East Mesa
Area Drainage Master Plan Update
Proposed Alternatives
Development & Evaluation
February, 2014 - FCD 2011C017

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Flood Control District of Maricopa County

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EAST MESA AREA DRAINAGE MASTER PLAN UPDATE

PROPOSED ALTERNATIVES DEVELOPMENT AND VOLUME AD

Contract FCD 2011C017

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EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
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EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
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EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
PROPOSED ALTERNATIVES DEVELOPMENT AND EVALUATION
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SECTION AD-1: INTRODUCTION

This report was prepared as part of the East Mesa Area Drainage Master Plan (ADMP) Update project and presents the results of the proposed alternatives developed and evaluated for this project.

1.1 PROJECT PURPOSE AND AUTHORIZATION

The East Mesa ADMP Update was initiated to develop and recommend context-sensitive, cost-effective strategies to reduce flood hazards and protect public safety in a 58-square-mile portion of southeastern Maricopa County. Entellus, Inc., was retained under Contract FCD 2011C017 to update the previous *East Mesa Area Drainage Master Plan* (*1998 ADMP*) prepared by others (**Reference 234**).

1.2 STUDY AREA

The limits of the study area are presented in **Figure AD 1.2**. The study area is bounded on the west by the East Maricopa Floodway (EMF), on the north by Elliot Road, on the east by the Powerline, Vineyard Road, and Rittenhouse Flood Retarding Structures (PVR Structures), and on the south by the Rittenhouse Channel and Ocotillo Road. It includes portions of Mesa, Queen Creek, Gilbert, Apache Junction, and unincorporated areas of Maricopa and Pinal counties.

The study area is a mix of residential, industrial, and agricultural development. Very little undeveloped desert land remains within the Maricopa County portion of the study area. Conversely, most of the area within Pinal County is undeveloped.

Portions of the study area are experiencing rapid changes, with agricultural and industrial areas being converted to residential and commercial uses. The most significant is the conversion of the former GM Desert Proving Grounds to residential and commercial uses.

The Phoenix-Mesa Gateway Airport lies within the study area, but it was omitted from the alternatives development as it was assumed that the current *Phoenix Mesa Gateway Drainage Master Plan* **(Reference 11)** addresses any drainage issues within the airport property.

The capacity of the Powerline Floodway was analyzed as part of the East Mesa ADMP Update (see *Powerline Floodway Hydraulic Analysis Technical Memorandum, Appendix D* of the *Data Collection Report - Volume DC*.) Any solutions to address potential capacity issues identified in the Technical Memorandum will be developed by the District under efforts separate from the East Mesa ADMP Update.

1.3 PUBLIC AND STAKEHOLDER COORDINATION

The public and stakeholder coordination effort initiated during the data collection portion of this study and documented in the *East Mesa ADMP Update Data Collection Report - Volume DC* has continued through the development and evaluation of alternatives.

Two public meetings were held for the project in May 2012 and June 2013. The purpose of the first public meeting was to collect data from residents on flooding problems. The second public meeting presented the preliminary alternatives for the Rittenhouse Zone to the residents of the Ellsworth Mini-Farms.

The project team also hosted four sets of group stakeholder meetings.

- April 2012: Introduce the project and obtain information on activities within the study area from public agencies and private landowners and developers.
- June 2012: Solicit feedback on the preliminary alternatives from public agencies and private landowners and developers.
- June 2013: All of the major landowners in the Rittenhouse Zone were invited to provide input on revised preliminary alternatives. The revisions to the preliminary alternatives were based on feedback received at one-on-one meetings with landowners.
- December 2013: Present the recommended alternative for the Rittenhouse Zone to the large landowners and developers.

In addition, the project team also held 25 individual meetings with public agencies and private landowners to discuss specific issues.

Summaries of the stakeholder meetings are included in **Appendix A**.

1.4 EVALUATION CRITERIA

Preliminary evaluation criteria were developed to rank the alternatives and presented to the entire team. They were subsequently refined based on the ensuing discussion (**Table AD 1.4**), and were applied to the alternatives in a two-step process. The first step is to rank the alternatives based on all categories, including cost. The second step is to exclude cost from the scoring and then compare the results. This allows consideration of the benefits that could be realized, regardless of differences in cost, in order to fully appreciate comparative benefits.

Table AD 1.4 - Evaluation Criteria

Performance Criteria	Definition	Range of Rating
Life-Cycle Cost	The cost to construct the facilities, as well as costs to maintain them throughout the useful life (assumed to be 50 years)	High • Lowest life-cycle cost Low • Highest life-cycle cost
Acceptability	Public, stakeholder, and agency support;	High

Performance Criteria	Definition	Range of Rating
	compatibility with the surrounding environment; effect on biological resources; multi-use opportunities	• Consensus of strong support by residents, stakeholders, and agencies • Is visually and functionally compatible with surroundings per the Landscape Inventory and Assessment (LIA). (See *Volume DC.*) • Enhances biological resources • Accommodates multi-use facilities <u>Low</u> • Strong opposition from residents, stakeholders, and agencies • Is not visually and functionally compatible with surroundings per the LIA • Does not enhance biological resources • Does not support multi-use opportunities
Implementation	Ease of construction (would not require special techniques or equipment); ability to construct in phases; availability of funding partners; need for construction of interim facilities	<u>High</u> • Construction does not require special techniques or equipment (straightforward) • Construction of elements can be easily phased, and segments are effective prior to completion of later phases • Has significant opportunities for funding partnerships • Does not require interim facilities <u>Low</u> • Construction is difficult and needs special equipment or materials • Phased construction does not offer flood protection until the entire facility is built • No significant opportunities for funding partnerships • Requires interim facilities to be constructed and later abandoned
Effectiveness	Level of flood protection provided; extent of watershed protected; use of existing drainage facilities	<u>High</u> • Provides 100-year flood protection typically offered by regional facilities • Protects a relatively large portion of the watershed • Fully uses the capacity of existing facilities <u>Low</u> • Provides reduced level of service as compared to 100-year flood protection

Performance Criteria	Definition	Range of Rating
		• Protects a relatively small portion of the watershed • Does not maximize the capacity of existing facilities

SECTION AD-2: HYDROLOGY

2.1 CHARACTERISTICS OF DRAINAGE AREA

The predominant direction of runoff is from east to west. It travels from the upper reaches of the watershed at the base of the PVR Structures and flows across the Central Arizona Project (CAP) Canal via overchutes at several locations. Runoff continues westerly in ill-defined washes and overland as sheet flow within Pinal County. At Meridian Road, runoff enters Maricopa County at several major concentration points within the study area. It continues overland, along streets, and in a few small channels to the existing Ellsworth Channel, Rittenhouse Channel, Powerline Floodway, and the EMF.

2.2 EXISTING FLOODING PROBLEMS AND FUTURE CONCERNS

Several system deficiencies have been identified along the three regional channels within the study area (Powerline Floodway, Ellsworth Channel, and Rittenhouse Channel) under existing and/or future conditions. The deficiencies ranged from minor freeboard shortages to predicted overtopping of short reaches of the channels. Another issue identified was the increase of runoff along Germann Road under future conditions. A more detailed discussion of deficiencies is provided in Section 3.

Additionally, drainage complaints were collected from the City of Mesa, the Town of Queen Creek, the Maricopa County Department of Transportation (MCDOT), and Maricopa County Department of Planning and Development. Most complaints are concentrated in two areas. The first is the Mountain/Erie neighborhood where the roads are frequently inundated during even minor storms. The second location is on and along Pecos Road where runoff frequently ponds and floods the area.

The deficiencies and public complaints were documented in the *East Mesa Area Drainage Master Plan Update - Data Collection Report* and are presented in **Figure AD 2.2a** - Drainage Issues, **Figure AD 2.2b** – Mountain / Erie Drainage Issues, and **Table AD 2.2**.

Table AD 2.2 - Flooding Issues

Map ID*	Description	Date	Source
1	Ellsworth Channel overtopping		Hydrology Update model, existing conditions
2	Ellsworth Channel freeboard deficiency (future conditions)		Hydrology Update model, future conditions
3	Erosion and fence damage at Pecos Road west of Ellsworth Road	12/10/2007	City of Mesa complaints

Map ID*	Description	Date	Source
4	City of Mesa PD roadway flooding at Pecos and Crismon	1/21/2010	City of Mesa complaints
5	City of Mesa PD roadway flooding at Pecos Road & 222 Street	1/21/2010	City of Mesa complaints
5	Culvert clogged at 222 Street north of Pecos Road	9/11/2006	City of Mesa complaints
6	City of Mesa PD street flooding at Mountain Road	1/21/2010	City of Mesa complaints
6	City of Mesa PD street flooding at Mountain Road	1/21/2010	City of Mesa complaints
7	Powerline Floodway deficient culvert capacity at Meridian Road		ADMPU model, future and existing conditions
8	Powerline Floodway culvert capacity issues: breakout to the south at Ironwood Road		ADMPU HEC-RAS model, existing and future conditions
9	Rittenhouse freeboard deficiencies (future conditions)		Hydrology Update model, future condition
10	Rittenhouse Channel overtopping (future conditions)		Hydrology Update model, future condition
11	Rittenhouse Channel freeboard deficiency (future conditions)		Hydrology Update model, future condition
12	Breach of non-engineered berm or levee-like embankment	Early 1990s	Hydrology Update
13	Uncontrolled wash through neighborhood		ADMPU aerial
14	Uncontrolled wash through neighborhood		ADMPU aerial
15	Flooding a couple of times a year		ADMPU public meeting
16	Powerline Floodway deficient culvert capacity		ADMPU modeling, existing and future conditions
17	Powerline Floodway freeboard Issues		ADMPU modeling, existing and future conditions
18	Wash ponds on Mountain Road		ADMPU public meeting
19	Culvert lacks capacity		ADMPU public meeting
20	Drainage across roadway		ADMPU public meeting
21	Flow accumulates on street		ADMPU public meeting
22	Wash was filled by landowner		ADMPU public meeting
23	Flow from Meridian Road concentrates along Ivanhoe Street		ADMPU public meeting
24	Wash flows through neighborhood		ADMPU public meeting

Map ID*	Description	Date	Source
25	Erosion damaging fences - wash is 5 to 6 feet deep		ADMPU public meeting
26	Flooding blocks driveways		ADMPU public meeting
27	Floods often		ADMPU public meeting
28	Two culverts clog		ADMPU public meeting

* See **Figures AD 2.2a** and **AD 2.2b**.

2.3 BASIS OF HYDROLOGIC ANALYSIS

The U.S. Army Corps of Engineers hydrology program HEC-1 was used to estimate peak runoff. The District had developed existing and future condition hydrology models in August 2011, using the latest information available for the watershed, including planned future improvements. The models were documented in the *East Mesa Area Drainage Master Plan Update*: *Hydrologic Analysis* (*Hydrology Update*) and were used as the basis for development of solutions for the project area.

Based on the *Hydrology Update*, it appears that most of the existing infrastructure will not meet current District freeboard policies. Additionally, infrastructure may be overtopped by the 100-year peak discharges at some locations.

To alleviate current and future drainage issues, several variations of infrastructure were proposed for each of three zones: SR-24, Ellsworth, and Rittenhouse. (The locations of the zones are described later in this report.) Because of the somewhat interconnected nature of the hydrology, different models were developed to evaluate the effectiveness of the proposed solutions. Each model includes one alternative for each of the zones. In all cases, the alternatives were analyzed for the hydrologic worst-case scenario based on the level of development (existing or future conditions) for the 100-year recurrence interval. Existing conditions were used for the SR-24 and Ellsworth Zones, while the future condition was used for the Rittenhouse Zone. Because of variations in proposed levels of protection, a total of four models were developed to fully depict hydrologic conditions in the SR-24 and Ellsworth zones.

2.3.1 **Existing Conditions Model**

The District's *Hydrology Update* existing conditions model was the basis of analysis. A total of 17 models had been developed by the District as part of the *Hydrology Update*, but the key models used during the current analysis were the 10-year and 100-year, 24-hour models for both existing and future conditions.

2.3.2 **Future Conditions Model**

The SR-24 freeway interceptor channel is a planned ADOT facility along the north side of the future freeway that would intercept runoff from the northern portion of the watershed and convey it to the Powerline Floodway just west of Ellsworth Road. The first phase of this freeway (Loop 202 to Ellsworth Road) is under construction, and a corridor study for the

second phase (Ellsworth Road to Ironwood Road) is underway. The future conditions models prepared during the *Hydrologic Update* included the SR-24 Channel flow interception and routed the flow along the proposed channel. East of Ironwood Road, three freeway alignments are currently being considered, but for hydrologic purposes the differences in alignments are inconsequential. Therefore, although the hydrology may not exactly represent the final alignment of the freeway, the effect on the flows entering Maricopa County and the future conditions model basin configuration was considered negligible.

The future condition model also used updated (NOAA 14) precipitation data to determine retention requirements for future development.

SECTION AD-3: ALTERNATIVES FORMULATION

3.1 INTRODUCTION

The consultant team met on April 3, 2012, to review the available data and to explore potential alternatives (seed ideas) to present to the entire team. To facilitate the meeting, Entellus prepared a set of exhibits for depicting available information, including drainage complaints/issues, land ownership, land use, and other relevant data. Based on the results of the data collection effort, locations with evidence of drainage problems were grouped into seven focus areas (See Seed Ideas - Drainage Issues Focus Areas Figure in **Appendix B**). The seed ideas were divided into three somewhat independent groupings based on their outfall facilities: SR-24 Channel, Ellsworth Channel, and Rittenhouse Channel.

The team then grouped the elements of the seed ideas into three themes: conveyance emphasis, storage emphasis, and natural path emphasis. Details of the initial seed ideas are included in **Appendix B**.

3.1.1 Brainstorming Exercise

On May 7, 2012, the study team, including the consultant, District, and City of Mesa, met to brainstorm potential drainage solutions for the study area. The seed ideas were presented and were modified and expanded with additional input from the group. Copies of the materials provided to the attendees and tables documenting the proposed elements are included in **Appendix C.**

After the brainstorming meeting, the different elements were combined into complete systems, and the consultant team conducted a preliminary screening to determine which elements would be advanced for further consideration. These recommendations were presented and discussed with the District on May 21, 2012, and a consensus was reached as to which elements should be considered further. At this point, the District elected to remove development of alternatives related to the Powerline Floodway from the scope of work for this project. A factor in this decision was that the floodway hydraulics are dependent on the assumed base flow from the PVR Structures, and the District has not developed a definitive policy regarding appropriate base flow assumptions at this time. The District will continue to analyze the floodway and related policies independently.

3.1.2 Design Criteria and Assumptions

As noted in **Section 2**, the basis of hydrologic modeling was the District's HEC-1analysis from the 2011 *Hydrology Update*. As described in **Section 4.2** and **Appendix D**, the model was subsequently modified to incorporated and evaluated alternatives. The hydrologic modifications were made per the February 2010 version of the District's *Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology* (Hydrology Manual).

Design criteria for proposed hydraulic structures were based on the District's June 2010 version of the *Drainage Design Manual for Maricopa County, Arizona, Volume II, Hydraulics* (Hydraulics Manual).

Open Channels: Initial channel layouts included three types: riprap-lined, movable bed, and turf-lined. Channel roughness coefficients were estimated for the banks and the channel bed separately, and a composite n value was used in hydraulic calculations. Factors considered were channel type, vegetation, and the natural soil D_{50}. However, per District direction, Rittenhouse Alternatives 4 and 5 were based on a set n value rather than composite n values.

A range of channel side slopes and velocities were assumed for the channels:

Channel Type	Minimum Side Slope (H:V)	Maximum Side Slope (H:V)	Minimum Velocity (fps)	Maximum Velocity (fps)
Riprap	2:1	4:1	2.5	6.5
Movable Bed	8:1	8:1	2.5	4.0
Turf-Lined	6:1	20:1	2.5	4.0

It is noted that the side slopes are steeper for the riprap sections than that recommended in the LIA. It was necessary to minimize the channel footprint because of a significant lack of available right-of-way.

There are a few instances where, due to limited natural slope, estimated channel velocities are below the minimum allowable.

Where estimated channel velocities based on the natural grade exceeded the allowable limits and a reduction of the velocity could not be achieved through a modified channel geometry, 4-foot drop structures were proposed.

Flow depths were kept generally in the range of 3 to 5.5 feet. Bottom widths were estimated based on the assumed flow depth for the channel. Per the Hydraulics Manual, freeboard was 25% of the flow depth plus the velocity head. A minimum freeboard of one foot was used for all channels regardless of the required freeboard calculation.

Details of the hydraulic and erosion analyses are presented in **Appendix E**. Typical Channel configurations utilized in analysis of the alternatives are presented in **Figure AD 3.1.2.**

Detention Basins: To estimate the required acreage for detention basins, side slopes were assumed to be in the following range:

Parameter	Minimum	Maximum
Side Slope	4:1	3:1
Depth	4 ft	12 ft

Landscaping: The drainage elements of the recommended plan were configured based on input from the Town of Queen Creek, and existing legal and physical constraints such as existing dedicated drainage easement widths. They were then refined to create opportunity for incorporating minimal landscape buffers for screening hardened

facilities and adjacent industrial facilities. Structure types, structural methods, and landscape design themes identified in the Landscape Inventory Analysis (LIA) were used to identify context-sensitive treatments for the proposed facilities to the extent possible. Visual mitigation was proposed in the form of landscape buffers with screening plant material, berms and water-harvesting micro-basins where limited rights-of-way or existing drainage easements required the use of a channel lining or flood protection method that was not compatible with the future setting. Although not included in the design or cost estimates, drainage facilities were developed and evaluated to accommodate multi-use opportunities in the future. Such additions would be implemented if funding is secured independent from the flood protection projects.

3.1.3 Life-Cycle Cost Criteria

Life-cycle cost includes initial construction costs, as well as continued operation and maintenance costs throughout its entire useful life. The following general assumptions were made when developing the life-cycle costs for each alternative:

- The planning-level estimates of costs are for comparison purposes only. After a recommended alternative is selected, the cost estimate will be refined accordingly.
- The comparison cost estimates include design, major construction items, landscape aesthetics, right-of-way land acquisition, and major utility relocations. Landscape costs are within the ceiling limits specified in the District's Policy for Landscape and Aesthetics, assuming the future landscape character units of the LIA.
- Costs were estimated in 2012 dollars.
- A 20% contingency was added to the cost for each alternative.
- Costs for interim features were estimated using the same approach as other permanent features without any discount applied for future abandonment.
- Collector and arterial road culverts were assumed to have the same costs for inlets and outlets, transitions, and unit length of culvert.
- Overhead electric relocation assumed 300-foot spacing of poles.
- A 10% contingency was added to right-of-way costs for channel alignments that do not follow section lines. This accounts for possible acquisition of remnant parcels and for costs to cure loss of use and other impacts.
- Unit costs for maintenance of retention basins and movable bed channels were developed using maintenance costs for the Rittenhouse FRS provided by the District. Interim basins were assumed to have approximately 60% less maintenance cost than permanent basins.
- Unit costs for maintenance of riprap lined channels (hardened channels) were developed using maintenance costs for the East Maricopa Floodway provided by the District.
- Unit costs for land acquisition were based on land prices provided by the District.

3.2 PROPOSED ALTERNATIVES

The study area was broken into three somewhat hydrologically independent drainage zones (**Figure AD 3.2**). The alternatives are described in the following sections for each of the three project zones.

3.2.1 SR-24 Zone

This zone includes the area contributing to the future SR-24 Channel. Since the time frame for the construction of the SR-24 Channel is uncertain, the alternatives include interim elements that would be required in case improvements are made to property within the SR-24 Zone before the SR-24 Channel is constructed by ADOT.

Alternatives proposed in this zone are intended to address well-documented flooding issues along Mountain Road, Erie Street, Galveston Street, Ivanhoe Street and Williams Field Road. A significant portion of the contributing runoff is generated in Pinal County. The alternatives for this zone do not address any potential flooding problems in Pinal County, except along Meridian Road.

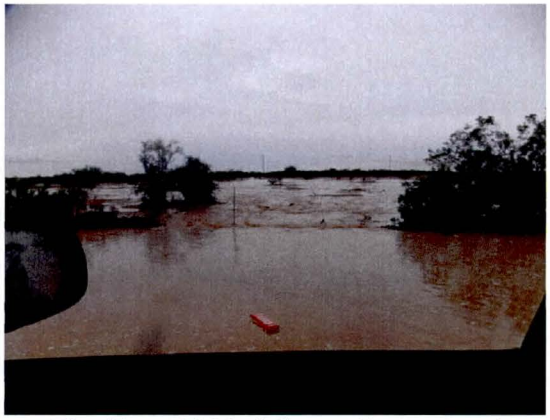
3.2.1.1 Existing Facilities

As shown in **Figure AD 3.2.1** and documented below, there are several existing drainage facilities within the study area:

Infrastructure in Master Planned Communities: The north portion of the watershed includes the master-planned communities of Desert Valley, Keighley Place, Bella Via, and Mountain Horizon, whose drainage infrastructure handles offsite runoff from the east. Keighley Place outfalls through two culverts to a natural wash at Ray Road. Mountain Horizon discharges sheet flow to the undeveloped land to the west of the Signal Butte Road alignment.

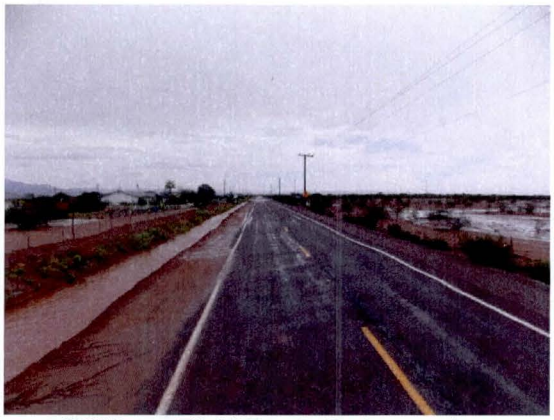
222nd Street Channel: A 25-foot wide earthen channel along the west side of 222nd Street outlets to a natural drainage path just north of Pecos Road. It is significantly undersized and overflows under even minor runoff events. Overflow from this channel floods 222nd street and undeveloped fields to the west.

Flooding of 222nd Street (facing north)



Flooding of 222nd Street (facing west)

Williams Field Road Channel: A15-foot wide earthen channel extends from Mountain Road west along the north side of Williams Field Road to the 222nd Street Channel. It has very limited capacity and overtops even during minor runoff events, flooding Williams Field Road and the surrounding area.



Williams Field Road (facing east)

Williams Field Road Channel Overtopping

Mountain Road Ditch: Significant flooding occurs along Mountain Road from Ray Road to Pecos Road. A ditch on the east side between Williams Field Road and Erie Street outfalls into the Williams Field Road Channel through a culvert. However, the ditch and culvert are undersized, and the area frequently floods. The worst flooding occurs at a low point just north of Williams Field Road where runoff has no outlet, and the Maricopa County Department of Transportation (MCDOT) pumps water out after every storm. A resident has maintained a small channel through his property to alleviate flooding and allow the ponded water to follow its historical flow path west. However, since the former GM Desert Proving Grounds closed, culverts at its east property line have become clogged and runoff continues to pond along the historical flow path.

Mountain Road Flooding (Residence)

Mountain Road Flooding

Erie Street Channel: A 20-foot wide earthen channel along the north side of Erie Street extends west from the Meridian Road alignment to its outfall at Mountain Road. Erie Street has a wet crossing just east of Mountain Road. The channel is in poor condition and does not have the capacity to handle significant flow. Significant erosion was observed, especially at the multiple driveway culverts along the channel.

Erie Street Channel Overtopping

Erie Street Channel Overtopping

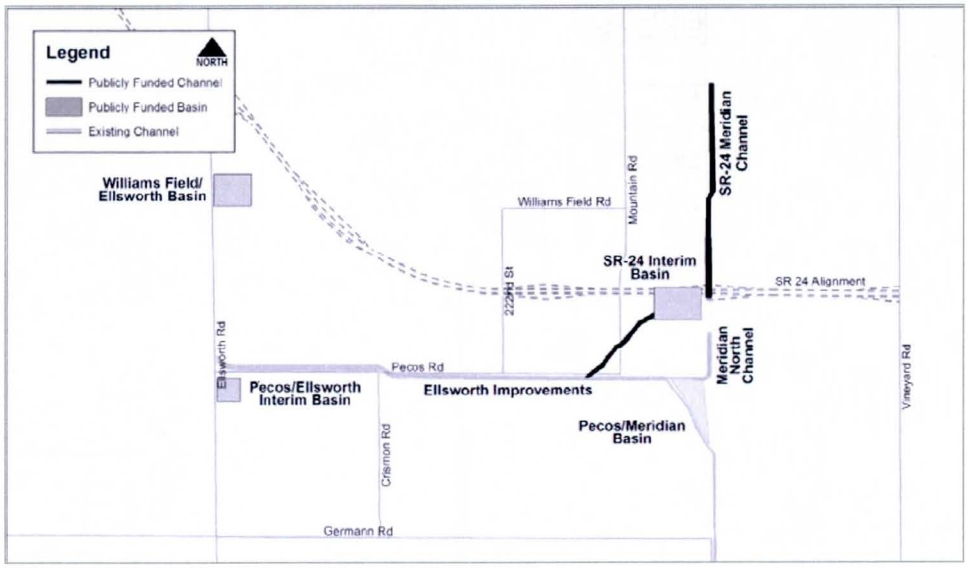
Meridian Channel: A small channel along the Meridian Road alignment north of Erie Street appears to have been constructed by residents to divert runoff away from their properties and onto Erie Street. A significant amount of runoff from Pinal County crosses the Meridian Road alignment and causes significant flooding throughout the single-lot residential area. The existing channel can only handle very minor flows, and it may overtop, erode, or be filled by sediment in a short period of time.

Meridian Channel

Except for onsite retention provided by the master planned communities, there are no significant storage facilities within the SR-24 Zone. However, incidental storage appears to occur throughout the zone where sheet flow is captured behind localized elevated areas.

3.2.2 **SR-24 Alternative 1**

The following diagram is a depiction of the SR-24 Alternative 1 features. Additional details on channel cross sections and alignments are included as **Figures AD 3.1.2** and **AD 3.2.2**, respectively.



SR-24 Zone Alternative 1

All of the SR-24 alternatives include a system of channels and retention/detention basins to deliver runoff to the Ellsworth Zone. Since these alternatives all drain to the Ellsworth Zone, they have an impact on the size of the improvements for the Ellsworth Zone. Also the alternatives for SR-24 Zone depend on one of the three Ellsworth alternatives being in place since the Ellsworth system is the outfall for the SR-24 Zone until SR-24 is constructed. They also include two basins (Pecos/Ellsworth and Williams Field/Ellsworth) within the Ellsworth Zone. Although they are physically located within the Ellsworth Zone, they are part of the SR-24 alternatives because their function is to mitigate peak runoff from the SR-24 Zone watershed. However, since these two basins mitigate the capacity issues in the Ellsworth Channel, they need to be considered when designing improvements for the Ellsworth Zone.

Some facilities are included in more than one alternative and are denoted as such.

3.2.2.1 **Pecos/Ellsworth Interim Basin (Alternatives 1, 2, and 3)**

The Pecos/Ellsworth basin is needed to reduce the 100-year peak flow to the design capacity of the Ellsworth Channel. It is located south of Pecos Road and outside of the airport's Runway Protection Zone (RPZ). The proposed Pecos/Ellsworth Interim Basin would have the following characteristics:

Alternative	Storage Volume (acre-feet)	Depth (feet)	Surface Area (acres)
1	92	7+/-	13+/-
2	170	7+/-	23+/-
3	118	7+/-	17+/-

The basin is an interim facility needed for existing conditions. Once development occurs with onsite retention requirements, and the SR-24 Channel is in place, the basin will no longer be needed. The basin was sized to hold flows in the Ellsworth Channel that originated from the SR-24 Zone (flows crossing the SR-24 alignment and being intercepted by the proposed Pecos Channel). Until SR-24 is constructed there is nothing that prevents local flows to cross its alignment and contribute flow to the Ellsworth system. Also SR-24 Alternatives 1 and 2 discharge into the Ellsworth system, and for SR-24 Alternative 3, all runoff in excess of the 10-year may flow into the Ellsworth system. If included as part of the recommended alternative, additional analysis could be performed to refine the required basin size under differing interim conditions: SR-24 Channel in place without the SR-24 Zone fully developed and SR-24 Channel not in place with the SR-24 Zone fully developed.

3.2.2.2 **Williams Field/Ellsworth Basin (Alternatives 1, 2, and 3)**

The purpose of this basin is to reduce the peak flows generated by the upstream watershed to meet the design capacity of Ellsworth Channel. The basin intercepts flow from the east and meters flows into the Ellsworth Channel via one of the existing culverts under Ellsworth Road. When the area develops in the future, and SR-24 is built most of this runoff will be retained onsite or cut off by the freeway and the need for the basin will be minimized. The proposed Williams Field/Ellsworth basin would have the following characteristics:

Alternative	Storage Volume (acre-feet)	Depth (feet)	Surface Area (acres)
1 and 2	135	5+/-	27+/-
3	216	5+/-	41+/-

3.2.2.3 **SR-24 Meridian Channel (Alternative 1)**

The Meridian Channel would intercept flows generated in Pinal County and alleviate flooding along the developed single residential lots east of the Meridian Road alignment.

The proposed facility is an earthen movable bed channel, designed to reflect the configuration of a natural wash, with a vegetated low-flow path that would carry the most frequent minor storm events. The remaining channel cross-section, designed to carry the 100-year storm event with freeboard, includes gentler 8-to-1 average side slopes. An upstream swale is included as part of the channel

cross-section and is intended to capture nuisance flows that could then be conveyed into the channel at pre-determined locations to minimize side-slope erosion issues. The Meridian Road landscape setback would allow for additional vegetative screening of the channel as part of the future roadway improvements.

The configuration of the channel has a natural look and feel that is conducive to recreational uses including equestrian and other passive recreational uses.

An exception to the typical channel configuration is near Williams Field Road where there is limited space between the future limits of Meridian Road and existing residences. For this reach (approximately 1,500 feet long), it was assumed that the channel would be substituted with a culvert to avoid purchasing residences.

The SR-24 Meridian Channel included in SR-24 Zone Alternative 1 would have the following characteristics:

- Top width: 90 to 150 feet
- Depth: 4 to 6 feet
- Channel type: movable bed
- Landscape setbacks: 10 feet west side, 10-foot landscape swale east side
- Operation and maintenance road: 14 feet wide
- Drop structures: none
- Total right-of-way width: 125 to 185 feet
- Length: 6,820 feet

3.2.2.4 **SR-24 Interim Basin**

This basin is located within the future SR-24 right-of-way west of Meridian Road. This basin is intended to reduce the peak flows collected by the Meridian Channel before discharging into the Pecos Channel. This is an interim basin that would not be needed once the SR-24 Channel is constructed and the Meridian Channel connects to it. Until the SR-24 Channel is built this alternative requires a drainage easement to drain the basin to the Ellsworth System (Pecos Channel)

The SR-24 Interim Basin included in the SR-24 Zone Alternative 1 would have the following characteristics:

- Storage volume: 178 acre-feet
- Depth: 7 feet
- Area: 34.4 acres

The basin was sized to reduce flows crossing the SR-24 alignment at the basin location to prevent the outlet from increasing the runoff that currently flows through this area. Because it is an interim facility that will be removed in the future, no landscaping or aesthetic treatment would be provided. However, hydroseed may be applied to the basin to avoid generation of excessive dust.

3.2.2.5 **SR-24 Interim Basin Outfall**

Until the SR-24 Channel is constructed and the SR-24 Basin is removed, an easement from the SR-24 Basin to the proposed Pecos Channel is needed to provide a means to drain the basin after a storm. The easement would follow the current flow path through the industrial area between the basin and Pecos Channel.

3.2.2.6 **Modifications to Ellsworth Zone Alternatives**

Since the Ellsworth Zone alternatives were developed assuming SR-24 Alternative 2 was in place, impacts of the other SR-24 Zone alternatives on the Ellsworth Zone alternatives were evaluated as part of the SR-24 Alternatives 1 and 3.

The SR-24 Meridian Channel included in SR-24 Zone Alternative 1 does not connect to the Meridian North Channel included in the Ellsworth Zone alternatives. This results in less runoff from the SR-24 Zone reaching the Meridian North and Pecos Road Channels. However, outfall from the SR-24 Interim Basin would reach the Pecos Channel. The resulting differences in required channel specifications are summarized below:

Impacts to Meridian North Channel

The channel would have the following characteristics:

- Top width: 90 feet (reduced from 120 feet)
- Depth: 4 feet (reduced from 4.5 feet)
- Total right-of-way width: 124 feet (reduced from 154 feet)

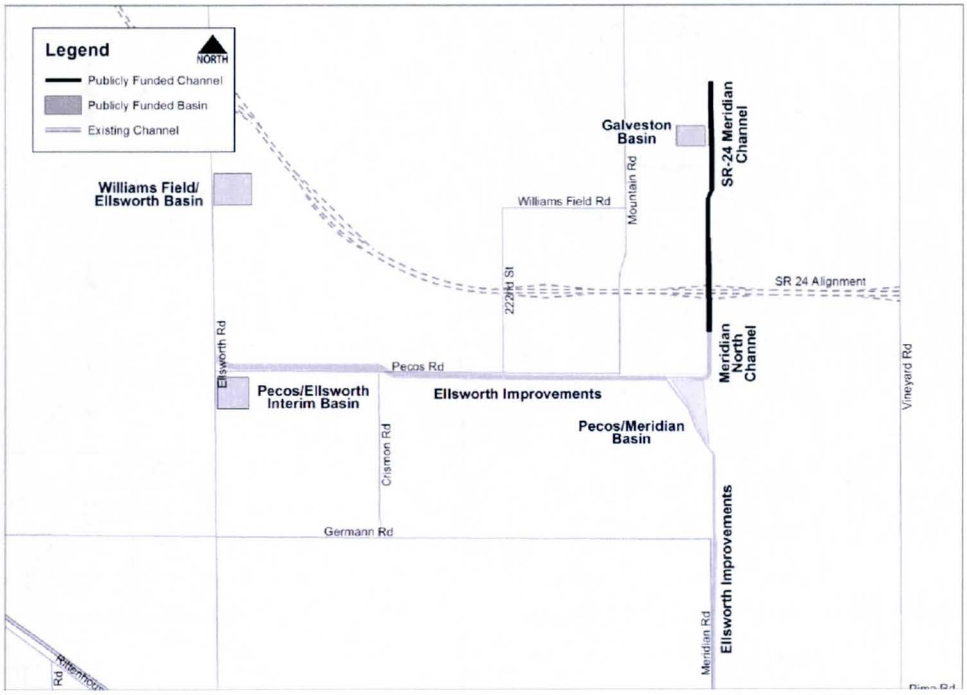
Impacts to Pecos Channel

The proposed channel would have the following characteristics:

- Top width: 80 to 95 feet (reduced from 85 to 140 feet)
- Depth: 7. to 8 feet (no change)
- Drop structures: no change (required from Crimson to Ellsworth Road for other alternatives)
- Total right-of-way width: 154 to 169 feet (reduced from 159 to 214 feet)

3.2.3 **SR-24 Alternative 2**

The following diagram is a depiction of features of the SR-24 Alternative 2. Additional details on channel cross sections and alignments are included as **Figures AD 3.1.2** and **AD 3.2.3**, respectively. Included are the common basins described in **Section 3.2.2**.



SR-24 Zone Alternative 2

3.2.3.1 SR-24 Meridian Channel

The channel would ultimately connect to the future SR-24 Channel. In the interim, the SR-24 Meridian Channel would convey flows to the Meridian North Channel included in the Ellsworth Zone alternatives. A basin at Galveston Street would reduce the peak flows and the size of the channel downstream. Further description of the SR-24 Meridian Channel is included in **Section 3.2.2**

The SR-24 Meridian Channel included in SR-24 Zone Alternative 2 would have the following characteristics:

- Top width: 90 to 125 feet
- Depth: 4 to 6 feet
- Channel type: movable bed
- Landscape setbacks: 10-foot setback west side, 10-foot landscape swale east side
- Operation and maintenance road: 14 feet wide
- Drop structures: none
- Total right-of-way width: 125 to 160 feet
- Length: 7,945 feet

3.2.3.2 **Galveston Basin**

Located on the southwest corner of the intersection of Galveston Street and Meridian Road, the basin would attenuate flows in the proposed SR-24 Meridian Channel. It would have the following characteristics:

- Storage volume: 47 acre-feet
- Depth: 5 feet
- Area: 13.1 acres

The Galveston Basin would be designed to be compatible with the existing rural/suburban character of the neighborhood. This will be accomplished by contouring the basin to reflect natural topographic features and by using native desert landscape materials conducive to passive recreation and wildlife habitat. This landscape material would consist of tall pots and hydroseed. No active multi-use facilities are planned for this basin site.

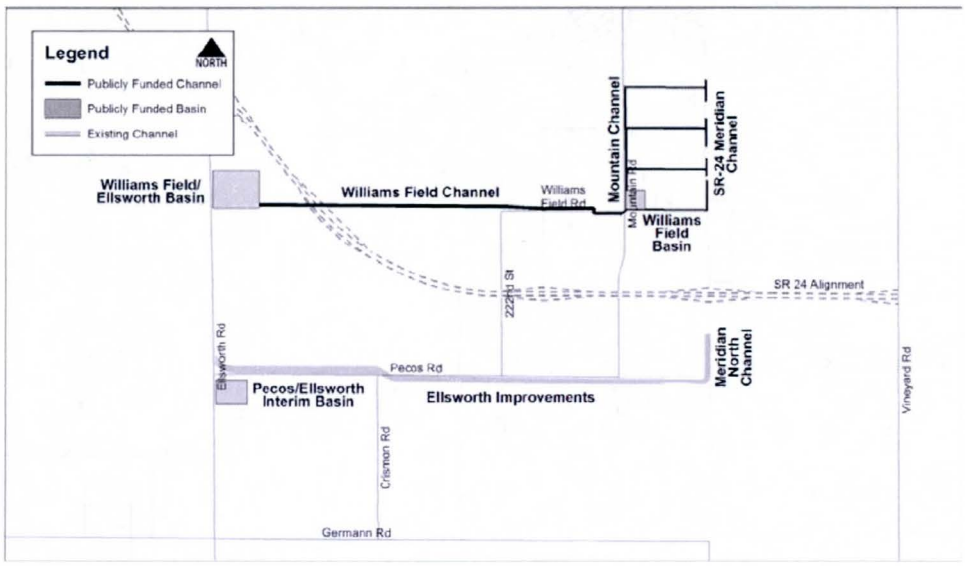
3.2.3.3 **Modifications to Ellsworth Zone Alternatives**

Since the Ellsworth Zone Alternatives were developed assuming SR-24 Alternative 2 was in place, there are no modifications to the Ellsworth Zone Alternatives associated with SR-24 Zone Alternative 2.

3.2.4 **SR-24 Alternative 3**

The following diagram is a depiction of features of the SR-24 Alternative 3. Additional details on channel cross sections and alignments are included as **Figures AD 3.1.2** and **AD 3.2.4**, respectively.

Other than the 100-year common elements described in **Section 3.2.2**, Alternative 3 would provide protection from the 10-year storm. As shown on the following page, elements include a channel along the north side of Williams Field Road from Meridian Road to Ellsworth Road, a channel along the east side of Mountain Road from Galveston Street to Williams field Road, a basin at Williams Field Road and Mountain Road, and interceptor channels along Erie, Galveston, Ivanhoe and Meridian.



SR-24 Zone Alternative 3

Since Alternative 3 is a 10-year system design, it also includes the delineation of the 100-year regulatory floodplain for future development and to identify structures currently at risk. At this stage, the extents of the floodplain have not been determined, but the general area where flooding could occur was roughly identified. If this alternative is selected, detailed floodplain delineation may be performed during the refinement of the preferred alternative.

3.2.4.1 **Williams Field Channel**

The channel would be located generally along the south side of the Williams Field Road alignment between Meridian Road and the proposed Williams Field/Ellsworth Basin. It would be sized for 10-year event flows and would convey runoff from local areas and from the upstream watershed in Pinal County. Ultimately, the Williams Field Channel would discharge into the future SR-24 Channel. In the interim, it would extend to the proposed Williams Field/Ellsworth Basin. When the SR-24 Channel is built, the segment that extends to the Williams Field/Ellsworth Basin could be abandoned. The channel would have the following characteristics:

- Top width: 20 to 35 feet
- Depth: 3 to 4 feet
- Channel type: riprap
- Landscape setbacks: None between Meridian and Mountain Roads; 15-foot buffers both sides from Meridian Road to Williams Field/Ellsworth Basin
- Operation and maintenance road: none between Meridian and Mountain Roads; 14 feet wide from Meridian Road to Williams Field/Ellsworth Basin

- Drop structures: none
- Total right-of-way width: 20 feet (Meridian to Mountain Roads), 75 to 80 feet (Mountain Road to Williams Field/Ellsworth Basin)
- Length: 14,420 feet

Between Meridian and Mountain Road, the channel would not include landscape buffers or maintenance roads due to limited right-of-way. At Mountain Road, the channel would cross to the south side of Williams Field Road and then cross back to the north side approximately 1,000 feet to the west to avoid impacting existing residential structures on the north side of Williams Field Road.

The channel side slopes would be lined with riprap and the bottoms would be earthen with hydroseed. No other vegetation is planned within the channel bottom. However, the 20-foot wide landscape setback on both sides of the channel would be landscaped with hydroseed and tall pot trees. It is noted that riprap is not considered to be visually compatible with the future setting for the Williams Field Channel. Therefore, the planned landscape setbacks will help buffer the riprap channel from future residents in the planned suburban and urban areas west of Mountain Road.

3.2.4.2 **Mountain Channel**

The channel would be located along the east side of Mountain Road between Ivanhoe Street and Williams Field Road. It would be sized to collect 10-year event local runoff and flows from the Ivanhoe, Galveston, and Erie Channels and convey them to the proposed Williams Field Channel. The Williams Field/Mountain Basin would serve as an offline basin to reduce the peak flows that enter the Williams Field Channel. The Mountain Channel would have the following characteristics:

- Top width: 35 to 45 feet
- Depth: 3.5 to 6.5 feet
- Channel type: riprap
- Landscape setbacks: none
- Operation and maintenance road: none
- Drop structures: none
- Total right-of-way width: 35 to 45 feet
- Length: 3,840 feet

The Mountain Channel would include riprap on the side slopes only with hydroseed on the earthen bottom. Due to the small scale of the channel and limited available right-of-way, no landscape setbacks or materials would be included.

3.2.4.3 **Ivanhoe, Galveston, and Erie Laterals and Meridian Interceptor Channels**

The three lateral east-west channels would collect and convey 10-year event flows from proposed north-south interceptor channels along the east side of the Meridian Road alignment to the proposed Mountain Channel. The laterals would be located along the south side of Ivanhoe Street, the north side of Galveston Street, and the north side of Erie Street. The proposed interceptor channels along the Meridian Road alignment would capture upstream runoff generated in Pinal County. The facilities would have the following characteristics:

- Top width: 20 to 40 feet
- Depth: 3 to 6 feet
- Channel type: riprap
- Landscape setbacks: none
- Operation and maintenance road: none
- Drop structures: none
- Total right-of-way width: 20 to 40 feet
- Length: Ivanhoe, Galveston, and Erie Laterals are each 2,540 feet and the Meridian Interceptor Channels range from 660 to 930 feet.

The lateral and interceptor channels would include riprap on the side slopes only with hydroseed on the earthen bottom. Due to the small scale of the channels and limited available right-of-way, no landscape setbacks or materials would be included.

3.2.4.4 **Williams Field/Mountain Basin**

This offline basin would attenuate the peak flow in the Mountain Channel and discharge into the Williams Field Channel. The intent would be to reduce the required size of the Williams Field Channel. The basin would have the following characteristics:

- Storage volume: 29 acre-feet
- Depth: 5 feet
- Area: 7.8 acres

The basin would be conducive to passive open space uses, keeping with the compatibility criteria for a basin in a rural (existing) or suburban (future) setting. This would be achieved through grading design emulating natural topographic features and the use of native landscape materials. No active recreation is planned for this site; future multi-use facilities could be added at the discretion of the City of Mesa. Maintenance roads associated with the basin will be accessible to the public, allowing passive use of the basin for walking and limited wildlife viewing.

3.2.4.5 **Modifications to Ellsworth Zone Alternatives**

Since the Ellsworth Zone alternatives were developed assuming SR-24 Alternative 2 was in place, impacts of the other SR-24 Zone alternatives on the Ellsworth Zone alternatives were evaluated as part of the SR-24 Alternatives 1 and 3.

SR-24 Zone Alternative 3 does not include a channel on Meridian Road that connects to the Meridian North Channel included in the Ellsworth Zone alternatives. This results in less runoff from the SR-24 Zone reaching the Meridian North and Pecos Road Channels. The resulting differences in required channel specifications are summarized below:

Impacts to Meridian North Channel

This proposed channel would have the following characteristics:

- Top width: 90 feet (reduced from 120 feet)
- Depth: 4 feet (reduced from 4 1/2 feet)
- Total right-of-way width: 124 feet (reduced from 154 feet)

Impacts to Pecos Channel

This proposed channel would have the following characteristics:

- Top width: 85 to 100 feet (reduced from 85 to 140 feet)
- Depth: 6 1/2 feet (reduced from 7 1/2 to 8 feet)
- Drop structures: none (required from Crimson to Ellsworth Road for other alternatives)
- Total right-of-way width: 159 to 174 feet (reduced from 159 to 214 feet)

3.2.5 **SR-24 No Further Action Alternative**

This alternative consists of continuing current regulations and maintenance of current facilities but does not include new or modified facilities. The No Further Action Alternative was evaluated on the basis of the potential damages that could occur without the construction of additional drainage infrastructure. A discussion of the analysis is included in **Appendix F** – Cost Estimates.

3.2.6 **Ellsworth Zone**

This zone includes the area contributing to the Ellsworth Channel located along Ellsworth Road. It extends from the future SR-24 alignment on the north to Germann Road on the south, and includes the contributing watershed between the CAP Canal and Ellsworth Road.

Alternatives proposed in this zone are intended to address well-documented flooding issues along Pecos Road and Meridian Road and capacity deficiencies in the Ellsworth Channel. A significant portion of the flow in this area is generated in Pinal County. The alternatives for this zone do not address any potential flooding problems in Pinal County, except for along Meridian Road.

Flooding through this zone occurs frequently and is well-documented, particularly along Pecos Road. The existing drainage infrastructure is incomplete and has inadequate capacity; at some locations, drainage structures are non-engineered.

3.2.6.1 **Existing Facilities**

As shown in **Figure AD 3.2.1** and documented below, there are several existing drainage facilities within the study area:

Ellsworth Channel. The Ellsworth Channel starts a quarter of a mile south of Pecos Road on the east side of Ellsworth Road. Near Pecos Road, it crosses Ellsworth Road and continues north along the east edge of the Phoenix-Mesa Gateway Airport and discharges into the Powerline Floodway approximately one mile west of Ellsworth Road.

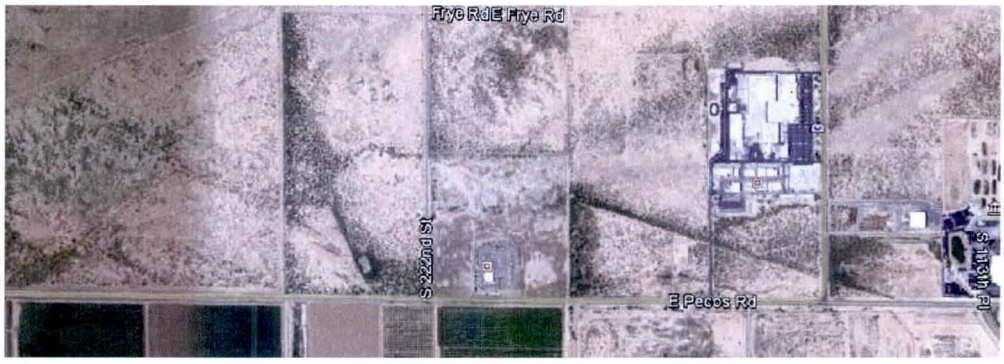
The Ellsworth Channel design was based on the recommendations from the 1998 East Mesa ADMP (**Reference 234**). As stated in the *Hydrology Update* (**Reference 99**), because some of the recommended upstream facilities have not being constructed and because of changes in the watershed and retention regulations, the channel currently has insufficient freeboard for a 100-year flow event and, in some reaches, may be overtopped. Freeboard is a standard design requirement that provides increased channel depth. This freeboard allows for deeper flows than the design calculations would require which provides a necessary safety factor to account for unforeseen circumstances such as obstructions, storm characteristics, maintenance cycles, and other conditions. The lack of adequate freeboard could result in overtopping of the channel if channel, watershed, or storm conditions differ from the assumptions made during the modeling.

Overtopping of the channel could flood the runways at the Phoenix-Mesa Gateway Airport, disrupt flying operations, and potentially damage some of the airport facilities. The future East Terminal also may be affected by overflow from the channel.

Pecos Channel. From Ellsworth Road to Crismon Road, there is an existing channel along the north side of Pecos Road. This channel was owned and maintained by the GM Desert Proving Grounds and is approximately 150 feet wide. The channel is heavily vegetated and lacks the capacity to convey runoff from a significant runoff event.

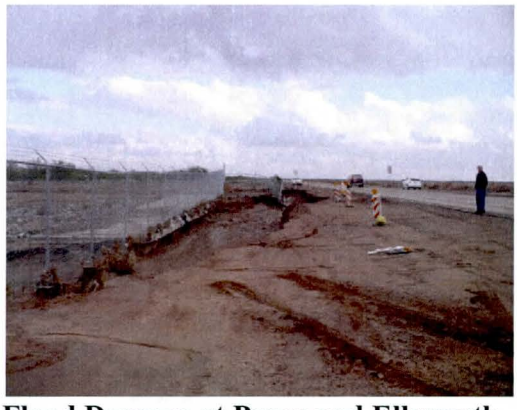
Existing Channel along Pecos Road at GM Proving Grounds

From Crismon Road to 1/4 mile west of Meridian Road, there is a combination of constructed and natural conveyances on the north side of Pecos Road. These include small dikes, dike/channel combinations, culverts, small channel segments, and wide overland flow paths. The facilities do not operate as a system and could exacerbate flooding on Pecos Road and the area north of Pecos.



Existing Drainage Features along Pecos Road

Flooding Along Pecos Road



Flood Damage at Pecos and Ellsworth

An earthen channel crosses portions of the Cactus Waste System property and the CRM of America tire recycling facility. The channel is approximately 60 feet wide and has some bank protection. There are two crossings in this channel:

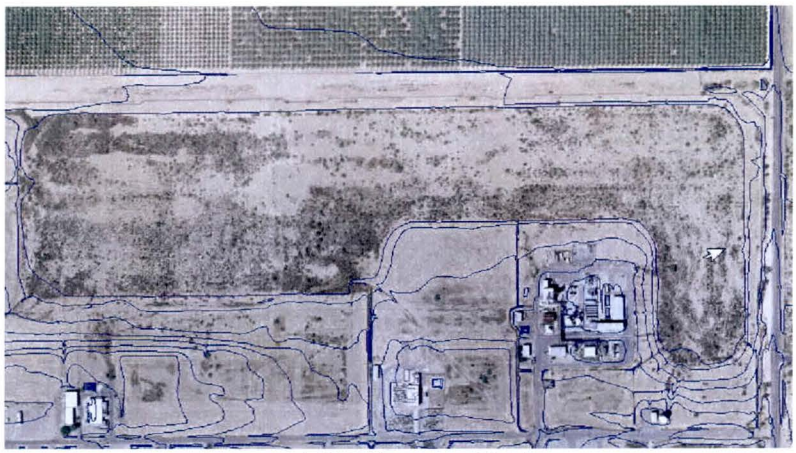
a private bridge on the CRM of America property and a culvert under Pecos Road. The drainage infrastructure along Pecos Road is inadequate and flooding along Pecos occurs frequently.

Meridian Channel. Near the east side of the CMC property at Pecos and Meridian roads, a combination berm/channel routes flows around its facilities. This drainage facility provides local flood protection for the CMC structures, but does not provide conveyance for regional 100-year flows. Large flows would overtop the east side of the channel and flood areas east of the Pecos Road terminus. These crossings, in particular the culvert under Pecos Road, lack capacity to convey even a small runoff event, and Pecos Road is often flooded.

South of the CMC property (Germann Road to south of Queen Creek), there is a combination dike/channel structure along the east side of the Meridian Road alignment. This channel provides some protection, but it is a non-engineered irrigation tail water ditch and its structural integrity is unknown. Portions of the dike had failed at least once in the past. Flooding west of Meridian Road in this area is not well-documented because the area is mostly agricultural and sparsely populated. However, as the area develops, more serious consequences from flooding can be expected.

Meridian Channel South of Pecos Road

TRW Retention Basin. The west side of the TRW property contains a large privately-owned retention area. The basin volume is large enough to accommodate onsite runoff from the TRW and CMC properties that cover almost one square mile.



TRW Storage Basin

Incidental Storage. The CMC property also contains several basins that handle its internal drainage. The undeveloped triangular piece on the southeast corner of the parcel may also provide some incidental storage for offsite flow. However, this may not have been intended for retention and may not provide usable storage.

There is a stock tank north of Pecos Road and west of 222nd Street. This structure is too small to be a jurisdictional dam; however, a breach could cause local damage to the area immediately downstream.

3.2.7 Ellsworth Alternative 1

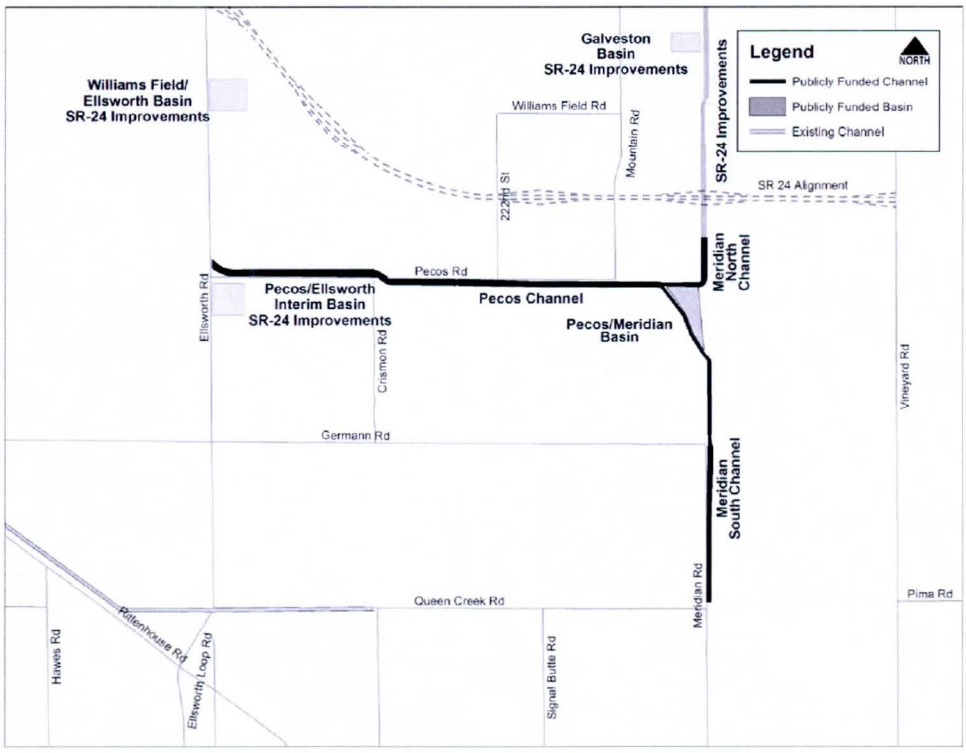
The Ellsworth Zone alternatives each include a system of channels and retention/detention basins to intercept flow from the upstream watershed and convey it to the Ellsworth Channel.

The following diagram is a depiction of features of Ellsworth Alternative 1. Additional details on channel cross sections and alignments are included as **Figures AD 3.1.2** and **AD 3.2.7**, respectively.

The alternatives all include the Meridian Channel and Pecos/Meridian Basin described below. The only difference among the three alternatives is the alignment of the Pecos Channel.

It is noted that several facilities are located near or within the proposed Ellsworth Zone facilities but are not a part of the system. These facilities are included in the SR-24 Zone and are presented in the corresponding sections. This includes the Pecos/Ellsworth Basin and the Williams Field/Ellsworth Basin. The size of these basins is not dependent on which of the three alternatives for Ellsworth is selected

(same size regardless of the Ellsworth alternative selected); however, they are very dependent on which SR-24 alternative is selected. For this reason, it is more appropriate to include these basins with the SR-24 Zone elements. Although these basins are a part of the SR-24 Zone, the basins mitigate the capacity issues in the Ellsworth Channel and need to be considered when designing improvements for the Ellsworth Zone.



Ellsworth Zone Alternative 1

The SR-24 Zone is located upstream of the Ellsworth Zone, and modifications to its drainage affect peak flows in the Ellsworth Zone. Subsequent impacts to Ellsworth Zone components, i.e., the Pecos and Meridian North channels, were included as part of the SR-24 Zone alternatives evaluation. The SR-24 Alternative 2 was used as a baseline to develop all Ellsworth Alternatives. **Therefore, the information presented throughout this section, specifically, the required sizes of the Pecos and Meridian North Channels, assumes the SR-24 Zone Alternative 2 is in place.**

3.2.7.1 Meridian Channel (All Alternatives)

This channel is common to all Ellsworth Zone alternatives and would intercept runoff from Pinal County and convey it to an offline detention basin at Pecos Road and ultimately to the Pecos Road Channel. The north segment of the

channel (Meridian North Channel) extends from SR-24 to the Pecos Basin, and the south segment (Meridian South Channel) extends from approximately Queen Creek Road to the Pecos Basin. Both segments of the channel are envisioned to be compatible with their surroundings, including residential, industrial, and potentially commercial development at arterial intersections. In order to accomplish this goal, the Meridian Channel is proposed as an earthen channel with a movable bed intended to replicate the visual and biological character typical of a natural wash. It should be noted that the Ellsworth alternatives were evaluated independently from the Rittenhouse alternatives. All of the Ellsworth alternatives assume that the Meridian Channel extends to just north of Queen Creek Road; however, the Rittenhouse alternatives include channels along Meridian Road that are different than those used for the evaluation of the Ellsworth Zone. It will be important to verify that the selected alternative for the Rittenhouse Zone is compatible with the selected alternative for the Ellsworth Zone.

Meridian North Channel would have the following characteristics (Assuming SR-24 Zone Alternative 2 is in place):

- Top width: 120 feet
- Depth: 4.4 feet
- Channel type: movable bed
- Landscape setbacks: 10 feet on west side, 10-foot swale on east side
- Operation and maintenance road: 14 feet wide
- Drop structures: none
- Total right-of-way width: 150 feet
- Length: 2,780 feet

Meridian South Channel (Queen Creek Road to Germann Road) would have the following characteristics:

- Top width: 80 to 110 feet
- Depth4.5 to 6.3 feet
- Channel type: movable bed
- Landscape setbacks: 10 feet on west side, 10-foot swale on east side
- Operation and maintenance road: 14 feet wide
- Drop structures: none
- Total right-of-way Width: 115 to 145 feet
- Length: 4,950 feet

Meridian South Channel (Germann Road to Pecos Road) would have the following characteristics:

- Top width: 50 to 70 feet
- Depth: 7 to 8 feet
- Channel type: riprap

- Landscape setbacks: 20 feet both sides
- Operation and maintenance road: 14 feet
- Drop structures: none
- Total right-of-way width: 105 to 120 feet
- Length: 5,600 feet

The movable bed channel was developed to reflect a natural wash with a vegetated low-flow channel bottom that would carry the more frequent minor storm events. The remaining channel cross-section, designed to carry the 100-year storm event with freeboard, includes gentler 8-to-1 average side slopes. A swale adjacent to the channel is intended to capture nuisance flows that could then be conveyed into the channel at pre-determined locations to minimize side-slope erosion issues. The Meridian Road landscape setback would allow for additional vegetative screening of the channel as part of any future roadway improvements. The more natural configuration of the channel is conducive to recreational uses, including equestrian and other passive recreational activity.

Between Germann and Pecos Roads, the channel narrows and is lined with riprap to more easily fit between the 69kV overhead electric power lines and existing developed parcels. The riprap channel segment has a 2-to-1 side slope to make the channel as narrow as possible. A 20-foot wide landscaped setback is used on both sides of the channel for screening from future development.

3.2.7.2 **Pecos/Meridian Basin (All Alternatives)**

This basin is common to all Ellsworth Zone alternatives and would detain runoff from Pinal County to reduce the peak flows reaching downstream facilities such as the Pecos Channel, Ellsworth Channel, Powerline Floodway, and East Maricopa Floodway. The basin would have the following characteristics:

- Storage volume: 150 acre-feet
- Depth: 10 feet
- Area: 24 acres

This offline basin would be located at the intersection of Pecos and Meridian Roads and could be a potential equestrian trailhead. Some of the existing mature vegetation on the basin site would be preserved with potential for passive recreation and to provide wildlife habitat. The basin configuration also includes some water harvesting features to provide moisture and maximize natural vegetation sustainability as well as reduce maintenance.

3.2.7.3 **Pecos Channel Alignment (Alternative 1)**

The Ellsworth Alternatives include different alignments of the Pecos Channel, which would convey the flows collected by the Meridian Road Channels to the Ellsworth Road Channel. It also serves as the outlet for the Pecos/Meridian

Basin and to collect local flows. This channel was configured with a stable earthen bottom and riprap banks and water harvesting features in the overbank. The size varies along the channel reaches and for each alternative.

The Pecos Channel sides would be riprapped to provide protection from high velocities and erodible native soils. The setting for this channel is planned as industrial, where hardened channels would be compatible. However, future development in the adjacent former GM Proving Grounds site could include sensitive viewers attracted to the potentially urban commercial core planned for this area. In order to mitigate potential visual impacts while taking advantage of sustainable low-water use design techniques, the proposed channel configuration, shown in **Figure 3.1.2**, will include water-harvesting, low-flow conveyance on the overbanks of the channels. These low-flows conveyances would reduce maintenance of the rip-rapped channel by collecting sediment and reducing bank erosion through controlling off-site flows, and would create a screen that allows the channel to transition visually into a wide range of adjacent landscape treatments.

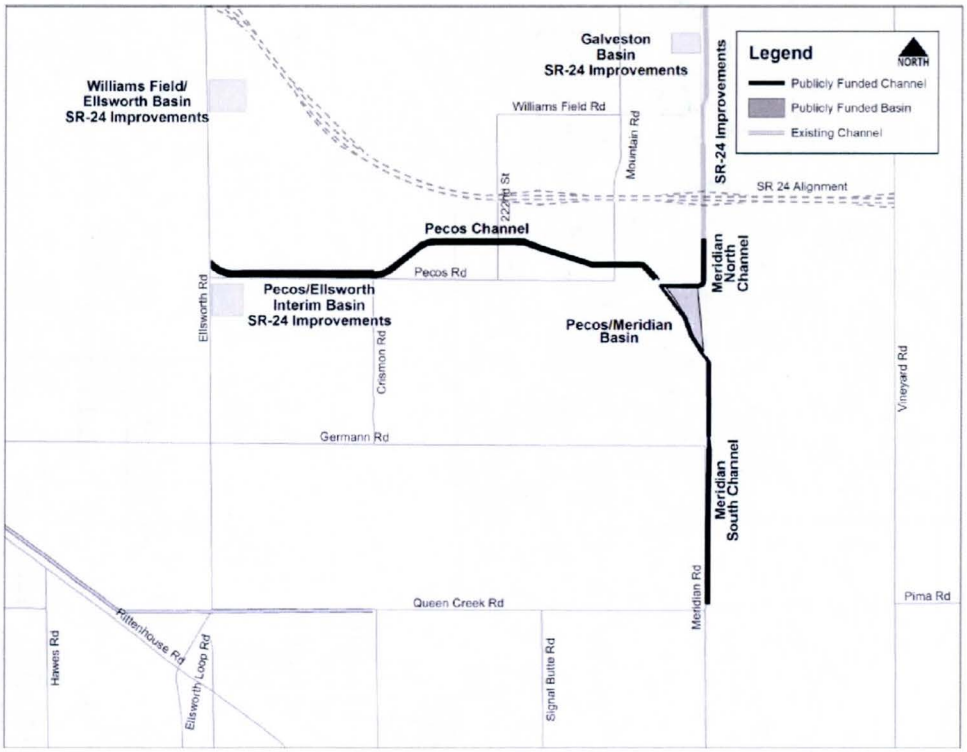
The channel requires an O&M road that could serve a dual-use as a multi-use trail, if access by the public were allowed.

As shown in **Figure AD 3.2.7**, the channel would be located along the south side of Pecos Road from the Pecos/Meridian Basin to the Crismon Road alignment, where it would cross under Pecos Road to take advantage of the existing channel right-of-way adjacent to the former GM Desert Proving Grounds. The proposed channel would have the following characteristics (assuming SR-24 Zone Alternative 2 is in place):

- Top width: 85 to 105 feet (Meridian to Crimson); 110 (Crimson to Ellsworth)
- Depth: 7 to 7.5 feet
- Channel type: riprap
- Landscape setbacks: 30-foot low flow channels, both sides
- Operation and maintenance road: 14 feet
- Drop structures: none
- Total right-of-way width: 160 to 185 feet
- Length: 14,480 feet

3.2.8 **Ellsworth Alternative 2**

As noted previously, all elements in Alternatives 1 and 3 are included in Alternative 2. As shown in the diagram below, only the alignment of the Pecos Channel is different:



Ellsworth Zone Alternative 2

3.2.8.1 **Pecos Channel (Alternative 2)**

As shown in **Figure AD 3.2.8**, the Alternative 2 alignment roughly follows the historical flow paths along private land north of Pecos Road. **Figure AD 3.1.2** includes the configuration of this channel. The channel begins north of Pecos Road at the proposed outlet to the Pecos/Meridian Basin, located about ¼ mile east of Mountain Road, and passes under Pecos Road. The Pecos Channel continues following the natural flow path to the Crismon Road Alignment, where it follows the existing channel along the south edge of the former GM Desert Proving Grounds and continues to the Ellsworth Channel through the existing culvert under Ellsworth Road.

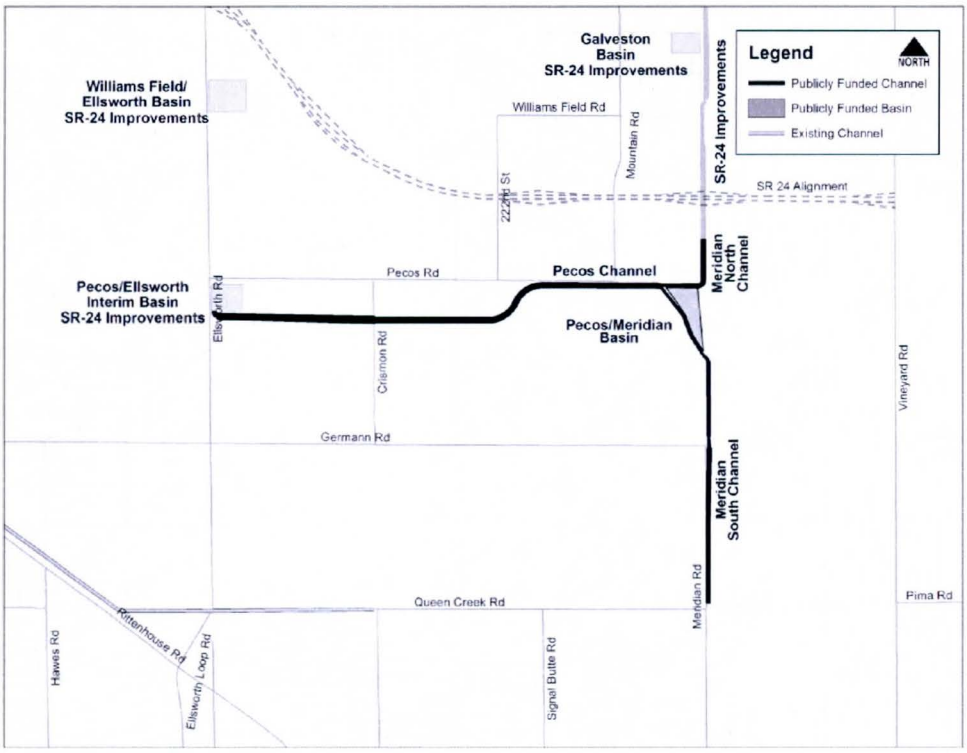
The proposed channel would have the following characteristics (assuming SR-24 Zone Alternative 2 is in place):

- Top width: 90 to 105 feet (Meridian to Crimson); 110 feet (Crimson to Ellsworth)
- Depth: 7 to 7.5 feet
- Channel type: riprap
- Landscape setbacks: 30-foot low flow channels, both sides
- Operation and maintenance road: 14 feet
- Drop structures: none

- Total right-of-way width: 160 to 185 feet
- Length: 14,770 feet

3.2.9 **Ellsworth Alternative 3**

As noted previously, all elements in Alternative 3 are included in Alternatives 1 and 2. As shown in the diagram below, only the alignment of the Pecos Channel is different:



Ellsworth Zone Alternative 3

3.2.9.1 **Pecos Channel (Alternative 3)**

As shown in **Figure AD 3.2.9**, this channel extends from the Pecos/Meridian Basin to the Signal Butte Road alignment along the south side of Pecos Road, approximately one mile. At this point, the alignment turns south for ¼ mile and continues west to Ellsworth Road. Improvements may be required at the south end of the existing Ellsworth Channel and the culvert under Pecos Road to accommodate the additional flows in this reach. **Figure AD 3.1.2** includes the configuration of this channel,

The proposed Pecos Road channel for Alternative 3 would have the following characteristics (assuming SR-24 Zone Alternative 2 is in place):

- Top width: 85 to 110 feet (Meridian to Crimson); 110 feet (Crimson to Ellsworth)
- Depth: 7 to 7.5 feet
- Channel type: riprap
- Landscape setbacks: 30-feet low flow channels, both sides
- Operation and maintenance road: 14 feet
- Drop structures: none
- Total right-of-way width: 160 to 185 feet
- Length: 14,770 feet

3.2.10 **Ellsworth No Further Action Alternative**

This alternative consists of continuing current regulations and maintenance of current facilities but does not include new or modified facilities. Evaluating this alternative requires consideration of drainage issues associated with existing facilities, or lack thereof, that would remain if this alternative were selected.

3.2.11 **Rittenhouse Zone**

The proposed alternatives address known flooding issues along the Queen Creek and Germann Roads, as well as capacity deficiencies in the Rittenhouse Channel.

3.2.11.1 **Existing Facilities**

As shown in **Figure AD 3.2.1** and documented below, there are several existing drainage facilities within the study area:

Rittenhouse Channel. The channel is located on the north side of Rittenhouse Road and the railroad tracks between Queen Creek Road and its outfall into the East Maricopa Floodway west of Power Road. Its design was based on higher retention requirements for future development than what is currently required. Because of this and some changes to the watershed, the channel lacks sufficient freeboard to handle the flow generated by the 100-year storm and, in some reaches, overtopping is likely (**Reference 99**). A lack of freeboard may be an acceptable risk for a short period of time, but over the life of the channel, the lack of freeboard could effectively reduce its level of flood protection.

Rittenhouse Channel Extension. At Queen Creek Road, the original Rittenhouse Channel was extended east to Crismon Road. The extension is an open channel except for a buried segment under Queen Creek High School. The channel does not have sufficient freeboard under 100-year flow conditions, and there are at least two locations where it does not have capacity to convey 100-year flow. Overtopping of the channel could flood adjacent development and affect traffic on arterial roads in the area.

Roadside Ditches and Agricultural Tailwater Ditches. Numerous roadside agricultural tailwater ditches along the roadway system serve as the main conveyance corridor for storm runoff. However, most of these facilities can only

carry a fraction of the runoff generated by the 100-year storm. Also, most are privately owned; maintenance conditions vary widely and there are significant deficiencies in the system connectivity to downstream facilities.

Meridian Road Channel and Berm. There is an agricultural tailwater channel on the alignment of Meridian Road. On the downstream (west) side of the channel, an earthen berm prevents flows from spilling out to the west. This is a non engineered berm, and it was breached during a storm in the early 1990s. The following are photos from the breach obtained from the *Hydrology Update*

Meridian Road south of Germann

Rittenhouse Basin. The basin is located at the downstream end of the watershed and attenuates flows in the East Maricopa Floodway; it does not control runoff within the Rittenhouse Zone.

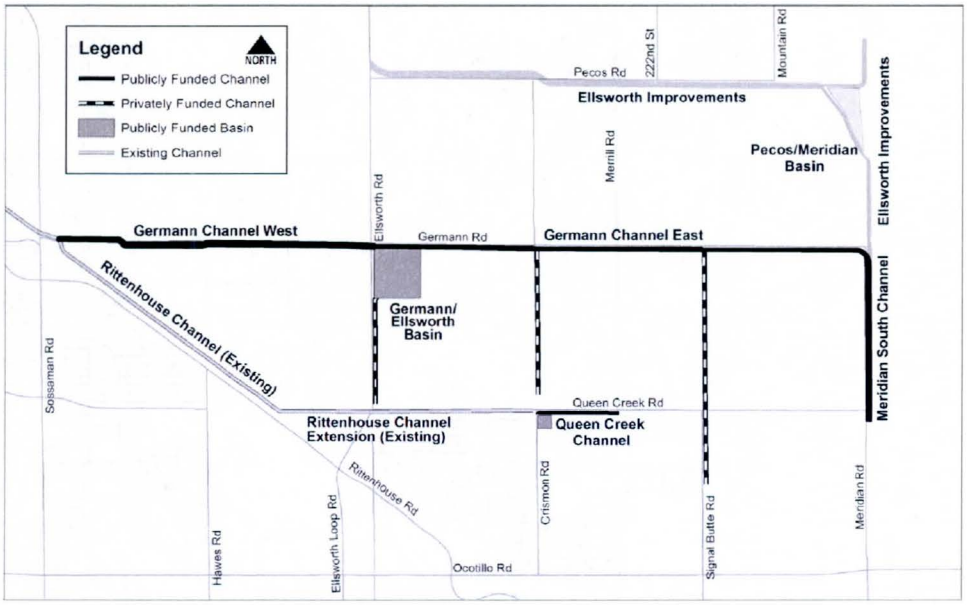
Development Retention. There are several master planned communities in this zone, and they all have centralized detention facilities to control onsite runoff

3.2.12 **Rittenhouse Alternative 1**

The following diagram is a depiction of the Rittenhouse Alternative 1 features. Additional details on channel cross sections and alignments are included as **Figures AD 3.1.2** and **AD 3.2.12**, respectively.

This alternative includes a main east-west channel along Germann Road to carry runoff from the diversion structure at Meridian Road to a new detention basin at Ellsworth Road. The channel would then transport the reduced peak runoff to a new outfall into the Rittenhouse Channel.

Interceptor channels along Ellsworth, Crismon, and Signal Butte Roads would collect and convey runoff to the channel. The alternative also includes extending the existing Rittenhouse Channel Extension along Queen Creek Road to approximately Merrill Road. This channel is referred to as the Queen Creek Channel.



Rittenhouse Zone Alternative 1

3.2.12.1 Modifications to the Ellsworth Zone Meridian South Channel

The Meridian South Channel, which is part of the Ellsworth Zone alternatives, would be upsized and extended to convey flows from the Rittenhouse Zone north to Germann Road. For this alternative, the channel would be extended further south to just south of Queen Creek Road to intercept Pinal County flows that concentrate just south of Queen Creek road. In order to deliver the same amount of flow to the Ellsworth Zone, a diversion structure is required to divert the additional flow that was intercepted by extending the channel south, and diverting it into the Germann Channel. This channel is larger and longer since it picks up all of the three flows crossing Meridian Road within the Rittenhouse Zone. The channel would have the following characteristics:

- Top width: 130-155 feet
- Depth: 6.5 feet
- Channel type: movable bed
- Landscape setbacks: 10 feet west side, 10-foot swale east side
- Operation and maintenance road: 14 feet
- Drop structures: none
- Total right-of-way width: 160-190 feet
- Length: 5,770 feet

The configuration would include landscape materials to replicate a natural wash, with the potential for equestrian use of the channel bottom and/or O&M road.

3.2.12.2 **Germann Channel East**

This channel would be located on the south side of Germann Road from the Meridian Road alignment to the proposed Germann/Ellsworth Basin. The channel would carry flows from the Meridian South Channel diversion structure, the Signal Butte and Crismon Road laterals, and local runoff. The channel would have the following characteristics:

- Top width: 75 feet
- Depth: 11.5 feet
- Channel type: riprap
- Landscape setbacks: 20 feet, both sides
- Operation and maintenance road: 14 feet
- Drop structures: yes
- Total right-of-way width: 130 feet
- Length: 15,350 feet

3.2.12.3 **Germann Channel West**

This segment would extend from the proposed Germann/Ellsworth Basin west approximately two miles to the Rittenhouse Channel. It would convey flows from the Germann/Ellsworth Basin and local areas such as the Ellsworth Mini-Farms. The channel would have the following characteristics:

- Top width: 50 feet
- Depth: 11 feet
- Channel type: riprap
- Landscape setbacks: none
- Operation and maintenance road: none
- Drop structures: yes
- Total right-of-way width: 50 feet
- Length: 10,115 feet

Maintenance roads and landscape setbacks have been excluded from this segment due to limited available right-of-way.

3.2.12.4 **Queen Creek Channel**

This channel would be located on the south side of Queen Creek Road at Merrill Road and extend to the existing Rittenhouse Channel Extension at Crismon Road to convey local runoff to the Rittenhouse Channel. The proposed channel would have the following characteristics:

- Top width: 40 feet
- Depth: 6.5 feet
- Channel type: riprap
- Landscape setbacks: 15 feet, both sides

- Operation and maintenance road: 14 feet
- Drop structures: none
- Total right-of-way width: 84 feet
- Length: 2,660 feet

3.2.12.5 **Interceptor Channels**

Several north-south laterals would intercept and convey flows to the Germann Channel or to the Ellsworth/Germann basin. The exact locations of these channels are not critical and can vary to accommodate developer needs. It is expected that all of these channels will be built by the developers as part of their internal drainage system.

3.2.12.6 **Queen Creek/Crismon Basin**

This basin would be located on the southeast corner of Queen Creek and Crismon Roads to attenuate flows from the Ryan Channel and mitigate capacity issues in the Rittenhouse Channel Extension. The basin would have the following characteristics:

- Storage volume: 11 acre-feet
- Depth: 4 feet
- Area: 4.5 acres

The Queen Creek/Crismon Basin is planned as a passive, open space conservation area and will be landscaped using native plant materials. Grading design is intended to emulate natural topographic forms and allow for passive recreation uses and wildlife habitat. No active recreation is planned for this basin site as the site is relatively small and the Town of Queen Creek has a large community park planned just north and east of this location near the Barney Farms Sports Complex on Queen Creek Road and 220th Street

3.2.12.7 **Germann/Ellsworth Basin**

The Germann/Ellsworth Basin would be located on the southwest corner of the Germann and Ellsworth Roads. The basin would attenuate flows from the Germann Channel and outflow to the Rittenhouse Channel. The basin would have the following characteristics:

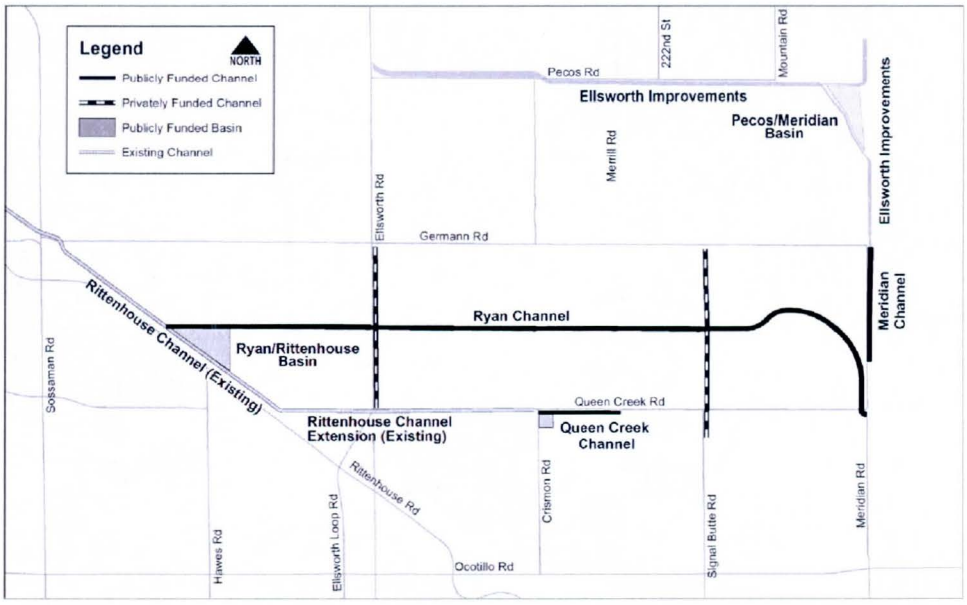
- Storage volume: 135 acre-feet
- Depth: 4.5 feet
- Area: 40 acres

The basin would serve as a gateway into Queen Creek from the north. With this in mind, the basin design is intended to include large buffer areas along the Ellsworth street frontage and include aesthetic landscape design features. Landscape and drainage elements for this basin should reflect the historic equestrian character of Queen Creek with space for an entrance feature on the

northwest corner of the basin site. Grading design for the basin is intended to create terraced "rooms" that will serve multiple multi-use functions for the Town at its discretion, provided the uses do not impede the flood protection function of the basin and the associated conveyance facilities.

3.2.13 **Rittenhouse Alternative 2**

The following diagram is a depiction of the Rittenhouse Alternative 2 features. Additional details on channel cross sections and alignments are included as **Figures AD 3.1.2** and **AD 3.2.13**, respectively.



Rittenhouse Zone Alternative 2

Alternative 2 consists of a channel that starts at the Queen Creek and Meridian intersection to pick up the flow from Pinal County. It runs northwest along the Signal Butte Road realignment to the Ryan Road alignment where it continues west and is co-located with a proposed SRP power line corridor. Similar to Alternative 1, the Rittenhouse Channel Extension is extended to approximately Merrill Road. Several laterals are included to capture and convey runoff to the Ryan Channel. Two detention basins would mitigate capacity issues in the Rittenhouse Channel Extension and Rittenhouse Channel.

3.2.13.1 **Ryan Channel**

The Ryan Channel intercepts runoff from Pinal County and conveys it west. The channel follows the future Signal Butte realignment from Meridian Road and then continues along the Ryan Road alignment to its outfall at the Rittenhouse Channel.

From the Signal Butte alignment west, the channel will share the corridor with an SRP power easement. The channel was configured to minimize conflicts with the power line. The channel from Queen Creek Road to the SRP easement would have the following characteristics:

Parameter	Meridian to SRP Easement	SRP Easement to Rittenhouse Channel
Top Width, ft	85	120
Depth, ft	11	11
Channel Type	Riprap	Riprap
Landscape Setbacks	20	None
O&M Road, ft	14	30 (both sides)
Drop Structures	No	No
Right-of-Way Width, ft	140	180
Length, ft	7,700	17,000

SRP normally requires a 50-foot flat, dry radius around each pole to allow access for maintenance. However, SRP may relax this requirement if a 30-feet maintenance road is placed on each side of the channel for access the poles from the road. Landscape materials planned within the SRP easement would be required to meet SRP's *Selection Criteria for Trees* and *Selection Criteria for Groundcovers*.

3.2.13.2 **Queen Creek Channel**

This channel would be located on the south side of Queen Creek Road starting at the intersection of Merrill and Queen Creek Roads and connecting to the existing Rittenhouse Channel Extension at Crismon Road. The channel would convey local runoff to the Rittenhouse Channel. The proposed channel would have the following characteristics:

- Top width: 40 feet
- Depth: 6.5 feet
- Channel type: riprap
- Landscape setbacks: 15 feet, both sides
- Operations and maintenance road: 14 feet wide
- Drop structures: none
- Total right-of-way width: 84 feet
- Length: 2,660 feet

3.2.13.3 **Meridian Channel**

This channel is a part of the Ellsworth system, but since the portion south of Pecos Road has a significant effect on the drainage of the Rittenhouse Zone, the portion south of Germann Road was included in this zone. The Meridian

Channel would begin north of Queen Creek Road and flow north to Pecos Road where it continues into the Ellsworth system. The Meridian Channel to Germann Road would have the following characteristics:

- Top width: 80 to 110 feet
- Depth: 4.5 to 6.5 feet
- Channel type: movable bed
- Landscape setbacks: 10 feet, both sides
- Operations and maintenance road: 14 feet wide
- Drop structures: none
- Total right-of-way width: 115 to 145 feet
- Length: 3,650 feet

3.2.13.4 **Interceptor Channels**

Several north-south, laterals would intercept flows and convey them to the Ryan Channel. The exact locations of these channels are not critical and can vary to accommodate developer needs. It is expected that all of these channels will be built by the developers as part of their internal drainage system.

3.2.13.5 **Ryan/Rittenhouse Basin**

The Ryan/Rittenhouse Basin would be located on the southeast corner of the Ryan and Rittenhouse Roads intersection. The basin would attenuate flows from the Ryan Channel and outflow into the Rittenhouse Channel. The basin would have the following characteristics:

- Storage volume: 137 acre-feet
- Depth: 6 feet
- Area: 30 acres

The Ryan/Rittenhouse Basin would be situated between multiple planned subdivisions, creating the opportunity to develop the basin as a turfed active recreation area. This open space could then serve as a buffer between the new development, the Rittenhouse channel, and the railroad and connect with the developer's open space areas.

3.2.13.6 **Queen Creek/Crismon Basin**

The Queen Creek/Crismon Basin would be located on the southeast corner of the Queen Creek and Crismon Roads intersection to attenuate flows from the Ryan Channel and mitigate capacity issues in the Rittenhouse Channel Extension. The basin would have the following characteristics:

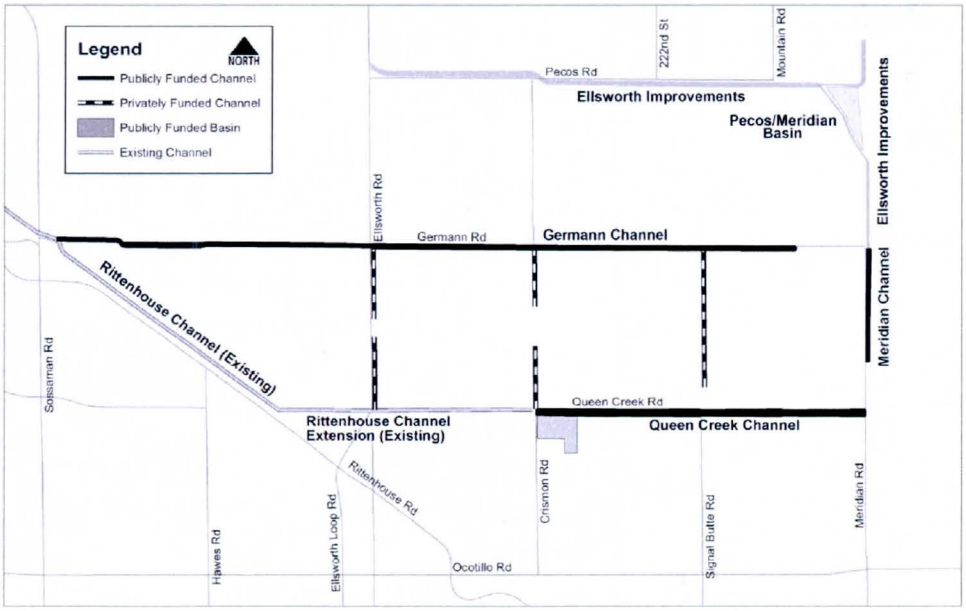
- Storage volume: 11 acre-feet
- Depth: 4 feet
- Area: 4.5 acres

The basin would be a passive, open space conservation area, landscaped using native plant materials. Grading design would emulate natural topographic forms and allow for passive recreation uses and wildlife habitat. No active recreation is planned as the Town of Queen Creek has plans for a large community park nearby

3.2.14 **Rittenhouse Alternative 3**

The following diagram is a depiction of the Rittenhouse Alternative 3 features. Additional details on channel cross sections and alignments are included as **Figures AD 3.1.2** and **AD 3.2.14**, respectively.

Alternative 3 includes an increased retention requirement for undeveloped areas and a dual channel system to convey runoff to the Rittenhouse Channel.



Rittenhouse Zone Alternative 3

3.2.14.1 **Increased Retention**

Alternative 3 includes an overlay of increased retention requirements for all undeveloped areas. It requires new development to fully retain a precipitation depth of 2.7 inches. Current regulations require retention of 2.19 inches.

At the time of this study, Queen Creek Station and La Jara Farms were in the planning stages, and for this alternative it was assumed that they would be required to provide additional retention.

3.2.14.2 **Queen Creek Channel**

This channel along the south side of Queen Creek Road starts at the Meridian Road alignment where it picks up flows generated in Pinal County. It extends to

Crimson Road where it would outfall into the proposed Crimson/Queen Creek Basin. The channel would also intercept and convey flows from the Rittenhouse Zone area south of Queen Creek Road. The proposed channel would have the following characteristics:

- Top width: 80 feet
- Depth: 11.5 feet
- Channel type: riprap
- Landscape setbacks: 23 feet, both sides
- Operation and maintenance road: 14 feet wide, south side
- Drop structures: yes
- Total right-of-way width: 140 feet
- Length: 10,500 feet

Between Merrill Road and Crismon Road, the channel may be shifted to the north side of the roadway in accordance with existing developer agreements with the Town of Queen Creek.

3.2.14.3 **Germann Channel**

This channel along the south side of Germann Road would start approximately ½ mile west of the Meridian Road alignment and extend west to the existing Rittenhouse Channel at Sossaman Road. It would have the following characteristics:

- Top width: 35 to 45 feet
- Depth: 6.5 to 7 feet
- Channel type: riprap
- Landscape setbacks: 15 feet both sides from Meridian to Ellsworth Rd; none west of Ellsworth
- Operation and maintenance road: 14 feet wide from Meridian to Ellsworth Rd; none west of Ellsworth
- Drop structures: none
- Total right-of-way width: 45 to 80 feet
- Length: 23,600 feet

West of Ellsworth Road, maintenance roads and landscape buffers have been excluded due to limited right-of-way availability.

3.2.14.4 **Meridian Channel**

This channel is a continuation of the Meridian South Channel in the Ellsworth Zone; since the portion south of Pecos Road has a significant effect on the drainage of the Rittenhouse Zone, it was included in this description. The Meridian Channel would begin north of Queen Creek Road and flow north to Pecos Road and continue into the Ellsworth Zone.

The Meridian Channel to Germann Road would have the following characteristics:

- Top width: 80 to 110 feet
- Depth: 4.5 to 6.5 feet
- Channel type: movable bed
- Landscape setbacks: 10 feet, both sides
- Operations and maintenance road: 14 feet
- Drop structures: none
- Total right-of-way width: 115 to 145 feet
- Length: 3,650 feet

3.2.14.5 **Interceptor Channels**

Several north-south laterals would intercept runoff and convey it to the Germann Channel. The exact locations are not critical and can vary to accommodate developer needs. It is expected that all of these channels will be built by the developers as part of their internal drainage system.

