Lower El Mirage Wash Basin
Design Report

FCDMC Contract No.: FCD2012 C018
Dibble Project No.: 101122.01

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Prepared For:

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I. Introduction

The Lower El Mirage Wash Basin is a proposed in-line flood attenuation facility being constructed by the Flood Control District of Maricopa County (FCDMC) in cooperation with the City of El Mirage. Lower El Mirage Wash is located in the northwest metro Phoenix area, Township 3 North, Range 1 West, Sections 23 & 24 in Maricopa County, Arizona, as shown on **Figure 1** and **Figure 2**. The watershed contributing to Lower El Mirage Wash includes portions of the cities of Surprise and El Mirage. The wash conveys storm flows southwesterly to the Agua Fria River.

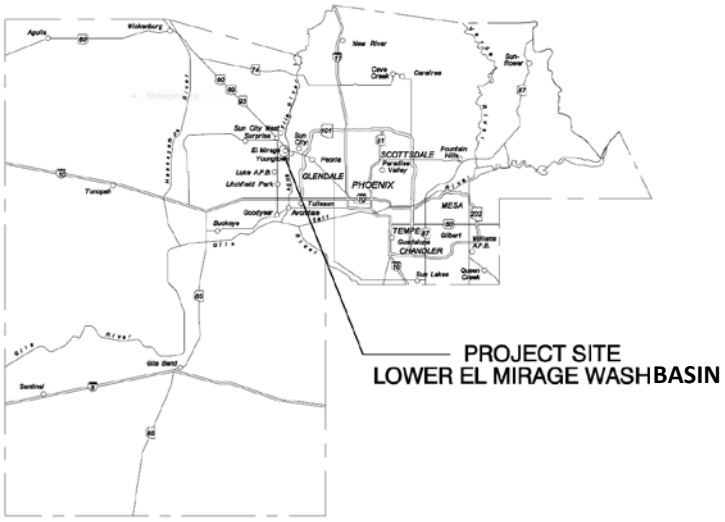

Figure 1 – Project Location Map

A. Project Area

This project is focused on the downstream reach of Lower El Mirage Wash, bounded by the Agua Fria river at the downstream end and the existing Cactus Road crossing at the upstream end, with a total reach length of approximately 1.31 river miles. The Lower El Mirage Wash Detention Basin (LEMWB) is located on an approximately 23.4-acre site along the Lower El Mirage Wash drainage between Cactus Road and Lower El Mirage Road, as shown on **Figure 2**.

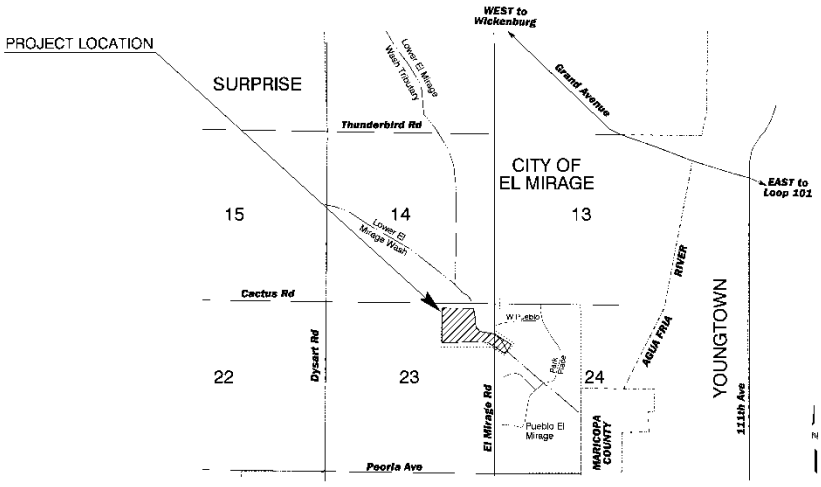

Figure 2 – Project Vicinity Map

B. Background

The downstream reach of Lower El Mirage Wash passes through Pueblo El Mirage, an active senior living community. This community was developed in 1985, several years before the first study of Lower El Mirage Wash was completed. The development used a design flow of 250-cfs for the portion of the wash located on their property (FCDMC, 2004). The area was included in the White Tanks/Agua Fria Area Drainage Master Study (ADMS) completed by the Flood Control District of Maricopa County (FCDMC) in 1991, which recommended a 100-year design flow of 1,800-cfs for this portion of the wash (FCDMC, 1991). There have been several updates to the hydrology included in the Area Drainage Study. These updates are listed in **Section III.A, Table 2**.

The Lower El Mirage Wash floodplain was mapped in 1991, as a part of the ADMS, using the 1,800-cfs design flow rate. The current effective flood hazard maps are based on this effort and design flow rate. The Design Concept Report (DCR) for this project, completed by FCDMC in 2011, estimates that the design flow rate in this portion of the wash after construction will be 230-cfs, a slight reduction from the flow rate used to design conveyance through the Pueblo El Mirage development. The effective mapping will be revised as a part of this project to this reduced flow rate through a Conditional Letter of Map Revision (CLOMR).

C. Purpose and Need

The primary purpose of this project is to reduce the flooding hazards presented by storm water conveyed in Lower El Mirage Wash. A secondary objective of the project is to re-profile the existing West Cactus Basin, located on the parcel where the LEMWB will be constructed, to provide positive drainage through the basin, reducing the health and safety risks associated with the approximately 20 acre-feet of dead storage of the current basin, and eliminating the roadway overtopping of El Mirage Road during high flows (FCDMC, 2011). As the project has progressed through the planning stages, other purposes and needs for the basin have been identified, including multi-use opportunities to enhance the value of the property to adjacent residential communities and the currently vacant commercial parcels.

D. Adjacent Projects

El Mirage Road is in the process of being widened to a five-lane section, with construction anticipated to begin in the latter half of 2013. This project is being designed to 95% completion for the Maricopa County Department of Transportation (MCDOT). Coordination with this project includes integration of the roadway storm drain system and the basin outlet culvert, and the interface between the roadway sidewalk and basin multi-use path.

The City of El Mirage (COEM) has plans to widen Cactus Road. These improvements include re-profiling the road to eliminate overtopping flows, installation of a pedestrian underpass allowing access between the basin site and the upper reach of Lower El Mirage Wash, and a storm drainage system. These plans have been completed and are pending final revisions prior to construction once project funding is available.

E. Scope of Work

The scope of work for this project includes the following:

- Development of the recommended alternative presented in the DCR to final construction drawings and specifications
- Completion of a design report documenting supporting calculations
- Application for a CLOMR of the FEMA floodplain for Lower El Mirage Wash downstream of the proposed basin site
- Submittal of a Technical Data Notebook in support of the CLOMR as a stand-alone document

II. Stakeholder Information

The key stakeholders for this project are listed below in **Table 1**.

Table 1 – List of Stakeholders

Organization	Stakeholder	Project Role
Flood Control District of Maricopa County	Harry Cooper	Landscape Architecture
	Mike Duncan	Project Manager
	Shimin Li	River Mechanics
	Gary Maiers	Utility Coordination
	Gary Shapiro	Engineering
	Scott Vogel	PM Branch Manager
	Gant Wegner	Public Outreach
City of El Mirage	Jorge Gastelum	CIP Engineer
	Dave Grace	Parks & Streets Operations Manager
	Sue McDermott	Deputy City Manager/City Engineer
Roberts Resorts	Niels Roberts	Project Aesthetics Advisory Committee Member
Rancho Mirage HOA	Robert Winefsky	Project Aesthetics Advisory Committee Member
	Jim McPheters	Project Aesthetics Advisory Committee Member
Sundial III HOA	Mary Koestner	Project Aesthetics Advisory Committee Member
Dibble Engineering	Kevin Roberts	Project Manager
	Josh Papworth	Hydraulics Engineer
	Jeremy Laipple	Project Engineer
	Dinesh Doshi	Quality Assurance
EPG	John Griffin	Landscape Architect

Minutes from project coordination meetings and the Project Aesthetics Advisory Committee meeting are included in **Appendix A**. Interim submittals were reviewed by staff from the Flood Control District of Maricopa County and the City of El Mirage.

III. Data Collection

A. Previous Studies

Several hydrology studies of Lower El Mirage Wash have been completed since the original Flood Insurance Study was conducted in 1985. The previous studies, and their corresponding 100-year peak discharges at El Mirage Road, are summarized in **Table 2**.

Table 2 – List of Referenced Studies

Date	Drainage Study Title	100-yr Peak Discharge *(cfs)*
1985	Federal Emergency Management Agency, Flood Insurance Study	250
2001	Lower El Mirage Wash Channelization Letter of Map Revision	1,753
2004	Loop 303 Corridor / White Tanks Area Drainage Master Plan Update	857
2009	Loop 303 / White Tanks ADMP-AHA	214
2010	Lower El Mirage Wash Basin Design Concept Report	230

B. Mapping and Survey Data

Mapping for final design was conducted in 2012 using aerial photography, supplemented by ground topography of critical utility and storm drain outlet locations. This mapping is based on the project benchmark NGS Monument 4GA2, and uses the North American Vertical Datum of 1988 (NAVD88), which was also used for both the Design Concept Report, El Mirage Road improvement plans and the Cactus Road improvement plans.

The Phase 1 study for this project was conducted using the National Geodetic Vertical Datum of 1929 (NGVD29), which was also used by FEMA for the current effective flood mapping of Lower El Mirage Wash. Subsequent to the study which produced the current effective map, FEMA has adopted NAVD88 as a datum reference for floodplain studies. The conversion from NGVD29 to NAVD88 in the project area is +1.87 ft (NGVD29 + 1.87 ft = NAVD88).

C. Utility Data

Utility maps were collected by the Flood Control District of Maricopa County, and were checked against the design drawings for the El Mirage Road and Cactus Road improvement plans. Potholes were taken in locations where conflicts between existing and proposed facilities are anticipated.

D. Pothole Data

Potholes were collected by Baseplans USA, under contract directly with the FCDMC on July 12, 2012, using coordinate points provided by Dibble Engineering. The pothole excavation sheets are included in **Appendix B**.

E. FEMA and Floodplain Data

The Federal Emergency Management Agency has identified and mapped the flooding hazard along Lower El Mirage Wash. The current Flood Insurance Rate Map for this project is Panel 04013C1605J (1605 of 4350) for Maricopa County and Incorporated Areas (FEMA, 2005). The current FIRM panel is included in **Appendix C**.

IV. Hydrology

A. Lower El Mirage Wash

The basis of hydrology for the watershed contributing to this project is the *Loop 303/White Tanks ADMPU Area Hydrologic Analysis* (ADMPU AHA), *Existing Conditions with CIP*, completed in 2009 (FCDMC, 2009). This hydrology model includes capital improvement projects anticipated to be performed in the coming years. The model represents a 100-year return period and 24-hour duration. NOAA Atlas 14 rainfall values are used. It should be noted that the Conditional Letter of Map Revision (CLOMR) for proposed basin design and resulting floodplain impacts will be based on a different version of the ADMPU hydrology, i.e. *Existing Conditions without CIP*, to truly reflect the existing watershed condition. That hydrology will be documented in a separate Technical Data Notebook for FEMA submittal.

Several revisions were made to the ADMPU HEC-1 model in order to correct a discovered inaccuracy, and to model the proposed condition for the LEMWB project. Revisions to the model are discussed below.

Hydrologic model names for are:

Pre Project Condition: LEMWB_PRE_CIP.dat
Post Project Condition with Future Cactus Road Culvert: LEMWB_POST_CIP_FC.dat
Post Project Condition with Existing Cactus Road Cuvlert: LEMWB_POST_CIP.dat

Analysis was performed using FCDMC's Drainage Design Management System for Windows (DDMSW) version 4.6.0. The revisions are as follows:

1. Revision 1 – Remove SRD14

This revision was made by Flood Control District of Maricopa County in October of 2009 to correct an inaccuracy regarding the storage at the intersection of Greenway Road and Dysart Road. The revision is based on a review of the HEC-1 model in combination with local physical conditions at this intersection.

2. Revision 2 – Extract the Contributing Watershed

The first Dibble revision was to extract the portion of Major Basin D draining to CPD54, which is the HEC-1 concentration point at the outlet of this project reach. The portion of the local watershed contained within the ADMPU-AHA Major Basin D that drains to CPD54 occupies a total area of 10.8 square miles and is illustrated on **Figure E.1** in **Appendix E**. Once extracted, an automated update of the model subbasins was performed within DDMSW. The result of the subbasin update was a slight change in peak flow values, e.g. the peak flow at the confluence of Lower El Mirage Wash and Lower El Mirage Wash Tributary was reduced from 660-cfs to 654-cfs. This change is believed to be the result of a recent correction within DDMSW's unit hydrograph procedure, MCHUP1. The following statement is provided by FCDMC regarding the update:

> *The issue is related to time of concentration values for a multiple and 24-hour storm. This issue is partially caused by the 16-bit compiler to 32-bit compiler transition. This new update will work under both 32-bit and 64-bit computers.*

The change in peak flows resulting from this software update do not represent a significant departure from basis of the 2011 DCR recommendations; the revised values have been used in the current design of the LEMWB.

3. *Revision 3 – Updated Operation SRD42 (Pre Project Condition)*

Operation SRD42 was updated within this model using supplemental survey data obtained during the planning stages of this project. The Cactus Road stage-storage-discharge modeling was updated using both 2004 Stanley Consultants survey data and 2010 FCDMC survey data. AZTEC Engineering developed a revised stage-storage-discharge curve based on this data as part of Phase 1 of the Lower El Mirage Wash DCR in June of 2010. The 2004 supplemental survey defined the channel geometry which represents the stage-storage data located upstream of Cactus Road. The 2010 supplemental survey data measured the Cactus Road culvert and roadway overtopping geometry and represents the stage-discharge data. The combined stage-storage-discharge data used for SRD42 (Cactus Road) is reproduced from the DCR and provided in **Appendix D.2.** The reader is referred to the DCR for further supporting documentation of the stage-storage-discharge data.

4. *Revision 4 – Removed Operation SRD42 (Post Project Condition)*

The fourth revision removed operation SRD42, a level pool storage route upstream of Cactus Road, in anticipation of a future large capacity culvert. The future culvert is expected to effectively eliminate any upstream storage attenuation, separate from the new basin. This future condition represents the 'worst' case for the peak inflow and the required storage attention in the new basin.

A separate post project condition model was developed that includes operation SRD42 for comparison purposes. However, governing design flows and required storage are not determined using that model. That model, "LEMWB_POST_CIP", is included with the electronic data submitted with this report.

5. *Revision 5 – Removed Operation D42D53 (Post Project Condition)*

Revision 5 accounts for the fact that the proposed basin effectively replaces D42D53, a short channel route from Cactus Road to El Mirage Road.

6. *Revision 6 – Revised Operation SRD53 (Post Project Condition)*

Revision 6 provides the stage storage discharge curve for the proposed basin design. The data table was developed using the proposed basin grading plan and discharge data for the proposed 60-inch culvert under El Mirage Road. The storage includes the volume within the existing channel upstream of Cactus Road, consistent with plans for a future large diameter culvert. The combined stage-storage-discharge data used for SRD53 is provided in **Appendix D.1**.

The resulting post project model is titled "LEMWB_POST_CIP_FC". The peak flows at relevant concentration points are summarized in the following table:

Table 3 – Peak Flow Summary

HEC-1 ID	Location	100-yr Peak Discharge *(cfs)*
CPD42	Confluence of Lower El Mirage Wash and Tributary	654
SRD42	Just upstream of Cactus Road	654
SRD53	Just upstream of El Mirage Road	191
CPD54	Approximately 2300' upstream of LEMW confluence with Agua Fria River	317

DDMSW supporting data tables and output tables can be found in **Appendix E**.

B. Storm Drain Inlets

There are three storm drain systems that drain to the LEMWB site:

- Rancho El Mirage Unit II Parcel II – Phase 1, which drains from Canterbury Drive
- Rancho El Mirage Unit II Parcel II – Phase 3, which drains from 125th Avenue
- Canterbury Drive Water Production Facility

The Rancho El Mirage Unit II subdivision plans were prepared in 1999 (Phase 1) and 2000 (Phase 3) by Sage Engineering Corporation of Phoenix. These plans were reviewed and approved by A-N West, who was contracted as the City Engineer for the City of El Mirage at the time these developments were constructed. The Phase 1 storm drain system consists of five catch basins that drain to a bubble-up structure within the existing basin, and the Phase 3 system consists of ten catch basins, which also outfall to a bubble-up structure. One of the objectives for the design of this project was to maintain positive drainage throughout the facility. In order to accomplish this the outfall reaches of the two storm drain systems must be vertically relocated. Despite an extensive search through City records, a drainage report for these facilities could not be located. A hydrologic analysis of these storm drain systems is outside the scope of work for this project. In order to ensure the realigned outfall reaches will have adequate capacity in the absence of hydrologic data, the hydraulic capacity of the upstream system components was estimated to establish a design flow rate. This design process is discussed further in **Section V.B.**

The Canterbury Drive Water Production Facility has a 36-inch outlet pipe that drains directly to the existing basin. This outlet serves both as a storm drain outlet and as an emergency outlet in the event of a failure of any of the facilities at the water campus. This outlet will be lowered slightly, with an invert elevation approximately 2-feet lower than the existing outlet headwall, in approximately the same horizontal location. The proposed system modifications will not have a negative impact on the hydraulic performance of the outlet system, and no additional hydrologic investigations were made beyond the scope of work for this project.

C. Adjacent Property Drainage

There are two properties adjacent to the basin site (the Bool property to the northwest of the basin, and the El Mirage Marketplace property to the northeast of the basin) for which down drains have been designed in order to convey excess runoff from the properties to the basin bottom in the interim condition, until these properties are developed. The down drain on the east side of the basin will also function as an outlet point for the City owned parcel north of the basin outlet culvert. Peak discharges

for these properties used to design the down drains were calculated using the rational method according to the procedures outlined in the FCDMC Drainage Design Manual, Volume 1. In addition, the City's water campus on the southwest corner of the basin site also drains to the basin through an existing 36" storm drain pipe. A rational method calculation has also been done for this site. There is a water production well located within the water campus that has a maximum production rate of 810 gpm (1.8 cfs). In order to account for the worst-case scenario, the well pump flow has been added to the peak storm water discharge from the water campus to determine the design flow for the 36" storm drain pipe. The design flows for these locations are summarized in the following table:

Table 4 – Minor Drainages Peak Flow Summary

Location	100-yr Peak Discharge *(cfs)*
Bool Property	20.3
El Mirage Marketplace Property	8.9
City of El Mirage Parcel	6.9
City of El Mirage Water Campus	15.5

The supporting calculations have been included in **Appendix E.2**.

V. Hydraulics

A. Lower El Mirage Wash

A HEC-RAS model has been developed to support basin design and to analyze the effects of the proposed basin, the El Mirage Road improvements, and the downstream channel revisions on the existing downstream conveyance system.

1. Method Description

The starting water surface value for the HEC-RAS computer model is normal depth. This is the result of an examination of a number of starting water surface options. Lower El Mirage Wash ends at the confluence with the Agua Fria River. However, it was concluded that it would not be appropriate to tie into the Agua Fria River water surface elevation, as the likelihood of coincident peaks is improbable. The model extends from the Agua Fria River to a point approximately 700-feet upstream of Cactus Road. Modeling was performed using HEC-RAS version 4.1.0, January, 2010.

2. Parameter Estimation

a. Roughness Coefficients

Two roughness coefficient investigations have been performed as part of this floodplain delineation, existing conditions and proposed conditions. **Appendix F** contains color photographs of the existing condition and supporting roughness coefficient calculations for both existing and proposed conditions. Proposed conditions Manning's n-values are limited to the basin area and the reach of new downstream channel.

Manning's roughness coefficients, or n-values, are determined using procedures adopted by the USGS. The following supporting materials are used in this analysis:

- Aerial Photographs: April 2012 flight date by Cooper Aerial Survey Company, Inc. used for the topographic base mapping of study area
- Ground Photographs: Color photographs taken during field reconnaissance
- Field Data: Information gathered during field reconnaissance

The Manning's n-value is affected by various factors such as bed material, cross section irregularities, depth of flow, vegetation, channel alignment, channel shape, obstructions, suspended material and bed-load. The typical USGS procedure consists of selection of a base n-value and the addition of several adjustment factors to determine a total roughness coefficient for each channel sub-section (main channel and overbanks).

The base n-value accounts for roughness due to the bed material. Further refinements to the n-value are made based on *Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona* (Thomsen, 1991). From this publication, it is found that the primary factors affecting the n-value are surface irregularities, obstructions and vegetation with consideration also given for flow depth and meander. And an excerpt from this publication is included in **Appendix F**. Based on the primary factors, the n-value is estimated from the equation:

$$n = (n_b + n_1 + n_2 + n_3) f_m$$

Where:
n_b = base Manning's value for a straight uniform channel
n_1 = value for surface irregularities
n_2 = value for obstructions
n_3 = value for vegetation
f_m = factor for meander

b. Expansion and Contraction Coefficients

Expansion and contraction coefficients for use in modeling Lower EL Mirage Wash in HEC-RAS are 0.1 and 0.5, respectively, for cross sections that model structures such as culverts. Expansion and contraction coefficients of 0.1 and 0.3, respectively, are used in locations of open channels, or areas not affected by drainage structures.

3. Cross Section Description

HEC-RAS cross sections are spaced at intervals less than 400-feet, and are at shorter intervals where a more detailed modeling of the terrain is necessary. Additional cross sections are added at roadway or driveway culverts, as required for proper modeling in the RAS model. In general, cross sections are oriented northeasterly to southwesterly and perpendicular to the Lower El Mirage Wash. For areas that are not being revised, cross section data was obtained from the project mapping and supplemented at existing culverts/bridges with survey data. Cross sections at areas proposed for improvement were obtained from the proposed grading for the LEMWB, El Mirage Road, and the downstream channel.

4. Bridges and Culverts

There are two existing culverts, one existing bridge, and one new culvert modeled in the proposed condition HEC-RAS model. These structures are discussed in the sections below.

a. Cactus Road Culvert (Existing)

An existing three barrel 24-inch diameter reinforced concrete pipe culvert is modeled at Cactus Road. The culvert inverts were obtained from 2010 FCDMC survey data and data to model the bridge deck was obtained from the project mapping. This culvert will ultimately be replaced with a new box culvert at the time that Cactus Road is improved. This is expected to be several years in the future.

b. El Mirage Road Culvert (Proposed)

A proposed 60-inch diameter reinforced concrete pipe culvert planned with this project is modeled at El Mirage Road. Bridge deck data was obtained from the proposed plans for EL Mirage Road being prepared by Premier Engineering. Relevant plan and profile sheets are provided in **Appendix G**.

c. Park Place Culvert (Existing)

A four barrel, 10-ft x 3-ft concrete box culvert exists within the resort golf course at the Park Place wash crossing. The culvert inverts were obtained from 2010 FCDMC survey data. Bridge deck data is obtained from the project mapping.

d. Golf Cart Path Bridge (Existing)

A small concrete bridge with an approximate span of 10-feet exists within the resort golf course for golf cart travel under a roadway. Bridge deck data was obtained from 2010 FCDMC survey data.

5. Ineffective Flow Areas

Ineffective flow areas are coded into HEC-RAS cross sections at abrupt changes in conveyance section. The expansion rate is 3 longitudinal to 1 lateral; the contraction rate is 1 to 1. These values are reasonable given the moderate wash velocities (generally less than 5-fps).

6. Modeling Warning and Error Messages

Warning messages and notes provided by HEC-RAS include:

- Critical Depth
  - During standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
  - Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.
- Velocity Head
  - The velocity head has changed by more than 0.5-ft (0.15-m). This may indicate the need for additional cross sections.
- Energy Equation
  - The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
  - The energy loss was greater than 1.0-ft (0.3-m) between the current and previous cross section. This may indicate the need for additional cross sections.
- Conveyance Ratio
  - The conveyance ratio (upstream conveyance divided by downstream conveyance) is less or greater than 1.4. This may indicate the need for additional cross sections.
- Divided Flow
  - Divided flow computed for this cross section.

These warnings have been reviewed at the locations where they occur, and are typical of overtopping roadway sections and reaches of conveyance with undulating ground slope and meandering alignment. Resulting water surfaces are reasonable and consistent based on field observation and standard methodologies.

7. *Hydraulic Analysis Results*

The HEC-RAS summary tables, profile, and cross section plots are provided in **Appendix H.** The peak stage within the proposed LEMWB is 1112.9'. The peak flow leaving the basin, 191-cfs, is contained within the proposed channel section and the existing downstream golf course. These numbers represent the 'worst' case, generated using the future condition of a large capacity culvert at Cactus Road. Peak velocities are generally less than 5-fps except at roadway overtopping sections and culvert outlets where erosion protection is provided.

A primary goal of this project is to maintain the peak flow elevation at least 1.0' below the finished floor of any adjacent buildings within the Pueblo El Mirage RV and Golf Resort, downstream of the proposed basin. The following table presents a comparison of finished floor elevations to peak flow elevations at the critical location near Park Place; all finished floors have at least 1.0' of freeboard above the adjacent 100-year water surface elevation. A map of the Roberts Resorts lots can be found at the end of **Appendix H**.

Table 5 – Finished Floor Summary

Lot #	Finished Floor Elev	Pad Elev	Ground Elev	Cross Section	100Yr WSE	Δ FF Elev & 100 Yr WSE *(ft)*
1228	1106.36	1106.26	1106.14	RM 0.646	1105.20	1.2
1229	1108.75	1106.60	1106.43	RM 0.646	1105.20	3.5
1230	1108.37	1106.97	1106.44	RM 0.646	1105.20	3.2
1231	1109.99	1107.34	1106.80	RM 0.680	1105.31	4.7
1232	1109.23	1107.23	1106.93	RM 0.680	1105.31	3.9
1233	1109.48	1107.48	1107.22	RM 0.680	1105.31	4.2
1234	1109.66	1107.51	1107.51	RM 0.680	1105.31	4.4
1235	1109.61	1107.26	1107.23	RM 0.726	1105.33	4.3
1236	1109.61	1107.46	1107.12	RM 0.726	1105.33	4.3
1237	1109.94	1107.54	1107.31	RM 0.726	1105.33	4.6
1238	1110.07	1107.92	1107.61	RM 0.726	1105.33	4.7
A78	1109.78	1106.88	1106.71	RM 0.638	1105.14	4.6
A77	1111.19	1108.29	1107.39	RM 0.638	1105.14	6.0
A3	1107.98	1107.78	1107.40	RM 0.646	1105.20	2.8

*Elevations are based on NAVD88 datum; finished floor elevations are results of 2010 FCDMC survey.

B. *Sediment Yield*

Sediment yield calculations were performed within DDMSW 4.6.0 software. The 100-year, 24-hour storm sediment yield and annual sediment yield are computed for the purpose of sizing a sedimentation basin at Cactus Road. The sediment-basin volume computation includes the summation of (1) a single 100-year storm sediment yield and (2) two times the annual sediment yield. This corresponds to a 2-year frequency sediment inspection and removal. The sediment yield consists of two parts and is defined as the sum of the wash load and the total bed material load delivered to the point of interest. The wash

load is calculated with the MUSLE method, and the total bed material load is calculated with the Zeller-Fullerton equation (Zeller and Fullerton, 1983), which is based on the assumption that the reach is at an equilibrium condition. For additional information concerning the yield calculations performed within DDMSW, the reader is referred to *River Mechanics Manual for DDMSW*, 2010.

Particle gradation data for calculations was obtained by field sampling, collected for this project in July 2012, within the wash bed at a location approximately 550-feet upstream of Cactus Road. The exploratory boring terminated approximately 3-feet below the bed surface. The boring log and gradation test results can be found in the project geotechnical report, Addendum 1, included in **Appendix I**.

1. *Parameter Estimation*

Other input parameters for the yield calculations are summarized below:

a. Peak Flow

Peak flow rates for the full range of return periods were obtained from concentration point CPD42 of the project hydrology, described in **Section IV.A**. This corresponds to a location just upstream of Cactus Road.

b. Bed Load Section Data

A representative cross section for the bed load calculation was obtained from the project mapping at a location approximately 150-feet upstream of Cactus Road. The slope of the channel section is the average slope for a distance of approximately 1000-feet upstream of Cactus Road, 0.33%.

c. Soil and Erosion Factors

Soil and erosion factors were assigned based on the unique soil identification number corresponding to NRCS soil classification. These values are the Soil Erodibility Factor (K) and the Erosion Control Factor (P). The default values within DDMSW have been selected. The specific weight of soil is calculated using the channel bed material soil sample. The D10 of the sediment sample is taken as the D50 of the wash load; D10 is defined as the diameter of which 10% is finer by weight. This is supported by Garde and Raju (1985), wherein it is proposed that the limiting size for the wash load by be arbitrarily chosen from a mechanical analysis of the bed material, as that particle size of which 10 percent of the bed material is finer.

d. Land Use Factors

Land use factors were assigned based on the unique land use codes within the watershed. Land use shape files, matching land use codes to geographic limits, are those used in Loop 303/White Tanks ADMPU AHA. These factors are the Cover Management Factor and the Percent Impervious; these values are drawn from land use data automatically with DDMSW. The default values have been selected.

e. Topographic Factor

The topographic factor was used within the MUSCLE to estimate shallow surface erosion prior to flow concentration. This factor is calculated from the slope length distance and the slope, in percent. Slope length is defined as the distance from the point of origin of overland flow to the point where either

slope gradient decreases enough such that deposition occurs, or the runoff water enters a well-defined channel that may be a part of a drainage network. The watershed for LEMWB is nearly completely developed; most development is single family residential homes with a drainage network of streets. For this reason the slope length is selected as a typical distance from the back of typical residential lot to the adjacent street curb: 100-ft. The slope is estimated as the average watershed slope: 0.43%.

2. *Results*

The resulting sediment yield is summarized below:

Table 6 – Sediment Yield

Event	Wash Load *(cu-ft)*	Bed Load *(cu-ft)*	Total Yield *(cu-ft)*
100 Year	2,570	7,754	10,324
Annual	174	305	479
Design*	2,918	8,364	11,282

*Design = 100 Year + 2 x Annual

These values appear reasonable considering the developed nature of the contributing watershed. DDMSW output tables can be found in **Appendix J**.

The volume provided in the sediment basin as shown on the 100% LEMWB plans submittal is 12,331 cu-ft, providing approximately 9% of additional sediment storage capacity over the calculated yield.

C. *Low Flow Ditch and Swale Hydraulics*

A number of minor conveyance features are designed within the basin footprint in order to maintain positive drainage throughout the basin. These features were designed to a typical section rather than to a target flow rate, with the capacities and hydraulic parameters calculated based on bank-full discharge.

A summary of the ditch sections and their hydraulic capacity and flow characteristics is shown blow, and detailed calculations are included in **Appendix K**.

Table 7 – Low Flow Ditch and Swale Hydraulic Summary

Ditch or Swale Section	Surface Material	Depth *(ft)*	Bottom Width *(ft)*	Side Slopes *(XH:1V)*	Max Longitudinal Slope *(ft/ft)*	Q *(cfs)*	V *(fps)*
Typical Section 7	Riprap, D_{50}=6”	1.0	-	4	0.2037	5.8*	5.8
Typical Section 8	Turf	2.1	-	100, 5.1	0.0015	417	1.8
Typical Section 9	Hydroseed Mix B	1.0	8	4	0.0015	17.1	1.4
Typical Section 10	Hydroseed Mix C	0.5	8	16, 8	0.0020	2.2	0.3
Typical Section 14	Rock Mulch, D_{50}=2”	0.5	-	3	0.0500	2.1	2.8

* Discharge for Typical Section 7 is based on 0.5’ flow depth rather than bank full depth, as the flow that could be conveyed to the section is limited to that generated from the El Mirage Marketplace property, and would be less than the maximum discharge of 8.9 cfs generated for the entire parcel.

D. Down Drain Hydraulics

There are three down drains that convey storm water from adjacent properties to the bottom of the basin, located near the basin outlet culvert, at the outfall from the Bool's property, and near the sidewalk connection to 125th Avenue. Peak discharges have been calculated for these first two connections; however, since the drain near 125th Avenue is designed as an overflow outlet for the storm drainage system in 125th Avenue, this down drain has been designed for the bank-full hydraulic capacity.

A summary of the down drain hydraulics is shown below, and detailed calculations are included included in **Appendix K**.

Table 8 – Down Drain Hydraulic Summary

Down Drain	Surface Material	Depth *(ft)*	Bottom Width *(ft)*	Side Slopes *(XH:1V)*	Longitudinal Slope *(ft/ft)*	Q *(cfs)*	V *(fps)*
City of El Mirage Parcel	Riprap, D_{50}=6"	1.0	8	4	0.1574	13.2	5.2
Bool Property	Riprap, D_{50}=6"	1.0	8	4	0.3400	20.3	7.7
125th Avenue	Riprap, D_{50}=6"	1.0	8	4	0.0695	85.4	7.1

E. Storm Drain System Hydraulics

The portions of the storm drain systems that are being reconstructed or replaced with this project were modeled using Hydraflow. The pipe outlet velocity from this model was used in sizing the riprap aprons, and the hydraulic grade lines were shown on the design documents. Detailed model calculations are included in **Appendix L**.

F. Erosion Protection

1. Storm Drain and Culvert Outlets

The procedures embedded in the District's DDMSW software package were used to size the rock used at the storm drain and culvert outlets. The "Channel Bed on Straight Reach" selection was used in sizing the rock, as this most closely represents the condition of the flows as they enter the basin. Velocities used were referenced from the existing storm drain hydraulic models, as discussed in Section V.D, and from the HEC-RAS model for the cross section immediately downstream from the Cactus Road culvert and the basin outfall culvert. Based on the uncertainties in the hydrology for the storm drain systems entering the basin, grouted riprap aprons were used at these locations. The grouted riprap apron thickness was designed according to the methods in FWHA HEC-11. The 125th Avenue storm drain outlet resulted in the largest apron thickness of 18"; this riprap section was used for all storm drain outlets to simplify construction. A summary of the riprap sizing calculations are provided in **Table 9**, and DDMSW printouts are included in **Appendix M**.

Table 9 – Storm Drain and Culvert Riprap Apron Sizing Summary

Outlet Location	Q *(cfs)*	V *(fps)*	Calculated d_{50} *(in)*	Design d_{50} *(in)*	Calculated Rock Depth *(in)*	Design Rock Depth *(in)*
125th Avenue Storm Drain	157	12.5	25.6	--	17.3	18
Canterbury Drive Storm	89	7.1	8.3	--	12.4	18
El Mirage Water Campus	16	5.6	5.2	--	12.0	18
Cactus Road Culvert	104	6.4	6.7	16	12.1	--
LEMWB Outlet Culvert	191	8.7	12.4	16	13.2	--

Riprap apron extents were designed based on FHWA HEC-14 design manual, which recommends apron dimensions based on the riprap size, in Table 10.1 of that publication. Based on the dumped rock size of 16-inches, an apron length of 6 times the culvert diameter is recommended, with a depth 2.2 times the rock diameter. The design drawings show a typical apron depth of 36-inches.

2. *Down Drains*

The "Sloped Drop Structure/Rock Chute" procedure in DDMSW was used to size the rock for the down drains. A summary of the riprap sizing calculations are provided in **Table 10**, and DDMSW printouts are included in **Appendix M**.

Table 10 – Down Drain Riprap Sizing Calculations Summary

Down Drain	Surface Material	Q *(cfs)*	Bottom Width *(ft)*	Side Slopes *(XH:1V)*	Longitudinal Slope *(ft/ft)*	Calculated d_{50} *(in)*	Design d_{50} *(in)*
City of El Mirage Parcel	Riprap, D_{50}=6"	13.2	8	4	0.1574	4.1	6
Bool Property	Riprap, D_{50}=6"	20.3	8	4	0.3400	6.5	6
125th Avenue	Riprap, D_{50}=6"	85.4	8	4	0.0695	7.1	6

3. *Cactus Road Overtopping Flows*

The procedures embedded in the District's DDMSW software package were used to size the rock used at the Cactus Road low-flow crossing. Both the "Downstream of Grade Control" and "Sloped Drop Structure" methods were analyzed (DDMSW printouts are included in **Appendix M**). The average velocity and average flow width was taken from the HEC-RAS model for the basin system, and the slope for the sloped drop structure was taken as the maximum grade along the flow path at the riprap apron location. The results indicate a rock size of 11.5 inches using the "Downstream of Grade Control" method, and 14.0 inches using the "Sloped Drop Structure" method. To maintain simplicity on the project, the 16-inch rock section designed for the storm drain and culvert outlets will be used at the Cactus Road low-flow crossing.

G. *Existing Storm Drain Systems*

As described in **Section IV.B**, hydrologic data was not available for the existing storm drain systems. There have been no issues with the functionality of the existing storm drain systems, and the intent of this project is to match the capacity of any system modifications to the capacity of the existing system. The capacity for each storm drain was estimated using Bentley Systems FlowMaster V8i (2009) software.

The inlet capacities were estimated and summed in order to determine the maximum flow that could be expected in the system. This was then checked against the modeled hydraulic performance of the outlet pipe and bubble-up structure to provide a comparison point in determining a design flow rate.

The storm drain inlets are all proposed to be MAG Type D catch basins. A clogging factor of 50% was used for the grated inlet, and the full length of the opening was used in the calculations, assuming no clogging, in order to increase the safety factor in the capacity calculations. The inlet capacities were then calculated based on a flow-full gutter depth of 6-inches at the inlet, with flows not captured by the inlet passed to the next downstream inlet.

1. *Rancho El Mirage Unit II Parcel II – Phase 1*

This system intercepts storm water from catch basins in Canterbury Drive and Berry Lane, and outfalls to a bubble-up structure in the western portion of the existing basin. The system includes 5 catch basin inlets, 4 manholes, the bubble-up outlet structure, with pipe sizes ranging from 24-inch to 36-inch, as shown in **Figure 3**. The inlet capacities are listed in **Table 7**.

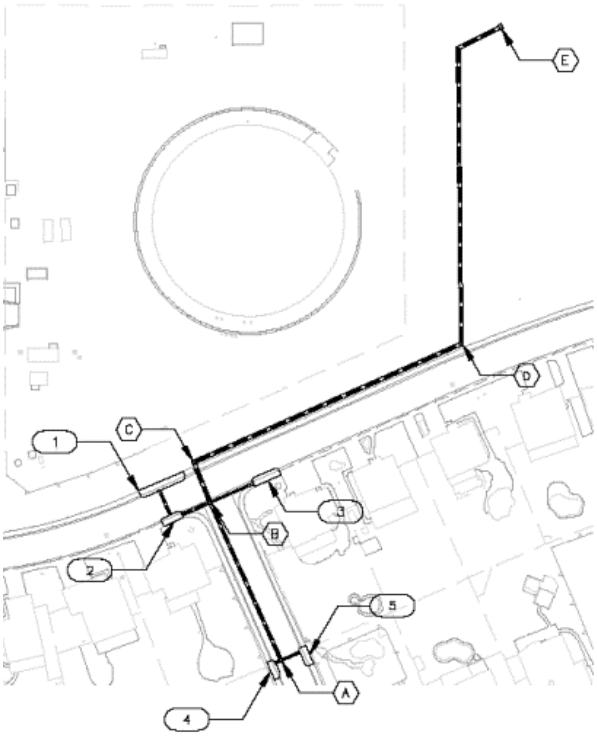

Figure 3 – Rancho El Mirage Unit II Parcel II – Phase 1 Storm Drain System

Table 11 – Rancho El Mirage Unit II Parcel II – Phase 1 Storm Drain Inlet Capacities

Inlet No	Curb Opening Length *(ft)*	Gutter Flow *(cfs)*	Inlet Flow *(cfs)*	Bypass Flow *(cfs)*	Downstream Inlet No
1	38.0	--	33	--	--
2	13.5	--	15	--	--
3	20.5	--	21	--	--
4	13.5	15	10	5	2
5	13.5	15	10	5	3
Total Intercepted Flow:			**89 cfs**		

The capacity of the bubble-up outlet structure was analyzed as a pressurized pipe, using the bubble-up structure top elevation (at elevation 1107.65') as the downstream condition, compared with upstream surcharge elevations (relative to the invert elevation of the upstream pipes draining to Manhole C) as described in **Table 8**. The outlet profile is shown in **Figure 4** and **Figure 5**.

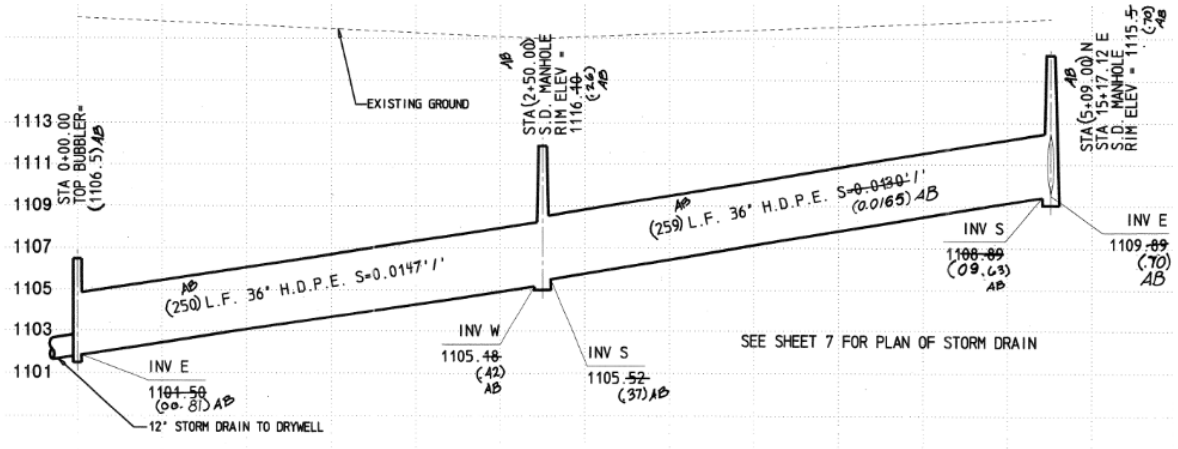

Figure 4 – Rancho El Mirage Unit II Parcel II – Phase 1 Storm Drain Outlet Profile

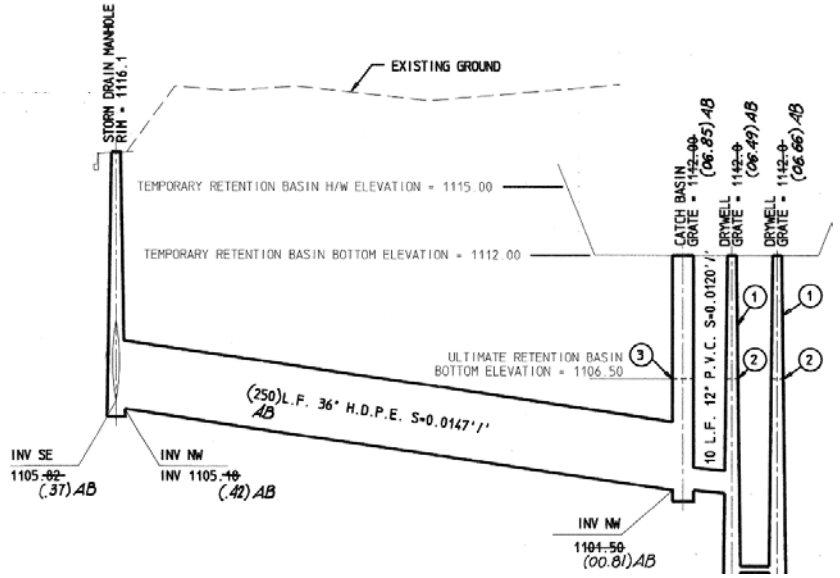

Figure 5 – Rancho El Mirage Unit II Parcel II – Phase 1 Storm Drain Outlet Profile

Table 12 – Rancho El Mirage Unit II Parcel II – Phase 1 Storm Drain Outlet Capacity

Surcharge Elevation *(ft)*	Relative Surcharge *(ft)*	Outlet Discharge *(cfs)*
1108.13	-1.5	45
1108.63	-1.0	65
1109.13	-0.5	80
1109.63	--	92
1110.13	+0.5	103

In addition to the surcharged pipe calculations, the full-flow capacity of the pipe segment between manholes D and E (shown on **Figure 3**) was calculated as 86-cfs. Based on these calculations, using the combined capacity of the storm drain system inlets of 89-cfs as a basis for design of the relocated outlet structure should not have a negative impact on the performance of the drainage system.

2. *Rancho El Mirage Unit II Parcel II – Phase 3*

This system intercepts storm water from catch basins in Laurel Lane, 125th Avenue, and Canterbury Drive, and outfalls to a bubble-up structure in the western portion of the existing basin. The system includes 10 catch basin inlets, 8 manholes, the bubble-up outlet structure, with pipe sizes ranging from 18-inch to 48-inch, as shown in **Figure 6**. The inlet capacities are listed in **Table 9**.

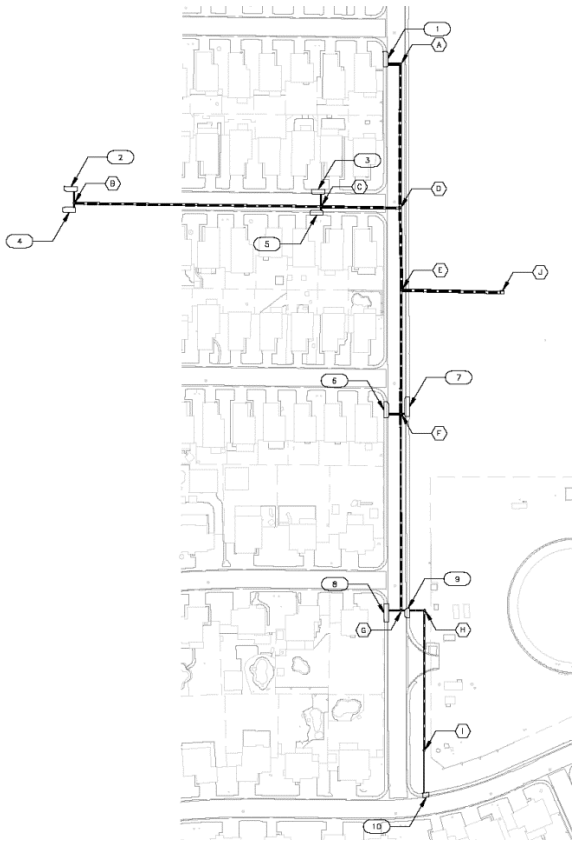

Figure 6 – Rancho El Mirage Unit II Parcel II – Phase 3 Storm Drain Map

Table 13 – Rancho El Mirage Unit II Parcel II – Phase 3 Storm Drain Inlet Capacities

Inlet No	Curb Opening Length *(ft)*	Gutter Flow *(cfs)*	Inlet Flow *(cfs)*	Bypass Flow *(cfs)*	Downstream Inlet No
1	13.5	33	16	17	6
2	9.5	38	13	25	3
3	9.5	25	12	13	6
4	9.5	41	16	25	5
5	9.5	25	12	13	6
6	20.5	--	21	--	--
7	20.5	--	21	--	--
8	24.0	--	23	--	--
9	13.5	--	15	--	--
10	6.5	21	8	13	Exits to Phase 1
Total Intercepted Flow			**157 cfs**		

The capacity of the bubble-up outlet structure was analyzed as a pressurized pipe, using the bubble-up structure top elevation (at elevation 1106.50') as the downstream condition, compared with upstream surcharge elevations (relative to the invert elevation of the upstream pipes draining to Manhole E) as described in **Table 10**. The outlet profile is shown in **Figure 7**.

