	Pvmt *	120+00	47' Rt	1.120	4.48	5.0	6.94	7.8
						5.0		**7.8**

* It is assumed the time of concentration (T_c) is 10 minutes for on-site drainage.

PROPOSED BAYSAVER SYSTEM

Model No.	Nominal Diameter (in)	Q_{10} (cfs)	MTR (cfs)	Q_{100} (cfs)	MHR (cfs)	Manhole Diameter (in)	Manhole Vault Depth (ft)
3K	**36**	5.0	7.8	7.8	30	**60**	**8**

MTR - Maximum Treatment Rate is the flow rate that can be fully treated by the BaySeparator without bypass.

MHR - Maximum Hydraulic Rate is the flow rate that can be conveyed through the BaySeparator.

Jacobs

BaySaver Design

Project:	**Power Road**	By:	**JPF**
Subject:	**BaySaver No. 5**	Date:	**5/11/2011**
	Sta 138+00, 69' Lt	Checked:	
		Jacobs Project No.:	**W7X77901**

Remarks:

Hydrology in accordance with
City of Mesa Engineering Procedure Manual

Design calculations were prepared in accordance with
BaySeparator Technical and Design Manual
BaySaver Technologies, Inc.
1302 Rising Ridge Road, Unit One
Mount Airy, Maryland 21771

DRAINAGE CONDITIONS

Drainage Structure	Sub-Basin	Station	Offset	CA	i_{10} (in/hr)	Q_{10} (cfs)	i_{100} (in/hr)	Q_{100} (cfs)
CB	Pvmt *	135+00	47' Lt	1.056	4.48	4.7	6.94	7.3
CB	Pvmt *	138+00	47' Lt	0.711	4.48	3.2	6.94	4.9
						7.9		**12.3**

* It is assumed the time of concentration (T_c) is 10 minutes for on-site drainage.

PROPOSED BAYSAVER SYSTEM

Model No.	Nominal Diameter (in)	Q_{10} (cfs)	MTR (cfs)	Q_{100} (cfs)	MHR (cfs)	Manhole Diameter (in)	Manhole Vault Depth (ft)
5K	**48**	7.9	11.1	12.3	50	**72**	**8**

MTR - Maximum Treatment Rate is the flow rate that can be fully treated by the BaySeparator without bypass.

MHR - Maximum Hydraulic Rate is the flow rate that can be conveyed through the BaySeparator.

Jacobs

BaySaver Design

Project:	**Power Road**	By:	**JPF**
Subject:	**BaySaver No. 6**	Date:	**5/11/2011**
	Sta 138+00, 57' Rt	Checked:	
		Jacobs Project No.:	**W7X77901**

Remarks:

Hydrology in accordance with
City of Mesa Engineering Procedure Manual

Design calculations were prepared in accordance with
BaySeparator Technical and Design Manual
BaySaver Technologies, Inc.
1302 Rising Ridge Road, Unit One
Mount Airy, Maryland 21771

DRAINAGE CONDITIONS

Drainage Structure	Sub-Basin	Station	Offset	CA	i_{10} (in/hr)	Q_{10} (cfs)	i_{100} (in/hr)	Q_{100} (cfs)
CB	Pvmt *	135+00	47' Rt	0.854	4.48	3.8	6.94	5.9
CB	Pvmt *	138+00	47' Rt	0.698	4.48	3.1	6.94	4.8
						7.0		**10.8**

* It is assumed the time of concentration (T_c) is 10 minutes for on-site drainage.

PROPOSED BAYSAVER SYSTEM

Model No.	Nominal Diameter (in)	Q_{10} (cfs)	MTR (cfs)	Q_{100} (cfs)	MHR (cfs)	Manhole Diameter (in)	Manhole Vault Depth (ft)
3K	**36**	7.0	7.8	10.8	30	**60**	**8**

MTR - Maximum Treatment Rate is the flow rate that can be fully treated by the BaySeparator without bypass.
MHR - Maximum Hydraulic Rate is the flow rate that can be conveyed through the BaySeparator.