3.2.14.6 **Queen Creek/Crismon Basin**

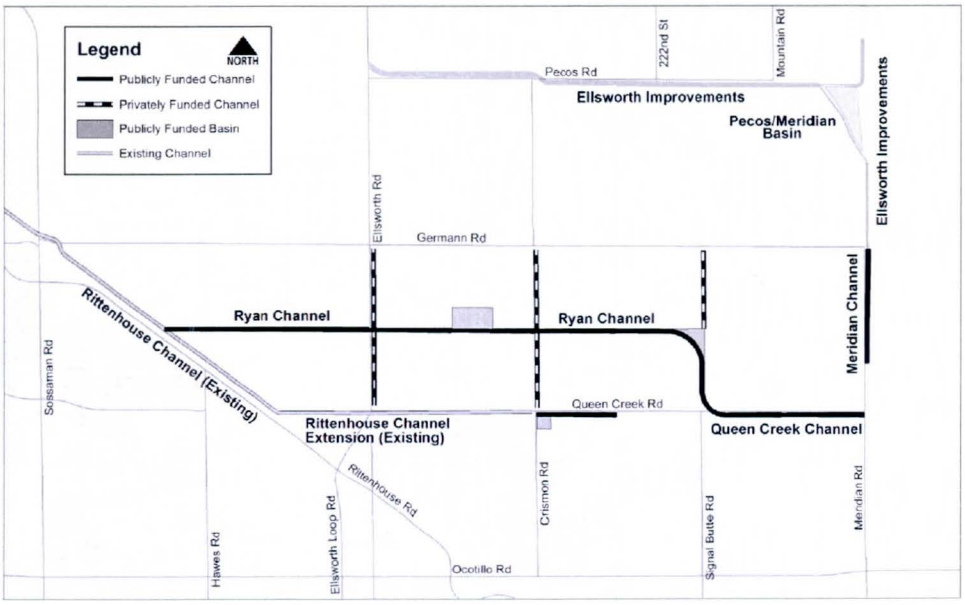
This offline basin would attenuate flow from the Queen Creek Channel to address capacity issues of the Rittenhouse Channel Extension. It would have the following characteristics:

- Storage volume: 105 acre-feet
- Depth: 6 feet
- Area: 26 acres

The basin would be a passive, open space conservation area, landscaped using native plant materials. Grading design would emulate natural topographic forms and allow for passive recreation uses and wildlife habitat. No active recreation is planned as the Town of Queen Creek has plans for a large community park nearby.

3.2.15 **Rittenhouse Alternative 4**

The following diagram is a depiction of the Rittenhouse Alternative 4 features. Additional details on channel cross sections and alignments are included as **Figures AD 3.1.2** and **AD 3.2.15**, respectively.



Rittenhouse Zone Alternative 4

A dual channel system is planned to convey runoff to the Rittenhouse Channel. The first channel is located along Queen Creek and ties into the existing Rittenhouse Channel Extension at Crismon Road. The second channel is located along the Ryan Road alignment. A basin on the Queen Creek Channel would reduce peak discharges into the existing Rittenhouse Channel Extension. Two basins along the Ryan Road Channel would reduce flows to the Rittenhouse Channel.

Several north-south laterals would intercept flows and convey them to the Ryan Channel. The exact locations of these channels are not critical and can vary to accommodate developer needs. It is expected that most, if not all of these channels will be built by the developers as part of their internal drainage system.

3.2.15.1 Queen Creek Channel

This channel would be located on the south side of Queen Creek Road starting from Merrill Road to the existing Rittenhouse Channel Extension at Crismon Road. It would have the following characteristics:

- Top width: 40 feet
- Depth: 6.5 feet
- Channel type: riprap
- Landscape setbacks: 15 feet, both sides
- Operation and maintenance road: 14 feet
- Drop structures: none
- Total right-of-way width: 84 feet
- Length: 2,660 feet

3.2.15.2 **Ryan Channel**

The Ryan Channel has three segments. The most upstream segment is along Queen Creek Road between Meridian and Signal Butte roads. The middle portion, co-located with the 100-foot SRP power line easement, turns north to the Ryan Road alignment and continues west to Ellsworth Road. The final segment (co-located with the SRP easement) is between Ellsworth Road and the Rittenhouse Channel. Characteristics are as follows:

Parameter	Queen Creek (Meridian to Signal Butte)	Ryan (Queen Creek to Ellsworth)	Ryan (Ellsworth to Rittenhouse)
Top Width, ft	190	120 - 225	140
Depth, ft	11	4.5 - 5	8.4
SRP Easement, ft	None	100	100
Channel Type	Movable Bed	Turf-Lined	Gravel Mulch
Landscape Setbacks	10 (both sides)	28 (one side)	None
O&M Road, ft	14	14	None
Drop Structures	Yes	No	No
Right-of-Way Width, ft	225	160 - 265	140
Length, ft	4,410	13,250	6,520

Between Ellsworth Road and the Rittenhouse Channel, maintenance roads and landscape buffers have been excluded due to limited right-of-way availability. An exception is the channel segment between Hawes Road and 196th Street that is adjacent to a residential development and would include landscape buffers on both sides of the channel.

3.2.15.3 **Meridian Channel**

This channel is a part of the Ellsworth system, but since the portion south of Pecos Road has a significant effect on the drainage of the Rittenhouse Zone it was included in this zone. The Meridian Channel would begin north of Queen Creek Road and flow north to Pecos Road where it continues to the proposed Ellsworth Zone channel.

The Meridian Channel to Germann Road would have the following characteristics:

- Top width: 80 to 110 feet
- Depth: 4.5 to 6.5 feet
- Channel type: movable bed
- Landscape setbacks: 10 feet, both sides
- Operations and maintenance road: 14 feet
- Drop structures: none

- Total right-of-way width: 115 to 145 feet
- Length: 3,650 feet

3.2.15.4 **Queen Creek/Crismon Basin**

This offline basin would attenuate flow from the Queen Creek Channel to meet capacity constraints of the existing Rittenhouse Channel Extension. The basin would have the following characteristics:

- Storage volume: 11 acre-feet
- Depth: 4 feet
- Area: 4.5 acres

The basin would be a passive, open space conservation area, landscaped using native plant materials. Grading design would emulate natural topographic forms and allow for passive recreation uses and wildlife habitat. No active recreation is planned as the Town of Queen Creek has plans for a large community park nearby.

3.2.15.5 **Ryan/Signal Butte Basin**

This offline basin would be located on Town property at the planned Queen Creek Sports Complex and the SRP power easement. The basin would attenuate flow in the Ryan Channel, reducing the require size of the channel downstream from the basin. The basin would have the following characteristics:

- Storage volume: 18 acre-feet
- Depth: 5.5 feet
- Area: 4.5 acres

The basin would be unprogrammed open turf, ornamental native-adapted streetscapes, and connecting to the Queen Creek Sports Complex along the Ryan Channel trail.

3.2.15.6 **Ryan/222nd Street Basin**

This offline basin is shown located within the Jorde Farms property. It would attenuate flow in the Ryan Channel, reducing the required channel size downstream and mitigating capacity issues in the Rittenhouse Channel. The basin would have the following characteristics:

- Storage volume: 101 acre-feet
- Depth: 5.5 feet
- Area: 25.5 acres

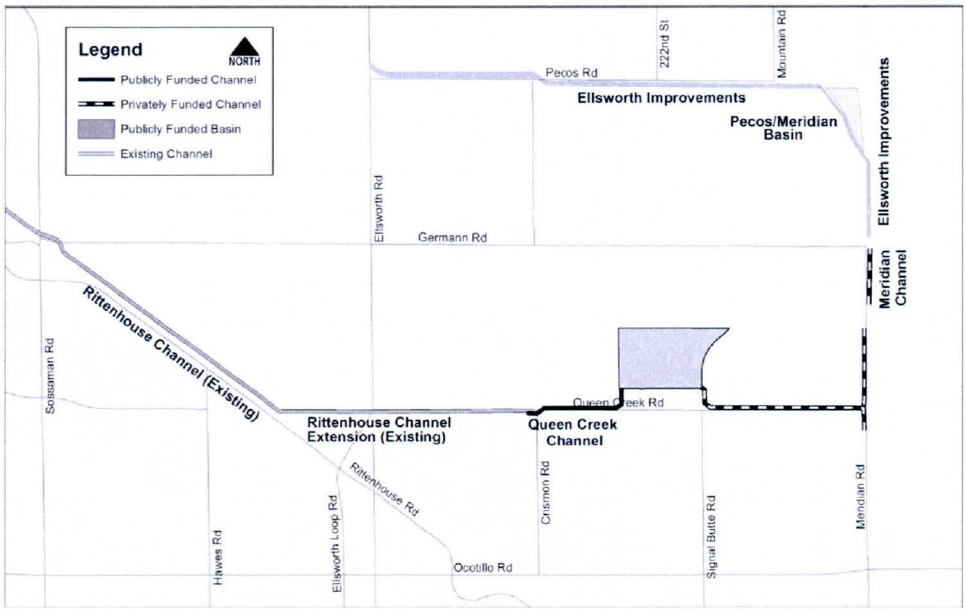
This basin would be designed to integrate with the open space for the Jorde Farms development and configured to meet the developer's theme. Landscape materials, plant palette, and multi-use would be developed to reflect the

development's landscape and provide loop trails and multi-use path connections to the Ryan Channel and its integrated O&M road/trail.

3.2.16 **Rittenhouse Alternative 5**

The following diagram is a depiction of the Rittenhouse Alternative 5 features. Additional details on channel cross sections and alignments are included as **Figures AD 3.1.2** and **AD 3.2.16**, respectively.

Alternative 5 consists of proposed increased retention requirements for all undeveloped areas to mitigate capacity issues in the Rittenhouse Channel and local flooding under developed conditions. It also includes a large basin and outfall channel at the future Town of Queen Creek Sports Complex and a channel along Meridian Road to convey Pinal County runoff north to an existing unimproved channel south of Pecos Road. Lateral channels are proposed to intercept and convey runoff to from Pinal County to the Sports Complex Basin.



Rittenhouse Zone Alternative 5

3.2.16.1 **Increased Retention**

The Rittenhouse Alternative 5 includes an overlay of increased retention requirements for all undeveloped areas. It requires new development to fully retain a precipitation depth of 2.6 inches. Current regulations require retention of 2.19 inches.

At the time of this study, Queen Creek Station and La Jara developments were too far in the permit process and for the purpose of this study it was assumed that they would not be required to provide additional retention.

3.2.16.2 **Outfall Channel**

An outfall channel is required to convey storm water from the Sports Complex Basin to the existing Rittenhouse Channel Extension. It would also intercept and convey flows from areas south of Queen Creek Road. The channel would have the following characteristics:

- Top width: 70 feet
- Depth: 5 feet
- Channel type: riprap
- Landscape setbacks: None
- Operation and maintenance road: None
- Drop structures: none
- Total right-of-way width: 70 feet
- Length: 4,650 feet

3.2.16.3 **Meridian Channel**

The Meridian Channel would start approximately 2,000 feet south of Pecos Road and outfall to the existing unimproved channel along the west boundary of CMC. It would be smaller for Alternative 5 since it only intercepts one of three flow concentrations crossing Meridian Road in the Rittenhouse Zone. The channel would have the following characteristics:

- Top width: 115 feet
- Depth: 6.5 feet
- Channel type: movable bed
- Landscape setbacks: 10 feet, both sides
- Operation and maintenance road: 14 feet wide
- Drop structures: none
- Total right-of-way width: 150 feet
- Length: 1,800 feet

3.2.16.4 **Interceptor Channels**

The Rittenhouse Alternative 5 includes two lateral channels to intercept flows reaching Meridian Road from Pinal County and convey them to the basin at the Sports Complex. The hydrologic analysis shows that the Pinal County flows will tend to concentrate and cross Ellsworth Road alignment just south of Queen Creek Road and between Queen Creek Road and the Ryan Road alignment. A potential flow split upstream, west of Meridian Road Alignment, in Pinal County, may or may not change the flows reaching each of these crossing points. Because the uncertainty of the flow distribution between these two areas this alternative recommends that the developers provide a detailed analysis of the flows entering from Pinal County, and provide sufficient conveyance to deliver the flows to the Sports Complex Basin.

The exact locations of these channels are not critical and can vary to accommodate developer needs. It is expected that these channels will be built by the developers as part of their internal drainage system.

3.2.16.5 **Sports Complex Basin**

The online Sports Complex Basin would be located within the future town park and would attenuate flow from Pinal County to meet capacity constraints of the Rittenhouse Channel Extension infrastructure. It would have the following characteristics:

- Storage volume: 120 acre-feet
- Depth: 6 feet
- Area: 30 acres

Formerly identified as East Park by the Town, the Queen Creek Sports Complex is intended to serve as a large, 90+ acre tournament-level ball field and soccer complex. Park programming includes:

- Eight ball fields – highest priority
- Between five and nine soccer fields
- A 25,000 sq. ft. recreation center that anchors an active core area to include basketball, tennis, and volleyball courts around a three-acre lake
- Multiple playgrounds

A 23-acre public works yard and 2.5 acre fire station also need to be accommodated on the Town-owned parcel.

Conceptual plans for integrating the required basins with the park program were developed, with the conveyance channel being routed partially along the SRP easement on the north property line, then south along Merrill. A deep sediment-capture basin was designed at the intended inlet located near the intersection of Signal Butte and Ryan roads, providing adjacent developers opportunity to connect to the basin system. Soccer fields and four ball fields were also located in basins connected to the channel.

3.2.17 **Rittenhouse No Further Action Alternative**

This alternative consists of continuing current regulations and maintenance of current facilities but does not include new or modified facilities. Evaluating this alternative requires consideration of drainage issues associated with existing facilities, or lack thereof, that would remain if this alternative were selected.

SECTION AD-4: PROPOSED ALTERNATIVES ANALYSIS

4.1 INTRODUCTION

The evaluation of alternatives was based on the following parameters:

4.2 HYDROLOGY MODEL MODIFICATIONS

This section describes the model modifications common to all of the alternatives. Model modifications specific to each alternative are described in **Appendix B**.

For the SR-24 and Ellsworth Zone the 100-year, 24-hour existing model were use to analyze the alternatives. A 10-year model was also used for SR24 Alternative 3. For the Rittenhouse Zone the alternatives were analyzed base on the 100-year, 24-hour future condition model.

Elements common to all alternatives include the Meridian South and Meridian North Channels, the basin at Meridian and Pecos Roads. Both the existing and future models were modified to account for the proposed interceptor channel along the Meridian Road alignment from south of Germann Road to Pecos Road. This modification required the re-routing of concentration points CPR9 (north of Queen Creek along Meridian) and CPR8 (south of Germann along Meridian) to concentration point CPE16 (intersection of Pecos and Meridian). This modification also required manual data entry of the contributing area to CPE16. The improvements to the Meridian Channel south are common for all the SR-24 / Ellsworth models (existing conditions); however, they are not common to all the Rittenhouse models (future conditions), since the Rittenhouse alternatives include several different lengths for this channel.

For the proposed Meridian Channel North (north of Pecos), the appropriate concentration points were re-routed south to Pecos Road and the contributing area at CPE16 adjusted as needed.

The proposed basin at Pecos and Meridian Roads is also common to all the alternatives, and a new storage record was added downstream of concentration point CPE16 (intersection of Pecos and Meridian). The basin was sized to maximize flow attenuation downstream.

4.2.1 **Alternatives Analysis Process**

The first step in the analysis of these alternatives was hydrologic modeling to determine what flows would reach each of the facilities within each alternative. Once the flows were obtained, channel and basin configurations were developed that could convey or store the flows through the system. This included normal depth hydraulic analyses and other simplified approaches to determine the flow characteristics and erosion potential. Once the general configurations were developed, the alternatives were overlaid onto the project maps and constraints such as right-of-way, existing and future land use, utilities, and other factors were identified and modifications were made to the alternative configurations to provide a constructible system.

The next step was to evaluate the alternatives based on the previously established criteria. In some cases, the evaluation led to further refinements or modifications of the

alternatives. The results of the alternatives analysis and evaluation would provide the basis for further consideration and ranking of the alternatives that would ultimately lead to a recommended alternative that is discussed in a later section of this report.

Consideration of channel configurations and materials is very important when analyzing potential alternatives. Whenever possible, the channels and basins will be configured to be compatible with the character of the surrounding area. Channel roughness coefficients were selected for the appropriate channel material and vegetative cover expected during the life of the project. Alternative channel configurations included a movable bed channel, riprap channel with water-harvesting overbank low flows (low flow channel), and a riprap channel with dual landscape buffers. These configurations served as a basis for the initial channel layouts. However, as the alternatives analysis progressed, the channel configurations were modified based on identified constraints and opportunities. For instance, where it would be extremely expensive or difficult to acquire right-of-way, the channel width was minimized by omitting or restricting the landscape buffers.

4.3 RANKING PROCESS

As described previously in **Table AD 1.4**, the alternatives were ranked on life cycle cost, acceptability, implementation, and effectiveness. Each alternative was evaluated according to the criteria and received relative rankings of low, moderate, or high. The rankings represent how well an alternative performed according to each criterion:

- Life-cycle Cost
    - HIGH – The least expensive alternative
    - MODERATE – The cost falls between low and high
    - LOW – The most expensive alternative

- Acceptability
    - HIGH – Meets all or most of the parameters. I s supported by stakeholders and residents; is visually compatible with the surrounding environment; enhances biological resources; accommodates multi-use opportunities. Meets all or most of the parameters.
    - MODERATE – Meets two or more of the parameters
    - LOW – Meets few or none of the parameters. Is not supported by stakeholders and residents; is visually incompatible with the surrounding environment; does not enhance biological resources; does not accommodate multi-use opportunities.
- Implementation
    - HIGH – Meets all or most of the parameters. Construction does not require special techniques or equipment; construction of elements can be easily phased, and segments are effective prior to completion of later phases; has

significant opportunities for funding partnership; does not require interim facilities. Meets all or most of the parameters.

- MODERATE – Meets two or more of the parameters
- LOW – Meets few or none of the parameters. Construction is difficult and needs special equipment or materials; phased construction does not offer flood protection until the entire facility is built; no significant opportunities for funding partnerships; requires interim facilities to be constructed and later abandoned.

- Effectiveness
  - HIGH – Meets all or most of the parameters. Provides 100-year flood protection typically offered by regional facilities; protects a relatively large portion of the watershed; fully uses the capacity of existing facilities.
  - MODERATE – Meets one or two of the parameters.
  - LOW – Meets few or none of the parameters. Provides reduced level of service as compared to 100-year flood protection; protects a relatively small portion of the watershed; does not maximize the use of existing facilities.

Once the individual criteria were ranked, a final ranking (low, moderate, high) was assigned to each alternative based on the predominant rank.

4.4 SR-24 ALTERNATIVES EVALUATION

The SR-24 Zone is located upstream of the Ellsworth Zone, and modifications to its drainage affect peak flows in the Ellsworth Zone. Subsequent impacts to the Ellsworth Zone alternatives were included as part of the SR-24 Zone alternatives evaluation. The Ellsworth Zone elements affected are the proposed Pecos and Meridian North Channels. The specific impacts to these facilities for each evaluation criterion are discussed throughout this section. To simplify the analysis, a single comparison was performed on the impacts of the SR-24 Zone alternatives assuming the combination of Ellsworth Alternative 1 and SR-24 Alternative 2, which would result in a "worst-case scenario" of greatest impact.

4.4.1 Life-Cycle Cost

This section includes a description of assumptions made during the development of life-cycle costs. Details, quantities, and unit cost justifications are included in **Appendix F**. The costs estimated for each of the SR-24 Zone alternatives are summarized in the table below.

Table AD 4.4.1 - SR-24 Zone - Overall Life-Cycle Costs

Item	Alternative 1	Alternative 2	Alternative 3
Land Acquisition	$11,972,000	$9,076,000	$11,585,000
Construction	$9,021,000	$6,490,000	$13,438,000
Utilities	$45,000	$45,000	$394,000
Landscaping	$109,000	$198,000	$204,000
Maintenance	$662,000	$589,000	$3,135,000
Contingency	$4,484,000	$3,280,000	$5,750,000
Total	**$26,293,000**	**$19,678,000**	**$34,506000**

- **Land Acquisition**

Alternative 1 Channels: The land acquisition cost includes right-of-way required for construction of the channels, maintenance road, and buffer area the cost of an interim drainage easement needed to drain the SR-24 basin. In addition, the cost includes savings resulting from reduction in size of the downstream Ellsworth Zone facilities, i.e., Pecos and Meridian North Channels

Alternative 2 Channels: As in Alternative 1, the cost includes the right-of-way necessary to construct the channel, maintenance road, and buffer area. No savings to the Ellsworth Zone are included because Alternative 2 was used as the baseline upstream conditions for sizing the Ellsworth Zone facilities.

Alternative 3 Channels: This cost includes right-of-way to construct the Williams Field, Mountain, Erie, Galveston, and Ivanhoe channels, as well as the interceptor channels along the Meridian Road alignment. None of these facilities have maintenance roads or buffer areas. In addition, the cost includes savings resulting from reduction in size of the Ellsworth Zone elements.

Alternatives 1, 2, and 3 Basins: Includes the land purchase for the permanent basins and interim basins and that will be abandoned once the SR-24 Channel is constructed. At that time, the land can be sold to ADOT and this cost recovered. However, for the purpose of this analysis no cost recovery was considered.

- **Construction**

Alternative 1 Channels: Include excavation and grading, placement of cutoff riprap walls, three arterial road culvert crossings, and a 1,500foot culvert under the future Meridian Road alignment near Williams Field Road. The cost also includes one culvert crossing for the outfall of the SR-24 Interim Basin. Cost savings resulting from reduction in size of the Ellsworth Zone elements are also included.

Alternative 2 Channels: Includes excavation and grading, placement of cutoff riprap walls, three arterial road culvert crossings, and a 1,500-foot culvert under the future Meridian Road alignment near Williams Field Road. No savings for

the Ellsworth Zone are included because Alternative 2 was used as the baseline upstream conditions for sizing the Ellsworth Zone facilities.

Alternative 3 Channels: Includes excavation and grading, compaction, and placement of riprap bank protection. It also includes multiple driveway culverts on the Erie, Galveston, and Ivanhoe Channels, three culverts along the Mountain Channel, and two on the Williams Field Channel. Cost savings resulting from reduction in size of the Ellsworth Zone elements are also included. The Alternative 3 improvements in the SR-24 Zone intercept runoff from the 10-year event which reduces the amount of flow that was assumed to enter the Ellsworth Zone. Also, the flows from this alternative enter the Ellsworth Zone system further downstream, reducing the upstream facility size requirements. In effect, Alternative 3 receives a credit for the reduction in cost that it will provide to the Ellsworth Zone.

Alternative 1, 2, and 3 Basins: Includes excavation and grading of permanent and interim basins. Basins identified as interim may be abandoned or reduced in size once the SR-24 is constructed and the area develops.

- **Utility Relocation**

Utility relocation costs include 1,850 feet, 3,000 feet, and 300 feet of distribution overhead electric for Alternatives 1, 2, and 3, respectively.

- **Landscaping**

Alternatives 1 and 2 Channels: Includes installing hydroseed and tall pot trees intended to replicate the same tree density found along natural washes in the study area. The Meridian Channel also includes landscaped setbacks and swales, whose costs include installation of tall pot trees and a native flowering shrub seed mix.

Alternative 3 Channels: The landscape costs for the Williams Field, Erie, Galveston, and Ivanhoe Channels include hydroseed for the channel bottom and tall pot trees with hydroseed for the landscape setback on Williams Field Road.

Cost savings resulting from reduction in size of the Ellsworth Zone elements are also included.

Alternative 1 Basin: All retention basins are interim; therefore, no landscaping was included.

Alternative 2 Basins: Landscape costs for the Galveston Basin include installing hydroseed and tall pot trees at densities comparable to the existing stock ponds near the basin site. The Pecos/Ellsworth and Williams Field/Ellsworth Basins are interim and may be abandoned or reduced in size once the SR-24 is constructed and the area develops. For this reason, these basins will not be landscaped.

Alternative 3 Basins: Landscape costs for the Williams Field Basin include installing hydroseed and tall pot trees at densities comparable to the existing stock ponds near the basin site. The Pecos/Ellsworth and Williams Field/Ellsworth Basins are interim and may be abandoned or reduced in size once the SR-24 is constructed and the area develops. For this reason, these basins will not be landscaped.

- **Maintenance**

Alternative 1 Channels: Limited to the culvert crossings since the intent of the movable bed channel is to allow nature to reshape the channel. Maintenance reduction for the Ellsworth Zone elements was also considered.

Alternative 2 Channels: Similar to Alternative 1, maintenance cost for the Meridian Channel is limited to the culvert crossings.

Alternative 3 Channels: Includes inspections, clean–up, and repairs required to maintain the integrity and capacity of the channels. Maintenance reduction for the Ellsworth Zone elements was also considered.

Alternative 1 Basins: Negligible maintenance required because they are interim basins with no landscaping.

Alternative 2 Basins: Includes normal maintenance such as sediment and debris removal, inspection and periodic repairs for the Galveston Basin, and minimal maintenance for the Pecos/Ellsworth and Williams Field/Ellsworth Interim Basins.

Alternative 3 Basins: This cost includes normal maintenance such as sediment and debris removal, inspection and periodic repairs of the Williams Field/Meridian basin and minimal cost for the Pecos/Ellsworth and Williams Field/Ellsworth Interim Basins.

4.4.2 **Acceptability**

A summary of the acceptability ratings for SR-24 Zone alternatives is described in the following sections.

Table AD 4.4.2 - SR-24 Zone - Acceptability

Criteria	Alternative 1	Alternative 2	Alternative 3
Public Support	No opinion expressed	No opinion expressed	• Supports the neighborhood channel network • May not be receptive of establishing regulatory floodplains on existing development.
Stakeholder Support	• Supported by ADOT and ASLD	• Supported by ADOT and ASLD	• Not supported by ADOT or ASLD
Agency Support	• Supported by Mesa and Pinal County	• Supported by Mesa and Pinal County	N/A
Context Sensitivity	• Movable bed design for the Meridian Channel is compatible • Interim basins not visually attractive • Moderately context-sensitive	• Movable bed design for the Meridian Channel is compatible • One interim basin and the Galveston Basin are visually appropriate • Context sensitivity is high	• Mountain/Erie channels are not context-sensitive
Biological Value	• Movable bed channels would enhance biological value	• Movable bed channels would enhance biological value • Galveston Basin has potential to improve value	• Limited opportunities to increase biological value • Interim basins would increase biological value only temporarily

Criteria	Alternative 1	Alternative 2	Alternative 3
Multiuse/Recreational opportunities	• Movable bed channels have opportunity for active & passive recreation	• Movable bed channels have opportunity for active & passive recreation • Galveston Basin provides passive open space	• Limited multi-use opportunity; lack of maintenance roads prevents dual use as trails • Williams Field/Mountain Basin provides passive open space
Overall Acceptability	**Moderate**	**High**	**Low**

4.4.3 **Implementation**

A summary of the implementation ratings for each SR24 Zone alternative is shown on the table below.

Table AD 4.4.3 - SR-24 Zone - Implementation

Criteria	Alternative 1	Alternative 2	Alternative 3
Straightforward construction	Straightforward	Straightforward	• Has the most individual structures; retrofits through neighborhood could post difficulties
Funding partners	• MCDOT, Pinal County, ASLD	• MCDOT, Pinal County, ASLD	• MCDOT
Need for interim facilities	• Three interim basins • A temporary easement is required for the SR-24 Basin	• Two interim basins	• Two interim basins • One interim channel
Ability to phase construction	Low	Low	High
Overall Implementation	**Moderate**	**Moderate**	**Moderate**

4.4.4 **Effectiveness**

The effectiveness of each SR-24 alternative was evaluated and is summarized in the table below, followed by a discussion of the ratings.

Table AD 4.4.4 - SR-24 Zone - Effectiveness

Criteria	Alternative 1	Alternative 2	Alternative 3
Efficient/effective use of existing facilities	Yes	Yes	Yes
Approx. Benefit Area	4 sq mi	4 sq mi	3 sq mi
Level of Protection	100-year regional	100-year regional	10-year regional & local
Overall Effectiveness	**High**	**High**	**Moderate**

4.4.5 **Evaluation of SR-24 No Further Action Alternative**

Costs

The cost associated with the No Further Action Alternative was assumed to be the value of land and improvements within the SR-24 Zone. Although it seems unlikely that the No Further Action Alternative would result in a complete loss of land and improvements, this approach was taken to provide a comparison between the proposed improvements and continuing into the future with only the existing infrastructure: Alternatives 1, 2, and 3 provide flood protection to land and improvements within the SR-24 Zone that has a total estimated value of $41 million (per 2011 assessed values).

Acceptability

There are well-documented drainage issues in this area and local agencies receive repeated complaints about flooding issues. MCDOT recently constructed a project to mitigate some of the flooding in the Mountain Road area but flooding issues persist and are likely to worsen as the area develops resulting in more complaints and dissatisfaction with the unresolved drainage conditions in this area.

Effectiveness

Retention requirements and other current regulations have been ineffective in controlling flows reaching this area. It is unlikely that it would be more successful going forward. There are no current floodplain delineations in this area and it is unclear how the runoff affects this area. Delineation of floodplains may be needed to more effectively apply current regulations and mitigate potential flooding conditions.

Implementation

At the very minimum, floodplains will need to be delineated in order to identify the flood prone areas and utilize the floodplain regulations. The flooding in this area is generated from areas in three different jurisdictions (Maricopa County, Pinal County, and City of Mesa). These agencies all have their own drainage regulations and there may be some inconsistent practices across jurisdictional boundaries.

4.4.6 SR-24 Zone Alternatives Evaluation Summary

Table AD 4.4.6a - SR-24 Zone - Evaluation Summary (Including Costs)

Criteria	Alternative 1	Alternative 2	Alternative 3
Life Cycle Costs	$26,293,000	$19,678,000	$34,506,000
Acceptability	Moderate	High	Low
Implementation	Moderate	Moderate	Moderate
Effectiveness	High	High	Moderate
Ranking			

Table AD 4.4.6b - SR-24 Zone - Evaluation Summary (Excluding Costs)

Criteria	Alternative 1	Alternative 2	Alternative 3
Acceptability	Moderate	High	Low
Implementation	Moderate	Moderate	Moderate
Effectiveness	High	High	Moderate
Ranking			

4.5 ELLSWORTH ZONE ALTERNATIVES EVALUATION

4.5.1 Life-Cycle Cost

Section 4.3.1 includes a description of assumptions made during the development of life-cycle costs. Details, quantities, and unit cost justifications are included in **Appendix F**. The costs estimated for each of the Ellsworth Zone alternatives are summarized in the table below.

Table AD 4.5.1 - Ellsworth Zone - Overall Life-Cycle Costs

Item	Alternative 1	Alternative 2	Alternative 3
Land Acquisition	$8,968,000	$9,487,000	$8,280,000
Construction	$17,028,000	$17,137,000	$18,799,000
Utilities	$1,334,000	$940,000	$1,572,000
Landscaping	$549,000	$553,000	$553,000
Maintenance	$2,075,000	$2,122,000	$2,122,000
Contingency	$5,991,000	$6,048,000	$6,266,000
Total	**$35,945,000**	**$36,287,000**	**$37,592,000**

- **Land Acquisition**

  Alternative 1, 2, and 3 Channels and Basins: Includes right-of-way needed to construct the channels and basins. An additional 10% contingency was added to the Pecos Channel because the alignment does not follow property lines. Additional costs may be incurred to buy parcel remnants.

- **Construction**

  All Alternatives: Includes costs for design, inspection, excavation, grading, riprap cutoff walls, drop structures, and culvert crossings.

  Alternatives 1 and 2: Some costs for cultural resources survey and mitigation were included for the Pecos Channel since it is likely that cultural sites will be encountered in the area.

- **Utility Relocation**

  All Alternatives: A distribution overhead electric line along Meridian Road would need to be relocated for most of the proposed Meridian Channel. An irrigation line on Meridian Road South of Germann would also need to be relocated. Meridian Channel crosses a water distribution line at Pecos Road. The water line would need to be lowered under the channel.

  Alternative 1: Includes water and gas line relocation where Pecos Channel crosses Pecos Road.

  Alternative 2: Includes water and gas line relocation where Pecos Channel crosses Pecos Road and Mountain Road.

- **Landscaping**

  All Alternatives: Channels include hydroseed and tall pot trees intended to replicate tree densities found along natural washes in the study. Riprap sections include hydroseed and tall pot trees for low-flow water harvesting swales and landscape overbanks. Detention basins include hydroseed and tall pot trees at densities comparable to the existing stock ponds near the basin site.

- **Maintenance**

  All Alternatives: The channels are intended to allow natural processes of erosion, deposition, vegetation, and others to reshape the wash. Therefore, the cost of maintenance was assumed to be minimal and limited to crossings, maintenance roads, and inspections. Basin maintenance includes sediment/debris removal, inlet and outlet structures, inspection, and maintenance. It does not include maintenance of other non-flood related multi-use facilities or amenities.

4.5.2 **Acceptability**

A summary of the acceptability ratings for the Ellsworth Zone alternatives is summarized in the table below.

Table AD 4.5.2 - Ellsworth Zone - Acceptability

Criteria	Alternative 1	Alternative 2	Alternative 3
Public Support	• Supports the Pecos Channel to alleviate significant flooding problems	• Supports the Pecos Channel to alleviate significant flooding problems	• Supports the Pecos Channel to alleviate significant flooding problems
Stakeholder Support	• Meridian channel would benefit Pinal County • Pecos/Meridian Basin is supported by the parcel owner • Pecos Channel alignment is supported by landowners and ASLD	• Meridian channel would benefit Pinal County • Pecos/Meridian Basin is supported by the parcel owner • Pecos Channel alignment is strongly opposed by adjacent landowners •	• Meridian channel would benefit Pinal County • Pecos/Meridian Basin is supported by the parcel owner • Pecos Channel alignment is strongly opposed by ASLD and adjacent landowners
Agency Support	• Supported by Mesa • The Pecos Channel water-harvesting feature reduces maintenance which Mesa supports	• Mesa does not support the Pecos Channel alignment	• Mesa does not support the Pecos Channel alignment
Context Sensitivity	• Meridian Channel and Pecos/Meridian Basin are compatible • Pecos Channel is moderately context-sensitive	• Meridian Channel and Pecos/Meridian Basin are compatible • Pecos Channel is moderately context-sensitive	• Meridian Channel and Pecos/Meridian Basin are compatible • Pecos Channel is moderately context-sensitive

Criteria	Alternative 1	Alternative 2	Alternative 3
Biological Value	• Movable bed channels would enhance biological value • Pecos Channel alignment is relatively less conducive to enhancing biological value • Basin would maintain value	• Movable bed channels would enhance biological value • Basin would maintain value	• Movable bed channels would enhance biological value • Basin would maintain value
Multiuse/ Recreational Opportunities	• Movable bed channels would allow equestrian passive recreation • Basin has multi-use potential, including an equestrian trailhead	• Movable bed channels would allow equestrian passive recreation • Basin has multi-use potential, including an equestrian trailhead • Pecos Channel alignment encourages trail use	• Movable bed channels would allow equestrian passive recreation • Basin has multi-use potential, including an equestrian trailhead • Pecos Channel alignment encourages trail use
Overall Acceptability	**High**	**Low**	**Low**

4.5.3 **Implementation**

A summary of the implementation ratings for the Ellsworth Zone alternatives is shown on the table below.

Table AD 4.5.3 - Ellsworth Zone - Implementation

Criteria	Alternative 1	Alternative 2	Alternative 3
Ease of construction	Straightforward	Straightforward	Improvements to the Ellsworth Channel and culvert under Ellsworth Road may pose difficulties
Funding partners	• Meridian Channel: Mesa, Queen Creek, Pinal County, MCDOT • Pecos/Meridian Basin & Pecos Channel: Mesa, industrial landowners, developers	• Meridian Channel: Mesa, Queen Creek, Pinal County, MCDOT • Pecos/Meridian Basin & Pecos Channel: Mesa, industrial landowners, developers	• Meridian Channel: Mesa, Queen Creek, Pinal County, MCDOT • Pecos/Meridian Basin & Pecos Channel: Mesa, industrial landowners, developers
Need for interim facilities	None	None	None

Criteria	Alternative 1	Alternative 2	Alternative 3
Potential for phased construction	Moderate: Basin could be constructed before the channels. Existing facilities could bring the flows into the basin and use it as an interim outfall, but could not be fully used until the channels are built.	Moderate: Basin could be constructed before the channels. Existing facilities could bring the flows into the basin and use it as an interim outfall, but could not be fully used until the channels are built.	Moderate: Basin could be constructed before the channels. Existing facilities could bring the flows into the basin and use it as an interim outfall, but it could not be fully used until the channels are built.
Overall Implementation	**Moderate**	**Moderate**	**Moderate**

4.5.4 **Effectiveness**

The effectiveness of each Ellsworth Zone alternative was evaluated and summarized in the table below.

Table AD 4.5.4 - Ellsworth Zone - Effectiveness

Criteria	Alternative 1	Alternative 2	Alternative 3
Efficient/effective use of existing facilities	The existing channel along the old GM Desert Proving Grounds could be improved, and it may be possible to use the existing right-of-way.	The existing channel along the old GM Desert Proving Grounds could be improved, and it may be possible to use the existing right-of-way.	Limited use of the existing channel along the old GM Proving Ground. Some existing facilities built privately will be abandoned or used for local drainage only.
Approximate Benefit Area	4.5 sq mi	4.5 sq mi	4.5 sq mi
Level of Protection	100-year	100-year	100-year
Overall Effectiveness	**High**	**High**	**Moderate**

4.5.5 **Evaluation of Ellsworth No Further Action Alternative**

Cost

The cost associated with the No Further Action Alternative was assumed to be the value of land and improvements within the Ellsworth Zone. Although it seems unlikely that the No Further Action alternative would result in a complete loss of land and improvements, this approach was taken to provide a comparison between Alternatives 1, 2, and 3 to the No Further Action Alternative: Alternatives 1, 2,

and 3 provide flood protection to land and improvements within the Ellsworth Zone that has a total estimated value of $64 million (per 2011 assessed values).

Acceptability

There are well-documented drainage issues along Pecos Road and access to the industrial development is interrupted during even minor storm events. There is also documented flooding along some of the north side streets. The flooding in this area also overtaxes the Ellsworth Channel resulting in a decreased level of protection provided by this facility. The City of Mesa is aware they need to resolve the drainage issues in the area in order to attract industrial and commercial development.

Effectiveness

The City of Mesa is requiring new development to elevate structures in this area above the 100-year flow using conservative flood elevation (worst case scenario). It is likely that recently constructed and future buildings would not be affected by flooding. However, flooding of at-grade facilities and access issues (due to roadway flooding) will continue and worsen as more land is developed.

The City of Mesa recently adopted new retention requirements that reduced the volume of storage required for new development (NOAA 14). This will reduce the effectiveness of their regulations in controlling runoff in this area.

Implementation

The jurisdictions within this area already have drainage regulations that they are enforcing. The success of the No Further Action Alternative will depend on how well jurisdictions enforce their regulations and how well those regulations address their flooding issues.

4.5.6 **Ellsworth Alternatives Evaluation Summary**

Table AD 4.5.6a - Ellsworth Zone -Evaluation Summary (Including Costs)

Criteria	Alternative 1	Alternative 2	Alternative 3
Life Cycle Costs	$35,945,000	$36,287,000	$37,592,000
Acceptability	High	Low	Low
Implementation	Moderate	Moderate	Moderate
Effectiveness	High	High	Moderate
Ranking			

Table AD 4.5.6b - Ellsworth Zone - Evaluation Summary (Excluding Costs)

Criteria	Alternative 1	Alternative 2	Alternative 3
Acceptability	**High**	**Low**	**Low**
Implementation	**Moderate**	**Moderate**	**Moderate**
Effectiveness	**High**	**High**	**Moderate**
Ranking			

4.6 RITTENHOUSE ZONE ALTERNATIVES EVALUATION

The alternatives were evaluated per the criteria identified in Section 1.4.

4.6.1 Life-Cycle Cost

Section 4.3.1 included a description of assumptions made during the development of life-cycle costs. Details, quantities, and unit cost justifications are included in **Appendix** I. The costs estimated for each of the Rittenhouse Zone alternatives are summarized on the table below with an explanation following.

Table AD 4.6.1 - Rittenhouse Zone – Life Cycle Cost Summary

Item	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Land Acquisition	$6,326,000	$5,019,000	$6,504,000	$6,587,000	$2,054,000
Construction	$20,500,000	$18,334,000	$16,521,000	$13,248,000	$3,010,000
Utilities	$2,902,000	$554,000	$1,649,000	$708,000	$1,132,000
Landscaping	$569,000	$764,000	$467,000	$3,067,000	$887,000
Maintenance	$2,992,000	$2,792,000	$3,345,000	$56,766,000	$983,000
Contingency	$6,626,000	$5,493,000	$5,665,000	$16,075,000	$1,613,000
Total	**$39,947,000**	**$32,956,000**	**$34,183,000**	**$96,451,000**	**$9,679,000**

- **Land Acquisition**

  Alternative 1 and 3 Channels: Costs include right-of-way needed to construct the Germann, Queen Creek, and interceptor channels. Cost was also included to purchase the right-of-way for a maintenance road and a small buffer area along some channels. Additional cost was included for the Meridian South Extension and Meridian South upsizing between Queen Creek Road and Germann Road.

  Alternative 2 Channels: Same as for Alternatives 1 and 3, except for segments of the channel system within the SRP easement where it was assumed that the land cost was only 50% of the market value.

  Alternatives 1, 2, 3, and 4 Basins: Cost includes the right-of-way needed to construct the basins.

Alternative 5 Basin: The Town of Queen Creek already owns the basin site. However the cost of the land was included in the cost estimates.

- **Construction**

  Channels for all Alternatives: Includes costs for excavation and grading, and placement of riprap liner and cutoff walls and numerous culvert crossings of arterial and private roads, Additional costs include:

  Alternative 1 Channels: Five drop structures for the Germann Channel and four siphon irrigation crossings of the German Channel west of Hawes Road.

  Alternative 2 Channels: Six drop-structures for the Ryan Channel.

  Alternative 3 Channels: Four drop structures for the Queen Creek Channel and four siphon irrigation crossings of the German Channel west of Hawes Road.

  It is noted that the existing Ellsworth Mini-Farms development along Germann Road, as well the potential to widen Germann Road in the future, limits available right-of way to construct a channel. Therefore, a buried box culvert may be needed in this area. The construction cost represents an open channel; the higher cost for buried box culvert was not estimated.

  Basins for all Alternatives: Includes the cost of excavation, grading, and construction of the inlet and outlet structures for the basins.

- **Utility Relocation**

  Alternative 1 - Channels: This alternative requires extensive relocation of an 8–inch waterline, 4-inch gas main, and irrigation facilities along Germann Road. Upsizing and extending the Ellsworth Zone Meridian South Channel would require additional irrigation facility relocation and 4-inch gas main relocation.

  Alternative 2 - Channels: This alternative requires only minor utility relocations for the Ryan and Queen Creek Channels. These relocations include water, gas, and irrigation lines.

  Alternative 3 - Channels: This alternative requires extensive relocation of water, irrigation, and gas lines along Germann Road. Some minor relocations are also required for the Queen Creek Channel.

  Basins for all Alternatives: It was assumed that no utility relocations would be needed to construct the Rittenhouse Zone Basins.

- **Landscaping**

  Landscaping cost includes landscaping the channel and buffer for the Meridian Channel. Riprap channels with earthen bottoms will be hydroseeded, and landscape setbacks will include tall pot trees and hydroseed.

  Except as noted below, all basins will be landscaped with tall pots and hydroseed at similar densities as described in the other zones. This is intended to reflect tree and plant levels found in the study area that are not supported by supplemental irrigation.

Alternative 5 Basin: The flood control portion of the Sports Complex basin will include basic landscape to prevent excessive erosion. Equipment and sports field surfacing or additional park vegetation and amenities will not be installed as part of a flood control project.

- **Maintenance**

  For all five alternatives, the intent of the Meridian Channel is to allow the natural processes of erosion, deposition, and vegetation to reshape the wash. Therefore, for all alternatives, the cost of maintaining the Meridian channel was assumed to be minimal and limited to crossings, maintenance road, and inspection.

  Alternative Nos.1, 2, and 3. For all the channels, except the meridian channel, it was assumed that they will require periodic sediment and debris removal, vegetation control, inspection, bank repair, and other activities to keep the channel functioning as designed for the 50-year project life.

  Alternative 4: Includes the cost of maintaining a grass lined channel on portions of the Ryan channel including watering, mowing, irrigation system repair, fertilizing, and pesticide application and other maintenance activities required to maintain the channel. It also includes the costs of periodic sediment and debris removal, vegetation control, inspection, bank repair, and other activities to keep the channels functioning as designed.

  Alternative 5: This alternative only includes maintenance for the outfall channel and the Meridian Channel.

  Basins: The cost reflects periodic sediment and debris removal, vegetation control, inspection, bank repair, and other activities to keep them functional. The cost of maintaining sports fields and equipment in the Alternative 5 basin was not included.

4.6.2 **Acceptability**

A summary of the acceptability ratings for the five Rittenhouse Zone alternatives is summarized in the table below.

Table AD 4.6.2 - Rittenhouse Zone - Acceptability

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Public Support	• Improvements along Germann Rd are strongly opposed by Ellsworth Mini-Farms • Germann Basin provides buffer to Ellsworth Mini-Farms, but would not maintain desired rural character	• Ryan Channel provides buffer to Ellsworth Mini-Farms, but would not maintain desired rural character	• Improvements along Germann Rd are strongly opposed by Ellsworth Mini-Farms	• Ryan Channel provides buffer to Ellsworth Mini-Farms, but would not maintain desired rural character	• Not evaluated
Stakeholder Support	• Supported by stakeholders	• Strongly opposed by stakeholders	• Supported by stakeholders	• Not supported by stakeholders	• Strongly supported by stakeholders
Agency Support	• Strongly opposed by Queen Creek • Poor image of the town from the north entrance. Could conflict with planned Germann Road improvements.	• Opposed by Queen Creek due to space constraints along portions of the Ryan Channel	• Not supported by Queen Creek • Could conflict with planned Germann Road improvements.	• Not supported by Queen Creek	• Strongly supported by Queen Creek
Context Sensitivity	• Meridian Road Channel is compatible • A portion of the Queen Creek Channel is not compatible • Germann Road Channel is not compatible, but is partially mitigated by landscape buffers	• Meridian Road Channel is compatible • A portion of the Ryan Road Channel is not compatible, but is partially mitigated by landscape buffers.	• Meridian Road Channel is compatible • A large portion of the Queen Creek Channel is not compatible • Germann Road Channel is not compatible, but is partially mitigated by landscape buffers	• Meridian Road Channel is compatible • A portion of the Ryan Road Channel is not compatible, but is partially mitigated by landscape buffers.	• Meridian Road Channel is compatible • Queen Creek Channel is not compatible because of limited right-of-way

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Biological Value	• Riprap channels decrease value • Basins increase value and preserve open space	• Riprap channels decrease value • Ryan Road Channel utility co-location diminishes biological habitat • Basins increase value and preserve open space	• Riprap channels decrease value • Basins increase value and preserves open space • Basins increase value and preserve open space	• Riprap channels decrease value • Ryan Road Channel utility co-location diminishes biological habitat • Basins increase value and preserve open space	• N/A
Multiuse /Recreational Opportunities	• Basin has high multi-use potential • Channels /maintenance roads could be used as walking trails	• Multi-use value of the Ryan Channel could be enhanced due to co-location of power line corridor • Channels/ maintenance roads could be used as walking trails	• Channels/ maintenance roads could be used as walking trails • Basin could be used to view limited wildlife	• Multi-use value of the Ryan Channel could be enhanced due to co-location of power line corridor • Channels/ maintenance roads could be used as walking trails	• Basin in future park has highest multi-use value • Trails could be incorporated along the Queen Creek and Meridian channels
Overall Acceptability	**Lowest**	**Low**	**Low**	**Moderate**	**Highest**

4.6.3 **Implementation**

A summary of the implementation ratings for the Rittenhouse Zone alternatives is shown on the table below.

Table AD 4.6.3 - Rittenhouse Zone - Implementation

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Ease of construction	Straightforward but utilities relocation may be challenging	Straightforward	Straightforward	Straightforward	Straightforward
Funding partners	• Germann Channel: Queen Creek, Mesa • Meridian Channel: Queen Creek, Pinal County • Interceptor channels: developers • Germann/Ellsworth Basin: Queen Creek	• Queen Creek is primary funding partner • Meridian Channel: Queen Creek, Pinal County • SRP may share right-of-way costs for Ryan Channel	• Germann Channel: Queen Creek, Mesa • Meridian Channel: Queen Creek, Pinal County • Queen Creek Channel & Basin: Queen Creek • Interceptor channels: developers	• Queen Creek is primary funding partner • Meridian Channel: Queen Creek, Pinal County • SRP may share right-of-way costs for Ryan Channel	• Meridian Channel: Developer built • Interceptor channels: developers • Detention basin: Queen Creek • Queen Creek Channel: Queen Creek
Need for interim facilities	None	None	None	None	None
Potential for phased construction	None	Limited: infrastructure is one main channel	Dual-channel scenario offers some opportunity for phasing	Limited: most of the improvements are for one main channel	High: Queen Creek may construct detention basin early
Overall Implementation	**Moderate**	**Low**	**Moderate**	**Low**	**High**

4.6.4 **Effectiveness**

The effectiveness of each Rittenhouse alternative was evaluated and summarized in the table below.

Table AD 4.6.4 - Rittenhouse Zone - Effectiveness

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Efficient / effective use of existing facilities	Yes	No	No	No	Yes
Approximate Benefit Area	6 ¼ sq mi	6 ¼ sq mi	6 ¼ sq mi	6 ¼ sq mi	6 ¼ sq mi
Level of Protection	100-year	100-year	100-year	Ryan Road Channel west of Ellsworth Road: Less than 100-year	Along Ryan Road west of Crismon Road: less than 100-year
Overall Effectiveness	**High**	**High**	**High**	**Moderate**	**High**

4.6.5 **Evaluation of Rittenhouse No Further Action Alternative**

Costs

The cost associated with the No Further Action Alternative was assumed to be the full cash value of property within the Rittenhouse Zone per 2011 assessed values. It is recognized that the cost of the No Further Action alternative would exclude land values; additionally, it is unlikely that improvements would suffer a complete loss. However, this approach was taken to provide a basic, relative cost comparison to aid in selecting a recommended alternative. As such, Alternatives 1 through 5 provide flood protection to land and improvements within the Rittenhouse Zone that has a total estimated value of $113 million.

Acceptability

Future conditions hydrologic modeling shows that flooding will increase significantly as the agricultural fields change to urban development. Flooding in the future will be a big issue in this area. Also, current regulations only require developers to pass the existing 100-year flow through their development. Since future flows will increase upstream, developers would be forced to accommodate these increased flows on-site since there are no downstream facilities to handle the increased flow. Property owners and developers are unlikely to accept this additional burden.

The outfall for this area is the Rittenhouse Channel owned by the District. The future flows that would reach the Rittenhouse Channel will overtax it, reducing the level of protection provided.

Effectiveness

Agricultural fields typically allow very little runoff even during large storm events. As these agricultural fields are developed, more runoff could be expected and current regulations to retain the NOAA 14 runoff may not mitigate the increases.

Implementation

The Town of Queen Creek follows the Maricopa County drainage regulations, which requires the retention of the NOAA 14 100-year 2-hour rainfall on-site.

4.6.6 **Rittenhouse Zone Alternatives Evaluation Summary**

Table AD 4.6.6a - Rittenhouse Zone - Evaluation Summary (Including Costs)

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Life Cycle Costs	$39,947,000	$32,956,000	$34,183,000	$96,451,000	$9,679,000
Acceptability	Lowest	Low	Low	Moderate	Highest
Implementation	Moderate	Low	Moderate	Low	High
Effectiveness	High	High	High	Moderate	High
Ranking					

Table AD 4.6.6b - Rittenhouse Zone - Evaluation Summary (Excluding Costs)

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Acceptability	Lowest	Low	Low	Moderate	Highest
Implementation	Moderate	Low	Moderate	Low	High
Effectiveness	High	High	High	Moderate	High
Ranking					

4.7 RITTENHOUSE ZONE RECOMMENDED ALTERNATIVE

Based on the rankings according to the established criteria, Alternative 5 was selected to move forward as the recommended. Alternative 5 will be studied in more detail and adjusted as necessary. Results of the analysis will be included in Volume RA – Recommended Alternative.

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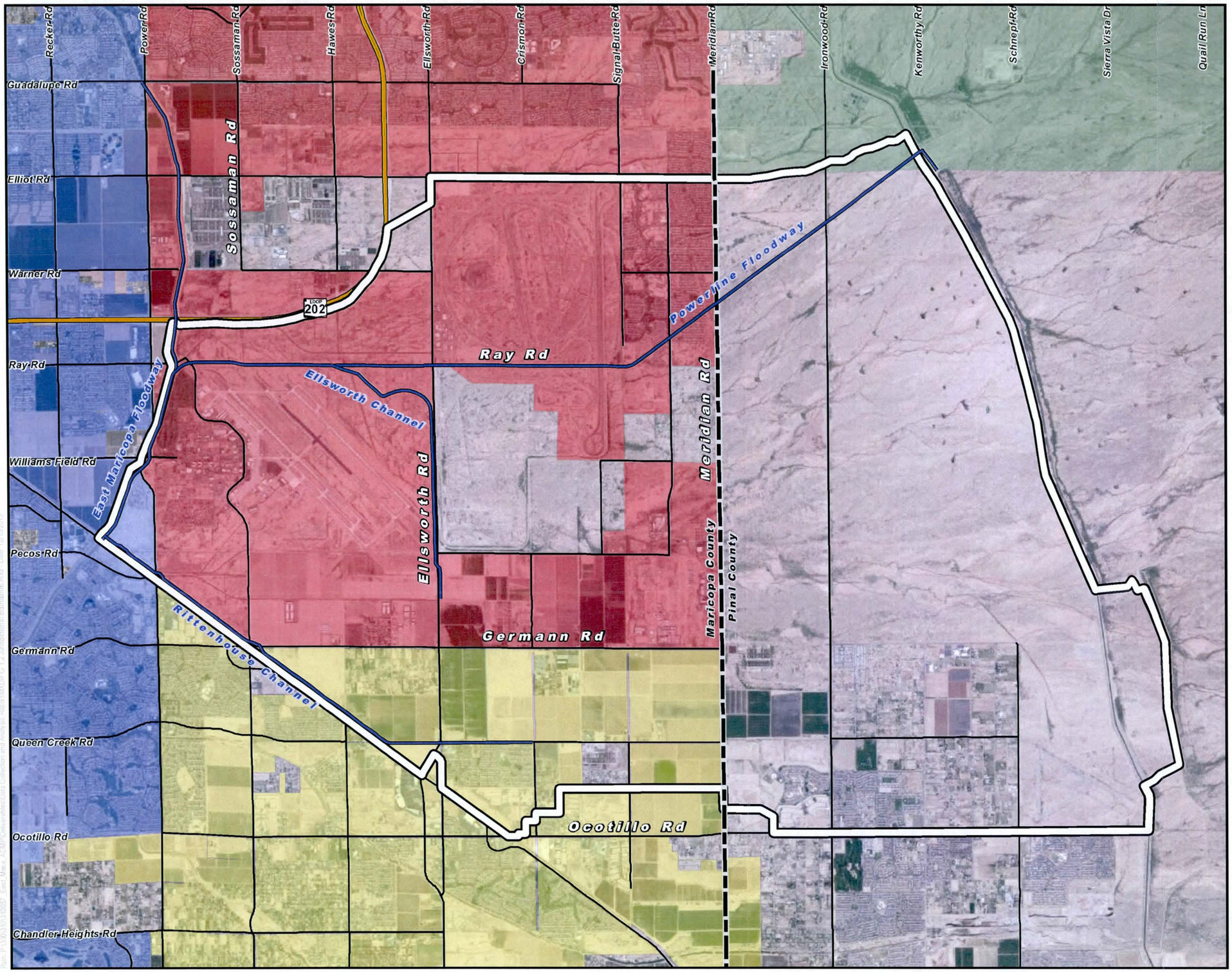

LEGEND

- Project Boundary
- County Boundary
- Mesa
- Queen Creek
- Gilbert
- Apache Junction

LOCATION MAP

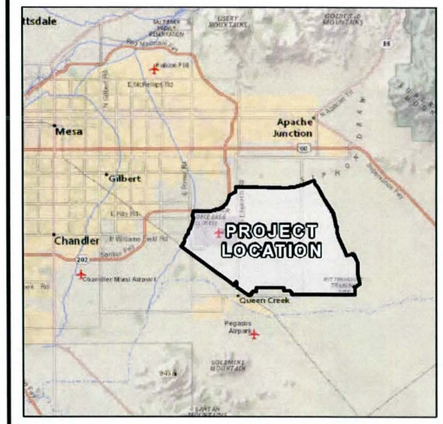

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FIGURE AD 1.2
STUDY AREA

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Flood Control District of Maricopa County

LEGEND

- Project Boundary
- County Boundary
- FCDMC Regional Channel
- Future SR 24 Alignment
- (1) Drainage Issue ID (See Table 2.2)

LOCATION MAP

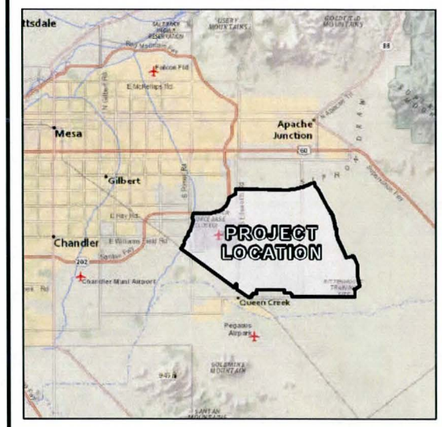

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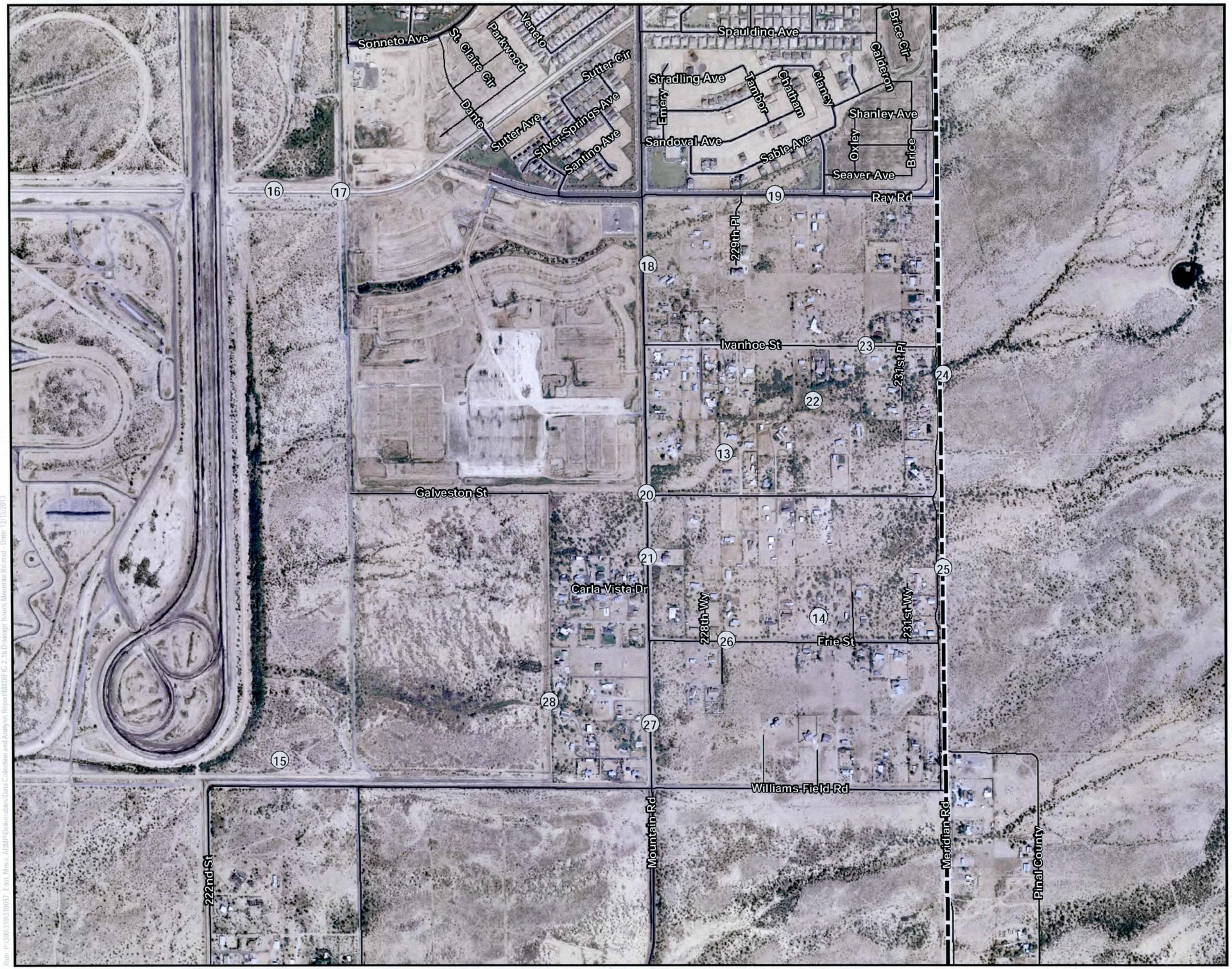
FIGURE AD 2.2a
DRAINAGE ISSUES

Elliot Rd
Recker Rd
Power Rd
Sossaman Rd
Hawes Rd
Ellsworth Rd
Crismon Rd
Signal Butte Rd
Meridian Rd
Ironwood Rd
Warner Rd
Ray Rd
Williams Field Rd
Pecos Rd
Germann Rd
Queen Creek Rd
Ocotillo Rd
LOOP 202
8
Power Line Floodway
East Maricopa Floodway
Ellsworth Channel
Rittenhouse Channel
See Figure 2.2b
Future ADOT SR 24
Assumed Location
1
2
3
4
5
6
7
9
10
11
12

Path: P:\300\310\310957 East Mesa ADMP\Deliverables\Data Collection and Analysis Report\MXD\FIG AD 2.2a Drainage Issues.mxd - Date: 1/31/2014

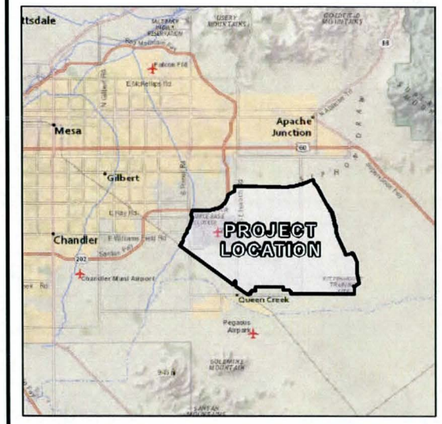


EAST MESA
AREA DRAINAGE
MASTER PLAN UPDATE
FCD 2011C017

LEGEND

- Project Boundary
- County Boundary
- (1) Drainage Issue ID (See Table 2.1)

LOCATION MAP



NORTH

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FIGURE AD 2.2b
MOUNTAIN/ERIE
DRAINAGE ISSUES

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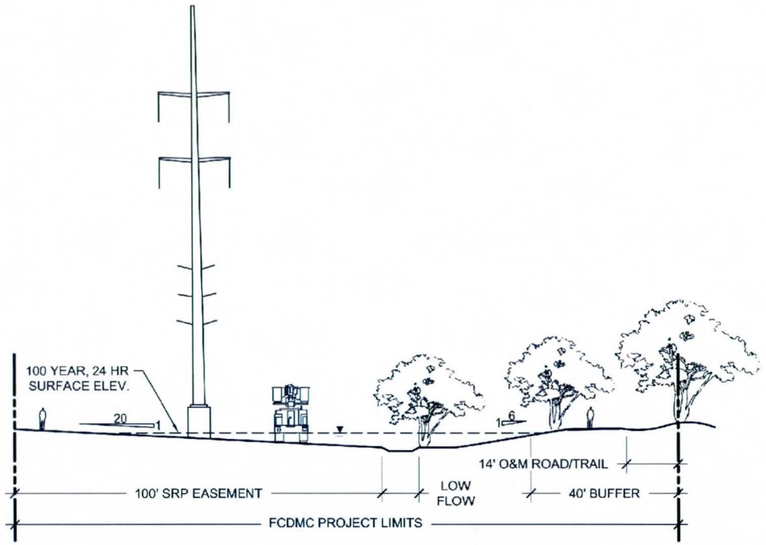
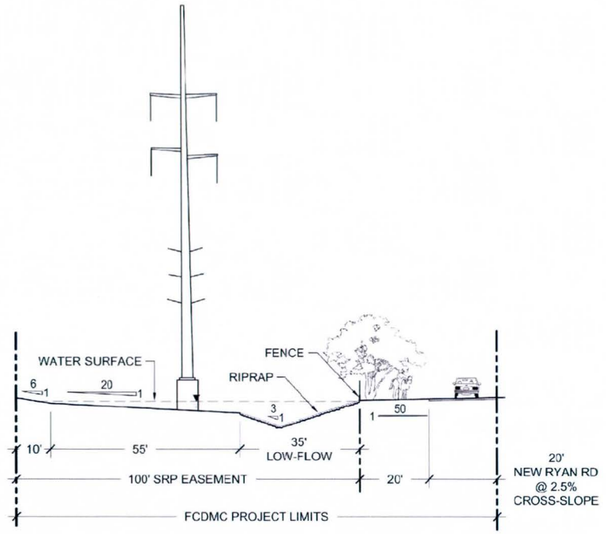
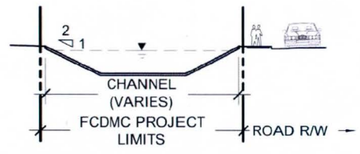


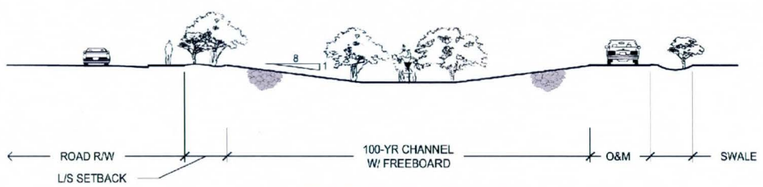
TURF CHANNEL W/ SRP EASEMENT



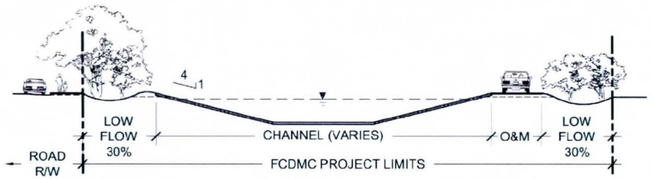
CHANNEL W/ SRP EASEMENT (CONSTRICTED)



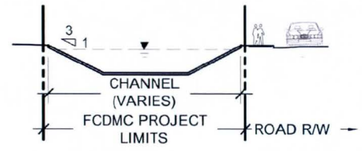
2:1 RIPRAP CHANNEL NO LANSCAPE



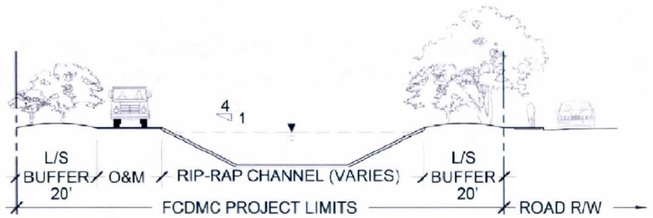
MOVABLE BED CHANNEL



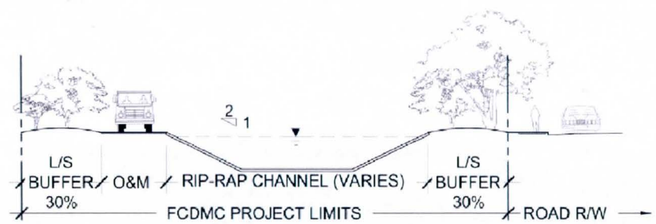
RIPRAP CHANNEL W/ WATER-HARVESTING



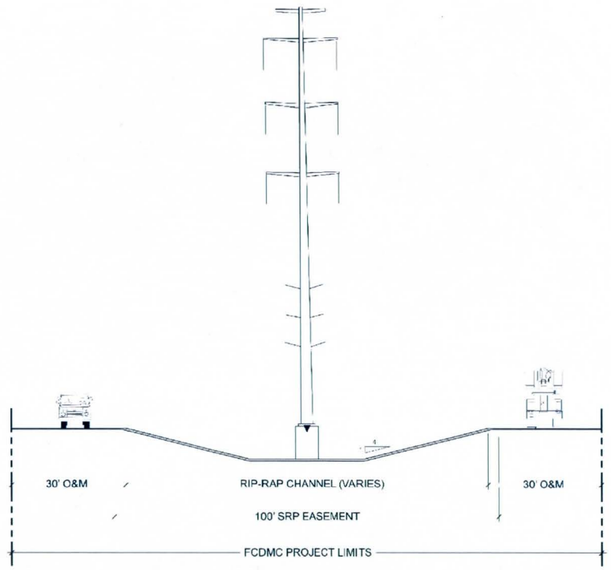
3:1 RIPRAP CHANNEL NO LANSCAPE



4:1 RIPRAP CHANNEL W/ DUAL LANDSCAPE BUFFERS



2:1 RIPRAP CHANNEL W/ DUAL LANDSCAPE BUFFERS



RIPRAP CHANNEL W/ SRP EASEMENT

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PLAN LEGEND

LOCATION MAP

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FIGURE AD 3.1.2
TYPICAL CROSS SECTIONS

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
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LEGEND

- Project Boundary
- Future SR 24 Alignment

Drainage Zones

- SR 24 System
- Ellsworth System
- Rittenhouse System

LOCATION MAP

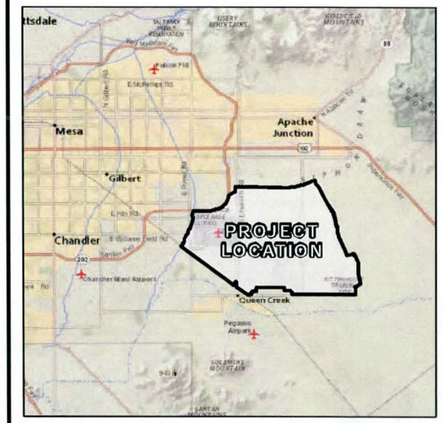

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FIGURE AD 3.2
DRAINAGE ZONES

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EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

LEGEND

- Stock Pond
- Culvert
- Channel - FCDMC
- Channel - Unknown Condition
- Embankment - FCDMC
- Embankment - Unknown Condition
- Future SR 24 Alignment
- Project Boundary
- Corporate Boundary
- County Boundary

LOCATION MAP

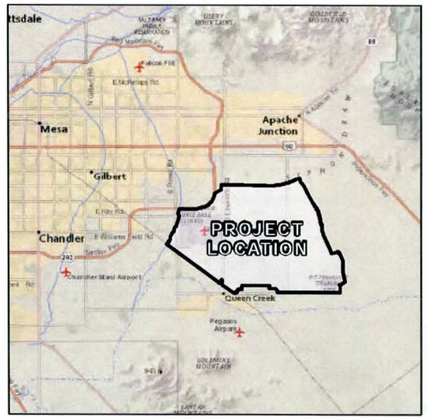

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FIGURE AD 3.2.1
EXISTING DRAINAGE FACILITIES

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EAST MESA AREA DRAINAGE MASTER PLAN UPDATE FCD 2011C017

Flood Control District of Maricopa County

PLAN LEGEND

- Proposed Channel Alignment (SR 24)
- Landscape Inventory Analysis Compatibility
  - Compatible
  - Incompatible but Mitigated
- Ellsworth Zone Alternative Feature
  - Upgrades to Ellsworth System
  - Proposed Culvert (SR 24)
  - Proposed Basin (SR 24)
  - Future Roadway
  - Parcels
  - Existing Runway Protection Zone
  - Ultimate Runway Protection Zone
  - Future SR 24 Alignment
  - Existing Channel
  - Water
  - Sewer
  - Storm Drain
  - Irrigation
  - Gas
  - Overhead/Underground Electric
  - Fiber Optic
  - Telephone

DETAIL LEGEND

- Movable Bed Channel
- Landscape Swale
- Landscape Setback
- O&M Road
- Future Roadway
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground
- Fiber Optic
- Telephone

LOCATION MAP

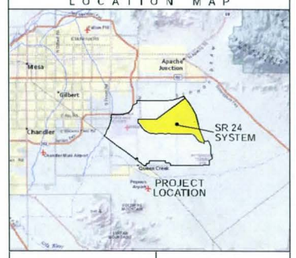

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FIGURE AD 3.2.2
SR 24 SYSTEM
ALTERNATIVE 1

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

Flood Control District of Maricopa County

PLAN LEGEND

Proposed Channel Alignment (SR 24)

Landscape Inventory Analysis Compatibility

- Compatible
- Incompatible but Mitigated

- Ellsworth Zone Alternative Feature
- Proposed Culvert (SR 24)
- Proposed Basin (SR 24)
- Future Roadway
- Parcels
- Existing Runway Protection Zone
- Ultimate Runway Protection Zone
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

DETAIL LEGEND

- Movable Bed Channel
- U/S Swale
- U/S Setback
- O&M Road
- Future Roadway
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

Detail 1
Movable Bed Channel

VARIES 130' - 160'

VARIES 95' - 125'

Detail 2
Movable Bed Channel

VARIES 125' - 155'

VARIES 90' - 120'

ROW = 130'

ROW = 160'

ROW = 135'

ROW = 155'

ROW = 125'

47 AF

135 AF

170 AF

Powerline Floodway

Ellsworth Channel

Williams Field Rd

Pecos Rd

Germann Rd

Signal Butte Rd

Meridian Rd

Ellsworth Rd

Crismon Rd

Vineyard Rd

BD218 LLC

ELLSWORTH ROAD 29 LLC

ELLSWORTH ROAD 30 LLC

PRAIRIE DOG INVESTMENTS III LLC

DMB MESA PROVING GROUNDS LLC

ARIZONA DEPARTMENT OF TRANSPORTATION

WILLIAMS GATEWAY AIRPORT AUTHORITY

PACIFIC PROVING LLC

PULTE HOME CORPORATION

DEMURO PROPERTIES

TUCKER PROPERTIES LTD

NAEGELI BRUCE A

PW INDUSTRIAL HOLDINGS LLC

CRM OF AMERICA HOLDINGS LLC

LEGACY BANK

FOOTHILLS PLAZA IV LLC

TRW VEHICLE SAFETY SYSTEMS INC

COMMERCIAL METALS COMPANY

EG160 LLC

D&M INVESTMENTS LLC

HARRIS CATTLE CO

JOHNSON ERNEST F JR/ANN TR/FULLER DONALD/KAY

ALLISON CRAIG TR/FIRST TRUS CO OF ONAGA ETAL

RSF PROPERTY LLC

RSF QUEEN CREEK PROPERTY LLC

JORDE FARMS INC

VLACHOS ENTERPRISES LLC

OCNIKO W LLC

OCNIKO I LLC

BARNEY NEWELL A/K/A THERINE M TR/KENNETH/GAIL A

BARNEY NEWELL/KATHERINE TR/KEN/G/P TR/ETAL

QUEEN CREEK TOWN OF

ZIMMERMAN LAND LLC

CHURCH OF JESUS CHRIST LATTER DAY SAINTS

DONOHUE PSHIP II LLP

LOCATION MAP

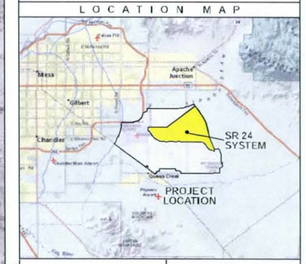

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FIGURE AD 3.2.3
SR 24 SYSTEM
ALTERNATIVE 2

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE FCD 2011C017

Flood Control District of Maricopa County

PLAN LEGEND

Proposed Channel Alignment (SR 24)

Landscape Inventory Analysis Compatibility

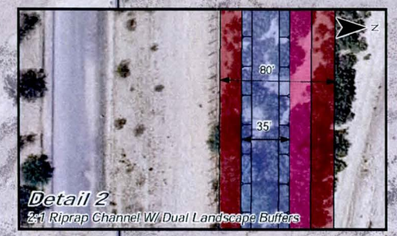
- Compatible
- Incompatible but Mitigated
- Incompatible

- Ellsworth Zone Alternative Feature
- Upgrades to Ellsworth System
- Proposed Basin (SR 24 System)
- Parcels
- Existing Runway Protection Zone
- Ultimate Runway Protection Zone
- Future SR 24 Alignment
- Existing Channel
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

DETAIL LEGEND

- Riprap Channel
- O&M Road
- Landscape Buffer
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

Detail 1
2:1 Riprap Channel No Landscape



Detail 2
2:1 Riprap Channel W/ Dual Landscape Buffers

LOCATION MAP

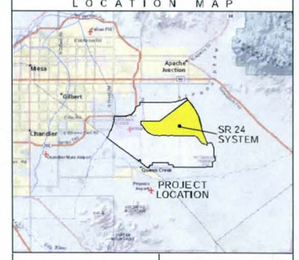


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FIGURE AD 3.2.4
SR 24 SYSTEM ALTERNATIVE 3

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE FCD 2011C017

Flood Control District of Maricopa County

PLAN LEGEND

Proposed Channel Alignment (Ellsworth)

Landscape Inventory Analysis Compatibility

- Compatible
- Incompatible but Mitigated
- Proposed Basin (Ellsworth)
- Future Roadway
- SR 24 Zone Alternative Feature
- Parcels
- Existing Runway Protection Zone
- Ultimate Runway Protection Zone
- Future SR 24 Alignment
- Existing Channel
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

DETAIL LEGEND

- Movable Bed Channel
- Riprap Channel
- Low Flow Channel
- Landscape Swale
- Landscape Setback
- O&M Road
- Future Roadway
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

LOCATION MAP

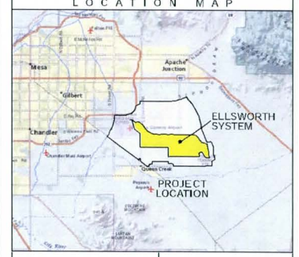

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FIGURE AD 3.2.7
ELLSWORTH SYSTEM
ALTERNATIVE 1

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

Flood Control District of Maricopa County

PLAN LEGEND

Proposed Channel Alignment (Ellsworth)

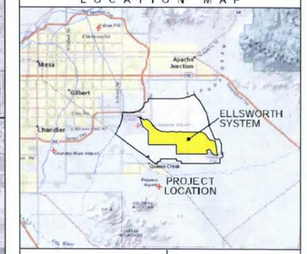
Landscape Inventory Analysis Compatibility

- Compatible
- Incompatible but Mitigated
- Proposed Basin (Ellsworth)
- Future Roadway
- SR 24 Zone Alternative Feature
- Parcels
- Existing Runway Protection Zone
- Ultimate Runway Protection Zone
- Future SR 24 Alignment
- Existing Channel
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

DETAIL LEGEND

- Movable Bed Channel
- Riprap Channel
- Low Flow Channel
- Landscape Swale
- Landscape Setback
- O&M Road
- Future Roadway
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

LOCATION MAP



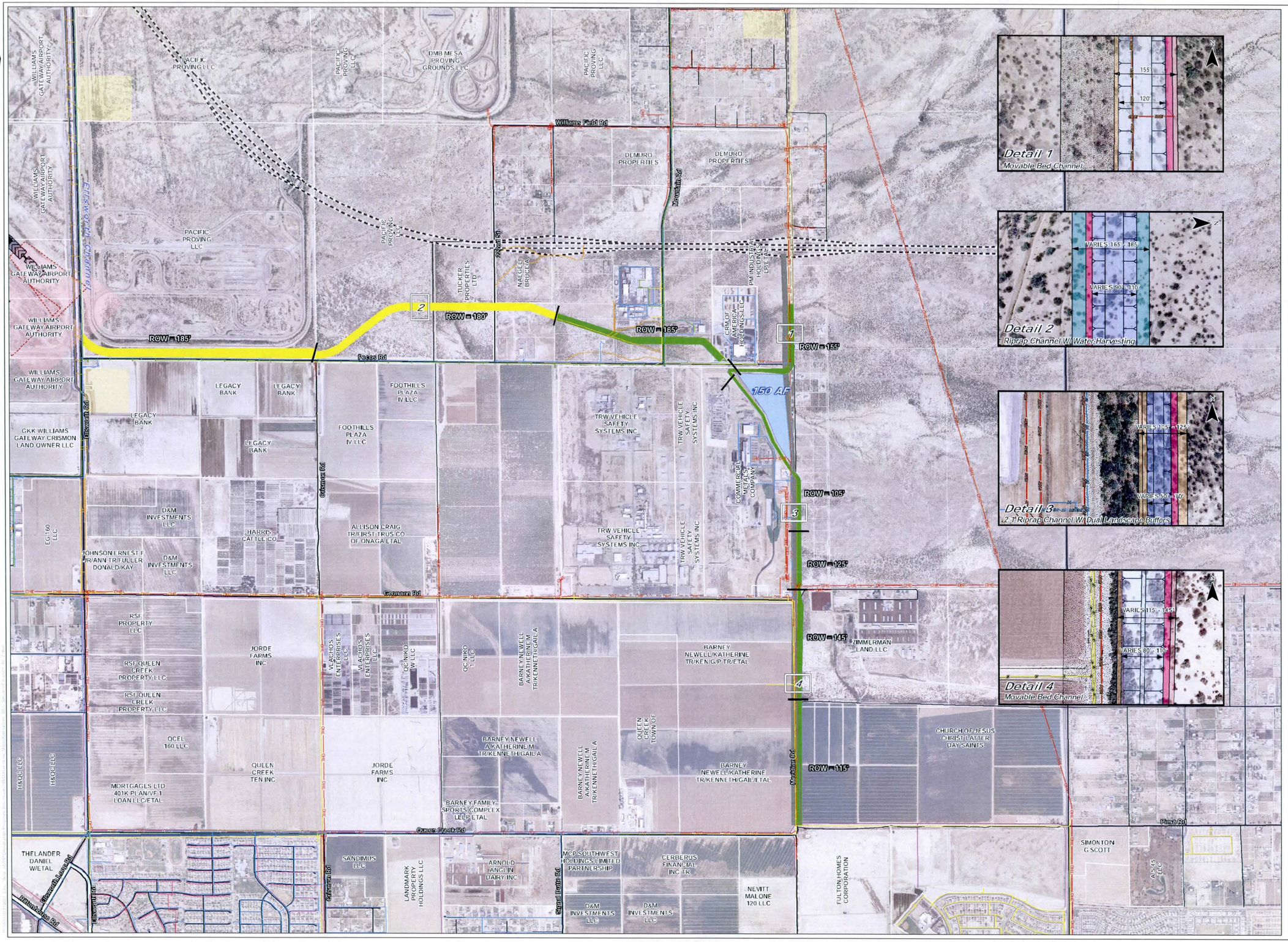


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FIGURE AD 3.2.8
ELLSWORTH SYSTEM
ALTERNATIVE 2

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

Flood Control District of Maricopa County

PLAN LEGEND

Proposed Channel Alignment (Ellsworth)
Landscape Inventory Analysis Compatibility
- Compatible
- Incompatible but Mitigated

- Proposed Basin (Ellsworth)
- Future Roadway
- SR 24 Zone Alternative Feature
- Parcels
- Existing Runway Protection Zone
- Ultimate Runway Protection Zone
- Future SR 24 Alignment
- Existing Channel
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

DETAIL LEGEND

- Movable Bed Channel
- Riprap Channel
- Low Flow Channel
- Landscape Swale
- Landscape Setback
- O&M Road
- Future Roadway
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

LOCATION MAP

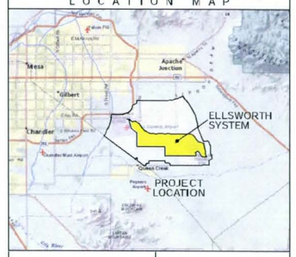

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FIGURE AD 3.2.9
ELLSWORTH SYSTEM
ALTERNATIVE 3

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

Flood Control District of Maricopa County

PLAN LEGEND

Proposed Channel Alignment (Rittenhouse)

Landscape Inventory Analysis Compatibility

- Compatible
- Incompatible but Mitigated
- Incompatible

- Ellsworth Zone Alternative Feature
- Proposed Basin (Rittenhouse)
- Future Drainage Improvements By Others
- Parcels
- Project Boundary
- Existing Channel
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

DETAIL LEGEND

- Movable Bed Channel
- Riprap Channel
- Landscape Swale
- Landscape Setback
- Landscape Buffer
- O&M Road
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

LOCATION MAP

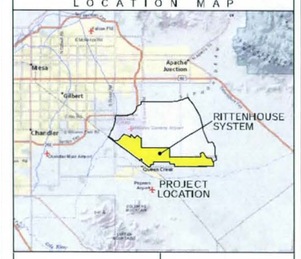

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FIGURE AD 3.2.12
RITTENHOUSE SYSTEM
ALTERNATIVE 1

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE FCD 2011C017

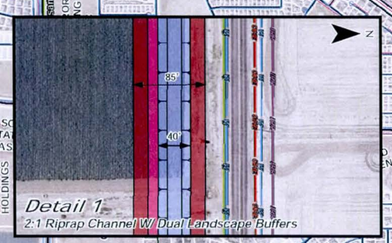
Flood Control District of Maricopa County

PLAN LEGEND

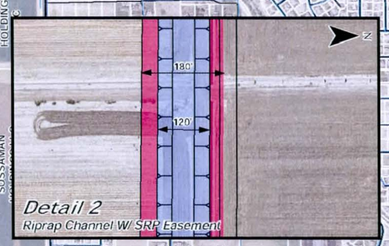
- Proposed Channel Alignment (Rittenhouse)
- Landscape Inventory Analysis Compatibility
  - Compatible
  - Incompatible but Mitigated
- Ellsworth Zone Alternative Feature
- Proposed Basin (Rittenhouse)
- Future Drainage Improvements By Others
- Future Roadway
- Parcels
- Project Boundary
- Existing Channel
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

DETAIL LEGEND

- Riprap Channel
- Landscape Buffer
- O&M Road
- Future Roadway
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone



Detail 1
2:1 Riprap Channel W/ Dual Landscape Buffers



Detail 2
Riprap Channel W/ SRP Easement

Detail 3
4:1 Riprap Channel W/ Dual Landscape Buffers

Detail 4
Movable Bed Channel

LOCATION MAP

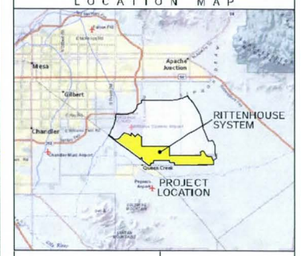


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FIGURE AD 3.2.13
RITTENHOUSE SYSTEM
ALTERNATIVE 2

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

Flood Control District of Maricopa County

PLAN LEGEND

Proposed Channel Alignment (Rittenhouse)

Landscape Inventory Analysis Compatibility

- Compatible
- Incompatible but Mitigated
- Incompatible

- Ellsworth Zone Alternative Feature
- Proposed Basin (Rittenhouse)
- Future Drainage Improvements By Others
- Areas W/ Increased Retention Requirements
- Parcels
- Project Boundary
- Existing Channel
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

DETAIL LEGEND

- Riprap Channel
- Landscape Buffer
- O&M Road
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

Detail 1
2:1 Riprap Channel W/ Dual Landscape Buffers

Detail 2
2:1 Riprap Channel No Landscape

Detail 3
2:1 Riprap Channel W/ Dual Landscape Buffers

Detail 4
Movable Bed Channel

LOCATION MAP

RITTENHOUSE SYSTEM
PROJECT LOCATION

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FIGURE AD 3.2.14
RITTENHOUSE SYSTEM
ALTERNATIVE 3

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

Flood Control District of Maricopa County

PLAN LEGEND

- Proposed Channel Alignment (Rittenhouse)
- Landscape Inventory Analysis Compatibility
  - Compatible
  - Incompatible but Mitigated
- Ellsworth Zone Alternative Feature
- Proposed Basin (Rittenhouse)
- Future Drainage Improvements By Others
- Future Roadway
- Parcels
- Project Boundary
- Existing Channel
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

DETAIL LEGEND

- Riprap Channel
- Landscape Buffer
- O&M Road
- Future Roadway
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

LOCATION MAP

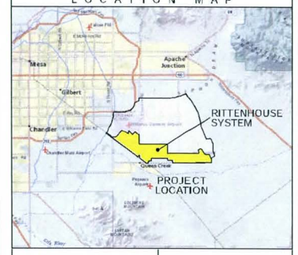

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FIGURE AD 3.2.15
RITTENHOUSE SYSTEM
ALTERNATIVE 4

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

Flood Control District of Maricopa County

PLAN LEGEND

- Proposed Channel Alignment (Rittenhouse)
- Landscape Inventory Analysis Compatibility
  - Compatible
  - Incompatible but Mitigated
- Ellsworth Zone Alternative Feature
- Proposed Basin (Rittenhouse)
- Future Drainage Improvements By Others
- Future Roadway
- Parcels
- Project Boundary
- Existing Channel
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

DETAIL LEGEND

- Movable Bed Channel
- Riprap Channel
- Landscape Swale
- Landscape Setback
- O&M Road
- Future Roadway
- Water
- Sewer
- Storm Drain
- Irrigation
- Gas
- Overhead Electric
- Underground Electric/Conduit
- Fiber Optic
- Telephone

Detail 1
3:1 Riprap Channel No Landscape

Detail 2
Movable Bed Channel

LOCATION MAP

RITTENHOUSE SYSTEM

PROJECT LOCATION

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FIGURE AD 3.2.16
RITTENHOUSE SYSTEM
ALTERNATIVE 5

APPENDIX A. STAKEHOLDER COORDINATION

A.1 Public Stakeholder Meeting Minutes

A.2 Private Stakeholder Meeting Minutes

A.1 Public Sector Stakeholder Meeting Summaries

Agency/Utility	Meeting Date
Group Stakeholder Meeting	4/23/2012
City of Mesa	6/27/2012
Group Stakeholder Meeting	6/28/2012
Salt River Project	8/8/2012
Arizona State Land Department	8/16/2012
Gateway Airport	9/5/2012
Town of Queen Creek	9/10/2012
Arizona Department of Transportation / Town of Queen Creek	12/10/2012
Town of Queen Creek	4/11/2013
Salt River Project	5/29/2013
Town of Queen Creek	6/11/2013
Town of Queen Creek	10/1/2013
Town of Queen Creek	10/23/2013
Town of Queen Creek	11/19/2013

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	April 23, 2012
Job No.:	FCD 2011C017	**Time:**	9:00 a.m.
Subject:	Public Sector Stakeholder Involvement Kick-Off Meeting	**Place:**	FCDMC

The following is a summary of discussion at the public sector stakeholder involvement kick-off meeting for the East Mesa Area Drainage Master Plan (ADMP) Update. The purpose of the meeting was to introduce the project to representatives of agencies that have activities in or regulatory responsibility for the study area and solicit input on storm drainage management solutions. The meeting agenda and list of attendees are attached.