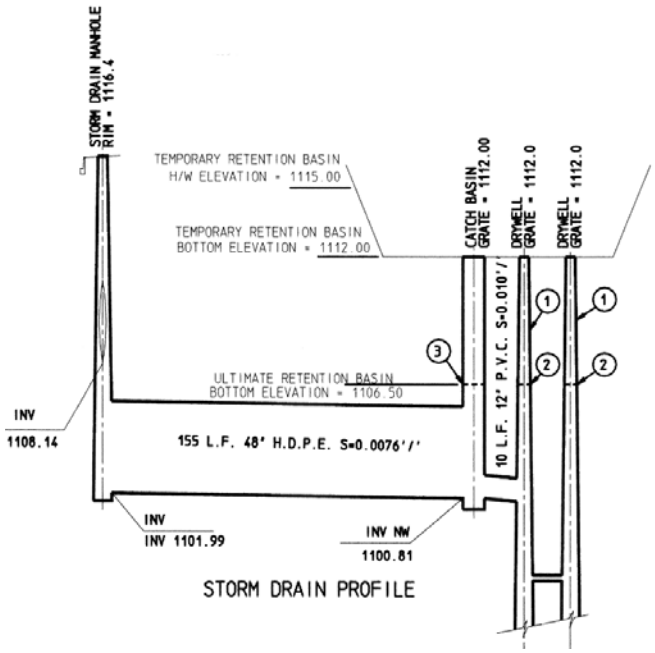

Figure 7 – Rancho El Mirage Unit II Parcel II – Phase 3 Storm Drain Outlet Profile

Table 14 – Rancho El Mirage Unit II Parcel II – Phase 3 Storm Drain Outlet Capacity

Surcharge Elevation *(ft)*	Relative Surcharge *(ft)*	Outlet Discharge *(cfs)*
1106.64	-1.5	43
1107.14	-1.0	91
1107.64	-0.5	122
1108.14	--	146
1108.64	+0.5	167
1109.14	+1.0	185

Based on these calculations, using the combined capacity of the storm drain system inlets of 157-cfs as a basis for design of the relocated outlet structure should not have a negative impact on the performance of the system.

VI. Landscape Irrigation System

EPG, Inc. is the designer of the landscape and irrigation system for this project. EPG has prepared a Technical Memorandum documenting their assumptions and design calculations. This memo is included in **Appendix N**.

VII. References

City of El Mirage. *Cactus Road: 125th Avenue to El Mirage Road - 100% Submittal.* Entellus, 2011.

City of El Mirage. *Canterbury Drive & Dietz-Crane Water Production Facilities: Phase II As-Built Drawings.* Malcolm Pirnie, Inc., 2001.

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Flood Control District of Maricopa County. *Lower El Mirage Wash Design Concept Report.* Aztec Engineering, 2011.

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Hancock Communities. *Rancho Mirage Unit II - Phase 1: As-Built Drawings.* Sage Engineering Corporation, 2001.

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Maricopa County Department of Transportation. *El Mirage Road: Peoria Avenue to Cactus Road - Pre-90% Drawings.* Premier Engineering, 2012.

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Appendix A

Project Coordination Meeting Minutes

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix, AZ 85009

CITY OF EL MIRAGE
12145 Grand Avenue
El Mirage, AZ 85335

MEETING MINUTES August 2, 2012

PROJECT NAME: Lower El Mirage Wash Basin (SW Corner of Cactus Road and El Mirage Road)

PURPOSE: Project Aesthetics Advisory Committee (PAAC) Meeting: 10:00AM – 11:30AM

LOCATION: Primrose Conference Room, City of El Mirage - City Hall
12145 Grand Avenue, El Mirage, Arizona 85335

Attendees: See attached sign-in sheet

Welcome/Introductions

Kevin Roberts, the consultant project manager, provided an overview of the project and the current status of the work to be performed. Kevin and Michael Duncan, the FCDMC's project manager, also discussed the project history including the previous studies performed and documented in a Design Concept Report, or DCR.

Landscape Planning Overview

Harry Cooper, the FCDMC's Landscape Architect, provided an overview of the PAAC meeting process, the FCDMC's landscape architecture policy related to why aesthetics and landscape is an important consideration for flood control projects, and the landscape-related items previously identified in the DCR.

Landscape Architecture Design

John Griffin, the consultant landscape architect, led an open discussion on the landscape components of the 40% design. This discussion is outlined below by subject with pertinent outcomes.

Parking – The PAAC expressed concern that the park activities would encourage traffic to enter the neighborhood and park along both Canterbury Drive and 125th Avenue. The added parked vehicles would greatly hinder the ingress and egress of large vehicles and trailers (which are common in this neighborhood) to and from the residential lots. They were strongly against such parking and asked that the team consider options for parking that would neither encourage an increase in neighborhood traffic nor on-street parking.

Resolution: Since this is a park activity issue, the team will pass this issue on to the City for their attention. The future parking area near 125th Avenue is intended to be accessed from Cactus Road through the

future commercial site. One option that was briefly discussed was encouraging parking on the City-owned 2-acre parcel along El Mirage Road.

Landscape Materials – The team provided graphics to the PAAC demonstrating the overall plant palette included in the DCR and asked the PAAC to confirm that this was the desired plant palette for the project. In general the PAAC confirmed that native and native-adapted flowering shrubs and grasses as depicted in the graphics were preferred. However, the PAAC questioned the use of prickly pear cactus in publicly accessible areas. The PAAC also questioned why Southern Live Oak was not included when they perceive it is a common species used in El Mirage and reflects the community's character.

Resolution: The design team will add Southern Live Oak to the plant palette. The team will also be selective in the use of cacti and limit the use of spiny or thorny plant material to areas where public access is discouraged.

Structural Aesthetic Treatment – The project will include a large headwall structure for the culvert crossing of El Mirage Road. There will also be three smaller headwalls (approx. 5-foot by 9-foot) on the project. The team provided two boards that illustrated potential aesthetic treatments for these headwalls.

One option to use gabions similar to what will be used at the Cactus Road crossing was considered favorable by one member of the PAAC. The gabion wall would discourage graffiti and blend in with other City of El Mirage projects in the area. The team pointed out that this may cost more than other options and asked for a second option in the event that the gabion treatment proved cost-prohibitive. The PAAC preferred the use of a formliner with the appearance of a dry-stacked stone wall over the other options demonstrated.

The team discussed color for the formliner. With the formliner option, a single color intended to blend the wall into the surrounding setting would be selected. The team agreed it should be coordinated with the chosen rock color. One option for the smaller headwalls would be to use painted concrete and with the intent of receding visually into the landscape.

Resolution: The design team will compare costs for the gabion wall option with the formliner option. The final design will reflect the PAAC's preferences along with project budget constraints.

Decomposed Granite – The team discussed options for decomposed granite or rock mulch. The team identified the existing well site as being dressed with a ½" minus Madison Gold decomposed granite which the PAAC specifically did not want to see on the basin project. The PAAC expressed a preference for a brown colored rock as well as using a larger aggregate than ½" minus rock. The team discussed options that would not include a 3" rock mulch, but perhaps an average size around 1" instead of the ½" or 3" rock.

Resolution: The team will specify a brown rock for the project such as the 'Express Brown' or 'Table Mesa Brown' selected by the PAAC. The team will identify a final rock size based on the project needs. Subsequent discussion suggests the ADOT mulch, which is called "1-1/4" minus", would both meet erosion protection needs as well as satisfy the PAAC's desires.

Appendix B

Pothole Data

VACUUM EXCAVATION DATA SHEET

BASEPLANS U.S.A.
2750 S. Hardy Dr. Suite 2, Tempe, AZ 85282 - Ph: (480)784-4452

Date:	12-Jul-12	FCDMC Proj. Name:	Lower El Mirage Wash Basin
BasePlans Job No.:	317-03	FCDMC Contract No:	2010C006

Pothole No.:	1
Type of Utility:	Centurylink Telephone
Approx. Outside Diameter of Pipe:	2-6"
Structure/Pipe Material Composition:	Plastic conduit
Approx. Width of Conduit/Slurry Bank:	1.25
Config. of Non-encased Multi Conduit System:	side by side

Station		Offset		Surface	Top	Bottom
Given	Actual	Given	Actual	Elev.	Elev.	Elev.
n/a	n/a	n/a	n/a	1113.03	1108.95	1108.45

Pothole Coordinates:	N= 392,978.421, E= 575,816.606
Surface to Top:	4.08
Surface to Bottom:	4.58
Benchmark Provided #1:	Control Point No. 126 Fnd 1/2" rebar, Sta. 186+89.42, 63.43' Rt Elev. = 1106.12
Benchmark Provided #2:	Control Point No. 140 Fnd 1/2" rebar, Sta. 240+87.45, 52.64' Rt Elev. = 1116.98

Swing Ties:	Distance	Description	Approx. Location
No. 1	67.11	Guardrail post	N=392972.527, E= 575883.452
No. 2	76.42	Guardrail post	N=392941.336, E= 575883.423
No. 3	47.90	Water valve	N=392975.173, E= 575864.397

Remarks:	All data is in English and based on information received from FCDMC.

VACUUM EXCAVATION DATA SHEET

BASEPLANS U.S.A.
2750 S. Hardy Dr. Suite 2, Tempe, AZ 85282 - Ph: (480)784-4452

Date:	12-Jul-12	FCDMC Proj. Name:	Lower El Mirage Wash Basin
BasePlans Job No.:	317-03	FCDMC Contract No:	2010C006

Pothole No.:	2
Type of Utility:	Sanitary sewer
Approx. Outside Diameter of Pipe:	21"
Structure/Pipe Material Composition:	Plastic
Approx. Width of Conduit/Slurry Bank:	n/a
Config. of Non-encased Multi Conduit System:	n/a

Station		Offset		Surface	Top	Bottom
Given	Actual	Given	Actual	Elev.	Elev.	Elev.
n/a	n/a	n/a	n/a	1112.93	1101.23	n/a

Pothole Coordinates:	N=392975.842, E= 575825.511
Surface to Top:	11.70
Surface to Bottom:	n/a
Benchmark Provided #1:	Control Point No. 126 Fnd 1/2" rebar, Sta. 186+89.42, 63.43' Rt Elev. = 1106.12
Benchmark Provided #2:	Control Point No. 140 Fnd 1/2" rebar, Sta. 240+87.45, 52.64' Rt Elev. = 1116.98

Swing Ties:	Distance	Description	Approx. Location
No. 1	58.04	Guardrail post	N=392972.527, E= 575883.452
No. 2	67.46	Guardrail post	N=392941.336, E= 575883.423
No. 3	38.89	Water valve	N=392975.173, E= 575864.397

Remarks:	All data is in English and based on information received from FCDMC.

VACUUM EXCAVATION DATA SHEET

BASEPLANS U.S.A.
2750 S. Hardy Dr. Suite 2, Tempe, AZ 85282 - Ph: (480)784-4452

Date:	12-Jul-12	FCDMC Proj. Name:	Lower El Mirage Wash Basin
BasePlans Job No.:	317-03	FCDMC Contract No:	2010C006

Pothole No.:	3
Type of Utility:	Water
Approx. Outside Diameter of Pipe:	12"
Structure/Pipe Material Composition:	Concrete
Approx. Width of Conduit/Slurry Bank:	n/a
Config. of Non-encased Multi Conduit System:	n/a

Station		Offset		Surface	Top	Bottom
Given	Actual	Given	Actual	Elev.	Elev.	Elev.
n/a	n/a	n/a	n/a	1112.61	1108.36	n/a

Pothole Coordinates:	N= 392963.077, E= 575864.163
Surface to Top:	4.25
Surface to Bottom:	n/a
Benchmark Provided #1:	Control Point No. 126 Fnd 1/2" rebar, Sta. 186+89.42, 63.43' Rt Elev. = 1106.12
Benchmark Provided #2:	Control Point No. 140 Fnd 1/2" rebar, Sta. 240+87.45, 52.64' Rt Elev. = 1116.98

Swing Ties:	Distance	Description	Approx. Location
No. 1	21.48	Guardrail post	N=392972.527, E= 575883.452
No. 2	29.05	Guardrail post	N=392941.336, E= 575883.423
No. 3	12.10	Water valve	N=392975.173, E= 575864.397

Remarks:	All data is in English and based on information received from FCDMC.

VACUUM EXCAVATION DATA SHEET

BASEPLANS U.S.A.
2750 S. Hardy Dr. Suite 2, Tempe, AZ 85282 - Ph: (480)784-4452

Date:	12-Jul-12	FCDMC Proj. Name:	Lower El Mirage Wash Basin
BasePlans Job No.:	317-03	FCDMC Contract No:	2010C006

Pothole No.:	4
Type of Utility:	Telephone
Approx. Outside Diameter of Pipe:	2-4", 1-2"
Structure/Pipe Material Composition:	Plastic conduit
Approx. Width of Conduit/Slurry Bank:	1.17
Config. of Non-encased Multi Conduit System:	side by side

Station		Offset		Surface	Top	Bottom
Given	Actual	Given	Actual	Elev.	Elev.	Elev.
n/a	n/a	n/a	n/a	1110.30	1107.30	1106.97

Pothole Coordinates:	N= 392960.204, E= 575900.806
Surface to Top:	3.00
Surface to Bottom:	3.33
Benchmark Provided #1:	Control Point No. 126 Fnd 1/2" rebar, Sta. 186+89.42, 63.43' Rt Elev. = 1106.12
Benchmark Provided #2:	Control Point No. 140 Fnd 1/2" rebar, Sta. 240+87.45, 52.64' Rt Elev. = 1116.98

Swing Ties:	Distance	Description	Approx. Location
No. 1	21.28	Guardrail post	N=392972.527, E= 575883.452
No. 2	25.65	Guardrail post	N=392941.336, E= 575883.423
No. 3	39.37	Water valve	N=392975.173, E= 575864.397

Remarks:	All data is in English and based on information received from FCDMC.

VACUUM EXCAVATION DATA SHEET

BASEPLANS U.S.A.
2750 S. Hardy Dr. Suite 2, Tempe, AZ 85282 - Ph: (480)784-4452

Date:	12-Jul-12	FCDMC Proj. Name:	Lower El Mirage Wash Basin
BasePlans Job No.:	317-03	FCDMC Contract No:	2010C006

Pothole No.:	5
Type of Utility:	Cox Cable TV Cable appears to be buried in concrete next to the guardrail
Approx. Outside Diameter of Pipe:	1"
Structure/Pipe Material Composition:	Direct bury cable
Approx. Width of Conduit/Slurry Bank:	n/a
Config. of Non-encased Multi Conduit System:	n/a

Station		Offset		Surface	Top	Bottom
Given	Actual	Given	Actual	Elev.	Elev.	Elev.
n/a	n/a	n/a	n/a	1112.04	1110.04	n/a

Pothole Coordinates:	N=392963.332, E= 575885.828
Surface to Top:	2.00
Surface to Bottom:	n/a
Benchmark Provided #1:	Control Point No. 126 Fnd 1/2" rebar, Sta. 186+89.42, 63.43' Rt Elev. = 1106.12
Benchmark Provided #2:	Control Point No. 140 Fnd 1/2" rebar, Sta. 240+87.45, 52.64' Rt Elev. = 1116.98

Swing Ties:	Distance	Description	Approx. Location
No. 1	9.50	Guardrail post	N=392972.527, E= 575883.452
No. 2	22.13	Guardrail post	N=392941.336, E= 575883.423
No. 3	24.49	Water valve	N=392975.173, E= 575864.397

Remarks:	All data is in English and based on information received from FCDMC.

VACUUM EXCAVATION DATA SHEET

BASEPLANS U.S.A.
2750 S. Hardy Dr. Suite 2, Tempe, AZ 85282 - Ph: (480)784-4452

Date:	12-Jul-12	FCDMC Proj. Name:	Lower El Mirage Wash Basin
BasePlans Job No.:	317-03	FCDMC Contract No:	2010C006

Pothole No.:	6
Type of Utility:	Storm drain
Approx. Outside Diameter of Pipe:	36"
Structure/Pipe Material Composition:	Concrete
Approx. Width of Conduit/Slurry Bank:	n/a
Config. of Non-encased Multi Conduit System:	n/a

Station		Offset		Surface	Top	Bottom
Given	Actual	Given	Actual	Elev.	Elev.	Elev.
n/a	n/a	n/a	n/a	1116.58	1111.50	n/a

Pothole Coordinates:	N= 393093.138, E= 574546.338
Surface to Top:	5.08
Surface to Bottom:	n/a
Benchmark Provided #1:	Control Point No. 126 Fnd 1/2" rebar, Sta. 186+89.42, 63.43' Rt Elev. = 1106.12
Benchmark Provided #2:	Control Point No. 140 Fnd 1/2" rebar, Sta. 240+87.45, 52.64' Rt Elev. = 1116.98

Swing Ties:	Distance	Description	Approx. Location
No. 1	22.73	End of irrigation pipe	N= 393114.016, E= 574555.327
No. 2	8.97	Set 60d nail	N= 393091.720, E= 574537.486
No. 3	10.57	Set 60d nail	N= 393094.190, E= 574556.851

Remarks:	All data is in English and based on information received from FCDMC.

BP Form No. 1009 Rev. 4/99

VACUUM EXCAVATION DATA SHEET

BASEPLANS U.S.A.
2750 S. Hardy Dr. Suite 2, Tempe, AZ 85282 - Ph: (480)784-4452

Date:	12-Jul-12	FCDMC Proj. Name:	Lower El Mirage Wash Basin
BasePlans Job No.:	317-03	FCDMC Contract No:	2010C006

Pothole No.:	7 - NOT FOUND, could not detect end of waterline stub, no Bluestake
Type of Utility:	Water
Approx. Outside Diameter of Pipe:	n/a
Structure/Pipe Material Composition:	n/a
Approx. Width of Conduit/Slurry Bank:	n/a
Config. of Non-encased Multi Conduit System:	n/a

Station		Offset		Surface	Top	Bottom
Given	Actual	Given	Actual	Elev.	Elev.	Elev.
n/a	n/a	n/a	n/a	n/a	n/a	n/a

Pothole Coordinates:	n/a
Surface to Top:	n/a
Surface to Bottom:	n/a
Benchmark Provided #1:	Control Point No. 126 Fnd 1/2" rebar, Sta. 186+89.42, 63.43' Rt Elev. = 1106.12
Benchmark Provided #2:	Control Point No. 140 Fnd 1/2" rebar, Sta. 240+87.45, 52.64' Rt Elev. = 1116.98

Swing Ties:	Distance	Description	Approx. Location
No. 1			
No. 2			
No. 3			

Remarks:	All data is in English and based on information received from FCDMC.

VACUUM EXCAVATION DATA SHEET

BASEPLANS U.S.A.
2750 S. Hardy Dr. Suite 2, Tempe, AZ 85282 - Ph: (480)784-4452

Date:	12-Jul-12	FCDMC Proj. Name:	Lower El Mirage Wash Basin
BasePlans Job No.:	317-03	FCDMC Contract No:	2010C006

Pothole No.:	8
Type of Utility:	Electric
Approx. Outside Diameter of Pipe:	6"
Structure/Pipe Material Composition:	Plastic
Approx. Width of Conduit/Slurry Bank:	n/a
Config. of Non-encased Multi Conduit System:	n/a

Station		Offset		Surface	Top	Bottom
Given	Actual	Given	Actual	Elev.	Elev.	Elev.
n/a	n/a	n/a	n/a	1117.12	1112.12	n/a

Pothole Coordinates:	N= 393354.986, E= 574187.425
Surface to Top:	5.00
Surface to Bottom:	n/a
Benchmark Provided #1:	Control Point No. 126 Fnd 1/2" rebar, Sta. 186+89.42, 63.43' Rt Elev. = 1106.12
Benchmark Provided #2:	Control Point No. 140 Fnd 1/2" rebar, Sta. 240+87.45, 52.64' Rt Elev. = 1116.98

Swing Ties:	Distance	Description	Approx. Location
No. 1	39.52	Back of sidewalk	N= 393340.142, E= 574175.674
No. 2	88.37	Back of sidewalk	N= 393355.286, E= 574175.569
No. 3	141.60	Back of sidewalk	N= 393370.843, E= 574175.314

Remarks:	All data is in English and based on information received from FCDMC.

VACUUM EXCAVATION DATA SHEET

BASEPLANS U.S.A.
2750 S. Hardy Dr. Suite 2, Tempe, AZ 85282 - Ph: (480)784-4452

Date:	12-Jul-12	FCDMC Proj. Name:	Lower El Mirage Wash Basin
BasePlans Job No.:	317-03	FCDMC Contract No:	2010C006

Pothole No.: 9

Type of Utility: Water - NOT FOUND, no waterline found at this location, no visible evidence
Bluestake markings indicate no waterlines

Approx. Outside Diameter of Pipe: n/a

Structure/Pipe Material Composition: n/a

Approx. Width of Conduit/Slurry Bank: n/a

Config. of Non-encased Multi Conduit System: n/a

Station		Offset		Surface	Top	Bottom
Given	Actual	Given	Actual	Elev.	Elev.	Elev.
n/a	n/a	n/a	n/a	n/a	n/a	n/a

Pothole Coordinates: n/a

Surface to Top: n/a
Surface to Bottom: n/a

Benchmark Provided #1: Control Point No. 126
Fnd 1/2" rebar, Sta. 186+89.42, 63.43' Rt
Elev. = 1106.12

Benchmark Provided #2: Control Point No. 140
Fnd 1/2" rebar, Sta. 240+87.45, 52.64' Rt
Elev. = 1116.98

Swing Ties:	Distance	Description	Approx. Location
No. 1			
No. 2			
No. 3			

Remarks: All data is in English and based on information received from FCDMC.

Appendix C

Current FEMA FIRM Panel

additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles, Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' National Geodetic Vertical Datum of 1929 (NGVD 29). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was *Arizona State Plane Zone 3176 (central Arizona)*. The **horizontal datum** was *NAD83, GRS80 spheroid*. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the *National Geodetic Vertical Datum of 1929*. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

Spatial Reference System Division
National Geodetic Survey, NOAA
Silver Spring Metro Center
1315 East-West Highway
Silver Spring, Maryland 20910
(310) 713-3191

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from multiple sources. Base map files were provided in digital format by Maricopa County. Orthophoto images were produced at a scale of 1:6000 using HARN for control. Aerial photography is dated December 2000 to December 2002.

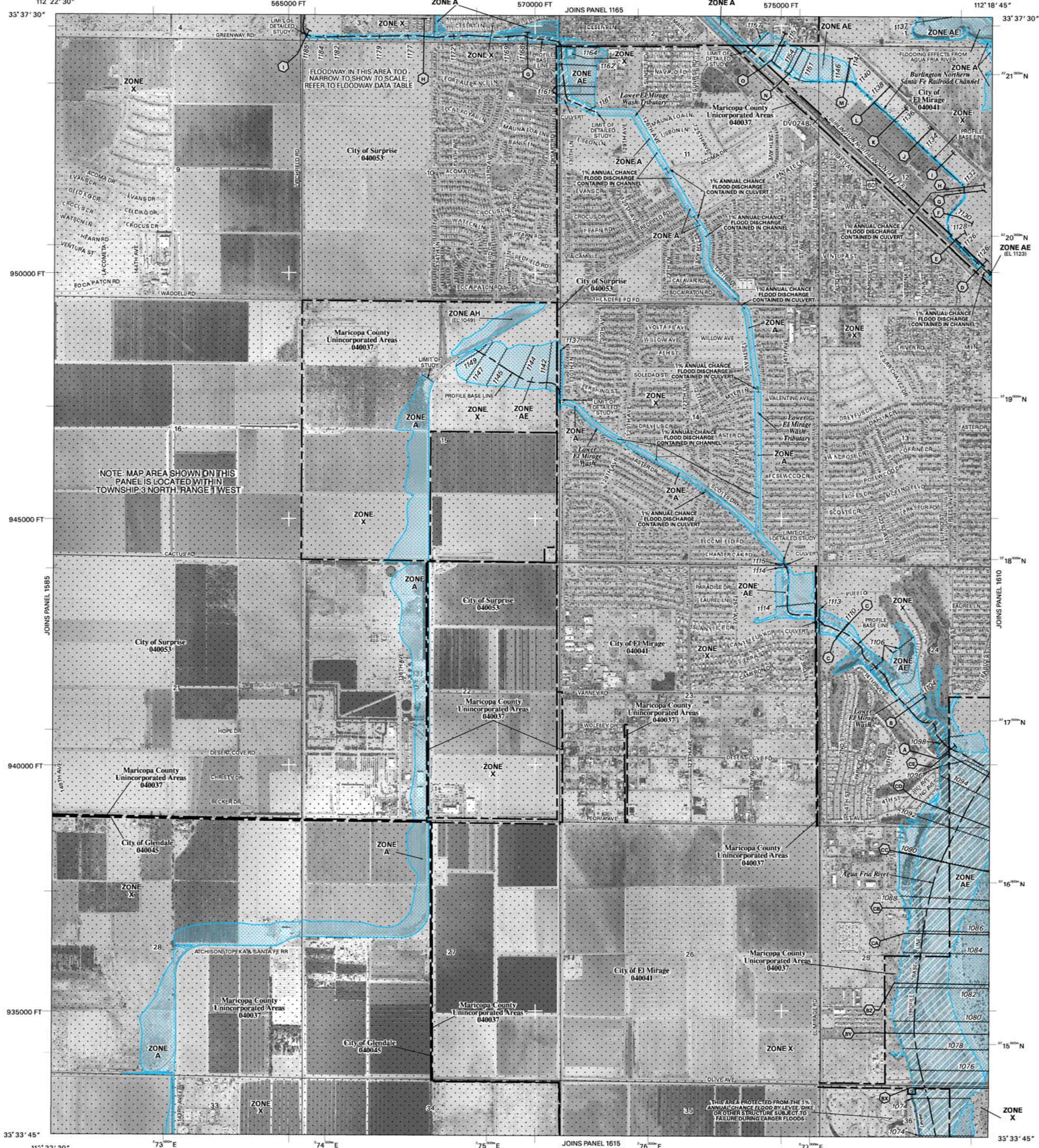
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMAMAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.



Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones, and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

~~~513~~~ Base Flood Elevation line and value; elevation in feet*

(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the National Geodetic Vertical Datum of 1929

(A)——(A) Cross section line

(2)······(2) Transect line

112° 07′ 08″, 33° 25′ 41″ Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere.

[42]76[000m]E 1000-meter Universal Transverse Mercator grid tick values zone 12

875000 FT 5000-foot grid tick values: Arizona State Plane coordinate system, central zone (FIPSZONE 3176) NAD83 (Transverse Mercator)

×DV2313 Bench mark (see explanation in Notes to Users section of this FIRM panel)

• M1.5 River Mile

MAP REPOSITORY

Refer to Repositories Listing on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

April 15, 1988

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

September 4, 1991, December 3, 1993, September 30, 1995, July 19, 2001

September 30, 2005 - to update corporate limits, to change Base Flood Elevations, to add Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to change zone designations, to add roads and road names, to incorporate previously issued Letters of Map Revision, and to incorporate previously issued Letters of Map Amendment.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

...ONAL FLOOD INSURANCE PROGRAM

PANEL 1605J

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

PANEL 1605 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL MIRAGE, CITY OF	040041	1605	J
GLENDALE, CITY OF	040045	1605	J
MARICOPA COUNTY	040037	1605	J
SURPRISE, CITY OF	040053	1605	J

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

04013C1605J

MAP REVISED
~~~

Appendix D.1

Post Project Stage Storage Discharge Data

Stage Storage Discharge Data for Proposed Basin - El Mirage Rd to Cactus Rd

100% Design Grading/60-inch Outlet Pipe

	PROPOSED BASIN				COMBINED WITH U/S CHANNEL
PT No.	WSE	V (CY)	V (ac-ft)	Q (cfs)*	V (ac-ft)
1	1105.606	-	-	0.0	-
2	1106.720	193.32	0.12	7.7	0.12
3	1107.720	1451.94	0.90	25.5	0.90
4	1108.720	6751.96	4.19	51.6	4.21
5	1109.720	19057.82	11.81	84.0	12.06
6	1110.220	27405.56	16.99	101.6	17.60
7	1110.720	36719.29	22.76	119.6	23.89
8	1111.220	46806.03	29.01	137.4	30.80
9	1111.720	57599.87	35.70	154.7	38.25
10	1111.920	62036.02	38.45	161.3	41.32
11	1112.120	66527.91	41.24	167.7	44.43
12	1112.320	71076.68	44.06	173.7	47.58
13	1112.520	75681.99	46.91	179.3	50.78
14	1112.720	80344.52	49.80	184.2	54.01
15	1112.820	82698.86	51.26	187.1	55.64
16	1112.920	85066.56	52.73	189.2	57.29
17	1113.020	87446.79	54.20	192.3	58.94
18	1113.120	89839.60	55.69	194.4	60.60
19	1113.220	92244.93	57.18	197.4	62.27
20	1113.320	94662.72	58.68	199.6	63.95

*Discharge Data Obtained from HY8 Runs Using Proposed Culvert Design Information

Appendix D.2

Pre Project Stage Storage Discharge Data

PRE PROJECT CONDITIONS - WEST CACTUS BASIN

Client: Flood Control District of Maricopa County
Project: FCD2008C014, WA#1 - Lower El Mirage Wash DCR, Phase 1
Description: **Existing condition stage-storage-discharge data**
AZTEC Project No.: AZE0913-02
Date: 5/19/10 By: dtp

Stage - Discharge Data for West Cactus Basin

Stage (feet)	Water Surface Elevation	Discharge, in cfs			Storage Volume ac-ft
		Total	Culvert	Weir	
0	1103	0	0	0	0
1	1104	0	0	0	0.66
2	1105	0	0	0	4.1
4.2	1107.2	0	0	0	20
5	1108	25	25	0	27.6
7	1110	225	225	0	47.2
8	1111	375	375	0	57.8
8.7	1111.7	430	430	0	67
9	1112	474	470	4	69.2
9.3	1112.3	526	500	26	74
9.7	1112.7	633	535	98	78
10	1113	737	550	187	81.7
10.2	1113.2	835	565	270	85
10.4	1113.4	955	575	380	87
10.6	1113.6	1117	580	537	90
10.8	1113.8	1362	605	757	93

Elevation datum = NGVD29

Stage - Storage - Discharge Data for West Cactus Basin
CODE into HEC-1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
SV	0	0.66	4.1	20	27.6	47.2	57.8	67	69.2	74
SV	78	81.7	85	87	90					
SQ	0	0	0	0	25	225	375	430	474	526
SQ	633	737	835	955	1117					
SE	1103	1104	1105	1107.2	1108	1110	1111	1111.7	1112	1112.3
SE	1112.7	1113	1113.2	1113.4	1113.6					

This data is a result of the following:

Storage data from: existing surface created from 2010 FCDMC survey data, supplemented with basin bottom spot elevation from the 2004 Stanley survey data.

Discharge data from: 2-10'x3' rcb combined with weir overflow data for controlling section as determined from 2010 survey data. Overflow weir data generated using COE uneven weir program.

PRE PROJECT CONDITIONS - UPSTREAM OF CACTUS ROAD

Client: Flood Control District of Maricopa County
Project: FCD2008C014, WA#1 - Lower El Mirage Wash DCR, Phase 1
Description: **Existing condition stage-storage-discharge data**
AZTEC Project No.: AZE0913-02
Date: 5/19/10 By: dtp

Stage - Discharge Data for Cactus Road

Stage (feet)	Water Surface Elevation	Discharge, in cfs			Storage Volume ac-ft
		Total	Culvert	Weir	
0	1105.16	0	0	0	0
1.84	1107	9	9	0	0.03
4.84	1110	41	41	0	1.63
8.84	1114	81	81	0	11.41
9.02	1114.18	82	82	0	12
9.24	1114.4	118	85	33	12.6
9.44	1114.6	147.5	86.5	61	13.3
9.64	1114.8	184	88	96	14
9.84	1115	230	90	140	14.62
10.04	1115.2	294	92	202	15.3
10.34	1115.5	422	95	327	16.4
10.84	1116	717	98	619	18.09
11.34	1116.5	1123	105	1018	20.2

Elevation datum = NGVD29

Stage - Storage - Discharge Data for Cactus Road
CODE into HEC-1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
SV	0	0.03	1.63	11.41	12	12.6	13.3	14	14.62	15.3
SV	16.4	18.09	20.2							
SQ	0	9	41	81	82	118	147.5	184	230	294
SQ	422	717	1123							
SE	1105.2	1107	1110	1114	1114.2	1114.4	1114.6	1114.8	1115	1115.2
SE	1115.5	1116	1116.5							

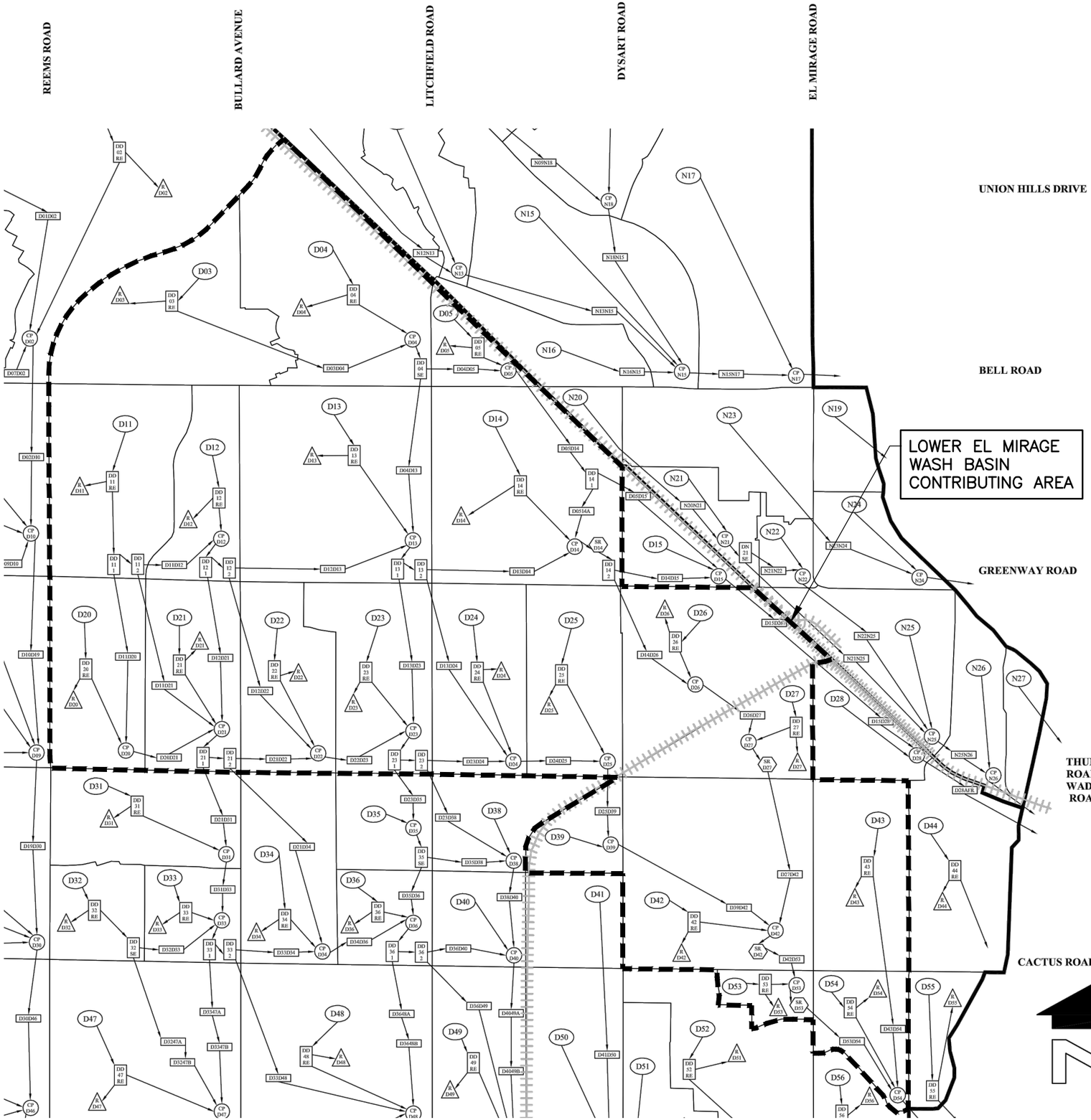
This data is a result of the following:

Storage data from: existing surface created from 2010 FCDMC survey data, supplemented with 2004 Stanley survey data north of Cactus Road.

Discharge data from: 3-24" rcp combined with weir overflow data for controlling section as determined from 2010 survey data. Overflow weir data generated using COE uneven weir program.

Appendix E.1

Hydrologic Modeling Data and Results



LEGEND

- HEC–1 REGION BOUNDARY
- MAJOR BASIN 02 BOUNDARY
- HYDROLOGIC SUBBASIN BOUNDARY
- W## — HYDROLOGIC SUBBASIN LABEL
- CP W## — CONCENTRATION POINT LABEL
- W##W## — ROUTE LABEL
- DW ## SW — DIVERSION LABEL
- R W## — RETENTION LABEL
- SR W## — STORAGE ROUTE LABEL
- RAILROAD

REFERENCE:
FIGURE 8 – CAPITAL IMPROVEMENT PROJECT CONDITIONS HYDROLOGY HEC–1 SCHEMATIC
FINAL HYDROLOGY REPORT, LOOP 303/WHITE TANKS ADMPU AREA HYDROLOGIC ANALYSIS, SEPTEMBER 2008
HDR, INC.

3000’ 0’ 3000’ 6000’
SCALE: 1”= 3000 FEET

Flood Control District of Maricopa County

Dibble Engineering

TITLE

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
LOWER EL MIRAGE WASH BASIN
Int. of Cactus Road & El Mirage Road | El Mirage, Arizona

SUBMITTAL

issued for: rev date

KEY MAP

PROJECT NUMBER
101120.01

Fig E.1
Contributing Watershed HEC-1 Schematic

Project

Reference	LEMWB_POST_CIP_FC
Title	100% Lower El Mirage Wash Basin Post Project Design Hydrology Dated 1/23/13
Location	Maricopa County
Agency	Flood Control District of Maricopa County

Project Defaults

Model	HEC1
Soils Agency	FCDMC
Land Use Agency	FCDMC
Rainfall	NOAA14
Roads Agency	MCDOT

HEC-1 Defaults

Unit Hydrograph	S-Graph
Loss Method	Green-Ampt
Duration	24 Hour
Tabulation Interval	5
No. Ordinates	2000
Output	3

Comments

Post project conditions model for LEMW Basin design. W/Future culvert at Cacuts Rd. Model origin is Loop 303/White Tanks ADMPU AHA-Exist Cond W/CIP, Major Basin 01. See Hydrology Data for revisions.

Major Basin	Area (sq mi)	Storm	Duration	Tab Interval	Ordinates	Output	Description
01	25.4480	Multiple	24 Hour	5	2,000	3	Major Basin 01

ID	Method	Duration	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
DEFAULT	NOAA14	5 MIN	0.248	0.337	0.405	0.497	0.568	0.641
	NOAA14	5 MIN	0.248	0.337	0.405	0.497	0.568	0.641
	NOAA14	10 MIN	0.377	0.513	0.617	0.757	0.865	0.975
	NOAA14	10 MIN	0.377	0.513	0.617	0.757	0.865	0.975
	NOAA14	15 MIN	0.468	0.636	0.765	0.938	1.072	1.209
	NOAA14	15 MIN	0.468	0.636	0.765	0.938	1.072	1.209
	NOAA14	30 MIN	0.630	0.857	1.030	1.264	1.443	1.628
	NOAA14	30 MIN	0.630	0.857	1.030	1.264	1.443	1.628
	NOAA14	1 HOUR	0.779	1.060	1.275	1.564	1.786	2.015
	NOAA14	1 HOUR	0.779	1.060	1.275	1.564	1.786	2.015
	NOAA14	2 HOUR	0.876	1.175	1.404	1.717	1.957	2.208
	NOAA14	2 HOUR	0.876	1.175	1.404	1.717	1.957	2.208
	NOAA14	3 HOUR	0.914	1.208	1.441	1.763	2.022	2.295
	NOAA14	3 HOUR	0.914	1.208	1.441	1.763	2.022	2.295
	NOAA14	6 HOUR	1.050	1.354	1.596	1.929	2.190	2.464
	NOAA14	6 HOUR	1.050	1.354	1.596	1.929	2.190	2.464
	NOAA14	12 HOUR	1.163	1.480	1.730	2.067	2.325	2.593
	NOAA14	12 HOUR	1.163	1.480	1.730	2.067	2.325	2.593
	NOAA14	24 HOUR	1.471	1.903	2.244	2.717	3.089	3.480
	NOAA14	24 HOUR	1.471	1.903	2.244	2.717	3.089	3.480

ID	Type	Area (sq mi)	Discharge cfs 2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Major Basin 01								
D03	Hydrograph	0.720						931
RD03	Diversion	0.720						931
DD03RE	Hydrograph	0.720						100
D03D04	Routed	0.720						61
D04	Hydrograph	0.890						1,115
RD04	Diversion	0.890						1,082
DD04RE	Hydrograph	0.890						831
CPD04	Combined	1.610						813
DD04S	Diversion	1.610						471
DD04SE	Hydrograph	1.610						342
D04D05	Routed	1.610						288
D05	Hydrograph	0.160						319
RD05	Diversion	0.160						134
DD05RE	Hydrograph	0.160						319
CPD05	Combined	1.780						317
D05D14	Routed	1.780						255
DD141S	Diversion	1.780						133
DD141	Hydrograph	1.780						122
D05D15	Routed	1.780						129
D11	Hydrograph	0.660						758
RD11	Diversion	0.660						728
DD11RE	Hydrograph	0.660						698
DD111S	Diversion	0.660						574
DD111	Hydrograph	0.660						124
DD112S	Diversion	0.660						45
DD112	Hydrograph	0.660						79
D11D12	Routed	0.660						46
D12	Hydrograph	0.350						236
RD12	Diversion	0.350						236
DD12RE	Hydrograph	0.350						209
CPD12	Combined	1.010						244
DD121S	Diversion	1.010						105
DD121	Hydrograph	1.010						139
DD122S	Diversion	1.010						58
DD122	Hydrograph	1.010						81
D12D13	Routed	1.010						47
D13	Hydrograph	1.030						1,106
RD13	Diversion	1.030						495
DD13RE	Hydrograph	1.030						1,106
DD04SE	Hydrograph	1.610						471
D04D13	Routed	1.610						156
CPD13	Combined	3.650						1,106
DD131S	Diversion	3.650						195
DD131	Hydrograph	3.650						902
DD132S	Diversion	3.650						383
DD132	Hydrograph	3.650						518
D13D14	Routed	3.650						440
D14	Hydrograph	0.940						1,065
RD14	Diversion	0.940						1,065
DD14RE	Hydrograph	0.940						384
DD141	Hydrograph	1.780						133
D0514A	Routed	1.780						107
CPD14	Combined	4.760						822
DD142S	Diversion	4.760						521

ID	Type	Area (sq mi)	Discharge cfs 2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
DD142	Hydrograph	4.760						301
D14D15	Routed	4.760						247
D15	Hydrograph	0.220						412
CPD15	Combined	4.980						406
D15D26	Routed	4.980						345
D15D28	Routed	4.980						325
D28	Hydrograph	0.250						415
CPD28	Combined	5.230						460
D28AFR	Routed	5.230						446
D26	Hydrograph	0.640						960
RD26	Diversion	0.640						960
DD26RE	Hydrograph	0.640						18
DD142	Hydrograph	4.760						521
D14D26	Routed	4.760						446
CPD26	Combined	5.400						448
D26D27	Routed	5.400						418
D27	Hydrograph	0.320						485
RD27	Diversion	0.320						122
DD27RE	Hydrograph	0.320						485
CPD27	Combined	5.720						477
SRD27	Routed	5.720						477
D27D42	Routed	5.720						398
D20	Hydrograph	0.500						573
RD20	Diversion	0.500						573
DD20RE	Hydrograph	0.500						7
DD111	Hydrograph	0.660						574
D11D20	Routed	0.660						303
CPD20	Combined	1.160						300
D20D21	Routed	1.160						221
D21	Hydrograph	0.500						548
RD21	Diversion	0.500						548
DD21RE	Hydrograph	0.500						6
DD112	Hydrograph	0.660						45
D11D21	Routed	0.660						20
DD121	Hydrograph	1.010						105
D12D21	Routed	1.010						82
CPD21	Combined	2.000						287
DD211S	Diversion	2.000						196
DD211	Hydrograph	2.000						91
DD212S	Diversion	2.000						49
DD212	Hydrograph	2.000						42
D21D22	Routed	2.000						29
D22	Hydrograph	0.450						547
RD22	Diversion	0.450						547
DD22RE	Hydrograph	0.450						5
DD122	Hydrograph	1.010						58
D12D22	Routed	1.010						43
CPD22	Combined	2.460						65
D22D23	Routed	2.460						60
D23	Hydrograph	0.540						539
RD23	Diversion	0.540						539
DD23RE	Hydrograph	0.540						34
DD131	Hydrograph	3.650						195
D13D23	Routed	3.650						120
CPD23	Combined	5.640						119
DD231S	Diversion	5.640						12

ID	Type	Area (sq mi)	Discharge cfs 2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
DD231	Hydrograph	5.640						107
DD232S	Diversion	5.640						13
DD232	Hydrograph	5.640						94
D23D24	Routed	5.640						79
D24	Hydrograph	0.490						521
RD24	Diversion	0.490						521
DD24RE	Hydrograph	0.490						2
DD132	Hydrograph	3.650						383
D13D24	Routed	3.650						286
CPD24	Combined	6.130						325
D24D25	Routed	6.130						294
D25	Hydrograph	0.500						557
RD25	Diversion	0.500						557
DD25RE	Hydrograph	0.500						12
CPD25	Combined	6.630						294
D25D39	Routed	6.630						274
D39	Hydrograph	0.180						108
CPD39	Combined	6.810						342
D39D42	Routed	6.810						277
D42	Hydrograph	0.990						1,278
RD42	Diversion	0.990						1,278
DD42RE	Hydrograph	0.990						112
CPD42	Combined	9.870						654
D53	Hydrograph	0.120						176
RD53	Diversion	0.120						176
DD53RE	Hydrograph	0.120						
CPD53	Combined	9.990						654
SRD53	Routed	9.990						191
D53D54	Routed	9.990						191
D43	Hydrograph	0.500						628
RD43	Diversion	0.500						628
DD43RE	Hydrograph	0.500						56
D43D54	Routed	0.500						28
D54	Hydrograph	0.270						327
RD54	Diversion	0.270						81
DD54RE	Hydrograph	0.270						327
CPD54	Combined	10.760						317

