Eloy Municipal Airport

PROFESSIONAL AIRPORT ENGINEERING SERVICES

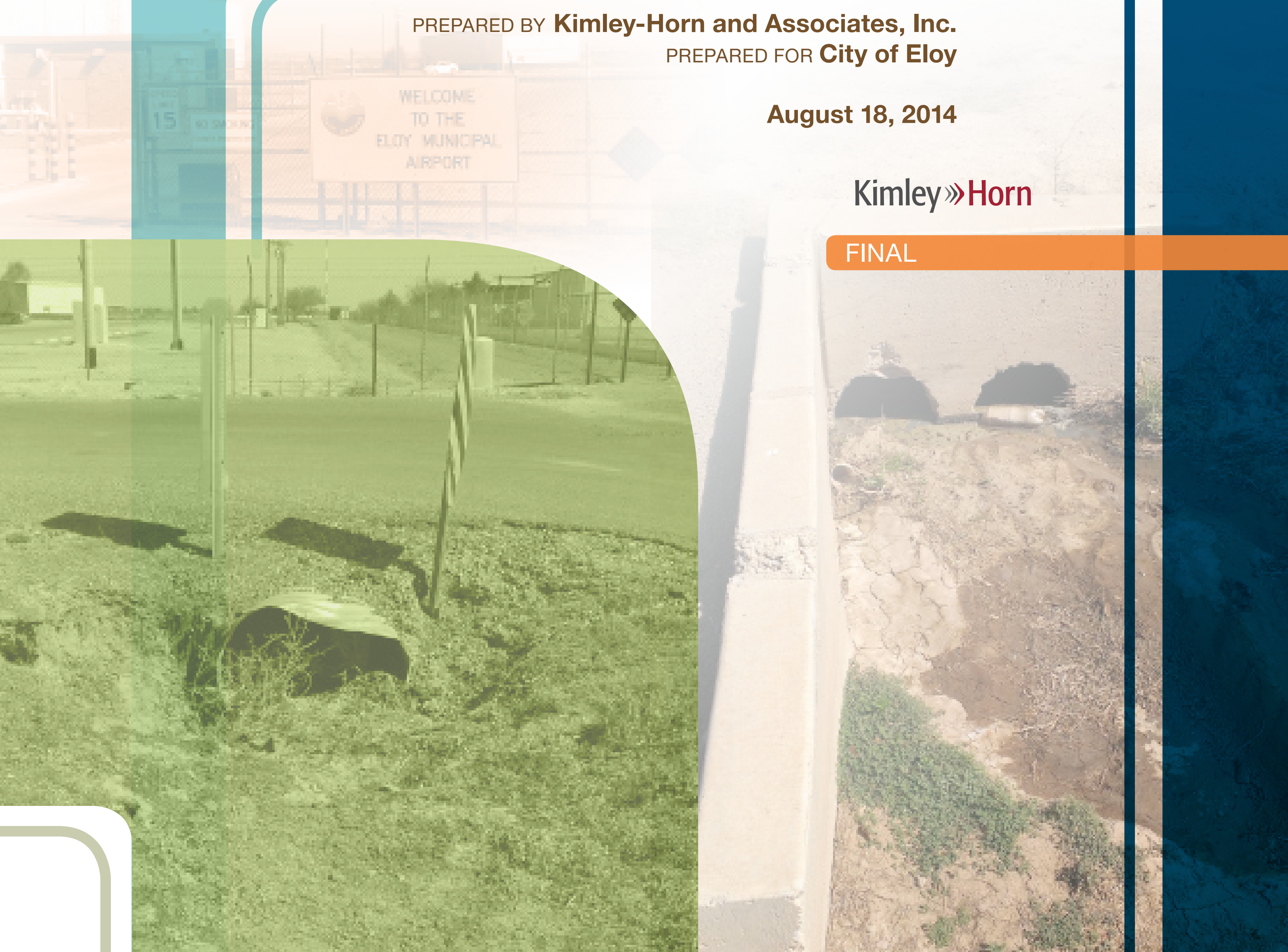
Airport Drainage
MASTER PLAN

PREPARED BY **Kimley-Horn and Associates, Inc.**
PREPARED FOR **City of Eloy**

August 18, 2014

Kimley»Horn

FINAL



Airport Drainage Master Plan Report

Eloy Municipal Airport

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City of Eloy

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August 18, 2014

Executive Summary

This document concludes a 10-month planning effort to 1) evaluate the Eloy Municipal Airport for drainage issues, drainage compliance, and drainage adequacy; and 2) identifying a program for implementing solutions to the deficiencies on airport property. The resulting document is referred to as the Eloy Municipal Airport Drainage Master Plan.

This project was funded with Federal Aviation Administration (FAA) Grant # 3-04-0014-011-2013 which provides that FAA picks up 91.06% of the cost. As a result, this project adheres to FAA guidelines and circulars for airports and meets all federal requirements. This project also adheres to drainage requirements, as applicable, in the Pinal County Floodplain Ordinance.

The Drainage Master Plan was prepared by completing multiple components which, once compiled, make a comprehensive plan for addressing the drainage on the Airport. The project began with collecting data and historical information about drainage. Studies had been completed on a more regional scale which looked at regional planning efforts, but none had been detailed enough to address the drainage issues of the airport. The Project Team consisting of Kimley-Horn and City of Eloy staff reached out to tenants on the airport for information on historical flooding. Tenants provided some valuable, on-ground, information and it was used to help calibrate the analytical engineering results to the real world.

The Drainage was quantified by determining rainfall runoff that comes from outside the boundary of the airport and runoff that is generated on the airport. Using these quantities of flow, hydraulic calculations were conducted to determine the adequacy of the existing airport drainage infrastructure. Results from the hydraulic analysis show that much of the drainage infrastructure is undersized and in need of upgrading or replacement in order to meet FAA drainage requirements.

Using the hydraulic analysis results, a list of alternatives was developed for the airport to address identified drainage inadequacies. This comprehensive list was categorized, evaluated using established criteria, and given a rank for the purposes of prioritization. The top 10 ranking alternatives became projects that were advanced to a 15% design which allowed sufficient detail to put a conceptual cost estimate together. Cost estimates for the projects included major construction items, construction contingency, final design costs, construction administration costs, and property acquisition costs.

The final step of the Drainage Master Plan included preparing an implementation plan to help the City, FAA, and ADOT plan for funding of the projects. The implementation plan presents a 3-term implementation period consisting of short-term, intermediate-term, and long-term projects, which was consistent with implementation periods in the *Airport Master Plan.* Projects were proposed in implementation periods which best coordinated with other planned airport projects.

The final deliverable for the Eloy Municipal Airport Drainage Master Plan compiles the aforementioned analyses and work products into a comprehensive document referred to as the Airport Drainage Master Plan Report.

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1 Introduction

1.1 Overview

The City of Eloy has requested Kimley-Horn and Associates, Inc. (KHA) prepare a comprehensive Drainage Master Plan (DMP) to document existing drainage issues as well as recommend drainage infrastructure to improve existing conditions and support the long term expansion of airport facilities at Eloy Municipal Airport.

The Airport DMP was conducted in three major phases. The first phase consisted of an analysis of the existing drainage conditions impacting the Airport. The existing conditions analysis included both hydrologic and hydraulic calculations. Hydrologic analysis included determination of peak discharges for local sub-basins on the airport property as well as the larger offsite watersheds. Peak discharges for on-site sub-basins were generated using the Rational Method and off-site peak discharges were determined with a rainfall runoff model using HEC-HMS. Hydrologic methodology was in conformance with the standards and methodologies presented in the *Pinal County Drainage Manual (PCDM)* and the *Federal Aviation Administration, Advisory Circular Number 150/5320-5D – Airport Drainage Design (FAA-AC).* The hydraulic analysis was conducted utilizing the results of the hydrologic analysis and included evaluating existing drainage infrastructure for capacity and determination of regulatory floodplain limits.

The second phase of the Airport DMP identified proposed drainage alternatives such as drainage channels, upgraded culverts, grading improvements, and retention/detention basins within and around the Airport. The objective of the preliminary alternative analysis was to provide airside and landside drainage improvements to:

- Mitigate existing drainage issues on and around the airport.
- Bring the airport up to current FAA drainage standards.
- Accommodate ultimate expansion of the airport.

Nineteen preliminary alternatives were developed utilizing the results of the hydrologic study and effects of future airport expansion documented in the *Eloy Municipal Airport – Airport Master Plan*, prepared by Coffman Associates. The second phase of the project was completed by evaluating and ranking the preliminary alternatives based on a set of criteria developed to meet the needs of the airport.

The third and final phase of the Airport DMP was to advance the ten (10) highest ranked alternatives to 15% concept plans, provide a conceptual cost estimate for each project, and develop an implementation plan for the ten projects. The implementation plan considered the implementation schedule for the airport expansion and the drainage projects necessary to complete the different airport improvement projects.

The three phases of the Eloy Municipal Airport Drainage Master Plan are further documented in this report.

1.2 Authorization

The City of Eloy retained KHA to prepare a Drainage Master Plan for the Eloy Municipal Airport. The contract was initiated in July 2013 and Notice to Proceed was given in September 2013.

1.3 Report Purpose

This report documents the Airport Drainage Master Plan for the Eloy Municipal Airport. The Drainage Master Plan for the Eloy Municipal Airport was developed to provide cost effective drainage solutions and improvements for existing drainage problems, upgrade drainage facilities to meet FAA standards, and design infrastructure necessary to accommodate the future expansion of the airport. Drainage improvement projects were developed after extensive review and understanding of the existing drainage problems, the direction of future growth within the Airport according to the *Eloy Municipal Airport – Airport Master Plan*, and discussions with Airport staff. This strategy includes the use of a series of drainage channels, upgraded and new culverts, and re-grading of both paved and unpaved areas to route the onsite and offsite runoff through and away from the Airport.

1.4 Project Coordination

The Project Team was established to provide coordination throughout the project. The Project Team included the following key members:

Table 1 – Project Team

Zenia Cornejo	City of Eloy – Project Manager
Harvey Krauss	City of Eloy – City Manager
James Humble	City of Eloy – City Engineer
Kyler Erhard	FAA
Scott Driver	ADOT
Scott Altherr	Kimley-Horn – Project Manager
Kevin Payne	Kimley-Horn – Principal Investigator
Leonard Fontes	CPE Consultants – Surveyor

1.5 Location

Eloy Municipal Airport (Airport) is located in the northwestern portion of the City of Eloy, specifically in Sections 13, 14, 23, and 24 of Township 7 South, Range 7 East, Gila and Salt River Meridian. **Figure 1** provides a location and vicinity map for the Airport.

Location and Vicinity Map

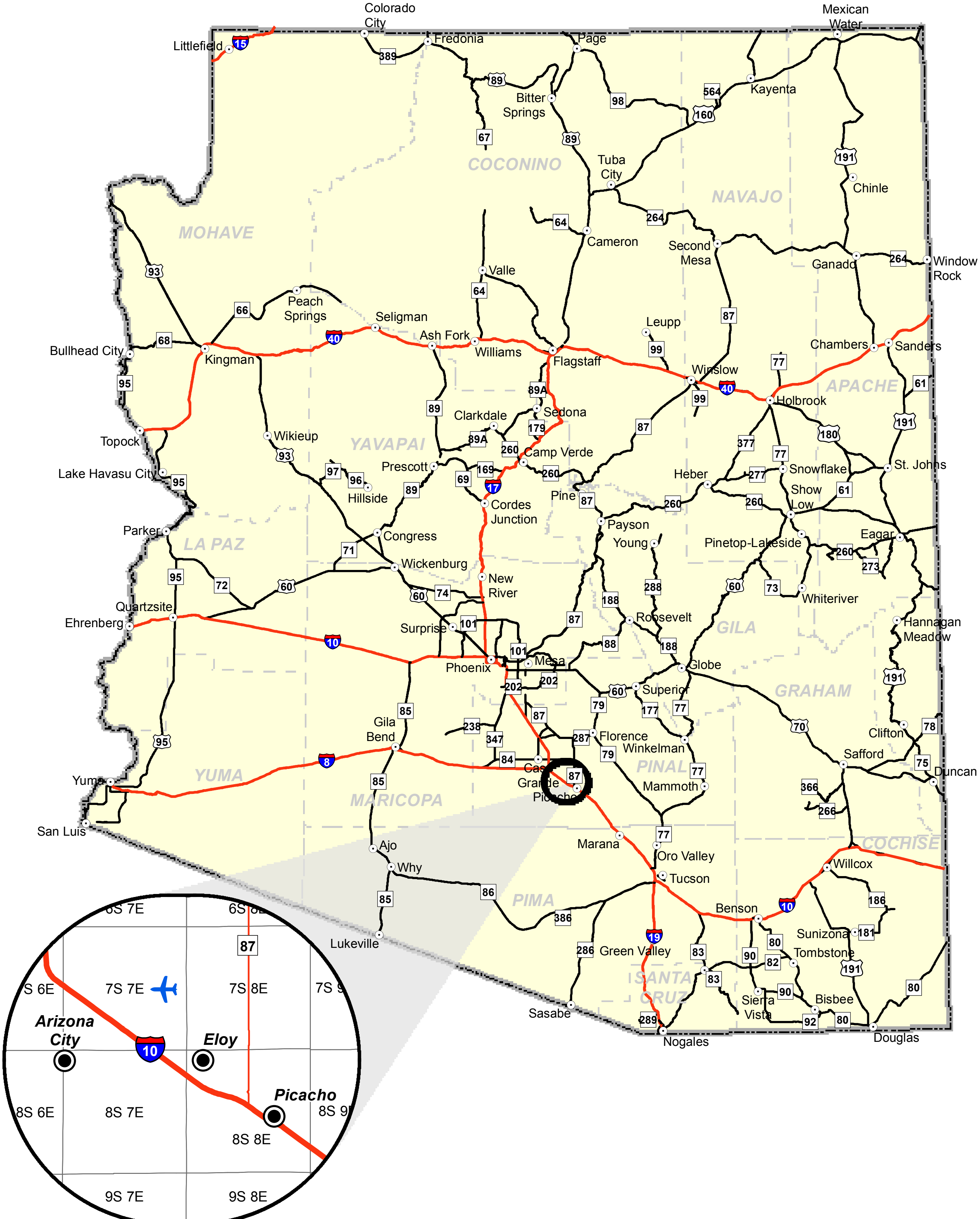

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FIGURE 1

Kimley»Horn

ELOY AIRPORT
DRAINAGE MASTER PLAN

1.6 Study Area Drainage Characteristics

The topography of the study area generally slopes from the southwest to northeast, with minimal vertical relief. Runoff generated from rainfall falling on the airport property flows parallel to the main taxiway and runway before flowing off the property and continuing north through undeveloped desert and agricultural fields (see **Figure 6** in **Appendix A**). Off-site watersheds impacting the airport begin southeast of the project with off-site runoff approaching the airport from the south and the east and flowing through the airport before continuing north (see **Figure 7** in **Appendix A**).

1.7 Data Collection Summary

Kimley-Horn collected and reviewed data from the City of Eloy, Pinal County, and other sources during the initial stages of this project. Some of the data items collected include:

- Previous Drainage Reports:

  McClellan Wash Restudy prepared by URS (2004)

  Pinal County Area Drainage Master Plan – Phase B – Casa Grande-Eloy Watershed prepared by Entellus (2008)

  Pinal County Area Drainage Master Plan – Phase C – McClellan Wash Watershed prepared by Entellus (2009)

  McClellan Wash Watercourse Master Plan prepared by HDR (2013)
- Existing topographic mapping and parcel database from Pinal County
- Topographic mapping and orthophotos developed for this project (See **Figure 2** for an Aerial Photo Map)
- Survey of existing drainage infrastructure
- Site visit observations and photos
- The Eloy Municipal Airport – Airport Master Plan prepared by Coffman Associates (2013)
- Drainage standards and parameters from the Pinal County Drainage Manual (PCDM), FAA Advisory Circular Number 150/5320-5D – Airport Drainage Design (FAA-AC), and FAA Advisory Circular Number 150/5200-33B – Hazardous Wildlife Attractants on or Near Airports
- Soils data from the Natural Resource Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database
- Airport tenant outreach forms and drainage complaints (**Appendix A**)
- FEMA Flood Insurance Rate Maps (FIRM) – See **Figure 3**
- Interview of appropriate agency and Airport maintenance staff for information

Aerial Photo Map

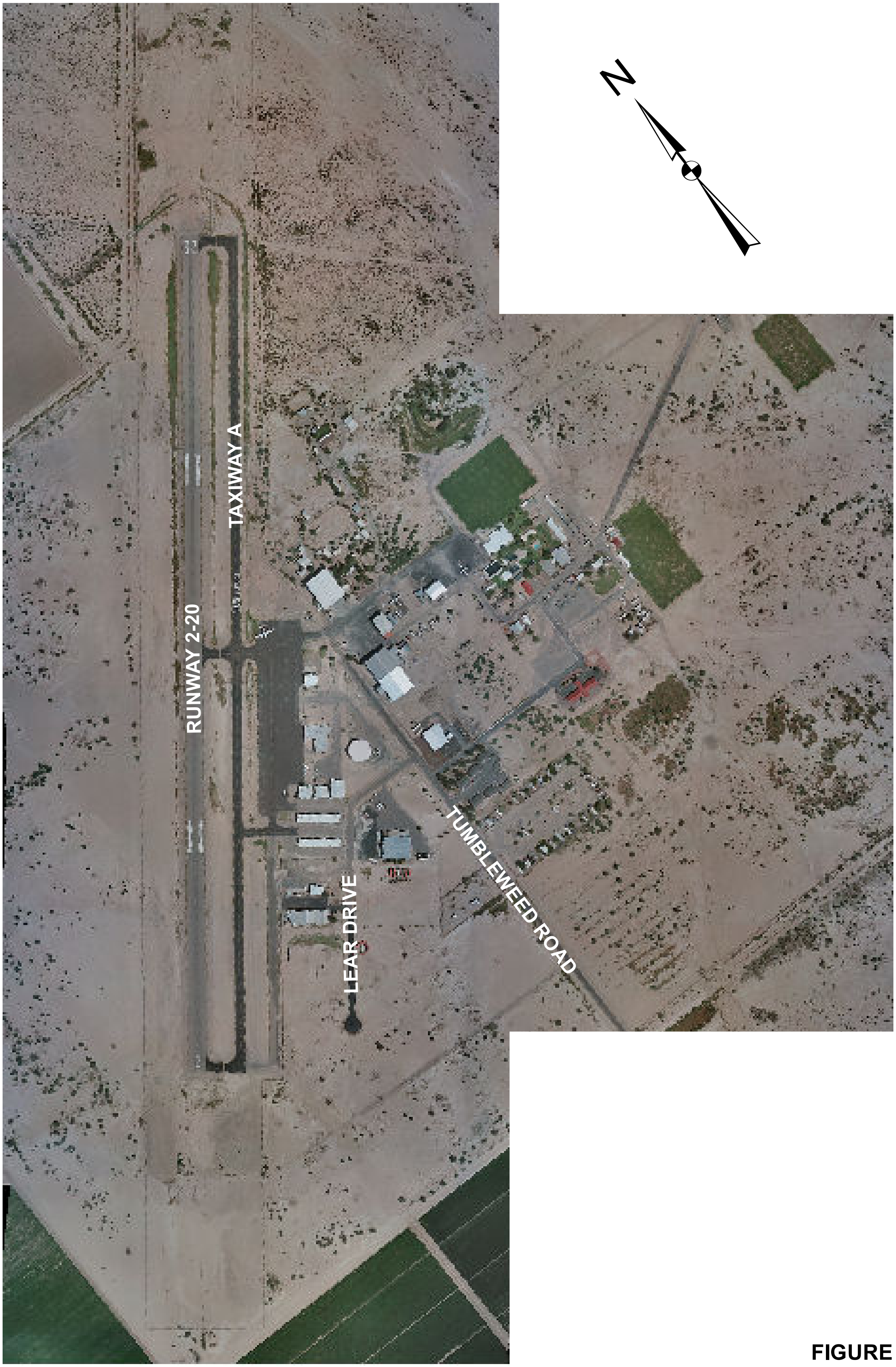

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FIGURE 2

Kimley»Horn

ELOY AIRPORT
DRAINAGE MASTER PLAN

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

NFIP

PANEL 1590E

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

PINAL COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 1590 OF 2575

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
PINAL COUNTY, UNINCORPORATED AREAS	040077	1590	E
ELOY, CITY OF	040083	1590	E

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
04021C1590E

EFFECTIVE DATE
DECEMBER 4, 2007

Federal Emergency Management Agency

2 Existing Drainage Analysis

The Eloy Municipal Airport is impacted by rainfall/runoff from three sources; rainfall falling on the Airport which flows through and off of the Airport, runoff generated off of Airport property which directly impacts the Airport, and regional, large scale, runoff which impacts not only the Airport but much of the region. This Airport Drainage Master Plan addresses both onsite and offsite runoff but is not scoped to address the impacts of regional runoff.

Regional runoff that potentially impacts the Airport comes from the McClellan Wash. The McClellan Wash originates east of the Picacho Mountains, flows south to the southern tip of the Picacho Mountains where it turns and flows northwest. The McClellan Wash continues in a northwesterly direction towards the Community of Picacho and City of Eloy where the main channel loses capacity causing the flow to fan out in multiple directions. A series of roads, canals, and farm fields expedite the dispersion of the wash. Portions of the McClellan wash ultimately continue northwesterly towards the Eloy Municipal Airport while others flow northerly towards Picacho Reservoir. As shown in Section 1.7, the McClellan Wash has been studied on multiple occasions. The studies identify the potential for the McClellan Wash to impact the Airport. These studies are either planning level studies, lacking detail, or detailed studies focused on other portions of the wash, therefore they do not provide specific information on the McClellan Wash's impact on the Airport.

2.1 Hydrologic Criteria

Hydrologic analyses were performed to quantify onsite and offsite runoff impacting the Airport. Hydrologic calculations followed the standards and methodologies presented in the *Pinal County Drainage Manual (PCDM)* and the *Federal Aviation Administration, Advisory Circular Number 150/5320-5D – Airport Drainage Design (FAA-AC)*. The areas of the watersheds and sub-basins dictated the methodology to be used as part of the hydrologic investigation.

2.1.1 Drainage Area Delineations

Drainage basin boundaries, areas, flow path, and slopes were obtained from two different sources of topography and verified with field observations. One topography source is the 1' contour interval topographic mapping that was flown for this project. The other topography source, 2' contours, from Pinal County was used to supplement the project specific mapping.

2.1.2 Precipitation

Rainfall depths for the project were obtained from Table 2-8 (Eloy) in the *PCDM*.

2.1.3 Soil Data

Soils data from the Natural Resource Conservation Service (NRCS) Soil Survey Geographic (SSURGO) Database was used to determine the Soil Texture and Hydrologic

Soil Group for all contributing watersheds. Hydrologic Soil Group is a key component of the Runoff Coefficient in the Rational Method while Soil Texture is necessary to determine Green & Ampt loss parameters for the HEC-HMS rainfall-runoff model. See **Figure 4** and **Figure 5** in **Appendix A** for hydrologic soil group and soil texture data.

2.2 Hydrologic Methodology

2.2.1 Rational Method

The Rational Method was used to generate peak discharge for on-site watersheds. The Rational Method calculations are provided in **Appendix A**. The Rational Method is based on the following equation:

$Q = CiA$

Where:

Q = Peak runoff (cfs)

C = Runoff coefficient

i = Rainfall intensity at the corresponding time of concentration (in/hr)

A = Area (acres)

The runoff coefficient (C) for the Rational Method was selected from Table 2-1 of the *PCDM*. The watersheds are classified as "Undeveloped Desert Rangeland", "Low Density Developed", and "Medium Density Developed". These classifications were selected in order to appropriately select the runoff parameters.

The time of concentration is iteratively computed based on the following equation:

$T_c = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i^{-0.38}$

Where:

T_c = Time of concentration along the longest hydraulic flow path (hours)

L = Length of the longest hydraulic flow path (miles)

K_b = Watershed resistance coefficient

S = Slope along the longest hydraulic flow path (ft/mile)

i = Rainfall intensity at the corresponding time of concentration (in/hr)

The rainfall intensity (i) in the rational equation is the average rainfall intensity for the selected return period with a rainfall duration equal to the time of concentration (T_c). The time of concentration is the time for a flood wave to travel from the hydraulically most distant point in the watershed to the point of concentration. An iterative process is used to determine the rainfall intensity since the time of concentration depends on the rainfall intensity. The minimum time of concentration is 5 minutes, as specified in the *PCDM*. The resistance coefficients (K_b) were determined from Table 2-2 in the *PCDM*.

2.2.2 HEC-HMS Modeling

Due to the larger size of the off-site watersheds, peak discharges were developed using the U.S. Army Corps of Engineers HEC-HMS Flood Hydrograph computer program. The input parameters (discussed below) were selected following the methodology in the *PCDM*.

Rainfall depths for the project were obtained from *PCDM* Table 2-8. Models were developed for the 100-year storm frequency using the SCS Type II 6-hour and 24-hour storm duration. Contributing off-site watersheds are greater than 1.0-square mile therefore the 24-hour storm duration was selected as the design storm duration.

Rainfall losses were estimated using the Green and Ampt equation. The Green and Ampt parameters were selected following the methodology in Chapter 3 of *ADOT's Highway Drainage Design Manual (HDDM) - Hydrology*. The HEC-HMS outputs and parameters are shown in **Appendix A**.

2.3 Hydrologic Results

KHA performed a hydrologic analysis of the existing conditions. The existing conditions analysis includes an analysis of on-site watersheds and off-site watersheds. Delineations for on-site and off-site watersheds are shown on **Figure 6** and **Figure** 7 (**Appendix A**) respectively.

2.3.1 On-Site Hydrologic Results

On-site watersheds were evaluated using the Rational Method and the parameters discussed in Section 2.2.1. **Table 2** and **Table 3** show the peak discharge for on-site watersheds and the cumulative peak discharge for each concentration point. See **Figure 6** for a Watershed Map.

Table 2 – On-Site Watershed Summary

SUB-BASIN	AREA [ac]	PEAK DISCHARGE [cfs]			
		2-YEAR	5-YEAR	10-YEAR	100-YEAR
E-1	11.4	7.9	12.2	16.6	32.2
E-2	17.4	9.9	15.3	21.4	44.0
E-3	34.6	19.2	29.5	39.5	79.8
E-4	39.7	15.8	27.1	37.6	76.4
E-5	8.9	8.3	12.7	16.7	31.4
E-6	4.0	4.6	6.6	8.5	15.6
E-7	2.7	5.0	7.0	8.9	15.5
E-8	0.3	0.7	0.9	1.1	1.7
E-9	0.6	1.2	1.6	2.0	3.5
E-10	1.5	4.2	5.7	7.0	11.5
E-11	3.6	6.6	9.2	11.5	20.3
E-12	5.3	10.6	14.7	18.2	31.8
E-13	1.1	1.6	2.2	2.8	5.2
E-14	1.3	2.7	3.8	4.8	8.2
E-15	8.4	5.8	8.7	11.4	21.8
E-16	8.9	7.5	11.0	14.9	29.1

Table 3 – On-Site Concentration Point Summary

CONCENTRATION POINT	CONTRIBUTING SUB-BASINS	CUMULATIVE PEAK DISCHARGE [cfs]			
		2-YEAR	5-YEAR	10-YEAR	100-YEAR
CP-1	E-1	7.9	12.2	16.6	32.2
CP-2	E-2	9.9	15.3	21.4	44.0
CP-3	E-3	19.2	29.5	39.5	79.8
CP-4	E-4 + CP-15	87.9	132.3	174.7	335.3
CP-5	E-5	8.3	12.7	16.7	31.4
CP-6	E-6 + CP-7	21.4	31.4	41.9	80.3
CP-7	E-7 + CP-2 + CP-8	16.8	24.8	33.4	64.7
CP-8	E-8,9	1.9	2.5	3.1	5.2
CP-9	E-9	1.2	1.6	2.0	3.5
CP-10	E-10	4.2	5.7	7.0	11.5
CP-11	E-11	6.6	9.2	11.5	20.3
CP-12	E-10 + E-12 + CP-6	36.2	51.8	67.1	123.6
CP-13	E-3,11,13	27.4	40.9	53.8	105.3
CP-14	E-14	2.7	3.8	4.8	8.2
CP-15	E-15 + CP-12 + CP-13 + CP-14	72.1	105.2	137.1	258.9
CP-16	E-5,16	15.8	23.7	31.6	60.5

2.3.2 Off-Site Hydrologic Results

As discussed in Section 2.2.2, a rainfall-runoff model utilizing HEC-HMS was developed to analyze the off-site watersheds. **Table 4** shows the peak discharge for off-site watersheds and the cumulative peak discharge for each concentration point. See **Figure 7** for a Watershed Map.

Table 4 – Off-Site Watershed Summary

WATERSHED / CONCENTRATION POINT	AREA [ac]	100-YEAR PEAK DISCHARGE [cfs]	CONTRIBUTING WATERSHEDS	TOTAL 100-YEAR PEAK DISCHARGE [cfs]
1A	47.6	12.0	--	12.0
1B	18.7	21.8	1B + 1C	21.8
1C	38.2	10.9	--	10.9
2	--	--	CP 2A + CP 2C	532.0
2A	41.3	44.2	2A + 2B	46.2
2B	79.6	29.6	--	29.6
2C	332.3	188	2C + CP 2D	494
2D	568.6	265	2D + CP 2E	356
2E	80.7	74.7	2E + 2F	95.6
2F	101.0	60.2	--	60.2
2+3	--	--	CP 2 + CP 3A	917
3A	437.9	260	3A + CP CB	501
3B	663.6	127	3B + CP 3C	493
3C	662.1	145	3C + CP 3D	376
3D	35.2	17.6	3D + CP 3E - Diversion	288
3E	438.0	91.9	3E + 3F + 3H + CP 3G	1212
3F	149.4	152	--	152
3G	74.7	241	3G + CP 3I	1095
3H	93.3	120	--	120
3I	397.9	814	3I + CP 3J	1015
3J	15.6	33.7	3J + CP 3K	264
3K	79.5	238	3K + 3L	241
3L	168.5	64.8	--	64.8

2.3.3 Detention/Retention

The airport property has one existing detention/retention basin (See **Figure 8** for its location). The basin has a storage volume of approximately 4,500 cubic-feet. The basin includes two 8-inch outlet pipes with invert elevations 0.8-feet above the basin bottom. The outlet pipes show signs of sedimentation, reducing their effectiveness. There is evidence, based on field visits to the airport, that the drain time for the basin is prolonged, which increases the likelihood that the basin will be full, or partially full at the beginning of the design storm. For these reasons, the hydraulic calculations performed on the downstream structures were completed assuming no attenuation occurs within the basin.

Additionally, the prolonged drain time for the basin has the potential to attract hazardous wildlife. Per *Federal Aviation Administration, Advisory Circular Number 150/5200-33B – Hazardous Wildlife Attractants On or Near Airports*, measures should be developed to minimize hazardous wildlife attraction.

2.4 Hydraulic Criteria

Hydraulic analyses were performed to evaluate the existing drainage conditions on and around the Airport. Hydraulic calculations followed the standards and methodologies presented in the *Pinal County Drainage Manual (PCDM)* and the *Federal Aviation Administration, Advisory Circular Number 150/5320-5D – Airport Drainage Design (FAA-AC).*

2.4.1 FAA Criteria

The *FAA-AC* defines the design standards for airport drainage infrastructure. For taxiways and runways, drainage infrastructure shall be designed to ensure the pavement (including shoulder) is free of ponding during the 5-year event and that the center 50-percent of the runway/taxiway is free of ponding during the 10-year event. For areas other than airfields (roadways, industrial areas, etc.) the design storm shall be the 10-year event.

2.4.2 Pinal County Criteria

Pinal County defines regulatory floodplains as areas with a 100-year discharge of 500 cfs or more. Regulatory floodplains shall be analyzed to ensure that habitable structures are elevated above the 100-year water surface elevation. Additionally, new development shall not increase the 100-year regulatory water surface elevations on adjacent properties.

2.5 Hydraulic Methodology

2.5.1 On-Site Drainage Analysis

Airport Drainage Infrastructure was evaluated to determine if it meets current FAA drainage standards. Airport culverts were analyzed using *Bentley's CulvertMaster*, following the *Federal Highway Administration (FHWA) Hydraulic Design Series Number 5 (HDS 5)*. Airport channels and swales were analyzed using Manning's Equation within *Bentley's FlowMaster.*

2.5.2 Off-Site Drainage Analysis

Per Pinal County standards, regulatory floodplains shall be analyzed. The analysis determines the areas impacted by the floodplain and provides a baseline for proposed drainage alternatives. The *Army Corps of Engineer's Hydrologic Engineering Center River Analysis System (HEC-RAS)* was used to model the off-site generated regulatory floodplains. Additionally, although runoff from Offsite Watersheds 2A and 2B are less than 500 cfs, thus non-regulatory, their floodplain has been modeled to determine the impact to the existing airport structures.

Manning's Roughness Coefficients were selected per the *PCDM*. The natural desert areas consist of primarily fine soils, with little to no rocks or gravel, vegetation is sparse desert brush, thus a Manning's n of 0.04 was selected. Many of the channels and low lying areas are similar with slightly denser amounts of vegetation, therefore 0.05 was selected. 0.05 was also used for the turf areas. 0.03 was used for earthen areas that have been stripped of vegetation. 0.018 was used for pavement. Some areas east of the airport consist of dense vegetation with small buildings, walls, and rubble; for these areas an n value of 0.1 was used.

Where large buildings are located within the model, blocked obstructions were used at the building locations. Ineffective flow areas were used in the building's conveyance shadows.

The HEC-RAS model shows multiple areas where cross-sections do not contain, resulting in breakout flow. At these breakout locations, lateral structures were used to determine the amount of flow breaking out. Due to the large number of lateral structures, automated flow optimization was not possible because the model would not converge. The flow values in each reach were manually, and iteratively, adjusted until the flow into each cross-section equaled the flow out of each cross-section, thus reaching convergence.

2.6 Hydraulic Results

2.6.1 On-Site Drainage Infrastructure

On-site culverts were evaluated using *Bentley's CulvertMaster.* **Table 5** and **Table 6** summarize the culvert analysis and **Figure 8** shows their locations.

Table 5 – Existing 5-Year Culvert Summary

CULVERT	SIZE & TYPE	5-YEAR DISCHARGE [cfs]	HEADWATER ELEVATION	CULVERT DISCHARGE [cfs]	OVERTOPPING DISCHARGE [cfs]
C-3	1-30" CMP	29.5	1508.71	15.7	13.9
C-5	3-19" Concrete	12.7	1505.67	12.7	0.0
C-6	1-24" Concrete	31.4	1508.49	20.5	11.0
C-7	2-15" Steel	24.8	1508.06	8.1	16.8
C-10	1-18" Concrete	5.7	1507.02	5.7	0.0
C-11	2-8" PVC	9.2	1507.73	3.4	5.8
C-12	1-20" Concrete	51.8	1506.41	10.5	41.4
C-13	1-14" CMP	40.9	1507.80	0.1	33.2
C-14	1-8" CMP	3.8	1506.99	0.0	0.0
C-15	3-36" CMP	105.2	1504.39	70.5	34.7
C-16	3-20" Concrete	23.7	1503.42	23.7	0.0
C-17	2-12" CMP	44.7	1506.92	4.9	39.9

Table 6 – Existing 10-Year Culvert Summary

CULVERT	SIZE & TYPE	10-YEAR DISCHARGE [cfs]	HEADWATER ELEVATION	CULVERT DISCHARGE [cfs]	OVERTOPPING DISCHARGE [cfs]
C-3	1-30" CMP	39.5	1508.81	14.7	24.9
C-5	3-19" Concrete	16.7	1505.90	16.7	0.0
C-6	1-24" Concrete	41.9	1508.56	20.8	21.1
C-7	2-15" Steel	33.4	1508.14	8.5	24.9
C-10	1-18" Concrete	7.0	1507.21	7.0	0.0
C-11	2-8" PVC	11.5	1507.78	3.5	8.0
C-12	1-20" Concrete	67.1	1506.49	9.9	57.4
C-13	1-14" CMP	53.8	1507.23	0.1	50.8
C-14	1-8" CMP	4.8	1506.99	0.0	10.4
C-15	3-36" CMP	137.1	1504.49	73.6	63.7
C-16	3-20" Concrete	31.6	1504.11	31.6	0.0
C-17	2-12" CMP	58.6	1506.99	4.7	54.0

Table 7 shows whether or not the existing culverts meet the standards in the *FAA-AC.*

Table 7 – Existing Culvert Summary

CULVERT	MEETS FAA STANDARDS?	
	5-YEAR	10-YEAR
C-3	N/A	NO
C-5	YES	YES
C-6	NO	NO
C-7	NO	NO
C-10	YES	YES
C-11	N/A	NO
C-12	NO	NO
C-13	N/A	NO
C-14	N/A	NO
C-15	NO	NO
C-16	YES	YES
C-17	NO	NO

The existing airport channels and swales were analyzed using *Bentley's FlowMaster*. The cross-section locations are shown on the On-Site Hydraulics Map (**Figure 8**) and **Table 8** summarizes the results of the analysis.

Table 8 – Existing Channel Summary

CROSS-SECTION	5-YEAR DISCHARGE [cfs]	NORMAL DEPTH [ft]	MEETS FAA STANDARD?	10-YEAR DISCHARGE [cfs]	NORMAL DEPTH [ft]	MEETS FAA STANDARD?
1	132.3	0.72	YES	174.7	0.82	YES
2	105.2	1.55	NO	137.1	1.71	NO
3	23.7	0.68	YES	31.6	0.76	YES
4	81.5	1.65	NO	105.5	1.80	YES
5	12.7	0.26	YES	16.7	0.29	YES
6	51.8	1.02	YES	67.1	1.15	YES
7	6.6	0.27	NO	8.5	0.28	YES

2.6.2 Regulatory Floodplains

Per Pinal County standards, regulatory floodplains (Q100 > 500 cfs) shall be analyzed. The *Army Corps of Engineer's Hydrologic Engineering Center River Analysis System (HEC-RAS)* was used to model the regulatory floodplains. The regulatory floodplain delineation is shown on the Floodplain Map (**Figure 9**).

2.7 Existing Drainage Summary

The Eloy Municipal Airport is impacted by runoff from both onsite and offsite rainfall. The onsite runoff flows through the airport via infield channels, and culverts. The onsite drainage hydraulic analysis is shown on the Onsite Hydraulics Map (**Figure 8**). The results show that many of the channels paralleling the runway and taxiways do NOT meet the FAA standards for the 5-year and/or 10-year storm. Additionally, the majority of the onsite culverts do NOT meet the FAA standards.

The 100-year floodplain was delineated for the offsite flows impacting the airport. The floodplain delineation is shown on the Floodplain Map (**Figure 9**). The results show that the drainage infrastructure located on and near the airport will not adequately convey the 100-year storm. Many of the private properties adjacent to the airport are flooded during the 100-year storm. Offsite runoff also floods much of the northeastern portion of the airport property.

3 *Design Criteria and Objectives*

This section of the Airport Drainage Master Plan describes the criteria used for design of the preliminary proposed drainage alternatives for the Eloy Municipal Airport. The criteria provided in this section were used as guidelines during the conceptual development of drainage facilities. These criteria are intended to be used in the final analysis and design of the DMP projects as well as future drainage projects not documented in the DMP. However, adjustments may be required and necessary during final design to accommodate updated site information, hydrology, or design constraints (e.g., utilities).

3.1 Engineering Standards

Drainage features shall be designed to comply with the applicable engineering standards in the *Pinal County Drainage Manual (PCDM)* and the *Federal Aviation Administration, Advisory Circular Number 150/5320-5D – Airport Drainage Design (FAA-AC).*

3.2 Existing Conditions

A thorough understanding of the existing conditions is necessary to complete the design of airport drainage improvements. The existing conditions are summarized in Section 2 of this report. Additional sources of information documenting existing conditions are listed in Section 1.7 of this report. These sources include other studies and reports as well as first-hand experience from airport tenants and city staff.

3.3 Future Conditions

The *Airport Master Plan* provides the layout of the expansion of the Airport. Many of the airport improvements will impact the drainage conditions on the Airport and/or need drainage improvements as part of the expansion.

3.4 Drainage Infrastructure

After review of engineering standards, existing drainage conditions, and the future layout of the airport, drainage infrastructure is designed using the following criteria.

3.4.1 Open Channels

As documented in the existing conditions analysis, many of the drainage channels/swales are currently undersized. Additionally, future airport improvements will necessitate the relocation of some channels as well as entirely new channels.

Channel Sections – Channels shall be designed to be earthen if possible. The maximum side slope for earthen channels is 3:1 (horizontal to vertical) with a preferred side slope of 4:1 or flatter. Where erosive conditions may occur (high flow velocity, channel bends, side inflow) or where property/right-of-way limits require smaller sections, channels shall be protected. The maximum side slope for rip-rap channels is 2:1 whereas concrete channels can have steeper side slopes up to 1:1. A minimum bottom width of 4-feet is required; however, an 8-foot bottom width is desired. The design channel depth is the normal flow depth plus freeboard. Required freeboard is 0.25 times the sum of the depth plus velocity head. The design storms for airport channels, per the *FAA-AC*, are the 5-year and 10-year storms. The 100-year storm shall be checked for impacts to infrastructure.

Side Drainage – Surface runoff entering the channel from the side should be directed to enter the channel at planned locations with side spillways. This will prevent rill erosion for earth channels and undermining at the concrete-soil interface for concrete channels. Where unconcentrated sheet flow enters a channel from the side, the channel shall be designed as a collector channel, with appropriate protection.

Manning's Roughness Coefficient – The following Manning's roughness coefficients are recommended for the development of channel design: Concrete lined channel n value equal 0.015; Earth-lined channel n value equal 0.025 – 0.030; Riprap lined channel n value equal 0.032 – 0.036. A sensitivity analysis of the n values should be considered in final design. An n value representative of a clean channel should be analyzed for flow velocity and potential erosion. An n value representative of a channel in need of maintenance should be analyzed for flow depths and freeboard requirements. The designer is responsible for selection of the final Manning's n value used in the design of open channels with consultation of the *PCDM*.

Longitudinal Slope – Natural slopes around the airport are very shallow, therefore design slopes are set as steeply as possible within the limitations of the channel material maximum allowable velocity and the limitation on Froude number. Due to the shallow slopes, maintenance will be key to remove unwanted vegetation and sediment accumulation.

Froude Number – Froude numbers for channel design are to be less than or equal to 0.86 for subcritical flow. Drop structures should be considered and provided, if necessary, to flatten the grade of the channel to achieve subcritical flow. Supercritical flow is allowed only in special circumstances. Supercritical flow channels, when used, are to have Froude numbers greater than 1.13 and less than 2.0. Supercritical flow conditions are not anticipated on the airport due to the shallow slopes.

3.4.2 Culverts

Minimum Diameter and Cover Requirements – A minimum diameter of 18-inches shall be provided for maintenance purposes. A minimum of 1-foot of cover (from top of pipe to top of subgrade) is preferred for all culverts. Due to the shallow slopes on and around the airport, providing adequate cover under existing roads, runway, or taxiway is difficult. Where minimum cover cannot be achieved, alternative designs such as elliptical pipes and/or concrete encasement shall be considered.

Design Flow – The design storms for airport culverts, per the *FAA-AC*, are the 5-year and 10-year storms. The 100-year storm shall be checked for impacts to infrastructure. The desired flow velocity for culverts flowing partially full shall be 3 feet per second or faster. The flow velocity through a culvert shall not exceed 20 feet per second.

3.4.3 Detention/Retention

Storage Volume – Per the *PCDM*, detention/retention facilities shall provide the volume necessary to store the 100-year, 2-hour storm runoff from all new impervious areas. No detention/retention facility shall retain standing water longer than 36 hours.

Design Considerations – Design of future detention/retention facilities shall also follow the standards in *FAA-AC 150/5320-5D* and *FAA-AC 150/5200-33B.* Above ground and below ground facilities shall both be considered. The benefits of above ground detention/retention basins include cost, ease of construction, and ease of maintenance. The benefit of underground detention/retention storage includes land requirements (can be constructed under most paved areas), and they are less likely to attract hazardous wildlife like above ground basins tend to do.

4 Preliminary Alternatives

This section of the Airport Drainage Master Plan summarizes the preliminary proposed drainage alternatives for the Eloy Municipal Airport. The preliminary alternatives provide airside and landside improvements to:

- Mitigate existing drainage issues on and around the airport.
- Bring the airport up to current FAA drainage standards.
- Accommodate ultimate expansion of the airport.

Refer to **Figure 10** and **Figure** 11 to see the location of each alternative.

4.1 Alternative 1 – T-Hangar Flooding Mitigation

Flooding of the two existing T-Hangars on the airport has been an issue documented by city staff and airport tenants. Runoff from the adjacent taxilanes has historically flowed into the hangars. In 2013, the city completed a Taxilane Reconstruction Project which included inverted crowns with valley gutters to drain runoff away from the hangars. The reconstruction also included a new culvert (C-10) to drain the taxilane runoff to the infield. See **Figure 10, Sheets 2 and 3**.

4.2 Alternative 2 – Mitigation of On-Airport Building Flooding

Flooding of the three existing hangars immediately north of the two T-Hangars as well as the two buildings further north is also an issue that has been documented by city staff and airport tenants. The flooding of these buildings is also caused by the surrounding paved and unpaved areas draining towards the buildings. Re-grading of these areas to provide positive slope away from the buildings will significantly reduce the likelihood of the buildings flooding. **See Figure 10, Sheet 2**.

4.3 Alternative 3 – Mitigation of Private Hangar Flooding

The existing private hangars on Lear Drive also have documented flooding issues. A berm just upstream (southwest) of the hangars currently protects them from flooding during minor storms. Larger rainfall events are likely to cause runoff to overtop the berm and flood the hangars. Although this alternative would address a private drainage problem, it has been identified as an alternative because of the previously documented flooding issue and because the berm that is currently protecting the private hangars is on City of Eloy property. To protect the hangar from the 100-year storm, a collector channel along with culverts under the existing taxiway could be constructed to direct runoff northwest, into the infield. This area is identified in the *Airport Master Plan* to be the future location of additional hangars and associated taxilanes therefore any improvements at these locations will be addressing an interim condition. See **Figure 10, Sheet 3**.

4.4 Alternative 4 – North Taxiway Drainage Improvements

The existing channels and culverts paralleling along the east side of Taxiway A do not meet FAA standards. The channel can be re-graded and the culverts replaced to provide more capacity and bring them up to standard. The *Airport Master Plan* recommends relocating Taxiway A to the south of its current location; therefore any north taxiway drainage improvements will only address an interim condition. See **Figure 10, Sheets 1 and 2**.

4.5 Alternative 5 – South Taxiway Drainage Improvements

Like the northern taxiway drainage improvements, the southern taxiway channel and culverts can be upgraded or replaced to provide additional capacity and meet FAA standards. These improvements will also be provisional, due to the relocation of Taxiway A. See **Figure 10, Sheets 2 and 3**.

4.6 Alternative 6 – Culvert Replacement West of T-Hangars

As discussed within Alternative 1, a new culvert was recently added northwest of the existing T-Hangars. An existing, undersized culvert is located approximately 120-feet south of the new culvert. Replacing this culvert will increase capacity to meet FAA standards, will also reduce nuisance ponding, reduce backwater effects on adjacent buildings, and reduce the maintenance requirements associated with these drainage issues. The relocation of Taxiway A will impact this culvert but the culvert can be designed to allow for extension when the taxiway is relocated. See **Figure 10, Sheets 2 and 3**.

4.7 Alternative 7 – Tumbleweed Road Culvert Replacements

The existing culverts along Tumbleweed Road, north of Lear Drive (Culverts C-13, C-14, and C-17) are all undersized. Replacing the culverts to meet FAA standards will more efficiently drain the east side of the airport, reduce backwater effects on buildings, and reduce nuisance ponding and maintenance. The culverts are either located completely off of airport property or start on airport property but extend off airport property. See **Figure 10, Sheet 2**.

4.8 Alternative 8 – Tumbleweed Road Drainage Realignment

Constructing a drainage channel along the west side of Tumbleweed Road, north of Lear Drive will more efficiently drain the eastern part of the property. New culverts will be necessary at the "through the fence" access point. The existing drainage infrastructure along Tumbleweed Road is undersized, causing backwater effects on both on and off airport property during both frequent small storms and the large, off-site regulatory flood. The area also has nuisance ponding resulting in maintenance issues. Much of the existing, undersized drainage infrastructure along Tumbleweed Road is offsite, on private property. Realigning the drainage system in this area will reduce the number of culverts needed to convey the flow through the property (alternative 7 would not be necessary). An additional benefit will be that it will provide more flexibility when designing ways to alleviate the airport flooding discussed in alternatives 2 and 9. See **Figure 10, Sheets 2 and 3**.

4.9 Alternative 9 – Detention Basin Outlet Culvert Replacement

An existing culvert that drains the onsite detention/retention basin under an access drive is currently undersized causing runoff to breakout over the roadway and flow towards the adjacent building. Replacing this culvert will alleviate the current issue, allow the grading necessary in Alternative 2, and reduce the basin drain time. See **Figure 10, Sheet 2**.

4.10 Alternative 10 – Culvert Replacement under Lear Drive at Tumbleweed Road

The culvert under Lear Drive at Tumbleweed Road is also undersized, causing roadway flooding and breakout into the airport. Replacement of this culvert will reduce flooding on the airport and adjacent properties. The inlet of the culvert is off airport property, while the outlet is on airport property. See **Figure 10, Sheet 3**.

4.11 Alternative 11 – Lear Drive Channel and Culvert Improvements

Offsite runoff currently breaks out over Lear Drive, impacting the existing airport hangars. A new channel and culverts along the east and south sides of Lear Drive could convey this runoff to the culvert discussed in alternative 10. These improvements will reduce the impacts of offsite runoff on the airport and adjacent properties. The improvements can be extended south along the current length as well as the extension of Lear Drive to protect the proposed hangars from offsite runoff. These improvements are located off airport property, partially in city right-of-way and partially on private property. Additional right-of-way or drainage easements would be necessary. See **Figure 10, Sheet 3**.

4.12 Alternative 12 – Collector Channel Upstream of New Hangars

In order to reduce the impact of offsite runoff on the future hangars, a collector channel is recommended upstream (southwest) of them. The collector channel will convey runoff west, into the infield. See **Figure 11, Sheet 3**.

4.13 Alternative 13 – Southwest Runway Extension Drainage Improvements

Culverts will be necessary to convey offsite and onsite runoff under the southwest runway and taxiway extensions. The new infield should be graded to direct runoff from the culverts under the taxiway extension to the culverts under the runway extension. See **Figure 11, Sheet 3**.

4.14 Alternative 14 – Infield Culverts and Channels for Taxiway Relocation

Relocation of the Taxiway will result in a larger infield. The new infield shall be graded so that the entire area between the runway and new taxiway drains to a single flowline paralleling the runway. This will allow the new infield to have a greater capacity than existing and also consolidate the culvert crossings. The design discharge of the new infield will be impacted by the new hangar area drainage improvements and the retention design for the airport. See **Figure 11, Sheets 1-3**.

4.15 Alternative 15 – T-Hangar Culvert Improvements for Taxiway Relocation

The two existing culverts west of the existing T-Hangars will need to be replaced or extended to account for the Taxiway Relocation. See **Figure 11, Sheets 2 and 3**.

4.16 Alternative 16 – Floodplain Improvements for Taxiway Relocation

As described in Section 2.6.2, much of the eastern and northeastern portions of the airport are significantly impacted by 100-year, off-site, regulatory floodplains. The primary conveyance of the floodwaters are the earthen swales that parallel Taxiway A and a 3-barrel pipe culvert located off the end of Runway 2-20. The swales, and culverts, as well as the canal over chute further downstream are all undersized, resulting in substantial flooding of the northeastern portion of the airport and overtopping of the runway and taxiway.

The relocation of Taxiway A eliminates the swales conveying the floodwaters and blocks the flow from turning north and flowing through the pipe culverts. Pinal County standards require that any improvements within a floodplain have no adverse impact on adjacent properties therefore a new concept to route the offsite floodwaters through the airport is recommended.

At the downstream (north) end, the irrigation canal over chute should be widened, allowing for a larger daylight channel to be constructed. The new daylight channel will convey runoff from new concrete box culverts under the runway and relocated taxiway. Upstream of the relocated taxiway, a new channel shall parallel the taxiway, collecting runoff and conveying it to the box culverts. Realignment of the channels and culverts from their current location will allow the length of the drainage concept to be reduced, thus maximizing the slope. The proposed concept will increase capacity from current conditions, ensuring no adverse impact on adjacent properties and reduce the flooding on the airport. Despite the increase in capacity, the 100-year flood will still breakout over the taxiway and runway.

The proposed alternative includes improvements off-site of airport property. The irrigation canal and property to the north will be impacted by the daylight channel. The proposed channel paralleling the new taxiway will not fit within the property acquisition identified in the *Airport Master Plan.* Property acquisition or new drainage easements will be necessary at these locations. See **Figure 11, Sheets 1 and 2**.

4.17 Alternative 17 – Drainage Improvements for Proposed Hangars

Drainage improvements for the proposed hangars are necessary to prevent flooding of the hangars. Channels are recommended in alternatives 11 and 12 which will prevent offsite runoff from impacting the hangars. Onsite runoff should be accounted for with standard engineering practices such elevating buildings to provide positive drainage away from the building, providing positive drainage in all adjacent paved and landscaped areas and ensuring downstream drainage infrastructure is adequately sized to prevent backup into the buildings. Specific drainage improvements are not recommended with this document due to the impacts that the site design will have on the drainage concept. Drainage improvements under the relocated taxiway will need to account for the ultimate runoff from the new hangar area. See **Figure 11, Sheet 3**.

4.18 Alternative 18 – Retention for Added Impervious

Pinal County requires that retention of the 100-year, 2-hour storm be provided for all new impervious areas. The net increase in impervious area for the improvements in the *Airport Master Plan* is approximately 9.5 acres. Based on Pinal County requirements, the ultimate required retention volume is approximately 2.1 acre-feet. Retention options include above ground basins and below ground tanks or chambers. Above ground basins are typically less expensive to construct but take up space and can become riparian-like, attracting wildlife. Below ground basins are typically more expensive but can be constructed under paved areas and do not risk attracting wildlife. The location and size of retention will impact the ultimate design discharges for many of the drainage improvements throughout the airport. See **Figure 11, Sheet 3**.

4.19 Alternative 19 – Regional Drainage Study

This Existing Conditions Analysis of this report identifies and quantifies onsite and offsite runoff directly impacting the Eloy Municipal Airport. Multiple other planning studies show that regional drainage, specifically the McClellan Wash, also impacts the Eloy Airport. Analysis of the regional drainage was not included in the scope of this project. A detailed analysis of the McClellan Wash would quantify the regional drainage impact on the Eloy Airport. Due to the large, regional scale study that would be necessary to analyze the McClellan Wash, the FAA would not be a funding source. A detailed drainage study on the McClellan Wash would benefit many stakeholders, both public and private.

4.20 Preliminary Alternatives Summary

Table 9 summarizes the conditions that the drainage alternative will address. Those marked as addressing existing conditions will mitigate existing drainage issues and/or bring the airport up to current FAA drainage standards. Those marked ultimate conditions will address drainage issues related to the ultimate airport layout in the Airport Master Plan. Those alternatives that are marked for both existing and ultimate conditions will mitigate existing drainage issues and/or bring the airport up to current FAA drainage standards while being compatible with the ultimate airport layout.

Table 9 – Alternative Objectives

ALTERNATIVE #	ALTERNATIVE TITLE	EXISTING CONDITIONS	ULTIMATE CONDITIONS
1*	T-HANGAR FLOODING MITIGATION *	X	X
2	OTHER ON-AIRPORT BUILDING FLOODING MITIGATION	X	X
3	PRIVATE HANGAR FLOODING MITIGATION	X	
4	NORTH TAXIWAY DRAINAGE IMPROVEMENTS	X	
5	SOUTH TAXIWAY DRAINAGE IMPROVEMENTS	X	
6	CULVERT REPLACEMENT WEST OF T-HANGARS	X	X
7	TUMBLEWEED ROAD CULVERT REPLACEMENTS	X	X
8	TUMBLEWEED ROAD DRAINAGE REALIGNMENT	X	X
9	DETENTION BASIN OUTLET CULVERT REPLACEMENT	X	X
10	CULVERT REPLACEMENT UNDER LEAR DRIVE AT TUMBLEWEED ROAD	X	X
11	LEAR DRIVE CHANNEL AND CULVERT IMPROVEMENTS	X	X
12	COLLECTOR CHANNEL UPSTREAM OF NEW HANGARS		X
13	SOUTHWEST RUNWAY EXTENSION CULVERTS		X
14	INFIELD CULVERTS AND CHANNELS FOR TAXIWAY RELOCATION		X
15	T-HANGAR CULVERT IMPROVEMENTS FOR TAXIWAY RELOCATION		X

ALTERNATIVE #	ALTERNATIVE TITLE	EXISTING CONDITIONS	ULTIMATE CONDITIONS
16	FLOODPLAIN IMPROVEMENTS FOR TAXIWAY RELOCATION		X
17	DRAINAGE IMPROVEMENTS FOR PROPOSED HANGARS		X
18	RETENTION FOR ADDED IMPERVIOUS		X
19	REGIONAL DRAINAGE STUDY		

* Construction completed in 2013.

Table 10 summarizes the conceptual improvements necessary with each alternative.

Table 10 – Preliminary Alternatives Improvement Summary

ALTERNATIVE #	ALTERNATIVE TITLE	IMPROVEMENTS		
EXISTING CONDITIONS				
1*	T-HANGAR FLOODING MITIGATION *	Re-grade taxilanes	Add valley gutters	Add 1-18" Culvert
2	OTHER ON-AIRPORT BUILDING FLOODING MITIGATION	Re-grade ~70,000 sq-ft		
3	PRIVATE HANGAR FLOODING MITIGATION	275 LF Collector Channel	Add 8-18" Culverts	
4	NORTH TAXIWAY DRAINAGE IMPROVEMENTS	2100 LF Channel	8-18" Culverts	
5	SOUTH TAXIWAY DRAINAGE IMPROVEMENTS	1000 LF Channel	3-24" Culverts	
6	CULVERT REPLACEMENT WEST OF T-HANGARS	3-18" Culverts		
7	TUMBLEWEED ROAD CULVERT REPLACEMENTS	6-18" Culverts	1-18" Culvert	8-18" Culverts
8	TUMBLEWEED ROAD DRAINAGE REALIGNMENT	1100 LF Channel	5-24" Culverts	

ALTERNATIVE #	ALTERNATIVE TITLE	IMPROVEMENTS		
9	DETENTION BASIN OUTLET CULVERT REPLACEMENT	2-18" Culverts	2-18" Culverts	Driveway Realignment
10	CULVERT REPLACEMENT UNDER LEAR DRIVE AT TUMBLEWEED ROAD	5-24" Culverts		
11	LEAR DRIVE CHANNEL AND CULVERT IMPROVEMENTS	1800 LF Channel	4-18" Culverts	4-18" Culverts
PROPOSED CONDITIONS				
12	COLLECTOR CHANNEL UPSTREAM OF NEW HANGARS	320 LF Collector Channel		
13	SOUTHWEST RUNWAY EXTENSION CULVERTS	2-18" Culverts	3-18" Culverts	Grade 145,000 sq-ft of Infield
14	INFIELD CULVERTS AND CHANNELS FOR TAXIWAY RELOCATION	Re-grade 900,000 sq-ft of infield		
15	T-HANGAR CULVERT IMPROVEMENTS FOR TAXIWAY RELOCATION	3-18" Culverts	Extend 1-18" Culvert	
16	FLOODPLAIN IMPROVEMENTS FOR TAXIWAY RELOCATION	1,900 LF Channel	4-10'x4' Box Culverts	4-10'x4' Box Culverts
17	DRAINAGE IMPROVEMENTS FOR PROPOSED HANGARS	Dependent on site design		
18	RETENTION FOR ADDED IMPERVIOUS	2.1 acre-feet		
OTHER				
19	REGIONAL DRAINAGE STUDY	Identified by additional study		

* Construction completed in 2013.

5 Alternatives Evaluation

5.1 Criteria

The criteria discussed below were used to evaluate and rate each of the preliminary alternatives.

5.1.1 Location

Preliminary alternatives were evaluated based on their location. Those improvements located on airport property are rated higher than those off of airport property due to the funding sources available for on airport improvements.

5.1.2 FAA Drainage Criteria

Each drainage alternative was evaluated on whether or not the drainage infrastructure currently meets FAA drainage standards. FAA standards require the runway and taxiway pavement and shoulder be free of flooding during the 5-year storm and that the center 50-percent of the runway and taxiway be free of flooding during the 10-year storm. Each of the three FAA drainage standards were evaluated separately and areas that do not currently meet FAA standards, thus needing drainage improvements, were rated higher.

5.1.3 Public Safety

Preliminary alternatives were evaluated based on their impact on both airside and landside safety. Airside safety considerations include impacts to the Runway Safety Area as well as runoff overtopping of the runway and failure potential due to erosion. The Runway Safety Area (shown on **Figure 11**) is an area that shall be kept free of obstacles to reduce the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway. Overtopping of the taxiway was not considered an airside safety concern due to the low speed of the aircrafts and the low flow velocities of the overtopping. Landside safety considerations include roadway clear zone, vehicle hydroplaning, and failure potential due to erosion. The airside and landside safety considerations were evaluated separately, meaning the alternatives that address issues with both airside and landside safety are rated higher than those that do not.

5.1.4 Impact on Buildings

Preliminary alternatives were evaluated on whether or not they currently do, or will ultimately have a drainage impact an on onsite or offsite building. Those alternatives impacting buildings, thus requiring drainage infrastructure, are rated higher than those that do not.

5.1.5 Floodplain Encroachment

The 100-year regulatory floodplain impacting the project was delineated as part of this project. The alternatives that will provide a positive impact on the regulatory floodplain are rated higher than those improvements that do not.

5.1.6 Conformance with Airport Master Plan

Preliminary alternatives were evaluated on how they impact or will be impacted by the expansion outlined in the *Airport Master Plan*. Each alternative was evaluated on whether or not it addresses the drainage needs for short-term, intermediate, and long-term Master Plan projects as well as the ultimate airport layout. Alternatives were also evaluated on their design/construction sequencing. Those projects that should be designed and constructed as stand-alone drainage improvements are rated higher than drainage improvements that should be designed and constructed as part of a project identified in the *Airport Master Plan*. This evaluation looked at not only the location of the improvements relative to the *Master Plan* improvements but also the complexity of the drainage design/construction.

5.1.7 Cost

Each alternative was qualitatively evaluated on construction cost. Alternatives considered to be low cost were rated higher than high cost alternatives.

5.2 Evaluation Summary

The Alternative Matrix (**Appendix B**) shows how each preliminary alternative was rated with respect to each applicable criteria. The alternatives were then ranked based on the percentage of applicable criteria that are met. **Table 11** summarizes the rankings.

Table 11 – Alternative Ranking

RANK	ALTERNATIVE #	ALTERNATIVE TITLE	SCORE [%]	FIGURE - SHEET
1	16	FLOODPLAIN IMPROVEMENTS FOR TAXIWAY RELOCATION	83.3	11-1, 11-2
2	9	DETENTION BASIN OUTLET CULVERT REPLACEMENT	80.0	10-2
3	8	TUMBLEWEED ROAD DRAINAGE REALIGNMENT	77.8	10-2
4	10	CULVERT REPLACEMENT UNDER LEAR DRIVE AT TUMBLEWEED ROAD	77.8	10-3

RANK	ALTERNATIVE #	ALTERNATIVE TITLE	SCORE [%]	FIGURE - SHEET
5	11	LEAR DRIVE CHANNEL AND CULVERT IMPROVEMENTS	75.0	10-3
6	1*	T-HANGAR FLOODING MITIGATION *	70.0	10-2, 10-3
7	2	OTHER ON-AIRPORT BUILDING FLOODING MITIGATION	70.0	10-2
8	7	TUMBLEWEED ROAD CULVERT REPLACEMENTS	66.7	10-2
9	12	COLLECTOR CHANNEL UPSTREAM OF NEW HANGARS	63.6	10-3
10	6	CULVERT REPLACEMENT WEST OF T-HANGARS	63.6	10-2, 10-3
11	15	T-HANGAR CULVERT IMPROVEMENTS FOR TAXIWAY RELOCATION	63.6	11-2, 11-3
12	13	SOUTHWEST RUNWAY EXTENSION CULVERTS	55.6	11-3
13	17	DRAINAGE IMPROVEMENTS FOR PROPOSED HANGARS	54.5	11-3
14	14	INFIELD CULVERTS AND CHANNELS FOR TAXIWAY RELOCATION	54.5	11-1, 11-2, 11-3
15	3	PRIVATE HANGAR FLOODING MITIGATION	50.0	10-3
16	19	REGIONAL DRAINAGE STUDY	50.0	--
17	18	RETENTION FOR ADDED IMPERVIOUS	45.5	11-3
18	4	NORTH TAXIWAY DRAINAGE IMPROVEMENTS	45.5	10-1, 10-2
19	5	SOUTH TAXIWAY DRAINAGE IMPROVEMENTS	45.5	10-2, 10-3

***** Construction completed in 2013.

6 Master Plan Projects

6.1 Introduction

The Airport Drainage Master Plan is the ultimate program of recommended improvements for alleviating existing drainage issues, bringing drainage up to standards, and accommodating future improvements. Recommendations began with alternatives that were evaluated, ranked, and prioritized to arrive at a final list of recommended projects. Final recommended projects were advanced to 15% concept design in order to assign cost and assess feasibility. A description of the projects' purpose, cost, and considerations follows. The explanation of each project adheres to the following general format:

6.1.1 Project Purpose

This section describes the need for the project.

6.1.2 Description

This section describes the solution to the need outlined in the Project Purpose.

6.1.3 Opinion of Probable Cost

This section provides the estimate of total project cost. The construction costs of the drainage improvements are computed using bidding information from recent Airport bid tabulations and internal Kimley-Horn construction cost databases. A summary of probable construction costs by Master Plan Project is presented in **Appendix C**. The conceptual costs include construction administration, contingencies, right-of-way acquisition (where applicable), and design and permitting costs.

6.1.4 Special Considerations

This section describes any special issues to be considered during final planning and design of the projects.

6.2 Project 1 – Floodplain Improvements for Taxiway Relocation

6.2.1 Project Purpose

The purpose for Project 1 (Alternative 16) is to convey runoff in the regulatory floodplains through the northeastern portion of the airport. As described in Section 2.7, much of the eastern and northeastern portions of the airport are significantly impacted by 100-year, off-site, regulatory floodplains. The primary conveyance of the floodwaters are the earthen swales that parallel Taxiway A and a 3-barrel pipe culvert located off the end of Runway 2-20. The swales, and culverts, as well as the canal over chute further downstream are all undersized, resulting in substantial flooding of the northeastern portion of the airport and overtopping of the runway and taxiway.

The relocation of Taxiway A eliminates the swales conveying the floodwaters and blocks the flow from turning north and flowing through the pipe culverts. Pinal County standards require that any improvements within a floodplain have no adverse impact on adjacent properties therefore a new concept to route the offsite floodwaters through the airport is required.

6.2.2 Description

Project 1 consists of a new channel as well as new box culverts. The new channel parallels the future relocated Taxiway A and collects runoff flowing north within the private properties immediately east of the airport as well as runoff flowing west towards the airport. The channel conveys the collected offsite runoff to the northeast before turning north, flowing through new box culverts under relocated Taxiway A and existing Runway 2-20. The channel continues north from the culvert outlet off of the airport property. Immediately north of the airport property, the over chute in the existing irrigation canal will need to be reconstructed to be widened.

6.2.3 Opinion of Probable Cost

Project 1 has the highest cost of the ten projects with a cost estimate of just over $1,350,000.

6.2.4 Special Considerations

The project will require property acquisition and/or drainage easements. The proposed channel paralleling the relocated taxiway will not fit within the property acquisition identified in the *Airport Master Plan.* Additionally, the channel must extend approximately 600-feet north of the airport property.

Reconstruction of the existing irrigation canal immediately north of the airport will require coordination with the irrigation district.

The proposed channel paralleling relocated Taxiway A collects side inflow from the offsite regulatory floodplains. Bank protection and/or spillways shall be considered during final design.

Construction schedule for Project 1 will be crucial due to the impacts to the runway and likely closure of the runway.

The cover necessary on the proposed box culverts under relocated Taxiway A and Runway 2-20 will need to be evaluated. The cover requirements impact the culvert invert elevations, channel flowline elevations, and the length of the channel extending north of the airport.

6.3 Project 2 – Detention Basin Outlet Culvert Replacement

6.3.1 Project Purpose

An existing culvert that drains the onsite detention/retention basin under an access drive is currently undersized causing runoff to breakout over the roadway and flow towards the adjacent building. Additionally, there is evidence that the basin holds runoff for an extended period of time. The purpose of Project 2 (Alternative 9) is to improve the drainage conditions of the eastern portion of the airport by alleviating the existing issues.

6.3.2 Description

The improvements in Project 2 include two new culvert crossings as well as reconstructed swales. 2-18" culverts will replace the existing culvert under the paved access drive. The gravel driveway connection will be realigned with 2-18" culverts under it. The culver inverts will be placed at the elevation of the basin bottom, draining the detention/retention basin. Swales will connect the culverts and drain the downstream culvert.