INTRODUCTIONS & PROJECT BACKGROUND

After attendee introductions, Jen Pokorski, project manager for the Flood Control District of Maricopa County (District) presented an overview of the project background, history, and goals. The original East Mesa ADMP was completed in 1998, and a significant portion of the recommended facilities have since been implemented. An update was initiated due to subsequent extensive development, the obligation to reserve capacity in the Powerline Floodway for upstream dam functions, and District jurisdictional decisions to locate all facilities within Maricopa County. Additionally, changes in watershed drainage patterns have exacerbated flooding in some areas.

PROJECT SCHEDULE & MILESTONES

The District recently prepared an update to the hydrologic modeling to account for changes to the watershed. Major milestones for the project include development and evaluation of alternatives (spring and summer 2012, respectively), selection of a recommended alternative (August 2012), and project completion in February 2013.

CURRENT/FUTURE REGIONAL ACTIVITIES, OPPORTUNITIES, & CONSTRAINTS

The study area is divided into four regions. Approximate boundaries are as follows:

- Zone 1: Northern boundary to the Powerline Floodway
- Zone 2: Powerline Floodway to Germann Road
- Zone 3: Phoenix-Mesa Gateway Airport
- Zone 4: Germann Road to southern boundary

Activities, opportunities, and constraints were discussed as follows by region.

Zone 1 Activities

SR 24. ADOT reported that the first mile of the SR 24 (Gateway Freeway) is now under construction. The first segment extends southeast from SR 202 to Ellsworth Road. The freeway drainage system includes an interceptor/conveyance channel on the north side of the freeway with detention basins at Ellsworth and SR 202. The outfall is to the existing Loop 202 drainage system. This phase of the new freeway will be constructed within 18 months.

MCDOT Bridges. MCDOT has a combination of a bridge and a box culvert at Meridian Road at the Powerline Floodway. The bridge spans the floodway, while the culvert passes surface drainage north of the floodway under the road.

ASLD. Arizona State Land Department (ASLD) does not have a specific land development plan for the Pinal County portion of the upstream watershed. However, the area has high potential for future development. *An email request for ASLD's most recent planning information should be sent to Manny Patel.*

Zone 2 Activities

SR 24. Pre-design (15%) of the next phase, from Ellsworth Road to Ironwood Road) is complete Construction is expected to begin after 2020; the timeline will be updated in July 2012. The design phase typically begins one to two years prior to construction.

Three alternative alignments of the Pinal County portion of the freeway have been identified, but a recommended alignment has not been selected yet. ADOT noted that it is important to avoid showing an alignment east of Ironwood on any exhibits since the final alignment has not been selected. Javier Gurrola, ADOT, may be contacted for additional information on that segment. Additionally, he may have information on the North/South Corridor Study from Coolidge/Eloy to Apache Junction.

Generally, ADOT freeways are designed to allow the 50-year storm to pass. However, if the freeway intercepts offsite drainage from a large area, the 100-year storm may be used in the design criteria. J2 Design is a drainage subconsultant on the freeway design team and will *provide the drainage design criteria.*

ADOT may be amenable to a future Intergovernmental Agreement (IGA) to coordinate drainage needs along the Gateway Freeway. If the East Mesa ADMP Update identifies a mutual benefit to combining drainage solutions along the freeway corridor, the effort should be coordinated with Ron McCulley (ADOT), AECOM (ADOT managing consultant), and Arizona State Land Department (ASLD). ASLD is also interested in the potential for drainage partnerships in developing regional solutions.

Meridian Road Corridor. ADOT has recently initiated a Planning Assistance for Rural Areas (PARA) study for Meridian Road with Pinal County and Apache Junction. Charla Glendening is the ADOT contact and Mike Sabatini, Michael Baker, Jr., is the consultant project manager. The extents of the study were not identified.

MCDOT has also initiated a study for Meridian Road. TY Lin is the consultant project manager. *The limits of the study were not identified.*

Pinal County noted the lack of development activity within its portion of the watershed and lack of transportation planning funds. The absence of development and shortage of funds dictate that transportation or drainage partnering opportunities along Meridian Road is a low priority for Pinal County.

Central Arizona Project. The CAP has recently constructed a 60-inch diameter turnout south of the Powerline Floodway. No drainage issues were identified along the CAP Canal within the project study area. Recharge basins are planned adjacent to the canal; however, they will be located south of the study area.

Mountain Road Corridor. MCDOT recently initiated roadway and drainage improvements along Mountain, Erie, and Galveston roads. The area was previously evaluated for improvements in response to neighborhood flooding complaints after Earie Street was paved. However, the improvements recommended in the evaluation had not been constructed. Leon Adair is the MCDOT project manager, and Raj Shah, Ritoch-Powell & Associates, is the consultant project manager. The current project design includes elevating Mountain Road and installing a culvert north of Williams Field Road. In addition, the existing channel along Erie Street from Meridian Road alignment to Mountain Road will be improved along with driveway crossings. The design is expected to be complete by the end of June 2012. Construction will begin in late July 2012.

Signal Butte Road Corridor Improvements Study. MCDOT conducted this study recently; EPS was the prime consultant and JE Fuller was a subconsultant. The MCDOT project manager was Denise Lacey was MCDOT. The limits of the corridor study were not identified.

Ironwood Road. It was noted that past improvements to Ironwood Road within the study area raised the road elevations. ASLD indicated that a hydrologic study was conducted and accounted for the corresponding impedance to natural drainage patterns.

Levees and Diversions. Several levees and diversions were noted on ASLD land in the southeastern portion of Zone 2, as well as the eastern portion of Zone 4. The structures may not have been engineered and may not be legal. The structures have a significant impact on drainage patterns. The lack of design and maintenance raise the probability of failure, so it is important to understand the impact on downstream drainage behavior for in-place conditions as well as if the berms were to fail. ASLD suggested that the project team *send an email request for more information on the history and status of the structures*. The District had determined that the levees and diversions in the eastern portion of the study area within Pinal County do not have a significant impact on the regional drainage analysis performed in advance of this project.

Zone 3 Activities

Zone 3 is the Phoenix-Mesa Gateway Airport, and since the airport has its own drainage plan, no additional regional facilities are needed. Therefore, Zone 3 activities and drainage issues are excluded from the project planning area and were not discussed.

Zone 4 Activities

Germann Road Corridor Study. Wilson & Company is currently conducting a study along Germann Road from Powerline Road to Meridian Road under ADOT's PARA program. A roadway centerline has been identified for a six-lane arterial roadway, and alternatives will be developed by the end of May 2012. The project will be completed in August 2012.

Flooding issues were identified in the vicinity of Ellsworth and Germann Roads.

Pinal County. The portion of Zone 4 within Pinal County has experienced some large-lot development. A channel was constructed as part of a subdivision that empties onto vacant land.

Queen Creek. The Town of Queen Creek was asked about opportunities to co-locate detention basins with future parks. Chris Dovel said that a municipal park is planned on town-owned land along Queen Creek Road east of Signal Butte Road, designated as East Park in the Town's Five Parks Master Plan. The Town has been approached to shift the park site to a parcel north and east of the Barney Family Sports Complex at Queen Creek and Merrill Roads. If this occurs, the town parcel would change ownership and land use as part of a land trade. The Town might be willing to discuss potential partnerships for co-locating retention with the park; other Town staff would provide additional input on this possibility.

Depending on the locations, trails may also be possible along drainage channels. Queen Creek has a trails master plan showing trails along arterial roads, washes, and other locations. However, funding for trail construction within the study area is not currently identified in the Five-Year Capital Improvement Projects budget. The trails master plan is intended as a guide for development.

FUTURE MEETINGS

Additional stakeholder meetings will be held to present and discuss proposed alternatives in early June 2012 and to present a draft recommended alternative in August 2012.

OTHER

Because of land value, ASLD prefers to avoid locating detention basins on arterial corners where commercial interest would be high.

ACTION ITEMS

The following action items were assigned:

Action Item	Responsible Party
Send an email request to Manny Patel for ASLD's most recent planning information.	Entellus
Send an email request to Manny Patel for information on the history and status of existing levee/diversion structures in the southeast portion of the study area, primarily along Meridian Road (Zone 4).	Entellus
Collect information from TY Lin/MCDOT on the corridor study for Meridian Road.	Entellus
Provide drainage design criteria for SR24 between Loop 202 and Ironwood Road.	J2

The preceding summary was prepared by Laurie Miller. Attendees were asked to report any discrepancies and/or omissions within one week of the May 4th distribution date.

c: Attendees

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	June 27, 2012
Job No.:	FCD 2011C017	**Time:**	2:30 p.m.
Subject:	Coordination Meeting	**Place:**	City of Mesa

Attendee	Affiliation	E-mail
Jen Pokorski	FCDMC	jmp@mail.maricopa.gov
Stephen Ganstrom	City of Mesa	stephen.ganstrom@mesaaz.gov
Hernan Aristizabal	Entellus	ahernan@entellus.com
Laurie Miller	LTM Engineering	miller@LTMengineering.com

The following is a summary of a meeting to discuss preliminary alternatives for the Mesa Area Drainage Master Plan (ADMP) Update.

SR-24 Zone

Alternative 3 was discussed, which includes a 10-year level of protection for the Mountain Road area, coupled with floodplain delineations. The City noted that the use of floodplain delineations should be maximized for areas that are not part of a master planned community so that residents have information on their potential flood risk.

Ellsworth Zone

The City is concerned with deficiencies in the extension of Ellsworth Channel at its south end. If a regional facility is needed to handle runoff, the channel should be extended to the south.

Alternatives 2 and 3 include alignments of a channel along Pecos Road that are offset from the road. These "off-road" configurations lend themselves to shared-use recreational facilities such as trails.

The preceding summary was prepared by Laurie Miller.

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	June 28, 2012
Job No.:	FCD 2011C017	**Time:**	9:00 a.m.
Subject:	Public Sector Stakeholder Involvement Meeting #2	**Place:**	FCDMC

The following is a summary of discussion at the public sector stakeholder involvement meeting to present draft alternatives for the East Mesa Area Drainage Master Plan (ADMP) Update. The purpose of the meeting was to solicit feedback on the alternatives from representatives of agencies that have activities in or regulatory responsibility for the study area. The following attachments are included: meeting agenda, list of attendees, and handouts of alternatives and descriptions.

INTRODUCTIONS & PROJECT BACKGROUND

After attendee introductions, Jen Pokorski, project manager for the Flood Control District of Maricopa County (District) presented an overview of the project background and goals. The original East Mesa ADMP was completed in 1998, and a significant portion of the recommended facilities have since been implemented. An update was initiated due to subsequent extensive development, reserve capacity obligations in the Powerline Floodway for upstream dam functions, and District jurisdictional decisions to locate all facilities within Maricopa County. Additionally, changes in watershed drainage patterns have exacerbated flooding in some areas.

PROJECT UPDATE

The District previously prepared an update to the hydrologic modeling to account for changes to the watershed. The consultant team has completed its data collection and evaluation tasks and has developed draft alternatives for further analysis. Throughout the summer, the consultant team will evaluate the alternatives and select a preliminary recommended alternative in September 2012. The recommended alternative will be refined as necessary and per stakeholder and public input, and the project completion is scheduled for February 2013.

PRESENTATION OF ALTERNATIVES

Jen Pokorski introduced the alternatives, which are depicted within three geographic zones:

- SR 24 System: Powerline Floodway to the future SR 24 freeway channel

- Ellsworth System: future SR 24 freeway channel to Germann Road (Maricopa County) and Queen Creek Road (Pinal County)
- Rittenhouse System: Germann Road (Maricopa County) and Queen Creek Road (Pinal County) to southern study boundary

It was noted that the study area north of the Powerline Floodway is being evaluated separately by others. Problems identified for this area are limited to two crossings in Maricopa County and one in Pinal County. The District is working with the adjacent landowner and evaluating its policies on capacity reserves to convey impounded water from the upstream Powerline, Vineyard Road, and Rittenhouse Flood Retarding Structures to mitigate capacity concerns with the Powerline Floodway.

SR 24 System

The interceptor channel planned as part of the future SR 24 freeway forms the backbone of the north portion of the study area and is common to all alternatives of all systems. The design capacity is the 100-year storm. Alternatives for this zone are focused on solving existing drainage and roadway access issues along Mountain Road, Erie Street, and Galveston Road. Input on the alternatives presented included:

- Approach downstream landowners such as DMB and Harvard Investments who would benefit from upstream channels along Meridian Road and west toward the future SR 24 channel. Since they would benefit from the improvements, they could be approached to help fund design and construction.
- ASLD is concerned with the location of a channel along Meridian Road and what agency(ies) would be impacted/what are the funding sources since the alignment is along the Maricopa/Pinal county line.
    - Tom Narva noted that a similar situation was encountered along Sonoqui Wash west of Power Road to Ocotillo Road. The issue was resolved by joint right-of-way dedication by adjacent property owners that was wide enough to accommodate both the roadway and drainage channel.
- ASLD suggested that a partnership with property owners could be formed to fund a regional channel along Meridian Road in exchange for relaxing onsite retention requirements for adjacent properties.
- A potential implementation approach could be to form a formal drainage improvement district with affected parties.
- Alternative 3: upsize the channel along Williams Field Road to achieve a 100-year capacity.
- Observation: the Mountain Road area is single-lot development that did not account for drainage needs. The lack of infrastructure is a local problem and the solution should not be subsidized by public funding.

- Alternative 3 (10-year facilities and 100-year floodplain delineations) does not address regional issues.

Ellsworth System

- Alternative 1: A question arose on potential issues with locating a detention basin at the end of the Phoenix-Mesa Gateway Airport runway. The concern is the potential to attract birds within the airport bird strike zone. The project team will coordinate directly with Phoenix-Mesa Gateway Airport to determine any constraints on design and/or location of a detention basin in the vicinity of the airport.
  - A shallow detention basin at the end of the Phoenix-Mesa Gateway Airport runway may be acceptable since it would drain quickly. Additionally, the basin location is attractive because it is within the high noise contours of the runway zone.
- A question arose on assumptions made for the presence or absence of existing non-engineered berms in the southeastern portion of the study area. Hernan Aristizabal noted that the berm near Meridian Road does impact drainage patterns within Maricopa County; however, the berm near the abandoned airfield is far enough upstream that its presence or absence does impact the drainage patterns within Maricopa County.
- Alternative 3: The alignment cuts through ASLD land and would therefore adversely impact the property value.
- Need to follow up with Queen Creek regarding the interest in agricultural preservation.
- Need to follow up with Queen Creek regarding acceptability of co-locating parks and detention basins.

Rittenhouse System

- Alternative 2: It was noted that the alignment of Signal Butte Road between Germann and Queen Creek roads may shift to the Meridian Road alignment in the future. Therefore, the alignment of proposed conveyances may need to shift accordingly.
- Alternative 2: It was noted that SRP has an approved alignment for its future large-capacity Abel-Moody transmission line. A portion of the future transmission follows the Ryan Street alignment between Germann and Queen Creek roads. This is the approximate location of a proposed conveyance; therefore, it may offer an opportunity to co-locate the two facilities. (*Note: details may be found at the link below*)

  http://www.azpower.org/abelmoody/pdf/AMroutemap1009revised.pdf

- SRP has recently sold a 50-foot easement to El Paso Gas along Queen Creek Road. It follows Rittenhouse Road to from Queen Creek Road to Sossaman Road. Since development would be restricted within the easement, this could provide an opportunity to preserve adjacent land along Rittenhouse Channel as a flooding buffer to address capacity issues.
- ASLD prefers that channel alignments be located along planned arterial roadways rather than at an offset to avoid bisecting parcels.
- Need to collect information on the planned Signal Butte Road alignment.
- Non-profit organizations may provide a source of funding to help offset lost tax revenue where agricultural preservation is implemented.

FUTURE MEETINGS

An additional stakeholder meeting will be held in mid-September to present and discuss the draft recommended alternative. A final meeting will be held to present the final recommended alternative before February 2013.

OTHER

The City of Mesa was unable to attend the stakeholder meeting. Stephen Ganstrom provided the following input on June 27, 2012:

- SR-24 System, Alternative 3: The City requires master-planned developments to delineate 100-year floodplains onsite and design the subdivisions accordingly. However, there may be a gap in areas where single-lot development occurs. Therefore, the City is interested in maximizing areas to be delineated that are outside a master-planned community.
- Ellsworth System: The existing Ellsworth Channel ends just south of Pecos Road. Analysis of the alternatives should include evaluating whether or not a channel extension is hydraulically necessary for a regional drainage solution. If so, the extension should be included in the alternatives.
- Ellsworth System, Alternatives 2 and 3: The conveyance alignment is offset from the arterial street (Pecos Road). The City recently established a preference to locate shared-use facilities such as drainage conveyance/trails in residential areas rather than along transportation corridors. Therefore, the alignments of Alternatives 2 and 3 would better meet its shared-use objective than Alternative 1.
- Rittenhouse System: Similar to the comment on the Ellsworth System alignments, Alternative 2 is more compatible with the City's shared-use objective than Alternatives 1 or 3.

ACTION ITEMS

The following action items were assigned:

Action Items	Responsible Party
Coordinate detention basin locations and potential design constraints with the Phoenix-Mesa Gateway Airport.	Entellus/LTM
Obtain alignment data on the future Signal Butte Road between Germann and Queen Creek roads.	Entellus
Meet with the Town of Queen Creek regarding the acceptability of agricultural preservation and co-location of parks and detention basins.	Entellus/EPG/LTM

The preceding summary was prepared by Laurie Miller.

c: Attendees

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	August 8, 2012
Job No.:	FCD 2011C017	**Time:**	1:00 p.m.
Subject:	SRP Coordination Meeting	**Place:**	FCDMC

Attendee	Affiliation	E-mail
Jen Pokorski	FCDMC	jpm@mail.maricopa.gov
Bill Johnsen	SRP	Bill.Johnsen@srpnet.com
Mike Voda	SRP	Michael.Voda@srpnet.com
Tom Novy	SRP	Tom.Novy@srpnet.com
Hernan Aristizabal	Entellus, Inc.	ahernan@entellus.com
Laurie Miller	LTM Engineering, Inc.	miller@LTMengineering.com

The following is a summary of the meeting with SRP to discuss coordination of utility corridors and partnering opportunities within the East Mesa Area Drainage Master Plan (ADMP) Update.

Abel-Moody Power Transmission Line

SRP has been granted a Certificate of Environmental Compliance for its proposed 230 kV power transmission line. A 250-foot corridor has been approved, and SRP is in the process of obtaining a 100-foot wide utility easement within the approved corridor. A segment of the future power line is along the Ryan Road alignment in Queen Creek, which coincides with Alternative 2 of the Rittenhouse System, which is being evaluated as a potential solution to the portion of the study area that drains to the Rittenhouse Channel (Attachment 1).

SRP noted the following:

- Along the Ryan Road alignment, SRP intends to secure a 100-foot easement on the south side of this ½ section line. Currently, the Town of Queen Creek is considering requiring a 40-foot right-of-way dedication from the landowners to the south for roadway construction and an additional 8-foot utility easement. If the road is improved, SRP will locate its 100-foot power line easement adjacent to the roadway/utility easement. If the Town does not require extension of Ryan Road, SRP's easement will be taken from the centerline of the Ryan Road alignment.
- Fulton Homes plans to develop the south side of Ryan Road between Ellsworth and Hawes Roads. Its current development plan shows a 100-foot allowance for the SRP easement, but Fulton Homes has asked the Town to forego the Ryan Road extension since its development plan has no ingress/egress along Ryan

Road. The Town is expected to make a decision on Ryan Road by the end of the year.

- The current estimate for construction of the Abel-Moody Transmission Line is 2018 or 2019; the timeframe will depend on power needs for the area.

Partnering Opportunities and Constraints

It was agreed that there may be potential partnering opportunities between the District and SRP regarding co-location of the Abel-Moody Transmission Line with drainage conveyance and/or detention facilities. The following considerations were noted:

- SRP secures perpetual easements only for 230 kV lines rather than land in fee.
- SRP requires flat, clear work areas (work pads) 100' x 100' with the transmission pole centered on the pad. However, if 30-foot access roads were provided on each side, the clear pad dimensions could be reduced, provided that the pole foundations were extended to account for increased load from channel flow.
- Allowable landscaping within the SRP easement would be limited primarily to ground cover and low-growth desert trees. Hard structures are limited to areas that would not impede access for maintenance.
- Detention basins and channels would require access ramps at 10H:1V.
- Channels may require erosion protection due to the anticipated velocity range of 5-6 fps.
- If culverts were used to convey runoff underneath the transmission pole pads, they would need to be designed to withstand the bearing pressure of the vehicular equipment (outriggers) and pole. Additionally, any additional costs incurred by SRP as a result of the culverts would be borne by the District.
- SRP has funding available for early-easement acquisition; however, the District does not.

Other partnering opportunities were discussed for the Rittenhouse corridor which includes the road, drainage channel, and railroad. SRP intends to construct power lines along the corridor. Similarly, the District is interested in maximizing its drainage channel capacity through the use of adjacent open space as overflow. SRP noted that it is constrained at the Rittenhouse Channel / East Maricopa Floodway confluence (railroad at Power Rd and railroad at Sossaman) and is interested in working with the District to develop a compatible solution.

Potential Conflicts with Existing SRP facilities

Hernan Aristizabal noted locations along the Meridian Road alignment where a new drainage channel may interfere with existing SRP transmission lines. SRP noted that the lines in question are 69 kV, which require a 30-foot easement. If SRP is required to move any poles, the District would need to pay for the relocation and provide a new easement

in perpetuity with SRP as the primary utility on the easement. Jeff Wruble with SRP can assist Entellus with estimating relocation costs.

Action Items

SRP has collected detailed property ownership information in the vicinity of the Abel-Moody Transmission Line and offered to make it available.

SRP will provide contact information for Fulton Homes.

SRP will provide sketches of potential transmission line alignments.

Hernan Aristizabal will coordinate with **Jeff Wruble**, **SRP**, in estimating relocation costs for the 69 kV power lines.

Jen Pokorski will provide additional information to SRP on permitting requirements for installation of power poles along the Rittenhouse Channel corridor and the East Maricopa Floodway.

The preceding summary was prepared by Laurie Miller.

c: Attendees

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	August 16, 2012
Job No.:	FCD 2011C017	**Time:**	10:00 a.m.
Subject:	ASLD Coordination Meeting	**Place:**	ASLD

Attendee	Affiliation	E-mail
Jen Pokorski	FCDMC	jpm@mail.maricopa.gov
Lillian Moodey	ASLD	Lmoodey@azland.gov
Manny Patel	ASLD	Mpatel@azland.gov
Adam Sharp	ASLD	Asharp@azland.gov
Ruben Ojeda	ASLD	Rojeda@azland.gov
Simon Pratt	Baker	Spratt@mbakercorp.com
Mike Sabatini	Baker	Michael.Sabatini@mbakercorp.com
Hernan Aristizabal	Entellus	ahernan@entellus.com
Laurie Miller	LTM Engineering	miller@LTMengineering.com

The following is a summary of a meeting with the Arizona State Land Department (ASLD) to discuss future drainage and transportation corridors and partnering opportunities within the East Mesa Area Drainage Master Plan (ADMP) Update study area. The agenda, attendance sheet, and handouts are attached.

Project Background

Jen Pokorski, project manager for the Flood Control District of Maricopa County (District), noted that Entellus was retained to update the East Mesa ADMP, originally developed in 1998. The update was initiated due to significant changes in the watershed and ongoing flooding concerns within the study area. Additionally, rainfall data has recently been updated and new mapping is available.

Significant flooding in Maricopa County has occurred in the Mountain Road area and along Pecos and Germann Roads at the Meridian Road alignment. The runoff originates in Pinal County and crosses into Maricopa County at Meridian Road. The need for constructing drainage infrastructure is immediate due to active flooding; however, actual implementation will be contingent on funding partnerships.

Concurrently, the Arizona Department of Transportation (ADOT) has retained Michael Baker Corporation to perform a transportation study along Meridian Road between McDowell and Germann Roads. The corridor study is funded through ADOT's Planning Assistance for Rural Areas (PARA), with Pinal County and the City of Apache Junction as participating jurisdictions. Mike Sabatini is Baker's project manager for the Meridian Road Corridor Study.

Preliminary ADMP Alternatives

Hernan Aristizabal, project manager for Entellus, presented preliminary alternatives under consideration. Three alternatives have been developed for each of three geographical areas:

SR 24 System: areas north of the future SR24 alignment (runoff to be captured by the future SR 24 interceptor channel)

Ellsworth System: area between the future SR24 alignment and Germann Road (drains to the Ellsworth Channel)

Rittenhouse System: southern portion of the study area (drains to the Rittenhouse Channel)

All three systems impact state trust lands along Meridian Road alignment. The majority of adjacent land on the east side within the study area is held in trust. On the west side, the adjacent land is privately owned and is substantially more developed. It was noted that 70 feet of street right-of-way has been secured along portions of the Maricopa County side, though not along the entire length of the corridor. These existing right-of-way segments would be used for the future road, but additional land will be required for roadway right-of-way and drainage easement. Mike Sabatini noted that securing right-of-way for the entire length of the corridor will be a study recommendation.

Segments of the Meridian Road drainage improvements under consideration include routing the channel alignment eastward around existing private development in Pinal County near Williams Field Road. Development has occurred on both sides of the Meridian Road alignment; although the roadway could be constructed between the developments, there is not enough available width to accommodate an adjacent open channel. Alternatively, a straight alignment could be maintained along the section lines and the channel could include a buried box or pipe section in the vicinity of Williams Field Road. ASLD expressed a preference for the underground segment. It was noted that, in addition to being less efficient hydraulically, the offset channel segment would result in a significant increase in land acquisition since the District would be required to purchase any parcels that would be segmented by a shifted channel.

Additionally, the Ellsworth System alternatives include a drainageway along Pecos Road. A parcel of state trust land along the south side of Pecos Road would be impacted by two of the proposed alternatives. ASLD would not support Alternative 3 because it divides this parcel and negatively impacts its viability for future development.

Future Development & Infrastructure Plans along Meridian Road

Mike Sabatini reported that a prior roadway study of Meridian Road by the Maricopa County Department of Transportation (MCDOT) had recommended a six-lane arterial roadway with 130 feet of right-of-way, which includes an on-pavement bike lane and an adjacent sidewalk. The concept design also included a raised median and a 10-year channel to convey road drainage. The MCDOT study acknowledged the improvements recommended in the 1998 East Mesa ADMP, but did not include them as part of the roadway recommendations. The report recommended a series of cross road culverts with 50-year or 100-year designs, depending on the drainage identified.

The current Baker study is based on the same footprint and is centered on the section lines, except in the vicinity of Baseline Road where the section lines are offset. An interchange is planned for access to US 60 from Meridian Road, but implementation of the remainder of the corridor study is indefinite.

ASLD requested additional information on the ADOT Meridian Road Corridor Study. Mike Sabatini will make it available on an ftp site.

ASLD noted the following:

- ASLD has detailed GIS coverage available of lands held in trust. Jen Pokorski will coordinate obtaining the files.
- Based on typical roadway and channel cross sections for Meridian Road provided by Entellus, the overall channel widths along Meridian Road are relatively high due to the inclusion of landscaping and other aesthetic treatments. It was clarified that a moveable bed, i.e., earthen bottom, channel was assumed. ASLD seeks to achieve a balance between aesthetic enhancements with associated greater land requirements and straight, narrower channels with minimal aesthetics.
- The current policy when right-of-way is required along state trust land is to share the burden equally with the adjacent landowner(s). Extenuating circumstances, e.g., the desire to avoid condemnation proceedings against existing development, may warrant a deviation from this policy. However, any such deviation would first require careful study.
- ASLD's preference is to locate a drainage channel adjacent to the roadway rather than shift the channel upstream "behind" future development:
  - Actual development patterns cannot be predicted; therefore, construction of a channel upstream of assumed development could reduce rather than enhance property values when the land is later offered for purchase.
  - Future development adjacent to Meridian Road would still need an outfall for onsite runoff. A channel on the upstream side of the roadway would provide an outfall; a channel located farther upstream would not.
- Manny Patel noted that ASLD would be interested in future development being allowed to drain directly to a channel along Meridian Road with waived retention requirements. Since the area in question is within Pinal County, it would also need to allow such a waiver. Additionally, downstream facilities may need to upsized to accept the runoff directly.
- The current study offers a benefit to ASLD because it eliminates the 1998 recommendation to construct detention basins on state trust land in the vicinity of Pecos Road.
- ASLD would be willing to consider allowing extension of the existing 70-foot Meridian Road right-of-way eastward to accommodate the wider road/channel corridor. However, ASLD would not contribute construction funds.
- The study results should recommend forming a Memorandum of Understanding or Inter-Governmental Agreement between ASLD and the District if partnering opportunities are proposed.

Potential Future Partnering Opportunities

The East Mesa ADMP Update project will select a preliminary recommended alternative in September or October 2012 and will present it to stakeholders, including ASLD, and the public at that time. The project will be complete in February 2013.

The Meridian Road Corridor Study will be completed by December 2012 and will include a public meeting at that time.

Jen Pokorski will contact Michelle Green, ASLD's planner for east Mesa, to discuss future plans for the region.

Summary

ASLD noted the following:

1. A narrower channel cross section is preferred in order to reduce the amount of land required.
2. In developed areas, it is acceptable to analyze extending the existing 70-foot right-of-way along Meridian Road eastward, recognizing that the overall roadway/channel width will exceed 140 feet. In undeveloped areas, the right-of-way would be split evenly between adjacent state trust lands and private owners.
3. Future development on state trust land adjacent to channels along Meridian Road should be allowed to discharge directly in lieu of retaining the 100-year, 2-hour storm.
4. Where possible, proposed channels should not be shifted onto state trust lands.

Action Items

The following action items were assigned:

Action Items	Responsible Party
Obtain GIS shapefiles of state trust lands	Jen Pokorski
Contact Michelle Green for ASLD planning information in east Mesa	Jen Pokorski
Provide information via ftp on the ADOT Meridian Road Corridor Study	Mike Sabatini
Include Ruben Ojeda on future ADMP stakeholder notifications	Laurie Miller

The preceding summary was prepared by Laurie Miller.

c: Attendees

MEETING SUMMARY

Project: East Mesa ADMP Update
Job No.: FCD 2011C017
Subject: Gateway Airport Coordination Meeting

Date: September 5, 2012
Time: 10:00 a.m.
Place: Gateway Airport

Attendee	Affiliation	Phone	E-mail
Jen Pokorski	FCD of Maricopa Co.	602-506-4695	jpm@mail.maricopa.gov
Carmen Williams	Phx-Mesa Gateway	480-988-7705	cwilliams@phxmesagateway.org
Roger Clark	Phx-Mesa Gateway	480-988-7705	rclark@phxmesagateway.org
Tone Steeneck	Phx-Mesa Gateway	480-988-7705	tsteeneck@phxmesagateway.org
Craig Herget	Phx-Mesa Gateway	480-988-7705	cherget@phxmesagateway.org
Ken Snyder	Dibble Engineering	602-957-1155	ken.snyder@dibblecorp.com
Kevin Roberts	Dibble Engineering	602-957-1155	kevin. roberts@dibblecorp.com
Hernan Aristizabal	Entellus, Inc.	602-244-2566	ahernan@entellus.com
Brian Fry	JE Fuller	623-889-0166	brian.fry@jefuller.com
Laurie Miller	LTM Engineering	602-485-5880	miller@LTMengineering.com

The following is a summary of a coordination meeting with Phoenix-Mesa Gateway Airport (PMGA) to discuss potential locations for drainage facilities as part of the East Mesa Area Drainage Master Plan (ADMP) Update and identify constraints due to airport operations and aviation safety regulations.

Future Phoenix-Mesa Gateway Airport Improvements

The PMGA has prepared Gateway 2030, a three-phased plan for future airport expansion and associated surrounding development. Phase I is estimated to be completed by 2017 and Phase II by 2021; however, the implementation schedule is contingent on airport traffic growth. The City of Mesa has identified the Pecos/Ellsworth area is projected to be a major development area. PMGA is working with the City to accommodate planned growth for the region while maintaining safe airport operations. The master plan and other supporting documents are available at:

http://www.phxmesagateway.org/DocumentsAndFormsLibrary.aspx

Considerations for Location of Regional Detention Basins

A portion of the study area contributes runoff collected by the Ellsworth Channel, which borders the airport's east side and crosses the property near its northern boundary. Because of capacity concerns of the Ellsworth Channel, the study team is evaluating potential detention

basin locations to reduce peak discharges in the channel. One location under consideration is near the intersection of Pecos Road. The following constraints were noted:

- The Federal Aviation Administration (FAA) prohibits retention/detention basins in the runway protection zone (RPZ), which includes the area identified at Pecos and Ellsworth Roads. Phoenix-Mesa Gateway Airport is currently working to acquire this property.
- Immediately outside the RPZ, the FAA strongly discourages retention/detention basins.
- The FAA Advisory Circular 150/5200-33B, Hazardous Wildlife Attractants On or Near Airports, provides details on restrictions for storm water detention/retention. It also includes mitigation methods where detention/retention already exists or where unavoidable.

Alternate locations for detention facilities near Pecos/Ellsworth were discussed. Hernan Aristizabal noted that local runoff produces a higher peak discharge to the Ellsworth Channel than that from the upstream watershed. Therefore, locating a detention basin farther east would diminish its effectiveness in alleviating the Ellsworth Channel. However, it is possible that detention could be shifted to the south along Ellsworth Road. The study team will evaluate this option.

Noise Impacts on Surrounding Development

The District requested information on noise contours for use in selecting detention basin sites that would not support development. The PMGA noted that the RPZ and associated building height restrictions in the vicinity of the airport inherently limit nearby development. PMGA will provide the District with shapefiles of noise contours and the RPZ.

Other

Dibble Consulting has been coordinating its drainage analyses for PGMA with Cathy Register at the District.

Action Items

Carmen Williams will provide noise contour and RPZ shapefiles to Jen Pokorski.

The preceding summary was prepared by Laurie Miller. Attendees are asked to advise Laurie within one week of dissemination via e-mail of any discrepancies and/or omissions.

c: Attendees

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	September 10, 2012
Job No.:	FCD 2011C017	**Time:**	1:00 p.m.
Subject:	Queen Creek Coordination Meeting	**Place:**	Town of Queen Creek

Attendee	Affiliation	E-mail
Jen Pokorski	FCDMC	jpm@mail.maricopa.gov
Tom Narva	TOQC	tom.narva@queencreek.org
Chris Dovel	TOQC	chris.dovel@queencreek.org
Wayne Balmer	TOQC	wayne.balmer@queencreek.org
Hernan Aristizabal	Entellus	ahernan@entellus.com
Laurie Miller	LTM Engineering	miller@LTMengineering.com

The following is a summary of a meeting with the Town of Queen Creek to discuss preliminary alternatives for the Queen Creek portion of the East Mesa Area Drainage Master Plan (ADMP) Update study area.

Project Update

Jen Pokorski, project manager for the Flood Control District of Maricopa County (District), provided a summary of three alternatives developed for the Queen Creek portion of the project study area (attached).

Ryan Road Corridor

Alternative 2 includes a channel along Ryan Road between Germann and Queen Creek Roads. The alignment coincides with SRP's future Abel-Moody transmission line. Jen noted that Fulton Homes is opposed to a channel along Ryan Road. SRP would support the alignment with certain restrictions regarding access to its power lines and distance required from the poles. The Town stated that any channel improvements along Ryan Road should be limited to within SRP's 100-foot right-of-way.

Jen asked for an update the status and future plans for improvements to Ryan Road. The only dedicated right-of-way along Ryan Road is on the south side adjacent to Siete Solar. The Town noted that it will be an important collector street. However, it will likely be downgraded to a local collector street (25 feet wide on each side) at its west terminus in the vicinity of La Jara Farms.

Additional Comments on Alternatives

The Town suggested increasing discharge to Germann Road with a comparable reduction of flow to Queen Creek Road. Queen Creek Road is expected to be a high-profile road, while Germann is a

more industrial corridor and would be less impacted. Additionally, the Town would favor limiting the Queen Creek Road channel extension to a terminus at Merrill Road rather than extending it to Meridian Road.

A 10-year solution was discussed in lieu of larger, 100-year conveyances. It was noted that roads would be flooded during larger storms. The Town would not be in favor of this scenario because of the requirement that one lane must remain open for emergency access.

Potential locations for regional detention basins was discussed. The Town stated that a parcel east of Jorde Farms on the north side of Ryan Road may have potential for a detention basin.

The Town would like the District to designate overlays of areas with higher retention. It was noted that the overlay would not have local support.

Other Stakeholders

Jen asked if any other stakeholders should be contacted regarding the ADMP Update. The Town noted that Jorde Farms is in the process of developing San Tan Settings on the west side of Siete Solar. John Whitrock is the contact.

Next Steps

The Queen Creek Planning Commission meets in November to consider an amendment to the General Plan. The Town will discuss the alternatives internally and provide comments after the November meeting.

Post-Meeting Input

Subsequent to the coordination meeting, Wayne Balmer provided the following additional input:

- It is very important to the Town to have an attractive northern entrance to our community - and things like 230 kV transmission lines and 130' drainage channels don't add much to our ambiance as a community.
- In so far as possible we would like any additional channels to be located in areas designated for future employment use and not within or adjacent to residential areas.
- The channel and retention basin west of Ellsworth would likely not be supported by the Town. We are working with Fulton on a compromise with their neighbors to the north on how to make a reasonable transition between the two uses, and the including of a major drainage channel in the SRP easement I don't think will be seen as helping resolve the outstanding issues - especially if it would look anything like the Rittenhouse Channel.
- Rather than having several small basins, I think the Town's preference would be to have one larger basin could be located on the east side of Ellsworth Road between Queen Creek and Germann Roads that could be landscaped and used as a park - like Freestone Park or Discovery Park in Gilbert.
- The channel on Queen Creek Road should remain relatively small and extend east to the northeast corner of Merrill and Queen Creek, linking the channel segments we have already been working on locally.

- The channel on Germann Road between Meridian and Power Road would be relatively low volume, like the one on Queen Creek Road.
- Rather than building another major channel west of Ellsworth Road, the Town would ask the district consider the reconstruction of the existing Rittenhouse Channel in that area.

Action Items

The following action items were assigned:

Action Items	Responsible Party
Review the alternatives internally and provide comments	Town staff
Add San Tan Settings to the list of stakeholders	Laurie Miller

The preceding summary was prepared by Laurie Miller.

c: Attendees

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	December 10, 2012
Job No.:	FCD 2011C017	**Time:**	3:00 p.m.
Subject:	Queen Creek Coordination – Germann Road Corridor Study	**Place:**	Town of Queen Creek

Attendee	Affiliation	E-mail
Jen Pokorski	FCDMC	jpm@mail.maricopa.gov
Afshin Ahouraiyan	FCDMC	afa@mail.maricopa.gov
Tom Narva	TOQC	tom.narva@queencreek.org
Chris Dovel	TOQC	chris.dovel@queencreek.org
Troy White	TOQC	troy.white@queencreek.org
David Williams	TOQC	david.williams@queencreek.org
Brett Anderson	ADOT	banderson@azdot.gov
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Alan Ferreira	Wilson & Co	alan.ferreira@wilsonco.com
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Hernan Aristizabal	Entellus	ahernan@entellus.com
Laurie Miller	LTM Engineering	miller@LTMengineering.com

The following is a summary of a meeting with the Town of Queen Creek, ADOT, and ADOT's consultant for its Germann Road Corridor Study to discuss preliminary alternatives for the Queen Creek portion of the East Mesa Area Drainage Master Plan (ADMP) Update study area.

Meeting Goal

Jen Pokorski, project manager for the Flood Control District of Maricopa County (District), identified the meeting goal is to identify both constraints and opportunities along the Germann Road corridor.

Rittenhouse Zone Alternative 1 – Germann Road Channel and Detention Basin

Alternative 1 includes a large channel along Germann Road and a large regional detention basin at Germann and Ellsworth roads. Hernan Aristizabal noted that the La Jara Farms development has a dedicated drainage easement on the north side (Germann Road).

Two concerns were raised with Alternative 1. First, the available right-of-way along Germann is limited due to existing development. The Germann Road Corridor Study is evaluating the need for future expansion and has not included regional drainage needs in its analysis. Second, the Germann/Ellsworth intersection is envisioned by the Town to be a gateway into Queen Creek from the north, and a large detention basin would detract from that vision. The land value would be high because of future interest in commercial activity, which would preclude a basin location.

Next Steps

The District asked that the Town hold discussions internally and provide direction on its future plans for Germann Road by January 1, 2012.

Action Items

The following action items were assigned:

Action Items	Responsible Party
Provide the Town with cross section information for the Germann Road Channel Alternative 1, right-of-way needs, and the worst-case scenario of homes that would need to be purchased	Hernan Aristizabal
Provide the District with the Town's feedback on alternatives and its vision for Germann Road	Troy White
Provide shapefiles channel extents to Wilson & Co	Hernan Aristizabal
Provide the District with a plot of existing and future right-of-way for Germann Road	Wilson & Co.

The preceding summary was prepared by Laurie Miller.

MEETING SUMMARY

Project: East Mesa ADMP Update
Job No.: FCD 2011C017
Subject: Queen Creek Coordination Meeting

Date: April 11, 2013
Time: 2:30 p.m.
Place: Town of Queen Creek

Attendee	Affiliation	E-mail
Jen Pokorski	FCDMC	jpm@mail.maricopa.gov
Harry Cooper	FCDMC	harryCooper@mail.maricopa.gov
Chris Dovel	TOQC	chris.dovel@queencreek.org
Troy White	TOQC	troy.white@queencreek.org
Ryan Sauer	Entellus	rsauer@entellus.com
Mike Bonar	Entellus	mbonar@entellus.com
Brian Fry	JE Fuller	brian.fry@jefuller.com
John Griffin	EPG	jgriffin@epgaz.com
Laurie Miller	LTM Engineering	miller@LTMengineering.com

The following is a summary of a meeting with the Town of Queen Creek to discuss preliminary alternatives for the Queen Creek portion of the East Mesa Area Drainage Master Plan (ADMP) Update study area. The meeting agenda is attached.

Meeting Purpose

Jen Pokorski, project manager for the Flood Control District of Maricopa County (District), provided a brief summary of progress to date, i.e., three alternatives were developed for the Queen Creek portion of the study area and the Town of Queen Creek (Town) has been holding internal discussions to determine what elements corresponding best with its vision for future development. During this time, the project team has been meeting with developers and other stakeholders in the area, and several have noted strong preferences for or against the three alternatives.

The purpose of the meeting was to identify opportunities and constraints with respect to the Town's planning efforts, obtain consensus on acceptable regional drainage solutions, and identify the desired outcomes of a proposed charrette to build consensus for an acceptable regional drainage plan.

Proposed Stakeholder Charrette

The status of proposed development was discussed. Fulton Homes has obtained preliminary plat approval from the Town, but has not yet submitted a final plat for approval. La Jara Farms, which includes large-lot development, has submitted Phase I only to the District for a drainage permit. The District noted that if no regional drainage solution is adopted (no further action alternative), the proposed Meridian Channel would not be constructed and peak flow rates entering Queen Creek

from the east would be considerably higher. If development occurs in hop-scotch fashion, flooding conditions would be further exacerbated. Jen noted that could decide to require future developments to return downstream discharge to sheet flow conditions to mitigate downstream flooding due to concentrated flow exiting developments.

Elements of the proposed charrette were presented, as shown on the agenda. Three scenarios of revised alternatives were also presented, including (1) a wider, multi-use version of the SRP Abel-Moody transmission power line corridor along the Ryan Road alignment to maximize conveyance, (2) adding regional detention basins to minimize conveyance, and (3) minimizing regional retention basins by requiring new development to retain the 100-year, 2-hour runoff based on the NOAA II Atlas (about 2.7 inches) rather than on the recently-updated NOAA 14 Atlas (reduced to about 2.2 inches).

During the discussions of the new scenarios, it was discovered that the Town had not been aware that one of the original alternatives (Alternative 3) included retaining runoff based on the NOAA II Atlas (2.7 inches). Town staff had noticed reduced peak discharges for Alternative 3, but assumed that it was due to regional detention rather than maintaining the old runoff-volume detention requirements.

Confirmation of Approach and Implications

It was agreed that the format of the Charrette is acceptable; however, consideration would be suspended until the project team has reviewed/verified its new scenarios and the Town could review them. Jen noted that the scenarios presented were "hot off the press" and had not undergone the normal quality control reviews. Therefore, the Town should not use the peak discharges, volumes, or channel and detention basin sizes/configurations at this time.

The Town noted the following:

- Incorporation of multi-use/equestrian trails along the Ryan Road alignment conforms to the Towns parks and trails master plan and provides connectivity to its planned West Park. Therefore, the Ryan Road alignment could be supported.
- The Town's priorities are to limit peak flow rates in the Queen Creek Road Channel to 540 cfs, which is the capacity of the existing portion of the channel.
- The preferred location of the proposed extension of the Queen Creek Road Channel is on the north side of the road. However, both sides should be evaluated, and utility and other constraints should be noted.
- Open-space credits could be offered to developers by the Town as an incentive to a regional drainage solution.
- Troy White and Chris Dovel will discuss the new scenarios internally and develop potential options by April 18th or 22nd.

The District noted the following:

- The project team will evaluate the effect on new development of using higher onsite retention requirements versus current requirements with respect to the relative footprint of land required for each case.
- The project team will conduct its internal quality control of the new scenarios and provide the results to the Town.
- The District will provide the Town with a bullet-point summary description of alternatives.
- All stakeholders affected by any of the three proposed alternatives should be invited to the charrette.

Other

Discussion of the remaining agenda items was postponed pending additional analysis and review of the scenarios.

Action Items

The following action items were assigned:

Action Items	Responsible Party
Provide the Town with a bullet-point summary description of the Queen Creek alternatives	Jen Pokorski
Evaluate the land-area impact of increase retention on new developments versus current requirements.	Entellus
Perform internal review of new scenarios and provide any revisions to the Town	Entellus
discuss the new scenarios internally and develop potential options by April 18th or 22nd	Troy White, Chris Dovel
Expand the stakeholder charrette to include all stakeholders affected by any of the Queen Creek alternatives.	Laurie Miller

The preceding summary was prepared by Laurie Miller. Attendees are asked to advise Laurie within one week of dissemination via e-mail of any discrepancies and/or omissions.

c: Attendees

MEETING SUMMARY

Project: East Mesa ADMP Update
Job No.: FCD 2011C017
Subject: SRP Coordination Meeting

Date: May 29, 2013
Time: 3:00 p.m.
Place: SRP XCUT facility

Attendee	Affiliation	E-mail	
Jen Pokorski	FCDMC	jpm@mail.maricopa.gov	602-506-4695
Mike Voda	SRP	Michael.Voda@srpnet.com	602-236-5122
Bill Johnsen	SRP	Bill.Johnsen@srpnet.com	602-236-8168
Jeff Wruble	SRP	Jeff.Wruble@srpnet.com	602-236-0465
Ryan Adams	SRP	Ralphie.Adams@srpnet.com	602-236-3703
Floyd Hardin	SRP	Floyd.Hardin@srpnet.com	602-236-8327
Jeffrey LeCheminant	SRP	Jeffrey.LeCheminant@srpnet.com	602-236-8065
Hernan Aristizabal	Entellus	ahernan@entellus.com	602-244-2566
John Griffin	EPG	jgriffin@epgaz.com	602-956-4370
Laurie Miller	LTM Engineering	miller@LTMengineering.com	602-485-5880

The following is a summary of the meeting with SRP to discuss modifications to drainage alternatives along the Ball-Pfister 230 kV transmission within the East Mesa Area Drainage Master Plan (ADMP) Update study area. The line was formerly named the Abel-Moody line.

Meeting Purpose

The purpose of the meeting was to present and obtain feedback on modifications to alternatives along the Ryan Road alignment in Queen Creek since our prior meeting in August 2012.

Ryan Road Channel Alternatives

Original Alternative 2. The original alternative along the Ryan Road alignment included a main hard-surface (e.g., riprap) channel within SRP's 100-foot transmission line easement. The channel would be centered under the power lines with a 35-foot maintenance road on each side. Based on input from area stakeholders and the Town of Queen Creek, several variations of this alternative have been developed as follows:

Alternative 2a –Channel Adjacent to SRP Easement. Includes a channel along the Ryan Road alignment, primarily outside the SRP easement. Peak discharges in the Ryan Road channel would be reduced by two off-line regional detention basins located outside the utility easement. The channel would be completely outside of the SRP easement around the poles but would meander in the easement within the poles. Channel side slopes vary from 8H:V1 to 6H:1V.

Alternative 2b – Adjacent Channel with Linear Retention Basins. Includes a series of detention basins within the SRP easement, as well as an adjacent channel outside the

easement. Alternative 2b is the widest of the alternatives, but does not include additional regional detention basins.

Other Configurations. An additional scenario includes a main hardened channel and a second multi-use earthen channel along the Ryan Road alignment. The main channel would be situated on the centerline of the SRP power line.

Another configuration includes an access road on one side only and an earthen channel immediately adjacent to the power line.

A third configuration included a concrete low flow section adjacent to the poles and a single all weather access road.

SRP commented on the revised alternatives and additional scenarios as follows:

- Alternatives
  - A channel adjacent to and outside the SRP easement would not pose any concerns.
  - There is opportunity to accommodate retention/conveyance between the power poles.
  - A scenario could be considered such as keeping SRP facilities above a 50-year channel as long as water depth and channel side slopes do not require fencing.
  - A hardened channel would not allow access to both sides of the poles; therefore, its use would not be acceptable.
  - The power easement will ultimately carry two separate 230kV transmission lines in the upper position and two separate 69kV lines in the lower position on a single pole. Equipment used to access each of the lines (230kV vs. 69kV) is different. The required equipment prohibits locating the poles in the center of the channel.
  - The proposed detention basin at the southwest corner of Signal Butte and Ryan Road alignment is adjacent to the SRP easement, so access and setup to a couple of the proposed poles would be a concern.
- SRP Requirements for Alternatives
  - The power poles must be above the channel water surface elevation. The standard "reveal height" is 2-3 feet. This could be accomplished by elevating the concrete supports under the poles and addressing intermittent flooding during design.
  - Vegetation on the channel side slopes within the 100-foot easement must conform to SRP specifications, i.e., material must be crushable. Requirements are more stringent within a 50-foot distance before and after each pole location for the width of the easement. For example, turf cannot be spray-irrigated.
  - Access ramps must be provided to the poles and to the lines between the poles at no steeper than a driving slope of 10H:1V.
  - The vertical distance between ground surface and 69 kV power lines cannot exceed 85 feet.
  - Irrigation equipment/components is not allowed where SRP needs vehicular access.

- General
  - Trees would not be allowed within the SRP easement; therefore, any trees shown on the cross sections of alternatives within the SRP easement should be removed.
  - SRP noted that Fulton Homes had provided a site plan that included retention basins for its proposed development within the SRP easement. It was not known whether this is the most recent development plan proposed by Fulton Homes.

Development of Hybrid Alternatives

Discussion of alternatives led to the development of a hybrid scenario. Components include a channel whose northern half lies across the southern portion of the SRP alignment at a maximum allowed 20H:1V side slope. The mild slope would not pose vehicular access issues for SRP. The channel cross section would continue south onto adjacent land (outside SRP easement) with a hardened low-flow channel, and the south embankment would rise outside the SRP easement at a steeper slope of 6H:1V. No fatal flaws were identified for this scenario.

The frequency storm that the low flow channel can carry without impacting the SRP easement has not being decided at this time. During the discussion several possibilities where mentioned ranging from 2-year event to a 50 year event.

SRP asked, based on historical records, how many times the capacity of different frequency low-flow portion would have been exceeded if it had been in place. Hernan will research precipitation records in the Queen Creek area and report on the number of times of exceedance.

Ball-Pfister Transmission Line Status

SRP has purchased a perpetual easement along the Siete Solar facility. The timeframe for the line to be in service is between 2018 and 2022.

Other Partnering Opportunities

SRP noted that two of its future poles west of the study area are constrained at the Rittenhouse Channel / East Maricopa Floodway (EMF) confluence (railroad at Power Rd and railroad at Sossaman). SRP is interested in purchasing an easement from the District to install the poles within the EMF embankment. SRP will provide a map of the proposed pole locations, and Jen will discuss permitting and design requirements with District staff.

SRP noted that a gas line crosses its 100-foot easement at the midpoint on the northeast side of Ryan and Rittenhouse Roads.

Action Items

The following action items were assigned:

Action Items	Responsible Party

Meet with District staff on the logistics of SRP obtaining a permit to install transmission poles in the EMF embankment	Jen Pokorski
Prepare cross sections of the proposed hybrid alternative.	John Griffin
Research historical rainfall records compared to low-flow channel exceedance.	Hernan Aristizabal
Prepare meeting summary	Laurie Miller
Provide a drawing of proposed locations of Power Poles #1 and #2 within the EMF embankment	SRP

The preceding summary was prepared by Laurie Miller.

c: Attendees

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	June 11, 2013
Job No.:	FCD 2011C017	**Time:**	6-8 p.m.
Subject:	Ellsworth Mini-Farms Public Meeting	**Place:**	Queen Creek Library

Residents of Ellsworth Mini-Farms were invited to an open-house to discuss alternatives in the Rittenhouse Zone. No comments were made at the meeting.

The preceding summary was prepared by Laurie Miller.

FINAL MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	October 1, 2013
Job No.:	FCD 2011C017	**Time:**	1:30 p.m.
Subject:	Queen Creek Coordination Meeting	**Place:**	Town of Queen Creek

Attendee	Affiliation	E-mail
Jen Pokorski	FCDMC	jmp@mail.maricopa.gov
Doug Williams	FCDMC	daw@mail.maricopa.gov
Chris Dovel	TOQC	chris.dovel@queencreek.org
Chris Anaradian	TOQC	chris.anaradian@queencreek.org
Wayne Balmer	TOQC	wayne.balmer@queencreek.org
Hernan Aristizabal	Entellus	ahernan@entellus.com
Laurie Miller	LTM Engineering	miller@LTMengineering.com

The following is a summary of a meeting with the Town of Queen Creek to discuss the Rittenhouse Zone alternatives for the Queen Creek portion of the East Mesa Area Drainage Master Plan (ADMP) Update study area. The meeting agenda is attached.

Overview of Preliminary Alternatives for Rittenhouse Zone

Jen Pokorski, project manager for the Flood Control District of Maricopa County (District), provided a brief summary on the status of alternatives under consideration for the Rittenhouse Zone, which generally includes the portion of the study area between Queen Creek and Germann roads and between Meridian Road and the existing Rittenhouse Channel. The alternatives were described as follows:

Alternative 4: A regional channel would be co-located with SRP's future transmission line along the Ryan Road alignment. The segment between Signal Butte and Merrill roads would be about 260 feet wide, extending about 160 feet beyond the 100-foot transmission easement. It would narrow to about 160 feet between Merrill and Ellsworth roads. The additional width would need to be acquired from adjacent landowners, either by purchase of the land or of a drainage easement or through developers dedicating the land. The channel was assumed to be fully landscaped with turf along the Ryan Road alignment and minimally landscaped between Ryan and Meridian roads.

Between Ellsworth Road and the Rittenhouse Channel, the drainage corridor was assumed to be contained within the 100-foot SRP easement. However, recent discussions with Fulton Homes revealed that the development intends to use a portion of the SRP easement for its onsite retention. Additionally, clusters of heavy vegetation are planned. In these areas of obstruction, the drainage channel would have to compensate with greater water depths (five feet) and steeper side slopes (3h:1v). The Town noted that these conditions may require fencing of the channel.

In addition to the channel, two regional detention basins are planned. One would be located in the northeast corner of the future town park and the other in the vicinity of the 211th and Ryan road alignments.

Construction and maintenance costs for the turf portion would be high, but the channel would offer ancillary benefits to future adjacent developments.

No Further Action Alternative: If Alternative 4 is not supported by the Town and adjacent landowners, the recommended alternative for the Rittenhouse Zone would likely be No Further Action (NFA). Although no construction would be required for the NFA, public costs due to future flooding could be high. Additionally, under current regulations, new development is required to preserve existing drainage characteristics to downstream properties. As a result, properties that are developed first enjoy relatively minimal costs to address offsite drainage entering and exiting the property. However, properties that are developed later bear a disproportionate cost of drainage infrastructure because they are severely limited by the downstream infrastructure. Another disadvantage is that the drainage infrastructure would be implemented in a piecemeal fashion and would be prone to local flooding.

Discussion of Alternatives

The merits and disadvantages of the alternatives were discussed, and the Town noted the following issues:

1. There is considerable interest in development between Crismon and Ellsworth roads. The preference in the development community is that a drainage corridor would be contained within SRP's 100-foot easement.
2. A constraint in Alternative 4 is that land would have to be secured before development occurs, and the Town does not have funding for such a purpose. Securing land through owner dedication would encourage higher-density development contrary to the Town's vision for this area.
3. Higher-density development would exacerbate the capacity concerns for Rittenhouse Channel under future conditions.
4. The Town would be interested in revisiting overlays of increased retention and decreased development densities in light of the current understanding of impacts to proposed and future development and to make the burden of a regional drainage solution more equitable.
5. The Town is interested in considering a hybrid plan of increased onsite retention, decreased development densities, and increased detention within its future park site (similar to Freestone Park in Gilbert) and within the SRP corridor. The Town would like additional information on the level of protection provided under this scenario if the facilities are entirely contained within the SRP transmission line corridor.

The District noted the following:

1. The estimated volume of runoff under future conditions has increased because of a recent update to federal precipitation-frequency estimates. NOAA Atlas 14 – Precipitation-Frequency Atlas supersedes the previous NOAA Atlas II, which had been used in the

development of the original hydrology. The net effect of NOAA Atlas 14 is a significant decrease in the runoff volume produced during a 100-year 2-hour storm. The previous 100-year, 2-hour runoff was about 2.7 inches, and the NOAA 14 estimate is about 2.2 inches.

2. The Rittenhouse Zone is unique in that two peaks in runoff occur of similar magnitude. The first peak is from the contribution from local drainage, and the second occurs as a result of runoff from Pinal County. Since the magnitude is similar, a reduction in one must be matched in the other. Therefore, local runoff could be mitigated through increased retention and decreased development, but the size of the proposed detention basin at the future park site would have to be increased as well.
3. The District could be a funding partner for facilities that provide less than 100-year protection.
4. The District is on a tight timeframe to complete the project. The District will hold a recommended alternative selection meeting by mid-November.

It was agreed that the study team will develop an alternative for consideration with the following elements:

- Modify the development density and retention assumptions in the hydrologic model to meet capacity limitations in the Rittenhouse Channel under future conditions as follows:
  - Assume an overall reduced-density overlay, either by increasing open-space requirements or decreasing housing density. The maximum increase in open space would equate to a housing density of no more than 5 du/acre.
  - Assume an increased-retention overlay of up to 2.7 inches.
- Provide the Town with a couple of options of increased open space and retention requirements and the associated level of protection they scenarios would provide.
- Increase the capacity of detention within the future Town park to reduce the offsite peak runoff. The park is assumed to function similar to Freestone Park so that portions of the park are inundated during frequent storms, but other areas are inundated during infrequent severe storms.
- Assume that the SRP easement would be designed to accommodate a series of linear detention basins rather than a channel. The basins would be constructed by adjacent developers as part of its drainage plan, similar to what is proposed by Fulton Homes. The basins would accept runoff exiting the adjacent developments and provide an outfall for the future town park detention basin and upstream offsite runoff.

Hernan Aristizabal said that the analysis could be performed within one week.

Next Steps

The Town will present and discuss the revised alternative at its November 6 Council executive session. The staff would need presentation materials by October 23. Following the study session, the Town will provide final input so that the study team can hold its evaluation and selection of recommended alternatives in early November.

The District asked for input from the Town on its expectations. The town responded that an acceptable outcome would be to:

- Increase detention within its future park similar to Freestone Park
- Eliminate the need to purchase an additional 60 feet from adjacent development and to increase housing densities
- Reduce construction costs

Action Items

The following action items were assigned:

Action Items	Responsible Party
Provide the Town with a revised alternative and associated levels of protection *(est. delivery the week of October 14)*	Entellus
Provide presentation materials to the Town staff by October 23	Entellus
Present the revised alternative to the Town Council at the November 6 Executive Session	TOQC

The preceding summary was prepared by Laurie Miller.

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	October 23, 2013
Job No.:	FCD 2011C017	**Time:**	1:30 p.m.
Subject:	Queen Creek Coordination Meeting	**Place:**	Town of Queen Creek

Attendee	Affiliation	E-mail
Jen Pokorski	FCDMC	jmp@mail.maricopa.gov
Doug Williams	FCDMC	daw@mail.maricopa.gov
Cathy Regester	FCDMC	cwr@mail.maricopa.gov
Chris Dovel	TOQC	chris.dovel@queencreek.org
Chris Anaradian	TOQC	chris.anaradian@queencreek.org
Wayne Balmer	TOQC	wayne.balmer@queencreek.org
Hernan Aristizabal	Entellus	ahernan@entellus.com
Laurie Miller	LTM Engineering	miller@LTMengineering.com

The following is a summary of a meeting with the Town of Queen Creek (Town) to discuss the impacts of modifying the proposed Alternative 4 within the Queen Creek portion of the East Mesa Area Drainage Master Plan (ADMP) Update study area.

Overview of Revised Alternative 4

Jen Pokorski, project manager for the Flood Control District of Maricopa County (District), provided a brief summary of the revised alternative:

- Assume an overlay for future development that would require additional onsite storm water retention beyond current regulations of 2.2 inches so that the capacity of the Rittenhouse Channel is not exceeded. Increases of 10%, 20%, and 30% were evaluated. An increase of 20% is recommended because it achieves the goal of preserving the capacity of Rittenhouse Channel through reduction of the peak local runoff. This approach also distributes the burden of a constrained system equitably among future developers.
- Increase the capacity of detention within the future Town park to reduce the offsite peak runoff. The park is assumed to function similar to Freestone Park so that portions of the park are inundated during frequent storms, but other areas are only inundated during infrequent severe storms.
- Assume that the future SRP easement along the Ryan Road alignment would accommodate a series of linear detention basins rather than a channel. The basins would be constructed by adjacent developers as part of their drainage plans, similar to what is proposed by Fulton Homes. The basins would accept runoff exiting the adjacent developments and provide an outfall for the future town park detention basin and upstream offsite runoff.

Discussion of Revised Alternative 4

The following assumptions were made in the analysis of the revised alternative:

1. A portion of offsite runoff from Pinal County would be conveyed to a proposed detention basin at Meridian and Pecos roads. The remainder from Pinal County would enter the Barney Farms property and was assumed to be diverted to the future town park. Onsite runoff from Barney Farms would be discharged to Germann Road.
2. Runoff collected in the future park would be metered to an extension of the Queen Creek Channel at Merrill Road.
3. The Town's most recent park layout concept was used to determine potential detention capacity.
4. The SRP corridor may be used by adjacent developers to detain and convey a portion of their onsite runoff.
5. Developers would be responsible for conveying the offsite flows from Pinal County to the basin at the future park site.

The revised alternative provides 100-year flood protection with the exception of the Ryan Road element. Because of the conditions presented by existing and near-future developments, the system is constrained at Ellsworth Road. Therefore, this portion of the system is estimated to provide 75-year flood protection.

Future Steps

The District noted that once the study is completed, the Town may adopt the ADMP Update by resolution. The District offered to assist the Town with preparing a package for use as guidelines for future developers.

The District recommended that the Town apply for CIP funding as soon as possible given the District's budget constraints. The Town noted that it may wish to construct the detention portion of the future park sooner than District cost-share funds are available. If so, it would request reimbursement from the District after construction is completed.

The study team will assist the Town in preparing a package for review by the Town Council. The following will be provided:

- Simplified exhibit of the revised alternative to include:
  - General symbols of runoff and flow direction
  - Lines indicating existing drainage infrastructure (green lines) and propose infrastructure (red lines)
  - Areas of proposed increased-retention overlay
- Simplified text describing the proposed alternative, including its advantages, such as:
  - Maximizes existing infrastructure
  - Does not require any new publicly-funded channels west of Ellsworth Road

  - Does not exceed capacity of Rittenhouse Channel
  - Reduces the need for expensive new infrastructure
  - Encourages open space in the design of future development
  - Turns the SRP utility corridor into an amenity
  - Does not require land purchase
  - Distributes contributions from future development fairly
- Exhibit of the previous Alternative 4 as background material for staff in answering any questions regarding the progression of the study:
  - Include a description of issues that had arisen during prior discussions with the Town staff, project stakeholders, and the public

The study team will provide a draft submittal to the Town before November 5, preferably next week.

Action Items

The following action items were assigned:

Action Items	Responsible Party
Provide the Town with exhibits for the November 6 Town Council executive session	Entellus
Provide the Town with descriptions of alternatives, advantages, and issues for the November 6 Town Council executive session	Entellus

The preceding summary was prepared by Laurie Miller. Attendees are asked to advise Laurie within one week of dissemination via e-mail of any discrepancies and/or omissions.

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	November 19, 2013
Job No.:	FCD 2011C017	**Time:**	3:30 p.m.
Subject:	Queen Creek Coordination Meeting	**Place:**	Town of Queen Creek

Attendee	Affiliation	E-mail
Jen Pokorski	FCDMC	jmp@mail.maricopa.gov
Cathy Regester	FCDMC	cwr@mail.maricopa.gov
Chris Anaradian	TOQC	chris.anaradian@queencreek.org
Chris Dovel	TOQC	chris.dovel@queencreek.org
Adam Robinson	TOQC	adam.robinson@queencreek.org
Hernan Aristizabal	Entellus	ahernan@entellus.com
John Griffin	EPG	jgriffin@epgaz.com
Dave Wilson	EPG	dwilson@epgaz.com
Laurie Miller	LTM Engineering	miller@LTMengineering.com

The following is a summary of a meeting with the Town of Queen Creek (Town) to discuss design and implementation details of the proposed Alternative 4 within the Queen Creek portion of the East Mesa Area Drainage Master Plan (ADMP) Update study area.

Jen Pokorski stated the meeting goals of identifying design criteria to co-locate a detention basin within the future Sports Complex and the regulatory implementation of an increased-retention overlay.

Detention Basin / Future QC Sports Complex Parameters

The study team described the process of analyzing the viability of co-locating a detention basin and park. First, the required storage volume was calculated. Then, the most recent conceptual park layout was reviewed and reconfigured to maximize the number of all-weather ball fields for tournament play. However, additional information is needed from the Town in order to develop design criteria that will accommodate the park plan and anticipated usage. The Town provided the following direction:

- The future Sports Complex is slated for tournament play. Baseball is played year-round and soccer is played in the fall.
- Tournament play requires that the fields be available (not inundated) for play at all times. Therefore, the detention basin and channel cannot interfere with tournament operations.
- Periodic inundation of baseball fields requires heavy maintenance and should be avoided if possible. Infrequent (e.g., 100-year storm) inundation may be acceptable.

- Adam Robinson will verify that the conceptual layout of the Sports Complex shown in the Parks Master Plan is still valid. The Parks Department will provide a summary of program requirements early next week.
- The Town owns a triangular parcel at the Ryan and Signal Butte alignments. If it is available for detention, its use should be maximized in order to minimize the likelihood of ball field inundation. Chris Dovel will verify its availability.
- Chris Dovel said that detention within a park has unique characteristics; therefore, design requirements such as water depth and side slopes would be treated on an individual basis.

Increased Retention Overlay

Chris Anaradian noted that inclusion of a retention overlay as an engineering requirement for future development will facilitate its implementation. He briefed the Town Council on November 6th in its executive session, and the reception was favorable.

Next Stakeholder Meeting

The next stakeholder meeting should be held in mid-December. Invitees should include those previously contacted (e.g., Jorde, Barney, Brimhall, Pew), plus a statement to pass the invitation to neighbors or others who may have an interest. The meeting should include the following points:

- Results of incorporating previous stakeholder input
- The burden of implementation is shared equitably among future developers, including the Town
- Approximate channel sizes for segments to be constructed by developers

Laurie Miller will draft an invitation to be sent by the District. The meeting will be at 5 PM at the Town offices. Chris Dovel will confirm the date; December 9, 10, or 12 is preferred.

A meeting was scheduled for December 2 at the Town offices to coordinate the stakeholder meeting agenda and exhibits.

Future Steps

Jen stated that after receipt of park program requirements, EPG will begin developing 15% design plans and coordination with Harry Cooper, FCDMC. The draft Recommended Alternative Report is due on December 12, 2013. Once the report is complete, the District and Town will develop a Capital Improvements Project proposal.

Action Items

The following action items were assigned:

Action Items	Responsible Party
Provide the study team with programming and requirements for the future Sports Complex	Adam Robinson
Verify the availability of the Town's triangular land parcel for detention	Chris Dovel
Select a date for the next stakeholder meeting	Chris Dovel
Bring to the stakeholder meeting the approximate channel sizes for segments to be constructed by developers	Hernan Aristizabal
Prepare a draft invitation for email distribution to stakeholders	Laurie Miller

The preceding summary was prepared by Laurie Miller. Attendees are asked to advise Laurie within one week of dissemination via e-mail of any discrepancies and/or omissions.

A.2 Private Stakeholder Meeting Minutes

Agency/Utility	Meeting Date
Group Stakeholder Meeting	4/23/2012
Group Stakeholder Meeting	6/28/2012
Fulton Homes	8/27/2012
Landmark Companies	9/19/2012
Landmark Companies	9/24/2012
Group Stakeholder Meeting	6/6/2013

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	April 23, 2012
Job No.:	FCD 2011C017	**Time:**	1:30 p.m.
Subject:	Private Sector Stakeholder Involvement Kick-Off Meeting	**Place:**	FCDMC

The following is a summary of discussion at the public sector stakeholder involvement kick-off meeting for the East Mesa Area Drainage Master Plan (ADMP) Update. The purpose of the meeting was to introduce the project to those with active and/or future development within the study area and solicit input on storm drainage management solutions. The meeting agenda and list of attendees are attached.

INTRODUCTIONS & PROJECT BACKGROUND

After attendee introductions, Jen Pokorski, project manager for the Flood Control District of Maricopa County (District) presented an overview of the project background, history, and goals. The original East Mesa ADMP was completed in 1998, and a significant portion of the recommended facilities have since been implemented. An update was initiated due to subsequent extensive development, the obligation to reserve capacity in the Powerline Floodway for upstream dam functions, and District jurisdictional decisions to locate all facilities within Maricopa County. Additionally, changes in watershed drainage patterns have exacerbated flooding in some areas.

PROJECT SCHEDULE & MILESTONES

The District recently prepared an update to the hydrologic modeling to account for changes to the watershed. Major milestones for the project include development and evaluation of alternatives (spring and summer 2012, respectively), selection of a recommended alternative (August 2012), and project completion in February 2013.

CURRENT/FUTURE REGIONAL ACTIVITIES, OPPORTUNITIES, & CONSTRAINTS

The study area is divided into four regions. Approximate boundaries are as follows:

- Zone 1: Northern boundary to the Powerline Floodway
- Zone 2: Powerline Floodway to Germann Road
- Zone 3: Phoenix-Mesa Gateway Airport
- Zone 4: Germann Road to southern boundary

Activities, opportunities, and constraints were discussed as follows by region.

Zone 1 Activities

Hawes & Ray Roads. Morgan Neville noted that the land on the northwest and southwest corners have commercial entitlements. There are no immediate plans for development. He mentioned a study that may be relevant to the project: the Northeast Development Plan prepared by Jacobs Consultancy for the Phoenix-Mesa Gateway Airport. It is available through the link titled "Draft NAPD" under the Current Planning Studies" section at: http://www.phxmesagateway.org/DocumentsAndFormsLibrary.aspx

Hawes & SR 202. Land at this location is zoned for dense mixed-use development, although there are no immediate plans for development.

Eastmark Development. Eastmark Development, located on the GM Proving Grounds site, covers a large portion of Zone 1 and extends into Zone 2. DMB is currently working through the District's permitting process on Development Unit 7, which impacts the Powerline Floodway. The project team will contact Hoskin/Ryan, the DU-7 consultant, for the latest development plan.

Zone 2 Activities

Pecos Road. Chronic flooding was noted along Pecos Road in the vicinity of Mountain Road. In general, drainage conveyance between Meridian and Signal Buttes roads is disjointed and subject to sheet flooding.

Germann & Meridian Roads. CMC Steel operates on the northwest corner of Germann and Meridian roads. Improvements are underway to address drainage problems within the property.

TRW has an industrial site on Germann Road adjacent to CMC Steel. A large onsite detention basin was constructed to handle onsite runoff. In the future, TRW may sell its land and lease back a portion of the site for its operations.

It was noted that a recent industrial development along Germann Road has improved drainage conditions at Germann and Meridian roads.

Zone 3 Activities

Zone 3 is the Phoenix-Mesa Gateway Airport, and since the airport has its own drainage plan, no additional regional facilities are needed. Therefore, Zone 3 activities and drainage issues are excluded from the project planning area and were not discussed.

Zone 4 Activities

Germann & Meridian Roads. Barney Farms owns 350 acres at the southwest corner of Germann and Meridian roads, across from the TRW facilities. Future development may

include residential and light industrial; however, such a development would require a major land use plan amendment. It was noted that the Signal Butte Road alignment would shift eastward between Germann Road and ½ mile south of Germann Road to the Meridian Road alignment and then continue south.

Barney Farms. Barney Farms has existing recreational facilities within Zone 4 and is discussing a potential land trade with the Town of Queen Creek to relocate a planned community park adjacent to the Barney Family Sports Complex. Barney Farms would be willing to co-locate future detention facilities if there are mutual benefits to do so. The park would be owned and operated by the Town; incorporating flood mitigation would be coordinated with the Town.

Queen Creek Station. A residential development is planned for a parcel north of the Rittenhouse Channel along Ellsworth Road. The project team will verify that the development was considered when updating the hydrologic analysis for the East Mesa ADMP Update.

A question arose as to whether crossing of the Rittenhouse Channel is allowed. Jen Pokorski responded that it can be crossed, but a permit is required to do so.

FUTURE MEETINGS

Additional stakeholder meetings will be held to present and discuss proposed alternatives in early June 2012 and to present a draft recommended alternative in August 2012.

OTHER

Questions arose regarding how non-engineered berms will be treated in the East Mesa ADMP Update. The berms have a significant effect on drainage patterns. However, lack of design and maintenance raise the probability of failure, so it is important to understand the impact on downstream drainage behavior for in-place conditions as well as if the berms were to fail. From a regulatory standpoint, they may not be counted on to function in the future. However, this situation poses difficulties for developers because of the uncertainty of what will be required of them to handle offsite drainage. Given Mesa's offsite/onsite retention and conveyance policies, developers need direction on how to proceed because the amount and location of offsite flow could change significantly.

Questions arose on the status of the Powerline, Vineyard Road, and Rittenhouse (PVR) Flood Retarding Structure rehabilitation project. The District will provide a status update to the stakeholders.

ACTION ITEMS

The following action items were assigned:

Action Item	Responsible Party
Collect and review the Northeast Development Plan prepared by Dibble & Associates for the Phoenix-Mesa Gateway Airport	Entellus
Collect and review the latest Eastmark Development plan from Hoskin/Ryan	Entellus
Verify that Queen Creek Station was considered when updating the hydrologic analysis for the East Mesa ADMP Update	FCDMC/Entellus
Provide a status update of the PVR Rehabilitation Project. to the stakeholders	FCDMC

The preceding summary was prepared by Laurie Miller. Attendees were asked to report any discrepancies and/or omissions within one week of the May 4th distribution date.

c: Attendees
Andy Sarat, CMC Americas
Nicholaus Fischer, Merit Partners, Inc.

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	June 28, 2012
Job No.:	FCD 2011C017	**Time:**	1:30 p.m.
Subject:	Private Sector Stakeholder Involvement Meeting #2	**Place:**	FCDMC

The following is a summary of discussion at the private sector stakeholder involvement meeting to present draft alternatives for the East Mesa Area Drainage Master Plan (ADMP) Update. The purpose of the meeting was to solicit feedback on the alternatives from those with active and/or future development within the study area. The following attachments are included: meeting agenda, list of attendees, and handouts of alternatives and descriptions.

INTRODUCTIONS & PROJECT BACKGROUND

After attendee introductions, Jen Pokorski, project manager for the Flood Control District of Maricopa County (District) presented an overview of the project background and goals. The original East Mesa ADMP was completed in 1998, and a significant portion of the recommended facilities have since been implemented. An update was initiated due to subsequent extensive development, reserve capacity obligations in the Powerline Floodway for upstream dam functions, and District jurisdictional decisions to locate all facilities within Maricopa County. Additionally, changes in watershed drainage patterns have exacerbated flooding in some areas.

PROJECT UPDATE

The District previously prepared an update to the hydrologic modeling to account for changes to the watershed. The consultant team has completed its data collection and evaluation tasks and has developed draft alternatives for further analysis. Throughout the summer, the project team will evaluate the alternatives and select a preliminary recommended alternative in September 2012. The recommended alternative will be refined as necessary and per stakeholder and public input, and the project completion is scheduled for February 2013.

PRESENTATION OF ALTERNATIVES

Jen Pokorski introduced the alternatives, which are depicted within three geographic zones:

- SR 24 System: Powerline Floodway to the future SR 24 freeway channel

- Ellsworth System: future SR 24 freeway channel to Germann Road (Maricopa County) and Queen Creek Road (Pinal County)
- Rittenhouse System: Germann Road (Maricopa County) and Queen Creek Road (Pinal County) to southern study boundary

It was noted that the study area north of the Powerline Floodway is being evaluated by the District under a separate effort. Problems identified for this area are limited to two crossings of the Powerline Floodway in Maricopa County and one in Pinal County. The District is working with the adjacent landowner and evaluating its policies on capacity reserves to convey impounded water from the upstream Powerline, Vineyard Road, and Rittenhouse Flood Retarding Structures to mitigate capacity concerns with the Powerline Floodway.

SR 24 System

The interceptor channel planned as part of the future SR 24 freeway forms the backbone of the north portion of the study area and is common to all alternatives of all systems. ADOT has stated that the future SR 24 channel will be designed to accommodate the 100-year storm. Alternatives for this zone are focused on solving existing drainage and roadway access issues along Mountain Road, Erie Street, and Galveston Road. Input on the alternatives presented included:

- Land between Mountain Road and the GM Desert Proving Grounds property was recently rezoned as residential.
- Harvard Investments has plans to develop the portion of the GM Desert Proving Grounds south of the DMB property. Drainage from the 100-year storm will be accommodated in the design.
- Ron Bertram noted that the Maricopa County Department of Transportation (MCDOT) recently lowered Mountain Road north of Williams Field Road by approximately two feet on the east side. The project team will contact MCDOT for an update.

Ellsworth System

- MGC Pure Chemicals, located one block north of Pecos Road along Mountain Road, recently constructed a drainage channel to collect and convey runoff from an existing wash to the east of its property. It was noted that the alignment of the Pecos Road conveyance for Alternative 2 would exacerbate the existing drainage problem at the site. MGC would prefer that the Pecos Road segment be located on the south side of the road.
- Alternative 3: The alignment cuts through existing parcels; therefore, future development of those parcels would be negatively impacted.

- TRW reported that it intends to sell its property and lease back approximately 85 acres at the southeast corner of the property for continued operations. The remaining parcel is vacant and would be developed as an industrial park. The new development on the TRW property will provide 100-year 2-hour retention, which is a change from the current condition which has 100% onsite retention.
  - It was noted that the previous hydrologic analyses assumed 100% onsite retention because the site includes a very large, deep retention basin. It was also mentioned that the onsite retention basin will most likely be filled by future developers. Therefore, the future condition models may need to be modified to reflect future development in the absence of the current retention capacity.

Rittenhouse System

- Regarding the concept of maintaining the existing 100-year, 2-hour retention depth of 2.7 inches in Queen Creek in the future: a suggestion was made that may facilitate implementation. If developers agreed to retain the higher depth, in turn, the requirement to drain retained waters within 36 hours could be adjusted to apply only to the lesser amount of 2.219 inches.
- It was noted that the Ironwood Crossing development, located in Pinal County between Queen Creek and Ocotillo roads, is moving forward. A drainage channel that had been partially constructed during a prior phase currently empties onto vacant agriculture land. Adding a channel extension along Meridian Road to eventually connect with this channel or lowering the proposed channel along Queen Creek to connect directly with the development's drainage channel should be evaluated as part of the Rittenhouse System alternatives.

FUTURE MEETINGS

An additional stakeholder meeting will be held in mid-September to present and discuss the draft recommended alternative. A final meeting will be held to present the final recommended alternative before February 2013.

ACTION ITEMS

The following action items were assigned:

Action Items	Responsible Party
Contact MCDOT for an update on the Mountain Road improvements	Entellus/LTM

Evaluate the need to modify the future condition hydrologic models to reflect potential future changes in retention within the TRW property.	District/Entellus

The preceding summary was prepared by Laurie Miller.

c: Attendees
Andy Sarat, CMC Americas
Nicholaus Fischer, Merit Partners, Inc.
Morgan Neville, Mesa Airport Growth Properties LLC

East Mesa
Area Drainage Master Plan Update

Proposed Alternatives

As described below and shown on the attached maps, the study area was divided into three somewhat independent zones. Each zone includes three proposed alignments for consideration and further analysis. In addition, a "no further action" alternative will be evaluated for each zone. It will be used to ascertain the value of the proposed alternatives and the consequences of maintaining the status quo (no maps are included for this alternative).

Note that the primary drainage issue in the area north of the Powerline Floodway/Ray Road alignment is capacity issues of the Powerline Floodway at the Ellsworth Road crossing. The Flood Control District of Maricopa County is working to address this issue independent of the East Mesa ADMP Update.

ADOT SR 24 Zone

The SR-24 Zone includes the contributing area between the Powerline Floodway and the future SR-24 freeway. The future freeway drainage system is the backbone of this zone and will intercept runoff and convey it to the Powerline Floodway. The remaining drainage issues are concentrated between the Mountain and Meridian road alignments from Ray Road on the north to Williams Field Road on the south. Significant runoff generated in Pinal County combines with local flows and floods large tracks of land and impedes traffic and local access.

Alternative 1:

- Interceptor channel along the Meridian Road Alignment from south of Ray Road to the SR-24 freeway channel.
- Interim detention basin within the SR-24 right-of-way to reduce peak flow until the freeway channel is built. At that time, the basin will be abandoned.

Alternative 2:

- Similar to Alternative 1, except that the detention basin would be a permanent structure located farther north at Galveston Road. This basin will reduce peak flows somewhat and allow a smaller downstream channel along Meridian Road.
  - Until the SR-24 channel is constructed, the channel would discharge into a natural wash that will eventually discharge into a new channel at Pecos Road.

Alternative 3:

This alternative proposes a 10-year level of protection to address more frequent, smaller flooding events rather than 100-year protection typically provided to address regional flooding issues and reduce the extent of floodplains. Components include:

- A series of small roadside channels to move runoff through the area and discharge it into the existing GM Desert Proving Grounds perimeter channel.
- Delineation of 100-year floodplains throughout the neighborhood to determine the extents of flood hazard and identify any structures at risk.

Ellsworth Zone

This zone includes the area contributing to the Ellsworth Channel and extends from the alignment of the future ADOT SR-24 freeway to Germann Road within Maricopa County and to Queen Creek Road in Pinal County. Drainage issues include capacity concerns of the Ellsworth Channel and chronic flooding along Pecos Road.

Alternative 1:

- Meridian North Channel intercepts runoff from Pinal County between the proposed SR-24 freeway and Pecos Road and conveys it to the proposed Pecos/Meridian Basin.
- Pecos/Meridian Basin shown at the southwest corner of the intersection Pecos and Meridian Roads on a vacant parcel currently owned by CMC Americas. The basin would reduce peak discharges along Pecos Road.
- Meridian South Channel intercepts runoff from Pinal County between Queen Creek and Pecos roads and conveys it north to the proposed Pecos/Meridian Basin.
- Pecos Road Channel conveys runoff from Meridian Road to the proposed Pecos/Ellsworth Basin.
- Pecos/Ellsworth Basin near the intersection of Pecos and Ellsworth Roads. The basin would reduce peak discharges to the Ellsworth Channel.

Alternative 2:

- Similar to Alternative 1, except that the Pecos Road Channel is offset from the road to follow historic drainage patterns. Additionally, the Pecos/Ellsworth Basin is eliminated.

Alternative 3:

- Similar to Alternative 2, except that a portion of the Pecos Road Channel is shifted ¼ mile to the south. Additionally, a short segment of the Ellsworth Channel and existing culvert under Ellsworth Road would require modification.
- Includes preserving some of the agricultural land within the drainage area through purchase of development rights to reduce overall runoff.

Rittenhouse Zone

The Rittenhouse Zone includes the area south of Germann Road in Maricopa County and south of Queen Creek Road in Pinal County. Issues include drainage complaints at the Germann Road crossing and capacity concerns with the Rittenhouse Channel under future conditions. Additionally, the area lacks regional conveyance facilities and significant runoff is likely to concentrate along Germann and Queen Creek roads.

Alternative 1:

- Regional channel along Germann Road from west of Meridian Road to the Rittenhouse Channel (Sossaman Road alignment)
- Regional channel along Queen Creek Road from Meridian Road to the end of the Rittenhouse Channel Extension (Crismon Road alignment)
- Lateral channel to convey the flows to either channel
- A detention basin along each of the regional channels to reduce peak flows, thus decreasing the size of infrastructure and potentially resolving any capacity deficiencies in the Rittenhouse Channel. The proposed location of these basins may change as the alternatives are further developed.

Alternative 2:

- Replaces the Germann and Queen Creek Channels with a single regional channel that roughly follows the historic flow path between the two roads.
- Several lateral channels to intercept and convey flow to the regional channel.
- Application of nonstructural solutions to address capacity issues with the Rittenhouse Channel. Options may include floodplain delineations, identification of risk zones along the channel, or providing a buffer along the channel that could accommodate some overflow from the channel without flooding adjacent properties.

Alternative 3:

- Similar to Alternative 1, except that the detention basins are eliminated. Instead, new development within Maricopa County or Queen Creek would be subject to a higher retention requirement.
- Includes preserving some of the existing agricultural lands within the drainage area through purchase of development rights to reduce overall runoff.
- Application of nonstructural solutions to address capacity issues with the Rittenhouse Channel. Options may include floodplain delineations, identification of risk zones along the channel, or providing a buffer along the channel that could accommodate some overflow from the channel without flooding adjacent properties.

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	August 27, 2012
Job No.:	FCD 2011C017	**Time:**	1:00 p.m.
Subject:	Fulton Homes Coordination Meeting	**Place:**	FCDMC

Attendee	Affiliation	E-mail
Jen Pokorski	FCDMC	jmp@mail.maricopa.gov
Norman Nicholls	Fulton Homes	Nnicholls@fultonhomes.com
Troy Peterson	Bowman Consulting	Tpeterson@bowmancg.com
Hernan Aristizabal	Entellus	ahernan@entellus.com
Laurie Miller	LTM Engineering	miller@LTMengineering.com

The following summarizes a meeting with Fulton Homes to discuss preliminary alternatives for the East Mesa Area Drainage Master Plan (ADMP) Update. Meeting handouts, provided by Entellus and Bowman Consulting, are attached.

Project Background

Jen Pokorski, project manager for the Flood Control District of Maricopa County (District), noted that Entellus was retained to update the East Mesa ADMP, originally developed in 1998. The update was initiated due to significant changes in the watershed and ongoing flooding concerns within the study area. Additionally, rainfall data has recently been updated and new mapping is available.

Significant flooding in Maricopa County has occurred at several locations, including in the southern portion of the study area along Germann and Queen Creek Roads. Runoff originates in Pinal County, crosses into Maricopa County at Meridian Road, and drains to the existing Rittenhouse Channel and ultimately to the East Maricopa Floodway (EMF). Preliminary alternatives have been developed, referred to as the Rittenhouse System, to address these flooding problems. It was noted that preliminary alternatives for the SR 24 System and Ellsworth System have also been developed to address flooding issues in the northern portions of the study area.

Development Plans within the Study Area

Fulton Homes is in the process of developing Queen Creek Station, a residential parcel in Queen Creek. The parcel is bounded by Queen Creek Road, Rittenhouse Channel, Ryan Road, and Ellsworth Road. The main entrance to Queen Creek Station will be from Ellsworth Road and not from Ryan Road. Mr. Nicholls noted that because of opposition from residents of Ellsworth Mini-Farms on the north side of Ryan Road, the south side of the road will **not** be improved.

Concurrently, Salt River Project (SRP) is securing a 100-foot easement on the south side of the Ryan Road centerline alignment for a 230-kV power transmission line.

Mr. Nicholls referenced several other parcels in the vicinity that may be impacted by the Rittenhouse System alternatives, including Jorde Farms, La Jara, and Newell Barney/Barney Farms.

Discussion of Rittenhouse System Alternatives

The three preliminary alternatives were presented and discussed. The infrastructure for Alternatives 1 and 3 are similar and include open channels along Germann and Queen Creek Roads. Alternative 1 includes two detention basins; Alternative 3 proposes an overlay with higher retention requirements for new development and agricultural preservation in lieu of detention basins. Alternative 2 combines the Germann and Queen Creek channels of Alternatives 1 and 3 into one channel along the Ryan Road alignment. Additionally, nonstructural elements are included in Alternatives 2 and 3 along Rittenhouse Channel to address capacity issues.

Mr. Nicholls stated a strong preference for either Alternative 1 or 3 and against Alternative 2. Fulton Homes intends to use the SRP utility easement as a green space amenity for Queen Creek Station. Additionally, Mr. Nicholls noted that road crossings of the transmission line corridor are much less expensive than a channel crossing.

Jen Pokorski reiterated that the alternatives presented are preliminary. The development of the ADMP Update not preclude Fulton Homes from moving forward with its development plans for Queen Creek Station in accordance with the Town of Queen Creek's current development regulations.

ADMP Update Schedule

Jen Pokorski noted that the alternatives will be evaluated by the project team based on several factors including effectiveness of solving the flood control issues, cost, and public and stakeholder input. A preliminary recommended alternative will be selected in October. The preliminary recommendations will be evaluated and refined based on continued public and stakeholder input. The project will be completed in February 2013.

The next stakeholder meeting is scheduled for October to present the draft recommended alternative.

Implementation of the recommended plan will occur as funds and funding partnerships are identified. Some elements may be designed and constructed in the near future to address immediate flooding issues, while others could take a number of years to implement due to funding and other constraints.

The preceding summary was prepared by Laurie Miller. Attendees are asked to advise Laurie within one week of dissemination via e-mail of any discrepancies and/or omissions.

c: Attendees

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	September 19, 2012
Job No.:	FCD 2011C017	**Time:**	10:00 a.m.
Subject:	Alternatives Discussion – Rittenhouse Zone	**Place:**	EPS

Attendee	Affiliation	Phone	E-mail
Jen Pokorski	FCDMC	602-506-4695	jpm@mail.maricopa.gov
Jason Barney	Landmark Co.	480-818-2000	jason@jasonbarney.com
John Hartman	Landmark Co.	480-305-7002	john@landmark.net
Bryan Kitchen	EPS Group	480-503-2250	bryan.kitchen@epsgroupinc.com
Kevin Morgan	EPS Group	480-503-2250	kevin.morgan@epsgroupinc.com
Brian Nicholls	EPS Group	480-503-2250	brian.nicholls@epsgroupinc.com
Ryan Sauer	Entellus, Inc.	602-244-2566	rsauer@entellus.com
Laurie Miller	LTM Engineering	602-485-5880	miller@LTMengineering.com

The following is a summary of a coordination meeting with to discuss alternatives presented at a stakeholder meeting on June 28, 2012 for the Rittenhouse Zone of the East Mesa Area Drainage Master Plan (ADMP) Update.