Area ID	Sub Basin Parameters								Rainfall Losses				
	Area (sq mi)	Length (mi)	Slope (ft/mi)	S-Graph	Lca (mi)	Lag (min)	Velocity (f/s)	Kn	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)
Major Basin ID: 01													
D03	0.723	1.11	25.2	VALLEY	0.69	21.10	4.62	0.030	0.23	0.25	4.80	0.38	35
D04	0.891	1.62	24.7	VALLEY	0.90	24.40	5.84	0.027	0.22	0.27	5.70	0.26	36
D05	0.163	0.76	26.2	VALLEY	0.40	10.90	6.19	0.022	0.11	0.26	4.90	0.39	73
D06	0.463	1.14	20.0	VALLEY	1.06	25.40	3.95	0.029	0.22	0.19	6.60	0.18	32
D07	0.886	2.46	19.6	VALLEY	1.03	34.90	6.19	0.030	0.21	0.23	6.20	0.22	27
D08	0.514	1.48	20.7	VALLEY	0.95	39.60	3.28	0.043	0.28	0.26	5.40	0.29	30
D09	0.265	1.31	20.8	VALLEY	0.64	22.70	5.07	0.030	0.25	0.25	5.70	0.24	35
D10	0.628	1.65	21.4	VALLEY	0.84	26.40	5.49	0.029	0.24	0.26	5.80	0.23	34
D11	0.662	1.90	18.5	VALLEY	0.70	28.60	5.85	0.031	0.25	0.25	5.60	0.27	37
D12	0.347	1.45	19.1	AGRICULTURE	0.86	48.30	2.64	0.054	0.24	0.25	5.80	0.28	33
D13	1.030	1.82	19.8	AGRICULTURE	0.50	22.00	7.26	0.028	0.29	0.33	4.90	0.31	17
D14	0.942	1.82	21.9	VALLEY	0.96	27.70	5.77	0.028	0.23	0.26	5.10	0.33	37
D15	0.220	0.87	25.9	VALLEY	0.44	14.00	5.46	0.026	0.19	0.15	7.00	0.16	52
D16	0.517	1.13	31.9	AGRICULTURE	0.56	59.50	1.67	0.095	0.48	0.25	4.90	0.44	5
D17	0.197	0.76	26.2	VALLEY	0.36	14.20	4.73	0.030	0.25	0.25	3.95	0.58	30
D18	0.199	0.83	24.0	VALLEY	0.33	14.50	5.07	0.030	0.25	0.25	4.60	0.40	30
D19	0.506	1.50	22.9	AGRICULTURE	0.77	26.80	4.92	0.032	0.27	0.26	4.65	0.39	26
D20	0.498	1.58	21.1	VALLEY	0.68	24.80	5.58	0.030	0.26	0.26	4.65	0.39	30
D21	0.496	1.52	19.8	VALLEY	0.80	26.40	5.07	0.030	0.25	0.25	4.65	0.40	32
D22	0.454	1.47	22.6	VALLEY	0.75	23.90	5.39	0.029	0.24	0.25	4.70	0.38	32
D23	0.541	1.70	21.7	VALLEY	0.77	31.10	4.81	0.035	0.27	0.27	5.00	0.33	26
D24	0.492	1.48	20.2	VALLEY	0.75	29.60	4.39	0.035	0.27	0.25	5.10	0.32	28
D25	0.497	1.55	17.6	VALLEY	0.73	26.30	5.20	0.030	0.25	0.25	4.80	0.36	30
D26	0.642	0.96	16.7	VALLEY	0.31	18.10	4.66	0.034	0.24	0.25	5.80	0.24	34
D27	0.316	0.91	5.0	VALLEY	0.25	16.30	4.92	0.027	0.20	0.24	4.90	0.36	42
D28	0.255	0.77	22.1	VALLEY	0.36	13.70	4.91	0.028	0.22	0.25	4.50	0.45	36
D29	0.509	1.13	33.4	AGRICULTURE	0.56	58.90	1.68	0.095	0.47	0.25	4.60	0.51	4
D30	0.914	1.36	36.7	AGRICULTURE	0.68	69.10	1.73	0.098	0.49	0.25	4.80	0.46	
D31	0.497	1.33	29.8	VALLEY	0.57	23.10	5.06	0.034	0.30	0.29	4.70	0.37	17
D32	0.248	0.99	20.6	VALLEY	0.50	18.60	4.67	0.030	0.25	0.25	4.70	0.38	35
D33	0.250	0.92	24.7	VALLEY	0.48	17.20	4.71	0.030	0.25	0.25	4.80	0.36	35
D34	0.500	1.17	28.3	AGRICULTURE	0.57	64.70	1.59	0.099	0.50	0.25	4.65	0.49	
D35	0.254	0.84	19.7	AGRICULTURE	0.23	43.40	1.71	0.099	0.50	0.25	4.55	0.53	
D36	0.247	0.89	18.7	VALLEY	0.32	25.60	3.05	0.050	0.32	0.25	4.80	0.39	25
D38	0.321	0.98	10.2	AGRICULTURE	0.75	81.50	1.06	0.099	0.50	0.25	5.10	0.40	

* Non default value

Area ID	Sub Basin Parameters								Rainfall Losses				
	Area (sq mi)	Length (mi)	Slope (ft/mi)	S-Graph	Lca (mi)	Lag (min)	Velocity (f/s)	Kn	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)
Major Basin ID: 01													
D39	0.182	0.50	18.6	AGRICULTURE	0.27	38.60	1.14	0.100	0.50	0.25	5.60	0.33	
D40	0.242	0.81	19.7	AGRICULTURE	0.22	42.50	1.68	0.100	0.50	0.25	5.40	0.35	
D41	0.253	0.57	28.0	AGRICULTURE	0.20	33.20	1.52	0.099	0.49	0.15	7.30	0.16	1
D42	0.994	1.46	22.4	VALLEY	0.57	22.30	5.76	0.030	0.24	0.24	5.20	0.30	32
D43	0.500	1.33	20.0	VALLEY	0.59	22.30	5.26	0.030	0.25	0.25	4.70	0.37	33
D44	0.535	1.45	13.8	VALLEY	0.71	25.60	4.97	0.029	0.26	0.26	3.85	0.58	23
D45	0.488	1.33	32.2	VALLEY	0.51	40.50	2.90	0.063	0.36	0.25	4.80	0.41	19
D46	0.918	1.81	27.8	VALLEY	1.20	36.00	4.43	0.035	0.26	0.24	4.70	0.37	29
D47	0.997	1.98	15.6	VALLEY	0.87	64.00	2.71	0.061	0.36	0.25	4.65	0.44	19
D48	0.998	2.05	15.6	VALLEY	1.00	53.90	3.35	0.048	0.33	0.25	4.80	0.36	14
D49	0.489	1.24	20.6	VALLEY	0.51	17.70	6.17	0.026	0.12	0.25	4.90	0.40	37
D50	0.505	1.34	19.3	AGRICULTURE	0.77	79.00	1.50	0.095	0.48	0.15	7.00	0.18	3
D51	0.287	0.83	16.3	VALLEY	0.34	17.80	4.11	0.034	0.30	0.15	7.60	0.11	18
D52	0.587	1.63	12.7	VALLEY	0.63	28.70	5.00	0.032	0.28	0.25	5.40	0.27	23
D53	0.118	0.66	19.5	VALLEY	0.33	13.80	4.22	0.030	0.31	0.32	4.60	0.36	11
D54	0.271	1.07	18.7	VALLEY	0.44	18.60	5.06	0.030	0.20	0.27	4.45	0.50	14

Flood Control District of Maricopa County
Drainage Design Management System
HEC-1 STORAGE FACILITIES
Project Reference: LEMWB_POST_CIP_FC

Storage Basin ID: **SRD27**

			1	2	3	4	5	6	7	8	9	10
Elevation Top of Dam:	0.00	**Volume (ac-ft)**							22.80	51.41		
Length of Dam:	0.00	**Discharge (cfs)**		52	202	415	658	906	1,127	2,999		
Discharge Coefficient:	0.00	**Elevation (ft)**	1,140.0	1,142.0	1,144.0	1,146.0	1,148.0	1,150.0	1,152.0	1,154.0	-	-
Weir Coefficient:	0.00											

	11	12	13	14.	15	16	17	18	19	20
Volume (ac-ft)	-	-	-	-	-	-	-	-	-	-
Discharge (cfs)	-	-	-	-	-	-	-	-	-	-
Elevation (ft)	-	-	-	-	-	-	-	-	-	-

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Peak Volume (ac-ft)						
Peak Stage (ft)						1,146.51

Storage Basin ID: **SRD53**

			1	2	3	4	5	6	7	8	9	10
Elevation Top of Dam:	0.00	**Volume (ac-ft)**		0.12	0.90	4.21	12.06	17.60	23.89	30.80	38.25	41.32
Length of Dam:	0.00	**Discharge (cfs)**		8	26	52	84	102	120	137	155	161
Discharge Coefficient:	0.00	**Elevation (ft)**	1,105.6	1,106.7	1,107.7	1,108.7	1,109.7	1,110.2	1,110.7	1,111.2	1,111.7	1,111.9
Weir Coefficient:	0.00											

	11	12	13	14.	15	16	17	18	19	20
Volume (ac-ft)	44.43	47.58	50.78	54.01	55.64	57.29	58.94	60.60	62.27	63.95
Discharge (cfs)	168	174	179	184	187	189	192	194	197	200
Elevation (ft)	1,112.1	1,112.3	1,112.5	1,112.7	1,112.8	1,112.9	1,113.0	1,113.1	1,113.2	1,113.3

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Peak Volume (ac-ft)						58.25
Peak Stage (ft)						1,112.96

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1****************************************                                    ****************************************
 *                                      *                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *             JUN   1998               *                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                    *         609 SECOND STREET            *
 *                                      *                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   24JAN13  TIME  18:33:13  *                                    *          (916) 756-1104              *
 *                                      *                                    *                                      *
 ****************************************                                    ****************************************

                                        X     X  XXXXXXX   XXXXX           X
                                        X     X  X        X     X         XX
                                        X     X  X        X               X
                                        XXXXXXX  XXXX     X        XXXXX  X
                                        X     X  X        X               X
                                        X     X  X        X     X         X
                                        X     X  XXXXXXX   XXXXX         XXX


 THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

 THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
 THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
 NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
 DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
 KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                              HEC-1 INPUT                                                    PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            1           ID        Flood Control District of Maricopa County
            2           ID        LEMWB_POST_CIP_FC - Lower El Mirage Wash Basin Post Project Conditions
            3           ID        With Future Cactus Rd Culvert Design Hydrology
            4           ID        100 YEAR
            5           ID        24 Hour Storm
            6           ID        Unit Hydrograph: S-Graph
            7           ID        1/23/2013
            8           ID
            9           ID    MODEL ORIGIN: LOOP 303/WHITE TANKS ADMPU
           10           ID    FCDMC CONTRACT 2007C031
           11           ID    BY HDR ENGINEERING (#79902)
           12           ID    EXISTING CONDITIONS WITH CIP-AUGUST 2009
           13           ID    MAJOR BASIN 01
           14           ID             HDR FILE NAME: ECIP-MB1.DAT
           15           ID
           16           ID      **************************************************************************
           17           ID
           18           ID      FOLLOWING ARE THE CHANGES BY FCDMC:
           19           ID      1. Removed SRD14. - by JWH 10-16-09
           20           ID      FILE NAME: WT1EC01.DAT
           21           ID
           22           ID      For details concerning changes to this HEC-1 model, please contact
           23           ID      FCDMC, H&H Branch.
           24           ID
           25           ID      **************************************************************************
           26           ID
           27           ID      DIBBLE revisions for FCD2011C004, Work Assignment No. 1 are listed below:
           28           ID      1. Extracted portion of Major Basin D draining to CPD54 (Lower El Mirage)
           29           ID      2. Removed opertation SRD25
           30           ID      3. Removed operation SRD42 to account for future large diameter culvert
           31           ID         at Cactus Road
           32           ID      4. Removed operation D42D53 (new basin occupies what was a channel route)
           33           ID      5. Revised D53D54 (golf coarse route) operation to without CIP condition
           34           ID      6. Revised operation SRD53 (model new west cactus basin)
           35           ID         Note: SRD53 (west cactus basin) contains the current 100% design
           36           ID         - Basin grading, dated 1/11/2013
           37           ID         - Outlet is a single new 60" pipe
           38           ID             - Volume includes ponded storage u/s of Cactus Rd
           39           ID
           40           ID      Filename: LEMWB_POST_CIP_FC.DAT              DaTE: 1/23/2013
           41           ID
           42           IT       5       0       0    2000
           43           IN      15
           44           IO       3
                       *DIAGRAM
                       *
           45           JD   3.480  0.0001
           46           PC   0.000   0.002   0.005   0.008   0.011   0.014   0.017   0.020   0.023   0.026
           47           PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056   0.060
           48           PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
           49           PC   0.110   0.115   0.120   0.126   0.133   0.140   0.147   0.155   0.163   0.172
           50           PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
           51           PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
           52           PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
           53           PC   0.913   0.918   0.922   0.926   0.930   0.934   0.938   0.942   0.946   0.950
1                                              HEC-1 INPUT                                                    PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

           54           PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977   0.980
           55           PC   0.983   0.986   0.989   0.992   0.995   0.998   1.000
           56           JD   3.306    10.0
           57           JD   3.132    30.0
           58           JD   3.028    60.0
           59           JD   2.965    90.0
           60           JD   2.927   120.0
           61           JD   2.895   150.0
           62           JD   2.805   300.0
                       *
                       *

           63           KK     D03   BASIN
           64           KM        BASIN BOUNDARY FROM KINGSWOOD PARKE
           65           BA   0.723
           66           LG    0.23    0.25    4.80    0.38      35
           67           UI       0     123     481     721    1150    1206     816     545     244     150
           68           UI      70      35      35       0       0       0       0       0       0       0
           69           UI       0       0       0       0       0       0       0       0       0       0
           70           UI       0       0       0       0       0       0       0       0       0       0
```

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  71          UI      0       0       0       0       0       0       0       0       0       0
              *

  72          KK  DD03RE  DIVERT
  73          KM        Master Drainage Report Update for Kingswood Parke Phase One
  74          KM        (excess retention provided for future development was
  75          KM        subtracted from total retenttion provided)
  76          DT    RD03    51.7     0.0
  77          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
  78          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

  79          KK  D03D04   ROUTE
  80          KM        Cross-section: Cross-section determined from aerial
  81          KM        Manning's N Value: street and earth with sparse trees and shrubs
  82          RS       4    FLOW
  83          RC   0.032   0.013   0.032    4458  0.0038    0.00
  84          RX  100.00  108.00  119.00  119.10  155.00  155.10  160.00  165.00
  85          RY  1000.3 1000.00  999.50  999.00  999.70 1000.20 1000.30 1000.40
              *

  86          KK     D04   BASIN
  87          KM        BASIN BOUNDARY FROM GRAND VILLAGE NORTH/SOUTH, BELLAZANO CONDOS,
  88          KM        HOPI VILLAGE, PIMA VILLAGE, SUN VILLAGE, ZUNI VILLAGE, PUEBLO VILLAGE,
  89          KM        GRAND AVE PROFF PLAZA AND GRAND AVE CHANNEL
  90          BA   0.891
  91          LG    0.22    0.27    5.70    0.26      36
  92          UI       0     123     429     682     934    1451    1138     831     585     291
  93          UI     187     115      38      38      38       0       0       0       0       0
  94          UI       0       0       0       0       0       0       0       0       0       0
  95          UI       0       0       0       0       0       0       0       0       0       0
  96          UI       0       0       0       0       0       0       0       0       0       0
              *
1                                        HEC-1 INPUT                                          PAGE  3

            LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  97          KK  DD04RE  DIVERT
  98          KM        Master Drainage Report Update for Kingswood Parke Phase One (Sun Village
  99          KM        Final Drainage Report for Grand Village Center Phase 6, Drainage Report
 100          KM        Grand Point Plaza, Final Drainage Report -Revised  For Grand Pointe
 101          KM        Plaza Montessori of Surprise SP06-41
 102          DT    RD04    46.9     0.0
 103          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 104          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 105          KK   CPD04 COMBINE
 106          HC       2   1.614
              *

 107          KK  DD04SE  DIVERT
 108          KM        Split flow Bell Rd at Litchfield Rd intersection
 109          DT   DD04S     0.0     0.0
 110          DI     0.0    86.1   158.5   512.0   904.0  1940.0     0.0     0.0     0.0     0.0
 111          DQ     0.0     0.0    42.4   259.0   534.0  1278.0     0.0     0.0     0.0     0.0
              *

 112          KK  D04D05   ROUTE
 113          KM        Cross-section: Cross-section determined from aerial
 114          KM        Manning's N Value: street and earth with sparse trees and shrubs
 115          RS       3    FLOW
 116          RC   0.032   0.013   0.013    2993  0.0027    0.00
 117          RX  100.00  119.00  135.00  135.10  180.00  180.10  181.00  182.00
 118          RY  1000.0  999.80  999.50  999.00  999.80 1000.30 1000.40 1000.50
              *

 119          KK     D05   BASIN
 120          KM        BASIN BOUNDARY FROM WAL MART STORE
 121          KM        SURPRISE TOWN CENTER AND GRAND AVE CHANNEL
 122          BA   0.163
 123          LG    0.11    0.26    4.90    0.39      73
 124          UI       0     127     387     470     197      58      15       0       0       0
 125          UI       0       0       0       0       0       0       0       0       0       0
 126          UI       0       0       0       0       0       0       0       0       0       0
 127          UI       0       0       0       0       0       0       0       0       0       0
 128          UI       0       0       0       0       0       0       0       0       0       0
              *

 129          KK  DD05RE  DIVERT
 130          KM        West Point Towne Center Final Master Infrastructure Drainage Report
 131          DT    RD05     8.2     0.0
 132          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 133          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *
1                                        HEC-1 INPUT                                          PAGE  4

            LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 134          KK   CPD05 COMBINE
 135          HC       2   1.777
              *

 136          KK  D05D14   ROUTE
 137          KM        Cross-section: Cross-section determined from aerial, assumed
 138          KM        3' depth / Manning's N Value: earth with grass and forbs
 139          RS       2    FLOW
 140          RC   0.032   0.032   0.032    3385  0.0053    0.00
 141          RX  100.00  101.00  102.00  122.00  142.00  162.00  163.00  164.00
 142          RY  1000.0  999.90  999.80  996.80  996.70  999.80  999.90 1000.00
              *

 143          KK   DD141  DIVERT
 144          KM
 145          DT  DD141S     0.0     0.0
 146          DI     0.0   122.0   500.0  1000.0     0.0     0.0     0.0     0.0     0.0     0.0
 147          DQ     0.0     0.0   378.0   878.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 148          KK  D05D15   ROUTE
 149          KM        Cross-section: Cross-section determined from aerial, assumed
 150          KM        3' depth  / Manning's N Value: concrete
 151          RS       8    FLOW
 152          RC   0.016   0.016   0.016    4588  0.0044    0.00
 153          RX  100.00  101.00  102.00  127.00  131.00  140.00  141.00  142.00
```

```
 154          RY  1000.0  999.90  999.80  996.80  996.70  999.80  999.90 1000.00
              *

 155          KK     D11   BASIN
 156          KM        BASIN BOUNDARY FROM ORCHIDS DEVELOPMENT
 157          KM        AND  GREENWAY ROAD DRAINAGE REPORT BY CMX (2008)
 158          BA   0.662
 159          LG    0.25    0.25    5.60    0.27      37
 160          UI       0      78     212     386     499     683     948     708     543     408
 161          UI     261     135     102      67      24      24      24      24       0       0
 162          UI       0       0       0       0       0       0       0       0       0       0
 163          UI       0       0       0       0       0       0       0       0       0       0
 164          UI       0       0       0       0       0       0       0       0       0       0
              *

 165          KK  DD11RE  DIVERT
 166          KM        Final Drainage Report for Parkway Bank, Drainage Report for Deer Valley
 167          KM        Credit Union Final Drainage Report for Jiffy Lube at Bell and Reems
 168          KM        for The Orchard Estates Apartments, Drainage Report
 169          KM        for Mountainside Fitness Center Lot 7 a
 170          DT    RD11    32.4     0.0
 171          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 172          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *
1                                        HEC-1 INPUT                                          PAGE  5

            LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 173          KK   DD111  DIVERT
 174          KM        Greenway at Parkview intersection split flow
 175          DT  DD111S     0.0     0.0
 176          DI     0.0    33.8   453.4  1486.3  2998.5     0.0     0.0     0.0     0.0     0.0
 177          DQ     0.0    25.6   376.5  1210.3  2419.3     0.0     0.0     0.0     0.0     0.0
              *

 178          KK   DD112  DIVERT
 179          KM        Greenway at Parkview intersection split flow
 180          DT  DD112S     0.0     0.0
 181          DI     0.0     8.2    77.0   276.0   579.1     0.0     0.0     0.0     0.0     0.0
 182          DQ     0.0     5.4    35.1    78.9   133.0     0.0     0.0     0.0     0.0     0.0
              *

 183          KK  D11D12   ROUTE
 184          KM        Cross-section: Cross-section determined from aerial
 185          KM        Manning's N Value: clean earth; straight
 186          RS       2    FLOW
 187          RC   0.022   0.022   0.022    2668  0.0037    0.00
 188          RX  100.00  124.00  154.00  155.00  156.00  157.00  158.00  159.00
 189          RY  1208.0 1203.00 1208.00 1208.10 1208.20 1208.30 1208.40 1208.50
              *

 190          KK     D12   BASIN
 191          KM        BASIN BOUNDARY FROM ORCHIDS PARK
 192          KM        AND  GREENWAY ROAD DRAINAGE REPORT BY CMX (2008)
 193          BA   0.347
 194          LG    0.24    0.25    5.80    0.28      33
 195          UI       0      26      26      55     112     153     167     211     223     223
 196          UI     210     185     198     139     145     103      85      78      61      46
 197          UI      39      33      26      24      19      15      15      15       4       3
 198          UI       3       3       3       3       3       3       3       3       3       3
 199          UI       3       3       3       3       0       0       0       0       0       0
              *

 200          KK  DD12RE  DIVERT
 201          KM        Final Drainage Report for Residence Inn by Marriot
 202          KM        Final Drainage Report for The Orchards Parcel 5
 203          KM        (Includes Parcels 9,11,12 and 1/2 of 8), Final Drainage Report for
 204          KM        Stadium Village (South) Residences
 205          KM        Final Drainage Report for Stadium Village Residences
 206          DT    RD12    15.3     0.0
 207          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 208          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 209          KK   CPD12 COMBINE
 210          HC       2   1.009
              *
1                                        HEC-1 INPUT                                          PAGE  6

            LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 211          KK   DD121  DIVERT
 212          KM        Greenway at Bullard intersection split flow
 213          DT  DD121S     0.0     0.0
 214          DI     0.0    68.7   371.0  1186.5  2407.4     0.0     0.0     0.0     0.0     0.0
 215          DQ     0.0    19.7   166.4   705.0  1553.4     0.0     0.0     0.0     0.0     0.0
              *

 216          KK   DD122  DIVERT
 217          KM        Greenway at Bullard intersection split flow
 218          DT  DD122S     0.0     0.0
 219          DI     0.0    48.9   204.6   481.5   854.0     0.0     0.0     0.0     0.0     0.0
 220          DQ     0.0    24.3    82.0   159.0   251.4     0.0     0.0     0.0     0.0     0.0
              *

 221          KK  D12D13   ROUTE
 222          KM        Cross-section: determined from aerial and contours
 223          KM        Manning's N Value: earth with sparse trees and shrubs for left
 224          KM        overbank and main channel, right overbank is pavement
 225          RS      10    FLOW
 226          RC   0.032   0.032   0.013    5345  0.0031    0.00
 227          RX  100.00  100.10  100.20  155.00  198.00  205.00  215.00  220.00
 228          RY  1000.2 1000.10 1000.00  998.00  998.40  998.50  998.60  998.70
              *

 229          KK     D13   BASIN
 230          KM        BASIN BOUNDARY FROM GREENWAY ROAD DRAINAGE REPORT BY CMX (2008)
 231          BA   1.030
 232          LG    0.29    0.33    4.90    0.31      17
 233          UI       0     187     635    1136    1450    1305    1090     762     495     293
 234          UI     195     139      98      46      22      22      22      22      22      22
 235          UI       0       0       0       0       0       0       0       0       0       0
 236          UI       0       0       0       0       0       0       0       0       0       0
 237          UI       0       0       0       0       0       0       0       0       0       0
              *
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238          KK  DD13RE  DIVERT
239          KM        Final Drainage Report for Surprise Festival, Final Drainage Report
240          KM        for The City at Surprise Office Building, Final Drainage Report for
241          KM        Surprise Tennis Center, Final Drainage Report for City of Surprise
242          KM        Central Utility Plant, Final Drainage Report for Hear
243          DT    RD13    17.1     0.0
244          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
245          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

246          KK  DD04SERETRIEVE
247          DR   DD04S
             *
1                                        HEC-1 INPUT                                                PAGE  7

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


248          KK  D04D13   ROUTE
249          KM        Cross-section: Cross-section determined from aerial
250          KM        Manning's N Value: Natural desert wash, sheet flow
251          RS      13    FLOW
252          RC   0.040   0.040   0.040    5483  0.0031    0.00
253          RX  100.00  101.00  102.00  150.00  155.00  700.00  710.00  720.00
254          RY 1000.0  999.90  999.80  997.80  997.90  999.80  999.90 1000.00
             *

255          KK   CPD13 COMBINE
256          HC       3   3.653
             *

257          KK   DD131  DIVERT
258          KM        Greenway at Litchfield intersection split flow
259          DT  DD131S     0.0     0.0
260          DI     0.0   519.2   917.3  1650.7  2842.4     0.0     0.0     0.0     0.0     0.0
261          DQ     0.0    18.8   121.1   423.4   996.3     0.0     0.0     0.0     0.0     0.0
             *

262          KK   DD132  DIVERT
263          KM        Greenway at Litchfield intersection split flow
264          DT  DD132S     0.0     0.0
265          DI     0.0   500.4   796.2  1227.2  1846.1     0.0     0.0     0.0     0.0     0.0
266          DQ     0.0   112.4   318.0   584.2   899.4     0.0     0.0     0.0     0.0     0.0
             *

267          KK  D13D14   ROUTE
268          KM        Cross-section: Cross-section determined from FCDMC 69
269          KM        Manning's N Value: earth with grass and forbs
270          RS       5    FLOW
271          RC   0.025   0.025   0.025    5304  0.0015    0.00
272          RX  100.00  120.00  122.40  140.40  158.40  176.40  176.80  196.80
273          RY 1175.5 1175.40 1175.00 1172.00 1171.90 1175.00 1175.40 1175.50
             *

274          KK     D14   BASIN
275          KM        BASIN BOUNDARY FROM WEST POINT DEVELOPMENT AND GRANDE AVE CHANNEL
276          BA   0.942
277          LG    0.23    0.26    5.10    0.33      37
278          UI       0     115     326     583     757    1079    1353     984     745     547
279          UI     300     193     123      66      35      35      35       0       0       0
280          UI       0       0       0       0       0       0       0       0       0       0
281          UI       0       0       0       0       0       0       0       0       0       0
282          UI       0       0       0       0       0       0       0       0       0       0
             *

283          KK  DD14RE  DIVERT
284          KM        West Point Towne Center Final Master Infrastructure Drainage Report
285          DT    RD14    63.4     0.0
286          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
287          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
             *
1                                        HEC-1 INPUT                                                PAGE  8

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


288          KK   DD141RETRIEVE
289          DR  DD141S
             *

290          KK  D0514A   ROUTE
291          KM        Cross-section: Cross-section determined from aerial
292          KM        Manning's N Value: street and ROW
293          KM        Route is from DD141 diversion to CPD14
294          RS       3    FLOW
295          RC   0.032   0.013   0.032    3147  0.0051    0.00
296          RX  100.00  120.00  140.00  140.10  200.00  200.10  220.00  240.00
297          RY 1000.0  999.50 1000.00  999.50  999.50 1000.00  999.50 1000.00
             *

298          KK   CPD14 COMBINE
299          HC       3   4.758
             *
             *
             *    Removed SRD 14 from schematic to show no storage routing per
             *    site visit by AMM  -  FCDMC/JWH 10-19-09
             *
             * KK SRD14STORAGE
             * KM      Storage in basin at Greenway and Dysart
             * KM      Volume estimated from topo
             * KO
             * RS     1    STOR
             * SV          0.30    4.10   17.00   40.40   95.20
             * SQ         23.60   83.80  162.00  645.50 2369.50
             * SE1164.0 1165.00 1166.00 1167.00 1168.00 1169.00
             * ST
             *                                                                  *

300          KK   DD142  DIVERT
301          KM        Greenway at Dysart intersection split flow
302          DT  DD142S     0.0     0.0
303          DI     0.0   295.5   693.0  1325.3  2531.5     0.0     0.0     0.0     0.0     0.0
304          DQ     0.0   269.3   457.1   770.3  1405.9     0.0     0.0     0.0     0.0     0.0
             *

305          KK  D14D15   ROUTE
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306          KM        Cross section: Cross-section determined from  aerial, 1/2 street section
307          KM        Manning's N Value: street, clean earth
308          RS       3    FLOW
309          RC   0.022   0.013   0.013    3351  0.0029    0.00
310          RX  100.00  100.10  110.00  110.10  120.00  125.00  133.90  134.00
311          RY  1003.0  999.80  999.70  999.20  999.40  999.50  999.70 1000.50
             *

312          KK     D15   BASIN
313          KM         BASIN BOUNDARY FROM SUCCESS SCHOOL
314          BA   0.220
315          LG    0.19    0.15    7.00    0.16      52
316          UI       0     101     306     560     408     206      75      26      16       0
317          UI       0       0       0       0       0       0       0       0       0       0
1                                          HEC-1 INPUT                                          PAGE  9

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

318          UI       0       0       0       0       0       0       0       0       0       0
319          UI       0       0       0       0       0       0       0       0       0       0
320          UI       0       0       0       0       0       0       0       0       0       0
             *

321          KK   CPD15 COMBINE
322          HC       3   4.978
             *

323          KK  D15D26   ROUTE
324          KM        Cross-section: Concrete channel along Grand Ave, assumed slope
325          KM        2:1 slide slopes, width and geometry based on aerial
326          RS       3    FLOW
327          RC   0.016   0.016   0.016    9949  0.0050    0.00
328          RX  100.00  112.00  122.00  134.00  145.00  157.00  169.00  185.00
329          RY  1040.4 1040.20 1040.00 1034.00 1034.00 1040.00 1040.20 1040.60
             *

330          KK  D15D28   ROUTE
331          KM        Channel along Grand Avenue
332          KM        Flow in basin D26 does not enter channel
333          RS       2    FLOW
334          RC   0.016   0.016   0.016    7000  0.0050    0.00
335          RX  100.00  112.00  122.00  134.00  145.00  157.00  169.00  185.00
336          RY  1040.4 1040.20 1040.00 1034.00 1034.00 1040.00 1040.20 1040.60
             *

337          KK     D28   BASIN
338          KM        BASIN BOUNDARY FROM EL MIRAGE TR 1-3 AND GRAND AVE CHANNEL
339          BA   0.255
340          LG    0.22    0.25    4.50    0.45      36
341          UI       0     122     370     668     464     220      84      25      19       0
342          UI       0       0       0       0       0       0       0       0       0       0
343          UI       0       0       0       0       0       0       0       0       0       0
344          UI       0       0       0       0       0       0       0       0       0       0
345          UI       0       0       0       0       0       0       0       0       0       0
             *

346          KK   CPD28 COMBINE
347          HC       2   5.233
             *

348          KK  D28AFR   ROUTE
349          KM        Direct discharge into Agua Fria River, field verified by FCDMC
350          RS       1    FLOW
351          RC   0.016   0.016   0.016    2990  0.0050    0.00
352          RX  100.00  112.00  122.00  134.00  145.00  157.00  169.00  185.00
353          RY  1040.4 1040.20 1040.00 1034.00 1034.00 1040.00 1040.20 1040.60
             *
1                                          HEC-1 INPUT                                          PAGE 10

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

354          KK     D26   BASIN
355          KM        BASIN BOUNDARY FROM RACHO EL MIRAGE, SCHOOL
356          KM        MOBILE HOME PARK, SUNWEST CEMETARY AND GRAND AVE CHANNEL
357          BA   0.642
358          LG    0.24    0.25    5.80    0.24      34
359          UI       0     165     560     873    1364     927     587     245     140      44
360          UI      37       0       0       0       0       0       0       0       0       0
361          UI       0       0       0       0       0       0       0       0       0       0
362          UI       0       0       0       0       0       0       0       0       0       0
363          UI       0       0       0       0       0       0       0       0       0       0
             *

364          KK  DD26RE  DIVERT
365          KM         Retention volume estimated based on aerial
366          DT    RD26    52.4     0.0
367          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
368          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

369          KK   DD142RETRIEVE
370          DR  DD142S
             *

371          KK  D14D26   ROUTE
372          KM        Cross-section: Cross-section from Lower El Mirage Channelization
373          KM        (Report FCDMC 18-198B) / Manning's N Value: clean earth; straight
374          RS       3    FLOW
375          RC   0.022   0.022   0.022    5050  0.0048    0.00
376          RX  100.00  102.50  105.50  137.50  187.50  219.50  222.00  225.00
377          RY  1000.0  999.50  999.00  991.00  991.10  999.00  999.80 1000.00
             *

378          KK   CPD26 COMBINE
379          HC       2     5.4
             *

380          KK  D26D27   ROUTE
381          KM        Cross-section: Cross-section determined from FCDMC 18
382          KM        Manning's N Value: Clean earth
383          RS       1    FLOW
384          RC   0.022   0.022   0.022    2050  0.0039    0.00
385          RX  100.00  102.50  105.50  137.50  187.50  219.50  222.00  225.00
386          RY  1000.0  999.50  999.00  991.00  991.00  999.00  999.50 1000.00
             *
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 387          KK     D27   BASIN
 388          KM        BASIN BOUNDARY FROM RANCHO EL MIRAGE
 389          KM        WEST EL MIRAGE AND BNSF RR ALIGNMENT
 390          BA   0.316
 391          LG    0.20    0.24    4.90    0.36      42
 392          UI       0     103     332     568     679     409     199      89      33      20
 393          UI       0       0       0       0       0       0       0       0       0       0
 394          UI       0       0       0       0       0       0       0       0       0       0
 395          UI       0       0       0       0       0       0       0       0       0       0
1                                        HEC-1 INPUT                                          PAGE 11

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 396          UI       0       0       0       0       0       0       0       0       0       0
              *

 397          KK  DD27RE  DIVERT
 398          KM        Retention volume estimated based on aerial
 399          DT    RD27     8.2     0.0
 400          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 401          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 402          KK   CPD27 COMBINE
 403          HC       2   5.716
              *

 404          KK   SRD27 STORAGE
 405          KM        Storage at culvert under TB Road
 406          KO
 407          RS       1    STOR
 408          SV                                                  22.80   51.41
 409          SQ           52.00  202.00  415.00  658.00  906.00 1127.00 2999.00
 410          SE  1140.0 1142.00 1144.00 1146.00 1148.00 1150.00 1152.00 1154.00
 411          ST
              *

 412          KK  D27D42   ROUTE
 413          KM        Cross-section: Cross-section determined from Waddell Road
 414          KM        Drainage Improvement CAR Final by HDR
 415          KM        dated April 10, 2009, RLE2
 416          RS       5    FLOW
 417          RC   0.030   0.030   0.030    5599  0.0020    0.00
 418          RX    0.00   24.40   34.40   44.40   54.40   64.40   74.40   98.80
 419          RY  1128.5 1122.40 1122.40 1122.40 1122.40 1122.40 1122.40 1128.50
              *

 420          KK     D20   BASIN
 421          KM        BASIN BOUNDARY FROM COUNTRYSIDE UNITS 1-4 AND COTTON GIN
 422          BA   0.498
 423          LG    0.26    0.26    4.65    0.39      30
 424          UI       0      68     230     371     502     789     646     473     338     179
 425          UI     111      68      25      21      21       0       0       0       0       0
 426          UI       0       0       0       0       0       0       0       0       0       0
 427          UI       0       0       0       0       0       0       0       0       0       0
 428          UI       0       0       0       0       0       0       0       0       0       0
              *

 429          KK  DD20RE  DIVERT
 430          KM        Final Drainage Report Greenway Marketplace Wal-mart Neighborhood
 431          KM        Market #4218-00, Drainage Report for Countryside Elementary School, Ash
 432          KM        Ranch Water Supply Facility Expansion, Countryside - Preliminary Drainag
 433          KM        Report, Final Drainage Report for Cotton Gin
 434          DT    RD20    38.1     0.0
 435          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 436          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *
1                                        HEC-1 INPUT                                          PAGE 12

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 437          KK   DD111RETRIEVE
 438          DR  DD111S
              *

 439          KK  D11D20   ROUTE
 440          KM        Cross-section: Cross-section determined from aerial
 441          KM        Manning's N Value: retention basins, earth w/ grass
 442          RS       5    FLOW
 443          RC   0.025   0.025   0.025    6256  0.0032    0.00
 444          RX  100.00  101.00  102.00  114.00  190.00  202.00  203.00  204.00
 445          RY  1000.2 1000.10 1000.00  997.00  996.90 1000.00 1000.10 1000.20
              *

 446          KK   CPD20 COMBINE
 447          HC       2    1.16
              *

 448          KK  D20D21   ROUTE
 449          KM        Cross-section:  / Manning's N Value: street and earth with sparse
 450          KM        trees and shrubs
 451          RS       6    FLOW
 452          RC   0.032   0.032   0.013    5323  0.0023    0.00
 453          RX  100.00  100.50  112.00  150.00  162.00  198.00  198.00  220.00
 454          RY  1000.1 1000.00  997.00  997.00 1000.00  999.50  998.90  999.40
              *

 455          KK     D21   BASIN
 456          KM        BASIN BOUNDARY FROM ASHTON RANCH MULTI UNITS
 457          BA   0.496
 458          LG    0.25    0.25    4.65    0.40      32
 459          UI       0      63     196     332     438     665     691     499     368     251
 460          UI     122      87      55      19      19      19       0       0       0       0
 461          UI       0       0       0       0       0       0       0       0       0       0
 462          UI       0       0       0       0       0       0       0       0       0       0
 463          UI       0       0       0       0       0       0       0       0       0       0
              *

 464          KK  DD21RE  DIVERT
 465          KM        Final Drainage Report for Ashton Ranch Unit 3, Final Drainage Report for
 466          KM        Ashton Ranch Unit 1, Final Drainage Report for Ashton Ranch Unit 2, Fina
 467          KM        Drainage Report for Ashton Ranch Unit 4
 468          DT    RD21    39.9     0.0
 469          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 470          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *
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 471          KK   DD112RETRIEVE
 472          DR  DD112S
              *
1                                        HEC-1 INPUT                                                    PAGE 13

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 473          KK  D11D21   ROUTE
 474          KM        Cross-section: determined from aerial, street section through subdivisio
 475          KM        Manning's N Value: street, earth with sparse trees and shrubs
 476          RS      10    FLOW
 477          RC   0.032   0.013   0.032    8031  0.0035    0.00
 478          RX  100.00  106.00  115.00  115.10  167.00  167.10  174.00  179.00
 479          RY  1000.0  999.80  999.50  999.00  998.90  999.50  999.80 1000.00
              *

 480          KK   DD121RETRIEVE
 481          DR  DD121S
              *

 482          KK  D12D21   ROUTE
 483          KM        Cross-section: Cross-section determined from aerial
 484          KM        Manning's N Value: street and earth with sparse trees and shrubs
 485          RS       2    FLOW
 486          RC   0.013   0.013   0.032    2810  0.0078    0.00
 487          RX  100.00  105.00  110.00  115.00  140.00  140.10  176.00  177.00
 488          RY  1000.0  999.90  999.80  999.70  999.20  999.70  999.80 1000.00
              *

 489          KK   CPD21 COMBINE
 490          HC       4   2.003
              *

 491          KK   DD211  DIVERT
 492          KM         Waddell at Bullard split flow
 493          DT  DD211S     0.0     0.0
 494          DI     0.0   184.9   770.2  1884.9  3510.6     0.0     0.0     0.0     0.0     0.0
 495          DQ     0.0   139.4   462.9  1049.1  1871.4     0.0     0.0     0.0     0.0     0.0
              *

 496          KK   DD212  DIVERT
 497          KM        Waddell at Bullard split flow
 498          DT  DD212S     0.0     0.0
 499          DI     0.0    45.5   307.3   835.8  1639.2     0.0     0.0     0.0     0.0     0.0
 500          DQ     0.0    36.2   111.1   209.5   326.8     0.0     0.0     0.0     0.0     0.0
              *

 501          KK  D21D22   ROUTE
 502          KM        Cross-section: Cross-section determined from aerial
 503          KM        Manning's N Value: earth with grass and forbs (main channel)
 504          KM        earth with sparse trees and shrubs (overbanks)
 505          RS       4    FLOW
 506          RC   0.032   0.025   0.032    2720  0.0029    0.00
 507          RX  100.00  103.00  105.00  116.00  151.00  160.00  165.00  170.00
 508          RY  1000.2 1000.10 1000.00  997.00  997.10 1000.00 1000.10 1000.20
              *
1                                        HEC-1 INPUT                                                    PAGE 14

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 509          KK     D22   BASIN
 510          KM        BASIN BOUNDARY FROM ROYAL RANCH UNIT I AND II
 511          BA   0.454
 512          LG    0.24    0.25    4.70    0.38      32
 513          UI       0      64     230     360     501     760     570     413     282     134
 514          UI      88      50      20      20      20       0       0       0       0       0
 515          UI       0       0       0       0       0       0       0       0       0       0
 516          UI       0       0       0       0       0       0       0       0       0       0
 517          UI       0       0       0       0       0       0       0       0       0       0
              *

 518          KK  DD22RE  DIVERT
 519          KM        Drainage Report for Royal Ranch Unit 2 (Basins P1&N in D23), Final Drain
 520          KM        Report for Royal Ranch Unit 2, Parcel 5, Final Drainage Report for Royal
 521          KM        Unit 2 Parcel 8, portion estimated by aerial for Del Webb
 522          DT    RD22    37.5     0.0
 523          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 524          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 525          KK   DD122RETRIEVE
 526          DR  DD122S
              *

 527          KK  D12D22   ROUTE
 528          KM        Cross-section: Cross section determined from aerial
 529          KM        Manning's N Value: street and earth with sparse trees and shrubs
 530          RS       7    FLOW
 531          RC   0.032   0.013   0.013    7744  0.0040    0.00
 532          RX  100.00  105.00  145.00  145.10  160.00  174.00  178.00  180.00
 533          RY  1000.0  999.90  999.50  999.00  999.20  999.50  999.60  999.70
              *

 534          KK   CPD22 COMBINE
 535          HC       3   2.457
              *

 536          KK  D22D23   ROUTE
 537          KM        Cross-section: Cross-section determined from aerial
 538          KM        Manning's N Value: earth with sparse trees and shrubs/ riprap
 539          RS       2    FLOW
 540          RC   0.032   0.032   0.032    2705  0.0037    0.00
 541          RX  100.00  104.00  106.00  110.00  118.00  122.00  126.00  138.00
 542          RY  1161.0 1160.00 1159.00 1158.00 1158.10 1159.00 1160.00 1161.00
              *

 543          KK     D23   BASIN
 544          KM        BASIN BOUNDARY FROM SIERRA VERDE
 545          BA   0.541
 546          LG    0.27    0.27    5.00    0.33      26
 547          UI       0      59     139     271     348     447     672     631     480     373
 548          UI     285     172     101      77      55      18      18      18      18       0
 549          UI       0       0       0       0       0       0       0       0       0       0
 550          UI       0       0       0       0       0       0       0       0       0       0
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 551          UI       0       0       0       0       0       0       0       0       0       0
              *

 552          KK  DD23RE  DIVERT
 553          KM        Final Drainage Report for Sierra Verde Parcel 5, Infrastructure Drainage
 554          KM        Sierra Verde (temporary basins removed), Final Drainage Report for Sierr
 555          KM        Final Drainage Report for Harmony Apartments, Drainage Report for Royal
 556          KM        Final Drainage Report for Sierra Verde Parcel 9, Final Drainage Report f
 557          KM        Parcel 3, Final Drainage Report for Sierra Verde Parcel 2, Final Drainag
 558          KM        Sierra Verde Parcel 1, Drainage Report for Fry's at Waddell and Litchfie
 559          DT    RD23    36.3     0.0
 560          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 561          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 562          KK   DD131RETRIEVE
 563          DR  DD131S
              *

 564          KK  D13D23   ROUTE
 565          KM        Cross-section: Cross-section determined from aerial 1/2 street section
 566          KM        Manning's N Value: street, earth with sparse trees and shrubs
 567          RS       3    FLOW
 568          RC   0.032   0.013   0.032    5460  0.0044    0.00
 569          RX  100.00  100.00  109.00  109.00  148.00  148.00  197.00  198.00
 570          RY  1180.0 1176.30 1176.30 1175.80 1175.00 1175.50 1177.00 1177.10
              *

 571          KK   CPD23 COMBINE
 572          HC       3   5.642
              *

 573          KK   DD231  DIVERT
 574          KM        Waddell at Litchfield split flow
 575          DT  DD231S     0.0     0.0
 576          DI     0.0   518.8   867.4  1680.6  2985.0     0.0     0.0     0.0     0.0     0.0
 577          DQ     0.0    51.3   223.3   727.6  1503.5     0.0     0.0     0.0     0.0     0.0
              *

 578          KK   DD232  DIVERT
 579          KM        Waddell at Litchfield split flow
 580          DT  DD232S     0.0     0.0
 581          DI     0.0   467.5   644.1   953.0  1481.6     0.0     0.0     0.0     0.0     0.0
 582          DQ     0.0    55.8   138.4   242.9   365.2     0.0     0.0     0.0     0.0     0.0
              *

 583          KK  D23D24   ROUTE
 584          KM        Cross-section: Cross-section determined from Waddell
 585          KM        Road Drainage Improvement CAR Final by HDR
 586          KM        dated April 10, 2009, R137
 587          RS       3    FLOW
 588          RC   0.035   0.035   0.035    2646  0.0044    0.00
 589          RX  894.00  906.00  912.00  918.00  926.00  930.00  934.00  942.00
 590          RY  1157.0 1155.00 1154.00 1153.00 1153.00 1154.00 1155.00 1157.00
              *
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 591          KK     D24   BASIN
 592          KM        BASIN BOUNDARY FROM LITCHFIELD MANOR
 593          BA   0.492
 594          LG    0.27    0.25    5.10    0.32      28
 595          UI       0      56     144     269     347     461     679     542     419     317
 596          UI     226     116      88      56      26      17      17      17       0       0
 597          UI       0       0       0       0       0       0       0       0       0       0
 598          UI       0       0       0       0       0       0       0       0       0       0
 599          UI       0       0       0       0       0       0       0       0       0       0
              *

 600          KK  DD24RE  DIVERT
 601          KM        Final Drainage Report for Litchfield Manor (excess retention per report)
 602          DT    RD24    40.9     0.0
 603          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 604          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 605          KK   DD132RETRIEVE
 606          DR  DD132S
              *

 607          KK  D13D24   ROUTE
 608          KM        Cross-section: Cross-section determined from aerial 1/2 street section
 609          KM        Manning's N Value: street, earth with sparse trees and shrubs
 610          RS       3    FLOW
 611          RC   0.032   0.013   0.013    5460  0.0044    0.00
 612          RX  100.00  100.10  145.00  145.10  175.00  175.10  184.90  185.00
 613          RY  1178.0 1176.50 1175.50 1175.00 1175.80 1176.30 1176.30 1180.00
              *

 614          KK   CPD24 COMBINE
 615          HC       3   6.134
              *

 616          KK  D24D25   ROUTE
 617          KM        Cross-section: Cross-section determined from Waddell
 618          KM        Road Drainage Improvement CAR Final by HDR
 619          KM        dated April 10, 2009, R138
 620          RS       2    FLOW
 621          RC   0.030   0.030   0.030    2701  0.0020    0.00
 622          RX  1000.0 1018.00 1019.00 1020.00 1026.00 1027.00 1028.00 1046.00
 623          RY  1100.0 1094.00 1094.00 1094.00 1094.00 1094.00 1094.00 1100.00
              *

 624          KK     D25   BASIN
 625          KM        BASIN BOUNDARY FROM ROSEVIEW MULTI PHASE
 626          BA   0.497
 627          LG    0.25    0.25    4.80    0.36      30
 628          UI       0      64     198     335     442     675     689     499     367     248
 629          UI     120      86      53      20      20      20       0       0       0       0
 630          UI       0       0       0       0       0       0       0       0       0       0
 631          UI       0       0       0       0       0       0       0       0       0       0
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 632          UI       0       0       0       0       0       0       0       0       0       0
              *
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 633          KK  DD25RE  DIVERT
 634          KM        Drainage Report for Roseview - Parcels 1-6, Master Drainage
 635          KM        Report for Roseview, Retention for Parcels 7 and 8 were estimated
 636          KM        based on aerial, Parcel 5a has no retention
 637          DT    RD25    37.1     0.0
 638          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 639          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 640          KK   CPD25 COMBINE
 641          HC       2   6.631
              *

 642          KK  D25D39   ROUTE
 643          KM        Cross-section: Cross-section determined from Waddell Road
 644          KM        Drainage Improvement CAR Final by HDR dated April 10, 2009, RLLE
 645          RS       1    FLOW
 646          RC   0.030   0.030   0.030    2020  0.0040    0.00
 647          RX    0.00   20.00   25.00   30.00   35.00   41.50   51.10   82.30
 648          RY   10.00    0.00    0.00    0.00    0.00    0.00    4.80   10.00
              *

 649          KK     D39   BASIN
 650          KM        BASIN BOUNDARY FROM  AG LAND, 1990 TOPO AND BNSF RR ALIGNMENT
 651          BA   0.182
 652          LG    0.50    0.25    5.60    0.33       0
 653          UI       0      17      25      56      98     120     137     146     139     125
 654          UI     113      98      69      54      50      31      26      21      16      14
 655          UI      10      10       7       2       2       2       2       2       2       2
 656          UI       2       2       2       2       2       0       0       0       0       0
 657          UI       0       0       0       0       0       0       0       0       0       0
              *

 658          KK   CPD39 COMBINE
 659          HC       2   6.813
              *

 660          KK  D39D42   ROUTE
 661          KM        Cross-section: Cross-section determined from Waddell
 662          KM        Road Drainage Improvement CAR Final
 663          KM        by HDR dated April 10, 2009, RLLE1
 664          RS       3    FLOW
 665          RC   0.030   0.030   0.030    5691  0.0039    0.00
 666          RX    0.00   30.00   38.00   54.00   76.50  104.00  139.00  154.00
 667          RY   10.00    4.00    4.00    0.00    0.00    0.00    7.00   10.00
              *

 668          KK     D42   BASIN
 669          KM        BASIN BOUNDARY FROM PARQUE VERDE MULTI PHASE
 670          KM        DYSART SCHOOL DISTRICT, AND BUENA VISTA
 671          BA   0.994
 672          LG    0.24    0.24    5.20    0.30      32
 673          UI       0     150     592     894    1340    1711    1182     824     458     248
 674          UI     147      46      46      46       0       0       0       0       0       0
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 675          UI       0       0       0       0       0       0       0       0       0       0
 676          UI       0       0       0       0       0       0       0       0       0       0
 677          UI       0       0       0       0       0       0       0       0       0       0
              *

 678          KK  DD42RE  DIVERT
 679          KM        Retention volume estimated based on aerial, Cactus and Dysart
 680          KM        Subdivision and Parque Verde - No Reports available
 681          DT    RD42    71.8     0.0
 682          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
 683          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 684          KK   CPD42 COMBINE
 685          HC       3    9.87
              *
              * Storage route - Data REMOVED by DIBBLE
              * to account for future large diameter culvert at Cactus Road (no attenuation)
              * KK SRD42 STORAGE
              * KM      Storage behind Cactus Road - 2009 ADMPU data
              * KM  To account for future large diameter culvert under Cacuts Rd-no attenuation
              * KO     1       2
              * RS     1    STOR
              * SV          0.03    1.63   11.41   12.00   12.60   13.30   14.00   14.62   15.
              * SV 16.40   18.09   20.20
              * SQ          9.00   41.00   81.00   82.00  118.00  147.50  184.00  230.00  294.
              * SQ422.00  717.00 1123.00
              * SE1105.2 1107.00 1110.00 1114.00 1114.20 1114.40 1114.60 1114.80 1115.00 1115.
              * SE1115.5 1116.00 1116.50
              *
              * Storage channel route - Data REMOVED by DIBBLE
              * to account for enlarged basin design spanning
              * previous channel route
              * KKD42D53   ROUTE
              * KM      Cross-section: Cross-section determined from
              * KM      Waddell Road Drainage Improvement CAR Final
              * KM      by HDR dated April 10, 2009, RLE3
              * RS     1    FLOW
              * RC 0.030   0.030   0.030    1558  0.0020    0.00
              * RX  0.00   10.00   22.00   97.00  171.00  172.00  184.00  194.00
              * RY  3.50    3.00    0.00    0.00    0.00    0.00    3.00    3.50
              *

 686          KK     D53   BASIN
 687          KM        BASIN BOUNDARY FROM EL MIRAGE MARKET PLACE, RANCHO MIRAGE UNIT 3
 688          BA   0.118
 689          LG    0.31    0.32    4.60    0.36      11
 690          UI       0      56     169     306     216     105      39      12       9       0
 691          UI       0       0       0       0       0       0       0       0       0       0
 692          UI       0       0       0       0       0       0       0       0       0       0
 693          UI       0       0       0       0       0       0       0       0       0       0
 694          UI       0       0       0       0       0       0       0       0       0       0
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          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

           695          KK  DD53RE  DIVERT
           696          KM        Retention volume estimated based on aerial
           697          DT    RD53    12.1     0.0
           698          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
           699          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                        *

           700          KK   CPD53 COMBINE
           701          KO       1       2
           702          HC       2   9.988
                        *

           703          KK   SRD53 STORAGE
           704          KM        West Cactus Basin - 2013 Design data revised by DIBBLE
           705          KM        100% grading plaN
           706          KM    Volume includes ponded channel storage u/s of Cactus Rd
           707          KO       1       3
           708          RS       1    STOR
           709          SV            0.12    0.90    4.21   12.06   17.60   23.89   30.80   38.25   41.32
           710          SV   44.43   47.58   50.78   54.01   55.64   57.29   58.94   60.60   62.27   63.95
           711          SQ            7.70   25.50   51.60   84.00  101.60  119.60  137.40  154.70  161.30
           712          SQ  167.70  173.70  179.30  184.20  187.10  189.20  192.30  194.40  197.40  199.60
           713          SE  1105.6 1106.70 1107.70 1108.70 1109.70 1110.20 1110.70 1111.20 1111.70 1111.90
           714          SE  1112.1 1112.30 1112.50 1112.70 1112.80 1112.90 1113.00 1113.10 1113.20 1113.30
                        *

           715          KK  D53D54   ROUTE
           716          KM        Cross-section: Golf course, Cross-section determined from
           717          KM        aerial-golf course / Manning's N Value: earth w/ grass
           718          RS       4    FLOW
           719          RC   0.025   0.025   0.025    3999  0.0045    0.00
           720          RX  100.00  174.00  228.00  298.00  357.50  413.00  468.00  486.00
           721          RY  1106.0 1104.00 1103.00 1102.00 1101.90 1103.00 1104.00 1104.10
                        *

           722          KK     D43   BASIN
           723          KM        BASIN BOUNDARY FROM MONTA BLANCA ESTATES, SUNNYVALE AND SUNDIAL
           724          BA   0.500
           725          LG    0.25    0.25    4.70    0.37      33
           726          UI       0      75     298     450     674     861     594     414     230     125
           727          UI      74      23      23      23       0       0       0       0       0       0
           728          UI       0       0       0       0       0       0       0       0       0       0
           729          UI       0       0       0       0       0       0       0       0       0       0
           730          UI       0       0       0       0       0       0       0       0       0       0
                        *

           731          KK  DD43RE  DIVERT
           732          KM        Retention volume estimated based on aerial
           733          DT    RD43    35.5     0.0
           734          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
           735          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                        *
```