6.3.3 Opinion of Probable Cost

Project 2 has a cost estimate of just over $100,000.

6.3.4 Special Considerations

Cover over the proposed culverts will need to be evaluated. Additionally, the outlet swale shall be designed to connect to Project 3.

6.4 Project 3 – Tumbleweed Road Drainage Realignment

6.4.1 Project Purpose

The purpose of Project 3 (Alternative 8) is to more efficiently drain the east side of the airport, reduce flooding impacts from offsite runoff, and provide a drainage outlet for other Drainage Improvement Projects.

6.4.2 Description

Project 3 consists of reconstructed and new drainage channels as well as a new culvert crossing. The channel begins at the outlet of the existing culvert under Lear Drive. The proposed channel will flow north, paralleling the property boundary. 5-24" culverts will be necessary where the drainage project crosses the "through the fence" access from the east. The channel will continue from the culvert outlets, ending near the beginning of Project 1.

6.4.3 Opinion of Probable Cost

The cost estimate for Project 3 is just over $200,000.

6.4.4 Special Considerations

Although utility conflicts must be considered during the final design of all projects, due to the proximity to existing buildings and other infrastructure, utility conflicts are considered more likely in Project 3 than many of the other projects.

6.5 Project 4 – Culvert Replacement under Lear Drive at Tumbleweed Road

6.5.1 Project Purpose

The existing culvert under Lear Drive at Tumbleweed Road is undersized causing runoff to overtop the roadway and flood much of the southwest corner of the intersection. Project 4 (Alternative 10) addresses the issue.

6.5.2 Description

Project 4 consists of 5-24" culverts replacing the existing culvert. The culverts will outlet into the channel in Project 3.

6.5.3 Opinion of Probable Cost

The cost estimate for Project 4 is just under $100,000.

6.5.4 Special Considerations

The cover over the proposed culverts is a design constraint for Project 4. Larger culverts could allow for fewer culverts but impacts to Lear Drive and Tumbleweed Road would increase. Cover requirements shall be evaluated in final design.

Grading will also be necessary at the inlet of the proposed culvert to direct runoff from the south and west to the culvert inlet. Right-of-way limitations will need to be considered.

6.6 Project 5 – Lear Drive Channel and Culvert Improvements

6.6.1 Project Purpose

The existing conditions analysis identified offsite runoff breaking out over Lear Drive, impacting existing hangars and taxilanes on the airport. Project 5 (Alternative 11) addresses this problem.

6.6.2 Description

Project 5 consists of new channel and culverts. The new channel runs along the east side of Lear Drive and shall also parallel the Lear Drive extension. The channel conveys runoff north. Access to the private property southeast of Lear Drive must be maintained therefore two culvert crossings, each with 4-18" culverts, will be provided. The channel will continue along the south side of Lear Drive after Lear turns to the east. The channel ultimately drains to the proposed culverts in Project 4.

6.6.3 Opinion of Probable Cost

The Cost Estimate for Project 5 is nearly $220,000.

6.6.4 Special Considerations

Special considerations for Project 5, as with many of the other projects, include culvert cover and utility conflicts.

Additional right-of-way or a drainage easement will be necessary as the improvements do not fit in the existing right-of-way.

The channel was conceptually designed with 4:1 side slopes. Since the channel is immediately adjacent to a roadway, the inside side slope shall be evaluated and adjusted as necessary. Any adjustments will impact the amount of property acquisition.

6.7 Project 6 – Mitigation of On-Airport Building Flooding

6.7.1 Project Purpose

Project 6 (Alternative 2) will reduce the flooding that has occurred in many of the on-airport hangars and other buildings. The primary cause of much of the flooding is inadequate elevation of the buildings and a lack of positive slope away from the buildings.

6.7.2 Description

Project 6 consists of site re-grading around the existing structures. The proposed grading concept will remove a few inches of material at the building foundation to provide a small step up from the surrounding grade. Additional grading will be completed to provide positive drainage away from the buildings.

6.7.3 Opinion of Probable Cost

The cost estimate for Project 6 is approximately $134,000.

6.7.4 Special Considerations

Special Considerations for Project 6 include the building foundations and utilities as well as the ultimate surface treatment of the existing gravel parking lot.

6.8 Project 7 – Collector Channel Upstream of New Hangars

6.8.1 Project Purpose

The *Airport Master Plan* proposes new hangars south of the existing hangars. This area is impacted by offsite runoff from the south. Additionally, an airport tenant confirmed the drainage issue caused by the offsite runoff.

6.8.2 Description

Project 7 (Alternative 12) proposes a collector channel at the southern edge of the new hangars. The channel collects the offsite runoff and conveys it west. The channel will tie into the future culverts (Project 10) under the future taxiway extension.

6.8.3 Opinion of Probable Cost

The cost estimate for Project 7 is approximately $32,000.

6.8.4 Special Considerations

Side inflow and the need for erosion protection along the south bank of the proposed channel will need to be evaluated.

6.9 Project 8 – Culvert Replacement West of T-Hangars

6.9.1 Project Purpose

The existing culvert west of the airport T-Hangars is undersized causing runoff to overtop the taxilanes and back up towards the hangars.

6.9.2 Description

Project 8 (Alternative 6) replaces the existing culvert with 3-18” culverts.

6.9.3 Opinion of Probable Cost

Project 8 costs approximately $86,000.

6.9.4 Special Considerations

Culvert covert should be reevaluated during final design. The future relocation of Taxiway A should also be considered when finalizing the culvert profile and cover.

6.10 Project 9 – Culvert Extensions for Taxiway Relocation

6.10.1 Project Purpose

The relocation of Taxiway A per the *Airport Master Plan* will require culverts under existing taxilanes be extending to ensure inlets and outlets are outside of the future Taxiway Safety Area.

6.10.2 Description

Project 9 (Alternative 15) includes extension of the culverts in Project 8 as well as the single culvert construction in 2013 with the Taxilane Reconstruction project.

6.10.3 Opinion of Probable Cost

The cost estimate for Project 9 is approximately $73,000.

6.10.4 Special Considerations

Culvert cover with regard to the elevation of relocated Taxiway A will need to be evaluated. Additionally, the relocation of Taxiway A may result in reconfiguring the layout of the connecting taxilanes therefore the culvert layout should also be reevaluated.

This project assumes that the current taxiway will be removed after it is relocated to form a single large infield.

6.11 Project 10 – Southwest Runway Extension Drainage Improvements

6.11.1 Project Purpose

The *Airport Master Plan* proposed extension of the runway and taxiway 650’ to the southwest. Runoff currently drains through this area, additionally Project 7 will direct runoff through this area.

6.11.2 Description

Project 10 (Alternative 13) will convey runoff through the area of the runway and taxiway extensions via culverts underneath the runway and taxiway. Project 10 proposes 2-18” culverts under the taxiway extension and 3-18” culverts under the runway extension. A small channel/swale connects the culverts and another channel/swale drains the outlet of the runway culverts.

6.11.3 Opinion of Probable Cost

Project 10 is estimated at nearly $200,000.

6.11.4 Special Considerations

The future grade of the taxiway and runway will affect culvert cover. Adjustments to culvert inverts can be accommodated by lengthening or shortening the daylight channel. Infield grading should also be considered with this project.

7 Implementation Plan

This section summarizes the strategy for implementing the ten (10) projects that were advanced to *15% Drainage Improvement Plans* as part of this Drainage Master Plan

7.1 Implementation Strategy

To develop an implementation strategy, the Drainage Improvement Projects were evaluated on their rank, compatibility with other Drainage Improvement Projects, as well as their compatibility with Airport Improvement Projects and the schedule of those projects. The recommended implementation strategy includes three periods matching the *Airport Master Plan*. **Table 12** identifies Airport Improvement Projects that are dependent upon a Drainage Improvement Project being constructed prior to or with the Airport Improvement Project.

Table 12 – Airport Improvement Project Drainage Requirements

AIRPORT IMPROVEMENT PROJECT	PERIOD	DRAINAGE IMPROVEMENT PROJECT
Construct Taxilanes for New Hangars	Short Term (FY 2015)	7
Construct New T-Hangars	Short Tern (FY 2015)	7
Relocate Taxiway A	Short Term (FY 2018)	1, 8
Extend Runway 2-20 and Taxiway A – SW	Short Term	10
Construct Terminal Building	Short Term	2, 6*
Construct Additional Hangars and Taxilanes	Intermediate Term	7
Extend Lear Drive, Utilities, Construct Parking Lot	Intermediate Term	5, 7
Extend Runway 2-20 and Taxiway A – NE	Long Term	1
Construct Final Hangars and Taxilanes	Long Term	7

* Proper elevation and grading around new terminal building can eliminate need to construct Drainage Projects 2 and 6 prior to terminal building.

Many of the Drainage Improvement Projects must be preceded by other Drainage Improvement Projects. **Table 13** identifies those prerequisites.

Table 13 – Drainage Improvement Project Requirements

DRAINAGE IMPROVEMENT PROJECT	PRECEDING PROJECT
1	N/A
2	3
3	N/A
4	3
5	4
6	2
7	10
8	N/A
9	8
10	N/A

7.2 Implementation Schedule

Based on the evaluation discussed with the Implementation Strategy, the following Implementation Schedule is proposed.

7.2.1 Project 10 – SW Runway Extension Drainage Improvements

The *Airport Capital Improvement Plan (ACIP)* identifies the new hangars and associated taxilanes as improvement projects in FY 2015. This area is impacted by runoff from the south requiring Drainage Project 7 to intercept the offsite runoff. Drainage Project 7 requires Project 10 be constructed to provide a positively sloped outfall.

7.2.2 Project 7 – Collector Channel Upstream of New Hangars

Project 7 shall be constructed to protect the new hangars from offsite runoff. Project 7 requires Project 10 be constructed. The two projects could be constructed concurrently as one project.

7.2.3 Project 8 – Culvert Replacement West of T-Hangars

Project 8 includes replacement of the undersized culvert west of the existing T-Hangars to improve drainage and meet FAA drainage standards.

7.2.4 Project 1 – Floodplain Improvements for Taxiway Relocation

Relocation of Taxiway A displaces the undersized drainage system which parallels the existing taxiway. Drainage Project 1 shall be constructed prior to or with the Taxiway relocation. The project could be phased to spread out construction cost. Construction should start from the downstream (north) and work upstream.

7.2.5 Project 9 – Culvert Extensions for Taxiway Relocation

The recently constructed culvert northwest of the existing T-Hangars and the culvert in Project 8 will need to be extended with the Taxiway A relocation.

7.2.6 Project 3 – Tumbleweed Road Drainage Realignment

Project 3 will allow the east side of the airport to drain more efficiently. This project needs to be constructed prior to Projects 2, 4, 5, & 6. Project 3 can drain into Project 1 or the existing swale at the outlet of this project.

7.2.7 Project 2 – Detention Basin Outlet

Project 2 will allow the east side of the airport to drain more adequately while realigning the driveway to the gravel parking area. Project 3 needs to be completed to provide an outlet for Project 2.

7.2.8 Project 6 – Mitigation of Building Flooding / Site Grading

Many of the buildings in the eastern portion of the airport have flooding issues due to inadequate drainage. Project 6 re-grades much of the area surrounding the buildings to provide positive drainage. The southern portion of Project 6 can be constructed independent of other drainage projects but the northern portion requires Project 2 be completed prior to Project 6.

7.2.9 Project 4 – Lear Drive Culvert Replacement

The culvert under Lear Drive, at the intersection with Tumbleweed Road shall be replaced to increase flow capacity. Project 3 is required in order for Project 4 to drain.

7.2.10 Project 5 – Lear Drive Channel and Culverts

Project 5 conveys runoff along Lear Drive, preventing it from overtopping Lear Drive and flowing into the airport. Project 4 must be constructed prior to Project 5.

7.3 Implementation Summary

As shown in **Table 12**, the implementation of the Drainage Improvement Projects is highly dependent on the timing of the Airport improvements. Some of the smaller projects can be combined to increase cost effectiveness due to economy of scale, while other larger projects can be phased to spread out the construction costs. **Table 14** summarizes the Drainage Improvement Project Implementation Plan.

Eloy Municipal Airport Drainage Master Plan
Drainage Improvment Project Implementation Plan

PERIOD	PROJECT NUMBER	PROJECT DESCRIPTION	TOTAL PROJECT COST*	FAA ELIGIBLE (91.06%)	ADOT ELIGIBLE (4.47%)	LOCAL SHARE (4.47%)
Short Term (FY 2015)	10	SW Runway Extension Drainage Improvements	$ 197,501	$ 179,844	$ 8,828	$ 8,828
Short Term (FY 2015)	7	Collector Channel Upstream of New Hangars (10)	$ 32,226	$ 29,345	$ 1,441	$ 1,441
		New T-Hangar and Taxilane Construction (7)				
Short Term	8	Culvert Replacement	$ 86,106	$ 78,408	$ 3,849	$ 3,849
Short Term	1	Floodplain Improvements for Taxiway Relocation	$ 1,353,087	$ 1,232,121	$ 60,483	$ 60,483
Short Term	9	Culvert Extensions for Taxiway Relocation (8)	$ 72,676	$ 66,179	$ 3,249	$ 3,249
		Relocation of Taxiway A (1, 9)				
		Extend Runway 2-20 and Taxiway A - SW (10)				
		Short Term Drainage Improvement Subtotal	$ 1,741,596	$ 1,585,897	$ 77,849	$ 77,849
		Additional T-Hangar and Taxilane Construction (7)				
Intermediate	3	Tumbleweed Road Drainage Realignment	$ 207,328	$ 188,793	$ 9,268	$ 9,268
Intermediate	2	Detention Basin Outlet (3)	$ 103,703	$ 94,432	$ 4,636	$ 4,636
Intermediate	4	Lear Drive Culvert Replacement (3)	$ 96,083	$ 87,493	$ 4,295	$ 4,295
Intermediate	5	Lear Drive Channel and Culvert Improvements (4)	$ 216,172	$ 196,846	$ 9,663	$ 9,663
		Extend Lear Drive, Utilities, and Construct Parking Lot (5)				
		Intermediate Term Drainage Improvement Subtotal	$ 623,286	$ 567,564	$ 27,861	$ 27,861
		Extend Runway 2-20 and Taxiway A - NE (1)				
		Final T-Hangar and Taxilane Construction (7)				
Long Term	6	Building Flooding Mitigation / Site Grading (2)	$ 134,104	$ 122,115	$ 5,994	$ 5,994
		Long Term Drainage Improvement Subtotal	$ 134,104	$ 122,115	$ 5,994	$ 5,994
		Drainage Improvement Total	$ 2,498,986	$ 2,275,577	$ 111,705	$ 111,705

Notes: *Italicized projects are Airport Improvement Projects requiring Drainage Improvements.*
( ) = Preceding Project
* Total Cost includes design/permitting costs but assumes that multiple small projects will be designed together to achieve economy of scale.

8 Environmental and Permit Issues

8.1 Arizona Pollutant Discharge Elimination System

The National Pollutant Discharge Elimination System (NPDES) is a national program under Section 402 of the Clean Water Act that regulates the discharge of pollutants from point sources into waters of the U.S. The NPDES permit program requires a NPDES general permit for construction activities that disturb one acre or more of land. The Arizona Department of Environmental Quality (ADEQ) has been delegated authority from the U.S. Environmental Protection Agency to administer the permit program within the State of Arizona. The State program is referred to as the Arizona Pollutant Discharge Elimination System (AZPDES).

If it is anticipated that one acre or more of land will be disturbed within the Eloy Municipal Airport property during a single construction project, or multiple projects included in a “larger common plan of development or sale,” therefore an AZPDES general permit will be required before construction activities commence. Preparation and implementation of a storm water pollution prevention plan will also be required if one acre or more of land is to be disturbed, and a Notice of Intent and Notice of Termination must be submitted to the ADEQ.

All environmental and permitting issues will be addressed and submitted under separate cover.

8.2 Section 404 of the Clean Water Act

The U.S. Army Corps of Engineers regulates the discharge of dredge and fill material into waters of the United States under Section 404 of the Clean Water Act. Any activity that will discharge dredge or fill material into jurisdictional waters, including wetlands, requires a Section 404 Permit, following the completion of a jurisdictional delineation or wetland delineation. A jurisdictional delineation will be necessary to determine if any jurisdictional waters are located on the airport.

All environmental and permitting issues, including jurisdictional or wetland delineation, will be addressed and submitted under separate cover.

9 Operation and Maintenance

Maintenance of Drainage Facilities is crucial to their efficient operation. Common reasons for conducting maintenance include, but are not limited to; erosion, sedimentation, debris, unwanted vegetation growth, and settling/subsidence. A lack of maintenance for Drainage Facilities can cause the facility to operate other than designed, less efficiently, and even lead to failure.

Through discussion with City of Eloy staff it has been found that at the present time any drainage maintenance that does occur is relatively infrequent and is usually in response to immediate local flooding. Standard, regular maintenance procedures may reduce replacement and overall maintenance costs.

Kimley-Horn recommends that the Airport develop an Operation and Maintenance Plan for Drainage Facilities. The Plan will provide recommended Standard Operating Procedures that outline the frequency and type of maintenance required for the drainage facilities. Several municipal agencies in Arizona have developed standard operation and maintenance procedures and stormwater management plans for cleaning and maintaining drainage structures. Kimley-Horn recommends that the Airport obtain the standard operating procedures (SOPs) for maintenance of the storm water system from these agencies and modify and adapt the SOPs for Airport purposes.

10 Conclusion

This Airport Drainage Master Plan for the Eloy Municipal Airport was completed in three major phases. The first phase studied and summarized the existing hydrologic and hydraulic conditions on and around the airport. The second phase of the project provided nineteen (19) preliminary drainage alternatives to; mitigate existing drainage issues, bring current drainage infrastructure up to FAA standards, or provide the drainage infrastructure necessary to accommodate future airport expansion. The second phase also included evaluating and ranking the alternatives based on a set of criteria developed specifically for the Airport. The third and final phase progressed the top ten (10) ranked alternatives to 15% concept plans, completed conceptual cost estimates for the ten (10) projects, and an implementation plan for the drainage improvements.

The results of this report are not intended to address all current or future drainage needs on the Airport. All future improvements must consider drainage, following engineering standards, in conformance with the Eloy Municipal Airport Drainage Master Plan.

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Appendix A - Existing Drainage Analysis Supporting Documentation

Figures

Figure 4 – Hydrologic Soils Map

Figure 5 – Soil Texture Map

Figure 6 – On-Site Sub-Basin Map

Figure 7 – Off-Site Watershed Map

Figure 8 – On-Site Hydraulics Map

Figure 9 – Floodplain Map

Hydrologic Analysis Supporting Documentation

Rational Method Calculations

HEC-HMS Model Parameters

HEC-HMS Model Outputs

Hydraulic Analysis Supporting Documentation

CulvertMaster Outputs

FlowMaster Outputs

HEC-RAS Outputs

Airport Tenant Outreach Forms

Appendix A - Existing Drainage Analysis Supporting Documentation

Figures

333 East Wetmore Road, Suite 280
Tucson, Arizona 85705 (520) 615-9191

PROJECT NO.
191645002

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: KWP
DRAWN BY: BY
CHECKED BY: SJA

DATE: MAY 2014

FIGURE 4
HYDROLOGIC SOIL GROUP MAP
ELOY AIRPORT
DRAINAGE MASTER PLAN

Sheet 1 of 1

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\HydroSoilGroupMap_Eloy.mxd

Kimley»Horn

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Tucson, Arizona 85705 (520) 615-9191

PROJECT NO.
191645002

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: KWP
DRAWN BY: BY
CHECKED BY: SJA

DATE: MAY 2014

FIGURE 5
SOIL TEXTURE MAP
ELOY AIRPORT
DRAINAGE MASTER PLAN

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\HydroSoilTextureMap_Eloy.mxd

ONSITE SUB-BASIN SUMMARY TABLE

SUB-BASIN	AREA [ac]	PEAK DISCHARGE [cfs]			
		2 YEAR	5 YEAR	10 YEAR	100 YEAR
E-1	11.4	7.9	12.2	16.6	32.2
E-2	17.4	9.9	15.3	21.4	44.0
E-3	34.6	19.2	29.5	39.5	79.8
E-4	39.7	15.8	27.1	37.6	76.4
E-5	8.9	8.3	12.7	16.7	31.4
E-6	4.0	4.6	6.6	8.5	15.6
E-7	2.7	5.0	7.0	8.9	15.5
E-8	0.3	0.7	0.9	1.1	1.7
E-9	0.6	1.2	1.6	2.0	3.5
E-10	1.5	4.2	5.7	7.0	11.5
E-11	3.6	6.6	9.2	11.5	20.3
E-12	5.3	10.6	14.7	18.2	31.8
E-13	1.1	1.6	2.2	2.8	5.2
E-14	1.3	2.7	3.8	4.8	8.2
E-15	8.4	5.8	8.7	11.4	21.8
E-16	8.9	7.5	11.0	14.9	29.1

ONSITE CONCENTRATION POINT SUMMARY TABLE

CONCENTRATION POINT	CONTRIBUTING SUB-BASINS	CUMULATIVE PEAK DISCHARGE* [cfs]			
		2-YEAR	5-YEAR	10-YEAR	100-YEAR
CP-1	E-1	7.9	12.2	16.6	32.2
CP-2	E-2	9.9	15.3	21.4	44.0
CP-3	E-3	19.2	29.5	39.5	79.8
CP-4	E-4 + CP-15	87.9	132.3	174.7	335.3
CP-5	E-5	8.3	12.7	16.7	31.4
CP-6	E-6 + CP-7	21.4	31.4	41.9	80.3
CP-7	E-7 + CP-2 + CP-8	16.8	24.8	33.4	64.7
CP-8	E-8,9	1.9	2.5	3.1	5.2
CP-9	E-9	1.2	1.6	2.0	3.5
CP-10	E-10	4.2	5.7	7.0	11.5
CP-11	E-11	6.6	9.2	11.5	20.3
CP-12	E-10 + E-12 + CP-6	36.2	51.8	67.1	123.6
CP-13	E-3,11,13	27.4	40.9	53.8	105.3
CP-14	E-14	2.7	3.8	4.8	8.2
CP-15	E-15 + CP-12 + CP-13 + CP-14	72.1	105.2	137.1	258.9
CP-16	E-5,16	15.8	23.7	31.6	60.5

* Arithmetic Sum

Kimley»Horn

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PROJECT NO. 191645002

N

1 inch = 100 feet

100 50 0 100 Feet

Contour Interval = 1'

Legend

- Concentration Points
- Sub Basin Boundaries
- Airport Boundary
- Culvert
- Flow Arrows

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: BY
DRAWN BY: BY
CHECKED BY: KWP

DATE: DECEMBER 2013

FIGURE 6
ON-SITE SUB-BASIN MAP
ELOY AIRPORT
DRAINAGE MASTER PLAN

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\Eloy_On Site Hydrology Exhibit.mxd

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E-4	39.7	15.8	27.1	37.6	76.4
E-5	8.9	8.3	12.7	16.7	31.4
E-6	4.0	4.6	6.6	8.5	15.6
E-7	2.7	5.0	7.0	8.9	15.5
E-8	0.3	0.7	0.9	1.1	1.7
E-9	0.6	1.2	1.6	2.0	3.5
E-10	1.5	4.2	5.7	7.0	11.5
E-11	3.6	6.6	9.2	11.5	20.3
E-12	5.3	10.6	14.7	18.2	31.8
E-13	1.1	1.6	2.2	2.8	5.2
E-14	1.3	2.7	3.8	4.8	8.2
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E-16	8.9	7.5	11.0	14.9	29.1

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CONCENTRATION POINT	CONTRIBUTING SUB-BASINS	CUMULATIVE PEAK DISCHARGE* [cfs]			
		2-YEAR	5-YEAR	10-YEAR	100-YEAR
CP-1	E-1	7.9	12.2	16.6	32.2
CP-2	E-2	9.9	15.3	21.4	44.0
CP-3	E-3	19.2	29.5	39.5	79.8
CP-4	E-4 + CP-15	87.9	132.3	174.7	335.3
CP-5	E-5	8.3	12.7	16.7	31.4
CP-6	E-6 + CP-7	21.4	31.4	41.9	80.3
CP-7	E-7 + CP-2 + CP-8	16.8	24.8	33.4	64.7
CP-8	E-8,9	1.9	2.5	3.1	5.2
CP-9	E-9	1.2	1.6	2.0	3.5
CP-10	E-10	4.2	5.7	7.0	11.5
CP-11	E-11	6.6	9.2	11.5	20.3
CP-12	E-10 + E-12 + CP-6	36.2	51.8	67.1	123.6
CP-13	E-3,11,13	27.4	40.9	53.8	105.3
CP-14	E-14	2.7	3.8	4.8	8.2
CP-15	E-15 + CP-12 + CP-13 + CP-14	72.1	105.2	137.1	258.9
CP-16	E-5,16	15.8	23.7	31.6	60.5

* Arithmetic Sum

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PROJECT NO. 191645002

N

1 inch = 100 feet

100 50 0 100 Feet

Contour Interval = 1'

Legend

- Concentration Points
- Sub Basin Boundaries
- Airport Boundary
- Culvert
- Flow Arrows

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: BY
DRAWN BY: BY
CHECKED BY: KWP

DATE: DECEMBER 2013

FIGURE 6
ON-SITE SUB-BASIN MAP
ELOY AIRPORT
DRAINAGE MASTER PLAN

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\Eloy_On Site Hydrology Exhibit.mxd

ONSITE SUB-BASIN SUMMARY TABLE

SUB-BASIN	AREA [ac]	PEAK DISCHARGE [cfs]			
		2 YEAR	5 YEAR	10 YEAR	100 YEAR
E-1	11.4	7.9	12.2	16.6	32.2
E-2	17.4	9.9	15.3	21.4	44.0
E-3	34.6	19.2	29.5	39.5	79.8
E-4	39.7	15.8	27.1	37.6	76.4
E-5	8.9	8.3	12.7	16.7	31.4
E-6	4.0	4.6	6.6	8.5	15.6
E-7	2.7	5.0	7.0	8.9	15.5
E-8	0.3	0.7	0.9	1.1	1.7
E-9	0.6	1.2	1.6	2.0	3.5
E-10	1.5	4.2	5.7	7.0	11.5
E-11	3.6	6.6	9.2	11.5	20.3
E-12	5.3	10.6	14.7	18.2	31.8
E-13	1.1	1.6	2.2	2.8	5.2
E-14	1.3	2.7	3.8	4.8	8.2
E-15	8.4	5.8	8.7	11.4	21.8
E-16	8.9	7.5	11.0	14.9	29.1

ONSITE CONCENTRATION POINT SUMMARY TABLE

CONCENTRATION POINT	CONTRIBUTING SUB-BASINS	CUMULATIVE PEAK DISCHARGE* [cfs]			
		2-YEAR	5-YEAR	10-YEAR	100-YEAR
CP-1	E-1	7.9	12.2	16.6	32.2
CP-2	E-2	9.9	15.3	21.4	44.0
CP-3	E-3	19.2	29.5	39.5	79.8
CP-4	E-4 + CP-15	87.9	132.3	174.7	335.3
CP-5	E-5	8.3	12.7	16.7	31.4
CP-6	E-6 + CP-7	21.4	31.4	41.9	80.3
CP-7	E-7 + CP-2 + CP-8	16.8	24.8	33.4	64.7
CP-8	E-8,9	1.9	2.5	3.1	5.2
CP-9	E-9	1.2	1.6	2.0	3.5
CP-10	E-10	4.2	5.7	7.0	11.5
CP-11	E-11	6.6	9.2	11.5	20.3
CP-12	E-10 + E-12 + CP-6	36.2	51.8	67.1	123.6
CP-13	E-3,11,13	27.4	40.9	53.8	105.3
CP-14	E-14	2.7	3.8	4.8	8.2
CP-15	E-15 + CP-12 + CP-13 + CP-14	72.1	105.2	137.1	258.9
CP-16	E-5,16	15.8	23.7	31.6	60.5

* Arithmetic Sum

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N

1 inch = 100 feet

100 50 0 100 Feet

Contour Interval = 1'

Legend

- Concentration Points
- Sub Basin Boundaries
- Airport Boundary
- Culvert
- Flow Arrows

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: BY
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CHECKED BY: KWP

DATE: DECEMBER 2013

FIGURE 6
ON-SITE SUB-BASIN MAP
ELOY AIRPORT
DRAINAGE MASTER PLAN

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OFFSITE WATERSHED SUMMARY

WATERSHED / CONCENTRATION POINT	AREA [ac]	100-YEAR PEAK DISCHARGE [cfs]	CONTRIBUTING WATERSHEDS	TOTAL 100-YEAR PEAK DISCHARGE [cfs]*
1A	47.6	12.0	--	12.0
1B	18.7	21.8	1B + 1C	21.8
1C	38.2	10.9	--	10.9
2	--	--	CP 2A + CP 2C	532.0
2A	41.3	44.2	2A + 2B	46.2
2B	79.6	29.6	--	29.6
2C	332.3	188	2C + CP 2D	494
2D	568.6	265	2D + CP 2E	356
2E	80.7	74.7	2E + 2F	95.6
2F	101.0	60.2	--	60.2
2+3	--	--	CP 2 + CP 3A	917
3A	437.9	260	3A + CP CB	501
3B	663.6	127	3B + CP 3C	493
3C	662.1	145	3C + CP 3D	376
3D	35.2	17.6	3D + CP 3E - Diversion	288
3E	438.0	91.9	3E + 3F + 3H + CP 3G	1212
3F	149.4	152	--	152
3G	74.7	241	3G + CP 3I	1095
3H	93.3	120	--	120
3I	397.9	814	3I + CP 3J	1015
3J	15.6	33.7	3J + CP 3K	264
3K	79.5	238	3K + 3L	241
3L	168.5	64.8	--	64.8

* Per HEC-HMS Model

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PROJECT NO. 191645002

N

1 inch = 500 feet

500 250 0 500 Feet

Contour Interval = 2'

Legend

- Watersheds
- Airport Boundary

SCALE(H):	SHOWN
SCALE(V):	NONE
DESIGNED BY:	KWP
DRAWN BY:	KWP
CHECKED BY:	SJA
DATE:	NOVEMBER 2013

FIGURE 7
OFF-SITE WATERSHED MAP
ELOY AIRPORT
DRAINAGE MASTER PLAN

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\Eloy_WatershedMaps.mxd

OFFSITE WATERSHED SUMMARY

WATERSHED / CONCENTRATION POINT	AREA [ac]	100-YEAR PEAK DISCHARGE [cfs]	CONTRIBUTING WATERSHEDS	TOTAL 100-YEAR PEAK DISCHARGE [cfs]*
1A	47.6	12.0	--	12.0
1B	18.7	21.8	1B + 1C	21.8
1C	38.2	10.9	--	10.9
2	--	--	CP 2A + CP 2C	532.0
2A	41.3	44.2	2A + 2B	46.2
2B	79.6	29.6	--	29.6
2C	332.3	188	2C + CP 2D	494
2D	568.6	265	2D + CP 2E	356
2E	80.7	74.7	2E + 2F	95.6
2F	101.0	60.2	--	60.2
2+3	--	--	CP 2 + CP 3A	917
3A	437.9	260	3A + CP CB	501
3B	663.6	127	3B + CP 3C	493
3C	662.1	145	3C + CP 3D	376
3D	35.2	17.6	3D + CP 3E - Diversion	288
3E	438.0	91.9	3E + 3F + 3H + CP 3G	1212
3F	149.4	152	--	152
3G	74.7	241	3G + CP 3I	1095
3H	93.3	120	--	120
3I	397.9	814	3I + CP 3J	1015
3J	15.6	33.7	3J + CP 3K	264
3K	79.5	238	3K + 3L	241
3L	168.5	64.8	--	64.8

* Per HEC-HMS Model

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N

1 inch = 500 feet

500 250 0 500 Feet

Contour Interval = 2'

Legend

- Watersheds
- Airport Boundary

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: KWP
DRAWN BY: KWP
CHECKED BY: SJA

DATE: NOVEMBER 2013

FIGURE 7
OFF-SITE WATERSHED MAP
ELOY AIRPORT
DRAINAGE MASTER PLAN

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OFFSITE WATERSHED SUMMARY

WATERSHED / CONCENTRATION POINT	AREA [ac]	100-YEAR PEAK DISCHARGE [cfs]	CONTRIBUTING WATERSHEDS	TOTAL 100-YEAR PEAK DISCHARGE [cfs]*
1A	47.6	12.0	--	12.0
1B	18.7	21.8	1B + 1C	21.8
1C	38.2	10.9	--	10.9
2	--	--	CP 2A + CP 2C	532.0
2A	41.3	44.2	2A + 2B	46.2
2B	79.6	29.6	--	29.6
2C	332.3	188	2C + CP 2D	494
2D	568.6	265	2D + CP 2E	356
2E	80.7	74.7	2E + 2F	95.6
2F	101.0	60.2	--	60.2
2+3	--	--	CP 2 + CP 3A	917
3A	437.9	260	3A + CP CB	501
3B	663.6	127	3B + CP 3C	493
3C	662.1	145	3C + CP 3D	376
3D	35.2	17.6	3D + CP 3E - Diversion	288
3E	438.0	91.9	3E + 3F + 3H + CP 3G	1212
3F	149.4	152	--	152
3G	74.7	241	3G + CP 3I	1095
3H	93.3	120	--	120
3I	397.9	814	3I + CP 3J	1015
3J	15.6	33.7	3J + CP 3K	264
3K	79.5	238	3K + 3L	241
3L	168.5	64.8	--	64.8

* Per HEC-HMS Model

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191645002

N

1 inch = 500 feet
500 250 0 500 Feet
Contour Interval = 2'

Legend
Watersheds
Airport Boundary

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: KWP
DRAWN BY: KWP
CHECKED BY: SJA

DATE: NOVEMBER 2013

FIGURE 7
OFF-SITE WATERSHED MAP
ELOY AIRPORT
DRAINAGE MASTER PLAN

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\Eloy_WatershedMaps.mxd

OFFSITE WATERSHED SUMMARY

WATERSHED / CONCENTRATION POINT	AREA [ac]	100-YEAR PEAK DISCHARGE [cfs]	CONTRIBUTING WATERSHEDS	TOTAL 100-YEAR PEAK DISCHARGE [cfs]*
1A	47.6	12.0	--	12.0
1B	18.7	21.8	1B + 1C	21.8
1C	38.2	10.9	--	10.9
2	--	--	CP 2A + CP 2C	532.0
2A	41.3	44.2	2A + 2B	46.2
2B	79.6	29.6	--	29.6
2C	332.3	188	2C + CP 2D	494
2D	568.6	265	2D + CP 2E	356
2E	80.7	74.7	2E + 2F	95.6
2F	101.0	60.2	--	60.2
2+3	--	--	CP 2 + CP 3A	917
3A	437.9	260	3A + CP CB	501
3B	663.6	127	3B + CP 3C	493
3C	662.1	145	3C + CP 3D	376
3D	35.2	17.6	3D + CP 3E - Diversion	288
3E	438.0	91.9	3E + 3F + 3H + CP 3G	1212
3F	149.4	152	--	152
3G	74.7	241	3G + CP 3I	1095
3H	93.3	120	--	120
3I	397.9	814	3I + CP 3J	1015
3J	15.6	33.7	3J + CP 3K	264
3K	79.5	238	3K + 3L	241
3L	168.5	64.8	--	64.8

* Per HEC-HMS Model

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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PROJECT NO. 191645002

N

1 inch = 500 feet

500 250 0 500 Feet

Contour Interval = 2'

Legend

Watersheds

Airport Boundary

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: KWP
DRAWN BY: KWP
CHECKED BY: SJA

DATE: NOVEMBER 2013

FIGURE 7
OFF-SITE WATERSHED MAP
ELOY AIRPORT
DRAINAGE MASTER PLAN

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\Eloy_WatershedMaps.mxd

Existing Culvert Summary - 5-YEAR STORM								
CULVERT	SIZE & TYPE	INLET ELEVATION	OUTLET ELEVATION	LENGTH [ft]	5 -YEAR DESIGN DISCHARGE [cfs]	HEADWATER ELEVATION	CULVERT DISCHARGE [cfs]	OVERTOPPING DISCHARGE [cfs]
C-3	1-30" CMP	1506.23	1506.00	40.4	29.5	1508.71	15.7	13.9
C-5	3-19" Concrete	1504.38	1504.29	90.8	12.7	1505.67	12.7	0.0
C-6	1-24" Concrete	1505.58	1505.14	93.9	31.4	1508.49	20.5	11.0
C-7	2-15" Steel	1506.60	1506.39	61.1	24.8	1508.06	8.1	16.8
C-10	1-18" Concrete	1505.63	1505.00	125.0	5.7	1507.02	5.7	0.0
C-11	2-8" PVC	1506.33	1506.07	50.1	9.2	1507.73	3.4	5.8
C-12	1-20" Concrete	1503.50	1503.39	106.4	51.8	1506.41	10.5	41.4
C-13	1-14" CMP	1504.53	1504.07	75.6	40.9	1507.80	0.1	33.2
C-14	1-8" CMP	1505.19	1504.61	18.6	3.8	1506.99	0.0	0.0
C-15	3-36" CMP	1501.19	1501.17	176.1	105.2	1504.39	70.5	34.7
C-16	3-20" Concrete	1501.44	1501.08	106.8	23.7	1503.42	23.7	0.0
C-17	2-12" CMP	1503.82	1503.69	98.7	44.7	1506.92	4.9	39.9

Existing Culvert Summary - 10-YEAR STORM								
CULVERT	SIZE & TYPE	INLET ELEVATION	OUTLET ELEVATION	LENGTH [ft]	10 YEAR DESIGN DISCHARGE [cfs]	HEADWATER ELEVATION	CULVERT DISCHARGE [cfs]	OVERTOPPING DISCHARGE [cfs]
C-3	1-30" CMP	1506.23	1506.00	40.4	39.5	1508.81	14.7	24.9
C-5	3-19" Concrete	1504.38	1504.29	90.8	16.7	1505.90	16.7	0.0
C-6	1-24" Concrete	1505.58	1505.14	93.9	41.9	1508.56	20.8	21.1
C-7	2-15" Steel	1506.60	1506.39	61.1	33.4	1508.14	8.5	24.9
C-10	1-18" Concrete	1505.63	1505.00	125.0	7.0	1507.21	7.0	0.0
C-11	2-8" PVC	1506.33	1506.07	50.1	11.5	1507.78	3.5	8.0
C-12	1-20" Concrete	1503.50	1503.39	106.4	67.1	1506.49	9.9	57.4
C-13	1-14" CMP	1504.53	1504.07	75.6	53.8	1507.23	0.1	50.8
C-14	1-8" CMP	1505.19	1504.61	18.6	4.8	1506.99	0.0	10.4
C-15	3-36" CMP	1501.19	1501.17	176.1	137.1	1504.49	73.6	63.7
C-16	3-20" Concrete	1501.44	1501.08	106.8	31.6	1504.11	31.6	0.0
C-17	2-12" CMP	1503.82	1503.69	98.7	58.6	1506.99	4.7	54.0

EXISTING CHANNEL SUMMARY						
CROSS-SECTION	5-YEAR DISCHARGE [cfs]	NORMAL DEPTH [ft]	MEETS FAA STANDARD?	10-YEAR DISCHARGE [cfs]	NORMAL DEPTH [ft]	MEETS FAA STANDARD?
1	132.3	0.72	YES	174.7	0.82	YES
2	105.2	1.55	NO	137.1	1.71	NO
3	23.7	0.68	YES	31.6	0.76	YES
4	81.5	1.65	NO	105.5	1.80	YES
5	12.7	0.26	YES	16.7	0.29	YES
6	51.8	1.02	YES	67.1	1.15	YES
7	6.6	0.27	NO	8.5	0.28	YES

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PROJECT NO.
191645002

N

1 inch = 100 feet

100 50 0 100 Feet

Contour Interval = 1'

Legend

- Concentration Points
- Sub Basin Boundaries
- Airport Boundary
- Culverts
- Cross Sections
- Flow Arrows

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: BY
DRAWN BY: BY
CHECKED BY: KWP

DATE: DECEMBER 2013

FIGURE 8
ON-SITE HYDRAULICS MAP
ELOY AIRPORT
DRAINAGE MASTER PLAN

Existing Culvert Summary - 5-YEAR STORM

CULVERT	SIZE & TYPE	INLET ELEVATION	OUTLET ELEVATION	LENGTH [ft]	5 -YEAR DESIGN DISCHARGE [cfs]	HEADWATER ELEVATION	CULVERT DISCHARGE [cfs]	OVERTOPPING DISCHARGE [cfs]
C-3	1-30" CMP	1506.23	1506.00	40.4	29.5	1508.71	15.7	13.9
C-5	3-19" Concrete	1504.38	1504.29	90.8	12.7	1505.67	12.7	0.0
C-6	1-24" Concrete	1505.58	1505.14	93.9	31.4	1508.49	20.5	11.0
C-7	2-15" Steel	1506.60	1506.39	61.1	24.8	1508.06	8.1	16.8
C-10	1-18" Concrete	1505.63	1505.00	125.0	5.7	1507.02	5.7	0.0
C-11	2-8" PVC	1506.33	1506.07	50.1	9.2	1507.73	3.4	5.8
C-12	1-20" Concrete	1503.50	1503.39	106.4	51.8	1506.41	10.5	41.4
C-13	1-14" CMP	1504.53	1504.07	75.6	40.9	1507.80	0.1	33.2
C-14	1-8" CMP	1505.19	1504.61	18.6	3.8	1506.99	0.0	0.0
C-15	3-36" CMP	1501.19	1501.17	176.1	105.2	1504.39	70.5	34.7
C-16	3-20" Concrete	1501.44	1501.08	106.8	23.7	1503.42	23.7	0.0
C-17	2-12" CMP	1503.82	1503.69	98.7	44.7	1506.92	4.9	39.9

Existing Culvert Summary - 10-YEAR STORM

CULVERT	SIZE & TYPE	INLET ELEVATION	OUTLET ELEVATION	LENGTH [ft]	10 YEAR DESIGN DISCHARGE [cfs]	HEADWATER ELEVATION	CULVERT DISCHARGE [cfs]	OVERTOPPING DISCHARGE [cfs]
C-3	1-30" CMP	1506.23	1506.00	40.4	39.5	1508.81	14.7	24.9
C-5	3-19" Concrete	1504.38	1504.29	90.8	16.7	1505.90	16.7	0.0
C-6	1-24" Concrete	1505.58	1505.14	93.9	41.9	1508.56	20.8	21.1
C-7	2-15" Steel	1506.60	1506.39	61.1	33.4	1508.14	8.5	24.9
C-10	1-18" Concrete	1505.63	1505.00	125.0	7.0	1507.21	7.0	0.0
C-11	2-8" PVC	1506.33	1506.07	50.1	11.5	1507.78	3.5	8.0
C-12	1-20" Concrete	1503.50	1503.39	106.4	67.1	1506.49	9.9	57.4
C-13	1-14" CMP	1504.53	1504.07	75.6	53.8	1507.23	0.1	50.8
C-14	1-8" CMP	1505.19	1504.61	18.6	4.8	1506.99	0.0	10.4
C-15	3-36" CMP	1501.19	1501.17	176.1	137.1	1504.49	73.6	63.7
C-16	3-20" Concrete	1501.44	1501.08	106.8	31.6	1504.11	31.6	0.0
C-17	2-12" CMP	1503.82	1503.69	98.7	58.6	1506.99	4.7	54.0

EXISTING CHANNEL SUMMARY

CROSS-SECTION	5-YEAR DISCHARGE [cfs]	NORMAL DEPTH [ft]	MEETS FAA STANDARD?	10-YEAR DISCHARGE [cfs]	NORMAL DEPTH [ft]	MEETS FAA STANDARD?
1	132.3	0.72	YES	174.7	0.82	YES
2	105.2	1.55	NO	137.1	1.71	NO
3	23.7	0.68	YES	31.6	0.76	YES
4	81.5	1.65	NO	105.5	1.80	YES
5	12.7	0.26	YES	16.7	0.29	YES
6	51.8	1.02	YES	67.1	1.15	YES
7	6.6	0.27	NO	8.5	0.28	YES

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PROJECT NO. 191645002

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1 inch = 100 feet

100 50 0 100 Feet

Contour Interval = 1'

Legend

- Concentration Points
- Sub Basin Boundaries
- Airport Boundary
- Culverts
- Cross Sections
- Flow Arrows

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: BY
DRAWN BY: BY
CHECKED BY: KWP

DATE: DECEMBER 2013

FIGURE 8
ON-SITE HYDRAULICS MAP
ELOY AIRPORT
DRAINAGE MASTER PLAN

Existing Culvert Summary - 5-YEAR STORM

CULVERT	SIZE & TYPE	INLET ELEVATION	OUTLET ELEVATION	LENGTH [ft]	5 -YEAR DESIGN DISCHARGE [cfs]	HEADWATER ELEVATION	CULVERT DISCHARGE [cfs]	OVERTOPPING DISCHARGE [cfs]
C-3	1-30" CMP	1506.23	1506.00	40.4	29.5	1508.71	15.7	13.9
C-5	3-19" Concrete	1504.38	1504.29	90.8	12.7	1505.67	12.7	0.0
C-6	1-24" Concrete	1505.58	1505.14	93.9	31.4	1508.49	20.5	11.0
C-7	2-15" Steel	1506.60	1506.39	61.1	24.8	1508.06	8.1	16.8
C-10	1-18" Concrete	1505.63	1505.00	125.0	5.7	1507.02	5.7	0.0
C-11	2-8" PVC	1506.33	1506.07	50.1	9.2	1507.73	3.4	5.8
C-12	1-20" Concrete	1503.50	1503.39	106.4	51.8	1506.41	10.5	41.4
C-13	1-14" CMP	1504.53	1504.07	75.6	40.9	1507.80	0.1	33.2
C-14	1-8" CMP	1505.19	1504.61	18.6	3.8	1506.99	0.0	0.0
C-15	3-36" CMP	1501.19	1501.17	176.1	105.2	1504.39	70.5	34.7
C-16	3-20" Concrete	1501.44	1501.08	106.8	23.7	1503.42	23.7	0.0
C-17	2-12" CMP	1503.82	1503.69	98.7	44.7	1506.92	4.9	39.9

Existing Culvert Summary - 10-YEAR STORM

CULVERT	SIZE & TYPE	INLET ELEVATION	OUTLET ELEVATION	LENGTH [ft]	10 YEAR DESIGN DISCHARGE [cfs]	HEADWATER ELEVATION	CULVERT DISCHARGE [cfs]	OVERTOPPING DISCHARGE [cfs]
C-3	1-30" CMP	1506.23	1506.00	40.4	39.5	1508.81	14.7	24.9
C-5	3-19" Concrete	1504.38	1504.29	90.8	16.7	1505.90	16.7	0.0
C-6	1-24" Concrete	1505.58	1505.14	93.9	41.9	1508.56	20.8	21.1
C-7	2-15" Steel	1506.60	1506.39	61.1	33.4	1508.14	8.5	24.9
C-10	1-18" Concrete	1505.63	1505.00	125.0	7.0	1507.21	7.0	0.0
C-11	2-8" PVC	1506.33	1506.07	50.1	11.5	1507.78	3.5	8.0
C-12	1-20" Concrete	1503.50	1503.39	106.4	67.1	1506.49	9.9	57.4
C-13	1-14" CMP	1504.53	1504.07	75.6	53.8	1507.23	0.1	50.8
C-14	1-8" CMP	1505.19	1504.61	18.6	4.8	1506.99	0.0	10.4
C-15	3-36" CMP	1501.19	1501.17	176.1	137.1	1504.49	73.6	63.7
C-16	3-20" Concrete	1501.44	1501.08	106.8	31.6	1504.11	31.6	0.0
C-17	2-12" CMP	1503.82	1503.69	98.7	58.6	1506.99	4.7	54.0

EXISTING CHANNEL SUMMARY

CROSS-SECTION	5-YEAR DISCHARGE [cfs]	NORMAL DEPTH [ft]	MEETS FAA STANDARD?	10-YEAR DISCHARGE [cfs]	NORMAL DEPTH [ft]	MEETS FAA STANDARD?
1	132.3	0.72	YES	174.7	0.82	YES
2	105.2	1.55	NO	137.1	1.71	NO
3	23.7	0.68	YES	31.6	0.76	YES
4	81.5	1.65	NO	105.5	1.80	YES
5	12.7	0.26	YES	16.7	0.29	YES
6	51.8	1.02	YES	67.1	1.15	YES
7	6.6	0.27	NO	8.5	0.28	YES

Kimley»Horn

333 East Wetmore Road, Suite 280
Tucson, Arizona 85705 (520) 615-9191

PROJECT NO. 191645002

N

1 inch = 100 feet

100 50 0 100 Feet

Contour Interval = 1'

Legend

- Concentration Points
- Sub Basin Boundaries
- Airport Boundary
- Culverts
- Cross Sections
- Flow Arrows

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: BY
DRAWN BY: BY
CHECKED BY: KWP

DATE: DECEMBER 2013

FIGURE 8
ON-SITE HYDRAULICS MAP
ELOY AIRPORT
DRAINAGE MASTER PLAN

Kimley»Horn

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333 East Wetmore Road, Suite 280
Tucson, Arizona 85705 (520) 615-9191

PROJECT NO.
191645002

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: KWP
DRAWN BY: BY
CHECKED BY: SJA

DATE: DECEMBER 2013

FIGURE 9
FLOODPLAIN MAP
ELOY AIRPORT
DRAINAGE MASTER PLAN

Sheet 1 of 1

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\Eloy_Offsite Floodplain Exhibit.mxd

Appendix A - Existing Drainage Analysis Supporting Documentation

Hydrologic Analysis Supporting Documentation

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD
REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project: Eloy On-Site Drainage
Proj.# KHA Proj. #191645002
Date: December, 2013
Prep By: BY
Rev By: SJA
Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtributing Subbasins: E-1

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
11.37	1098	1513.6	1510.2	0.0031

Source of Rainfall data:
Pinal County Hydrology Manual

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	100.00	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	0.00	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.30	0.35	0.40	0.44	0.48	0.50

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern Code	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	100.00	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.065
A	0.00	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.033
	100.0 %	Kb,weighted =	0.065

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	23.1	20.7	19.4	18.0	17.2	16.5
i	(in/hr)	2.32	3.08	3.65	4.44	5.03	5.66
C	weighted	0.30	0.35	0.40	0.44	0.48	0.50
Q	**(cfs)**	**7.9**	**12.2**	**16.6**	**22.2**	**27.4**	**32.2**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project:	Eloy On-Site Drainage
Proj.#	KHA Proj. #191645002
Date:	December, 2013
Prep By:	BY
Rev By:	SJA

Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtibuting Subbasins: E-2

Source of Rainfall data: Pinal County Hydrology Manual

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
17.37	1601	1512.2	1508.6	0.0022

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	96.35	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	3.65	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.32	0.37	0.42	0.46	0.50	0.52

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern Code	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	96.35	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.063
A	3.65	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.032
	100.0 %	Kb,weighted =	0.062

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	32.8	29.5	27.2	25.0	23.6	22.5
i	(in/hr)	1.81	2.40	2.96	3.72	4.30	4.90
C	weighted	0.32	0.37	0.42	0.46	0.50	0.52
Q	**(cfs)**	**9.9**	**15.3**	**21.4**	**29.6**	**37.1**	**44.0**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET

RATIONAL METHOD

REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project: Eloy On-Site Drainage
Proj.# KHA Proj. #191645002
Date: December, 2013
Prep By: BY
Rev By: SJA

Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtibuting Subbasins: E-3

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
34.63	2263	1512.0	1507.2	0.0021

Source of Rainfall data: Pinal County Hydrology Manual

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	91.92	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	8.08	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.34	0.39	0.44	0.48	0.52	0.54

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern Code	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	91.92	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.059
A	8.08	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.030
	100.0 %	Kb,weighted =	0.057

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	39.3	35.2	33.0	30.7	28.9	27.3
i	(in/hr)	1.65	2.20	2.62	3.17	3.70	4.30
C	weighted	0.34	0.39	0.44	0.48	0.52	0.54
Q	**(cfs)**	**19.2**	**29.5**	**39.5**	**52.8**	**66.5**	**79.8**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD
REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project:	Eloy On-Site Drainage
Proj.#	KHA Proj. #191645002
Date:	December, 2013
Prep By:	BY
Rev By:	SJA

Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtibuting Subbasins: E-4

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
39.72	4605	1512.6	1501.2	0.0025

Source of Rainfall data:
Pinal County Hydrology Manual

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	88.57	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	11.43	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.35	0.40	0.45	0.50	0.53	0.55

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern Code	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	88.57	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.058
A	11.43	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.030
	100.0 %	Kb,weighted =	0.055

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	60.6	52.0	48.0	44.0	41.6	39.6
i	(in/hr)	1.13	1.70	2.10	2.63	3.06	3.49
C	weighted	0.35	0.40	0.45	0.50	0.53	0.55
Q	**(cfs)**	**15.8**	**27.1**	**37.6**	**52.0**	**64.9**	**76.4**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET

RATIONAL METHOD

REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project: Eloy On-Site Drainage
Proj.# KHA Proj. #191645002
Date: December, 2013
Prep By: BY
Rev By: SJA

Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtibuting Subbasins: E-5

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
8.86	1947	1511.4	1504.8	0.0034

Source of Rainfall data:
Pinal County Hydrology Manual

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	60.54	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	39.46	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.48	0.53	0.58	0.64	0.67	0.68

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern

Code	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	60.54	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.067
A	39.46	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.034
	100.0 %	Kb,weighted =	0.054

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	28.9	25.5	23.7	21.9	20.8	19.9
i	(in/hr)	1.95	2.71	3.27	4.04	4.62	5.23
C	weighted	0.48	0.53	0.58	0.64	0.67	0.68
Q	**(cfs)**	**8.3**	**12.7**	**16.7**	**22.8**	**27.2**	**31.4**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project: Eloy On-Site Drainage
Proj.# KHA Proj. #191645002
Date: December, 2013
Prep By: BY
Rev By: SJA
Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtibuting Subbasins: E-6

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
3.96	1068	1510.8	1506.4	0.0041

Source of Rainfall data:
Pinal County Hydrology Manual

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	66.70	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	33.30	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.45	0.50	0.55	0.61	0.64	0.65

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern

Code	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	66.70	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.072
A	33.30	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.036
	100.0 %	Kb,weighted =	0.060

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	19.1	17.3	16.3	15.2	14.5	13.8
i	(in/hr)	2.58	3.34	3.93	4.74	5.38	6.08
C	weighted	0.45	0.50	0.55	0.61	0.64	0.65
Q	**(cfs)**	**4.6**	**6.6**	**8.5**	**11.4**	**13.6**	**15.6**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD
REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project: Eloy On-Site Drainage
Proj.# KHA Proj. #191645002
Date: December, 2013
Prep By: BY
Rev By: SJA
Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtibuting Subbasins: E-7

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
2.65	484	1509.4	1507.0	0.0050

Source of Rainfall data:
Pinal County Hydrology Manual

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	45.12	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	54.88	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.55	0.60	0.65	0.71	0.74	0.75

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern Code	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	45.12	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.074
A	54.88	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.037
	100.0 %	Kb,weighted =	0.054

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	10.3	9.4	8.8	8.3	7.8	7.5
i	(in/hr)	3.44	4.44	5.16	6.19	7.07	7.84
C	weighted	0.55	0.60	0.65	0.71	0.74	0.75
Q	**(cfs)**	**5.0**	**7.0**	**8.9**	**11.7**	**13.8**	**15.5**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD
REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project:	Eloy On-Site Drainage
Proj.#	KHA Proj. #191645002
Date:	December, 2013
Prep By:	BY
Rev By:	SJA

Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtibuting Subbasins: E-8

Source of Rainfall data:
Pinal County Hydrology Manual

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
0.25	92	1509.4	1508.0	0.0152

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	43.08	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	56.92	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.56	0.61	0.66	0.72	0.75	0.76

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern Code	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	43.08	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.088
A	56.92	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.044
	100.0 %	Kb,weighted =	0.063

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	5.0	5.0	5.0	5.0	5.0	5.0
i	(in/hr)	4.68	5.64	6.36	7.32	8.16	8.88
C	weighted	0.56	0.61	0.66	0.72	0.75	0.76
Q	**(cfs)**	**0.7**	**0.9**	**1.1**	**1.3**	**1.5**	**1.7**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET	Project:	Eloy On-Site Drainage
RATIONAL METHOD	Proj.#	KHA Proj. #191645002
REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2	Date:	December, 2013
	Prep By:	BY
	Rev By:	SJA
		Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtibuting Subbasins: E-9

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
0.58	410	1510.8	1507.8	0.0073

Source of Rainfall data:
Pinal County Hydrology Manual

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	48.91	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	51.09	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.53	0.58	0.63	0.70	0.72	0.73

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	48.91	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.083
A	51.09	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.041
	100.0 %	Kb,weighted =	0.062

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	8.7	7.9	7.5	7.1	6.7	6.5
i	(in/hr)	3.79	4.83	5.57	6.61	7.50	8.28
C	weighted	0.53	0.58	0.63	0.70	0.72	0.73
Q	**(cfs)**	**1.2**	**1.6**	**2.0**	**2.7**	**3.1**	**3.5**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD
REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project:	Eloy On-Site Drainage
Proj.#	KHA Proj. #191645002
Date:	December, 2013
Prep By:	BY
Rev By:	SJA

Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtributing Subbasins: E-10

Source of Rainfall data: Pinal County Hydrology Manual

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
1.50	366	1508.6	1507.0	0.0044

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	10.40	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	89.60	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.70	0.75	0.80	0.89	0.90	0.90

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	10.40	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.078
A	89.60	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.039
	100.0 %	Kb,weighted =	0.043

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	7.8	7.2	6.8	6.4	6.1	5.9
i	(in/hr)	4.00	5.04	5.80	6.84	7.74	8.53
C	weighted	0.70	0.75	0.80	0.89	0.90	0.90
Q	**(cfs)**	**4.2**	**5.7**	**7.0**	**9.1**	**10.4**	**11.5**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD
REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project: Eloy On-Site Drainage
Proj.# KHA Proj. #191645002
Date: December, 2013
Prep By: BY
Rev By: SJA

Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtibuting Subbasins: E-11

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
3.59	466	1507.8	1506.6	0.0026

Source of Rainfall data:
Pinal County Hydrology Manual

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	38.09	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	61.91	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.58	0.63	0.68	0.75	0.77	0.78

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	38.09	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.072
A	61.91	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.037
	100.0 %	Kb,weighted =	0.050

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	12.3	11.2	10.6	9.9	9.4	9.0
i	(in/hr)	3.19	4.08	4.71	5.61	6.47	7.25
C	weighted	0.58	0.63	0.68	0.75	0.77	0.78
Q	**(cfs)**	**6.6**	**9.2**	**11.5**	**15.1**	**17.9**	**20.3**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD
REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project: Eloy On-Site Drainage
Proj.# KHA Proj. #191645002
Date: December, 2013
Prep By: BY
Rev By: SJA
Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtibuting Subbasins: E-12

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
5.30	842	1508.2	1503.8	0.0052

Source of Rainfall data:
Pinal County Hydrology Manual

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	25.80	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	74.20	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.63	0.68	0.73	0.81	0.83	0.83

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	25.80	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.070
A	74.20	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.035
	100.0 %	Kb,weighted =	0.044

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	12.5	11.4	10.8	10.1	9.5	9.1
i	(in/hr)	3.16	4.06	4.69	5.57	6.42	7.19
C	weighted	0.63	0.68	0.73	0.81	0.83	0.83
Q	**(cfs)**	**10.6**	**14.7**	**18.2**	**23.9**	**28.2**	**31.8**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD
REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project: Eloy On-Site Drainage
Proj.# KHA Proj. #191645002
Date: December, 2013
Prep By: BY
Rev By: SJA
Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtibuting Subbasins: E-13

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
1.08	504	1508.4	1505.8	0.0052

Source of Rainfall data:
Pinal County Hydrology Manual

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	66.36	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	33.64	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.45	0.50	0.55	0.61	0.64	0.65

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	66.36	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.080
A	33.64	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.040
	100.0 %	Kb,weighted =	0.066

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	11.8	10.8	10.2	9.5	9.0	8.6
i	(in/hr)	3.25	4.15	4.77	5.75	6.62	7.39
C	weighted	0.45	0.50	0.55	0.61	0.64	0.65
Q	**(cfs)**	**1.6**	**2.2**	**2.8**	**3.8**	**4.6**	**5.2**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD
REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project:	Eloy On-Site Drainage
Proj.#	KHA Proj. #191645002
Date:	December, 2013
Prep By:	BY
Rev By:	SJA

Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtibuting Subbasins: E-14

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
1.35	261	1507.0	1506.2	0.0031

Source of Rainfall data:
Pinal County Hydrology Manual

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	47.27	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	52.73	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.54	0.59	0.64	0.70	0.73	0.74

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	47.27	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.078
A	52.73	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.039
	100.0 %	Kb,weighted =	0.058

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	8.8	8.0	7.6	7.1	6.8	6.5
i	(in/hr)	3.77	4.81	5.55	6.59	7.48	8.26
C	weighted	0.54	0.59	0.64	0.70	0.73	0.74
Q	**(cfs)**	**2.7**	**3.8**	**4.8**	**6.3**	**7.3**	**8.2**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD
REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project: Eloy On-Site Drainage
Proj.# KHA Proj. #191645002
Date: December, 2013
Prep By: BY
Rev By: SJA
Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage
Conrtributing Subbasins: E-15

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
8.39	2447	1507.0	1501.4	0.0023

Source of Rainfall data:
Pinal County Hydrology Manual

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	71.90	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	28.10	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.43	0.48	0.53	0.58	0.61	0.63

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	71.90	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.067
A	28.10	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.034
	100.0 %	Kb,weighted =	0.058

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	40.8	36.5	34.2	31.7	30.2	28.5
i	(in/hr)	1.61	2.17	2.58	3.13	3.57	4.15
C	weighted	0.43	0.48	0.53	0.58	0.61	0.63
Q	**(cfs)**	**5.8**	**8.7**	**11.4**	**15.2**	**18.3**	**21.8**

*:Minimum Tc,total =10 minutes

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD
REFERENCE: PINAL COUNTY DRAINAGE MANUAL VOLUME 2

Project: Eloy On-Site Drainage
Proj.# KHA Proj. #191645002
Date: December, 2013
Prep By: BY
Rev By: SJA
Base sheet prepared by GA

LOCATION: Eloy On-Site Drainage

Conrtibuting Subbasins: E-16

SUBBASIN PARAMETERS

Area (ac)	Length (ft)	Top Elev. (ft)	Bot. Elev. (ft)	Average Slope (ft/ft)
8.89	1914	1506.8	1502.2	0.0024

Source of Rainfall data:
Pinal County Hydrology Manual

DDF(in)	5-min	10-min	15-min	30-min	60-min
2-yr	0.39	0.58	0.71	0.94	1.14
5-yr	0.47	0.71	0.88	1.18	1.46
10-yr	0.53	0.80	1.01	1.36	1.68
25-yr	0.61	0.93	1.19	1.60	1.99
50-yr	0.68	1.04	1.32	1.79	2.24
100-yr	0.74	1.14	1.46	1.98	2.48

RUNOFF COEFFICIENT "C"

C-Charts Code	% of Subbasin	Land Use/Type Description (Per Table 2.1)	C-2	C-5	C-10	C-25	C-50	C-100
UDR	62.30	Undeveloped Desert Rangeland	0.30	0.35	0.40	0.44	0.48	0.50
PR	37.70	Pavement and Rooftops	0.75	0.80	0.85	0.94	0.95	0.95
	100.0 %	Cweighted=	0.47	0.52	0.57	0.63	0.66	0.67

RESISTANCE COEF. "Kb"

Land Use& Flow Pattern	% of Subbasin	Land Use Description (Per Table 2-1)	Kb
B	62.30	Agricultural Fields, Pastures, Desert Rangelands, Undeveloped Urban Lands	0.067
A	37.70	Commercial/industrial areas, Residential Areas, Parks, Golf Courses	0.034
	100.0 %	Kb,weighted =	0.055

Rainfall Intensity

IDF(in/hr)	5-min	10-min	15-min	30-min	60-min
2-yr	4.68	3.48	2.84	1.88	1.14
5-yr	5.64	4.26	3.52	2.36	1.46
10-yr	6.36	4.80	4.04	2.72	1.68
25-yr	7.32	5.58	4.76	3.20	1.99
50-yr	8.16	6.24	5.28	3.58	2.24
100-yr	8.88	6.84	5.84	3.96	2.48

PEAK FLOW

Initial Tc,lot, when applicable, (minutes)= 0.0

Frequency--->		2-Y	5-Y	10-Y	25-Y	50-Y	100-Y
Tc,tot*	(minutes)	33.0	29.7	27.4	25.1	23.7	22.6
i	(in/hr)	1.81	2.39	2.95	3.71	4.29	4.89
C	weighted	0.47	0.52	0.57	0.63	0.66	0.67
Q	**(cfs)**	**7.5**	**11.0**	**14.9**	**20.7**	**25.1**	**29.1**

*:Minimum Tc,total =10 minutes

Eloy Airport Drainage Master Plan

CALCULATIONS FOR THE GREEN AND AMPT PARAMETER XKSAT-HYDRAULIC CONDUCTIVITY IN INCHES/HOUR

Eloy Airport Drainage Master Plan

CALCULATIONS FOR THE GREEN AND AMPT PARAMETER XKSAT-HYDRAULIC CONDUCTIVITY IN INCHES/HOUR

SUB BASIN AREAS			SOIL TYPES AS A PERCENT OF TOTAL AREA					FROM NRCS SOIL SURVEY AZ703																					
			Sand		Loamy Sand		Sandy Loam		Loam		Silt Loam		Silt		Sandy Clay Loam		Clay Loam		Silty Clay Loam		Sandy Clay		Silty Clay		Clay		Bedrock		COMPOSITE
BASIN	AREA (A_t)	AREA	$XKSAT_i$ = 4.60		$XKSAT_i$ = 1.20		$XKSAT_i$ = 0.40		$XKSAT_i$ = 0.25		$XKSAT_i$ = 0.15		$XKSAT_i$ = 0.10		$XKSAT_i$ = 0.06		$XKSAT_i$ = 0.04		$XKSAT_i$ = 0.04		$XKSAT_i$ = 0.02		$XKSAT_i$ = 0.02		$XKSAT_i$ = 0.01		$XKSAT_i$ = 0.00		XKSAT
ID	(ac)	(sq mi)	AREA (A_i)	% AREA	AREA (A_i)	% AREA	AREA (A_i)	% AREA	AREA (A_i)	% AREA	AREA (A_i)	% AREA	AREA (A_i)	% AREA	AREA (A_i)	% AREA	AREA (A_i)	% AREA	AREA (A_i)	% AREA	AREA (A_i)	% AREA	AREA (A_i)	% AREA	AREA (A_i)	% AREA	AREA (A_i)	% AREA	in/hour
1A	47.56	0.074	0.00	0.0%	0.00	0.0%	47.56	100.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.40
1B	18.73	0.029	0.00	0.0%	0.00	0.0%	18.73	100.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.40
1C	38.17	0.060	0.00	0.0%	0.00	0.0%	38.17	100.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.40
2A	41.25	0.064	0.00	0.0%	0.00	0.0%	41.25	100.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.40
2B	79.58	0.124	0.00	0.0%	0.00	0.0%	79.58	100.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.40
2C	332.32	0.519	0.00	0.0%	0.00	0.0%	332.32	100.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.40
2D	568.62	0.888	0.00	0.0%	0.00	0.0%	568.62	100.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.40
2E	80.73	0.126	0.00	0.0%	0.00	0.0%	80.71	100.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.02	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.40
2F	101.04	0.158	0.00	0.0%	0.00	0.0%	86.91	86.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	14.13	14.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.29
3A	437.86	0.684	0.00	0.0%	0.00	0.0%	404.37	92.4%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	33.49	7.6%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.34
3B	663.62	1.037	0.00	0.0%	0.00	0.0%	524.42	79.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	139.20	21.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.25
3C	662.06	1.034	0.00	0.0%	0.00	0.0%	456.12	68.9%	0.00	0.0%	15.29	2.3%	0.00	0.0%	0.00	0.0%	190.65	28.8%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.20
3D	35.21	0.055	0.00	0.0%	0.00	0.0%	34.97	99.3%	0.00	0.0%	0.24	0.7%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.40
3E	438.01	0.684	0.00	0.0%	0.00	0.0%	411.66	94.0%	5.49	1.3%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	20.86	4.8%	0.00	0.0%	0.33
3F	149.43	0.233	0.00	0.0%	0.00	0.0%	82.36	55.1%	12.38	8.3%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	54.69	36.6%	0.00	0.0%	0.10
3G	74.71	0.117	0.00	0.0%	0.00	0.0%	21.57	28.9%	31.18	41.7%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	21.96	29.4%	0.00	0.0%	0.11
3H	93.34	0.146	0.00	0.0%	0.00	0.0%	93.34	100.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.40
3I	397.86	0.622	0.00	0.0%	0.00	0.0%	229.59	57.7%	84.22	21.2%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	84.05	21.1%	0.00	0.0%	0.17
3J	15.56	0.024	0.00	0.0%	0.00	0.0%	0.00	0.0%	14.61	93.9%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.95	6.1%	0.00	0.0%	0.21
3K	79.53	0.124	0.00	0.0%	0.00	0.0%	5.92	7.4%	8.31	10.4%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	65.30	82.1%	0.00	0.0%	0.02
3L	168.52	0.263	0.00	0.0%	0.00	0.0%	86.32	51.2%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	82.20	48.8%	0.00	0.0%	0.07
TOTAL	4,523.7	7.068	0.0 Acres		0.0 Acres		3,644.5 Acres		156.2 Acres		15.5 Acres		0.0 Acres		0.0 Acres		377.5 Acres		0.0 Acres		0.0 Acres		0.0 Acres		330.0 Acres		0.0 Acres		4,523.7