Discussion of Alternatives

The alternatives presented at the June 28, 2012, stakeholder meeting were discussed. The main components of alternatives in the Rittenhouse Zone are:

- Alternative 1 – Regional channels along Germann and Queen Creek roads with adjacent detention basins.
- Alternative 2 – Germann and Queen Creek channels would be replaced by a single channel along the Ryan Road alignment.
- Alternative 3 – Similar to Alternative 1, except the large detention basins are eliminated and replaced with higher retention requirements for new development.

The capacity of the existing Queen Creek Channel Extension is about 500 cfs, so its ability to handle additional flow is very limited. The Town of Queen Creek plans to extend the channel to Merrill Road.

Of the alternatives presented, Landmark Companies strongly objects to Alternative 2. Jason Barney is interested in the ultimate location and size of a regional channel so he can evaluate its impacts on land planning to date. He intends to be at the preliminary plat stage in about a year.

Discussion of Hydrology

EPS is submitting a drainage report for Ironwood Crossing just east of Meridian Road. CMX had prepared a drainage report for Ironwood Crossing previously, and the peak offsite runoff was estimated to be 610 cfs. However, the ADMP model shows 1,400 cfs. EPS agreed to evaluate the differences in the two model approaches to identify the reasons for such a large gap in results.

The group will meet again on September 24, 2012, to discuss the differences in hydrology. Stacey Brimhall will be invited to the meeting as well.

Action Items

The following action items were assigned:

Action Items	Responsible Party
Provide channel dimensions for all Rittenhouse Zone alternatives	Ryan Sauer
Provide CMX drainage report for Ironwood Crossing to the District	Bryan Kitchen
Evaluate the differences in hydrologic methodology and results between the District regional model and the EPS Ironwood Crossing model	Bryan Kitchen
Provide area land plan for Landmark Companies	Jason Barney
Provide a parcel map for the section of land south of the Barney property	Jen Pokorski
Provide a copy of the ADMP future condition model to EPS	Jen Pokorski

The preceding summary was prepared by Laurie Miller.

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	September 24, 2012
Job No.:	FCD 2011C017	**Time:**	3:00 p.m.
Subject:	Hydrologic Analysis Discussion – Rittenhouse Zone	**Place:**	EPS

Attendee	Affiliation	Phone	E-mail
Jen Pokorski	FCDMC	602-506-4695	jpm@mail.maricopa.gov
Cathy Regester	FCDMC	602-506-1501	cwr@mail.maricopa.gov
Felicia Terry	FCDMC	602-506-8111	fet@mail.maricopa.gov
Jason Barney	Landmark Co.	480-818-2000	jason@jasonbarney.com
John Hartman	Landmark Co.	480-305-7002	john@landmark.net
Stacy Brimhall	Langley Properties	602-531-5691	stacy@langeyland.com
Monte Nevitt	Nevitt Farms	602-402-1529	feller58@gmail.com
Bryan Kitchen	EPS Group	480-503-2250	bryan.kitchen@epsgroupinc.com
Kevin Morgan	EPS Group	480-503-2250	kevin.morgan@epsgroupinc.com
Brian Nicholls	EPS Group	480-503-2250	brian.nicholls@epsgroupinc.com
Hernan Aristizabal	Entellus, Inc.	602-244-2566	ahernan@entellus.com
Laurie Miller	LTM Engineering	602-485-5880	miller@LTMengineering.com

The following is a summary of a coordination meeting with to discuss hydrologic modeling assumptions and results for the Rittenhouse Zone of the East Mesa Area Drainage Master Plan (ADMP) Update.

Hydrologic Discussion

EPS is currently working on the Ironwood Crossing development just east of the Rittenhouse Zone planning area. Jason Barney noted that Barney Park Estates is also planned in the area.

Brian Kitchen reported that the Ironwood Crossing drainage report has been approved by Pinal County, and there were several differences in peak runoff estimates compared to the ADMP estimates. His comparison with the ADMP model included the following:

- The Ironwood Crossing analysis was based on 100-year, 6-hour rainfall, whereas the ADMP model evaluated the 100-year 24-hour.
- Assumptions in routing and loss parameters differed.
- Offsite (upstream) flow for the subdivision model was modeled in more detail than the regional planning model.
- The EPS model includes a flow split upstream of the subdivision that takes a portion of runoff to the south. The topography is very flat, and the regional model does not include a

flow split at that location. It was agreed that with or without the flow split, runoff discharges to the same location.

Monte Nevitt identified locations of breakout that moves runoff along the railroad tracks.

Discussion of Alternatives

Of the alternatives developed to date, landowners in the vicinity support channels along Germann Road and Queen Creek Road.

Next Steps

Jen Pokorski, project manager for the East Mesa ADMP Update, reported that the schedule for the next public and stakeholder meetings has been delayed until spring 2013 in order to respond to input to date.

Action Items

The following action items were assigned:

Action Items	Responsible Party
Evaluate the 100-year, 24-hour rainfall for the Ironwood Crossing development and compare with the ADMP model	Bryan Kitchen
Provide a copy of the ADMP future condition model to EPS	Jen Pokorski

The preceding summary was prepared by Laurie Miller.

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	June 6, 2013
Job No.:	FCD 2011C017	**Time:**	1:30 3:30 p.m.
Subject:	Stakeholder Involvement Meeting #3 - Charrette	**Place:**	Town of Queen Creek

The following is a summary of discussion private sector charrette to present revised alternatives for the Rittenhouse Zone of the East Mesa Area Drainage Master Plan (ADMP) Update. The purpose of the meeting was to solicit feedback on the alternatives from those with active and/or future development within the study area.

INTRODUCTION

Tim Phillips, general manager for the Flood Control District of Maricopa County (District), expressed the meeting goal to obtain consensus on implementing a regional drainage infrastructure for Queen Creek. If consensus is not obtained, the Town of Queen Creek will need to make a decision on the preferred alternative. If no regional plan is selected, the "no further action" alternative will be recommended.

DISCUSSION

The following questions were discussed:

Q: Can the existing channel along Queen Creek Road be used to accept more runoff from the area?

A: The Queen Creek Channel is fully used; it has no additional capacity. Additionally, it drains to the Rittenhouse Channel, which has capacity issues.

Q: Can a larger channel be constructed along Germann Road?

A: "Fatal flaws" were identified in constructing a channel along Germann Road, i.e., existing homes would have to be purchased and removed.

Q: Has the channel shown along Meridian Road been constructed?

A: No. ADOT is currently conducting a corridor study, and the District is interested in partnering when future road improvements are made.

Q: Will the channel along Queen Creek Road be on the north or south side of the road?

A: The south side appears to be most efficient, but the actual alignment has not been set.

ADDITIONAL COMMENTS

The following comments were made during the discussion:

- There was interest in participating in a regional drainage solution
- The Town is willing to participate in a coordinated plan
- The District would consider a drainage plan with less than 100-year protection, e.g., 50-year protection
- Examples of greenbelts within SRP power transmission corridors were viewed

APPENDIX B. SEED IDEAS

Flood Hazard Mitigation Solutions – Brainstorming, Seed Ideas

Based on the information gathered during the data collection and analysis phases, the Consultant team developed seed ideas for solutions to drainage issues identified throughout the study area. The seed ideas addressed the following existing and potential drainage issue focus areas:

Table 1: Existing and Potential Drainage Issue Focus Areas

Label	Location	Issue
A	Powerline Floodway	Freeboard and culvert capacity issues.
B	Meridian and Mountain Road (Williams Field Road to Ray Road)	Reported flooding issues.
C	Ellsworth Channel	Freeboard and overtopping issues.
D	Pecos Road (Meridian Road to Ellsworth Road)	Reported flooding issues.
E	Germann Road (Meridian Road to Rittenhouse Road)	No adequate facilities to convey/retain increase in flows predicted for future conditions.
F	Queen Creek Road (Meridian Road to Rittenhouse Road)	No adequate facilities to convey/retain increase in flows predicted for future conditions.
G	Rittenhouse Channel (Queen Creek Road to East Maricopa Floodway)	Future watershed conditions result in insufficient freeboard.

The Consultant team discussed potential methods to mitigating the identified drainage issues and developed seed ideas that fall into three main categories:

- Conveyance
- Storage
- Natural Grade

Conveyance Seed Idea

A set of possible solutions to drainage problems throughout the study area was developed that mostly relied on new or expanded conveyance facilities set along roadway corridors.

Table 2: Conveyance Seed Idea Summary

Drainage Issue Focus Area	Seed Idea Feature
A – Powerline Floodway	Extend channel liner to provide additional capacity. Crossing upgrades to eliminate bottle necks.
B – Meridian and Mountain Road (Williams Field to Ray)	Construct a new channel along Meridian Road to intercept flows and convey them south. Eventually, the channel would connect to a joint ADOT/FCDMC channel along the north side of the new freeway. In the interim, the channel would extend south to a new channel along Pecos Road.
C – Ellsworth Channel	Intercepting flows before they enter the Ellsworth channel with a joint ADOT/FCDMC channel along the north side of the new freeway. If needed, or as an interim solution, a basin at Meridian and Pecos Roads could provide additional flow attenuation.
D – Pecos Road (Meridian to Ellsworth)	Construct a new channel along Pecos Road, utilizing existing infrastructure wherever possible, from Meridian Road to the Ellsworth Channel. A basin at Meridian and Pecos Roads could reduce the required channel size.
E – Germann Road (Meridian to Rittenhouse)	Construct a new channel along Germann Road that outfalls into the Rittenhouse Channel. The eastern channel limit would be set approximately ½ mile east of Signal Butte Road so that only flows currently reaching the Rittenhouse Channel would be intercepted. A channel along Meridian Road that connects to a basin and/or channel on Pecos Road could reduce the required channel size on Germann Road and reduce flows reaching the Rittenhouse Channel but would increase flows reaching the Ellsworth Channel.
F – Queen Creek Road (Meridian to Rittenhouse)	Construct an extension to the channel on Queen Creek Road(Rittenhouse Channel) east of the existing .
G – Rittenhouse Channel	Construct a channel along Meridian Road from ½ mile north of Queen Creek Road to a basin and/or channel along Pecos Road.

Natural Grade Seed Idea

A variation of the Conveyance Seed Idea was developed that, wherever feasible, included conveyance channels that were set mostly along natural flow paths instead of roadway corridors.

Table 3: Natural Grade Seed Idea Summary

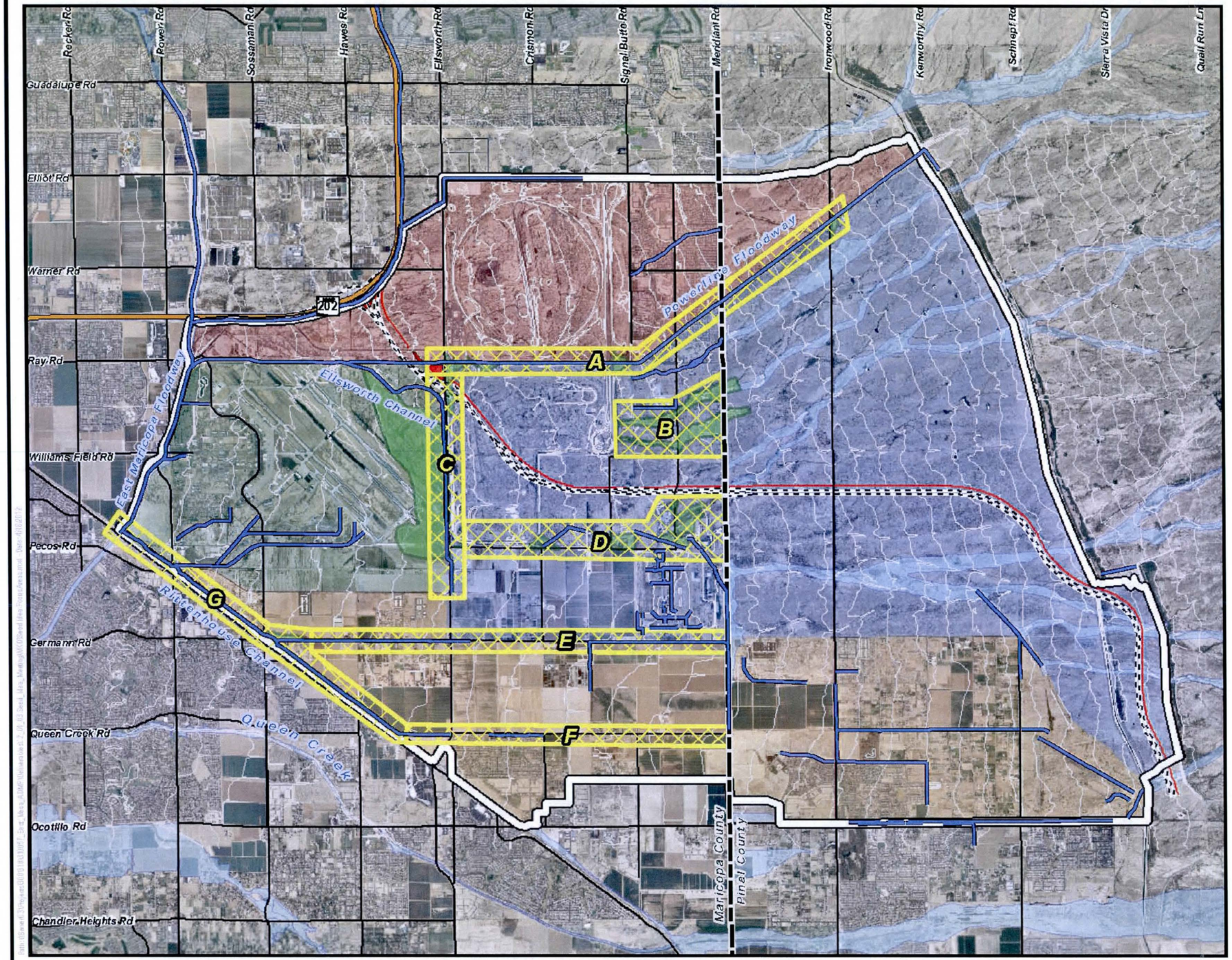
Drainage Issue Focus Area	Seed Idea Feature
A – Powerline Floodway	No feature specific to this seed idea.
B – Meridian and Mountain Road (Williams Field to Ray)	Convey flow through channels/ditches/washes in along natural flow patterns/directions between Meridian Road and Signal Butte Road. Flows discharge along Signal Butte Road at there natural discharge points.
C – Ellsworth Channel	No feature specific to this seed idea.
D – Pecos Road (Meridian to Ellsworth)	Convey flow through channels/ditches/washes along natural flow patterns/directions between Meridian Road and Pecos Road. These conveyances would be abandoned with the construction of a new channel along the north side of the future freeway.
E – Germann Road (Meridian to Rittenhouse)	Construct a channel along the natural flow course at approximately the ½ mile street between Queen Creek and Germann Roads to approximately Meridian Road. The channel could meander around existing development, as needed. The channel could be extended beyond Meridian Road to intercept flows headed towards Queen Creek Road.
F – Queen Creek Road (Meridian to Rittenhouse)	See E – Germann Road, above.
G – Rittenhouse Channel	No feature specific to this seed idea.

Storage Seed Idea

A set of possible solutions to drainage problems throughout the study area was developed that mostly relied on new storage facilities.

Table 3: Storage Seed Idea Summary

Drainage Issue Focus Area	Seed Idea Feature
A – Powerline Floodway	Require future development to provide additional retention before discharging into floodway.
B – Meridian and Mountain Road (Williams Field to Ray)	Construct a new channel along Meridian Road to intercept flows and convey them south to a new basin along the north side of the new freeway. Eventually, the basin would outfall to a joint ADOT/FCDMC channel along the north side of the new freeway. In the interim, the basin would outfall into a new channel between Williams Field and Pecos Roads.
C – Ellsworth Channel	Intercepting flows before they enter the Ellsworth channel with a new channel along Meridian and a new basin along the north side of the new freeway. Basins along Pecos Road could provide additional or alternative flow attenuation.
D – Pecos Road (Meridian to Ellsworth)	Construct new basins along Pecos Road with a new channel connecting them to Ellsworth Road. Potential basin sites are on the southeast corner of Meridian and Pecos and at the southeast corner of Ellsworth and Pecos.
E – Germann Road (Meridian to Rittenhouse)	Construct a new basin at Meridian Road that outfalls into a new channel along Germann Road.
F – Queen Creek Road (Meridian to Rittenhouse)	Construct a new basin between Crimson and Signal Butte Roads along Queen Creek Road that discharges into existing facilities.
G – Rittenhouse Channel	New basins constructed along Germann and Queen Creek Roads could attenuate flows in the Rittenhouse Channel.



EAST MESA
AREA DRAINAGE
MASTER PLAN UPDATE
FCD 2011C017

LEGEND

- SR 24 Alignment
- SR 24 Channel
- SR 24 Basins
- Channel
- Project Boundary
- Flooding Complaints
- Floodplains
- Drainage Issue Focus Areas
- County Boundary

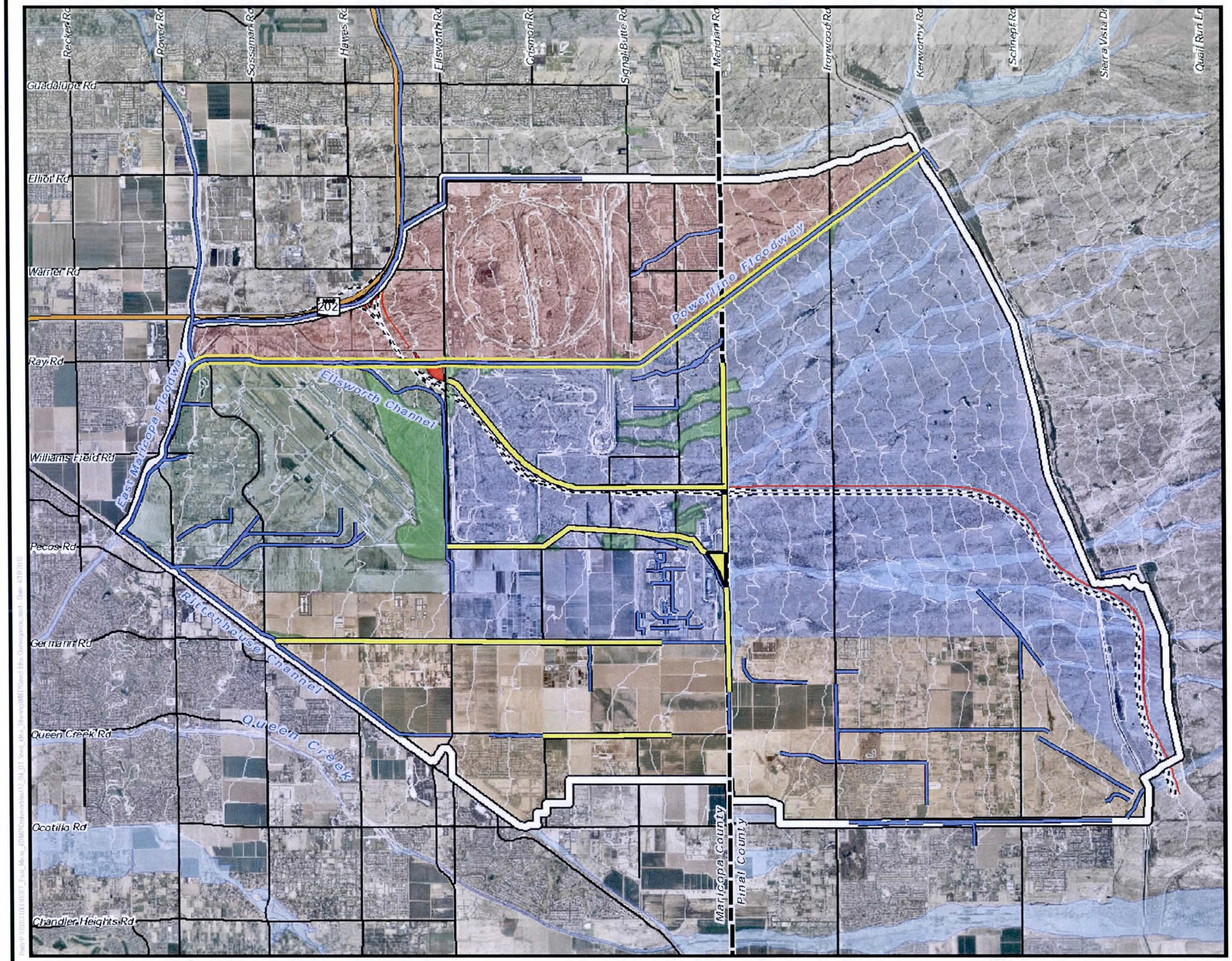
Sub Basins

- Zone 1
- Zone 2
- Zone 3
- Zone 4

NORTH 0 1 2 Miles

Entellus
2255 N. 44th Street Suite 125
Phoenix, Arizona 85008-3209
Tel. 602.244.3566
Fax. 602.244.8947
Web. www.entellus.com

SEED IDEA DRAINAGE
ISSUE FOCUS AREAS



EAST MESA
AREA DRAINAGE
MASTER PLAN UPDATE
FCD 2011C017

LEGEND

- Proposed Channel
- Proposed Interim Channel
- Proposed Facility Improvements
- Proposed Basin
- SR 24 Alignment
- SR 24 Channel
- SR 24 Basins
- Channel
- Project Boundary
- Flooding Complaints
- Floodplains
- County Boundary

Sub Basins

- Zone 1
- Zone 2
- Zone 3
- Zone 4

NORTH 0 1 2 Miles

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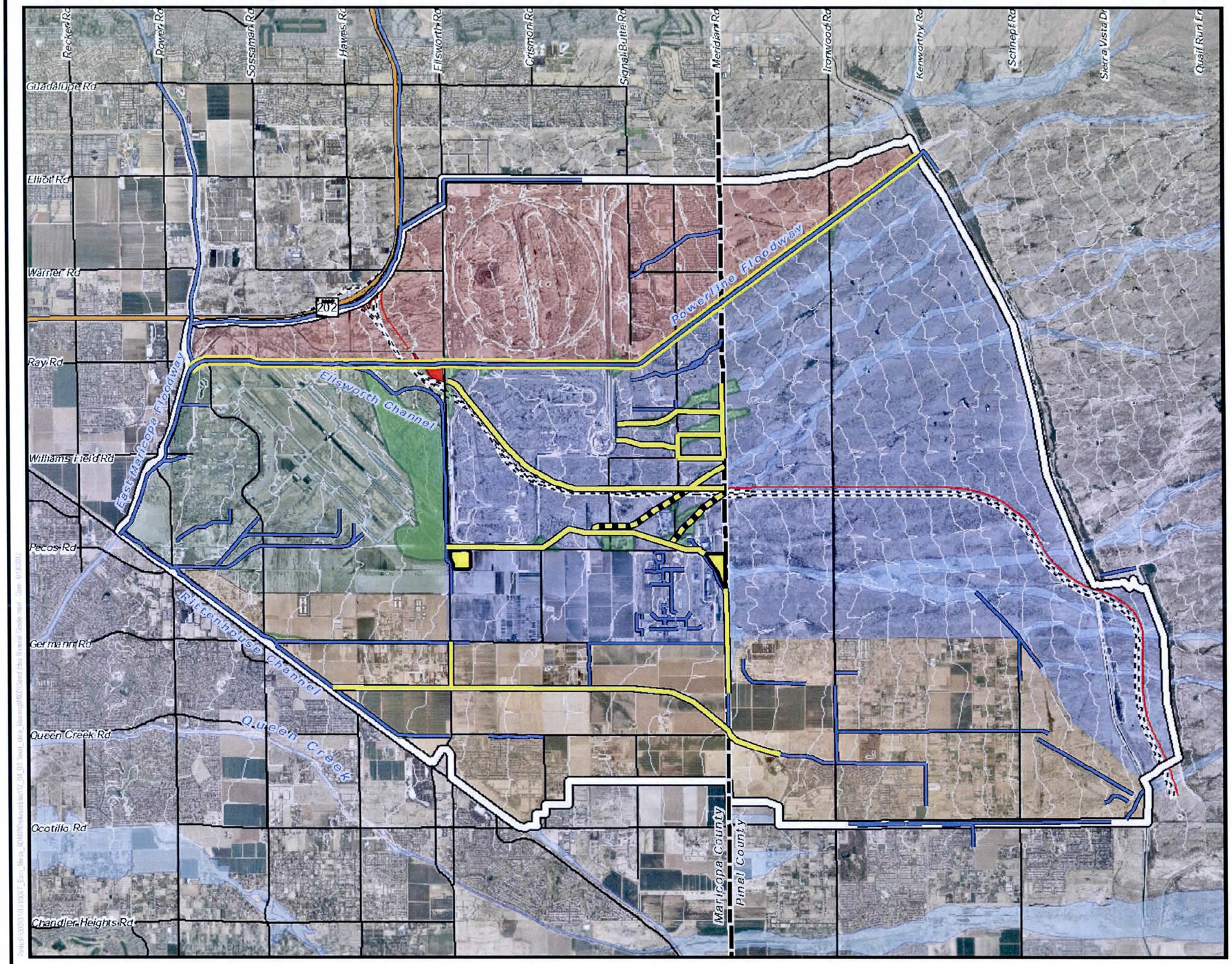
SEED IDEA
CONVEYANCE



EAST MESA
AREA DRAINAGE
MASTER PLAN UPDATE
FCD 2011C017

LEGEND

- Proposed Channel
- Proposed Interim Channel
- Proposed Facility Improvements
- Proposed Basin
- SR 24 Alignment
- SR 24 Channel
- SR 24 Basins
- Channel
- Project Boundary
- Flooding Complaints
- Floodplains
- County Boundary

Sub Basins

- Zone 1
- Zone 2
- Zone 3
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NORTH

0 1 2 Miles

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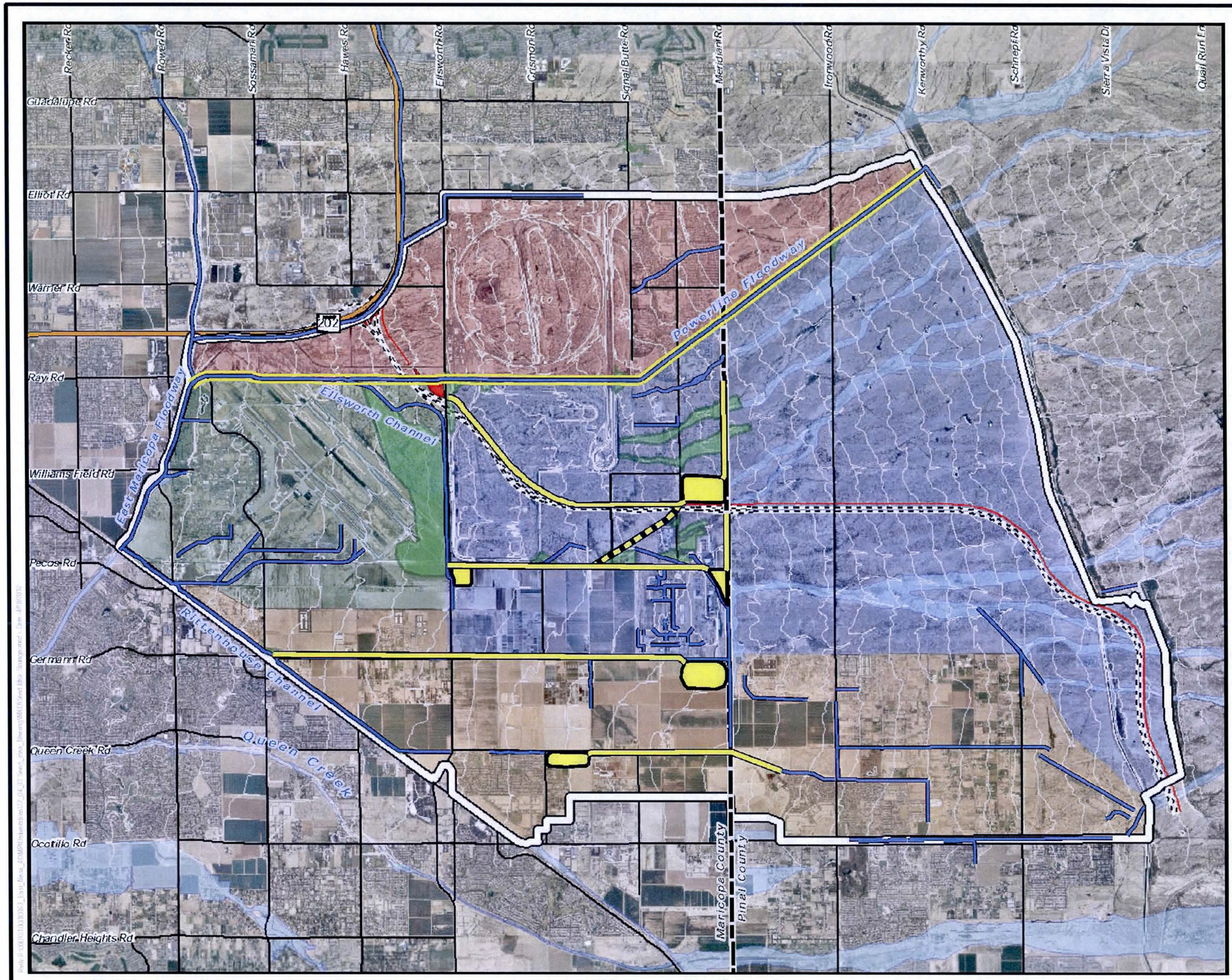
SEED IDEA
NATURAL GRADE



EAST MESA
AREA DRAINAGE
MASTER PLAN UPDATE
FCD 2011C017

LEGEND

- Proposed Channel
- Proposed Interim Channel
- Proposed Facility Improvements
- Proposed Basin
- SR 24 Alignment
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- County Boundary

Sub Basins

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- Zone 4

NORTH

0 1 2 Miles

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SEED IDEA
STORAGE

APPENDIX C. BRAINSTORMING MEETING

C.1 Brainstorming Meeting Summary May 7, 2012

C.2 Tables of Preliminary Analysis of Brainstorming Elements

C.3 Propose Alternatives Selection Meeting May 21, 2012

C.1 Brainstorming Meeting Summary May 7, 2012

East Mesa ADMPU Meeting
Flood Control District: Adobe Room
May 7, 2012 • 1:00-5:00 PM

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1. **Welcome and Introduction (Jen)** **1:00-1:15 PM**
- Meeting Purpose
- Project Overview
- Purpose and Goals and Objectives

2. **Opportunities and Constraints** **1:15-2:00 PM**
- Land Use
- Land Ownership
- Planned Facilities
- Subsidence and Earth Fissures
- Major Utilities
- Landscape/Biological Resources
- Hydrology & Hydraulics Analysis

3. **Drainage and Flooding Problems** **2:00-2:15 PM**
- Focus Areas

Break **2:15-2:30 PM**

4. **Brainstorming** **2:30-4:30 PM**
- Preliminary Seed Ideas
- Open Discussion

5. **Evaluation Criteria** **4:30-4:50 PM**
- Overview
- Open Discussion

6. **Next Steps** **4:50-5:00 PM**
- Action Items

Sign-In Sheet

Meeting: East Mesa Brainstorming **Date:** 5/7/12

Name	Company	Phone Number	Email
Jen Pokorski	FCD	4695	jmp@mail.maricopa.g
CATHY REGESTER	FCD	602-506-4001	cwr@mail.maricopa.gov
Afshin Ahouraiyan	FCD	602-506-4519	afa@mail.maricopa.gov
HARRY COOPER	FCDMC	602.506.2956	harrycoop@mail.maricopa.gov
John Hathaway	FCD	602-506-0503	johe mail.maricopa.gov
J Rafael Pacheco	FCD		joepacheco@
JOHN GRIFFIN	EPG	602.956.4370	JGRIFFIN@EPGAZ.COM
Laurie Miller	LTM	602-485-5880	miller@LTMengineering.com
Brian Fry	JE Fuller	623.889.0166	brian.fry@jefuller.com
Ryan Sauer	Entellus	602.244.2566x14	rsauer@entellus.com
Stephen Gabrielson	City of Mesa	480-644-5207	Stephen.Gabrielson@MesaAZ.gov
Herman Aristeabal	Entellus	602-244-2566	Aherman@Entellus.com

MEETING SUMMARY

Project:	East Mesa ADMP Update	**Date:**	May 7, 2012
Job No.:	FCD 2011C017	**Time:**	1:00 p.m.
Subject:	Alternatives Brainstorming Meeting	**Place:**	FCDMC

The following is a summary of the brainstorming meeting to discuss seed ideas previously developed by the Entellus consultant team. The meeting agenda, attendance sheet, and hand-outs are attached.

1. INTRODUCTION

Jen Pokorski provided an overview of the study purpose and objectives. The primary objectives in developing alternatives are:

- Provide regional (preferably 100-year protection) drainage solutions
- Focus on efficiency of implementation in recognition of funding constraints among the project partners
- Avoid the placement of structures in Pinal County
- Accommodate multi-use opportunities if practicable

2. OPPORTUNITIES & CONSTRAINTS

Hernan Aristizabal presented study area characteristics and how they relate to opportunities and/or constraints:

Land Use. Current land use is predominantly industrial/commercial, residential, and agricultural

Land Ownership. Land ownership is a mix of private and public lands. Public lands are primarily State Trust Lands in Pinal County.

Planned Facilities. SR 24 will bisect the study area and is the predominant planned facility

Subsidence and Earth Fissures. The northeast portion of the study area, predominantly in Pinal County, is most prone to earth fissures and subsidence. However, the risk is low to moderate, and no new facilities are anticipated outside Maricopa County. It was noted that if any facilities are planned, a recommendation for additional analysis would be prudent.

Major Utilities. Data on water, sewer, municipal gas, and SRP overhead power lines have been collected. The City of Mesa has a natural gas gate station at Pecos and Power

roads; all gas lines north of this location is city-owned; all areas south are served by Southwest Gas. An 8-inch line owned by Southwest Gas was noted in the vicinity of Rittenhouse Road.

Data on telephone lines were taken from the original 1998 ADMP. Stephen Ganstrom noted a fiber optic infrastructure hub on the southwest corner of Williams Field and Power roads with a north/south cable line along Power Road.

Entellus noted several shallow, low-pressure buried irrigation lines in Queen Creek along Germann Road and Queen Creek Road between Power and Meridian Roads.

Landscape/Biological Resources. John Griffin reported several landscape/multi-use features. A segment of the Maricopa Regional Trail system runs along the Powerline Floodway; within Maricopa County, constructed reaches of trail are parallel to the floodway alignment but outside of its right-of-way. Pedestrian access to the floodway is possible on the Pinal County reach.

A significant recreation feature is the planned Great Park within the DMB development. The DMB plans also include a future golf course adjacent to the First Solar facility on Elliot Road.

The existing Toka Sticks Golf Course is on the western border of the study area adjacent to the ASU Polytech campus.

Queen Creek's planned East Park remains a possible option for co-locating detention facilities, to be discussed further with the Town of Queen Creek. It was noted that any storage alternatives should be co-located with East Park if practicable.

Planned trail nodes at Germann and Sossaman and at Germann and Ellsworth roads offer multi-use opportunities as key trail connection points to the greater Queen Creek trail system to the south. Trail segments identified in Queen Creeks trails plan that are in the same location as a potential conveyance facility could be implemented as part of the flood mitigation project. However, based on previous, funds are not included in Queen Creek's Capital Improvements Plan for trail construction.

Maricopa Association of Governments' (MAG) *Desert Spaces Plan* has identified Environmentally Sensitive Development Areas within the project boundary upstream of the Rittenhouse Channel; this information could be used to guide improvements and develop landscape design themes in this area.

Cultural resource impacts were documented during the hydrology update project and have been identified throughout the study area. Based on the findings of this report, it appears that cultural resources are prolific in the study area; therefore any future facilities would likely have to address the impacts to cultural resources regardless of location.

Biological resources were also documented during the hydrology update for the project. Areas identified as having high habitat value are primarily located in Pinal County where there has been minimal disturbance to the natural desert. The report recommends preserving areas with habitat value, including those not mapped.

Hydrology & Hydraulics Analyses. The hydrologic analysis performed by the District and verified by Entellus noted deficiencies at the following locations:

- Powerline Floodway (Ironwood, east boundary crossing of DMB, and west boundary crossing of DMB)
- Ellsworth Channel
- Germann Road corridor
- Rittenhouse Channel
- Pecos Road corridor
- Mountain/Erie/Galveston neighborhood
- Queen Creek Road corridor
- Germann/Ellsworth intersection

3. DRAINAGE & FLOODING PROBLEMS

The problem areas identified are the focus of developing alternatives for the East Mesa ADMP Update and are described in the next section.

4. BRAINSTORMING

A. Powerline Floodway

The Powerline Floodway has freeboard issues and is constricted at Ironwood Road, at the DMB east boundary crossing, and at the Ellsworth Road crossing. The seed idea was to extend the existing channel lining to the top-of-bank to alleviate freeboard issues.

The District is coordinating with Pinal County to resolve the issue at the Ironwood Road crossing. Additionally, the District is coordinating with DMB to resolve the constriction at its east property boundary. Therefore, no additional action will be proposed at these two locations at this time.

Possible solutions discussed for the Ellsworth Road crossing include:

- Construct a parallel bypass channel to increase capacity and outlet into the new ADOT basin
- Replace existing culverts with a bridge
- Preserve culverts; relocate and upsize the proposed ADOT freeway detention basin east of Ellsworth
- Add detention upstream
- Widen the Powerline Floodway downstream of Ellsworth/SR 24
  - Would need to determine ADOT constraints since this segment of SR 24 is under construction

B. Mountain Road Corridor

The Mountain Road neighborhood is frequently flooded by offsite sheet flow from Pinal County. Prior street paving by MCDOT has exacerbated drainage problems and has created a sump condition near Mountain and Williams Field roads. The seed ideas are to install a combination of detention basins and channels to intercept runoff upstream of the development along Meridian Road.

Possible solutions discussed include:

- Construct an interim basin within the existing ADOT SR 24 alignment (avoids right-of-way or easement purchase)
- Delineate floodplains and develop a local flood response plan
  - Does not mitigate flooding or access issues
- Purchase impacted homes
- Shift proposed channel along Meridian to Mountain Road and construct basin at Williams Field Road as the outfall
- Purchase frontage along the north side of Erie and widen the channel to provide 10-year flood protection; connect to a new basin at Mountain and Williams Field roads.
- Shift basin location to the southwest corner of Meridian and Galveston Roads
- Relocate channel on Mr. Bertram's property south to the Williams Field channel along Mountain Road.
- At the Signal Butte alignment, redirect the Bertram channel south to the Williams Field channel.

C. Ellsworth Channel

Freeboard and overtopping issues were identified for the Ellsworth Channel. However, solutions for Pecos Road may mitigate these capacity concerns. It was noted that the Pecos Road solution should include the design criterion to size the detention basin(s) such that the Ellsworth freeboard issue is mitigated. Because improvement along Meridian Road appear to have little effect on the flows reaching the Ellsworth Channel, (local flows tend to control) a basin location should be investigated that would attenuate the local flows. The corner of Pecos and Ellsworth is an ideal location. There is an online basin already at this location that could be upsized or converted to off-line to provide additional storage.

D. Pecos Road Corridor

Pecos Road is frequently flooded by offsite sheet flow from Pinal County and from drainage along Meridian Road from the north and south. The seed ideas are to install a system of detention basins and channels to intercept runoff at Meridian Road and transport it to the Ellsworth Channel. It was noted that a channel segment was

constructed along Meridian Road as part of the CMC facility at Pecos and Meridian roads.

Possible alternatives include:

- Increase Retention requirements
- Construct conveyance channel at +/- 1/8-mile south of Pecos to keep high-value street frontage properties available for development while placing constructed drainage at actual low point of watershed. This might also increase open space and recreation value of the channel in addition to minimizing lost property value costs on Pecos.
- Preserve prime farmlands as identified by the NRCS to remain agricultural
  - Identify cost of constructing infrastructure required to offset loss of storage provided by existing agriculture for cost-value analysis
  - Explore non-structural incentives for Mesa and Queen Creek to preserve farmland (e.g., increased water supply allotments, distribution for infrastructure need offset by preserving agricultural stormwater retention)
  - Maintains the retention benefits of farmlands
  - Preserves cultural identity
  - Could provide water resources security through interruptible water rights

E. Germann Road Corridor

The Germann Road corridor does not have capacity to convey runoff under future conditions. The seed ideas are to install a combination of detention basins and channels to intercept runoff at Meridian Road and transport it to the Rittenhouse Channel.

Possible alternative solutions discussed include:

- Shift the CMC Channel along Meridian Road to Germann past the TRW property; continue north to ¼ mile south of Pecos Road and continue west to a proposed basin at Ellsworth Road.
- Located a channel and detention basin ½ mile south of Germann Road
- Replace the proposed Germann Channel with a 10-year storm drain
- Increase retention requirement
- Agricultural preservation

F. Queen Creek Road Corridor

The Queen Creek Road corridor does not have capacity to convey runoff under future conditions. The seed ideas are to install a combination of detention and conveyance to intercept runoff at Meridian Road and transport it west to the Rittenhouse Channel. Channel alignment could be Queen Creek Road or ½ mile north of and parallel to Queen Creek Road.

Discussion points:

- If the Germann Road Channel were shifted ½ mile to the south, a channel along Queen Creek Road may not be needed.
- It should be stated explicitly if portions of the facilities will be implemented by others.
- Increase retention requirement
- Agricultural preservation

G. Rittenhouse Channel Extension

The Rittenhouse Channel has freeboard deficiencies under future development conditions.

Possible alternative solutions include:

- Revisit the District's freeboard criteria to determine if the criteria are applicable at this location.
- Widen Rittenhouse Channel.
- Transfer runoff to farmlands via sump as an irrigation source
- Purchase property adjacent to the channel to be used to accommodate overflow
- Notify adjacent property owners of future freeboard deficiencies and do not pursue remedial measures
- Purchase drainage easement on the north side of the channel
- Develop a freeboard-risk overlay
- Prepare a new floodplain delineation for Rittenhouse Channel
  - FEMA delineation would have to be based on existing conditions
- Determine if the implementation of other plan elements alleviate the freeboard issues in Rittenhouse Channel
- Agricultural preservation

5. EVALUATION CRITERIA

Draft evaluation criteria were discussed (attached). Scoring of criteria with several components was clarified. The average score of components should be taken rather than individual scores for each. Otherwise, the weight of one element with several components would overshadow the other criteria.

The cost component was clarified to mean total life-cycle cost, regardless of whether project partners, outside agencies, or private developments provide funding and/or construction. Cost-sharing opportunities will be considered in the cost criterion scoring.

6. NEXT STEPS

The Entellus consultant team will synthesize the brainstorming ideas and develop up to three alternatives plus a no-action alternative for each planning area by the end of the week and will provide these draft alternatives to the District for review. In turn, the District will reschedule the May progress meeting for earlier in the month. The draft alternatives will be discussed and finalized at the May progress meeting.

The preceding summary was prepared by Laurie Miller.

c: Attendee

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE FCD 2011C017

LEGEND

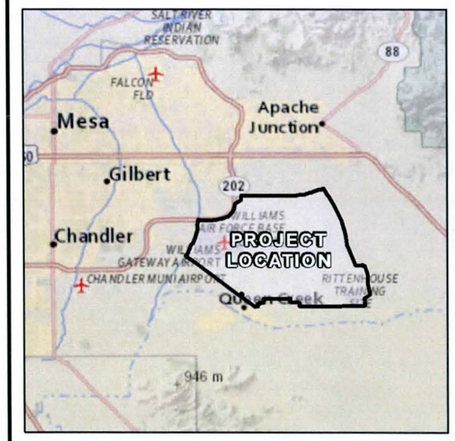
- Project Boundary
- Proposed Conveyance
- Proposed Basins

Drainage Zones

- Ellsworth System
- Rittenhouse System
- SR 24 System

Future ADOT SR 24 Interceptor Channel (Assumed Location for Hydrology Purposes Only. Actual Alignment TBD)

LOCATION MAP



NORTH 0 1 2 Miles

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2255 N. 44th Street Suite 125
Phoenix, Arizona 85008.3299
Tel. 602.244.2566
Fax. 602.244.8947
Web. www.entellus.com

epg | LTM Engineering, Inc. | Ninyo & Moore | JE FULLER

FIGURE X.X
ALTERNATIVE 1

Path: P:\300\310\310057\Maps ADMP Deliverables\Proposed Alternatives\MXD\Preliminary_Alternatives\Alt_1.mxd - Date: 6/13/2012

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE FCD 2011C017

Flood Control District of Maricopa County

LEGEND

- Project Boundary
- Proposed Conveyance
- Proposed Basins
- Proposed Agricultural Preservation
- Proposed Increased or Maintained Retention Requirements

Drainage Zones

- Ellsworth System
- Rittenhouse System
- SR 24 System

Future ADOT SR 24 Interceptor Channel (Assumed Location for Hydrology Purposes Only. Actual Alignment TBD)

LOCATION MAP

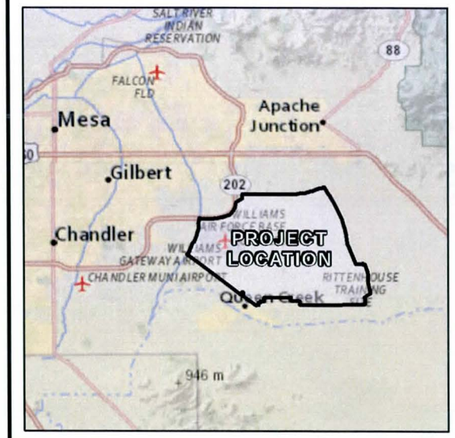

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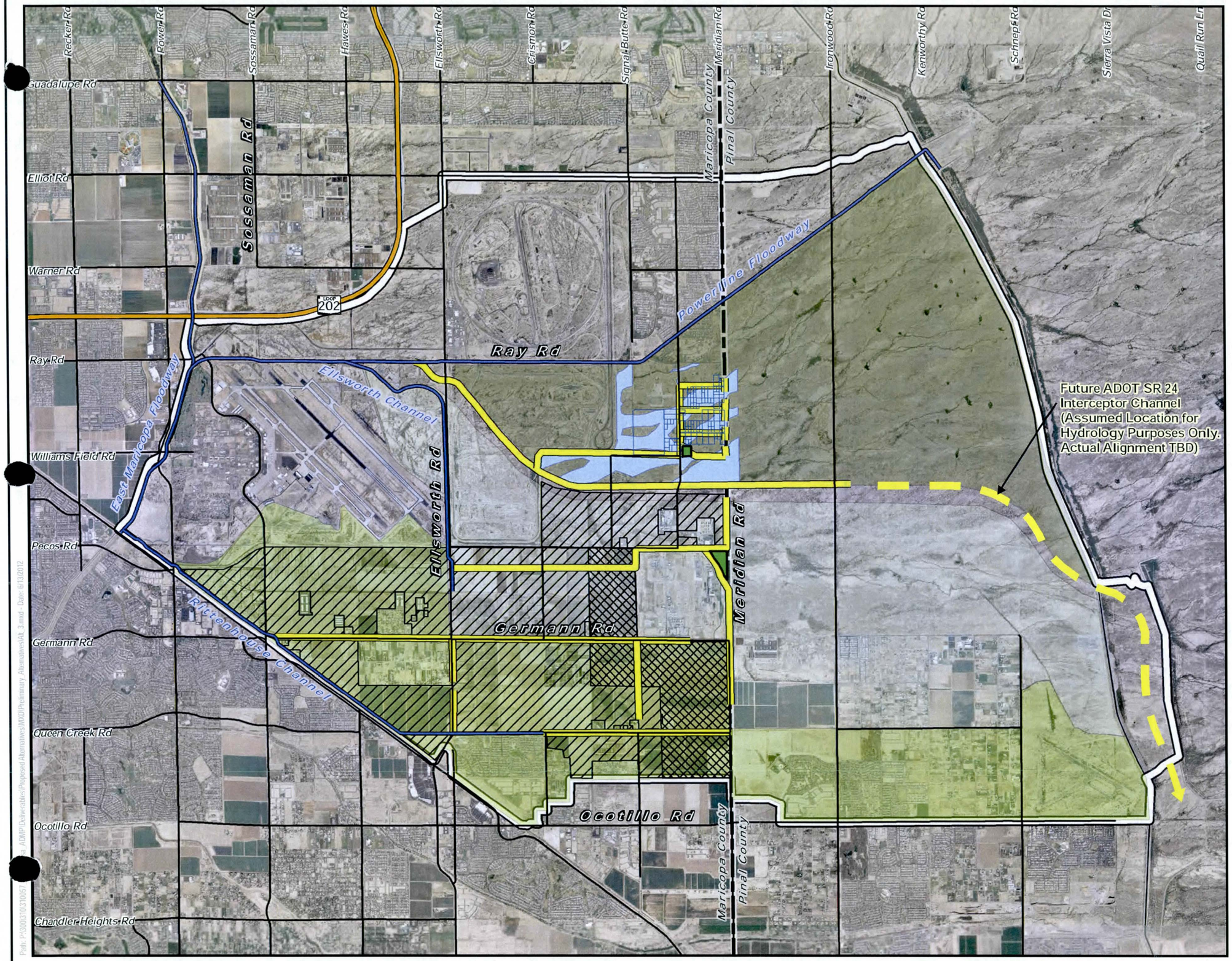
FIGURE X.X
ALTERNATIVE 2

Path: P:\2010\3104\0067\...\ADMP\Deliverables\Proposed Alternatives\MXD\Preliminary_AlternativesAlt_2.mxd - Date: 6/13/2012

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017



LEGEND

- Project Boundary
- Potential Floodplain Delineation
- Parcels Potentially Impacted by Floodplain Delineation
- Proposed Conveyance
- Proposed Basins
- Proposed Agricultural Preservation
- Proposed Increased or Maintained Retention Requirements

Drainage Zones

- Ellsworth System
- Rittenhouse System
- SR 24 System

LOCATION MAP

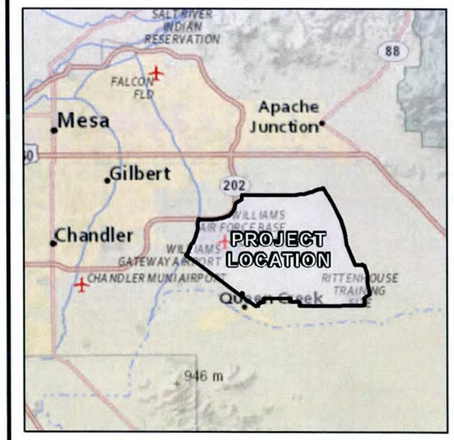


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FIGURE X.X
ALTERNATIVE 3

Path: P:\90031\03100571 - ADMP\Deliverables\Proposed Alternatives\MXD\Preliminary Alternatives\Alt 3.mxd - Date: 6/13/2012

C.2 Tables of Preliminary Analysis of Brainstorming Elements

	Powerline Floodway at Ellsworth	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	No further action	Damages to structures upstream from Ellsworth; roadway overtopping and	NRCS may not accept; public will object when flooded. Airport may object to potential access issues.			Potential for significant damage as area develops and traffic on Ellsworth Road
2	Construct a parallel bypass channel to drain into ADOT basin	Land, new culvert, construction of channel and transitions	ADOT under construction and unlikely to accept. Disturbance to traffic on Ellsworth. DMB may not be receptive to providing land.		Additional facilities to maintain. Potential for shared maintenance on basin with ADOT.	Increases capacity of channel; provides 100-year protection.
3	Replace existing culvert with bridge	Removal and new construction approximately $1.5 million.	Traffic disturbances on Ellsworth Road.		Easiest to maintain; no additional facilities to maintain.	Maintains capacity of upstream/downstream channel. Provides 100-year protection.
4	Relocate/upsize ADOT basin east of Ellsworth Road	Land for the new location. Spillway from floodway pipes under Ellsworth for freeway	Prime commercial parcel		Potential shared responsibility	Supercritical flow spillway difficult to predict/design. Provides 100-year
5	Add detention upstream	Land, construction, spillway, dewatering	Prime commercial parcel		Additional facilities to maintain	Supercritical flow spillway difficult to
6	Widen Powerline Floodway downstream from Ellsworth Road	Land, construction	ADOT under construction and unlikely to accept. Airport may not be receptive to providing land. Prime commercial parcels.		Potential minor increase in maintenance	Unlikely to provide any benefit upstream because supercritical flow is controlled by upstream conditions and the hydraulic jump is controlled by momentum, not
7	Add barrels to existing culvert	New culvert construction and transitions upstream and downstream. Land cost for transition. Approximately $ 1 mil	Would need to be to the north to avoid ADOT basin. Private owner and DMB would have to dedicate additional ROW.		Potential minor increase in maintenance	Maintains capacity of upstream and downstream channels. Provides 100 year protection

	Mountain Road Corridor	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	Do Nothing	$10 M to $15 M in liability; approx, $2.2 M	Not acceptable to residents; agencies liable.			
2	Storage seed idea with basin on ADOT future ROW	6,000 ft large channel, temporary basin, ROW for channel, easement for basin, easement for basin outfall.	Very acceptable to neighborhood. Some property owners may have to give up some land, or it may need to be built on state land (Pinal County).	Easy to construct. Some interim facilities required to drain basin until ADOT channel is built.	Reliable and easy to maintain	Very effective in cutting flows entering neighborhood. Protects existing and future development west of Meridian. Provides 100-year protection.
3	Floodplain delineation and local flood response plan	86 parcels affected, 53 w/structures, 23 vacant. Potential damages: 10% of value $2.2 M. Liability	Many people unhappy to have to pay flood insurance, and no resolution of street or property flooding.		Frequent roadway and property maintenance	Limited effectiveness. Existing homes with flooding issues; roadway flooding not
4	Purchase impacted homes	Properties in floodplain approximately 90. Land value $15 M, structures value $7 M. Liability $5	Don't see much support from resident for this.			Does not solve roadway flooding.
5	Channel along Mountain Road and basins at Williams Field Road	2,600 feet of channel; basin; outfall channel to proving grounds channel or SR-24 channel.	Solves Mountain Road problems, provides outfall for Erie and Galveston. Probably supported by residents.	Many driveway culverts	Number of culverts may increase maintenance.	
6	Basin seed idea, but basin located at Meridian and Galveston	Channel 6,000 ft along Meridian; basin at Galveston and Meridian.	Very accepted by neighborhood. Some property owners may have to give up some land or be built on state land (Pinal County).			Very effective in cutting flows entering neighborhood provides 100-year protection
7	Channel along Mountain Road and west along Williams Field Road Channel along Erie Street and basin at Williams Field and Mountain Roads	7,500 ft small channels. 8,000 ft large channel, 5,000ft improved channel.	Many people impacted		Multiple channels and culverts to maintain.	Solves issues in area but may not benefit below Williams Field - 100 -year protection for limited area.
8	Channel at edge of proving grounds to redirect flows from existing channel to Williams Field Road	1,700 ft small channel, 4,000 ft large channel, 5,000 improved channel, basin at Williams Field and Mountain	Harvard Investments may not be receptive.			Solves lack of capacity on existing channel but does not address how flows could get to the channel or flooding on Mountain Road.

	Pecos Road	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	Do nothing	Damages to existing industrial development, liability.	Flooding of Pecos and Mountain Road. Flooding of industrial development along Pecos may not be acceptable by property owners.			Significant roadway and property flooding.
2	Conveyance seed Idea channel at Pecos	4,000 ft improved ag channel, 5,300 ft improved CRC channel, 9,200 ft new channel, 4,700 improved GM	Some ROW may be needed to implement.		Easy to maintain	Provides 100-year protection.
3	Conveyance seed Idea channel north of Pecos	4,000 ft improved ag channel, 5,300 ft improved CRC channel, 9,200 ft new channel north of Pecos, 4,700	More ROW to include maintenance road, but flow currently gets there.		More difficult to maintain (away from road).	Provides 100-year protection.
4	Conveyance seed Idea channel on Germann to Pecos, leaving CRC channel in place		Property owners may have objections to alignment.			Some flow would bypass Pecos basin with increased channel size downstream. Provides 100-year protection.
5	Increase retention requirement	Reduction in size of channel along Pecos	Probable resistance from developers and property owners because of reduction of buildable		Smaller channel, less maintenance required.	Provides 100-year protection
6	Agricultural preservation	Reduction of channel along Pecos	Difficult to gauge at this time; many political and legal issues. Property owners may be reluctant.		Difficult to maintain in perpetuity.	Provides 100-year protection but may be less reliable
7	10-year storm drain on Pecos	10-year in storm drain; remaining for 100-year along road.	Probably public-supported since it may not require additional ROW.		Storm drain is harder to maintain.	Provides 10-year protection and 100-year reduced risk.
8	Conveyance moved 1/4 mile south of Pecos alignment	Lower land value	Away from prime commercial	Easier to connect to Ellsworth Channel		Provides 100-year protection.

	Ellsworth Channel	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	Do nothing				Potential additional maintenance to ensure lack of freeboard does not affect	Not quite 100-year protection.
2	Increase retention requirement		Probable resistance from developers and property owners because of reduction of buildable space.			May provide 100-year protection
3	Agricultural preservation		Difficult to gauge at this time; many political and legal issues. Property owners may be reluctant.			May provide 100-year protection
4	Basin at Pecos and Ellsworth	Basin, land and structures	Good commercial corner; in front of flight path.			Provides 100-year protection.

	Germann Road	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	Do nothing	Liability	Increased flooding will be difficult to accept by residents.			Flooding along road and potential property flooding.
2	Channel along Germann Road Basin to reduce channel size along Germann	Land and construction	Some resistance from property owners because of ROW needs.		Many driveways across potential channel.	
3	Increase retention requirement in combination with channel	Reduces required size of infrastructure. Increases cost to developers.	Probable resistance from developers and property owners because of reduction of buildable space.			May Provide 100-year protection in combination with channel.
4	Agricultural preservation in combination with channel	Reduces required size of infrastructure. Increases cost to developers.	Difficult to gauge at this time; many political an legal issues. Property owners may be reluctant.			May provide 100-year protection in combination with
5	Shift channel south approximately 1/2 mile Basin to reduce size of infrastructure	single channel vs. two channels. Requires laterals from both	Away from arterial road			Provides 100-year protection.
6	10-year storm drain (not a brainstorming idea)	No additional ROW; more expensive construction.	No ROW by property owners; no driveway culverts.	issues, especially irrigation low-pressure lines.		Provides 10-year protection and 100-year reduced risk.

	Queen Creek	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	Do nothing	Liability	Increased flooding will be difficult to accept by residents.			Flooding along road and potential property flooding.
2	Channel along Queen Creek Road Basin to reduce channel size along Queen Creek or alt alignment		Some resistance from property owners because of ROW needs.			Provides 100-year protection.
3	Increase retention requirement	Reduces required size of infrastructure.	Probable resistance from developers and property owners because of reduction of buildable space.			May provide 100-year protection in combination with channel.
4	Agricultural preservation	Reduces required size of infrastructure.	Difficult to gauge at this time; many political an legal issues. Property owners may be reluctant.			May provide 100-year protection in combination with
5	Shift channel north approximately 1/2 mile Basin to reduce channel size	Less expensive ROW, single channel vs. two channels. Requires	Away from arterial road			Provides 100-year protection.
6	10-year storm drain (not a brainstorming idea)	No additional ROW. More expensive construction.	No ROW by property owners; no driveway culverts.	issues, especially irrigation low-pressure lines.		Provides 10-year protection and 100-year reduced risk.

	Rittenhouse Channel	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	Do nothing Revise freeboard criteria Public notification Freeboard risk overlay FEMA floodplain				Potential additional maintenance to ensure lack of freeboard does not affect channel.	Not quite 100-year protection.
2	Increase retention requirement		Probable resistance from developers and property owners because of reduction of buildable space.			May provide 100-year protection.
3	Agricultural preservation / Ag diversion		Difficult to gauge at this time; many political an legal issues. Property owners may be reluctant.			May provide 100-year protection.
4	Basin at Germann or Queen Creek	Basin, land, and structures				Provides 100-year protection.
5	Widen channel					
6	Basin at Queen Creek and Rittenhouse (not from brainstorming)	Inexpensive land		May be too small		May be too small.
7	Purchase easement on north side of channel			Great multi-use opportunities.		May provide 100-year protection.

	Powerline Floodway at Ellsworth	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	No further action	Damages to structures upstream from Ellsworth; roadway overtopping and associated liability.	NRCS may not accept; public will object when flooded. Airport may object to potential access issues.			Potential for significant damage as area develops and traffic on Ellsworth Road increases.
2	Construct a parallel bypass channel to drain into ADOT basin	Land, new culvert, construction of channel and transitions	ADOT under construction and unlikely to accept. Disturbance to traffic on Ellsworth. DMB may not be receptive to providing land.		Additional facilities to maintain. Potential for shared maintenance on basin with ADOT.	Increases capacity of channel; provides 100-year protection.
3	Replace existing culvert with bridge	Removal and new construction approximately $1.5 million.	Traffic disturbances on Ellsworth Road.		Easiest to maintain; no additional facilities to maintain.	Maintains capacity of upstream/downstream channel. Provides 100-year protection.
4	Relocate/upsize ADOT basin east of Ellsworth Road	Land for the new location. Spillway from floodway pipes under Ellsworth for freeway drainage.	Prime commercial parcel		Potential shared responsibility	Supercritical flow spillway difficult to predict/design. Provides 100-year protection.
5	Add detention upstream	Land, construction, spillway, dewatering system.	Prime commercial parcel		Additional facilities to maintain	Supercritical flow spillway difficult to predict/design.
6	Widen Powerline Floodway downstream from Ellsworth Road	Land, construction	ADOT under construction and unlikely to accept. Airport may not be receptive to providing land. Prime commercial parcels.		Potential minor increase in maintenance	Unlikely to provide any benefit upstream because supercritical flow is controlled by upstream conditions and the hydraulic jump is controlled by momentum, not energy.
7	Add barrels to existing culvert	New culvert construction and transitions upstream and downstream. Land cost for transition. Approximately $ 1 mil	Would need to be to the north to avoid ADOT basin. Private owner and DMB would have to dedicate additional ROW.		Potential minor increase in maintenance	Maintains capacity of upstream and downstream channels. Provides 100 year protection

	Mountain Road Corridor	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	Do Nothing	$10 M to $15 M in liability; approx, $2.2 M in property damage.	Not acceptable to residents; agencies liable.			
2	Storage seed idea with basin on ADOT future ROW	6,000 ft large channel, temporary basin, ROW for channel, easement for basin, easement for basin outfall.	Very acceptable to neighborhood. Some property owners may have to give up some land, or it may need to be built on state land (Pinal County).	Easy to construct. Some interim facilities required to drain basin until ADOT channel is built.	Reliable and easy to maintain	Very effective in cutting flows entering neighborhood. Protects existing and future development west of Meridian. Provides 100-year protection.
3	Floodplain delineation and local flood response plan	86 parcels affected, 53 w/structures, 23 vacant. Potential damages: 10% of value $2.2 M. Liability (injuries, deaths) $5 M to $10 M .	Many people unhappy to have to pay flood insurance, and no resolution of street or property flooding.		Frequent roadway and property maintenance	Limited effectiveness. Existing homes with flooding issues; roadway flooding not addressed.
4	Purchase impacted homes	Properties in floodplain approximately 90. Land value $15 M, structures value $7 M. Liability $5 M to $10 M.	Don't see much support from resident for this.			Does not solve roadway flooding.
5	Channel along Mountain Road and basins at Williams Field Road	2,600 feet of channel; basin; outfall channel to proving grounds channel or SR-24 channel.	Solves Mountain Road problems, provides outfall for Erie and Galveston. Probably supported by residents.	Many driveway culverts	Number of culverts may increase maintenance.	
6	Basin seed idea, but basin located at Meridian and Galveston	Channel 6,000 ft along Meridian; basin at Galveston and Meridian.	Very accepted by neighborhood. Some property owners may have to give up some land or be built on state land (Pinal County).			Very effective in cutting flows entering neighborhood provides 100-year protection
7	Channel along Mountain Road and west along Williams Field Road Channel along Erie Street and basin at Williams Field and Mountain Roads	7,500 ft small channels. 8,000 ft large channel, 5,000ft improved channel.	Many people impacted		Multiple channels and culverts to maintain.	Solves issues in area but may not benefit below Williams Field - 100 -year protection for limited area.
8	Channel at edge of proving grounds to redirect flows from existing channel to Williams Field Road	1,700 ft small channel, 4,000 ft large channel, 5,000 improved channel, basin at Williams Field and Mountain	Harvard Investments may not be receptive.			Solves lack of capacity on existing channel but does not address how flows could get to the channel or flooding on Mountain Road.

	Pecos Road	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	Do nothing	Damages to existing industrial development, liability.	Flooding of Pecos and Mountain Road. Flooding of industrial development along Pecos may not be acceptable by property owners.			Significant roadway and property flooding.
2	Conveyance seed Idea channel at Pecos	4,000 ft improved ag channel, 5,300 ft improved CRC channel, 9,200 ft new channel, 4,700 improved GM channel, 4,100 ft new channel Meridian north of Pecos.	Some ROW may be needed to implement.		Easy to maintain	Provides 100-year protection.
3	Conveyance seed Idea channel north of Pecos	4,000 ft improved ag channel, 5,300 ft improved CRC channel, 9,200 ft new channel north of Pecos, 4,700 improved GM channel, 4,100 ft new channel Meridian north of Pecos.	More ROW to include maintenance road, but flow currently gets there.		More difficult to maintain (away from road).	Provides 100-year protection.
4	Conveyance seed Idea channel on Germann to Pecos, leaving CRC channel in place		Property owners may have objections to alignment.			Some flow would bypass Pecos basin with increased channel size downstream. Provides 100-year protection.
5	Increase retention requirement	Reduction in size of channel along Pecos	Probable resistance from developers and property owners because of reduction of buildable space.		Smaller channel, less maintenance required.	Provides 100-year protection
6	Agricultural preservation	Reduction of channel along Pecos	Difficult to gauge at this time; many political and legal issues. Property owners may be reluctant.		Difficult to maintain in perpetuity.	Provides 100-year protection but may be less reliable
7	10-year storm drain on Pecos	10-year in storm drain; remaining for 100-year along road.	Probably public-supported since it may not require additional ROW.		Storm drain is harder to maintain.	Provides 10-year protection and 100-year reduced risk.
8	Conveyance moved 1/4 mile south of Pecos alignment	Lower land value	Away from prime commercial	Easier to connect to Ellsworth Channel		Provides 100-year protection.

	Ellsworth Channel	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	Do nothing				Potential additional maintenance to ensure lack of freeboard does not affect channel.	Not quite 100-year protection.
2	Increase retention requirement		Probable resistance from developers and property owners because of reduction of buildable space.			May provide 100-year protection
3	Agricultural preservation		Difficult to gauge at this time; many political and legal issues. Property owners may be reluctant.			May provide 100-year protection
4	Basin at Pecos and Ellsworth	Basin, land and structures	Good commercial corner; in front of flight path.			Provides 100-year protection.

	Germann Road	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	Do nothing	Liability	Increased flooding will be difficult to accept by residents.			Flooding along road and potential property flooding.
2	Channel along Germann Road Basin to reduce channel size along Germann	Land and construction	Some resistance from property owners because of ROW needs.		Many driveways across potential channel.	
3	Increase retention requirement in combination with channel	Reduces required size of infrastructure. Increases cost to developers.	Probable resistance from developers and property owners because of reduction of buildable space.			May Provide 100-year protection in combination with channel.
4	Agricultural preservation in combination with channel	Reduces required size of infrastructure. Increases cost to developers.	Difficult to gauge at this time; many political an legal issues. Property owners may be reluctant.			May provide 100-year protection in combination with channel.
5	Shift channel south approximately 1/2 mile Basin to reduce size of infrastructure	single channel vs. two channels. Requires laterals from both	Away from arterial road			Provides 100-year protection.
6	10-year storm drain (not a brainstorming idea)	No additional ROW; more expensive construction.	No ROW by property owners; no driveway culverts.	Utilities may create issues, especially irrigation low-pressure lines.		Provides 10-year protection and 100-year reduced risk.

	Queen Creek	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	Do nothing	Liability	Increased flooding will be difficult to accept by residents.			Flooding along road and potential property flooding.
2	Channel along Queen Creek Road Basin to reduce channel size along Queen Creek or alt alignment		Some resistance from property owners because of ROW needs.			Provides 100-year protection.
3	Increase retention requirement	Reduces required size of infrastructure.	Probable resistance from developers and property owners because of reduction of buildable space.			May provide 100-year protection in combination with channel.
4	Agricultural preservation	Reduces required size of infrastructure.	Difficult to gauge at this time; many political an legal issues. Property owners may be reluctant.			May provide 100-year protection in combination with channel.
5	Shift channel north approximately 1/2 mile Basin to reduce channel size	Less expensive ROW, single channel vs. two channels. Requires	Away from arterial road			Provides 100-year protection.
6	10-year storm drain (not a brainstorming idea)	No additional ROW. More expensive construction.	No ROW by property owners; no driveway culverts.	Utilities may create issues, especially irrigation low-pressure lines.		Provides 10-year protection and 100-year reduced risk.

	Rittenhouse Channel	Cost	Acceptability	Constructability	Maintenance	Effectiveness
1	Do nothing Revise freeboard criteria Public notification Freeboard risk overlay FEMA floodplain				Potential additional maintenance to ensure lack of freeboard does not affect channel.	Not quite 100-year protection.
2	Increase retention requirement		Probable resistance from developers and property owners because of reduction of buildable space.			May provide 100-year protection.
3	Agricultural preservation / Ag diversion		Difficult to gauge at this time; many political an legal issues. Property owners may be reluctant.			May provide 100-year protection.
4	Basin at Germann or Queen Creek	Basin, land, and structures				Provides 100-year protection.
5	Widen channel					
6	Basin at Queen Creek and Rittenhouse (not from brainstorming)	Inexpensive land		May be too small		May be too small.
7	Purchase easement on north side of channel			Great multi-use opportunities.		May provide 100-year protection.

	Powerline Floodway at Ellsworth	Life Cycle Cost	Acceptability	Constructability	Effectiveness
1	No further action	Damages to structures upstream from Ellsworth, roadway overtopping and associated liability	NRCS may not accept, Public will object when flooded. Airport may object to potential access issues		Potential for significant damage as adjacent development and traffic in Ellsworth Road increases
2	Construct a parallel bypass channel to empty on ADOT basin	land, new culvert, construction of channel and transitions; Additional facilities to maintain. Potential for shared maintenance on basin with ADOT	SR 24 already under construction, Disturbance to traffic on Ellsworth, DMB may not be receptive to providing land		Increases capacity of channel, Provides 100-year protection
3	Replace existing culvert with bridge	removal and new construction approximately $1.5 mil; Easiest to maintain no additional facilities to maintain	Traffic disturbances on Ellsworth		Maintains capacity of channel Provides 100-year protection
4	Relocate/upsize ADOT basin east of Ellsworth	Land (ADOT already owns land west of Ellsworth). Spillway from floodway pipes under Ellsworth for freeway drainage	prime commercial parcel		supercritical flow spillway difficult to predict/design Provides 100-year protection
5	Add detention upstream	Land, construction, spillway, dewatering system, Additional facilities to maintain	DMB may not be receptive prime commercial parcel		supercritical flow spillway difficult to predict/design
6	Widen Powerline floodway downstream from Ellsworth	land, construction	ADOT under construction and unlikely to accept, Airport may not be receptive to provide land, prime commercial parcels		Unlikely to provide any benefit upstream because supercritical flow is controlled by upstream conditions and the hydraulic jump is controlled by momentum not energy.
7	Add additional barrels to culvert	new culvert construction, and transitions upstream and downstream, land for transition Approximately $ 1 mil	would need to be to the north to avoid ADOT basin, Private owner and DMB would have to provide additional ROW		Maintain capacity of upstream and downstream channels Provides 100 year protection

	Mountain Road Corridor	Life Cycle Cost	Acceptability	Constructability	Effectiveness
1	No Further Action	$10mil to $15mil in liability approx. $2.2 in property damage	Not acceptable to residents		
2	Storage seed idea with basin on ADOT future ROW	6,000 ft large channel, Temporary basin, row for channel, easement for basin, easement for basin outfall	Very accepted by neighborhood, some property owners may have to give up some land or be built on state land (Pinal County)	Easy to construct some interim facilities to drain basin until ADOT channel is built	Very effective in cutting flows entering neighborhood protect existing and future development west of Meridian Provides 100-year protection
3	Channel along Mountain and basins at Williams Field	2,600 feet of channel, basin, outfall channel to proving grounds channel or SR-24 channel	Solve Mountain Road problems, provides outfall for Erie and Galveston probably supported by residents	Many driveway culverts	
4	Basin seed idea but basin at Meridian and Galveston	Channel 6,000ft along Meridian, basin at Galveston and Meridian	Very accepted by neighborhood, some property owners may have to give up some land or be built on state land (Pinal County)		Very effective in cutting flows entering neighborhood provides 100-year protection
5	10-year Channel along Mountain Road and west along Williams Field OR 10-year channel along Erie and a basin at Williams Field and Mountain PLUS floodplain delineation and local flood response plan w/ purchase of impacted homes	7,500 ft small channels. 8,000 ft large channel, 5,000ft improved channel; Multiple channels and culverts to maintain	many people impacted		Solve issues in area but may not provide benefit south of Williams Field - 100 -year protection for limited area
6	Channel at edge of proving grounds to redirect flows from existing channel to Williams Field	1,700 ft small channel, 4,000 ft large channel, 5,000 improved channel, basin at Williams Field and Mountain	Harvard investments may not be receptive		Solves lack of capacity on existing channel but does not address how flows could get to the channel or flooding other the Mountain

	Pecos Road	Life Cycle Cost	Acceptability	Constructability	Effectiveness
1	No Further Action	Damages to existing industrial development	Flooding of Pecos and Mountain roads, flooding of industrial development along Pecos may not be acceptable to property owners		significant roadway and property flooding
2	Conveyance seed idea (channel at Pecos)	4,000ft improve agricultural channel, 5,300 Improve CRC channel, 9,200ft new channel, 4,700 Improved GM channel, 4,100ft new channel Meridian	some ROW may be needed to implement		provide 100-year protection
3	Conveyance seed idea (channel north of Pecos)	4,000ft improve agricultural channel, 5,300 Improve CRC channel,9,600ft new channel north of Pecos, 4,700 Improved GM channel, 4,100ft new channel Meridian north of Pecos; more difficult to maintain (away from	More ROW to include maintenance road but flow currently gets there anyways		Provides 100-year protection
4	Conveyance seed Idea channel on Germann to Pecos leaving CRC channel in place		property owners may have objections to alignment		Some flow would bypass Pecos basin increasing channel size downstream, Provides 100-year protection
5	Increase Retention Requirement (Combined with 2, 3 and 8)	Reduction in size of channel along Pecos	Probably resistance from developers and property owners because of reduction of buildable space		Provides 100-year protection
6	Agricultural preservation (Combined with 2, 3 and 8)	Reduction in channel size along Pecos; Difficult to maintain in perpetuity	Many potential political and legal issues, property owners may be reluctant		Provides 100-year protection but may be less reliable
7	10-year storm drain on Pecos	10-year in storm drain and remaining for 100-year in road; Storm drain harder to maintain	probably public supported since it may not require additional ROW		Provides 10-year protection and 100-year reduced risk
8	Conveyance moved 1/4 mile south of Pecos alignment	Lower land value land	Away from prime commercial		Provides 100-year protection

	Ellsworth Channel	Life Cycle Cost	Acceptability	Constructability	Effectiveness
1	No further action	Potential additional maintenance to insure lack of freeboard does not affect channel			Not quite 100-year protection
2	Retention-based Solution		Possible resistance from developers and property owners because of reduction of buildable space		May provide 100-year protection
3	Basin at Pecos and Ellsworth	Basin, land and structures	Good commercial corner, in front of fly path		Provides 100-year protection

	Germann Road	Life Cycle Cost	Acceptability	Constructability	Effectiveness
1	No further action				Flooding along road and potential property flooding
2	Channel along Germann Road Basin to reduce channel size along Germann	Land and construction; Many driveways across potential channel	Some resistance from property owners because ROW needs		
3	Increase retention requirements in combination with channel (and possible agricultural preservation)	Reduce require size of infrastructure increase cost to developers	Probably resistance from developers and property owners because of reduction of buildable space		May Provide 100-year protection in combination with channel
4	Shift channel south approximately 1/2 mile Basin to reduce size of infrastructure	Less expensive ROW , single channel vs. Two channels, require laterals from both Germann and	Away from arterial road		Provides 100-year protection

	Queen Creek	Life Cycle Cost	Acceptability	Constructability	Effectiveness
1	No further action		increased flooding will be difficult to accept by residents		Flooding along road and potential property flooding
2	Channel along Queen Creek Road Basin to reduce channel size along Queen Creek or alt alignment		Some resistance from property owners because ROW needs		Provide 100-year protection
3	Retention based solution	Reduce required size of infrastructure	Probably resistance from developers and property owners because of reduction of buildable space		May provide 100-year protection in combination with channel
4	Shift channel north approximately 1/2 mile Basin to reduce channel size	channel vs. two channels, require laterals from both Germann and Queen Creek	Away from arterial road		Provides 100-year protection

	Rittenhouse Channel	Life Cycle Cost	Acceptability	Constructability	Effectiveness
1	No further action				
2	Retention based solution		Probably resistance from developers and property owners because of reduction of buildable space		May provide 100-year protection
3	Agricultural preservation/ Agricultural diversion		difficult to gauge at this time, Many political and legal issues, property owners may be reluctant		May Provide 100-year protection
4	Basin at Germann or Queen Creek	Basin, land and structures			provides 100-year protection
5	Widen Channel				
6	Basin at Queen Creek and Rittenhouse (not from brainstorming)	Inexpensive land			may be too small
7	Non-structural solution including purchasing easement on north side of channel, revising freeboard criteria, public notification, freeboard risk overlay and floodplain delineation			Great multi use opportunities	May provide 100-year protection

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

LEGEND

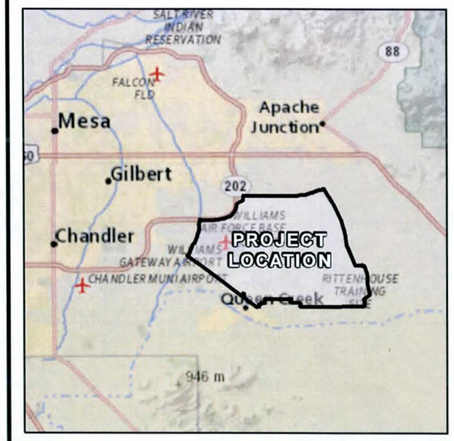
- Project Boundary
- Proposed Conveyance
- Proposed Basins

Drainage Zones

- SR 24 System

Future ADOT SR 24 (Assumed Location for Hydrology Purposes Only. Actual Alignment TBD)

LOCATION MAP



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SR 24 SYSTEM
ALTERNATIVE 1

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EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

LEGEND

- Project Boundary
- Proposed Conveyance
- Proposed Basins

Drainage Zones

- SR 24 System

Future ADOT SR 24 (Assumed Location for Hydrology Purposes Only. Actual Alignment TBD)

Guadalupe Rd
Elliot Rd
Warner Rd
Ray Rd
Pecos Rd
Germann Rd
Queen Creek Rd
Ocotillo Rd
Chandler Heights Rd
Williams Field Rd

Recker Rd
Power Rd
Sossaman Rd
Hawes Rd
Ellsworth Rd
Crismon Rd
Signal Butte Rd
Meridian Rd
Ironwood Rd
Kenworthy Rd
Schnepf Rd
Sierra Vista Dr
Quail Run Ln

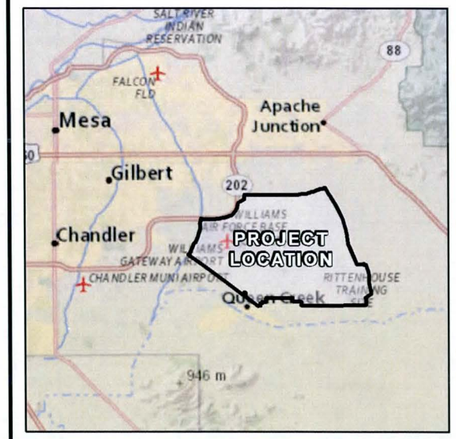
Sossaman Rd
Ray Rd
Meridian Rd
Germann Rd
Ocotillo Rd
Ellsworth Rd

Maricopa County
Pinal County

Powerline Floodway
East Maricopa Floodway
Ellsworth Channel
Rittenhouse Channel

LOOP 202

LOCATION MAP



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SR 24 SYSTEM ALTERNATIVE 2

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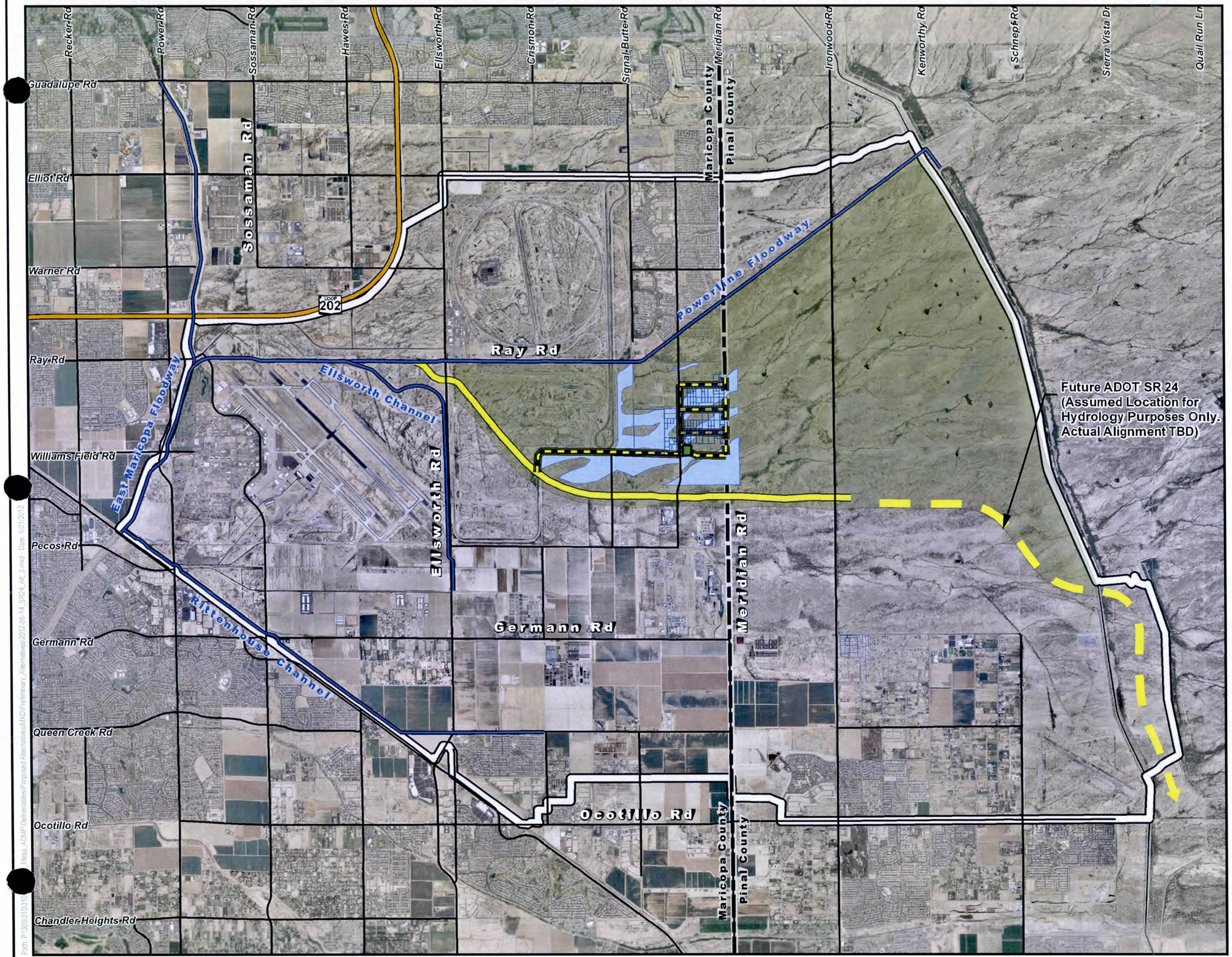

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EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

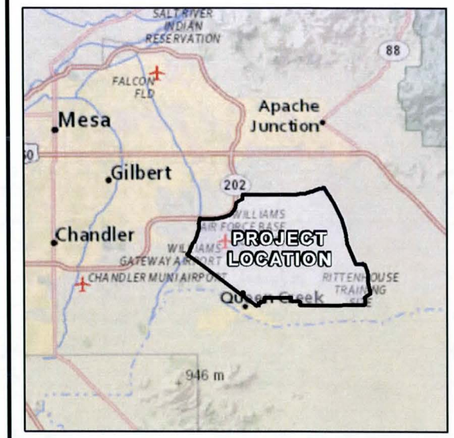
LEGEND

- Project Boundary
- Proposed 10-Year Conveyance
- Proposed 100-Year Conveyance
- Proposed Basins
- Potential Floodplain Delineation
- Parcels Potentially Impacted by Floodplain Delineation

Drainage Zones

- SR 24 System

LOCATION MAP



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SR 24 SYSTEM
ALTERNATIVE 3

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
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LEGEND

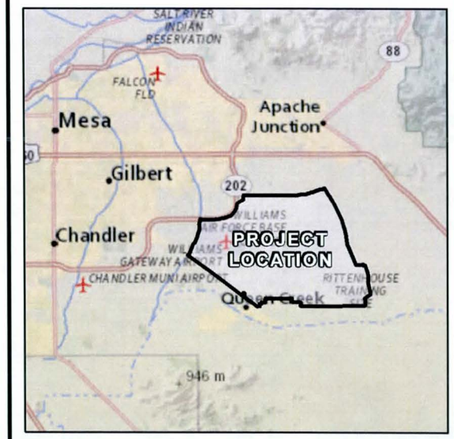
Project Boundary

Drainage Zones

SR 24 System

NOTE: No proposed infrastructure for this alternative.