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          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

           736          KK  D43D54   ROUTE
           737          KM        Cross-section: Golf course, assumed 0.5%
           738          KM        side slopes, V-ditch / Manning's N Value: grass - golf course
           739          RS      14    FLOW
           740          RC   0.025   0.025   0.025    3872  0.0023    0.00
           741          RX  100.00  200.00  400.00  500.00  550.00  600.00  800.00  900.00
           742          RY  1000.0  999.50  998.50  998.00  998.30  998.50  999.50 1000.00
                        *

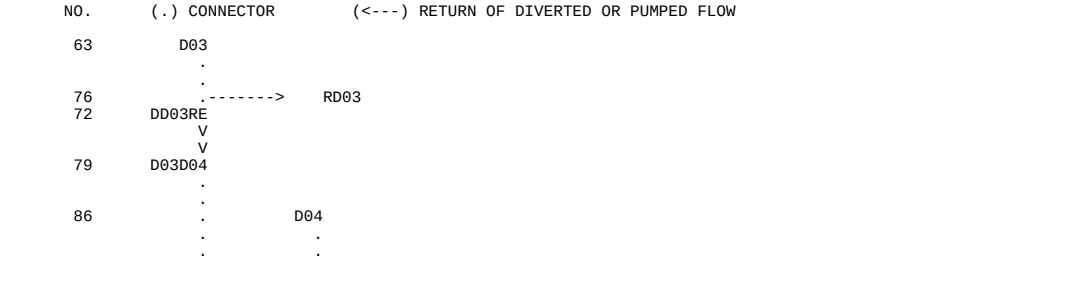
           743          KK     D54   BASIN
           744          KM        BASIN BOUNDARY FROM FAIRWAYS GOLF COURSE DIVISION
           745          KM        AND PUEBLO EL MIRAGE RV RESORT
           746          BA   0.271
           747          LG    0.20    0.27    4.45    0.50      14
           748          UI       0      65     225     347     561     401     260     119      64      26
           749          UI      15      15       0       0       0       0       0       0       0       0
           750          UI       0       0       0       0       0       0       0       0       0       0
           751          UI       0       0       0       0       0       0       0       0       0       0
           752          UI       0       0       0       0       0       0       0       0       0       0
                        *

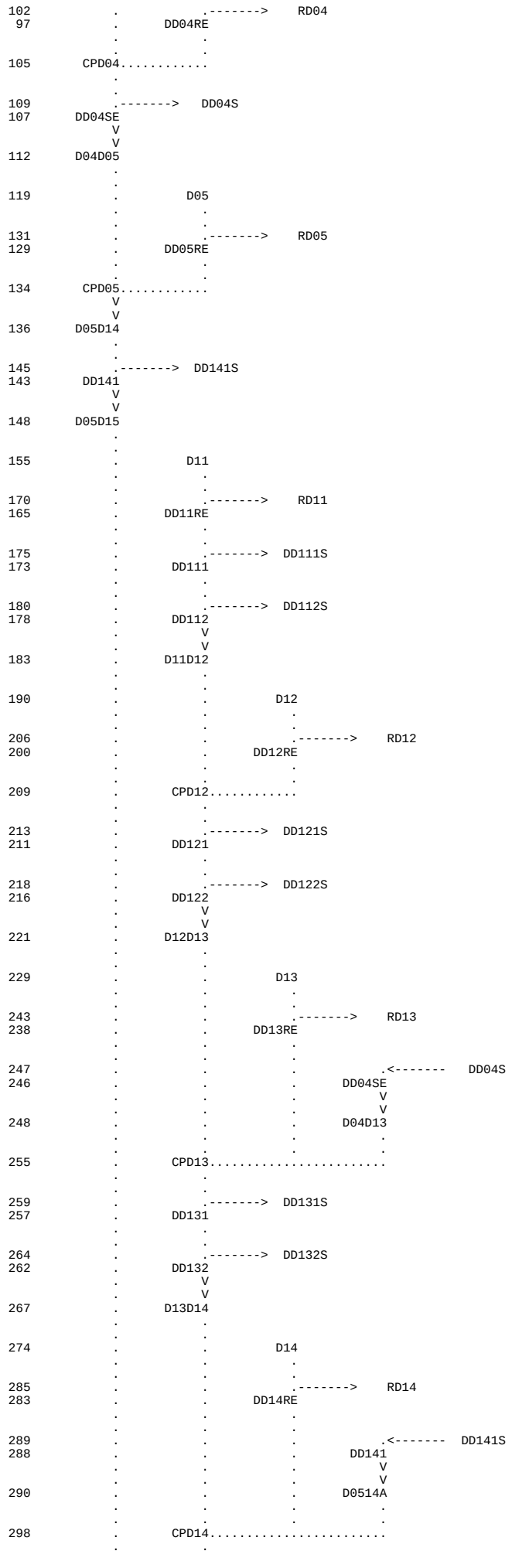
           753          KK  DD54RE  DIVERT
           754          KM        NO REPORTS - ESTIMATED FIRST FLUSH RETENTION FROM AERIAL
           755          KM        DUE TO LOCATION OF DEVELOPMENT TO THE RIVER
           756          DT    RD54     3.0     0.0
           757          DI     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
           758          DQ     0.0   500.0  5000.0 50000.0     0.0     0.0     0.0     0.0     0.0     0.0
                        *

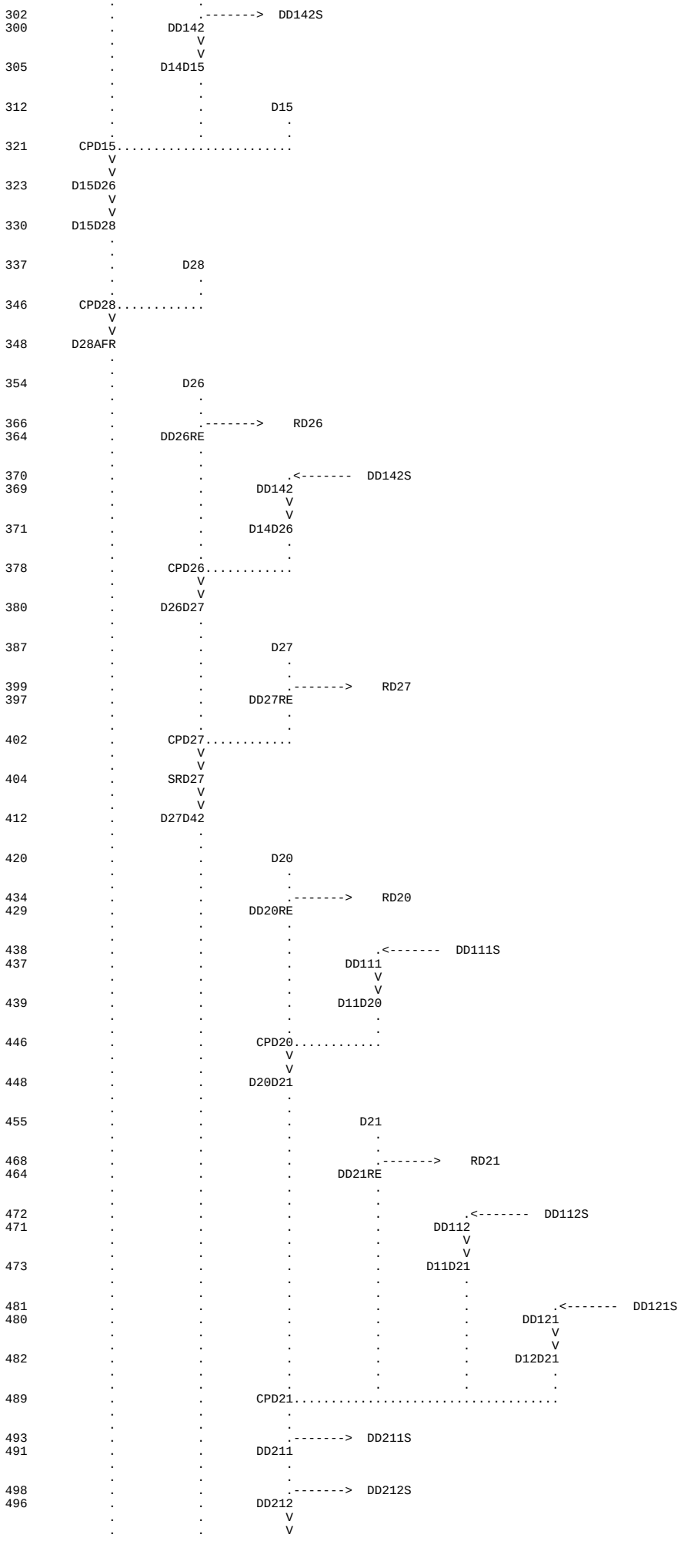
           759          KK   CPD54 COMBINE
           760          HC       3  10.759
                        *
                        *
           761          ZZ
```

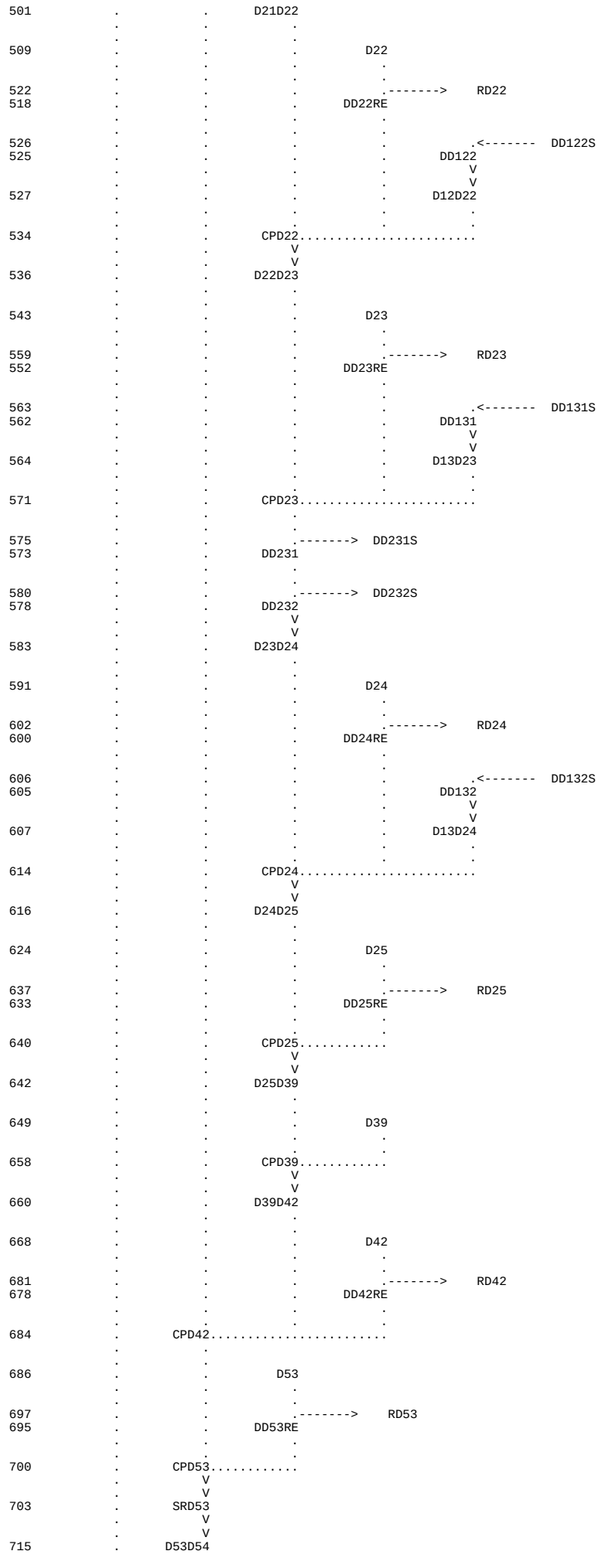
1

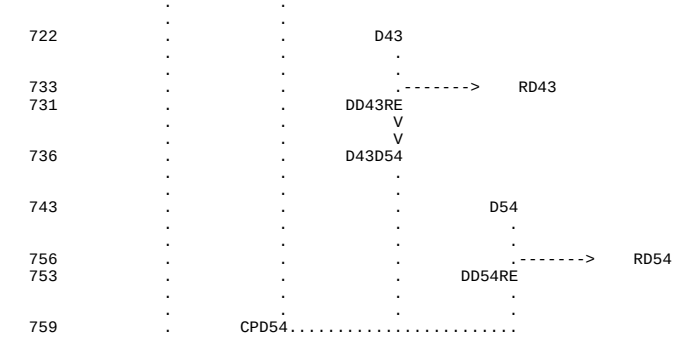
SCHEMATIC DIAGRAM OF STREAM NETWORK




RD04
DD04RE
CPD04
DD04S
DD04SE
D04D05
D05
RD05
DD05RE
CPD05
D05D14
DD141S
DD141
D05D15
D11
RD11
DD11RE
DD111S
DD111
DD112S
DD112
D11D12
D12
RD12
DD12RE
CPD12
DD121S
DD121
DD122S
DD122
D12D13
D13
RD13
DD13RE
DD04S
DD04SE
D04D13
CPD13
DD131S
DD131
DD132S
DD132
D13D14
D14
RD14
DD14RE
DD141S
DD141
D0514A
CPD14


302 DD142S
300 DD142
305 D14D15
312 D15
321 CPD15
323 D15D26
330 D15D28
337 D28
346 CPD28
348 D28AFR
354 D26
366 RD26
364 DD26RE
370 DD142S
369 DD142
371 D14D26
378 CPD26
380 D26D27
387 D27
399 RD27
397 DD27RE
402 CPD27
404 SRD27
412 D27D42
420 D20
434 RD20
429 DD20RE
438 DD111S
437 DD111
439 D11D20
446 CPD20
448 D20D21
455 D21
468 RD21
464 DD21RE
472 DD112S
471 DD112
473 D11D21
481 DD121S
480 DD121
482 D12D21
489 CPD21
493 DD211S
491 DD211
498 DD212S
496 DD212


501 D21D22
509 D22
522 RD22
518 DD22RE
526 DD122S
525 DD122
527 D12D22
534 CPD22
536 D22D23
543 D23
559 RD23
552 DD23RE
563 DD131S
562 DD131
564 D13D23
571 CPD23
575 DD231S
573 DD231
580 DD232S
578 DD232
583 D23D24
591 D24
602 RD24
600 DD24RE
606 DD132S
605 DD132
607 D13D24
614 CPD24
616 D24D25
624 D25
637 RD25
633 DD25RE
640 CPD25
642 D25D39
649 D39
658 CPD39
660 D39D42
668 D42
681 RD42
678 DD42RE
684 CPD42
686 D53
697 RD53
695 DD53RE
700 CPD53
703 SRD53
715 D53D54



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                                        *****************************************
 *                                       *                                        *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                        *    U.S. ARMY CORPS OF ENGINEERS       *
 *               JUN   1998              *                                        *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                                        *          609 SECOND STREET            *
 *                                       *                                        *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   24JAN13  TIME  18:33:13   *                                        *           (916) 756-1104              *
 *                                       *                                        *                                       *
 *****************************************                                        *****************************************
```

```
  Flood Control District of Maricopa County
  LEMWB_POST_CIP_FC - Lower El Mirage Wash Basin Post Project Conditions
  With Future Cactus Rd Culvert Design Hydrology
  100 YEAR
  24 Hour Storm
  Unit Hydrograph: S-Graph
  1/23/2013

 MODEL ORIGIN: LOOP 3O3/WHITE TANKS ADMPU
 FCDMC CONTRACT 2007C031
 BY HDR ENGINEERING (#79902)
 EXISTING CONDITIONS WITH CIP-AUGUST 2009
 MAJOR BASIN 01
 HDR FILE NAME: ECIP-MB1.DAT

*************************************************************************

FOLLOWING ARE THE CHANGES BY FCDMC:
1. Removed SRD14. - by JWH 10-16-09
FILE NAME: WT1EC01.DAT

For details concerning changes to this HEC-1 model, please contact
FCDMC, H&H Branch.

*************************************************************************

DIBBLE revisions for FCD2011C004, Work Assignment No. 1 are listed below:
1. Extracted portion of Major Basin D draining to CPD54 (Lower El Mirage)
2. Removed opertation SRD25
3. Removed operation SRD42 to account for future large diameter culvert
   at Cactus Road
4. Removed operation D42D53 (new basin occupies what was a channel route)
5. Revised D53D54 (golf coarse route) operation to without CIP condition
6. Revised operation SRD53 (model new west cactus basin)
   Note: SRD53 (west cactus basin) contains the current 100% design
      - Basin grading, dated 1/11/2013
      - Outlet is a single new 60" pipe
       - Volume includes ponded storage u/s of Cactus Rd

Filename: LEMWB_POST_CIP_FC.DAT          DaTE: 1/23/2013
```

```
 44 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

 43 IN          TIME DATA FOR INPUT TIME SERIES
                       JXMIN          15  TIME INTERVAL IN MINUTES
                      JXDATE      1    0  STARTING DATE
                      JXTIME           0  STARTING TIME

    IT          HYDROGRAPH TIME DATA
                       NMIN           5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ        2000  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      7    0  ENDING DATE
                      NDTIME        2235  ENDING TIME
                      ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL    0.08 HOURS
                       TOTAL TIME BASE  166.58 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT

 45 JD          INDEX STORM NO. 1
                       STRM        3.48  PRECIPITATION DEPTH
                       TRDA        0.00  TRANSPOSITION DRAINAGE AREA

 46 PI            PRECIPITATION PATTERN
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
```

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	166.58-HR
		(CFS)				
317.	12.25		187.	88.	29.	13.
		(INCHES)	0.162	0.305	0.305	0.305
		(AC-FT)	93.	175.	175.	175.

CUMULATIVE AREA = 10.76 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	D03	931.	12.25	106.	33.	11.	0.72		
DIVERSION TO	RD03	931.	12.25	96.	26.	9.	0.72		
HYDROGRAPH AT	DD03RE	100.	12.83	21.	7.	2.	0.72		
ROUTED TO	D03D04	61.	13.17	21.	7.	2.	0.72		
HYDROGRAPH AT	D04	1115.	12.33	138.	43.	14.	0.89		
DIVERSION TO	RD04	1082.	12.33	85.	24.	8.	0.89		
HYDROGRAPH AT	DD04RE	831.	12.42	67.	19.	6.	0.89		
2 COMBINED AT	CPD04	813.	12.42	86.	26.	9.	1.61		
DIVERSION TO	DD04S	471.	12.42	25.	6.	2.	1.61		
HYDROGRAPH AT	DD04SE	342.	12.42	62.	20.	7.	1.61		
ROUTED TO	D04D05	288.	12.67	61.	20.	7.	1.61		
HYDROGRAPH AT	D05	319.	12.17	34.	12.	4.	0.16		
DIVERSION TO	RD05	134.	11.92	13.	4.	1.	0.16		
HYDROGRAPH AT	DD05RE	319.	12.17	27.	8.	3.	0.16		
2 COMBINED AT	CPD05	317.	12.67	85.	27.	9.	1.78		
ROUTED TO	D05D14	255.	12.83	83.	27.	9.	1.78		
DIVERSION TO	DD141S	133.	12.83	14.	3.	1.	1.78		
HYDROGRAPH AT	DD141	122.	12.25	70.	24.	8.	1.78		
ROUTED TO	D05D15	129.	12.50	69.	24.	8.	1.78		
HYDROGRAPH AT	D11	758.	12.42	104.	32.	11.	0.66		
DIVERSION TO	RD11	728.	12.33	58.	16.	5.	0.66		
HYDROGRAPH AT	DD11RE	698.	12.50	57.	16.	5.	0.66		
DIVERSION TO	DD111S	574.	12.50	46.	13.	4.	0.66		
HYDROGRAPH AT	DD111	124.	12.50	11.	3.	1.	0.66		
DIVERSION TO	DD112S	45.	12.50	6.	2.	1.	0.66		
HYDROGRAPH AT	DD112	79.	12.50	5.	1.	0.	0.66		
ROUTED TO	D11D12	46.	12.67	5.	1.	0.	0.66		
HYDROGRAPH AT	D12	236.	12.58	52.	16.	5.	0.35		
DIVERSION TO	RD12	236.	12.58	28.	8.	3.	0.35		
HYDROGRAPH AT	DD12RE	209.	12.83	30.	8.	3.	0.35		
2 COMBINED AT	CPD12	244.	12.83	34.	10.	3.	1.01		
DIVERSION TO	DD121S	105.	12.83	12.	3.	1.	1.01		
HYDROGRAPH AT									

+		DD121	139.	12.83	22.	6.	2.	1.01
+	DIVERSION TO	DD122S	58.	12.83	10.	3.	1.	1.01
+	HYDROGRAPH AT	DD122	81.	12.83	12.	3.	1.	1.01
+	ROUTED TO	D12D13	47.	13.67	11.	3.	1.	1.01
+	HYDROGRAPH AT	D13	1106.	12.25	120.	35.	12.	1.03
+	DIVERSION TO	RD13	495.	12.08	30.	9.	3.	1.03
+	HYDROGRAPH AT	DD13RE	1106.	12.25	99.	26.	9.	1.03
+	HYDROGRAPH AT	DD04SE	471.	12.42	25.	6.	2.	1.61
+	ROUTED TO	D04D13	156.	13.50	24.	6.	2.	1.61
+	3 COMBINED AT	CPD13	1106.	12.25	134.	36.	12.	3.65
+	DIVERSION TO	DD131S	195.	12.25	12.	3.	1.	3.65
+	HYDROGRAPH AT	DD131	902.	12.25	120.	32.	11.	3.65
+	DIVERSION TO	DD132S	383.	12.25	36.	10.	3.	3.65
+	HYDROGRAPH AT	DD132	518.	12.25	84.	22.	7.	3.65
+	ROUTED TO	D13D14	440.	12.67	82.	22.	7.	3.65
+	HYDROGRAPH AT	D14	1065.	12.42	144.	45.	15.	0.94
+	DIVERSION TO	RD14	1065.	12.42	117.	32.	11.	0.94
+	HYDROGRAPH AT	DD14RE	384.	12.75	42.	13.	4.	0.94
+	HYDROGRAPH AT	DD141	133.	12.83	14.	3.	1.	1.78
+	ROUTED TO	D0514A	107.	13.08	14.	3.	1.	1.78
+	3 COMBINED AT	CPD14	822.	12.75	135.	38.	13.	4.76
+	DIVERSION TO	DD142S	521.	12.75	111.	32.	11.	4.76
+	HYDROGRAPH AT	DD142	301.	12.75	25.	7.	2.	4.76
+	ROUTED TO	D14D15	247.	12.83	25.	7.	2.	4.76
+	HYDROGRAPH AT	D15	412.	12.17	43.	14.	5.	0.22
+	3 COMBINED AT	CPD15	406.	12.17	129.	43.	15.	4.98
+	ROUTED TO	D15D26	345.	13.08	128.	43.	15.	4.98
+	ROUTED TO	D15D28	325.	13.25	128.	43.	15.	4.98
+	HYDROGRAPH AT	D28	415.	12.17	37.	12.	4.	0.25
+	2 COMBINED AT	CPD28	460.	12.25	160.	54.	18.	5.23
+	ROUTED TO	D28AFR	446.	12.25	160.	54.	18.	5.23
+	HYDROGRAPH AT	D26	960.	12.25	99.	30.	10.	0.64
+	DIVERSION TO	RD26	960.	12.25	96.	26.	9.	0.64
+	HYDROGRAPH AT	DD26RE	18.	14.33	10.	4.	1.	0.64
+	HYDROGRAPH AT	DD142	521.	12.75	111.	32.	11.	4.76
+	ROUTED TO	D14D26	446.	12.92	109.	32.	11.	4.76
+	2 COMBINED AT	CPD26	448.	12.92	118.	35.	12.	5.40
+	ROUTED TO	D26D27	418.	13.00	117.	35.	12.	5.40
+	HYDROGRAPH AT	D27	485.	12.17	51.	16.	5.	0.32
	DIVERSION TO							

+	RD27	122.	11.92	13.	4.	1.	0.32
+ HYDROGRAPH AT	DD27RE	485.	12.17	44.	12.	4.	0.32
+ 2 COMBINED AT	CPD27	477.	12.17	156.	47.	16.	5.72
+ ROUTED TO	SRD27	477.	12.17	156.	47.	16.	5.72
+ ROUTED TO	D27D42	398.	13.42	151.	47.	16.	5.72
+ HYDROGRAPH AT	D20	573.	12.33	69.	21.	7.	0.50
+ DIVERSION TO	RD20	573.	12.33	68.	19.	6.	0.50
+ HYDROGRAPH AT	DD20RE	7.	16.92	5.	2.	1.	0.50
+ HYDROGRAPH AT	DD111	574.	12.50	46.	13.	4.	0.66
+ ROUTED TO	D11D20	303.	12.92	43.	13.	4.	0.66
+ 2 COMBINED AT	CPD20	300.	12.92	46.	14.	5.	1.16
+ ROUTED TO	D20D21	221.	13.42	44.	14.	5.	1.16
+ HYDROGRAPH AT	D21	548.	12.33	70.	22.	7.	0.50
+ DIVERSION TO	RD21	548.	12.33	70.	20.	7.	0.50
+ HYDROGRAPH AT	DD21RE	6.	18.42	5.	2.	1.	0.50
+ HYDROGRAPH AT	DD112	45.	12.50	6.	2.	1.	0.66
+ ROUTED TO	D11D21	20.	13.33	5.	2.	1.	0.66
+ HYDROGRAPH AT	DD121	105.	12.83	12.	3.	1.	1.01
+ ROUTED TO	D12D21	82.	13.00	12.	3.	1.	1.01
+ 4 COMBINED AT	CPD21	287.	13.33	61.	21.	7.	2.00
+ DIVERSION TO	DD211S	196.	13.33	45.	15.	5.	2.00
+ HYDROGRAPH AT	DD211	91.	13.33	16.	5.	2.	2.00
+ DIVERSION TO	DD212S	49.	13.33	12.	4.	1.	2.00
+ HYDROGRAPH AT	DD212	42.	13.33	4.	1.	0.	2.00
+ ROUTED TO	D21D22	29.	13.67	4.	1.	0.	2.00
+ HYDROGRAPH AT	D22	547.	12.33	65.	20.	7.	0.45
+ DIVERSION TO	RD22	547.	12.33	65.	19.	6.	0.45
+ HYDROGRAPH AT	DD22RE	5.	19.58	3.	1.	0.	0.45
+ HYDROGRAPH AT	DD122	58.	12.83	10.	3.	1.	1.01
+ ROUTED TO	D12D22	43.	13.42	10.	3.	1.	1.01
+ 3 COMBINED AT	CPD22	65.	13.67	15.	5.	2.	2.46
+ ROUTED TO	D22D23	60.	13.83	14.	5.	2.	2.46
+ HYDROGRAPH AT	D23	539.	12.42	73.	22.	7.	0.54
+ DIVERSION TO	RD23	539.	12.42	68.	18.	6.	0.54
+ HYDROGRAPH AT	DD23RE	34.	13.42	10.	4.	1.	0.54
+ HYDROGRAPH AT	DD131	195.	12.25	12.	3.	1.	3.65
+ ROUTED TO	D13D23	120.	12.50	12.	3.	1.	3.65
+ 3 COMBINED AT	CPD23	119.	12.50	34.	11.	4.	5.64
+ DIVERSION TO	DD231S	12.	12.50	3.	1.	0.	5.64
HYDROGRAPH AT							

+		DD231	107.	12.50	30.	10.	3.	5.64
	DIVERSION TO							
+		DD232S	13.	12.50	4.	1.	0.	5.64
	HYDROGRAPH AT							
+		DD232	94.	12.50	27.	9.	3.	5.64
	ROUTED TO							
+		D23D24	79.	12.75	26.	9.	3.	5.64
	HYDROGRAPH AT							
+		D24	521.	12.42	68.	21.	7.	0.49
	DIVERSION TO							
+		RD24	521.	12.42	68.	20.	7.	0.49
	HYDROGRAPH AT							
+		DD24RE	2.	18.17	1.	0.	0.	0.49
	HYDROGRAPH AT							
+		DD132	383.	12.25	36.	10.	3.	3.65
	ROUTED TO							
+		D13D24	286.	12.50	36.	10.	3.	3.65
	3 COMBINED AT							
+		CPD24	325.	12.58	62.	18.	6.	6.13
	ROUTED TO							
+		D24D25	294.	12.75	61.	18.	6.	6.13
	HYDROGRAPH AT							
+		D25	557.	12.33	70.	21.	7.	0.50
	DIVERSION TO							
+		RD25	557.	12.33	68.	19.	6.	0.50
	HYDROGRAPH AT							
+		DD25RE	12.	14.67	7.	3.	1.	0.50
	2 COMBINED AT							
+		CPD25	294.	12.75	66.	21.	7.	6.63
	ROUTED TO							
+		D25D39	274.	12.83	65.	21.	7.	6.63
	HYDROGRAPH AT							
+		D39	108.	12.50	15.	4.	1.	0.18
	2 COMBINED AT							
+		CPD39	342.	12.83	78.	24.	8.	6.81
	ROUTED TO							
+		D39D42	277.	13.08	77.	24.	8.	6.81
	HYDROGRAPH AT							
+		D42	1278.	12.33	147.	45.	15.	0.99
	DIVERSION TO							
+		RD42	1278.	12.33	135.	36.	12.	0.99
	HYDROGRAPH AT							
+		DD42RE	112.	12.92	26.	9.	3.	0.99
	3 COMBINED AT							
+		CPD42	654.	13.33	250.	79.	26.	9.87
	HYDROGRAPH AT							
+		D53	176.	12.17	12.	3.	1.	0.12
	DIVERSION TO							
+		RD53	176.	12.17	12.	3.	1.	0.12
	HYDROGRAPH AT							
+		DD53RE	0.	0.00	0.	0.	0.	0.12
	2 COMBINED AT							
+		CPD53	654.	13.33	250.	79.	26.	9.99
	ROUTED TO							
+		SRD53	191.	15.58	176.	79.	26.	9.99
	ROUTED TO							
+		D53D54	191.	15.92	176.	79.	26.	9.99
	HYDROGRAPH AT							
+		D43	628.	12.33	73.	22.	7.	0.50
	DIVERSION TO							
+		RD43	628.	12.33	66.	18.	6.	0.50
	HYDROGRAPH AT							
+		DD43RE	56.	12.92	14.	5.	2.	0.50
	ROUTED TO							
+		D43D54	28.	14.08	13.	5.	2.	0.50
	HYDROGRAPH AT							
+		D54	327.	12.25	28.	8.	3.	0.27
	DIVERSION TO							
+		RD54	81.	12.00	5.	2.	1.	0.27
	HYDROGRAPH AT							
+		DD54RE	327.	12.25	25.	6.	2.	0.27
	3 COMBINED AT							
+		CPD54	317.	12.25	187.	88.	29.	10.76

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION SRD27
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1142.00	0.00	0.00
STORAGE	0.	0.	0.
OUTFLOW	52.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1147.36	1147.36	0.	580.	166.58	13.00	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1142.00	0.00	0.00
STORAGE	0.	0.	0.
OUTFLOW	52.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1146.50	1146.50	0.	476.	166.58	12.25	0.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1142.00	0.00	0.00
STORAGE	0.	0.	0.
OUTFLOW	52.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1146.25	1146.25	0.	445.	166.58	12.25	0.00

PLAN 4 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1142.00	0.00	0.00
STORAGE	0.	0.	0.
OUTFLOW	52.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1146.09	1146.09	0.	426.	166.58	12.17	0.00

PLAN 5 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1142.00	0.00	0.00
STORAGE	0.	0.	0.
OUTFLOW	52.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1146.00	1146.00	0.	415.	166.58	12.25	0.00

PLAN 6 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1142.00	0.00	0.00
STORAGE	0.	0.	0.
OUTFLOW	52.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1145.94	1145.94	0.	408.	166.58	12.25	0.00

PLAN 7 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1142.00	0.00	0.00
STORAGE	0.	0.	0.
OUTFLOW	52.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1145.89	1145.89	0.	403.	166.58	12.25	0.00

PLAN 8 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1142.00	0.00	0.00
STORAGE	0.	0.	0.
OUTFLOW	52.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1145.73	1145.73	0.	386.	166.58	12.25	0.00

*** NORMAL END OF HEC-1 ***

Appendix E.2

Minor Drainage Hydrologic Calculations and Data

Hydrologic Design Data Record - Rational Method

Project Name:	Lower El Mirage Wash Basin	Sub-basin ID:	1	Calc:	JWL
Project No:	10-1122.01	Sub-basin Lat:	33.5928	Date:	Jan '13
Outfall Location:	City of El Mirage Parcel Down Drain	Sub-basin Long:	-112.3257	Chkd:	KWR

Design Data

Hydr. Soil Group: A Drainage Length: 1,555' Minimum T_c: 5 min K_b: 0.0340

Elevations:

Top of Drainage Area: 1118.40' Sub-basin Outfall: 1114.00' Sub-basin Slope: 14.94 ft/mi

Drainage Areas					Land Use	C Values
A_1	308,135	sf	7.07	ac	A_1 AG	A_1 Max
A_2	87,113	sf	2.00	ac	A_2 DL2	A_2 Max
A_3		sf	--	ac	A_3	A_3
A_4		sf	--	ac	A_4	A_4
Total	395,248	sf	9.07	ac		

Calculation Results

		Design Frequency						
		2	5	10	25	50	100	Year
Time of Concentration	T_c	23.8	20.4	18.7	17.1	16.1	15.3	min
Rainfall Intensity	i	1.49	2.22	2.79	3.55	4.14	4.77	in/hr
Runoff Coefficients	C_1	0.20	0.20	0.20	0.22	0.24	0.25	
	C_2	0.40	0.40	0.40	0.44	0.48	0.50	
	C_3	--	--	--	--	--	--	
	C_4	--	--	--	--	--	--	
Weighted Runoff Coefficient	C_w	0.24	0.24	0.24	0.27	0.29	0.31	

		2	5	10	25	50	100	
Peak Discharge $Q_p = C_w\ i\ A$	Q_p	3.3	4.9	6.2	8.6	11.0	13.2	cfs

		2	5	10	25	50	100	Year
2-hr Precipitation	P_2	0.88	1.18	1.41	1.72	1.96	2.21	
Required Retention Volume $V = C_w\ P_2\ A$		0.16	0.22	0.26	0.35	0.43	0.51	ac-ft
Required Retention Volume		262	351	420	563	700	823	cy

Notes:

1. The K_b parameter is calculated based on the following equation: $K_b = m\ \log_{10} A + b$; where m and b are equation parameters taken from Table 3.1 of the Drainage Design Manual for Maricopa County, Vol. 1, and A is the total sub-basin area in acres.
2. Land use codes, descriptions, and C values are based on Tables 3.2 and 3.3 of the Drainage Design Manual for Maricopa County, Vol. 1.
3. The time of concentration is calculated using the equation developed by Papadakis and Kazan: $T_c = 11.4\ L^{0.5}\ K_b^{0.52}\ S^{-0.31}\ i^{-0.38}$
4. Rainfall intensity values are interpolated from NOAA Atlas 14 values pulled from the online database using the sub-basin coordinates listed above.

Hydrologic Design Data Record - Rational Method

Project Name:	Lower El Mirage Wash Basin	Sub-basin ID:	2	Calc:	JWL
Project No:	10-1122.01	Sub-basin Lat:	33.5932	Date:	Jan '13
Outfall Location:	Bool Property Down Drain	Sub-basin Long:	-112.3288	Chkd:	KWR

Design Data

Hydr. Soil Group: A Drainage Length: 1,196' Minimum T_c: 5 min K_b: 0.0330

Elevations:

Top of Drainage Area: 1121.70' Sub-basin Outfall: 1114.00' Sub-basin Slope: 33.99 ft/mi

Drainage Areas					Land Use	C Values
A_1	582,527	sf	13.37	ac	A_1 AG	A_1 Max
A_2		sf	--	ac	A_2	A_2
A_3		sf	--	ac	A_3	A_3
A_4		sf	--	ac	A_4	A_4
Total	582,527	sf	13.37	ac		

Calculation Results

		Design Frequency						
		2	5	10	25	50	100	Year
Time of Concentration	T_c	14.6	12.5	11.5	10.5	9.9	9.3	min
Rainfall Intensity	i	1.87	2.79	3.47	4.42	5.19	6.07	in/hr
Runoff Coefficients	C_1	0.20	0.20	0.20	0.22	0.24	0.25	
	C_2	--	--	--	--	--	--	
	C_3	--	--	--	--	--	--	
	C_4	--	--	--	--	--	--	
Weighted Runoff Coefficient	C_w	0.20	0.20	0.20	0.22	0.24	0.25	

		2	5	10	25	50	100	
Peak Discharge $Q_p = C_w\ i\ A$	Q_p	5.0	7.5	9.3	13.0	16.7	20.3	cfs

		2	5	10	25	50	100	Year
2-hr Precipitation	P_2	0.88	1.18	1.41	1.72	1.96	2.21	
Required Retention Volume $V = C_w\ P_2\ A$		0.20	0.26	0.31	0.42	0.52	0.62	ac-ft
Required Retention Volume		316	424	507	680	846	993	cy

Notes:

1. The K_b parameter is calculated based on the following equation: $K_b = m\ \log_{10} A + b$; where m and b are equation parameters taken from Table 3.1 of the Drainage Design Manual for Maricopa County, Vol. 1, and A is the total sub-basin area in acres.
2. Land use codes, descriptions, and C values are based on Tables 3.2 and 3.3 of the Drainage Design Manual for Maricopa County, Vol. 1.
3. The time of concentration is calculated using the equation developed by Papadakis and Kazan: $T_c = 11.4\ L^{0.5}\ K_b^{0.52}\ S^{-0.31}\ i^{-0.38}$
4. Rainfall intensity values are interpolated from NOAA Atlas 14 values pulled from the online database using the sub-basin coordinates listed above.