FORMULA USED TO AREA WEIGHT SOILS

COMPOSITE XKSAT = ANTILOG[Σ(A_i*LOG($XKSAT_i$))]/A_T

Eloy Airport Drainage Master Plan

RAINFALL LOSS CALCULATIONS

PREDEVELOPMENT						LAND USE		DTHETA Fig 3-3		PSIF Fig 3-3	VEGETATION COVER %	CORRECTION FACTOR Ck	ADJUSTED XKSAT	IA Table 3-1	RTIMP
						DEVELOPED									
AREA WEIGHTING FOR LAND USE						UNDEVELOPED			NO CHANGE	NO CHANGE	10%	1.00	NO CHANGE	VARIES	VARIES
BASIN ID	TOTAL AREA [ac]	DEVELOPED AREA	DEVEL. AREA %	UNDEVELOPED AREA	UNDEVEL. AREA %	COMPOSITE XKSAT	DTHETA CONDITION	DRY DTHETA	COMPOSITE DTHETA	COMPOSITE PSIF	COMPOSITE VEG. COVER %	COMPOSITE FACTOR Ck	ADJUSTED XKSAT	COMPOSITE IA	COMPOSITE RTIMP
1A	47.6	0.0	0.0%	47.6	100.0%	0.40	sat	0.35	0.00	4.0	0%	1.00	0.40	0.50	0.0%
1B	18.7	0.0	0.0%	18.7	100.0%	0.40	dry	0.35	0.35	4.0	10%	1.00	0.40	0.35	2.0%
1C	38.2	0.0	0.0%	38.2	100.0%	0.40	sat	0.35	0.00	4.0	0%	1.00	0.40	0.50	0.0%
2A	41.3	13.1	31.8%	28.2	68.2%	0.40	dry	0.35	0.35	4.0	7%	1.00	0.40	0.28	20.0%
2B	79.6	0.0	0.0%	79.6	100.0%	0.40	sat	0.35	0.00	4.0	0%	1.00	0.40	0.50	0.0%
2C	332.3	33.4	10.1%	298.9	89.9%	0.40	dry	0.35	0.35	4.0	9%	1.00	0.40	0.33	5.0%
2D	568.6	0.0	0.0%	568.6	100.0%	0.40	dry	0.35	0.35	4.0	10%	1.00	0.40	0.35	2.0%
2E	80.7	0.0	0.0%	80.7	100.0%	0.40	dry	0.35	0.35	4.0	10%	1.00	0.40	0.35	2.0%
2F	101.0	5.6	5.5%	95.4	94.5%	0.29	dry	0.35	0.35	4.5	9%	1.00	0.29	0.34	5.0%
3A	437.9	28.5	6.5%	409.4	93.5%	0.34	dry	0.35	0.35	4.3	9%	1.00	0.34	0.34	5.0%
3B	663.6	0.0	0.0%	663.6	100.0%	0.25	sat	0.35	0.00	4.8	0%	1.00	0.25	0.50	2.0%
3C	662.1	0.0	0.0%	662.1	100.0%	0.20	sat	0.37	0.00	5.1	0%	1.00	0.20	0.50	2.0%
3D	35.2	0.0	0.0%	35.2	100.0%	0.40	dry	0.35	0.35	4.1	10%	1.00	0.40	0.35	5.0%
3E	438.0	0.0	0.0%	438.0	100.0%	0.33	sat	0.35	0.00	4.3	0%	1.00	0.33	0.50	2.0%
3F	149.4	0.0	0.0%	149.4	100.0%	0.10	dry	0.35	0.35	6.4	10%	1.00	0.10	0.35	2.0%
3G	74.7	20.6	27.6%	54.1	72.4%	0.11	dry	0.36	0.36	6.2	7%	1.00	0.11	0.28	15.0%
3H	93.3	0.0	0.0%	93.3	100.0%	0.40	dry	0.35	0.35	4.0	10%	1.00	0.40	0.35	5.0%
3I	397.9	397.9	100.0%	0.0	0.0%	0.17	normal	0.39	0.25	5.4	0%	1.00	0.17	0.10	60.0%
3J	15.6	12.2	78.4%	3.4	21.6%	0.21	dry	0.37	0.37	5.1	2%	1.00	0.21	0.16	30.0%
3K	79.5	75.6	95.1%	3.9	4.9%	0.02	dry	0.19	0.19	11.4	0%	1.00	0.02	0.11	40.0%
3L	168.5	49.2	29.2%	119.3	70.8%	0.07	sat	0.30	0.00	7.4	7%	1.00	0.07	0.38	20.0%
TOTALS	4,523.7	636.1		3,887.6											

Eloy Airport DMP

CLARK UNIT HYDROGRAPH TIME OF CONCENTRATION CALCULATIONS

BASIN ID	BASIN TYPE	AREA SQ.MI.	RTIMP %	L MILES	L_{ca} MILES	ELEVATION TOP FT	ELEVATION BOTTOM FT	SLOPE FT/MILE	T_c HOURS	STORAGE COEFFICIENT R	FLOWLINE L FT	CENTROID L_{ca} FT	NMIN T_c x 0.25(MIN.)
1A	AG	0.07	0	0.56	0.31	1515	1512	4.8	2.618	2.98	2,961	1,637	39.27
1B	DM	0.03	2	0.31	0.16	1512	1509	7.8	0.522	0.52	1,618	819	7.82
1C	AG	0.06	0	0.50	0.22	1515	1513	4.8	2.291	2.66	2,642	1,171	34.36
2A	DM	0.06	20	0.54	0.34	1512	1504	14.9	0.693	0.72	2,840	1,770	10.39
2B	AG	0.12	0	0.49	0.25	1516	1512	8.1	2.275	1.72	2,610	1,305	34.12
2C	DM	0.52	5	1.45	0.70	1519	1504	10.4	1.409	1.06	7,630	3,670	21.14
2D	DM	0.89	2	1.67	0.98	1530	1517	7.8	1.780	1.13	8,800	5,200	26.70
2E	DM	0.13	2	0.62	0.31	1530	1522	12.9	0.774	0.62	3,270	1,635	11.61
2F	DM	0.16	5	1.09	0.41	1532	1525	6.4	1.123	1.29	5,760	2,150	16.85
3A	DM	0.68	5	1.47	0.79	1519	1504	10.2	1.504	0.98	7,750	4,150	22.57
3B	AG	1.04	2	1.96	0.98	1525	1510	7.7	5.659	4.25	10,340	5,170	84.89
3C	AG	1.03	2	1.91	0.96	1534	1518	8.4	5.494	4.04	10,100	5,050	82.41
3D	DM	0.06	5	1.03	0.22	1536	1528	7.8	0.819	1.58	5,420	1,150	12.28
3E	AG	0.68	2	1.47	0.72	1543	1531	8.2	4.614	3.40	7,740	3,800	69.21
3F	DM	0.23	2	0.79	0.55	1539	1532	8.9	1.086	0.77	4,150	2,900	16.29
3G	DM	0.12	15	0.22	0.11	1544	1539	22.4	0.413	0.14	1,180	590	6.20
3H	DM	0.15	5	0.47	0.24	1547	1540	14.8	0.668	0.39	2,500	1,250	10.03
3I	UR	0.62	60	1.87	1.05	1562	1542	10.7	0.594	0.45	9,890	5,550	8.91
3J	UR	0.02	30	0.48	0.28	1556	1550	12.6	0.275	0.41	2,510	1,490	4.13
3K	UR	0.12	40	0.70	0.35	1560	1552	11.4	0.346	0.28	3,720	1,860	5.19
3L	AG	0.26	20	1.34	0.59	1575	1560	11.2	3.666	4.24	7,100	3,100	54.99

Time of Concentration Equation (Desert/Mountain Watershed)

$T_c = 2.4*A^{0.1}*L^{0.25}*L_{ca}^{0.25}*S^{-0.2}$

Storage Coefficient Equation

$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$

Project: Eloy_DMP Simulation Run: 100yr, 24hr

Start of Run:	01Jan2013, 00:00	Basin Model:	Offsite-100yr
End of Run:	02Jan2013, 12:00	Meteorologic Model:	SCS Type II - 100yr, 24
Compute Time:	27Dec2013, 11:15:59	Control Specifications:	36hr model

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
1A	0.074	12.0	01Jan2013, 14:20	4.4
1B	0.029	21.8	01Jan2013, 12:20	1.6
1C	0.060	10.9	01Jan2013, 14:02	3.5
1C-1B	0.060	10.9	01Jan2013, 14:32	3.5
2A	0.064	44.2	01Jan2013, 12:30	5.8
2B	0.124	29.6	01Jan2013, 13:54	7.3
2B-2	0.124	29.5	01Jan2013, 14:06	7.3
2C	0.519	188.2	01Jan2013, 13:06	31.9
2D	0.888	264.8	01Jan2013, 13:24	48.8
2D-2	1.172	354.4	01Jan2013, 13:40	66.5
2E	0.126	74.7	01Jan2013, 12:34	6.9
2E-2D	0.284	94.8	01Jan2013, 13:10	17.4
2F	0.158	60.2	01Jan2013, 12:54	10.5
2F-2E	0.158	58.4	01Jan2013, 13:12	10.5
3A	0.684	259.5	01Jan2013, 13:10	43.3
3B	1.037	127.3	01Jan2013, 16:52	79.3
3B-3A (1)	4.339	491.6	01Jan2013, 16:48	359.9
3B-3A (2)	4.339	491.5	01Jan2013, 17:02	359.4
3C	1.034	145.2	01Jan2013, 16:44	87.1
3C-3B	3.302	374.8	01Jan2013, 15:08	280.6
3D	0.055	17.6	01Jan2013, 12:40	3.3
3D-3C	2.268	286.9	01Jan2013, 13:04	194.0
3E	0.684	91.9	01Jan2013, 15:56	46.5
3E-3D	2.213	270.0	01Jan2013, 13:04	190.9
3F	0.233	152.0	01Jan2013, 12:50	19.1
3G	0.117	240.8	01Jan2013, 12:10	12.1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
3G-3E	1.150	1069.8	01Jan2013, 12:34	186.3
3H	0.146	119.9	01Jan2013, 12:26	8.8
3H-3E (1)	0.146	106.9	01Jan2013, 13:08	9.1
3H-3E (2)	0.146	46.2	01Jan2013, 14:26	9.1
3I	0.622	813.5	01Jan2013, 12:22	108.7
3I-3G	1.033	1006.3	01Jan2013, 12:28	174.3
3J	0.024	33.7	01Jan2013, 12:08	2.9
3J-3I	0.411	241.2	01Jan2013, 12:30	65.6
3K	0.124	238.1	01Jan2013, 12:10	22.7
3K-3J	0.387	233.4	01Jan2013, 12:16	62.8
3L	0.263	64.8	01Jan2013, 15:20	40.2
3L-3K	0.263	64.6	01Jan2013, 15:42	40.1
CP-1B	0.089	21.8	01Jan2013, 12:20	5.1
CP-2	1.879	532.1	01Jan2013, 13:28	111.6
CP-2+3	6.902	916.6	01Jan2013, 13:52	514.3
CP-2A	0.188	46.2	01Jan2013, 12:34	13.2
CP-2C	1.691	493.5	01Jan2013, 13:28	98.4
CP-2D	1.172	356.4	01Jan2013, 13:20	66.2
CP-2E	0.284	95.6	01Jan2013, 12:56	17.4
CP-3A	5.023	500.6	01Jan2013, 16:50	402.7
CP-3B	4.339	493.4	01Jan2013, 16:30	359.9
CP-3C	3.302	375.9	01Jan2013, 14:48	281.1
CP-3D	2.268	287.6	01Jan2013, 12:40	194.2
CP-3E	2.213	1212.7	01Jan2013, 12:34	261.1
CP-3G	1.150	1095.4	01Jan2013, 12:26	186.4
CP-3I	1.033	1015.4	01Jan2013, 12:26	174.3
CP-3J	0.411	264.2	01Jan2013, 12:14	65.7
CP-3K	0.387	241.0	01Jan2013, 12:10	62.7
Diversion-3E	2.213	270.0	01Jan2013, 12:06	190.9

Appendix A - Existing Drainage Analysis Supporting Documentation

Hydraulic Analysis Supporting Documentation

Culvert Analysis Report
Culvert10_100yr

Comments: Subbasin E-10 to E-12

Analysis Component			
Storm Event	Design	Discharge	11.50 cfs

Peak Discharge Method: User-Specified			
Design Discharge	11.50 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	11.50 cfs	Bottom Elevation	1,505.80 ft
Depth	0.38 ft	Velocity	1.45 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	8.97 cfs	1,507.67 ft	6.01 ft/s
Weir	Roadway	2.54 cfs	1,507.67 ft	N/A
Total	----------------	11.51 cfs	1,507.67 ft	N/A

Culvert Analysis Report
Culvert10_100yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,507.67	ft	Discharge	8.97	cfs
Inlet Control HW Elev.	1,507.48	ft	Tailwater Elevation	1,506.18	ft
Outlet Control HW Elev.	1,507.67	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.36				

Grades					
Upstream Invert	1,505.63	ft	Downstream Invert	1,505.00	ft
Length	125.00	ft	Constructed Slope	0.005040	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.18	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.16	ft
Velocity Downstream	6.01	ft/s	Critical Slope	0.008206	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	1,507.67	ft	Upstream Velocity Head	0.40	ft
Ke	0.20		Entrance Loss	0.08	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,507.48	ft	Flow Control	N/A	
Inlet Type	Groove end projecting		Area Full	1.8	ft²
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Culvert Analysis Report
Culvert10_100yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	2.54	cfs	Allowable HW Elevation	1,507.67	ft
Roadway Width	33.82	ft	Overtopping Coefficient	2.92	US
Low Point	1,507.50	ft	Headwater Elevation	1,507.67	ft
Discharge Coefficient (Cr)	2.92		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,506.18	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.20
22.20	1,508.00
38.80	1,507.80
60.36	1,507.60
80.00	1,507.50

Culvert Analysis Report
Culvert10_10yr

Comments: Subbasin E-10 to E-12

Analysis Component			
Storm Event	Design	Discharge	7.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	7.00 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	7.00 cfs	Bottom Elevation	1,505.80 ft
Depth	0.29 ft	Velocity	1.24 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	7.00 cfs	1,507.21 ft	5.08 ft/s
Weir	Roadway	0.00 cfs	1,507.21 ft	N/A
Total	----------------	7.00 cfs	1,507.21 ft	N/A

Culvert Analysis Report
Culvert10_10yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,507.21 ft	Discharge	7.00 cfs
Inlet Control HW Elev.	1,507.18 ft	Tailwater Elevation	1,506.09 ft
Outlet Control HW Elev.	1,507.21 ft	Control Type	Outlet Control
Headwater Depth/Height	1.06		

Grades			
Upstream Invert	1,505.63 ft	Downstream Invert	1,505.00 ft
Length	125.00 ft	Constructed Slope	0.005040 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	1.09 ft
Slope Type	Mild	Normal Depth	1.15 ft
Flow Regime	Subcritical	Critical Depth	1.02 ft
Velocity Downstream	5.08 ft/s	Critical Slope	0.006766 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,507.21 ft	Upstream Velocity Head	0.36 ft
Ke	0.20	Entrance Loss	0.07 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,507.18 ft	Flow Control	N/A
Inlet Type	Groove end projecting	Area Full	1.8 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert10_10yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	0.00	cfs	Allowable HW Elevation	1,507.21	ft
Roadway Width	33.82	ft	Overtopping Coefficient	2.90	US
Low Point	1,507.50	ft	Headwater Elevation	N/A	ft
Discharge Coefficient (Cr)	2.90		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,506.09	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.20
22.20	1,508.00
38.80	1,507.80
60.36	1,507.60
80.00	1,507.50

Culvert Analysis Report
Culvert10_2yr

Comments: Subbasin E-10 to E-12

Analysis Component			
Storm Event	Design	Discharge	4.20 cfs

Peak Discharge Method: User-Specified			
Design Discharge	4.20 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	4.20 cfs	Bottom Elevation	1,505.80 ft
Depth	0.22 ft	Velocity	1.06 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	4.20 cfs	1,506.79 ft	3.29 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report
Culvert10_2yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,506.79 ft	Discharge	4.20 cfs
Inlet Control HW Elev.	1,506.75 ft	Tailwater Elevation	1,506.02 ft
Outlet Control HW Elev.	1,506.79 ft	Control Type	Outlet Control
Headwater Depth/Height	0.77		

Grades			
Upstream Invert	1,505.63 ft	Downstream Invert	1,505.00 ft
Length	125.00 ft	Constructed Slope	0.005040 ft/ft

Hydraulic Profile			
Profile	M1	Depth, Downstream	1.02 ft
Slope Type	Mild	Normal Depth	0.81 ft
Flow Regime	Subcritical	Critical Depth	0.79 ft
Velocity Downstream	3.29 ft/s	Critical Slope	0.005479 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,506.79 ft	Upstream Velocity Head	0.29 ft
Ke	0.20	Entrance Loss	0.06 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,506.75 ft	Flow Control	N/A
Inlet Type	Groove end projecting	Area Full	1.8 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert10_5yr

Comments: Subbasin E-10 to E-12

Analysis Component			
Storm Event	Design	Discharge	5.70 cfs

Peak Discharge Method: User-Specified			
Design Discharge	5.70 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	5.70 cfs	Bottom Elevation	1,505.80 ft
Depth	0.26 ft	Velocity	1.17 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	5.70 cfs	1,507.02 ft	4.27 ft/s
Weir	Roadway	0.00 cfs	1,507.02 ft	N/A
Total	----------------	5.70 cfs	1,507.02 ft	N/A

Culvert Analysis Report
Culvert10_5yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,507.02	ft	Discharge	5.70	cfs
Inlet Control HW Elev.	1,506.98	ft	Tailwater Elevation	1,506.06	ft
Outlet Control HW Elev.	1,507.02	ft	Control Type	Outlet Control	
Headwater Depth/Height	0.92				

Grades					
Upstream Invert	1,505.63	ft	Downstream Invert	1,505.00	ft
Length	125.00	ft	Constructed Slope	0.005040	ft/ft

Hydraulic Profile					
Profile	M1		Depth, Downstream	1.06	ft
Slope Type	Mild		Normal Depth	0.98	ft
Flow Regime	Subcritical		Critical Depth	0.92	ft
Velocity Downstream	4.27	ft/s	Critical Slope	0.006083	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	1,507.02	ft	Upstream Velocity Head	0.34	ft
Ke	0.20		Entrance Loss	0.07	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,506.98	ft	Flow Control	N/A	
Inlet Type	Groove end projecting		Area Full	1.8	ft²
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Culvert Analysis Report
Culvert10_5yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	0.00	cfs	Allowable HW Elevation	1,507.02	ft
Roadway Width	33.82	ft	Overtopping Coefficient	2.90	US
Low Point	1,507.50	ft	Headwater Elevation	N/A	ft
Discharge Coefficient (Cr)	2.90		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,506.06	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.20
22.20	1,508.00
38.80	1,507.80
60.36	1,507.60
80.00	1,507.50

Culvert Analysis Report
Culvert11_100yr

Comments: Subbasin E-11 to E-13

Analysis Component			
Storm Event	Design	Discharge	20.30 cfs

Peak Discharge Method: User-Specified			
Design Discharge	20.30 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	20.30 cfs	Bottom Elevation	1,506.00 ft
Depth	0.75 ft	Velocity	2.61 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-8 inch Circular	3.58 cfs	1,507.89 ft	5.13 ft/s
Weir	Roadway	16.77 cfs	1,507.89 ft	N/A
Total	----------------	20.35 cfs	1,507.89 ft	N/A

Culvert Analysis Report
Culvert11_100yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,507.89	ft	Discharge	3.58	cfs
Inlet Control HW Elev.	1,507.52	ft	Tailwater Elevation	1,506.75	ft
Outlet Control HW Elev.	1,507.89	ft	Control Type	Outlet Control	
Headwater Depth/Height	2.35				

Grades					
Upstream Invert	1,506.33	ft	Downstream Invert	1,506.07	ft
Length	50.06	ft	Constructed Slope	0.005044	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	0.68	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	0.61	ft
Velocity Downstream	5.13	ft/s	Critical Slope	0.011321	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.010	
Section Material	PVC		Span	0.67	ft
Section Size	8 inch		Rise	0.67	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	1,507.89	ft	Upstream Velocity Head	0.41	ft
Ke	0.20		Entrance Loss	0.08	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,507.52	ft	Flow Control	N/A	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	0.7	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Analysis Report
Culvert11_100yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	16.77	cfs	Allowable HW Elevation	1,507.89	ft
Roadway Width	29.00	ft	Overtopping Coefficient	2.93	US
Low Point	1,507.40	ft	Headwater Elevation	1,507.89	ft
Discharge Coefficient (Cr)	2.93		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,506.75	ft			

Sta (ft)	Elev. (ft)
0.00	1,507.40
16.50	1,507.60
32.00	1,507.80
47.30	1,508.00
72.80	1,508.20
106.75	1,508.20
132.10	1,508.00
191.10	1,507.80

Culvert Analysis Report
Culvert11_10yr

Comments: Subbasin E-11 to E-13

Analysis Component			
Storm Event	Design	Discharge	11.50 cfs

Peak Discharge Method: User-Specified			
Design Discharge	11.50 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	11.50 cfs	Bottom Elevation	1,506.00 ft
Depth	0.57 ft	Velocity	2.24 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-8 inch Circular	3.46 cfs	1,507.78 ft	5.21 ft/s
Weir	Roadway	8.04 cfs	1,507.78 ft	N/A
Total	----------------	11.50 cfs	1,507.78 ft	N/A

Culvert Analysis Report
Culvert11_10yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,507.78 ft	Discharge	3.46 cfs
Inlet Control HW Elev.	1,507.47 ft	Tailwater Elevation	1,506.57 ft
Outlet Control HW Elev.	1,507.78 ft	Control Type	Outlet Control
Headwater Depth/Height	2.18		

Grades			
Upstream Invert	1,506.33 ft	Downstream Invert	1,506.07 ft
Length	50.06 ft	Constructed Slope	0.005044 ft/ft

Hydraulic Profile			
Profile	CompositeM2PressureProfile	Depth, Downstream	0.60 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	0.60 ft
Velocity Downstream	5.21 ft/s	Critical Slope	0.010644 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.010
Section Material	PVC	Span	0.67 ft
Section Size	8 inch	Rise	0.67 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	1,507.78 ft	Upstream Velocity Head	0.38 ft
Ke	0.20	Entrance Loss	0.08 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,507.47 ft	Flow Control	N/A
Inlet Type	Beveled ring, 33.7° bevels	Area Full	0.7 ft²
K	0.00180	HDS 5 Chart	3
M	2.50000	HDS 5 Scale	B
C	0.02430	Equation Form	1
Y	0.83000		

Culvert Analysis Report
Culvert11_10yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	8.04	cfs	Allowable HW Elevation	1,507.78	ft
Roadway Width	29.00	ft	Overtopping Coefficient	2.92	US
Low Point	1,507.40	ft	Headwater Elevation	1,507.78	ft
Discharge Coefficient (Cr)	2.92		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,506.57	ft			

Sta (ft)	Elev. (ft)
0.00	1,507.40
16.50	1,507.60
32.00	1,507.80
47.30	1,508.00
72.80	1,508.20
106.75	1,508.20
132.10	1,508.00
191.10	1,507.80

Culvert Analysis Report
Culvert11_2yr

Comments: Subbasin E-11 to E-13

Analysis Component			
Storm Event	Design	Discharge	6.60 cfs

Peak Discharge Method: User-Specified			
Design Discharge	6.60 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	6.60 cfs	Bottom Elevation	1,506.00 ft
Depth	0.43 ft	Velocity	1.92 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-8 inch Circular	3.29 cfs	1,507.67 ft	5.01 ft/s
Weir	Roadway	3.32 cfs	1,507.67 ft	N/A
Total	----------------	6.61 cfs	1,507.67 ft	N/A

Culvert Analysis Report
Culvert11_2yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,507.67	ft	Discharge	3.29	cfs
Inlet Control HW Elev.	1,507.42	ft	Tailwater Elevation	1,506.43	ft
Outlet Control HW Elev.	1,507.67	ft	Control Type	Outlet Control	
Headwater Depth/Height	2.01				

Grades					
Upstream Invert	1,506.33	ft	Downstream Invert	1,506.07	ft
Length	50.06	ft	Constructed Slope	0.005044	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	0.59	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	0.59	ft
Velocity Downstream	5.01	ft/s	Critical Slope	0.009742	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.010	
Section Material	PVC		Span	0.67	ft
Section Size	8 inch		Rise	0.67	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	1,507.67	ft	Upstream Velocity Head	0.34	ft
Ke	0.20		Entrance Loss	0.07	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,507.42	ft	Flow Control	N/A	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	0.7	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Analysis Report
Culvert11_2yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	3.32	cfs	Allowable HW Elevation	1,507.67	ft
Roadway Width	29.00	ft	Overtopping Coefficient	2.91	US
Low Point	1,507.40	ft	Headwater Elevation	1,507.67	ft
Discharge Coefficient (Cr)	2.91		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,506.43	ft			

Sta (ft)	Elev. (ft)
0.00	1,507.40
16.50	1,507.60
32.00	1,507.80
47.30	1,508.00
72.80	1,508.20
106.75	1,508.20
132.10	1,508.00
191.10	1,507.80

Culvert Analysis Report
Culvert11_5yr

Comments: Subbasin E-11 to E-13

Analysis Component			
Storm Event	Design	Discharge	9.20 cfs

Peak Discharge Method: User-Specified			
Design Discharge	9.20 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	9.20 cfs	Bottom Elevation	1,506.00 ft
Depth	0.51 ft	Velocity	2.11 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-8 inch Circular	3.39 cfs	1,507.73 ft	5.13 ft/s
Weir	Roadway	5.83 cfs	1,507.73 ft	N/A
Total	----------------	9.22 cfs	1,507.73 ft	N/A

Culvert Analysis Report
Culvert11_5yr

Component:Culvert-1

Culvert Summary				
Computed Headwater Elevation	1,507.73 ft		Discharge	3.39 cfs
Inlet Control HW Elev.	1,507.45 ft		Tailwater Elevation	1,506.51 ft
Outlet Control HW Elev.	1,507.73 ft		Control Type	Outlet Control
Headwater Depth/Height	2.11			

Grades				
Upstream Invert	1,506.33 ft		Downstream Invert	1,506.07 ft
Length	50.06 ft		Constructed Slope	0.005044 ft/ft

Hydraulic Profile				
Profile	CompositeM2PressureProfile		Depth, Downstream	0.60 ft
Slope Type	Mild		Normal Depth	N/A ft
Flow Regime	Subcritical		Critical Depth	0.60 ft
Velocity Downstream	5.13 ft/s		Critical Slope	0.010267 ft/ft

Section				
Section Shape	Circular		Mannings Coefficient	0.010
Section Material	PVC		Span	0.67 ft
Section Size	8 inch		Rise	0.67 ft
Number Sections	2			

Outlet Control Properties				
Outlet Control HW Elev.	1,507.73 ft		Upstream Velocity Head	0.37 ft
Ke	0.20		Entrance Loss	0.07 ft

Inlet Control Properties				
Inlet Control HW Elev.	1,507.45 ft		Flow Control	N/A
Inlet Type	Beveled ring, 33.7° bevels		Area Full	0.7 ft²
K	0.00180		HDS 5 Chart	3
M	2.50000		HDS 5 Scale	B
C	0.02430		Equation Form	1
Y	0.83000			

Culvert Analysis Report
Culvert11_5yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	5.83	cfs	Allowable HW Elevation	1,507.73	ft
Roadway Width	29.00	ft	Overtopping Coefficient	2.92	US
Low Point	1,507.40	ft	Headwater Elevation	1,507.73	ft
Discharge Coefficient (Cr)	2.92		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,506.51	ft			

Sta (ft)	Elev. (ft)
0.00	1,507.40
16.50	1,507.60
32.00	1,507.80
47.30	1,508.00
72.80	1,508.20
106.75	1,508.20
132.10	1,508.00
191.10	1,507.80

Culvert Analysis Report
Culvert12_100yr

Comments: Subbasins E-2,6,7,8,9,10, and 12 converge at E-12 to E-15

Analysis Component			
Storm Event	Design	Discharge	123.60 cfs

Peak Discharge Method: User-Specified			
Design Discharge	123.60 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	123.60 cfs	Bottom Elevation	1,503.60 ft
Depth	2.52 ft	Velocity	2.82 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-20 inch Circular	7.85 cfs	1,506.70 ft	3.60 ft/s
Weir	Roadway	115.79 cfs	1,506.70 ft	N/A
Total	----------------	123.64 cfs	1,506.70 ft	N/A

Culvert Analysis Report
Culvert12_100yr

Component:Culvert-1

Culvert Summary

Computed Headwater Elevation	1,506.70 ft	Discharge	7.85 cfs
Inlet Control HW Elev.	1,506.12 ft	Tailwater Elevation	1,506.12 ft
Outlet Control HW Elev.	1,506.70 ft	Control Type	Outlet Control
Headwater Depth/Height	1.93		

Grades

Upstream Invert	1,503.50 ft	Downstream Invert	1,503.39 ft
Length	106.38 ft	Constructed Slope	0.000987 ft/ft

Hydraulic Profile

Profile	PressureProfile	Depth, Downstream	2.73 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	1.05 ft
Velocity Downstream	3.60 ft/s	Critical Slope	0.006026 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.67 ft
Section Size	20 inch	Rise	1.67 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	1,506.70 ft	Upstream Velocity Head	0.20 ft
Ke	0.20	Entrance Loss	0.04 ft

Inlet Control Properties

Inlet Control HW Elev.	1,506.12 ft	Flow Control	N/A
Inlet Type	Groove end projecting	Area Full	2.2 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert12_100yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	115.79	cfs	Allowable HW Elevation	1,506.70	ft
Roadway Width	53.00	ft	Overtopping Coefficient	2.99	US
Low Point	1,506.00	ft	Headwater Elevation	1,506.70	ft
Discharge Coefficient (Cr)	2.99		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,506.12	ft			

Sta (ft)	Elev. (ft)
0.00	1,507.00
59.20	1,506.80
71.80	1,506.60
85.34	1,506.40
98.33	1,506.20
120.38	1,506.00
142.74	1,506.00
165.20	1,506.20

Culvert Analysis Report
Culvert12_10yr

Comments: Subbasins E-2,6,7,8,9,10, and 12 converge at E-12 to E-15

Analysis Component			
Storm Event	Design	Discharge	67.10 cfs

Peak Discharge Method: User-Specified			
Design Discharge	67.10 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	67.10 cfs	Bottom Elevation	1,503.60 ft
Depth	1.97 ft	Velocity	2.42 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-20 inch Circular	9.86 cfs	1,506.49 ft	4.52 ft/s
Weir	Roadway	57.35 cfs	1,506.49 ft	N/A
Total	----------------	67.21 cfs	1,506.49 ft	N/A

Culvert Analysis Report
Culvert12_10yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,506.49 ft	Discharge	9.86 cfs
Inlet Control HW Elev.	1,505.57 ft	Tailwater Elevation	1,505.57 ft
Outlet Control HW Elev.	1,506.49 ft	Control Type	Outlet Control
Headwater Depth/Height	1.79		

Grades			
Upstream Invert	1,503.50 ft	Downstream Invert	1,503.39 ft
Length	106.38 ft	Constructed Slope	0.000987 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	2.18 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	1.19 ft
Velocity Downstream	4.52 ft/s	Critical Slope	0.006885 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.67 ft
Section Size	20 inch	Rise	1.67 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,506.49 ft	Upstream Velocity Head	0.32 ft
Ke	0.20	Entrance Loss	0.06 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,505.57 ft	Flow Control	N/A
Inlet Type	Groove end projecting	Area Full	2.2 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert12_10yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	57.35	cfs	Allowable HW Elevation	1,506.49	ft
Roadway Width	53.00	ft	Overtopping Coefficient	2.96	US
Low Point	1,506.00	ft	Headwater Elevation	1,506.49	ft
Discharge Coefficient (Cr)	2.96		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,505.57	ft			

Sta (ft)	Elev. (ft)
0.00	1,507.00
59.20	1,506.80
71.80	1,506.60
85.34	1,506.40
98.33	1,506.20
120.38	1,506.00
142.74	1,506.00
165.20	1,506.20

Culvert Analysis Report
Culvert12_2yr

Comments: Subbasins E-2,6,7,8,9,10, and 12 converge at E-12 to E-15

Analysis Component			
Storm Event	Design	Discharge	36.20 cfs

Peak Discharge Method: User-Specified			
Design Discharge	36.20 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	36.20 cfs	Bottom Elevation	1,503.60 ft
Depth	1.53 ft	Velocity	2.07 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-20 inch Circular	11.23 cfs	1,506.32 ft	5.15 ft/s
Weir	Roadway	24.97 cfs	1,506.32 ft	N/A
Total	----------------	36.20 cfs	1,506.32 ft	N/A

Culvert Analysis Report
Culvert12_2yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,506.32 ft	Discharge	11.23 cfs
Inlet Control HW Elev.	1,505.48 ft	Tailwater Elevation	1,505.13 ft
Outlet Control HW Elev.	1,506.32 ft	Control Type	Outlet Control
Headwater Depth/Height	1.69		

Grades			
Upstream Invert	1,503.50 ft	Downstream Invert	1,503.39 ft
Length	106.38 ft	Constructed Slope	0.000987 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	1.74 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	1.26 ft
Velocity Downstream	5.15 ft/s	Critical Slope	0.007638 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.67 ft
Section Size	20 inch	Rise	1.67 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,506.32 ft	Upstream Velocity Head	0.41 ft
Ke	0.20	Entrance Loss	0.08 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,505.48 ft	Flow Control	N/A
Inlet Type	Groove end projecting	Area Full	2.2 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert12_2yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	24.97	cfs	Allowable HW Elevation	1,506.32	ft
Roadway Width	53.00	ft	Overtopping Coefficient	2.94	US
Low Point	1,506.00	ft	Headwater Elevation	1,506.32	ft
Discharge Coefficient (Cr)	2.94		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,505.13	ft			

Sta (ft)	Elev. (ft)
0.00	1,507.00
59.20	1,506.80
71.80	1,506.60
85.34	1,506.40
98.33	1,506.20
120.38	1,506.00
142.74	1,506.00
165.20	1,506.20

Culvert Analysis Report
Culvert12_5yr

Comments: Subbasins E-2,6,7,8,9,10, and 12 converge at E-12 to E-15

Analysis Component			
Storm Event	Design	Discharge	51.80 cfs

Peak Discharge Method: User-Specified			
Design Discharge	51.80 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	51.80 cfs	Bottom Elevation	1,503.60 ft
Depth	1.77 ft	Velocity	2.27 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-20 inch Circular	10.50 cfs	1,506.41 ft	4.81 ft/s
Weir	Roadway	41.38 cfs	1,506.41 ft	N/A
Total	----------------	51.87 cfs	1,506.41 ft	N/A

Culvert Analysis Report
Culvert12_5yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,506.41 ft	Discharge	10.50 cfs
Inlet Control HW Elev.	1,505.40 ft	Tailwater Elevation	1,505.37 ft
Outlet Control HW Elev.	1,506.41 ft	Control Type	Outlet Control
Headwater Depth/Height	1.75		

Grades			
Upstream Invert	1,503.50 ft	Downstream Invert	1,503.39 ft
Length	106.38 ft	Constructed Slope	0.000987 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	1.98 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	1.22 ft
Velocity Downstream	4.81 ft/s	Critical Slope	0.007220 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.67 ft
Section Size	20 inch	Rise	1.67 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,506.41 ft	Upstream Velocity Head	0.36 ft
Ke	0.20	Entrance Loss	0.07 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,505.40 ft	Flow Control	N/A
Inlet Type	Groove end projecting	Area Full	2.2 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert12_5yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	41.38	cfs	Allowable HW Elevation	1,506.41	ft
Roadway Width	53.00	ft	Overtopping Coefficient	2.95	US
Low Point	1,506.00	ft	Headwater Elevation	1,506.41	ft
Discharge Coefficient (Cr)	2.95		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,505.37	ft			

Sta (ft)	Elev. (ft)
0.00	1,507.00
59.20	1,506.80
71.80	1,506.60
85.34	1,506.40
98.33	1,506.20
120.38	1,506.00
142.74	1,506.00
165.20	1,506.20

Culvert Analysis Report
Culvert13_100yr

Comments: Subbasins E-3, 11, and 13 converge at E-13 to off site

Analysis Component			
Storm Event	Design	Discharge	105.30 cfs

Peak Discharge Method: User-Specified			
Design Discharge	105.30 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	105.30 cfs	Bottom Elevation	1,506.00 ft
Depth	1.66 ft	Velocity	2.16 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-14 inch Circular	0.16 cfs	1,507.67 ft	0.15 ft/s
Weir	Roadway	101.01 cfs	1,507.67 ft	N/A
Total	----------------	101.17 cfs	1,507.67 ft	N/A

Culvert Analysis Report
Culvert13_100yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,507.67 ft	Discharge	0.16 cfs
Inlet Control HW Elev.	1,507.66 ft	Tailwater Elevation	1,507.66 ft
Outlet Control HW Elev.	1,507.67 ft	Control Type	Outlet Control
Headwater Depth/Height	2.69		

Grades			
Upstream Invert	1,504.53 ft	Downstream Invert	1,504.07 ft
Length	75.55 ft	Constructed Slope	0.006089 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	3.59 ft
Slope Type	N/A	Normal Depth	0.21 ft
Flow Regime	N/A	Critical Depth	0.16 ft
Velocity Downstream	0.15 ft/s	Critical Slope	0.020025 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.17 ft
Section Size	14 inch	Rise	1.17 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,507.67 ft	Upstream Velocity Head	0.00 ft
Ke	0.90	Entrance Loss	0.00 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,507.66 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	1.1 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report
Culvert13_100yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	101.01	cfs	Allowable HW Elevation	1,507.67	ft
Roadway Width	12.00	ft	Overtopping Coefficient	0.70	US
Low Point	1,506.40	ft	Headwater Elevation	1,507.67	ft
Discharge Coefficient (Cr)	3.03		Submergence Factor (Kt)	0.23	
Tailwater Elevation	1,507.66	ft			

Sta (ft)	Elev. (ft)
0.00	1,506.40
51.80	1,506.60
70.70	1,506.80
89.10	1,507.00
154.75	1,507.20
205.50	1,507.40

Culvert Analysis Report
Culvert13_10yr

Comments: Subbasins E-3, 11, and 13 converge at E-13 to off site

Analysis Component			
Storm Event	Design	Discharge	53.80 cfs

Peak Discharge Method: User-Specified			
Design Discharge	53.80 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	53.80 cfs	Bottom Elevation	1,506.00 ft
Depth	1.23 ft	Velocity	1.81 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-14 inch Circular	0.14 cfs	1,507.23 ft	0.13 ft/s
Weir	Roadway	50.82 cfs	1,507.23 ft	N/A
Total	----------------	50.96 cfs	1,507.23 ft	N/A

Culvert Analysis Report
Culvert13_10yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,507.23 ft	Discharge	0.14 cfs
Inlet Control HW Elev.	1,507.23 ft	Tailwater Elevation	1,507.23 ft
Outlet Control HW Elev.	1,507.23 ft	Control Type	Outlet Control
Headwater Depth/Height	2.31		

Grades			
Upstream Invert	1,504.53 ft	Downstream Invert	1,504.07 ft
Length	75.55 ft	Constructed Slope	0.006089 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	3.16 ft
Slope Type	N/A	Normal Depth	0.20 ft
Flow Regime	N/A	Critical Depth	0.15 ft
Velocity Downstream	0.13 ft/s	Critical Slope	0.020371 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.17 ft
Section Size	14 inch	Rise	1.17 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,507.23 ft	Upstream Velocity Head	0.00 ft
Ke	0.90	Entrance Loss	0.00 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,507.23 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	1.1 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report
Culvert13_10yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	50.82	cfs	Allowable HW Elevation	1,507.23	ft
Roadway Width	12.00	ft	Overtopping Coefficient	1.34	US
Low Point	1,506.40	ft	Headwater Elevation	1,507.23	ft
Discharge Coefficient (Cr)	2.99		Submergence Factor (Kt)	0.45	
Tailwater Elevation	1,507.23	ft			

Sta (ft)	Elev. (ft)
0.00	1,506.40
51.80	1,506.60
70.70	1,506.80
89.10	1,507.00
154.75	1,507.20
205.50	1,507.40

Culvert Analysis Report
Culvert13_2yr

Comments: Subbasins E-3, 11, and 13 converge at E-13 to off site

Analysis Component			
Storm Event	Design	Discharge	27.40 cfs

Peak Discharge Method: User-Specified			
Design Discharge	27.40 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	27.40 cfs	Bottom Elevation	1,506.00 ft
Depth	0.89 ft	Velocity	1.52 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-14 inch Circular	0.18 cfs	1,506.90 ft	0.17 ft/s
Weir	Roadway	27.56 cfs	1,506.90 ft	N/A
Total	----------------	27.73 cfs	1,506.90 ft	N/A

Culvert Analysis Report
Culvert13_2yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,506.90	ft	Discharge	0.18	cfs
Inlet Control HW Elev.	1,506.89	ft	Tailwater Elevation	1,506.89	ft
Outlet Control HW Elev.	1,506.90	ft	Control Type	Outlet Control	
Headwater Depth/Height	2.03				

Grades					
Upstream Invert	1,504.53	ft	Downstream Invert	1,504.07	ft
Length	75.55	ft	Constructed Slope	0.006089	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	2.82	ft
Slope Type	N/A		Normal Depth	0.22	ft
Flow Regime	N/A		Critical Depth	0.17	ft
Velocity Downstream	0.17	ft/s	Critical Slope	0.019861	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	1.17	ft
Section Size	14 inch		Rise	1.17	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	1,506.90	ft	Upstream Velocity Head	0.00	ft
Ke	0.90		Entrance Loss	0.00	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,506.89	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	1.1	ft²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Analysis Report
Culvert13_2yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	27.56	cfs	Allowable HW Elevation	1,506.90	ft
Roadway Width	12.00	ft	Overtopping Coefficient	1.86	US
Low Point	1,506.40	ft	Headwater Elevation	1,506.90	ft
Discharge Coefficient (Cr)	2.94		Submergence Factor (Kt)	0.63	
Tailwater Elevation	1,506.89	ft			

Sta (ft)	Elev. (ft)
0.00	1,506.40
51.80	1,506.60
70.70	1,506.80
89.10	1,507.00
154.75	1,507.20
205.50	1,507.40

Culvert Analysis Report
Culvert13_5yr

Comments: Subbasins E-3, 11, and 13 converge at E-13 to off site

Analysis Component			
Storm Event	Design	Discharge	40.90 cfs

Peak Discharge Method: User-Specified			
Design Discharge	40.90 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	40.90 cfs	Bottom Elevation	1,506.00 ft
Depth	1.08 ft	Velocity	1.69 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-14 inch Circular	0.14 cfs	1,507.08 ft	0.13 ft/s
Weir	Roadway	33.24 cfs	1,507.08 ft	N/A
Total	----------------	33.37 cfs	1,507.08 ft	N/A

Culvert Analysis Report
Culvert13_5yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,507.08	ft	Discharge	0.14	cfs
Inlet Control HW Elev.	1,507.08	ft	Tailwater Elevation	1,507.08	ft
Outlet Control HW Elev.	1,507.08	ft	Control Type	Outlet Control	
Headwater Depth/Height	2.19				

Grades					
Upstream Invert	1,504.53	ft	Downstream Invert	1,504.07	ft
Length	75.55	ft	Constructed Slope	0.006089	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	3.01	ft
Slope Type	N/A		Normal Depth	0.19	ft
Flow Regime	N/A		Critical Depth	0.14	ft
Velocity Downstream	0.13	ft/s	Critical Slope	0.020276	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	1.17	ft
Section Size	14 inch		Rise	1.17	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	1,507.08	ft	Upstream Velocity Head	0.00	ft
Ke	0.90		Entrance Loss	0.00	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,507.08	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	1.1	ft^2
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Analysis Report
Culvert13_5yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	33.24	cfs	Allowable HW Elevation	1,507.08	ft
Roadway Width	12.00	ft	Overtopping Coefficient	1.12	US
Low Point	1,506.40	ft	Headwater Elevation	1,507.08	ft
Discharge Coefficient (Cr)	2.97		Submergence Factor (Kt)	0.38	
Tailwater Elevation	1,507.08	ft			

Sta (ft)	Elev. (ft)
0.00	1,506.40
51.80	1,506.60
70.70	1,506.80
89.10	1,507.00
154.75	1,507.20
205.50	1,507.40

Culvert Analysis Report
Culvert14_100yr

Comments: Subbasin E-14 to off site

Analysis Component			
Storm Event	Design	Discharge	8.20 cfs

Peak Discharge Method: User-Specified			
Design Discharge	8.20 cfs	Check Discharge	0.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	1,506.82 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-8 inch Circular	0.00 cfs	1,506.82 ft	0.00 ft/s
Weir	Roadway	20.66 cfs	1,506.82 ft	N/A
Total	----------------	20.66 cfs	1,506.82 ft	N/A

Culvert Analysis Report
Culvert14_100yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	N/A	ft	Discharge	0.00	cfs
Inlet Control HW Elev.	N/A	ft	Tailwater Elevation	1,506.82	ft
Outlet Control HW Elev.	N/A	ft	Control Type	Inlet Control	
Headwater Depth/Height	2.45				

Grades					
Upstream Invert	1,505.19	ft	Downstream Invert	1,504.61	ft
Length	18.55	ft	Constructed Slope	0.031159	ft/ft

Hydraulic Profile					
Profile	Dry		Depth, Downstream	0.00	ft
Slope Type	Dry		Normal Depth	0.00	ft
Flow Regime	Subcritical		Critical Depth	0.00	ft
Velocity Downstream	0.00	ft/s	Critical Slope	0.000000	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	0.67	ft
Section Size	8 inch		Rise	0.67	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	N/A	ft	Upstream Velocity Head	0.00	ft
Ke	0.50		Entrance Loss	4.29	ft

Inlet Control Properties					
Inlet Control HW Elev.	N/A	ft	Flow Control	N/A	
Inlet Type	Headwall		Area Full	0.3	ft²
K	0.00780		HDS 5 Chart	2	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

Culvert Analysis Report
Culvert14_100yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	20.66	cfs	Allowable HW Elevation	1,506.82	ft
Roadway Width	16.60	ft	Overtopping Coefficient	0.45	US
Low Point	1,506.40	ft	Headwater Elevation	1,506.82	ft
Discharge Coefficient (Cr)	2.96		Submergence Factor (Kt)	0.15	
Tailwater Elevation	1,506.82	ft			

Sta (ft)	Elev. (ft)
0.00	1,506.80
9.85	1,506.80
24.58	1,506.60
47.10	1,506.40
105.40	1,506.40
154.86	1,506.60
175.75	1,506.80

Culvert Analysis Report
Culvert14_10yr

Comments: Subbasin E-14 to off site

Analysis Component			
Storm Event	Design	Discharge	4.80 cfs

Peak Discharge Method: User-Specified			
Design Discharge	4.80 cfs	Check Discharge	0.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	1,506.99 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-8 inch Circular	0.00 cfs	1,506.99 ft	0.00 ft/s
Weir	Roadway	10.43 cfs	1,506.99 ft	N/A
Total	----------------	10.43 cfs	1,506.99 ft	N/A

Culvert Analysis Report
Culvert14_10yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	N/A ft	Discharge	0.00 cfs
Inlet Control HW Elev.	N/A ft	Tailwater Elevation	1,506.99 ft
Outlet Control HW Elev.	N/A ft	Control Type	Inlet Control
Headwater Depth/Height	2.70		

Grades			
Upstream Invert	1,505.19 ft	Downstream Invert	1,504.61 ft
Length	18.55 ft	Constructed Slope	0.031159 ft/ft

Hydraulic Profile			
Profile	Dry	Depth, Downstream	0.00 ft
Slope Type	Dry	Normal Depth	0.00 ft
Flow Regime	Subcritical	Critical Depth	0.00 ft
Velocity Downstream	0.00 ft/s	Critical Slope	0.000000 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	0.67 ft
Section Size	8 inch	Rise	0.67 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	N/A ft	Upstream Velocity Head	0.00 ft
Ke	0.50	Entrance Loss	1.47 ft

Inlet Control Properties			
Inlet Control HW Elev.	N/A ft	Flow Control	N/A
Inlet Type	Headwall	Area Full	0.3 ft²
K	0.00780	HDS 5 Chart	2
M	2.00000	HDS 5 Scale	1
C	0.03790	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert14_10yr

Component:Weir

Hydraulic Component(s): Roadway			
Discharge	10.43 cfs	Allowable HW Elevation	1,506.99 ft
Roadway Width	16.60 ft	Overtopping Coefficient	0.33 US
Low Point	1,506.40 ft	Headwater Elevation	1,506.99 ft
Discharge Coefficient (Cr)	2.99	Submergence Factor (Kt)	0.11
Tailwater Elevation	1,506.99 ft		

Sta (ft)	Elev. (ft)
0.00	1,506.80
9.85	1,506.80
24.58	1,506.60
47.10	1,506.40
105.40	1,506.40
154.86	1,506.60
175.75	1,506.80

Culvert Analysis Report
Culvert14_2yr

Comments: Subbasin E-14 to off site

Analysis Component			
Storm Event	Design	Discharge	2.70 cfs

Peak Discharge Method: User-Specified			
Design Discharge	2.70 cfs	Check Discharge	0.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	1,506.84 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-8 inch Circular	0.00 cfs	1,506.84 ft	0.00 ft/s
Weir	Roadway	7.88 cfs	1,506.84 ft	N/A
Total	----------------	7.88 cfs	1,506.84 ft	N/A

Culvert Analysis Report
Culvert14_2yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	N/A ft	Discharge	0.00 cfs
Inlet Control HW Elev.	N/A ft	Tailwater Elevation	1,506.84 ft
Outlet Control HW Elev.	N/A ft	Control Type	Inlet Control
Headwater Depth/Height	2.48		

Grades			
Upstream Invert	1,505.19 ft	Downstream Invert	1,504.61 ft
Length	18.55 ft	Constructed Slope	0.031159 ft/ft

Hydraulic Profile			
Profile	Dry	Depth, Downstream	0.00 ft
Slope Type	Dry	Normal Depth	0.00 ft
Flow Regime	Subcritical	Critical Depth	0.00 ft
Velocity Downstream	0.00 ft/s	Critical Slope	0.000000 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	0.67 ft
Section Size	8 inch	Rise	0.67 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	N/A ft	Upstream Velocity Head	0.00 ft
Ke	0.50	Entrance Loss	0.46 ft

Inlet Control Properties			
Inlet Control HW Elev.	N/A ft	Flow Control	N/A
Inlet Type	Headwall	Area Full	0.3 ft²
K	0.00780	HDS 5 Chart	2
M	2.00000	HDS 5 Scale	1
C	0.03790	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert14_2yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	7.88	cfs	Allowable HW Elevation	1,506.84	ft
Roadway Width	16.60	ft	Overtopping Coefficient	0.56	US
Low Point	1,506.40	ft	Headwater Elevation	1,506.84	ft
Discharge Coefficient (Cr)	2.97		Submergence Factor (Kt)	0.19	
Tailwater Elevation	1,506.84	ft			

Sta (ft)	Elev. (ft)
0.00	1,506.80
9.85	1,506.80
24.58	1,506.60
47.10	1,506.40
105.40	1,506.40
154.86	1,506.60
175.75	1,506.80

Culvert Analysis Report
Culvert14_5yr

Comments: Subbasin E-14 to off site

Analysis Component			
Storm Event	Design	Discharge	3.80 cfs

Peak Discharge Method: User-Specified			
Design Discharge	3.80 cfs	Check Discharge	0.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	1,506.99 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-8 inch Circular	0.00 cfs	1,506.99 ft	0.00 ft/s
Weir	Roadway	0.00 cfs	1,506.99 ft	N/A
Total	----------------	0.00 cfs	1,506.99 ft	N/A

Culvert Analysis Report
Culvert14_5yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	N/A ft	Discharge	0.00 cfs
Inlet Control HW Elev.	N/A ft	Tailwater Elevation	1,506.99 ft
Outlet Control HW Elev.	N/A ft	Control Type	Inlet Control
Headwater Depth/Height	2.70		

Grades			
Upstream Invert	1,505.19 ft	Downstream Invert	1,504.61 ft
Length	18.55 ft	Constructed Slope	0.031159 ft/ft

Hydraulic Profile			
Profile	Dry	Depth, Downstream	0.00 ft
Slope Type	Dry	Normal Depth	0.00 ft
Flow Regime	Subcritical	Critical Depth	0.00 ft
Velocity Downstream	0.00 ft/s	Critical Slope	0.000000 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	0.67 ft
Section Size	8 inch	Rise	0.67 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	N/A ft	Upstream Velocity Head	0.00 ft
Ke	0.50	Entrance Loss	0.92 ft

Inlet Control Properties			
Inlet Control HW Elev.	N/A ft	Flow Control	N/A
Inlet Type	Headwall	Area Full	0.3 ft²
K	0.00780	HDS 5 Chart	2
M	2.00000	HDS 5 Scale	1
C	0.03790	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert14_5yr

Component:Weir

Hydraulic Component(s): Roadway				
Discharge	0.00 cfs		Allowable HW Elevation	1,506.99 ft
Roadway Width	16.60 ft		Overtopping Coefficient	0.36 US
Low Point	1,506.40 ft		Headwater Elevation	N/A ft
Discharge Coefficient (Cr)	2.99		Submergence Factor (Kt)	0.12
Tailwater Elevation	1,506.99 ft			

Sta (ft)	Elev. (ft)
0.00	1,506.80
9.85	1,506.80
24.58	1,506.60
47.10	1,506.40
105.40	1,506.40
154.86	1,506.60
175.75	1,506.80

Culvert Analysis Report
Culvert15_100yr

Comments: Subbasins E-2,3,5,6,7,8,9,10,11,12,13,14,15, and 16 converge at E-15 to E-4

Analysis Component				
Storm Event	Design	Discharge	258.90	cfs

Peak Discharge Method: User-Specified					
Design Discharge	258.90	cfs	Check Discharge	0.00	cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.					
Discharge	258.90	cfs	Bottom Elevation	1,501.20	ft
Depth	2.08	ft	Velocity	3.39	ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-36 inch Circular	78.59 cfs	1,504.77 ft	4.95 ft/s
Weir	Roadway	180.44 cfs	1,504.77 ft	N/A
Total	----------------	259.04 cfs	1,504.77 ft	N/A

Culvert Analysis Report
Culvert15_100yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,504.77 ft	Discharge	78.59 cfs
Inlet Control HW Elev.	1,503.83 ft	Tailwater Elevation	1,503.28 ft
Outlet Control HW Elev.	1,504.77 ft	Control Type	Outlet Control
Headwater Depth/Height	1.20		

Grades			
Upstream Invert	1,501.19 ft	Downstream Invert	1,501.17 ft
Length	176.14 ft	Constructed Slope	0.000066 ft/ft

Hydraulic Profile			
Profile	CompositeM2PressureProfile	Depth, Downstream	2.10 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.65 ft
Velocity Downstream	4.95 ft/s	Critical Slope	0.015242 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	3.00 ft
Section Size	36 inch	Rise	3.00 ft
Number Sections	3		

Outlet Control Properties			
Outlet Control HW Elev.	1,504.77 ft	Upstream Velocity Head	0.21 ft
Ke	0.90	Entrance Loss	0.19 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,503.83 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	21.2 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report
Culvert15_100yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	180.44	cfs	Allowable HW Elevation	1,504.77	ft
Roadway Width	122.00	ft	Overtopping Coefficient	2.67	US
Low Point	1,504.00	ft	Headwater Elevation	1,504.77	ft
Discharge Coefficient (Cr)	2.67		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,503.28	ft			

Sta (ft)	Elev. (ft)
0.00	1,504.40
24.00	1,504.20
39.60	1,504.20
54.20	1,504.40
63.80	1,504.60
83.20	1,504.60
90.40	1,504.40
108.00	1,504.20
179.00	1,504.00

Culvert Analysis Report
Culvert15_10yr

Comments: Subbasins E-2,3,5,6,7,8,9,10,11,12,13,14,15, and 16 converge at E-15 to E-4

Analysis Component			
Storm Event	Design	Discharge	137.10 cfs

Peak Discharge Method: User-Specified			
Design Discharge	137.10 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	137.10 cfs	Bottom Elevation	1,501.20 ft
Depth	1.52 ft	Velocity	2.85 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-36 inch Circular	73.61 cfs	1,504.49 ft	6.41 ft/s
Weir	Roadway	63.66 cfs	1,504.49 ft	N/A
Total	----------------	137.27 cfs	1,504.49 ft	N/A

Culvert Analysis Report
Culvert15_10yr

Component:Culvert-1

Culvert Summary

Computed Headwater Elevation	1,504.49 ft	Discharge	73.61 cfs
Inlet Control HW Elev.	1,503.71 ft	Tailwater Elevation	1,502.72 ft
Outlet Control HW Elev.	1,504.49 ft	Control Type	Outlet Control
Headwater Depth/Height	1.10		

Grades

Upstream Invert	1,501.19 ft	Downstream Invert	1,501.17 ft
Length	176.14 ft	Constructed Slope	0.000066 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	1.60 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.60 ft
Velocity Downstream	6.41 ft/s	Critical Slope	0.014948 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	3.00 ft
Section Size	36 inch	Rise	3.00 ft
Number Sections	3		

Outlet Control Properties

Outlet Control HW Elev.	1,504.49 ft	Upstream Velocity Head	0.19 ft
Ke	0.90	Entrance Loss	0.17 ft

Inlet Control Properties

Inlet Control HW Elev.	1,503.71 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	21.2 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report
Culvert15_10yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	63.66	cfs	Allowable HW Elevation	1,504.49	ft
Roadway Width	122.00	ft	Overtopping Coefficient	2.57	US
Low Point	1,504.00	ft	Headwater Elevation	1,504.49	ft
Discharge Coefficient (Cr)	2.57		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,502.72	ft			

Sta (ft)	Elev. (ft)
0.00	1,504.40
24.00	1,504.20
39.60	1,504.20
54.20	1,504.40
63.80	1,504.60
83.20	1,504.60
90.40	1,504.40
108.00	1,504.20
179.00	1,504.00

Culvert Analysis Report
Culvert15_2yr

Comments: Subbasins E-2,3,5,6,7,8,9,10,11,12,13,14,15, and 16 converge at E-15 to E-4

Analysis Component			
Storm Event	Design	Discharge	72.10 cfs

Peak Discharge Method: User-Specified			
Design Discharge	72.10 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	72.10 cfs	Bottom Elevation	1,501.20 ft
Depth	1.09 ft	Velocity	2.38 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-36 inch Circular	65.05 cfs	1,504.22 ft	6.15 ft/s
Weir	Roadway	7.11 cfs	1,504.22 ft	N/A
Total	----------------	72.16 cfs	1,504.22 ft	N/A

Culvert Analysis Report
Culvert15_2yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,504.22 ft	Discharge	65.05 cfs
Inlet Control HW Elev.	1,503.51 ft	Tailwater Elevation	1,502.29 ft
Outlet Control HW Elev.	1,504.22 ft	Control Type	Outlet Control
Headwater Depth/Height	1.01		

Grades			
Upstream Invert	1,501.19 ft	Downstream Invert	1,501.17 ft
Length	176.14 ft	Constructed Slope	0.000066 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	1.50 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.50 ft
Velocity Downstream	6.15 ft/s	Critical Slope	0.014497 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	3.00 ft
Section Size	36 inch	Rise	3.00 ft
Number Sections	3		

Outlet Control Properties			
Outlet Control HW Elev.	1,504.22 ft	Upstream Velocity Head	0.16 ft
Ke	0.90	Entrance Loss	0.14 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,503.51 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	21.2 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report
Culvert15_2yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	7.11	cfs	Allowable HW Elevation	1,504.22	ft
Roadway Width	122.00	ft	Overtopping Coefficient	2.51	US
Low Point	1,504.00	ft	Headwater Elevation	1,504.22	ft
Discharge Coefficient (Cr)	2.51		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,502.29	ft			

Sta (ft)	Elev. (ft)
0.00	1,504.40
24.00	1,504.20
39.60	1,504.20
54.20	1,504.40
63.80	1,504.60
83.20	1,504.60
90.40	1,504.40
108.00	1,504.20
179.00	1,504.00

Culvert Analysis Report
Culvert15_5yr

Comments: Subbasins E-2,3,5,6,7,8,9,10,11,12,13,14,15, and 16 converge at E-15 to E-4

Analysis Component			
Storm Event	Design	Discharge	105.20 cfs

Peak Discharge Method: User-Specified			
Design Discharge	105.20 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	105.20 cfs	Bottom Elevation	1,501.20 ft
Depth	1.33 ft	Velocity	2.65 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-36 inch Circular	70.53 cfs	1,504.39 ft	6.32 ft/s
Weir	Roadway	34.68 cfs	1,504.39 ft	N/A
Total	----------------	105.21 cfs	1,504.39 ft	N/A

Culvert Analysis Report
Culvert15_5yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,504.39 ft	Discharge	70.53 cfs
Inlet Control HW Elev.	1,503.64 ft	Tailwater Elevation	1,502.53 ft
Outlet Control HW Elev.	1,504.39 ft	Control Type	Outlet Control
Headwater Depth/Height	1.07		

Grades			
Upstream Invert	1,501.19 ft	Downstream Invert	1,501.17 ft
Length	176.14 ft	Constructed Slope	0.000066 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	1.56 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.56 ft
Velocity Downstream	6.32 ft/s	Critical Slope	0.014780 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	3.00 ft
Section Size	36 inch	Rise	3.00 ft
Number Sections	3		

Outlet Control Properties			
Outlet Control HW Elev.	1,504.39 ft	Upstream Velocity Head	0.18 ft
Ke	0.90	Entrance Loss	0.16 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,503.64 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	21.2 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report
Culvert15_5yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	34.68	cfs	Allowable HW Elevation	1,504.39	ft
Roadway Width	122.00	ft	Overtopping Coefficient	2.54	US
Low Point	1,504.00	ft	Headwater Elevation	1,504.39	ft
Discharge Coefficient (Cr)	2.54		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,502.53	ft			

Sta (ft)	Elev. (ft)
0.00	1,504.40
24.00	1,504.20
39.60	1,504.20
54.20	1,504.40
63.80	1,504.60
83.20	1,504.60
90.40	1,504.40
108.00	1,504.20
179.00	1,504.00

Culvert Analysis Report
Culvert16_100yr

Comments: Subbasins E-5 and 16 converge at E-16 to E-15

Analysis Component			
Storm Event	Design	Discharge	60.50 cfs

Peak Discharge Method: User-Specified			
Design Discharge	60.50 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	60.50 cfs	Bottom Elevation	1,501.60 ft
Depth	1.87 ft	Velocity	2.18 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-20 inch Circular	35.20 cfs	1,504.91 ft	5.38 ft/s
Weir	Roadway	25.30 cfs	1,504.91 ft	N/A
Total	----------------	60.50 cfs	1,504.91 ft	N/A

Culvert Analysis Report
Culvert16_100yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,504.91	ft	Discharge	35.20	cfs
Inlet Control HW Elev.	1,503.71	ft	Tailwater Elevation	1,503.47	ft
Outlet Control HW Elev.	1,504.91	ft	Control Type	Outlet Control	
Headwater Depth/Height	2.08				

Grades					
Upstream Invert	1,501.44	ft	Downstream Invert	1,501.08	ft
Length	106.75	ft	Constructed Slope	0.003413	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	2.40	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	1.29	ft
Velocity Downstream	5.38	ft/s	Critical Slope	0.007962	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.67	ft
Section Size	20 inch		Rise	1.67	ft
Number Sections	3				

Outlet Control Properties					
Outlet Control HW Elev.	1,504.91	ft	Upstream Velocity Head	0.45	ft
Ke	0.50		Entrance Loss	0.22	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,503.71	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	6.5	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Analysis Report
Culvert16_100yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	25.30	cfs	Allowable HW Elevation	1,504.91	ft
Roadway Width	44.00	ft	Overtopping Coefficient	2.94	US
Low Point	1,504.60	ft	Headwater Elevation	1,504.91	ft
Discharge Coefficient (Cr)	2.94		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,503.47	ft			

Sta (ft)	Elev. (ft)
0.00	1,505.00
13.75	1,504.80
26.00	1,504.60
52.20	1,504.60
78.00	1,504.80
100.50	1,505.00
145.00	1,505.00
194.66	1,504.80

Culvert Analysis Report
Culvert16_10yr

Comments: Subbasins E-5 and 16 converge at E-16 to E-15

Analysis Component			
Storm Event	Design	Discharge	31.60 cfs

Peak Discharge Method: User-Specified			
Design Discharge	31.60 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	31.60 cfs	Bottom Elevation	1,501.60 ft
Depth	1.35 ft	Velocity	1.83 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-20 inch Circular	31.59 cfs	1,504.11 ft	4.83 ft/s
Weir	Roadway	0.00 cfs	1,504.11 ft	N/A
Total	----------------	31.59 cfs	1,504.11 ft	N/A

Culvert Analysis Report
Culvert16_10yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,504.11 ft	Discharge	31.59 cfs
Inlet Control HW Elev.	1,503.49 ft	Tailwater Elevation	1,502.95 ft
Outlet Control HW Elev.	1,504.11 ft	Control Type	Outlet Control
Headwater Depth/Height	1.60		

Grades			
Upstream Invert	1,501.44 ft	Downstream Invert	1,501.08 ft
Length	106.75 ft	Constructed Slope	0.003413 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	1.88 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	1.22 ft
Velocity Downstream	4.83 ft/s	Critical Slope	0.007234 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.67 ft
Section Size	20 inch	Rise	1.67 ft
Number Sections	3		

Outlet Control Properties			
Outlet Control HW Elev.	1,504.11 ft	Upstream Velocity Head	0.36 ft
Ke	0.50	Entrance Loss	0.18 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,503.49 ft	Flow Control	N/A
Inlet Type	Square edge w/headwall	Area Full	6.5 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Analysis Report
Culvert16_10yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	0.00	cfs	Allowable HW Elevation	1,504.11	ft
Roadway Width	44.00	ft	Overtopping Coefficient	2.90	US
Low Point	1,504.60	ft	Headwater Elevation	N/A	ft
Discharge Coefficient (Cr)	2.90		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,502.95	ft			

Sta (ft)	Elev. (ft)
0.00	1,505.00
13.75	1,504.80
26.00	1,504.60
52.20	1,504.60
78.00	1,504.80
100.50	1,505.00
145.00	1,505.00
194.66	1,504.80

Culvert Analysis Report
Culvert16_2yr

Comments: Subbasins E-5 and 16 converge at E-16 to E-15

Analysis Component			
Storm Event	Design	Discharge	15.80 cfs

Peak Discharge Method: User-Specified			
Design Discharge	15.80 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	15.80 cfs	Bottom Elevation	1,501.60 ft
Depth	0.94 ft	Velocity	1.50 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-20 inch Circular	15.79 cfs	1,502.88 ft	2.59 ft/s
Weir	Roadway	0.00 cfs	1,502.88 ft	N/A
Total	----------------	15.79 cfs	1,502.88 ft	N/A

Culvert Analysis Report
Culvert16_2yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,502.88 ft	Discharge	15.79 cfs
Inlet Control HW Elev.	1,502.69 ft	Tailwater Elevation	1,502.54 ft
Outlet Control HW Elev.	1,502.88 ft	Control Type	Outlet Control
Headwater Depth/Height	0.86		

Grades			
Upstream Invert	1,501.44 ft	Downstream Invert	1,501.08 ft
Length	106.75 ft	Constructed Slope	0.003413 ft/ft

Hydraulic Profile			
Profile	M1	Depth, Downstream	1.46 ft
Slope Type	Mild	Normal Depth	0.98 ft
Flow Regime	Subcritical	Critical Depth	0.86 ft
Velocity Downstream	2.59 ft/s	Critical Slope	0.005239 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.67 ft
Section Size	20 inch	Rise	1.67 ft
Number Sections	3		

Outlet Control Properties			
Outlet Control HW Elev.	1,502.88 ft	Upstream Velocity Head	0.15 ft
Ke	0.50	Entrance Loss	0.07 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,502.69 ft	Flow Control	N/A
Inlet Type	Square edge w/headwall	Area Full	6.5 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Analysis Report
Culvert16_2yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	0.00	cfs	Allowable HW Elevation	1,502.88	ft
Roadway Width	44.00	ft	Overtopping Coefficient	2.90	US
Low Point	1,504.60	ft	Headwater Elevation	N/A	ft
Discharge Coefficient (Cr)	2.90		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,502.54	ft			

Sta (ft)	Elev. (ft)
0.00	1,505.00
13.75	1,504.80
26.00	1,504.60
52.20	1,504.60
78.00	1,504.80
100.50	1,505.00
145.00	1,505.00
194.66	1,504.80