LOCATION MAP



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SR 24 SYSTEM
ALTERNATIVE 4

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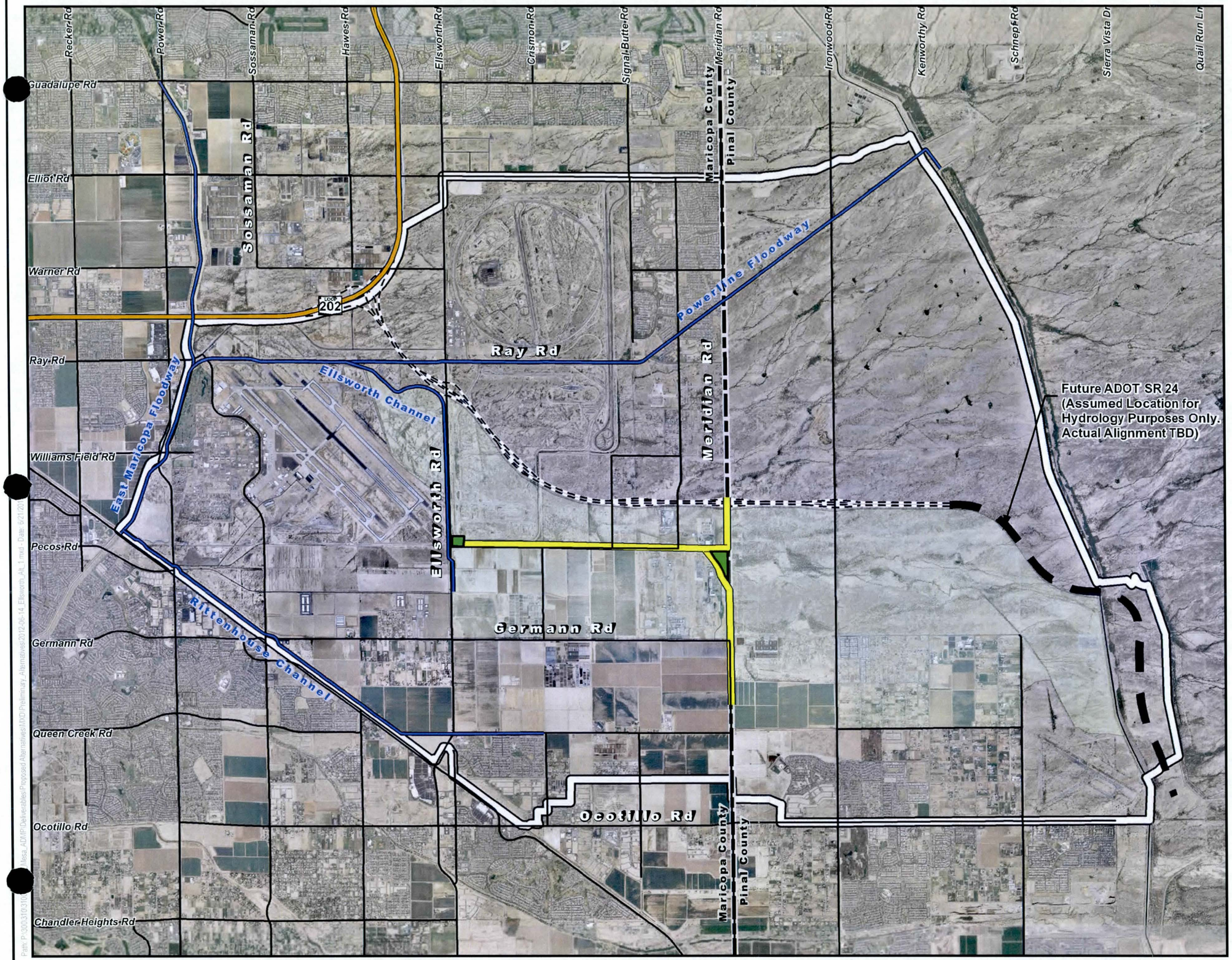


EAST MESA
AREA DRAINAGE
MASTER PLAN UPDATE
FCD 2011C017

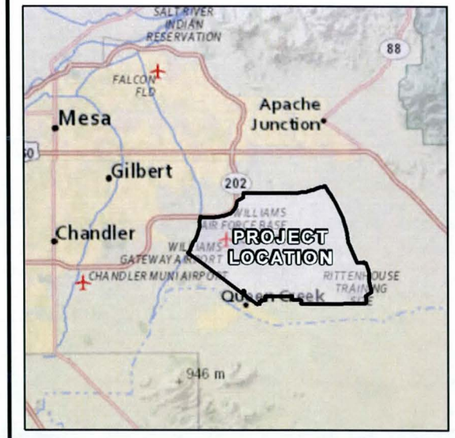
LEGEND

- Project Boundary
- Proposed Conveyance
- Proposed Basins

Drainage Zones

- Ellsworth System

LOCATION MAP



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ELLSWORTH SYSTEM
ALTERNATIVE 1

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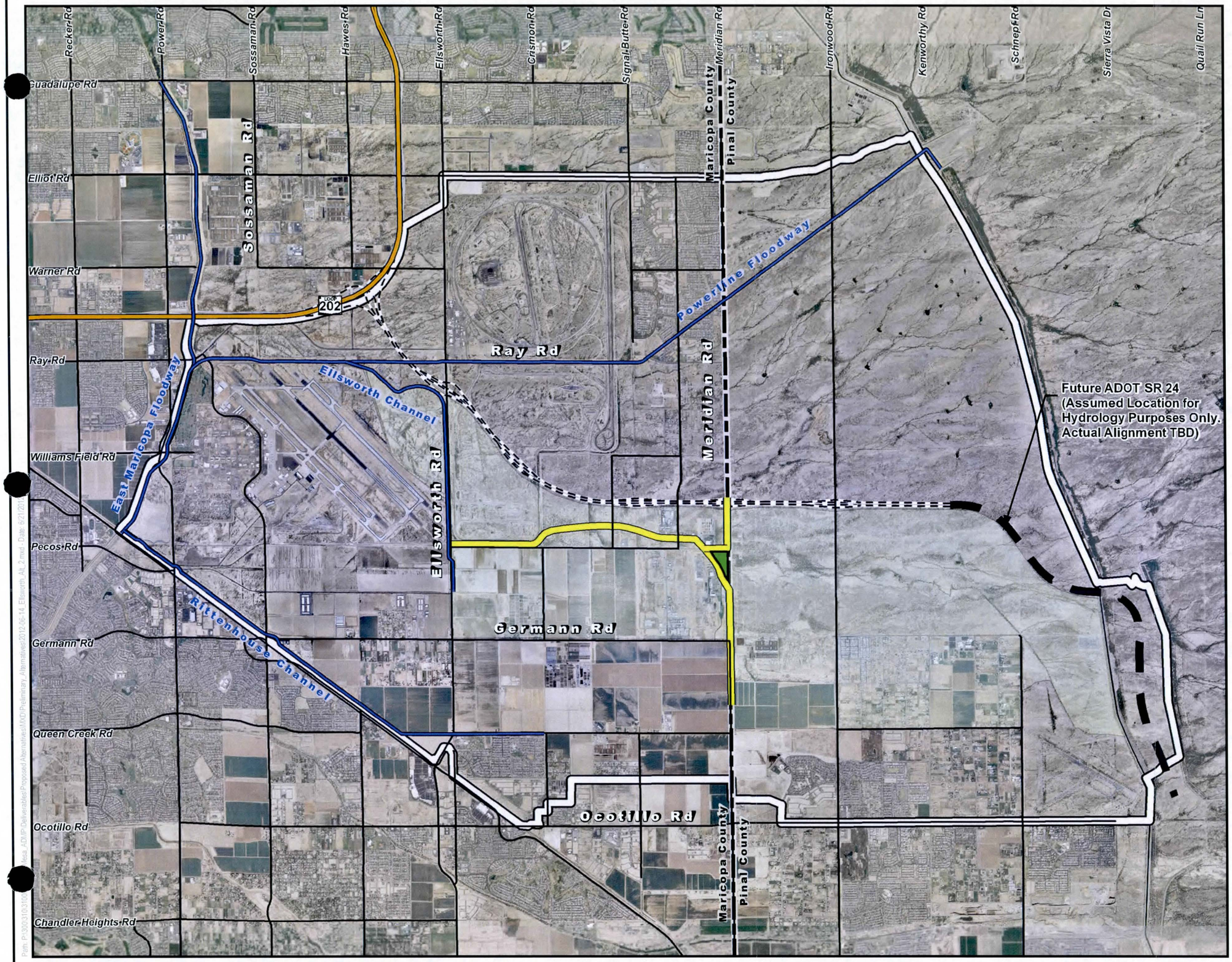


EAST MESA
AREA DRAINAGE
MASTER PLAN UPDATE
FCD 2011C017

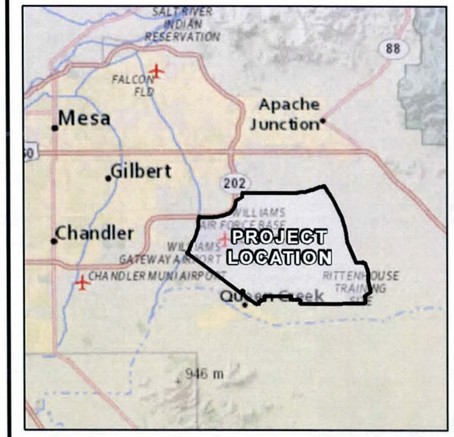
LEGEND

- Project Boundary
- Proposed Conveyance
- Proposed Basins

Drainage Zones

- Ellsworth System

LOCATION MAP



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ELLSWORTH SYSTEM
ALTERNATIVE 2

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EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

Flood Control District of Maricopa County

LEGEND

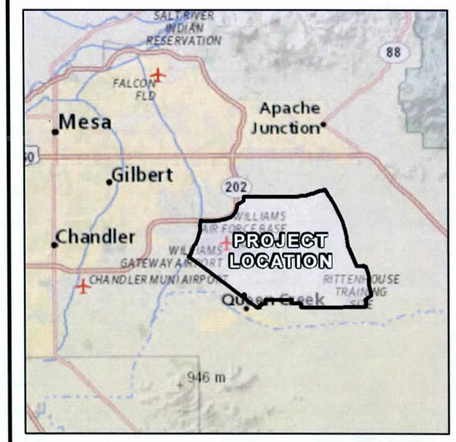
- Project Boundary
- Proposed Conveyance
- Proposed Basins

Drainage Zones

- Ellsworth System

NOTE: Proposed development rights purchase for agriculture areas heritage preservation. (Not Shown Graphically)

LOCATION MAP



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ELLSWORTH SYSTEM ALTERNATIVE 3

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EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

LEGEND

Project Boundary

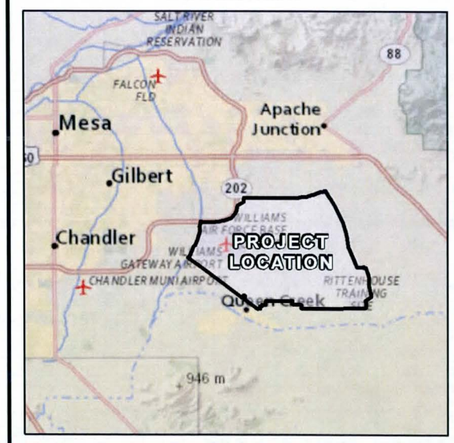
Drainage Zones

Ellsworth System

NOTE: No proposed infrastructure for this alternative.

Future ADOT SR 24 (Assumed Location for Hydrology Purposes Only. Actual Alignment TBD)

LOCATION MAP



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ELLSWORTH SYSTEM
ALTERNATIVE 4

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EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

LEGEND

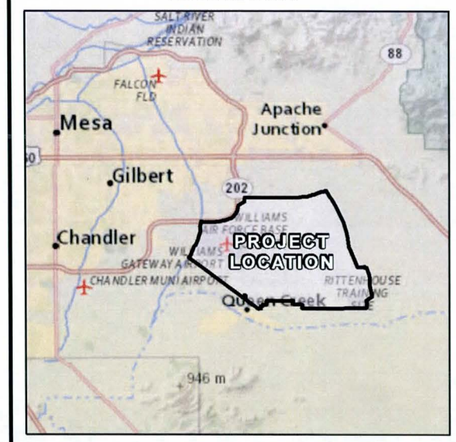
- Project Boundary
- Proposed Conveyance
- Proposed Basins

Drainage Zones

- Rittenhouse System

Future ADOT SR 24 (Assumed Location for Hydrology Purposes Only. Actual Alignment TBD)

LOCATION MAP



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RITTENHOUSE SYSTEM ALTERNATIVE 1

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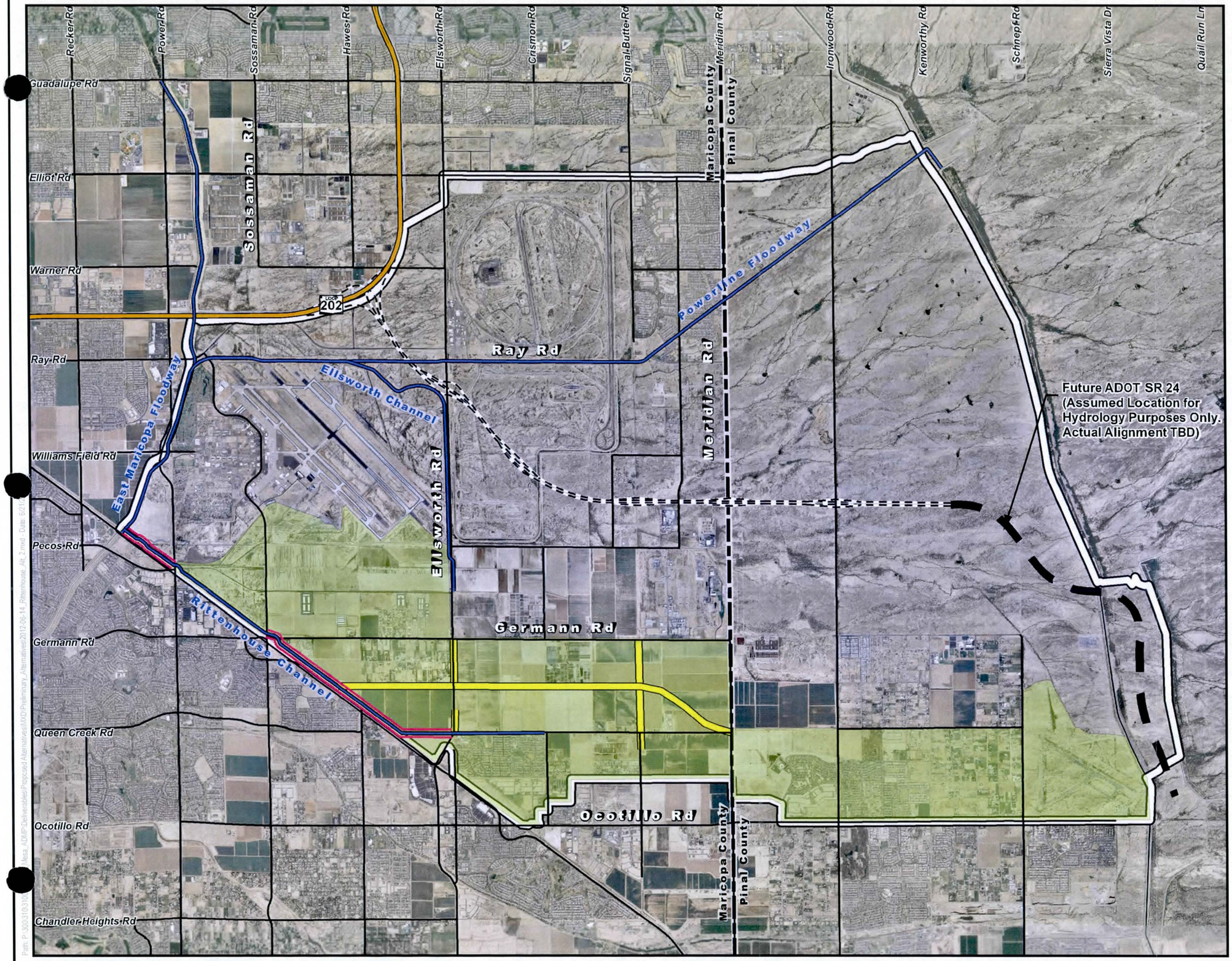
FCD 2011C017



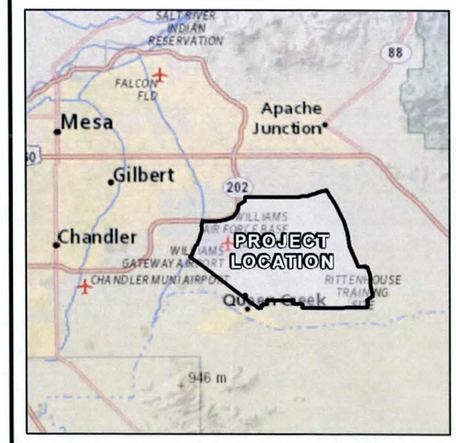
LEGEND

- Project Boundary
- Proposed Conveyance
- Proposed Non-Structural Element

Drainage Zones

- Rittenhouse System

LOCATION MAP



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RITTENHOUSE SYSTEM ALTERNATIVE 2

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

Flood Control District of Maricopa County

LEGEND

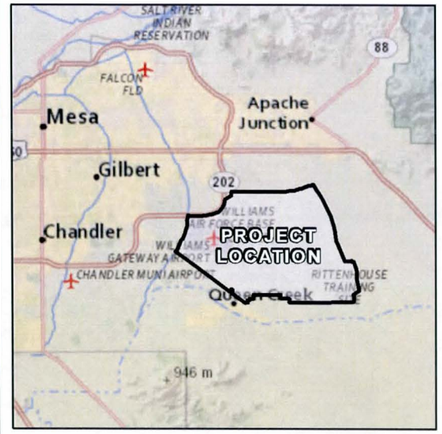
- Project Boundary
- Proposed Conveyance
- Proposed Non-Structural Element
- Proposed Increased or Maintained Retention Requirements

Drainage Zones

- Rittenhouse System

NOTE: Proposed development rights purchase for agriculture areas heritage preservation. (Not Shown Graphically)

LOCATION MAP



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RITTENHOUSE SYSTEM
ALTERNATIVE 3

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EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

LEGEND

Project Boundary

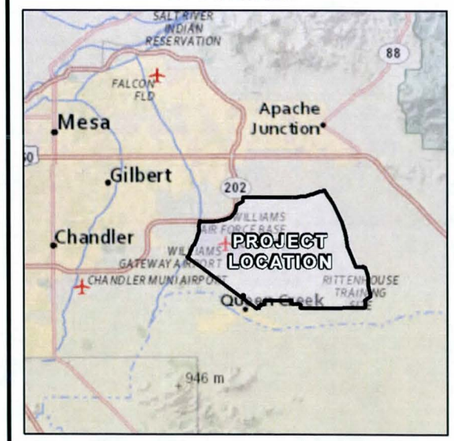
Drainage Zones

Rittenhouse System

NOTE: No proposed infrastructure for this alternative.

Future ADOT SR 24 (Assumed Location for Hydrology Purposes Only. Actual Alignment TBD)

LOCATION MAP



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RITTENHOUSE SYSTEM ALTERNATIVE 4

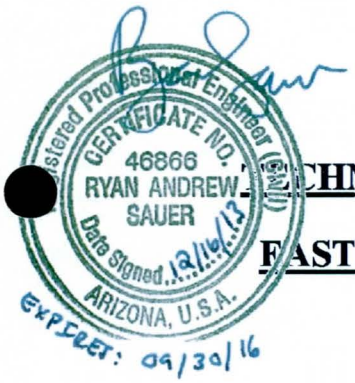
APPENDIX D. HYDROLOGY

D1 - Hydrologic Analysis Technical Memorandum

D2 - Ellsworth Mini-Farms Hydrology Memorandum

D3 - Queen Creek Retention Analysis

D.1 Hydrologic Analysis Technical Memorandum



TECHNICAL MEMORANDUM - HYDROLOGIC ANALYSIS

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE

December 2013

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Appendix D-1. Hydrologic Evaluation of Proposed Infrastructure

To alleviate current and future drainage issues, several variations of infrastructure were proposed for each of the three zones: SR-24, Ellsworth, and Rittenhouse. Both existing and future conditions were evaluated to determine which represents the greatest flood potential. The SR-24 and Ellsworth Zones used existing conditions as the base, which did not include the future SR-24 freeway and channel. The Rittenhouse Zone used the future conditions as the base model.

The models were developed with the U.S. Army Corps of Engineers HEC-1hydrology program. Models developed by the District in its 2011 *East Mesa Area Drainage Master Plan Update: Hydrologic Analysis* (*Hydrology Update*) were updated and modified to simulate conditions for each alternative.

Three alternatives were developed initially for each zone. Two additional alternatives were subsequently developed specifically for the Rittenhouse area. Components and associated changes to the models are described below, grouped by the alternative number and the base model type (i.e., existing for Ellsworth and SR-24; future for Rittenhouse).

1.1. Alternative 1

Alternative 1 includes open channels to convey storm water along Meridian, Pecos, Germann, and Queen Creek Roads. Five regional retention basins would attenuate peak flow, two on Pecos Road and one each on Germann and Queen Creek Roads and at SR-24. The following describes this infrastructure and how it was incorporated into the HEC-1 model.

1.1.1. SR-24 and Ellsworth Conveyance Components

SR-24 Meridian Channel: The SR-24 Meridian Channel begins approximately 1/2 mile north of Galveston Street. It intercepts flow approaching from the east and conveys it south along Meridian Road toward the SR-24 alignment, which is assumed to be approximately 1/2 mile south of Williams Field Road. An interim regional retention basin is proposed at this location.

Meridian North Channel: The Meridian North Channel begins south of SR-24 and ends at Pecos Road. CP14 was rerouted south to CPE15. New routes were defined along Meridian Road to better represent channel conditions.

Meridian South Channel: The Meridian South Channel begins at approximately Queen Creek Road. It conveys flows intercepted from the east to Pecos Road. CPR9 and CPR8 were rerouted north to combine with CPE15 at Pecos Road. New routes were defined along Meridian Road to better represent channel conditions.

Pecos Channel: Pecos Channel extends between Meridian and Ellsworth roads. It will collect flow from the subbasins immediately north and south of Pecos Road. The HEC-1 models were modified to combine local flows from both the north and south side of Pecos Road at subbasin boundaries, or at about every mile. CPE24 was modified to combine subbasins E25 and E24 at Signal Butte Road. CPE28was modified to combine subbasins E27, E28, E29 and at Crismon Road. New routes were defined on Pecos Road to represent channel conditions.

1.1.2. Rittenhouse Conveyance Components

Germann Channel: Germann Channel begins at Meridian Road and ends at the Rittenhouse Channel. It intercepts flow approaching from the south and conveys it west to the Rittenhouse Channel. New routes were defined on Germann Road to represent channel conditions.

Queen Creek Channel: Queen Creek Channel extends from Merrill Road to the existing Rittenhouse Channel Extension at Crimson Road. Similar to Germann Channel, Queen Creek Channel intercepts flow coming from the south and conveys it west to Rittenhouse Channel. Unlike Germann Channel, Queen Creek Channel picks flows along its path from both the north and south. The HEC-1 models were modified so that the channel picks up flows from subbasins R14 and R17. CPR15, CPR18 and CPR17 were affected. New routes were defined on Queen Creek Road.

1.1.3. SR-24 and Ellsworth Retention Components

Increased Retention Requirements: Alternative 1 includes the increased retention requirement in the City of Mesa, assumed to be 2.7 inches. See the HEC-1 model for details.

SR-24 Interim Basin: The SR-24 Interim Basin is located at Meridian Road, on the future alignment of the SR-24 Freeway. The online basin was sized to reduce the flow at CPE14N to what it was before the model was modified to convey flow along Meridian Road. Flow at this concentration point prior to the modification was 162 cfs and after is 1,041 cfs. It was determined that this basin would require a volume of approximately 180 ac-ft to reduce flow by such a large amount. A diversion record, DIV24, was placed downstream of CPE14N with a 100% DI/DQ curve and maximum volume of 180 ac-ft.

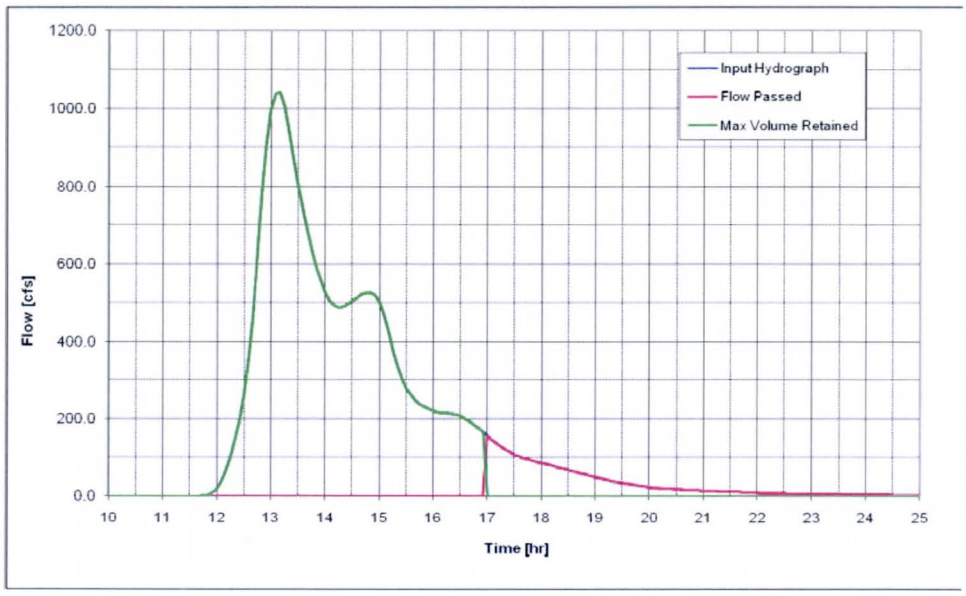


Figure 1.1 - SR-24 Interim Basin Sizing based @ CPE14N

Pecos/Meridian Basin: This offline retention basin is located at the southwest intersection of Pecos and Meridian Roads. The retention volume was optimized to be the minimum possible while providing the greatest benefit downstream. This optimization was done in both the existing and future conditions, and as shown in **Figure 1.1** and **Figure 1.2** below, the effects of increased retention provided little benefit downstream for existing conditions. This is particularly true farther downstream from the basin. It is shown that even if 100% of the flow was removed at Meridian Road and Pecos Road, the flow entering Ellsworth Channel (CPE31) would be about 1,500 cfs, which is more than 300 cfs over the capacity of Ellsworth Channel at this location. Because of this, the basin was sized at 150 ac-ft for the future condition. This value was chosen because it is close to the inflection point of the curve in **Figure 1.2**, and this volume can reasonably be held on the basin site.

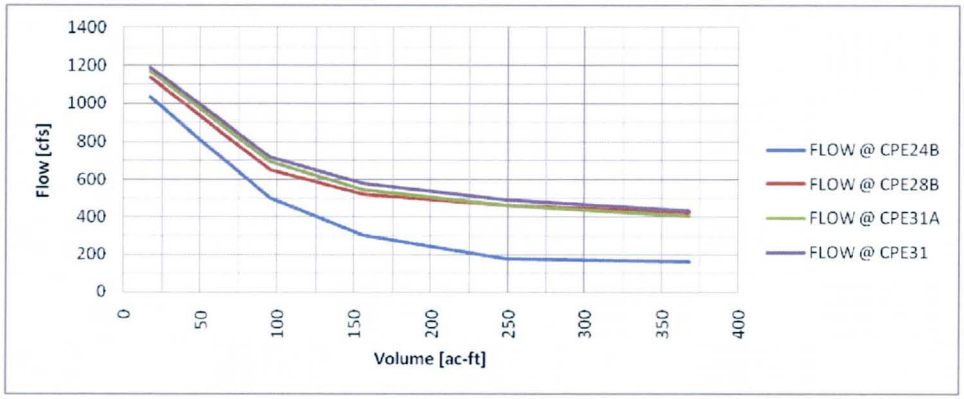


Figure 1.2 Pecos/Meridian Retention Basin Optimization (Existing Conditions)

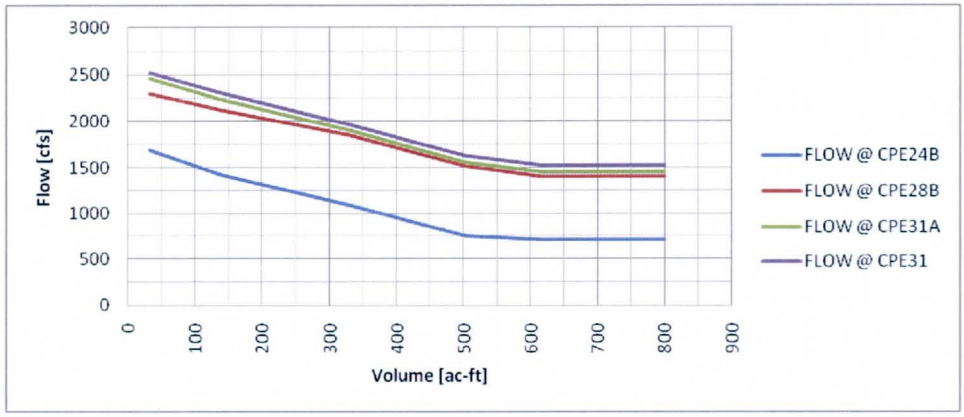


Figure 1.3 Pecos/Meridian Retention Basin Optimization (Future Conditions)

The hydrograph from CPE15 was used to determine the minimum passing flow that would fully use 150 ac-ft of volume. The passing flow was 265 cfs and 965 cfs for the future condition and existing conditions, respectively. This basin was modeled in HEC-1 as diversion DIVPB downstream from CPE15. The results of passing flow calculation are shown in the figures below.

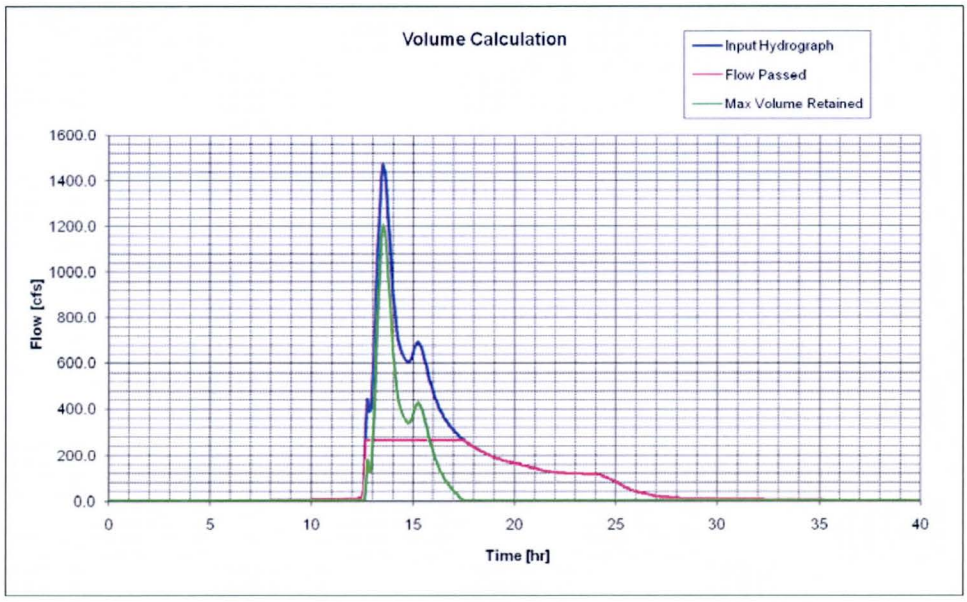


Figure 1.4 - Pecos/Meridian Passing Flow Calculation @ CPE15 for the Future Conditions

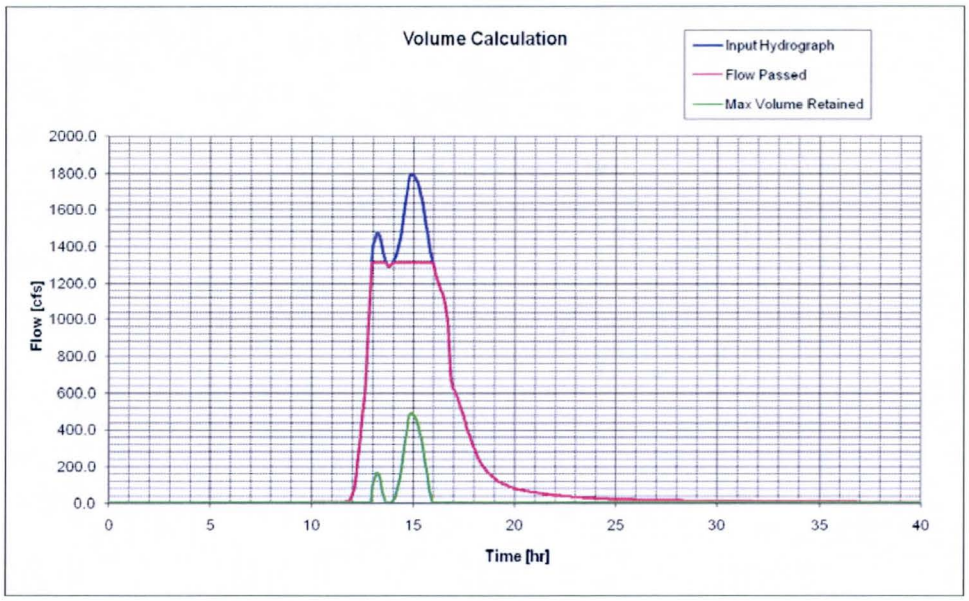


Figure 1.5 - Pecos/Meridian Passing Flow Calculation @ CPE15 for the Existing Conditions

Pecos/Ellsworth Interim Basin: This offline retention basin located in the vicinity of Pecos and Ellsworth Roads. It was sized to reduce flow at CPE31 to the capacity of the Ellsworth Channel at this location (1,170 cfs) for the existing conditions. Based on the hydrograph at CPE31, it was estimated that with a passing flow of 1,150 cfs, 90 ac-ft of volume would be required. The results are shown below in **Figure 1.3**. A diversion, DIVEB, was placed downstream of CPE31 with a bypass flow of 1150 cfs.

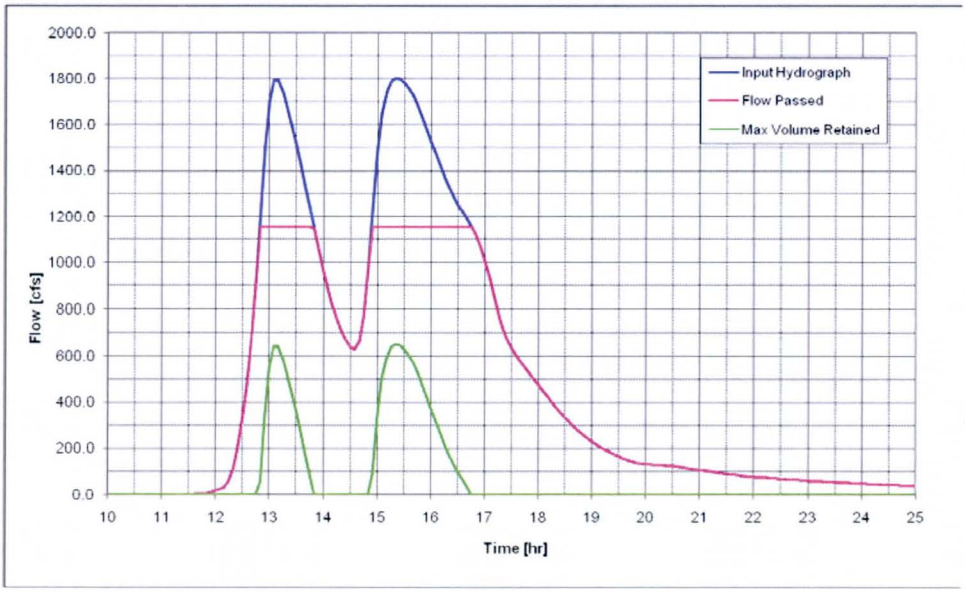


Figure 1.6 - Pecos/Ellsworth Interim Basin Sizing @ CPE31

Williams Field/Ellsworth Interim Basin: This offline retention basin, located on the northeast corner of Williams Field and Ellsworth roads, is included only for existing conditions because of the associated high peak flow. A retention basin is necessary here to reduce flow entering the Ellsworth Channel at Williams Field Road in order to alleviate capacity issues in Ellsworth Channel. To reduce flow at CPE26 to less than 1,740 cfs only 250 cfs can enter Ellsworth Channel at Williams Field Road. To achieve this, a 135 ac-ft retention basin will be necessary. This was included in the HEC-1 model as DIVWFE downstream of CPE26A. The resulting flow at CPE26 is 1749 cfs, approximately equal to design capacity of the channel.

1.1.4. Rittenhouse Retention Components

Germann Basin: This offline retention basin would be located in the vicinity of Germann and Ellsworth roads. The basin size was determined to be about 135 ac-ft.

Queen Creek Retention: A retention basin of 11 ac-ft is proposed on the southeast corner of Queen Creek and Crismon roads. The purpose of this basin is to reduce the flows entering the Rittenhouse Extension channel to existing capacity.

1.2. Alternative 2

1.2.1. SR-24 and Ellsworth Conveyance Components

Meridian Channel: SR-24 Meridian Channel, Meridian North Channel, and Meridian South Channel are the same as for Alternative 1 with one exception. In the existing conditions model the SR-24 Meridian Channel and Meridian North Channel are connected. In Alternative 1, the SR-24 Interim Basin separates these two channels. Alternative 2 does not include this retention basin, so CPE14N was rerouted south to combine with CPE14, and is then conveyed to the Pecos/Meridian Retention Basin instead.

Pecos Channel: See **Alternative 1**. The channel alignment was modified, but in general the channel picks up the same contributing areas.

1.2.2. Rittenhouse Conveyance Components

Ryan Channel: The upstream limit of Ryan Channel is near the intersection of Meridian and Queen Creek roads. The channel extends northwest to the intersection of Ryan and Signal Butte roads. From there, the channel continues west to it confluence with Rittenhouse Channel. The proposed channel collects runoff from the subbasins immediately north and south of Ryan Road as well as flows from east of Meridian Road and south of Queen Creek Road (CPR10).

The HEC-1 models were modified to reroute CPR10 through subbasin R11 rather than R12. Modifications were also made to combine local flows from both the north and south side of Ryan Road at subbasin boundaries, or about every mile. CPR13 was modified to pick up R14 at Crismon Road, CPR16 was modified to pick up R17 at Ellsworth Road, and CPR22A was added to combine R21 and R22 before Rittenhouse Channel.

Special consideration for this channel was taken for subbasin R17. Due to the existing Rittenhouse Channel Extension on Queen Creek Road, it was determined that half of the flow from subbasin R17 would drain to the Rittenhouse Channel Extension. This was modeled by placing a diversion, DR17N, downstream of R17 with a 50/50 DI/DQ curve. Combined CPR18 and CPR17 were hard coded to include only half the area of R17.

1.2.3. SR -24 and Ellsworth Retention Components

Increased Retention Requirements: Alternative 2 includes the increased retention requirement in the City of Mesa, assumed to be 2.7 inches. See the HEC-1 model for details.

Galveston Basin: This offline retention basin, located at the southwest intersection of Galveston Street and Meridian Road, was sized to provide optimum benefit downstream at the smallest volume. It was determined that 47 ac-ft provided the greatest benefit downstream. It can be seen in **Figure 1.3** that volumes greater than that do not provide much additional downstream benefit.

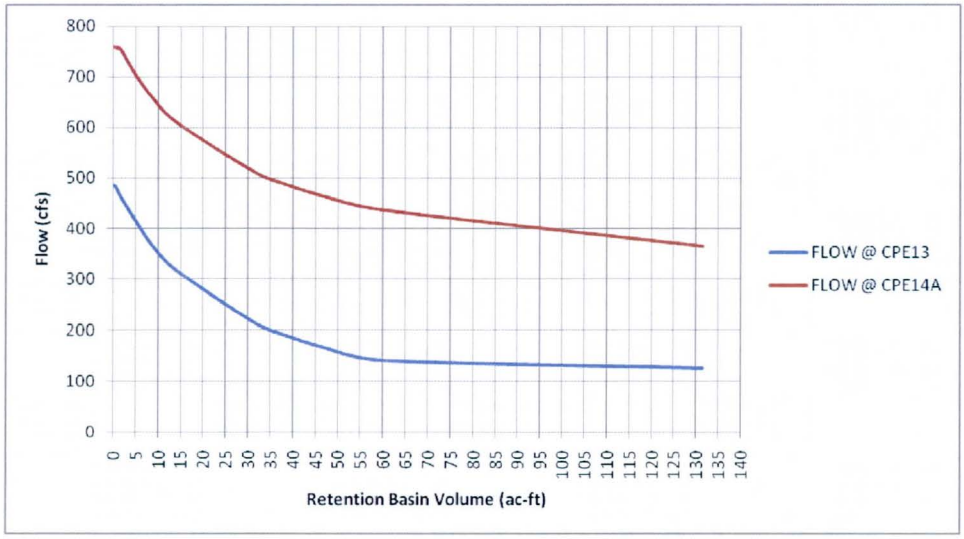


Figure 1.7 Galveston Basin Optimization

Pecos/Meridian Basin: See **Alternative 1**.

1.2.4. Rittenhouse Retention Components

Ryan/Rittenhouse Basin: This offline retention basin, located south of Ryan Road at Rittenhouse Road, was sized to reduce flows in Rittenhouse Channel to its design capacity. The required volume was determined to be 137 ac-ft. The bypass flow was estimated at 400 cfs.

1.3. Alternative 3

1.3.1. SR -24 and Ellsworth Conveyance Components

Mountain System: The Mountain System is a set of channels that conveys runoff along the local streets. The channels were sized for the existing conditions 10-year storm event. The system was also included in the 100-year model to evaluate their performance during a 100-year storm event.

The first of five channels is located on Mountain Road between Ivanhoe Street and Williams Field Road. The other four are located on Ivanhoe Street, Galveston Street, Erie Street, and Williams Field Road. These four channels convey flow west from Meridian Road to Mountain Road. To model this system, CPE18 and CPE19 were rerouted south and a new combine (CPE20) was added to combine CPE19 and E20. Diversions and new routes were defined on the area to size and to simulate channel conditions.

Williams Field Channel: Williams Field Channel was also sized for the existing conditions 10-year storm event, and was included in the Alternative 3 100-year model to evaluate performance under 100-year conditions. The channel is located on Williams Field Road from Mountain Road to the SR-24 alignment. It collects flow from the Mountain system as well as the subbasins north of Williams Field Road. New routes were defined in HEC-1 on Williams Field Road to represent channel conditions.

Meridian North Channel: See **Alternative 1**.

Pecos Channel: See **Alternative 1**.

1.3.2. Rittenhouse Conveyance Components

Germann Channel: Germann Channel begins approximately one half mile east of Signal Butte Road and ends at Rittenhouse Channel. It intercepts flow approaching from the south and conveys it west to the Rittenhouse Channel. New routes were defined on Germann Road to represent channel conditions. It should be noted that due to Meridian Channel, Germann Channel only collects local flows. It does not receive any flow coming from east of Meridian Road.

Queen Creek Channel: Queen Creek Channel extends from Meridian Road to the existing Rittenhouse Channel Extension at Crimson Road. Similar to Germann Channel, Queen Creek Channel intercepts flow coming from the south and conveys it west to Rittenhouse Channel. Unlike Germann Channel, Queen Creek Channel picks up flows along its path from both the north and south. The HEC-1 models were modified so that the channel picks up flows from subbasins R14 and R17. CPR15, CPR18 and CPR17 were affected. New routes were defined on Queen Creek Road.

1.3.3. SR-24 and Ellsworth Retention:

Williams Field Basin: See Alternative 1, with the exception that the required size for Alternative 3 was 216 acre-ft.

Pecos/Meridian Basin: See **Alternative 1**.

Queen Creek Retention: A retention basin was proposed near the intersection of Queen Creek and Crismon. Based on the downstream Rittenhouse Channel Extension, the diversion DIVQCB was added downstream of CPR15 with a bypass flow of 150 cfs and maximum volume of 101 ac-ft.

Increased Retention Requirements: Alternative 3 includes the increased retention requirement in the City of Mesa and Town of Queen and also extends this increase in retention to subbasins outside of the City of Mesa. The assumed requirement was 2.7 inches. See the HEC-1 model for details.

1.4. Alternative 4

Alternative 4 was developed specifically for the Rittenhouse system, and only the future conditions model was created.

1.4.1. Rittenhouse Conveyance Components

Queen Creek Channel: See **Alternative 1**.

Meridian Channel: See Alternative 2 & Alternative 3.

Ryan Road Channel: The Ryan Road Channel begins near the intersection of Queen Creek Road and Meridian, and then continues along Queen Creek to Signal Butte. The channel follows the Signal Butte alignment along the proposed SRP easement to Ryan Road where the proposed channel would follow the SRP easement along Ryan Road to the Rittenhouse Channel. Some of the model modifications were similar to Alternative 2 for the Rittenhouse area and included combining and re-routing all flow along the corridor. A special channel section was utilized for the channel portion sharing the SRP easement.

1.4.2. Rittenhouse Retention Components

Increased Retention Requirements: Alternative 4 includes the increased retention requirement applied to the City of Mesa. The assumed requirement was 2.7 inches. See the HEC-1 model for details.

Queen Creek Retention: See **Alternative 1**.

Signal Butte and Ryan Road: Offline retention was assumed near the alignments of Signal Butte and Ryan Road. This retention basin was estimated to be about 18 acre-ft with a bypass flow of 800 cfs.

Ryan Road and 122nd: This offline retention basin is required to reduce flows to the Rittenhouse Channel. The retention basin was estimated to be 101 acre-ft with a bypass flow of 275 cfs.

1.5. Alternative 5

Alternative 5 was developed specifically for the Rittenhouse system and only the future conditions model was created. Alternative 5 has the following elements:

- Increased retention (2.6") for the undeveloped areas of Queen Creek
- Large regional retention basin on the proposed Queen Creek Sports Complex
- Merrill Road & Queen Creek Road channel
- Meridian Road Channel

1.5.1. Rittenhouse Conveyance Components

Merrill Road and Queen Creek Channel: This channel is similar in alignment to Alternative 1 with the exception being the continuation along Merrill Road as the outfall for the Sports Complex retention basin.

Meridian Road: This channel begins near Ranch Road and extends to the Pecos basin.

1.5.2. Rittenhouse Retention Components

Sports Complex: Regional retention was assumed at the proposed sports complex site. This large retention basin was assumed to be at least 120 acre-ft and is included to attenuate flows from Pinal County. Runoff from local subbasins was not included in the regional retention estimation. To achieve this, flows from two major offsite routes from Pinal County were combined at the Sports Complex site (concentration point PINAL). The site subbasin (R14A) was included in the concentration point PINAL. A stage-storage-discharge relationship was generated (SBPINL) to model the retention of the site.

Increased Retention: Increased retention was assumed for the undeveloped portion of the Queen Creek area only. Several iterations were conducted and the final value was the equivalent of 2.6" of runoff, which is the runoff from the NOAA 14 100-year, 2-hour event. It was assumed that two proposed subdivisions, La Jara and Queen Creek Station, would not be required to meet this additional retention requirement.

Appendix D-2. **Special Considerations**

2.1. Area Reduction

Along the majority of Vineyard Road (Ironwood Road), flow is diverted west and south at subbasin boundaries. In the base models, the majority of the combines downstream of the retrieve were hard coded such that 100% of the area upstream of the diversion was used for both the west and south diversion. Areas were then reconciled at combines where the diversions come back together. Due to the Meridian Channel, the area value at these reconciliation combines, and sometimes the location of the reconciliation combine, was changed. A system was devised which, based on the HEC-1 output, would determine which combines needed to be hard coded and what the value should be. For consistency with the original models, this value was calculated as 100% of the area upstream of the combine. The output of all models was checked against this system to ensure that proper hard coded values and location were being used.

Attachment 1: Increased Retention Calculations

Project: East Mesa Area Drainage Master Plan Update
Client: Flood Control District of Maricopa County
Entellus Project Number: 310.057
FCDMC Project Number: FCD2011C017

Maricopa County Modified Retention Calculations Alternatives 1 and 2

Subbasin ID	area (sq-mi)	DDMSW q100 (cfs)	DDMSW vol100[1] (ac-ft)	Original 80% Retention vol100 (ac-ft)	New 100% Retention vol100[4] (ac-ft)	New 80% Retention vol100 (ac-ft)	Subbasin Undeveloped (%)	Original Future Volume to be Retained[2] (ac-ft)	New Future Volume to be Retained[2] (ac-ft)	Subbasin Developed (%)	Ex Retention Volume (ac-ft)	80% Ex Retention Volume (ac-ft)	Orignal Fut Vol to be retained + Ex Retention (80%)[3] (ac-ft)	New Fut Vol to be retained + Ex Retention (80%)[3] (ac-ft)	Notes:
E24A	0.53	1003	49.49	39.59	60.38	48.30	100	39.59	48.3	0			39.6	48.3	
E24B	0.46	979	45.63	36.50	55.67	44.53	72	26.28	32.07	28	15.46	12.37	38.7	44.4	
E26A	0.87	1308	82.48	65.98	100.63	80.50	100	65.98	80.5	0			66.0	80.5	
E26B	0.26	511	25.07	20.06	30.59	24.47	100	20.06	24.47	0			20.1	24.5	
E27A	0.54	765	52.49	41.99	64.04	51.23	100	41.99	51.23	0			42.0	51.2	
E28B	0.54	940	52.51	42.01	64.06	51.25	100	42.01	51.25	0			42.0	51.3	
E29	1	1488	92.4	73.92	112.73	90.18	100	73.92	90.18	0			73.9	90.2	
E30B	0.88	962	83.89	67.11	102.35	81.88	100	67.11	81.88	0			67.1	81.9	
E31	0.81	1144	70.64	56.51	86.18	68.94	100	56.51	68.94	0			56.5	68.9	
E32	0.25	509	21.45	17.16	26.17	20.94	100	17.16	20.94	0			17.2	20.9	
E33B	0.85	1618	83.53	66.82	101.91	81.53	100	66.82	81.53	0			66.8	81.5	
EMF1A	0.94	2217	99.27	79.42	121.11	96.89	100	79.42	96.89	0			79.4	96.9	EMF1A not included in original hydrology update model.
EMF1B	1.04	1777	105.85	84.68	129.14	103.31	100	84.68	103.31	0	0.40	0.32	85.0	103.6	
EMF2	1.85	1914	179.45	143.56	218.93	175.14	9	12.92	15.76	91	121.19	96.95	109.9	112.7	(assumes undeveloped = 20% education, 30% GI, 5% trans = 9%)
EMF3	1.49	1549	125.17	100.14	152.71	122.17	59	59.08	72.08	41			59.1	72.1	(assumes undeveloped = 55% edu, 75% GI, 30% trans, 100% CC = 59%)
R19	1.53	2190	136.06	108.85	165.99	132.79	100	108.85	88.97	0	44.00	35.20	144.1	124.2	New Future Vol exludes 33% of R19 which is located on PMGA property. DIVR19 excludes existing ret.
R20	0.5	742	39.99	31.99	48.79	39.03	75	23.99	29.27	25	13.02	10.42	34.4	39.7	
R23	0.5	866	43.12	34.50	52.61	42.09	90	31.05	37.88	10	5.21	4.17	35.2	42.1	
R24	0.29	486	24.82	19.86	30.28	24.22	99	19.66	23.98	1			19.7	24.0	
R25	0.28	540	22.59	18.07	27.56	22.05	78.8	14.24	17.37	21.2			14.2	17.4	

[1] 100-YR, 2-HR Runoff Volumes from File: FUT EMADMP 20100705P

[2] 80% of total retention requirement

[3] Values in this column used in HEC-1 for future conditions retention requirements

[4] Values increased by the ratio of the City of Mesa precipitation depth to the 100-YR, 2-HR precipitation depth = 2.7 / 2.219 = 1.22

Project: East Mesa Area Drainage Master Plan Update
Client: Flood Control District of Maricopa County
Entellus Project Number: 310.057
FCDMC Project Number: FCD2011C017

Maricopa County Modified Retention Calculations Alternative 3

Subbasin ID	area (sq-mi)	DDMSW q100 (cfs)	DDMSW vol100[1] (ac-ft)	Original 80% Retention vol100 (ac-ft)	New 100% Retention vol100[4] (ac-ft)	New 80% Retention vol100 (ac-ft)	Subbasin Undeveloped (%)	Subbasin Non-Agriculture (%)	Original Future Volume to be Retained(2) (ac-ft)	New Future Volume to be Retained[2] (ac-ft)	Subbasin Developed (%)	Ex Retention Volume (ac-ft)	80% Ex Retention Volume (ac-ft)	Orignal Fut Vol to be retained + Ex Retention (80%)[3] (ac-ft)	New Fut Vol to be retained + Ex Retention (80%)[3] (ac-ft)	Notes:
E24A	0.53	1003	49.49	39.59	60.38	48.30	100	100	39.59	48.3	0			39.6	48.3	
E24B	0.46	979	45.63	36.50	55.67	44.53	72	100	26.28	32.07	28	15.46	12.37	38.7	44.4	
E26A	0.87	1308	82.48	65.98	100.63	80.50	100	100	65.98	80.5	0			66.0	80.5	
E26B	0.26	511	25.07	20.06	30.59	24.47	100	100	20.06	24.47	0			20.1	24.5	
E27A	0.54	765	52.49	41.99	64.04	51.23	100	100	41.99	51.23	0			42.0	51.2	
E28B	0.54	940	52.51	42.01	64.06	51.25	100	100	42.01	51.25	0			42.0	51.3	
E29	1	1488	92.4	73.92	112.73	90.18	100	100	73.92	90.18	0			73.9	90.2	
E30B	0.88	962	83.89	67.11	102.35	81.88	100	100	67.11	81.88	0			67.1	81.9	
E31	0.81	1144	70.64	56.51	86.18	68.94	100	100	56.51	68.94	0			56.5	68.9	
E32	0.25	509	21.45	17.16	26.17	20.94	100	100	17.16	20.94	0			17.2	20.9	
E33B	0.85	1618	83.53	66.82	101.91	81.53	100	100	66.82	81.53	0			66.8	81.5	
EMF1A	0.94	2217	99.27	79.42	121.11	96.89	100	100	79.42	96.89	0			79.4	96.9	EMF1A not included in original hydrology update model.
EMF1B	1.04	1777	105.85	84.68	129.14	103.31	100	100	84.68	103.31	0	0.40	0.32	85.0	103.6	
EMF2	1.85	1914	179.45	143.56	218.93	175.14	9	100	12.92	15.76	81	121.19	96.95	109.9	112.7	(assumes undeveloped = 20% education, 30% GI, 5% trans = 9%)
EMF3	1.49	1549	125.17	100.14	152.71	122.17	59	100	59.08	72.08	41			59.1	72.1	(assumes undeveloped = 55% edu, 75% GI, 30% trans, 100% CC = 59%)
R11	0.99	1403	84.92	67.94	103.60	82.88	100	100	67.94	82.88	0		0	67.9	82.9	
R12	0.49	1196	50.37	40.30	61.45	49.16	100	100	40.3	49.16	0		0	40.3	49.2	
R13	0.5	866	42.24	33.79	51.53	41.23	100	100	33.79	41.23	0		0	33.8	41.2	
R14	0.5	1018	44.94	35.95	54.83	43.86	91.7	100	32.97	40.22	8.3	1.18	0.95	33.9	41.2	
R15	0.56	707	41.04	32.83	50.07	40.06	63.5	100	20.85	25.43	36.5	2.5551	2.04	22.9	27.5	
R16	0.5	944	46.56	37.25	56.80	45.44	100	100	37.25	45.44	0		0	37.3	45.4	
R17	0.49	572	38.05	30.44	46.42	37.14	100	100	30.44	37.14	0		0	30.4	37.1	
R18	0.8	750	55.46	44.37	67.66	54.13	3.2	100	1.42	1.73	96.8	61.77	49.41	50.8	51.1	
R19	1.53	2190	136.06	108.85	165.99	132.79	100	100	108.85	88.97	0	44.00	35.20	144.1	124.2	New Future Vol exludes 33% of R19 which is located on PMGA property. DIVR19 excludes existing ret.
R20	0.5	742	39.99	31.99	48.79	39.03	75	100	23.99	29.27	25	13.02	10.42	34.4	39.7	
R21	0.84	865	61.14	48.91	74.59	59.67	37.6	100	18.39	22.44	0			18.4	22.4	
R22	0.57	976	49.15	39.32	59.96	47.97	95.6	100	37.59	45.86	0			37.6	45.9	
R23	0.5	866	43.12	34.50	52.61	42.09	90	100	31.05	37.88	10	5.21	4.17	35.2	42.1	
R24	0.29	486	24.82	19.86	30.28	24.22	99	100	19.66	23.98	0			19.7	24.0	
R25	0.28	540	22.59	18.07	27.56	22.05	78.8	100	14.24	17.37	0			14.2	17.4	

[1] 100-YR, 2-HR Runoff Volumes from File: FUT EMADMP 20100705P

[2] 80% of total retention requirement

[3] Values in this column used in HEC-1 for future conditions retention requirements

[4] Values increased by the ratio of the increased precipitation depth to the original precipitation depth = 2.7 / 2.219 = 1.22

Alternative 5

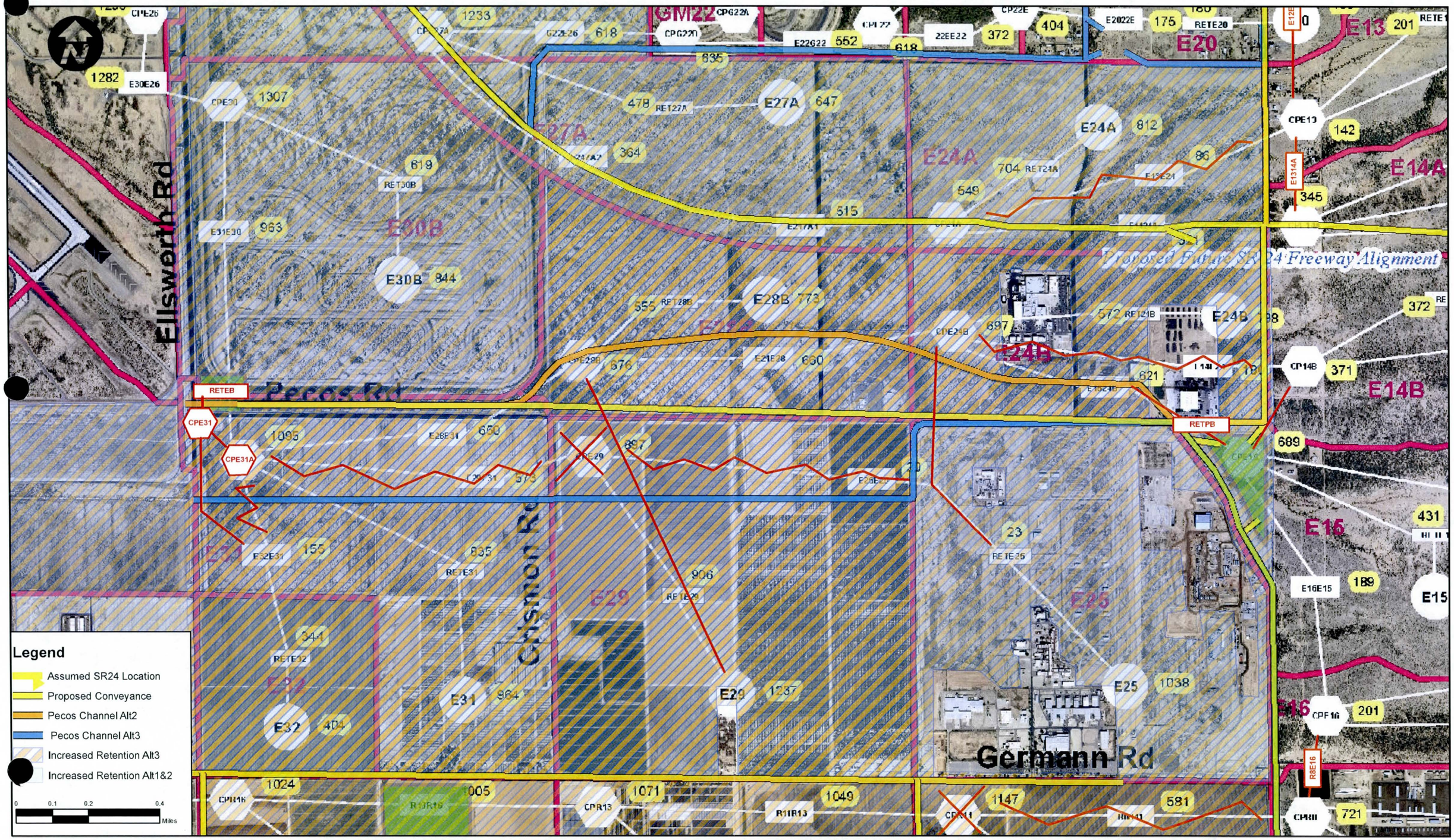
Subbasin ID	Area	Subbasin Undeveloped	80% of Ex Retention	* Future 100-yr, 2-hr	80% of Fu Retention	Retention Volume
	[sq miles]	[%]	[ac-ft]	[ac-ft]	[ac-ft]	[ac-ft]
R11	0.986	100.0	0.00	106.95	85.6	85.6
R12	0.489	100.0	0.00	59.78	47.8	47.8
R13	0.501	100.0	0.00	50.81	40.6	40.6
R14B	0.303	91.7	0.95	32.89	24.1	25.1
R15	0.562	63.5	2.04	51.24	26.0	28.1
R16	0.498	100.0	0.00	42.90	34.3	34.3
R17	0.491	100.0	0.00	44.83	35.9	35.9
R18	0.797	3.2	49.41	70.25	1.8	51.2
R21	0.836	7.5	0.00	65.47	3.9	3.9
R22	0.574	16.4	29.71	54.90	7.2	36.9

* Based on 2.6" 100-yr 2-hr runoff volume event

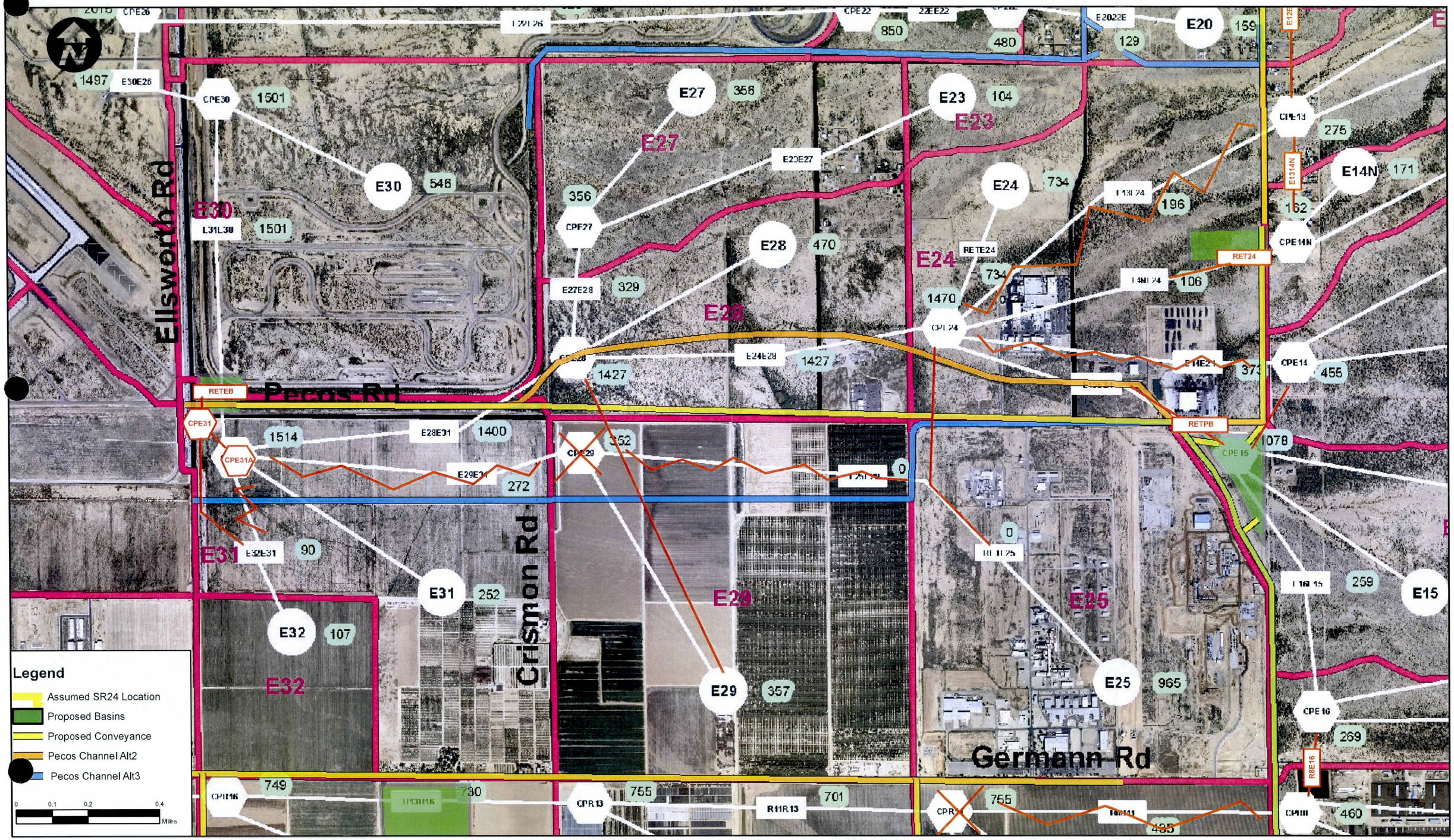
Attachment 2: Hydrology Modification Schematics

Pecos System

East Mesa Area Drainage Master Plan Update
Alternatives 1, 2, & 3: Pecos System, Future Conditions HEC-1 Modifications

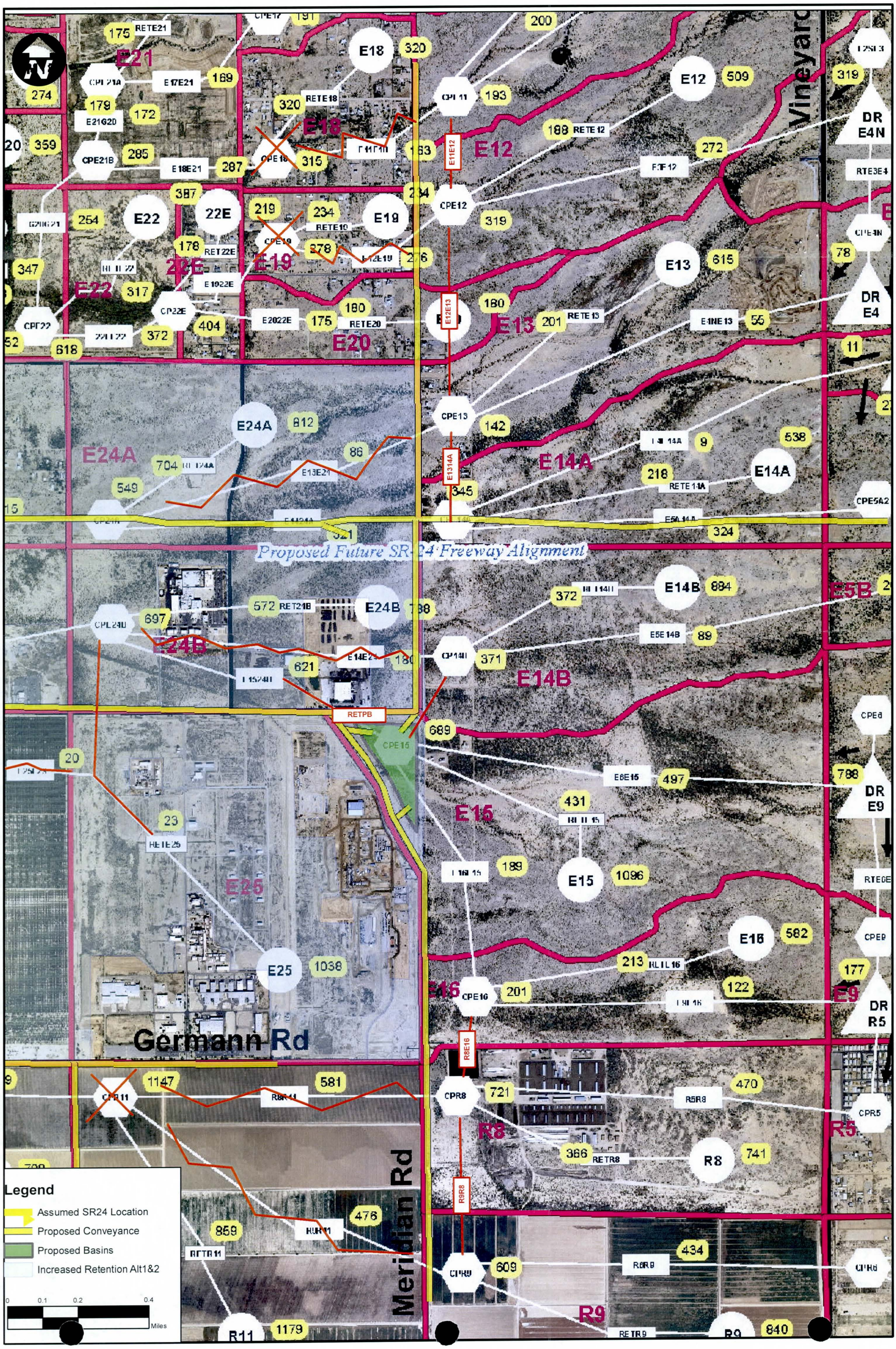


East Mesa Area Drainage Master Plan Update
Alternatives 1, 2, & 3: Pecos System, Existing Conditions HEC-1 Modifications

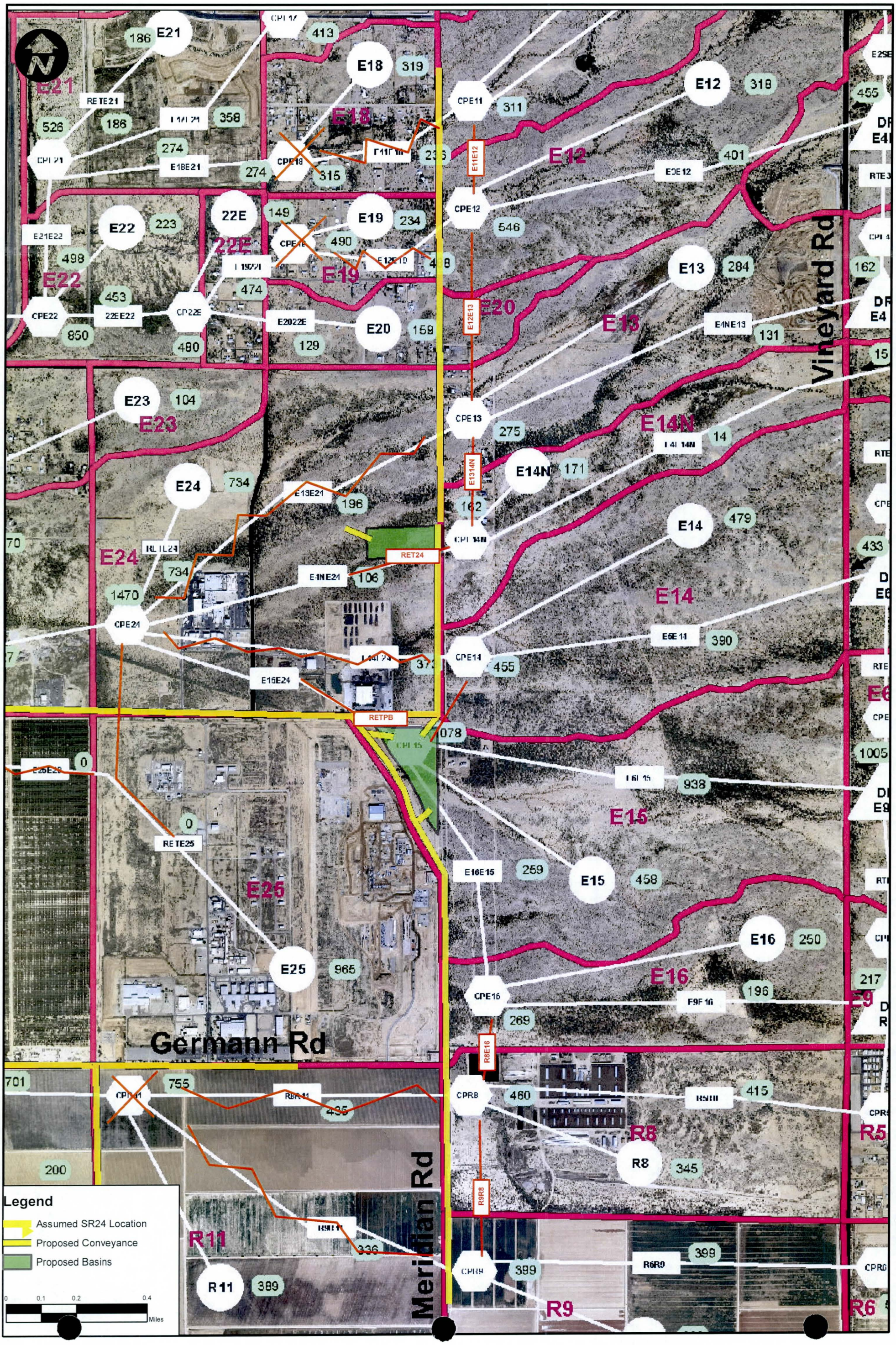


Meridian System

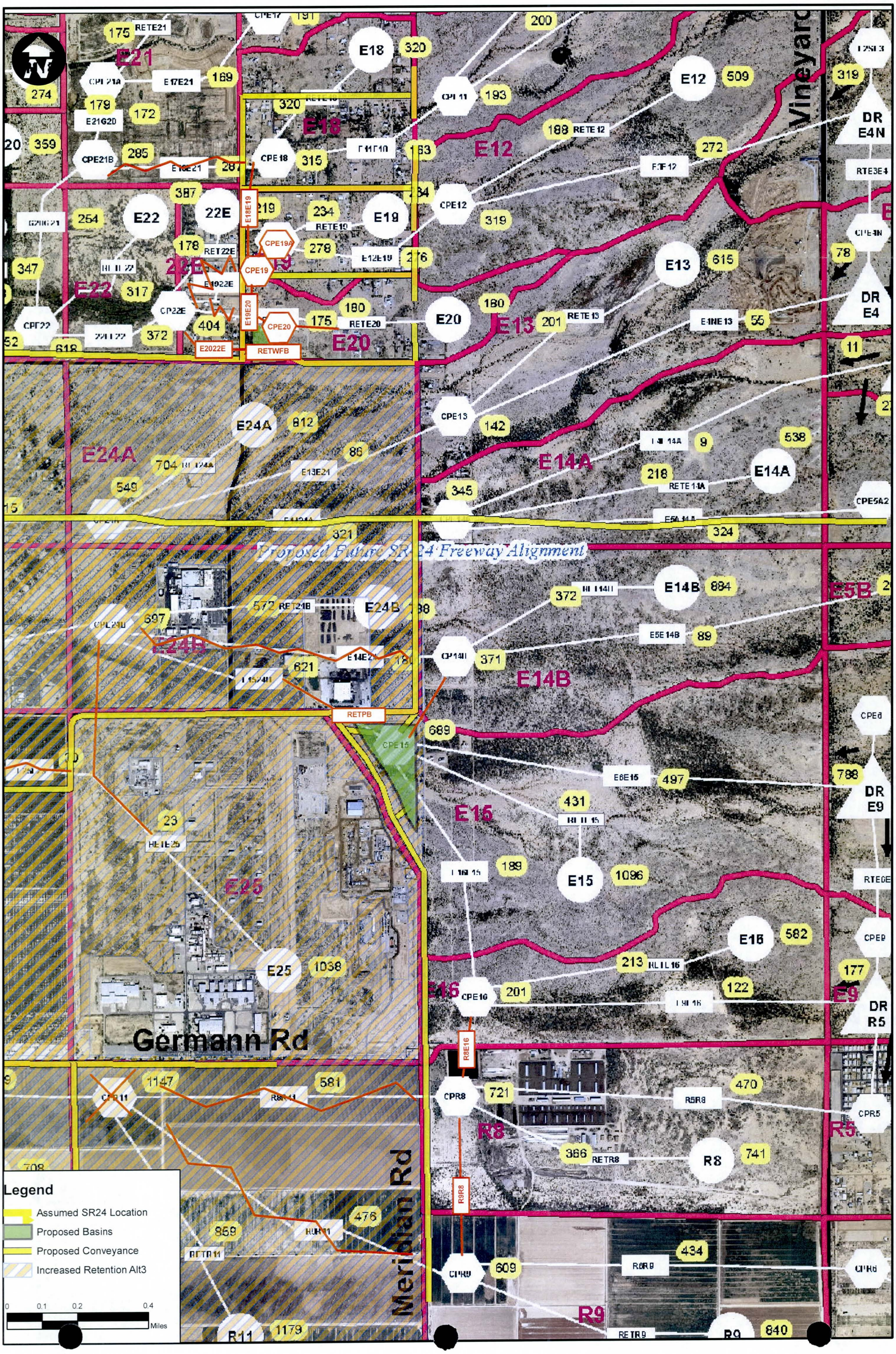
East Mesa Area Drainage Master Plan Update
Alternatives 1 & 2: MeridianSystem, Future Conditions HEC-1 Modifications



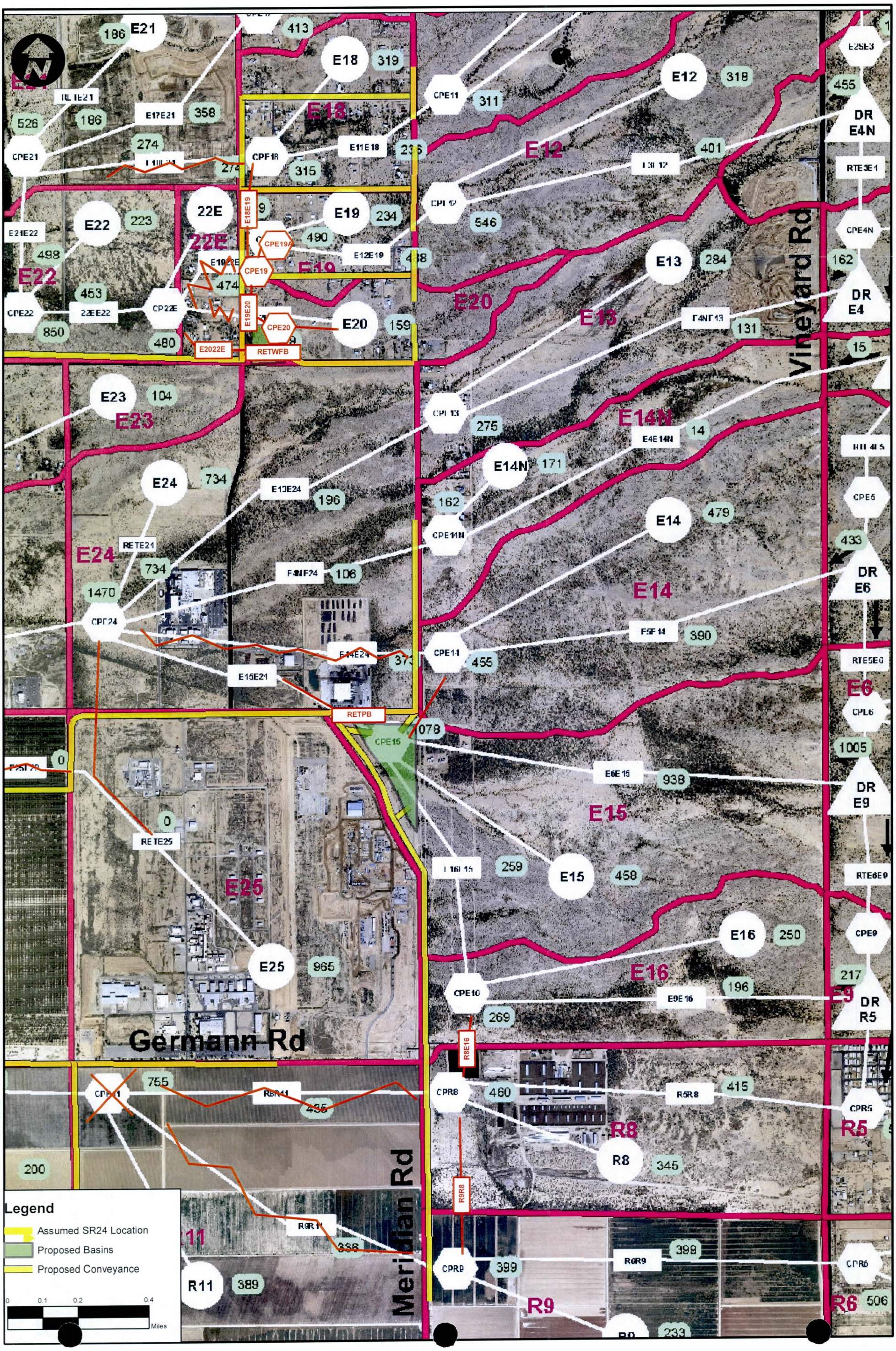
East Mesa Area Drainage Master Plan Update
Alternatives 1 & 2: MeridianSystem, Existing Conditions HEC-1 Modifications



East Mesa Area Drainage Master Plan Update
Alternatives 3: Meridian & Mountain Systems, Future Conditions HEC-1 Modifications



East Mesa Area Drainage Master Plan Update
Alternative 3: Meridian & Mountain Systems, Existing Conditions HEC-1 Modifications



Other Systems

East Mesa Area Drainage Master Plan Update
Alternatives 1 & 3: Germann & Queen Creek Systems, Existing/Future Conditions HEC-1 Modifications

Retention Basin was not effective, and was not included in the HEC-1 model.

Germann Rd

Queen Creek Rd

Rittenhouse Rd

Meridian Rd

Crismon Rd

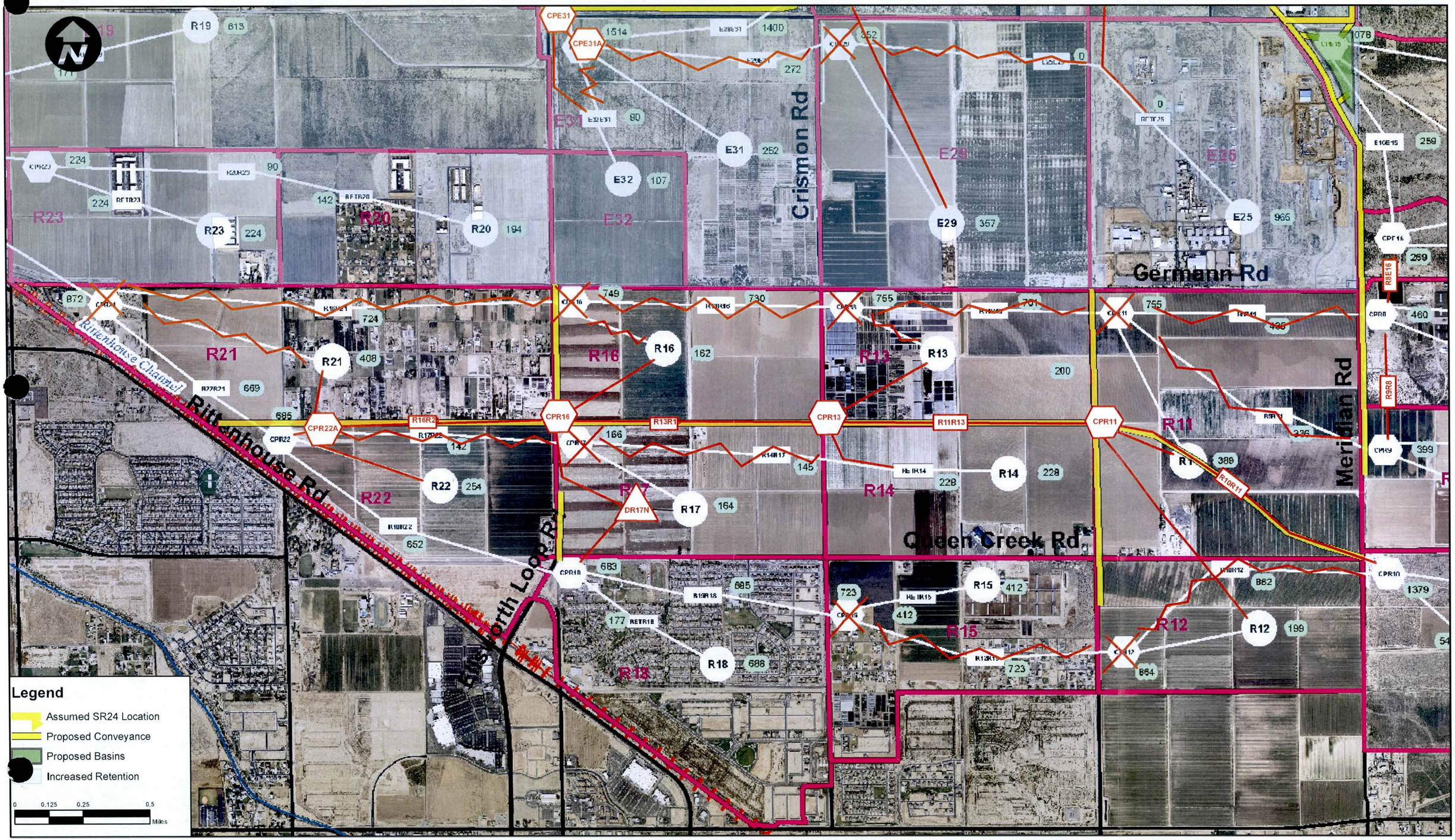
Ellsworth Loop Rd

Legend

- Assumed SR24 Location
- Proposed Conveyance
- Proposed Basins
- Increased Retention Alt1
- Increased Retention Alt3

0 0.125 0.25 0.5 Miles

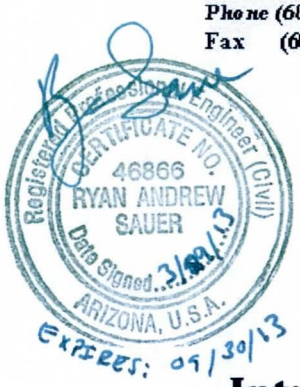
East Mesa Area Drainage Master Plan Update
Alternative 2: Ryan System, Existing/Future Conditions HEC-1 Modifications



D.2 Ellsworth Mini-farms Hydrology Memorandum

Entellus
2255 North 44th Suite, Suite 125
Phoenix, Arizona 85008
Phone (602)244-2566
Fax (602)244-8947

TO:	Jennifer Pokorski
FROM:	Entellus, Inc
JOB NO:	310.057
DATE:	March 29 2013



PROJECT NAME: Ellsworth Mini-Farms Hydrology Memorandum

MEMORANDUM

Introduction

This Memorandum documents the additional hydrologic analysis performed for Basin R21 of the East Mesa future hydrologic model. This analysis consisted of breaking basin R21 into four separate basins and adjusting the model to more accurately reflect the flow paths and concentration points for these four basins.

The original Basin R21 included the existing Ellsworth Mini Farms Development, the plated and graded La Jara Farms development, and a small agricultural area near the Rittenhouse channel.

Ellsworth Mini Farms

Ellsworth Mini Farms development is a large lot residential development with a flood irrigation system and no formal retention. For the ADMP we are interested in knowing the flows reaching Germann Road. Only the north lots in this development face Germann Road and they are the only lots that can drain directly into Germann Road. The lots further south, flow west and eventually the flow would reach Hawes road where it can be directed north or south by the La Jara Farms drainage infrastructure.

La Jara Farms

La Jara Farms is located just west of Ellsworth Mini Farms and based on their drainage report only on-lot retention will be provided. The development drainage report shows channels along Hawes Road to intercept the flow from the east and conveys it either north to Ellsworth or south and into the Rittenhouse channel.

HEC-1 Modifications:

Some modifications were done to properly reflect the existing and future conditions.

Subbasin R21

Subbasin R21 was split into the following subbasins:

- R21A contributes to Germann Channel East of Hawes Road
- R21B contributes to Germann Channel @ Hawes Road
- R21C contributes to Ryan Road at Hawes Road
- R21D contributes to Germann Channel east of Rittenhouse

See attached DDMSW reports for Land Use, Soil and subbasin information used in the hydrology model.

Modified Route R16R21

Modified Germann Channel Route R16R21 to end at Hawes Road. The Route R16R21 was approximated to carry the flow coming out of the regional basin and the north portion of subbasin R21 (R21A). The Basin was assumed to be 5-feet deep so the channel along Germann Road from Ellsworth to Hawes Road was assumed to be the same depth. To minimize the channel's top width, a triangular channel was assumed with side slopes of 2:1 resulting in a top width of 20-feet.

Added Concentration point CPR21A

Concentration point CPR21A was added to combine R16R21 & R21A. This was the flow used for the Germann Channel from Ellsworth to Hawes Road.

Added route R2121A

Route R2121A was added to convey flow from subbasin R21B from Ryan Road to the intersection of Germann and Hawes Road. The channel geometry was obtained from La Jara Farms Paving and grading plans dated 4/31/2012. The channel was assumed to have 6:1 side slopes with a bottom width of 5-feet and a longitudinal slope of 0.32%.

Added CP CPR21B

Added Concentration point CPR21B to combine CPR21A & R2121A (route for subbasin R21B).

Added route R2121D

R2121D is the Germann Channel from Hawes Rd to Rittenhouse Rd.

Added CP CPR21D to combine R2121D & R21D

Concentration point CPR21D was added to combine R2121D & the southern portion of subbasin R21, R21D. This was the flow used for the Germann Channel from Hawes Road to approximately Rittenhouse Road.

CPR21 now combines CPR21D & R22R21

Modified CPR22 to combine R21C, R22 & R18R22

Proposed Regional Basin RETGEB

There is the proposed regional basin on the southeast corner of Germann and Ellsworth Road. The online basin approximated contains 160ac-ft of storage. The basin will outlet to the gravity bleed system. The bleed off rate for this basin needs to be sufficient to drain the regional basin in a maximum of 36-hours per The Town of Queen Creek Standards.

$$Q = \frac{(V_{ac-ft})(43560\,^{ft^2}/_{ac})}{(36hrs)(3600\,^{sec}/_{hr})}$$

Once the flow was calculated to adequately drain the basin within the required time, the pipe was sized based on the orifice flow equation as follows (solving for the area).

$$Q = C_d \times A\sqrt{2 \times g \times h}$$

Where:

- Q = orifice flow [cfs]
- C_d = orifice discharge coefficient for sharp edged openings (0.62)
- A= orifice area [ft^2]
- g = gravity [32.2 ft/s^2]
- h = hydraulic head [ft]

Using the orifice equation, a pipe size of 42-inches was approximated to drain the basin within 36-hours with an outflow of approximately 100-cfs

The storage HEC-1 card was modified to allow 100cfs to continue west along Germann Road.

La Jara Farms Retention

As mentioned earlier, the La Jara development has no centralized proposed retention, but instead states that it will utilize on-lot retention. On-lot retention is historically unenforceable and inconsistent, especially as ownership of the properties change. Due to this, two scenarios were presented; one assuming the La Jara development is able to maintain the full design retention and the second assuming no retention for the development.

Per the drainage report, the development size is 142.3 acres and the 100-year 2-hour precipitation depth is 2.6 inches and an average runoff coefficient of 0.55. From this the total development retention volume is estimated as being:

142.3 acres * 2.6 /12 feet * 0.55 = 17.0 acre-ft

The East Mesa hydrology models have assumed an 80% efficiency rate and so the modeled retention volume was as follows:

17.0 ac-ft * 80% = 13.6 acre-ft

Modeling Results:

The table below summarizes the modeling results for 3 models:

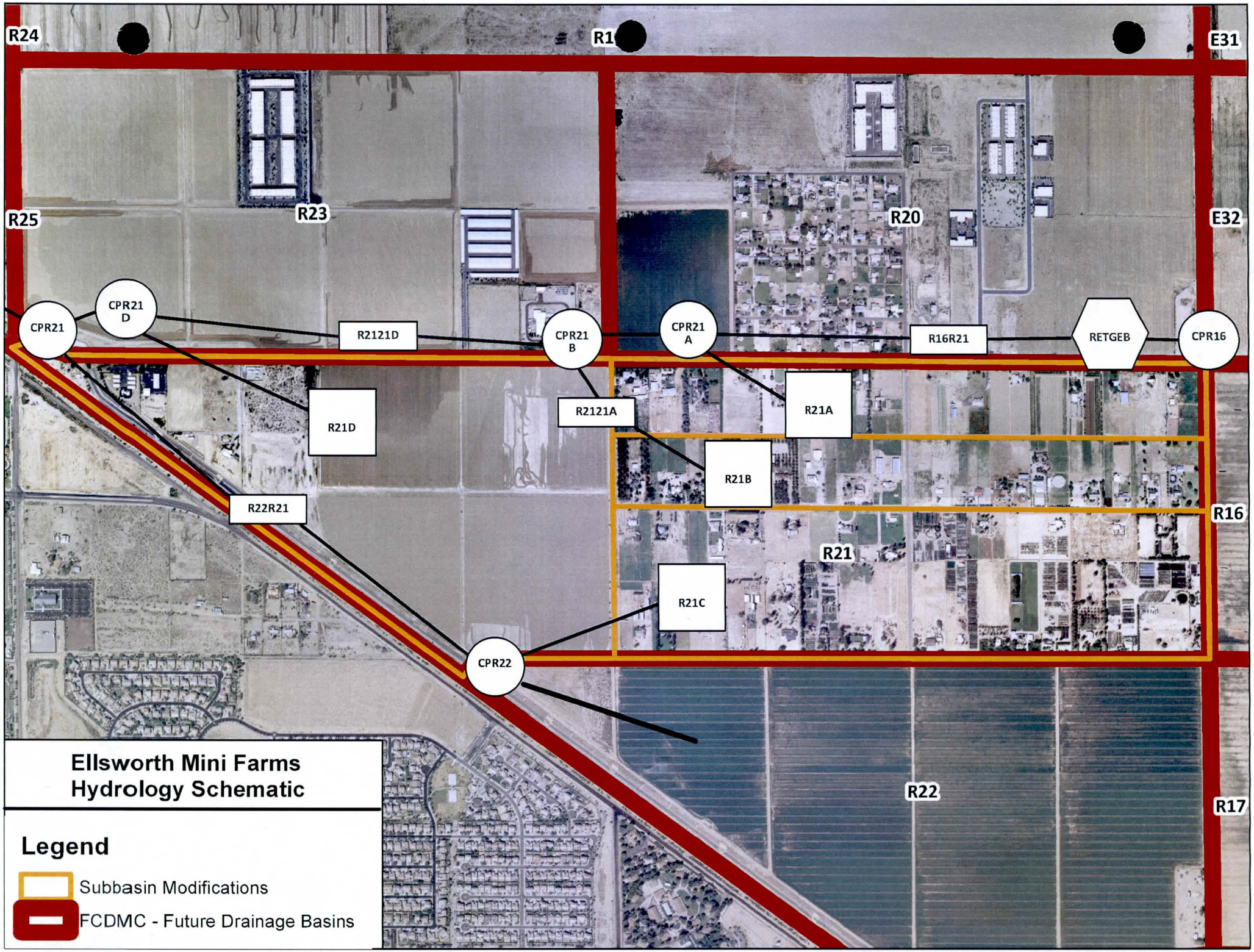
- Previous 100-year 24-hour model (Alternative 1, Future Conditions, for alternatives submitted 2012.10.22 with modified R13R16 route)
- Modified with La Jara retention
- Modified without La Jara retention

Original ID	Modified ID	Location	Previous Model Flow [cfs]	La Jara Model with retention [cfs]	La Jara Model No retention [cfs]	Description
R21	R21A R21B R21C R21D		757	129 119 240 395	129 119 240 395	La Jara Retention is part of subbasin R21D - no affect on 100-year 24-hour model.
CPR16	CPR16	Ellsworth & Germann	1127	1127	1127	Before Regional retention
RETGEB	RETGEB	Ellsworth & Germann	1062	100	100	Proposed Regional Retention ~160 acre-ft
CPR21A (@ Rittenhouse)	CPR21A	Germann Channel east of Hawes	961	123	123	Germann Channel
CPR21A	CPR21D	Germann Channel east of Rittenhouse	961	482	482	Germann Channel
CPR22	CPR22	Rittenhouse & Hawes Rd.	399**	610**	610**	Rittenhouse Channel**
CPR21	CPR21	Rittenhouse & Germann	1034	505	505	Rittenhouse Channel

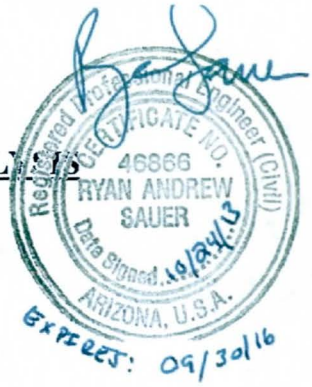
**Flow increase in Rittenhouse channel is due to La Jara directly discharging into the Rittenhouse Channel. The design capacity of this portion of the Rittenhouse channel varies between 810 and 1050 cfs.