Hydrologic Design Data Record - Rational Method

Project Name:	Lower El Mirage Wash Basin	Sub-basin ID:	3	Calc:	JWL
Project No:	10-1122.01	Sub-basin Lat:	33.5908	Date:	Jan '13
Outfall Location:	City of El Mirage Water Campus	Sub-basin Long:	-112.3294	Chkd:	KWR

Design Data

Hydr. Soil Group: A Drainage Length: 250' Minimum T_c: 5 min K_b: 0.0362

Elevations:

Top of Drainage Area: 1119.00' Sub-basin Outfall: 1118.00' Sub-basin Slope: 21.12 ft/mi

	Drainage Areas				Land Use	C Values
A_1	178,763	sf	4.10	ac	DL2	Ave
A_2		sf	--	ac		
A_3		sf	--	ac		
A_4		sf	--	ac		
Total	178,763	sf	4.10	ac		

Calculation Results

		Design Frequency						
		2	5	10	25	50	100	Year
Time of Concentration	T_c	7.2	6.2	5.8	5.3	5.0	5.0	min
Rainfall Intensity	i	2.59	3.72	4.62	5.80	6.72	7.56	in/hr
Runoff Coefficients	C_1	0.35	0.35	0.35	0.39	0.42	0.44	
	C_2	--	--	--	--	--	--	
	C_3	--	--	--	--	--	--	
	C_4	--	--	--	--	--	--	
Weighted Runoff Coefficient	C_w	0.35	0.35	0.35	0.39	0.42	0.44	

		2	5	10	25	50	100	
Peak Discharge $Q_p = C_w\ i\ A$	Q_p	3.7	5.3	6.6	9.2	11.6	13.7	cfs

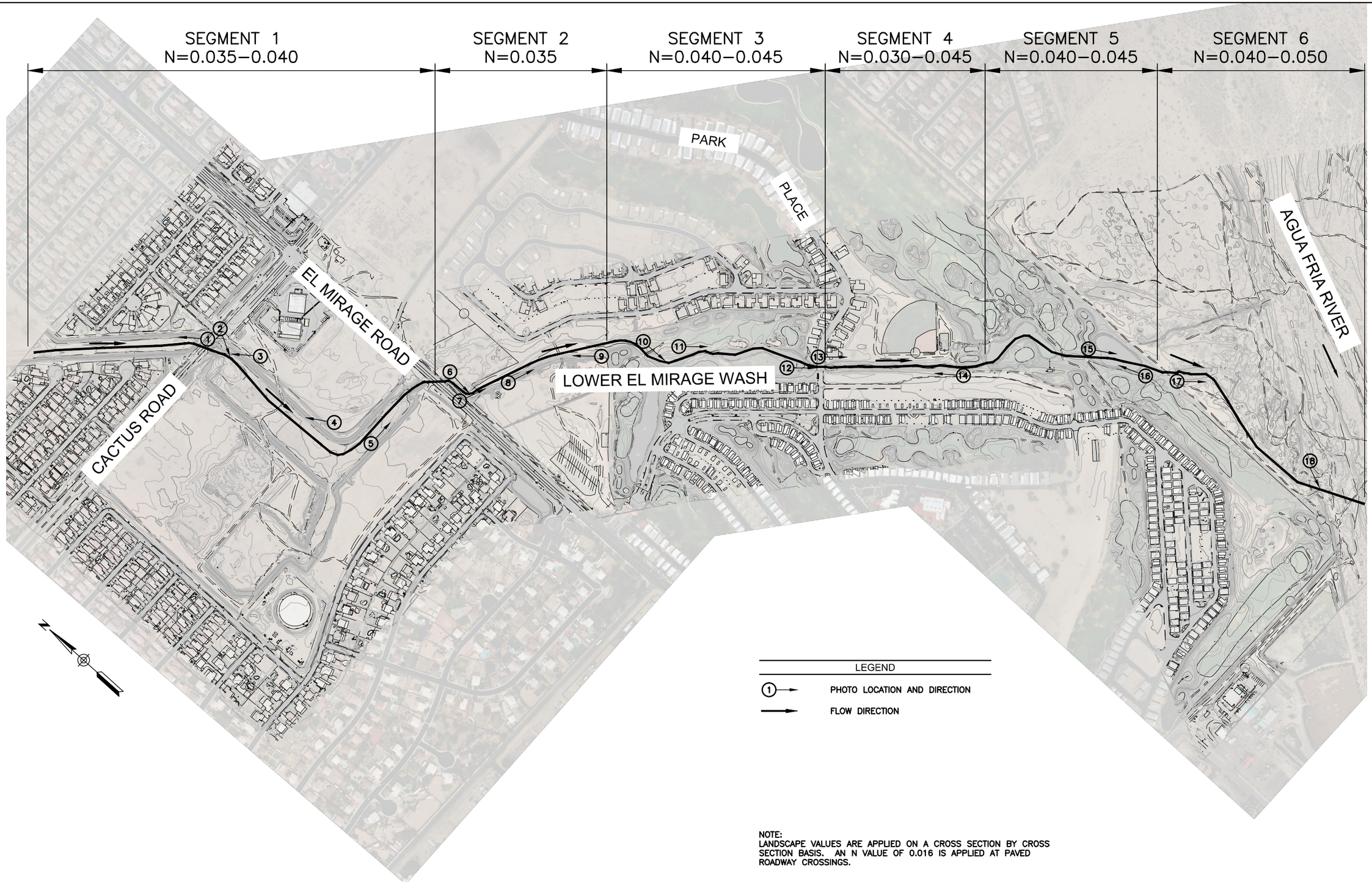
		2	5	10	25	50	100	Year
2-hr Precipitation	P_2	0.87	1.17	1.40	1.71	1.95	2.19	
Required Retention Volume $V = C_w\ P_2\ A$		0.10	0.14	0.17	0.23	0.28	0.33	ac-ft
Required Retention Volume		168	226	270	363	452	532	cy

Notes:

1. The K_b parameter is calculated based on the following equation: $K_b = m\ \log_{10} A + b$; where m and b are equation parameters taken from Table 3.1 of the Drainage Design Manual for Maricopa County, Vol. 1, and A is the total sub-basin area in acres.
2. Land use codes, descriptions, and C values are based on Tables 3.2 and 3.3 of the Drainage Design Manual for Maricopa County, Vol. 1.
3. The time of concentration is calculated using the equation developed by Papadakis and Kazan: $T_c = 11.4\ L^{0.5}\ K_b^{0.52}\ S^{-0.31}\ i^{-0.38}$
4. Rainfall intensity values are interpolated from NOAA Atlas 14 values pulled from the online database using the sub-basin coordinates listed above.

Appendix F

Manning's Roughness Estimation



LEGEND

① PHOTO LOCATION AND DIRECTION

FLOW DIRECTION

NOTE:
LANDSCAPE VALUES ARE APPLIED ON A CROSS SECTION BY CROSS SECTION BASIS. AN N VALUE OF 0.016 IS APPLIED AT PAVED ROADWAY CROSSINGS.

0' 250' 500' 1000'

SCALE: 1"=500'

Flood Control District of Maricopa County

Dibble Engineering

TITLE

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
LOWER EL MIRAGE WASH BASIN

Int. of Cactus Road & El Mirage Road | El Mirage, Arizona

SUBMITTAL

rev date

issued for:

KEY MAP

PROJECT NUMBER
101120.01

Fig F.1

Existing
Conditions
Manning's N

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Lower El Mirage Wash
Stream: El Mirage Wash
Location: Segment 1
Notes: Existing Wash Between Cactus Culvert and El Mirage Culvert

Channel Conditions		Manning's n Adjustment		Left Overbank	Left Bank (Earth)	Left Bank (Rip-Rap)	Channel	Right Bank (Earth)	Right Bank (Rip-Rap)	Right Overbank
Channel Material	Firm Soil	n_b	.025 - .032							
	Coarse Sand		.026 - .035	0.030	0.026		0.026	0.026		0.030
	Gravel		.028 - .035							
	Cobble		.030 - .050							
	Boulder		.040 - .070							
Degree of Irregularity	Smooth	n_1	0							
	Minor		.001 - .005	0.001	0.003		0.001	0.003		0.001
	Moderate		.006 - .010							
	Severe		.011 - .020							
Effects of Obstruction	Negligible	n_2	.000 - .004	0.001	0.001		0.001	0.001		0.001
	Minor		.005 - .015							
	Appreciable		.020 - .030							
	Severe		.040 - .060							
Vegetation	Small	n_3	.002 - .010	0.002			0.006			0.002
	Medium		.010 - .025		0.010			0.010		
	Large		.025 - .050							
	Very Large		.050 - .100							
Variations in Channel Cross Section	Gradual	n_4	0	0.000	0.000		0.000	0.000		0.000
	Occ. Alt.		.001 - .005							
	Freq. Alt.		.010 - .015							
Subtotal				0.034	0.040		0.034	0.040		0.034
Degree of Meandering	Minor	m	1	1	1		1	1		1
	Appreciable		1.15							
	Severe		1.3							
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.034	0.040	0.000	0.034	0.040	0.000	0.034
Manning's n Value Used				**0.035**	**0.040**	**0.000**	**0.035**	**0.040**	**0.000**	**0.035**

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Lower El Mirage Wash
Stream: El Mirage Wash
Location: Segment 2
Notes: Existing Wash Between El Mirage Culvert and Golf Course

Channel Conditions		Manning's n Adjustment		Left Overbank	Left Bank (Earth)	Left Bank (Rip-Rap)	Channel	Right Bank (Earth)	Right Bank (Rip-Rap)	Right Overbank
Channel Material	Firm Soil	n_b	.025 - .032							
	Coarse Sand		.026 - .035	0.030			0.026			0.030
	Gravel		.028 - .035							
	Cobble		.030 - .050							
	Boulder		.040 - .070							
Degree of Irregularity	Smooth	n_1	0							
	Minor		.001 - .005	0.001			0.001			0.001
	Moderate		.006 - .010							
	Severe		.011 - .020							
Effects of Obstruction	Negligible	n_2	.000 - .004	0.001			0.001			0.001
	Minor		.005 - .015							
	Appreciable		.020 - .030							
	Severe		.040 - .060							
Vegetation	Small	n_3	.002 - .010	0.002			0.006			0.002
	Medium		.010 - .025							
	Large		.025 - .050							
	Very Large		.050 - .100							
Variations in Channel Cross Section	Gradual	n_4	0	0.000			0.000			0.000
	Occ. Alt.		.001 - .005							
	Freq. Alt.		.010 - .015							
Subtotal				0.034			0.034			0.034
Degree of Meandering	Minor	m	1	1			1			1
	Appreciable		1.15							
	Severe		1.3							
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.034	0.000	0.000	0.034	0.000	0.000	0.034
Manning's n Value Used				**0.035**	**0.000**	**0.000**	**0.035**	**0.000**	**0.000**	**0.035**

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Lower El Mirage Wash
Stream: El Mirage Wash
Location: Segment 3
Notes: Existing Wash along western portion of Golf Course

Channel Conditions		Manning's n Adjustment		Left Overbank	Left Bank (Earth)	Left Bank (Rip-Rap)	Channel	Right Bank (Earth)	Right Bank (Rip-Rap)	Right Overbank
Channel Material	Firm Soil	n_b	.025 - .032	0.025			0.025			0.025
	Coarse Sand		.026 - .035							
	Gravel		.028 - .035							
	Cobble		.030 - .050							
	Boulder		.040 - .070							
Degree of Irregularity	Smooth	n_1	0	0.000			0.000			0.000
	Minor		.001 - .005							
	Moderate		.006 - .010							
	Severe		.011 - .020							
Effects of Obstruction	Negligible	n_2	.000 - .004	0.000						0.000
	Minor		.005 - .015				0.005			
	Appreciable		.020 - .030							
	Severe		.040 - .060							
Vegetation	Small	n_3	.002 - .010	0.010			0.010			0.010
	Medium		.010 - .025							
	Large		.025 - .050							
	Very Large		.050 - .100							
Variations in Channel Cross Section	Gradual	n_4	0	0.000			0.000			0.000
	Occ. Alt.		.001 - .005							
	Freq. Alt.		.010 - .015							
Subtotal				0.035			0.040			0.035
Degree of Meandering	Minor	m	1							
	Appreciable		1.15	1.15			1.15			1.15
	Severe		1.3							
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.040	0.000	0.000	0.046	0.000	0.000	0.040
Manning's n Value Used				**0.040**	**0.000**	**0.000**	**0.045**	**0.000**	**0.000**	**0.040**

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Lower El Mirage Wash
Stream: El Mirage Wash
Location: Segement 4
Notes: Existing Wash along riparion improvement area

Channel Conditions		Manning's n Adjustment		Left Overbank	Left Bank (Earth)	Left Bank (Rip-Rap)	Channel	Right Bank (Earth)	Right Bank (Rip-Rap)	Right Overbank
Channel Material	Firm Soil	n_b	.025 - .032	0.025			0.025			0.025
	Coarse Sand		.026 - .035							
	Gravel		.028 - .035							
	Cobble		.030 - .050							
	Boulder		.040 - .070							
Degree of Irregularity	Smooth	n_1	0							
	Minor		.001 - .005	0.001			0.001			0.001
	Moderate		.006 - .010							
	Severe		.011 - .020							
Effects of Obstruction	Negligible	n_2	.000 - .004	0.001						0.001
	Minor		.005 - .015				0.010			
	Appreciable		.020 - .030							
	Severe		.040 - .060							
Vegetation	Small	n_3	.002 - .010	0.005			0.010			0.005
	Medium		.010 - .025							
	Large		.025 - .050							
	Very Large		.050 - .100							
Variations in Channel Cross Section	Gradual	n_4	0	0.000			0.000			0.000
	Occ. Alt.		.001 - .005							
	Freq. Alt.		.010 - .015							
Subtotal				0.032			0.046			0.032
Degree of Meandering	Minor	m	1	1			1			1
	Appreciable		1.15							
	Severe		1.3							
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.032	0.000	0.000	0.046	0.000	0.000	0.032
Manning's n Value Used				**0.030**	**0.000**	**0.000**	**0.045**	**0.000**	**0.000**	**0.030**

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Lower El Mirage Wash
Stream: El Mirage Wash
Location: Segment 5
Notes: Existing Wash along eastern portion of Golf Course

Channel Conditions		Manning's n Adjustment		Left Overbank	Left Bank (Earth)	Left Bank (Rip-Rap)	Channel	Right Bank (Earth)	Right Bank (Rip-Rap)	Right Overbank
Channel Material	Firm Soil	n_b	.025 - .032	0.025			0.025			0.025
	Coarse Sand		.026 - .035							
	Gravel		.028 - .035							
	Cobble		.030 - .050							
	Boulder		.040 - .070							
Degree of Irregularity	Smooth	n_1	0	0.000			0.000			0.000
	Minor		.001 - .005							
	Moderate		.006 - .010							
	Severe		.011 - .020							
Effects of Obstruction	Negligible	n_2	.000 - .004	0.000						0.000
	Minor		.005 - .015				0.005			
	Appreciable		.020 - .030							
	Severe		.040 - .060							
Vegetation	Small	n_3	.002 - .010	0.010			0.010			0.010
	Medium		.010 - .025							
	Large		.025 - .050							
	Very Large		.050 - .100							
Variations in Channel Cross Section	Gradual	n_4	0	0.000			0.000			0.000
	Occ. Alt.		.001 - .005							
	Freq. Alt.		.010 - .015							
Subtotal				0.035			0.040			0.035
Degree of Meandering	Minor	m	1							
	Appreciable		1.15	1.15			1.15			1.15
	Severe		1.3							
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.040	0.000	0.000	0.046	0.000	0.000	0.040
Manning's n Value Used				**0.040**	**0.000**	**0.000**	**0.045**	**0.000**	**0.000**	**0.040**

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Lower El Mirage Wash
Stream: El Mirage Wash
Location: Segment 6
Notes: Existing Wash between Golf Course and Agua Fria Thalwag

Channel Conditions		Manning's n Adjustment		Left Overbank	Left Bank (DG)	Left Bank (Rip-Rap)	Channel	Right Bank (DG)	Right Bank (Rip-Rap)	Right Overbank (Golf Course)
Channel Material	Firm Soil	n_b	.025 - .032							0.025
	Coarse Sand		.026 - .035	0.030			0.026			
	Gravel		.028 - .035							
	Cobble		.030 - .050							
	Boulder		.040 - .070							
Degree of Irregularity	Smooth	n_1	0							
	Minor		.001 - .005							0.001
	Moderate		.006 - .010	0.008			0.008			
	Severe		.011 - .020							
Effects of Obstruction	Negligible	n_2	.000 - .004	0.001			0.001			0.001
	Minor		.005 - .015							
	Appreciable		.020 - .030							
	Severe		.040 - .060							
Vegetation	Small	n_3	.002 - .010							0.010
	Medium		.010 - .025	0.010			0.010			
	Large		.025 - .050							
	Very Large		.050 - .100							
Variations in Channel Cross Section	Gradual	n_4	0	0.000			0.000			
	Occ. Alt.		.001 - .005							0.003
	Freq. Alt.		.010 - .015							
Subtotal				0.049			0.045			0.040
Degree of Meandering	Minor	m	1	1			1			1
	Appreciable		1.15							
	Severe		1.3							
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.049			0.045			0.040
Manning's n Value Used				**0.050**	**0.000**	**0.000**	**0.045**	**0.000**	**0.000**	**0.040**

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Lower El Mirage Wash
Stream: El Mirage Wash
Location: North-South Segment of Proposed Basin
Notes: Surface Treatment as Proposed by Landscape Architect

Channel Conditions		Manning's n Adjustment		Left Overbank	Left Bank (Earth)	Left Bank (Rip-Rap)	Channel	Right Bank (Earth)	Right Bank (Rip-Rap)	Right Overbank (Golf Course)
Channel Material	Firm Soil	n_b	.025 - .032		0.025		0.025	0.025		
	Coarse Sand		.026 - .035	0.030						0.030
	Gravel		.028 - .035							
	Cobble		.030 - .050							
	Boulder		.040 - .070							
Degree of Irregularity	Smooth	n_1	0							
	Minor		.001 - .005	0.001	0.001		0.001	0.001		0.001
	Moderate		.006 - .010							
	Severe		.011 - .020							
Effects of Obstruction	Negligible	n_2	.000 - .004	0.001			0.000			0.001
	Minor		.005 - .015		0.010			0.010		
	Appreciable		.020 - .030							
	Severe		.040 - .060							
Vegetation	Small	n_3	.002 - .010	0.002						0.002
	Medium		.010 - .025		0.010		0.020	0.010		
	Large		.025 - .050							
	Very Large		.050 - .100							
Variations in Channel Cross Section	Gradual	n_4	0	0.000	0.000		0.000	0.000		0.000
	Occ. Alt.		.001 - .005							
	Freq. Alt.		.010 - .015							
Subtotal				0.034	0.046		0.046	0.046		0.034
Degree of Meandering	Minor	m	1	1	1		1	1		1
	Appreciable		1.15							
	Severe		1.3							
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.034	0.046	0.000	0.046	0.046	0.000	0.034
Manning's n Value Used				**0.035**	**0.045**	**0.000**	**0.045**	**0.045**	**0.000**	**0.035**

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Lower El Mirage Wash
Stream: El Mirage Wash
Location: East-West Segment of Proposed Basin
Notes: Surface Treatment as Proposed by Landscape Architect

Channel Conditions		Manning's n Adjustment		Left Overbank	Left Bank (Earth)	Left Bank (Rip-Rap)	Channel	Right Bank (Earth)	Right Bank (Rip-Rap)	Right Overbank (Golf Course)
Channel Material	Firm Soil	n_b	.025 - .032		0.025		0.025	0.025		
	Coarse Sand		.026 - .035	0.030						0.030
	Gravel		.028 - .035							
	Cobble		.030 - .050							
	Boulder		.040 - .070							
Degree of Irregularity	Smooth	n_1	0							
	Minor		.001 - .005	0.001	0.001		0.001	0.001		0.001
	Moderate		.006 - .010							
	Severe		.011 - .020							
Effects of Obstruction	Negligible	n_2	.000 - .004	0.001						0.001
	Minor		.005 - .015		0.010		0.010	0.010		
	Appreciable		.020 - .030							
	Severe		.040 - .060							
Vegetation	Small	n_3	.002 - .010	0.002						0.002
	Medium		.010 - .025		0.010		0.020	0.010		
	Large		.025 - .050							
	Very Large		.050 - .100							
Variations in Channel Cross Section	Gradual	n_4	0	0.000	0.000		0.000	0.000		0.000
	Occ. Alt.		.001 - .005							
	Freq. Alt.		.010 - .015							
Subtotal				0.034	0.046		0.056	0.046		0.034
Degree of Meandering	Minor	m	1	1	1		1	1		1
	Appreciable		1.15							
	Severe		1.3							
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.034	0.046	0.000	0.056	0.046	0.000	0.034
Manning's n Value Used				**0.035**	**0.045**	**0.000**	**0.055**	**0.045**	**0.000**	**0.035**

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Lower El Mirage Wash
Stream: El Mirage Wash
Location: Proposed Unlined Channel Downstream of El Mirage Road
Notes:

Channel Conditions		Manning's n Adjustment		Left Overbank	Left Bank (Earth)	Left Bank (Rip-Rap)	Channel	Right Bank (Earth)	Right Bank (Rip-Rap)	Right Overbank (Golf Course)
Channel Material	Firm Soil	n_b	.025 - .032		0.025		0.025	0.025		
	Coarse Sand		.026 - .035	0.030						0.030
	Gravel		.028 - .035							
	Cobble		.030 - .050							
	Boulder		.040 - .070							
Degree of Irregularity	Smooth	n_1	0		0.000		0.000	0.000		
	Minor		.001 - .005	0.001						0.001
	Moderate		.006 - .010							
	Severe		.011 - .020							
Effects of Obstruction	Negligible	n_2	.000 - .004	0.001	0.001		0.001	0.001		0.001
	Minor		.005 - .015							
	Appreciable		.020 - .030							
	Severe		.040 - .060							
Vegetation	Small	n_3	.002 - .010	0.002	0.005		0.005	0.005		0.002
	Medium		.010 - .025							
	Large		.025 - .050							
	Very Large		.050 - .100							
Variations in Channel Cross Section	Gradual	n_4	0	0.000	0.000		0.000	0.000		0.000
	Occ. Alt.		.001 - .005							
	Freq. Alt.		.010 - .015							
Subtotal				0.034	0.031		0.031	0.031		0.034
Degree of Meandering	Minor	m	1	1	1		1	1		1
	Appreciable		1.15							
	Severe		1.3							
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.034	0.031	0.000	0.031	0.031	0.000	0.034
Manning's n Value Used				**0.035**	**0.030**	**0.000**	**0.030**	**0.030**	**0.000**	**0.035**

Segment 1 - Photo #1

Segment 1 - Photo #2

Segment 1 - Photo #3

Segment 1 - Photo #4

Segment 1 - Photo #6

Segment 2 - Photo #7

Segment 2 - Photo #8

Segment 2 - Photo #9

Segment 2 - Photo #10

Segment 3 - Photo #11

Segment 3 - Photo #12

Segment 3 - Photo #13

Segment 4 - Photo #14

Segment 4 - Photo #15

Segment 5 - Photo #16

Segment 5 - Photo #17

Segment 6 - Photo #18

Segment 6 - Photo #19

Appendix G

El Mirage Road Design Plans

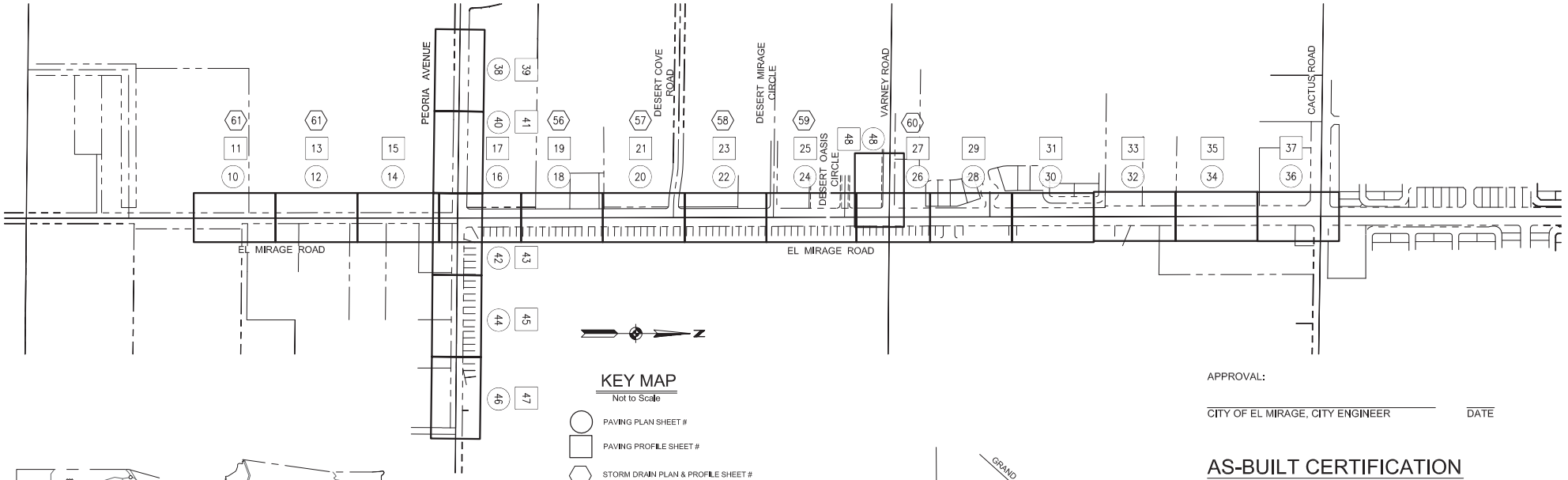
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT344 (PHASE 2)	1	121	

CITY OF EL MIRAGE

EL MIRAGE, ARIZONA

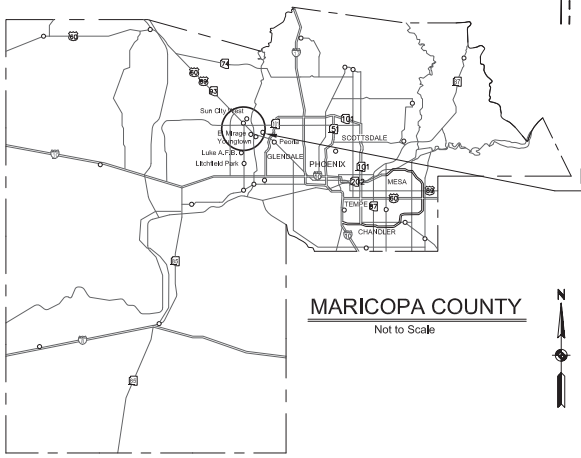
EL MIRAGE ROAD: PEORIA AVENUE TO CACTUS ROAD

PROJECT NO. TT344 (PHASE 2)



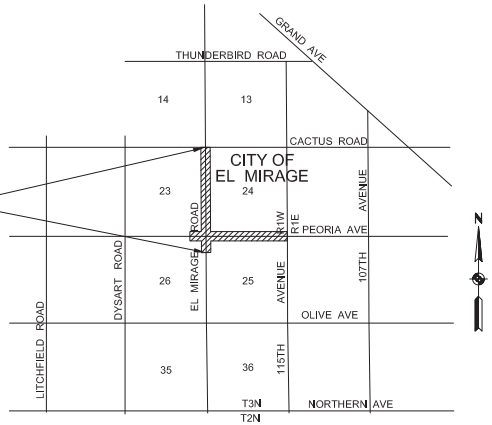
KEY MAP
Not to Scale

- PAVING PLAN SHEET #
- PAVING PROFILE SHEET #
- STORM DRAIN PLAN & PROFILE SHEET #
- * SEE LANDSCAPE AND TRAFFIC PLANS FOR RESPECTIVE KEY MAPS



MARICOPA COUNTY
Not to Scale

PROJECT NO. TT344 (PHASE 2)



VICINITY MAP
Not to Scale

APPROVAL:

CITY OF EL MIRAGE, CITY ENGINEER — DATE

AS-BUILT CERTIFICATION

I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION OR AS NOTED, AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

REGISTERED LAND SURVEYOR/ENGINEER — DATE

REGISTRATION NUMBER

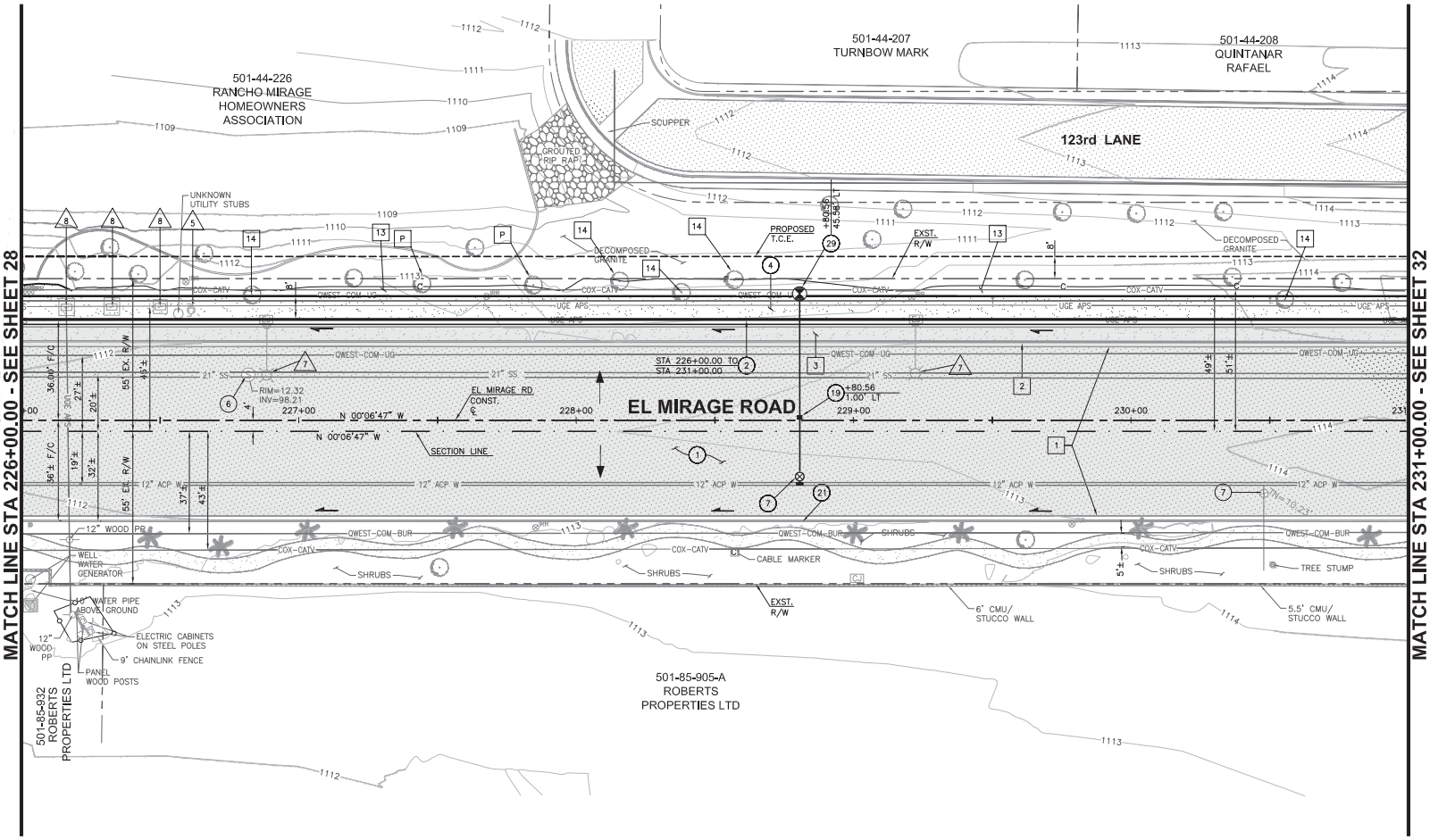
COMPANY

90% SUBMITTAL

PRELIMINARY NOT FOR CONSTRUCTION

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

PREMIER
ENGINEERING CORPORATION
6437 W. CHANDLER BLVD SUITE 1
CHANDLER, AZ 85226 (480) 829-6000



NOTES:

1. SEE SHEETS 56 TO 63 FOR STORM DRAIN PLANS.
2. VALVES, MANHOLES, CLEANOUTS LABELED "NF" ARE SHOWN PER AS-BUILT/UTILITY MAPS BUT COULD NOT BE FOUND DURING SITE FIELD INVESTIGATIONS. CONTRACTOR TO FIELD VERIFY PRIOR TO FINAL ADJUSTMENTS.

0 20 40

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT344 (PHASE 2)	30	121	

M MATCH
P PROTECT
S SAWCUT

REMOVAL/RELOCATE

NO.	DESCRIPTION	QTY	UNIT
1	SAWCUT & REMOVE EXISTING A.C. PAVEMENT.	–	–
2	REMOVE EXISTING CURB & GUTTER.	500	LF
3	REMOVE EXISTING SIDEWALK.	2500	SF
13	REMOVE EXISTING MISC. LANDSCAPE MATERIAL INCLUDING RIVER ROCK, CONCRETE HEADER, BOULDERS, DG, ETC. WITHIN CUT/FILL SLOPES. SALVAGE AND RETURN TO OWNER.	7490	SF
14	REMOVE EXISTING TREE AND ROOT SYSTEM, COMPLETE.	3	EA

CONSTRUCTION

NO.	DESCRIPTION	QTY	UNIT
1	CONSTRUCT ROADWAY PAVEMENT PER SECTION A ON SHEET 7.		
	SUBGRADE PREP	3840	SY
	ABC	2454	TON
	AC PVMT (3/4" MIX)	756	TON
	TACK COAT	1.6	TON
	AR-ACFC	294	TON
2	CONSTRUCT CONCRETE CURB & GUTTER PER M.A.G. STD. DETAIL 220-1, TYPE 'A'.	500	LF
4	CONSTRUCT CONCRETE SIDEWALK PER M.A.G. STD. DETAIL 230.	4000	SF
6	ADJUST MANHOLE FRAME & COVER TO FINISHED GRADE PER C.O.E.M. STD. DETAIL 422.	1	EA
7	ADJUST VALVE BOX & COVER PER C.O.E.M. STD. DETAIL 393.	2	EA
19	CONSTRUCT FIRE HYDRANT MARKER PER C.O.E.M. STD. DETAIL 271. (NPI)	1	EA
21	EXISTING CURB & GUTTER TO REMAIN. PROTECT IN PLACE.	–	–
29	CONSTRUCT FIRE HYDRANT ASSEMBLY PER C.O.E.M. STD. DETAIL 360.		
	6" DIP WATERLINE	68	LF
	12"x6" T.S.V.B. & C. (M.A.G. STD. DETAIL 340)	1	EA
	FIRE HYDRANT	1	EA

RELOCATE BY OTHERS

5 EXISTING COMMUNICATIONS VAULT/CABINET TO BE RELOCATED BY CENTURY LINK.
7 EXISTING STREET LIGHT TO BE RELOCATED BY APS.
8 EXISTING TRANSFORMER TO BE RELOCATED BY APS.

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE

CITY OF EL MIRAGE

EL MIRAGE ROAD
PEORIA AVENUE TO CACTUS ROAD
PROJECT NO. TT344 (PHASE 2)

90% SUBMITTAL
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	J. BOYD	10/12
DRAWN	J. ROJAS	10/12
CHECKED	K. BOYD	10/12

PREMIER

PAVING PLAN
STA: 226+00 - STA: 231+00

SHEET 30 OF 121

10/6/2012 2:32 PM Plotted by: JESSE BOYD
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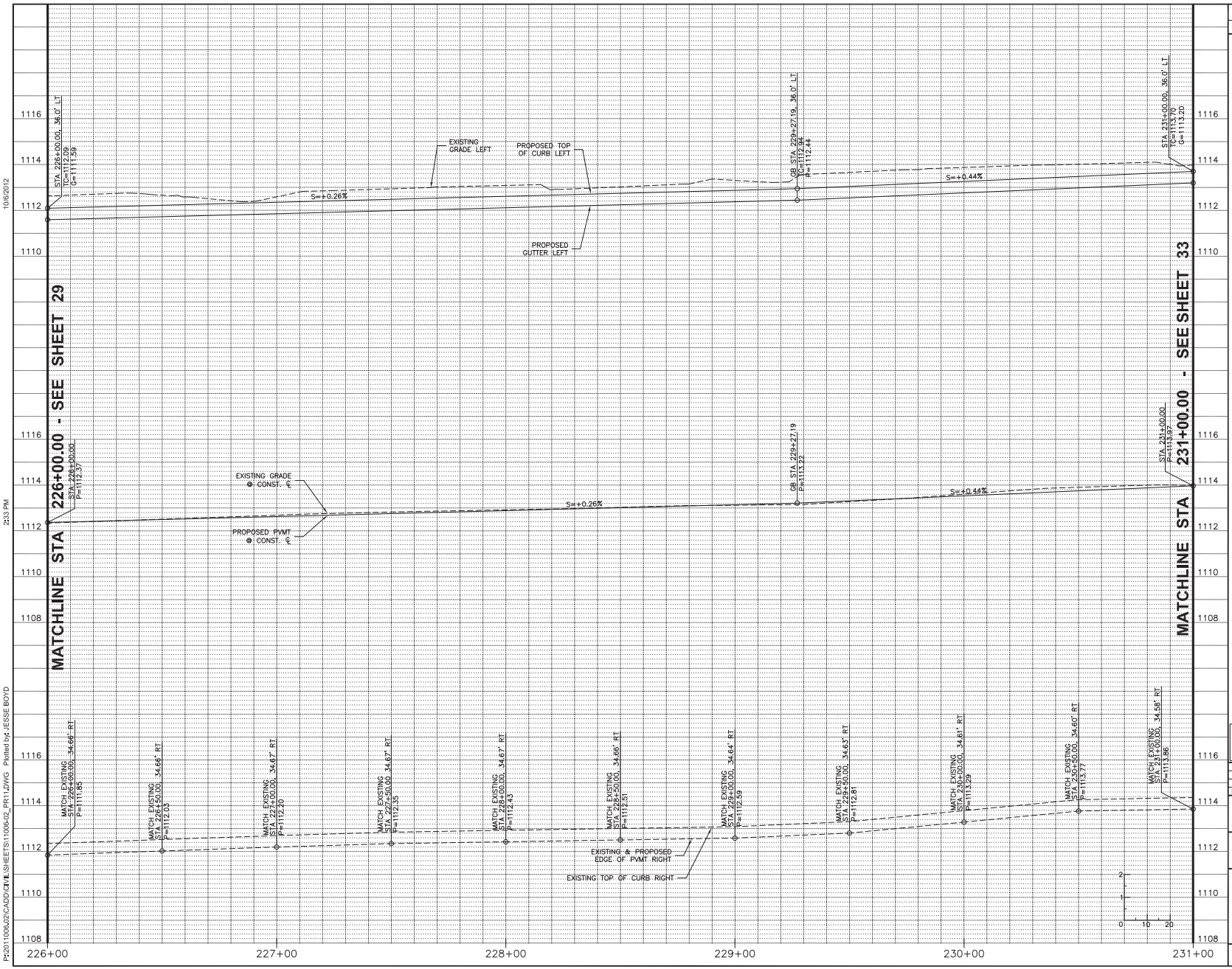

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F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT344 (PHASE 2)	31	121	

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE

CITY OF EL MIRAGE

EL MIRAGE ROAD
PEORIA AVENUE TO CACTUS ROAD
PROJECT NO. TT344 (PHASE 2)

90% SUBMITTAL

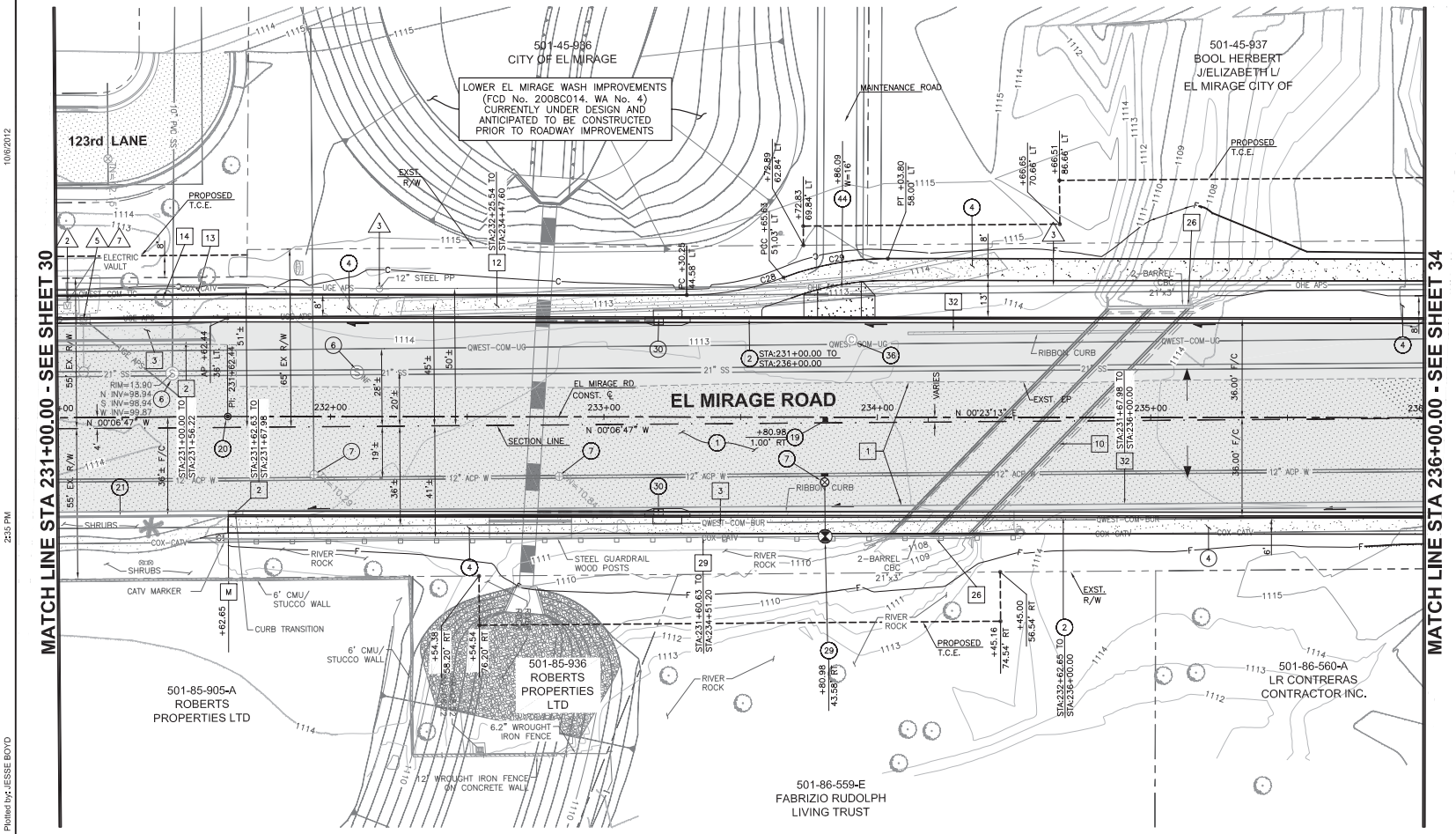
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	J. BOYD	10/12
DRAWN	D. HENRY	10/12
CHECKED	K. BOYD	10/12

PREMIER

PAVING PROFILE
STA: 226+00 - STA: 231+00

SHEET 31 OF 121



CURVE TABLE				
CURVE	LENGTH	RADIUS	TANGENT	DELTA
C28	36.16'	100.00'	18.28'	020°43'04"
C29	39.01'	108.00'	19.72'	020°41'39"

NOTES:

1. SEE SHEETS 56 TO 63 FOR STORM DRAIN PLANS.
2. VALVES, MANHOLES, CLEANOUTS LABELED "NF" ARE SHOWN PER AS-BUILT/UTILITY MAPS BUT COULD NOT BE FOUND DURING SITE FIELD INVESTIGATIONS. CONTRACTOR TO FIELD VERIFY PRIOR TO FINAL ADJUSTMENTS.

RELOCATE BY OTHERS

2 EXISTING ELECTRICAL JUNCTION BOX/CABINET TO BE RELOCATED BY APS.
3 EXISTING OVERHEAD LINES AND POWER POLES TO BE RELOCATED BY APS.
5 EXISTING COMMUNICATIONS VAULT/CABINET TO BE RELOCATED BY QWEST.
7 EXISTING STREET LIGHT TO BE RELOCATED BY APS.