Culvert Analysis Report
Culvert16_5yr

Comments: Subbasins E-5 and 16 converge at E-16 to E-15

Analysis Component			
Storm Event	Design	Discharge	23.70 cfs

Peak Discharge Method: User-Specified			
Design Discharge	23.70 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	23.70 cfs	Bottom Elevation	1,501.60 ft
Depth	1.17 ft	Velocity	1.68 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-20 inch Circular	23.71 cfs	1,503.42 ft	3.62 ft/s
Weir	Roadway	0.00 cfs	1,503.42 ft	N/A
Total	----------------	23.71 cfs	1,503.42 ft	N/A

Culvert Analysis Report
Culvert16_5yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,503.42 ft	Discharge	23.71 cfs
Inlet Control HW Elev.	1,503.08 ft	Tailwater Elevation	1,502.77 ft
Outlet Control HW Elev.	1,503.42 ft	Control Type	Outlet Control
Headwater Depth/Height	1.18		

Grades			
Upstream Invert	1,501.44 ft	Downstream Invert	1,501.08 ft
Length	106.75 ft	Constructed Slope	0.003413 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	1.69 ft
Slope Type	N/A	Normal Depth	1.33 ft
Flow Regime	N/A	Critical Depth	1.06 ft
Velocity Downstream	3.62 ft/s	Critical Slope	0.006041 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.67 ft
Section Size	20 inch	Rise	1.67 ft
Number Sections	3		

Outlet Control Properties			
Outlet Control HW Elev.	1,503.42 ft	Upstream Velocity Head	0.20 ft
Ke	0.50	Entrance Loss	0.10 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,503.08 ft	Flow Control	N/A
Inlet Type	Square edge w/headwall	Area Full	6.5 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

Culvert Analysis Report
Culvert16_5yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	0.00	cfs	Allowable HW Elevation	1,503.42	ft
Roadway Width	44.00	ft	Overtopping Coefficient	2.90	US
Low Point	1,504.60	ft	Headwater Elevation	N/A	ft
Discharge Coefficient (Cr)	2.90		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,502.77	ft			

Sta (ft)	Elev. (ft)
0.00	1,505.00
13.75	1,504.80
26.00	1,504.60
52.20	1,504.60
78.00	1,504.80
100.50	1,505.00
145.00	1,505.00
194.66	1,504.80

Culvert Analysis Report
Culvert17_100yr

Comments: Runoff from E-3,11,13, and 14 converge at off site to off site to compute headwater for Culvert 244

Analysis Component			
Storm Event	Design	Discharge	113.50 cfs

Peak Discharge Method: User-Specified			
Design Discharge	113.50 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	113.50 cfs	Bottom Elevation	1,503.80 ft
Depth	2.12 ft	Velocity	3.40 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-12 inch Circular	3.43 cfs	1,506.82 ft	2.19 ft/s
Weir	Roadway	110.43 cfs	1,506.82 ft	N/A
Total	----------------	113.86 cfs	1,506.82 ft	N/A

Culvert Analysis Report
Culvert17_100yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,506.82 ft	Discharge	3.43 cfs
Inlet Control HW Elev.	1,505.92 ft	Tailwater Elevation	1,505.92 ft
Outlet Control HW Elev.	1,506.82 ft	Control Type	Outlet Control
Headwater Depth/Height	3.00		

Grades			
Upstream Invert	1,503.82 ft	Downstream Invert	1,503.69 ft
Length	98.73 ft	Constructed Slope	0.001317 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	2.23 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	0.56 ft
Velocity Downstream	2.19 ft/s	Critical Slope	0.022121 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.00 ft
Section Size	12 inch	Rise	1.00 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	1,506.82 ft	Upstream Velocity Head	0.07 ft
Ke	0.50	Entrance Loss	0.04 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,505.92 ft	Flow Control	N/A
Inlet Type	Headwall	Area Full	1.6 ft²
K	0.00780	HDS 5 Chart	2
M	2.00000	HDS 5 Scale	1
C	0.03790	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert17_100yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	110.43	cfs	Allowable HW Elevation	1,506.82	ft
Roadway Width	68.00	ft	Overtopping Coefficient	2.98	US
Low Point	1,506.20	ft	Headwater Elevation	1,506.82	ft
Discharge Coefficient (Cr)	2.98		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,505.92	ft			

Sta (ft)	Elev. (ft)
0.00	1,506.40
30.16	1,506.40
72.50	1,506.60
98.90	1,506.80
128.50	1,506.60
163.15	1,506.40
197.90	1,506.20

Culvert Analysis Report
Culvert17_10yr

Comments: Runoff from E-3,11,13, and 14 converge at off site to off site to compute headwater for Culvert 244

Analysis Component			
Storm Event	Design	Discharge	58.60 cfs

Peak Discharge Method: User-Specified			
Design Discharge	58.60 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	58.60 cfs	Bottom Elevation	1,503.80 ft
Depth	1.51 ft	Velocity	2.82 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-12 inch Circular	4.71 cfs	1,506.99 ft	3.00 ft/s
Weir	Roadway	54.01 cfs	1,506.99 ft	N/A
Total	----------------	58.72 cfs	1,506.99 ft	N/A

Culvert Analysis Report
Culvert17_10yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,506.99 ft	Discharge	4.71 cfs
Inlet Control HW Elev.	1,505.31 ft	Tailwater Elevation	1,505.31 ft
Outlet Control HW Elev.	1,506.99 ft	Control Type	Outlet Control
Headwater Depth/Height	3.17		

Grades			
Upstream Invert	1,503.82 ft	Downstream Invert	1,503.69 ft
Length	98.73 ft	Constructed Slope	0.001317 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	1.62 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	0.66 ft
Velocity Downstream	3.00 ft/s	Critical Slope	0.025279 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.00 ft
Section Size	12 inch	Rise	1.00 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	1,506.99 ft	Upstream Velocity Head	0.14 ft
Ke	0.50	Entrance Loss	0.07 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,505.31 ft	Flow Control	N/A
Inlet Type	Headwall	Area Full	1.6 ft²
K	0.00780	HDS 5 Chart	2
M	2.00000	HDS 5 Scale	1
C	0.03790	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert17_10yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	54.01	cfs	Allowable HW Elevation	1,506.99	ft
Roadway Width	68.00	ft	Overtopping Coefficient	2.96	US
Low Point	1,506.40	ft	Headwater Elevation	1,506.99	ft
Discharge Coefficient (Cr)	2.96		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,505.31	ft			

Sta (ft)	Elev. (ft)
0.00	1,507.00
84.38	1,507.00
102.60	1,506.80
132.87	1,506.80
155.57	1,506.60
190.23	1,506.40

Culvert Analysis Report
Culvert17_2yr

Comments: Runoff from E-3,11,13, and 14 converge at off site to off site to compute headwater for Culvert 244

Analysis Component			
Storm Event	Design	Discharge	30.10 cfs

Peak Discharge Method: User-Specified			
Design Discharge	30.10 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	30.10 cfs	Bottom Elevation	1,503.80 ft
Depth	1.05 ft	Velocity	2.31 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-12 inch Circular	5.13 cfs	1,506.84 ft	3.27 ft/s
Weir	Roadway	25.02 cfs	1,506.84 ft	N/A
Total	----------------	30.15 cfs	1,506.84 ft	N/A

Culvert Analysis Report
Culvert17_2yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,506.84 ft	Discharge	5.13 cfs
Inlet Control HW Elev.	1,504.90 ft	Tailwater Elevation	1,504.85 ft
Outlet Control HW Elev.	1,506.84 ft	Control Type	Outlet Control
Headwater Depth/Height	3.02		

Grades			
Upstream Invert	1,503.82 ft	Downstream Invert	1,503.69 ft
Length	98.73 ft	Constructed Slope	0.001317 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	1.16 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	0.69 ft
Velocity Downstream	3.27 ft/s	Critical Slope	0.026565 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.00 ft
Section Size	12 inch	Rise	1.00 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	1,506.84 ft	Upstream Velocity Head	0.17 ft
Ke	0.50	Entrance Loss	0.08 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,504.90 ft	Flow Control	N/A
Inlet Type	Headwall	Area Full	1.6 ft²
K	0.00780	HDS 5 Chart	2
M	2.00000	HDS 5 Scale	1
C	0.03790	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert17_2yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	25.02	cfs	Allowable HW Elevation	1,506.84	ft
Roadway Width	68.00	ft	Overtopping Coefficient	2.94	US
Low Point	1,506.40	ft	Headwater Elevation	1,506.84	ft
Discharge Coefficient (Cr)	2.94		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,504.85	ft			

Sta (ft)	Elev. (ft)
0.00	1,507.00
84.38	1,507.00
102.60	1,506.80
132.87	1,506.80
155.57	1,506.60
190.23	1,506.40

Culvert Analysis Report
Culvert17_5yr

Comments: Runoff from E-3,11,13, and 14 converge at off site to off site to compute headwater for Culvert 244

Analysis Component			
Storm Event	Design	Discharge	44.70 cfs

Peak Discharge Method: User-Specified			
Design Discharge	44.70 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	44.70 cfs	Bottom Elevation	1,503.80 ft
Depth	1.30 ft	Velocity	2.60 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-12 inch Circular	4.91 cfs	1,506.92 ft	3.12 ft/s
Weir	Roadway	39.90 cfs	1,506.92 ft	N/A
Total	----------------	44.80 cfs	1,506.92 ft	N/A

Culvert Analysis Report
Culvert17_5yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,506.92 ft	Discharge	4.91 cfs
Inlet Control HW Elev.	1,505.10 ft	Tailwater Elevation	1,505.10 ft
Outlet Control HW Elev.	1,506.92 ft	Control Type	Outlet Control
Headwater Depth/Height	3.10		

Grades			
Upstream Invert	1,503.82 ft	Downstream Invert	1,503.69 ft
Length	98.73 ft	Constructed Slope	0.001317 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	1.41 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	0.67 ft
Velocity Downstream	3.12 ft/s	Critical Slope	0.025852 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.00 ft
Section Size	12 inch	Rise	1.00 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	1,506.92 ft	Upstream Velocity Head	0.15 ft
Ke	0.50	Entrance Loss	0.08 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,505.10 ft	Flow Control	N/A
Inlet Type	Headwall	Area Full	1.6 ft²
K	0.00780	HDS 5 Chart	2
M	2.00000	HDS 5 Scale	1
C	0.03790	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert17_5yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	39.90	cfs	Allowable HW Elevation	1,506.92	ft
Roadway Width	68.00	ft	Overtopping Coefficient	2.95	US
Low Point	1,506.40	ft	Headwater Elevation	1,506.92	ft
Discharge Coefficient (Cr)	2.95		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,505.10	ft			

Sta (ft)	Elev. (ft)
0.00	1,507.00
84.38	1,507.00
102.60	1,506.80
132.87	1,506.80
155.57	1,506.60
190.23	1,506.40

Culvert Analysis Report
Culvert3_100yr

Comments: Subbasin E-3 to E-13

Analysis Component			
Storm Event	Design	Discharge	79.80 cfs

Peak Discharge Method: User-Specified			
Design Discharge	79.80 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	79.80 cfs	Bottom Elevation	1,506.80 ft
Depth	2.24 ft	Velocity	3.15 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-30 inch Circular	5.13 cfs	1,509.09 ft	1.04 ft/s
Weir	Roadway	74.48 cfs	1,509.09 ft	N/A
Total	----------------	79.61 cfs	1,509.09 ft	N/A

Culvert Analysis Report
Culvert3_100yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,509.09	ft	Discharge	5.13	cfs
Inlet Control HW Elev.	1,509.04	ft	Tailwater Elevation	1,509.04	ft
Outlet Control HW Elev.	1,509.09	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.14				

Grades					
Upstream Invert	1,506.23	ft	Downstream Invert	1,506.00	ft
Length	40.43	ft	Constructed Slope	0.005689	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	3.04	ft
Slope Type	N/A		Normal Depth	0.95	ft
Flow Regime	N/A		Critical Depth	0.75	ft
Velocity Downstream	1.04	ft/s	Critical Slope	0.014100	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.50	ft
Section Size	30 inch		Rise	2.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	1,509.09	ft	Upstream Velocity Head	0.02	ft
Ke	0.90		Entrance Loss	0.02	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,509.04	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	4.9	ft²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Analysis Report
Culvert3_100yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	74.48	cfs	Allowable HW Elevation	1,509.09	ft
Roadway Width	30.00	ft	Overtopping Coefficient	2.89	US
Low Point	1,508.20	ft	Headwater Elevation	1,509.09	ft
Discharge Coefficient (Cr)	2.99		Submergence Factor (Kt)	0.97	
Tailwater Elevation	1,509.04	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.40
4.45	1,508.40
34.10	1,508.60
45.95	1,508.80
56.00	1,509.00
65.20	1,509.20
77.70	1,509.20
80.90	1,509.00
99.00	1,508.80
103.20	1,508.60
107.30	1,508.40
109.40	1,508.20

Culvert Analysis Report
Culvert3_10yr

Comments: Subbasin E-3 to E-13

Analysis Component			
Storm Event	Design	Discharge	39.50 cfs

Peak Discharge Method: User-Specified			
Design Discharge	39.50 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	39.50 cfs	Bottom Elevation	1,506.80 ft
Depth	1.58 ft	Velocity	2.61 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-30 inch Circular	14.69 cfs	1,508.81 ft	3.05 ft/s
Weir	Roadway	24.88 cfs	1,508.81 ft	N/A
Total	----------------	39.57 cfs	1,508.81 ft	N/A

Culvert Analysis Report
Culvert3_10yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,508.81 ft	Discharge	14.69 cfs
Inlet Control HW Elev.	1,508.38 ft	Tailwater Elevation	1,508.38 ft
Outlet Control HW Elev.	1,508.81 ft	Control Type	Outlet Control
Headwater Depth/Height	1.03		

Grades			
Upstream Invert	1,506.23 ft	Downstream Invert	1,506.00 ft
Length	40.43 ft	Constructed Slope	0.005689 ft/ft

Hydraulic Profile			
Profile	M1	Depth, Downstream	2.38 ft
Slope Type	Mild	Normal Depth	1.81 ft
Flow Regime	Subcritical	Critical Depth	1.29 ft
Velocity Downstream	3.05 ft/s	Critical Slope	0.015651 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.50 ft
Section Size	30 inch	Rise	2.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,508.81 ft	Upstream Velocity Head	0.15 ft
Ke	0.90	Entrance Loss	0.14 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,508.38 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	4.9 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report
Culvert3_10yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	24.88	cfs	Allowable HW Elevation	1,508.81	ft
Roadway Width	30.00	ft	Overtopping Coefficient	2.95	US
Low Point	1,508.20	ft	Headwater Elevation	1,508.81	ft
Discharge Coefficient (Cr)	2.95		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,508.38	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.40
4.45	1,508.40
34.10	1,508.60
45.95	1,508.80
56.00	1,509.00
65.20	1,509.20
77.70	1,509.20
80.90	1,509.00
99.00	1,508.80
103.20	1,508.60
107.30	1,508.40
109.40	1,508.20

Culvert Analysis Report
Culvert3_2yr

Comments: Subbasin E-3 to E-13

Analysis Component			
Storm Event	Design	Discharge	19.20 cfs

Peak Discharge Method: User-Specified			
Design Discharge	19.20 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	19.20 cfs	Bottom Elevation	1,506.80 ft
Depth	1.09 ft	Velocity	2.13 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-30 inch Circular	15.50 cfs	1,508.57 ft	3.90 ft/s
Weir	Roadway	3.73 cfs	1,508.57 ft	N/A
Total	----------------	19.23 cfs	1,508.57 ft	N/A

Culvert Analysis Report
Culvert3_2yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,508.57 ft	Discharge	15.50 cfs
Inlet Control HW Elev.	1,508.32 ft	Tailwater Elevation	1,507.89 ft
Outlet Control HW Elev.	1,508.57 ft	Control Type	Outlet Control
Headwater Depth/Height	0.93		

Grades			
Upstream Invert	1,506.23 ft	Downstream Invert	1,506.00 ft
Length	40.43 ft	Constructed Slope	0.005689 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	1.89 ft
Slope Type	Mild	Normal Depth	1.90 ft
Flow Regime	Subcritical	Critical Depth	1.33 ft
Velocity Downstream	3.90 ft/s	Critical Slope	0.015871 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.50 ft
Section Size	30 inch	Rise	2.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,508.57 ft	Upstream Velocity Head	0.24 ft
Ke	0.90	Entrance Loss	0.21 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,508.32 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	4.9 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report
Culvert3_2yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	3.73	cfs	Allowable HW Elevation	1,508.57	ft
Roadway Width	30.00	ft	Overtopping Coefficient	2.92	US
Low Point	1,508.20	ft	Headwater Elevation	1,508.57	ft
Discharge Coefficient (Cr)	2.92		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,507.89	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.40
4.45	1,508.40
34.10	1,508.60
45.95	1,508.80
56.00	1,509.00
65.20	1,509.20
77.70	1,509.20
80.90	1,509.00
99.00	1,508.80
103.20	1,508.60
107.30	1,508.40
109.40	1,508.20

Culvert Analysis Report
Culvert3_5yr

Comments: Subbasin E-3 to E-13

Analysis Component			
Storm Event	Design	Discharge	29.50 cfs

Peak Discharge Method: User-Specified			
Design Discharge	29.50 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	29.50 cfs	Bottom Elevation	1,506.80 ft
Depth	1.36 ft	Velocity	2.41 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-30 inch Circular	15.66 cfs	1,508.71 ft	3.47 ft/s
Weir	Roadway	13.85 cfs	1,508.71 ft	N/A
Total	----------------	29.51 cfs	1,508.71 ft	N/A

Culvert Analysis Report
Culvert3_5yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,508.71 ft	Discharge	15.66 cfs
Inlet Control HW Elev.	1,508.34 ft	Tailwater Elevation	1,508.16 ft
Outlet Control HW Elev.	1,508.71 ft	Control Type	Outlet Control
Headwater Depth/Height	0.99		

Grades			
Upstream Invert	1,506.23 ft	Downstream Invert	1,506.00 ft
Length	40.43 ft	Constructed Slope	0.005689 ft/ft

Hydraulic Profile			
Profile	M1	Depth, Downstream	2.16 ft
Slope Type	Mild	Normal Depth	1.92 ft
Flow Regime	Subcritical	Critical Depth	1.34 ft
Velocity Downstream	3.47 ft/s	Critical Slope	0.015917 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.50 ft
Section Size	30 inch	Rise	2.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,508.71 ft	Upstream Velocity Head	0.19 ft
Ke	0.90	Entrance Loss	0.18 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,508.34 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	4.9 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report
Culvert3_5yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	13.85	cfs	Allowable HW Elevation	1,508.71	ft
Roadway Width	30.00	ft	Overtopping Coefficient	2.94	US
Low Point	1,508.20	ft	Headwater Elevation	1,508.71	ft
Discharge Coefficient (Cr)	2.94		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,508.16	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.40
4.45	1,508.40
34.10	1,508.60
45.95	1,508.80
56.00	1,509.00
65.20	1,509.20
77.70	1,509.20
80.90	1,509.00
99.00	1,508.80
103.20	1,508.60
107.30	1,508.40
109.40	1,508.20

Culvert Analysis Report
Culvert5_100yr

Comments: Subbasin E-5 to E-16

Analysis Component			
Storm Event	Design	Discharge	31.40 cfs

Peak Discharge Method: User-Specified			
Design Discharge	31.40 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	31.40 cfs	Bottom Elevation	1,504.40 ft
Depth	0.65 ft	Velocity	4.90 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-19 inch Circular	26.18 cfs	1,506.55 ft	5.81 ft/s
Weir	Roadway	5.24 cfs	1,506.55 ft	N/A
Total	----------------	31.42 cfs	1,506.55 ft	N/A

Culvert Analysis Report
Culvert5_100yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,506.55	ft	Discharge	26.18	cfs
Inlet Control HW Elev.	1,506.23	ft	Tailwater Elevation	1,505.05	ft
Outlet Control HW Elev.	1,506.55	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.37				

Grades					
Upstream Invert	1,504.38	ft	Downstream Invert	1,504.29	ft
Length	90.80	ft	Constructed Slope	0.001068	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.13	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.13	ft
Velocity Downstream	5.81	ft/s	Critical Slope	0.007035	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.58	ft
Section Size	19 inch		Rise	1.58	ft
Number Sections	3				

Outlet Control Properties					
Outlet Control HW Elev.	1,506.55	ft	Upstream Velocity Head	0.31	ft
Ke	0.50		Entrance Loss	0.15	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,506.23	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	5.9	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Analysis Report
Culvert5_100yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	5.24	cfs	Allowable HW Elevation	1,506.55	ft
Roadway Width	44.00	ft	Overtopping Coefficient	2.92	US
Low Point	1,506.20	ft	Headwater Elevation	1,506.55	ft
Discharge Coefficient (Cr)	2.92		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,505.05	ft			

Sta (ft)	Elev. (ft)
0.00	1,506.20
13.14	1,506.40
26.30	1,506.60
41.40	1,506.80
59.80	1,507.00
140.00	1,507.00

Culvert Analysis Report
Culvert5_10yr

Comments: Subbasin E-5 to E-16

Analysis Component			
Storm Event	Design	Discharge	16.70 cfs

Peak Discharge Method: User-Specified			
Design Discharge	16.70 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	16.70 cfs	Bottom Elevation	1,504.40 ft
Depth	0.45 ft	Velocity	3.99 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-19 inch Circular	16.69 cfs	1,505.90 ft	4.85 ft/s
Weir	Roadway	0.00 cfs	1,505.90 ft	N/A
Total	----------------	16.69 cfs	1,505.90 ft	N/A

Culvert Analysis Report
Culvert5_10yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,505.90	ft	Discharge	16.69	cfs
Inlet Control HW Elev.	1,505.72	ft	Tailwater Elevation	1,504.85	ft
Outlet Control HW Elev.	1,505.90	ft	Control Type	Outlet Control	
Headwater Depth/Height	0.96				

Grades					
Upstream Invert	1,504.38	ft	Downstream Invert	1,504.29	ft
Length	90.80	ft	Constructed Slope	0.001068	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	0.89	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	0.89	ft
Velocity Downstream	4.85	ft/s	Critical Slope	0.005618	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.58	ft
Section Size	19 inch		Rise	1.58	ft
Number Sections	3				

Outlet Control Properties					
Outlet Control HW Elev.	1,505.90	ft	Upstream Velocity Head	0.17	ft
Ke	0.50		Entrance Loss	0.09	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,505.72	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	5.9	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Analysis Report
Culvert5_10yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	0.00	cfs	Allowable HW Elevation	1,505.90	ft
Roadway Width	44.00	ft	Overtopping Coefficient	2.90	US
Low Point	1,506.20	ft	Headwater Elevation	N/A	ft
Discharge Coefficient (Cr)	2.90		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,504.85	ft			

Sta (ft)	Elev. (ft)
0.00	1,506.20
13.14	1,506.40
26.30	1,506.60
41.40	1,506.80
59.80	1,507.00
140.00	1,507.00

Culvert Analysis Report
Culvert5_2 yr

Comments: Subbasin E-5 to E-16

Analysis Component			
Storm Event	Design	Discharge	8.30 cfs

Peak Discharge Method: User-Specified			
Design Discharge	8.30 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	8.30 cfs	Bottom Elevation	1,504.40 ft
Depth	0.30 ft	Velocity	3.13 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-19 inch Circular	8.30 cfs	1,505.39 ft	3.86 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report
Culvert5_2 yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,505.39	ft	Discharge	8.30	cfs
Inlet Control HW Elev.	1,505.26	ft	Tailwater Elevation	1,504.70	ft
Outlet Control HW Elev.	1,505.39	ft	Control Type	Outlet Control	
Headwater Depth/Height	0.64				

Grades					
Upstream Invert	1,504.38	ft	Downstream Invert	1,504.29	ft
Length	90.80	ft	Constructed Slope	0.001068	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	0.62	ft
Slope Type	Mild		Normal Depth	0.97	ft
Flow Regime	Subcritical		Critical Depth	0.62	ft
Velocity Downstream	3.86	ft/s	Critical Slope	0.004923	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.58	ft
Section Size	19 inch		Rise	1.58	ft
Number Sections	3				

Outlet Control Properties					
Outlet Control HW Elev.	1,505.39	ft	Upstream Velocity Head	0.10	ft
Ke	0.50		Entrance Loss	0.05	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,505.26	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	5.9	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Analysis Report
Culvert5_5yr

Comments: Subbasin E-5 to E-16

Analysis Component			
Storm Event	Design	Discharge	12.70 cfs

Peak Discharge Method: User-Specified			
Design Discharge	12.70 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	12.70 cfs	Bottom Elevation	1,504.40 ft
Depth	0.39 ft	Velocity	3.63 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-19 inch Circular	12.71 cfs	1,505.67 ft	4.41 ft/s
Weir	Roadway	0.00 cfs	1,505.67 ft	N/A
Total	----------------	12.71 cfs	1,505.67 ft	N/A

Culvert Analysis Report
Culvert5_5yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,505.67	ft	Discharge	12.71	cfs
Inlet Control HW Elev.	1,505.51	ft	Tailwater Elevation	1,504.79	ft
Outlet Control HW Elev.	1,505.67	ft	Control Type	Outlet Control	
Headwater Depth/Height	0.81				

Grades					
Upstream Invert	1,504.38	ft	Downstream Invert	1,504.29	ft
Length	90.80	ft	Constructed Slope	0.001068	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	0.78	ft
Slope Type	Mild		Normal Depth	1.43	ft
Flow Regime	Subcritical		Critical Depth	0.78	ft
Velocity Downstream	4.41	ft/s	Critical Slope	0.005223	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.58	ft
Section Size	19 inch		Rise	1.58	ft
Number Sections	3				

Outlet Control Properties					
Outlet Control HW Elev.	1,505.67	ft	Upstream Velocity Head	0.14	ft
Ke	0.50		Entrance Loss	0.07	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,505.51	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	5.9	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Analysis Report
Culvert5_5yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	0.00	cfs	Allowable HW Elevation	1,505.67	ft
Roadway Width	44.00	ft	Overtopping Coefficient	2.90	US
Low Point	1,506.20	ft	Headwater Elevation	N/A	ft
Discharge Coefficient (Cr)	2.90		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,504.79	ft			

Sta (ft)	Elev. (ft)
0.00	1,506.20
13.14	1,506.40
26.30	1,506.60
41.40	1,506.80
59.80	1,507.00
140.00	1,507.00

Culvert Analysis Report
Culvert6_100yr

Comments: Subbasins E-2,9,7,8, and 6 converge at E-6 to E-12

Analysis Component			
Storm Event	Design	Discharge	80.30 cfs

Peak Discharge Method: User-Specified			
Design Discharge	80.30 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	80.30 cfs	Bottom Elevation	1,505.80 ft
Depth	1.02 ft	Velocity	2.49 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	21.61 cfs	1,508.70 ft	7.67 ft/s
Weir	Roadway	58.78 cfs	1,508.70 ft	N/A
Total	----------------	80.39 cfs	1,508.70 ft	N/A

Culvert Analysis Report
Culvert6_100yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,508.70	ft	Discharge	21.61	cfs
Inlet Control HW Elev.	1,508.46	ft	Tailwater Elevation	1,506.82	ft
Outlet Control HW Elev.	1,508.70	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.56				

Grades					
Upstream Invert	1,505.58	ft	Downstream Invert	1,505.14	ft
Length	93.94	ft	Constructed Slope	0.004684	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.68	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.66	ft
Velocity Downstream	7.67	ft/s	Critical Slope	0.008906	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	1,508.70	ft	Upstream Velocity Head	0.74	ft
Ke	0.20		Entrance Loss	0.15	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,508.46	ft	Flow Control	N/A	
Inlet Type	Groove end projecting		Area Full	3.1	ft²
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Culvert Analysis Report
Culvert6_100yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	58.78	cfs	Allowable HW Elevation	1,508.70	ft
Roadway Width	33.00	ft	Overtopping Coefficient	2.97	US
Low Point	1,508.20	ft	Headwater Elevation	1,508.70	ft
Discharge Coefficient (Cr)	2.97		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,506.82	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.60
10.69	1,508.40
29.25	1,508.40
46.69	1,508.60
93.43	1,508.60
127.43	1,508.40
164.89	1,508.20

Culvert Analysis Report
Culvert6_10yr

Comments: Subbasins E-2,9,7,8, and 6 converge at E-6 to E-12

Analysis Component			
Storm Event	Design	Discharge	41.90 cfs

Peak Discharge Method: User-Specified			
Design Discharge	41.90 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	41.90 cfs	Bottom Elevation	1,505.80 ft
Depth	0.74 ft	Velocity	2.09 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	20.84 cfs	1,508.56 ft	7.57 ft/s
Weir	Roadway	21.13 cfs	1,508.56 ft	N/A
Total	----------------	41.97 cfs	1,508.56 ft	N/A

Culvert Analysis Report
Culvert6_10yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,508.56 ft	Discharge	20.84 cfs
Inlet Control HW Elev.	1,508.35 ft	Tailwater Elevation	1,506.54 ft
Outlet Control HW Elev.	1,508.56 ft	Control Type	Outlet Control
Headwater Depth/Height	1.49		

Grades			
Upstream Invert	1,505.58 ft	Downstream Invert	1,505.14 ft
Length	93.94 ft	Constructed Slope	0.004684 ft/ft

Hydraulic Profile			
Profile	CompositeM2PressureProfile	Depth, Downstream	1.64 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.64 ft
Velocity Downstream	7.57 ft/s	Critical Slope	0.008515 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,508.56 ft	Upstream Velocity Head	0.68 ft
Ke	0.20	Entrance Loss	0.14 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,508.35 ft	Flow Control	N/A
Inlet Type	Groove end projecting	Area Full	3.1 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert6_10yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	21.13	cfs	Allowable HW Elevation	1,508.56	ft
Roadway Width	33.00	ft	Overtopping Coefficient	2.94	US
Low Point	1,508.20	ft	Headwater Elevation	1,508.56	ft
Discharge Coefficient (Cr)	2.94		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,506.54	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.60
10.69	1,508.40
29.25	1,508.40
46.69	1,508.60
93.43	1,508.60
127.43	1,508.40
164.89	1,508.20

Culvert Analysis Report
Culvert6_2yr

Comments: Subbasins E-2,9,7,8, and 6 converge at E-6 to E-12

Analysis Component			
Storm Event	Design	Discharge	21.40 cfs

Peak Discharge Method: User-Specified			
Design Discharge	21.40 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	21.40 cfs	Bottom Elevation	1,505.80 ft
Depth	0.53 ft	Velocity	1.73 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	19.72 cfs	1,508.35 ft	7.34 ft/s
Weir	Roadway	1.70 cfs	1,508.35 ft	N/A
Total	----------------	21.42 cfs	1,508.35 ft	N/A

Culvert Analysis Report
Culvert6_2yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,508.35 ft	Discharge	19.72 cfs
Inlet Control HW Elev.	1,508.20 ft	Tailwater Elevation	1,506.33 ft
Outlet Control HW Elev.	1,508.35 ft	Control Type	Outlet Control
Headwater Depth/Height	1.39		

Grades			
Upstream Invert	1,505.58 ft	Downstream Invert	1,505.14 ft
Length	93.94 ft	Constructed Slope	0.004684 ft/ft

Hydraulic Profile			
Profile	CompositeM2PressureProfile	Depth, Downstream	1.60 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.60 ft
Velocity Downstream	7.34 ft/s	Critical Slope	0.007994 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	1,508.35 ft	Upstream Velocity Head	0.61 ft
Ke	0.20	Entrance Loss	0.12 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,508.20 ft	Flow Control	N/A
Inlet Type	Groove end projecting	Area Full	3.1 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert6_2yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	1.70	cfs	Allowable HW Elevation	1,508.35	ft
Roadway Width	33.00	ft	Overtopping Coefficient	2.91	US
Low Point	1,508.20	ft	Headwater Elevation	1,508.35	ft
Discharge Coefficient (Cr)	2.91		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,506.33	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.60
10.69	1,508.40
29.25	1,508.40
46.69	1,508.60
93.43	1,508.60
127.43	1,508.40
164.89	1,508.20

Culvert Analysis Report
Culvert6_5yr

Comments: Subbasins E-2,9,7,8, and 6 converge at E-6 to E-12

Analysis Component			
Storm Event	Design	Discharge	31.40 cfs

Peak Discharge Method: User-Specified			
Design Discharge	31.40 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	31.40 cfs	Bottom Elevation	1,505.80 ft
Depth	0.64 ft	Velocity	1.93 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	20.45 cfs	1,508.49 ft	7.49 ft/s
Weir	Roadway	10.95 cfs	1,508.49 ft	N/A
Total	----------------	31.41 cfs	1,508.49 ft	N/A

Culvert Analysis Report
Culvert6_5yr

Component:Culvert-1

Culvert Summary

Computed Headwater Elevation	1,508.49 ft	Discharge	20.45 cfs
Inlet Control HW Elev.	1,508.30 ft	Tailwater Elevation	1,506.44 ft
Outlet Control HW Elev.	1,508.49 ft	Control Type	Outlet Control
Headwater Depth/Height	1.45		

Grades

Upstream Invert	1,505.58 ft	Downstream Invert	1,505.14 ft
Length	93.94 ft	Constructed Slope	0.004684 ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile	Depth, Downstream	1.62 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.62 ft
Velocity Downstream	7.49 ft/s	Critical Slope	0.008329 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	1,508.49 ft	Upstream Velocity Head	0.66 ft
Ke	0.20	Entrance Loss	0.13 ft

Inlet Control Properties

Inlet Control HW Elev.	1,508.30 ft	Flow Control	N/A
Inlet Type	Groove end projecting	Area Full	3.1 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report
Culvert6_5yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	10.95	cfs	Allowable HW Elevation	1,508.49	ft
Roadway Width	33.00	ft	Overtopping Coefficient	2.92	US
Low Point	1,508.20	ft	Headwater Elevation	1,508.49	ft
Discharge Coefficient (Cr)	2.92		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,506.44	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.60
10.69	1,508.40
29.25	1,508.40
46.69	1,508.60
93.43	1,508.60
127.43	1,508.40
164.89	1,508.20

Culvert Analysis Report
Culvert7_100yr

Comments: Subbasins E-2, 9, 8, and 7 converge at E-7 to E-6

Analysis Component			
Storm Event	Design	Discharge	64.70 cfs

Peak Discharge Method: User-Specified			
Design Discharge	64.70 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	64.70 cfs	Bottom Elevation	1,507.20 ft
Depth	0.44 ft	Velocity	2.40 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-15 inch Circular	8.75 cfs	1,508.30 ft	3.56 ft/s
Weir	Roadway	56.08 cfs	1,508.30 ft	N/A
Total	----------------	64.82 cfs	1,508.30 ft	N/A

Culvert Analysis Report
Culvert7_100yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,508.30 ft	Discharge	8.75 cfs
Inlet Control HW Elev.	1,508.07 ft	Tailwater Elevation	1,507.64 ft
Outlet Control HW Elev.	1,508.30 ft	Control Type	Outlet Control
Headwater Depth/Height	1.36		

Grades			
Upstream Invert	1,506.60 ft	Downstream Invert	1,506.39 ft
Length	61.10 ft	Constructed Slope	0.003519 ft/ft

Hydraulic Profile			
Profile	PressureProfile	Depth, Downstream	1.26 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	0.85 ft
Velocity Downstream	3.56 ft/s	Critical Slope	0.007127 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Steel	Span	1.25 ft
Section Size	15 inch	Rise	1.25 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	1,508.30 ft	Upstream Velocity Head	0.20 ft
Ke	0.90	Entrance Loss	0.18 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,508.07 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	2.5 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report
Culvert7_100yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	56.08	cfs	Allowable HW Elevation	1,508.30	ft
Roadway Width	50.50	ft	Overtopping Coefficient	2.97	US
Low Point	1,507.60	ft	Headwater Elevation	1,508.30	ft
Discharge Coefficient (Cr)	2.97		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,507.64	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.40
73.19	1,508.20
114.07	1,508.20
144.24	1,508.20
163.55	1,508.00
182.82	1,507.80
203.76	1,507.60

Culvert Analysis Report
Culvert7_10yr

Comments: Subbasins E-2, 9, 8, and 7 converge at E-7 to E-6

Analysis Component			
Storm Event	Design	Discharge	33.40 cfs

Peak Discharge Method: User-Specified			
Design Discharge	33.40 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	33.40 cfs	Bottom Elevation	1,507.20 ft
Depth	0.31 ft	Velocity	1.96 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-15 inch Circular	8.54 cfs	1,508.14 ft	3.67 ft/s
Weir	Roadway	24.91 cfs	1,508.14 ft	N/A
Total	----------------	33.46 cfs	1,508.14 ft	N/A

Culvert Analysis Report
Culvert7_10yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,508.14	ft	Discharge	8.54	cfs
Inlet Control HW Elev.	1,508.04	ft	Tailwater Elevation	1,507.51	ft
Outlet Control HW Elev.	1,508.14	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.23				

Grades					
Upstream Invert	1,506.60	ft	Downstream Invert	1,506.39	ft
Length	61.10	ft	Constructed Slope	0.003519	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.13	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	0.84	ft
Velocity Downstream	3.67	ft/s	Critical Slope	0.007030	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Steel		Span	1.25	ft
Section Size	15 inch		Rise	1.25	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	1,508.14	ft	Upstream Velocity Head	0.20	ft
Ke	0.90		Entrance Loss	0.18	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,508.04	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	2.5	ft^2
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Analysis Report
Culvert7_10yr

Component:Weir

Hydraulic Component(s): Roadway			
Discharge	24.91 cfs	Allowable HW Elevation	1,508.14 ft
Roadway Width	50.50 ft	Overtopping Coefficient	2.94 US
Low Point	1,507.60 ft	Headwater Elevation	1,508.14 ft
Discharge Coefficient (Cr)	2.94	Submergence Factor (Kt)	1.00
Tailwater Elevation	1,507.51 ft		

Sta (ft)	Elev. (ft)
0.00	1,508.40
73.19	1,508.20
114.07	1,508.20
144.24	1,508.20
163.55	1,508.00
182.82	1,507.80
203.76	1,507.60

Culvert Analysis Report
Culvert7_2yr

Comments: Subbasins E-2, 9, 8, and 7 converge at E-7 to E-6

Analysis Component			
Storm Event	Design	Discharge	16.80 cfs

Peak Discharge Method: User-Specified			
Design Discharge	16.80 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	16.80 cfs	Bottom Elevation	1,507.20 ft
Depth	0.21 ft	Velocity	1.57 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-15 inch Circular	7.38 cfs	1,507.96 ft	3.42 ft/s
Weir	Roadway	9.43 cfs	1,507.96 ft	N/A
Total	----------------	16.80 cfs	1,507.96 ft	N/A

Culvert Analysis Report
Culvert7_2yr

Component:Culvert-1

Culvert Summary			
Computed Headwater Elevation	1,507.96 ft	Discharge	7.38 cfs
Inlet Control HW Elev.	1,507.89 ft	Tailwater Elevation	1,507.41 ft
Outlet Control HW Elev.	1,507.96 ft	Control Type	Outlet Control
Headwater Depth/Height	1.09		

Grades			
Upstream Invert	1,506.60 ft	Downstream Invert	1,506.39 ft
Length	61.10 ft	Constructed Slope	0.003519 ft/ft

Hydraulic Profile			
Profile	M1	Depth, Downstream	1.03 ft
Slope Type	Mild	Normal Depth	0.98 ft
Flow Regime	Subcritical	Critical Depth	0.78 ft
Velocity Downstream	3.42 ft/s	Critical Slope	0.006523 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Steel	Span	1.25 ft
Section Size	15 inch	Rise	1.25 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	1,507.96 ft	Upstream Velocity Head	0.19 ft
Ke	0.90	Entrance Loss	0.17 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,507.89 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	2.5 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report
Culvert7_2yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	9.43	cfs	Allowable HW Elevation	1,507.96	ft
Roadway Width	50.50	ft	Overtopping Coefficient	2.92	US
Low Point	1,507.60	ft	Headwater Elevation	1,507.96	ft
Discharge Coefficient (Cr)	2.92		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,507.41	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.40
73.19	1,508.20
114.07	1,508.20
144.24	1,508.20
163.55	1,508.00
182.82	1,507.80
203.76	1,507.60

Culvert Analysis Report
Culvert7_5yr

Comments: Subbasins E-2, 9, 8, and 7 converge at E-7 to E-6

Analysis Component			
Storm Event	Design	Discharge	24.80 cfs

Peak Discharge Method: User-Specified			
Design Discharge	24.80 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	24.80 cfs	Bottom Elevation	1,507.20 ft
Depth	0.26 ft	Velocity	1.79 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-15 inch Circular	8.05 cfs	1,508.06 ft	3.58 ft/s
Weir	Roadway	16.79 cfs	1,508.06 ft	N/A
Total	----------------	24.85 cfs	1,508.06 ft	N/A

Culvert Analysis Report
Culvert7_5yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	1,508.06	ft	Discharge	8.05	cfs
Inlet Control HW Elev.	1,507.98	ft	Tailwater Elevation	1,507.46	ft
Outlet Control HW Elev.	1,508.06	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.17				

Grades					
Upstream Invert	1,506.60	ft	Downstream Invert	1,506.39	ft
Length	61.10	ft	Constructed Slope	0.003519	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.08	ft
Slope Type	Mild		Normal Depth	1.09	ft
Flow Regime	Subcritical		Critical Depth	0.81	ft
Velocity Downstream	3.58	ft/s	Critical Slope	0.006806	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Steel		Span	1.25	ft
Section Size	15 inch		Rise	1.25	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	1,508.06	ft	Upstream Velocity Head	0.20	ft
Ke	0.90		Entrance Loss	0.18	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,507.98	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	2.5	ft²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Analysis Report
Culvert7_5yr

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	16.79	cfs	Allowable HW Elevation	1,508.06	ft
Roadway Width	50.50	ft	Overtopping Coefficient	2.93	US
Low Point	1,507.60	ft	Headwater Elevation	1,508.06	ft
Discharge Coefficient (Cr)	2.93		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,507.46	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.40
73.19	1,508.20
114.07	1,508.20
144.24	1,508.20
163.55	1,508.00
182.82	1,507.80
203.76	1,507.60

Worksheet for 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01500	ft/ft
Discharge	132.30	ft^3/s
Section Definitions		

Station (ft)	Elevation (ft)
0+00	1505.40
0+01	1505.20
0+02	1505.00
0+03	1504.80
0+04	1504.60
0+04	1504.40
0+05	1504.20
0+05	1504.00
0+06	1503.80
0+08	1503.60
0+08	1503.40
0+09	1503.20
0+10	1503.00
0+11	1502.80
0+13	1502.60
0+14	1502.40
0+21	1502.20
0+24	1502.00
0+27	1501.80
0+36	1501.60
0+38	1501.60
0+50	1501.80
0+51	1502.00
0+53	1502.20
0+53	1502.40
0+54	1502.60
0+55	1502.80

Worksheet for 1

Input Data

Station (ft)	Elevation (ft)
0+56	1503.00
0+57	1503.20
0+58	1503.40
0+58	1503.60
0+60	1503.80
0+61	1504.00
0+62	1504.20
0+63	1504.60
0+63	1504.80
0+64	1505.00
0+65	1505.20
0+66	1505.40

Start Station	Ending Station	Roughness Coefficient
(0+00, 1505.40)	(0+66, 1505.40)	0.015

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.72	ft
Elevation Range	1501.60 to 1505.40 ft	
Flow Area	17.73	ft²
Wetted Perimeter	36.78	ft
Hydraulic Radius	0.48	ft
Top Width	36.71	ft

Worksheet for 1

Results

Normal Depth		0.72	ft
Critical Depth		0.98	ft
Critical Slope		0.00374	ft/ft
Velocity		7.46	ft/s
Velocity Head		0.87	ft
Specific Energy		1.59	ft
Froude Number		1.89	
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	0.72	ft
Critical Depth	0.98	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.00374	ft/ft

Worksheet for 2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00200	ft/ft
Discharge	137.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	1503.00
0+08	1502.80
0+13	1502.60
0+15	1502.40
0+18	1502.20
0+21	1502.00
0+24	1501.80
0+26	1501.60
0+35	1501.60
0+38	1501.80
0+40	1502.00
0+41	1502.20
0+42	1502.40
0+43	1502.60
0+44	1502.80
0+45	1503.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 1503.00)	(0+45, 1503.00)	0.025

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method

Worksheet for 2

Options

Closed Channel Weighting Method	Pavlovskii's Method	

Results

Normal Depth	1.71	ft
Elevation Range	1501.60 to 1503.00 ft	
Flow Area	49.18	ft²
Wetted Perimeter	45.78	ft
Hydraulic Radius	1.07	ft
Top Width	45.00	ft
Normal Depth	1.71	ft
Critical Depth	1.21	ft
Critical Slope	0.01002	ft/ft
Velocity	2.79	ft/s
Velocity Head	0.12	ft
Specific Energy	1.83	ft
Froude Number	0.47	
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	1.71	ft
Critical Depth	1.21	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.01002	ft/ft

Worksheet for 3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00070	ft/ft
Discharge	31.60	ft³/s
Section Definitions		

Station (ft)	Elevation (ft)
0+00	1505.00
0+15	1504.80
0+22	1504.60
0+27	1504.40
0+30	1504.20
0+34	1504.00
0+38	1503.80
0+41	1503.60
0+52	1503.40
0+60	1503.20
0+77	1503.40
0+93	1503.60
1+13	1503.80
1+18	1504.00
1+22	1504.20
1+28	1504.40
1+33	1504.60
1+36	1504.80
1+38	1505.00
1+39	1505.20
1+40	1505.40

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient

Worksheet for 3

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+00, 1505.00)	(1+40, 1505.40)	0.025

Options

Current Roughness Weighted Method	Pavlovskii's Method		
Open Channel Weighting Method	Pavlovskii's Method		
Closed Channel Weighting Method	Pavlovskii's Method		

Results

Normal Depth		0.76	ft
Elevation Range	1503.20 to 1505.40 ft		
Flow Area		35.28	ft²
Wetted Perimeter		82.12	ft
Hydraulic Radius		0.43	ft
Top Width		82.10	ft
Normal Depth		0.76	ft
Critical Depth		0.43	ft
Critical Slope		0.01521	ft/ft
Velocity		0.90	ft/s
Velocity Head		0.01	ft
Specific Energy		0.77	ft
Froude Number		0.24	
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		0.76	ft
Critical Depth		0.43	ft

Worksheet for 3

GVF Output Data

Channel Slope	0.00070	ft/ft
Critical Slope	0.01521	ft/ft

Worksheet for 4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00050	ft/ft
Discharge	105.50	ft³/s
Section Definitions		

Station (ft)	Elevation (ft)
0+00	1505.60
0+08	1505.40
0+10	1505.20
0+13	1505.00
0+17	1504.80
0+21	1504.60
0+24	1504.40
0+32	1504.20
0+38	1504.00
0+45	1503.80
0+48	1503.60
0+51	1503.60
0+55	1503.80
0+56	1504.00
0+58	1504.20
0+61	1504.40
0+74	1504.60
0+85	1504.80
0+87	1505.00
0+93	1505.20
0+97	1505.40

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient

Worksheet for 4

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+00, 1505.60)	(0+97, 1505.40)	0.025

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		1.80	ft
Elevation Range	1503.60 to 1505.60 ft		
Flow Area		83.17	ft²
Wetted Perimeter		89.19	ft
Hydraulic Radius		0.93	ft
Top Width		89.08	ft
Normal Depth		1.80	ft
Critical Depth		1.06	ft
Critical Slope		0.01172	ft/ft
Velocity		1.27	ft/s
Velocity Head		0.03	ft
Specific Energy		1.83	ft
Froude Number		0.23	
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	1.80	ft
Critical Depth	1.06	ft

Worksheet for 4

GVF Output Data

Channel Slope	0.00050	ft/ft
Critical Slope	0.01172	ft/ft

Worksheet for 5

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00300	ft/ft
Discharge	16.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	1508.20
0+03	1508.00
0+14	1507.80
0+18	1507.60
0+23	1507.40
0+32	1507.20
0+47	1507.00
0+84	1506.80
1+05	1506.80
1+13	1507.00
1+22	1507.20
1+26	1507.40
1+29	1507.60
1+32	1507.80
1+34	1508.00
1+36	1508.20

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 1508.20)	(1+36, 1508.20)	0.025

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method

Worksheet for 5

Options

Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.29	ft
Elevation Range	1506.80 to 1508.20 ft		
Flow Area		15.14	ft²
Wetted Perimeter		76.83	ft
Hydraulic Radius		0.20	ft
Top Width		76.83	ft
Normal Depth		0.29	ft
Critical Depth		0.19	ft
Critical Slope		0.01807	ft/ft
Velocity		1.10	ft/s
Velocity Head		0.02	ft
Specific Energy		0.31	ft
Froude Number		0.44	
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	0.29	ft
Critical Depth	0.19	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.01807	ft/ft

Worksheet for 6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00160	ft/ft
Discharge	67.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	1507.00
0+01	1506.80
0+03	1506.60
0+15	1506.40
0+19	1506.20
0+21	1506.00
0+23	1505.80
0+26	1505.60
0+27	1505.40
0+29	1505.20
0+30	1505.00
0+32	1504.80
0+37	1504.60
0+45	1504.60
0+50	1504.80
0+55	1505.00
0+62	1505.20
0+68	1505.40
0+73	1505.60
0+77	1505.80
0+79	1506.00
0+79	1506.20
0+80	1506.40

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient

Worksheet for 6

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+00, 1507.00)	(0+80, 1506.40)	0.025

Options

Current Roughness Weighted Method	Pavlovskii's Method	
Open Channel Weighting Method	Pavlovskii's Method	
Closed Channel Weighting Method	Pavlovskii's Method	

Results

Normal Depth	1.15	ft
Elevation Range	1504.60 to 1507.00 ft	
Flow Area	36.07	ft²
Wetted Perimeter	52.12	ft
Hydraulic Radius	0.69	ft
Top Width	52.02	ft
Normal Depth	1.15	ft
Critical Depth	0.73	ft
Critical Slope	0.01185	ft/ft
Velocity	1.86	ft/s
Velocity Head	0.05	ft
Specific Energy	1.20	ft
Froude Number	0.39	
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	1.15	ft
Critical Depth	0.73	ft
Channel Slope	0.00160	ft/ft

Worksheet for 6

GVF Output Data

Critical Slope	0.01185	ft/ft

Worksheet for 7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00220	ft/ft
Discharge	8.50	ft³/s
Section Definitions		

Station (ft)	Elevation (ft)
0+00	1509.80
0+11	1509.60
0+18	1509.40
0+22	1509.20
0+91	1509.20
1+05	1509.20
1+28	1509.00
1+30	1509.00
1+37	1509.20
1+52	1509.40

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 1509.80)	(1+52, 1509.40)	0.025

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.28	ft
Elevation Range	1509.00 to 1509.80 ft	
Flow Area	13.38	ft²

Worksheet for 7

Results

Wetted Perimeter		122.97	ft
Hydraulic Radius		0.11	ft
Top Width		122.97	ft
Normal Depth		0.28	ft
Critical Depth		0.23	ft
Critical Slope		0.02402	ft/ft
Velocity		0.64	ft/s
Velocity Head		0.01	ft
Specific Energy		0.29	ft
Froude Number		0.34	
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	0.28	ft
Critical Depth	0.23	ft
Channel Slope	0.00220	ft/ft
Critical Slope	0.02402	ft/ft

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: EloyAirport
Project File : EloyAirport.prj
Run Date and Time: 12/16/2013 4:45:17 PM

Project in English units

PLAN DATA

Plan Title: Existing
Plan File : k:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\Drainage\Hydraulics\HEC-RAS\EloyAirport.p04

Geometry Title: Existing
Geometry File : k:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\Drainage\Hydraulics\HEC-RAS\EloyAirport.g01

Flow Title   : Existing
Flow File   : k:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\Drainage\Hydraulics\HEC-RAS\EloyAirport.f03

Plan Summary Information:

Number of:					
Cross Sections	=	44	Multiple Openings	=	0
Culverts	=	8	Inline Structures	=	0
Bridges	=	0	Lateral Structures	=	11

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 40
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

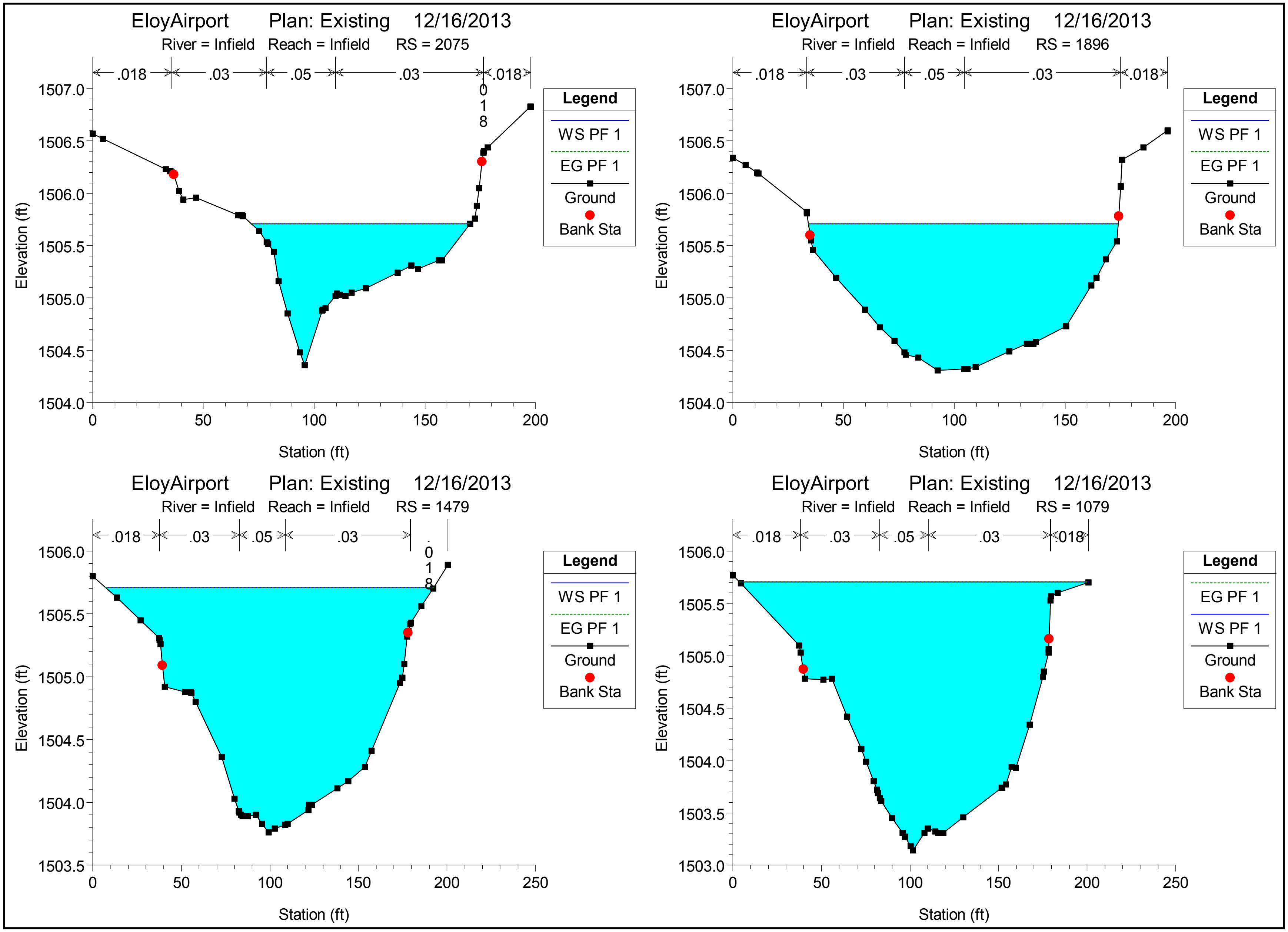
Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

HEC-RAS Plan: Exist Profile: PF 1

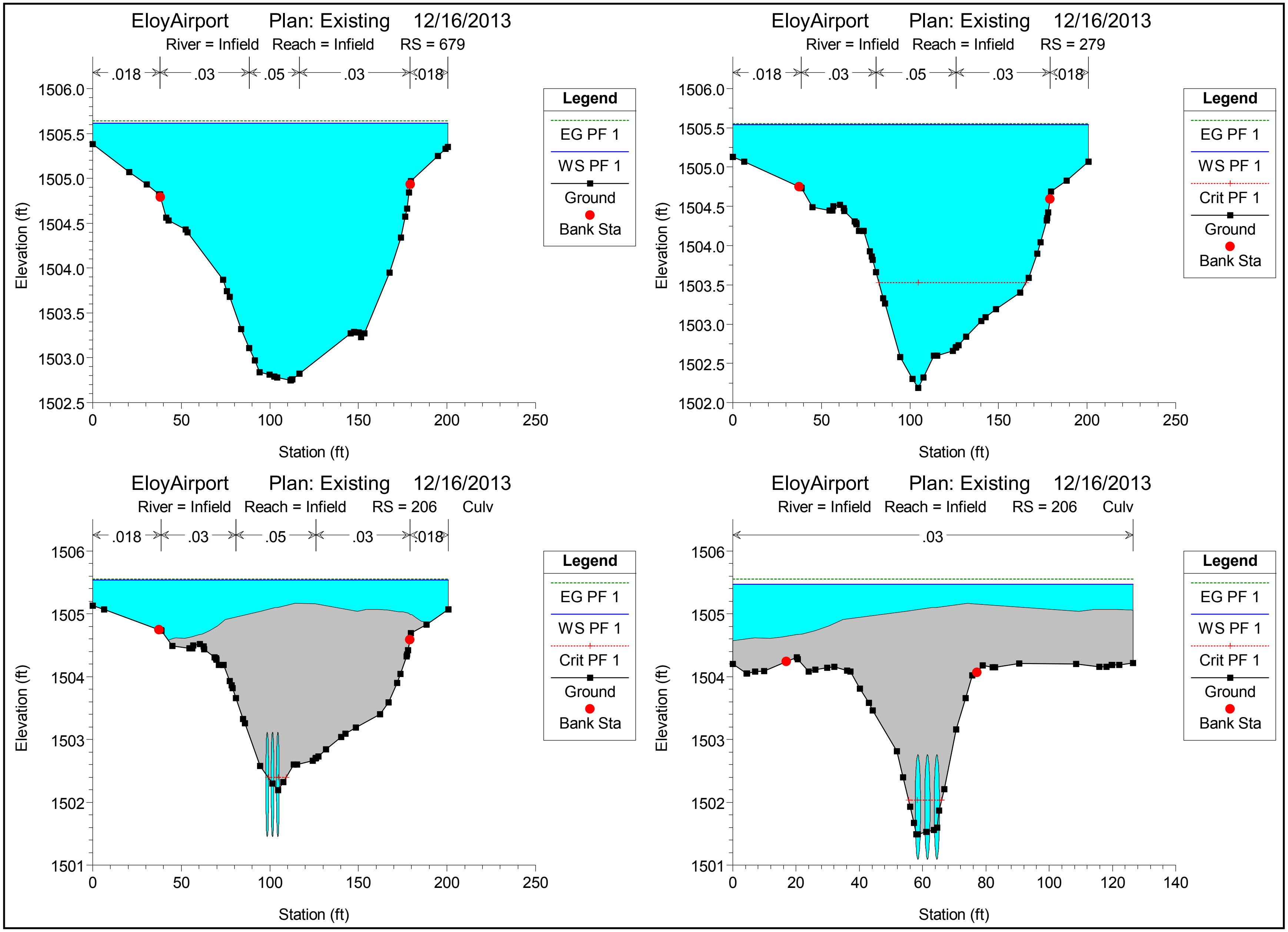
River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
West Tumbleweed	West	1353	PF 1	46.00	1509.26	1509.85	1509.76	1509.85	0.001869	0.91	100.12	697.23	0.30
West Tumbleweed	West	1150	PF 1	46.00	1508.82	1509.11		1509.13	0.009955	1.47	38.41	420.05	0.64
West Tumbleweed	West	952	PF 1	46.00	1508.06	1508.78		1508.78	0.000618	0.72	78.65	279.88	0.19
West Tumbleweed	West	750	PF 1	46.00	1507.66	1508.38	1508.38	1508.44	0.012114	2.69	27.77	274.61	0.80
West Tumbleweed	West	604	PF 1	46.00	1507.22	1508.32	1508.00	1508.33	0.000145	0.44	127.73	384.51	0.10
West Tumbleweed	West	568		Culvert									
West Tumbleweed	West	539	PF 1	46.00	1506.56	1507.71	1507.65	1507.73	0.002305	1.76	49.72	235.88	0.38
West Tumbleweed	West	351	PF 1	11.00	1506.50	1507.13		1507.20	0.007549	2.28	5.48	21.78	0.65
West Tumbleweed	West	152	PF 1	11.00	1505.96	1506.94		1506.95	0.000444	0.76	19.96	64.79	0.17
West Tumbleweed	West	88	PF 1	11.00	1505.73	1506.94	1506.19	1506.94	0.000064	0.27	48.03	114.70	0.06
West Tumbleweed	West	36		Culvert									
West Tumbleweed	West	2	PF 1	11.00	1505.89	1506.93		1506.93	0.000117	0.45	26.55	57.61	0.09
Tumbleweed	East	2200	PF 1	494.00	1508.27	1509.80		1509.81	0.001337	1.45	594.55	1325.52	0.30
Tumbleweed	East	2020	PF 1	494.00	1508.24	1509.48	1509.14	1509.49	0.002593	1.87	624.74	1328.38	0.41
Tumbleweed	East	1990		Culvert									
Tumbleweed	East	1960	PF 1	494.00	1508.01	1509.48		1509.49	0.001331	1.48	741.58	1280.04	0.30
Tumbleweed	East	1840	PF 1	494.00	1507.89	1509.29	1508.94	1509.30	0.001857	1.87	653.65	1217.28	0.36
Tumbleweed	East	1720	PF 1	494.00	1507.31	1508.95	1508.71	1508.99	0.003739	2.25	328.68	1015.77	0.46
Tumbleweed	East	1690		Culvert									
Tumbleweed	East	1660	PF 1	494.00	1507.54	1508.92	1508.56	1508.96	0.002099	1.33	331.11	640.36	0.29
Tumbleweed	East	1555	PF 1	494.00	1507.09	1508.41	1508.33	1508.50	0.013571	3.60	221.55	658.91	0.78
Tumbleweed	East	1535		Culvert									
Tumbleweed	East	1510	PF 1	494.00	1507.09	1508.17	1508.00	1508.22	0.003760	1.84	270.16	626.87	0.47
Tumbleweed	East	1360	PF 1	494.00	1506.60	1507.79		1507.83	0.001922	1.70	321.09	587.57	0.36
Tumbleweed	East	1200	PF 1	494.00	1506.24	1507.51	1507.16	1507.53	0.001706	1.45	370.70	688.59	0.33
Tumbleweed	East	1000	PF 1	494.00	1505.92	1507.13	1506.75	1507.16	0.002096	1.77	391.01	604.41	0.37
Tumbleweed	Lower	783	PF 1	532.00	1504.64	1506.79	1506.50	1506.83	0.001153	1.99	328.15	622.46	0.31
Tumbleweed	Lower	694		Culvert									
Tumbleweed	Lower	659	PF 1	532.00	1503.70	1506.73	1506.25	1506.75	0.000958	1.91	526.85	745.05	0.28
Tumbleweed	Lower	500		Lat Struct									
Tumbleweed	Lower	400	PF 1	405.00	1504.29	1506.52	1506.07	1506.54	0.001010	1.98	568.53	863.39	0.28
Tumbleweed	Lower	200		Lat Struct									
Tumbleweed	Lower	92	PF 1	183.00	1503.39	1506.41		1506.41	0.000136	0.36	681.29	902.93	0.05
Main	Upper	4649	PF 1	1.00	1503.60	1506.50		1506.50	0.000000	0.00	199.37	221.53	0.00
Main	Upper	4469	PF 1	127.00	1503.99	1506.49		1506.50	0.000083	0.51	277.06	260.60	0.07
Main	Upper	4300		Lat Struct									
Main	Upper	4107	PF 1	257.00	1503.74	1506.38		1506.41	0.000535	1.45	184.17	121.36	0.17
Main	Middle	4055	PF 1	825.00	1503.79	1506.36	1505.52	1506.38	0.000500	1.35	766.59	882.02	0.16
Main	Middle	3800		Lat Struct									
Main	Middle	3655	PF 1	458.00	1503.42	1506.09	1505.48	1506.13	0.001139	1.91	384.15	649.06	0.24
Main	Middle	3400		Lat Struct									
Main	Middle	3255	PF 1	148.00	1503.46	1505.90		1505.91	0.000130	0.63	332.67	525.66	0.08
Main	Middle	2855	PF 1	418.00	1503.55	1505.48		1505.58	0.003424	2.78	174.55	235.74	0.41

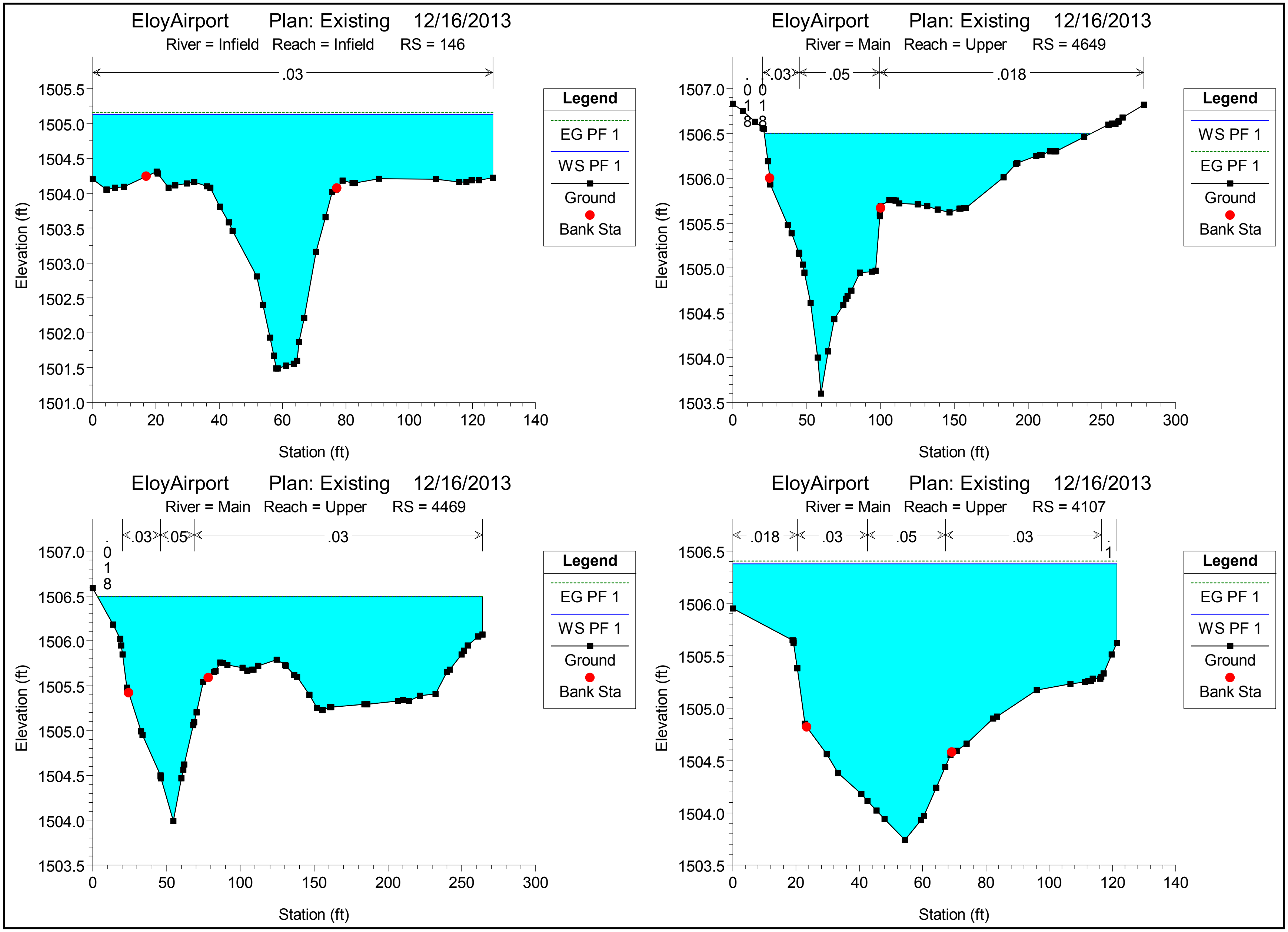
HEC-RAS Plan: Exist Profile: PF 1 (Continued)