The main results are as follows:

- The La Jara retention scenario has no effect on peak discharge results for the 100-year 24-hour model.
- With limiting the contributing area to the Germann Channel to the homes along Germann between Ellsworth & Hawes it becomes possible to effectively utilize a regional retention basin upstream of Ellsworth & Germann.
- Germann Channel flow between Ellsworth & Hawes decreases to ~125 cfs.
- Flows in the Rittenhouse Channel at Germann decrease significantly too due to proposed retention.


R24
R1
E31
R25
R23
R20
E32
CPR21
CPR21 D
R2121D
CPR21 B
CPR21 A
R16R21
RETGEB
CPR16
R21D
R2121A
R21A
R21B
R22R21
R16
R21
R21C
CPR22
R22
R17
Ellsworth Mini Farms
Hydrology Schematic
Legend
Subbasin Modifications
FCDMC - Future Drainage Basins

D.3 Queen Creek Retention Analysis



TECHNICAL MEMORANDUM - QUEEN CREEK RETENTION ANALYSIS

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE

October, 2013

Background and Purpose

The following memorandum documents the analysis and assumptions requested by the Town of Queen Creek in the coordination meeting on October 1st, 2013. The Town desired to see the effects of increasing the retention requirement within the Town's portion of the East Mesa ADMP study area (the Rittenhouse Zone), and providing a regional retention basin to handle the flows entering from Pinal County.

Future Land Use Modifications:

To perform this analysis, the first step was to update the future land use based on the latest land use plan, which included modifications to several areas. The main changes included modifications to the land use for the Queen Creek Station and the La Jara developments. These two developments are in different stages in the planning and construction phases, and it was assumed that the current plans will be constructed without major changes.

Other changes to the land use included amendments to the Town of Queen Creek General Plan for the Barney Farms property, and The States at Queen Creek (see **Queen Creek General Plan Amendments** in the attachments). Land use codes and parameters similar to those utilized in the Original Master Plan update were utilized to maintain consistency. The final future land use codes used for the area are included in the **Future Land Use Figure** in the attachments.

Subbasin Retention Modifications:

Due to the changes in future land use for the area, modifications to the subbasin retention were made. Future retention requirements and total subbasin retention are estimated as follows:

1. Modified land use is input into DDMSW and the various subbasin parameters are estimated: Green and Ampt parameters and S-Graphs.
2. DDMSW is utilized to run the 100-year, 2-hour HEC-1 model and estimate the runoff volumes for each subbasin for this storm event. This runoff volume is 100% of the required retention for the subbasin. The 100-year, 2-hour storm was assumed to be 2.219 inches of precipitation.
3. The existing retention for each subbasin was estimated and 80% of the retention volume was assumed to be effective. The Original Master Plan Update estimated the retention for existing development within each of the subbasins and this was utilized for all subbasins, except for subbasin R22, which includes the planned Queen Creek Station subdivision. For R22 the existing retention was estimated based on what would be

required, and then assumed to be 80% effective. The La Jara subdivision was designed without centralized retention (on-lot retention only). Since this type of retention is not reliable, for subbasin R21 it was assumed that the La Jara area was developed and without retention.

4. Future development retention was estimated based on the amount of undeveloped land within each subbasin. The future retention was estimated based on what would be required, and then assumed to be 80% effective. As mentioned above, Queen Creek Station and La Jara subdivisions were assumed to be existing developments for the purpose of this analysis.
5. Total retention was estimated and is simply the sum of the existing and the future retention volumes. These retention values were utilized as the base retention values for all analyses.

Various increased retention requirement scenarios were utilized in the analyses performed. In all cases no modifications were made to the existing development retention. Modifications were only made to the future development retention. Since Queen Creek Station and the La Jara subdivisions were assumed to be existing, no retention increases were assumed for those areas. The different retention scenarios examined include the following:

- Standard base retention condition.
- 10% increase in future retention.
- 20% increase in future retention.
- 30% increase in future retention.
- 21.7% increase in future retention - this is approximately equivalent to a 100-year 2-hour event of 2.7". This value was utilized because it was the previous City of Mesa retention requirement and had been utilized in other analyses as part of this East Mesa ADMP project.

Table 1 summarizes the retention assumptions and estimates for these analyses.

HEC-1 Scenarios

Several iterations and scenarios were created for this study. The various hydrologic modifications and scenarios can be broken down into 3 categories:

- Assumed retention requirements for future development
- Pinal County off-site flow routing modifications
- Regional retention at Queen Creek Sports Complex (see **Queen Creek Sports Complex Figure** in the Attachments)

Assumed retention requirements for future development

The estimation of the various retention scenarios was described above and includes Standard, and 10%, 20%, 30%, 21.7% increases.

Pinal County Off-Site Flow Routing Modifications

There are 3 flows entering the Town of Queen Creek from Pinal County. They are as follows:

- R8R11 crosses Meridian Road between Germann and Ryan Roads.
- R9R11 crosses Meridian Road between Ryan and Queen Creek Roads.
- R10R12 crosses Meridian Road south of Queen Creek Road.

The following scenarios were looked at for this analysis:

- No modification to the Pinal County routes. They are assumed to continue on their originally assumed paths.
- Combining all 3 routes into one single location for regional retention.
- Combining the 2 southernmost routes (R9R11 & R10R12) to a single location for regional retention and sending the third route, R8R11 to the north along a potential Meridian Road channel.

Regional Retention at Queen Creek Sports Complex

As part of this analysis regional retention scenarios were examined. The regional retention is assumed to be part of the planned Queen Creek Sports Complex that will be located west of the Signal Butte alignment and north of Queen Creek Road. The purpose of the regional retention would be to attenuate the off-site flows from Pinal County. In all the regional retention scenarios, no modification was made to the Pinal County routes. Additionally, the Sports Complex site was subdivided into its own subbasin and assumed to contribute to the regional retention site.

The following scenarios were examined as part of this analysis:

- No regional retention.
- Regional retention of 168 acre-ft. This is sufficient volume to attenuate all 3 off-site flows from Pinal County.
- Regional retention of 120 acre-ft. This is sufficient volume to attenuate the 2 southernmost off-site flows from Pinal County.

In order to achieve sufficient attenuation of flows, the regional retention was modeled as an online retention basin. If the regional retention is modeled as offline significant increases in downstream flows are seen. The outfall for the regional retention facility was assumed to be Queen Creek Road. This is similar to the assumption of the Original ADMP.

HEC-1 Modeling Iterations

Numerous HEC-1 models were created to model different combinations of the HEC-1 scenarios: retention modifications, Pinal County off-site flows and regional retention. **Table 2** summarizes the flows from the various iteration runs including the Original Master Plan Model.

Analysis: All Pinal County Flows to Queen Creek Sports Complex Retention

For this analysis, all 3 flows from Pinal County were combined at the Queen Creek Sports Complex. The Sports Complex retention was modeled as an on-line retention basin using a diversion card. The analysis focused on negligible increases in flows downstream, in particular at the Rittenhouse Extension Channel. By trial and error, the size of the retention volume was set to 168 ac-ft. This was the minimum retention volume required that would sufficiently attenuate the Pinal County flows and match design capacities in the existing channel.

In order for this scenario to work, additional future development retention above the standard retention is required. This is typical to all scenarios due to the limited capacity (516 cfs) of the Rittenhouse Extension Channel along Queen Creek Road. The contributing flow from the local subbasins under the standard retention scenario is sufficient to overwhelm the channel. In order for this and all other scenarios to be feasible, additional subbasin retention of 20% or more is required.

The 168 ac-ft of storage at the Queen Creek Sports Complex appears to be larger than the site would be able to handle. Preliminary analysis shows that it is possible to design this storage into the site, but it may sacrifice some of the functionality of the Sports Complex.

In an attempt to reduce the needed retention volume at the Sports Complex a stage/storage/discharge was created for the regional retention basin and optimized to maintain the downstream flows within the capacity of the existing channels. This resulted in a decrease in the needed volume in the Queen Creek Sports Complex of about 30 ac-ft to approximately 140 ac-ft of required retention volume. However, this reduction relies heavily on the timing of the hydrographs and since a real storm may not exactly behave as the modeled storm, it may be risky to rely on this number. The feasibility of achieving this stage/storage/discharge at the given site was not evaluated.

Analysis: Two Routes from Pinal County to Queen Creek Sports Complex Retention and Meridian Channel

Another option to reduce the volume reaching the Sports Complex would be to divert the R8R11 tributary area north to the Ellsworth Zone. This would have the effect of reducing the flow and volume reaching the Sports Complex basin. This option resulted in a decrease in the needed volume in the Sports Complex of about 50 ac-ft to approximately 120 ac-ft of required online

retention volume. As aforementioned, additional future development retention increases of 20% or more are required to limit local flows in the downstream channel and make this scenario feasible.

Analysis: Additional Retention

For the various scenarios to be feasible, additional future development retention is required. From the various results, it appeared that the 20% or greater increase in retention requirement generates enough attenuation to resolve the capacity issues in the Rittenhouse Extension channel. It is recommended that an increased retention requirement of 20% be utilized.

Queen Creek Future Channel

The Town has secured a 70-foot easement along the North side of Queen Creek Road for the Queen Creek Channel. The downstream portion of the channel has already been constructed. The original design flow for the channel is smaller than the recommended flow from this analysis but the configuration of the channel can be easily modified to accommodate higher flows. The capacity of the downstream channel is 516 cfs and the 70-foot easement can easily accommodate a channel with this capacity. See **Queen Creek Channel FlowMaster** analysis in attachments.

Recommendations

From the various analyses it is recommended that 120 ac-ft retention be located at the Queen Creek Sports Complex, thus routing Pinal flows from R9R11 and R10R12 to the Sports Complex retention and diverting the flow from R8R11 north along Meridian Road. It is also recommended that the future development retention requirement be increased by 20%. See **Figure Additional Retention** in the Attachments.

Attachments

Maps and additional information will be available for review and comment at the open houses in August and September. Residents are also encouraged to attend the Public Hearings on November 5 and December 4.

The following Major General Plan Amendment applications were filed on June 13, 2013:

2013 General Plan Amendments Map

- **La Jara Farms (GP13-025)** *Map *Narrative
  - Applicant - Lindsay Schube on behalf of VIP Homes
  - 140.76 acres located at the southwest corner of Hawes and Germann roads
  - Change from Employment Type A to Very Low Density Residential (up to 1 du/acre)
  - Currently zoned R1-43, Single Family Residential

- **Estates at Queen Creek Station (GP13-026)** *Map *Narrative
  - Applicant - Ralph Pew on behalf of RSF Property, LLC and RSF Queen Creek Property, LLC
  - 156 acres located at the southeast corner of Ellsworth and Germann roads
  - Change from Employment Type A to Low Density Residential (up to 2 du/acre)
  - Currently zoned R1-43, Single Family Residential

- **Meridian Crossings (GP13-027)** *Map *Narrative
  - Applicant - Mario Mangiamele on behalf of Westcor/Queen Creek LLC Company
  - 466 acres located on the south side of Riggs Road, west of the railroad
  - Change from Regional Commercial to Medium Density Residential (up to 3 du/acre)
  - Not located in Town limits

- **Barney Farms (GP13-028)** *Map *Narrative
  - Applicant - Mario Mangiamele on behalf of Ken, Newell, Gail and Pamela Barney and Dane Chaffee
  - 241 acres located at the northeast corner of Signal Butte and Queen Creek roads
  - Change from Employment Type B and Recreation/Conservation to Mixed Use and High Density Residential (up to 8 du/acre)
  - Currently zoned I-1, Heavy Industrial

- **The Vineyards (GP13-029)** *Map *Narrative
  - Applicant - Ralph Pew on behalf of Healy Faulkner, LLC
  - 55 acres located west of Ironwood Road at the north side of Combs Road
  - Change from Commercial and Mixed Use to Medium Density Residential (up to 3 du/acre)
  - Currently zoned R1-43, Single Family Residential

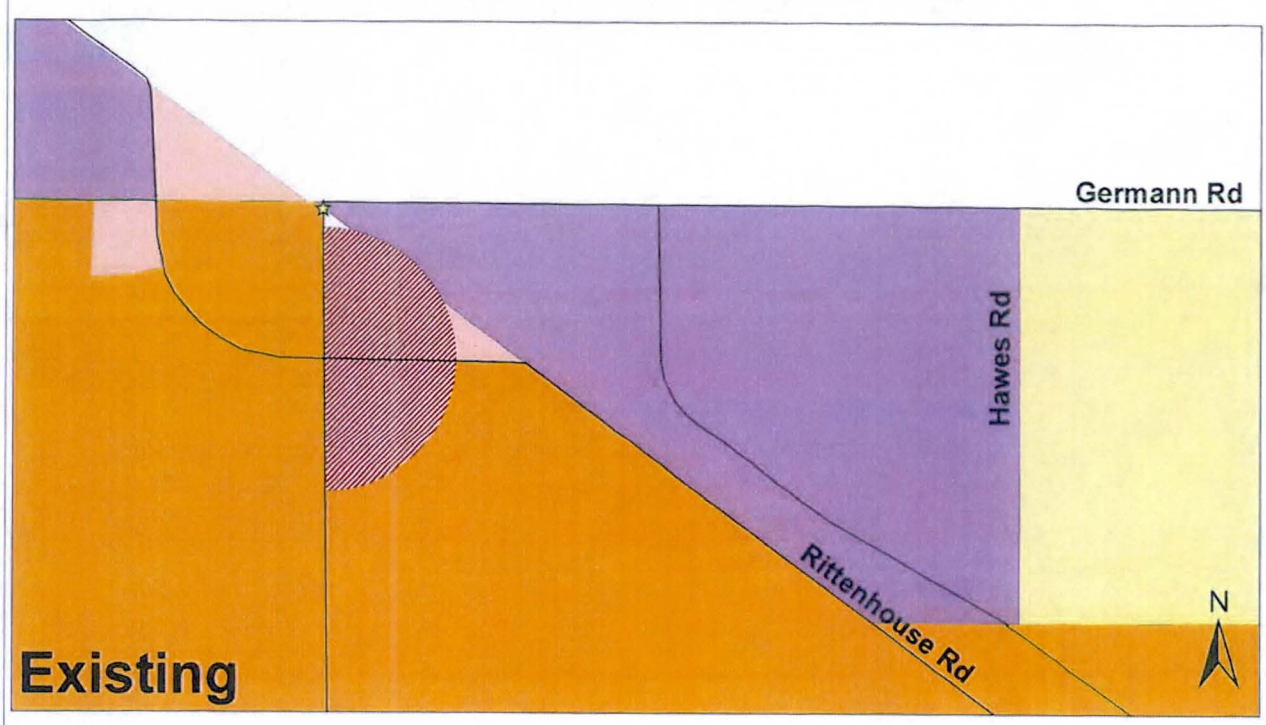
- **Sonoqui Creek Village (GP13-030)** *Map *Narrative
  - Applicant - Ralph Pew on behalf of KEMF Hawes & Riggs, LLC
  - 107 acres located at the northwest corner of Hawes and Riggs roads
  - Change from Very Low Density Residential (up to 1 du/acre) to Low Density Residential (up to 2 du/acre)
  - Currently zoned R1-35, Single Family Residential

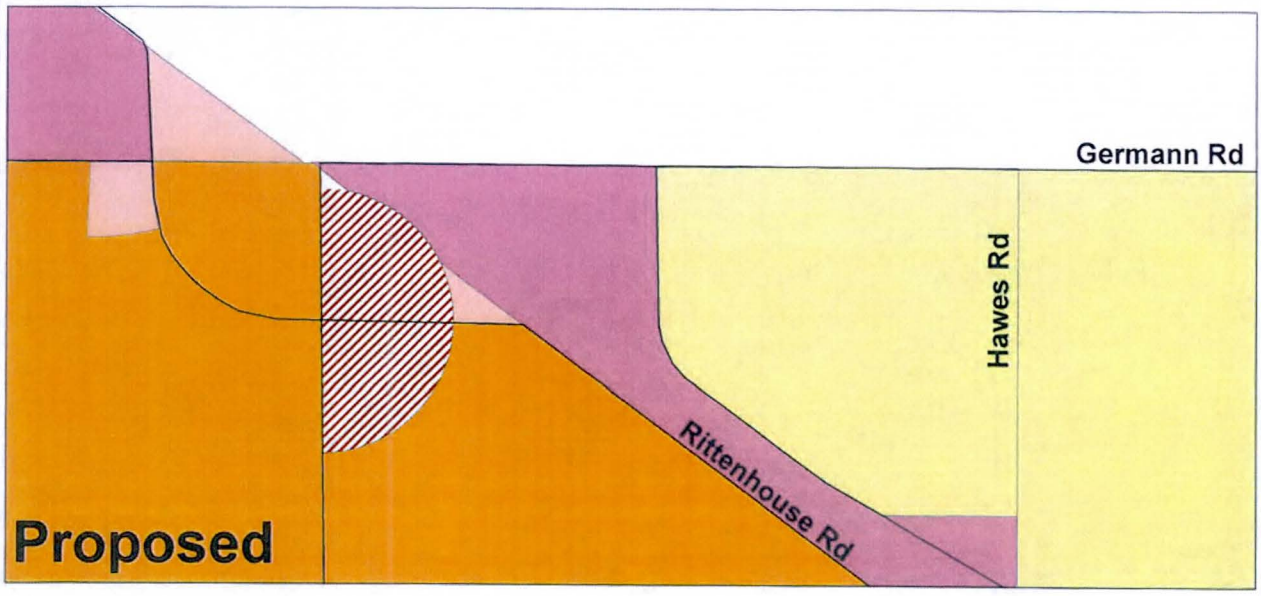
NAVIGATION

me

About Us

Town of Queen Creek
2013 General Plan Amendment
GP13-025 La Jara Farms





General Plan Land Use Legend

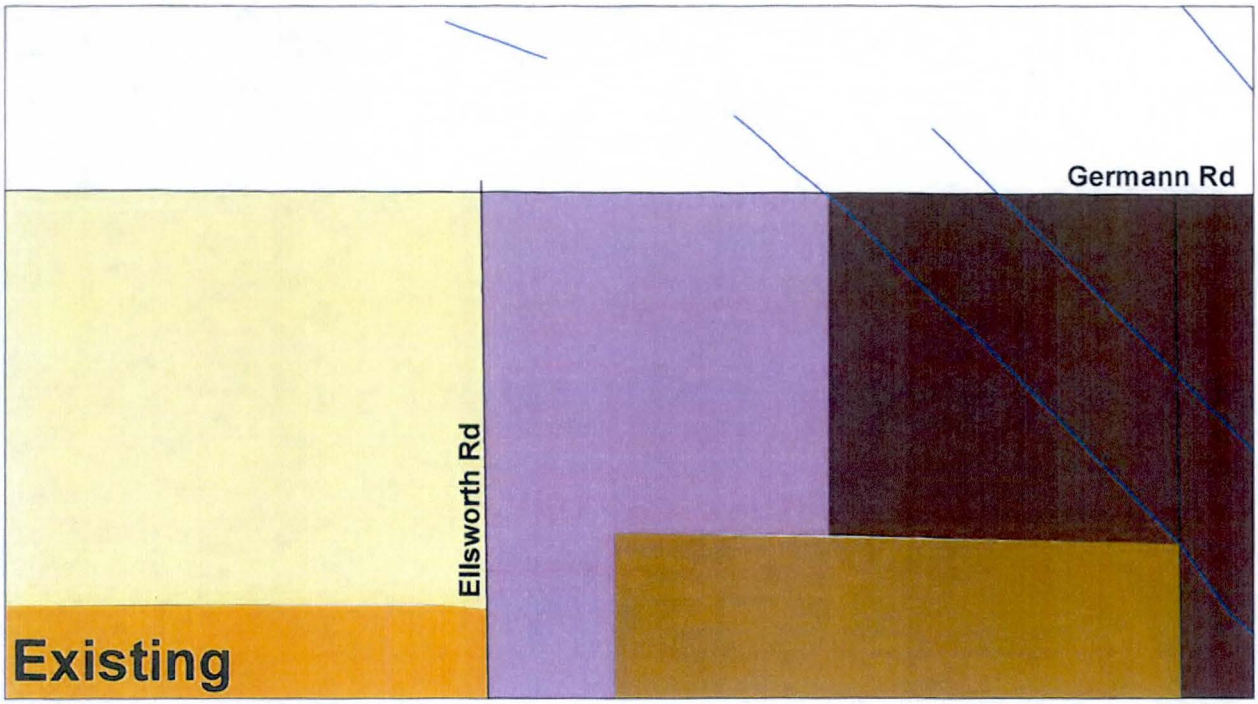
- Very Low Density Residential (0-1 DU/AC)
- Low Density Residential (0-2 DU/AC)
- Medium Density Residential (0-3 DU/AC)
- Master Planned Community (0-1.8 DU/AC)
- Medium High Density Residential Type A (0-5 DU/AC)
- Multifamily
- Mixed Use
- Neighborhood Commercial
- Community Commercial
- Office/Services
- Commercial
- Employment Type A
- Employment Type B
- Public/Quasi-Public
- Open Space
- Regional Commercial Center
- San Tan Regional Park
- Noise Contours
- Future Intersection Modification
- Resort / Tourism / Entertainment

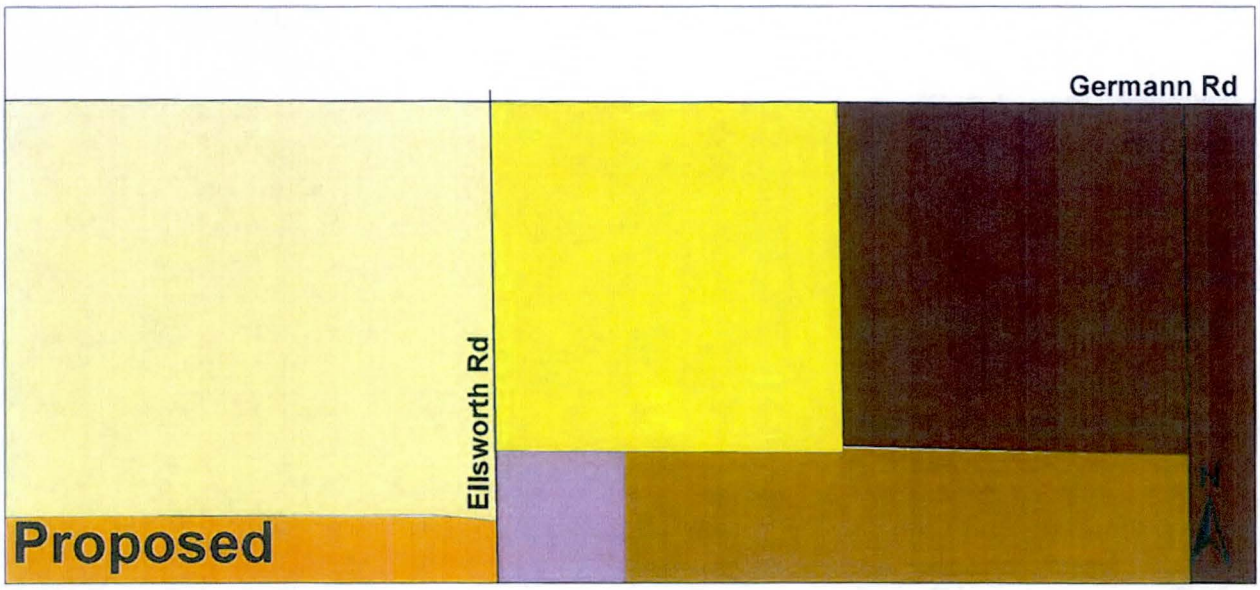
Modified by Resolutions 813-09, 814-09, 824-10, 924-12 and 934-13

All information is believed to be accurate as the date of publication, however is not guaranteed.
Created by Sidney Urias 480-358-3094

TOWN OF QUEEN CREEK ARIZONA

Town of Queen Creek
2013 General Plan Amendment
GP13-026 The Estates at Queen Creek Station





General Plan Land Use Legend

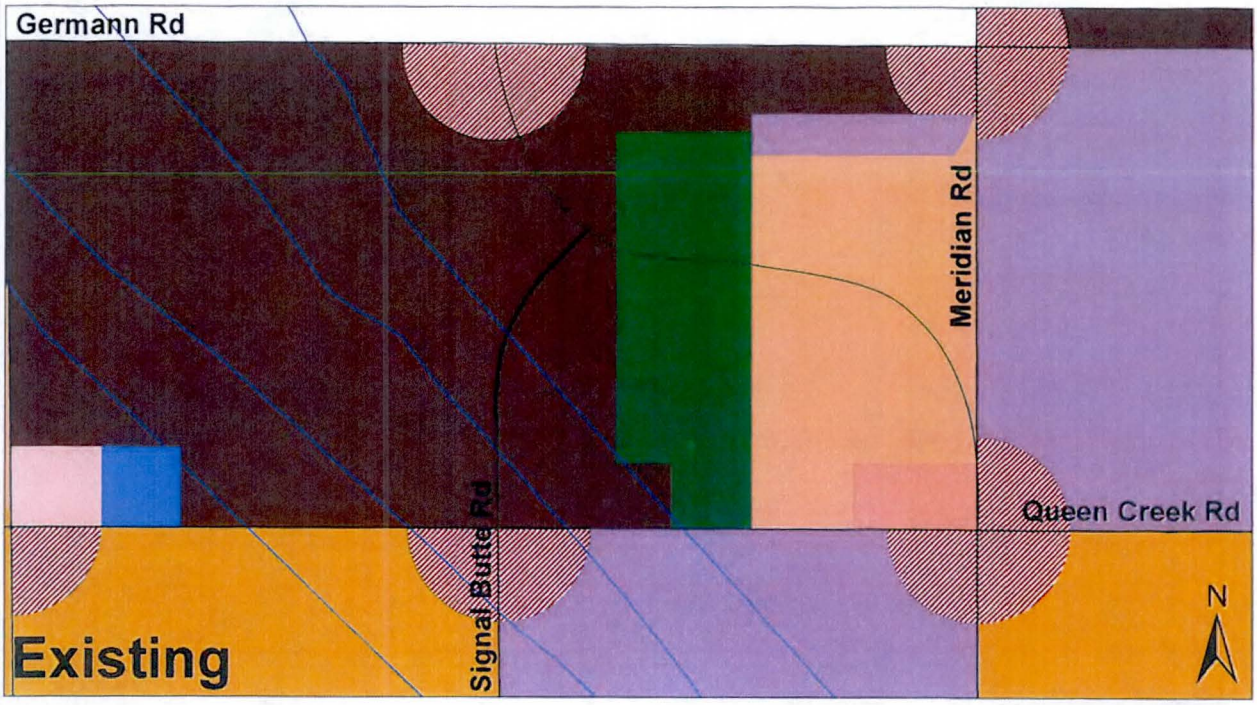
- Very Low Density Residential (0-1 DU/AC)
- Low Density Residential (0-2 DU/AC)
- Medium Density Residential (0-3 DU/AC)
- Master Planned Community (0-1.8 DU/AC)
- Medium High Density Residential Type A (0-5 DU/AC)
- Multifamily
- Mixed Use
- Neighborhood Commercial
- Community Commercial
- Office/Services
- Commercial
- Employment Type A
- Employment Type B
- Public/Quasi-Public
- Open Space
- Regional Commercial Center
- San Tan Regional Park
- Noise Contours
- Future Intersection Modification
- Resort / Tourism / Entertainment

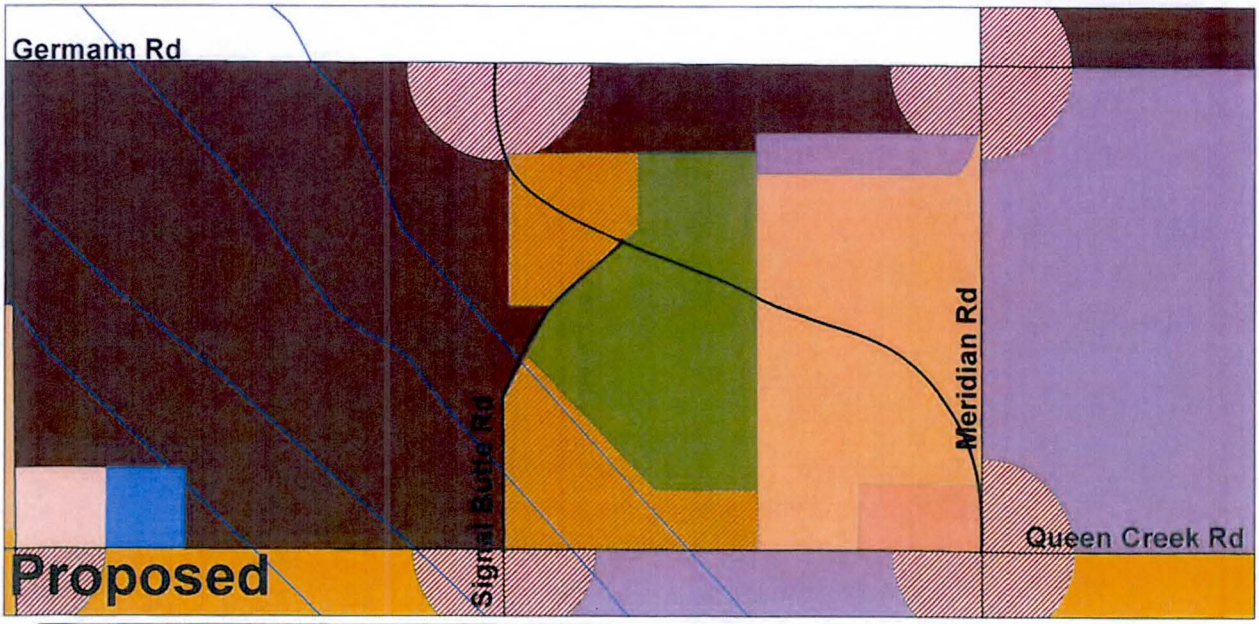
Modified by Resolutions 813-09, 814-09, 824-10, 924-12 and 934-13

All information is believed to be accurate as the date of publication, however is not guaranteed.
Created by Sidney Urias 480-358-3094

TOWN OF QUEEN CREEK ARIZONA

Town of Queen Creek
2013 General Plan Amendment
GP13-028 Barney Farms





General Plan Land Use Legend

- Very Low Density Residential (0-1 DU/AC)
- Low Density Residential (0-2 DU/AC)
- Medium Density Residential (0-3 DU/AC)
- Master Planned Community (0-1.8 DU/AC)
- Medium High Density Residential Type A (0-5 DU/AC)
- Medium High Density Residential Type B (0-8 DU/AC)
- Multifamily
- Mixed Use
- Neighborhood Commercial
- Community Commercial
- Office/Services
- Commercial
- Employment Type A
- Employment Type B
- Public/Quasi-Public
- Open Space
- Regional Commercial Center
- San Tan Regional Park
- Noise Contours
- Future Intersection Modification
- Resort / Tourism / Entertainment

Modified by Resolutions 813-09, 814-09, 824-10, 924-12 and 934-13

All information is believed to be accurate as the date of publication, however is not guaranteed.

Created by Sidney Urias 480-358-3094

TOWN OF QUEEN CREEK ARIZONA

Design Q = 813 cfs

Design Q = 516 cfs

Germann Rd

Queen Creek Rd

Ellsworth Rd

Crismon Rd

Hawes Rd

Rittenhouse Rd

Ocotillo Rd

Signal Butte Rd

Meridian Rd

LUCODE	Descriptio	Group
120	Estate Residential (1/5 du per acre to 1 du per acre)	Residential
130	Large Lot Residential - Single Family (1-2 du per acre)	Residential
140	Medium Lot Residential - Single Family (2-4 du per acre)	Residential
150	Small Lot Residential - Single Family (4-6 du per acre)	Residential
160	Very Small Lot Residential - Single Family (>6 du per acre)	Residential
220	Neighborhood Commercial (50,000 to 100,000 sq. ft.)	Commercial
230	Community Commercial (100,000 to 500,000 sq. ft.)	Commercial
300	General Industrial (Industrial w here no detail available)	Industrial
310	Warehouse/Distribution Centers	Industrial
550	Public Facilities (comm centers, libraries, sub-stations)	Institutional
590	Other Employment - high	Other Employment
710	Active Open Space (Includes parks)	Open Space
730	Passive Open Space (Includes mountain preserves and w ashes)	Open Space
740	Water	Open Space
900	Vacant (Existing land use database only)	Open Space

Legend

Future Subbasin

NORTH

0 0.25 0.5 Miles

Entellus
2255 N. 44th Street Suite 125
Phoenix, Arizona 85008.3299
Tel. 602.244.2566
Fax. 602.244.8947
Web. www.entellus.com

EAST MESA ADMPU
FUTURE LAND USE - 10/24/2013

Path: P:\30013\10\3\GIS\Mesa_ADMP\Deliverables\Stakeholders\GIS Stakeholders\Future_Landuse_memo_11x17_2013_10_24.mxd - Date: 10/24/2013

From: Hernan Aristizabal
To: "Jennifer Pokorski - FCDX"; Catherine Regester - FCDX
Subject: East mesa ADMPU Queen creek channel capacity
Date: Monday, October 21, 2013 11:35:55 AM
Attachments: Queen creek channel.fm8

This are the parameters for the Queen Creek channel from City basin to existing channel

Original ADMP (From Reference 107 - East Mesa ADMP Recommended Design Report Sheet 41)

Q=426cfs
S=0.0010 with drop structures
Ground Slope ~ 0.004
Type=Natural earthen channel
Manning's= 0.025
Bottom with= 10
Side slopes 6:1
freeboard=1 ft
design depth= 4.9 ft
Velocity=3.3ft/sec
Top width 69.2ft
Maintenance road = 0 ft
landscape buffer = 0 ft
Vertical drop structures 8.6 ft

Outfall from City Park Basin

New flow = 597 cfs
by increasing the side slopes to 4:1
increase bottom width to 30 ft
slide increase in longitudinal slope S=0.00103 (Reduce height of vertical drops by ~ 0.09 ft)
Increased Manning's to 0.03
Velocity = 3.25 ft/sec
Top width = 70 ft
flow depth = 4 ft
freeboard = 1ft

The 70ft available for the channel should be adequate to convey the outflow from the City basin

Hernan A. Aristizabal PE
Entellus Inc.
2255 N. 44th Street
Suite 125

R19

R23

R20

E31

E32

Crismon Rd

E29

E25

E15

E16

R25

CPR21

Q_{Ex} = 850cfs
$Q_{20\%}$ = 650cfs
Q_{Base} = 800cfs

R21

CPR16

Germann Rd

CPR13

Q_{Ex} = 750cfs
$Q_{20\%}$ = 300cfs
Q_{Base} = 600cfs

R16

CPR11

Q_{Ex} = 750cfs
$Q_{20\%}$ = 350cfs
Q_{Base} = 600cfs

R13

Q_{Ex} = 750cfs
$Q_{20\%}$ = 450cfs
Q_{Base} = 850cfs

Q_{Fut} = 700cfs

CPR8

R8

Design Q = 800 cfs

CPR22

Q_{Ex} = 700cfs
$Q_{20\%}$ = 550cfs
Q_{Base} = 550cfs

Ellsworth Rd

CPR17

Q_{Ex} = 150cfs
$Q_{20\%}$ = 300cfs
Q_{Base} = 550cfs

Q_{Ex} = 200cfs
$Q_{20\%}$ = 300cfs
Q_{Base} = 450cfs

Ret. Basin
120 af
R14A

R11

CPR9

Q_{Fut} = 600cfs

Haves Rd

R22

Queen Creek Rd

Rittenhouse Rd

CPR18

Design Q = 500 cfs

CPR15

Queen Creek Rd

CPR12

Q_{Ex} = 700cfs
$Q_{20\%}$ = 500cfs
Q_{Base} = 550cfs

R18

Q_{Ex} = 700cfs
$Q_{20\%}$ = 500cfs
Q_{Base} = 600cfs

R15

Q_{Ex} = 850cfs
$Q_{20\%}$ = 600cfs
Q_{Base} = 750cfs

R12

CPR10

Q_{Fut} = 1400cfs

R10

Crismon Rd

Signal Butte Rd

Meridian Rd

Ellsworth Rd

Ocotillo Rd

Ellsworth Loop Rd

Legend

- Future Subbasin
- Concentration Point
- Germann Rd 20% Additional Retention
- Ryan Rd 20% Additional Retention
- Queen Creek Rd 20% Additional Retention

NORTH

0 0.25 0.5 Miles

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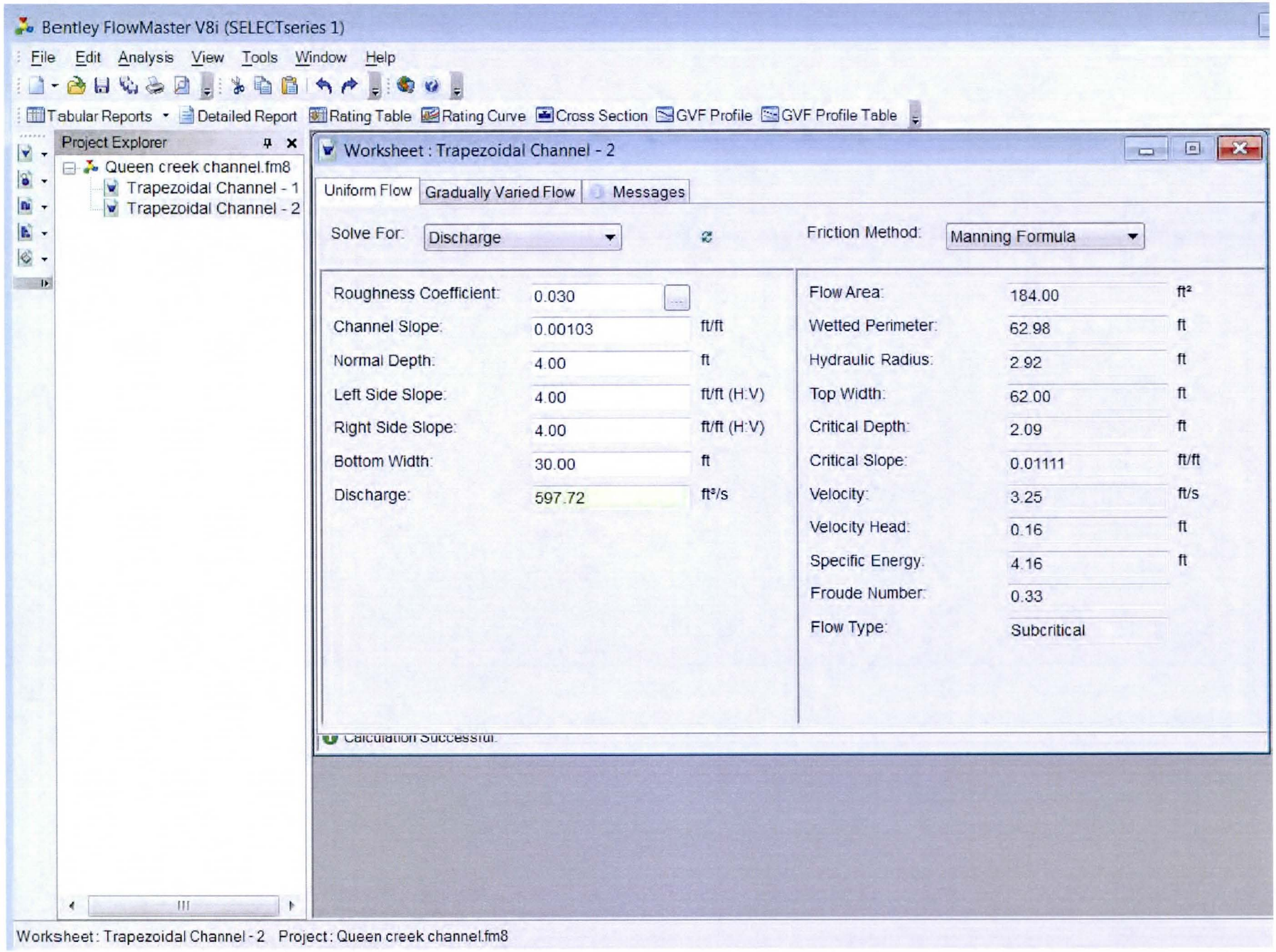
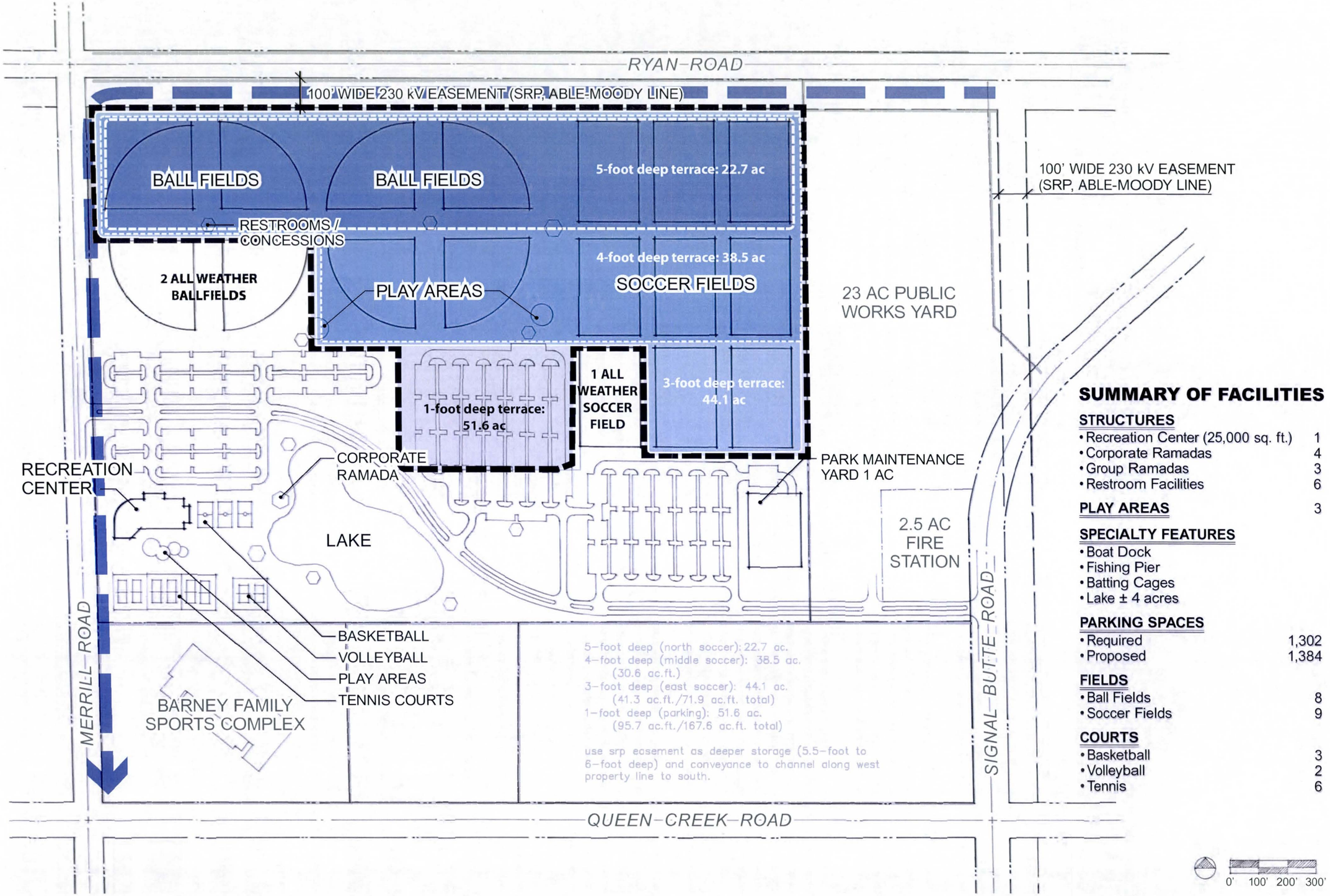
EAST MESA ADMPU
ADDITIONAL RETENTION
10/24/2013

Note: Additional refinement of flows is required for design and implementation.

Path: P:\30\310\310...\Mesa_ADMP\Deliverables\Stakeholders\QC Stakeholders\Future_Landuse_Flows_11x17.mxd - Date: 10/24/2013


Bentley FlowMaster V8i (SELECTseries 1)
File Edit Analysis View Tools Window Help
Tabular Reports Detailed Report Rating Table Rating Curve Cross Section GVF Profile GVF Profile Table
Project Explorer
Queen creek channel.fm8
Trapezoidal Channel - 1
Trapezoidal Channel - 2
Worksheet : Trapezoidal Channel - 2
Uniform Flow
Gradually Varied Flow
Messages
Solve For: Discharge
Friction Method: Manning Formula
Roughness Coefficient: 0.030
Channel Slope: 0.00103 ft/ft
Normal Depth: 4.00 ft
Left Side Slope: 4.00 ft/ft (H:V)
Right Side Slope: 4.00 ft/ft (H:V)
Bottom Width: 30.00 ft
Discharge: 597.72 ft³/s
Flow Area: 184.00 ft²
Wetted Perimeter: 62.98 ft
Hydraulic Radius: 2.92 ft
Top Width: 62.00 ft
Critical Depth: 2.09 ft
Critical Slope: 0.01111 ft/ft
Velocity: 3.25 ft/s
Velocity Head: 0.16 ft
Specific Energy: 4.16 ft
Froude Number: 0.33
Flow Type: Subcritical
Calculation Successful.
Worksheet: Trapezoidal Channel - 2 Project: Queen creek channel.fm8



SUMMARY OF FACILITIES

STRUCTURES	
• Recreation Center (25,000 sq. ft.)	1
• Corporate Ramadas	4
• Group Ramadas	3
• Restroom Facilities	6
PLAY AREAS	3
SPECIALTY FEATURES	
• Boat Dock	
• Fishing Pier	
• Batting Cages	
• Lake ± 4 acres	
PARKING SPACES	
• Required	1,302
• Proposed	1,384
FIELDS	
• Ball Fields	8
• Soccer Fields	9
COURTS	
• Basketball	3
• Volleyball	2
• Tennis	6

June 10, 2011 Master Plan

Queen Creek Sports Complex

Queen Creek, Arizona

epg
4141 North 32nd Street, Suite 102
Phoenix, Arizona 85018
P 602.956.4370
F 602.956.4374
www.epgaz.com

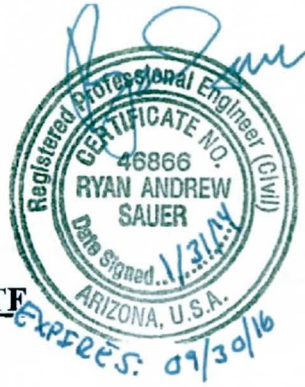
TABLE 1

Subbasin ID	Area	Subbasin Undeveloped	80% of Ex Retention	Future 100-yr, 2-hr	80% of Fu Retention	Retention Volume	Retention Volume			
							10%	20%	30%	21.7% (2.7")
	[sq miles]	[%]	[ac-ft]	[ac-ft]	[ac-ft]	[ac-ft]	[ac-ft]	[ac-ft]	[ac-ft]	[ac-ft]
R11	0.986	100.0	0.00	88.14	70.5	70.5	77.6	84.6	91.7	85.8
R12	0.489	100.0	0.00	50.37	40.3	40.3	44.3	48.4	52.4	49.0
R13	0.501	100.0	0.00	42.00	33.6	33.6	37.0	40.3	43.7	40.9
R14B	0.303	91.7	0.95	27.22	20.0	20.9	22.9	24.9	26.9	25.3
R15	0.562	63.5	2.04	41.04	20.8	22.9	25.0	27.1	29.1	27.4
R16	0.498	100.0	0.00	34.58	27.7	27.7	30.4	33.2	36.0	33.7
R17	0.491	100.0	0.00	36.14	28.9	28.9	31.8	34.7	37.6	35.2
R18	0.797	3.2	49.41	55.46	1.4	50.8	51.0	51.1	51.3	51.1
R21	0.836	7.5	0.00	50.40	3.0	3.0	3.3	3.6	3.9	3.7
R22	0.574	16.4	29.71	44.43	5.8	35.5	36.1	36.7	37.3	36.8

TABLE 2

MODEL ID	*Original_FCDMC*	*QC_24h_Stan_NA_NA*	*QC_24h_Stan_120af_2R*	*QC_24h_10p_120af_2R*	*QC_24h_20p_120af_2R*	*QC_24h_30p_120af_2R*	*QC_24h_2.7in_120af_2R*	*QC_24h_Stan_168af_3R*	*QC_24h_10p_168af_3R*	*QC_24h_20p_168af_3R*	*QC_24h_30p_168af_3R*	*QC_24h_Stan_SSD_3R*	*QC_24h_2.7in_168af_3R*	*MODEL ID*
Subbasin Retention	[ORIGINAL]	[Standard]	[Standard]	[10% Increase]	[20% Increase]	[30% Increase]	[2.7" ~ 21.7% Increase]	[Standard]	[10% Increase]	[20% Increase]	[30% Increase]	[Standard]	[2.7" ~ 21.7% Increase]	*Subbasin Retention*
Regional Retention	[NONE]	[NONE]	[120af]	[120af]	[120af]	[120af]	[120af]	[168af]	[168af]	[168af]	[168af]	[Stage-Storage]	[168af]	Regional Retention
Pinal Route Modifications	[NONE]	[NONE]	[2 Routes]	[2 Routes]	[2 Routes]	[2 Routes]	[2 Routes]	[3 Routes]	[3 Routes]	[3 Routes]	[3 Routes]	[3 Routes]	[3 Routes]	Pinal Route Modifications
	Peak Q [cfs]	Peak Q [cfs]	Peak Q [cfs]	Peak Q [cfs]	Peak Q [cfs]	Peak Q [cfs]	Peak Q [cfs]	Peak Q [cfs]	Peak Q [cfs]	Peak Q [cfs]	Peak Q [cfs]	Peak Q [cfs]	Peak Q [cfs]	
R10R12	1124	1124	1124	1124	1124	1124	1124	1124	1124	1124	1124	1124	1124	R10R12
R14A	#N/A	224	224	224	224	224	224	224	224	224	224	224	224	R14A
Pinal	#N/A	#N/A	1377	1377	1377	1377	1377	1757	1757	1757	1757	1757	1757	Pinal
SBPINL	#N/A	#N/A	554	554	554	554	554	592	592	592	592	333	592	SBPINL
R12	939	939	939	939	939	939	939	939	939	939	939	939	939	R12
DIVR12	887	887	887	622	423	230	378	887	622	423	230	887	378	DIVR12
CPR12	1165	1165	728	600	575	575	575	671	613	613	613	676	613	CPR12
R15	616	616	616	616	616	616	616	616	616	616	616	616	616	R15
DIVR15	616	616	616	616	613	539	571	616	616	613	539	616	571	DIVR15
CPR15	953	953	586	586	516	516	516	581	581	528	528	581	528	CPR15
R18	661	661	661	661	661	661	661	661	661	661	661	661	661	R18
DIVR18	354	354	354	354	354	354	354	354	354	354	354	354	354	DIVR18
CPR18	907	907	568	527	501	501	501	544	498	494	494	545	494	CPR18
R14B	#N/A	511	511	511	511	511	511	511	511	511	511	511	511	R14B
DVR14B	#N/A	439	439	414	282	176	282	439	414	282	176	439	282	DVR14B
R17	497	466	466	466	466	466	466	466	466	466	466	466	466	R17
DIVR17	360	366	366	261	208	123	208	366	261	208	123	366	208	DIVR17
CPR17	729	566	566	412	311	190	306	566	412	311	190	566	306	CPR17
R22	794	667	667	667	667	667	667	667	667	667	667	667	667	R22
DIVR22	723	534	534	504	421	421	421	534	504	421	421	534	421	DIVR22
CPR22	893	878	534	509	496	496	496	534	487	455	455	534	455	CPR22
R11	1179	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	R11
DIVR11	859	829	829	697	532	289	444	829	697	532	289	829	444	DIVR11
R13	708	698	698	698	698	698	698	698	698	698	698	698	698	R13
DIVR13	599	612	612	435	304	178	304	612	435	304	178	612	304	DIVR13
R16	765	507	507	507	507	507	507	507	507	507	507	507	507	R16
DIVR16	604	369	369	298	227	116	167	369	298	227	116	369	167	DIVR16
CPR16	1024	1068	605	460	336	202	311	605	460	336	202	605	311	CPR16
R21	757	603	603	603	603	603	603	603	603	603	603	603	603	R21
DIVR21	757	603	603	603	603	603	603	603	603	603	603	603	603	DIVR21
CPR21	1519	1525	809	694	631	645	606	782	676	631	696	792	633	CPR21

APPENDIX E. HYDRAULIC AND EROSION ANALYSIS



TECHNICAL MEMORANDUM

HYDRAULIC AND EROSION ANALYSIS

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE

Revised January 2014

Background and Purpose

This memo documents an erosion analysis performed by Entellus for the Flood Control District of Maricopa County (District) under contract number 2011C017, East Mesa Area Drainage Master Plan (ADMP) Update. The erosion analysis supports the evaluation of the hydraulics and potential flood hazard mitigation solutions and is described under Section 3.3.3.12 of the contract scope of work.

This analysis determined hydraulic parameters, potential scour depths, and required riprap sizes for conveyance channels included in the study alternatives. **Figure AD 3.1.2** located in the Figures section of the *Proposed Alternatives Development and Evaluation Report,* illustrates the characteristics of the channels included in this analysis.

Soil Information

Shallow sediment samples were collected at or near the locations of potential conveyance channel solutions. The sediment sampling was performed in general accordance with ASTM D 422. The sampling locations and results are included in **Attachment 2**.

Approach and Methodology

Scour depths and riprap sizes were generally estimated using the methodology described in the *Draft Drainage Design Manual for Maricopa County Volume II - Hydraulics (FCD, June 2010)*, hereinafter referred to as the *Hydraulics Manual*. The specific equations and approach used for the analysis were referenced from the *River Mechanics Manual for DDMSW (FCD, April 2010)*, hereinafter referred to as the *DDMSW Manual*.

The conveyance channels included in the alternative solutions were subdivided into reaches based on their hydrologic boundaries. Total scour depths and required loose riprap sizes were

estimated for each reach. The total scour depths were estimated with the assumption that the channels would be comprised of the existing soils, as represented by the collected soil samples.

The scour estimates assumed the following:

- A factor of safety of 1.3 was used, in accordance with recommendations in the *DDMSW Manual*.
- Level 1 - State Standard equation was used for long term scour. A detailed analysis is outside the scope of work for the East Mesa ADMP Update.
- Lacey's equation was utilized for estimating the general scour.
- Bend, local, and contraction scour were assumed to be negligible and were not estimated.
- When estimating the bedform scour, the dune height was set equal to 0.225 X the hydraulic depth.
- Low flow scour depth was assumed to be 1.0 foot.
- Froude Numbers were less than 0.7.

Scour Equations from *DDMSW Manual*

$$y_{total} = FS\left(y_{lt} + y_{gs} + y_{bf} + y_b + y_{lf}\right) + FS_{local}\left(y_{loc}\right)$$

$f = Lacey's\ silt\ factor = 1.76(D_m)^{\frac{1}{2}}$
$D_m = mean\ grain\ size, D_{50}\ (mm)$
$Q = design\ flow = set\ to\ Q_{100}$
$y_{bf} = bedform\ scour\ depth\ (ft)$
$y_h = hydraulic\ depth\ of\ flow\ (ft)$
$y_b = bend\ scour\ depth\ (ft)$
$y_{lf} = low\ flow\ scour\ depth\ (ft)$
$y_{loc} = local\ scour\ depth\ (ft)$

$y_{total} = total\ scour\ depth\ (ft)$
$FS = factor\ of\ safety$
$y_{lt} = long\ term\ scour\ depth\ (ft) = 0.02\ (Q_{100})^{0.6}$
$Q_{100} = 100\ year\ flow\ rate\ (cfs)$

$$y_{gs} = general\ scour\ depth\ (ft) = Zy_m = Z\left(0.47\left[\frac{Q}{f}\right]^{\frac{1}{3}}\right)$$

$Z = multiplying\ factor$

The estimated loose riprap sizes are the sizes of riprap required to eliminate all potential scour in the channels. The District-recommended Isbash equation was used to determine the required median rock size (D_{50}) of the riprap. The equation does not rely on the channel's existing soil composition, as it assumes the channel is fully lined with riprap. The D_{50} estimated by the equation depends on the channel's average velocity, bank angle, and a coefficient that varies depending on the channel curvature. The riprap sizes were originally estimated for both the banks and the channel bottom. The bank angle was set to zero for estimating the riprap size required for the channel bottom, as recommended in the *DDMSW Manual*. The initial analysis showed that the bank angles of the proposed channels were small enough to result in only a

slight numerical difference in required riprap sizes between the channels and the banks. Once these values were rounded to the nearest physical size of riprap generally available, the required riprap sizes for bank and channel were identical. Therefore, the analysis documentation was simplified to only show a single riprap size required, which was based on the calculation of the required riprap size for the banks.

District-Recommended Isbash Equation for Loose Riprap Sizing from *DDMSW Manual*

$$D_{50} = X \frac{V_a^2}{\cos \emptyset} \left(\frac{\gamma_w}{\gamma_s - \gamma_w} \right)$$

D_{50} = median diameter of required riprap (ft)

V_a = average velocity $\left(\frac{\text{ft}}{\text{s}}\right)$

γ_s = specific weight of stone $\left(\frac{\text{lb}}{\text{ft}^3}\right)$

γ_w = specific weight of water $\left(\frac{\text{lb}}{\text{ft}^3}\right)$

$\emptyset$ = bank angle (degrees)

X = Coefficient from DDMSW Manual

Grade control was considered where riprap sizes in excess of approximately eight inches were required to eliminate scour or excessive velocities were seen. Where this threshold was exceeded using the slope of the existing grade, four-foot drops were added that reduced the slopes and lowered the velocities allowing smaller riprap along the channel. The riprap size limit, drop heights, and number of drops will be considered further as the alternatives are refined and a recommended alternative generated.

Riprap for the drop structures was estimated utilizing the *Hydraulics Manual* for drop structure riprap sizing. This estimate can be found in **Attachment 1**. Additionally, riprap sizing for channel bed protection downstream of drop structures was estimated utilizing the *Hydraulics Manual* and can also be found in **Attachment 1**.

Hydraulics

The erosion analysis required estimation of the average channel velocity and depth for each alternative. Flows generated from the HEC-1 models created for the East Mesa ADMP Update were utilized to estimate the required hydraulic parameters using manning's equation for open channel flow. The hydraulic parameters are shown in the tables included in **Attachment 1**.

For Alternatives 1, 2 & 3, the roughness coefficients were estimated using methods described in the *Hydraulics Manual*. These n values vary by channel material and assumed vegetation. For Alternatives 4 and 5 (Rittenhouse Zone), per District direction, an n value of 0.040 was utilized for all channels that had not been previously estimated. This includes the following channels:

- Alternative 4 Channel from Signal Butte and Queen Creek Rd to Ryan Rd and Rittenhouse.
- Alternative 5 Merrill Rd. Channel.
- Alternative 4 & 5 Queen Creek Channel.

In estimating the n values, it was assumed that all riprap-lined channels would have loose riprap placed on the channel banks, and the channel bed would be native material with some light vegetation. Further analysis of the recommended alternative may include refinement of the n values based on the specific characteristics, such as riprap placement, of each channel. Additional information regarding the development of n values and the hydraulic analysis is presented in **Appendix H** - Hydraulic Analysis of the East Mesa Area Drainage Master Plan Update - Proposed Alternatives and Evaluation Report. Channel longitudinal slopes were initially set to the existing grades estimated using USGS contours and then adjusted to consider grade control where necessary. The freeboard stated in the hydraulic tables in **Attachment 1** includes the drop structure drop height where pertinent.

Queen Creek Station Channel: The channel through the proposed Queen Creek Station development for Rittenhouse Alternative 4 was analyzed differently from other channels. Data on the area available for a channel was taken from a plan set provided by the developer's engineer. The plan set showed many obstructions to possible channel flow, and these obstructions varied widely throughout the plan set. Additionally, the longitudinal slope and dimensions available for the channel also vary throughout the reach. The two most restrictive segments were used for hydraulic estimation of the proposed channel. These two segments were as follows:

- 40' of bank obstruction and a longitudinal slope of approximately 0.0016 ft/ft
- 50' of bank obstruction and a longitudinal slope of approximately 0.0027 ft/ft

The proposed channel section has various side slopes and includes a proposed trail and Ryan Road within the channel freeboard. Because of the multiple side slopes, FlowMaster was used to analyze the channel capacity; however, FlowMaster does not allow for obstructions within the cross section. Therefore, an artificial obstruction was created cross section and assigned a very low n value to the edge of this obstruction. This method removes flow from the area of the. See the FlowMaster output in **Attachment 1** for details.

Results and Conclusions

Moveable Bed Channels: The analysis confirms that, for all alternatives, configuring the proposed channels on Meridian Road as moveable bed channels appears to be a reasonable approach as the scour depths and velocities are relatively low. Additionally, the scour equations may overestimate the scour depths in these channels as the equations do not account for sediment deposition. The low channel velocities and sandy soil types will likely result in aggradation that reduces the overall scour depths and could end up being more of a concern than erosion. A more detailed analysis of the sedimentation potential of these channels is not a part of the current scope and was not performed at this time. The analysis also showed that configuring the channels of Alternative 3 on Mountain, Galveston, Erie, and Williams Field Roads with moveable beds instead of riprap may be viable as the scour depths and velocities are relatively low. There was one instance where drop structures are proposed for a moveable bed channel. This occurs for the Rittenhouse Zone Alternative 4 along Queen Creek Rd from Meridian to Signal Butte. The existing natural grade of this segment requires the use of grade control structures to mitigate velocities.

Riprap Channels: The velocities and potential scour depths of all other channels appear to be too high to consider moveable bed channels, and loose riprap placement or other channel protection is recommended. The riprap could either be placed across the entire channel bed and banks or could be placed on the banks and toed into the channel to at least the scour depth. Where the erosion analysis predicated required loose riprap sizes exceeding eight inches using natural grades, grade control was considered to reduce the required riprap size. For this analysis, four-foot drop structures were added to channel segments until the required riprap size dropped below eight inches. Reducing the channel slopes typically resulted in wider top widths and deeper channels.

Grade Control: Evaluation of grade control showed that drop structures can be used to reduce the required channel riprap sizes but will result in wider and deeper channels. A reasonable approach for locating these drops may be to combine drop structures with roadway crossings such that the drops could occur through culvert crossings. In order to keep the channel riprap sizes below the threshold limit chosen at this stage in the analysis (eight inches), the results indicated that grade control would be required for the following segments (all within the Rittenhouse Zone):

- Alternative 1 – Germann Rd from Meridian to Rittenhouse
- Alternative 2 – Ryan Rd from Signal Butte to Rittenhouse
- Alternative 3 – Queen Creek Channel
- Alternative 4 – Ryan Rd Channel along Queen Creek Rd from Meridian to Signal Butte

Attachment 1

Entellus

Entellus
Project: East Mesa ADMPU
Project Number: FCD2011C017

ZONE: SR24

Alternative 1

Meridian Channel (Movable Bed Channel)

	Inputs										Hydraulic Calculations										Scour and Riprap Parameters														
	left	right	slope	n-value	Flow	k	Freeboard	Freeboard (calculated)	O&M Road	Other ROW	Depth	Total Depth (w/Freeboard)	BW	A	P	R	V	TW	Q	Total Chan TW	Total ROW	Curvature Coefficient X	Bank Angle ø	Req. Riprap Size: D_{50}	# of Drops	Soil Sample ID	Median Soil Particle Size D_{50}	Froude No. F_r	Hydraulic depth y_h	Z	General Scour y_{gs}	Low Flow Scour Y_{lf}	Bedform Scour y_{bf}	Long Term Scour y_R	Factor of Safety FS	Total Scour y
	[H:V]	[H:V]	[ft/ft]		[cfs]		[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft²]	[ft]	[ft]	[fps]	[ft]	[cfs]	[ft]	[ft]		[degrees]	[in]			[mm]		[ft]		[ft]	[ft]	[ft]	[ft]		[ft]
Ivanhoe to N. of Galveston	8	8	0.0018	0.038	310	1.49	1.3	0.67	14	20	2.6	3.9	27.5	125.6	69.4	1.8	2.47	69.1	310	90	123.9	0.0191	7.13	1.1		B-1	0.260	0.323	1.817	0.25	0.8	1	0.2	0.6	1.3	3.4
N. of Galveston to S. or Erie	8	8	0.0018	0.038	840	1.49	1.1	0.94	14	20	3.6	4.7	45.7	268.2	103.7	2.6	3.13	103.3	840	121	154.9	0.0191	7.13	1.7		B-1	0.260	0.343	2.596	0.25	1.1	1	0.3	1.1	1.3	4.6
S. of Erie to N. of Williams Field	8	8	0.0018	0.037	980	1.49	1.1	0.94	14	20	3.6	4.7	54.2	298.8	112.2	2.7	3.28	111.8	981	129	163.4	0.0191	7.13	1.8		B-1	0.260	0.354	2.673	0.25	1.2	1	0.3	1.2	1.3	4.9
N. of Williams Field to 1000' S. of WF [Underground]																																		
End of Pipe to N. of Frye	8	8	0.0018	0.037	980	1.49	2.3	0.94	14	20	3.6	5.9	54.2	298.8	112.2	2.7	3.28	111.8	981	149	182.6	0.0191	7.13	1.8		B-1	0.260	0.354	2.673	0.25	1.2	1	0.3	1.2	1.3	4.9
N. of Frye to SR24	8	8	0.0018	0.037	1040	1.49	1	0.94	14	20	3.6	4.6	58.5	314.3	116.5	2.7	3.31	116.1	1040	132	166.1	0.0191	7.13	1.9		B-1	0.260	0.355	2.707	0.25	1.2	1	0.3	1.3	1.3	5.0

Pecos Channel (Riprap Channel W/Water Harvesting)

(Ellsworth Alt 1 Alignment & Alt 1 Q's)

After Basin to Signal Butte	4	4	0.0043	0.037	1400	1.49	1.6	1.52	14	60	5.5	7.1	19.7	229.4	65.1	3.5	6.12	63.7	1403	77	150.5	0.0191	14.04	6.4		B-2	0.052	0.568	3.600	0.25	1.8	1	0.4	1.5	1.3	6.1
to Crismon	4	4	0.0034	0.035	2100	1.49	1.8	1.53	14	60	5.5	7.3	39.3	337.2	84.7	4.0	6.24	83.3	2103	98	171.7	0.0191	14.04	6.6		B-6	0.130	0.546	4.047	0.25	1.7	1	0.5	2.0	1.3	6.7
to Ellsworth	4	4	0.0029	0.034	2160	1.49	1.6	1.51	14	60	5.5	7.1	43.5	360.3	88.9	4.1	6.00	87.5	2162	100	174.3	0.0191	14.04	6.1		B-7	0.105	0.521	4.117	0.25	1.8	1	0.5	2.0	1.3	6.9

Meridian Channel North to Retention Basin (Movable Bed Channel - Alt 1 Q's)

	8	8	0.0018	0.032	460	1.49	1	0.79	14	20	3.0	4.0	24.9	146.7	73.3	2.0	3.14	72.9	460	89	122.9	0.0191	7.13	1.7		B-2	0.052	0.390	2.012	0.25	1.2	1	0.2	0.8	1.3	4.2

Alternative 2

Meridian Channel (Movable Bed Channel)

	Inputs										Hydraulic Calculations										Scour and Riprap Parameters														
	left	right	slope	n-value	Flow	k	Freeboard	Freeboard (calculated)	O&M Road	Other ROW	Depth	Total Depth (w/Freeboard)	BW	A	P	R	V	TW	Q	Total Chan TW	Total ROW	Curvature Coefficient X	Bank Angle ø	Req. Riprap Size: D_{50}	# of Drops	Soil Sample ID	Median Soil Particle Size D_{50}	Froude No. F_r	Hydraulic depth y_h	Z	General Scour y_{gs}	Low Flow Scour Y_{lf}	Bedform Scour y_{bf}	Long Term Scour y_R	Factor of Safety FS	Total Scour y
	[H:V]	[H:V]	[ft/ft]		[cfs]		[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft²]	[ft]	[ft]	[fps]	[ft]	[cfs]	[ft]	[ft]		[degrees]	[in]			[mm]		[ft]		[ft]	[ft]	[ft]	[ft]		[ft]
Ivanhoe to N. of Galveston	8	8	0.0018	0.038	310	1.49	1.3	0.65	14	20	2.5	3.8	30.7	126.8	71.0	1.8	2.45	70.7	310	92	125.5	0.0191	7.125016	1.0		B-1	0.260	0.322	1.793	0.25	0.8	1	0.2	0.6	1.3	3.4
N. of Galveston to Retention basin	8	8	0.0018	0.038	840	1.49	1.1	0.91	14	20	3.5	4.6	49.2	270.2	105.6	2.6	3.11	105.2	841	123	156.8	0.0191	7.125016	1.6		B-1	0.260	0.342	2.568	0.25	1.1	1	0.3	1.1	1.3	4.6
Retention basin to S of Erie	8	8	0.0018	0.038	520	1.49	1.3	0.91	14	20	3.5	4.8	23.9	181.7	80.3	2.3	2.87	79.9	521	101	134.7	0.0191	7.125016	1.4		B-1	0.260	0.335	2.273	0.25	1.0	1	0.3	0.9	1.3	4.0
S. of Erie to N. of Williams Field	8	8	0.0018	0.038	520	1.49	1.1	0.91	14	20	3.5	4.6	23.9	181.7	80.3	2.3	2.87	79.9	521	98	131.5	0.0191	7.125016	1.4		B-1	0.260	0.335	2.273	0.25	1.0	1	0.3	0.9	1.3	4.0
N. of Williams Field to 1000' S. of WF [Underground]																																		
End of Pipe to N. of Frye	8	8	0.0018	0.038	530	1.49	2.3	0.91	14	20	3.5	5.8	24.7	184.5	81.1	2.3	2.88	80.7	531	118	151.5	0.0191	7.125016	1.4		B-1	0.260	0.335	2.286	0.25	1.0	1	0.3	0.9	1.3	4.0
N. of Frye to Interim Channel	8	8	0.003	0.038	530	1.49	1	0.92	14	20	3.5	4.5	15.0	150.5	71.4	2.1	3.53	71.0	531	87	121.0	0.0191	7.125016	2.1		B-1	0.260	0.427	2.120	0.25	1.0	1	0.2	0.9	1.3	4.0

Pecos Channel (Riprap Channel W/Water Harvesting)

(Ellsworth Alt 1 Alignment & Alt 2 Q's)

After Basin to Signal Butte	4	4	0.0043	0.037	1710	1.49	1.6	1.53	14	60	5.5	7.1	27.0	269.5	72.4	3.7	6.35	71.0	1710	84	157.8	0.0191	14.03624	6.8		B-2	0.052	0.574	3.796	0.25	1.9	1	0.4	1.7	1.3	6.6
to Crismon	4	4	0.0034	0.035	2330	1.49	1.8	1.53	14	60	5.5	7.3	44.9	368.0	90.3	4.1	6.33	88.9	2331	103	177.3	0.0191	14.03624	6.8		B-6	0.130	0.549	4.139	0.25	1.8	1	0.5	2.1	1.3	7.0
to Ellsworth	4	4	0.0029	0.034	2470	1.49	1.6	1.52	14	60	5.5	7.1	51.5	404.3	96.9	4.2	6.12	95.5	2473	108	182.3	0.0191	14.03624	6.4		B-7	0.105	0.524	4.233	0.25	1.9	1	0.5	2.2	1.3	7.2

Meridian Channel North to Retention Basin (Movable Bed Channel - Alt 2 Q's)

	8	8	0.0018	0.032	890	1.49	1	0.90	14	20	3.4	4.4	45.5	247.2	100.3	2.5	3.60	99.9	891	116	149.9	0.0191	7.125016	2.2		B-2	0.052	0.404	2.474	0.25	1.5	1	0.3	1.2	1.3	5.2

Alternative 3

	Inputs										Hydraulic Calculations										Scour and Riprap Parameters															
	left	right	slope	n-value	Flow	k	Freeboard	Freeboard (calculated)	O&M Road	Other ROW	Depth	Total Depth (w/Freeboard)	BW	A	P	R	V	TW	Q	Total Chan TW	Total ROW	Curvature Coefficient X	Bank Angle ø	Req. Riprap Size: D_{50}	# of Drops	Soil Sample ID	Median Soil Particle Size D_{50}	Froude No. F_r	Hydraulic depth y_h	Z	General Scour y_{gs}	Low Flow Scour y_{lf}	Bedform Scour y_{bf}	Long Term Scour y_{lt}	Factor of Safety FS	Total Scour y
	[H:V]	[H:V]	[ft/ft]		[cfs]		[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft²]	[ft]	[ft]	[fps]	[ft]	[cfs]	[ft]	[ft]		[degrees]	[in]			[mm]		[ft]		[ft]	[ft]	[ft]	[ft]		[ft]
Mountain & Erie System																																				
(2:1 Riprap Channel No Landscape)																																				
Meridian - Lateral to Ivanhoe	2	2	0.0018	0.036	120	1.49	1	0.73			2.8	3.8	10.2	44.2	22.7	1.9	2.73	21.4	121	25	25.4	0.0191	26.56505	1.4		B-1	0.260	0.334	2.067	0.25	0.6	1	0.2	0.4	1.3	2.8
Ivanhoe - Lateral to Mountain	2	2	0.0045	0.040	120	1.49	1	0.80			3.0	4.0	4.9	32.7	18.3	1.8	3.69	16.9	121	21	20.9	0.0191	26.56505	2.5		B-1	0.260	0.467	1.935	0.25	0.6	1	0.2	0.4	1.3	2.8
Mountain (18A18B)	2	2	0.0015	0.035	140	1.49	1.1	0.65			2.5	3.6	16.8	54.5	28.0	1.9	2.58	26.8	141	31	31.2	0.0191	26.56505	1.3		B-1	0.260	0.319	2.034	0.25	0.6	1	0.2	0.4	1.3	2.9
Mountain (E18E19)	2	2	0.0015	0.038	360	1.49	1.9	1.17			4.5	6.4	15.9	112.1	36.0	3.1	3.22	33.9	360	42	41.5	0.0191	26.56505	1.9		B-1	0.260	0.312	3.305	0.25	0.9	1	0.4	0.7	1.3	3.8
Mountain (E19E20)	2	2	0.0015	0.038	380	1.49	1.1	1.22			4.7	5.8	15.1	115.2	36.1	3.2	3.30	33.9	380	38	38.3	0.0191	26.56505	2.0		B-5	0.071	0.316	3.397	0.25	1.1	1	0.4	0.7	1.3	4.1
(2:1 Riprap Channel No Landscape)																																				
Williams Field (E20E20)	2	2	0.0045	0.03816	50	1.49	1	0.51			1.9	2.9	5.0	16.7	13.5	1.2	3.02	12.6	51	17	16.6	0.0191	26.57	1.7		B-5	0.071	0.462	1.327	0.25	0.6	1	0.1	0.2	1.3	2.5
(2:1 Riprap Channel W/Dual Landscape Buffers)																																				
Williams Field (E2022E)	2	2	0.0045	0.034	230	1.49	1	0.60	14	30	2.1	3.1	21.2	53.3	30.6	1.7	4.32	29.6	230	34	77.6	0.0191	26.56505	3.5		B-5	0.071	0.567	1.802	0.25	0.9	1	0.2	0.5	1.3	3.4
Williams Field (22EE22)	2	2	0.0045	0.037	290	1.49	1	0.83	14	30	3.0	4.0	14.9	62.7	28.3	2.2	4.64	26.9	291	31	74.9	0.0191	26.56505	4.0		B-5	0.071	0.536	2.331	0.25	1.0	1	0.3	0.6	1.3	3.7
Williams Field (E22E26)	2	2	0.0045	0.037	290	1.49	1	0.83	14	30	3.0	4.0	14.9	62.7	28.3	2.2	4.64	26.9	291	31	74.9	0.0191	26.56505	4.0		B-5	0.071	0.536	2.331	0.25	1.0	1	0.3	0.6	1.3	3.7
(2:1 Riprap Channel No Landscape)																																				
Meridian - Lateral to Galveston	2	2	0.0018	0.037	270	1.49	2	0.95			3.7	5.7	15.6	83.6	31.9	2.6	3.24	30.2	271	38	38.2	0.0191	26.56505	2.0		B-1	0.260	0.344	2.768	0.25	0.8	1	0.3	0.6	1.3	3.5
Galveston - Lateral to Mountain	2	2	0.0049	0.041	270	1.49	1.5	0.94			3.5	5.0	10.6	60.4	26.0	2.3	4.50	24.4	272	30	30.4	0.0191	26.56505	3.8		B-1	0.260	0.504	2.474	0.25	0.8	1	0.3	0.6	1.3	3.4
Meridian - Lateral to Erie	2	2	0.0018	0.038	30	1.49	1	0.46			1.8	2.8	5.3	16.0	13.3	1.2	1.90	12.5	30	17	16.5	0.0191	26.56505	0.7		B-1	0.260	0.295	1.282	0.25	0.4	1	0.1	0.2	1.3	2.2
Erie - Lateral to Mountain	2	2	0.0049	0.038	50	1.49	1	0.49			1.8	2.8	5.5	16.4	13.5	1.2	3.08	12.7	51	17	16.7	0.0191	26.56505	1.8		B-1	0.260	0.479	1.290	0.25	0.4	1	0.1	0.2	1.3	2.3
Meridian - Lateral to Williams Field	2	2	0.0018	0.034	50	1.49	1.1	0.44			1.7	2.8	10.1	23.0	17.7	1.3	2.18	16.9	50	21	21.3	0.0191	26.56505	0.9		B-5	0.071	0.330	1.358	0.25	0.6	1	0.2	0.2	1.3	2.5
Pecos Channel																																				
(Riprap Channel W/Water Harvesting)																																				
(Ellsworth Alt 1 Alignment & Alt 3 Q's)																																				
After Basin to Signal Butte	4	4	0.0043	0.037	1420	1.49	1.6	1.52	14	60	5.5	7.1	20.2	232.1	65.6	3.5	6.13	64.2	1424	77	151.0	0.0191	14.03624	6.4		B-2	0.052	0.569	3.615	0.25	1.8	1	0.4	1.6	1.3	6.2
to Crismon	4	4	0.0034	0.035	2080	1.49	1.8	1.53	14	60	5.5	7.3	38.8	334.4	84.2	4.0	6.23	82.8	2082	97	171.2	0.0191	14.03624	6.6		B-6	0.13	0.546	4.039	0.25	1.7	1	0.5	2.0	1.3	6.7
to Ellsworth	4	4	0.0029	0.034	2210	1.49	1.7	1.52	14	60	5.5	7.2	44.8	367.4	90.2	4.1	6.02	88.8	2212	102	176.4	0.0191	14.03624	6.2		B-7	0.105	0.522	4.137	0.25	1.8	1	0.5	2.0	1.3	6.9
Meridian Channel North to Retention Basin (Movable Bed Channel - Alt 3 Q's)	8	8	0.0018	0.032	460	1.49	1	0.89	14	20	3.4	4.4	15.2	144.2	70.0	2.1	3.20	69.6	461	86	119.6	0.0191	7.125016	1.7		B-2	0.052	0.391	2.071	0.25	1.2	1	0.2	0.8	1.3	4.2

******NOTE*** All channel widths are rounded up to the nearest 5' for the cost estimate.***

******NOTE*** All right-of-way widths are rounded up to the nearest 5' for the cost estimate.***

Entellus

Entellus
Project: East Mesa ADMPU
Project Number: FCD2011C017

ZONE: Ellsworth

Alternative 1

	Inputs										Hydraulic Calculations										Scour and Riprap Parameters													
	left	right	slope	n-value	Flow	k	Freeboard	Freeboard (calculated)	O&M Road	Other ROW	Depth	Total Depth (w/Freeboard)	BW	A	P	R	V	TW	Q	Total Chan TW	Total ROW	Curvature Coefficient X	Bank Angle Ø	Req. Riprap Size: D_{50}	# of Drops	Soil Sample ID	Median Soil Particle Size D_{50}	Froude No. F_r	Hydraulic depth y_h	Z	General Scour y_{gs}	Low Flow Scour Y_{lf}	Bedform Scour y_{bf}	Long Term Scour y_{lt}	Factor of Safety FS	Total Scour y
	[H:V]	[H:V]	[ft/ft]		[cfs]		[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft^2]	[ft]	[ft]	[fps]	[ft]	[cfs]	[ft]	[ft]		[degrees]	[in]			[mm]		[ft]		[ft]	[ft]	[ft]	[ft]		[ft]
Meridian Channel North (Movable Bed Channel)	8	8	0.0018	0.032	890	1.49	1	0.90	14	20	3.4	4.4	45.5	247.2	100.3	2.5	3.60	99.9	891	116	149.9	0.0191	7.13	2.2		B-2	0.052	0.404	2.474	0.25	1.5	1.0	0.3	1.2	1.3	5.2
Meridian Channel South																																		
(Movable Bed Channel)																																		
Queen Creek to Ranch Rd	8	8	0.002	0.033	400	1.49	1	0.91	14	20	3.5	4.5	8.2	126.7	64.6	2.0	3.16	64.2	401	80	114.2	0.0191	7.125016	1.7		B-4	0.056	0.397	1.974	0.25	1.2	1.0	0.2	0.7	1.3	4.0
Ranch to Germann	8	8	0.001	0.036	630	1.49	1.3	1.28	14	20	5.0	6.3	9.2	246.0	89.8	2.7	2.56	89.2	630	110	144.0	0.0191	7.125016	1.1		B-4	0.056	0.272	2.758	0.25	1.3	1.0	0.3	1.0	1.3	4.7
(2:1 Riprap Channel No Landscape)																																		
Germann to 1/2 way to basin	2	2	0.0006	0.032	780	1.49	2.1	1.44	14	40	5.6	7.7	35.0	258.7	60.0	4.3	3.02	57.4	781	66	119.8	0.0191	26.56505	1.7		B-3	0.105	0.251	4.507	0.25	1.3	1.0	0.5	1.1	1.3	5.1
to Pecos - past basin	2	2	0.0017	0.032	780	1.49	1.5	1.49	14	40	5.6	7.1	18.5	166.3	43.5	3.8	4.69	40.9	780	47	100.9	0.0191	26.56505	4.1		B-3	0.105	0.410	4.067	0.25	1.3	1.0	0.5	1.1	1.3	5.0
Pecos Channel (Riprap Channel W/Water Harvesting)																																		
(Ellsworth Alt 1 Alignment & Alt 2 Q's)																																		
After Basin to Signal Butte	4	4	0.0043	0.037	1710	1.49	1.6	1.53	14	60	5.5	7.1	27.0	269.5	72.4	3.7	6.35	71.0	1710	84	157.8	0.0191	14.04	6.8		B-2	0.052	0.574	3.796	0.25	1.9	1.0	0.4	1.7	1.3	6.6
to Crismon	4	4	0.0034	0.035	2330	1.49	1.8	1.53	14	60	5.5	7.3	44.9	368.0	90.3	4.1	6.33	88.9	2331	103	177.3	0.0191	14.04	6.8		B-6	0.130	0.549	4.139	0.25	1.8	1.0	0.5	2.1	1.3	7.0
to Ellsworth	4	4	0.0029	0.034	2470	1.49	1.6	1.52	14	60	5.5	7.1	51.5	404.3	96.9	4.2	6.12	95.5	2473	108	182.3	0.0191	14.04	6.4		B-3	0.105	0.524	4.233	0.25	1.9	1.0	0.5	2.2	1.3	7.2

Alternative 2

	Inputs										Hydraulic Calculations										Scour and Riprap Parameters													
	left	right	slope	n-value	Flow	k	Freeboard	Freeboard (calculated)	O&M Road	Other ROW	Depth	Total Depth (w/Freeboard)	BW	A	P	R	V	TW	Q	Total Chan TW	Total ROW	Curvature Coefficient X	Bank Angle Ø	Req. Riprap Size: D_{50}	# of Drops	Soil Sample ID	Median Soil Particle Size D_{50}	Froude No. F_r	Hydraulic depth y_h	Z	General Scour y_{gs}	Low Flow Scour Y_{lf}	Bedform Scour y_{bf}	Long Term Scour y_{lt}	Factor of Safety FS	Total Scour y
	[H:V]	[H:V]	[ft/ft]		[cfs]		[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft^2]	[ft]	[ft]	[fps]	[ft]	[cfs]	[ft]	[ft]		[degrees]	[in]			[mm]		[ft]		[ft]	[ft]	[ft]	[ft]		[ft]
Meridian Channel North (Movable Bed Channel)	8	8	0.0018	0.032	890	1.49	1	0.90	14	20	3.4	4.4	45.5	247.2	100.3	2.5	3.60	99.9	891	116	149.9	0.0191	7.13	2.2		B-2	0.052	0.404	2.474	0.25	1.5	1.0	0.3	1.2	1.3	5.2
Meridian Channel South																																		
(Movable Bed Channel)																																		
Queen Creek to Ranch Rd	8	8	0.002	0.033	400	1.49	1	0.91	14	20	3.5	4.5	8.2	126.7	64.6	2.0	3.16	64.2	401	80	114.2	0.0191	7.125016	1.7		B-4	0.056	0.397	1.974	0.25	1.2	1.0	0.2	0.7	1.3	4.0
Ranch to Germann	8	8	0.001	0.036	630	1.49	1.3	1.28	14	20	5.0	6.3	9.2	246.0	89.8	2.7	2.56	89.2	630	110	144.0	0.0191	7.125016	1.1		B-4	0.056	0.272	2.758	0.25	1.3	1.0	0.3	1.0	1.3	4.7
(2:1 Riprap Channel W/Dual Landscape Buffers)																																		
Germann to 1/2 way to basin	2	2	0.0006	0.032	780	1.49	2.1	1.44	14	40	5.6	7.7	35.0	258.7	60.0	4.3	3.02	57.4	781	66	119.8	0.0191	26.56505	1.7		B-3	0.105	0.251	4.507	0.25	1.3	1.0	0.5	1.1	1.3	5.1
to Pecos (past basin)	2	2	0.0017	0.032	780	1.49	1.5	1.49	14	40	5.6	7.1	18.5	166.3	43.5	3.8	4.69	40.9	780	47	100.9	0.0191	26.56505	4.1		B-3	0.105	0.410	4.067	0.25	1.3	1.0	0.5	1.1	1.3	5.0
Pecos Channel (Riprap Channel W/Water Harvesting)																																		
(Ellsworth Alt 2 Alignment & Alt 2 Q's)																																		
After Basin to Signal Butte	4	4	0.0042	0.037	1710	1.49	1.8	1.53	14	60	5.5	7.3	27.5	272.3	72.9	3.7	6.28	71.5	1711	86	159.9	0.0191	14.04	6.7		B-2	0.052	0.568	3.808	0.25	1.9	1.0	0.4	1.7	1.3	6.6
to Crismon	4	4	0.0032	0.035	2330	1.49	1.7	1.52	14	60	5.5	7.2	46.7	377.9	92.1	4.1	6.17	90.7	2333	104	178.3	0.0191	14.04	6.5		B-6	0.130	0.533	4.166	0.25	1.8	1.0	0.5	2.1	1.3	7.0
to Ellsworth	4	4	0.003	0.034	2470	1.49	1.9	1.52	14	60	5.5	7.4	50.4	398.2	95.8	4.2	6.21	94.4	2472	110	183.6	0.0191	14.04	6.5		B-3	0.105	0.533	4.218	0.25	1.9	1.0	0.5	2.2	1.3	7.2

Alternative 3

	Inputs										Hydraulic Calculations										Scour and Riprap Parameters														
	left	right	slope	n-value	Flow	k	Freeboard	Freeboard (calculated)	O&M Road	Other ROW	Depth	Total Depth (w/Freeboard)	BW	A	P	R	V	TW	Q	Total Chan TW	Total ROW	Curvature Coefficient X	Bank Angle Ø	Req. Riprap Size: D_{50}	# of Drops	Soil Sample ID	Median Soil Particle Size D_{50}	Froude No. F_r	Hydraulic depth y_h	Z	General Scour y_{gs}	Low Flow Scour y_{lf}	Bedform Scour y_{bf}	Long Term Scour y_{lt}	Factor of Safety FS	Total Scour y
	[H:V]	[H:V]	[ft/ft]		[cfs]		[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft²]	[ft]	[ft]	[fps]	[ft]	[cfs]	[ft]	[ft]		[degrees]	[in]			[mm]		[ft]		[ft]	[ft]	[ft]	[ft]		[ft]
Meridian Channel North (Movable Bed Channel)	8	8	0.0018	0.032	890	1.49	1	0.90	14	20	3.4	4.4	45.5	247.2	100.3	2.5	3.60	99.9	891	116	149.9	0.0191	7.13	2.2		B-2	0.052	0.404	2.474	0.25	1.5	1.0	0.3	1.2	1.3	5.2
Meridian Channel South																																			
(Movable Bed Channel)																																			
Queen Creek to Ranch Rd	8	8	0.002	0.033	400	1.49	1	0.91	14	20	3.5	4.5	8.2	126.7	64.6	2.0	3.16	64.2	401	80	114.2	0.0191	7.125016	1.7		B-4	0.056	0.397	1.974	0.25	1.2	1.0	0.2	0.7	1.3	4.0
Ranch to Germann	8	8	0.001	0.036	630	1.49	1.3	1.28	14	20	5.0	6.3	9.2	246.0	89.8	2.7	2.56	89.2	630	110	144.0	0.0191	7.125016	1.1		B-4	0.056	0.272	2.758	0.25	1.3	1.0	0.3	1.0	1.3	4.7
(2:1 Riprap Channel W/Dual Landscape Buffers)																																			
Germann to 1/2 way to basin	2	2	0.0006	0.032	780	1.49	2.1	1.44	14	40	5.6	7.7	35.0	258.7	60.0	4.3	3.02	57.4	781	66	119.8	0.0191	26.56505	1.7		B-3	0.105	0.251	4.507	0.25	1.3	1.0	0.5	1.1	1.3	5.1
to Pecos (past basin)	2	2	0.0017	0.032	780	1.49	1.5	1.49	14	40	5.6	7.1	18.5	166.3	43.5	3.8	4.69	40.9	780	47	100.9	0.0191	26.56505	4.1		B-3	0.105	0.410	4.067	0.25	1.3	1.0	0.5	1.1	1.3	5.0
Pecos Channel (Riprap Channel W/Water Harvesting)																																			
(Ellsworth Alt 3 Alignment & Alt 2 Q's)																																			
After Basin to Signal Butte	4	4	0.0043	0.037	1710	1.49	1.6	1.53	14	60	5.5	7.1	27.0	269.5	72.4	3.7	6.35	71.0	1710	84	157.8	0.0191	14.04	6.8		B-2	0.052	0.574	3.796	0.25	1.9	1.0	0.4	1.7	1.3	6.6
to Crismon	4	4	0.0032	0.035	2330	1.49	1.9	1.52	14	60	5.5	7.4	46.7	377.9	92.1	4.1	6.17	90.7	2333	106	179.9	0.0191	14.04	6.5		B-6	0.130	0.533	4.166	0.25	1.8	1.0	0.5	2.1	1.3	7.0
to Ellsworth	4	4	0.003	0.034	2470	1.49	1.9	1.52	14	60	5.5	7.4	50.4	398.2	95.8	4.2	6.21	94.4	2472	110	183.6	0.0191	14.04	6.5		B-3	0.105	0.533	4.218	0.25	1.9	1.0	0.5	2.2	1.3	7.2