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT344 (PHASE 2)	32	121	

M MATCH
P PROTECT
S SAWCUT

REMOVAL/RELOCATE

NO.	DESCRIPTION	QTY	UNIT
1	SAWCUT & REMOVE EXISTING A.C. PAVEMENT.	–	–
2	REMOVE EXISTING CURB & GUTTER.	120	LF
3	REMOVE EXISTING SIDEWALK.	4147	SF
10	REMOVE EXISTING BOX CULVERT. BACKILL & COMPACT (95%).	110	LF
13	REMOVE EXISTING MISC. LANDSCAPE MATERIAL INCLUDING RIVER ROCK, CONCRETE HEADER, BOULDERS, DG, ETC. WITHIN CUT/FILL SLOPES. SALVAGE AND RETURN TO OWNER.	1190	SF
14	REMOVE EXISTING TREE AND ROOT SYSTEM, COMPLETE.	1	EA
26	REMOVE EXISTING CONCRETE HEADWALL.	2	EA
29	REMOVE EXISTING GUARD RAIL COMPLETE.	290	LF
32	REMOVE EXISTING RIBBON CURB.	432	LF

CONSTRUCTION

NO.	DESCRIPTION	QTY	UNIT
1	CONSTRUCT ROADWAY PAVEMENT PER SECTION A ON SHEET 7.		
	SUBGRADE PREP	3842	SY
	ABC	2455	TON
	AC PVMT (3/4" MIX)	756	TON
	TACK COAT	1.6	TON
	AR-ACFC	294	TON
2	CONSTRUCT CONCRETE CURB & GUTTER PER M.A.G. STD. DETAIL 220-1, TYPE 'A'.	938	LF
4	CONSTRUCT CONCRETE SIDEWALK PER M.A.G. STD. DETAIL 230.	6673	SF
6	ADJUST MANHOLE FRAME & COVER TO FINISHED GRADE PER C.O.E.M. STD. DETAIL 422.	2	EA
7	ADJUST VALVE BOX & COVER PER C.O.E.M. STD. DETAIL 393.	3	EA
19	CONSTRUCT FIRE HYDRANT MARKER PER C.O.E.M. STD. DETAIL 271. (NPI)	1	EA
20	CONSTRUCT SURVEY MARKER PER M.A.G. STD. DETAIL 120-2, TYPE 'D'.	1	EA
21	EXISTING CURB & GUTTER TO REMAIN. PROTECT IN PLACE.	–	–
29	CONSTRUCT FIRE HYDRANT ASSEMBLY PER C.O.E.M. STD. DETAIL 360.		
	6" DIP WATERLINE	22	LF
	12"x6" T.S.V.B. & C. (M.A.G. STD. DETAIL 340)	1	EA
	FIRE HYDRANT	1	EA
30	PROPOSED CATCH BASIN PER STORM DRAIN PLANS.	2	EA
36	ADJUST COMMUNICATIONS MANHOLE TO FINISHED GRADE.	1	EA
44	CONSTRUCT DRIVEWAY PER MAG STD. DETAIL 262.	322	SF

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602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE

CITY OF EL MIRAGE

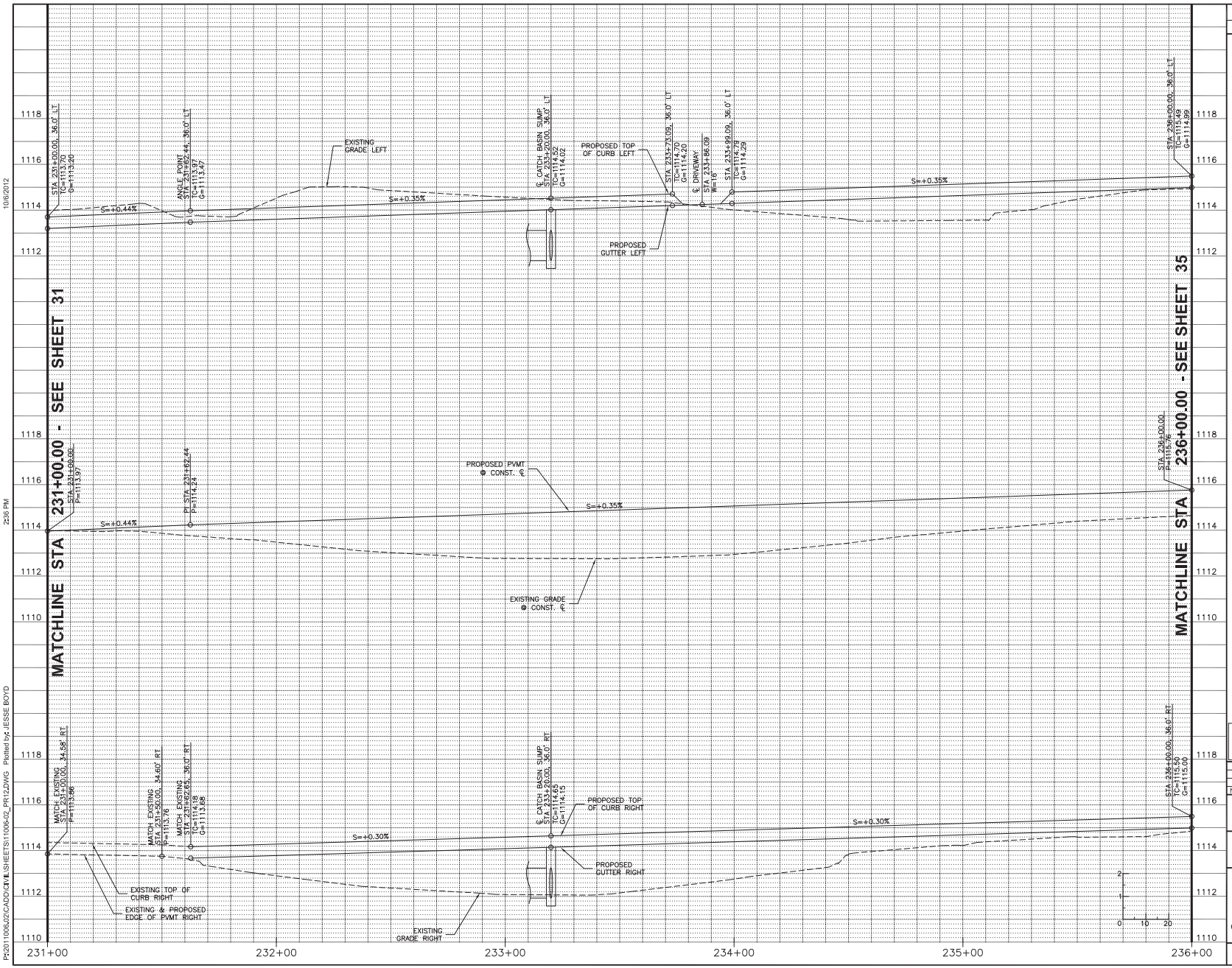
EL MIRAGE ROAD
PEORIA AVENUE TO CACTUS ROAD
PROJECT NO. TT344 (PHASE 2)

		BY	DATE
90% SUBMITTAL	DESIGNED	J. BOYD	10/12
	DRAWN	J. ROJAS	10/12
PRELIMINARY NOT FOR CONSTRUCTION	CHECKED	K. BOYD	10/12

PREMIER

PAVING PLAN
STA: 231+00 - STA: 236+00

SHEET 32 OF 121



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT344 (PHASE 2)	33	121	

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE

CITY OF EL MIRAGE

EL MIRAGE ROAD
PEORIA AVENUE TO CACTUS ROAD
PROJECT NO. TT344 (PHASE 2)

90% SUBMITTAL

PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	J. BOYD	10/12
DRAWN	D. HENRY	10/12
CHECKED	K. BOYD	10/12

PREMIER

PAVING PROFILE
STA: 231+00 - STA: 236+00

SHEET 33 OF 121

10/6/2012 2:36 PM Plotted by: JESSE BOYD
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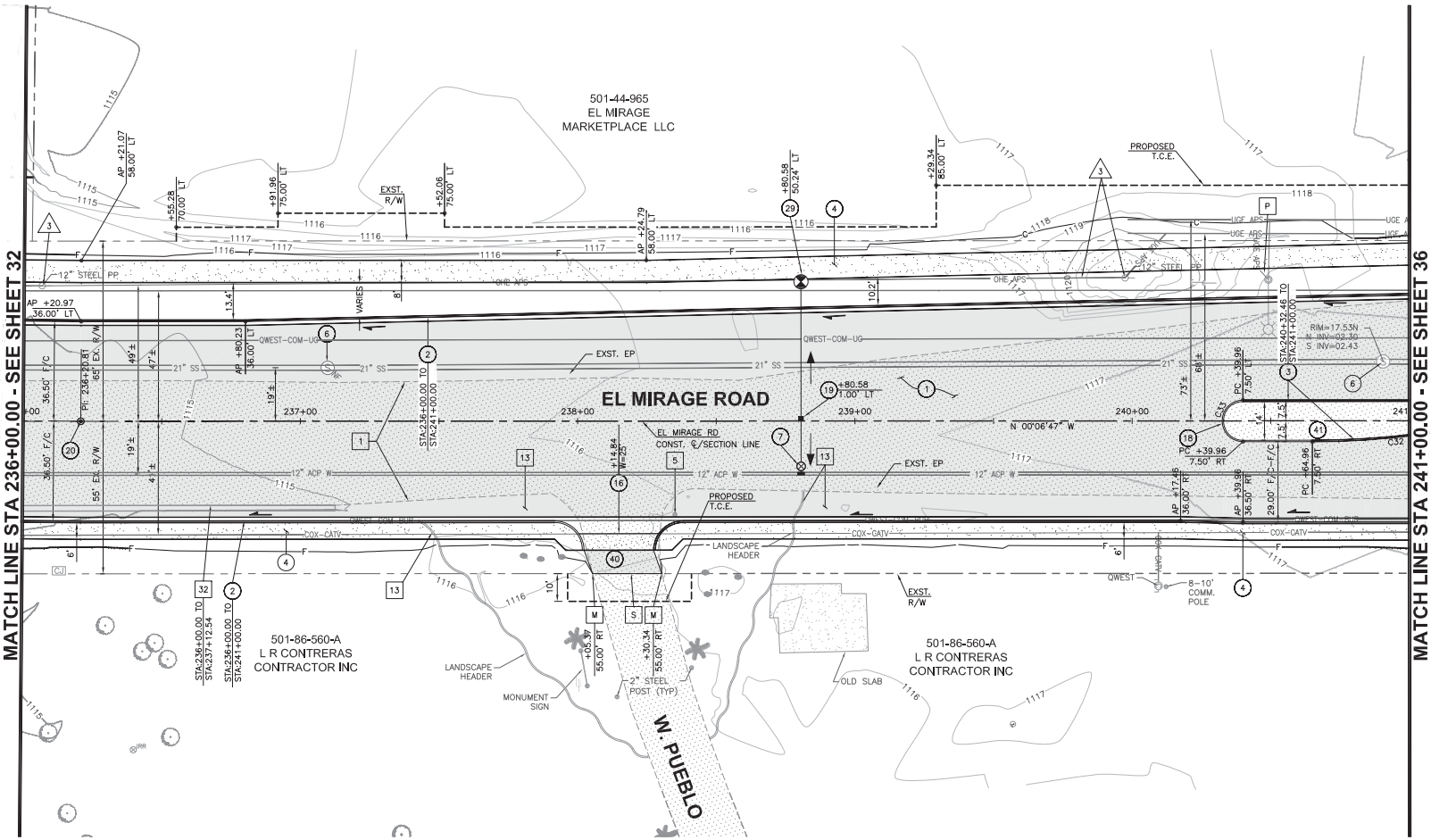

CURVE TABLE				
CURVE	LENGTH	RADIUS	TANGENT	DELTA
C32	57.53'	300.00'	28.86'	010°59'17"
C33	23.56'	7.50'	INFINITY'	180°00'00"

NOTES:

1. SEE SHEETS 56 TO 63 FOR STORM DRAIN PLANS.
2. VALVES, MANHOLES, CLEANOUTS LABELED "NF" ARE SHOWN PER AS-BUILT/UTILITY MAPS BUT COULD NOT BE FOUND DURING SITE FIELD INVESTIGATIONS. CONTRACTOR TO FIELD VERIFY PRIOR TO FINAL ADJUSTMENTS.

0 20 40

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT344 (PHASE 2)	34	121	

M MATCH
P PROTECT
S SAWCUT

REMOVAL/RELOCATE

NO.	DESCRIPTION	QTY	UNIT
1	SAWCUT & REMOVE EXISTING A.C. PAVEMENT.	–	–
5	REMOVE EXISTING SIGN, POST & FOUNDATION. SEE SIGNING & MARKING PLANS.	1	EA
13	REMOVE EXISTING MISC. LANDSCAPE MATERIAL INCLUDING RIVER ROCK, CONCRETE HEADER, BOULDERS, DG, ETC. WITHIN CUT/FILL SLOPES. SALVAGE AND RETURN TO OWNER.	1977	SF
32	REMOVE EXISTING RIBBON CURB.	113	LF

CONSTRUCTION

NO.	DESCRIPTION	QTY	UNIT
1	CONSTRUCT ROADWAY PAVEMENT PER SECTION A ON SHEET 7.		
	SUBGRADE PREP	3956	SY
	ABC	2528	TON
	AC PVMT (3/4" MIX)	779	TON
	TACK COAT	1.6	TON
	AR-ACFC	303	TON
2	CONSTRUCT CONCRETE CURB & GUTTER PER M.A.G. STD. DETAIL 220-1, TYPE 'A'.	1001	LF
3	CONSTRUCT SINGLE CURB PER M.A.G. STD. DETAIL 222, TYPE 'A'.	144	LF
4	CONSTRUCT CONCRETE SIDEWALK PER M.A.G. STD. DETAIL 230.	6863	SF
6	ADJUST MANHOLE FRAME & COVER TO FINISHED GRADE PER C.O.E.M. STD. DETAIL 422.	1	EA
7	ADJUST VALVE BOX & COVER PER C.O.E.M. STD. DETAIL 393.	1	EA
16	CONSTRUCT COMMERCIAL DRIVEWAY PER CITY OF PEORIA STD. DETAIL PE-251-1, R=10'.	380	SF
18	CONSTRUCT MEDIAN BULL NOSE PER M.A.G. STD. DETAIL 223 & CITY OF PEORIA STD. DETAIL PE-018.	1	EA
19	CONSTRUCT FIRE HYDRANT MARKER PER C.O.E.M. STD. DETAIL 271. (NPI)	1	EA
20	CONSTRUCT SURVEY MARKER PER M.A.G. STD. DETAIL 120-2, TYPE 'D'.	1	EA
29	CONSTRUCT FIRE HYDRANT ASSEMBLY PER C.O.E.M. STD. DETAIL 360.		
	6" DIP WATERLINE	61	LF
	12"x6" T.S.V.B. & C. (M.A.G. STD. DETAIL 340)	1	EA
	FIRE HYDRANT	1	EA
40	CONSTRUCT ASPHALT PAVEMENT DRIVEWAY CONNECTION PER SECTION D ON SHEET 7. SEE DRIVEWAY PROFILES FOR MATCH POINT, SHEETS 50 TO 51.		
	SUBGRADE PREP	25	SY
	ABC	12	TON
	AC PVMT (3/4" MIX)	4	TON
41	GRADE MEDIAN PER DETAIL P4 ON SHEET 52.	–	–

RELOCATE BY OTHERS

3 EXISTING OVERHEAD LINES AND POWER POLES TO BE RELOCATED BY APS.

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PEORIA AVENUE TO CACTUS ROAD
PROJECT NO. TT344 (PHASE 2)

90% SUBMITTAL

PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	J. BOYD	10/12
DRAWN	J. ROJAS	10/12
CHECKED	K. BOYD	10/12

PREMIER

PAVING PLAN
STA: 236+00 - STA: 241+00

SHEET 34 OF 121

10/6/2012 2:37 PM Plotted by: JESSE BOYD
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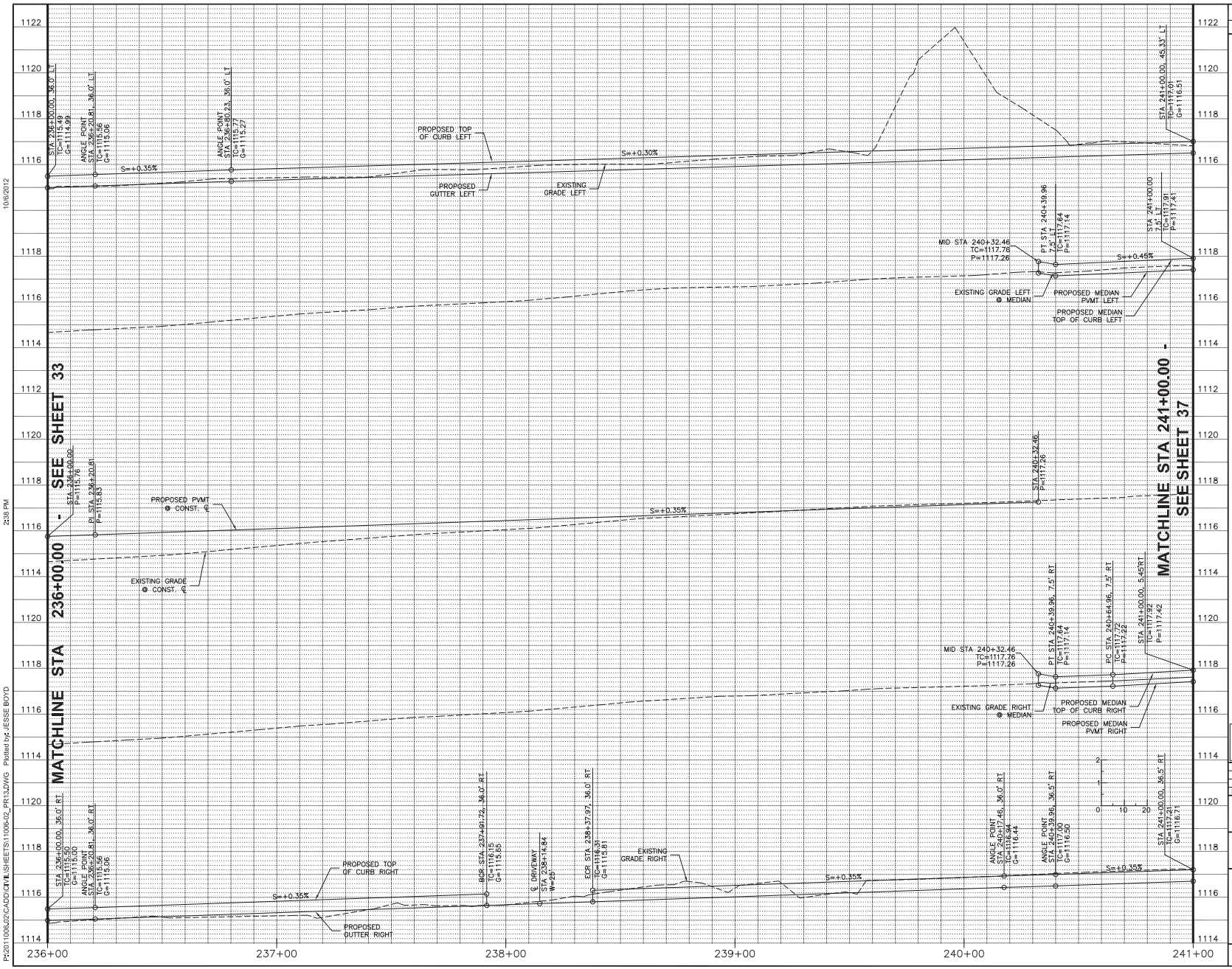

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT344 (PHASE 2)	35	121	

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE

CITY OF EL MIRAGE

EL MIRAGE ROAD
PEORIA AVENUE TO CACTUS ROAD
PROJECT NO. TT344 (PHASE 2)

90% SUBMITTAL

PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	J. BOYD	10/12
DRAWN	D. HENRY	10/12
CHECKED	K. BOYD	10/12

PREMIER

PAVING PROFILE
STA: 236+00 - STA: 241+00

SHEET 35 OF 121

10/6/2012 2:39 PM Plotted by: JESSE BOYD

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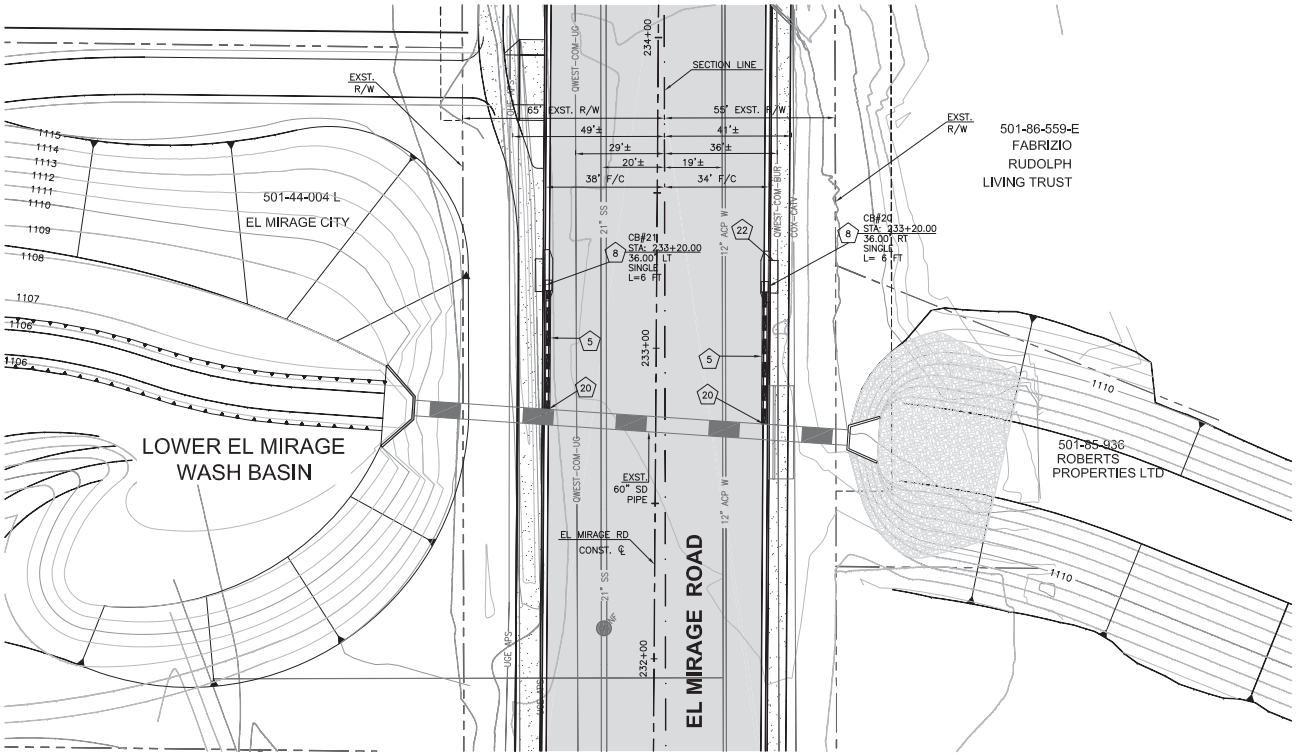


EL MIRAGE ROAD - STA:233+20.00

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT344 (PHASE 2)	63	121	

REMOVAL NOTES

NO.	DESCRIPTION	QTY	UNIT

CONSTRUCTION NOTES

NO.	DESCRIPTION	QTY	UNIT
5	INSTALL 18" CLASS IV RGRCP CONCRETE PIPE	81	LF
8	INSTALL CONCRETE CATCH BASIN PER M.A.G. STD. DETAIL 533 TYPE "D", "L" AND WING PER PLAN	2	EA
20	REMOVE EXISTING CAP AND CONNECT TO EXISTING TEE	2	EA
22	EXISTING UNDERGROUND COMMUNICATION LINE TO BE RELOCATED (BY CENTURY LINK)	1	EA

NOTES:

1. SEE PAVING PLANS FOR CONSTRUCTION OF PAVEMENT, CURB AND GUTTER, SIDEWALK, SCUPPER AND GRADING OF RETENTION BASINS.
2. CONTRACTOR IS RESPONSIBLE TO PROTECT ALL EXISTING UTILITIES IN PLACE OR ADJUST TO FINISHED GRADE PER MAG SPECIFICATIONS AS NEEDED.
3. SEE SHEET 69 FOR CONNECTOR PIPE PROFILE.
4. ALL CATCH BASIN OFFSET DIMENSIONS ARE TO THE FACE OF CURB.

TWO WORKING DAYS BEFORE YOU DIG, CALL 602-263-1100 BLUE STAKE

NO.	REVISION	BY	DATE

CITY OF EL MIRAGE

EL MIRAGE ROAD
PEORIA AVENUE TO CACTUS ROAD
PROJECT NO. TT344 (PHASE 2)

90% SUBMITTAL

PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	R. SHRESTHA	10/12
DRAWN	J. ROJAS	10/12
CHECKED	K. BOYD	10/12

PREMIER

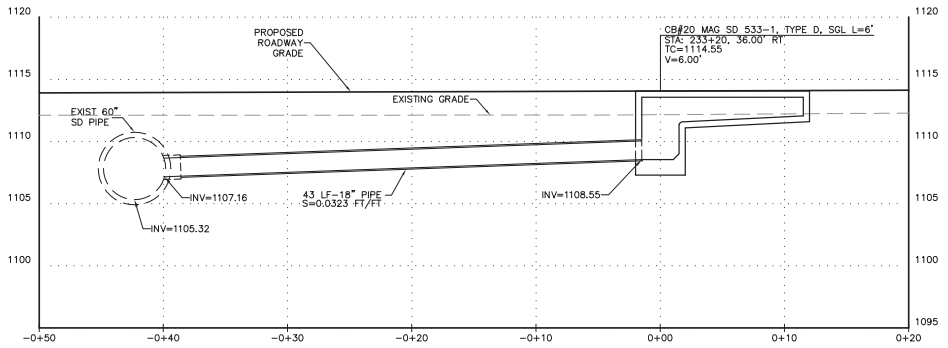
STORM DRAIN PLAN
STA 233+20.00

SHEET 63 OF 121

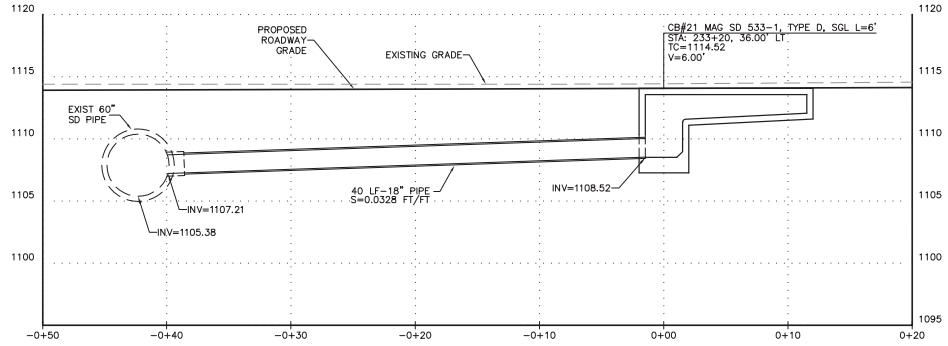
N

0 20 40

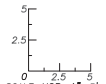
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ	TT344 (PHASE 2)	69	121	



CB20 SHT 63 **CONNECTOR PIPE PROFILE**



CB21 SHT 63 **CONNECTOR PIPE PROFILE**



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PEORIA AVENUE TO CACTUS ROAD
PROJECT NO. TT344 (PHASE 2)

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	BY	DATE
DESIGNED	R. SHRESTHA	10/12
DRAWN	J. ROJAS	10/12
CHECKED	K. BOYD	10/12

PREMIER

CONNECTOR PIPE PROFILE

SHEET 69 OF 121

10/6/2012 2:02 PM Plotted by: EMILY GARCIA

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Appendix H

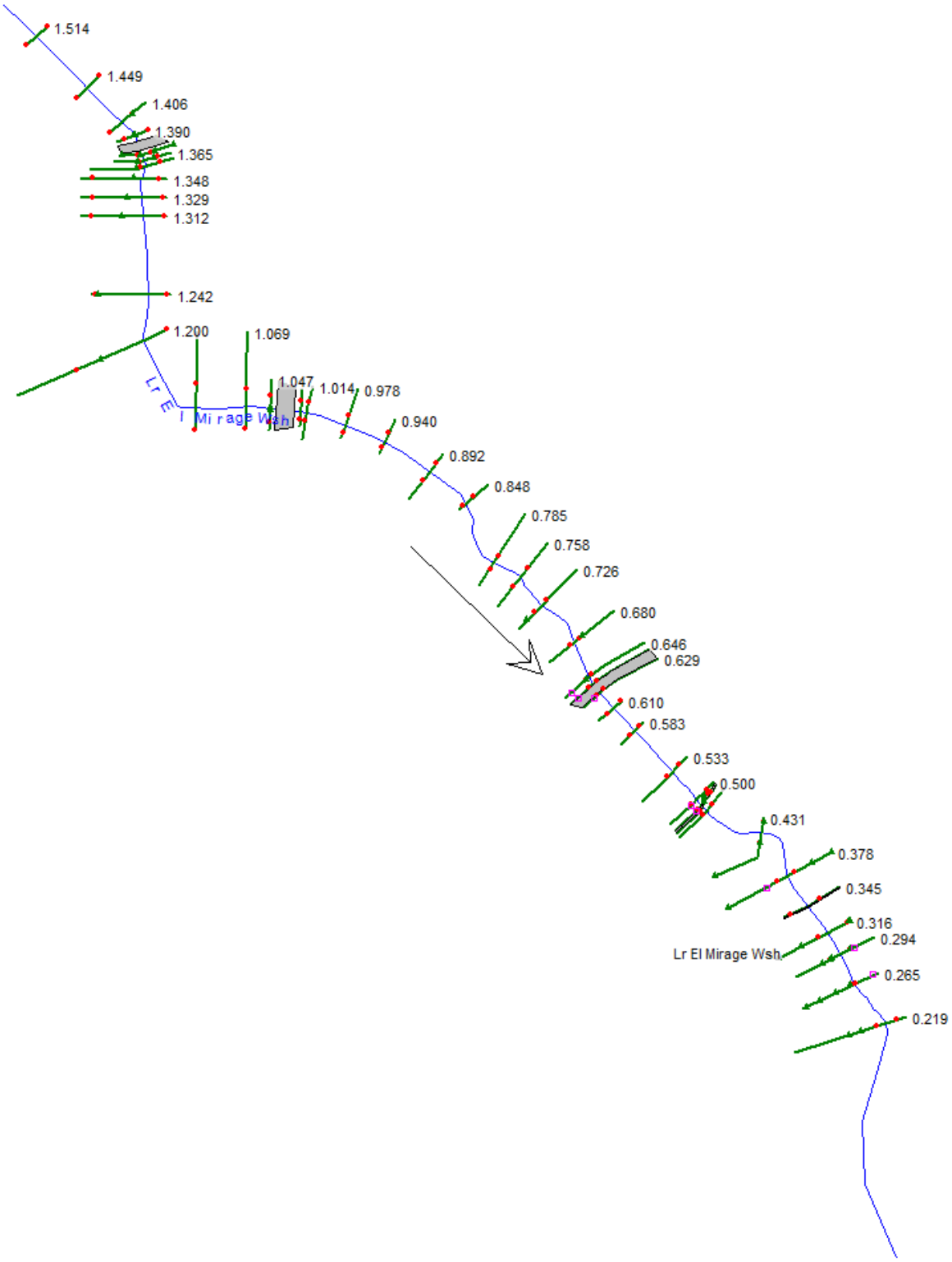
HEC RAS Supporting Documentation & Results

HEC-RAS Plan: PropLEMW River: Lr El Mirage Wsh Reach: Lr El Mirage Wsh Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Lr El Mirage Wsh	1.514	PF 1	654.00	1109.98	1117.23		1117.25	0.000085	1.11	586.66	109.88	0.09
Lr El Mirage Wsh	1.449	PF 1	654.00	1109.01	1117.21		1117.22	0.000052	0.92	707.49	117.89	0.07
Lr El Mirage Wsh	1.406	PF 1	654.00	1108.76	1117.20		1117.21	0.000037	0.83	787.00	186.01	0.06
Lr El Mirage Wsh	1.390	PF 1	654.00	1106.86	1117.10	1112.90	1117.18	0.000973	2.33	282.23	130.73	0.26
Lr El Mirage Wsh	1.379		Culvert									
Lr El Mirage Wsh	1.371	PF 1	654.00	1106.71	1112.60		1113.24	0.010807	6.42	101.80	48.79	0.68
Lr El Mirage Wsh	1.365	PF 1	654.00	1106.82	1112.76	1110.32	1112.88	0.001597	2.85	231.05	143.87	0.28
Lr El Mirage Wsh	1.360	PF 1	654.00	1106.75	1112.76	1110.31	1112.83	0.000913	2.31	292.43	160.29	0.22
Lr El Mirage Wsh	1.348	PF 1	654.00	1108.66	1112.59	1111.03	1112.74	0.002360	3.06	213.69	181.83	0.33
Lr El Mirage Wsh	1.329	PF 1	654.00	1107.91	1112.58	1109.47	1112.62	0.000476	1.60	409.87	258.45	0.15
Lr El Mirage Wsh	1.312	PF 1	654.00	1107.77	1112.56	1109.56	1112.58	0.000214	1.10	593.55	286.68	0.10
Lr El Mirage Wsh	1.242	PF 1	654.00	1107.22	1112.53	1109.17	1112.53	0.000074	0.66	992.16	280.09	0.06
Lr El Mirage Wsh	1.200	PF 1	654.00	1106.82	1112.52		1112.52	0.000035	0.50	1302.27	694.15	0.04
Lr El Mirage Wsh	1.115	PF 1	654.00	1106.08	1112.47		1112.49	0.000207	1.05	621.52	169.39	0.10
Lr El Mirage Wsh	1.069	PF 1	654.00	1105.71	1112.42		1112.44	0.000226	1.14	571.51	151.69	0.10
Lr El Mirage Wsh	1.047	PF 1	191.00	1105.54	1112.26	1107.85	1112.37	0.001073	2.70	70.61	69.29	0.19
Lr El Mirage Wsh	1.03		Culvert									
Lr El Mirage Wsh	1.020	PF 1	191.00	1105.40	1107.87	1107.87	1109.04	0.034772	8.68	22.00	9.46	1.00
Lr El Mirage Wsh	1.014	PF 1	191.00	1105.43	1107.81		1108.14	0.008152	4.62	41.32	24.08	0.62
Lr El Mirage Wsh	0.978	PF 1	191.00	1105.23	1107.51		1107.61	0.001143	2.45	77.82	43.29	0.32
Lr El Mirage Wsh	0.940	PF 1	191.00	1105.03	1107.27		1107.37	0.001216	2.51	76.14	42.94	0.33
Lr El Mirage Wsh	0.892	PF 1	191.00	1104.78	1106.93	1105.92	1107.03	0.001500	2.52	75.89	50.04	0.36
Lr El Mirage Wsh	0.848	PF 1	191.00	1104.55	1105.63	1105.63	1106.07	0.031844	5.30	36.03	41.98	1.01
Lr El Mirage Wsh	0.785	PF 1	191.00	1100.87	1105.41		1105.42	0.000104	0.73	289.47	137.87	0.07
Lr El Mirage Wsh	0.758	PF 1	191.00	1103.55	1105.33		1105.38	0.002577	1.69	113.38	121.54	0.30
Lr El Mirage Wsh	0.726	PF 1	191.00	1101.66	1105.33	1102.47	1105.33	0.000064	0.58	380.04	218.88	0.06
Lr El Mirage Wsh	0.680	PF 1	191.00	1101.72	1105.31		1105.32	0.000062	0.58	389.62	295.99	0.06
Lr El Mirage Wsh	0.646	PF 1	191.00	1102.00	1105.20	1103.48	1105.28	0.001489	2.32	83.39	88.29	0.26
Lr El Mirage Wsh	0.638	PF 1	191.00	1102.24	1105.14	1103.63	1105.21	0.001487	2.12	89.90	40.18	0.25
Lr El Mirage Wsh	0.634		Culvert									
Lr El Mirage Wsh	0.629	PF 1	191.00	1102.04	1105.14	1103.40	1105.20	0.001130	1.96	97.47	39.80	0.22
Lr El Mirage Wsh	0.610	PF 1	191.00	1102.04	1105.01		1105.06	0.001592	1.91	100.05	56.91	0.25
Lr El Mirage Wsh	0.583	PF 1	191.00	1102.26	1104.57		1104.70	0.004323	2.86	66.72	43.67	0.41
Lr El Mirage Wsh	0.533	PF 1	191.00	1101.08	1103.43		1103.55	0.004361	2.77	68.95	47.82	0.41
Lr El Mirage Wsh	0.500	PF 1	191.00	1099.34	1103.23	1101.12	1103.26	0.000777	1.41	135.69	70.44	0.18
Lr El Mirage Wsh	0.493	PF 1	191.00	1099.67	1103.15	1102.04	1103.21	0.001848	1.94	98.21	81.95	0.27
Lr El Mirage Wsh	0.492		Bridge									
Lr El Mirage Wsh	0.491	PF 1	191.00	1099.60	1102.12	1101.58	1102.34	0.010018	3.77	50.73	55.80	0.60
Lr El Mirage Wsh	0.486	PF 1	191.00	1099.64	1101.27	1101.27	1101.82	0.029832	5.94	32.14	29.84	1.01

HEC-RAS Plan: PropLEMW River: Lr El Mirage Wsh Reach: Lr El Mirage Wsh Profile: PF 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Lr El Mirage Wsh	0.431	PF 1	317.00	1092.94	1098.11		1098.20	0.002887	2.40	131.87	149.46	0.33
Lr El Mirage Wsh	0.378	PF 1	317.00	1092.94	1097.98	1096.49	1097.99	0.000259	0.83	366.98	235.01	0.10
Lr El Mirage Wsh	0.345	PF 1	317.00	1095.49	1097.81	1097.03	1097.88	0.002933	2.13	148.95	113.63	0.33
Lr El Mirage Wsh	0.344		Inl Struct									
Lr El Mirage Wsh	0.316	PF 1	317.00	1092.90	1096.98		1097.00	0.000827	1.11	290.41	280.19	0.17
Lr El Mirage Wsh	0.294	PF 1	317.00	1092.90	1096.60	1096.42	1096.74	0.011156	3.13	110.47	184.50	0.59
Lr El Mirage Wsh	0.265	PF 1	317.00	1094.52	1095.35	1094.75	1095.49	0.004387	1.48	107.81	201.01	0.34
Lr El Mirage Wsh	0.219	PF 1	317.00	1093.80	1094.65	1094.26	1094.76	0.003000	1.47	126.17	138.56	0.33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1.242
1.200
1.069
1.047
1.014
0.978
0.940
0.892
0.848
0.785
0.758
0.726
0.680
0.646
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0.610
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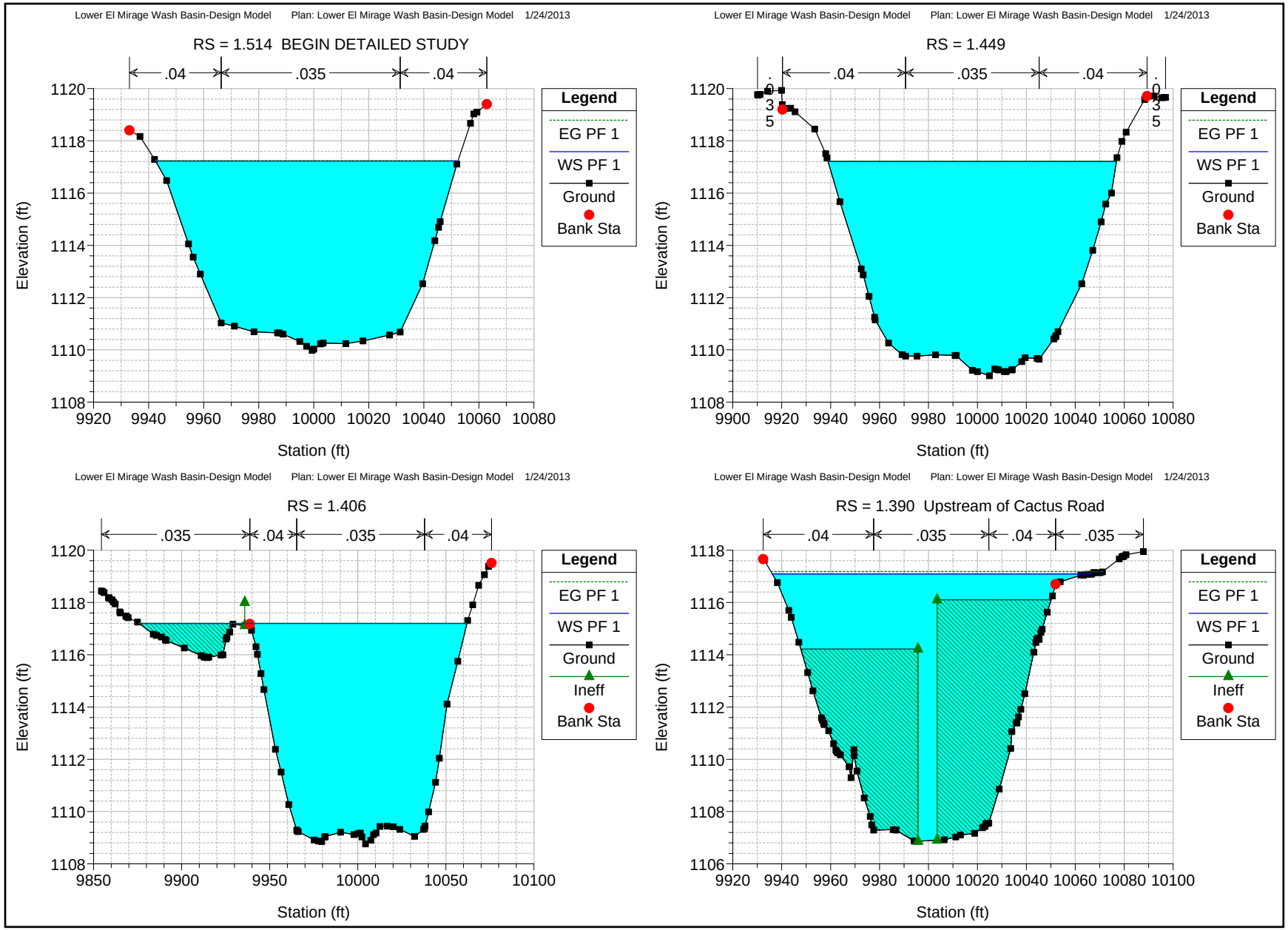
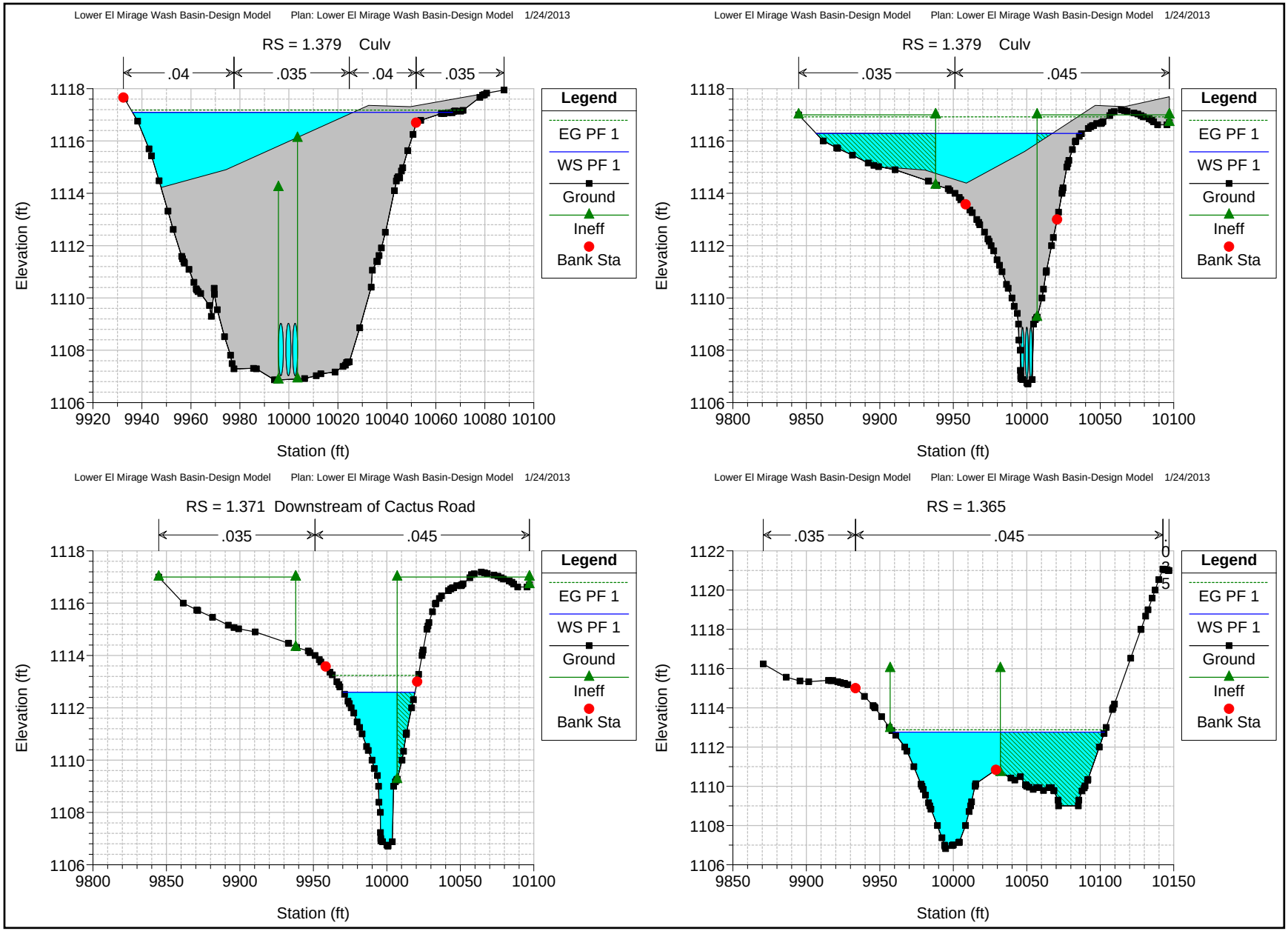
Lr El Mirage Wsh
Lr El Mirage Wsh


Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.514 BEGIN DETAILED STUDY
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.449
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.406
.035
.04
.035
.04
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.390 Upstream of Cactus Road
Ineff


Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.379 Culv
.04
.035
.04
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.379 Culv
.035
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.371 Downstream of Cactus Road
.035
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.365
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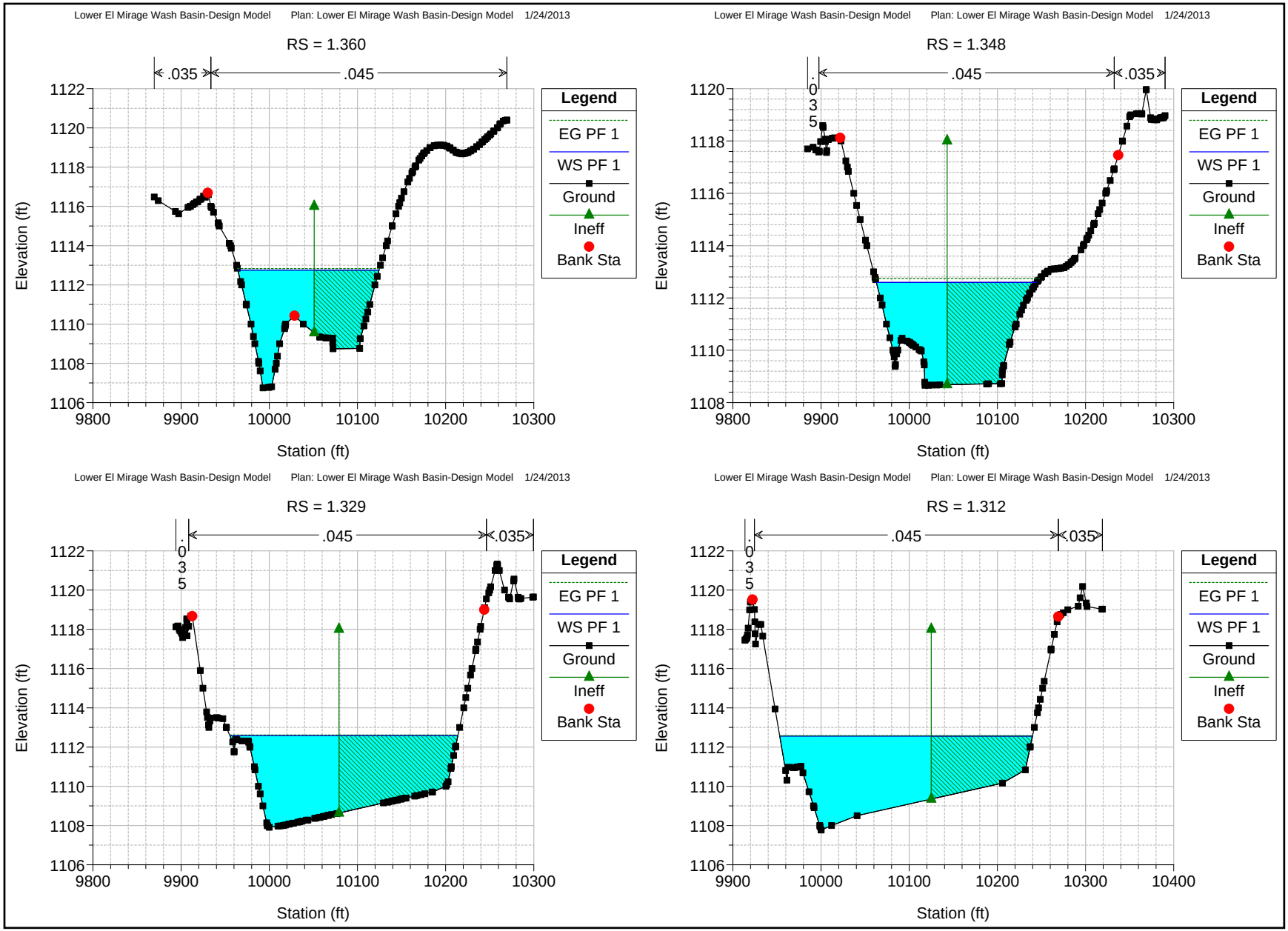
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta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RS = 1.360
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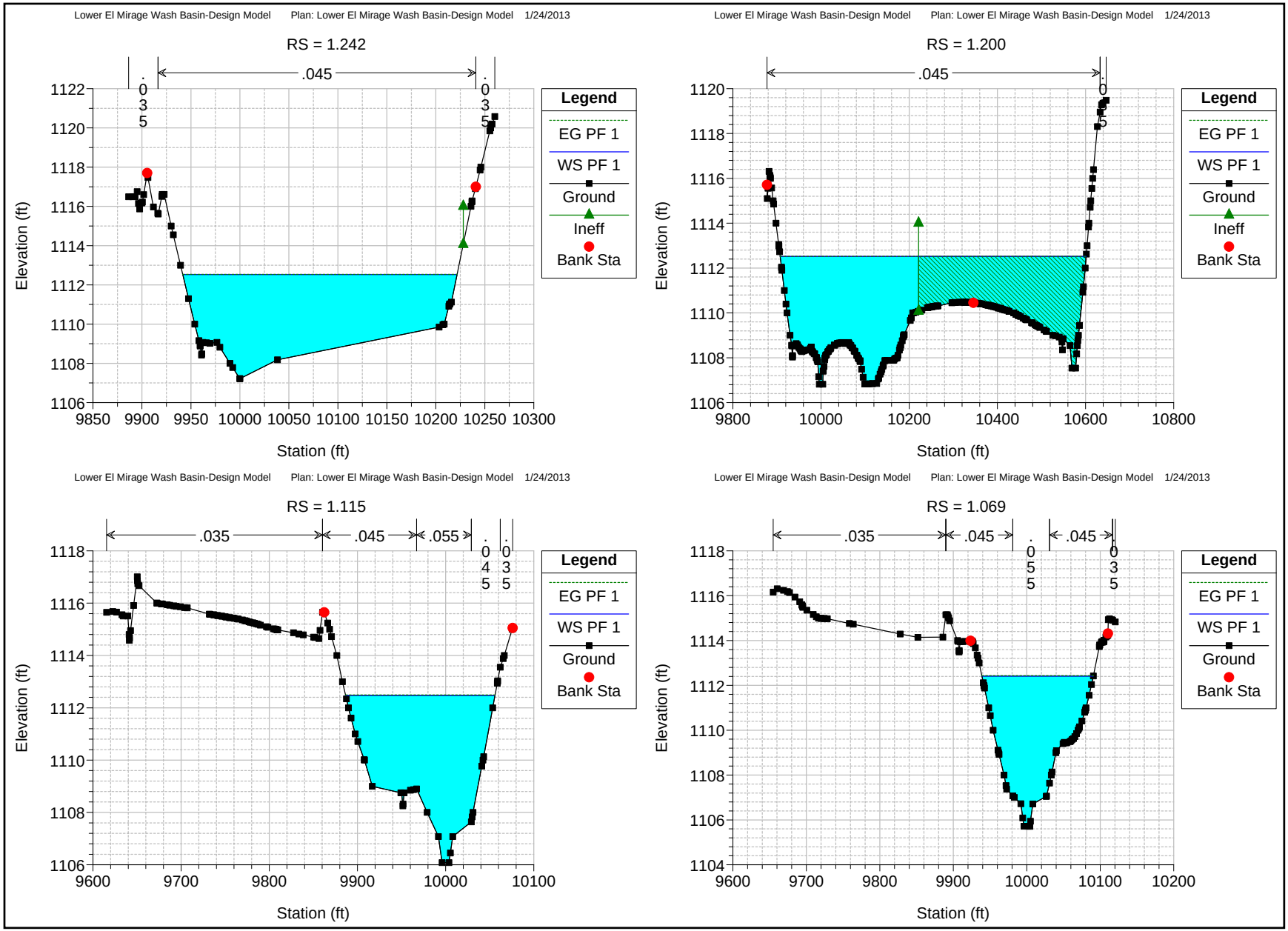
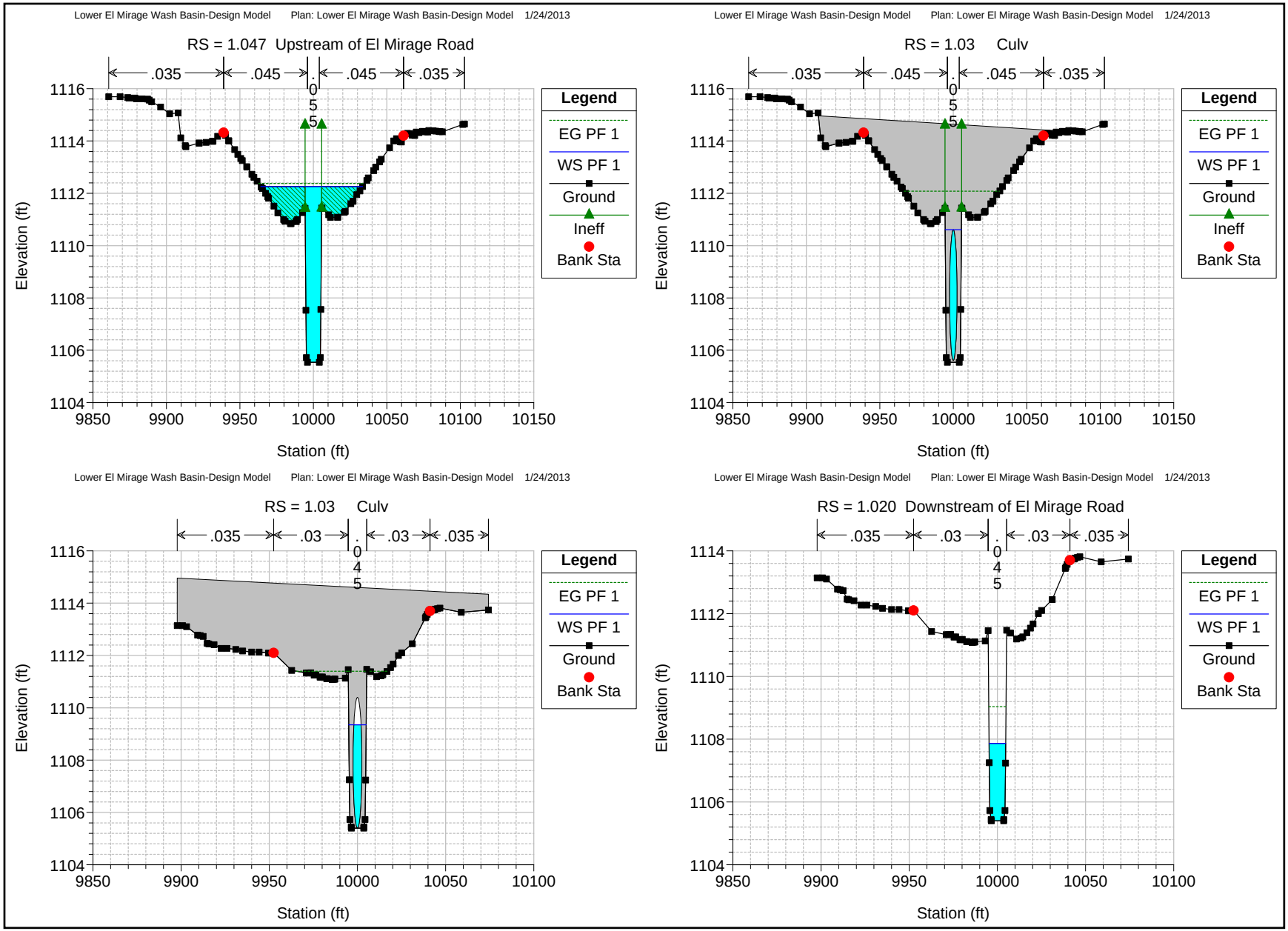
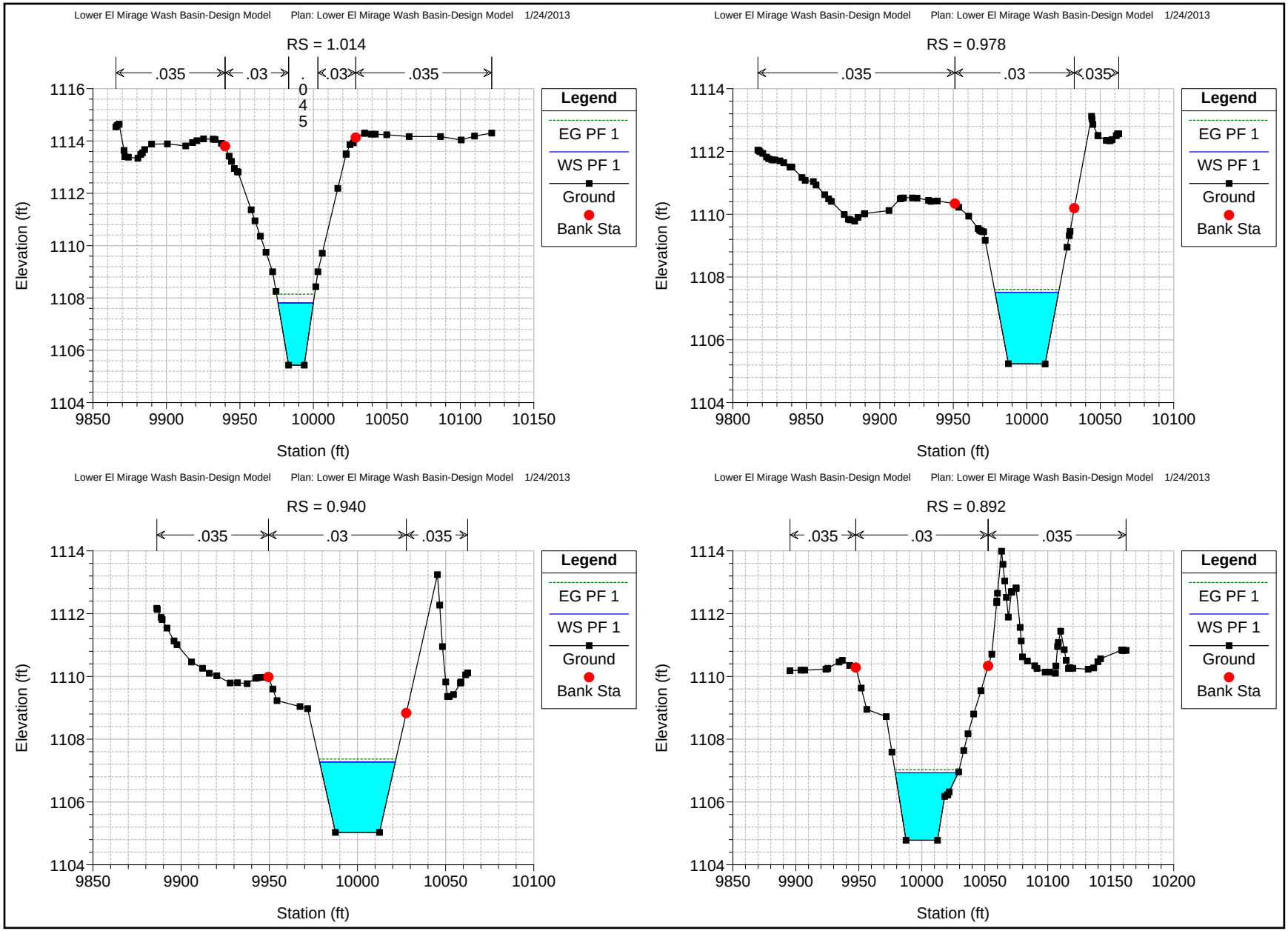
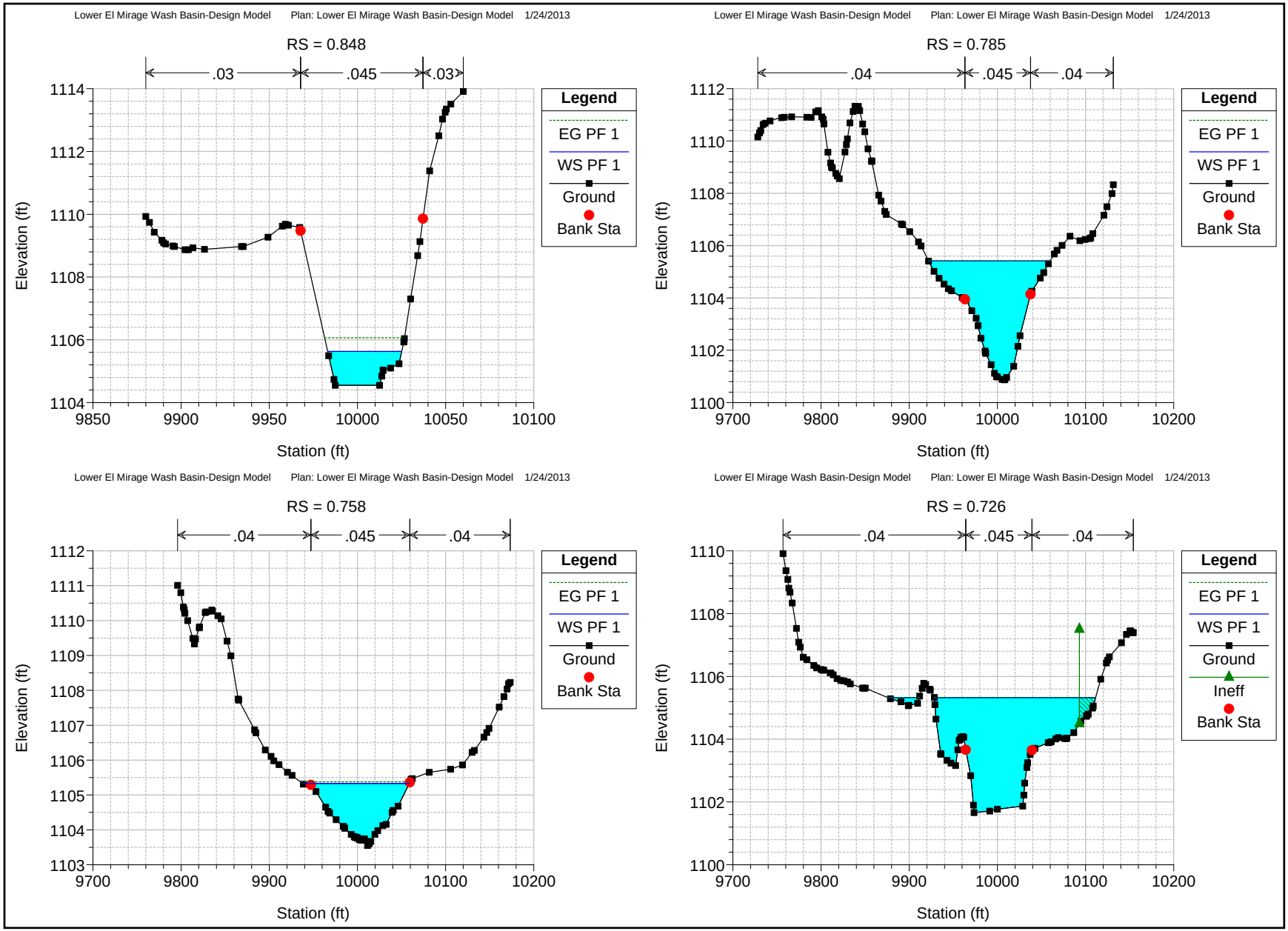
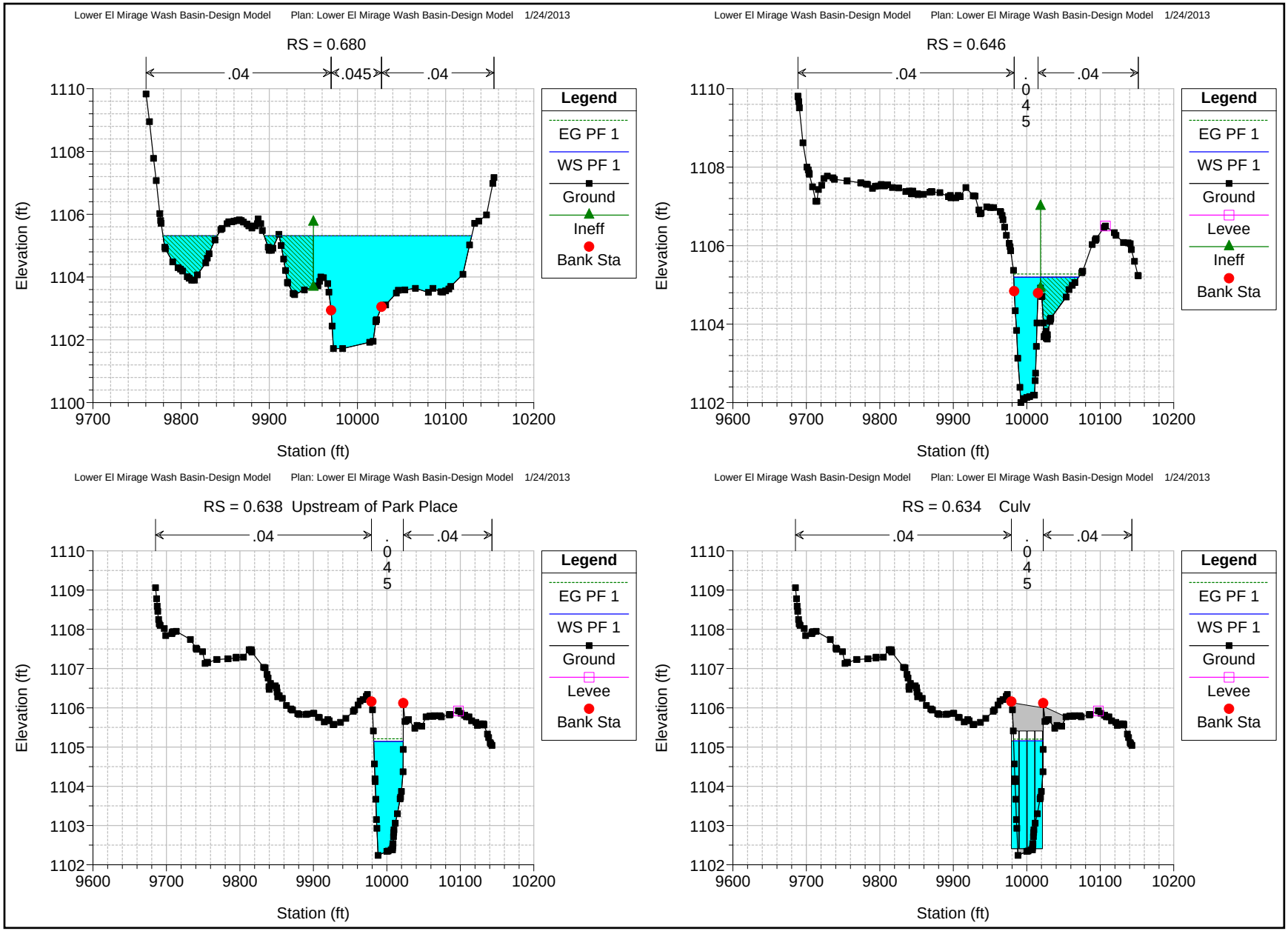
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.348
.035
.045
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.329
.035
.045
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.312
.035
.045
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta

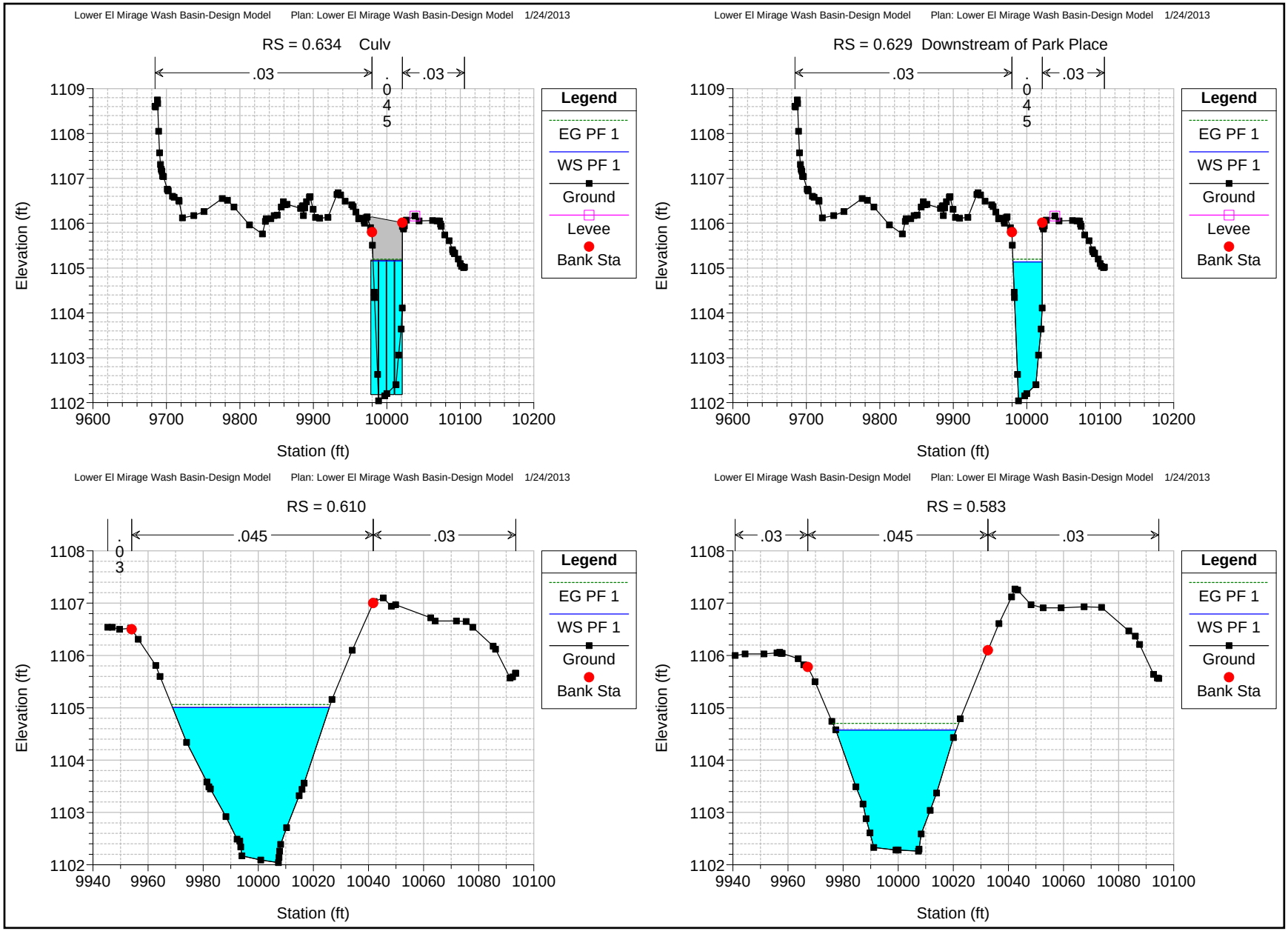

Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.242
.045
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.200
.045
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.115
.035
.045
.055
.045
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.069
.035
.045
.055
.045
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

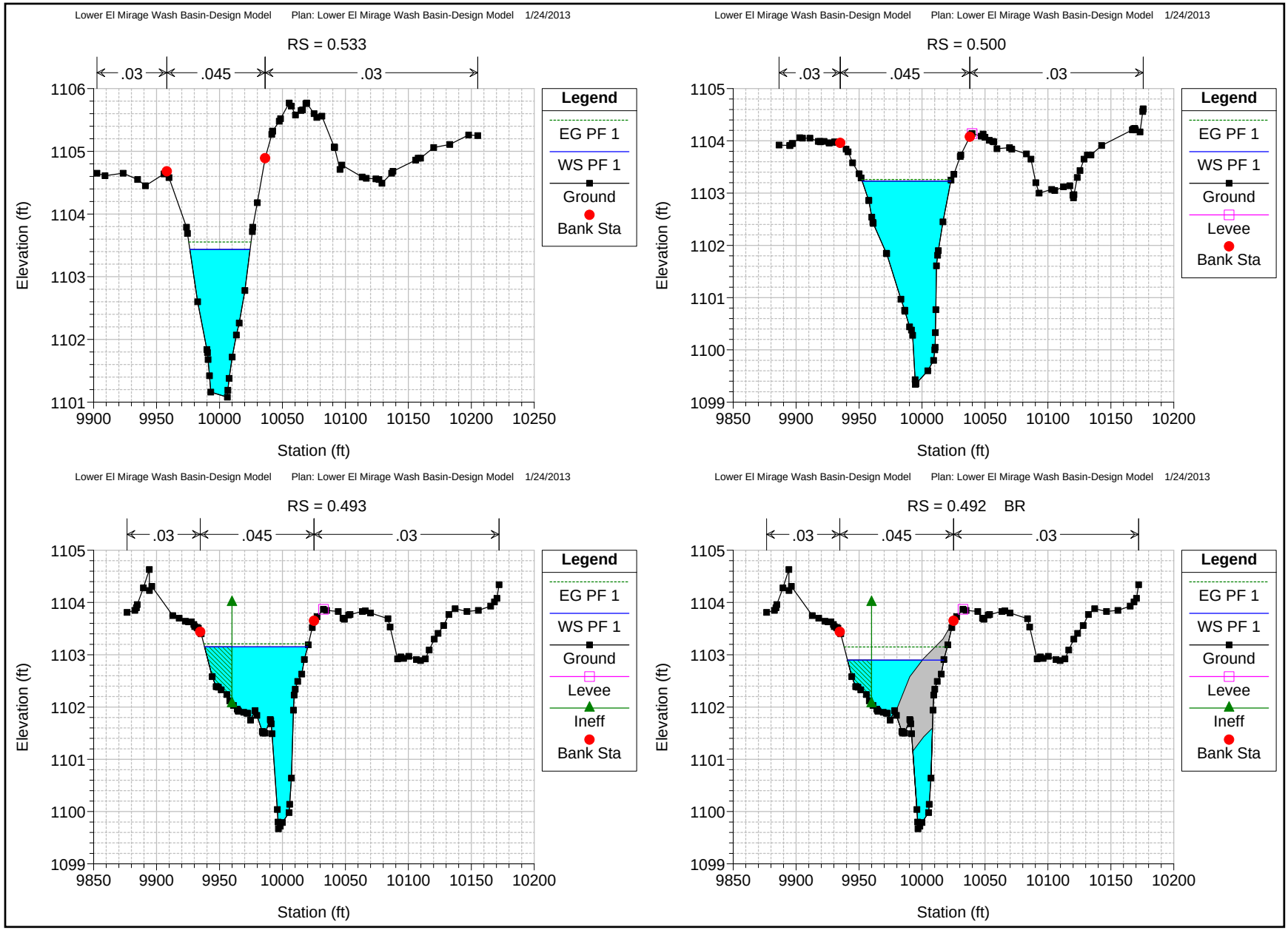

Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.047 Upstream of El Mirage Road
.035
.045
.045
.035
0.055
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1116
1114
1112
1110
1108
1106
1104
9850
9900
9950
10000
10050
10100
10150
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.03 Culv
.035
.045
.045
.035
0.055
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1116
1114
1112
1110
1108
1106
1104
9850
9900
9950
10000
10050
10100
10150
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.03 Culv
.035
.03
.03
.035
0.045
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
1116
1114
1112
1110
1108
1106
1104
9850
9900
9950
10000
10050
10100
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.020 Downstream of El Mirage Road
.035
.03
.03
.035
0.045
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
1114
1112
1110
1108
1106
1104
9850
9900
9950
10000
10050
10100

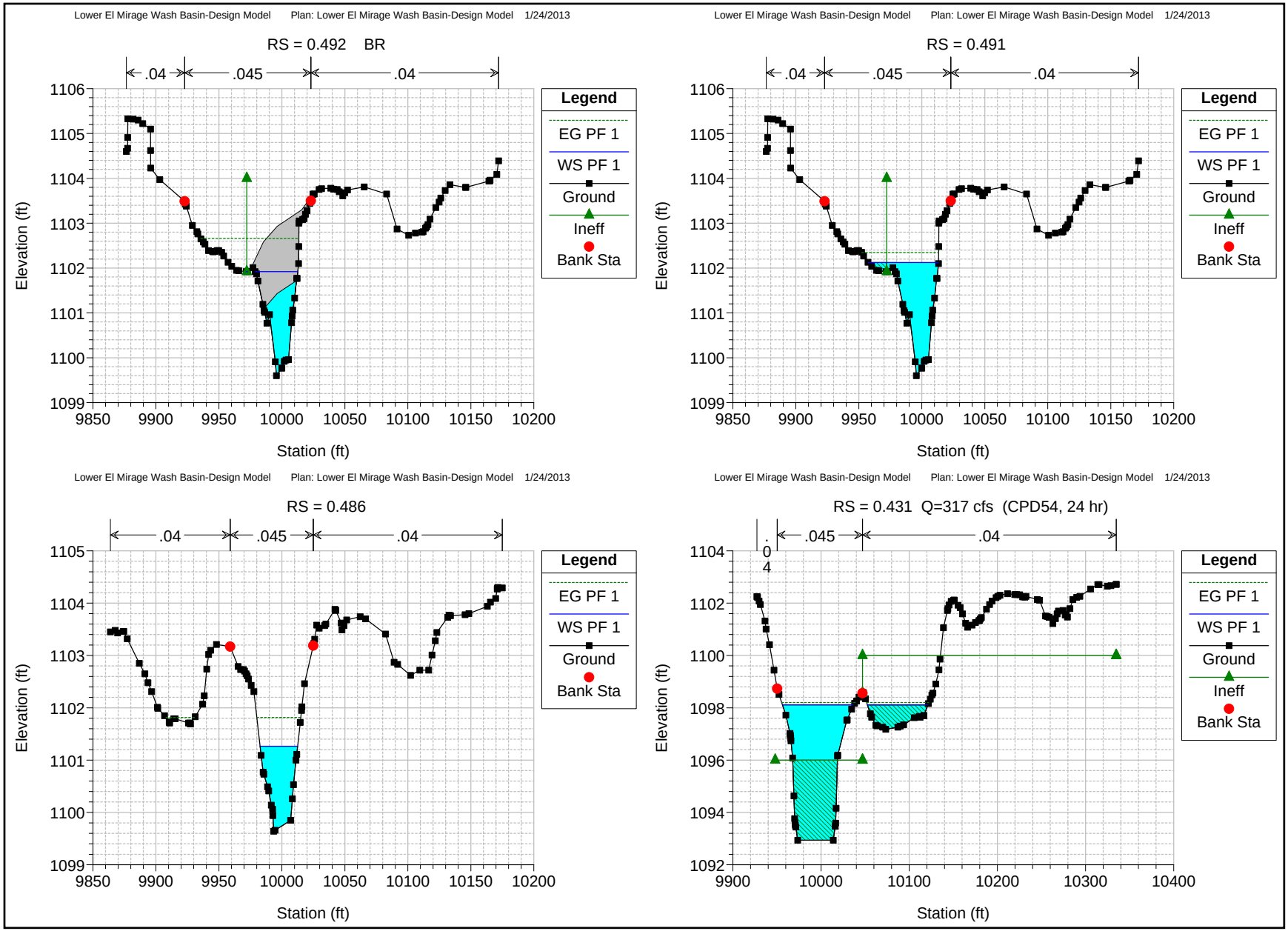

Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 1.014
.035
.03
.045
.03
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.978
.035
.03
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.940
.035
.03
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.892
.035
.03
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

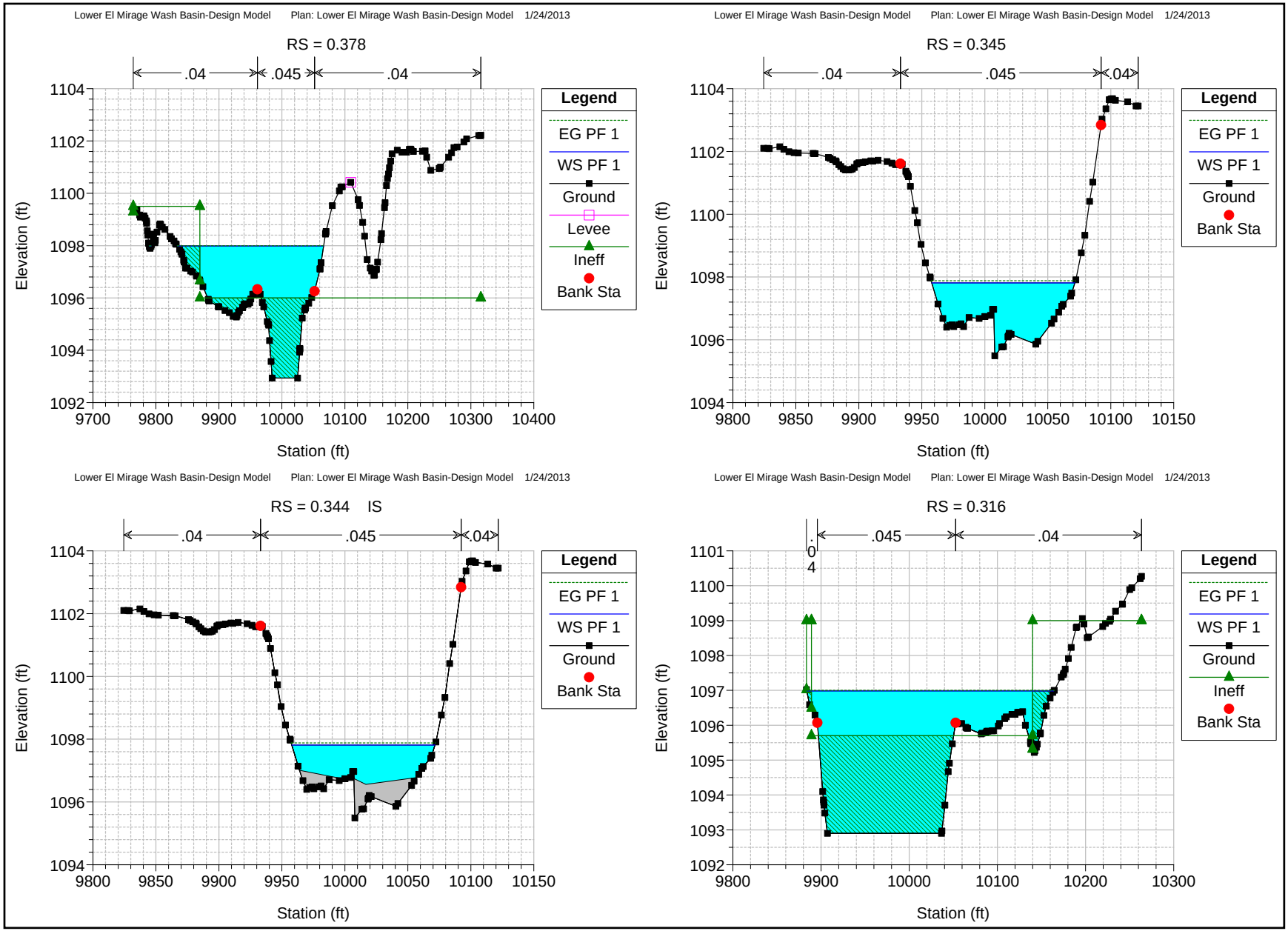

Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.848
.03
.045
.03
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.785
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.758
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.726
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta

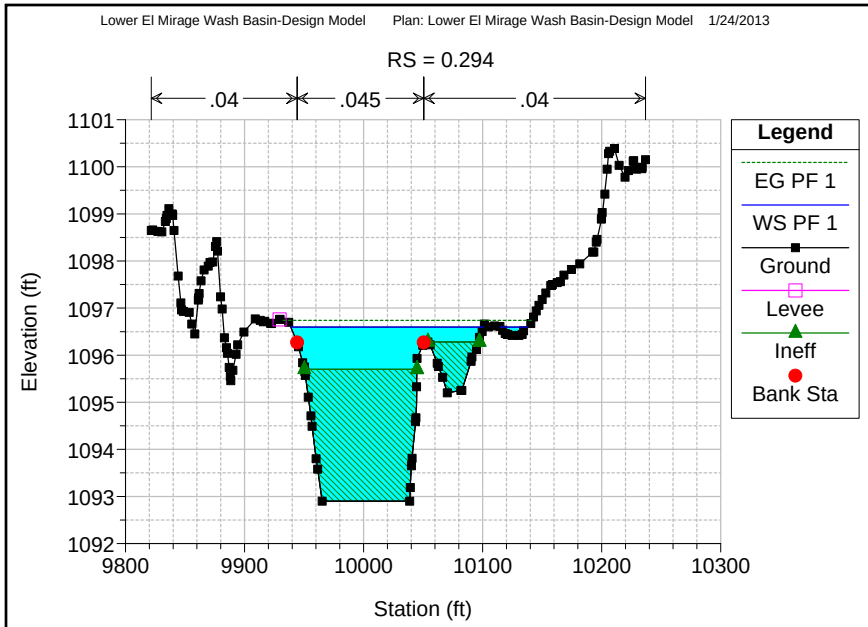

Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.680
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.646
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Levee
Ineff
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.638 Upstream of Park Place
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Levee
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.634 Culv
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Levee
Bank Sta


Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.634 Culv
.03
.045
.03
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Levee
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.629 Downstream of Park Place
.03
.045
.03
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Levee
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.610
.03
.045
.03
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.583
.03
.045
.03
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.533
.03
.045
.03
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.500
.03
.045
.03
Legend
EG PF 1
WS PF 1
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.493
.03
.045
.03
Legend
EG PF 1
WS PF 1
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.492 BR
.03
.045
.03
Legend
EG PF 1
WS PF 1
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.492 BR
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.491
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.486
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.431 Q=317 cfs (CPD54, 24 hr)
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta


Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.378
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Levee
Ineff
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.345
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.344 IS
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.316
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta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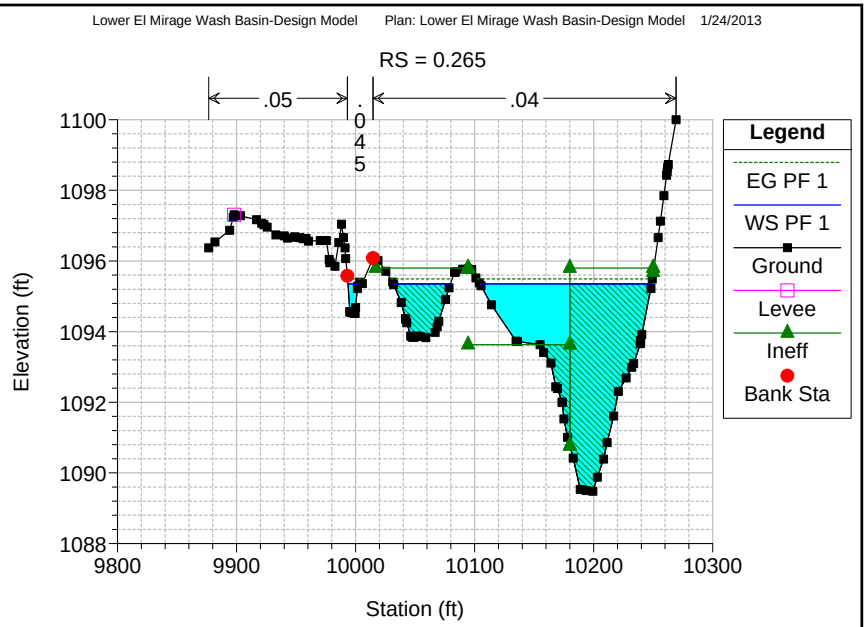
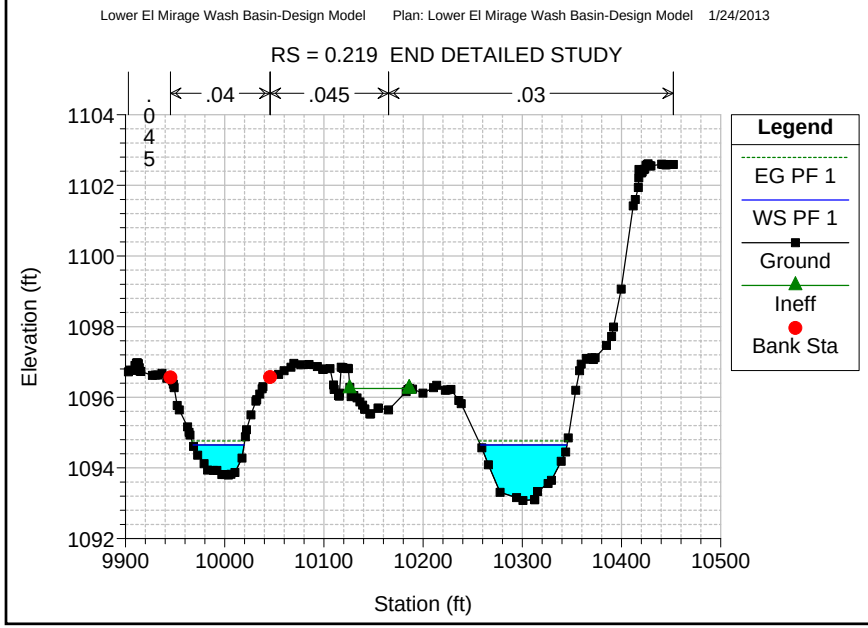
RS = 0.294
.04
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Levee
Ineff
Bank Sta


Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.265
.05
.045
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Levee
Ineff
Bank Sta


Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013
RS = 0.219 END DETAILED STUDY
.045
.04
.045
.03
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta

Lower El Mirage Wash Basin-Design Model Plan: Lower El Mirage Wash Basin-Design Model 1/24/2013

Lr El Mirage Wsh Lr El Mirage Wsh

Legend
EG PF 1
WS PF 1
Ground

Elevation (ft)

1120
1115
1110
1105
1100
1095
1090

0.219 0.265 0.294 0.316 0.344 0.378 0.431 0.486 0.500 0.533 0.583 0.610 0.629 0.634 0.680 0.726 0.758 0.785 0.848 0.892 0.940 0.978 1.014 1.03 1.069 1.115 1.200 1.242 1.312 1.329 1.348 1.360 1.371 1.379 1.406 1.449 1.514

0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6

Main Channel Distance (mi)

IMPORTANT NUMBERS

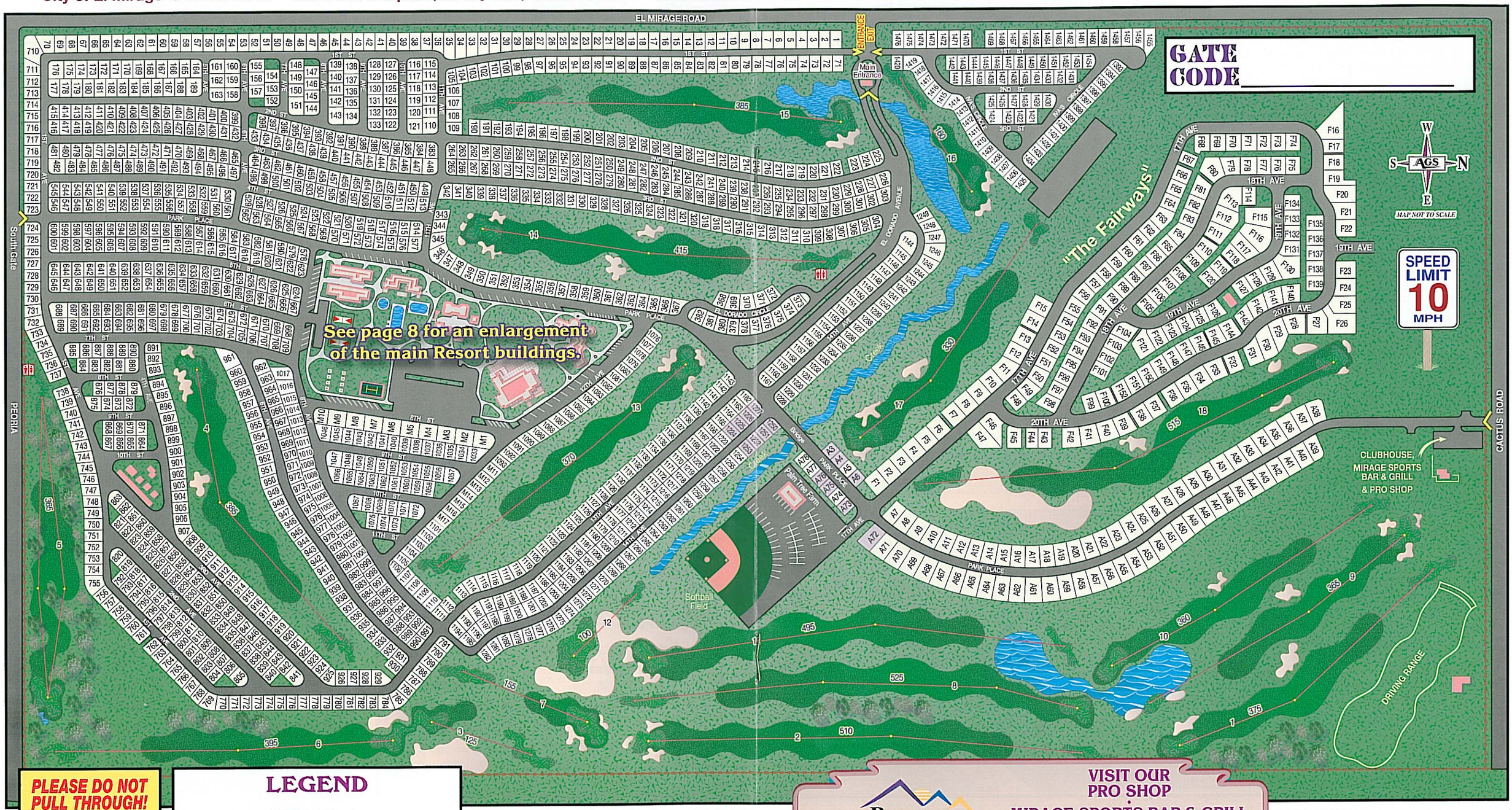
POLICE:
City of El Mirage 623-933-1341

HOSPITALS:
Boswell Hospital (Sun City) 623-977-7211
Del Webb Hospital (Sun City West) 623-214-4000

SECURITY: 623-583-4010
ACTIVITIES: 623-583-6092
BUSINESS/RESERVATIONS: 623-583-0464

PRO SHOP: 623-583-0425
RESTAURANT: 623-583-2121

PARK MODEL SALES: 623-583-8698
MANUFACTURED HOME SALES: 602-635-1330



PLEASE DO NOT PULL THROUGH!
You will be responsible for any damage caused by pulling through spaces. Thank You!
The Management

LEGEND

- Display Model Sales
- Restrooms
- Shuffleboard
- Tennis Courts
- Horseshoes
- Gates
- Trash Pick-up at site.