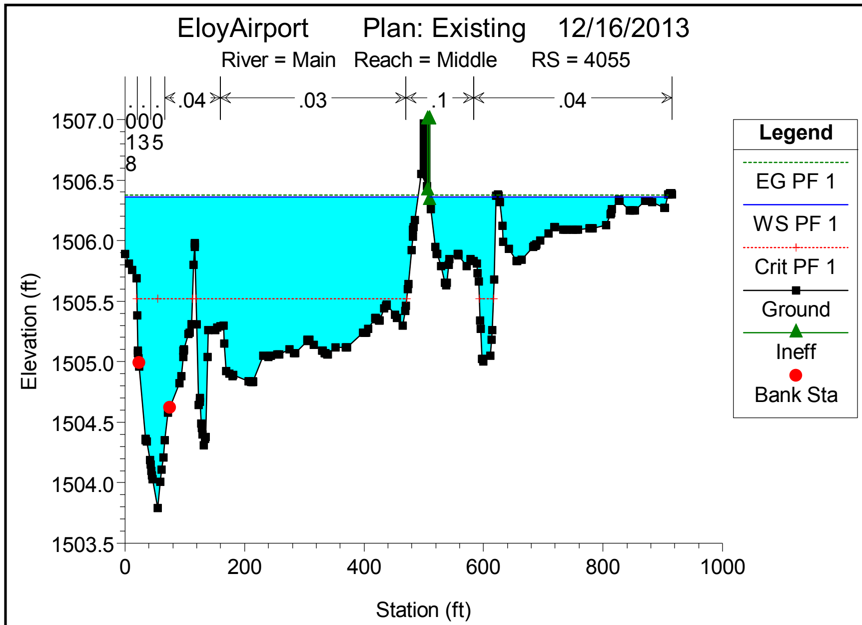
River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main	Lower	2490	PF 1	675.00	1501.48	1505.01	1503.78	1505.05	0.000938	1.78	473.81	597.60	0.21
Main	Lower	2387		Culvert									
Main	Lower	2306	PF 1	675.00	1501.09	1504.30	1503.67	1504.34	0.000936	1.64	450.07	631.63	0.19
Main	Lower	2200		Lat Struct									
Main	Lower	2141	PF 1	563.66	1501.45	1504.05	1503.52	1504.13	0.002087	2.18	266.44	1092.20	0.28
Main	Lower	2000	PF 1	531.35	1501.54	1503.08	1503.08	1503.41	0.025408	4.93	116.15	1044.58	1.00
Main	Lower	1838	PF 1	531.35	1501.25	1502.84	1502.00	1502.87	0.001000	1.27	405.49	1187.82	0.21
Infield	Infield	2075	PF 1	1.00	1504.36	1505.71		1505.71	0.000000	0.02	54.03	98.96	0.00
Infield	Infield	1896	PF 1	1.00	1504.31	1505.71		1505.71	0.000000	0.01	136.33	139.84	0.00
Infield	Infield	1600		Lat Struct									
Infield	Infield	1479	PF 1	1.00	1503.76	1505.71		1505.71	0.000000	0.01	204.49	185.30	0.00
Infield	Infield	1200		Lat Struct									
Infield	Infield	1079	PF 1	92.00	1503.14	1505.70		1505.71	0.000029	0.36	263.12	197.00	0.05
Infield	Infield	800		Lat Struct									
Infield	Infield	679	PF 1	402.00	1502.75	1505.62		1505.64	0.000315	1.28	322.50	200.60	0.16
Infield	Infield	400		Lat Struct									
Infield	Infield	300		Lat Struct									
Infield	Infield	279	PF 1	257.00	1502.19	1505.54	1503.53	1505.55	0.000129	0.78	334.33	200.77	0.09
Infield	Infield	206		Culvert									
Infield	Infield	146	PF 1	257.00	1501.49	1505.13		1505.16	0.000515	1.69	175.27	126.53	0.22

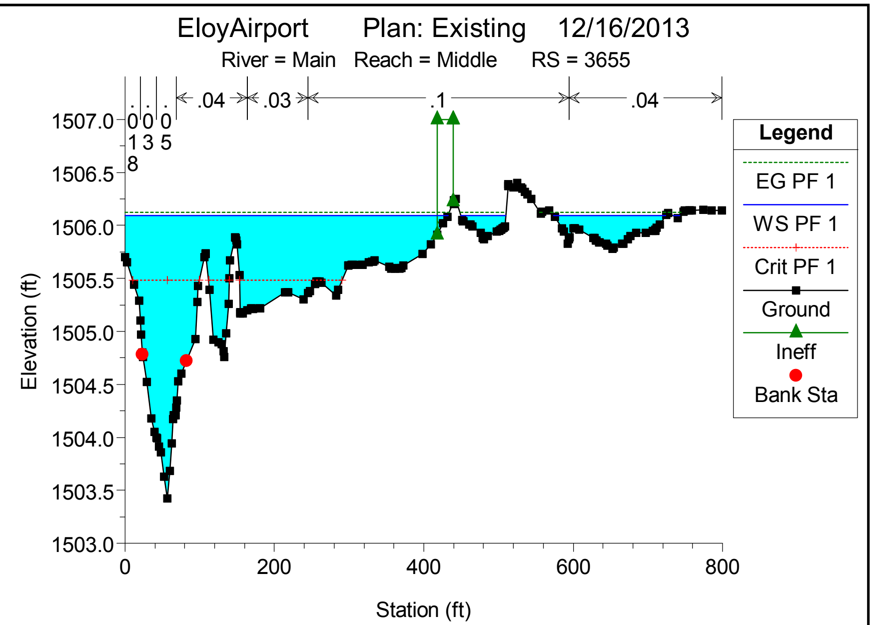


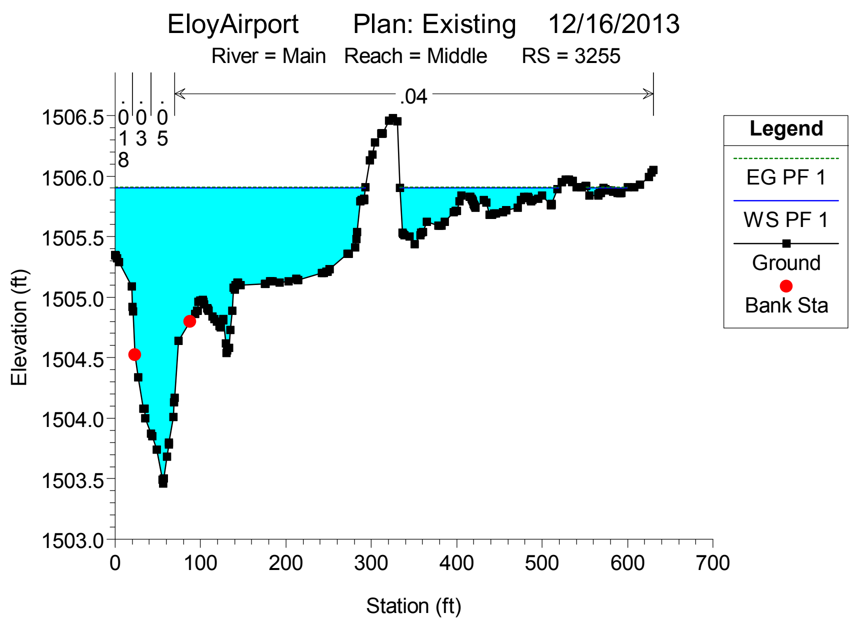
EloyAirport Plan: Existing 12/16/2013
River = Infield Reach = Infield RS = 2075
.018 .03 .05 .03 .018
Legend
WS PF 1
EG PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
EloyAirport Plan: Existing 12/16/2013
River = Infield Reach = Infield RS = 1896
EloyAirport Plan: Existing 12/16/2013
River = Infield Reach = Infield RS = 1479
EloyAirport Plan: Existing 12/16/2013
River = Infield Reach = Infield RS = 1079

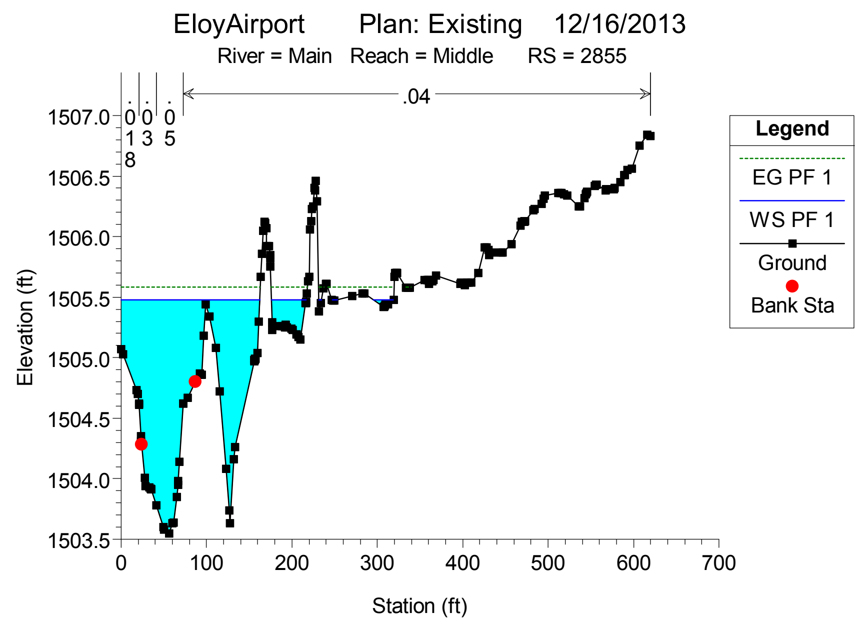

EloyAirport Plan: Existing 12/16/2013
River = Infield Reach = Infield RS = 679
.018 .03 .05 .03 .018
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1506.0
1505.5
1505.0
1504.5
1504.0
1503.5
1503.0
1502.5
0 50 100 150 200 250
Station (ft)
EloyAirport Plan: Existing 12/16/2013
River = Infield Reach = Infield RS = 279
.018 .03 .05 .03 .018
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1506.0
1505.5
1505.0
1504.5
1504.0
1503.5
1503.0
1502.5
1502.0
0 50 100 150 200 250
Station (ft)
EloyAirport Plan: Existing 12/16/2013
River = Infield Reach = Infield RS = 206 Culv
.018 .03 .05 .03 .018
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1506
1505
1504
1503
1502
1501
0 50 100 150 200 250
Station (ft)
EloyAirport Plan: Existing 12/16/2013
River = Infield Reach = Infield RS = 206 Culv
.03
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1506
1505
1504
1503
1502
1501
0 20 40 60 80 100 120 140
Station (ft)

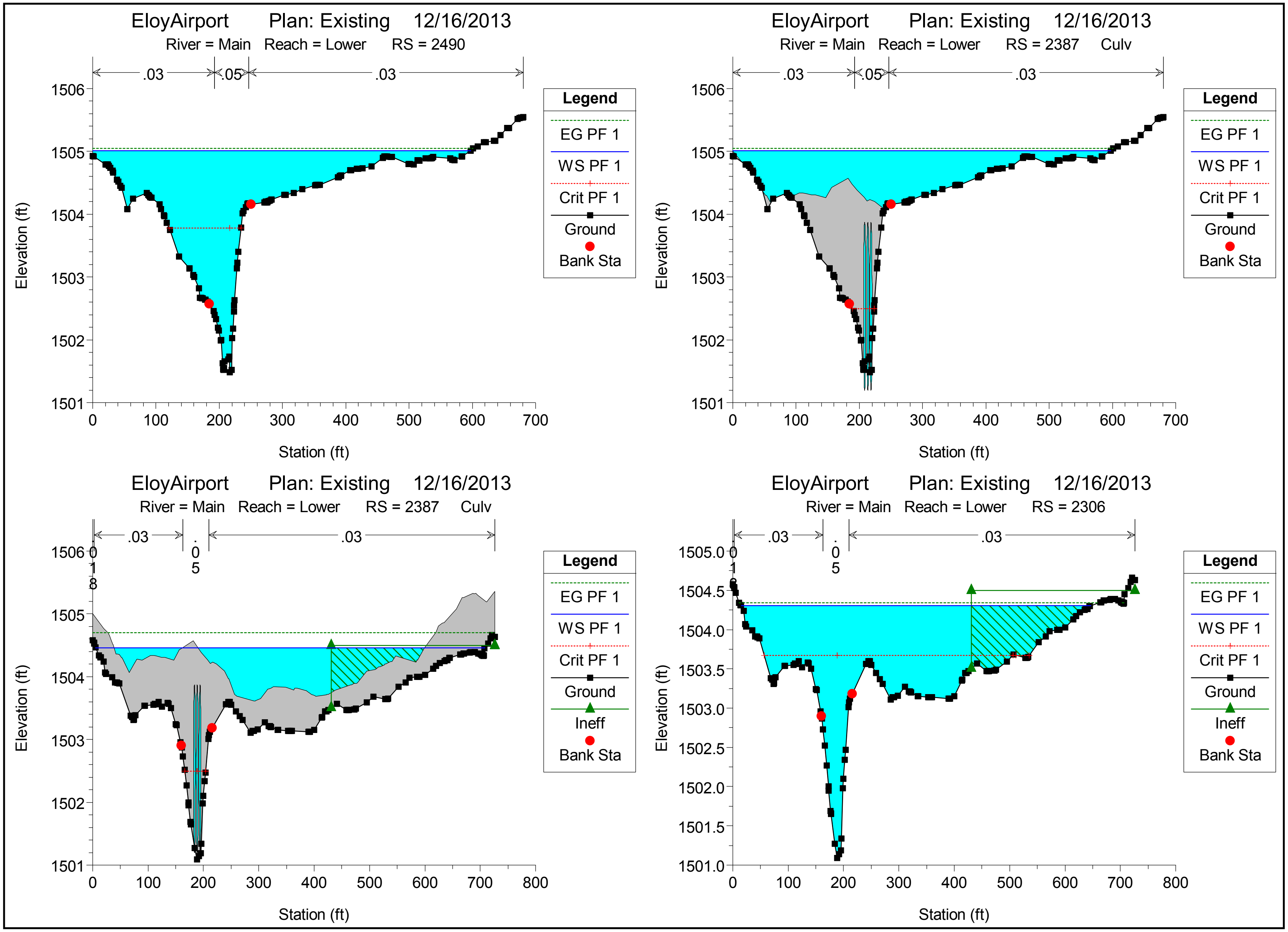

EloyAirport Plan: Existing 12/16/2013
River = Infield Reach = Infield RS = 146
.03
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Upper RS = 4649
.018 .03 .05 .018
Elevation (ft)
Station (ft)
Legend
WS PF 1
EG PF 1
Ground
Bank Sta
EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Upper RS = 4469
.018 .03 .05 .03
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Upper RS = 4107
.018 .03 .05 .03 .1
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Middle RS = 4055
.04
.03
.1
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

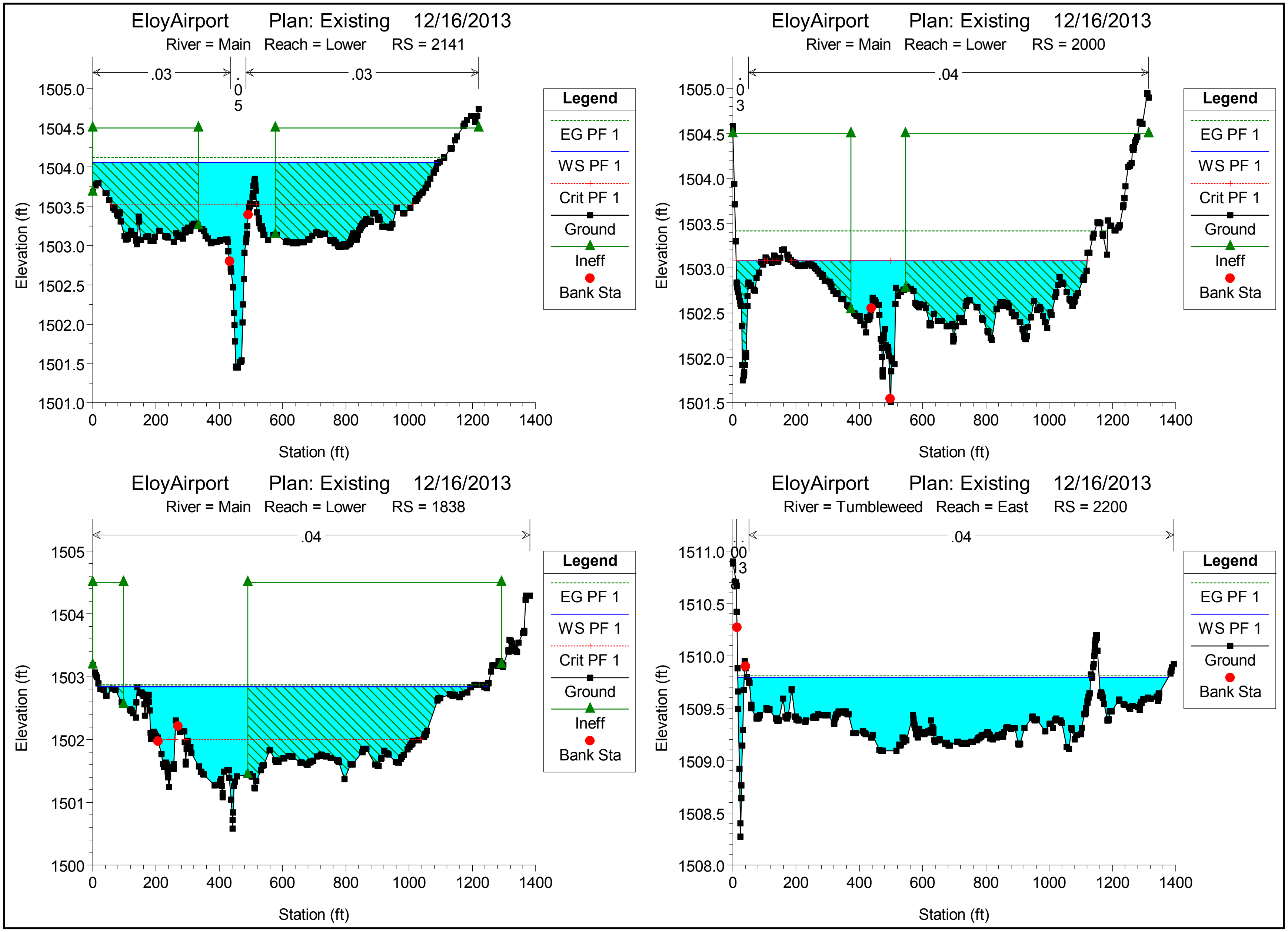

EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Middle RS = 3655
.04
.03
.1
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

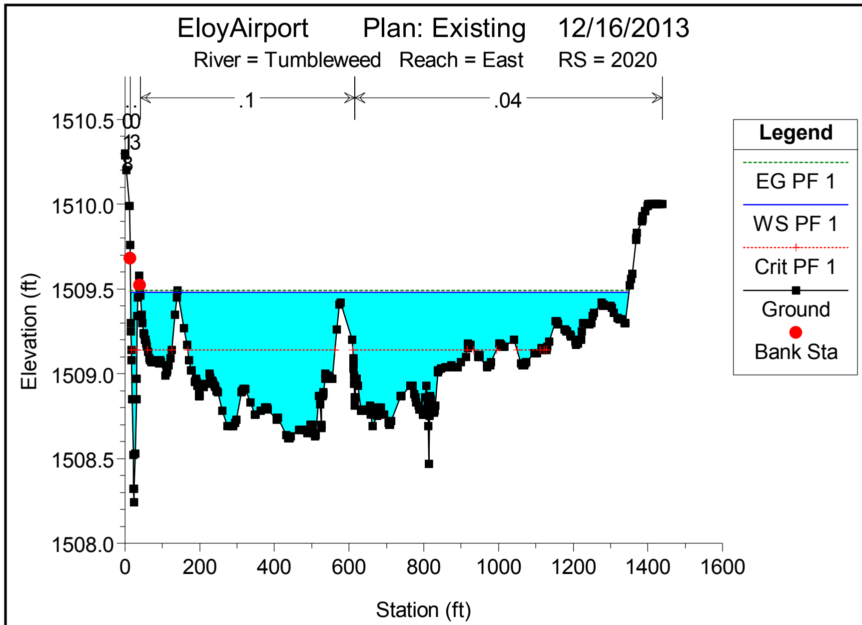

EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Middle RS = 3255
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

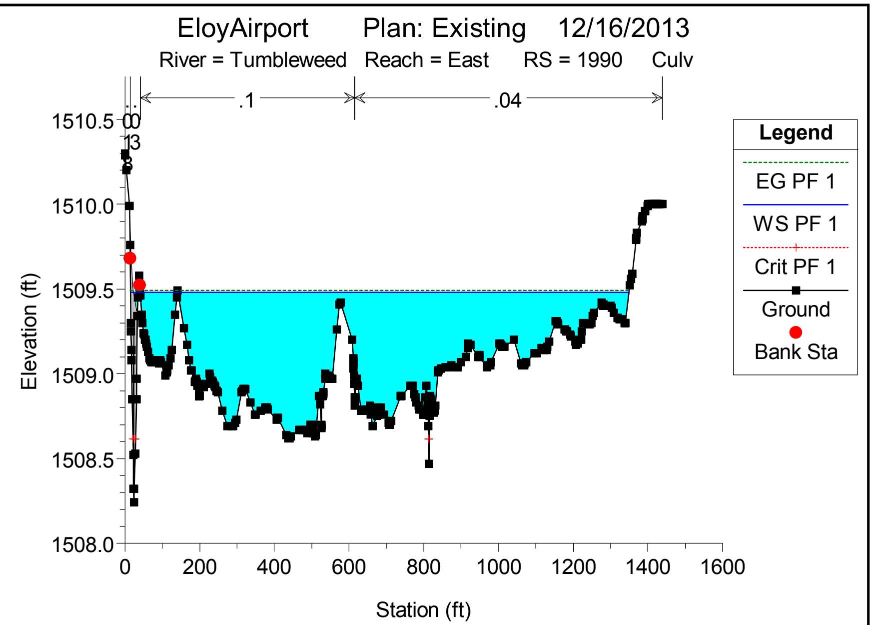

EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Middle RS = 2855
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

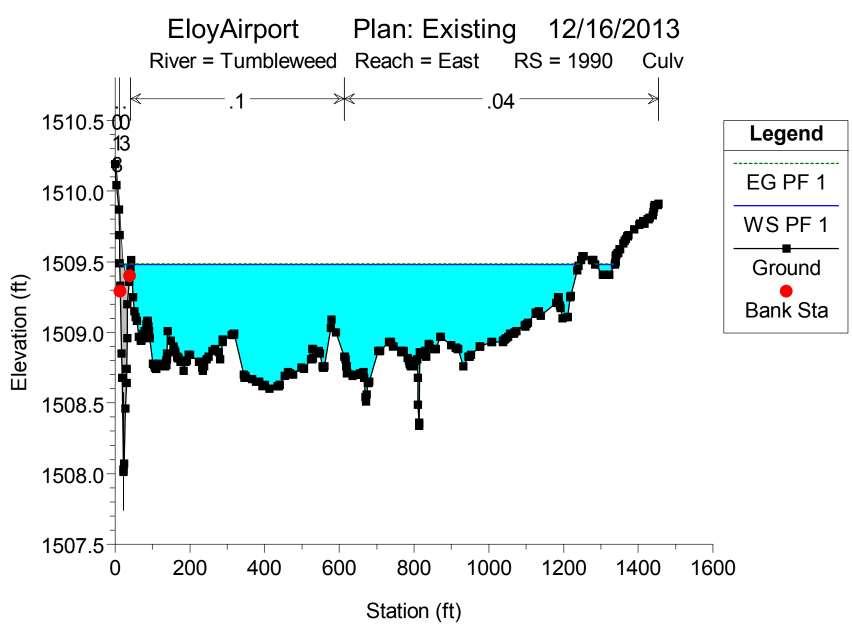


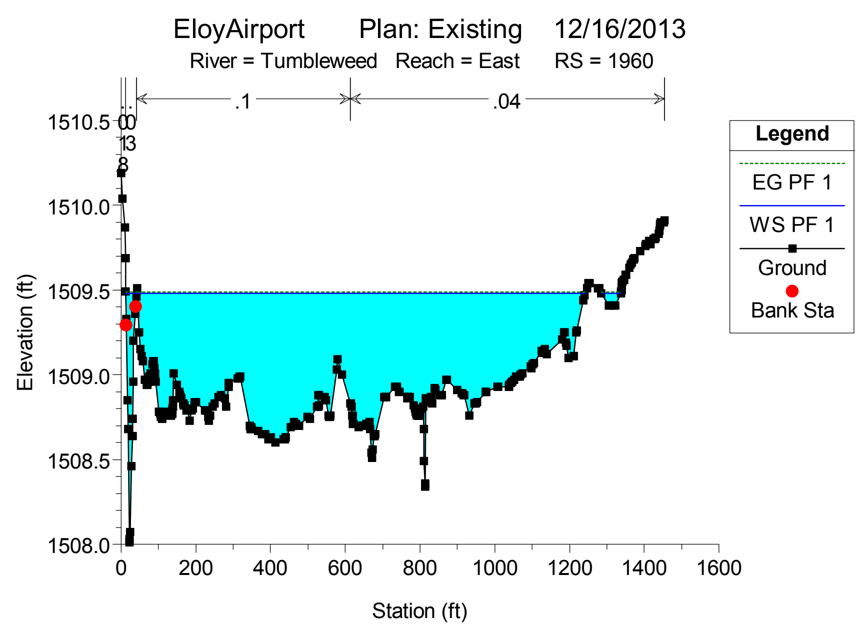
EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Lower RS = 2490
.03 .05 .03
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Lower RS = 2387 Culv
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Lower RS = 2387 Culv
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Lower RS = 2306
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

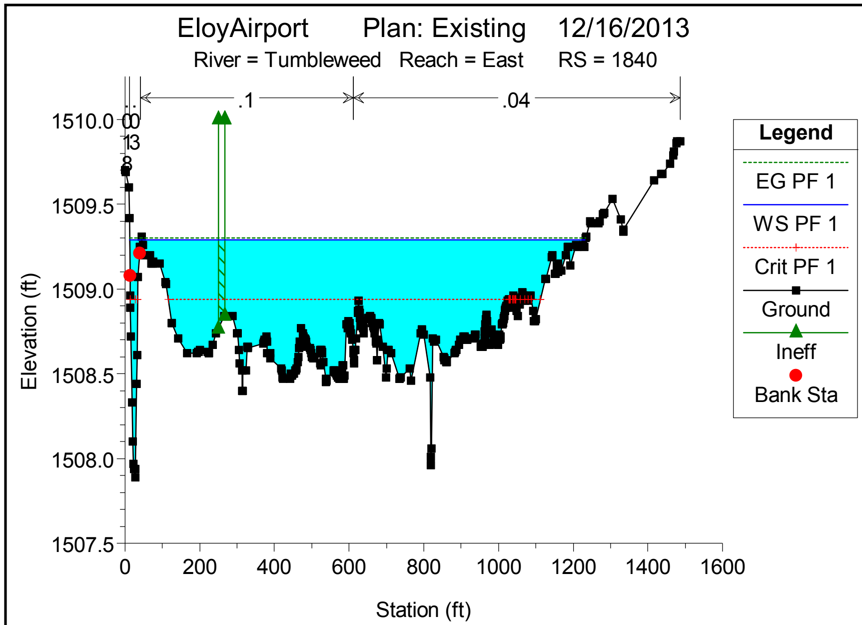

EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Lower RS = 2141
.03
.
0
5
.03
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1505.0
1504.5
1504.0
1503.5
1503.0
1502.5
1502.0
1501.5
1501.0
0
200
400
600
800
1000
1200
1400
EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Lower RS = 2000
.
0
3
.04
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1505.0
1504.5
1504.0
1503.5
1503.0
1502.5
1502.0
1501.5
0
200
400
600
800
1000
1200
1400
EloyAirport Plan: Existing 12/16/2013
River = Main Reach = Lower RS = 1838
.04
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1505
1504
1503
1502
1501
1500
0
200
400
600
800
1000
1200
1400
EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 2200
. .
00
3
.04
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
1511.0
1510.5
1510.0
1509.5
1509.0
1508.5
1508.0
0
200
400
600
800
1000
1200
1400

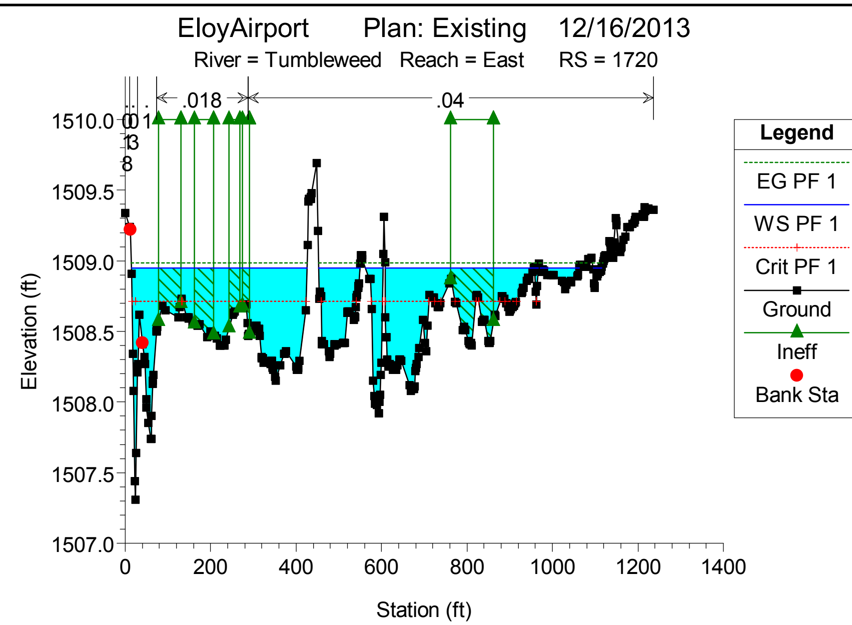

EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 2020
.1
.04
Elevation (ft)
1510.5
1510.0
1509.5
1509.0
1508.5
1508.0
0 200 400 600 800 1000 1200 1400 1600
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

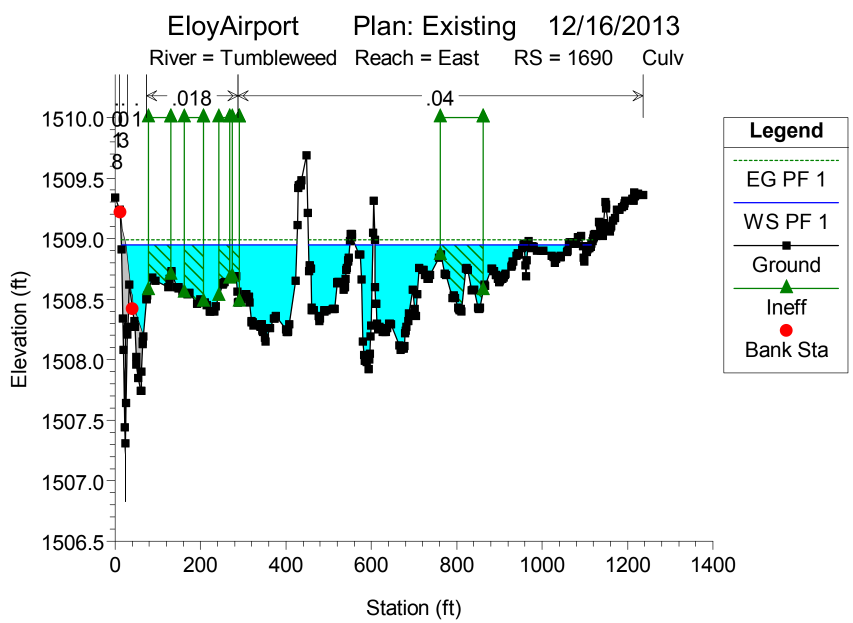

EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1990 Culv
.1
.04
Elevation (ft)
1510.5
1510.0
1509.5
1509.0
1508.5
1508.0
0 200 400 600 800 1000 1200 1400 1600
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

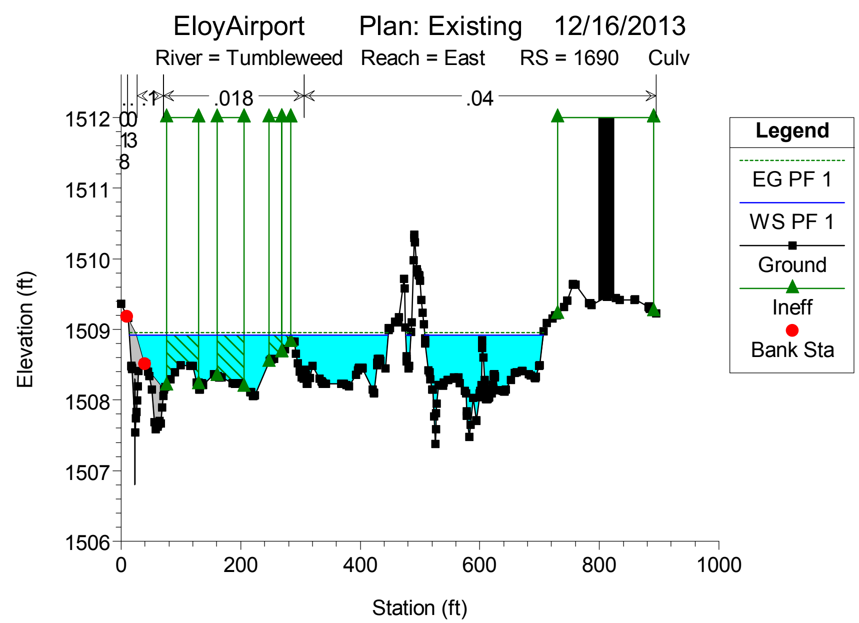

EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1990 Culv
.1
.04
Elevation (ft)
1510.5
1510.0
1509.5
1509.0
1508.5
1508.0
1507.5
0 200 400 600 800 1000 1200 1400 1600
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

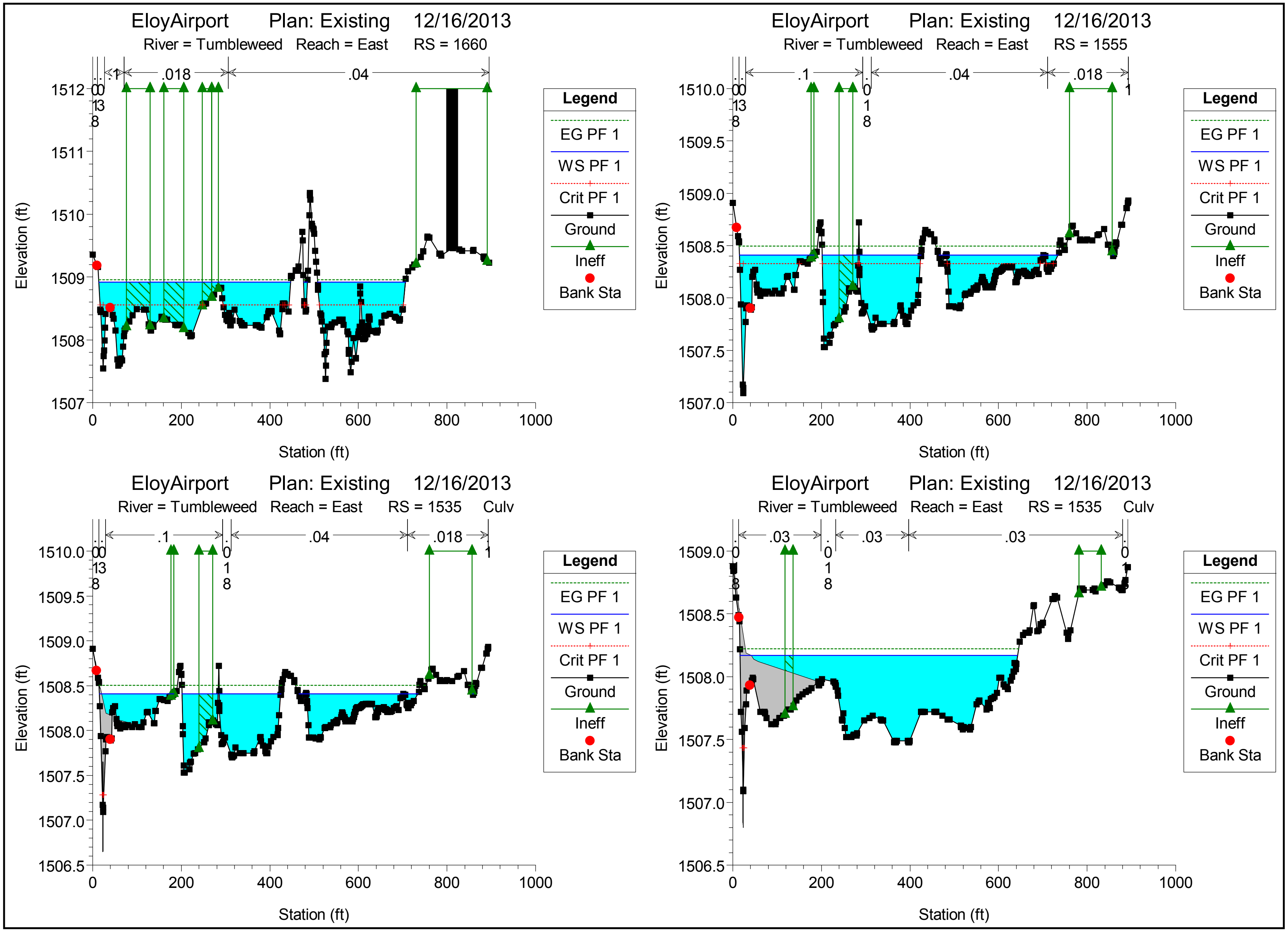

EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1960
.1
.04
Elevation (ft)
1510.5
1510.0
1509.5
1509.0
1508.5
1508.0
0 200 400 600 800 1000 1200 1400 1600
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1840
.1
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

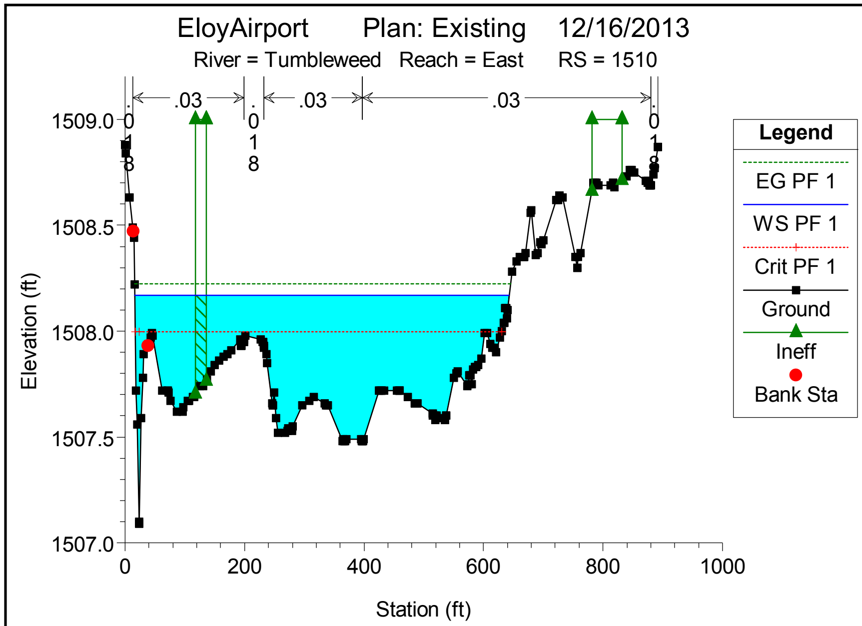

EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1720
.018
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

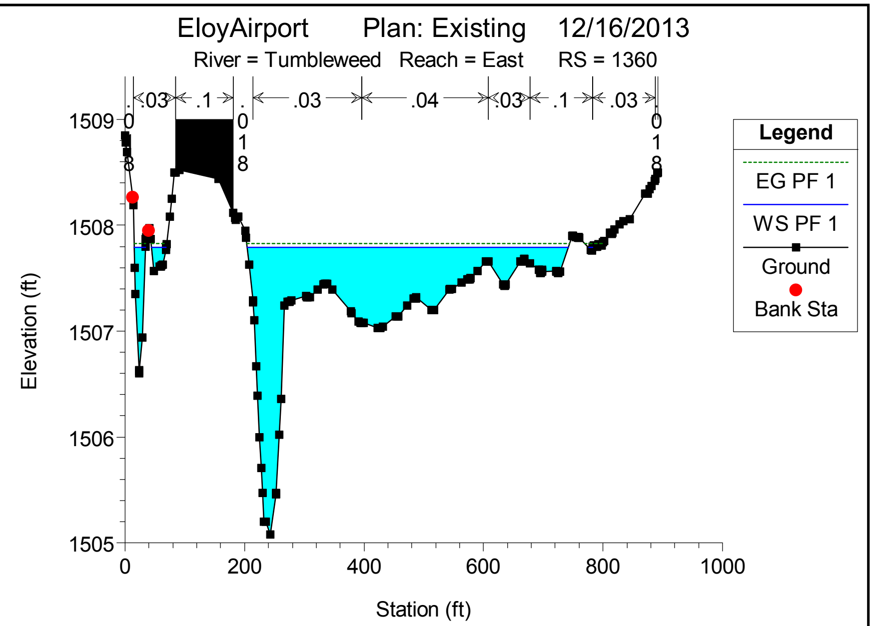

EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1690 Culv
.018
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta

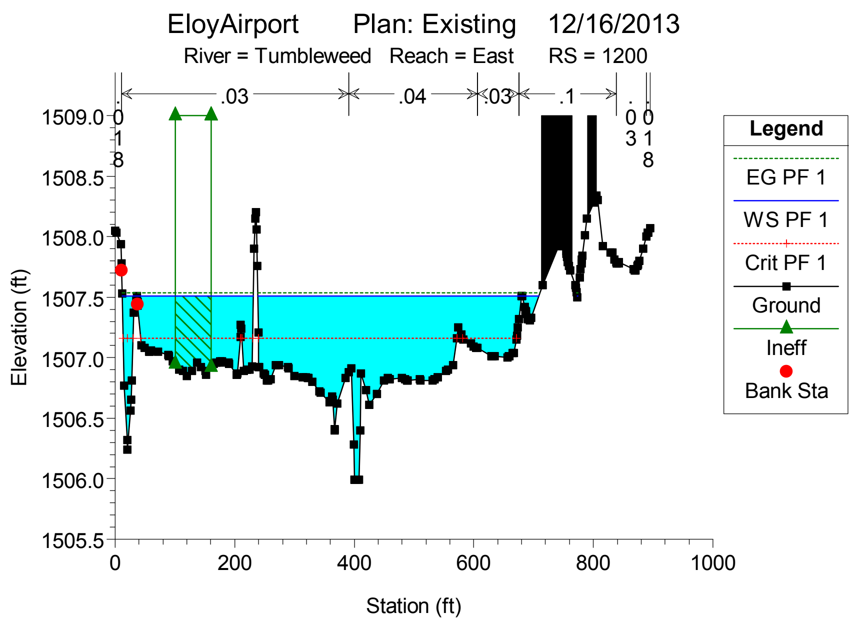

EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1690 Culv
.018
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Ineff
Bank Sta

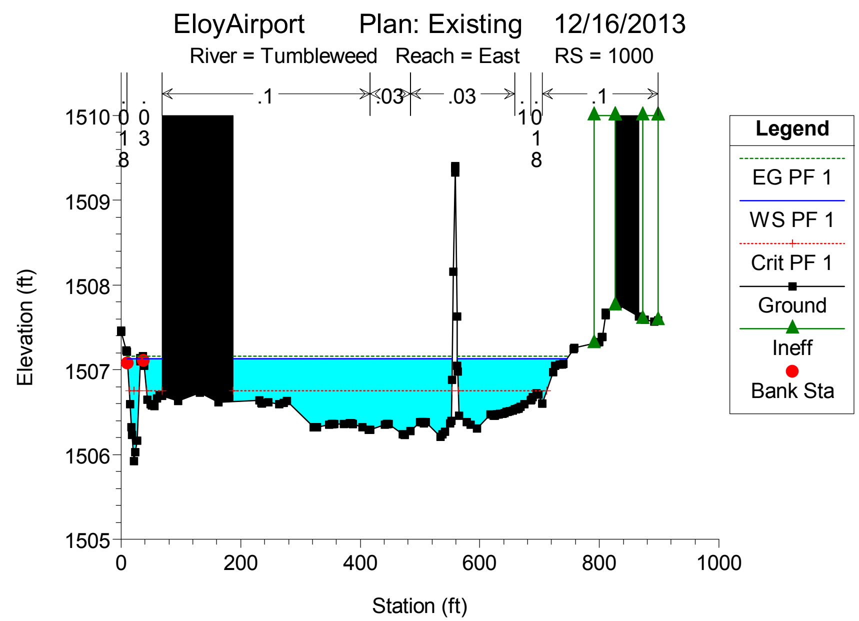


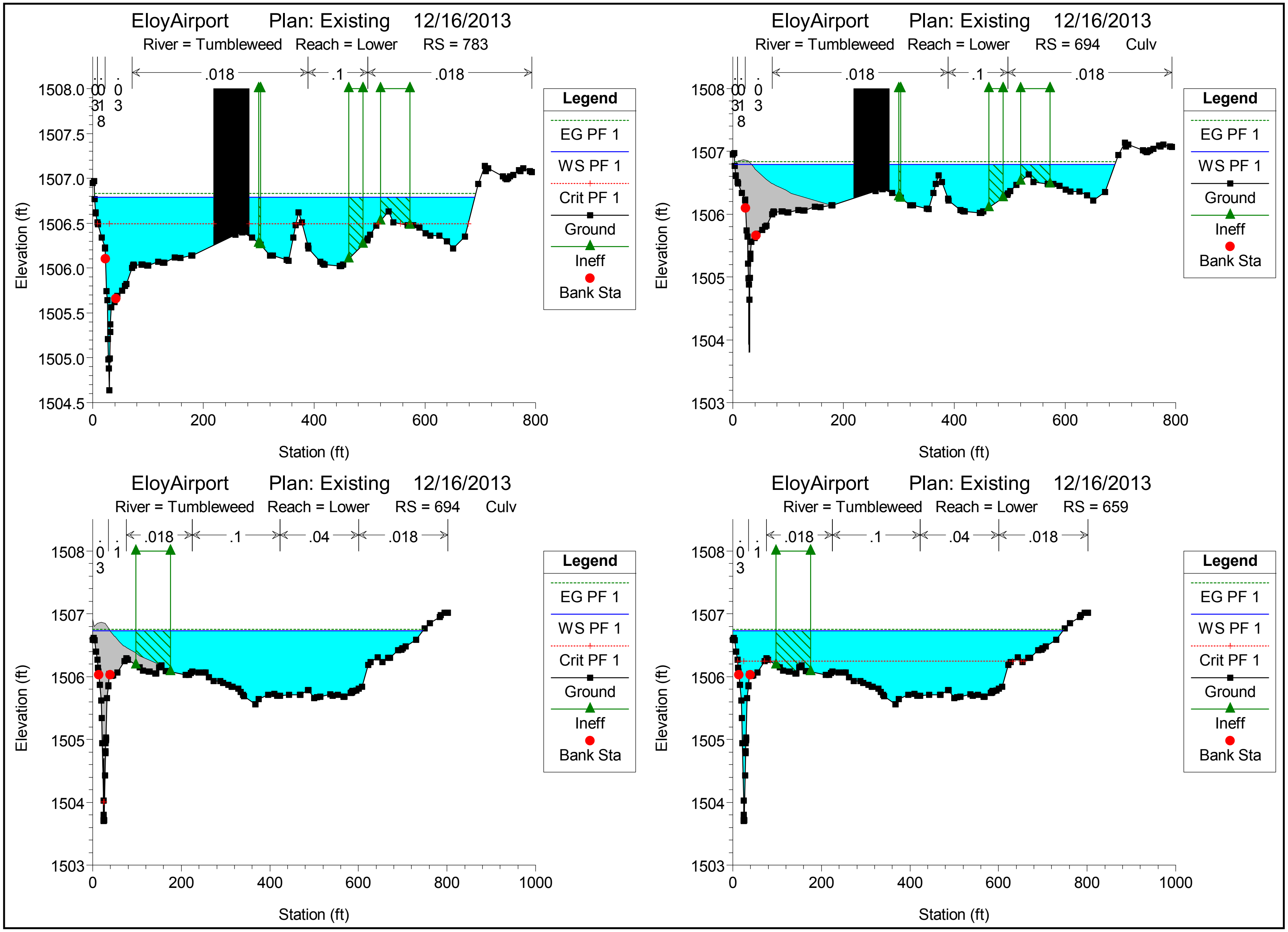
EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1660
.1
.018
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1555
.1
.04
.018
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1535 Culv
.1
.04
.018
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1535 Culv
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

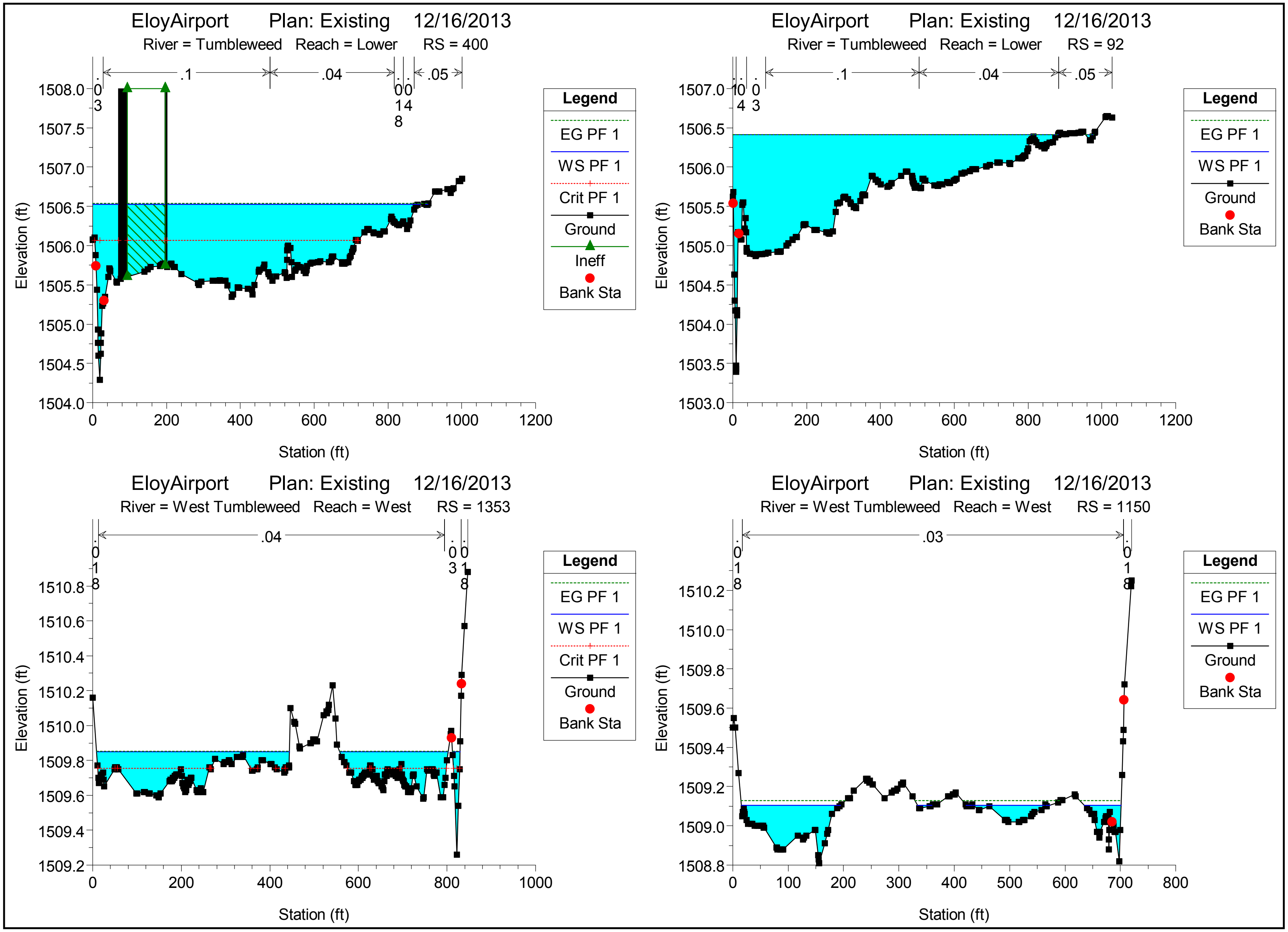

EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1510
.03
.03
.03
Elevation (ft)
1509.0
1508.5
1508.0
1507.5
1507.0
0
200
400
600
800
1000
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta


EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1360
.03
.1
.03
.04
.03
.1
.03
Elevation (ft)
1509
1508
1507
1506
1505
0
200
400
600
800
1000
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

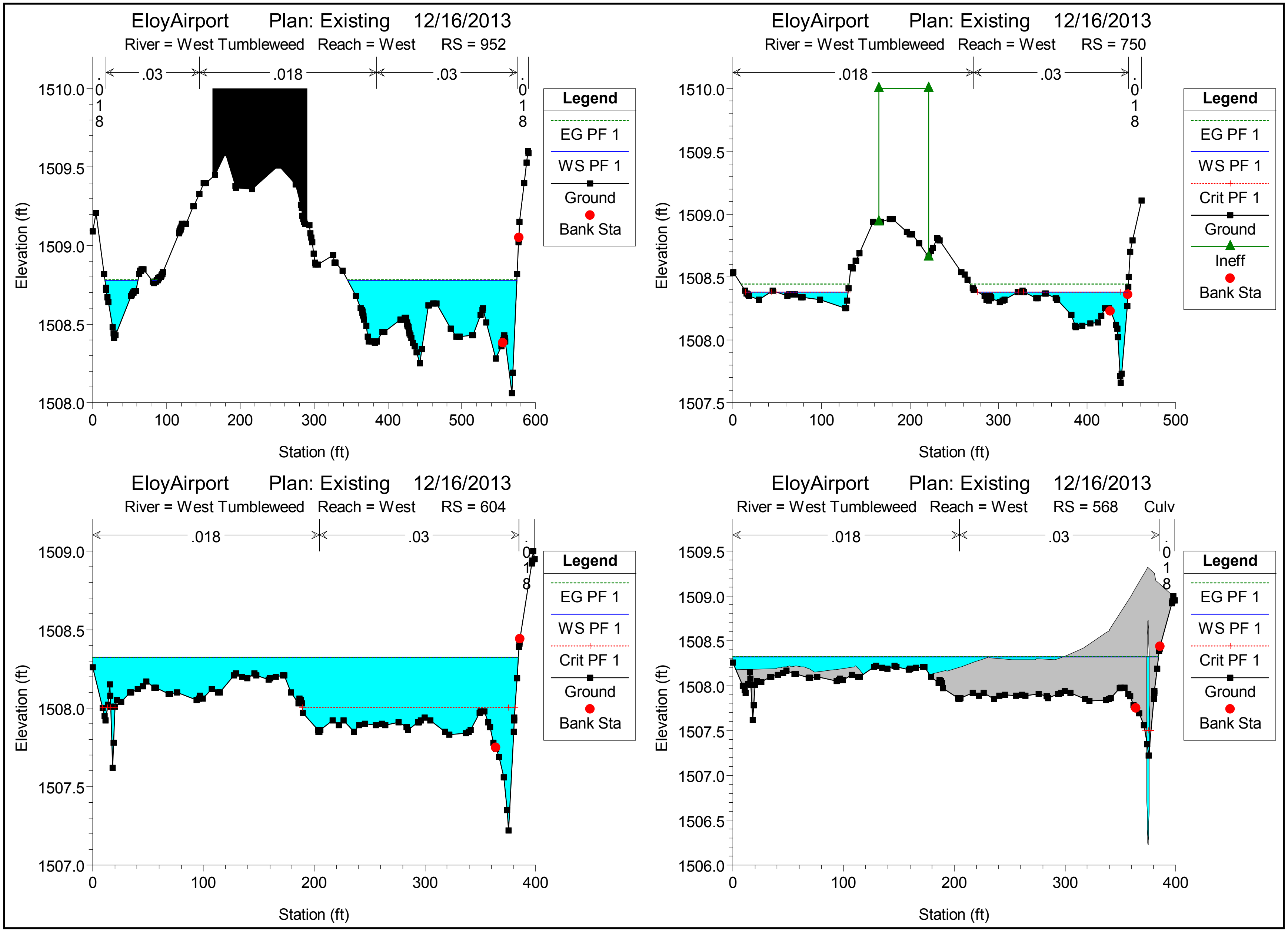

EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1200
.03
.04
.03
.1
Elevation (ft)
1509.0
1508.5
1508.0
1507.5
1507.0
1506.5
1506.0
1505.5
0
200
400
600
800
1000
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

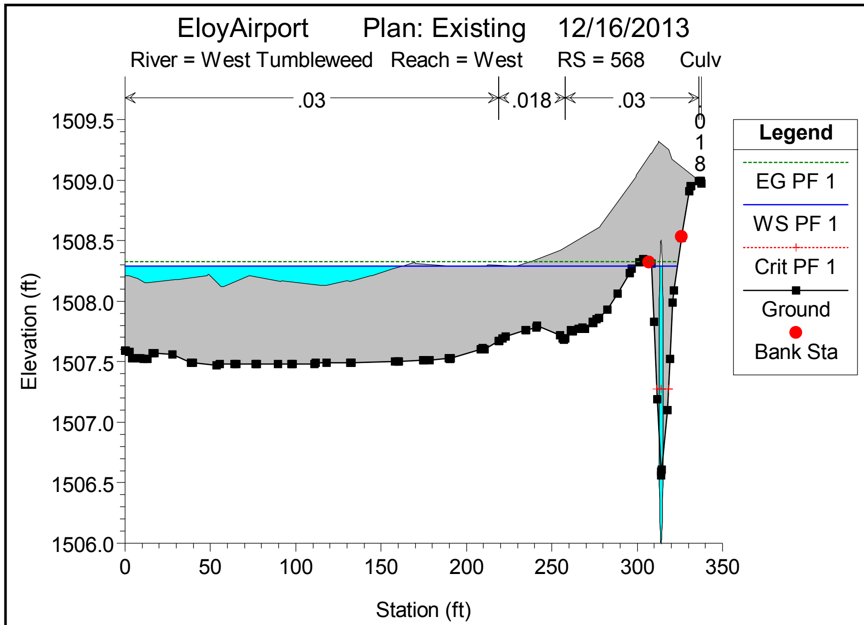

EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = East RS = 1000
.1
.03
.03
.1
Elevation (ft)
1510
1509
1508
1507
1506
1505
0
200
400
600
800
1000
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

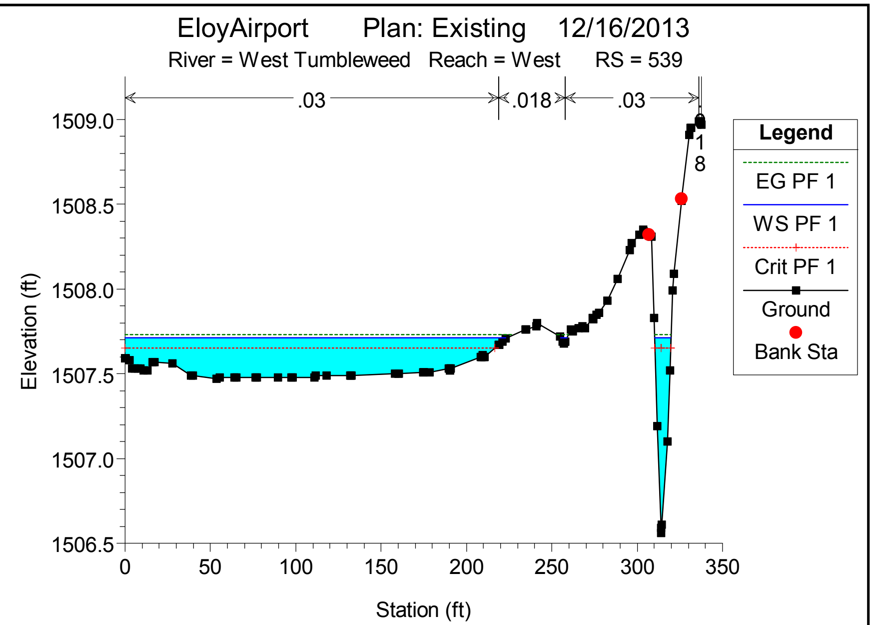

EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = Lower RS = 783
.018
.1
.018
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = Lower RS = 694 Culv
.018
.1
.018
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = Lower RS = 694 Culv
.018
.1
.04
.018
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = Lower RS = 659
.018
.1
.04
.018
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)



EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = Lower RS = 400
.1
.04
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
EloyAirport Plan: Existing 12/16/2013
River = Tumbleweed Reach = Lower RS = 92
.1
.04
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
EloyAirport Plan: Existing 12/16/2013
River = West Tumbleweed Reach = West RS = 1353
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
EloyAirport Plan: Existing 12/16/2013
River = West Tumbleweed Reach = West RS = 1150
.03
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


EloyAirport Plan: Existing 12/16/2013
River = West Tumbleweed Reach = West RS = 952
.03
.018
.03
.018
.018
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
1510.0
1509.5
1509.0
1508.5
1508.0
0
100
200
300
400
500
600
EloyAirport Plan: Existing 12/16/2013
River = West Tumbleweed Reach = West RS = 750
.018
.03
.018
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1510.0
1509.5
1509.0
1508.5
1508.0
1507.5
0
100
200
300
400
500
EloyAirport Plan: Existing 12/16/2013
River = West Tumbleweed Reach = West RS = 604
.018
.03
.018
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
1509.0
1508.5
1508.0
1507.5
1507.0
0
100
200
300
400
EloyAirport Plan: Existing 12/16/2013
River = West Tumbleweed Reach = West RS = 568 Culv
.018
.03
.018
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
1509.5
1509.0
1508.5
1508.0
1507.5
1507.0
1506.5
1506.0
0
100
200
300
400


EloyAirport Plan: Existing 12/16/2013
River = West Tumbleweed Reach = West RS = 568 Culv
.03
.018
.03
.018
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta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.018
.03
.018
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Station (ft)
Legend
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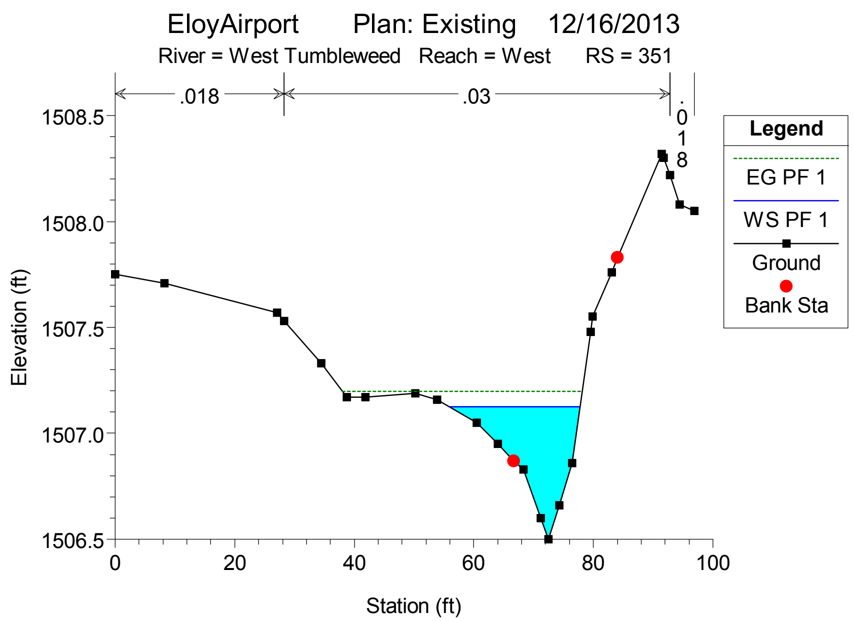
WS PF 1
Crit PF 1
Ground
Bank Sta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.03
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Station (ft)
Legend
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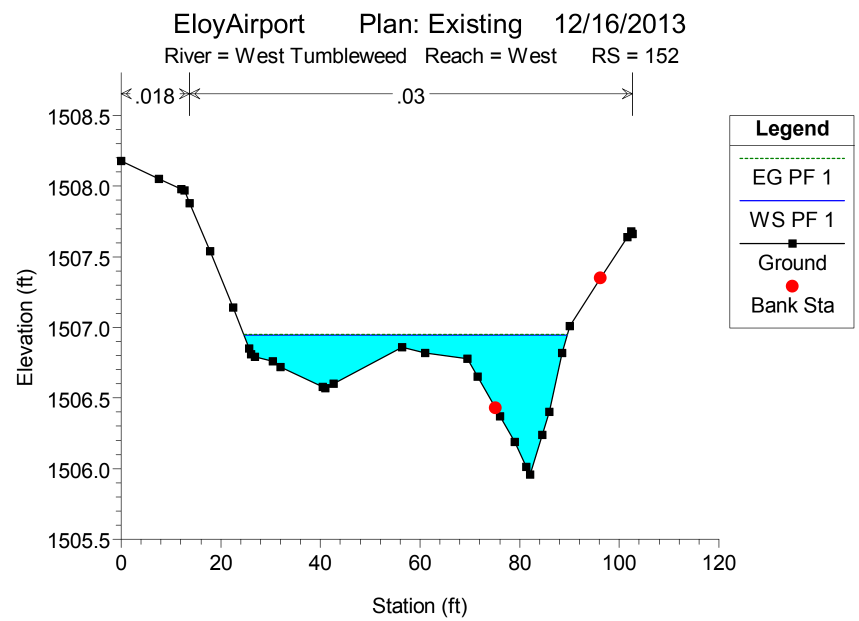
WS PF 1
Ground
Bank Sta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.018
.03
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Station (ft)
Legend
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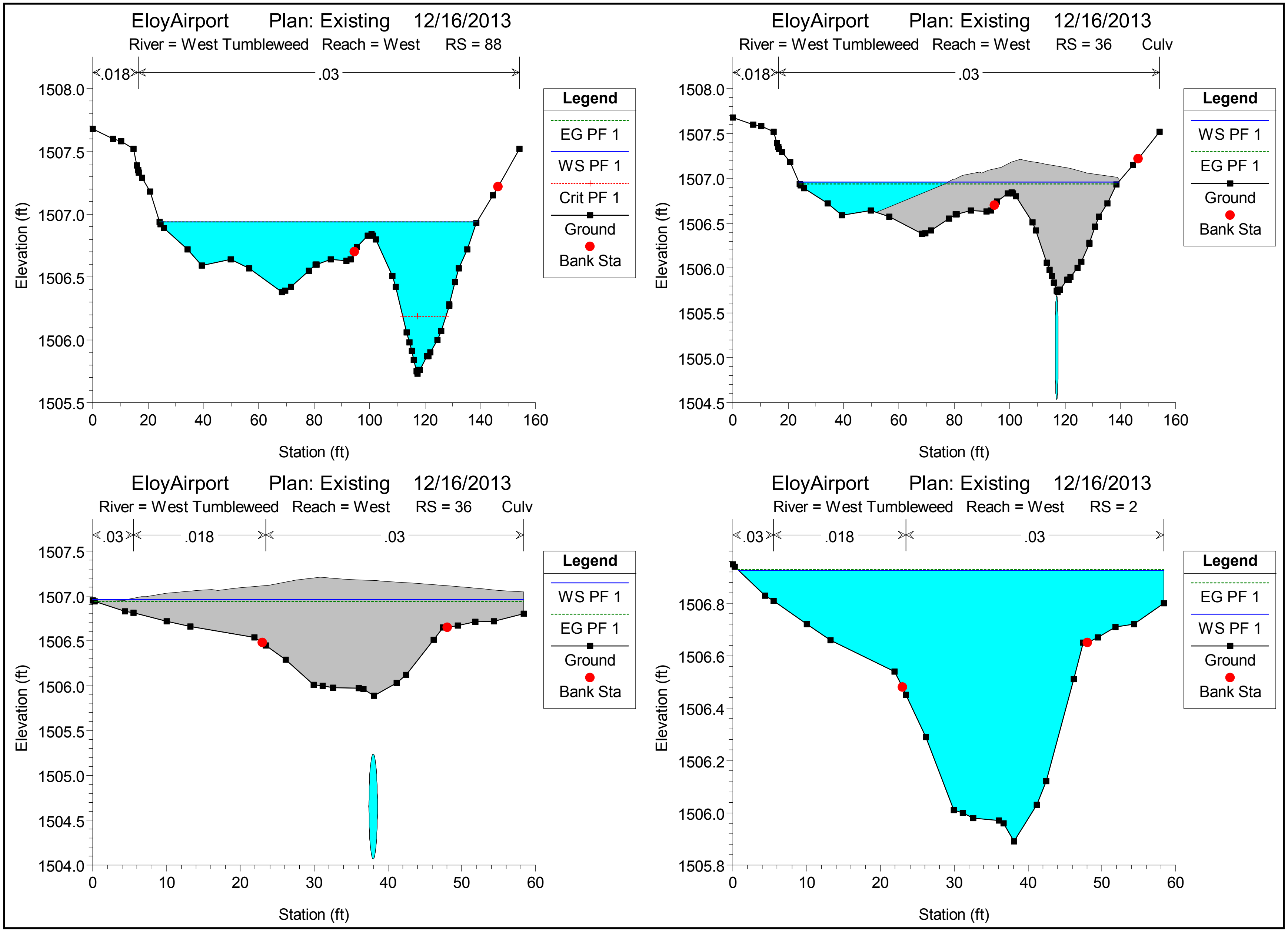
WS PF 1
Ground
Bank Sta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River = West Tumbleweed Reach = West RS = 88
.018
.03
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
EloyAirport Plan: Existing 12/16/2013
River = West Tumbleweed Reach = West RS = 36 Culv
.018
.03
Legend
WS PF 1
EG PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
EloyAirport Plan: Existing 12/16/2013
River = West Tumbleweed Reach = West RS = 36 Culv
.03
.018
.03
Legend
WS PF 1
EG PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
EloyAirport Plan: Existing 12/16/2013
River = West Tumbleweed Reach = West RS = 2
.03
.018
.03
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
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PROJECT DATA
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Project File : EloyAirport.prj
Run Date and Time: 7/16/2014 1:28:29 PM