******NOTE*** All channel widths are rounded up to the nearest 5' for the cost estimate.***

******NOTE*** All right-of-way widths are rounded up to the nearest 5' for the cost estimate.***

Entellus

Entellus
Project: East Mesa ADMPU
Project Number: FCD2011C017

ZONE: Rittenhouse

Alternative 1

Germann Rd

(2:1 Riprap Channel W/Dual Landscape Buffers)
(4' Drop Structures Required: Natural Slope = 0.0034)

	Inputs										Hydraulic Calculations										Scour and Riprap Parameters														
	left	right	slope	n-value	Flow	k	Freeboard	Freeboard (calculated)	O&M Road	Other ROW	Depth	Total Depth (w/Freeboard)	BW	A	P	R	V	TW	Q	Total Chan TW	Total ROW	Curvature Coefficient X	Bank Angle Ø	Req. Riprap Size: D_{50}	# of Drops	Soil Sample ID	Median Soil Particle Size D_{50}	Froude No. F_r	Hydraulic depth y_h	Z	General Scour y_{gs}	Low Flow Scour Y_{lf}	Bedform Scour y_{bf}	Long Term Scour y_{lt}	Factor of Safety FS	Total Scour y
	[H:V]	[H:V]	[ft/ft]		[cfs]		[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft²]	[ft]	[ft]	[fps]	[ft]	[cfs]	[ft]	[ft]		[degrees]	[in]			[mm]		[ft]		[ft]	[ft]	[ft]	[ft]		[ft]
Meridian to Signal Butte	2	2	0.0026	0.031	1380	1.49	6	1.53	14	40	5.5	11.5	29.0	220.0	53.6	4.1	6.28	51.0	1382	75	129.0	0.0191	26.57	7.3	1	B-8	0.061	0.533	4.314	0.25	1.7	1	0.5	1.5	1.3	6.2
Signal Butte to Crismon	2	2	0.0026	0.031	1380	1.49	6	1.53	14	40	5.5	11.5	29.0	220.0	53.6	4.1	6.28	51.0	1382	75	129.0	0.0191	26.57	7.3	1	B-8	0.061	0.533	4.314	0.25	1.7	1	0.5	1.5	1.3	6.2
Crismon to Ellsworth	2	2	0.0026	0.031	1380	1.49	6	1.53	14	40	5.5	11.5	29.0	220.0	53.6	4.1	6.28	51.0	1382	75	129.0	0.0191	26.57	7.3	1	B-11	0.081	0.533	4.314	0.25	1.6	1	0.5	1.5	1.3	6.1
Ellsworth to Rittenhouse	2	2	0.0026	0.031	460	1.49	5.5	1.48			5.5	11.0	5.4	90.2	30.0	3.0	5.11	27.4	461	49	49.4	0.0191	26.57	4.8	2	B-11	0.081	0.496	3.292	0.25	1.1	1	0.4	0.8	1.3	4.3

Queen Creek Channel

(2:1 Riprap Channel W/Dual Landscape Buffers)

	2	2	0.0039	0.035	650	1.49	1.5	1.38	14	30	5.0	6.5	12.5	112.5	34.9	3.2	5.81	32.5	653	39	82.5	0.0191	26.57	6.2		B-9	0.081	0.550	3.462	0.25	1.3	1	0.4	1.0	1.3	4.7

Meridian Channel to Germann (Movable Bed Channel)

Queen Creek to Ranch Rd	8	8	0.002	0.033	1380	1.49	1.3	1.32	14	20	5.0	6.3	24.7	323.5	105.3	3.1	4.27	104.7	1380	126	159.5	0.0191	7.13	3.0		B-4	0.056	0.428	3.090	0.25	1.7	1	0.3	1.5	1.3	6.0
Ranch Rd to Germann	8	8	0.001	0.036	1410	1.49	1.3	1.29	14	20	5.0	6.3	53.7	468.5	134.3	3.5	3.01	133.7	1410	155	188.5	0.0191	7.13	1.5		B-4	0.056	0.283	3.504	0.25	1.8	1	0.4	1.6	1.3	6.1

Alternative 2

Ryan Rd (Riprap Channel)

(4:1 Riprap Channel W/Dual Landscape Buffers)

	Inputs										Hydraulic Calculations										Scour and Riprap Parameters														
	left	right	slope	n-value	Flow	k	Freeboard	Freeboard (calculated)	O&M Road	Other ROW	Depth	Total Depth (w/Freeboard)	BW	A	P	R	V	TW	Q	Total Chan TW	Total ROW	Curvature Coefficient X	Bank Angle Ø	Req. Riprap Size: D_{50}	# of Drops	Soil Sample ID	Median Soil Particle Size D_{50}	Froude No. F_r	Hydraulic depth y_h	Z	General Scour y_{gs}	Low Flow Scour Y_{lf}	Bedform Scour y_{bf}	Long Term Scour y_{lt}	Factor of Safety FS	Total Scour y
	[H:V]	[H:V]	[ft/ft]		[cfs]		[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft²]	[ft]	[ft]	[fps]	[ft]	[cfs]	[ft]	[ft]		[degrees]	[in]			[mm]		[ft]		[ft]	[ft]	[ft]	[ft]		[ft]
Meridian to Signal Butte	4	4	0.0023	0.035	1380	1.49	1.5	1.47	14	40	5.5	7.0	28.8	279.4	74.2	3.8	4.94	72.8	1381	85	138.8	0.0191	14.036243	4.2		B-10	0.110	0.445	3.838	0.25	1.6	1	0.4	1.5	1.3	5.9

(Riprap Channel w/SRP Easement)
(4' Drop Structures Required: Natural Slope = 0.003)

Signal Butte to Ellsworth	4	4	0.0023	0.035	1380	1.49	5.5	1.47	60		5.5	11.0	28.8	279.4	74.2	3.8	4.94	72.8	1381	117	176.8	0.0191	14.036243	4.2	3	B-10	0.110	0.445	3.838	0.25	1.6	1	0.4	1.5	1.3	5.9
Ellsworth to Rittenhouse	4	4	0.002	0.035	1380	1.49	5.5	1.46	60		5.5	11.0	31.8	295.9	77.2	3.8	4.66	75.8	1380	120	179.8	0.0191	14.036243	3.7	3	B-12	0.050	0.416	3.904	0.25	1.8	1	0.4	1.5	1.3	6.2

Queen Creek Channel

(2:1 Riprap Channel W/Dual Landscape Buffers)

	2	2	0.0039	0.035	650	1.49	1.5	1.38	14	30	5.0	6.5	12.5	112.5	34.9	3.2	5.81	32.5	653	39	82.5	0.0191	26.57	6.2		B-9	0.081	0.550	3.462	0.25	1.3	1	0.4	1.0	1.3	4.7

Meridian Channel to Germann (Movable Bed Channel)

Queen Creek to Ranch Rd	8	8	0.002	0.033	400	1.49	1	0.91	14	20	3.5	4.5	8.2	126.7	64.6	2.0	3.16	64.2	401	80	114.2	0.0191	7.1250163	1.7		B-4	0.056	0.397	1.974	0.25	1.2	1	0.2	0.7	1.3	4.0
Ranch to Germann	8	8	0.001	0.036	630	1.49	1.3	1.28	14	20	5.0	6.3	9.2	246.0	89.8	2.7	2.56	89.2	630	110	144.0	0.0191	7.1250163	1.1		B-4	0.056	0.272	2.758	0.25	1.3	1	0.3	1.0	1.3	4.7

Alternative 3

Germann Rd

(2:1 Riprap Channel W/Dual Landscape Buffers)

	Inputs										Hydraulic Calculations										Scour and Riprap Parameters														
	left	right	slope	n-value	Flow	k	Freeboard	Freeboard (calculated)	O&M Road	Other ROW	Depth	Total Depth (w/Freeboard)	BW	A	P	R	V	TW	Q	Total Chan TW	Total ROW	Curvature Coefficient X	Bank Angle Ø	Req. Riprap Size: D_{50}	# of Drops	Soil Sample ID	Median Soil Particle Size D_{50}	Froude No. F_r	Hydraulic depth y_h	Z	General Scour y_{gs}	Low Flow Scour Y_{lf}	Bedform Scour y_{bf}	Long Term Scour y_{lt}	Factor of Safety FS	Total Scour y
	[H:V]	[H:V]	[ft/ft]		[cfs]		[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft²]	[ft]	[ft]	[fps]	[ft]	[cfs]	[ft]	[ft]		[degrees]	[in]			[mm]		[ft]		[ft]	[ft]	[ft]	[ft]		[ft]
Meridian to Ellsworth	2	2	0.0034	0.042	400	1.49	1.5	1.45	14	30	5.5	7.0	5.8	92.4	30.4	3.0	4.34	27.8	401	34	77.8	0.0191	26.565051	3.5		B-8	0.061	0.420	3.324	0.25	1.1	1	0.4	0.7	1.3	4.2

(2:1 Riprap Channel No Landscape)

Ellsworth to Rittenhouse	2	2	0.0034	0.037	740	1.49	1.5	1.36			5.0	6.5	17.6	138.0	40.0	3.5	5.36	37.6	740	44	43.6	0.0191	26.565051	5.3		B-11	0.081	0.493	3.670	0.25	1.3	1	0.4	1.1	1.3	4.9

Queen Creek Channel (Riprap Channel)

(2:1 Riprap Channel W/Dual Landscape Buffers)
(4' Drop Structures Required: Natural Slope = 0.0039)

	2	2	0.0024	0.030	1380	1.49	6	1.50	14	45.6	5.4	11.4	30.4	222.5	54.5	4.1	6.21	52.0	1382	76	135.6	0.0191	26.565051	7.1	4	B-9	0.081	0.529	4.278	0.25	1.6	1	0.5	1.5	1.3	6.1

Meridian Channel to Germann (Movable Bed Channel)

1/4 mile north of Queen Creek to Ranch Rd	8	8	0.0020	0.033	400	1.49	1	0.91	14	20	3.5	4.5	8.2	126.7	64.6	2.0	3.16	64.2	401	80	114.2	0.0191	7.1250163	1.7		B-4	0.056	0.397	1.974	0.25	1.2	1	0.2	0.7	1.3	4.0
Ranch to Germann	8	8	0.0010	0.036	630	1.49	1.3	1.28	14	20	5.0	6.3	9.2	246.0	89.8	2.7	2.56	89.2	630	110	144.0	0.0191	7.1250163	1.1		B-4	0.056	0.272	2.758	0.25	1.3	1	0.3	1.0	1.3	4.7

Entellus

Entellus
Project: East Mesa ADMPU
Project Number: FCD2011C017

ZONE: Rittenhouse

Alternative 4

	Inputs										Hydraulic Calculations										Scour and Riprap Parameters														
	left	right	slope	n-value	Flow	k	Freeboard	Freeboard (calculated)	O&M Road	Other ROW	Depth	Total Depth (w/Freeboard)	BW	A	P	R	V	TW	Q	Total Chan TW	Total ROW	Curvature Coefficient X	Bank Angle Ø	Req. Riprap Size: D_{50}	# of Drops	Soil Sample ID	Median Soil Particle Size D_{50}	Froude No. F_r	Hydraulic depth y_h	Z	General Scour y_{gs}	Low Flow Scour y_{lf}	Bedform Scour y_{bf}	Long Term Scour y_{lt}	Factor of Safety FS	Total Scour y
	[H:V]	[H:V]	[ft/ft]		[cfs]		[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft^2]	[ft]	[ft]	[fps]	[ft]	[cfs]	[ft]	[ft]		[degrees]	[in]			[mm]		[ft]		[ft]	[ft]	[ft]	[ft]		[ft]
Ryan Rd Channel																																			
(Movable Bed Channel)																																			
(4' Drop Structures Required: Natural Slope = 0.0039)																																			
Queen Creek: Meridian to Signal Butte	8	8	0.0020	0.033	1380	1.49	5.5	1.45	14	20	5.5	11.0	14.3	320.7	103.0	3.1	4.31	102.3	1381	190	224.3	0.0191	7.1250163	3.1	3	B-9	0.081	0.429	3.134	0.25	1.6	1	0.4	1.5	1.3	5.9
(Turf Channel W/ SRP Easement)																																			
Signal Butte: Queen Creek to Ryan Rd	20	6	0.0010	0.040	1380	1.49	1	1.02	14	28	4.0	5.0	91.2	572.8	195.6	2.9	2.41	195.2	1381	221	263.2	0.0191	2.8624052	1.0		B-9	0.081	0.248	2.934	0.25	1.6	1	0.3	1.5	1.3	5.9
Ryan Rd: Signal Butte to 122nd	20	6	0.0038	0.040	1050	1.49	1	1.06	14	28	4.0	5.0	14.8	267.2	119.2	2.2	3.93	118.8	1051	145	186.8	0.0191	2.8624052	2.6		B-10	0.110	0.462	2.249	0.25	1.4	1	0.3	1.3	1.3	5.2
Ryan Rd: 122nd to Ellsworth	20	6	0.0034	0.040	500	1.49	1	0.91	14	28	3.5	4.5	0.0	159.3	91.4	1.7	3.15	91.0	501	117	159.0	0.0191	2.8624052	1.7		B-10	0.110	0.419	1.750	0.25	1.1	1	0.2	0.8	1.3	4.1
(Channel W/SRP Easement (Constricted)) *(This cross-section has multiple side slopes and is approximated by the cross section below. See FlowMaster output for correct channel geometry)*																																			
Ryan Rd: Ellsworth to Rittenhouse	15.5	3	0.0034	0.040	750	1.49	1	1.05		35	4.0	5.0	12.9	199.6	87.7	2.3	3.76	86.9	750	105	140.4	0.0191	3.691386	2.4		B-12	0.050	0.437	2.297	0.25	1.5	1	0.3	1.1	1.3	4.9
Queen Creek Channel (Riprap Channel)																																			
(2:1 Riprap Channel W/Dual Landscape Buffers)	2	2	0.0039	0.04	650	1.49	1.5	1.36	14	30	5.0	6.5	15.0	125.0	37.4	3.3	5.20	35.0	650	41	85.0	0.0191	26.57	5.0		B-9	0.081	0.485	3.571	0.25	1.3	1	0.4	1.0	1.3	4.8
Meridian Channel to Germann (Movable Bed Channel)																																			
1/4 mile north of Queen Creek to Ranch Rd	8	8	0.0020	0.033	400	1.49	1	0.91	14	20	3.5	4.5	8.2	126.7	64.6	2.0	3.16	64.2	401	80	114.2	0.0191	7.1250163	1.7		B-4	0.056	0.397	1.974	0.25	1.2	1	0.2	0.7	1.3	4.0
Ranch to Germann	8	8	0.0010	0.036	630	1.49	1.3	1.28	14	20	5.0	6.3	9.2	246.0	89.8	2.7	2.56	89.2	630	110	144.0	0.0191	7.1250163	1.1		B-4	0.056	0.272	2.758	0.25	1.3	1	0.3	1.0	1.3	4.7

Alternative 5

	Inputs										Hydraulic Calculations										Scour and Riprap Parameters														
	left	right	slope	n-value	Flow	k	Freeboard	Freeboard (calculated)	O&M Road	Other ROW	Depth	Total Depth (w/Freeboard)	BW	A	P	R	V	TW	Q	Total Chan TW	Total ROW	Curvature Coefficient X	Bank Angle Ø	Req. Riprap Size: D_{50}	# of Drops	Soil Sample ID	Median Soil Particle Size D_{50}	Froude No. F_r	Hydraulic depth y_h	Z	General Scour y_{gs}	Low Flow Scour y_{lf}	Bedform Scour y_{bf}	Long Term Scour y_{lt}	Factor of Safety FS	Total Scour y
	[H:V]	[H:V]	[ft/ft]		[cfs]		[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft^2]	[ft]	[ft]	[fps]	[ft]	[cfs]	[ft]	[ft]		[degrees]	[in]			[mm]		[ft]		[ft]	[ft]	[ft]	[ft]		[ft]
Merrill Channel																																			
(3:1 Riprap Channel No Landscape)	3	3	0.0010	0.040	330	1.49	1	0.79			3.1	4.1	40.0	151.1	59.4	2.5	2.19	58.4	332	64	64.4	0.0191	18.434949	0.9		B-9	0.081	0.240	2.586	0.25	1.0	1	0.3	0.6	1.3	3.8
Queen Creek Channel																																			
(3:1 Riprap Channel No Landscape)	3	3	0.0030	0.040	520	1.49	1	0.78			2.9	3.9	40.0	141.8	58.4	2.4	3.69	57.5	523	63	63.5	0.0191	18.434949	2.4		B-9	0.081	0.413	2.468	0.25	1.2	1	0.3	0.9	1.3	4.3
Meridian Channel to Germann (Movable Bed Channel)	8	8	0.0010	0.036	720	1.49	1.3	1.28	14	20	5.0	6.3	14.6	273.0	95.2	2.9	2.64	94.6	721	115	149.4	0.0191	7.1250163	1.2		B-4	0.056	0.274	2.886	0.25	1.4	1	0.3	1.0	1.3	4.9

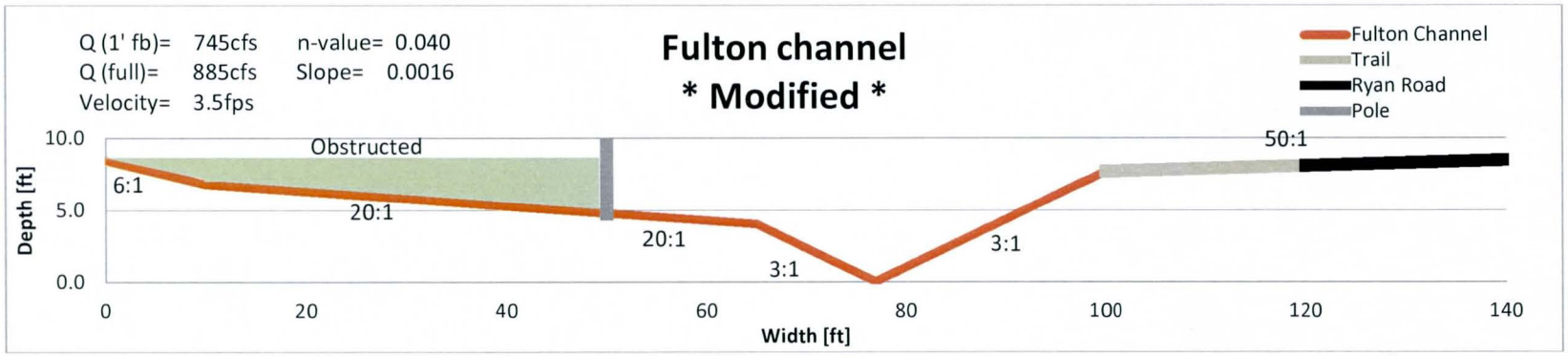
NOTE All channel widths are rounded up to the nearest 5' for the cost estimate.*

NOTE All right-of-way widths are rounded up to the nearest 5' for the cost estimate.*

2013.08.12

Fulton Channel
in SRP Easement

Point #	L	H:Z	S	X	Y
0				0	8.4
1	10	-6	(0.17)	10	6.8
2	30	-20	(0.05)	40	5.3
3	0	-4	(0.25)	40	5.3
2	25	-20	(0.05)	65	4.0
3	12	-3	(0.33)	77	0.0
4	12	3	0.33	89	4.0
3	11	3	0.33	100	7.7
4	40	50	0.02	140	8.5



Attachment 2

Cross Section for Sta 1700 - 40' @ 0.0016

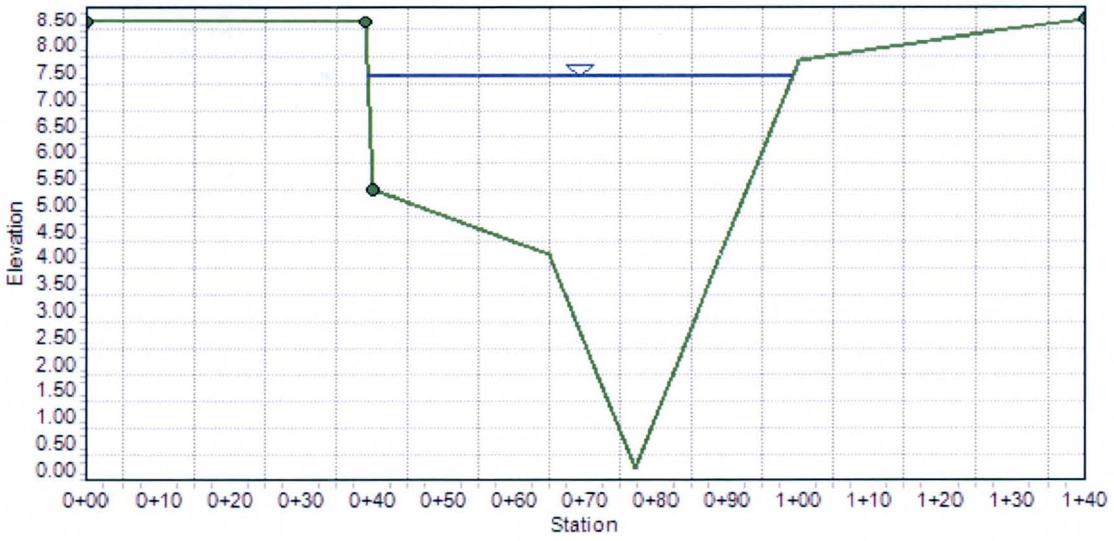
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00160	ft/ft
Normal Depth	7.40	ft
Discharge	745.42	ft^3/s

Cross Section Image



Worksheet for Sta 1700 - 40' @ 0.0016

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00160	ft/ft
Normal Depth	7.40	ft

Section Definitions

Station (ft)	Elevation (ft)
0+00	8.42
0+39	8.42
0+40	5.25
0+65	4.00
0+65	4.00
0+65	4.00
0+65	4.00
0+77	0.00
0+89	4.00
1+00	7.67
1+40	8.47

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 8.42)	(0+39, 8.42)	0.001
(0+39, 8.42)	(0+40, 5.25)	0.001
(0+40, 5.25)	(1+40, 8.47)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Worksheet for Sta 1700 - 40' @ 0.0016

Results

Discharge		745.42	ft^3/s
Elevation Range	0.00 to 8.47 ft		
Flow Area		216.85	ft^2
Wetted Perimeter		63.32	ft
Hydraulic Radius		3.42	ft
Top Width		59.87	ft
Normal Depth		7.40	ft
Critical Depth		5.27	ft
Critical Slope		0.01908	ft/ft
Velocity		3.44	ft/s
Velocity Head		0.18	ft
Specific Energy		7.58	ft
Froude Number		0.32	
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	7.40	ft
Critical Depth	5.27	ft
Channel Slope	0.00160	ft/ft
Critical Slope	0.01908	ft/ft

Cross Section for Sta 4500 - 50' @ 0.0027

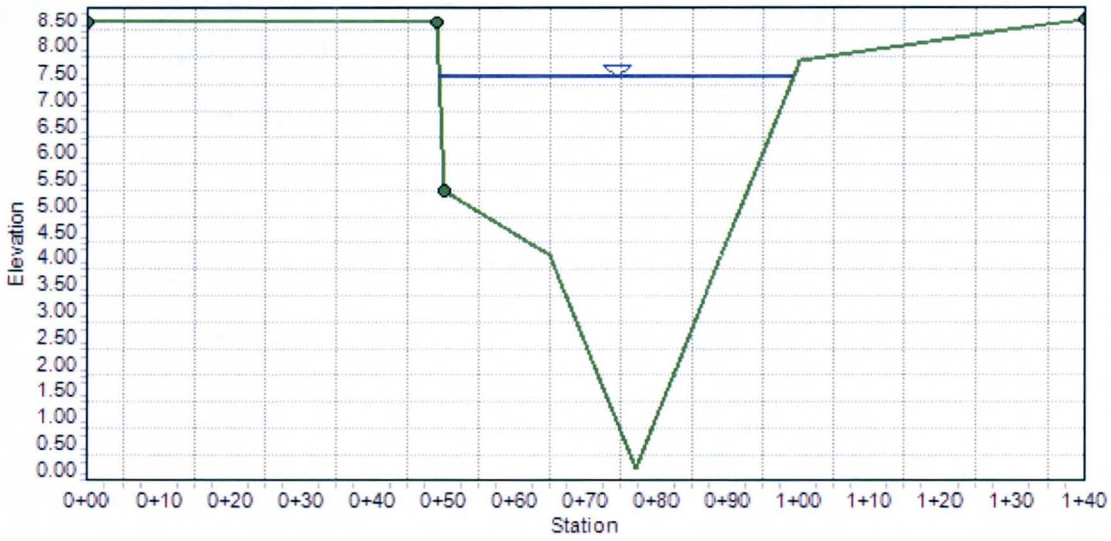
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00270	ft/ft
Normal Depth	7.40	ft
Discharge	867.33	ft^3/s

Cross Section Image



Worksheet for Sta 4500 - 50' @ 0.0027

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00270	ft/ft
Normal Depth	7.40	ft

Section Definitions

Station (ft)	Elevation (ft)
0+00	8.42
0+49	8.42
0+50	5.25
0+65	4.00
0+65	4.00
0+65	4.00
0+65	4.00
0+77	0.00
0+89	4.00
1+00	7.67
1+40	8.47

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 8.42)	(0+49, 8.42)	0.001
(0+49, 8.42)	(0+50, 5.25)	0.001
(0+50, 5.25)	(1+40, 8.47)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Worksheet for Sta 4500 - 50' @ 0.0027

Results

Discharge		867.33	ft^3/s
Elevation Range	0.00 to 8.47 ft		
Flow Area		189.13	ft^2
Wetted Perimeter		53.34	ft
Hydraulic Radius		3.55	ft
Top Width		49.87	ft
Normal Depth		7.40	ft
Critical Depth		5.50	ft
Critical Slope		0.01782	ft/ft
Velocity		4.59	ft/s
Velocity Head		0.33	ft
Specific Energy		7.72	ft
Froude Number		0.42	
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	7.40	ft
Critical Depth	5.50	ft
Channel Slope	0.00270	ft/ft
Critical Slope	0.01782	ft/ft

ZONE: Rittenhouse

Entellus
Project: East Mesa ADMPU
Project Number: FCD2011C017

Downstream of Grade Control / Drop Structure Rip-Rap Sizing

$D_{50\ [ft]} = 0.0372 * V_a^2 * (\gamma_w/[\gamma_s-\gamma_w])$

Alternative 1

Germann Rd

(2:1 Riprap Channel W/Dual Landscape Buffers)

(4' Drop Structures Required: Natural Slope = 0.0034)

	Coefficient	V	γ_w	γ_s	D_{50}
		[fps]	[lbs/ft^3]	[lbs/ft^3]	[in]
Meridian to Signal Butte	0.0372	6.28	62.3	150	12.5
Signal Butte to Crismon	0.0372	6.28	62.3	150	12.5
Crismon to Ellsworth	0.0372	6.28	62.3	150	12.5
Ellsworth to Rittenhouse	0.0372	5.1	62.3	150	8.2

Alternative 2

Ryan Rd (Riprap Channel)

(Riprap Channel w/SRP Easement)

(4' Drop Structures Required: Natural Slope = 0.003)

	Coefficient	V	γ_w	γ_s	D_{50}
		[fps]	[lbs/ft^3]	[lbs/ft^3]	[in]
Signal Butte to Ellsworth	0.0372	4.94	62.3	150	7.7
Ellsworth to Rittenhouse	0.0372	4.66	62.3	150	6.9

Alternative 3

Queen Creek Channel (Riprap Channel)

(2:1 Riprap Channel W/Dual Landscape Buffers)

(4' Drop Structures Required: Natural Slope = 0.0039)

Coefficient	V	γ_w	γ_s	D_{50}
	[fps]	[lbs/ft^3]	[lbs/ft^3]	[in]
0.0372	6.21	62.3	150	12.2

Alternative 4

Ryan Rd Channel

(Movable Bed Channel)

(4' Drop Structures Required: Natural Slope = 0.0039)

	Coefficient	V	γ_w	γ_s	D_{50}
		[fps]	[lbs/ft^3]	[lbs/ft^3]	[in]
Queen Creek: Meridian to Signal Butte	0.0372	4.31	62.3	150	5.9

ZONE: Rittenhouse

Sloped Drop Structure Rip-Rap Sizing

$$D_{50\ [ft]} = 1.413 * q^{0.529} * S_o^{0.794}$$

Entellus
Project: East Mesa ADMPU
Project Number: FCD2011C017

Alternative 1

Germann Rd

(2:1 Riprap Channel W/Dual Landscape Buffers)
(4' Drop Structures Required: Natural Slope = 0.0034)

	Coefficient	Discharge [cfs]	Wetted Area [ft^2]	Flow Depth [ft]	Width [ft]	Drop Slope [ft/ft]	q [cfs/ft]	D_{50} [in]
Meridian to Signal Butte	1.413	1380	220.0	5.5	40	0.1	34.5	17.7
Signal Butte to Crismon	1.413	1380	220.0	5.5	40	0.1	34.5	17.7
Crismon to Ellsworth	1.413	1380	220.0	5.5	40	0.1	34.5	17.7
Ellsworth to Rittenhouse	1.413	460	90.2	5.5	16.4	0.1	28.0	15.9

Alternative 2

Ryan Rd (Riprap Channel)

(Riprap Channel w/SRP Easement)
(4' Drop Structures Required: Natural Slope = 0.003)

	Coefficient	Discharge [cfs]	Wetted Area [ft^2]	Flow Depth [ft]	Width [ft]	Drop Slope [ft/ft]	q [cfs/ft]	D_{50} [in]
Signal Butte to Ellsworth	1.413	1380	279.4	5.5	50.8	0.1	27.2	15.6
Ellsworth to Rittenhouse	1.413	1380	295.9	5.5	53.8	0.1	25.7	15.2

Alternative 3

Queen Creek Channel (Riprap Channel)

(2:1 Riprap Channel W/Dual Landscape Buffers)
(4' Drop Structures Required: Natural Slope = 0.0039)

	Coefficient	Discharge [cfs]	Wetted Area [ft^2]	Flow Depth [ft]	Width [ft]	Drop Slope [ft/ft]	q [cfs/ft]	D_{50} [in]
	1.413	1380	222.5	5.4	41.2	0.1	33.5	17.5

Alternative 4

Ryan Rd Channel

(Movable Bed Channel)
(4' Drop Structures Required: Natural Slope = 0.0039)

	Coefficient	Discharge [cfs]	Wetted Area [ft^2]	Flow Depth [ft]	Width [ft]	Drop Slope [ft/ft]	q [cfs/ft]	D_{50} [in]
Queen Creek: Meridian to Signal Butte	1.413	1380	320.7	5.5	58.3	0.1	23.7	14.5

Aerial Photograph Source: FCDMC, 2012.
Note: Dimensions directions and locations are approximate.

file no: 3640cub0

EAST MESA
AREA DRAINAGE
MASTER PLAN UPDATE
FCD 2011C017

LEGEND

B-12 ⊕ Sample Location

NORTH

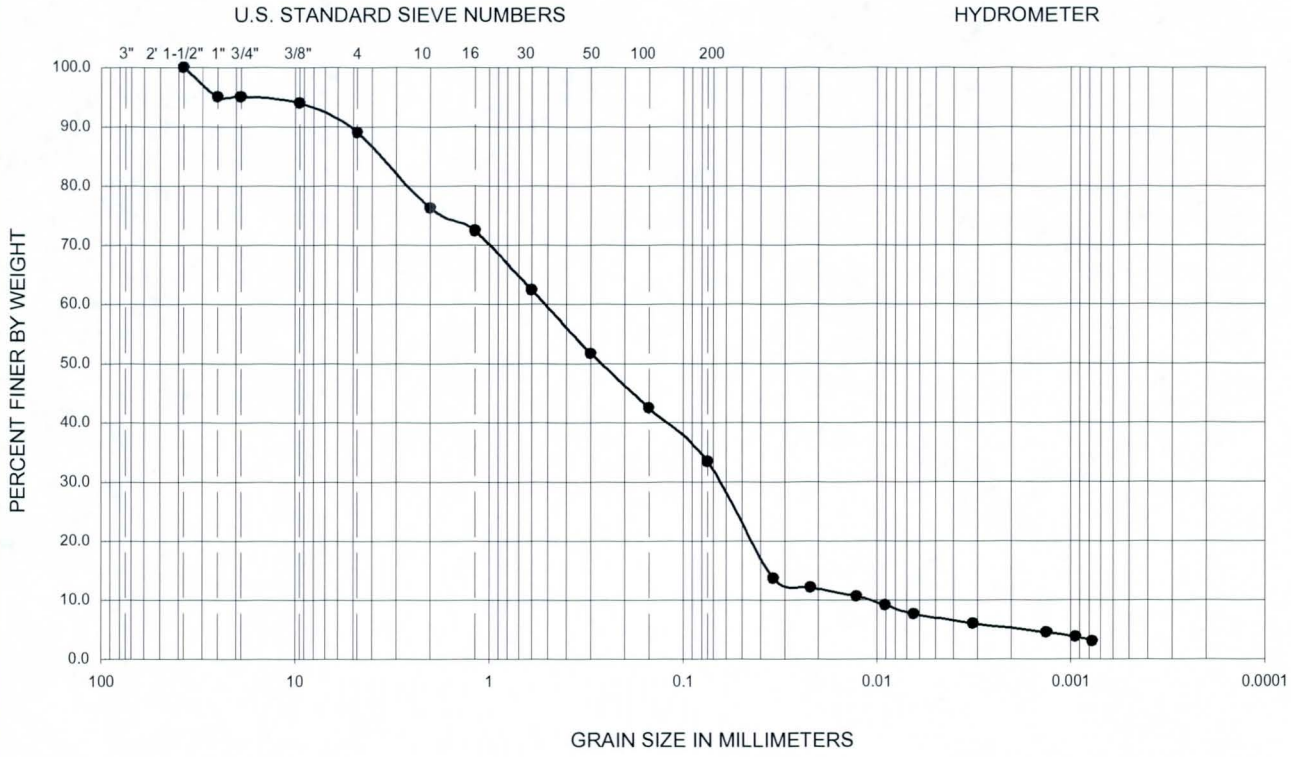
0 6000
Approximate Scale:

Entellus
2255 N. 44th Street Suite 125
Phoenix, Arizona 85008.3299
Tel. 602.244.2566
Fax. 602.244.8947
Web. www.entellus.com

epg · LTM Engineering Inc. · Ninyo & Moore · JE FULLER

SAMPLE LOCATIONS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

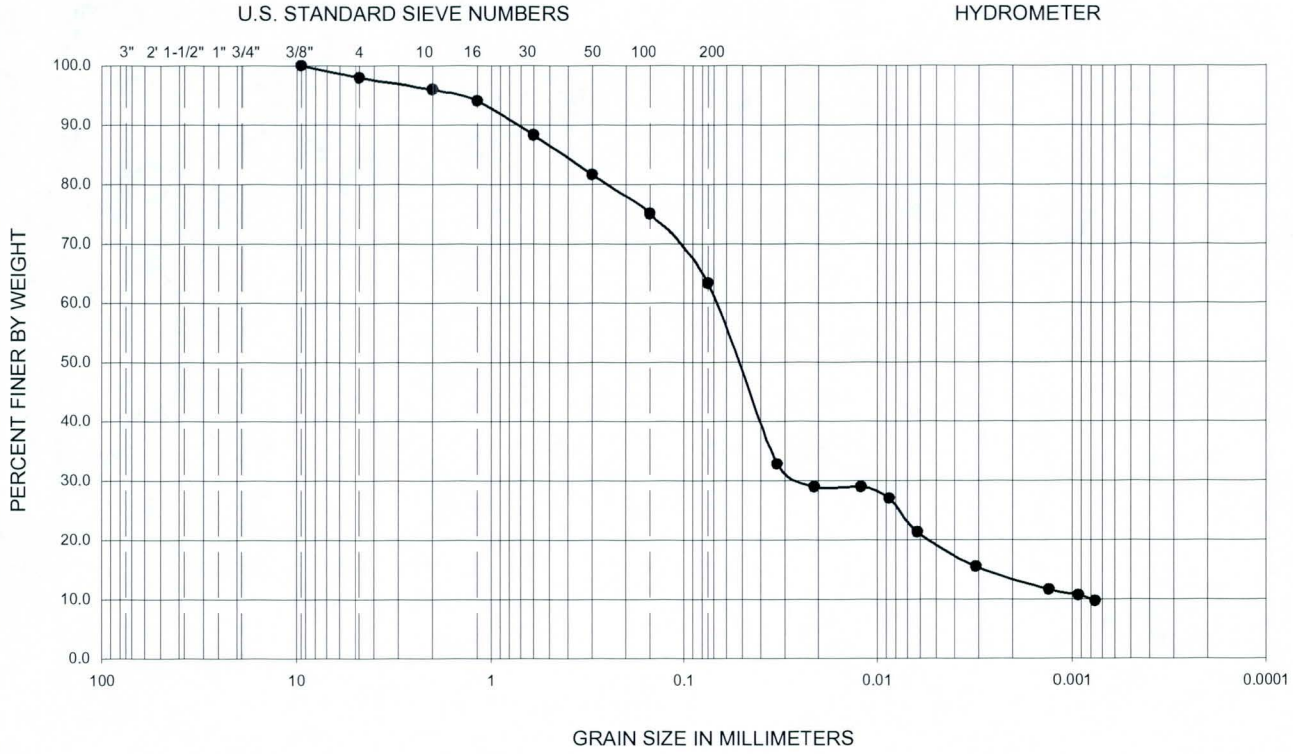


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{50}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-1	0-1.5	--	--	--	--	--	0.260	--	--	33	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	EAST MESA AREA DRAINAGE MASTER PLAN UPDATE MARICOPA AND PINAL COUNTIES, ARIZONA	A-1
603640001 / 7/12	CONTRACT FCD 2011C017; ENTELLUS PROJECT NO. 310.057; N&M TASK NO. 3.3.3.12	

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

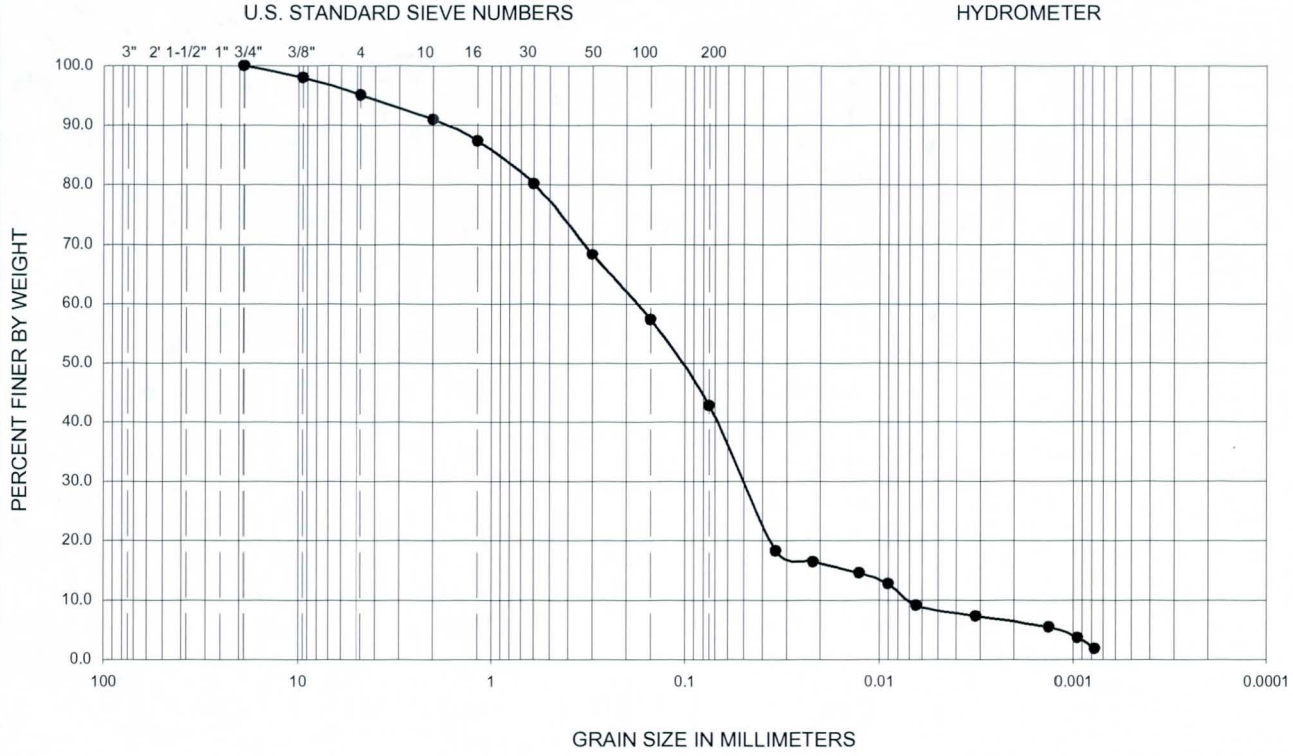


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{50}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-2	0-1	--	--	--	--	--	0.052	--	--	63	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	EAST MESA AREA DRAINAGE MASTER PLAN UPDATE MARICOPA AND PINAL COUNTIES, ARIZONA	A-2
603640001 / 7/12	CONTRACT FCD 2011C017; ENTELLUS PROJECT NO. 310.057; N&M TASK NO. 3.3.3.12	

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

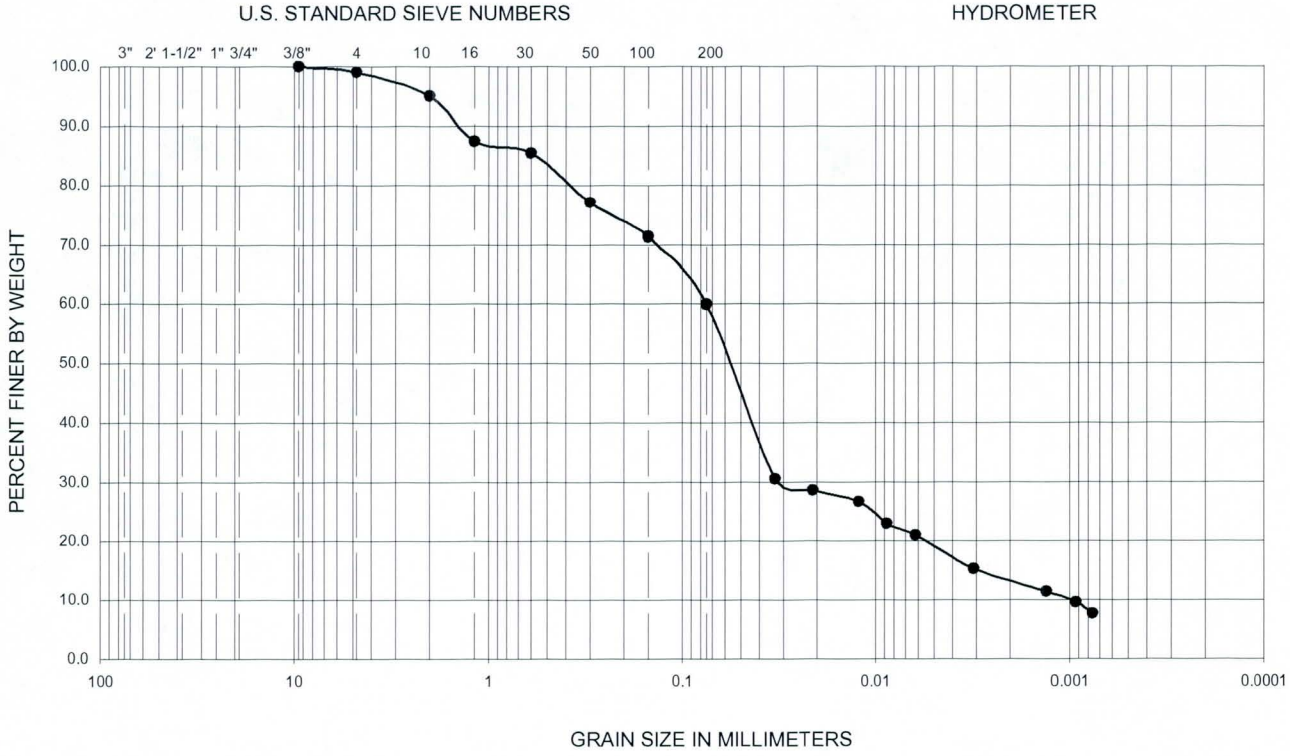


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{50}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-3	0-1	--	--	--	--	--	0.105	--	--	43	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	EAST MESA AREA DRAINAGE MASTER PLAN UPDATE MARICOPA AND PINAL COUNTIES, ARIZONA	A-3
603640001 / 7/12	CONTRACT FCD 2011C017; ENTELLUS PROJECT NO. 310.057; N&M TASK NO. 3.3.3.12	

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

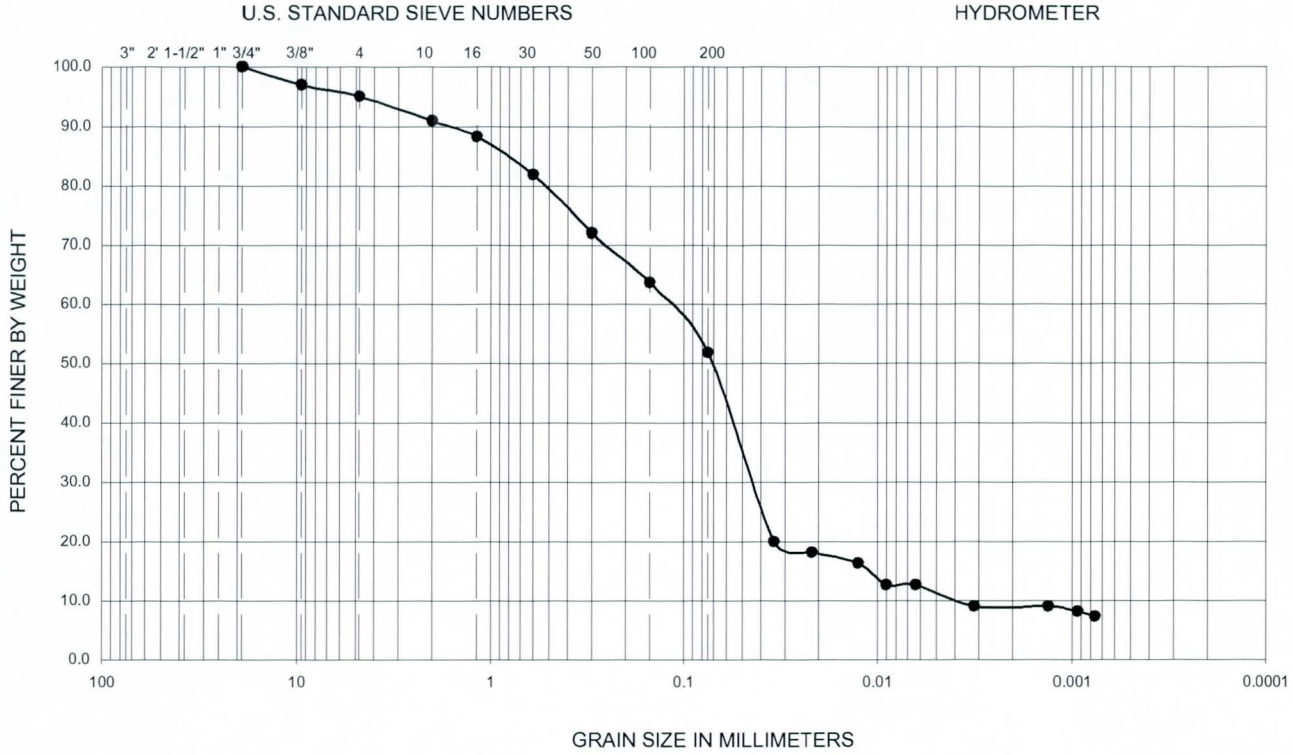


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{50}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-4	0-1	--	--	--	--	--	0.056	--	--	60	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	EAST MESA AREA DRAINAGE MASTER PLAN UPDATE MARICOPA AND PINAL COUNTIES, ARIZONA	A-4
603640001 / 7/12	CONTRACT FCD 2011C017; ENTELLUS PROJECT NO. 310.057; N&M TASK NO. 3.3.3.12	

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

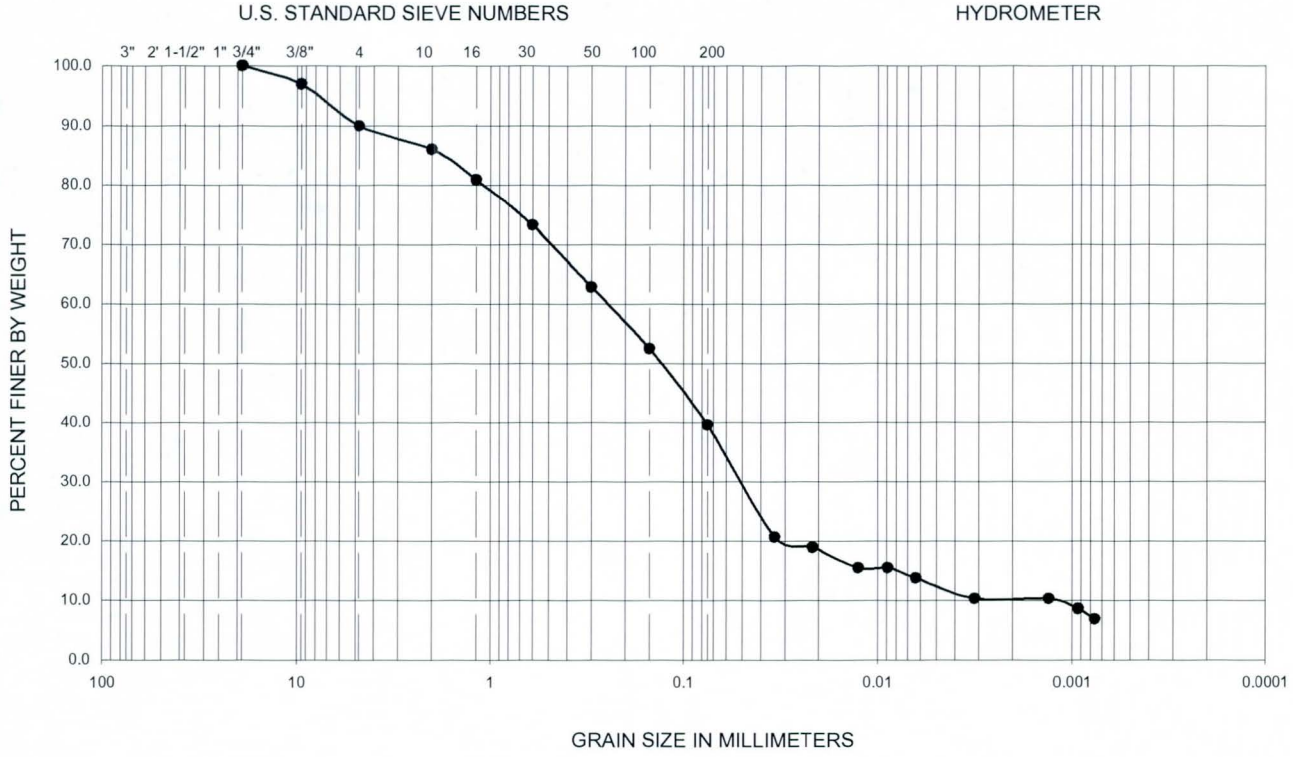


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{50}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-5	0-1	--	--	--	--	--	0.071	--	--	52	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	EAST MESA AREA DRAINAGE MASTER PLAN UPDATE MARICOPA AND PINAL COUNTIES, ARIZONA	A-5
603640001 / 7/12	CONTRACT FCD 2011C017; ENTELLUS PROJECT NO. 310.057; N&M TASK NO. 3.3.3.12	

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

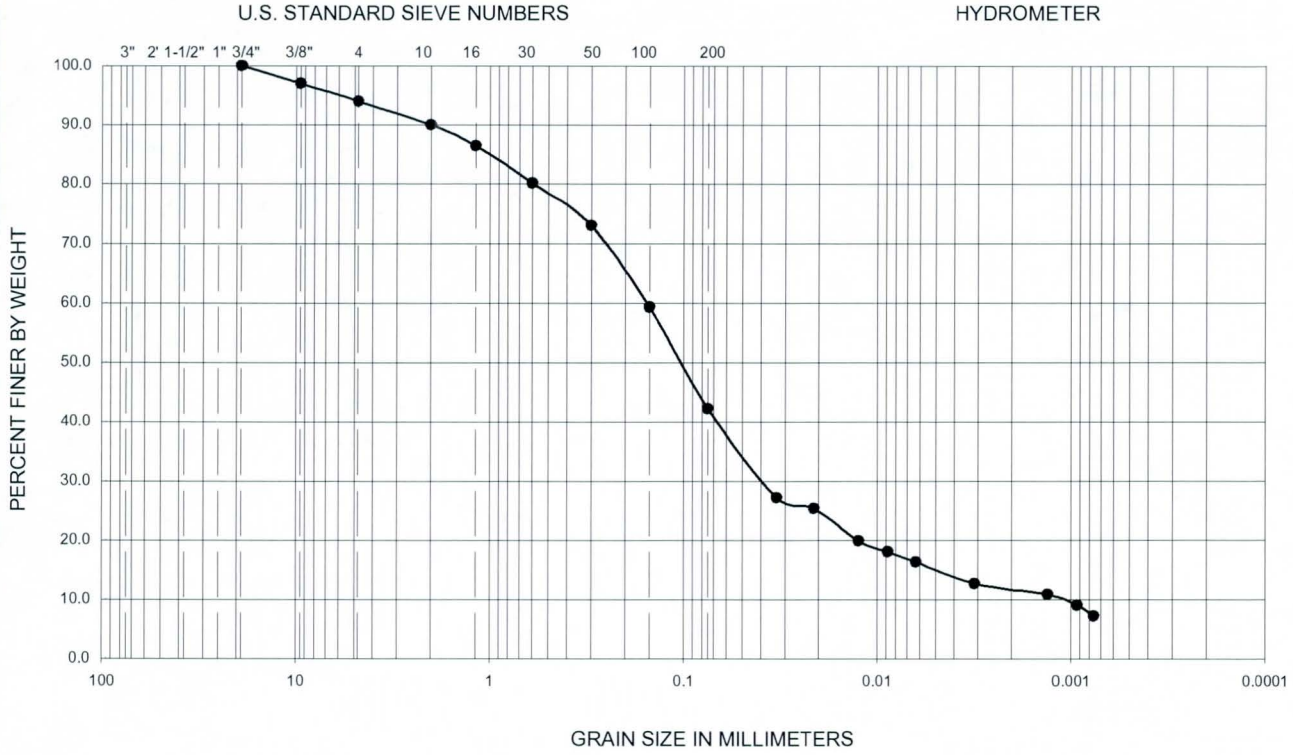


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{50}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-6	0-1	--	--	--	--	--	0.130	--	--	40	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	EAST MESA AREA DRAINAGE MASTER PLAN UPDATE MARICOPA AND PINAL COUNTIES, ARIZONA	A-6
603640001 / 7/12	CONTRACT FCD 2011C017; ENTELLUS PROJECT NO. 310.057; N&M TASK NO. 3.3.3.12	

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

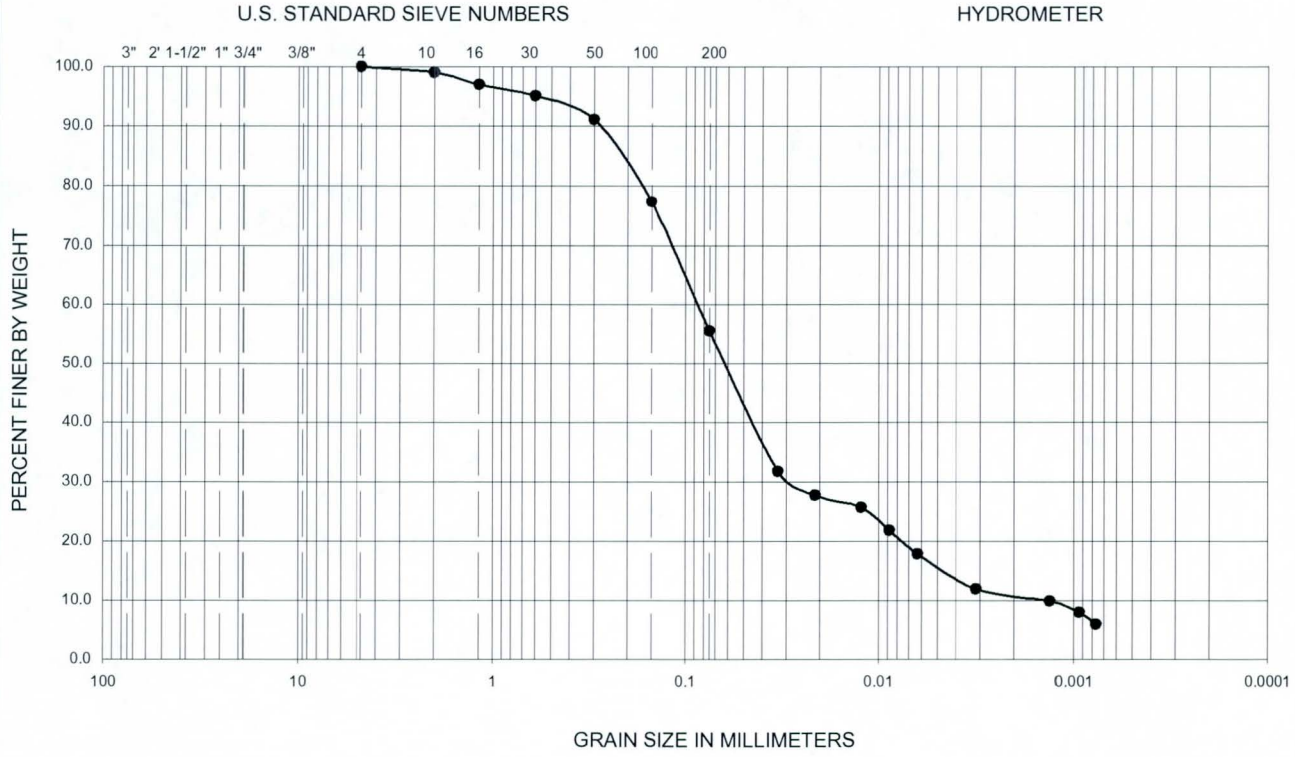


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{50}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-7	0-1	--	--	--	--	--	0.105	--	--	42	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	EAST MESA AREA DRAINAGE MASTER PLAN UPDATE MARICOPA AND PINAL COUNTIES, ARIZONA	A-7
603640001 / 7/12	CONTRACT FCD 2011C017; ENTELLUS PROJECT NO. 310.057; N&M TASK NO. 3.3.3.12	

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

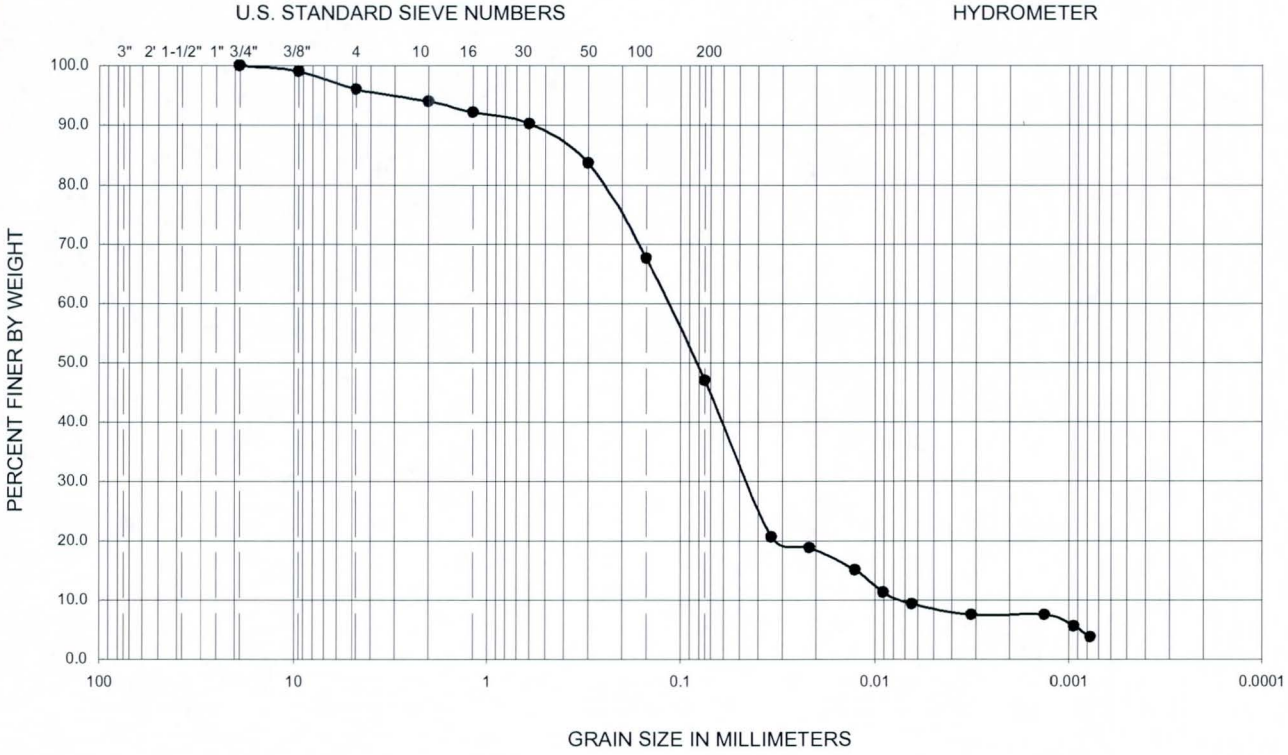


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{50}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-8	0-1	--	--	--	--	--	0.061	--	--	55	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	EAST MESA AREA DRAINAGE MASTER PLAN UPDATE MARICOPA AND PINAL COUNTIES, ARIZONA	A-8
603640001 / 7/12	CONTRACT FCD 2011C017; ENTELLUS PROJECT NO. 310.057; N&M TASK NO. 3.3.3.12	

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

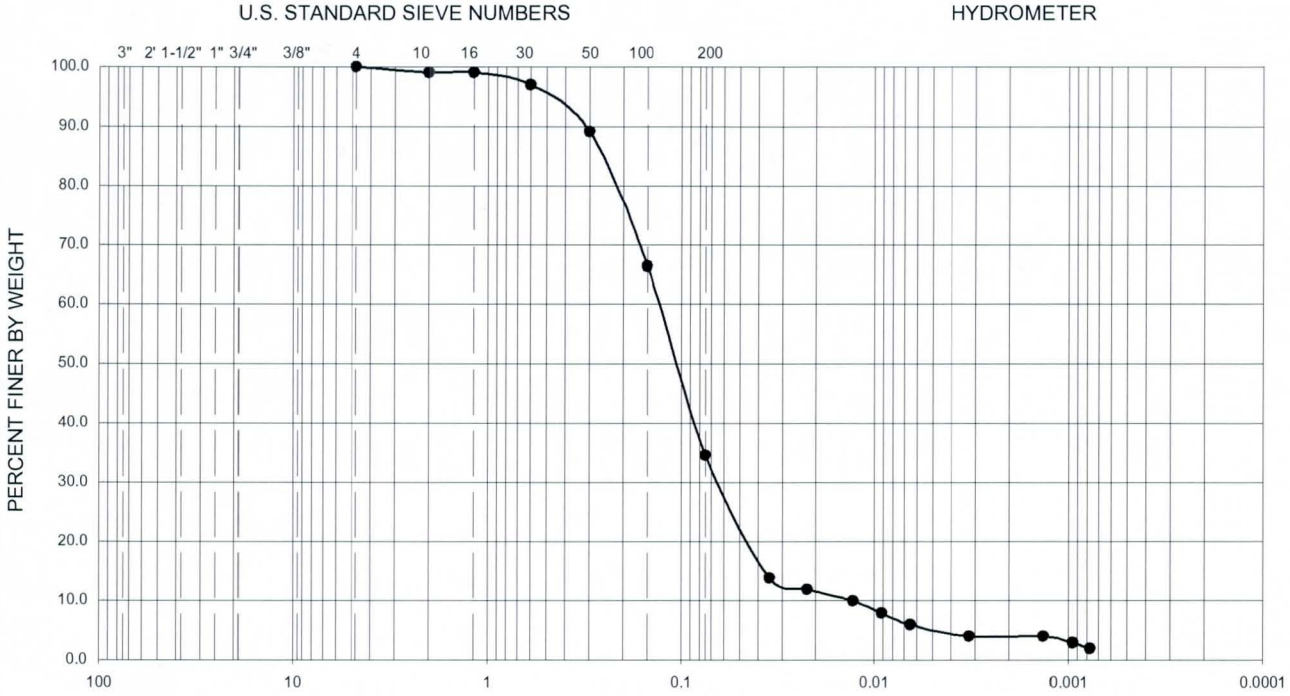


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{50}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-9	0.3-1.3	--	--	--	--	--	0.081	--	--	47	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	EAST MESA AREA DRAINAGE MASTER PLAN UPDATE MARICOPA AND PINAL COUNTIES, ARIZONA	A-9
603640001 / 7/12	CONTRACT FCD 2011C017; ENTELLUS PROJECT NO. 310.057; N&M TASK NO. 3.3.3.12	

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

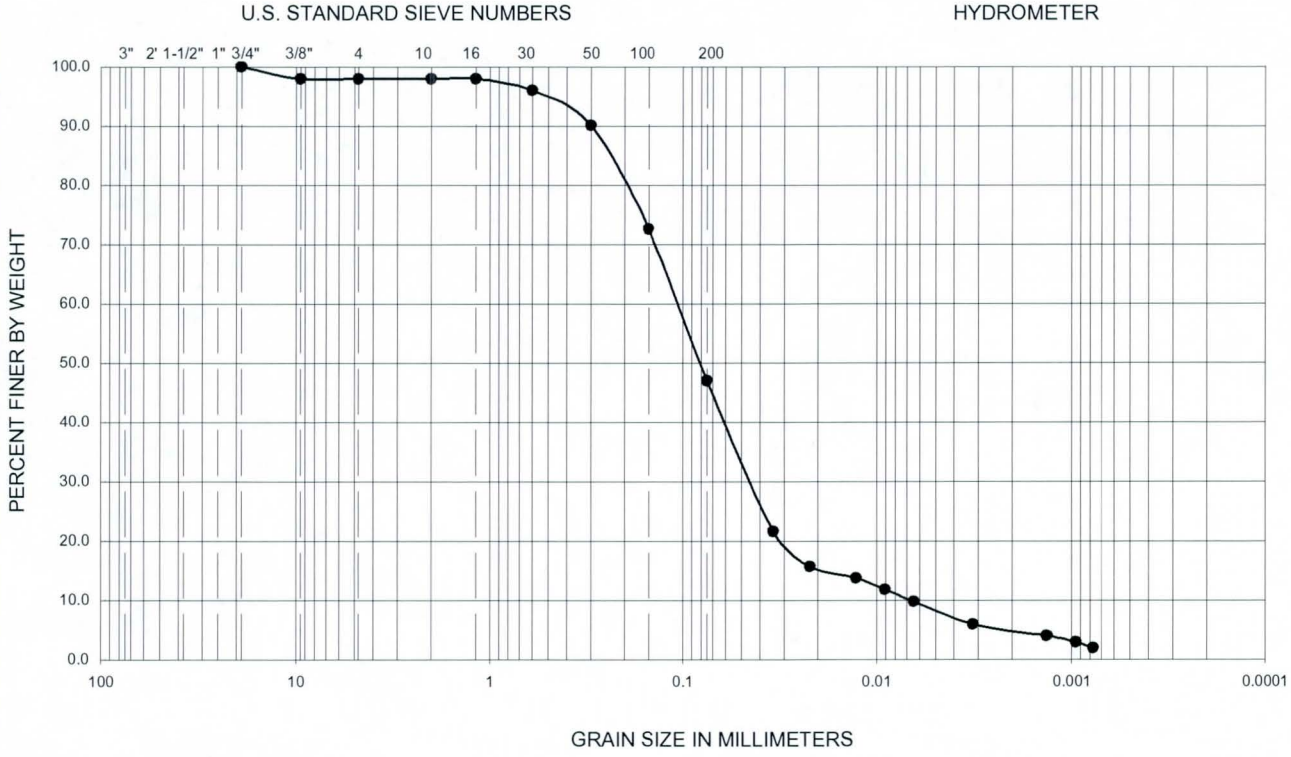


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{50}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-10	0-1	--	--	--	--	--	0.110	--	--	35	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	EAST MESA AREA DRAINAGE MASTER PLAN UPDATE MARICOPA AND PINAL COUNTIES, ARIZONA	A-10
603640001 / 7/12	CONTRACT FCD 2011C017; ENTELLUS PROJECT NO. 310.057; N&M TASK NO. 3.3.3.12	

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

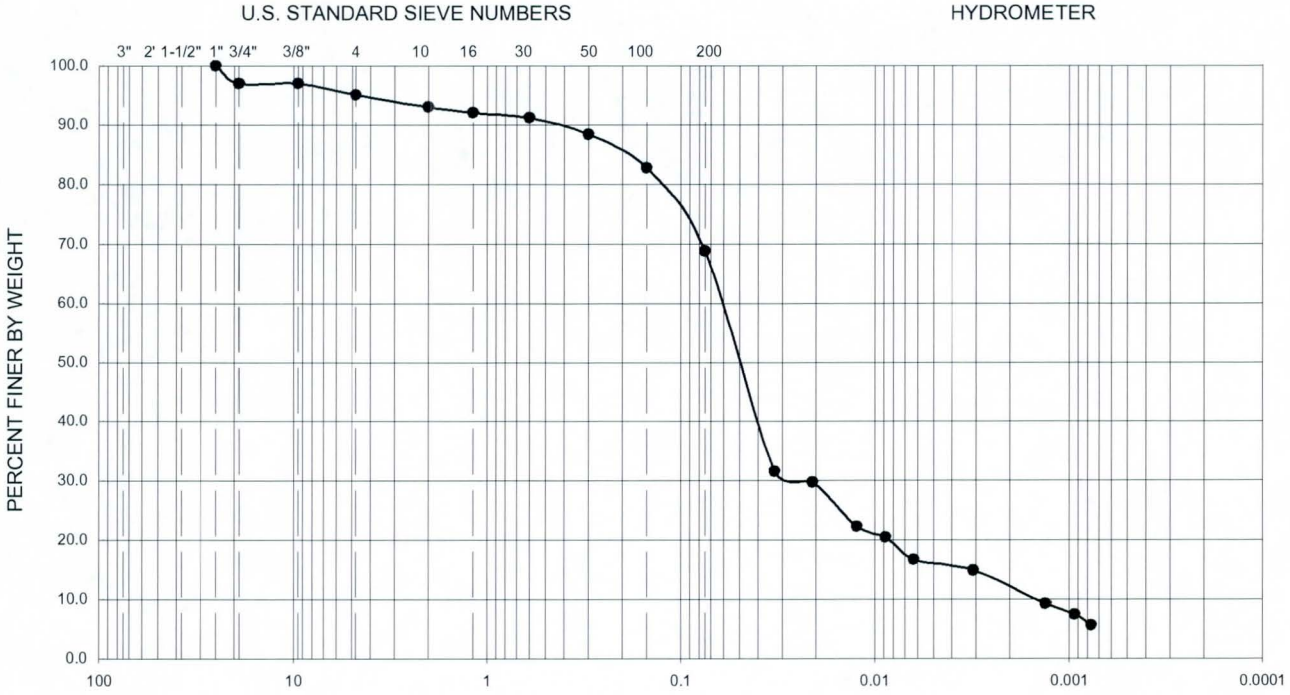


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{50}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-11	0-1	--	--	--	--	--	0.081	--	--	47	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore		GRADATION TEST RESULTS	FIGURE
PROJECT NO.	DATE	EAST MESA AREA DRAINAGE MASTER PLAN UPDATE MARICOPA AND PINAL COUNTIES, ARIZONA	A-11
603640001	7/12	CONTRACT FCD 2011C017; ENTELLUS PROJECT NO. 310.057; N&M TASK NO. 3.3.3.12	

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{50}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-12	0-1	--	--	--	--	--	0.050	--	--	69	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	EAST MESA AREA DRAINAGE MASTER PLAN UPDATE MARICOPA AND PINAL COUNTIES, ARIZONA	A-12
603640001 / 7/12	CONTRACT FCD 2011C017; ENTELLUS PROJECT NO. 310.057; N&M TASK NO. 3.3.3.12	

APPENDIX F. COST ESTIMATES DOCUMENTATION

SR-24 Zone

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
Alternative 1							
SR-24 Meridian Channel	$ 6,163,000	$ 120,000	$ 45,000	$ 499,000	$ 114,000	$ 1,388,000	$ 8,329,000
Modifications to Ellsworth Zone Meridian North Channel	$ (433,000)	$ (8,000)	$ -	$ (34,000)	$ (14,000)	$ (98,000)	$ (587,000)
Modifications to Ellsworth Zone Pecos Channel	$ (505,000)	$ (3,000)	$ -	$ (311,000)	$ -	$ (164,000)	$ (983,000)
SR-24 Interim Retention Basin	$ 1,668,000	$ -	$ -	$ 5,435,000	$ 258,000	$ 1,594,000	$ 8,955,000
Pecos & Ellsworth Interim Retention Basin	$ 851,000	$ -	$ -	$ 2,054,000	$ 98,000	$ 601,000	$ 3,604,000
Williams Field & Ellsworth Interim Retention Basin	$ 1,254,000	$ -	$ -	$ 4,329,000	$ 206,000	$ 1,158,000	$ 6,947,000
	$ 8,998,000	**$ 109,000**	**$ 45,000**	**$ 11,972,000**	**$ 662,000**	**$ 4,479,000**	**$ 26,265,000**
Alternative 2							
SR-24 Meridian Channel	$ 3,223,000	$ 132,000	$ 45,000	$ 497,000	$ 114,000	$ 802,000	$ 4,813,000
Modifications to Ellsworth Zone Meridian North Channel	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Modifications to Ellsworth Zone Pecos Channel	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Galveston Retention Basin	$ 437,000	$ 66,000	$ -	$ 648,000	$ 98,000	$ 250,000	$ 1,499,000
Pecos & Ellsworth Interim Retention Basin	$ 1,576,000	$ -	$ -	$ 3,602,000	$ 171,000	$ 1,070,000	$ 6,419,000
Williams Field & Ellsworth Interim Retention Basin	$ 1,254,000	$ -	$ -	$ 4,329,000	$ 206,000	$ 1,158,000	$ 6,947,000
	$ 6,490,000	**$ 198,000**	**$ 45,000**	**$ 9,076,000**	**$ 589,000**	**$ 3,280,000**	**$ 19,678,000**
Alternative 3							
Mountain System	$ 8,275,000	$ 5,000	$ 323,000	$ 144,000	$ 1,283,000	$ 2,006,000	$ 12,036,000
Williams Field Channel	$ 3,011,000	$ 147,000	$ 71,000	$ 2,061,000	$ 1,330,000	$ 1,324,000	$ 7,944,000
Modifications to Ellsworth Zone Meridian North Channel	$ (430,000)	$ 15,000	$ -	$ (32,000)	$ 24,000	$ (85,000)	$ (508,000)
Modifications to Ellsworth Zone Pecos Channel	$ (782,000)	$ (2,000)	$ -	$ (217,000)	$ -	$ (201,000)	$ (1,202,000)
Williams Field Retention Basin	$ 270,000	$ 39,000	$ -	$ 386,000	$ 59,000	$ 151,000	$ 905,000
Pecos & Ellsworth Interim Retention Basin	$ 1,093,000	$ -	$ -	$ 2,718,000	$ 129,000	$ 788,000	$ 4,728,000
Williams Field & Ellsworth Interim Retention Basin	$ 2,001,000	$ -	$ -	$ 6,525,000	$ 310,000	$ 1,767,000	$ 10,603,000
	$ 13,438,000	**$ 204,000**	**$ 394,000**	**$ 11,585,000**	**$ 3,135,000**	**$ 5,750,000**	**$ 34,506,000**

Ellsworth Zone

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
Alternative 1							
Meridian Channel North	$ 1,342,000	$ 62,000	$ 83,000	$ 224,000	$ 57,000	$ 354,000	$ 2,122,000
Meridian Channel South	$ 3,130,000	$ 161,000	$ 635,000	$ 2,498,000	$ 554,000	$ 1,396,000	$ 8,374,000
Pecos Channel	$ 11,164,000	$ 205,000	$ 616,000	$ 2,438,000	$ 1,283,000	$ 3,141,000	$ 18,847,000
Pecos/Meridian Retention Basin	$ 1,392,000	$ 121,000	$ -	$ 3,808,000	$ 181,000	$ 1,100,000	$ 6,602,000
	$ 17,028,000	**$ 549,000**	**$ 1,334,000**	**$ 8,968,000**	**$ 2,075,000**	**$ 5,991,000**	**$ 35,945,000**
Alternative 2							
Meridian Channel North	$ 1,342,000	$ 62,000	$ 83,000	$ 224,000	$ 57,000	$ 354,000	$ 2,122,000
Meridian Channel South	$ 3,130,000	$ 161,000	$ 635,000	$ 2,498,000	$ 554,000	$ 1,396,000	$ 8,374,000
Pecos Channel	$ 11,273,000	$ 209,000	$ 222,000	$ 2,957,000	$ 1,330,000	$ 3,198,000	$ 19,189,000
Pecos/Meridian Retention Basin	$ 1,392,000	$ 121,000	$ -	$ 3,808,000	$ 181,000	$ 1,100,000	$ 6,602,000
	$ 17,137,000	**$ 553,000**	**$ 940,000**	**$ 9,487,000**	**$ 2,122,000**	**$ 6,048,000**	**$ 36,287,000**
Alternative 3							
Meridian Channel North	$ 1,342,000	$ 62,000	$ 83,000	$ 224,000	$ 57,000	$ 354,000	$ 2,122,000
Meridian Channel South	$ 3,130,000	$ 161,000	$ 635,000	$ 2,498,000	$ 554,000	$ 1,396,000	$ 8,374,000
Pecos Channel	$ 12,935,000	$ 209,000	$ 854,000	$ 1,750,000	$ 1,330,000	$ 3,416,000	$ 20,494,000
Pecos/Meridian Retention Basin	$ 1,392,000	$ 121,000	$ -	$ 3,808,000	$ 181,000	$ 1,100,000	$ 6,602,000
	$ 18,799,000	**$ 553,000**	**$ 1,572,000**	**$ 8,280,000**	**$ 2,122,000**	**$ 6,266,000**	**$ 37,592,000**

Rittenhouse Zone

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
Alternative 1							
Germann Channel	$ 15,952,000	$ 177,000	$ 1,767,000	$ 3,676,000	$ 2,280,000	$ 4,770,000	$ 28,622,000
Meridian Channel (to Germann)	$ 2,130,000	$ 142,000	$ 1,090,000	$ 1,077,000	$ 140,000	$ 916,000	$ 5,495,000
Queen Creek Channel	$ 1,060,000	$ 27,000	$ 45,000	$ 416,000	$ 238,000	$ 357,000	$ 2,143,000
Queen Creek & Crismon Retention Basin	$ 104,000	$ 23,000	$ -	$ 117,000	$ 34,000	$ 56,000	$ 334,000
Germann & Ellsworth Retention Basin	$ 1,254,000	$ 200,000	$ -	$ 1,040,000	$ 300,000	$ 559,000	$ 3,353,000
	$ 20,500,000	**$ 569,000**	**$ 2,902,000**	**$ 6,326,000**	**$ 2,992,000**	**$ 6,658,000**	**$ 39,947,000**
Alternative 2							
Ryan Channel	$ 15,446,000	$ 491,000	$ 139,000	$ 3,099,000	$ 2,233,000	$ 4,282,000	$ 25,690,000
Queen Creek Channel	$ 1,060,000	$ 27,000	$ 45,000	$ 416,000	$ 238,000	$ 357,000	$ 2,143,000
Meridian Channel (to Germann)	$ 453,000	$ 73,000	$ 370,000	$ 607,000	$ 62,000	$ 313,000	$ 1,878,000
Queen Creek & Crismon Retention Basin	$ 104,000	$ 23,000	$ -	$ 117,000	$ 34,000	$ 56,000	$ 334,000
Ryan & Rittenhouse Retention Basin	$ 1,271,000	$ 150,000	$ -	$ 780,000	$ 225,000	$ 485,000	$ 2,911,000
	$ 18,334,000	**$ 764,000**	**$ 554,000**	**$ 5,019,000**	**$ 2,792,000**	**$ 5,493,000**	**$ 32,956,000**
Alternative 3							
Germann Channel	$ 8,669,000	$ 138,000	$ 1,185,000	$ 1,785,000	$ 2,138,000	$ 2,783,000	$ 16,698,000
Queen Creek Channel	$ 6,427,000	$ 126,000	$ 94,000	$ 2,825,000	$ 950,000	$ 2,084,000	$ 12,506,000
Meridian Channel (to Germann)	$ 453,000	$ 73,000	$ 370,000	$ 607,000	$ 62,000	$ 313,000	$ 1,878,000
Queen Creek & Crismon Retention Basin	$ 972,000	$ 130,000	$ -	$ 1,287,000	$ 195,000	$ 517,000	$ 3,101,000
	$ 16,521,000	**$ 467,000**	**$ 1,649,000**	**$ 6,504,000**	**$ 3,345,000**	**$ 5,697,000**	**$ 34,183,000**
Alternative 4							
Meridian to Signal Butte	$ 3,265,000	$ 131,000	$ 61,000	$ 1,139,000	$ 167,000	$ 952,000	$ 5,715,000
Queen Creek to Ryan	$ 1,806,000	$ 597,000	$ 158,000	$ 916,000	$ 9,278,000	$ 2,551,000	$ 15,306,000
Signal Butte to 122nd St	$ 2,384,000	$ 771,000	$ 33,000	$ 1,176,000	$ 11,207,000	$ 3,114,000	$ 18,685,000
122nd St to Ellsworth	$ 605,000	$ 275,000	$ -	$ 347,000	$ 3,817,000	$ 1,008,000	$ 6,052,000
Ellsworth to Rittenhouse	$ 2,467,000	$ 333,000	$ 41,000	$ 384,000	$ 7,363,000	$ 2,118,000	$ 12,706,000
Queen Creek	$ 1,060,000	$ 27,000	$ 45,000	$ 416,000	$ 238,000	$ 358,000	$ 2,144,000
Meridian Channel (to Germann)	$ 453,000	$ 73,000	$ 370,000	$ 607,000	$ 62,000	$ 313,000	$ 1,724,000
Queen Creek & Crismon Retention Basin	$ 104,000	$ 23,000	$ -	$ 117,000	$ 34,000	$ 56,000	$ 334,000
Signal Butte Retention Basin	$ 167,000	$ 126,000	$ -	$ 223,000	$ 3,690,000	$ 841,000	$ 5,047,000
Ryan & Ellsworth Retention Basin	$ 937,000	$ 711,000	$ -	$ 1,262,000	$ 20,910,000	$ 4,764,000	$ 28,584,000
	$ 13,248,000	**$ 3,067,000**	**$ 708,000**	**$ 6,587,000**	**$ 56,766,000**	**$ 16,075,000**	**$ 96,451,000**
Alternative 5							
Merrill Channel	$ 628,000	$ 1,000	$ 14,000	$ 149,000	$ 143,000	$ 187,000	$ 1,122,000
Queen Creek Channel	$ 784,000	$ 1,000	$ 918,000	$ 241,000	$ 285,000	$ 446,000	$ 2,675,000
Meridian Channel (to Germann)	$ 271,000	$ 48,000	$ 200,000	$ 179,000	$ 63,000	$ 152,000	$ 913,000
Signal Butte Retention Basin	$ 1,327,000	$ 837,000	$ -	$ 1,485,000	$ 492,000	$ 828,000	$ 4,969,000
	$ 3,010,000	**$ 887,000**	**$ 1,132,000**	**$ 2,054,000**	**$ 983,000**	**$ 1,613,000**	**$ 9,679,000**

SR-24 Zone - Alternative 1

SR-24 Meridian Channel - Alternative 1

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	95,591	$ 5.00	$ 478,000
Cut-off-Walls (6" Riprap)	CF	71,044	$ 2.41	$ 171,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Liner Subtotal				***NA***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	150	$ 1,845	$ 277,000
5'x8' Culvert (Quadruple)	FT	1,550	$ 2,375	$ 3,681,000
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	150	$ 2,540	$ 381,000
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	1	$ 118,000	$ 118,000
5'x8' Headwall & Transition (Quadruple)	EA	1	$ 126,000	$ 126,000
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	1	$ 127,000	$ 127,000
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 4,710,000***
Design and Inspection 15%				$ 804,000
Construction Subtotal				***$ 6,163,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	15.2	$ 4,500	$ 68,000
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	1.2	$ 6,100	$ 7,000
Landscaped Swale	AC	1.2	$ 13,400	$ 16,000
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	8,229	$ 3.52	$ 29,000
Landscaping Subtotal				***$ 120,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	3,000	$ 15	$ 45,000
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	NA	$ 100	NA
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 45,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	19	$ 26,000	$ 499,000
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
Land Acquisition Subtotal				***$ 499,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	15.2	$ 150	$ 114,000
Hardened Channel	MI/YEAR	NA	$ 9,500	NA
Maintenance Subtotal				***$ 114,000***

SR-24 Meridian Channel Subtotal				***$ 6,941,000***
Contingency 20%				$ 1,388,000
SR-24 Meridian Channel Total				***$ 8,329,000***

Meridian North Channel - Alternative 1

		Base Channel Costs (Ellsworth Alt. 1)			Channel Costs with Zone SR-24 Alternative 1			
Construction	**UM**	**Quantity**	**Unit Cost**	**Budgetary Cost**	**Quantity**	**Unit Cost**	**Budgetary Cost**	**Cost Difference**
Excavation[1]	CY	44,049	$ 5.00	$ 220,000	30,075	$ 5.00	$ 150,000	$ (70,000)
Cut-off-Walls (6" Riprap)	CF	41,922	$ 2.41	$ 101,000	34,694	$ 2.41	$ 84,000	$ (17,000)
Liner								
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA	NA	$ 13.54	NA	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA	NA	$ 16.25	NA	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA	NA	$ 18.96	NA	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA	NA	$ 21.67	NA	NA
Liner Subtotal				***NA***			***NA***	***NA***
Culverts								
5'x8' Culvert (Single)	FT	NA	$ 760	NA	NA	$ 760	NA	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA	250	$ 1,335	$ 334,000	$ 334,000
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA	NA	$ 1,845	NA	NA
5'x8' Culvert (Quadruple)	FT	250	$ 2,375	$ 594,000	NA	$ 2,375	NA	$ (594,000)
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA	NA	$ 2,910	NA	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA	NA	$ 3,470	NA	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA	NA	$ 1,020	NA	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA	NA	$ 1,805	NA	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA	NA	$ 2,540	NA	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA	NA	$ 3,215	NA	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA	NA	$ 4,000	NA	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA	NA	$ 4,735	NA	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA	NA	$ 103,000	NA	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA	2	$ 111,000	$ 222,000	$ 222,000
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA	NA	$ 118,000	NA	NA
5'x8' Headwall & Transition (Quadruple)	EA	2	$ 126,000	$ 252,000	NA	$ 126,000	NA	$ (252,000)
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA	NA	$ 133,000	NA	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA	NA	$ 142,000	NA	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA	NA	$ 108,000	NA	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA	NA	$ 118,000	NA	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA	NA	$ 127,000	NA	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA	NA	$ 137,000	NA	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA	NA	$ 146,000	NA	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA	NA	$ 155,000	NA	NA
Culverts Subtotal				***$ 846,000***			***$ 556,000***	***$ (290,000)***
Design and Inspection 15%				$ 175,000			$ 119,000	$ (56,000)
Construction Subtotal				***$ 1,342,000***			***$ 909,000***	***$ (433,000)***

		Base Channel Costs (Ellsworth Alt. 1)			Channel Costs with Zone SR-24 Alternative 1			
Landscaping	**UM**	**Quantity**	**Unit Cost**	**Budgetary Cost**	**Quantity**	**Unit Cost**	**Budgetary Cost**	**Cost Difference**
Movable Bed Channel	AC	7.7	$ 4,500	$ 34,000	5.7	$ 4,500	$ 26,000	$ (8,000)
Riprap Channel Bottom	AC	NA	$ 1,500	NA	NA	$ 1,500	NA	NA
Landscaped Setback	AC	0.6	$ 6,100	$ 4,000	0.6	$ 6,100	$ 4,000	$ -
Landscaped Swale	AC	0.6	$ 13,400	$ 9,000	0.6	$ 13,400	$ 9,000	$ -
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA	NA	$ 6,100	NA	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA	NA	$ 6,100	NA	NA
O&M Road	SY	4,324	$ 3.52	$ 15,000	4,324	$ 3.52	$ 15,000	$ -
Landscaping Subtotal				***$ 62,000***			***$ 54,000***	$ (8,000)

		Base Channel Costs (Ellsworth Alt. 1)			Channel Costs with Zone SR-24 Alternative 1			
Utility Relocation	**UM**	**Quantity**	**Unit Cost**	**Budgetary Cost**	**Quantity**	**Unit Cost**	**Budgetary Cost**	**Cost Difference**
Distribution OHE Relocation	FT	1,500	$ 15	$ 23,000	1,500	$ 15	$ 23,000	$ -
69kV OHE Relocation	FT	NA	$ 185	NA	NA	$ 185	NA	NA
8" Water Line Relocation	FT	NA	$ 125	NA	NA	$ 125	NA	NA
12" Water Line Relocation	FT	NA	$ 175	NA	NA	$ 175	NA	NA
16" Water Line Relocation	FT	200	$ 300	$ 60,000	200	$ 300	$ 60,000	$ -
Water Service Line	EA	NA	$ 10,500	NA	NA	$ 10,500	NA	NA
Irrigation Relocation	FT	NA	$ 100	NA	NA	$ 100	NA	NA
2" Gas Line Relocation	FT	NA	$ 100	NA	NA	$ 100	NA	NA
4" Gas Line Relocation	FT	NA	$ 120	NA	NA	$ 120	NA	NA
Fiber Optics Relocation	FT	NA	$ 10	NA	NA	$ 10	NA	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA	NA	$ 2,500	NA	NA
Drop Structure	EA	NA	$ -	NA	NA	$ -	NA	NA
Existing Fence Relocation	FT	NA	$ 20	NA	NA	$ 20	NA	NA
Sewer Service Line	EA	NA	$ 24,000	NA	NA	$ 24,000	NA	NA
Sewer Line Relocation	FT	NA	$ -	NA	NA	$ -	NA	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA	NA	$ 40,000	NA	NA
Utility Relocation Subtotal				***$ 83,000***			***$ 83,000***	$ -