Jacobs

BaySaver Design

Project:	**Power Road**	By:	**JPF**
Subject:	**BaySaver No. 7**	Date:	**5/11/2011**
	Sta 248+12, 35' Rt	Checked:	
		Jacobs Project No.:	**W7X77901**

Remarks:

Hydrology in accordance with
City of Mesa Engineering Procedure Manual

Design calculations were prepared in accordance with
BaySeparator Technical and Design Manual
BaySaver Technologies, Inc.
1302 Rising Ridge Road, Unit One
Mount Airy, Maryland 21771

DRAINAGE CONDITIONS

Drainage Structure	Sub-Basin	Station	Offset	CA	i_{10} (in/hr)	Q_{10} (cfs)	i_{100} (in/hr)	Q_{100} (cfs)
CB	Pvmt *	248+00	33' Rt	1.402	4.48	6.3	6.94	9.7
						6.3		**9.7**

* It is assumed the time of concentration (T_c) is 10 minutes for on-site drainage.

PROPOSED BAYSAVER SYSTEM

Model No.	Nominal Diameter (in)	Q_{10} (cfs)	MTR (cfs)	Q_{100} (cfs)	MHR (cfs)	Manhole Diameter (in)	Manhole Vault Depth (ft)
3K	**36**	6.3	7.8	9.7	30	**60**	**8**

MTR - Maximum Treatment Rate is the flow rate that can be fully treated by the BaySeparator without bypass.

MHR - Maximum Hydraulic Rate is the flow rate that can be conveyed through the BaySeparator.

Jacobs

BaySaver Design

Project:	**Power Road**	By:	**JPF**
Subject:	**BaySaver No. 8**	Date:	**5/11/2011**
	Sta 258+08, 34' Rt	Checked:	
		Jacobs Project No.:	**W7X77901**

Remarks:

Hydrology in accordance with
City of Mesa Engineering Procedure Manual

Design calculations were prepared in accordance with
BaySeparator Technical and Design Manual
BaySaver Technologies, Inc.
1302 Rising Ridge Road, Unit One
Mount Airy, Maryland 21771

DRAINAGE CONDITIONS

Drainage Structure	Sub-Basin	Station	Offset	CA	i_{10} (in/hr)	Q_{10} (cfs)	i_{100} (in/hr)	Q_{100} (cfs)
CB	Pvmt *	258+00	27' Rt	0.873	4.48	3.9	6.94	6.1
						3.9		**6.1**

* It is assumed the time of concentration (T_c) is 10 minutes for on-site drainage.

PROPOSED BAYSAVER SYSTEM

Model No.	Nominal Diameter (in)	Q_{10} (cfs)	MTR (cfs)	Q_{100} (cfs)	MHR (cfs)	Manhole Diameter (in)	Manhole Vault Depth (ft)
3K	**36**	3.9	7.8	6.1	30	**60**	**8**

MTR - Maximum Treatment Rate is the flow rate that can be fully treated by the BaySeparator without bypass.

MHR - Maximum Hydraulic Rate is the flow rate that can be conveyed through the BaySeparator.

Jacobs

BaySaver Design

Project:	**Power Road**	By:	**JPF**
Subject:	**BaySaver No. 9**	Date:	**5/11/2011**
	Sta 264+40, 60' Rt	Checked:	
		Jacobs Project No.:	**W7X77901**

Remarks:

Hydrology in accordance with
City of Mesa Engineering Procedure Manual

Design calculations were prepared in accordance with
BaySeparator Technical and Design Manual
BaySaver Technologies, Inc.
1302 Rising Ridge Road, Unit One
Mount Airy, Maryland 21771

DRAINAGE CONDITIONS

Drainage Structure	Sub-Basin	Station	Offset	CA	i_{10} (in/hr)	Q_{10} (cfs)	i_{100} (in/hr)	Q_{100} (cfs)
CB	Pvmt *	270+15	33' Rt	0.963	4.48	4.3	6.94	6.7
CB	Pvmt *	626+00	33' Lt	0.457	4.48	2.0	6.94	3.2
CB	Pvmt *	627+10	33' Lt	0.826	4.48	3.7	6.94	5.7
CB	Pvmt *	625+85	33' Rt	0.494	4.48	2.2	6.94	3.4
CB	Pvmt *	627+10	33' Rt	1.009	4.48	4.5	6.94	7.0
CB	Pvmt *	265+40	33' Rt	0.782	4.48	3.5	6.94	5.4
						18.3		**28.3**

* It is assumed the time of concentration (T_c) is 10 minutes for on-site drainage.

PROPOSED BAYSAVER SYSTEM

Model No.	Nominal Diameter (in)	Q_{10} (cfs)	MTR (cfs)	Q_{100} (cfs)	MHR (cfs)	Manhole Diameter (in)	Manhole Vault Depth (ft)
10K	**60**	18.3	21.8	28.3	100	**120**	**8**

MTR - Maximum Treatment Rate is the flow rate that can be fully treated by the BaySeparator without bypass.