Project in English units

PLAN DATA

Plan Title: Exist-EastOnly
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Geometry Title: Existing-EastOnly
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Flow Title : Existing-East
Flow File : k:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\Drainage\Hydraulics\HEC-RAS\EloyAirport.f07

Plan Summary Information:

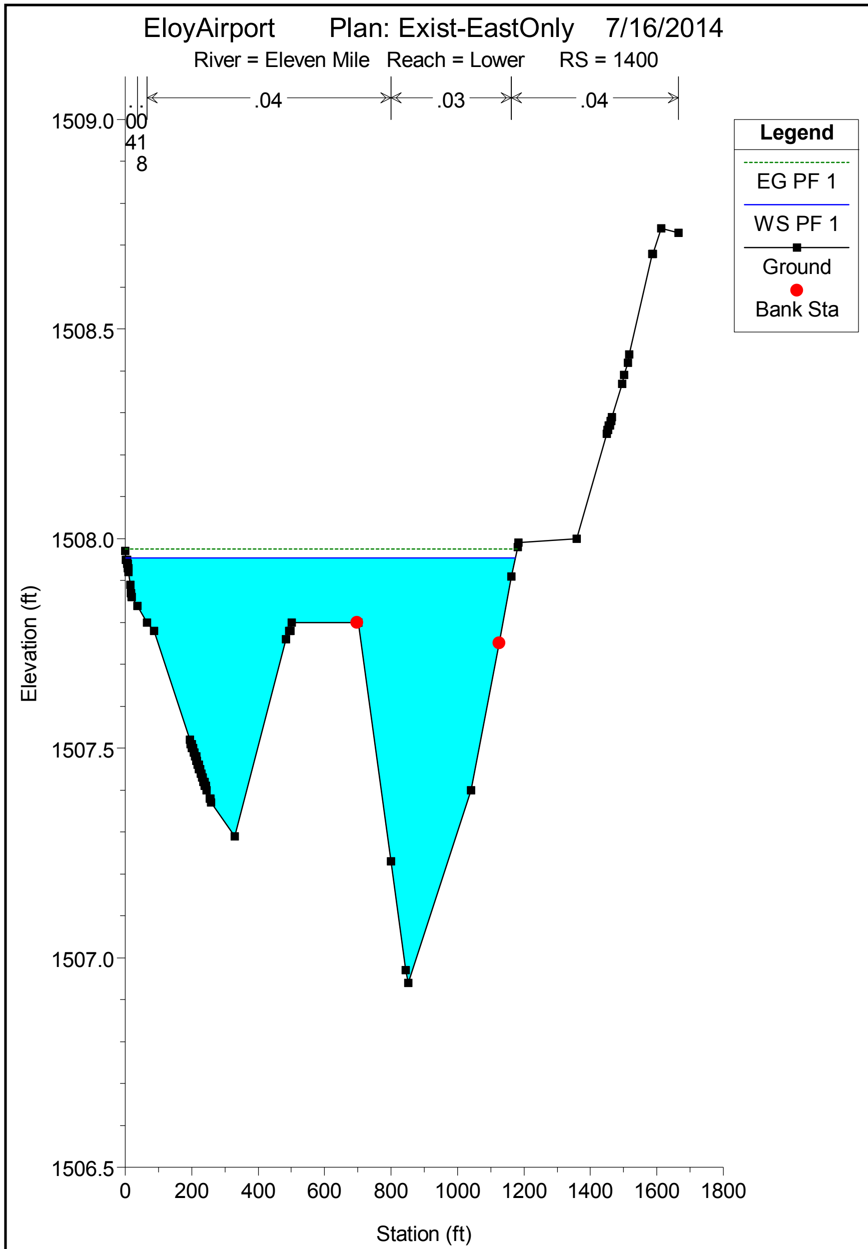
Number of:	Cross Sections =	5	Multiple Openings =	0
	Culverts =	0	Inline Structures =	0
	Bridges =	0	Lateral Structures =	0

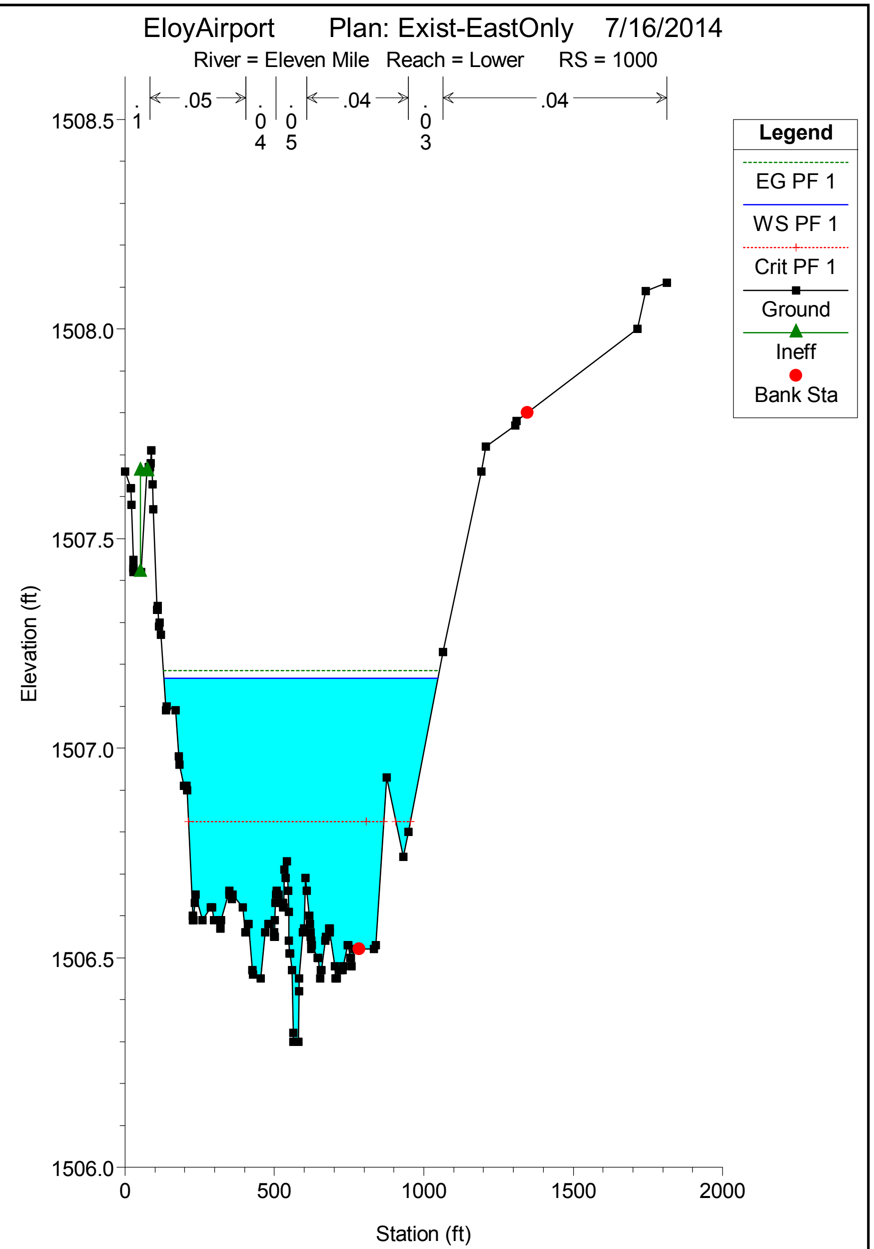
Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

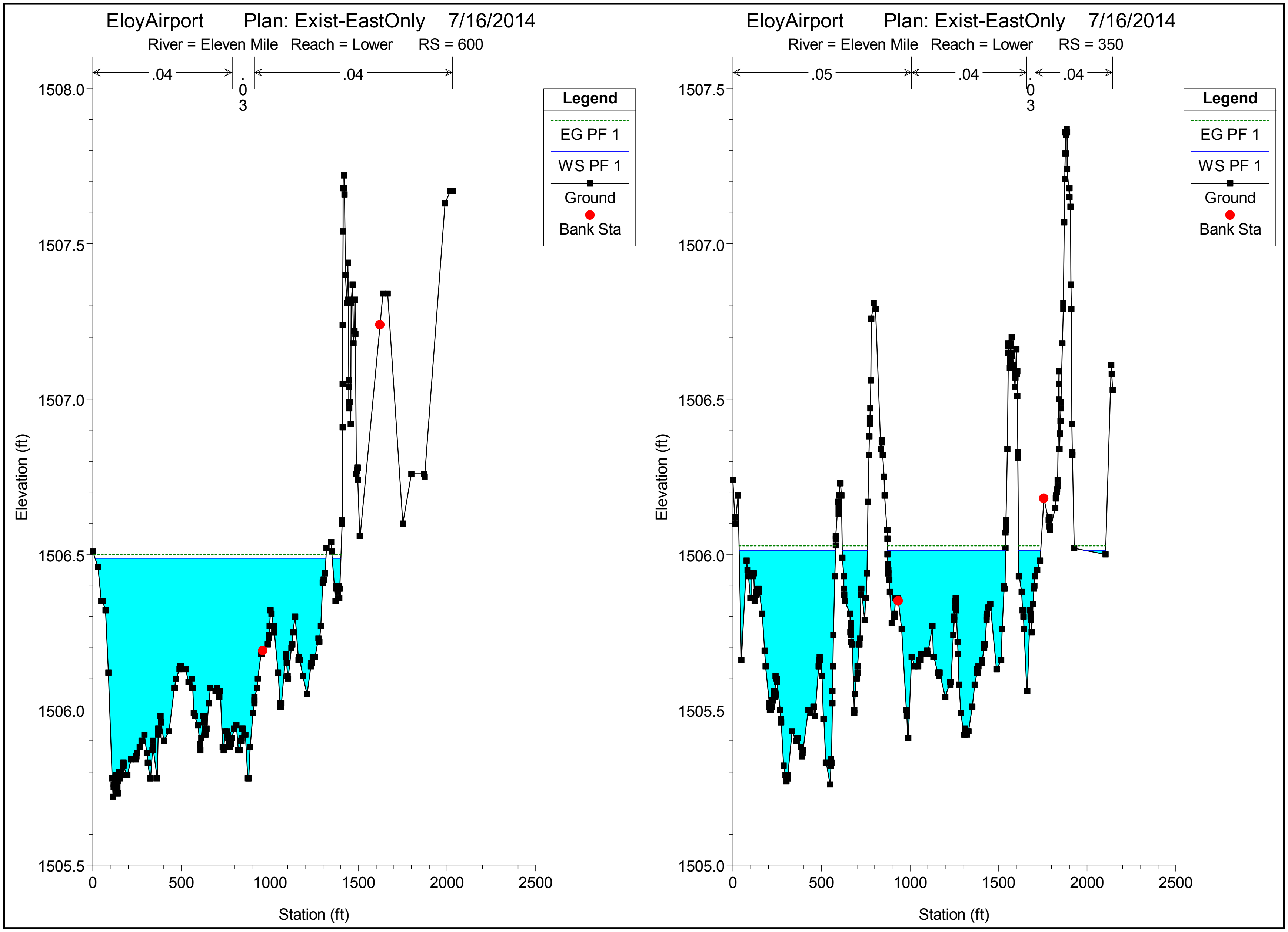
Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

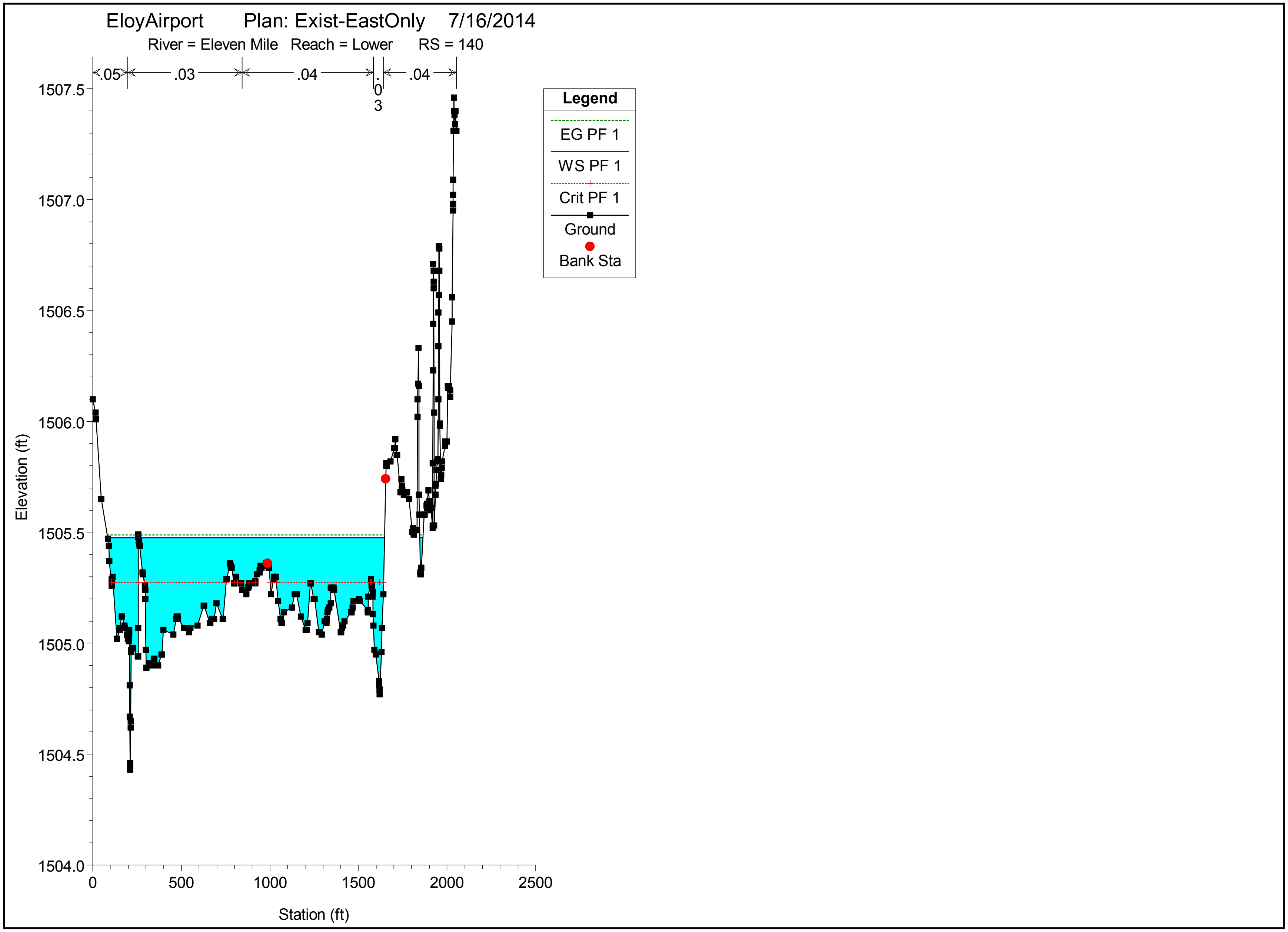
HEC-RAS Plan: East River: Eleven Mile Reach: Lower Profile: PF 1

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)	
Lower	1400	PF 1	501.00	1506.94	1507.95		1507.98	0.001339	1.32	493.97	1172.46	0.29
Lower	1000	PF 1	501.00	1506.52	1507.17	1506.83	1507.19	0.002339	1.02	455.09	916.51	0.30
Lower	600	PF 1	501.00	1506.01	1506.49		1506.50	0.001288	0.56	596.38	1351.82	0.19
Lower	350	PF 1	501.00	1505.41	1506.01		1506.03	0.002987	1.00	533.54	1602.49	0.30
Lower	140	PF 1	501.00	1504.77	1505.47	1505.28	1505.49	0.002001	0.86	520.42	1578.82	0.26


EloyAirport Plan: Exist-EastOnly 7/16/2014
River = Eleven Mile Reach = Lower RS = 1400
.04
.03
.04
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


EloyAirport Plan: Exist-EastOnly 7/16/2014
River = Eleven Mile Reach = Lower RS = 1000
.05
.04
.04
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


EloyAirport Plan: Exist-EastOnly 7/16/2014
River = Eleven Mile Reach = Lower RS = 600
.04
.03
.04
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1508.0
1507.5
1507.0
1506.5
1506.0
1505.5
0
500
1000
1500
2000
2500
Station (ft)
EloyAirport Plan: Exist-EastOnly 7/16/2014
River = Eleven Mile Reach = Lower RS = 350
.05
.04
.03
.04
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1507.5
1507.0
1506.5
1506.0
1505.5
1505.0
0
500
1000
1500
2000
2500
Station (ft)



EloyAirport Plan: Exist-EastOnly 7/16/2014
River = Eleven Mile Reach = Lower RS = 140
.05
.03
.04
.03
.04
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1507.5
1507.0
1506.5
1506.0
1505.5
1505.0
1504.5
1504.0
0
500
1000
1500
2000
2500
Station (ft)

Appendix A - Existing Drainage Analysis Supporting Documentation

Airport Tenant Outreach Forms

Tenant Outreach Form

Eloy Municipal Airport – Drainage Master Plan
Data Collection Outreach

City of Eloy is currently preparing a Drainage Master Plan for the Eloy Municipal Airport. The Drainage Master Plan begins with a data collection and drainage inventory phase in which the City's consultant is attempting to gather all relevant data/information regarding flooding and drainage problems within the study area. The City of Eloy would really appreciate your involvement by providing the consultant with valuable insight on existing drainage issues that our Airport Tenants and Patrons have experienced, observed, and/or captured with photos. We are interested in both historical as well as recent experiences. Please assist us by answering the questions below:

Questions	Answers
How long have you been an Airport Tenant or Patron?	SINCE 1995
Have you experienced flooding or drainage problems while on the Airport Premises? Please explain and indicate location on attached maps.	YES - DURING A HEAVY SUMMER MONSOON RAIN 5 OR 6 YEARS AGO. HANGERS AND OFFICE FLOODED WITH WATER AND MUD FROM CITY OWNED PROPERTY ADJACENT TO MY PROPERTY (SOUTH). THE
Do you have photos or newspaper clippings of any observations or experiences?	CITY GRADED A BERM BETWEEN OUR PROPERTIES THAT HAS SO FAR PREVENTED MORE FLOODING,
Have you experienced any flood related damage to personal property on the airport premises?	HOWEVER, THERE HAVE BEEN SEVERAL INSTANCES WHEN THE WATER LEVEL WAS WITHIN FRACTIONS OF AN INCH OF
How do we best contact you to discuss your information further?	FLOODING MY HANGERS. DURING A STORM THIS PAST
Were you an Airport Tenant or Patron during either the 1983 or 1993 flood?	SUMMER WATER RAN NORTH ALONG LEAR AND DUMPED

If additional room is needed, please attach an additional sheet

ONTO MY PROPERTY AT MY SOUTH PROPERTY LINE. CURRENTY CONSTRUCTION CREWS HAVE KNOCKED DOWN THE BERM THAT PROTECTS ME FROM FLOODING. HOPEFULLY, THEY WILL REBUILD IT.

Eloy Municipal Airport

Tenant Outreach Form

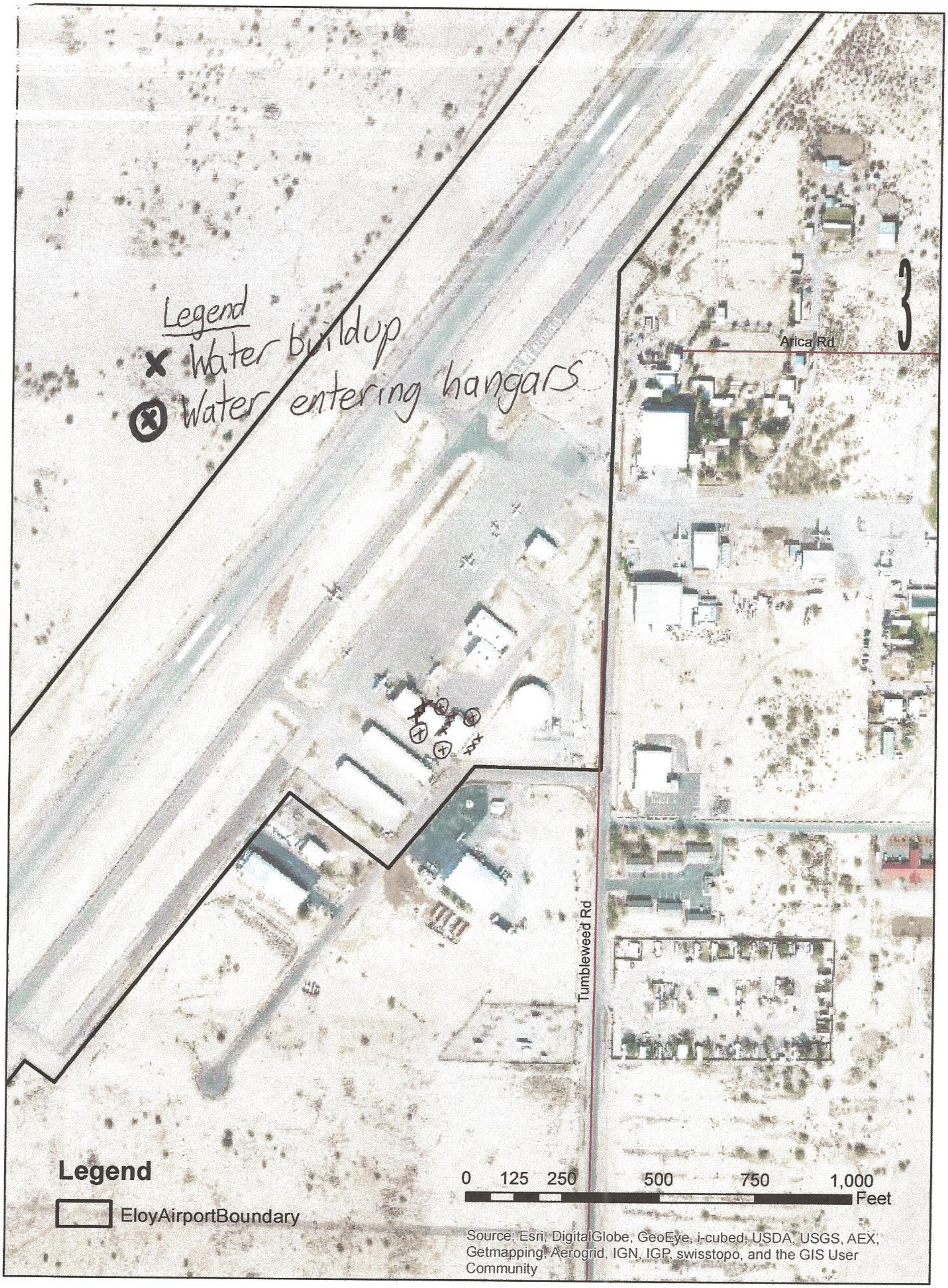
Eloy Municipal Airport – Drainage Master Plan
Data Collection Outreach

City of Eloy is currently preparing a Drainage Master Plan for the Eloy Municipal Airport. The Drainage Master Plan begins with a data collection and drainage inventory phase in which the City's consultant is attempting to gather all relevant data/information regarding flooding and drainage problems within the study area. The City of Eloy would really appreciate your involvement by providing the consultant with valuable insight on existing drainage issues that our Airport Tenants and Patrons have experienced, observed, and/or captured with photos. We are interested in both historical as well as recent experiences. Please assist us by answering the questions below:

Questions	Answers
How long have you been an Airport Tenant or Patron?	2 yrs.
Have you experienced flooding or drainage problems while on the Airport Premises? Please explain and indicate location on attached maps.	Yes. During monsoon storms water builds up around the perimeters of hangars 3+4. This water flows into these hangars.
Do you have photos or newspaper clippings of any observations or experiences?	No.
Have you experienced any flood related damage to personal property on the airport premises?	Minor water damage to Company equipment within hangars 3+4.
How do we best contact you to discuss your information further?	856 571 4717
Were you an Airport Tenant or Patron during either the 1983 or 1993 flood?	No

If additional room is needed, please attach an additional sheet

Eloy Municipal Airport



Appendix B - Preliminary Alternatives Supporting Documentation

Figures

Figure 10 – Drainage Improvements for Existing Conditions

Figure 11 – Drainage Improvements for Proposed Conditions

Airport Master Plan Exhibits

Alternatives Matrix

Hydraulic Design Supporting Documentation

CulvertMaster Outputs

FlowMaster Outputs

HEC-RAS Outputs

Appendix B - Preliminary Alternatives Supporting Documentation

Figures

Kimley»Horn

333 East Wetmore Road, Suite 280
Tucson, Arizona 85705 (520) 615-9191

PROJECT NO. 191645002

N

1 inch = 100 feet

100 50 0 100 Feet

Contour Interval = 1'

Legend

- Airport Boundary
- Sub Basin Boundaries
- Existing Culvert
- Flow Arrow for Alternative

Existing Drainage Alternatives

- Centerline
- Culvert
- Toe of Bank
- Top of Bank

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: KWP
DRAWN BY: KWP
CHECKED BY: SJA

DATE: FEBRUARY 2014

FIGURE 10
DRAINAGE IMPROVEMENTS FOR EXISTING CONDITIONS
ELOY AIRPORT DRAINAGE MASTER PLAN

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\Eloy_Existing Alternatives Exhibit.mxd

Kimley»Horn

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Tucson, Arizona 85705 (520) 615-9191

PROJECT NO.
191645002

N

1 inch = 100 feet

100 50 0 100 Feet

Contour Interval = 1'

Legend

- Airport Boundary
- Sub Basin Boundaries
- Existing Culvert
- Flow Arrow for Alternative

Existing Drainage Alternatives

- Centerline
- Culvert
- Toe of Bank
- Top of Bank

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: KWP
DRAWN BY: KWP
CHECKED BY: SJA

DATE: FEBRUARY 2014

FIGURE 10
DRAINAGE IMPROVEMENTS FOR EXISTING CONDITIONS
ELOY AIRPORT
DRAINAGE MASTER PLAN

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\Eloy_Existing Alternatives Exhibit.mxd

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Tucson, Arizona 85705 (520) 615-9191

PROJECT NO.
191645002

N

1 inch = 100 feet
100 50 0 100 Feet
Contour Interval = 1'

Legend

- Airport Boundary
- Sub Basin Boundaries
- Existing Culvert
- Flow Arrow for Alternative

Existing Drainage Alternatives
- Centerline
- Culvert
- Toe of Bank
- Top of Bank

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: KWP
DRAWN BY: KWP
CHECKED BY: SJA

DATE: FEBRUARY 2014

FIGURE 10
DRAINAGE IMPROVEMENTS
FOR EXISTING CONDITIONS
ELOY AIRPORT
DRAINAGE MASTER PLAN

Sheet 3 of 3

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\Eloy_Existing Alternatives Exhibit.mxd

Kimley»Horn

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Tucson, Arizona 85705 (520) 615-9191

PROJECT NO. 191645002

N

1 inch = 100 feet

100 50 0 100 Feet

Contour Interval = 1'

Legend

- Ultimate Airport Boundary
- Sub Basin Boundaries
- Existing Culvert
- Flow Arrow for Alternative
- Ultimate Airport Buildings
- Ultimate Airport Pavement
- Ultimate Roads and Parking
- Runway Safety Area

Proposed Drainage Alternatives
- Centerline
- Culvert
- Toe of Bank
- Top of Bank

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: KWP
DRAWN BY: KWP
CHECKED BY: SJA

DATE: FEBRUARY 2014

FIGURE 11
DRAINAGE IMPROVEMENTS
FOR PROPOSED CONDITIONS
ELOY AIRPORT
DRAINAGE MASTER PLAN

Sheet 1 of 3

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\Eloy_Proposed Alternatives Exhibit.mxd

Kimley»Horn

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333 East Wetmore Road, Suite 280
Tucson, Arizona 85705 (520) 615-9191

PROJECT NO. 191645002

N

1 inch = 100 feet

100 50 0 100 Feet

Contour Interval = 1'

Legend

- Ultimate Airport Boundary
- Sub Basin Boundaries
- Existing Culvert
- Flow Arrow for Alternative
- Ultimate Airport Buildings
- Ultimate Airport Pavement
- Ultimate Roads and Parking
- Runway Safety Area

Proposed Drainage Alternatives
- Centerline
- Culvert
- Toe of Bank
- Top of Bank

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: KWP
DRAWN BY: KWP
CHECKED BY: SJA

DATE: FEBRUARY 2014

FIGURE 11
DRAINAGE IMPROVEMENTS
FOR PROPOSED CONDITIONS
ELOY AIRPORT
DRAINAGE MASTER PLAN

Sheet 2 of 3

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\Eloy_Proposed Alternatives Exhibit.mxd

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PROJECT NO. 191645002

N

1 inch = 100 feet

100 50 0 100 Feet

Contour Interval = 1'

Legend

- Ultimate Airport Boundary
- Sub Basin Boundaries
- Existing Culvert
- Flow Arrow for Alternative
- Ultimate Airport Buildings
- Ultimate Airport Pavement
- Ultimate Roads and Parking
- Runway Safety Area

Proposed Drainage Alternatives

- Centerline
- Culvert
- Toe of Bank
- Top of Bank

SCALE(H): SHOWN
SCALE(V): NONE

DESIGNED BY: KWP
DRAWN BY: KWP
CHECKED BY: SJA

DATE: FEBRUARY 2014

FIGURE 11
DRAINAGE IMPROVEMENTS
FOR PROPOSED CONDITIONS
ELOY AIRPORT
DRAINAGE MASTER PLAN

Sheet 3 of 3

Document Path: K:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\GIS\Eloy_Proposed Alternatives Exhibit.mxd

Appendix B - Preliminary Alternatives Supporting Documentation

Airport Master Plan Exhibits

09MP03-5A-08/03/11

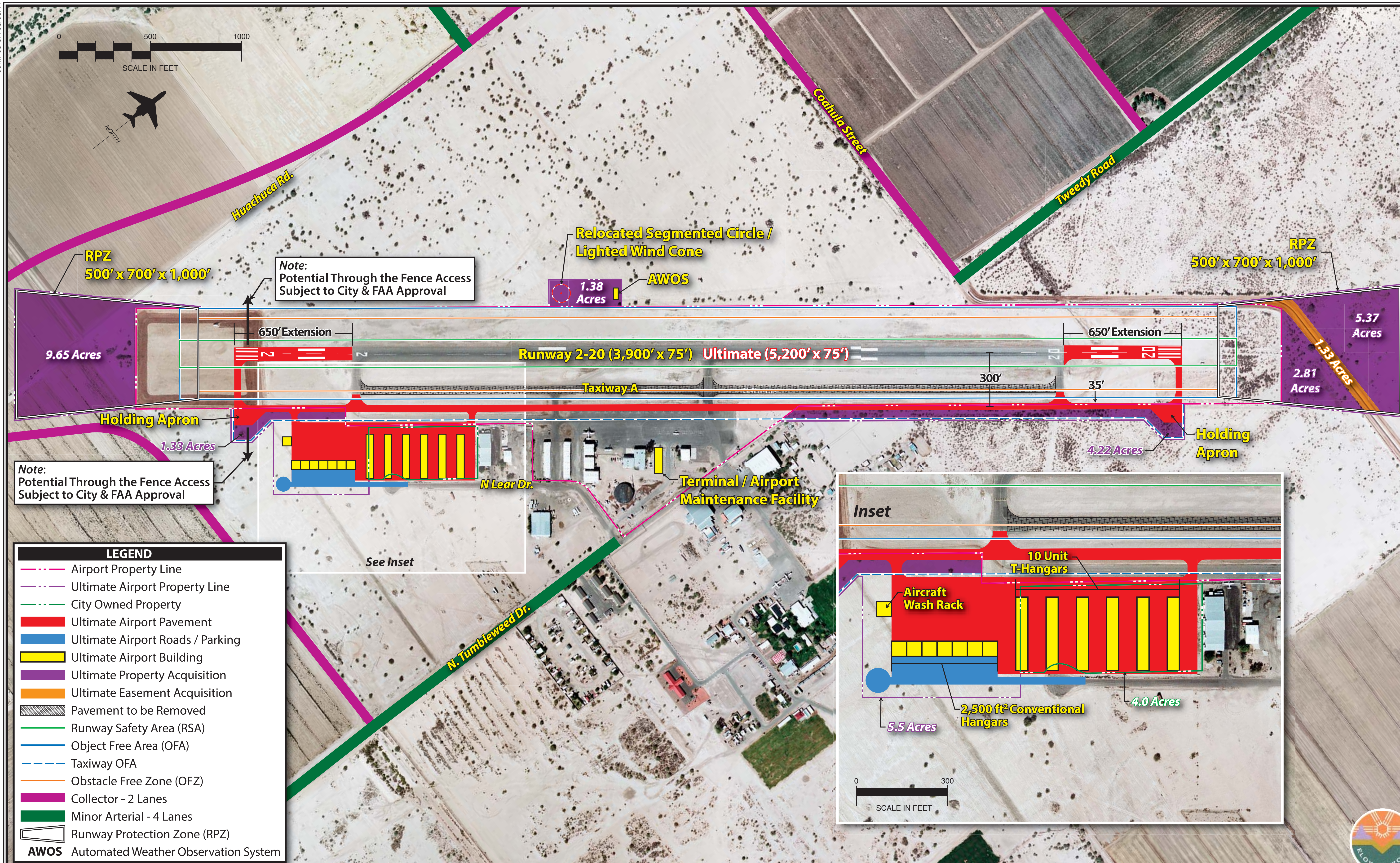

Exhibit 5A
RECOMMENDED MASTER PLAN CONCEPT

09MP03-6B-02/08/11

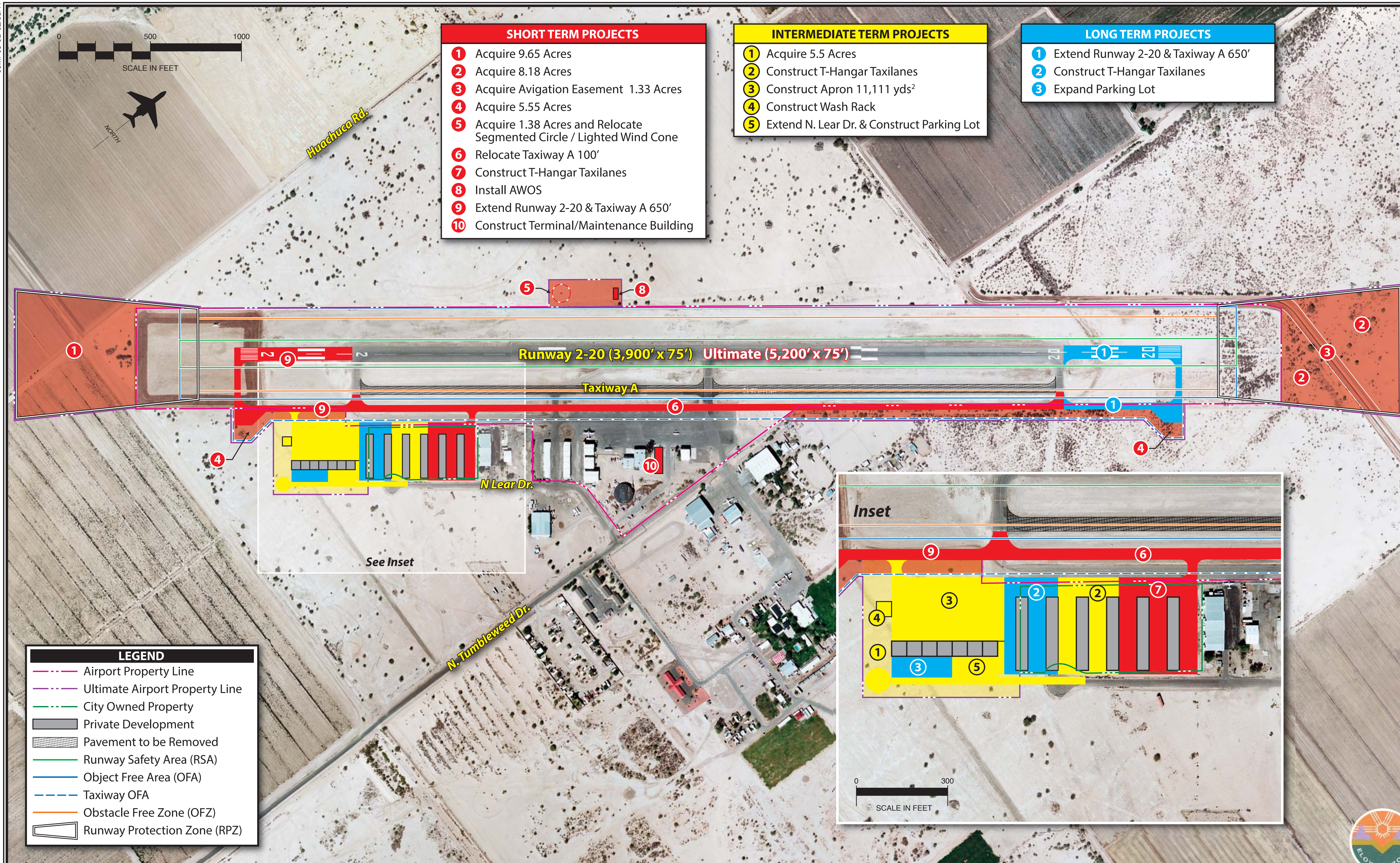

Exhibit 6B
DEVELOPMENT STAGING

Appendix B - Preliminary Alternatives Supporting Documentation

Alternatives Matrix

#	Feature	Location (On Airport Property)	Meets FAA Drainage Criteria for: 5-year Storm	10-year Storm	Impacts: Airside Safety	Landside Safety	Buildings	100-Year Floodplain	In conformance with: Short Term Projects	Intermediate Projects	Long Term Projects	Ultimate Airport Layout	Designed / Constructed with Airport Improvements	Cost	Grade: Total	Possible	%
	Upgrade Existing Features																
1	T-Hangar Flooding Mitigation	Yes	No	No	No	No	Yes	No	N/A	N/A	N/A	Yes	No	Low	7	10	70.0%
2	Other On-Airport Building Flooding Mitigation	Yes	No	No	No	No	Yes	No	N/A	N/A	N/A	Yes	No	Low	7	10	70.0%
3	Private Hangar Flooding Mitigation	No	No	No	No	No	Yes	No	N/A	N/A	N/A	No	No	Low	5	10	50.0%
4	North Taxiway Drainage Improvements	Yes	No	No	No	No	No	Yes	No	N/A	N/A	No	No	High	5	11	45.5%
5	South Taxiway Drainage Improvements	Yes	No	No	No	No	No	No	No	N/A	N/A	No	No	Low	5	11	45.5%
6	Culvert Replacement West of T-Hangars	Yes	No	No	No	No	Yes	No	Yes	N/A	N/A	Yes	Yes	Low	7	11	63.6%
7	North Tumbleweed Road Culvert Replacements	No	N/A	No	No	Yes	Yes	Yes	N/A	N/A	N/A	Yes	No	High	6	9	66.7%
8	North Tumbleweed Road Drainage Realignment	Yes	N/A	No	No	Yes	Yes	Yes	N/A	N/A	N/A	Yes	No	High	7	9	77.8%
9	Detention Basin Outlet Culvert Replacement	Yes	N/A	No	No	Yes	Yes	No	Yes	N/A	N/A	Yes	No	Low	8	10	80.0%
10	Culvert Replacement under Lear Drive at Tumbleweed Road	No	N/A	No	No	Yes	Yes	Yes	N/A	N/A	N/A	Yes	No	Low	7	9	77.8%
11	Lear Drive Channel and Culvert Improvements	No	N/A	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	High	9	12	75.0%

#	Feature	Location (On Airport Property)	Meets FAA Drainage Criteria for: 5-year Storm	10-year Storm	Impacts: Airside Safety	Landside Safety	Buildings	100-Year Floodplain	In conformance with: Short Term Projects	Intermediate Projects	Long Term Projects	Ultimate Airport Layout	Designed / Constructed with Airport Improvements	Cost	Grade:		
	Improvements for Proposed Plans																
12	Collector Channel Upstream of New Hangars	Yes	N/A	N/A	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Low	7	11	63.6%
13	Southwest Runway Extension Culverts	Yes	N/A	N/A	Yes	No	No	No	Yes	N/A	N/A	Yes	Yes	Low	5	9	55.6%
14	Infield Culverts and Channels for Taxiway Relocation	Yes	Yes	Yes	Yes	No	No	Yes	Yes	N/A	N/A	Yes	Yes	Low	6	11	54.5%
15	T-Hangar Culvert Improvements for Taxiway Relocation	Yes	No	No	No	No	Yes	No	Yes	N/A	N/A	Yes	Yes	Low	7	11	63.6%
16	Floodplain Improvements for Taxiway Relocation	No	No	No	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	No	High	10	12	83.3%
17	Drainage Improvements for Proposed Hangars	Yes	N/A	N/A	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	High	6	11	54.5%
18	Retention for Added Impervious	Yes	N/A	N/A	No	No	No	No	Yes	Yes	Yes	Yes	Yes	High	5	11	45.5%
	Other																
19	Regional Drainage Study	No	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A	N/A	N/A	N/A	N/A	1	2	50.0%

Appendix B - Preliminary Alternatives Supporting Documentation

Hydraulic Design Supporting Documentation

Culvert Designer/Analyzer Report
Alternative 03_100yr

Comments: 100-yr design to verify no impact to buildings

Peak Discharge Method: User-Specified					
Design Discharge	44.00	cfs	Check Discharge	0.00	cfs

Grades Model: Inverts					
Invert Upstream	1,507.65	ft	Invert Downstream	1,507.45	ft
Length	100.00	ft	Slope	0.002000	ft/ft
Drop	0.20	ft			

Headwater Model: Maximum Allowable HW		
Headwater Elevation	1,509.20	ft

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.					
Discharge	44.00	cfs	Bottom Elevation	1,507.45	ft
Depth	0.97	ft	Velocity	1.99	ft/s

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	8-18 inch Circular	44.00 cfs	1,509.11 ft	4.56 ft/s

Culvert Designer/Analyzer Report
Alternative 03_100yr

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	1,509.20	ft	Storm Event	Design	
Computed Headwater Eleva	1,509.11	ft	Discharge	44.00	cfs
Headwater Depth/Height	0.98		Tailwater Elevation	1,508.42	ft
Inlet Control HW Elev.	1,508.95	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	1,509.11	ft			

Grades					
Upstream Invert	1,507.65	ft	Downstream Invert	1,507.45	ft
Length	100.00	ft	Constructed Slope	0.002000	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	0.97	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	0.90	ft
Velocity Downstream	4.56	ft/s	Critical Slope	0.005987	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	8				

Outlet Control Properties					
Outlet Control HW Elev.	1,509.11	ft	Upstream Velocity Head	0.20	ft
Ke	0.20		Entrance Loss	0.04	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,508.95	ft	Flow Control	N/A	
Inlet Type	Groove end w/headwall		Area Full	14.1	ft^2
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Culvert Designer/Analyzer Report
Alternative 04

Analysis Component			
Storm Event	Design	Discharge	51.80 cfs

Peak Discharge Method: User-Specified			
Design Discharge	51.80 cfs	Check Discharge	67.10 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	51.80 cfs	Bottom Elevation	1,503.40 ft
Depth	1.07 ft	Velocity	1.71 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	8-18 inch Circular	51.81 cfs	1,505.25 ft	4.77 ft/s
Weir	Roadway	0.00 cfs	1,505.25 ft	N/A
Total	----------------	51.81 cfs	1,505.25 ft	N/A

Culvert Designer/Analyzer Report
Alternative 04

Component:Culvert-1

Culvert Summary

Computed Headwater Eleva	1,505.25	ft	Discharge	51.81	cfs
Inlet Control HW Elev.	1,504.97	ft	Tailwater Elevation	1,504.47	ft
Outlet Control HW Elev.	1,505.25	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.17				

Grades

Upstream Invert	1,503.50	ft	Downstream Invert	1,503.39	ft
Length	106.38	ft	Constructed Slope	0.000987	ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile		Depth, Downstream	1.08	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	0.98	ft
Velocity Downstream	4.77	ft/s	Critical Slope	0.006467	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	8				

Outlet Control Properties

Outlet Control HW Elev.	1,505.25	ft	Upstream Velocity Head	0.21	ft
Ke	0.20		Entrance Loss	0.04	ft

Inlet Control Properties

Inlet Control HW Elev.	1,504.97	ft	Flow Control	N/A	
Inlet Type	Groove end projecting		Area Full	14.1	ft²
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Culvert Designer/Analyzer Report
Alternative 04

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	0.00	cfs	Allowable HW Elevation	1,505.25	ft
Roadway Width	53.00	ft	Overtopping Coefficient	2.90	US
Low Point	1,506.00	ft	Headwater Elevation	N/A	ft
Discharge Coefficient (Cr)	2.90		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,504.47	ft			

Sta (ft)	Elev. (ft)
0.00	1,507.00
59.20	1,506.80
71.80	1,506.60
85.34	1,506.40
98.33	1,506.20
120.38	1,506.00
142.74	1,506.00
165.20	1,506.20

Culvert Designer/Analyzer Report
Alternative 05

Analysis Component			
Storm Event	Check	Discharge	41.90 cfs

Peak Discharge Method: User-Specified			
Design Discharge	31.40 cfs	Check Discharge	41.90 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Check Storm.			
Discharge	41.90 cfs	Bottom Elevation	1,505.10 ft
Depth	0.74 ft	Velocity	2.09 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-24 inch Circular	41.89 cfs	1,507.65 ft	6.21 ft/s
Weir	Roadway	0.00 cfs	1,507.65 ft	N/A
Total	----------------	41.89 cfs	1,507.65 ft	N/A

Culvert Designer/Analyzer Report
Alternative 05

Component:Culvert-1

Culvert Summary			
Computed Headwater Eleva	1,507.65 ft	Discharge	41.89 cfs
Inlet Control HW Elev.	1,507.61 ft	Tailwater Elevation	1,505.84 ft
Outlet Control HW Elev.	1,507.65 ft	Control Type	Outlet Control
Headwater Depth/Height	1.03		

Grades			
Upstream Invert	1,505.58 ft	Downstream Invert	1,505.14 ft
Length	93.94 ft	Constructed Slope	0.004684 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	1.35 ft
Slope Type	Mild	Normal Depth	1.49 ft
Flow Regime	Subcritical	Critical Depth	1.35 ft
Velocity Downstream	6.21 ft/s	Critical Slope	0.006040 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	3		

Outlet Control Properties			
Outlet Control HW Elev.	1,507.65 ft	Upstream Velocity Head	0.49 ft
Ke	0.20	Entrance Loss	0.10 ft

Inlet Control Properties			
Inlet Control HW Elev.	1,507.61 ft	Flow Control	N/A
Inlet Type	Groove end projecting	Area Full	9.4 ft²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Designer/Analyzer Report
Alternative 05

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	0.00	cfs	Allowable HW Elevation	1,507.65	ft
Roadway Width	33.00	ft	Overtopping Coefficient	2.90	US
Low Point	1,508.20	ft	Headwater Elevation	N/A	ft
Discharge Coefficient (Cr)	2.90		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,505.84	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.60
10.69	1,508.40
29.25	1,508.40
46.69	1,508.60
93.43	1,508.60
127.43	1,508.40
164.89	1,508.20

Culvert Designer/Analyzer Report
Alternative 06

Analysis Component			
Storm Event	Check	Discharge	33.40 cfs

Peak Discharge Method: User-Specified			
Design Discharge	24.80 cfs	Check Discharge	33.40 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Check Storm.			
Discharge	33.40 cfs	Bottom Elevation	1,505.80 ft
Depth	0.88 ft	Velocity	2.77 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	4-15 inch Circular	24.11 cfs	1,507.96 ft	5.77 ft/s
Weir	Roadway	9.29 cfs	1,507.96 ft	N/A
Total	----------------	33.40 cfs	1,507.96 ft	N/A

Culvert Designer/Analyzer Report
Alternative 06

Component:Culvert-1

Culvert Summary

Computed Headwater Eleva	1,507.96 ft	Discharge	24.11 cfs
Inlet Control HW Elev.	1,507.77 ft	Tailwater Elevation	1,506.68 ft
Outlet Control HW Elev.	1,507.96 ft	Control Type	Outlet Control
Headwater Depth/Height	1.45		

Grades

Upstream Invert	1,506.15 ft	Downstream Invert	1,505.80 ft
Length	70.00 ft	Constructed Slope	0.005000 ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile	Depth, Downstream	0.99 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	0.99 ft
Velocity Downstream	5.77 ft/s	Critical Slope	0.009250 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.25 ft
Section Size	15 inch	Rise	1.25 ft
Number Sections	4		

Outlet Control Properties

Outlet Control HW Elev.	1,507.96 ft	Upstream Velocity Head	0.37 ft
Ke	0.20	Entrance Loss	0.07 ft

Inlet Control Properties

Inlet Control HW Elev.	1,507.77 ft	Flow Control	N/A
Inlet Type	Beveled ring, 33.7° bevels	Area Full	4.9 ft²
K	0.00180	HDS 5 Chart	3
M	2.50000	HDS 5 Scale	B
C	0.02430	Equation Form	1
Y	0.83000		

Culvert Designer/Analyzer Report
Alternative 06

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	9.29	cfs	Allowable HW Elevation	1,507.96	ft
Roadway Width	50.50	ft	Overtopping Coefficient	2.92	US
Low Point	1,507.60	ft	Headwater Elevation	1,507.96	ft
Discharge Coefficient (Cr)	2.92		Submergence Factor (Kt)	1.00	
Tailwater Elevation	1,506.68	ft			

Sta (ft)	Elev. (ft)
0.00	1,508.40
73.19	1,508.20
114.07	1,508.20
144.24	1,508.20
163.55	1,508.00
182.82	1,507.80
203.76	1,507.60

Culvert Designer/Analyzer Report
Alternative 07_C13

Analysis Component				
Storm Event	Design	Discharge	53.80	cfs

Peak Discharge Method: User-Specified					
Design Discharge	53.80	cfs	Check Discharge	0.00	cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.					
Discharge	53.80	cfs	Bottom Elevation	1,504.10	ft
Depth	1.76	ft	Velocity	1.79	ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	6-18 inch Circular	53.80 cfs	1,506.89 ft	5.07 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Designer/Analyzer Report
Alternative 07_C13

Component:Culvert-1

Culvert Summary					
Computed Headwater Eleva	1,506.89	ft	Discharge	53.80	cfs
Inlet Control HW Elev.	1,506.18	ft	Tailwater Elevation	1,505.86	ft
Outlet Control HW Elev.	1,506.89	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.71				

Grades					
Upstream Invert	1,504.33	ft	Downstream Invert	1,504.10	ft
Length	75.00	ft	Constructed Slope	0.003000	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	1.76	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	1.16	ft
Velocity Downstream	5.07	ft/s	Critical Slope	0.008201	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	6				

Outlet Control Properties					
Outlet Control HW Elev.	1,506.89	ft	Upstream Velocity Head	0.40	ft
Ke	0.20		Entrance Loss	0.08	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,506.18	ft	Flow Control	N/A	
Inlet Type	Groove end w/headwall		Area Full	10.6	ft²
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Culvert Designer/Analyzer Report
Alternative 07_C14

Peak Discharge Method: User-Specified					
Design Discharge	4.80	cfs	Check Discharge	0.00	cfs

Grades Model: Inverts					
Invert Upstream	1,504.08	ft	Invert Downstream	1,504.00	ft
Length	26.00	ft	Slope	0.003000	ft/ft
Drop	0.08	ft			

Headwater Model: Maximum Allowable HW		
Headwater Elevation	1,506.70	ft

Tailwater Conditions: Constant Tailwater		
Tailwater Elevation	1,505.90	ft

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	1-18 inch Circular	4.80 cfs	1,506.09 ft	2.72 ft/s

Culvert Designer/Analyzer Report
Alternative 07_C14

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	1,506.70	ft	Storm Event	Design	
Computed Headwater Eleva	1,506.09	ft	Discharge	4.80	cfs
Headwater Depth/Height	1.34		Tailwater Elevation	1,505.90	ft
Inlet Control HW Elev.	1,505.90	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	1,506.09	ft			

Grades					
Upstream Invert	1,504.08	ft	Downstream Invert	1,504.00	ft
Length	26.00	ft	Constructed Slope	0.003000	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	1.90	ft
Slope Type	N/A		Normal Depth	1.05	ft
Flow Regime	N/A		Critical Depth	0.84	ft
Velocity Downstream	2.72	ft/s	Critical Slope	0.005698	ft/ft

Section				
Section Shape	Circular	Mannings Coefficient	0.013	
Section Material	Concrete	Span	1.50	ft
Section Size	18 inch	Rise	1.50	ft
Number Sections	1			

Outlet Control Properties					
Outlet Control HW Elev.	1,506.09	ft	Upstream Velocity Head	0.11	ft
Ke	0.20		Entrance Loss	0.02	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,505.90	ft	Flow Control	N/A	
Inlet Type	Groove end w/headwall		Area Full	1.8	ft²
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Culvert Designer/Analyzer Report
Alternative 07_C17

Peak Discharge Method: User-Specified					
Design Discharge	58.60	cfs	Check Discharge	0.00	cfs

Grades Model: Inverts					
Invert Upstream	1,503.82	ft	Invert Downstream	1,503.69	ft
Length	100.00	ft	Slope	0.001300	ft/ft
Drop	0.13	ft			

Headwater Model: Maximum Allowable HW		
Headwater Elevation	1,506.00	ft

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.					
Discharge	58.60	cfs	Bottom Elevation	1,503.65	ft
Depth	1.44	ft	Velocity	2.85	ft/s

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	8-18 inch Circular	58.60 cfs	1,505.90 ft	4.27 ft/s

Culvert Designer/Analyzer Report
Alternative 07_C17

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	1,506.00	ft	Storm Event	Design	
Computed Headwater Eleva	1,505.90	ft	Discharge	58.60	cfs
Headwater Depth/Height	1.38		Tailwater Elevation	1,505.09	ft
Inlet Control HW Elev.	1,505.38	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	1,505.90	ft			

Grades					
Upstream Invert	1,503.82	ft	Downstream Invert	1,503.69	ft
Length	100.00	ft	Constructed Slope	0.001300	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.40	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.05	ft
Velocity Downstream	4.27	ft/s	Critical Slope	0.006966	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	8				

Outlet Control Properties					
Outlet Control HW Elev.	1,505.90	ft	Upstream Velocity Head	0.27	ft
Ke	0.20		Entrance Loss	0.05	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,505.38	ft	Flow Control	N/A	
Inlet Type	Groove end w/headwall		Area Full	14.1	ft^2
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Culvert Designer/Analyzer Report
Alternative 08

Analysis Component			
Storm Event	Design	Discharge	65.60 cfs

Peak Discharge Method: User-Specified			
Design Discharge	65.60 cfs	Check Discharge	0.00 cfs

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.			
Discharge	65.60 cfs	Bottom Elevation	1,504.20 ft
Depth	1.41 ft	Velocity	2.41 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	5-21 inch Circular	65.60 cfs	1,506.67 ft	6.31 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Designer/Analyzer Report
Alternative 08

Component:Culvert-1

Culvert Summary					
Computed Headwater Eleva	1,506.67	ft	Discharge	65.60	cfs
Inlet Control HW Elev.	1,506.47	ft	Tailwater Elevation	1,505.61	ft
Outlet Control HW Elev.	1,506.67	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.35				

Grades					
Upstream Invert	1,504.31	ft	Downstream Invert	1,504.20	ft
Length	53.60	ft	Constructed Slope	0.002000	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.41	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.35	ft
Velocity Downstream	6.31	ft/s	Critical Slope	0.007756	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.75	ft
Section Size	21 inch		Rise	1.75	ft
Number Sections	5				

Outlet Control Properties					
Outlet Control HW Elev.	1,506.67	ft	Upstream Velocity Head	0.46	ft
Ke	0.20		Entrance Loss	0.09	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,506.47	ft	Flow Control	N/A	
Inlet Type	Groove end w/headwall		Area Full	12.0	ft²
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Culvert Designer/Analyzer Report
Alternative 09

Peak Discharge Method: User-Specified					
Design Discharge	11.50	cfs	Check Discharge	0.00	cfs

Grades Model: Inverts					
Invert Upstream	1,505.25	ft	Invert Downstream	1,505.10	ft
Length	50.00	ft	Slope	0.003000	ft/ft
Drop	0.15	ft			

Headwater Model: Maximum Allowable HW		
Headwater Elevation	1,507.00	ft

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.					
Discharge	11.50	cfs	Bottom Elevation	1,506.00	ft
Depth	0.54	ft	Velocity	2.61	ft/s

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	2-18 inch Circular	11.50 cfs	1,506.87 ft	3.30 ft/s

Culvert Designer/Analyzer Report
Alternative 09

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	1,507.00	ft	Storm Event	Design	
Computed Headwater Eleva	1,506.87	ft	Discharge	11.50	cfs
Headwater Depth/Height	1.08		Tailwater Elevation	1,506.54	ft
Inlet Control HW Elev.	1,506.58	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	1,506.87	ft			

Grades					
Upstream Invert	1,505.25	ft	Downstream Invert	1,505.10	ft
Length	50.00	ft	Constructed Slope	0.003000	ft/ft

Hydraulic Profile					
Profile	M1		Depth, Downstream	1.44	ft
Slope Type	Mild		Normal Depth	1.23	ft
Flow Regime	Subcritical		Critical Depth	0.93	ft
Velocity Downstream	3.30	ft/s	Critical Slope	0.006097	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	1,506.87	ft	Upstream Velocity Head	0.17	ft
Ke	0.20		Entrance Loss	0.03	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,506.58	ft	Flow Control	N/A	
Inlet Type	Groove end w/headwall		Area Full	3.5	ft²
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Culvert Designer/Analyzer Report
Alternative 10

Peak Discharge Method: User-Specified

Design Discharge	45.20	cfs	Check Discharge	0.00	cfs

Grades Model: Inverts

Invert Upstream	1,505.90	ft	Invert Downstream	1,505.80	ft
Length	50.00	ft	Slope	0.002000	ft/ft
Drop	0.10	ft			

Headwater Model: Maximum Allowable HW

Headwater Elevation	1,507.50	ft

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.

Discharge	45.20	cfs	Bottom Elevation	1,505.80	ft
Depth	1.15	ft	Velocity	2.14	ft/s

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	5-24 inch Circular	45.20 cfs	1,507.53 ft	4.86 ft/s

Culvert Designer/Analyzer Report
Alternative 10

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	1,507.50	ft	Storm Event	Design	
Computed Headwater Eleva	1,507.53	ft	Discharge	45.20	cfs
Headwater Depth/Height	0.81		Tailwater Elevation	1,506.95	ft
Inlet Control HW Elev.	1,507.42	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	1,507.53	ft			

Grades					
Upstream Invert	1,505.90	ft	Downstream Invert	1,505.80	ft
Length	50.00	ft	Constructed Slope	0.002000	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.15	ft
Slope Type	Mild		Normal Depth	1.47	ft
Flow Regime	Subcritical		Critical Depth	1.07	ft
Velocity Downstream	4.86	ft/s	Critical Slope	0.005043	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	5				

Outlet Control Properties					
Outlet Control HW Elev.	1,507.53	ft	Upstream Velocity Head	0.27	ft
Ke	0.20		Entrance Loss	0.05	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,507.42	ft	Flow Control	N/A	
Inlet Type	Groove end w/headwall		Area Full	15.7	ft²
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Culvert Designer/Analyzer Report
Alternative 11 (1)

Peak Discharge Method: User-Specified

Design Discharge	22.20	cfs	Check Discharge	0.00	cfs

Grades Model: Inverts

Invert Upstream	1,506.31	ft	Invert Downstream	1,506.22	ft
Length	44.00	ft	Slope	0.002000	ft/ft
Drop	0.09	ft			

Headwater Model: Maximum Allowable HW

Headwater Elevation	1,508.00	ft

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.

Discharge	22.20	cfs	Bottom Elevation	1,506.22	ft
Depth	1.24	ft	Velocity	1.86	ft/s

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	4-18 inch Circular	22.20 cfs	1,507.81 ft	3.54 ft/s

Culvert Designer/Analyzer Report
Alternative 11 (1)

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	1,508.00	ft	Storm Event	Design	
Computed Headwater Eleva	1,507.81	ft	Discharge	22.20	cfs
Headwater Depth/Height	1.00		Tailwater Elevation	1,507.46	ft
Inlet Control HW Elev.	1,507.61	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	1,507.81	ft			

Grades					
Upstream Invert	1,506.31	ft	Downstream Invert	1,506.22	ft
Length	44.00	ft	Constructed Slope	0.002000	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.24	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	0.91	ft
Velocity Downstream	3.54	ft/s	Critical Slope	0.006009	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	4				

Outlet Control Properties					
Outlet Control HW Elev.	1,507.81	ft	Upstream Velocity Head	0.18	ft
Ke	0.20		Entrance Loss	0.04	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,507.61	ft	Flow Control	N/A	
Inlet Type	Groove end w/headwall		Area Full	7.1	ft²
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Culvert Designer/Analyzer Report
Alternative 11 (2)

Peak Discharge Method: User-Specified

Design Discharge	22.20	cfs	Check Discharge	0.00	cfs

Grades Model: Inverts

Invert Upstream	1,506.87	ft	Invert Downstream	1,506.70	ft
Length	85.00	ft	Slope	0.002000	ft/ft
Drop	0.17	ft			

Headwater Model: Maximum Allowable HW

Headwater Elevation	1,508.50	ft

Tailwater properties: Trapezoidal Channel

Tailwater conditions for Design Storm.