LOCAL CHANNELS

3	KTVK	IND	10	KSAZ	FOX
5	KPHO	CBS	12	KPNX	NBC
8	KAET	PBS	15	KNXV	ABC
21	KPAZ	TBN			
45	KUTP	UPN			
61	KASW	WB			

Appendix I

Addendum No. 1 to Soil Sampling and Analysis

August 17, 2012
Project No. 603785001

Mr. Kevin Roberts, P.E.
Dibble Engineering
7500 North Dreamy Draw Drive, Suite 200
Phoenix, Arizona 85020

Subject: Addendum No. 1 to Geotechnical Soil Sampling and Analysis
Dated July 16, 2012
Lower El Mirage Wash Basin
El Mirage, Arizona

Dear Mr. Roberts:

Per your request, we have performed the soil sampling and analysis for the upstream portion of Lower El Mirage Wash Basin in El Mirage, Arizona (Figure 1). The purpose of our evaluation was to conduct additional laboratory testing at the site on the upstream side of the project (Figure 2) for soil analysis for the construction of a new basin. This letter presents our findings as well as the results of the laboratory tests at the project site.

SCOPE OF SERVICES

The scope of our services for the project generally included:

- Drilling, logging, and sampling one exploratory boring to approximately 3 feet below ground surface (bgs). The boring log is presented on Figure 3.
- Performing laboratory testing on the collected sample. The laboratory testing consisted of particle-size gradation, Atterberg limits, and agronomic testing. The laboratory test results are presented on Figures 4 and 5, and the agronomic test analysis is attached to this letter.
- Presenting our findings in this data report.

FIELD EXPLORATION

On July 25, 2012, Ninyo & Moore conducted subsurface sampling at the site to collect site soils for laboratory testing. Our field work consisted of drilling, logging, and sampling one exploratory boring to approximately 3 feet bgs. The boring was drilled using manual excavation

equipment. The location of the boring is depicted on the Figure 2. The boring log is presented on Figure 3.

The soil samples collected from our field activities were transported to the Ninyo & Moore laboratory for laboratory testing. The testing included particle-size gradation, Atterberg limits, and agronomic testing. The results of the laboratory testing are presented on the Figures 4 and 5. The agronomic test results are attached.

SUBSURFACE CONDITIONS

Alluvium was encountered at the surface of our boring and extended to the total explored depth. The alluvium generally consisted of well graded sand with silt and gravel in our boring. Cobbles and possible boulders were also encountered in our boring.

We appreciate the opportunity to be of service to you during this phase of the project.

Sincerely,
NINYO & MOORE

REGISTERED GEOLOGIST
CERTIFICATE NO.
49080
JEFFREY
RODGERS
Date Signed 8/17/12
ARIZONA, U.S.A.

Jeffrey S. Rodgers, RG
Project Geologist

EXPIRES: 03/31/15

Steven D. Nowaczyk, PE
Principal Engineer

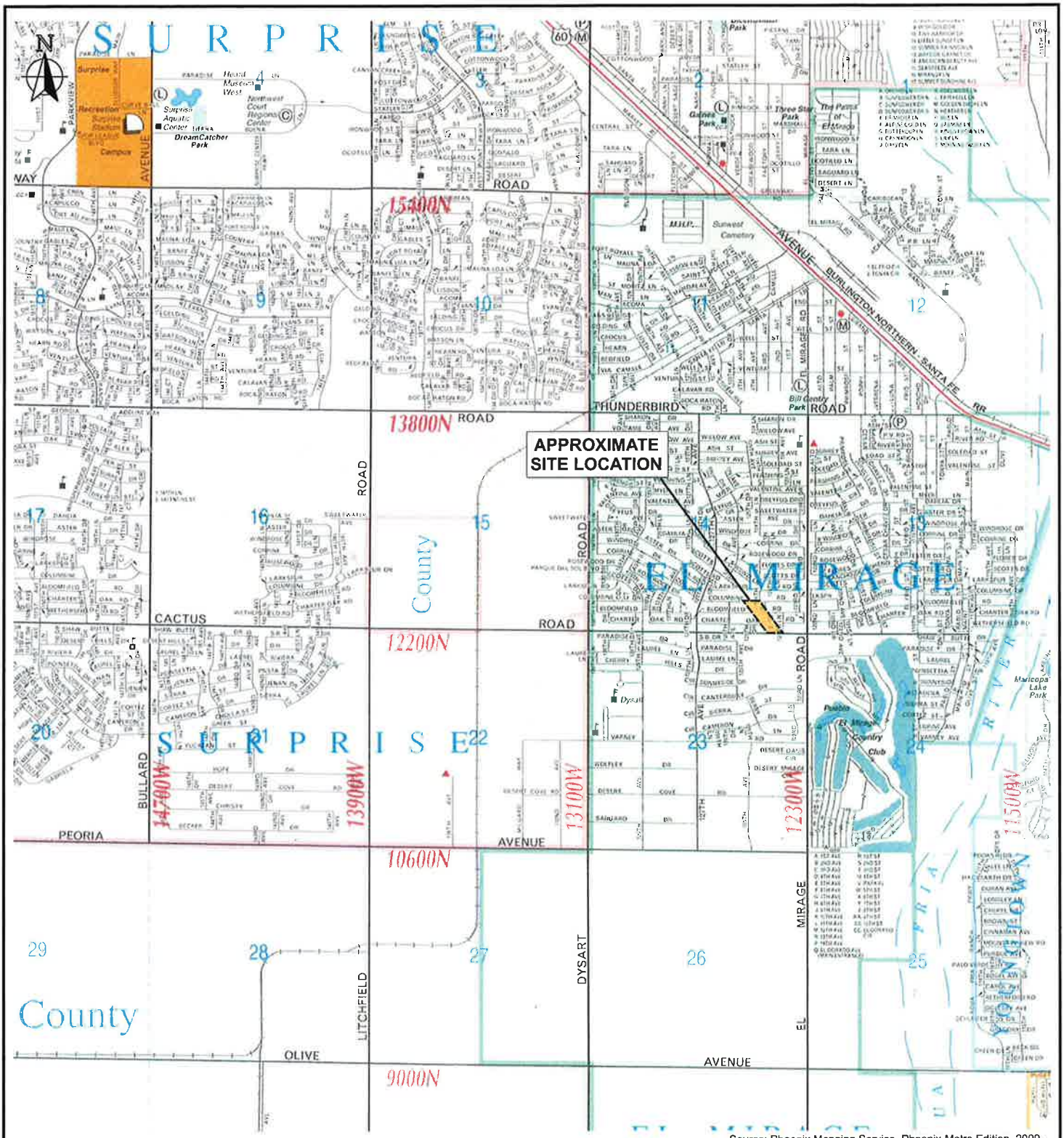
Registered Professional Engineer (Civil)
CERTIFICATE NO.
34866
STEVEN D.
NOWACZYK
Date Signed 8-17-12
ARIZONA U.S.A.

EXPIRES 06/30/2015

JSR/SDN/clj

Distribution: (1) Addressee

Attachments: Figure 1 – Site Location
Figure 2 – Boring Location
Figure 3 – Boring Log
Figures 4 and 5 – Laboratory Test Results
Motzz Laboratory Soil Analysis Report



Source: Phoenix Mapping Service, Phoenix Metro Edition, 2009.

Note: Dimensions, directions and locations are approximate.

Ninyo & Moore		SITE LOCATION	FIGURE 1
PROJECT NO: 603785001	DATE: 8/12	LOWER EL MIRAGE WASH BASIN CACTUS ROAD AND EL MIRAGE ROAD EL MIRAGE, ARIZONA	

file no: 3785vmap0812

Note: Dimensions, directions, and locations are approximate.

Ninyo & Moore	BORING LOCATION	FIGURE 2
PROJECT NO: 603785001	DATE: 8/12	LOWER EL MIRAGE WASH BASIN CACTUS ROAD AND EL MIRAGE ROAD EL MIRAGE, ARIZONA

file no: 3785blm0812

DATE DRILLED 7/25/12 BORING NO. B-1

GROUND ELEVATION -- SHEET 1 OF 1

METHOD OF DRILLING Hand Auger

DRIVE WEIGHT -- DROP --

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SW-SM	ALLUVIUM: Brown, damp, loose, well-graded SAND with silt and gravel; cobbles and possible boulders.
							Total Depth = 2.7 feet. Groundwater not encountered during drilling. Backfilled on 7/25/12 promptly after completion of drilling. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
5							
10							
15							
20							

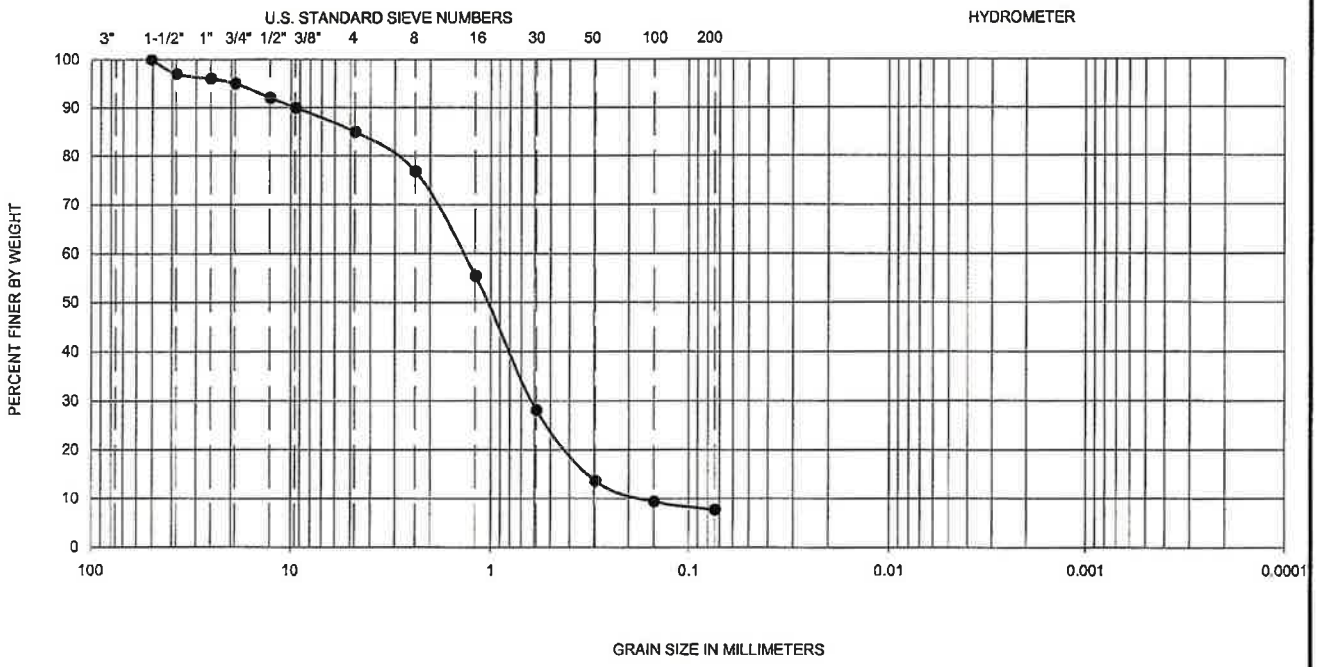
Ninyo & Moore

BORING LOG

Lower El Mirage Wash Basin
El Mirage, Arizona

PROJECT NO.	DATE	FIGURE
603785001	8/12	3

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-1	1-2.5	--	--	NP	0.18	0.64	1.50	8.6	1.5	8	SW-SM

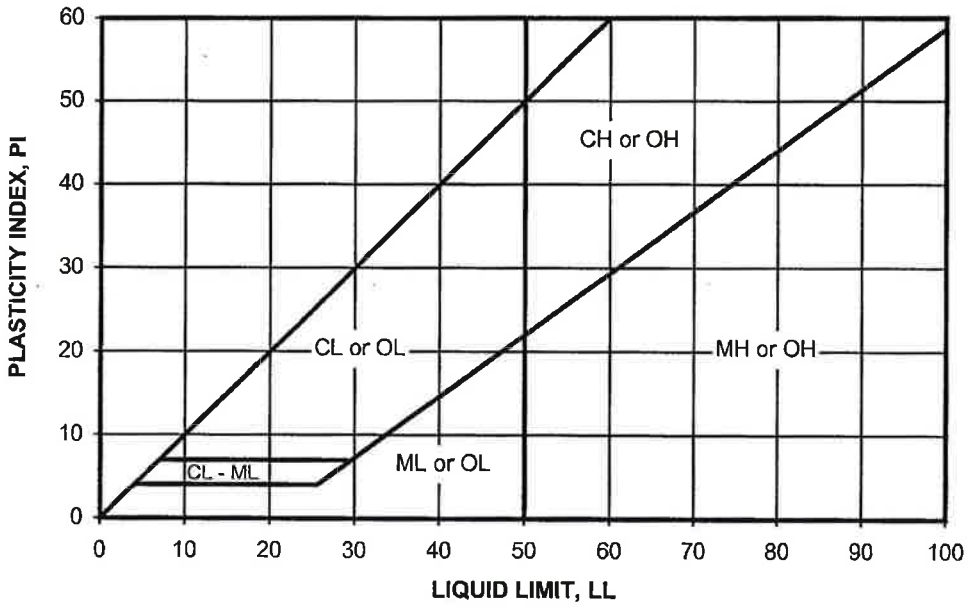
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

NP - INDICATES NON-PLASTIC

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LOWER EL MIRAGE WASH BASIN CACTUS ROAD AND EL MIRAGE ROAD EL MIRAGE, ARIZONA	4
603785001 / 8/12		

SYMBOL	LOCATION	DEPTH (FT)	LIQUID LIMIT, LL	PLASTIC LIMIT, PL	PLASTICITY INDEX, PI	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS (Entire Sample)
●	B-1	1-2.5	--	--	NP	ML	SW-SM

NP - INDICATES NON-PLASTIC



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

Ninyo & Moore	ATTERBERG LIMITS TEST RESULTS	FIGURE
PROJECT NO. 603785001 / DATE 8/12	LOWER EL MIRAGE WASH BASIN CACTUS ROAD AND EL MIRAGE ROAD EL MIRAGE, ARIZONA	5

Appendix J

Sediment Yield Calculations

Project

Reference	LEMW_SEDIMENT
Title	Loop 303/ White Tanks ADMPU AHA
Location	Maricopa County
Agency	Flood Control District of Maricopa County

Project Defaults

Model	HEC1
Soils Agency	FCDMC
Land Use Agency	FCDMC
Rainfall	NOAA14
Roads Agency	MCDOT

HEC-1 Defaults

Unit Hydrograph	S-Graph
Loss Method	Green-Ampt
Duration	24 Hour
Tabulation Interval	5
No. Ordinates	2000
Output	3

Comments

Section ID	Flow Type	Entire Section Q (cfs)	Slope (f/f)	Man'g N	W.P. (ft)	Hyd Depth (ft)	Area (sq ft)	Max Depth (ft)	Vel (f/s)	Channel Section Hyd Depth (ft)	Vel (ft/sec)	Froude Num
SEDIMENT YIELD	Design	654	0.003300	0.026	83.52	1.69	140.58	2.15	4.65	1.69	4.65	0.63
	Dominant	113	0.003300	0.026	73.99	0.63	46.63	.96	2.42	0.63	2.42	0.54

Sediment Area ID	Area (sq mi)	SDR (%)	Soil and Erosion Factors: Soil Erodibility Factor (K)	Erosion Control Factor (P)	Specific Weight (lb/cu ft)	Land Use Factors: Effects of Canopy Cover (Ci)	Effects of Vegetation (Cii)	Effects of Tillage (Ciii)	Cover Management Factor (C)	Percent Impervious (%)	Topographic Factors: Slope Length (ft)	Slope (%)	Topographic Factor (LS)
ID: SED1			**Specific Weight Method: Channel Bed Material Soil Sample**							**Bed Material Soil Sample D10 (mm): 0.18**			
SED1	9.8700	48.8	0.31	1.0	85.28	0.71	0.86	0.32	0.20	34	100	0.43	0.09

Flood Control District of Maricopa County
Drainage Design Management System
RIVER MECHANICS - BED LOAD
Project Reference: LEMW_SEDIMENT

	Slope (ft/ft)	Manning's n	D16 (mm)	D50 (mm)	D84 (mm)		Average Velocity (ft/sec)	Hydraulic Depth (ft)	Normal Depth (ft)	Average Width (ft)	Bed Load per Foot, qs (cfs/ft)	Bed Load (cfs)
ID: SED1	0.003300	0.026	0.330	1.100	4.800	**2 Year:**	0.69	0.11	0.40	18.13	-	-
Cross Section ID: SEDIMENT YIELD						**5 Year:**	1.77	0.38	0.69	39.30	-	0.01
						10 Year:	2.42	0.63	0.96	48.64	-	0.04
						25 Year:	3.23	0.98	1.35	56.41	-	0.16
						50 Year:	3.79	1.23	1.62	60.10	0.01	0.31
						100 Year:	4.65	1.69	2.15	65.42	0.01	0.74
						Design:	-	-	-	-	-	-

Flood Control District of Maricopa County
Drainage Design Management System
RIVER MECHANICS - SEDIMENT
Project Reference: LEMW_SEDIMENT

ID: SED1

Return Periods for Analysis: All

	Q (cfs)	Volume (ac-ft)	Wash Load (ac-ft)	Bed Load (ac-ft)	Total Yield (ac-ft)
2 Year:	5	2.62	-	-	-
5 Year:	48	16.27	0.004	0.004	0.008
10 Year:	113	30.97	0.009	0.012	0.021
25 Year:	246	53.06	0.019	0.034	0.053
50 Year:	369	90.57	0.031	0.076	0.107
100 Year:	654	156.89	0.059	0.178	0.237
Design:	-	-	-	-	-
Annual:			0.004	0.007	0.011

Appendix K

Low Flow Ditch and Swale Hydraulic Calculations

Typical Section 7

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.20370	ft/ft
Normal Depth	0.50	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	5.80	ft^3/s
Flow Area	1.00	ft^2
Wetted Perimeter	4.12	ft
Hydraulic Radius	0.24	ft
Top Width	4.00	ft
Critical Depth	0.67	ft
Critical Slope	0.04434	ft/ft
Velocity	5.80	ft/s
Velocity Head	0.52	ft
Specific Energy	1.02	ft
Froude Number	2.04	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.50	ft
Critical Depth	0.67	ft
Channel Slope	0.20370	ft/ft
Critical Slope	0.04434	ft/ft

Typical Section 8

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.033	
Channel Slope	0.00150	ft/ft
Normal Depth	2.10	ft
Left Side Slope	100.00	ft/ft (H:V)
Right Side Slope	5.10	ft/ft (H:V)

Results

Discharge	417.24	ft^3/s
Flow Area	231.75	ft^2
Wetted Perimeter	220.92	ft
Hydraulic Radius	1.05	ft
Top Width	220.71	ft
Critical Depth	1.31	ft
Critical Slope	0.01828	ft/ft
Velocity	1.80	ft/s
Velocity Head	0.05	ft
Specific Energy	2.15	ft
Froude Number	0.31	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.10	ft
Critical Depth	1.31	ft
Channel Slope	0.00150	ft/ft
Critical Slope	0.01828	ft/ft

Typical Section 9

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.033	
Channel Slope	0.00150	ft/ft
Normal Depth	1.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	8.00	ft

Results

Discharge	17.10	ft^3/s
Flow Area	12.00	ft^2
Wetted Perimeter	16.25	ft
Hydraulic Radius	0.74	ft
Top Width	16.00	ft
Critical Depth	0.48	ft
Critical Slope	0.02179	ft/ft
Velocity	1.42	ft/s
Velocity Head	0.03	ft
Specific Energy	1.03	ft
Froude Number	0.29	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.48	ft
Channel Slope	0.00150	ft/ft

Typical Section 10

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.033	
Channel Slope	0.00020	ft/ft
Normal Depth	0.50	ft
Left Side Slope	8.00	ft/ft (H:V)
Right Side Slope	16.00	ft/ft (H:V)
Bottom Width	8.00	ft

Results

Discharge	2.21	ft^3/s
Flow Area	7.00	ft^2
Wetted Perimeter	20.05	ft
Hydraulic Radius	0.35	ft
Top Width	20.00	ft
Critical Depth	0.13	ft
Critical Slope	0.03337	ft/ft
Velocity	0.32	ft/s
Velocity Head	0.00	ft
Specific Energy	0.50	ft
Froude Number	0.09	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.50	ft
Critical Depth	0.13	ft
Channel Slope	0.00020	ft/ft

Typical Section 14

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.05000	ft/ft
Normal Depth	0.50	ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)

Results

Discharge	2.12	ft^3/s
Flow Area	0.75	ft^2
Wetted Perimeter	3.16	ft
Hydraulic Radius	0.24	ft
Top Width	3.00	ft
Critical Depth	0.50	ft
Critical Slope	0.05027	ft/ft
Velocity	2.83	ft/s
Velocity Head	0.12	ft
Specific Energy	0.62	ft
Froude Number	1.00	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.50	ft
Critical Depth	0.50	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.05027	ft/ft

City of El Mirage Parcel DD

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.34000	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	8.00	ft
Discharge	20.30	ft^3/s

Results

Normal Depth	0.29	ft
Flow Area	2.63	ft^2
Wetted Perimeter	10.37	ft
Hydraulic Radius	0.25	ft
Top Width	10.30	ft
Critical Depth	0.53	ft
Critical Slope	0.03935	ft/ft
Velocity	7.72	ft/s
Velocity Head	0.93	ft
Specific Energy	1.21	ft
Froude Number	2.69	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.53	ft
Channel Slope	0.34000	ft/ft

Bool Property DD

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.15740	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	8.00	ft
Discharge	13.20	ft^3/s

Results

Normal Depth	0.28	ft
Flow Area	2.55	ft^2
Wetted Perimeter	10.31	ft
Hydraulic Radius	0.25	ft
Top Width	10.24	ft
Critical Depth	0.41	ft
Critical Slope	0.04239	ft/ft
Velocity	5.17	ft/s
Velocity Head	0.42	ft
Specific Energy	0.70	ft
Froude Number	1.82	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.28	ft
Critical Depth	0.41	ft
Channel Slope	0.15740	ft/ft

125th Avenue DD

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.06950	ft/ft
Normal Depth	1.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	8.00	ft

Results

Discharge	85.36	ft^3/s
Flow Area	12.00	ft^2
Wetted Perimeter	16.25	ft
Hydraulic Radius	0.74	ft
Top Width	16.00	ft
Critical Depth	1.23	ft
Critical Slope	0.03135	ft/ft
Velocity	7.11	ft/s
Velocity Head	0.79	ft
Specific Energy	1.79	ft
Froude Number	1.45	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

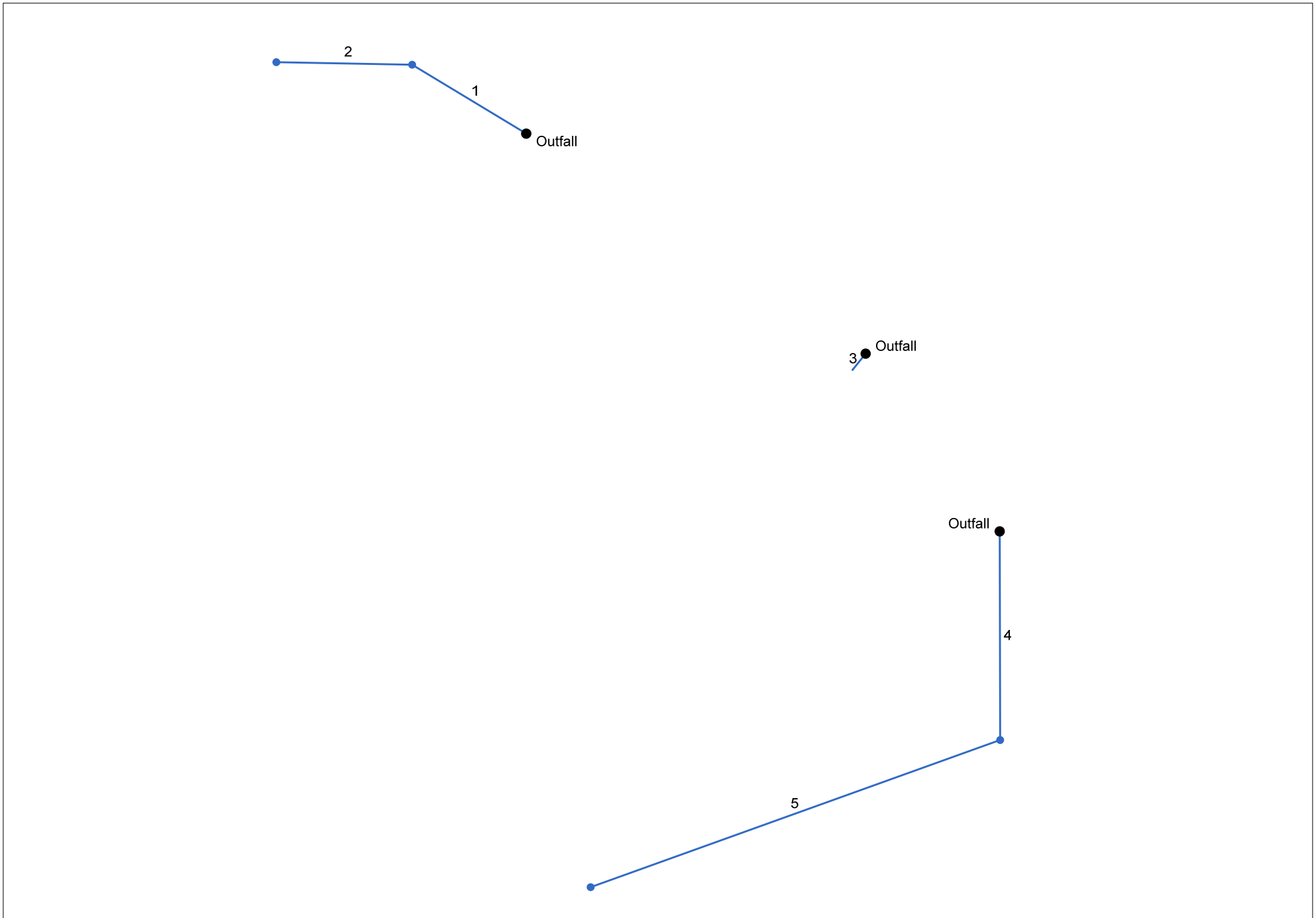
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	1.23	ft
Channel Slope	0.06950	ft/ft

Appendix L

Storm Drain Calculations

Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2011 Plan



Project File: Subdivision Storm Drain.stm	Number of lines: 5	Date: 1/31/2013

Hydraulic Grade Line Computations

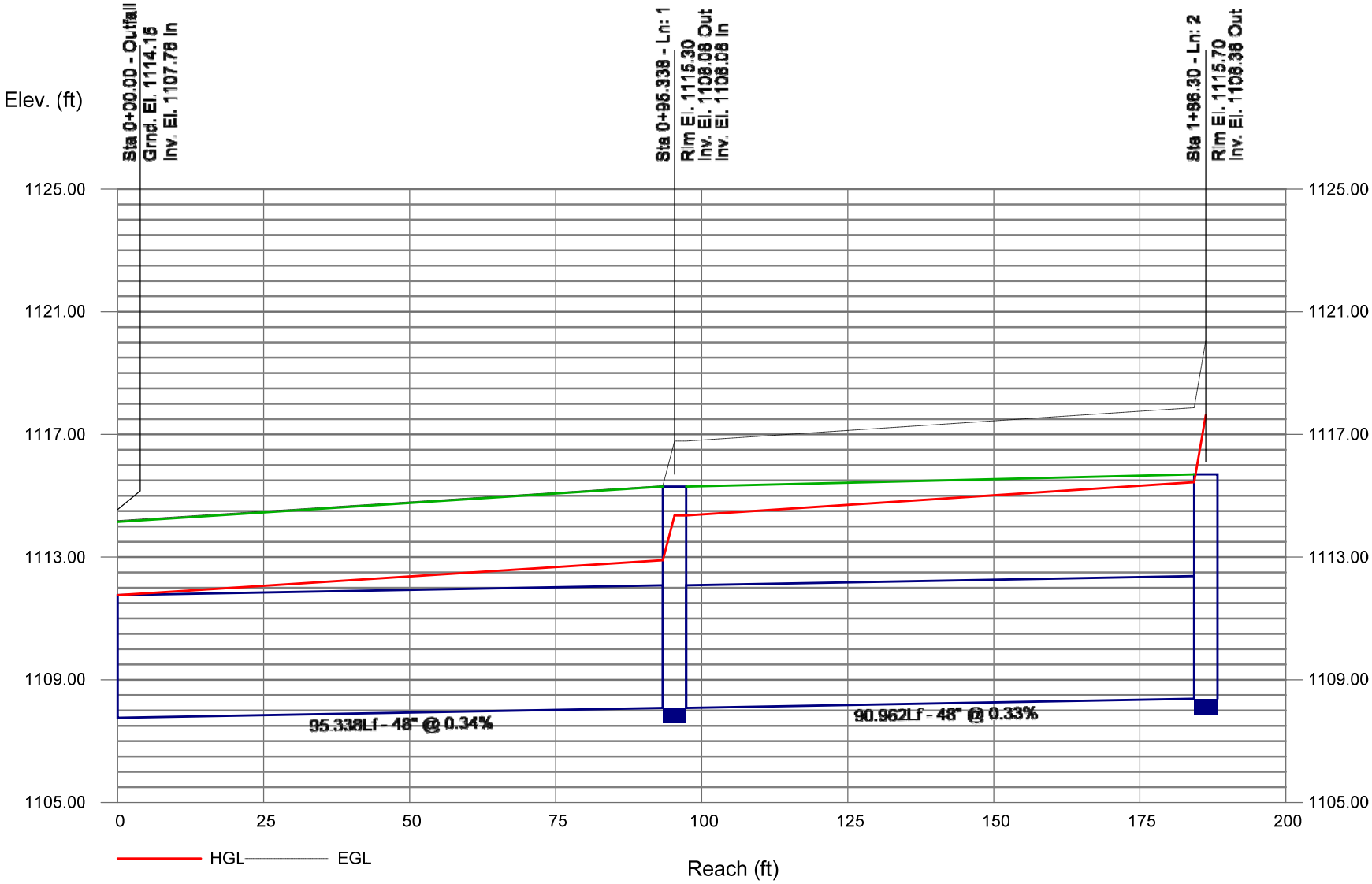
Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
(1)	(in) (2)	(cfs) (3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(ft) (12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(K) (23)	(ft) (24)
1	48	157.0	1107.76	1111.76	4.00	12.56	12.50	2.43	1114.19	1.195	95.338	1108.08	1112.90	4.00	12.57	12.49	2.43	1115.33	1.195	1.195	1.139	0.60	1.46
2	48	157.0	1108.08	1114.36	4.00	12.56	12.50	2.43	1116.78	1.195	90.962	1108.38	1115.44	4.00	12.57	12.49	2.43	1117.87	1.195	1.195	1.087	0.90	2.18
3	36	16.00	1107.85	1109.13	1.28	2.88	5.56	0.48	1109.61	0.401	16.000	1108.50	1109.78 j	1.28**	2.86	5.59	0.49	1110.26	0.407	0.404	n/a	0.60	0.29
4	48	89.00	1107.68	1110.94	3.26	10.97	8.12	1.02	1111.96	0.388	172.813	1108.35	1111.61	3.26	10.96	8.12	1.02	1112.63	0.388	0.388	0.670	0.80	0.82
5	48	89.00	1108.45	1112.43	3.98	12.56	7.09	0.78	1113.21	0.361	300.028	1109.63	1113.44	3.81	12.36	7.20	0.81	1114.25	0.333	0.347	1.041	0.80	0.65

Project File: Subdivision Storm Drain.stm | Number of lines: 5 | Run Date: 1/31/2013

Notes: ; ** Critical depth.; j-Line contains hyd. jump. ; c = cir e = ellip b = box

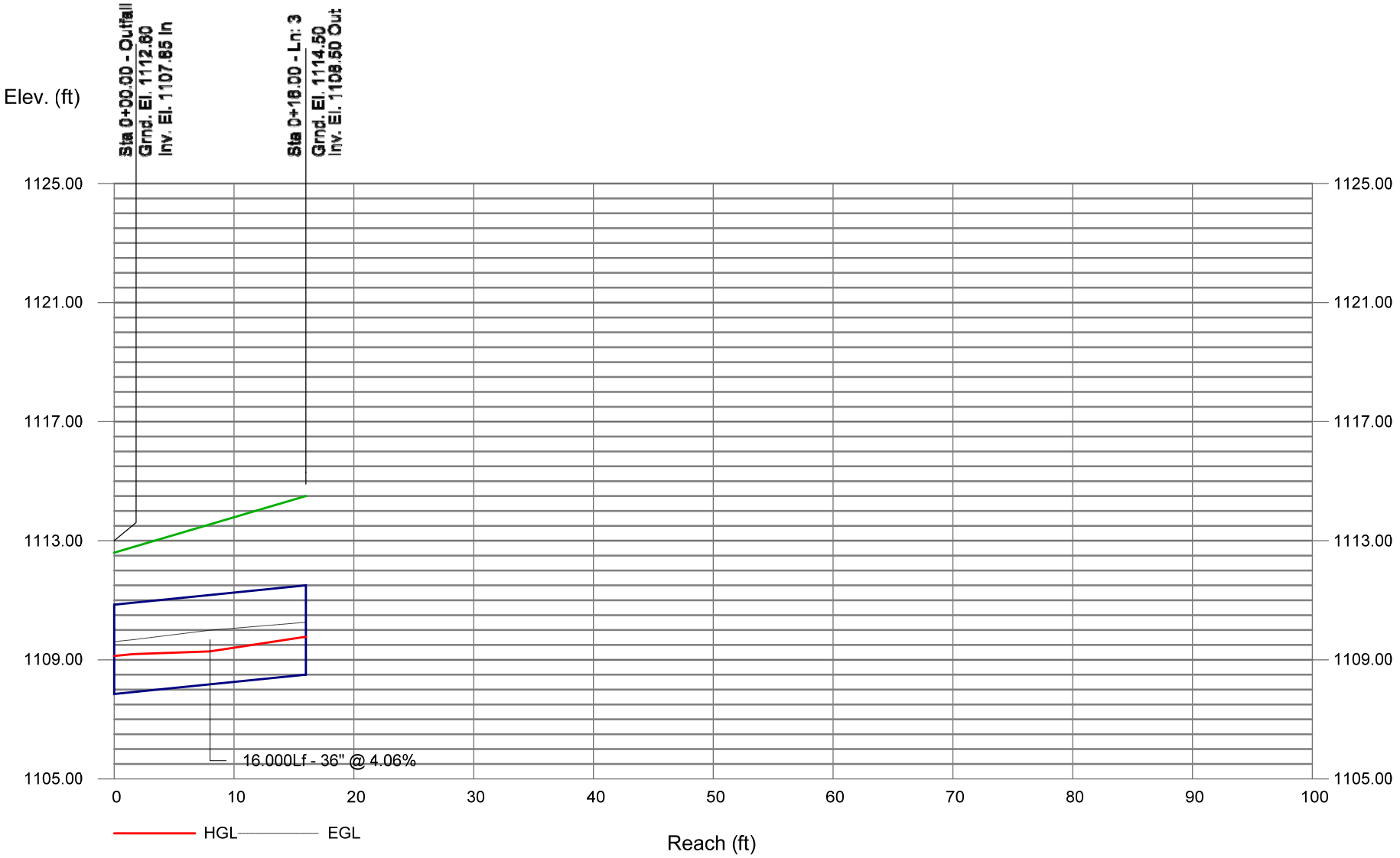
Storm Sewer Profile

Proj. file: Subdivision Storm Drain.stm



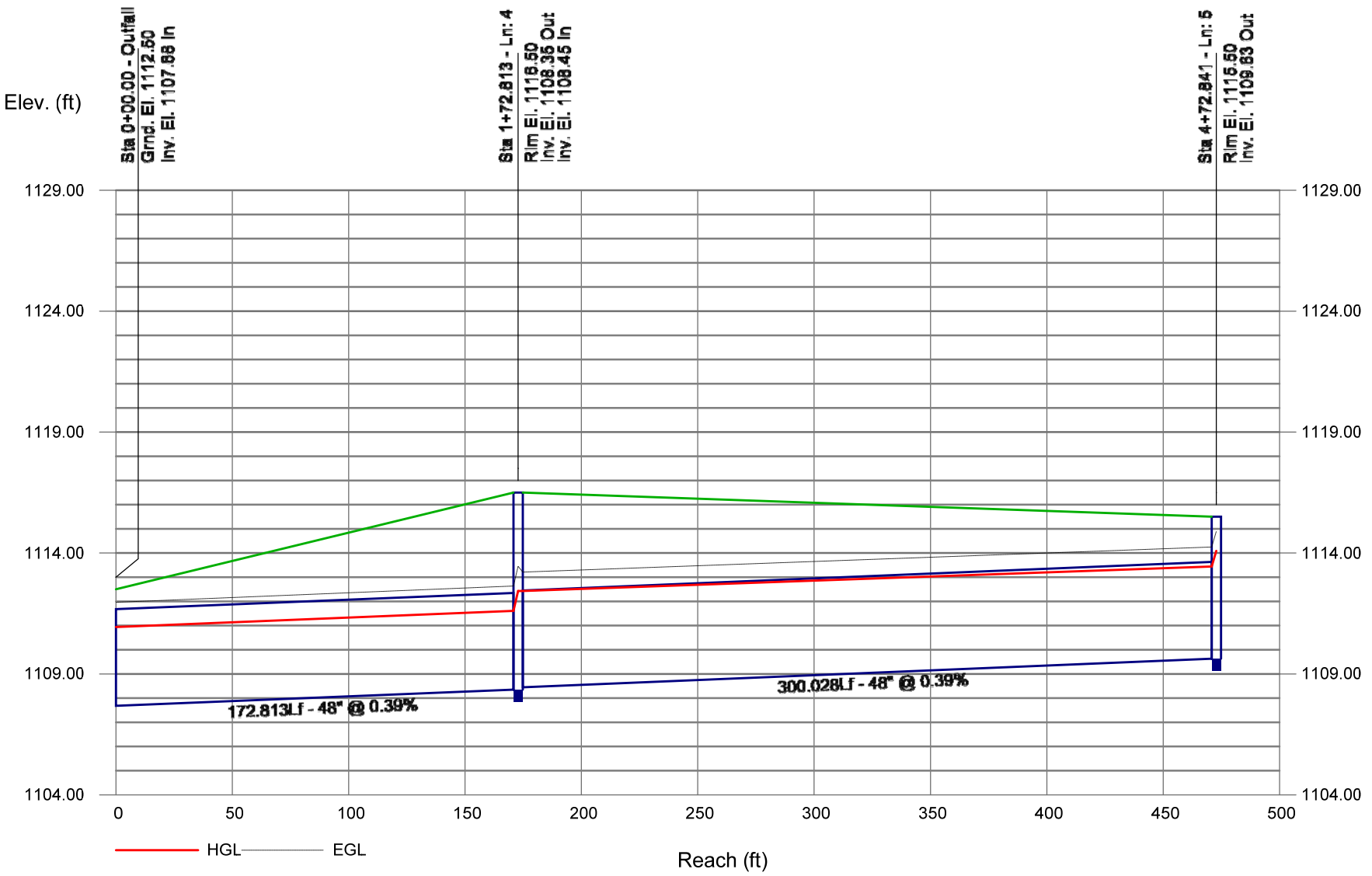
Storm Sewer Profile

Proj. file: Subdivision Storm Drain.stm



Storm Sewer Profile

Proj. file: Subdivision Storm Drain.stm



Appendix M

Riprap Sizing Calculations

ID	Type	Section ID	Design Q (cfs)	Slope (ft/ft)	Width (ft)	Average Velocity (ft/s)	Specific Weight Stone (lb/cu ft)	Specific Weight Water (lb/cu ft)	Bank Angle (degrees)	D50 (ft)
125DD	Sloped Drop Structure/Rock Chute		85	0.07	8.00	-	-	-	-	0.59
125TH	Channel Bed on Straight Reach		-	-	-	12.50	150.00	62.40	-	2.13
BOOLD	Sloped Drop Structure/Rock Chute		20	0.34	8.00	-	-	-	-	0.54
BSNOU	Channel Bed on Straight Reach		-	-	-	8.70	150.00	62.43	-	1.03
CACT	Channel Bed on Straight Reach		-	-	-	6.40	150.00	62.43	-	0.56
CANTB	Channel Bed on Straight Reach		-	-	-	7.10	150.00	62.43	-	0.69
COEMD	Sloped Drop Structure/Rock Chute		13	0.16	8.00	-	-	-	-	0.34
EMWC	Channel Bed on Straight Reach		-	-	-	5.60	150.00	62.43	-	0.43

Appendix N

Irrigation System Design Memo

LOWER EL MIRAGE WASH BASIN PROJECT

IRRIGATION ASSUMPTIONS AND CALCULATIONS MEMO

100% Design Submittal – December 21, 2012

Prepared by:

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Prepared for:

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On Behalf of:

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009

City of El Mirage
12145 NW Grand Avenue
El Mirage, Arizona 85335

December 20, 2012

Kevin Roberts, P.E.
Vice-President - Drainage & Flood Control
Dibble Engineering
7500 North Dreamy Draw Drive
Suite 200
Phoenix, Arizona 85020

Dear Mr. Roberts,

This technical memorandum is intended to document the following assumptions and findings used to develop the 100% irrigation design for the El Mirage Wash Basin Project for the Flood Control District and the City of El Mirage:

- Irrigation Standards, Equipment, and Conditions
- Design Calculations

Irrigation Standards, Equipment, and Conditions

The following standard practices and assumptions were used to determine probable preliminary irrigation needs for the Lower El Mirage Wash Basin Project:

- The Tucor RKD controller is a two-wire system which will accommodate up to 100 stations.
- The point of connection (POC) is tapped off of the existing 8" potable water supply line in Canterbury Drive.
- A typical water window of 8 hours, six days per week was used to determine peak demand requirement of 201 GPM for the turf areas. This requires a *minimum* mainline size of 4" class 200 PVC pipe.
- Static pressure is 70 PSI at the point of connection (from the pressure reading).
- Friction-loss through the point of connection is +/- 17 psi.
- The design requires 40 psi at furthest head from the point of connection.
- Head placement in the turf areas is triangular spacing for open space with strategic head placement for proposed and future ball field layouts.
- Irrigation equipment is specified with non-potable markings (purple color or tags) for future conversion of system to a reclaimed water source.
- Trees and shrubs are irrigated on separate valve zones.
- Drip valves are centered within zones as much as possible. Typical lateral line length from valve to farthest emitter for drip zones is +/-250' for ¾" class 200 PVC pipe.

The following were used to mitigate the relatively low pressure that occurs on-site:

- The mainline pipe has been upsized to 6" class 200 PVC to reduce pressure loss due to friction.
- Hunter I-60 rotor heads and MPRotator heads are being used in turf areas due to their low pressure operating range.

Design Calculations

The exhibits below, “Friction-Loss Calculations”, shows the probable worst-case pressure loss due to friction for the proposed 100% design. This information was used to verify system viability with existing pressure at the proposed POC.

Friction-Loss Calculations (Dead-end)
Worst Case - Largest Zone

Assuming class 200 PVC pipe laterals , class 200 PVC pipe mainline

Pipe Leg	GPM for this Pipe Leg	Length of this Pipe Leg (feet)	Pipe ID	Preliminary Friction Loss	Elevation Difference for this Pipe Leg (feet), negative for uphill positive for downhill	Pressure Difference from Elevation	Total Friction Loss This Leg
Leg #1	11	53	1.189	-0.691		0.00	-0.691
Leg #2	21	51	1.502	-0.843		0.00	-0.843
Leg #3	32	46	1.720	-0.858		0.00	-0.858
Leg #4	42	58	2.149	-0.605		0.00	-0.605
Leg #5	84	24	3.166	-0.137		0.00	-0.137
Leg #6	200	1986	5.993	-2.538	6.0	2.60	0.060
PSI Loss through Pipe (from above)							3.074
PSI Needed at the Furthest Head							40
PSI Loss through zone valve							2.8
PSI Loss through master valve/flow sensor (200 GPM)							2
PSI Loss through backflows (100 GPM per backflow)							12
PSI Loss through meters (100 GPM per meter)							2.5
PSI Loss through supply lines (100 GPM per line)							0.28523
Subtotal PSI Loss							62.659
10% Contingency							6.265932
Total PSI Needed at POC							**68.92525**

Friction-Loss Calculations (Dead-end)
Worst Case - Farthest Zone

Assuming class 200 PVC pipe laterals , class 200 PVC pipe mainline

Pipe Leg	GPM for this Pipe Leg	Length of this Pipe Leg (feet)	Pipe ID	Preliminary Friction Loss	Elevation Difference for this Pipe Leg (feet), negative for uphill positive for downhill	Pressure Difference from Elevation	Total Friction Loss This Leg
Leg #1	11	47	1.189	-0.613		0.00	-0.613
Leg #2	21	45	1.502	-0.744		0.00	-0.744
Leg #3	32	48	1.720	-0.895		0.00	-0.895
Leg #4	42	20	2.149	-0.209		0.00	-0.209
Leg #5	200	1826	5.993	-2.334	7.0	3.03	0.697
PSI Loss through Pipe (from above)							1.763
PSI Needed at the Furthest Head							40
PSI Loss through zone valve							1.8
PSI Loss through master valve/flow sensor (200 GPM)							2
PSI Loss through backflows (100 GPM per backflow)							12
PSI Loss through meters (100 GPM per meter)							2.5
PSI Loss through supply lines (100 GPM per line)							0.28523
Subtotal PSI Loss							60.348
10% Contingency							6.034783
Total PSI Needed at POC							**66.38262**

The exhibit below, “Landscape Irrigation System Peak Demand Requirement”, shows the probable daily volume during the peak water demand period for the proposed 100% design. This information was used in part to determine probable irrigation water-need, minimum mainline size, and meter sizing.

Landscape Irrigation System Peak Demand Requirement
Turf Areas Only

The following calculations were used to determine the gallons per minute (GPM) necessary for peak water demand periods, which occurs on average about July 8. While an area might survive for short periods with less water by utilizing soil moisture reserves, extended periods of drought will require the maximum system capacity. The calculations below are only a general guide for determining the capacity requirement at a master plan level. The final quotient is no more accurate than the factors that go into the formulas.

$$\frac{0.01213 \times Et_O \times Area \times K_C}{DU \times HA} = GPM$$

0.01213 = constant for conversion of area, flow, and inches per day, 6-day water schedule, etc.
Et_O = 0.36 daily evapotranspiration rate average maximum in June/July
Area = area to be irrigated in square feet
K_C = crop coefficient of 0.75 for high quality warm season grass
DU = 0.70 distribution uniformity or irrigation efficiency
HA = Hours daily water window available for spray irrigation

$$\frac{0.01213 \times 0.36 \times 343791 \times 0.75}{0.70 \times 8} = 201 \text{ GPM}$$

7.89 Turf Acres Estimated
96,509 Gallons per Day Estimated

Respectfully submitted,

EPG, Inc.

John J. Griffin, RLA
Landscape Architect

Enclosures