MHR - Maximum Hydraulic Rate is the flow rate that can be conveyed through the BaySeparator.

Jacobs

BaySaver Design

Project:	**Power Road**	By:	**JPF**
Subject:	**BaySaver No. 10**	Date:	**5/11/2011**
	Sta 360+90, 43' Rt	Checked:	
		Jacobs Project No.:	**W7X77901**

Remarks:

Hydrology in accordance with
City of Mesa Engineering Procedure Manual

Design calculations were prepared in accordance with
BaySeparator Technical and Design Manual
BaySaver Technologies, Inc.
1302 Rising Ridge Road, Unit One
Mount Airy, Maryland 21771

DRAINAGE CONDITIONS

Drainage Structure	Sub-Basin	Station	Offset	CA	i_{10} (in/hr)	Q_{10} (cfs)	i_{100} (in/hr)	Q_{100} (cfs)
CB	Pvmt *	357+00	33' Rt	0.660	4.48	3.0	6.94	4.6
CB	Pvmt *	361+90	33' Rt	0.381	4.48	1.7	6.94	2.6
						4.7		**7.2**

* It is assumed the time of concentration (T_c) is 10 minutes for on-site drainage.

PROPOSED BAYSAVER SYSTEM

Model No.	Nominal Diameter (in)	Q_{10} (cfs)	MTR (cfs)	Q_{100} (cfs)	MHR (cfs)	Manhole Diameter (in)	Manhole Vault Depth (ft)
3K	**36**	4.7	7.8	7.2	30	**60**	**8**

MTR - Maximum Treatment Rate is the flow rate that can be fully treated by the BaySeparator without bypass.

MHR - Maximum Hydraulic Rate is the flow rate that can be conveyed through the BaySeparator.

Power Road
Pecos Road to 202L
Final Drainage Report

Appendix M

Retention Basins

Power Road
Pecos Road to 202L
Final Drainage Report

Appendix M

Retention Basins

Power Road			
Pecos Road to Santan Freeway			
100-yr 2-hr rainfall , inches		2.70	
Basin SB 349+00			
INLET	CA		
SB 349+00	1.514		
	Volume	0.341	Ac-ft
		14839	Ft^3
Basin SB 363+60			
INLET	CA		
SB 363+68.91	0.106		
	Volume	0.024	Ac-ft
		1039	Ft^3
Basin SB 386+20			
INLET	CA		
SB 376+00	0.740		
SB 379+00	1.053		
	1.793		
	Volume	0.403	Ac-ft
		17573	Ft^3

Power Road			
Pecos Road to Santan Freeway			
Basin NB 510+40			
INLET	CA		
NB 283+74	0.969		
NB 285+46	0.111		
NB 286+00	0.259		
SB 389+00	1.189		
NB 495+90	0.860		
SB 496+00	0.829		
SB 497+57	0.653		
SB 501+00	0.401		
NB 502+07	0.804		
SB 504+00	0.697		
NB 513+00	0.669		
NB 516+60	0.484		
NB 522+10	0.690		
WB Ray 727+02	0.075		
WB Ray 727+50	0.078		
WB Ray 728+00	0.156		
WB Ray 729+00	0.137		
WB Ray 730+00	0.256		
WB Ray 732+46	0.595		
EB Ray 727+15	0.264		
EB Ray 729+50	0.350		
EB Ray 732+46	0.780		
	11.306		
	Volume	2.544	Ac-ft
		110810	Ft^3
Basin NB 526+25			
INLET	CA		
NB 523+92.2	0.425		
NB 526+25	0.475		
NB 530+60	0.540		
	1.440		
	Volume	0.324	Ac-ft
		14113	Ft^3
Basin EB WFRd 617+00			
INLET	CA		
EB WFRd 617+00	0.444		
	Volume	0.100	Ac-ft
		4352	Ft^3

Power Road			
Pecos Road to Santan Freeway			
Basin EB WFRD 620+50			
INLET	CA		
EB WFRd 620+50	0.140		
WB WFRd 621+00	0.125		
	0.265		
	Volume	0.060	Ac-ft
		2597	Ft^3
Basin WB WFRd 617+00			
INLET	CA		
WB WFRd 617+00	0.600		
	Volume	0.135	Ac-ft
		5881	Ft^3