Discharge	22.20	cfs	Bottom Elevation	1,506.70	ft
Depth	1.24	ft	Velocity	1.86	ft/s

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	4-18 inch Circular	22.20 cfs	1,508.40 ft	3.54 ft/s

Culvert Designer/Analyzer Report
Alternative 11 (2)

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	1,508.50	ft	Storm Event	Design	
Computed Headwater Eleva	1,508.40	ft	Discharge	22.20	cfs
Headwater Depth/Height	1.02		Tailwater Elevation	1,507.94	ft
Inlet Control HW Elev.	1,508.18	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	1,508.40	ft			

Grades					
Upstream Invert	1,506.87	ft	Downstream Invert	1,506.70	ft
Length	85.00	ft	Constructed Slope	0.002000	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.24	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	0.91	ft
Velocity Downstream	3.54	ft/s	Critical Slope	0.006009	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	4				

Outlet Control Properties					
Outlet Control HW Elev.	1,508.40	ft	Upstream Velocity Head	0.18	ft
Ke	0.20		Entrance Loss	0.04	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,508.18	ft	Flow Control	N/A	
Inlet Type	Groove end w/headwall		Area Full	7.1	ft^2
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Culvert Designer/Analyzer Report
Alternative 13_Runway

Analysis Component			
Storm Event	Design	Discharge	12.80 cfs

Peak Discharge Method: User-Specified			
Design Discharge	12.80 cfs	Check Discharge	17.30 cfs

Tailwater properties: Triangular Channel

Tailwater conditions for Design Storm.			
Discharge	12.80 cfs	Bottom Elevation	1,509.50 ft
Depth	0.97 ft	Velocity	1.36 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	5-18 inch Circular	12.80 cfs	1,510.78 ft	2.12 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Designer/Analyzer Report
Alternative 13_Runway

Component:Culvert-1

Culvert Summary					
Computed Headwater Eleva	1,510.78	ft	Discharge	12.80	cfs
Inlet Control HW Elev.	1,510.66	ft	Tailwater Elevation	1,510.47	ft
Outlet Control HW Elev.	1,510.78	ft	Control Type	Outlet Control	
Headwater Depth/Height	0.64				

Grades					
Upstream Invert	1,509.82	ft	Downstream Invert	1,509.50	ft
Length	160.00	ft	Constructed Slope	0.002000	ft/ft

Hydraulic Profile					
Profile	M1		Depth, Downstream	0.97	ft
Slope Type	Mild		Normal Depth	0.79	ft
Flow Regime	Subcritical		Critical Depth	0.61	ft
Velocity Downstream	2.12	ft/s	Critical Slope	0.005038	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	5				

Outlet Control Properties					
Outlet Control HW Elev.	1,510.78	ft	Upstream Velocity Head	0.10	ft
Ke	0.20		Entrance Loss	0.02	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,510.66	ft	Flow Control	N/A	
Inlet Type	Groove end w/headwall		Area Full	8.8	ft²
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Culvert Designer/Analyzer Report
Alternative 13_Taxiway

Analysis Component			
Storm Event	Check	Discharge	7.70 cfs

Peak Discharge Method: User-Specified			
Design Discharge	5.50 cfs	Check Discharge	7.70 cfs

Tailwater properties: Triangular Channel

Tailwater conditions for Check Storm.			
Discharge	7.70 cfs	Bottom Elevation	1,510.60 ft
Depth	0.80 ft	Velocity	1.20 ft/s

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-18 inch Circular	7.70 cfs	1,511.96 ft	4.01 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Designer/Analyzer Report
Alternative 13_Taxiway

Component:Culvert-1

Culvert Summary					
Computed Headwater Eleva	1,511.96	ft	Discharge	7.70	cfs
Inlet Control HW Elev.	1,511.85	ft	Tailwater Elevation	1,511.40	ft
Outlet Control HW Elev.	1,511.96	ft	Control Type	Outlet Control	
Headwater Depth/Height	0.78				

Grades					
Upstream Invert	1,510.80	ft	Downstream Invert	1,510.60	ft
Length	100.00	ft	Constructed Slope	0.002000	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	0.80	ft
Slope Type	Mild		Normal Depth	1.03	ft
Flow Regime	Subcritical		Critical Depth	0.75	ft
Velocity Downstream	4.01	ft/s	Critical Slope	0.005370	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	1,511.96	ft	Upstream Velocity Head	0.16	ft
Ke	0.20		Entrance Loss	0.03	ft

Inlet Control Properties					
Inlet Control HW Elev.	1,511.85	ft	Flow Control	N/A	
Inlet Type	Groove end w/headwall		Area Full	3.5	ft²
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Alternatives_Channels Report

Label	Solve For	Friction Method	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (ft)	Left Side Slope (ft/ft (H:V))	Right Side Slope (ft/ft (H:V))	Bottom Width (ft)	Discharge (ft³/s)	Flow Area (ft²)	Wetted Perimeter (ft)
Alternative 03	Normal Depth	Manning Formula	0.030	0.00200	0.97	3.00	3.00	20.00	44.00	22.16	26.12
Alternative 04	Normal Depth	Manning Formula	0.030	0.00100	1.74	6.00	6.00	22.00	105.20	56.26	43.12
Alternative 05	Normal Depth	Manning Formula	0.030	0.00450	1.41	6.00	6.00	0.00	31.40	12.01	17.21
Alternative 08	Normal Depth	Manning Formula	0.030	0.00200	1.41	3.00	3.00	15.00	65.60	27.21	23.94
Alternative 11	Normal Depth	Manning Formula	0.030	0.00200	1.24	6.00	3.00	4.00	22.20	11.93	15.49
Alternative 12	Normal Depth	Manning Formula	0.030	0.00200	0.77	3.00	3.00	10.00	15.70	9.54	14.90

Hydraulic Radius (ft)	Top Width (ft)	Critical Depth (ft)	Critical Slope (ft/ft)	Velocity (ft/s)	Velocity Head (ft)	Specific Energy (ft)	Froude Number	Flow Type	Notes	Messages
0.85	25.80	0.52	0.01688	1.99	0.06	1.03	0.38	Subcritical		
1.30	42.83	0.82	0.01488	1.87	0.05	1.79	0.29	Subcritical		
0.70	16.98	1.11	0.01624	2.61	0.11	1.52	0.55	Subcritical		
1.14	23.48	0.80	0.01503	2.41	0.09	1.50	0.39	Subcritical		
0.77	15.19	0.74	0.01677	1.86	0.05	1.30	0.37	Subcritical		
0.64	14.65	0.41	0.01858	1.65	0.04	0.82	0.36	Subcritical		

```
                    HEC-RAS Version 4.1.0 Jan 2010
                     U.S. Army Corps of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California

     X     X  XXXXXX    XXXX        XXXX       XX      XXXX
     X     X  X        X    X       X   X     X  X    X
     X     X  X        X            X   X    X    X   X
     XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
     X     X  X        X            X  X     X    X        X
     X     X  X        X    X       X   X    X    X        X
     X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
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Project File : EloyAirport.prj
Run Date and Time: 3/18/2014 9:23:43 AM

Project in English units

PLAN DATA

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Geometry Title: Ultimate2
Geometry File : k:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\Drainage\Hydraulics\HEC-RAS\EloyAirport.g11

Flow Title   : Ultimate2
Flow File   : k:\TUC_WaterResources\191645002_Eloy Airport DMP\Design\Drainage\Hydraulics\HEC-RAS\EloyAirport.f06

Plan Summary Information:

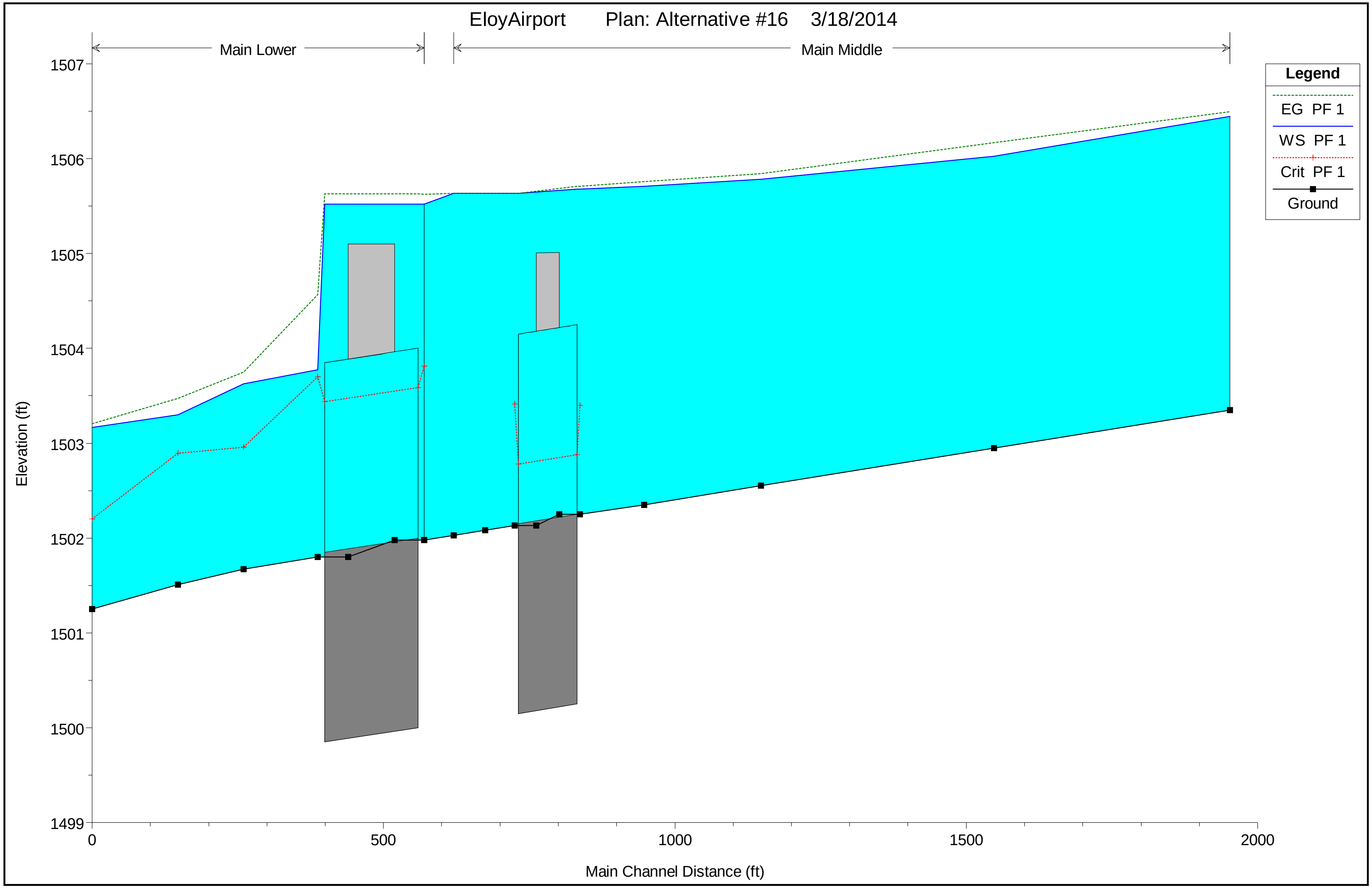
Number of:	Cross Sections	= 16	Multiple Openings	=	0
	Culverts	= 2	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	6

Computational Information
    Water surface calculation tolerance = 0.01
    Critical depth calculation tolerance = 0.01
    Maximum number of iterations   = 40
    Maximum difference tolerance   = 0.3
    Flow tolerance factor   = 0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method: Average Conveyance
    Computational Flow Regime: Subcritical Flow

HEC-RAS Plan: A-16 Profile: PF 1

River	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)	
Main	Middle	3791	PF 1	917.00	1503.35	1506.45		1506.50	0.000662	2.55	725.53	803.73	0.27
Main	Middle	3700		Lat Struct									
Main	Middle	3386	PF 1	617.14	1502.95	1506.02		1506.17	0.001184	3.29	306.82	516.36	0.35
Main	Middle	3300		Lat Struct									
Main	Middle	2986	PF 1	399.62	1502.55	1505.78		1505.84	0.000433	2.03	259.94	312.93	0.21
Main	Middle	2786	PF 1	399.62	1502.35	1505.71		1505.76	0.000379	1.95	268.13	238.94	0.20
Main	Middle	2675	PF 1	399.62	1502.25	1505.68	1503.40	1505.71	0.000344	1.48	335.90	293.28	0.18
Main	Middle	2600		Culvert									
Main	Middle	2563	PF 1	399.62	1502.13	1505.64	1503.42	1505.64	0.000011	0.38	1221.26	451.36	0.04
Main	Middle	2550		Lat Struct									
Main	Middle	2513	PF 1	348.29	1502.08	1505.64		1505.64	0.000008	0.33	1223.53	451.48	0.03
Main	Middle	2459	PF 1	294.03	1502.03	1505.64		1505.64	0.000006	0.28	1225.76	452.13	0.03
Main	Lower	2408	PF 1	743.91	1501.98	1505.52	1503.81	1505.62	0.000690	2.99	408.52	453.15	0.28
Main	Lower	2317		Culvert									
Main	Lower	2225	PF 1	743.91	1501.80	1503.77	1503.70	1504.57	0.009749	7.16	103.93	377.41	0.94
Main	Lower	2200		Lat Struct									
Main	Lower	2098	PF 1	836.23	1501.67	1503.62	1502.96	1503.75	0.002010	3.35	349.86	971.19	0.43
Main	Lower	1986	PF 1	827.32	1501.51	1503.30	1502.90	1503.48	0.002880	3.60	278.25	1136.04	0.49
Main	Lower	1838	PF 1	827.32	1501.25	1503.17	1502.20	1503.20	0.001000	1.51	565.63	1263.01	0.22
Infield	Infield	1141	PF 1	1.00	1503.76	1505.75		1505.75	0.000000	0.00	360.88	273.05	0.00
Infield	Infield	1100		Lat Struct									
Infield	Infield	741	PF 1	300.86	1503.14	1505.73		1505.74	0.000065	0.63	487.99	296.35	0.08
Infield	Infield	700		Lat Struct									
Infield	Infield	341	PF 1	450.88	1502.75	1505.70		1505.71	0.000079	0.78	592.52	297.41	0.09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Main Lower
Main Middle
Legend
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WS PF 1
Crit PF 1
Ground
Elevation (ft)
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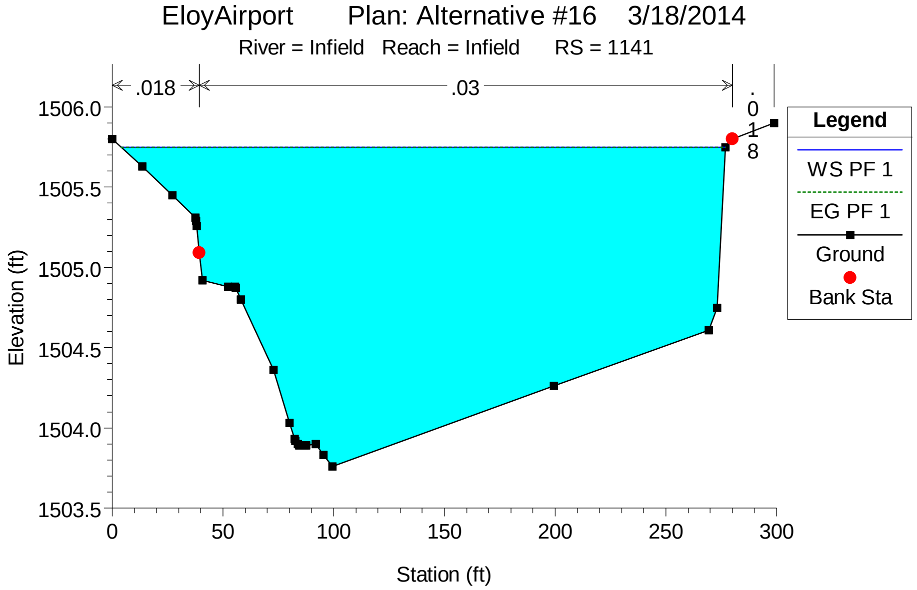
1500
1501
1502
1503
1504
1505
1506
1507
0
500
1000
1500
2000
Main Channel Distance (ft)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.03
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Legend
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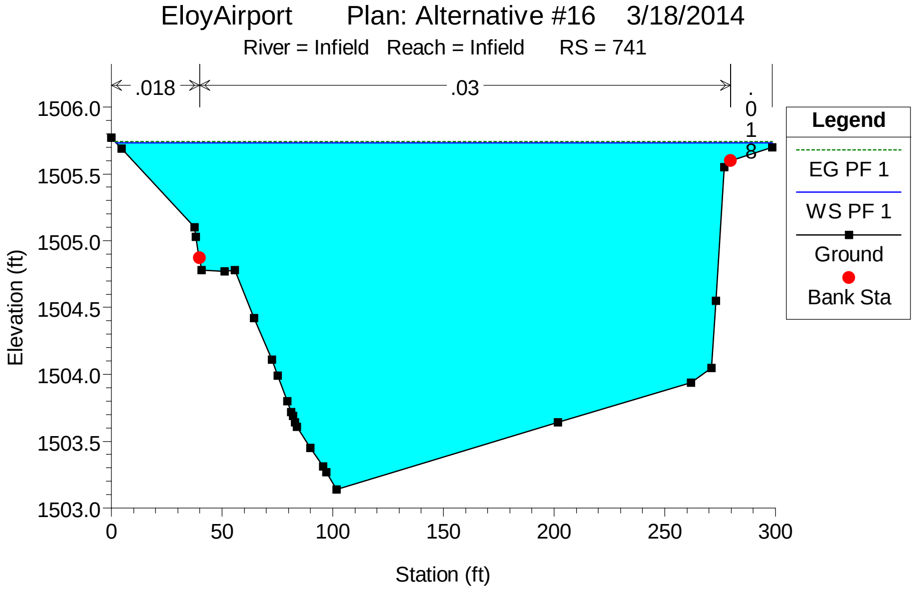
EG PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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.03
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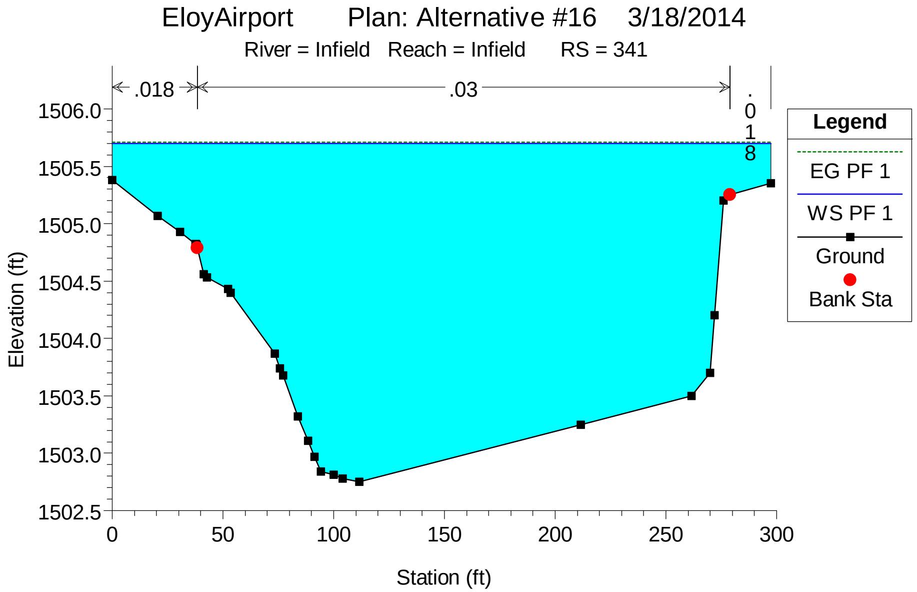
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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.03
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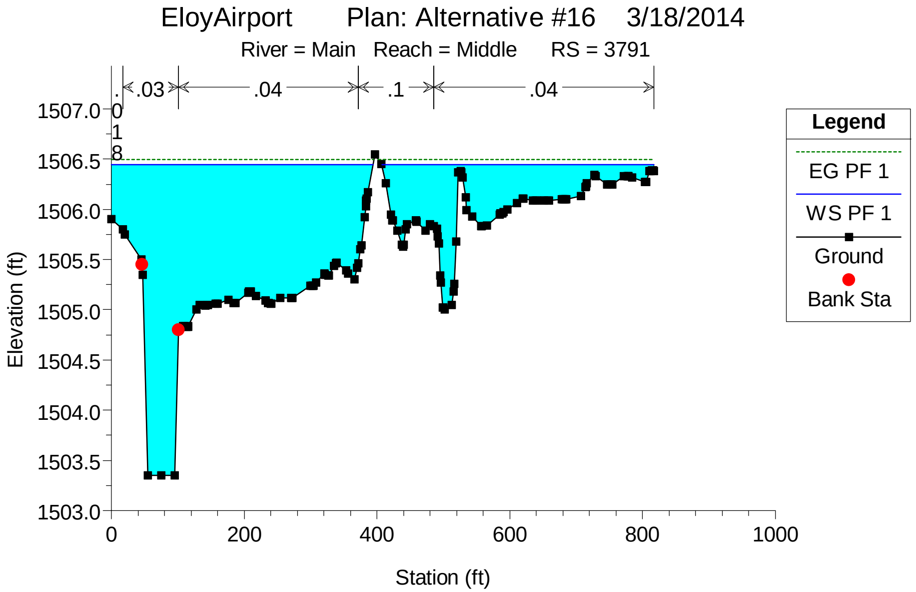
Ground
Bank Sta
Elevation (ft)
Station (ft)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.1
.04
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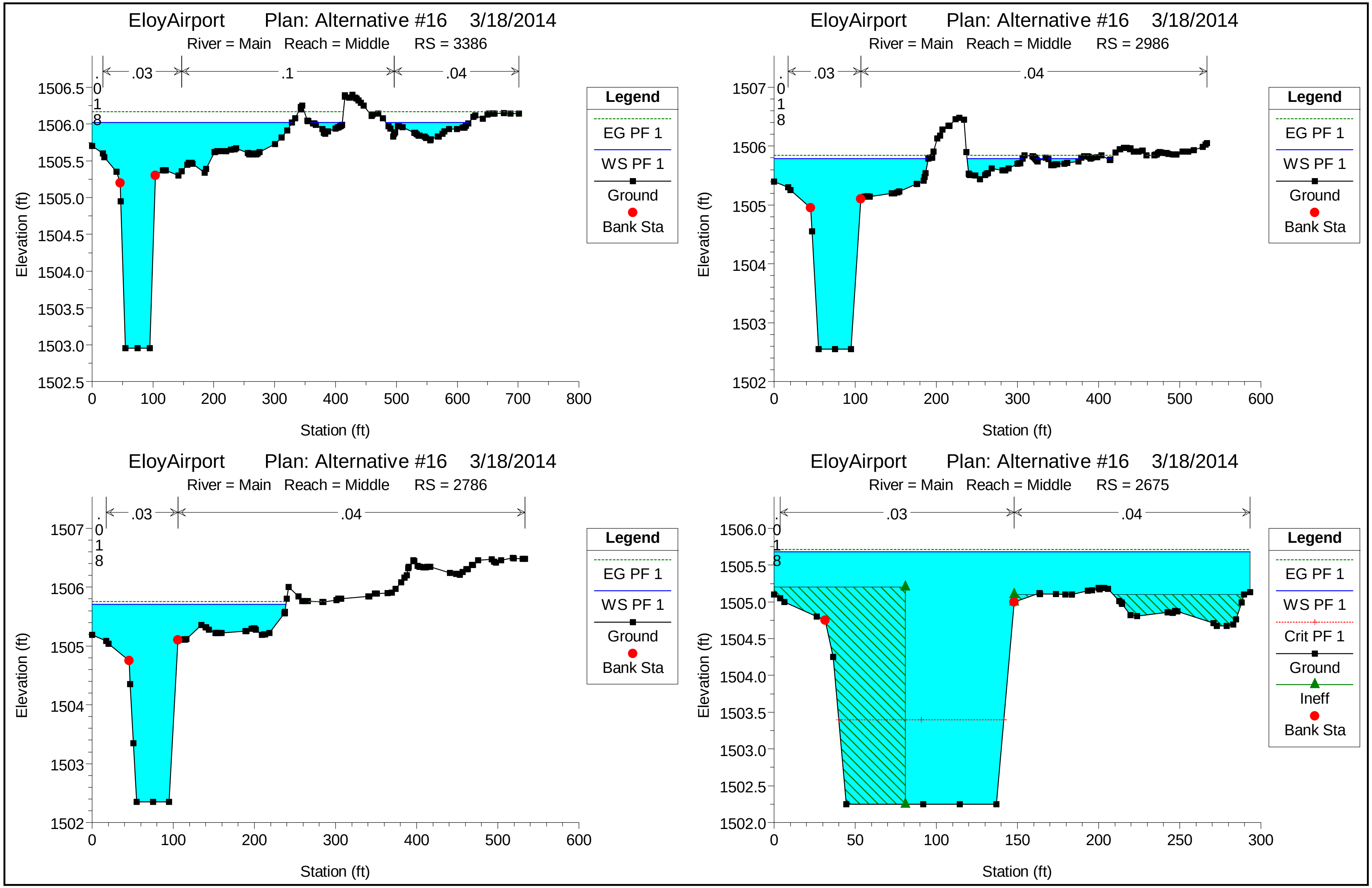
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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.1
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Legend
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WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
EloyAirport Plan: Alternative #16 3/18/2014
River = Main Reach = Middle RS = 2986
EloyAirport Plan: Alternative #16 3/18/2014
River = Main Reach = Middle RS = 2786
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River = Main Reach = Middle RS = 2675
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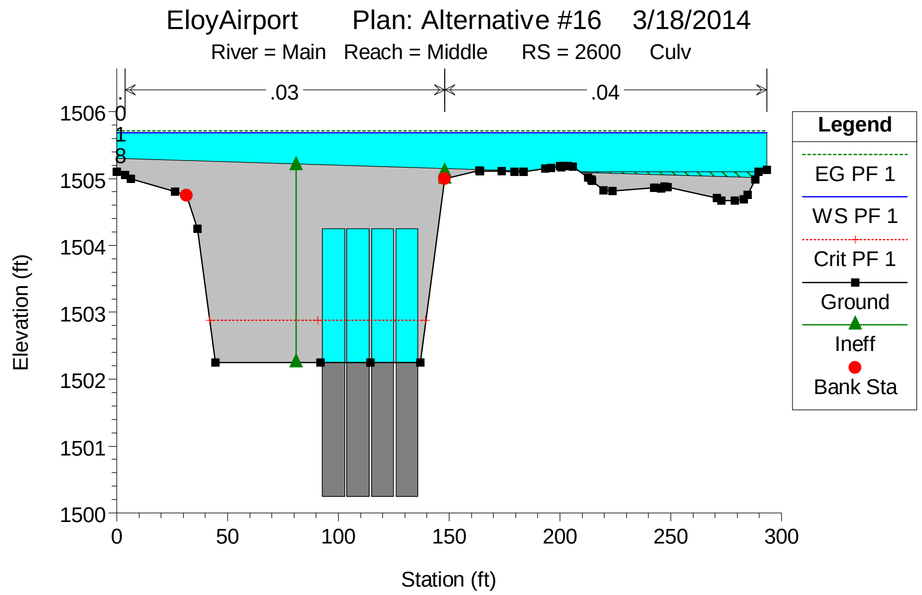
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.04
Elevation (ft)
Station (ft)
Legend
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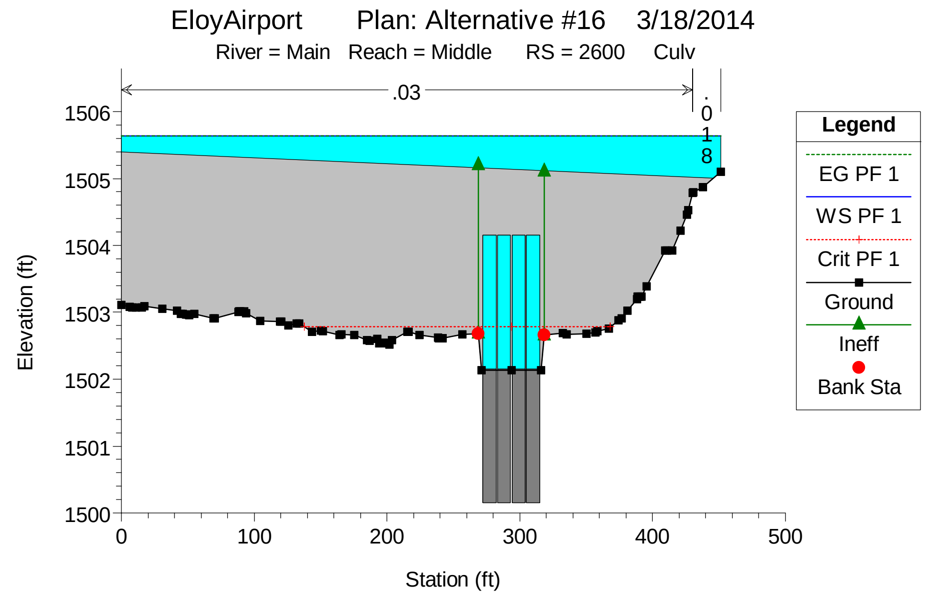
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta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Station (ft)
Legend
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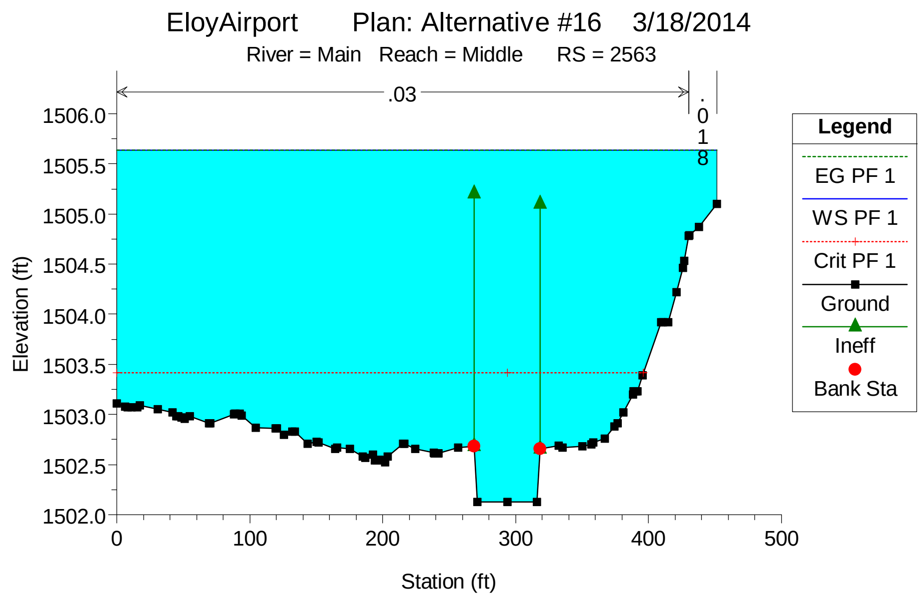
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
Legend
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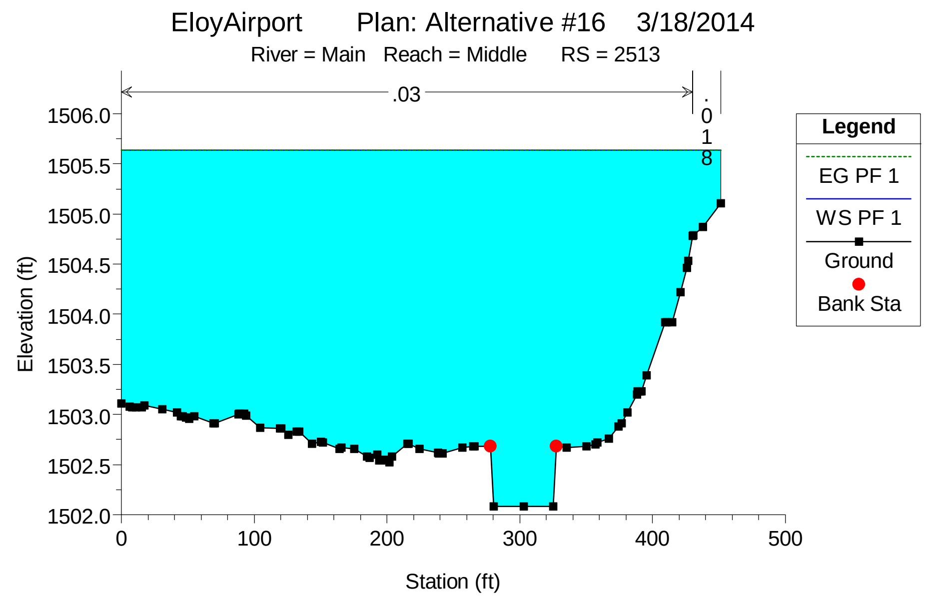
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta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Station (ft)
Legend
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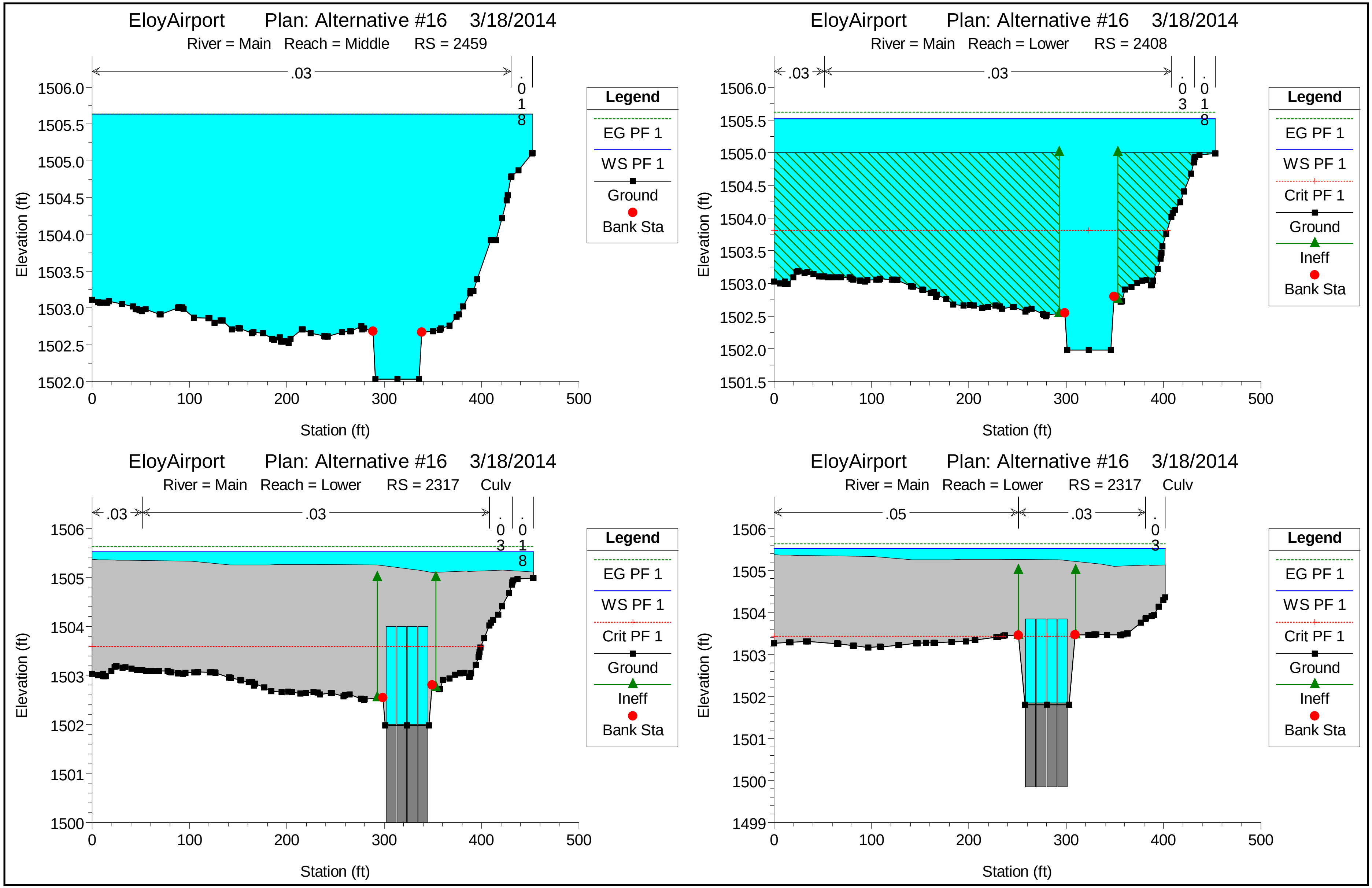
Ground
Bank Sta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Elevation (ft)
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Legend
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WS PF 1
Ground
Bank Sta
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River = Main Reach = Lower RS = 2408
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
EloyAirport Plan: Alternative #16 3/18/2014
River = Main Reach = Lower RS = 2317 Culv
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
EloyAirport Plan: Alternative #16 3/18/2014
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Elevation (ft)
Station (ft)
Legend
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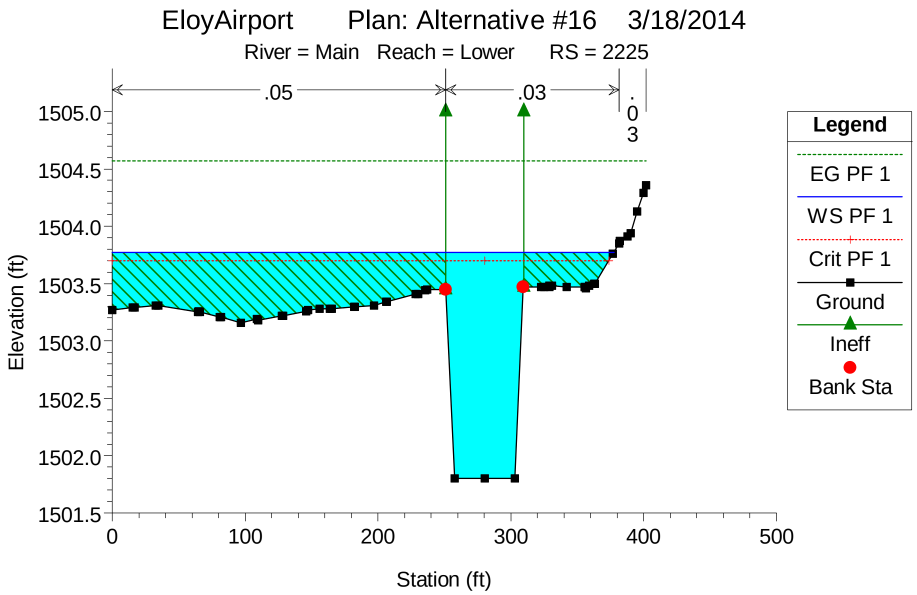
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta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.03
Elevation (ft)
Station (ft)
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Crit PF 1
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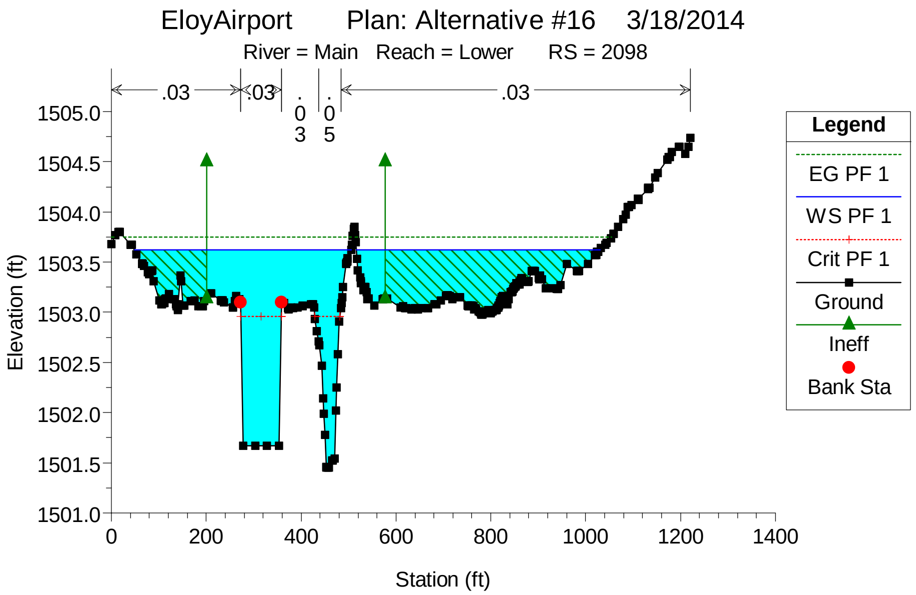
Ineff
Bank Sta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Station (ft)
Legend
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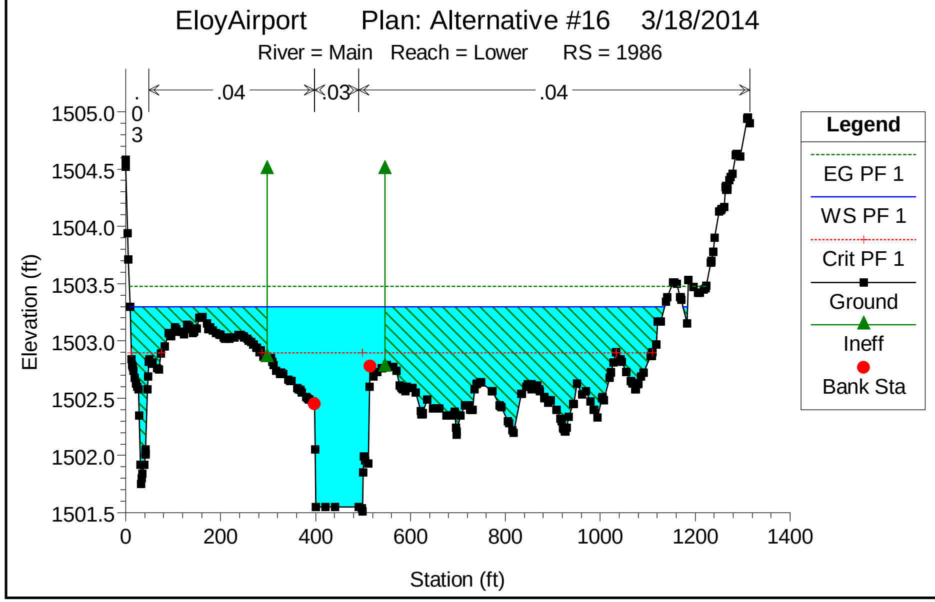
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta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.03
.04
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Station (ft)
Legend
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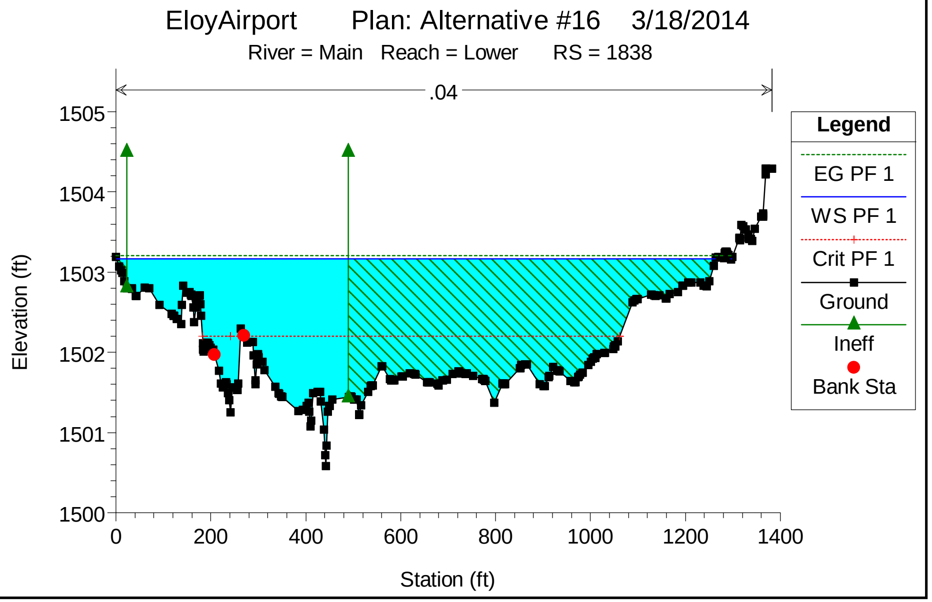
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
Legend
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WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta

Appendix C - Master Plan Supporting Documentation

15% Drainage Improvement Plans

15% Cost Estimate

Appendix C - Master Plan Supporting Documentation

15% Drainage Improvement Plans

DRAINAGE IMPROVEMENT PLANS

ELOY MUNICIPAL AIRPORT

ELOY, ARIZONA

DRAINAGE ALTERNATIVES

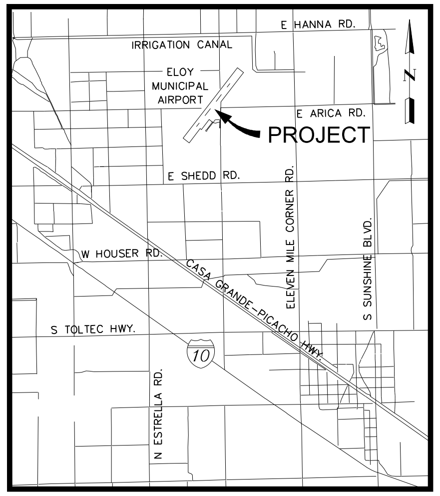
FAA AIP PROJECTS NO. X-XX-XXXX-XX
ADOT TRACS NO. XXXXX

OWNER/DEVELOPER:

CITY OF ELOY
628 NORTH MAIN STREET
ELOY, ARIZONA 85231
PH. (520) 464-3406
ATTN: ZENIA CORNEJO

ENGINEER:

KIMLEY-HORN AND ASSOCIATES, INC.
333 E. WETMORE RD. SUITE 280
TUCSON, ARIZONA 85705
PH. (520) 615-9191
WWW.KIMLEY-HORN.COM
ATTN: KEVIN PAYNE, P.E.



VICINITY MAP
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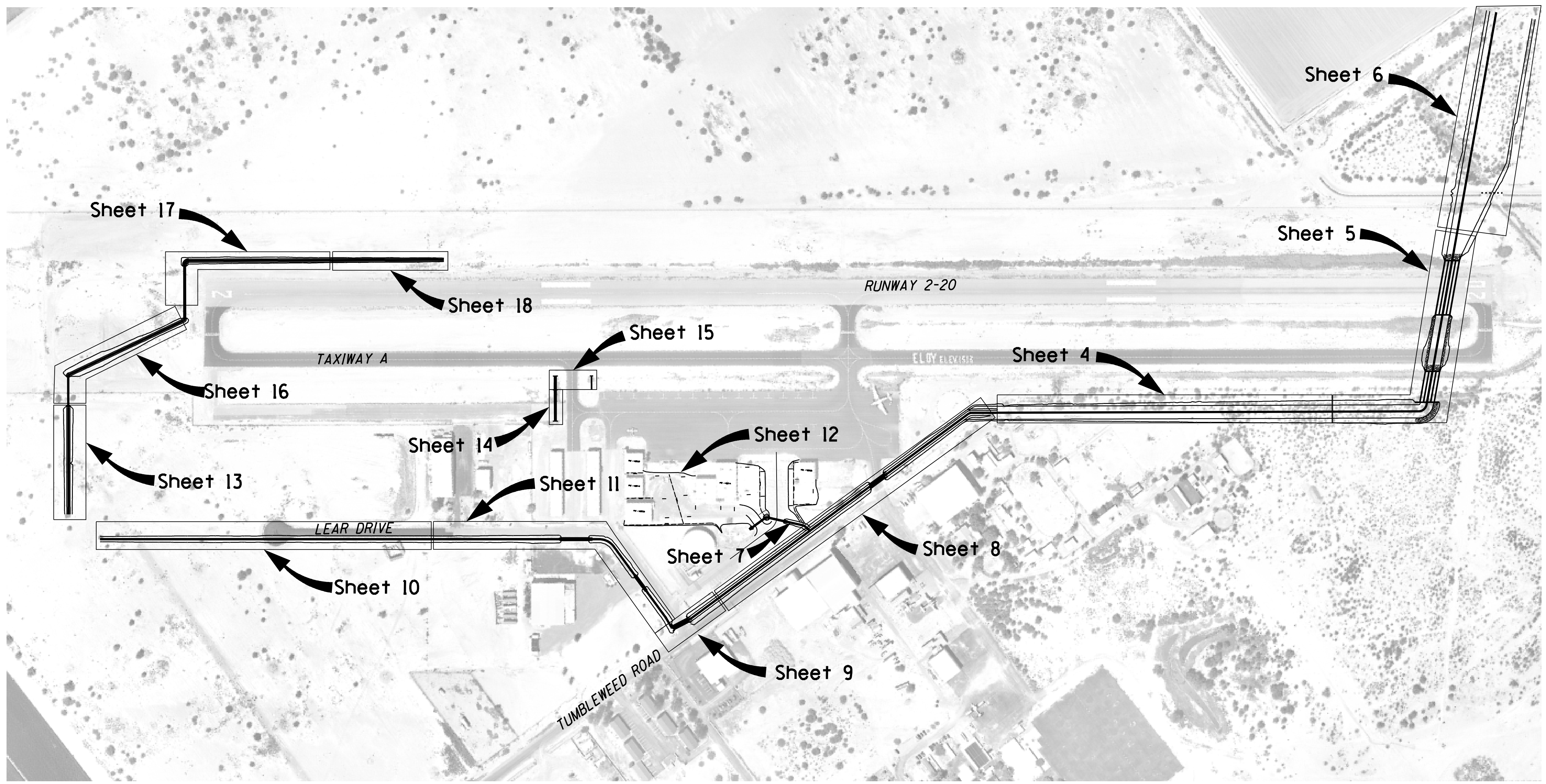
LOCATION MAP
NTS



SHEET INDEX

SHEET NO.	DESCRIPTION
1	COVER SHEET
2-3	TYPICAL SECTIONS
4-6	PROJECT #1
7	PROJECT #2
8	PROJECT #3
9	PROJECT #4
10-11	PROJECT #5
12	PROJECT #6
13	PROJECT #7
14	PROJECT #8
15	PROJECT #9
16-18	PROJECT #10

15% REVIEW

JULY 7, 2014

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Date	MAY 2014
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Drawn	MAK
Checked	SA

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Review
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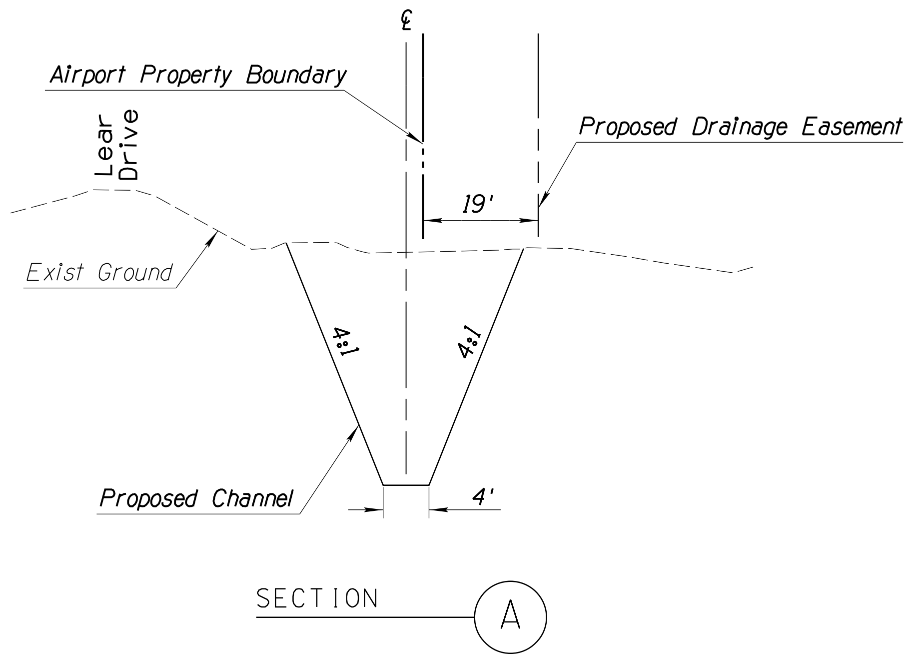
ELOY MUNICIPAL AIRPORT
ELOY, ARIZONA

DRAINAGE IMPROVEMENT PLANS

COVER SHEET

PROJECT NO. 191645002
FILE NO. d5002d01
SHEET 1 OF 18



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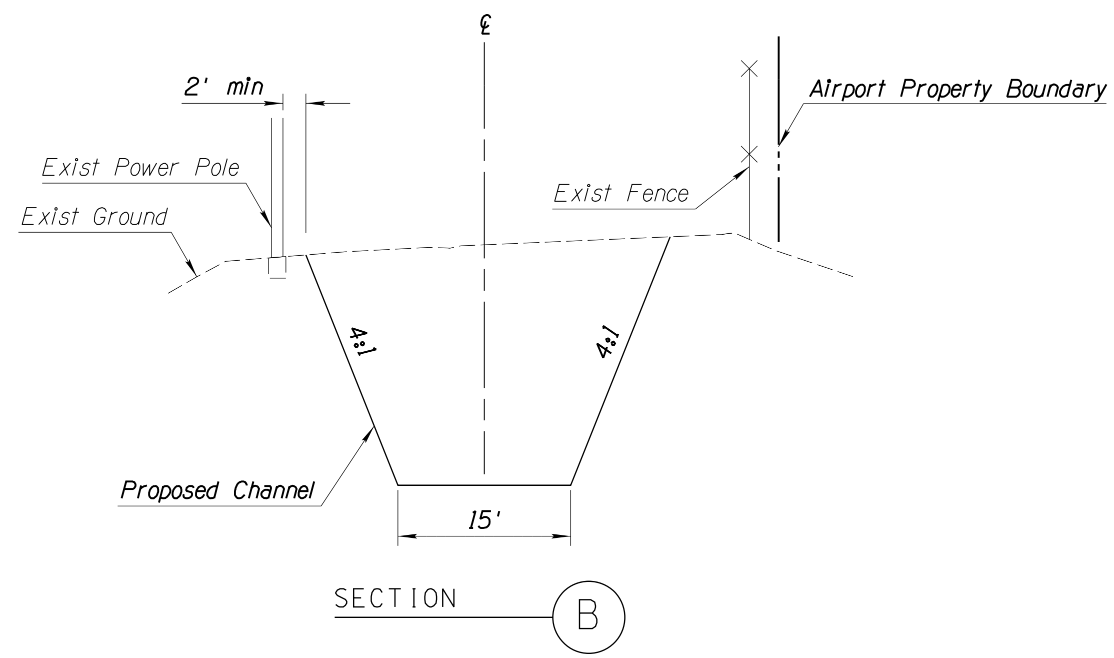

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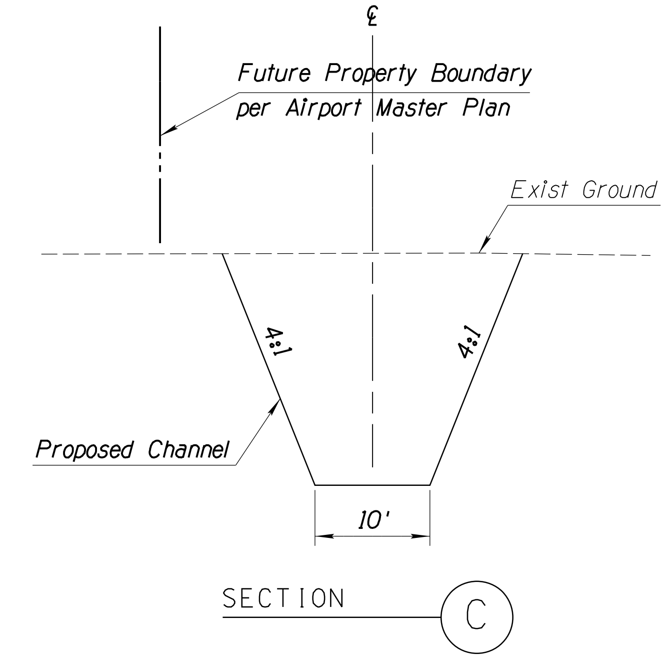

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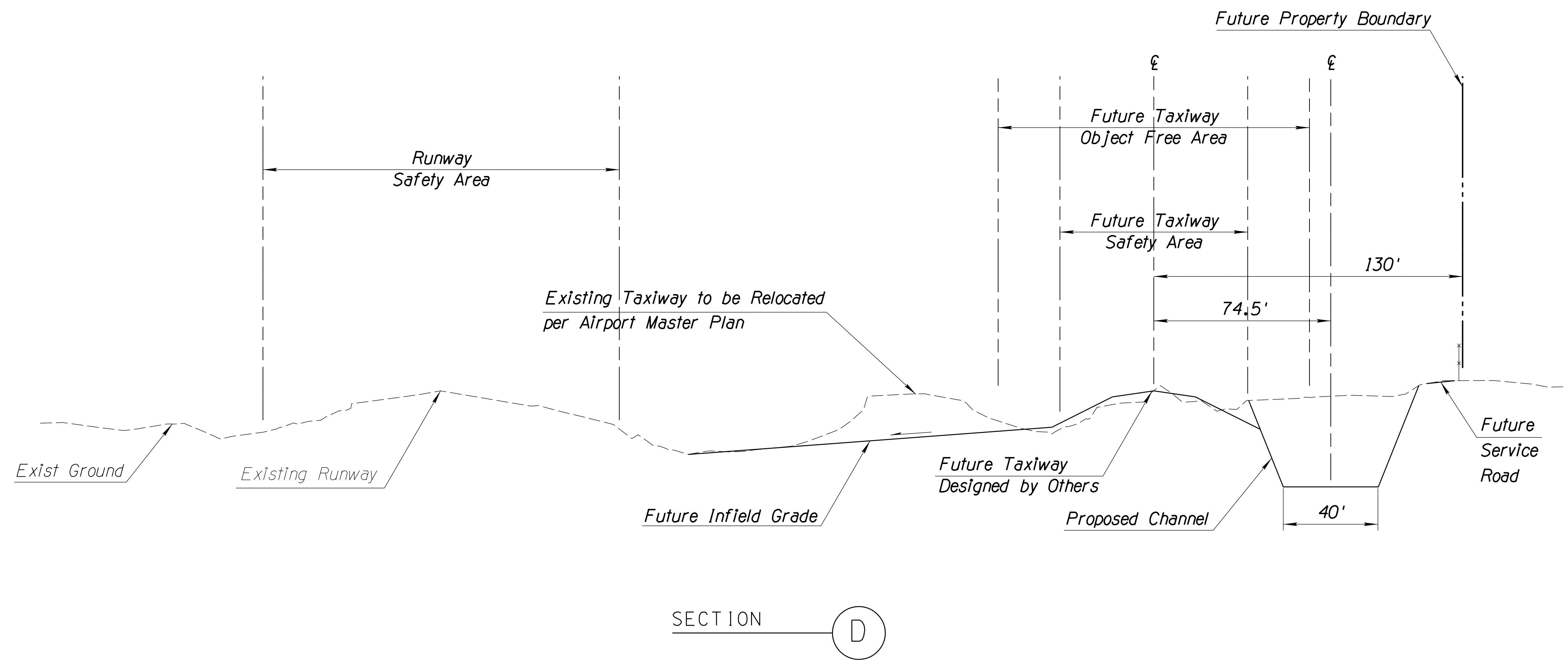

SECTION D

LEGEND

- Existing Ground
- Safety Area/Object Free Area
- Airport Property Boundary
- Project Const ℄
- Proposed Drainage Easement
- Future Grade
- Overhead Power Lines — OP — OP —

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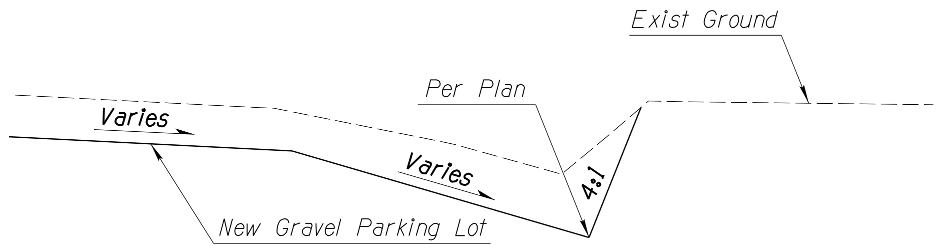
ELOY, ARIZONA

DRAINAGE IMPROVEMENT PLAN

TYPICAL SECTIONS

PROJECT NO. 191645002
FILE NO. d5002d02
SHEET 2 OF 18



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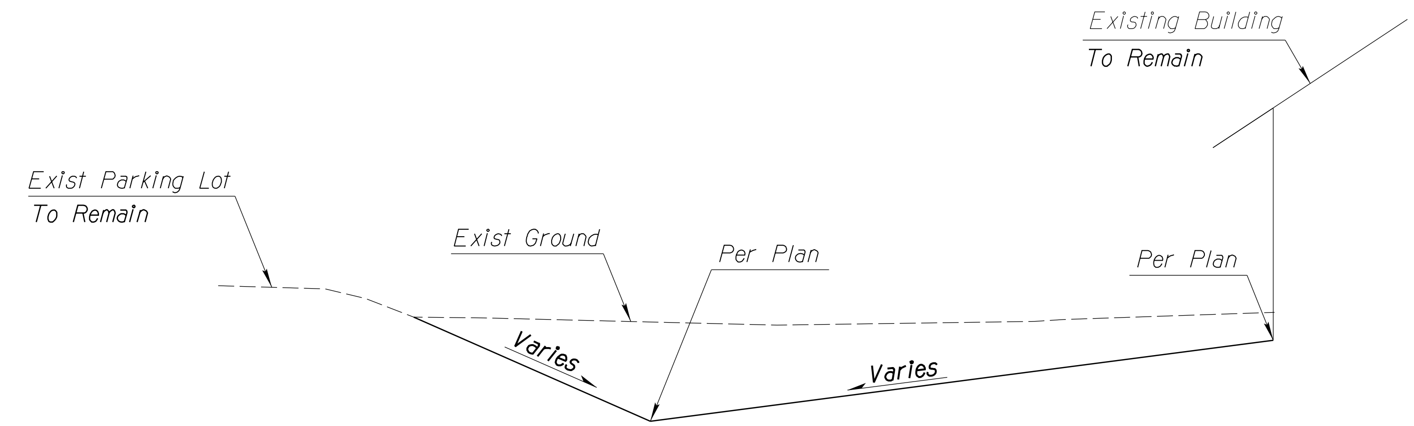

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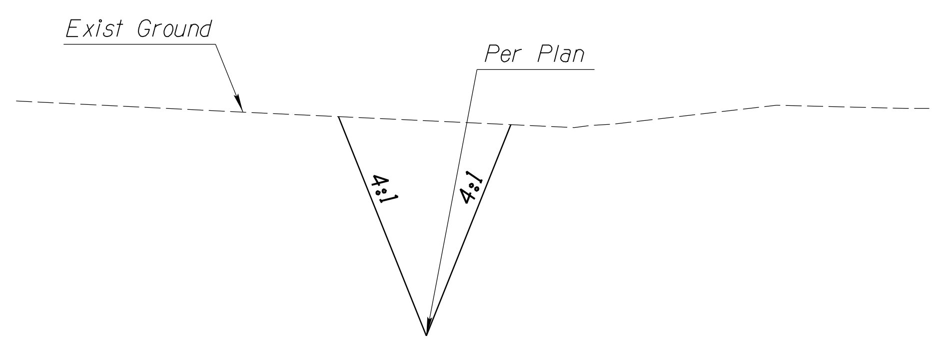

SECTION (G)

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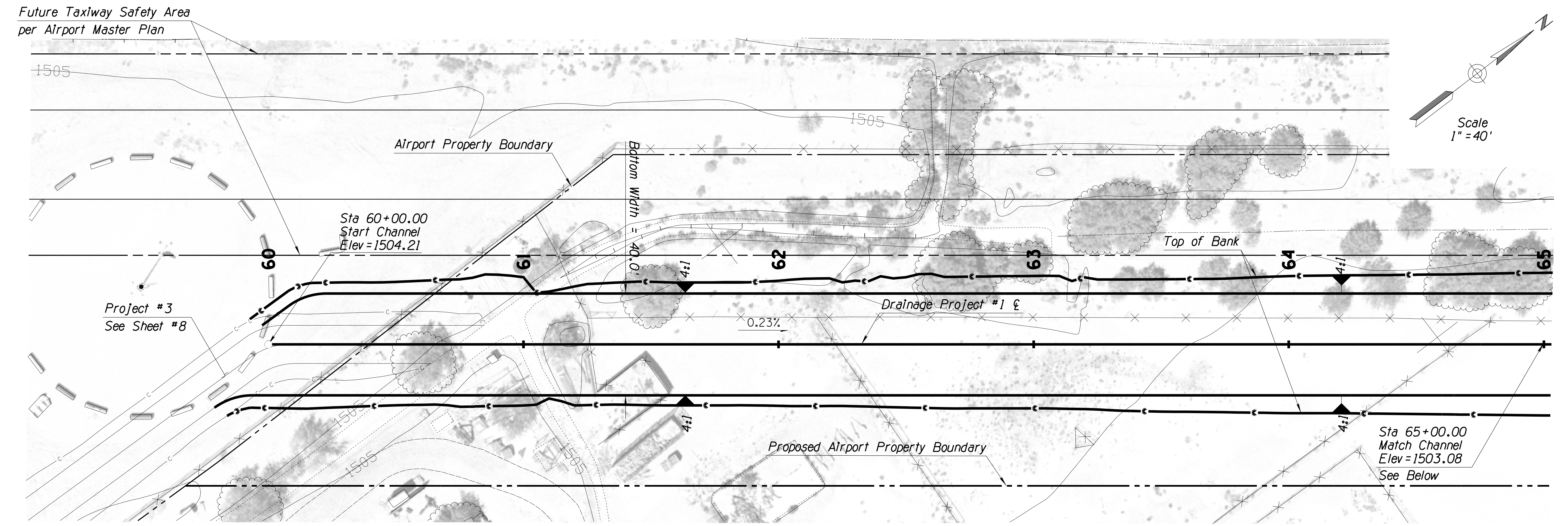
ELOY, ARIZONA

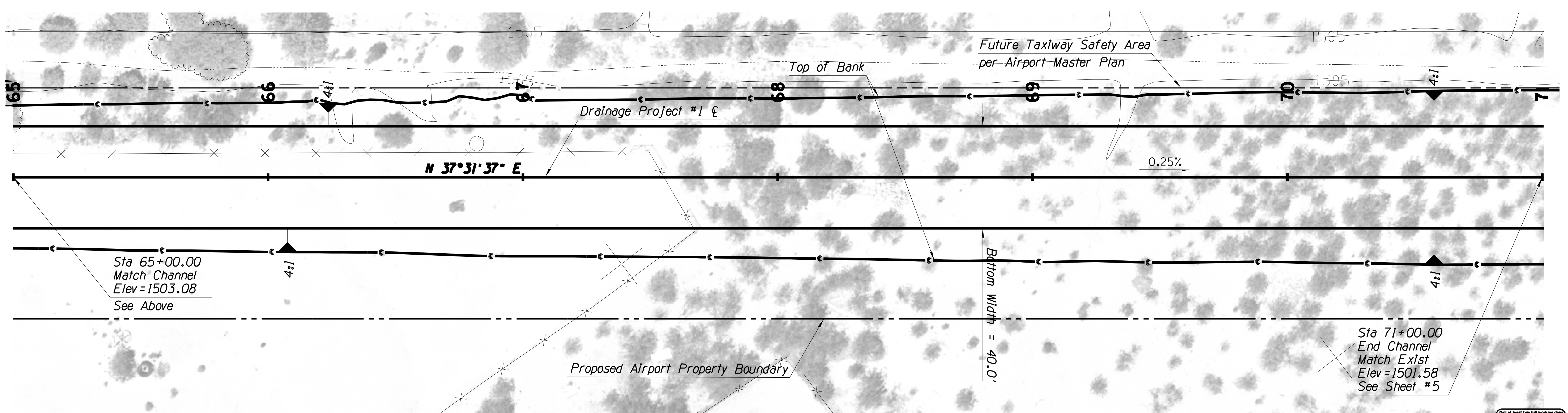
ELOY, ARIZONA

DRAINAGE IMPROVEMENT PLAN

TYPICAL SECTIONS

PROJECT NO. 191645002
FILE NO. d5002d02.1
SHEET 3 OF 18





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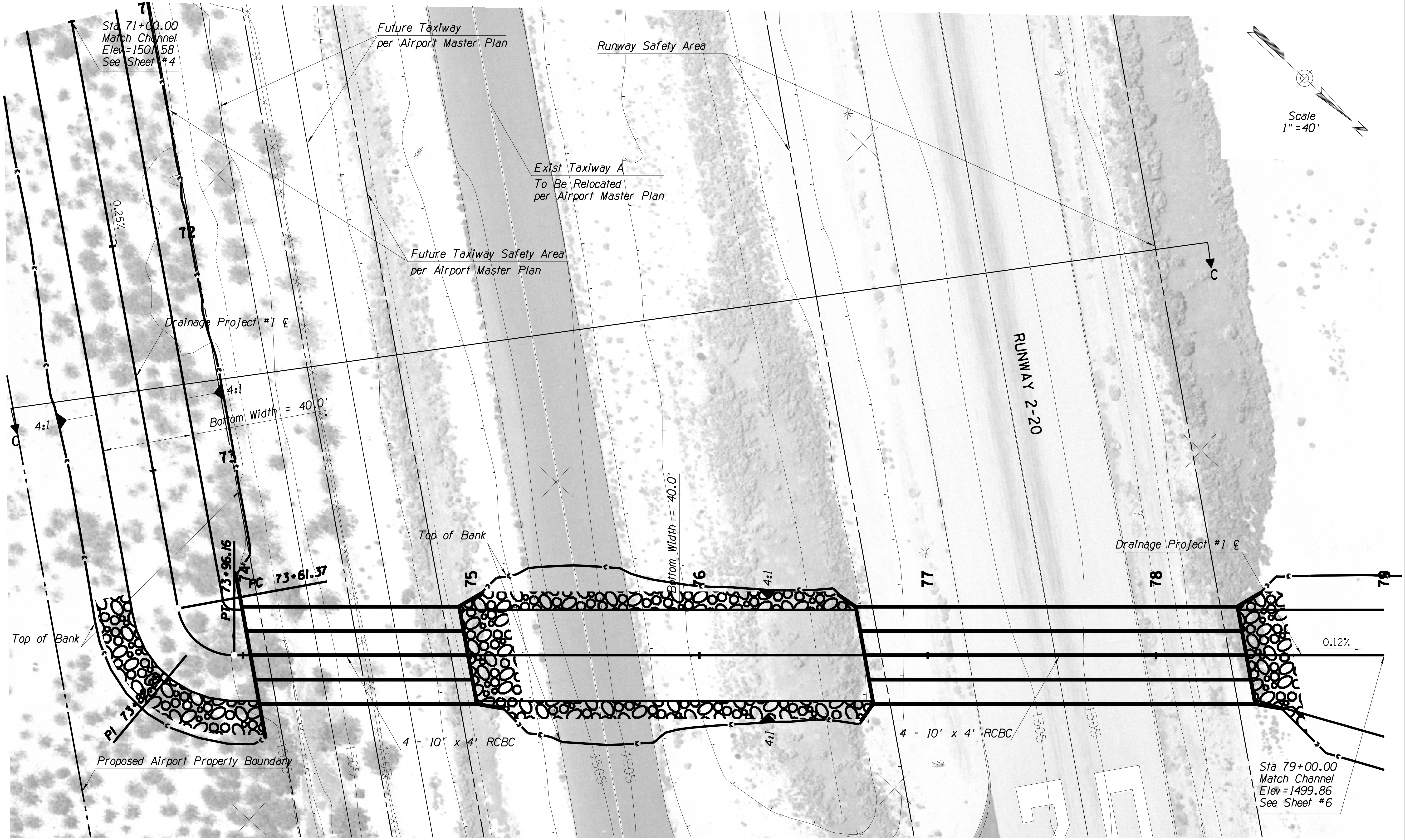
ELOY, ARIZONA

DRAINAGE IMPROVEMENT PLAN
PLAN SHEET
Sta 60+00.00 to Sta 71+00.00
PROJECT #1

PROJECT NO. 191645002
FILE NO. d5002d03
SHEET 4 OF 18



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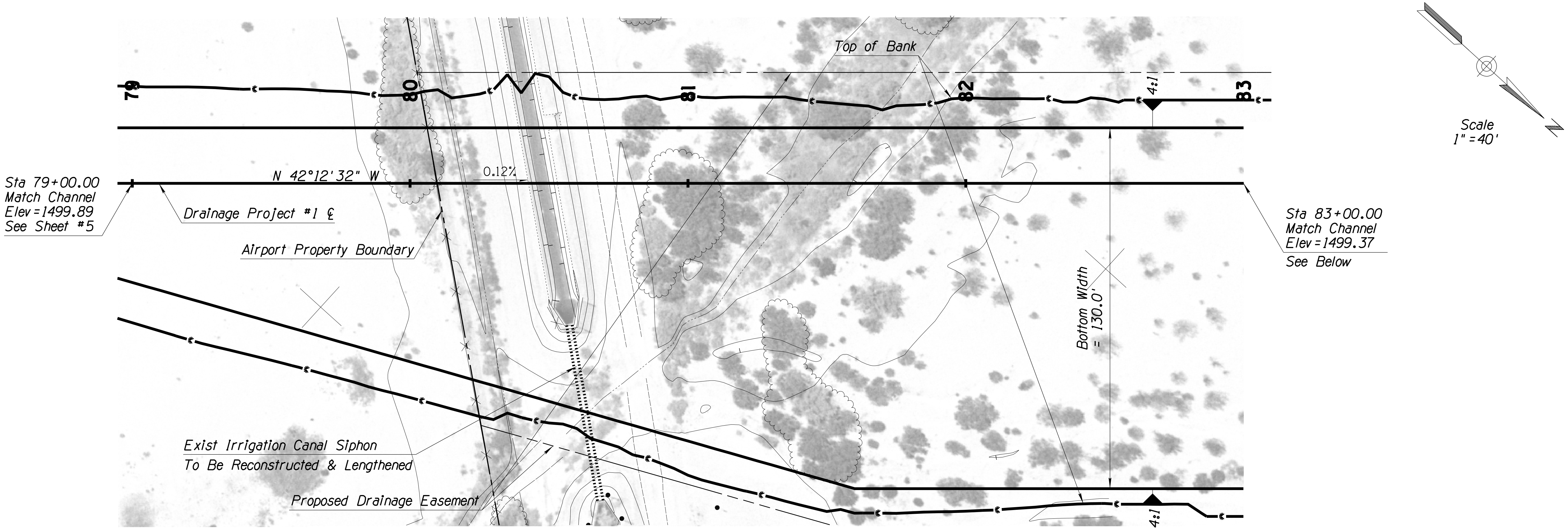
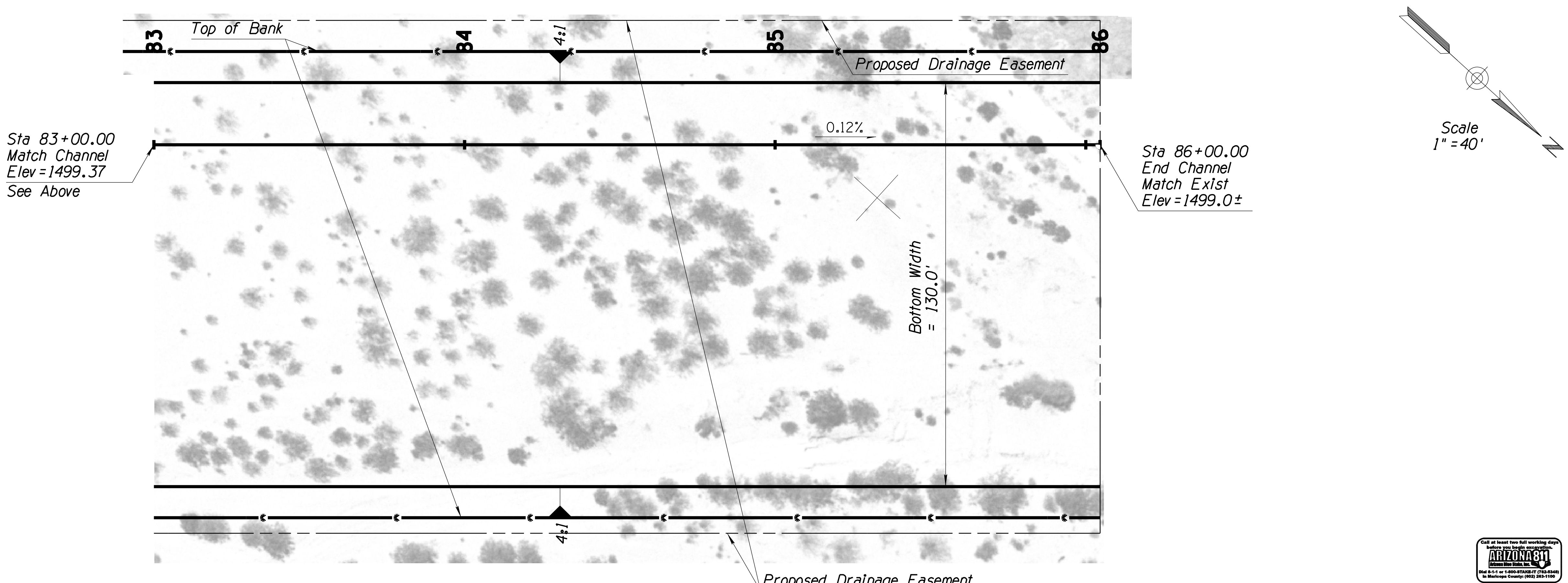
DRAINAGE IMPROVEMENT PLAN

PLAN SHEET
STA 71+00.00 TO STA 79+00.00
PROJECT #1

PROJECT NO. 191645002
FILE NO. d5002d04
SHEET 5 OF 18





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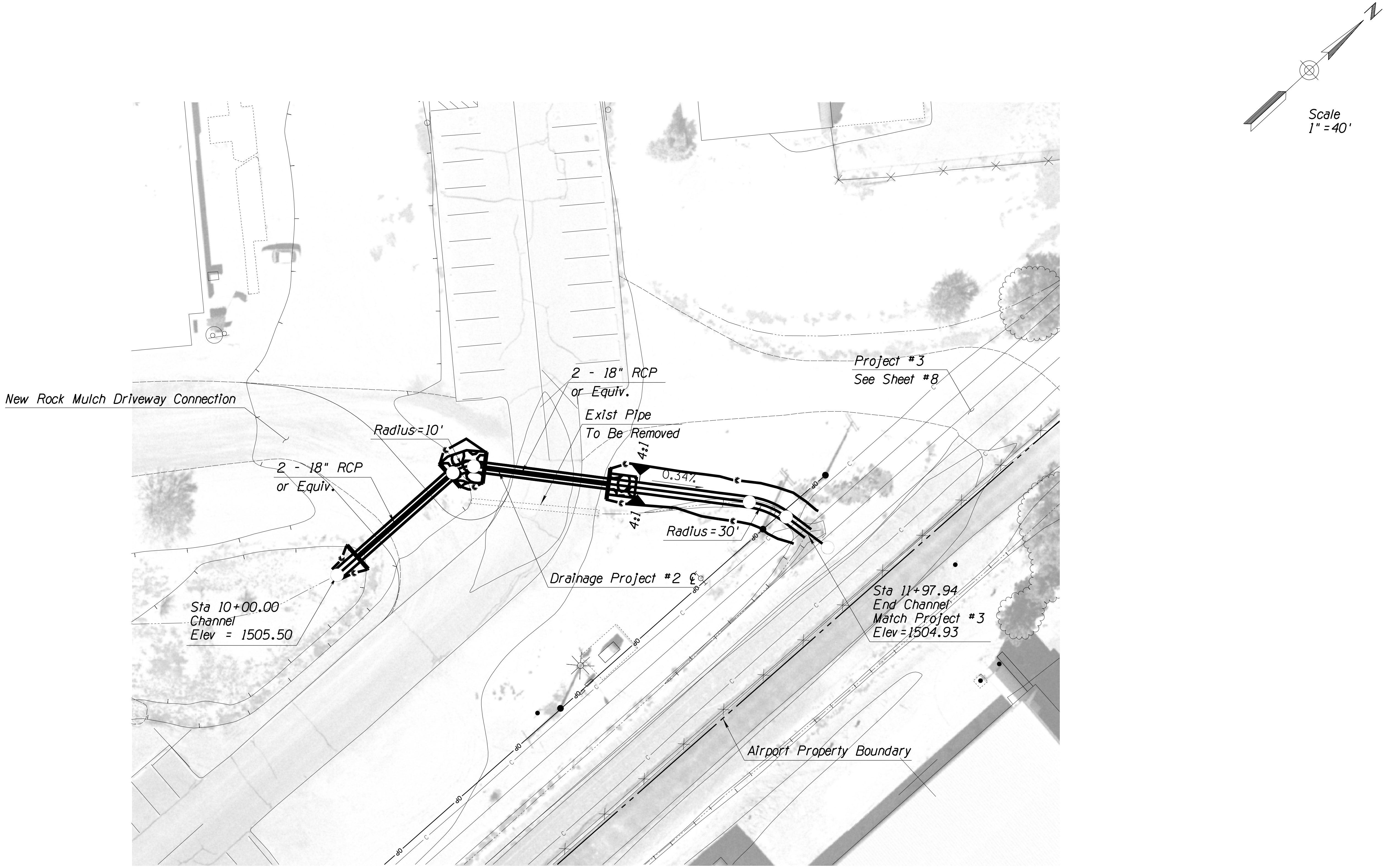
ELOY, ARIZONA

ELOY, ARIZONA

DRAINAGE IMPROVEMENT PLAN
PLAN SHEET
Sta 79+00.00 to Sta 86+00.00
PROJECT #1

PROJECT NO. 191645002
FILE NO. d5002d05
SHEET 6 OF 18



Call at least two full working days before you begin excavation.
ARIZONA 811
Arizona Blue Stake, Inc.
Dial 8-1-1 or 1-800-STAKE-IT (782-5348)
In Maricopa County: (602) 263-1100

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ELOY, ARIZONA

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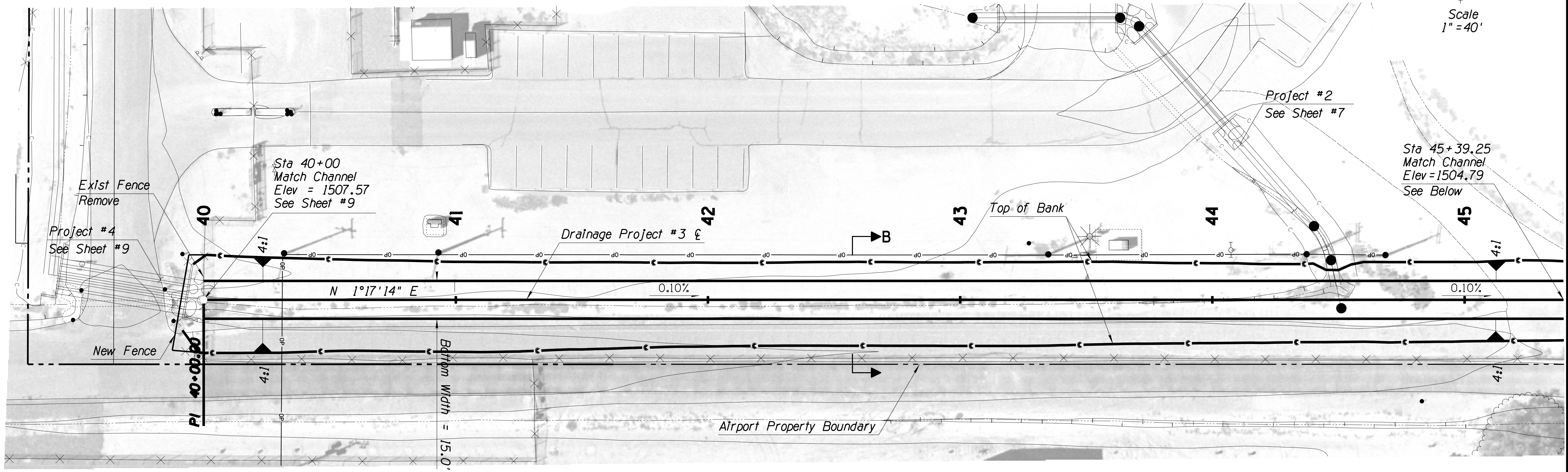
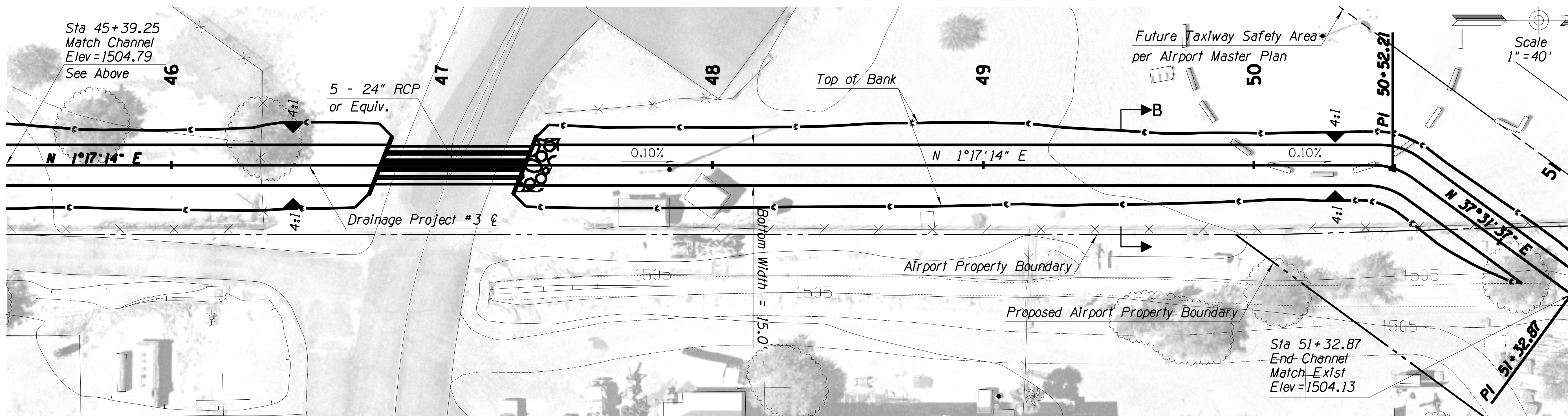
DRAINAGE IMPROVEMENT PLAN

PLAN SHEET
STA 10+00.00 TO STA 11+97.94
Project #2

PROJECT NO. 191645002
FILE NO. d5002d06
SHEET 7 OF 18

4:18:44 PM 7/7/2014 ADAM.GOMEZ K:\TUC_WATERRESOURCES\191645002_ELOY AIRPORT DMP\CADD\D5002D06-P2.DGN





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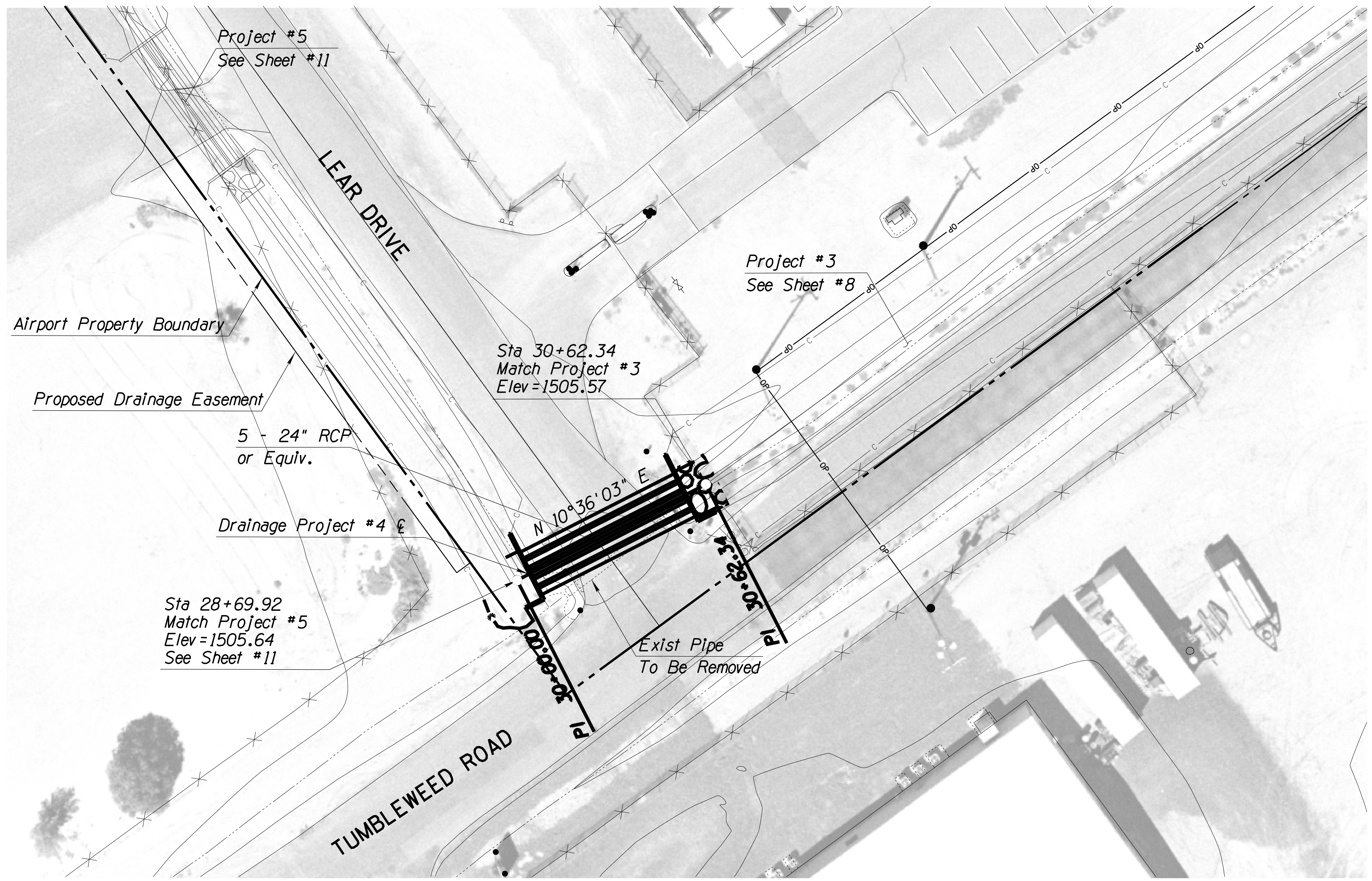
ELOY MUNICIPAL AIRPORT
ELOY, ARIZONA

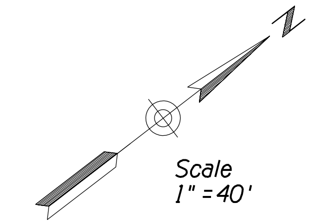
ELOY, ARIZONA

DRAINAGE IMPROVEMENT PLAN

PLAN SHEET
STA 40+00.00 TO STA 51+32.87
PROJECT #3

PROJECT NO. 191645002
FILE NO. d5002d07
SHEET 8 OF 18





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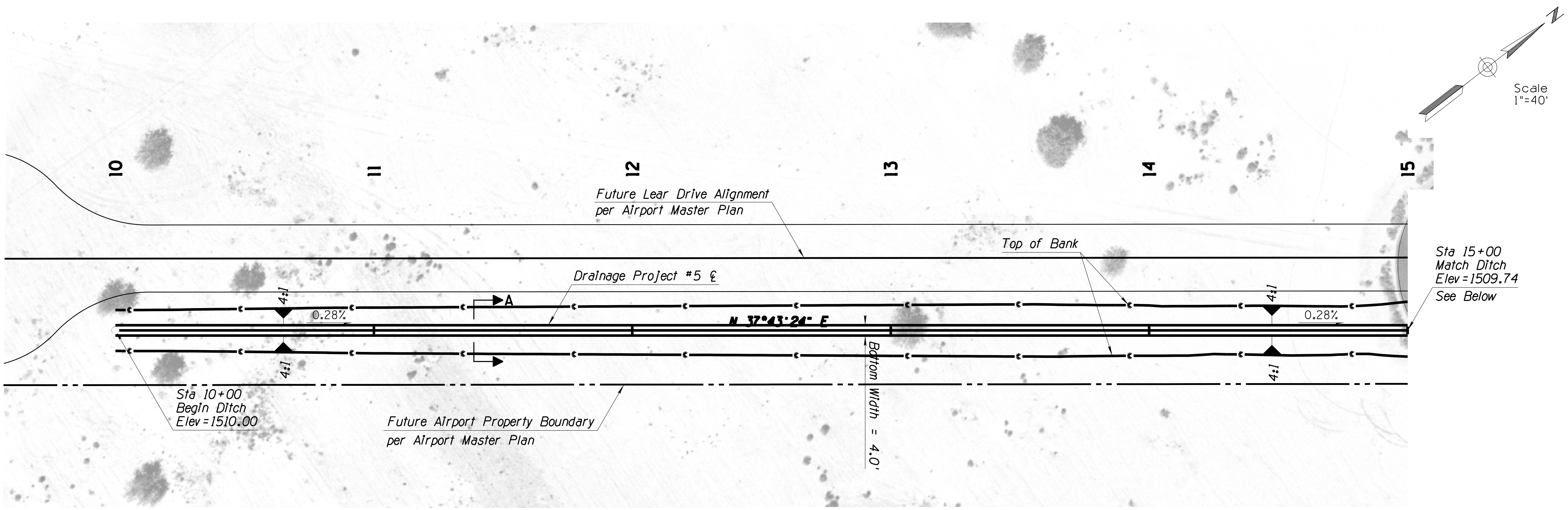
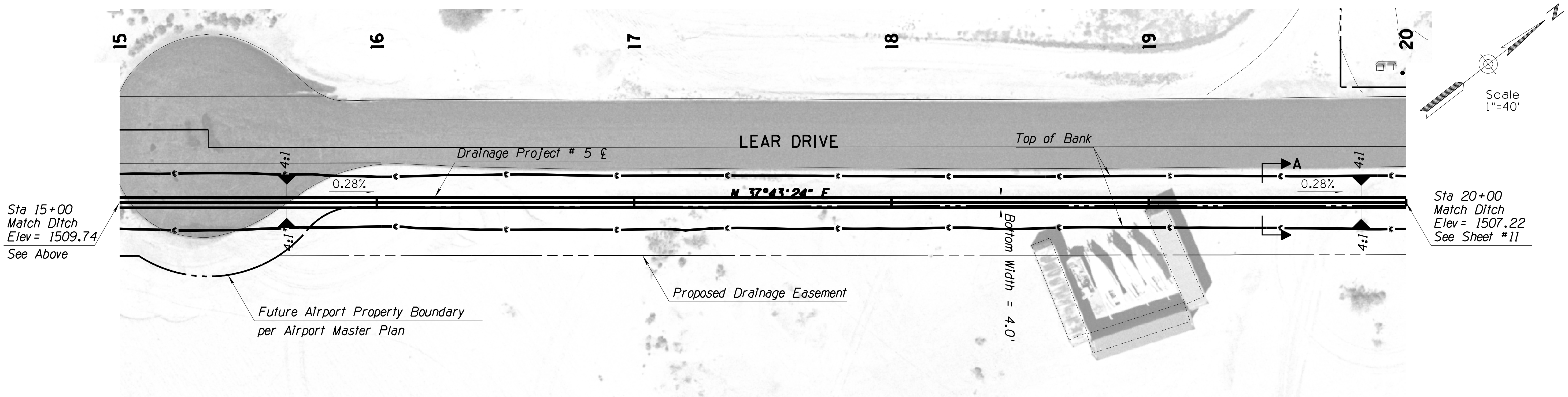
ELOY, ARIZONA

DRAINAGE IMPROVEMENT PLAN

PLAN SHEET
STA 28+69.92 TO STA 30+62.34
PROJECT #4

PROJECT NO. 191645002
FILE NO. d5002d08
SHEET 9 OF 18





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Date	MAY 2014
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Drawn	MAK
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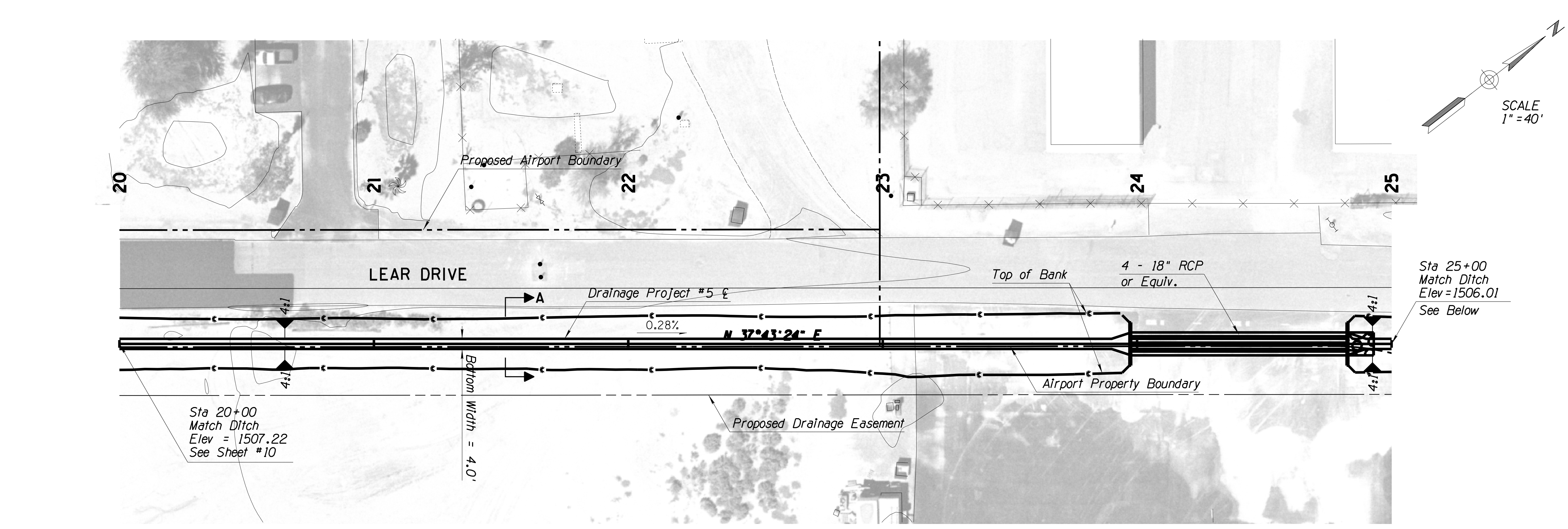
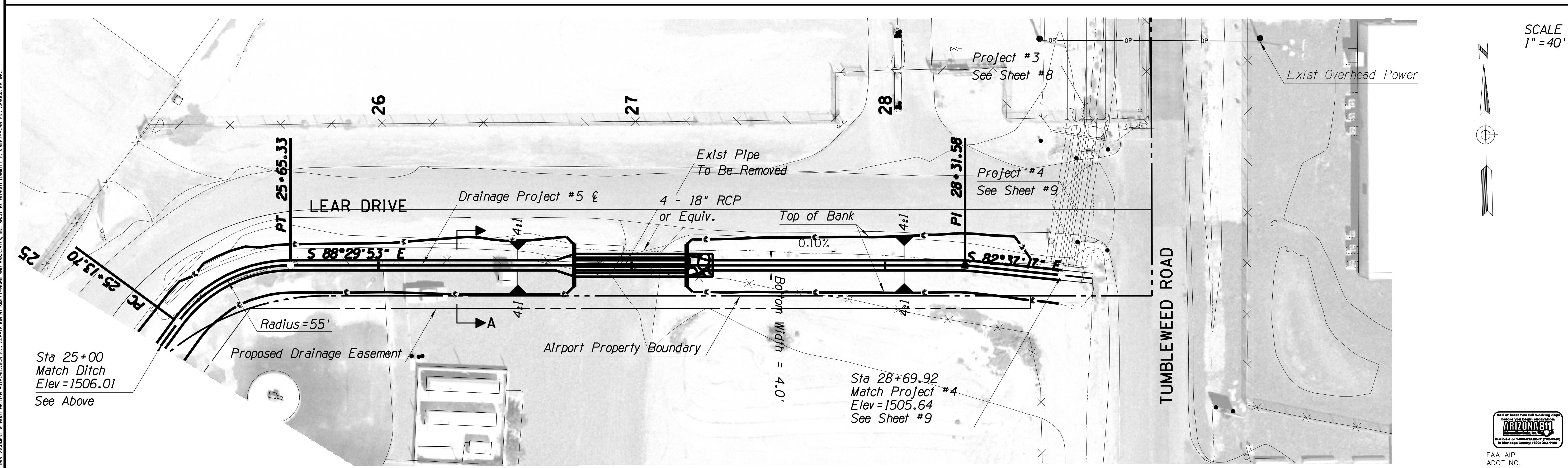
ELOY, ARIZONA

DRAINAGE IMPROVEMENT PLAN

PLAN SHEET
Sta 10+00.00 to Sta 20+00.00
PROJECT #5

PROJECT NO. 191645002
FILE NO. d5002d09
SHEET 10 OF 18





NO.	DATE	REVISION	BY	APPD.

Date	MAY 2014
Designed	KP
Drawn	MAK
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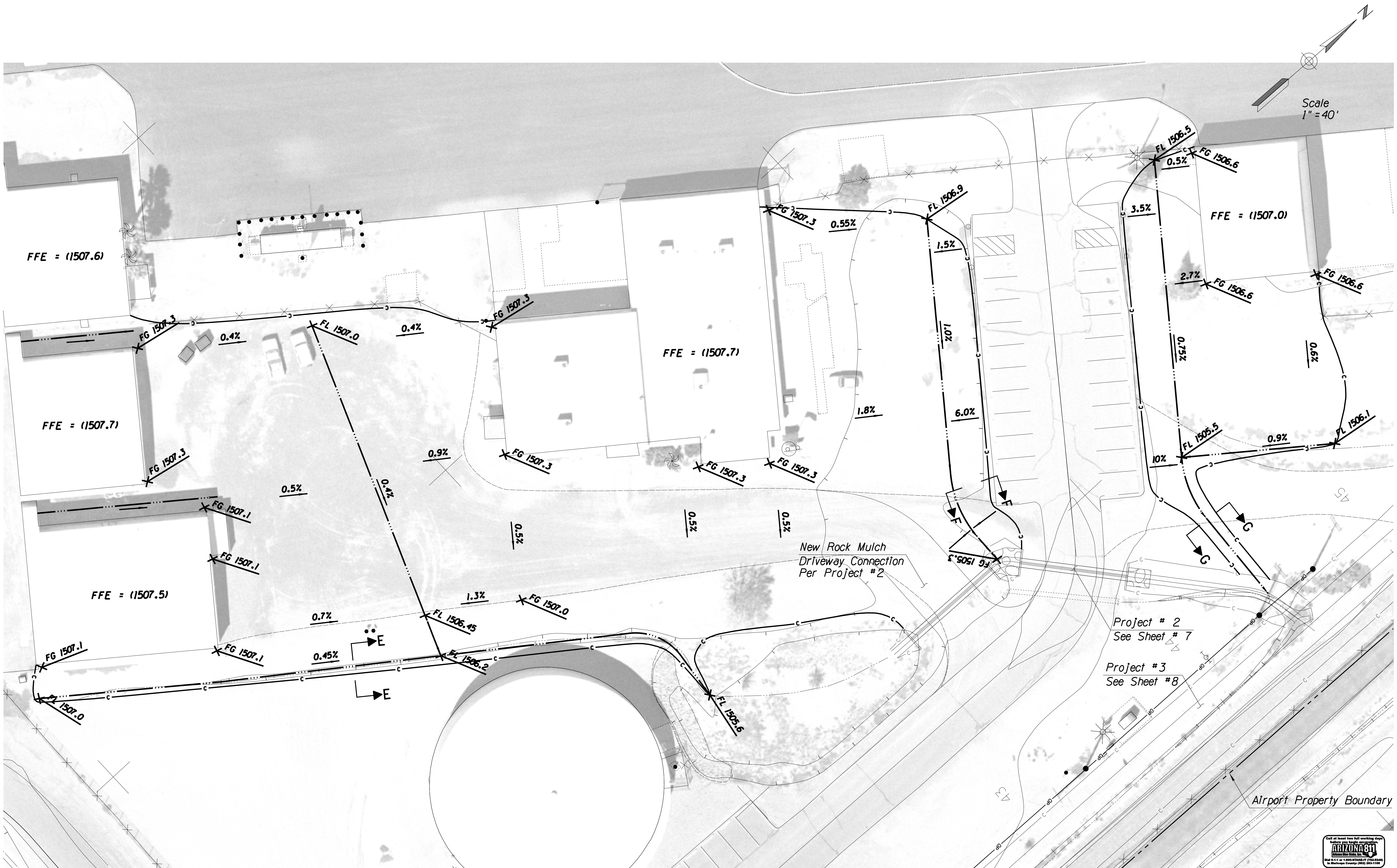
DRAINAGE IMPROVEMENT PLAN

PLAN SHEET
Sta 20+00.00 to Sta 28+69.92
PROJECT #5

PROJECT NO. 191645002
FILE NO. d5002d10
SHEET 11 OF 18



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Date MAY 2014
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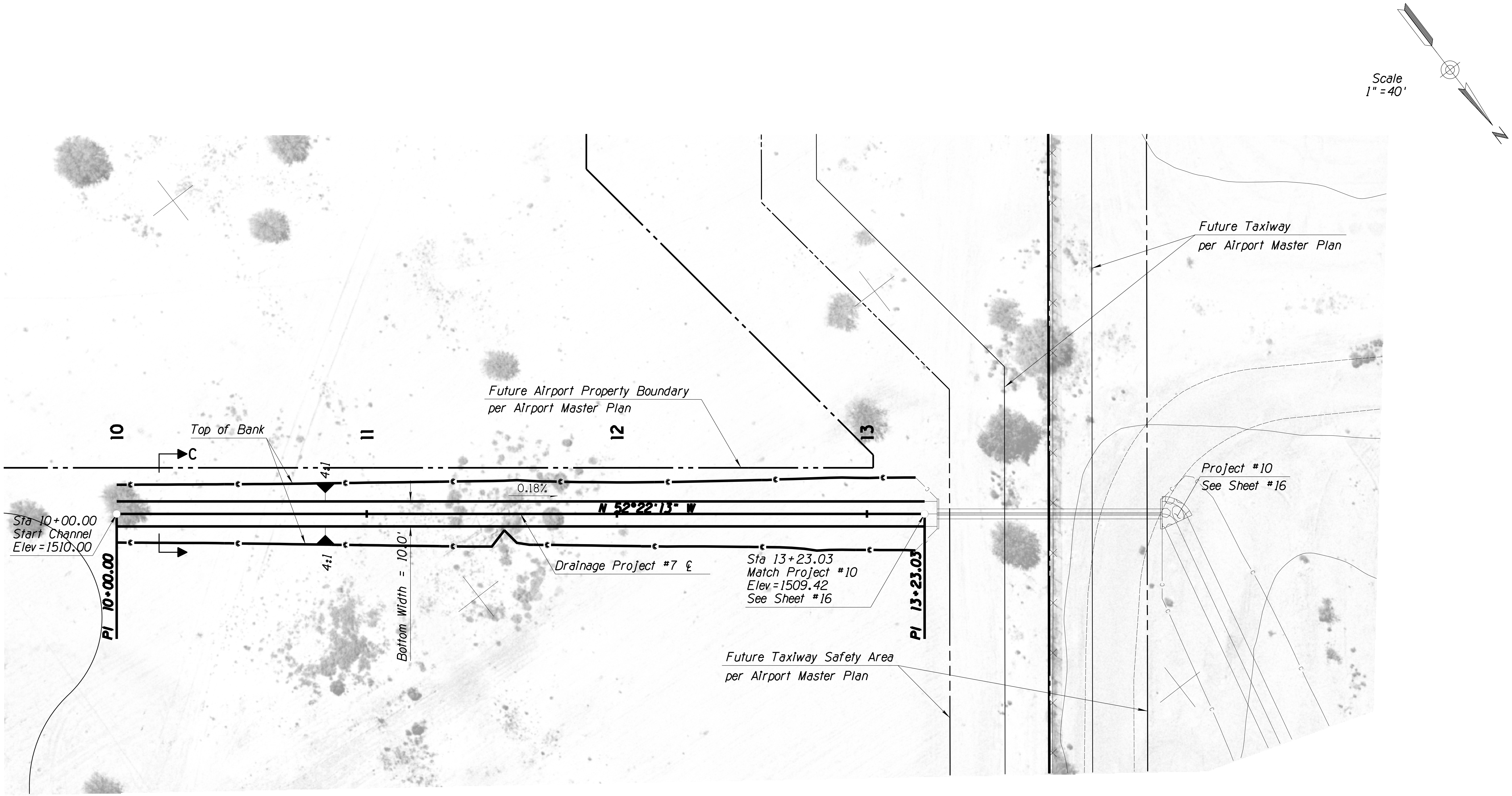
ELOY MUNICIPAL AIRPORT
ELOY, ARIZONA

ELOY, ARIZONA

DRAINAGE IMPROVEMENT PLAN

PLAN SHEET
HANGAR SITE GRADING
PROJECT #6

PROJECT NO. 191645002
FILE NO. d5002d11
SHEET 12 OF 18



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ELOY, ARIZONA

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DRAINAGE IMPROVEMENT PLAN

PLAN SHEET
STA 10+00.00 TO STA 13+23.03
PROJECT #7

PROJECT NO. 191645002
FILE NO. d5002d12
SHEET 13 OF 18

4:20:26 PM 7/7/2014 ADAM.GOMEZ K:\TUC_WATERRESOURCES\191645002_ELOY AIRPORT DMP\CADD\D5002D12-P7.DGN

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ELOY, ARIZONA

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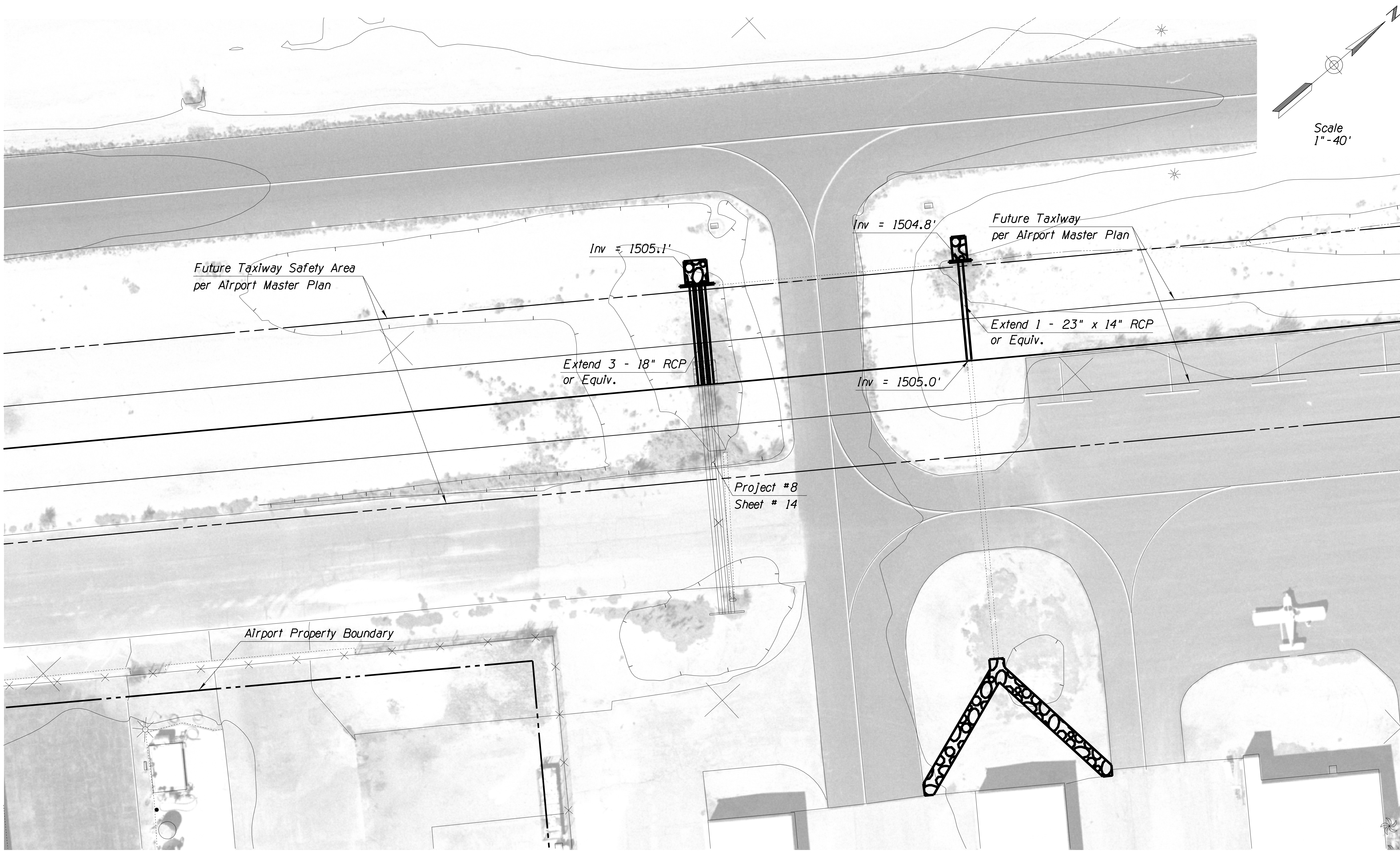
DRAINAGE IMPROVEMENT PLAN

PLAN SHEET
NEW CULVERTS
PROJECT #8

PROJECT NO. 191645002
FILE NO. d5002d13
SHEET 14 OF 18



Scale
1"-40'

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ELOY MUNICIPAL AIRPORT
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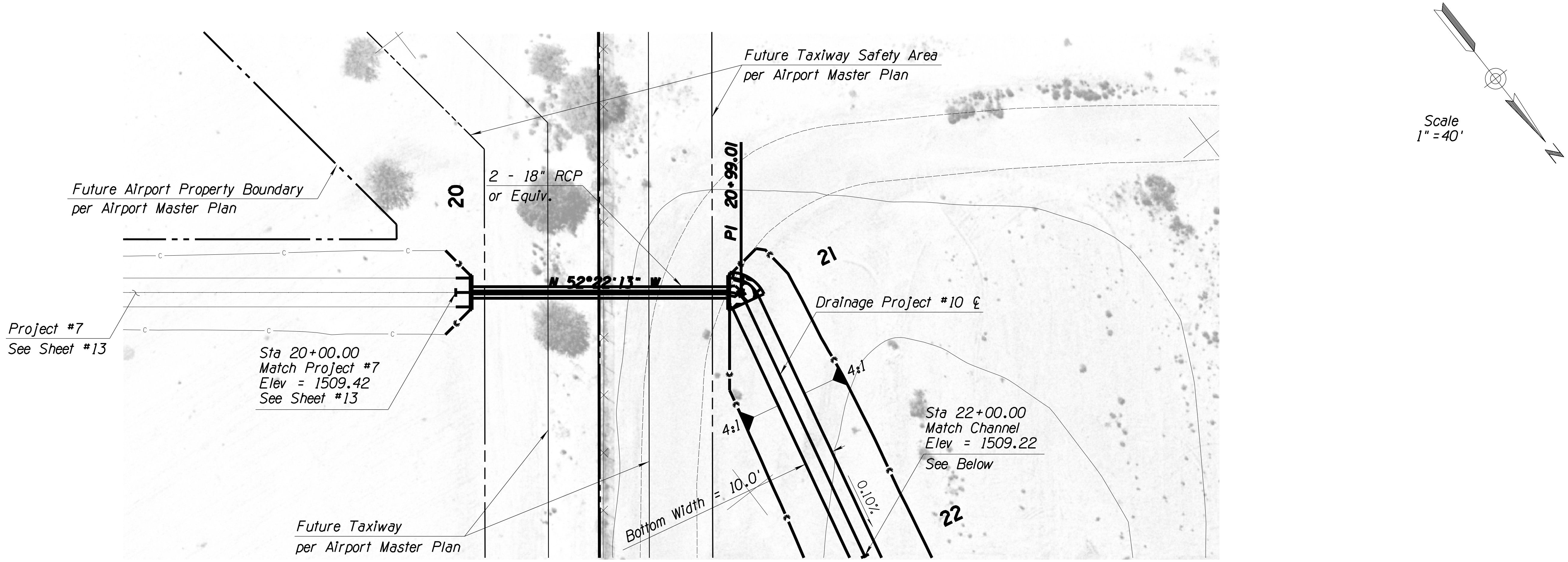
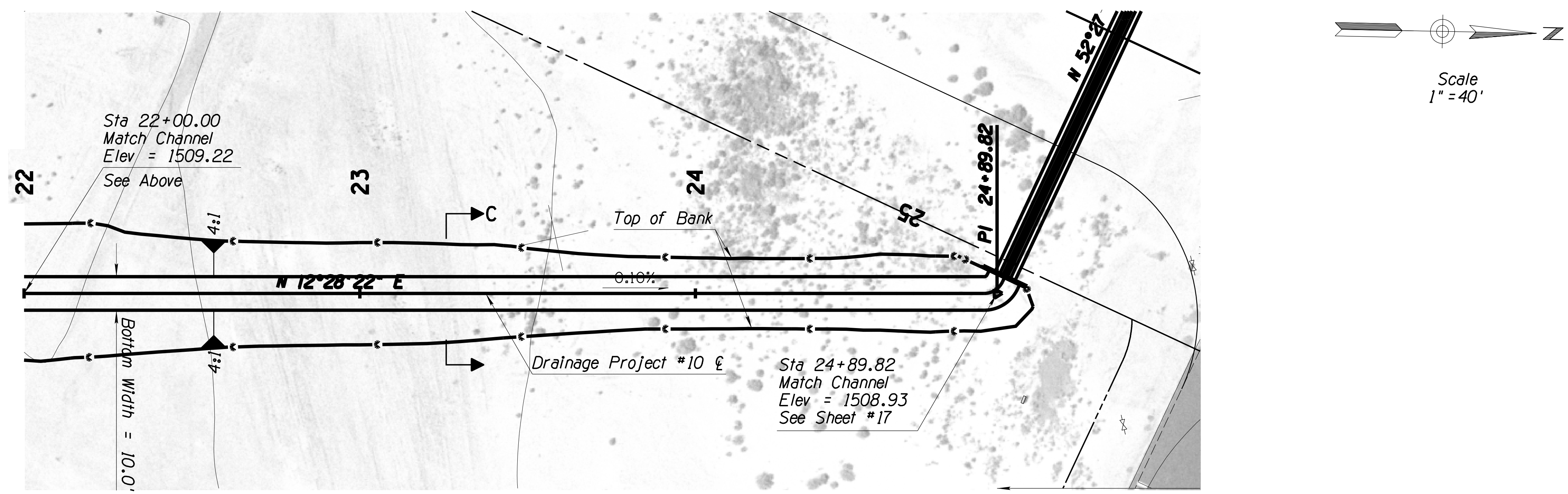
DRAINAGE IMPROVEMENT PLAN

PLAN SHEET
CULVERT EXTENSIONS
PROJECT #9

PROJECT NO. 191645002
FILE NO. d5002d14
SHEET 15 OF 18





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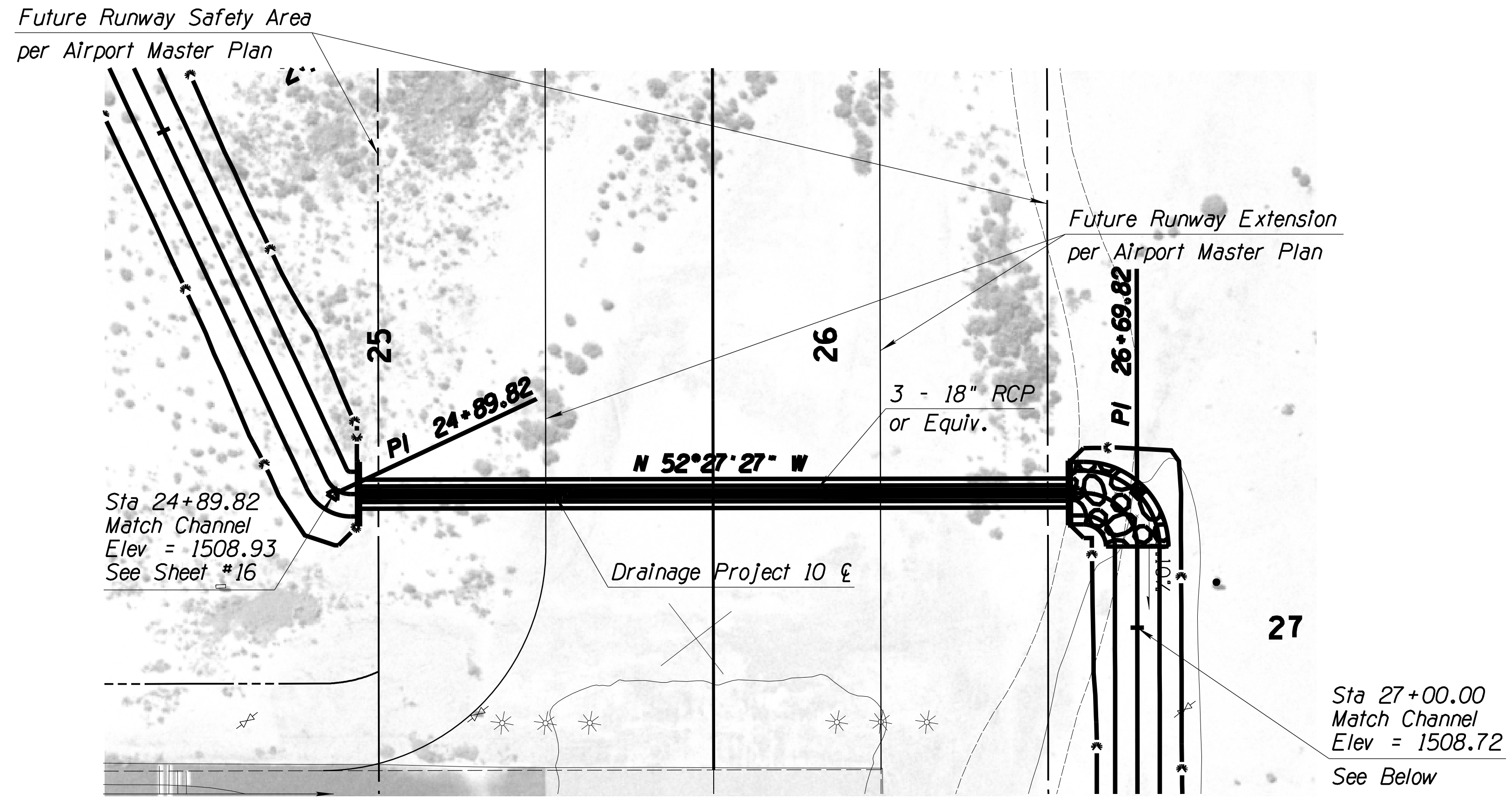
ELOY, ARIZONA

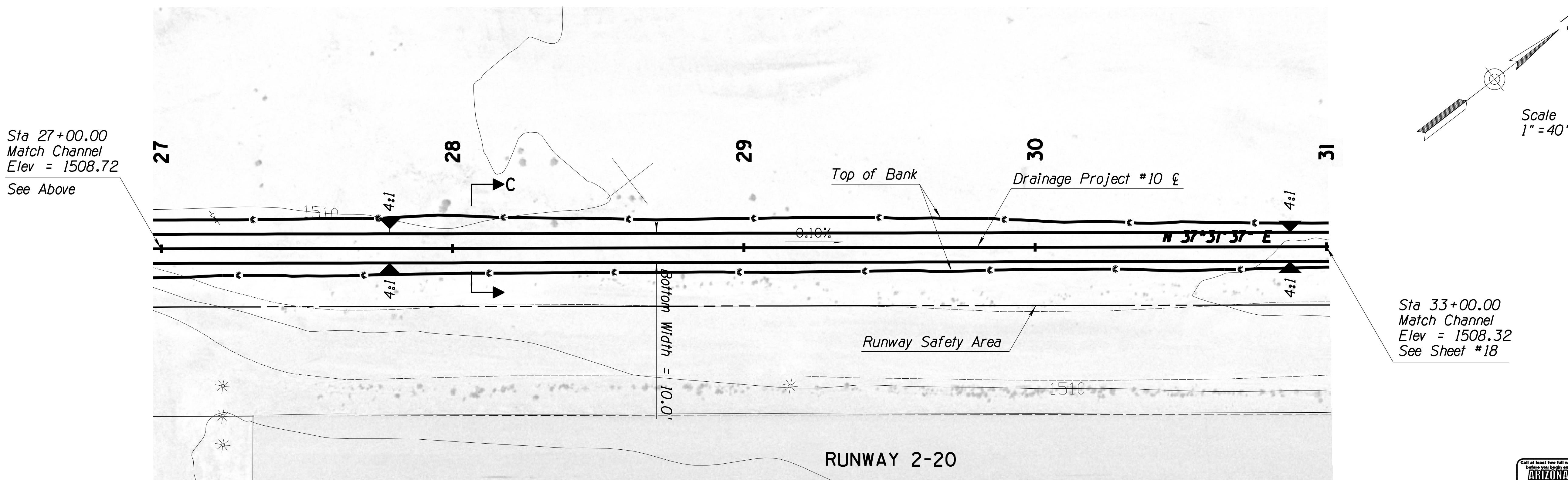
ELOY, ARIZONA

DRAINAGE IMPROVEMENT PLAN

PLAN SHEET
Sta 20+00.00 to Sta 24+89.82
PROJECT #10

PROJECT NO. 191645002
FILE NO. d5002d15
SHEET 16 OF 18





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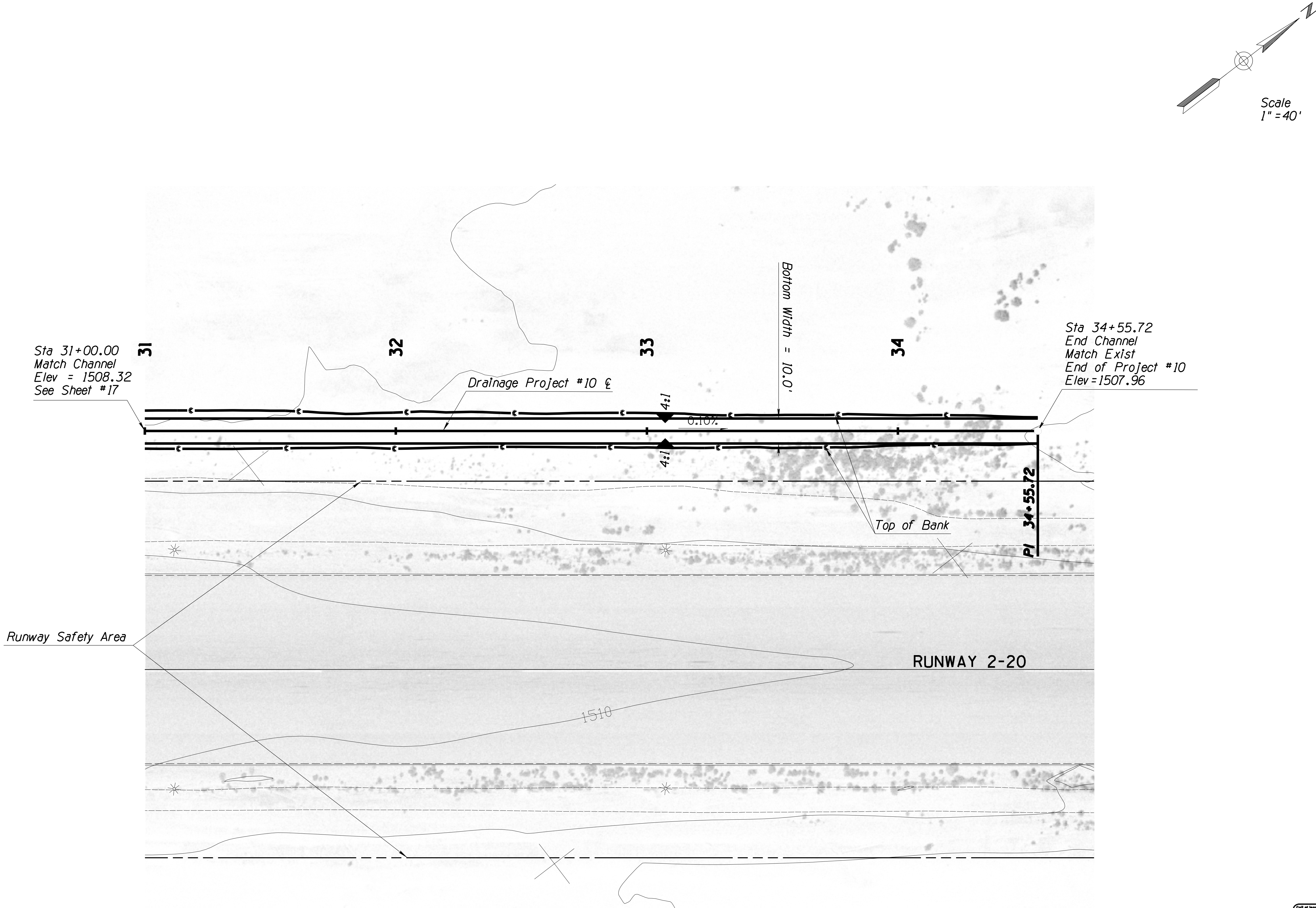
ELOY, ARIZONA

DRAINAGE IMPROVEMENT PLAN

PLAN SHEET
Sta 24+89.82 to Sta 31+00.00
PROJECT #10

PROJECT NO. 191645002
FILE NO. d5002d16
SHEET 17 OF 18



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DRAINAGE IMPROVEMENT PLAN
PLAN SHEET
STA 31+00.00 TO STA 34+55.72
PROJECT #10

PROJECT NO. 191645002
FILE NO. d5002d17
SHEET 18 OF 18

Appendix C - Master Plan Supporting Documentation

15% Cost Estimate

ELOY MUNICIPAL AIRPORT PRELIMINARY CIVIL AND DRAINAGE COST ESTIMATE

Kimley»Horn

Work Order No :
Proj Manager : **Scott Altherr, PE**

Project Location : **Eloy Municipal Airport**
Project Description : **Project 1**
Bid Advertisement Date : **TBD**

ITEM No.	ITEM DESCRIPTION	UNIT	DATE:	08/14/14	
			QUANTITY	UNIT PRICE	AMOUNT
2010011	Clearing and Grubbing	ACRE	5	$2,000.00	$10,000.00
2010020	Removal of Trees	EACH	10	$800.00	$8,000.00
2020022	Removal of Structures and Obstructions	L.S.	1	$5,000.00	$5,000.00
2020029	Removal of Asphaltic Concrete Pavement	S.Y.	548	$5.00	$2,740.00
2020101	Fence Removal	L.F.	2400	$5.00	$12,000.00
2030401	Drainage Excavation	C.Y.	18750	$15.00	$281,250.00
2030611	Irrigation Canal Siphon Reconstruction/Extension	L.F.	128	$500.00	$64,000.00
4060009	Asphaltic Concrete (Miscellaneous Pavement)	TON	157	$120.00	$18,840.00
5041995	Drainage Structure	EACH	3	$6,000.00	$18,000.00
5041996	Drainage Structure (Headwall)	EACH	1	$6,000.00	$6,000.00
6017101	Precast Reinforced Concrete Box Culvert	L.F.	250	$1,000.00	$250,000.00
7320713	Utility Relocation Work	L.S.	1	$5,000.00	$5,000.00
9010001	Mobilization (10%)	L.S.	1	$75,000.00	$75,000.00
9020005	Chain Link Fence, Type 1 (78")	L.F.	2400	$15.00	$36,000.00
9130008	Riprap (Dumped)	C.Y.	600	$100.00	$60,000.00
	Incidentals	F.A.	5000	$1.00	$5,000.00
	CONSTRUCTION COST SUBTOTAL:				**$856,830.00**
	Construction Administration (15%)				$128,525
	R/W Acquisition (additional necessary for Drainage Improvements)	L.S.	1	$25,000.00	$25,000
	Contingencies (25%)				$214,208
	Design and Permitting				$128,525
	TOTAL PROJECT COST				**$1,353,087**

ELOY MUNICIPAL AIRPORT PRELIMINARY CIVIL AND DRAINAGE COST ESTIMATE

Kimley»Horn

Work Order No :
Proj Manager : **Scott Altherr, PE**

Project Location : **Eloy Municipal Airport**
Project Description : **Project 2**
Bid Advertisement Date : **TBD**

ITEM No.	ITEM DESCRIPTION	UNIT	DATE:	08/14/14	
			QUANTITY	UNIT PRICE	AMOUNT
2010011	Clearing and Grubbing	ACRE	1	$2,000.00	$2,000.00
2020029	Removal of Asphaltic Concrete Pavement	S.Y.	13	$5.00	$65.00
2030401	Drainage Excavation	C.Y.	14	$50.00	$700.00
4060009	Asphaltic Concrete (Miscellaneous Pavement)	TON	5	$400.00	$2,000.00
5011014	Pipe, Reinforced Concrete Class IV, 18"	L.F.	192	$80.00	$15,360.00
5041996	Drainage Structure (Headwall)	EACH	4	$6,000.00	$24,000.00
7310832	Relocate Existing Light Poles	EACH	1	$1,000.00	$1,000.00
7320713	Utility Relocation Work	L.S.	1	$6,000.00	$6,000.00
8030111	Rock Mulch	C.Y.	40	$80.00	$3,200.00
9010001	Mobilization (10%)	L.S.	1	$5,000.00	$5,000.00
9130008	Riprap (Dumped)	TON	10	$100.00	$1,000.00
	Incidentals	F.A.	5000	$1.00	$5,000.00
	CONSTRUCTION COST SUBTOTAL:				**$65,325.00**

Construction Administration (15%)	$9,799
Contingencies (25%)	$16,331
Design and Permitting	$12,248
TOTAL PROJECT COST	**$103,703**

ELOY MUNICIPAL AIRPORT PRELIMINARY CIVIL AND DRAINAGE COST ESTIMATE

Kimley»Horn

Work Order No :
Proj Manager : **Scott Altherr, PE**

Project Location : **Eloy Municipal Airport**
Project Description : **Project 3**
Bid Advertisement Date : **TBD**

ITEM No.	ITEM DESCRIPTION	UNIT	DATE:	08/14/14	
			QUANTITY	UNIT PRICE	AMOUNT
2010011	Clearing and Grubbing	ACRE	1	$2,000.00	$2,000.00
2010020	Removal of Trees	EACH	3	$800.00	$2,400.00
2020011	Removal of Building	EACH	2	$2,000.00	$4,000.00
2020022	Removal of Structures and Obstructions	L.F.	102	$5.00	$510.00
2020029	Removal of Asphaltic Concrete Pavement	S.Y.	886	$5.00	$4,430.00
2020101	Fence Removal	L.F.	1,200	$5.00	$6,000.00
2030401	Drainage Excavation	C.Y.	1684	$15.00	$25,260.00
4060009	Asphaltic Concrete (Miscellaneous Pavement)	TON	10	$120.00	$1,200.00
5011022	Pipe, Reinforced Concrete Class II, 24"	L.F.	270	$100.00	$27,000.00
5041996	Drainage Structure (Headwall)	EACH	2	$6,000.00	$12,000.00
7310832	Relocate Existing Light Poles	EACH	6	$1,000.00	$6,000.00
7320713	Utility Relocation Work	L.S.	1	$5,000.00	$5,000.00
9010001	Mobilization (10%)	L.S.	1	$11,000.00	$11,000.00
9020005	Chain Link Fence, Type 1 (78")	L.F.	1200	$15.00	$18,000.00
9130008	Riprap (Dumped)	TON	8	$100.00	$800.00
	Incidentals	F.A.	5000	$1.00	$5,000.00
	CONSTRUCTION COST SUBTOTAL:				**$130,600.00**
	Construction Administration (15%)				$19,590
	Contingencies (25%)				$32,650
	Design and Permitting				$24,488
	TOTAL PROJECT COST				**$207,328**

ELOY MUNICIPAL AIRPORT PRELIMINARY CIVIL AND DRAINAGE COST ESTIMATE

Work Order No :
Proj Manager : **Scott Altherr, PE**

Project Location : **Eloy Municipal Airport**
Project Description : **Project 4**
Bid Advertisement Date : **TBD**

ITEM No.	ITEM DESCRIPTION	UNIT	DATE: 08/14/14		
			QUANTITY	UNIT PRICE	AMOUNT
2020029	Removal of Asphaltic Concrete Pavement	S.Y.	49	$5.00	$245.00
2020041	Removal of Pipe	L.F.	40	$20.00	$800.00
2030401	Drainage Excavation	C.Y.	180	$15.00	$2,700.00
4060009	Asphaltic Concrete (Miscellaneous Pavement)	TON	16	$130.00	$2,080.00
5011024	Pipe, Reinforced Concrete Class IV, 24"	L.F.	260	$100.00	$26,000.00
5041996	Drainage Structure (Headwall)	EACH	2	$6,000.00	$12,000.00
7320713	Utility Relocation Work	L.S.	1	$5,000.00	$5,000.00
9010001	Mobilization (10%)	L.S.	1	$6,000.00	$6,000.00
9130008	Riprap (Dumped)	TON	7	$100.00	$700.00
	Incidentals	F.A.	5000	$1.00	$5,000.00
	CONSTRUCTION COST SUBTOTAL:				**$60,525.00**

Construction Administration (15%)	$9,079
Contingencies (25%)	$15,131
Design and Permitting	$11,348
TOTAL PROJECT COST	**$96,083**

ELOY MUNICIPAL AIRPORT PRELIMINARY CIVIL AND DRAINAGE COST ESTIMATE

Kimley»Horn

Work Order No :
Proj Manager : **Scott Altherr, PE**

Project Location : **Eloy Municipal Airport**
Project Description : **Project 5**
Bid Advertisement Date : **TBD**

ITEM No.	ITEM DESCRIPTION	UNIT	DATE: 08/14/14		
			QUANTITY	UNIT PRICE	AMOUNT
2010011	Clearing and Grubbing	ACRE	1	$2,000.00	$2,000.00
2020001	Removal of Structures and Obstructions	L.S.	1	$5,000.00	$5,000.00
2020101	Fence Removal	L.F.	394	$5.00	$1,970.00
2020029	Removal of Asphaltic Concrete Pavement	S.Y.	965	$5.00	$4,825.00
2020041	Removal of Pipe	L.F.	18	$20.00	$360.00
2030401	Drainage Excavation	C.Y.	1716	$15.00	$25,740.00
4060009	Asphaltic Concrete (Miscellaneous Pavement)	TON	20	$120.00	$2,400.00
5011014	Pipe, Reinforced Concrete Class IV, 18"	L.F.	516	$80.00	$41,280.00
5041996	Drainage Structure (Headwall)	EACH	4	$6,000.00	$24,000.00
7320713	Utility Relocation Work	L.S.	1	$5,000.00	$5,000.00
9010001	Mobilization (10%)	L.S.	1	$13,000.00	$13,000.00
9020005	Chain Link Fence Type 1 (78")	L.F.	394	$15.00	$5,910.00
9130008	Riprap (Dumped)	TON	4	$100.00	$400.00
	Incidentals	F.A.	5000	$1.00	$5,000.00
	CONSTRUCTION COST SUBTOTAL:				**$136,885.00**
	Construction Administration (15%)				$20,533
	R/W Acquisition	L.S.	1	$4,000.00	$4,000
	Contingencies (25%)				$34,221
	Design and Permitting				$20,533
	TOTAL PROJECT COST				**$216,172**

ELOY MUNICIPAL AIRPORT PRELIMINARY CIVIL AND DRAINAGE COST ESTIMATE

Kimley»Horn

Work Order No :
Proj Manager : **Scott Altherr, PE**

Project Location : **Eloy Municipal Airport**
Project Description : **Project 6**
Bid Advertisement Date : **TBD**

ITEM No.	ITEM DESCRIPTION	UNIT	DATE: 07/07/14		
			QUANTITY	UNIT PRICE	AMOUNT
2010011	Clearing and Grubbing	ACRE	0.5	$2,000.00	$1,000.00
2030401	Drainage Excavation	C.Y.	1545	$15.00	$23,175.00
7310832	Relocate Existing Light Poles	EACH	1	$1,000.00	$1,000.00
7320713	Utility Relocation Work	L.S.	1	$1,500.00	$1,500.00
8030111	Rock Mulch	C.Y.	560	$80.00	$44,800.00
9010001	Mobilization (10%)	L.S.	1	$8,000.00	$8,000.00
	Incidentals	F.A.	5000	$1.00	$5,000.00
	CONSTRUCTION COST SUBTOTAL:				**$84,475.00**

Construction Administration (15%)	$12,671
Contingencies (25%)	$21,119
Design and Permitting	$15,839
TOTAL PROJECT COST	**$134,104**

ELOY MUNICIPAL AIRPORT PRELIMINARY CIVIL AND DRAINAGE COST ESTIMATE

Kimley»Horn

Work Order No :		**Project Location :**	**Eloy Municipal Airport**
Proj Manager :	**Scott Altherr, PE**	**Project Description :**	**Project 7**
		Bid Advertisement Date :	**TBD**

ITEM No.	ITEM DESCRIPTION	UNIT	DATE: 07/07/14		
			QUANTITY	UNIT PRICE	AMOUNT
2010011	Clearing and Grubbing	ACRE	1	$2,000.00	$2,000.00
2030401	Drainage Excavation	C.Y.	420	$15.00	$6,300.00
7320713	Utility Relocation Work	L.S.	1	$5,000.00	$5,000.00
9010001	Mobilization (10%)	L.S.	1	$2,000.00	$2,000.00
	Incidentals	F.A.	5000	$1.00	$5,000.00
	CONSTRUCTION COST SUBTOTAL:				**$20,300.00**

Construction Administration (15%)	$3,045
Contingencies (25%)	$5,075
Design and Permitting	$3,806
TOTAL PROJECT COST	**$32,226**

ELOY MUNICIPAL AIRPORT PRELIMINARY CIVIL AND DRAINAGE COST ESTIMATE

Kimley»Horn

Work Order No :
Proj Manager : **Scott Altherr, PE**

Project Location : **Eloy Municipal Airport**
Project Description : **Project 8**
Bid Advertisement Date : **TBD**

ITEM No.	ITEM DESCRIPTION	UNIT	DATE:	08/14/14	
			QUANTITY	UNIT PRICE	AMOUNT
2010011	Clearing and Grubbing	ACRE	0.2	$2,000.00	$400.00
2020029	Removal of Asphaltic Concrete Pavement	S.Y.	37	$20.00	$740.00
2020041	Removal of Pipe	L.F.	61	$20.00	$1,220.00
4060009	Asphaltic Concrete (Miscellaneous Pavement)	TON	12	$120.00	$1,440.00
5011014	Pipe, Reinforced Concrete Class IV, 18"	L.F.	288	$80.00	$23,040.00
5041996	Drainage Structure (Headwall)	EACH	2	$6,000.00	$12,000.00
7320713	Utility Relocation Work	L.S.	1	$5,000.00	$5,000.00
9130008	Riprap (Dumped)	TON	4	$100.00	$400.00
9010001	Mobilization (10%)	L.S.	1	$5,000.00	$5,000.00
	Incidentals	F.A.	5000	$1.00	$5,000.00
	CONSTRUCTION COST SUBTOTAL:				**$54,240.00**

Construction Administration (15%)	$8,136
Contingencies (25%)	$13,560
Design and Permitting	$10,170
TOTAL PROJECT COST	**$86,106**

ELOY MUNICIPAL AIRPORT PRELIMINARY CIVIL AND DRAINAGE COST ESTIMATE

Kimley»Horn

Work Order No :
Proj Manager : **Scott Altherr, PE**

Project Location : **Eloy Municipal Airport**
Project Description : **Project 9**
Bid Advertisement Date : **TBD**

ITEM No.	ITEM DESCRIPTION	UNIT	DATE: 08/14/14		
			QUANTITY	UNIT PRICE	AMOUNT
2010011	Clearing and Grubbing	ACRE	1	$2,000.00	$2,000.00
5011014	Pipe, Reinforced Concrete Class IV, 18"	L.F.	126	$80.00	$10,080.00
5011214	Pipe, Reinforced Concrete Class IV, 14" X 23"	L.F.	42	$100.00	$4,200.00
5041996	Drainage Structure (Headwall)	EACH	2	$6,000.00	$12,000.00
7320713	Utility Relocation Work	L.S.	1	$5,000.00	$5,000.00
9130008	Riprap (Dumped)	TON	35	$100.00	$3,500.00
9010001	Mobilization (10%)	L.S.	1	$4,000.00	$4,000.00
	Incidentals	F.A.	5000	$1.00	$5,000.00
	CONSTRUCTION COST SUBTOTAL:				**$45,780.00**

Construction Administration (15%)	$6,867
Contingencies (25%)	$11,445
Design and Permitting	$8,584
TOTAL PROJECT COST	**$72,676**

ELOY MUNICIPAL AIRPORT PRELIMINARY CIVIL AND DRAINAGE COST ESTIMATE

Kimley»Horn

Work Order No :
Proj Manager : Scott Altherr, PE

Project Location : Eloy Municipal Airport
Project Description : Project 10
Bid Advertisement Date : TBD

ITEM No.	ITEM DESCRIPTION	UNIT	DATE:	08/14/14	
			QUANTITY	UNIT PRICE	AMOUNT
2010011	Clearing and Grubbing	ACRE	1	$2,000.00	$2,000.00
2020101	Fence Removal	L.F.	14	$20.00	$280.00
2030401	Drainage Excavation	C.Y.	1430	$15.00	$21,450.00
5011014	Pipe, Reinforced Concrete Class IV, 18"	L.F.	660	$80.00	$52,800.00
5041996	Drainage Structure (Headwall)	EACH	4	$6,000.00	$24,000.00
7320713	Utility Relocation Work	L.S.	1	$5,000.00	$5,000.00
9010001	Mobilization (10%)	L.S.	1	$12,000.00	$12,000.00
9020005	Chain Link Fence Type 1 (78")	L.F.	14	$20.00	$280.00
9130008	Riprap (Dumped)	TON	16	$100.00	$1,600.00
	Incidentals	F.A.	5000	$1.00	$5,000.00
	CONSTRUCTION COST SUBTOTAL:				**$124,410.00**

Construction Administration (15%)	$18,662
Contingencies (25%)	$31,103
Design and Permitting	$23,327
TOTAL PROJECT COST	**$197,501**