		Base Channel Costs (Ellsworth Alt. 1)			Channel Costs with Zone SR-24 Alternative 1			
Land Acquisition	**UM**	**Quantity**	**Unit Cost**	**Budgetary Cost**	**Quantity**	**Unit Cost**	**Budgetary Cost**	**Cost Difference**
Vacant Held for Investment	AC	9	$ 26,000	$ 224,000	7	$ 26,000	$ 190,000	$ (34,000)
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA	NA	$ 49,500	NA	NA
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA	NA	$ 158,000	NA	NA
Residential Home	AC	NA	$ 130,000	NA	NA	$ 130,000	NA	NA
Land Acquisition Subtotal				***$ 224,000***			***$ 190,000***	***$ (34,000)***

		Base Channel Costs (Ellsworth Alt. 1)			Channel Costs with Zone SR-24 Alternative 1			
Maintenance	**UM**	**Quantity**	**Unit Cost**	**Budgetary Cost[2]**	**Quantity**	**Unit Cost**	**Budgetary Cost[2]**	**Cost Difference**
Movable Bed Channel	AC/YEAR	7.7	$ 150	$ 57,000	5.7	$ 150	$ 43,000	$ (14,000)
Hardened Channel	MI/YEAR	NA	$ 9,500	NA	NA	$ 9,500	NA	NA
Maintenance Subtotal				***$ 57,000***			***$ 43,000***	***$ (14,000)***

	Base Channel Costs (Ellsworth Alt. 1)	Channel Costs with Zone SR-24 Alternative 1	Cost Difference
Meridian North Channel Subtotal	***$ 1,768,000***	***$ 1,279,000***	$ (489,000)
Contingency 20%	$ 354,000	$ 256,000	$ (98,000)
Meridian North Channel Total	***$ 2,122,000***	***$ 1,535,000***	***$ (587,000)***

Pecos Channel - Alternative 1

Construction	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 1 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Excavation[1]	CY	333,106	$ 5.00	$ 1,666,000	307,727	$ 5.00	$ 1,539,000	$ (127,000)
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA	NA	$ 2.41	NA	NA
Liner								
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA	NA	$ 13.54	NA	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA	NA	$ 16.25	NA	NA
Riprap d_{50} = 7"	SY	201,733	$ 18.96	$ 3,825,000	196,578	$ 18.96	$ 3,727,000	$ (98,000)
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA	NA	$ 21.67	NA	NA
Liner Subtotal				***$ 3,825,000***			***$ 3,727,000***	***NA***
Culverts								
5'x8' Culvert (Single)	FT	NA	$ 760	NA	NA	$ 760	NA	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA	NA	$ 1,335	NA	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA	NA	$ 1,845	NA	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA	NA	$ 2,375	NA	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA	NA	$ 2,910	NA	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA	NA	$ 3,470	NA	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA	NA	$ 1,020	NA	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA	NA	$ 1,805	NA	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA	NA	$ 2,540	NA	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA	205	$ 3,215	$ 659,000	$ 659,000
6'x10' Culvert (Five)	FT	160	$ 4,000	$ 640,000	430	$ 4,000	$ 1,720,000	$ 1,080,000
6'x10' Culvert (Six)	FT	530	$ 4,735	$ 2,510,000	100	$ 4,735	$ 474,000	$ (2,036,000)
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA	NA	$ 103,000	NA	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA	NA	$ 111,000	NA	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA	NA	$ 118,000	NA	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA	NA	$ 126,000	NA	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA	NA	$ 133,000	NA	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA	NA	$ 142,000	NA	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA	NA	$ 108,000	NA	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA	NA	$ 118,000	NA	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA	NA	$ 127,000	NA	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA	3	$ 137,000	$ 411,000	$ 411,000
6'x10' Headwall & Transition (Five)	EA	2	$ 146,000	$ 292,000	4	$ 146,000	$ 584,000	$ 292,000
6'x10' Headwall & Transition (Six)	EA	5	$ 155,000	$ 775,000	1	$ 155,000	$ 155,000	$ (620,000)
Culverts Subtotal				***$ 4,217,000***			***$ 4,003,000***	***$ (214,000)***
Design and Inspection 15%				$ 1,456,000			$ 1,390,000	$ (66,000)
Construction Subtotal				***$ 11,164,000***			***$ 10,659,000***	***$ (505,000)***

Landscaping	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 1 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Movable Bed Channel	AC	NA	$ 4,500	NA	NA	$ 4,500	NA	NA
Riprap Channel Bottom	AC	14.2	$ 1,500	$ 21,000	12.0	$ 1,500	$ 18,000	$ (3,000)
Landscaped Setback	AC	NA	$ 6,100	NA	NA	$ 6,100	NA	NA
Landscaped Swale	AC	NA	$ 13,400	NA	NA	$ 13,400	NA	NA
Landscaped Low Flow Channel	AC	19.9	$ 6,100	$ 122,000	19.9	$ 6,100	$ 122,000	$ -
Landscaped Buffer Zone	AC	NA	$ 6,100	NA	NA	$ 6,100	NA	NA
O&M Road	SY	22,524	$ 3.52	$ 79,000	22,524	$ 3.52	$ 79,000	$ -
Landscaping Subtotal				***$ 222,000***			***$ 219,000***	$ (3,000)

Utility Relocation	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 1 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Distribution OHE Relocation	FT	NA	$ 15	NA	NA	$ 15	NA	NA
69kV OHE Relocation	FT	NA	$ 185	NA	NA	$ 185	NA	NA
8" Water Line Relocation	FT	NA	$ 125	NA	NA	$ 125	NA	NA
12" Water Line Relocation	FT	NA	$ 175	NA	NA	$ 175	NA	NA
16" Water Line Relocation	FT	200	$ 300	$ 60,000	200	$ 300	$ 60,000	$ -
Water Service Line	EA	4	$ 10,500	$ 42,000	4	$ 10,500	$ 42,000	$ -
Irrigation Relocation	FT	300	$ 100	$ 30,000	300	$ 100	$ 30,000	$ -
2" Gas Line Relocation	FT	NA	$ 100	NA	NA	$ 100	NA	NA
4" Gas Line Relocation	FT	200	$ 120	$ 24,000	200	$ 120	$ 24,000	$ -
Fiber Optics Relocation	FT	NA	$ 10	NA	NA	$ 10	NA	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA	NA	$ 2,500	NA	NA
Drop Structure	EA	NA	$ -	NA	NA	$ -	NA	NA
Existing Fence Relocation	FT	5,000	$ 20	$ 100,000	5,000	$ 20	$ 100,000	$ -
Sewer Service Line	EA	15	$ 24,000	$ 360,000	15	$ 24,000	$ 360,000	$ -
Sewer Line Relocation (No Conflict: Channel not deep enough)	FT	250	$ -	$ -	250	$ -	$ -	$ -
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA	NA	$ 40,000	NA	NA
Utility Relocation Subtotal				***$ 616,000***			***$ 616,000***	$ -

Land Acquisition	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 1 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Vacant Held for Investment	AC	34	$ 26,000	$ 884,000	33	$ 26,000	$ 850,000	$ (34,000)
Residential Lots 1-5 acres	AC	31	$ 49,500	$ 1,554,000	26	$ 49,500	$ 1,277,000	$ (277,000)
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA	NA	$ 158,000	NA	NA
Residential Home	AC	NA	$ 130,000	NA	NA	$ 130,000	NA	NA
Land Acquisition Subtotal				***$ 2,438,000***			***$ 2,127,000***	***$ (311,000)***

Maintenance	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost[2]	Channel Costs with Zone SR-24 Alternative 1 Quantity	Unit Cost	Budgetary Cost[2]	Cost Difference
Movable Bed Channel	AC/YEAR	NA	$ 150	NA	NA	$ 150	NA	NA
Hardened Channel	MI/YEAR	2.7	$ 9,500	$ 1,283,000	2.7	$ 9,500	$ 1,283,000	$ -
Maintenance Subtotal				***$ 1,283,000***			***$ 1,283,000***	$ -

	Base Channel Costs (Ellsworth Alt. 1)	Channel Costs with Zone SR-24 Alternative 1	Cost Difference
Pecos Channel Subtotal	***$ 15,725,000***	***$ 14,904,000***	$ (819,000)
Contingency 20%	$ 3,145,000	$ 2,981,000	$ (164,000)
Pecos Channel Total	***$ 18,868,000***	***$ 17,885,000***	***$ (983,000)***

SR-24 Interim Retention Basin - Alternative 1

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	290,000	$ 5.00	$ 1,450,000
Design and Inspection 15% of Excavation Cost				$ 218,000
Construction Subtotal				***$ 1,668,000***
Land Acq. (Vacant Undeveloped Commercial)	AC	34.4	$ 158,000	$ 5,435,000
Interim Channel Easement	AC	4.8	$ 126,400	$ 609,000
Landscaping	AC	34.4	$ -	$ -
Maintenance	AC/YEAR	34.4	$ 150	$ 258,000
SR-24 Interim Retention Basin Subtotal				***$ 7,970,000***
Contingency 20%				$ 1,594,000
SR-24 Interim Retention Basin Total				***$ 9,564,000***

Pecos & Ellsworth Interim Retention Basin - Alternative 1

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	148,000	$ 5.00	$ 740,000
Design and Inspection 15% of Excavation Cost				$ 111,000
Construction Subtotal				***$ 851,000***
Land Acq. (Vacant Undeveloped Commercial)	AC	13.0	$ 158,000	$ 2,054,000
Landscaping	AC	13.0	$ -	$ -
Maintenance	AC/YEAR	13.0	$ 150	$ 98,000
Pecos & Ellsworth Interim Retention Basin Subtotal				***$ 3,003,000***
Contingency 20%				$ 601,000
Pecos & Ellsworth Interim Retention Basin Total				***$ 3,604,000***

Williams Field & Ellsworth Interim Retention Basin - Alternative 1

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	218,000	$ 5.00	$ 1,090,000
Design and Inspection 15% of Excavation Cost				$ 164,000
Construction Subtotal				***$ 1,254,000***
Land Acq. (Vacant Undeveloped Commercial)	AC	27.4	$ 158,000	$ 4,329,000
Landscaping	AC	27.4	$ -	$ -
Maintenance	AC/YEAR	27.4	$ 150	$ 206,000
Williams Field & Ellsworth Interim Retention Basin Subtotal				***$ 5,789,000***
Contingency 20%				$ 1,158,000
Williams Field & Ellsworth Interim Retention Basin Total				***$ 6,947,000***

SR24 Alternative 1 Channel - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
SR-24 Meridian Channel	$ 6,163,000	$ 120,000	$ 45,000	$ 499,000	$ 114,000	$ 1,388,000	$ 8,329,000
Modifications to Ellsworth Zone Meridian North Channel	$ (433,000)	$ (8,000)	$ -	$ (34,000)	$ (14,000)	$ (98,000)	$ (587,000)
Modifications to Ellsworth Zone Pecos Channel	$ (505,000)	$ (3,000)	$ -	$ (311,000)	$ -	$ (164,000)	$ (983,000)
Totals	$ 5,225,000	$ 109,000	$ 45,000	$ 154,000	$ 100,000	$ 1,126,000	$ 6,759,000

SR24 Alternative 1 Basin - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
SR-24 Interim Retention Basin	$ 1,668,000	$ -	$ -	$ 5,435,000	$ 258,000	$ 1,594,000	$ 8,955,000
Pecos & Ellsworth Interim Retention Basin	$ 851,000	$ -	$ -	$ 2,054,000	$ 98,000	$ 601,000	$ 3,604,000
Williams Field & Ellsworth Interim Retention Basin	$ 1,254,000	$ -	$ -	$ 4,329,000	$ 206,000	$ 1,158,000	$ 6,947,000
Totals	$ 3,773,000	$ -	$ -	$ 11,818,000	$ 562,000	$ 3,353,000	$ 19,506,000

SR-24 Zone - Alternative 2

SR-24 Meridian Channel - Alternative 2

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	87,220	$ 5.00	$ 436,000
Cut-off-Walls (6" Riprap)	CF	77,741	$ 2.41	$ 187,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Liner Subtotal				***NA***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	1,550	$ 1,335	$ 2,069,000
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	1	$ 111,000	$ 111,000
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 2,180,000***
Design and Inspection 15%				$ 420,000
Construction Subtotal				***$ 3,223,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	15.2	$ 4,500	$ 68,000
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	1.5	$ 6,100	$ 9,000
Landscaped Swale	AC	1.5	$ 13,400	$ 20,000
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	9,979	$ 3.52	$ 35,000
Landscaping Subtotal				***$ 132,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	3,000	$ 15	$ 45,000
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	NA	$ 100	NA
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 45,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	19	$ 26,000	$ 497,000
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
Land Acquisition Subtotal				***$ 497,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	15.2	$ 150	$ 114,000
Hardened Channel	MI/YEAR	NA	$ 9,500	NA
Maintenance Subtotal				***$ 114,000***

Mountain System Subtotal				***$ 4,011,000***
Contingency 20%				$ 802,000
SR-24 Meridian Channel Total				***$ 4,813,000***

Meridian North - Alternative 2

Construction	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 2 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Excavation[1]	CY	44,049	$ 5.00	$ 220,000	44,049	$ 5.00	$ 220,000	$ -
Cut-off-Walls (6" Riprap)	CF	41,922	$ 2.41	$ 101,000	41,922	$ 2.41	$ 101,000	$ -
Liner								
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA	NA	$ 13.54	NA	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA	NA	$ 16.25	NA	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA	NA	$ 18.96	NA	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA	NA	$ 21.67	NA	NA
Liner Subtotal				$ -			$ -	*N/A*
Culverts								
5'x8' Culvert (Single)	FT	NA	$ 760	NA	NA	$ 760	NA	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA	NA	$ 1,335	NA	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA	NA	$ 1,845	NA	NA
5'x8' Culvert (Quadruple)	FT	250	$ 2,375	$ 594,000	250	$ 2,375	$ 594,000	$ -
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA	NA	$ 2,910	NA	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA	NA	$ 3,470	NA	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA	NA	$ 1,020	NA	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA	NA	$ 1,805	NA	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA	NA	$ 2,540	NA	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA	NA	$ 3,215	NA	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA	NA	$ 4,000	NA	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA	NA	$ 4,735	NA	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA	NA	$ 103,000	NA	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA	NA	$ 111,000	NA	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA	NA	$ 118,000	NA	NA
5'x8' Headwall & Transition (Quadruple)	EA	2	$ 126,000	$ 252,000	2	$ 126,000	$ 252,000	$ -
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA	NA	$ 133,000	NA	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA	NA	$ 142,000	NA	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA	NA	$ 108,000	NA	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA	NA	$ 118,000	NA	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA	NA	$ 127,000	NA	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA	NA	$ 137,000	NA	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA	NA	$ 146,000	NA	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA	NA	$ 155,000	NA	NA
Culverts Subtotal		-		*$ 846,000*			*$ 846,000*	$ -
Design and Inspection 15%				$ 175,000			$ 175,000	$ -
Construction Subtotal				*$ 1,342,000*			*$ 1,342,000*	$ -

Landscaping	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 2 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Movable Bed Channel	AC	7.7	$ 4,500	$ 34,000	7.7	$ 4,500	$ 34,000	$ -
Riprap Channel Bottom	AC	NA	$ 1,500	NA	NA	$ 1,500	NA	NA
Landscaped Setback	AC	0.6	$ 6,100	$ 4,000	0.6	$ 6,100	$ 4,000	$ -
Landscaped Swale	AC	0.6	$ 13,400	$ 9,000	0.6	$ 13,400	$ 9,000	$ -
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA	NA	$ 6,100	NA	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA	NA	$ 6,100	NA	NA
O&M Road	SY	4,324	$ 3.52	$ 15,000	4,324	$ 3.52	$ 15,000	$ -
Landscaping Subtotal				*$ 62,000*			*$ 62,000*	$ -

Utility Relocation	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 2 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Distribution OHE Relocation	FT	1,500	$ 15	$ 23,000	1,500	$ 15	$ 23,000	$ -
69kV OHE Relocation	FT	NA	$ 185	NA	NA	$ 185	NA	NA
8" Water Line Relocation	FT	NA	$ 125	NA	NA	$ 125	NA	NA
12" Water Line Relocation	FT	NA	$ 175	NA	NA	$ 175	NA	NA
16" Water Line Relocation	FT	200	$ 300	$ 60,000	200	$ 300	$ 60,000	$ -
Water Service Line	EA	NA	$ 10,500	NA	NA	$ 10,500	NA	NA
Irrigation Relocation	FT	NA	$ 100	NA	NA	$ 100	NA	NA
2" Gas Line Relocation	FT	NA	$ 100	NA	NA	$ 100	NA	NA
4" Gas Line Relocation	FT	NA	$ 120	NA	NA	$ 120	NA	NA
Fiber Optics Relocation	FT	NA	$ 10	NA	NA	$ 10	NA	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA	NA	$ 2,500	NA	NA
Drop Structure	EA	NA	$ -	NA	NA	$ -	NA	NA
Existing Fence Relocation	FT	NA	$ 20	NA	NA	$ 20	NA	NA
Sewer Service Line	EA	NA	$ 24,000	NA	NA	$ 24,000	NA	NA
Sewer Line Relocation	FT	NA	$ -	NA	NA	$ -	NA	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA	NA	$ 40,000	NA	NA
Utility Relocation Subtotal				*$ 83,000*			*$ 83,000*	$ -

Land Acquisition	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 2 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Vacant Hold for Investment	AC	9	$ 26,000	$ 224,000	9	$ 26,000	$ 224,000	$ -
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA	NA	$ 49,500	NA	NA
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA	NA	$ 158,000	NA	NA
Residential Home	AC	NA	$ 130,000	NA	NA	$ 130,000	NA	NA
Land Acquisition Subtotal				*$ 224,000*			*$ 224,000*	$ -

Maintenance	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost[1]	Channel Costs with Zone SR-24 Alternative 2 Quantity	Unit Cost	Budgetary Cost[1]	Cost Difference
Movable Bed Channel	AC/YEAR	7.7	$ 150	$ 57,000	7.7	$ 150	$ 57,000	$ -
Hardened Channel	MI/YEAR	NA	$ 9,500	NA	NA	$ 9,500	NA	NA
Maintenance Subtotal				*$ 57,000*			*$ 57,000*	$ -

	Base Channel Costs (Ellsworth Alt. 1)		Channel Costs with Zone SR-24 Alternative 2		Cost Difference
Meridian North Channel Subtotal		*$ 1,768,000*		*$ 1,768,000*	$ -
Contingency 20%		$ 354,000		$ 354,000	$ -
Meridian North Total		*$ 2,122,000*		*$ 2,122,000*	*$ -*

Pecos Channel - Alternative 2

Construction	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 2 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Excavation[1]	CY	333,106	$ 5.00	$ 1,666,000	333,106	$ 5.00	$ 1,666,000	$ -
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA	NA	$ 2.41	NA	NA
Liner								
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA	NA	$ 13.54	NA	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA	NA	$ 16.25	NA	NA
Riprap d_{50} = 7"	SY	201,733	$ 18.96	$ 3,825,000	201,733	$ 18.96	$ 3,825,000	$ -
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA	NA	$ 21.67	NA	NA
Liner Subtotal				***$ 3,825,000***			***$ 3,825,000***	***NA***
Culverts								
5'x8' Culvert (Single)	FT	NA	$ 760	NA	NA	$ 760	NA	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA	NA	$ 1,335	NA	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA	NA	$ 1,845	NA	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA	NA	$ 2,375	NA	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA	NA	$ 2,910	NA	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA	NA	$ 3,470	NA	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA	NA	$ 1,020	NA	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA	NA	$ 1,805	NA	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA	NA	$ 2,540	NA	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA	NA	$ 3,215	NA	NA
6'x10' Culvert (Five)	FT	160	$ 4,000	$ 640,000	160	$ 4,000	$ 640,000	$ -
6'x10' Culvert (Six)	FT	530	$ 4,735	$ 2,510,000	530	$ 4,735	$ 2,510,000	$ -
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA	NA	$ 103,000	NA	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA	NA	$ 111,000	NA	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA	NA	$ 118,000	NA	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA	NA	$ 126,000	NA	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA	NA	$ 133,000	NA	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA	NA	$ 142,000	NA	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA	NA	$ 108,000	NA	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA	NA	$ 118,000	NA	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA	NA	$ 127,000	NA	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA	NA	$ 137,000	NA	NA
6'x10' Headwall & Transition (Five)	EA	2	$ 146,000	$ 292,000	2	$ 146,000	$ 292,000	$ -
6'x10' Headwall & Transition (Six)	EA	5	$ 155,000	$ 775,000	5	$ 155,000	$ 775,000	$ -
Culverts Subtotal				***$ 4,217,000***			***$ 4,217,000***	$ -
Design and Inspection 15%				$ 1,456,000			$ 1,456,000	$ -
Construction Subtotal				***$ 11,164,000***			***$ 11,164,000***	***$ -***

Landscaping	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 2 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Movable Bed Channel	AC	NA	$ 4,500	NA	NA	$ 4,500	NA	NA
Riprap Channel Bottom	AC	14.2	$ 1,500	$ 21,000	14.2	$ 1,500	$ 21,000	$ -
Landscaped Setback	AC	NA	$ 6,100	NA	NA	$ 6,100	NA	NA
Landscaped Swale	AC	NA	$ 13,400	NA	NA	$ 13,400	NA	NA
Landscaped Low Flow Channel	AC	19.9	$ 6,100	$ 122,000	19.9	$ 6,100	$ 122,000	$ -
Landscaped Buffer Zone	AC	NA	$ 6,100	NA	NA	$ 6,100	NA	NA
O&M Road	SY	22,524	$ 3.52	$ 79,000	22,524	$ 3.52	$ 79,000	$ -
Landscaping Subtotal				***$ 222,000***			***$ 222,000***	$ -

Utility Relocation	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 2 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Distribution OHE Relocation	FT	NA	$ 15	NA	NA	$ 15	NA	NA
69kV OHE Relocation	FT	NA	$ 185	NA	NA	$ 185	NA	NA
8" Water Line Relocation	FT	NA	$ 125	NA	NA	$ 125	NA	NA
12" Water Line Relocation	FT	NA	$ 175	NA	NA	$ 175	NA	NA
16" Water Line Relocation	FT	200	$ 300	$ 60,000	200	$ 300	$ 60,000	$ -
Water Service Line	EA	4	$ 10,500	$ 42,000	4	$ 10,500	$ 42,000	$ -
Irrigation Relocation	FT	300	$ 100	$ 30,000	300	$ 100	$ 30,000	$ -
2" Gas Line Relocation	FT	NA	$ 100	NA	NA	$ 100	NA	NA
4" Gas Line Relocation	FT	200	$ 120	$ 24,000	200	$ 120	$ 24,000	$ -
Fiber Optics Relocation	FT	NA	$ 10	NA	NA	$ 10	NA	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA	NA	$ 2,500	NA	NA
Drop Structure	EA	NA	$ -	NA	NA	$ -	NA	NA
Existing Fence Relocation	FT	5,000	$ 20	$ 100,000	5,000	$ 20	$ 100,000	$ -
Sewer Service Line	EA	15	$ 24,000	$ 360,000	15	$ 24,000	$ 360,000	$ -
Sewer Line Relocation (No Conflict: Channel not deep enough)	FT	250	$ -	$ -	250	$ -	$ -	$ -
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA	NA	$ 40,000	NA	NA
Utility Relocation Subtotal				***$ 616,000***			***$ 616,000***	$ -

Land Acquisition	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 2 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Vacant Held for Investment	AC	34	$ 26,000	$ 884,000	34	$ 26,000	$ 884,000	$ -
Residential Lots 1-5 acres	AC	31	$ 49,500	$ 1,554,000	31	$ 49,500	$ 1,554,000	$ -
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA	NA	$ 158,000	NA	NA
Residential Home	AC	NA	$ 130,000	NA	NA	$ 130,000	NA	NA
Land Acquisition Subtotal				***$ 2,438,000***			***$ 2,438,000***	$ -

Maintenance	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost[2]	Channel Costs with Zone SR-24 Alternative 2 Quantity	Unit Cost	Budgetary Cost[2]	Cost Difference
Movable Bed Channel	AC/YEAR	NA	$ 150	NA	NA	$ 150	NA	NA
Hardened Channel	MI/YEAR	2.7	$ 9,500	$ 1,283,000	2.7	$ 9,500	$ 1,283,000	$ -
Maintenance Subtotal				***$ 1,283,000***			***$ 1,283,000***	$ -

	Base Channel Costs (Ellsworth Alt. 1)	Channel Costs with Zone SR-24 Alternative 2	Cost Difference
Pecos Channel Subtotal	***$ 15,723,000***	***$ 15,723,000***	$ -
Contingency 20%	$ 3,145,000	$ 3,145,000	$ -
Pecos System Total	***$ 18,868,000***	***$ 18,868,000***	***$ -***

Galveston Retention Basin - Alternative 2

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	76,000	$ 5.00	$ 380,000
Design and Inspection 15% of Excavation Cost				$ 57,000
Construction Subtotal				***$ 437,000***
Land Acq. (Residential Lots 1-5 acres)	AC	13.1	$ 49,500	$ 648,000
Landscaping	AC	13.1	$ 5,000	$ 66,000
Maintenance	AC/YEAR	13.1	$ 150	$ 98,000
Galveston Retention Basin Subtotal				***$ 1,249,000***
Contingency 20%				$ 250,000
Galveston Retention Basin Total				***$ 1,499,000***

Pecos & Ellsworth Interim Retention Basin - Alternative 2

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	274,000	$ 5.00	$ 1,370,000
Design and Inspection 15% of Excavation Cost				$ 206,000
Construction Subtotal				***$ 1,576,000***
Land Acq. (Vacant Undeveloped Commercial)	AC	22.8	$ 158,000	$ 3,602,000
Landscaping	AC	22.8	$ -	$ -
Maintenance	AC/YEAR	22.8	$ 150	$ 171,000
Pecos & Ellsworth Interim Retention Basin Subtotal				***$ 5,349,000***
Contingency 20%				$ 1,070,000
Pecos & Ellsworth Interim Retention Basin Total				***$ 6,419,000***

Williams Field & Ellsworth Interim Retention Basin - Alternative 2

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	218,000	$ 5.00	$ 1,090,000
Design and Inspection 15% of Excavation Cost				$ 164,000
Construction Subtotal				***$ 1,254,000***
Land Acq. (Vacant Undeveloped Commercial)	AC	27.4	$ 158,000	$ 4,329,000
Landscaping	AC	27.4	$ -	$ -
Maintenance	AC/YEAR	27.4	$ 150	$ 206,000
Williams Field & Ellsworth Interim Retention Basin Subtotal				***$ 5,789,000***
Contingency 20%				$ 1,158,000
Williams Field & Ellsworth Interim Retention Basin Total				***$ 6,947,000***

SR24 Alternative 2 Channel - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
SR-24 Meridian Channel	$ 3,223,000	$ 132,000	$ 45,000	$ 497,000	$ 114,000	$ 802,000	$ 4,813,000
Modifications to Ellsworth Zone Meridian North Channel	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Modifications to Ellsworth Zone Pecos Channel	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Totals	$ 3,223,000	$ 132,000	$ 45,000	$ 497,000	$ 114,000	$ 802,000	$ 4,813,000

SR24 Alternative 2 Basin - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
Galveston Retention Basin	$ 437,000	$ 66,000	$ -	$ 648,000	$ 98,000	$ 250,000	$ 1,499,000
Pecos & Ellsworth Interim Retention Basin	$ 1,576,000	$ -	$ -	$ 3,602,000	$ 171,000	$ 1,070,000	$ 6,419,000
Williams Field & Ellsworth Interim Retention Basin	$ 1,254,000	$ -	$ -	$ 4,329,000	$ 206,000	$ 1,158,000	$ 6,947,000
Totals	$ 3,267,000	$ 66,000	$ -	$ 8,579,000	$ 475,000	$ 2,478,000	$ 14,865,000

SR-24 Zone - Alternative 3

Mountain System - Alternative 3

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	59,385	$ 5.00	$ 297,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	4,018	$ 7.00	$ 28,000
Riprap d_{50} = 2"	SY	31,861	$ 7.00	$ 223,000
Riprap d_{50} = 3"	SY	9,466	$ 7.00	$ 66,000
Riprap d_{50} = 4"	SY	11,485	$ 7.00	$ 80,000
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Liner Subtotal				***$ 397,000***
Culverts				
5'x8' Culvert (Single)	FT	1,095	$ 760	$ 832,000
5'x8' Culvert (Double)	FT	325	$ 1,335	$ 434,000
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	95	$ 1,020	$ 97,000
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	36	$ 103,000	$ 3,708,000
5'x8' Headwall & Transition (Double)	EA	9	$ 111,000	$ 999,000
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	4	$ 108,000	$ 432,000
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 6,502,000***
Design and Inspection 15%				$ 1,079,000
Construction Subtotal				***$ 8,275,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	3.5	$ 1,500	$ 5,000
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	NA	$ 3.52	NA
Landscaping Subtotal				***$ 5,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	1,805	$ 15	$ 27,000
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	75	$ 300	$ 23,000
Water Service Line	EA	1	$ 10,500	$ 11,000
Irrigation Relocation	FT	NA	$ 100	NA
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	3,500	$ 20	$ 70,000
Sewer Service Line	EA	8	$ 24,000	$ 192,000
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 323,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	3	$ 49,500	$ 144,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
Land Acquisition Subtotal				***$ 144,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	2.7	$ 9,500	$ 1,283,000
Maintenance Subtotal				***$ 1,283,000***

Mountain System Subtotal				***$ 10,030,000***
Contingency 20%				$ 2,006,000
Mountain System Total				***$ 12,036,000***

Williams Field Channel - Alternative 3

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	54,832	$ 5.00	$ 274,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	7,235	$ 7.00	$ 51,000
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	46,341	$ 7.00	$ 324,000
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Liner Subtotal				***$ 375,000***
Culverts				
5'x8' Culvert (Single)	FT	225	$ 760	$ 171,000
5'x8' Culvert (Double)	FT	320	$ 1,335	$ 427,000
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	9	$ 103,000	$ 927,000
5'x8' Headwall & Transition (Double)	EA	4	$ 111,000	$ 444,000
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 1,969,000***
Design and Inspection 15%				$ 393,000
Construction Subtotal				***$ 3,011,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	4.6	$ 1,500	$ 7,000
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	9.9	$ 6,100	$ 61,000
O&M Road	SY	22,431	$ 3.52	$ 79,000
Landscaping Subtotal				***$ 147,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	2,735	$ 15	$ 41,000
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	NA	$ 100	NA
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	1,500	$ 20	$ 30,000
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation (No Conflict: Channel not deep enough)	FT	50	$ -	$ -
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 71,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Hold for Investment	AC	2	$ 26,000	$ 44,000
Residential Lots 1-5 acres	AC	10	$ 49,500	$ 500,000
Vacant Undeveloped Commercial	AC	10	$ 158,000	$ 1,517,000
Residential Home	AC	NA	$ 130,000	NA
Land Acquisition Subtotal				***$ 2,061,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	2.8	$ 9,500	$ 1,330,000
Maintenance Subtotal				***$ 1,330,000***

Williams Field Channel Subtotal				***$ 6,620,000***
Contingency 20%				$ 1,324,000
Williams Field Channel Total				***$ 7,944,000***

Meridian North Channel - Alternative 3

Construction	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 3 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Excavation[1]	CY	44,049	$ 5.00	$ 220,000	30,454	$ 5.00	$ 152,000	$ (68,000)
Cut-off-Walls (6" Riprap)	CF	41,922	$ 2.41	$ 101,000	35,417	$ 2.41	$ 85,000	$ (16,000)
Liner								
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA	NA	$ 13.54	NA	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA	NA	$ 16.25	NA	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA	NA	$ 18.96	NA	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA	NA	$ 21.67	NA	NA
Liner Subtotal				***NA***			***NA***	***NA***
Culverts								
5'x8' Culvert (Single)	FT	NA	$ 760	NA	NA	$ 760	NA	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA	250	$ 1,335	$ 334,000	$ 334,000
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA	NA	$ 1,845	NA	NA
5'x8' Culvert (Quadruple)	FT	250	$ 2,375	$ 594,000	NA	$ 2,375	NA	$ (594,000)
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA	NA	$ 2,910	NA	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA	NA	$ 3,470	NA	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA	NA	$ 1,020	NA	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA	NA	$ 1,805	NA	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA	NA	$ 2,540	NA	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA	NA	$ 3,215	NA	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA	NA	$ 4,000	NA	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA	NA	$ 4,735	NA	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA	NA	$ 103,000	NA	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA	2	$ 111,000	$ 222,000	$ 222,000
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA	NA	$ 118,000	NA	NA
5'x8' Headwall & Transition (Quadruple)	EA	2	$ 126,000	$ 252,000	NA	$ 126,000	NA	$ (252,000)
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA	NA	$ 133,000	NA	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA	NA	$ 142,000	NA	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA	NA	$ 108,000	NA	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA	NA	$ 118,000	NA	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA	NA	$ 127,000	NA	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA	NA	$ 137,000	NA	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA	NA	$ 146,000	NA	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA	NA	$ 155,000	NA	NA
Culverts Subtotal				***$ 846,000***			***$ 556,000***	***$ (290,000)***
Design and Inspection 15%				$ 175,000			$ 119,000	$ (56,000)
Construction Subtotal				***$ 1,342,000***			***$ 912,000***	***$ (430,000)***

Landscaping	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 3 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Movable Bed Channel	AC	7.7	$ 4,500	$ 34,000	10.8	$ 4,500	$ 49,000	$ 15,000
Riprap Channel Bottom	AC	NA	$ 1,500	NA	NA	$ 1,500	NA	NA
Landscaped Setback	AC	0.6	$ 6,100	$ 4,000	0.6	$ 6,100	$ 4,000	$ -
Landscaped Swale	AC	0.6	$ 13,400	$ 9,000	0.6	$ 13,400	$ 9,000	$ -
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA	NA	$ 6,100	NA	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA	NA	$ 6,100	NA	NA
O&M Road	SY	4,324	$ 3.52	$ 15,000	4,324	$ 3.52	$ 15,000	$ -
Landscaping Subtotal				***$ 62,000***			***$ 77,000***	$ 15,000

Utility Relocation	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 3 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Distribution OHE Relocation	FT	1,500	$ 15	$ 23,000	1,500	$ 15	$ 23,000	$ -
69kV OHE Relocation	FT	NA	$ 185	NA	NA	$ 185	NA	NA
8" Water Line Relocation	FT	NA	$ 125	NA	NA	$ 125	NA	NA
12" Water Line Relocation	FT	NA	$ 175	NA	NA	$ 175	NA	NA
16" Water Line Relocation	FT	200	$ 300	$ 60,000	200	$ 300	$ 60,000	$ -
Water Service Line	EA	NA	$ 10,500	NA	NA	$ 10,500	NA	NA
Irrigation Relocation	FT	NA	$ 100	NA	NA	$ 100	NA	NA
2" Gas Line Relocation	FT	NA	$ 100	NA	NA	$ 100	NA	NA
4" Gas Line Relocation	FT	NA	$ 120	NA	NA	$ 120	NA	NA
Fiber Optics Relocation	FT	NA	$ 10	NA	NA	$ 10	NA	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA	NA	$ 2,500	NA	NA
Drop Structure	EA	NA	$ -	NA	NA	$ -	NA	NA
Existing Fence Relocation	FT	NA	$ 20	NA	NA	$ 20	NA	NA
Sewer Service Line	EA	NA	$ 24,000	NA	NA	$ 24,000	NA	NA
Sewer Line Relocation	FT	NA	$ -	NA	NA	$ -	NA	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA	NA	$ 40,000	NA	NA
Utility Relocation Subtotal				***$ 83,000***			***$ 83,000***	$ -

Land Acquisition	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost	Channel Costs with Zone SR-24 Alternative 3 Quantity	Unit Cost	Budgetary Cost	Cost Difference
Vacant Held for Investment	AC	9	$ 26,000	$ 224,000	7	$ 26,000	$ 192,000	$ (32,000)
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA	NA	$ 49,500	NA	NA
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA	NA	$ 158,000	NA	NA
Residential Home	AC	NA	$ 130,000	NA	NA	$ 130,000	NA	NA
Land Acquisition Subtotal				***$ 224,000***			***$ 192,000***	***$ (32,000)***

Maintenance	UM	Base Channel Costs (Ellsworth Alt. 1) Quantity	Unit Cost	Budgetary Cost[2]	Channel Costs with Zone SR-24 Alternative 3 Quantity	Unit Cost	Budgetary Cost[2]	Cost Difference
Movable Bed Channel	AC/YEAR	7.7	$ 150	$ 57,000	10.8	$ 150	$ 81,000	$ 24,000
Hardened Channel	MI/YEAR	NA	$ 9,500	NA	NA	$ 9,500	NA	NA
Maintenance Subtotal				***$ 57,000***			***$ 81,000***	***$ 24,000***

	Base Channel Costs (Ellsworth Alt. 1)	Channel Costs with Zone SR-24 Alternative 3	Cost Difference
Pecos Channel Subtotal	***$ 1,768,000***	***$ 1,345,000***	$ (423,000)
Contingency 20%	$ 354,000	$ 269,000	$ (85,000)
Pecos System Total	***$ 2,122,000***	***$ 1,614,000***	***$ (508,000)***

Pecos Channel - Alternative 3

		Base Channel Costs (Ellsworth Alt. 1)			Channel Costs with Zone SR-24 Alternative 3			
Construction	UM	Quantity	Unit Cost	Budgetary Cost	Quantity	Unit Cost	Budgetary Cost	Cost Difference
Excavation[1]	CY	333,106	$ 5.00	$ 1,666,000	310,914	$ 5.00	$ 1,555,000	$ (111,000)
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA	NA	$ 2.41	NA	NA
Liner								
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA	NA	$ 7.00	NA	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA	NA	$ 13.54	NA	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA	NA	$ 16.25	NA	NA
Riprap d_{50} = 7"	SY	201,733	$ 18.96	$ 3,825,000	197,887	$ 18.96	$ 3,752,000	$ (73,000)
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA	NA	$ 21.67	NA	NA
Liner Subtotal				***$ 3,825,000***			***$ 3,752,000***	$ (73,000)
Culverts								
5'x8' Culvert (Single)	FT	NA	$ 760	NA	NA	$ 760	NA	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA	NA	$ 1,335	NA	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA	NA	$ 1,845	NA	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA	NA	$ 2,375	NA	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA	NA	$ 2,910	NA	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA	NA	$ 3,470	NA	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA	NA	$ 1,020	NA	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA	NA	$ 1,805	NA	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA	NA	$ 2,540	NA	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA	160	$ 3,215	$ 514,000	$ 514,000
6'x10' Culvert (Five)	FT	160	$ 4,000	$ 640,000	430	$ 4,000	$ 1,720,000	$ 1,080,000
6'x10' Culvert (Six)	FT	530	$ 4,735	$ 2,510,000	100	$ 4,735	$ 474,000	$ (2,036,000)
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA	NA	$ 103,000	NA	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA	NA	$ 111,000	NA	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA	NA	$ 118,000	NA	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA	NA	$ 126,000	NA	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA	NA	$ 133,000	NA	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA	NA	$ 142,000	NA	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA	NA	$ 108,000	NA	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA	NA	$ 118,000	NA	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA	NA	$ 127,000	NA	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA	2	$ 137,000	$ 274,000	$ 274,000
6'x10' Headwall & Transition (Five)	EA	2	$ 146,000	$ 292,000	4	$ 146,000	$ 584,000	$ 292,000
6'x10' Headwall & Transition (Six)	EA	5	$ 155,000	$ 775,000	1	$ 155,000	$ 155,000	$ (620,000)
Culverts Subtotal				***$ 4,217,000***			***$ 3,721,000***	***$ (496,000)***
Design and Inspection 15%				$ 1,456,000			$ 1,354,000	$ (102,000)
Construction Subtotal				***$ 11,164,000***			***$ 10,382,000***	***$ (782,000)***

		Base Channel Costs (Ellsworth Alt. 1)			Channel Costs with Zone SR-24 Alternative 3			
Landscaping	UM	Quantity	Unit Cost	Budgetary Cost	Quantity	Unit Cost	Budgetary Cost	Cost Difference
Movable Bed Channel	AC	NA	$ 4,500	NA	NA	$ 4,500	NA	NA
Riprap Channel Bottom	AC	14.2	$ 1,500	$ 21,000	12.6	$ 1,500	$ 19,000	$ (2,000)
Landscaped Setback	AC	NA	$ 6,100	NA	NA	$ 6,100	NA	NA
Landscaped Swale	AC	NA	$ 13,400	NA	NA	$ 13,400	NA	NA
Landscaped Low Flow Channel	AC	19.9	$ 6,100	$ 122,000	19.9	$ 6,100	$ 122,000	$ -
Landscaped Buffer Zone	AC	NA	$ 6,100	NA	NA	$ 6,100	NA	NA
O&M Road	SY	22,524	$ 3.52	$ 79,000	22,524	$ 3.52	$ 79,000	$ -
Landscaping Subtotal				***$ 222,000***			***$ 220,000***	$ (2,000)

		Base Channel Costs (Ellsworth Alt. 1)			Channel Costs with Zone SR-24 Alternative 3			
Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost	Quantity	Unit Cost	Budgetary Cost	Cost Difference
Distribution OHE Relocation	FT	NA	$ 15	NA	NA	$ 15	NA	NA
69kV OHE Relocation	FT	NA	$ 185	NA	NA	$ 185	NA	NA
8" Water Line Relocation	FT	NA	$ 125	NA	NA	$ 125	NA	NA
12" Water Line Relocation	FT	NA	$ 175	NA	NA	$ 175	NA	NA
16" Water Line Relocation	FT	200	$ 300	$ 60,000	200	$ 300	$ 60,000	$ -
Water Service Line	EA	4	$ 10,500	$ 42,000	4	$ 10,500	$ 42,000	$ -
Irrigation Relocation	FT	300	$ 100	$ 30,000	300	$ 100	$ 30,000	$ -
2" Gas Line Relocation	FT	NA	$ 100	NA	NA	$ 100	NA	NA
4" Gas Line Relocation	FT	200	$ 120	$ 24,000	200	$ 120	$ 24,000	$ -
Fiber Optics Relocation	FT	NA	$ 10	NA	NA	$ 10	NA	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA	NA	$ 2,500	NA	NA
Drop Structure	EA	NA	$ -	NA	NA	$ -	NA	NA
Existing Fence Relocation	FT	5,000	$ 20	$ 100,000	5,000	$ 20	$ 100,000	$ -
Sewer Service Line	EA	15	$ 24,000	$ 360,000	15	$ 24,000	$ 360,000	$ -
Sewer Line Relocation (No Conflict: Channel not deep enough)	FT	250	$ -	$ -	250	$ -	$ -	$ -
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA	NA	$ 40,000	NA	NA
Utility Relocation Subtotal				***$ 616,000***			***$ 616,000***	$ -

		Base Channel Costs (Ellsworth Alt. 1)			Channel Costs with Zone SR-24 Alternative 3			
Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost	Quantity	Unit Cost	Budgetary Cost	Cost Difference
Vacant Held for Investment	AC	34	$ 26,000	$ 884,000	34	$ 26,000	$ 884,000	$ -
Residential Lots 1-5 acres	AC	31	$ 49,500	$ 1,554,000	27	$ 49,500	$ 1,337,000	$ (217,000)
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA	NA	$ 158,000	NA	NA
Residential Home	AC	NA	$ 130,000	NA	NA	$ 130,000	NA	NA
Land Acquisition Subtotal				***$ 2,438,000***			***$ 2,221,000***	***$ (217,000)***

		Base Channel Costs (Ellsworth Alt. 1)			Channel Costs with Zone SR-24 Alternative 3			
Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]	Quantity	Unit Cost	Budgetary Cost[2]	Cost Difference
Movable Bed Channel	AC/YEAR	NA	$ 150	NA	NA	$ 150	NA	NA
Hardened Channel	MI/YEAR	2.7	$ 9,500	$ 1,283,000	2.7	$ 9,500	$ 1,283,000	$ -
Maintenance Subtotal				***$ 1,283,000***			***$ 1,283,000***	$ -

	Base Channel Costs (Ellsworth Alt. 1)	Channel Costs with Zone SR-24 Alternative 3	
			Cost Difference
Pecos Channel Subtotal	*$ 15,723,000*	*$ 14,722,000*	$ (1,001,000)
Contingency 20%	$ 3,145,000	$ 2,944,000	$ (201,000)
Pecos System Total	***$ 18,868,000***	***$ 17,666,000***	***$ (1,202,000)***

Williams Field Retention Basin - Alternative 3

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	47000	$ 5.00	$ 235,000
Design and Inspection 15% of Excavation Cost				$ 35,000
Construction Subtotal				***$ 270,000***
Land Acq. (Residential Los 1-5 acres)	AC	7.8	$ 49,500	$ 386,000
Landscaping	AC	7.8	$ 5,000	$ 39,000
Maintenance	AC/YEAR	7.8	$ 150	$ 59,000
Williams Field Retention Basin Subtotal				***$ 754,000***
Contingency 20%				$ 151,000
Williams Field Retention Basin Total				***$ 905,000***

Pecos & Ellsworth Interim Retention Basin - Alternative 3

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	190,000	$ 5.00	$ 950,000
Design and Inspection 15% of Excavation Cost				$ 143,000
Construction Subtotal				***$ 1,093,000***
Land Acq. (Vacant Undeveloped Commercial)	AC	17.2	$ 158,000	$ 2,718,000
Landscaping	AC	17.2	$ -	$ -
Maintenance	AC/YEAR	17.2	$ 150	$ 129,000
Pecos & Ellsworth Interim Retention Basin Subtotal				***$ 3,940,000***
Contingency 20%				$ 788,000
Pecos & Ellsworth Interim Retention Basin Total				***$ 4,728,000***

Williams Field & Ellsworth Interim Retention Basin - Alternative 3

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	348,000	$ 5.00	$ 1,740,000
Design and Inspection 15% of Excavation Cost				$ 261,000
Construction Subtotal				***$ 2,001,000***
Land Acq. (Vacant Undeveloped Commercial)	AC	41.3	$ 158,000	$ 6,525,000
Landscaping	AC	41.3	$ -	$ -
Maintenance	AC/YEAR	41.3	$ 150	$ 310,000
Williams Field & Ellsworth Interim Retention Basin Subtotal				***$ 8,836,000***
Contingency 20%				$ 1,767,000
Williams Field & Ellsworth Interim Retention Basin Total				***$ 10,603,000***

SR24 Alternative 3 Channel - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
Mountain System	$ 8,275,000	$ 5,000	$ 323,000	$ 144,000	$ 1,283,000	$ 2,006,000	$ 12,036,000
Williams Field Channel	$ 3,011,000	$ 147,000	$ 71,000	$ 2,061,000	$ 1,330,000	$ 1,324,000	$ 7,944,000
Modifications to Ellsworth Zone Meridian North Channel	$ (430,000)	$ 15,000	$ -	$ (32,000)	$ 24,000	$ (85,000)	$ (508,000)
Modifications to Ellsworth Zone Pecos Channel	$ (782,000)	$ (2,000)	$ -	$ (217,000)	$ -	$ (201,000)	$ (1,202,000)
Totals	$ 10,074,000	$ 165,000	$ 394,000	$ 1,956,000	$ 2,637,000	$ 3,044,000	$ 18,270,000

SR24 Alternative 3 Basin - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
Williams Field Retention Basin	$ 270,000	$ 39,000	$ -	$ 386,000	$ 59,000	$ 151,000	$ 905,000
Pecos & Ellsworth Interim Retention Basin	$ 1,093,000	$ -	$ -	$ 2,718,000	$ 129,000	$ 788,000	$ 4,728,000
Williams Field & Ellsworth Interim Retention Basin	$ 2,001,000	$ -	$ -	$ 6,525,000	$ 310,000	$ 1,767,000	$ 10,603,000
Totals	$ 3,364,000	$ 39,000	$ -	$ 9,629,000	$ 498,000	$ 2,706,000	$ 16,236,000

Ellsworth Zone - Alternative 1

Meridian Channel North - Alternative 1

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	44,049	$ 5.00	$ 220,000
Cut-off-Walls (6" Riprap)	CF	41,922	$ 2.41	$ 101,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Liner Subtotal				***NA***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	250	$ 2,375	$ 594,000
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	2	$ 126,000	$ 252,000
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 846,000***
Design and Inspection 15%				$ 175,000
Construction Subtotal				***$ 1,342,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	7.7	$ 4,500	$ 34,000
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	0.6	$ 6,100	$ 4,000
Landscaped Swale	AC	0.6	$ 13,400	$ 9,000
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	4,324	$ 3.52	$ 15,000
Landscaping Subtotal				***$ 62,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	1,500	$ 15	$ 23,000
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	200	$ 300	$ 60,000
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	NA	$ 100	NA
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 83,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Hold for Investment	AC	9	$ 26,000	$ 224,000
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
Land Acquisition Subtotal				***$ 224,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	7.7	$ 150	$ 57,000
Hardened Channel	MI/YEAR	NA	$ 9,500	NA
Maintenance Subtotal				***$ 57,000***

Meridian Channel North Subtotal		***$ 1,768,000***
Contingency 20%		$ 354,000
Meridian Channel North Total		***$ 2,122,000***

Meridian Channel South - Alternative 1

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	134,360	$ 5.00	$ 672,000
Cut-off-Walls (6" Riprap)	CF	67,444	$ 2.41	$ 163,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	11,315	$ 7.00	$ 79,000
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	25,909	$ 13.54	$ 351,000
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Liner Subtotal				***$ 430,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	40	$ 1,335	$ 53,000
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	520	$ 1,805	$ 939,000
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	1	$ 111,000	$ 111,000
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	3	$ 118,000	$ 354,000
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 1,457,000***
Design and Inspection 15%				$ 408,000
Construction Subtotal				***$ 3,130,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	10.6	$ 4,500	$ 48,000
Riprap Channel Bottom	AC	1.0	$ 1,500	$ 2,000
Landscaped Setback	AC	6.3	$ 6,100	$ 38,000
Landscaped Swale	AC	1.1	$ 13,400	$ 15,000
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	16,411	$ 3.52	$ 58,000
Landscaping Subtotal				***$ 161,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	5,000	$ 15	$ 75,000
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	200	$ 300	$ 60,000
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	5,000	$ 100	$ 500,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 635,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Hold for Investment	AC	11.0	$ 26,000	$ 286,000
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA
Vacant Undeveloped Commercial	AC	14.0	$ 158,000	$ 2,212,000
Residential Home	AC	NA	$ 130,000	NA
Land Acquisition Subtotal				***$ 2,498,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	10.6	$ 150	$ 79,000
Hardened Channel	MI/YEAR	1.0	$ 9,500	$ 475,000
Maintenance Subtotal				***$ 554,000***

Meridian Channel South Subtotal		***$ 6,978,000***
Contingency 20%		$ 1,396,000
Meridian Channel South Total		***$ 8,374,000***

Pecos Channel - Alternative 1

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	333,106	$ 5.00	$ 1,666,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	201,733	$ 18.96	$ 3,825,000
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ 3,825,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	160	$ 4,000	$ 640,000
6'x10' Culvert (Six)	FT	530	$ 4,735	$ 2,510,000
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	2	$ 146,000	$ 292,000
6'x10' Headwall & Transition (Six)	EA	5	$ 155,000	$ 775,000
Culverts Subtotal				***$ 4,217,000***
Design and Inspection 15%				$ 1,456,000
Construction Subtotal				***$ 11,164,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	2.7	$ 1,500	$ 4,000
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	19.9	$ 6,100	$ 122,000
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	22,524	$ 3.52	$ 79,000
Landscaping Subtotal				***$ 205,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	200	$ 300	$ 60,000
Water Service Line	EA	4	$ 10,500	$ 42,000
Irrigation Relocation	FT	300	$ 100	$ 30,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	200	$ 120	$ 24,000
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	5,000	$ 20	$ 100,000
Sewer Service Line	EA	15	$ 24,000	$ 360,000
Sewer Line Relocation (No Conflict: Channel not deep enough)	FT	250	$ -	$ -
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 616,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	34	$ 26,000	$ 884,000
Residential Lots 1-5 acres	AC	31	$ 49,500	$ 1,554,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
Land Acquisition Subtotal				***$ 2,438,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	2.7	$ 9,500	$ 1,283,000
Maintenance Subtotal				***$ 1,283,000***

Pecos Channel Subtotal				***$ 15,706,000***
Contingency 20%				$ 3,141,000
Pecos Channel Total				***$ 18,847,000***

Pecos/Meridian Retention Basin - Alternative 1

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	242,000	$ 5.00	$ 1,210,000
Design and Inspection 15% of Excavation Cost				$ 182,000
Construction Subtotal				***$ 1,392,000***
Land Acq. (Vacant Undeveloped Commercial)	AC	24.1	$ 158,000	$ 3,808,000
Landscaping	AC	24.1	$ 5,000	$ 121,000
Maintenance	AC/YEAR	24.1	$ 150	$ 181,000
Pecos/Meridian Retention Basin Subtotal				***$ 5,502,000***
Contingency 20%				$ 1,100,000
Pecos/Meridian Retention Basin Total				***$ 6,602,000***

Ellsworth Alternative 1 Channel - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
Meridian Channel North	$ 1,342,000	$ 62,000	$ 83,000	$ 224,000	$ 57,000	$ 354,000	$ 2,122,000
Meridian Channel South	$ 3,130,000	$ 161,000	$ 635,000	$ 2,498,000	$ 554,000	$ 1,396,000	$ 8,374,000
Pecos Channel	$ 11,164,000	$ 205,000	$ 616,000	$ 2,438,000	$ 1,283,000	$ 3,141,000	$ 18,847,000
Totals	$ 15,636,000	$ 428,000	$ 1,334,000	$ 5,160,000	$ 1,894,000	$ 4,891,000	$ 29,343,000

Ellsworth Alternative 1 Basin - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Total
Pecos/Meridian Retention Basin	$ 1,392,000	$ 121,000	$ -	$ 3,808,000	$ 181,000	$ 1,100,000	$ 6,602,000

Ellsworth Zone - Alternative 2

Meridian Channel North - Alternative 2

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	44,049	$ 5.00	$ 220,000
Cut-off-Walls (6" Riprap)	CF	41,922	$ 2.41	$ 101,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ -***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	250	$ 2,375	$ 594,000
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	2	$ 126,000	$ 252,000
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 846,000***
Design and Inspection 15%				$ 175,000
Construction Subtotal				***$ 1,342,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	7.7	$ 4,500	$ 34,000
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	0.6	$ 6,100	$ 4,000
Landscaped Swale	AC	0.6	$ 13,400	$ 9,000
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	4,324	$ 3.52	$ 15,000
Landscaping Subtotal				***$ 62,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	1,500	$ 15	$ 23,000
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	200	$ 300	$ 60,000
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	NA	$ 100	NA
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 83,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Hold for Investment	AC	8.6	$ 26,000	$ 224,000
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
Land Acquisition Subtotal				***$ 224,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	7.7	$ 150	$ 57,000
Hardened Channel	MI/YEAR	NA	$ 9,500	NA
Maintenance Subtotal				***$ 57,000***

Meridian Channel North Subtotal	***$***	***1,768,000***
Contingency 20%	$	354,000
Meridian Channel North Total	***$***	***2,122,000***

Meridian Channel South - Alternative 2

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	134,360	$ 5.00	$ 672,000
Cut-off-Walls (6" Riprap)	CF	67,444	$ 2.41	$ 163,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	11,315	$ 7.00	$ 79,000
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	25,909	$ 13.54	$ 351,000
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ 430,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	40	$ 1,335	$ 53,000
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	520	$ 1,805	$ 939,000
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	1	$ 111,000	$ 111,000
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	3	$ 118,000	$ 354,000
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 1,457,000***
Design and Inspection 15%				$ 408,000
Construction Subtotal				***$ 3,130,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	10.6	$ 4,500	$ 48,000
Riprap Channel Bottom	AC	1.0	$ 1,500	$ 2,000
Landscaped Setback	AC	6.3	$ 6,100	$ 38,000
Landscaped Swale	AC	1.1	$ 13,400	$ 15,000
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	16,411	$ 3.52	$ 58,000
Landscaping Subtotal				***$ 161,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	5,000	$ 15	$ 75,000
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	200	$ 300	$ 60,000
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	5,000	$ 100	$ 500,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 635,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Hold for Investment	AC	11.0	$ 26,000	$ 286,000
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA
Vacant Undeveloped Commercial	AC	14.0	$ 158,000	$ 2,212,000
Residential Home	AC	NA	$ 130,000	NA
Land Acquisition Subtotal				***$ 2,498,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	10.6	$ 150	$ 79,000
Hardened Channel	MI/YEAR	1.0	$ 9,500	$ 475,000
Maintenance Subtotal				***$ 554,000***

Meridian Channel South Subtotal				***$ 6,978,000***
Contingency 20%				$ 1,396,000
Meridian Channel South Total				***$ 8,374,000***

Pecos Channel - Alternative 2

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	349,617	$ 5.00	$ 1,748,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	207,364	$ 18.96	$ 3,932,000
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ 3,932,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	345	$ 4,000	$ 1,380,000
6'x10' Culvert (Six)	FT	325	$ 4,735	$ 1,539,000
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	4	$ 146,000	$ 584,000
6'x10' Headwall & Transition (Six)	EA	4	$ 155,000	$ 620,000
Culverts Subtotal				***$ 4,123,000***
Design and Inspection 15%				$ 1,470,000
Construction Subtotal				***$ 11,273,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	2.8	$ 1,500	$ 4,000
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	20.3	$ 6,100	$ 124,000
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	22,976	$ 3.52	$ 81,000
Landscaping Subtotal				***$ 209,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	185	$ 300	$ 56,000
Water Service Line	EA	1	$ 10,500	$ 11,000
Irrigation Relocation	FT	NA	$ 100	NA
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	260	$ 120	$ 31,000
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	6,200	$ 20	$ 124,000
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation (No Conflict: Channel not deep enough)	FT	200	$ -	$ -
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 222,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	26	$ 26,000	$ 668,000
Residential Lots 1-5 acres	AC	41	$ 49,500	$ 2,020,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
Contingency 10%				$269,000
Land Acquisition Subtotal				***$ 2,957,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	2.8	$ 9,500	$ 1,330,000
Maintenance Subtotal				***$ 1,330,000***

Pecos Channel Subtotal	***$ 15,991,000***
Contingency 20%	$ 3,198,000
Pecos Channel Total	***$ 19,189,000***

Pecos/Meridian Retention Basin - Alternative 2

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	242,000	$ 5.00	$ 1,210,000
Design and Inspection 15% of Excavation Cost				$ 182,000
Construction Subtotal				***$ 1,392,000***
Land Acq. (Vacant Undeveloped Commercial)	AC	24.1	$ 158,000	$ 3,808,000
Landscaping	AC	24.1	$ 5,000	$ 121,000
Maintenance	AC/YEAR	24.1	$ 150	$ 181,000
Pecos/Meridian Retention Basin Subtotal				***$ 5,502,000***
Contingency 20%				$ 1,100,000
Pecos/Meridian Retention Basin Total				***$ 6,602,000***

Ellsworth Alternative 2 Channel - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
Meridian Channel North	$ 1,342,000	$ 62,000	$ 83,000	$ 224,000	$ 57,000	$ 354,000	$ 2,122,000
Meridian Channel South	$ 3,130,000	$ 161,000	$ 635,000	$ 2,498,000	$ 554,000	$ 1,396,000	$ 8,374,000
Pecos Channel	$ 11,273,000	$ 209,000	$ 222,000	$ 2,957,000	$ 1,330,000	$ 3,198,000	$ 19,189,000
Totals	$ 15,745,000	$ 432,000	$ 940,000	$ 5,679,000	$ 1,941,000	$ 4,948,000	$ 29,685,000

Ellsworth Alternative 2 Basin - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Total
Pecos/Meridian Retention Basin	$ 1,392,000	$ 121,000	$ -	$ 3,808,000	$ 181,000	$ 1,100,000	$ 6,602,000

Ellsworth Zone - Alternative 3

Meridian Channel North - Alternative 3

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	44,049	$ 5.00	$ 220,000
Cut-off-Walls (6" Riprap)	CF	41,922	$ 2.41	$ 101,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ -***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	250	$ 2,375	$ 594,000
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	2	$ 126,000	$ 252,000
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 846,000***
Design and Inspection 15%				$ 175,000
Construction Subtotal				***$ 1,342,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	7.7	$ 4,500	$ 34,000
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	0.6	$ 6,100	$ 4,000
Landscaped Swale	AC	0.6	$ 13,400	$ 9,000
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	4,324	$ 3.52	$ 15,000
Landscaping Subtotal				***$ 62,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	1,500	$ 15	$ 23,000
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	200	$ 300	$ 60,000
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	NA	$ 100	NA
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 83,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Hold for Investment	AC	9	$ 26,000	$ 224,000
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
Land Acquisition Subtotal				***$ 224,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	8	$ 150	$ 57,000
Hardened Channel	MI/YEAR	NA	$ 9,500	NA
Maintenance Subtotal				***$ 57,000***

Meridian Channel South Subtotal				***$ 1,768,000***
Contingency 20%				$ 354,000
Meridian Channel North Total				***$ 2,122,000***

Meridian Channel South - Alternative 3

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	134,360	$ 5.00	$ 672,000
Cut-off-Walls (6" Riprap)	CF	67,444	$ 2.41	$ 163,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	11,315	$ 7.00	$ 79,000
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	25,909	$ 13.54	$ 351,000
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ 430,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	40	$ 1,335	$ 53,000
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	520	$ 1,805	$ 939,000
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	1	$ 111,000	$ 111,000
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	3	$ 118,000	$ 354,000
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 1,457,000***
Design and Inspection 15%				$ 408,000
Construction Subtotal				***$ 3,130,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	10.6	$ 4,500	$ 48,000
Riprap Channel Bottom	AC	1.0	$ 1,500	$ 2,000
Landscaped Setback	AC	6.3	$ 6,100	$ 38,000
Landscaped Swale	AC	1.1	$ 13,400	$ 15,000
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	16,411	$ 3.52	$ 58,000
Landscaping Subtotal				***$ 161,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	5,000	$ 15	$ 75,000
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	200	$ 300	$ 60,000
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	5,000	$ 100	$ 500,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 635,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	11	$ 26,000	$ 286,000
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA
Vacant Undeveloped Commercial	AC	14	$ 158,000	$ 2,212,000
Residential Home	AC	NA	$ 130,000	NA
Land Acquisition Subtotal				***$ 2,498,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	11	$ 150	$ 79,000
Hardened Channel	MI/YEAR	1.0	$ 9,500	$ 475,000
Maintenance Subtotal				***$ 554,000***

Meridian Channel South Subtotal				***$ 6,978,000***
Contingency 20%				$ 1,396,000
Meridian Channel South Total				***$ 8,374,000***

Pecos Channel - Alternative 3

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	350,704	$ 5.00	$ 1,754,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	207,682	$ 18.96	$ 3,938,000
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ 3,938,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	145	$ 4,000	$ 580,000
6'x10' Culvert (Six)	FT	760	$ 4,735	$ 3,599,000
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	2	$ 146,000	$ 292,000
6'x10' Headwall & Transition (Six)	EA	7	$ 155,000	$ 1,085,000
Culverts Subtotal				***$ 5,556,000***
Design and Inspection 15%				$ 1,687,000
Construction Subtotal				***$ 12,935,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	2.8	$ 1,500	$ 4,000
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	20.3	$ 6,100	$ 124,000
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	22,976	$ 3.52	$ 81,000
Landscaping Subtotal				***$ 209,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	6,675	$ 100	$ 668,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	4,500	$ 20	$ 90,000
Sewer Service Line	EA	4	$ 24,000	$ 96,000
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 854,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	61	$ 26,000	$ 1,591,000
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
Contingency 10%				$159,000
Land Acquisition Subtotal				***$ 1,750,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	2.8	$ 9,500	$ 1,330,000
Maintenance Subtotal				***$ 1,330,000***

Pecos Channel Subtotal		***$ 17,078,000***
Contingency 20%		$ 3,416,000
Pecos Channel Total		***$ 20,494,000***

Pecos/Meridian Retention Basin - Alternative 3

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	242,000	$ 5.00	$ 1,210,000
Design and Inspection 15% of Excavation Cost				$ 182,000
Construction Subtotal				***$ 1,392,000***
Land Acq. (Vacant Undeveloped Commercial)	AC	24.1	$ 158,000	$ 3,808,000
Landscaping	AC	24.1	$ 5,000	$ 121,000
Maintenance	AC/YEAR	24.1	$ 150	$ 181,000
Pecos/Meridian Retention Basin Subtotal				***$ 5,502,000***
Contingency 20%				$ 1,100,000
Pecos/Meridian Retention Basin Total				***$ 6,602,000***

Ellsworth Alternative 3 Channel - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
Meridian Channel North	$ 1,342,000	$ 62,000	$ 83,000	$ 224,000	$ 57,000	$ 354,000	$ 2,122,000
Meridian Channel South	$ 3,130,000	$ 161,000	$ 635,000	$ 2,498,000	$ 554,000	$ 1,396,000	$ 8,374,000
Pecos Channel	$ 12,935,000	$ 209,000	$ 854,000	$ 1,750,000	$ 1,330,000	$ 3,416,000	$ 20,494,000
Totals	$ 17,407,000	$ 432,000	$ 1,572,000	$ 4,472,000	$ 1,941,000	$ 5,166,000	$ 30,990,000

Ellsworth Alternative 3 Basin - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Total
Pecos/Meridian Retention Basin	$ 1,392,000	$ 121,000	$ -	$ 3,808,000	$ 181,000	$ 1,100,000	$ 6,602,000

Rittenhouse Zone - Alternative 1

Germann Channel - Alternative 1

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	541,004	$ 5.00	$ 2,705,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	75,895	$ 13.54	$ 1,028,000
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	137,775	$ 21.67	$ 2,986,000
Riprap Subtotal				***$ 4,014,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	735	$ 2,540	$ 1,867,000
6'x10' Culvert (Quadruple)	FT	440	$ 3,215	$ 1,415,000
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	24	$ 127,000	$ 3,048,000
6'x10' Headwall & Transition (Quadruple)	EA	6	$ 137,000	$ 822,000
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 7,152,000***
Design and Inspection 15%				$ 2,081,000
Construction Subtotal				***$ 15,952,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	4.8	$ 1,500	$ 7,000
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	14.1	$ 6,100	$ 86,000
O&M Road	SY	23,878	$ 3.52	$ 84,000
Landscaping Subtotal				***$ 177,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	2,920	$ 125	$ 365,000
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	5,380	$ 100	$ 538,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	4,967	$ 120	$ 596,000
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	5	$ 10,633	$ 53,000
Existing Fence Relocation	FT	2,770	$ 20	$ 55,000
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	4	$ 40,000	$ 160,000
Utility Relocation Subtotal				***$ 1,767,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	40	$ 26,000	$ 1,040,000
Residential Lots 1-5 acres	AC	5	$ 49,500	$ 248,000
Vacant Undeveloped Commercial	AC	13	$ 158,000	$ 2,054,000
Residential Home	AC	NA	$ 130,000	NA
Contingency 10%				$334,000
Land Acquisition Subtotal				***$ 3,676,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	ML/YEAR	4.8	$ 9,500	$ 2,280,000
Maintenance Subtotal				***$ 2,280,000***

Germann Channel Subtotal		***$ 23,852,000***
Contingency 20%		$ 4,770,000
Germann Channel Total		***$ 28,622,000***

Meridian Channel (to Germann) - Alternative 1

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	139,806	$ 5.00	$ 699,000
Cut-off-Walls (6" Riprap)	CF	105,656	$ 2.41	$ 255,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Liner Subtotal			$	-
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	340	$ 1,335	$ 454,000
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	4	$ 111,000	$ 444,000
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal			$	***898,000***
Design and Inspection 15%			$	278,000
Construction Subtotal			$	***2,130,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	18.6	$ 4,500	$ 84,000
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	1.3	$ 6,100	$ 8,000
Landscaped Swale	AC	1.3	$ 13,400	$ 18,000
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	8,976	$ 3.52	$ 32,000
Landscaping Subtotal			$	***142,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	4,980	$ 15	$ 75,000
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	110	$ 125	$ 14,000
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	7,160	$ 100	$ 716,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	2,375	$ 120	$ 285,000
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal			$	***1,090,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	17	$ 26,000	$ 429,000
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA
Vacant Undeveloped Commercial	AC	4	$ 158,000	$ 648,000
Residential Home	AC	NA	$ 130,000	NA
Land Acquisition Subtotal			$	***1,077,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	18.6	$ 150	$ 140,000
Hardened Channel	MI/YEAR	NA	$ 9,500	NA
Maintenance Subtotal			$	***140,000***

Meridian Channel (to Germann) Subtotal			$	***4,579,000***
Contingency 20%			$	916,000
Meridian Channel (to Germann) Total			$	***5,495,000***

Queen Creek Channel - Alternative 1

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	21,457	$ 5.00	$ 107,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	16,258	$ 18.96	$ 308,000
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ 308,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	150	$ 1,805	$ 271,000
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	2	$ 118,000	$ 236,000
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 507,000***
Design and Inspection 15%				$ 138,000
Construction Subtotal				***$ 1,060,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	0.5	$ 1,500	$ 1,000
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	1.8	$ 6,100	$ 11,000
O&M Road	SY	4,138	$ 3.52	$ 15,000
Landscaping Subtotal				***$ 27,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	75	$ 125	$ 9,000
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	220	$ 100	$ 22,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	120	$ 120	$ 14,000
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 45,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	5	$ 49,500	$ 248,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	1	$ 130,000	$ 130,000
Contingency 10%				$38,000
Land Acquisition Subtotal				***$ 416,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	0.5	$ 9,500	$ 238,000
Maintenance Subtotal				***$ 238,000***

Queen Creek Channel Subtotal		***$ 1,786,000***
Contingency 20%		$ 357,000
Queen Creek Channel Total		***$ 2,143,000***

Queen Creek & Crismon Retention Basin - Alternative 1

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	18,000	$ 5.00	$ 90,000
Design and Inspection 15% of Excavation Cost				$ 14,000
Construction Subtotal				***$ 104,000***
Land Acq. (Vacant Hold for Investment)	AC	4.5	$ 26,000	$ 117,000
Landscaping	AC	4.5	$ 5,000	$ 23,000
Maintenance	AC/YEAR	4.5	$ 150	$ 34,000
Queen Creek & Crismon Retention Basin				***$ 278,000***
Contingency 20%				$ 56,000
Queen Creek & Crismon Retention Basin				***$ 334,000***

Germann & Ellsworth Retention Basin - Alternative 1

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	218,000	$ 5.00	$ 1,090,000
Design and Inspection 15% of Excavation Cost				$ 164,000
Construction Subtotal				***$ 1,254,000***
Land Acq. (Vacant Hold for Investment)	AC	40.0	$ 26,000	$ 1,040,000
Landscaping	AC	40.0	$ 5,000	$ 200,000
Maintenance	AC/YEAR	40.0	$ 150	$ 300,000
Germann & Ellsworth Retention Basin Total				***$ 2,794,000***
Contingency 20%				$ 559,000
Germann & Ellsworth Retention Basin Total				***$ 3,353,000***

Rittenhouse Alternative 1 Channel - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
Germann Channel	$ 15,952,000	$ 177,000	$ 1,767,000	$ 3,676,000	$ 2,280,000	$ 4,770,000	$ 28,622,000
Meridian Channel (to Germann)	$ 2,130,000	$ 142,000	$ 1,090,000	$ 1,077,000	$ 140,000	$ 916,000	$ 5,495,000
Queen Creek Channel	$ 1,060,000	$ 27,000	$ 45,000	$ 416,000	$ 238,000	$ 357,000	$ 2,143,000
Totals	$ 19,142,000	$ 346,000	$ 2,902,000	$ 5,169,000	$ 2,658,000	$ 6,043,000	$ 36,260,000

Rittenhouse Alternative 1 Basin - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Total
Queen Creek & Crismon Retention Basin	$ 104,000	$ 23,000	$ -	$ 117,000	$ 34,000	$ 56,000	$ 334,000
Germann & Ellsworth Retention Basin	$ 1,254,000	$ 200,000	$ -	$ 1,040,000	$ 300,000	$ 559,000	$ 3,353,000

Rittenhouse Zone - Alternative 2

Ryan Channel - Alternative 2

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	744,315	$ 5.00	$ 3,722,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	383,668	$ 13.54	$ 5,195,000
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal			***$***	***5,195,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	200	$ 2,540	$ 508,000
6'x10' Culvert (Quadruple)	FT	665	$ 3,215	$ 2,138,000
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	5	$ 127,000	$ 635,000
6'x10' Headwall & Transition (Quadruple)	EA	9	$ 137,000	$ 1,233,000
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal			***$***	***4,514,000***
Design and Inspection 15%			$	2,015,000
Construction Subtotal			***$***	***15,446,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	4.7	$ 1,500	$ 7,000
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	7.1	$ 6,100	$ 43,000
O&M Road	SY	125,311	$ 3.52	$ 441,000
Landscaping Subtotal			***$***	***491,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	80	$ 125	$ 10,000
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	280	$ 100	$ 28,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	120	$ 120	$ 14,000
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structures	EA	6	$ 14,500	$ 87,000
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal			***$***	***139,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	25	$ 49,500	$ 1,236,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
SRP Easement	AC	70	$ 24,750	$ 1,739,000
Contingency 10%				$124,000
Land Acquisition Subtotal			***$***	***3,099,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	4.7	$ 9,500	$ 2,233,000
Maintenance Subtotal			***$***	***2,233,000***

Ryan Channel Subtotal	***$***	***21,408,000***
Contingency 20%	$	4,282,000
Ryan Channel Total	***$***	***25,690,000***

Queen Creek Channel - Alternative 2

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	21,457	$ 5.00	$ 107,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	16,258	$ 18.96	$ 308,000
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ 308,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	150	$ 1,805	$ 271,000
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	2	$ 118,000	$ 236,000
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 507,000***
Design and Inspection 15%				$ 138,000
Construction Subtotal				***$ 1,060,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	0.5	$ 1,500	$ 1,000
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	1.8	$ 6,100	$ 11,000
O&M Road	SY	4,138	$ 3.52	$ 15,000
Landscaping Subtotal				***$ 27,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	75	$ 125	$ 9,000
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	220	$ 100	$ 22,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	120	$ 120	$ 14,000
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 45,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Hold for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	5	$ 49,500	$ 248,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	1	$ 130,000	$ 130,000
Contingency 10%				$38,000
Land Acquisition Subtotal				***$ 416,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	0.5	$ 9,500	$ 238,000
Maintenance Subtotal				***$ 238,000***

Queen Creek Channel Subtotal				***$ 1,786,000***
Contingency 20%				$ 357,000
Queen Creek Channel Total				***$ 2,143,000***

Meridian Channel (to Germann) - Alternative 2

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	53,983	$ 5.00	$ 270,000
Cut-off-Walls (6" Riprap)	CF	51,272	$ 2.41	$ 124,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				$ -
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				$ -
Design and Inspection 15%				$ 59,000
Construction Subtotal				$ ***453,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	8.2	$ 4,500	$ 37,000
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	0.8	$ 6,100	$ 5,000
Landscaped Swale	AC	0.8	$ 13,400	$ 11,000
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	5,678	$ 3.52	$ 20,000
Landscaping Subtotal				$ ***73,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	3,700	$ 100	$ 370,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				$ ***370,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Hold for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	11	$ 49,500	$ 552,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
Contingency 10%				$55,000
Land Acquisition Subtotal				$ ***607,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	8	$ 150	$ 62,000
Hardened Channel	MI/YEAR	NA	$ 9,500	NA
Maintenance Subtotal				$ ***62,000***

Meridian Channel (to Germann) Subtotal	$	***1,565,000***
Contingency 20%	$	313,000
Meridian Channel (to Germann) Total	$	***1,878,000***

Queen Creek & Crismon Retention Basin - Alternative 2

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	18,000	$ 5.00	$ 90,000
Design and Inspection 15% of Excavation Cost				$ 14,000
Construction Subtotal				***$ 104,000***
Land Acq. (Vacant Hold for Investment)	AC	4.5	$ 26,000	$ 117,000
Landscaping	AC	4.5	$ 5,000	$ 23,000
Maintenance	AC/YEAR	4.5	$ 150	$ 34,000
Queen Creek & Crismon Retention Basin				***$ 278,000***
Contingency 20%				$ 56,000
Queen Creek & Crismon Retention Basin				***$ 334,000***

Ryan & Rittenhouse Retention Basin - Alternative 2

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	221,000	$ 5.00	$ 1,105,000
Design and Inspection 15% of Excavation Cost				$ 166,000
Construction Subtotal				***$ 1,271,000***
Land Acq. (Vacant Hold for Investment)	AC	30	$ 26,000	$ 780,000
Landscaping	AC	30	$ 5,000	$ 150,000
Maintenance	AC/YEAR	30	$ 150	$ 225,000
Ryan & Rittenhouse Retention Basin				***$ 2,426,000***
Contingency 20%				$ 485,000
Ryan & Rittenhouse Retention Basin				***$ 2,911,000***

Rittenhouse Alternative 2 Channel - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
Ryan Channel	$ 15,446,000	$ 491,000	$ 139,000	$ 3,099,000	$ 2,233,000	$ 4,282,000	$ 25,690,000
Queen Creek Channel	$ 1,060,000	$ 27,000	$ 45,000	$ 416,000	$ 238,000	$ 357,000	$ 2,143,000
Meridian Channel (to Germann)	$ 453,000	$ 73,000	$ 370,000	$ 607,000	$ 62,000	$ 313,000	$ 1,878,000
Totals	$ 16,959,000	$ 591,000	$ 554,000	$ 4,122,000	$ 2,533,000	$ 4,952,000	$ 29,711,000

Rittenhouse Alternative 2 Basin - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Total
Queen Creek & Crismon Retention Basin	$ 104,000	$ 23,000	$ -	$ 117,000	$ 34,000	$ 56,000	$ 334,000
Ryan & Rittenhouse Retention Basin	$ 1,271,000	$ 150,000	$ -	$ 780,000	$ 225,000	$ 485,000	$ 2,911,000

Rittenhouse Zone - Alternative 3

Germann Channel - Alternative 3

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	183,404	$ 5.00	$ 917,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	83,182	$ 7.00	$ 582,000
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	62,734	$ 16.25	$ 1,019,000
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ 1,601,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	440	$ 1,020	$ 449,000
6'x10' Culvert (Double)	FT	735	$ 1,805	$ 1,327,000
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	6	$ 108,000	$ 648,000
6'x10' Headwall & Transition (Double)	EA	22	$ 118,000	$ 2,596,000
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 5,020,000***
Design and Inspection 15%				$ 1,131,000
Construction Subtotal				***$ 8,669,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	4.5	$ 1,500	$ 7,000
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	9.3	$ 6,100	$ 57,000
O&M Road	SY	21,000	$ 3.52	$ 74,000
Landscaping Subtotal				***$ 138,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	3,130	$ 125	$ 391,000
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 105,000	NA
Irrigation Relocation	FT	5,030	$ 100	$ 503,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	630	$ 120	$ 76,000
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	2,770	$ 20	$ 55,000
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	4	$ 40,000	$ 160,000
Utility Relocation Subtotal				***$ 1,185,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	27	$ 26,000	$ 689,000
Residential Lots 1-5 acres	AC	5	$ 49,500	$ 223,000
Vacant Undeveloped Commercial	AC	5	$ 158,000	$ 711,000
Residential Home	AC	NA	$ 130,000	NA
Contingency 10%				$162,000
Land Acquisition Subtotal				***$ 1,785,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	4.5	$ 9,500	$ 2,138,000
Maintenance Subtotal				***$ 2,138,000***

Germann Channel Subtotal		***$ 13,915,000***
Contingency 20%		$ 2,783,000
Germann Channel Total		***$ 16,698,000***

Queen Creek Channel - Alternative 3

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	273,986	$ 5.00	$ 1,370,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	97,045	$ 21.67	$ 2,103,000
Riprap Subtotal				***$ 2,103,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	445	$ 3,215	$ 1,431,000
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	5	$ 137,000	$ 685,000
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 2,116,000***
Design and Inspection 15%				$ 838,000
Construction Subtotal				***$ 6,427,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	2.0	$ 1,500	$ 3,000
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	10.8	$ 6,100	$ 66,000
O&M Road	SY	16,333	$ 3.52	$ 57,000
Landscaping Subtotal				***$ 126,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	100	$ 125	$ 13,000
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	260	$ 100	$ 26,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	100	$ 120	$ 12,000
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	4	$ 10,633	$ 43,000
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 94,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Hold for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	24	$ 49,500	$ 1,188,000
Vacant Undeveloped Commercial	AC	8	$ 158,000	$ 1,185,000
Residential Home	AC	2	$ 130,000	$ 195,000
Contingency 10%				$257,000
Land Acquisition Subtotal				***$ 2,825,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	2.0	$ 9,500	$ 950,000
Maintenance Subtotal				***$ 950,000***

Queen Creek Channel Subtotal		***$ 10,422,000***
Contingency 20%		$ 2,084,000
Queen Creek Channel Total		***$ 12,506,000***

Meridian Channel (to Germann) - Alternative 3

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	53,983	$ 5.00	$ 270,000
Cut-off-Walls (6" Riprap)	CF	51,272	$ 2.41	$ 124,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ -***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ -***
Design and Inspection 15%				$ 59,000
Construction Subtotal				***$ 453,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	8.2	$ 4,500	$ 37,000
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	0.8	$ 6,100	$ 5,000
Landscaped Swale	AC	0.8	$ 13,400	$ 11,000
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	5,678	$ 3.52	$ 20,000
Landscaping Subtotal				***$ 73,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	3,700	$ 100	$ 370,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 370,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	11	$ 49,500	$ 552,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
Contingency 10%				$55,000
Land Acquisition Subtotal				***$ 607,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	8	$ 150	$ 62,000
Hardened Channel	MI/YEAR	NA	$ 9,500	NA
Maintenance Subtotal				***$ 62,000***

Meridian Channel (to Germann) Subtotal				***$ 1,565,000***
Contingency 20%				$ 313,000
Meridian Channel (to Germann) Total				***$ 1,878,000***

Queen Creek & Crismon Retention Basin - Alternative 3

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	169,000	$ 5.00	$ 845,000
Design and Inspection 15% of Excavation Cost				$ 127,000
Construction Subtotal				***$ 972,000***
Land Acq. (Residential Lots 1-5 acres)	AC	26	$ 49,500	$ 1,287,000
Landscaping	AC	26	$ 5,000	$ 130,000
Maintenance	AC/YEAR	26	$ 150	$ 195,000
Queen Creek & Crismon Retention Basin Subtotal				***$ 2,584,000***
Contingency 20%				$ 517,000
Queen Creek & Crismon Retention Basin Total				***$ 3,101,000***

Rittenhouse Alternative 3 Channel - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
Germann Channel	$ 8,669,000	$ 138,000	$ 1,185,000	$ 1,785,000	$ 2,138,000	$ 2,783,000	$ 16,698,000
Queen Creek Channel	$ 6,427,000	$ 126,000	$ 94,000	$ 2,825,000	$ 950,000	$ 2,084,000	$ 12,506,000
Meridian Channel (to Germann)	$ 453,000	$ 73,000	$ 370,000	$ 607,000	$ 62,000	$ 313,000	$ 1,878,000
Totals	$ 15,549,000	$ 337,000	$ 1,649,000	$ 5,217,000	$ 3,150,000	$ 5,180,000	$ 31,082,000

Rittenhouse Alternative 3 Basin - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Total
Queen Creek & Crismon Retention Basin	$ 972,000	$ 130,000	$ -	$ 1,287,000	$ 195,000	$ 517,000	$ 3,101,000

Rittenhouse Zone - Alternative 4

Ryan Channel (along Queen Creek Road) Meridian to Signal Butte - Alternative 4

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	228,198	$ 5.00	$ 1,141,000
Cut-off-Walls (6" Riprap)	CF	80,262	$ 2.41	$ 193,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				$ -
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	270	$ 3,470	$ 937,000
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	4	$ 142,000	$ 568,000
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				$ 1,505,000
Design and Inspection 15%				$ 426,000
Construction Subtotal				***$ 3,265,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	19.2	$ 4,500	$ 87,000
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	1.0	$ 6,100	$ 6,000
Landscaped Swale	AC	1.0	$ 13,400	$ 14,000
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	6,860	$ 3.52	$ 24,000
Landscaping Subtotal				***$ 131,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	NA	$ 100	NA
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	3	$ 20,300	$ 61,000
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 61,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Hold for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	23.0	$ 49,500	$ 1,139,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
SRP Easement	AC	NA	$ 24,750	NA
Land Acquisition Subtotal				***$ 1,139,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	19.2	$ 150	$ 144,000
Landscaped Setback	AC/YEAR	1.0	$ 150	$ 8,000
Landscaped Swale	AC/YEAR	1.0	$ 150	$ 8,000
O&M Road	AC/YEAR	1.4	$ 100	$ 7,000
Hardened Channel	MI/YEAR	NA	$ 9,500	NA
Maintenance Subtotal				***$ 167,000***

Ryan Channel (along Queen Creek Road) Meridian to Signal Butte Subtotal	***$***	***4,596,000***
Contingency 20%	$	919,000
Ryan Channel (along Queen Creek Road) Meridian to Signal Butte Total	***$***	***5,515,000***

Ryan Channel (along Signal Butte) Queen Creek to Ryan - Alternative 4
(Turf Channel w/ SRP Easment)

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	141,321	$ 5.00	$ 707,000
Low Flow Channel	FT	3,800	$ 50	$ 190,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				$ -
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	160	$ 3,470	$ 555,000
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	2	$ 142,000	$ 284,000
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				$ ***839,000***
Design and Inspection 15%				$ 260,000
Construction Subtotal				$ ***1,806,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	2.5	$ 26,180	$ 65,000
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	5,911	$ 3.52	$ 21,000
Turf-Lined Channel	AC	19.5	$ 26,180	$ 511,000
Landscaping Subtotal				$ ***597,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	700	$ 175	$ 123,000
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	350	$ 100	$ 35,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation (No Conflict: Channel not deep enough)	FT	350	$ -	$ -
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				$ ***158,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	14.0	$ 49,500	$ 693,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
SRP Easement	AC	9.0	$ 24,750	$ 223,000
Land Acquisition Subtotal				$ ***916,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	NA	$ 150	NA
Landscaped Setback	AC/YEAR	1.4	$ 150	$ 11,000
O&M Road	AC/YEAR	0.7	$ 100	$ 4,000
Turf-Lined Channel	AC/YEAR	19.5	$ 9,500	$ 9,262,500
Maintenance Subtotal				$ ***9,278,000***

Ryan Channel (along Signal Butte) Queen Creek to Ryan Subtotal	$	***3,477,000***
Contingency 20%	$	695,000
Ryan Channel (along Signal Butte) Queen Creek to Ryan Total	$	***4,172,000***

Ryan Channel - Signal Butte to 122nd St - Alternative 4
(Turf Channel w/ SRP Easment)

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	140,504	$ 5.00	$ 703,000
Low Flow Channel	FT	6,900	$ 50	$ 345,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				$ -
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	110	$ 1,845	$ 203,000
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	110	$ 2,910	$ 320,000
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	2	$ 118,000	$ 236,000
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	2	$ 133,000	$ 266,000
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 1,025,000***
Design and Inspection 15%				$ 311,000
Construction Subtotal				***$ 2,384,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	4.5	$ 26,180	$ 118,000
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	10,733	$ 3.52	$ 38,000
Turf-Lined Channel	AC	23.5	$ 26,180	$ 615,000
Landscaping Subtotal				***$ 771,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	150	$ 100	$ 15,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	150	$ 120	$ 18,000
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 33,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	12.8	$ 49,500	$ 633,000
Vacant Undeveloped Commercial	AC	0.7	$ 158,000	$ 108,000
Residential Home	AC	NA	$ 130,000	NA
SRP Easement (vacant undeveloped comm.)	AC	0.8	$ 79,000	$ 63,000
SRP Easement (residential)	AC	15.0	$ 24,750	$ 372,000
Land Acquisition Subtotal				***$ 1,176,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	NA	$ 150	NA
Landscaped Setback	AC/YEAR	4.4	$ 150	$ 33,000
O&M Road	AC/YEAR	2.2	$ 100	$ 11,000
Turf-Lined Channel	AC/YEAR	23.5	$ 9,500	$ 11,163,000
Maintenance Subtotal				***$ 11,207,000***

Ryan Channel - Signal Butte to 122nd St Subtotal	***$***	***4,364,000***
Contingency 20%	$	873,000
Ryan Channel - Signal Butte to 122nd St Total	***$***	***5,237,000***

Ryan Channel - 122nd St to Ellsworth - Alternative 4
(Turf Channel w/ SRP Easment)

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	17,400	$ 5.00	$ 87,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				$ -
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	110	$ 1,845	$ 203,000
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	2	$ 118,000	$ 236,000
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				$ ***439,000***
Design and Inspection 15%				$ 79,000
Construction Subtotal				$ ***605,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	2.0	$ 26,180	$ 52,000
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	4,060	$ 3.52	$ 14,000
Turf-Lined Channel	AC	8.0	$ 26,180.00	$ 209,000
Landscaping Subtotal				$ ***275,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	NA	$ 100	NA
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				$ -

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	4.0	$ 49,500	$ 198,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
SRP Easement	AC	6.0	$ 24,750	$ 149,000
Land Acquisition Subtotal				$ ***347,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	ML/YEAR	NA	$ 150	NA
Landscaped Setback	AC/YEAR	1.7	$ 150	$ 13,000
O&M Road	AC/YEAR	0.8	$ 100	$ 4,000
Turf-Lined Channel	AC/YEAR	8.0	$ 9,500	$ 3,800,000
Maintenance Subtotal				$ ***3,817,000***

Ryan Channel - 122nd St to Ellsworth Subtotal	$	***1,227,000***
Contingency 20%	$	245,000
Ryan Channel - 122nd St to Ellsworth Total	$	***1,472,000***

Ryan Channel - Ellsworth to Rittenhouse - Alternative 4
(Channel w/ SRP Easment Constricted)

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	126,496	$ 5.00	$ 632,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	26,958	$ 18.96	$ 511,000
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal			***$***	***511,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	110	$ 1,845	$ 203,000
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	2	$ 118,000	$ 236,000
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal			***$***	***439,000***
Misc. Construction Items				
Remove AC Pavement	SY	11,733	$ 3	$ 35,000
Sidewalk Removal	SF	36,326	$ 0.88	$ 32,000
Prepare Subgrade and Install A.C. Pavement	SY	11,733	$ 35	$ 411,000
Remove and Relocate Existing Fence	LF	2,600	$ 25	$ 65,000
Remove and Replace Incidentals (Mail Boxes, etc.)	LS	1	$ 20,000	$ 20,000
Misc. Construction Items Subtotal			***$***	***563,000***
Design and Inspection 15%			$	322,000
Construction Subtotal			***$***	***2,467,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	NA	$ 3.52	NA
Channel - Fulton Homes Reach	LS	1	$ 245,300	$ 245,000
Construct 6' Concrete Sidewalk	SF	36,326	$ 2.43	$ 88,000
Landscaping Subtotal			***$***	***333,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	140	$ 175	$ 25,000
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	140	$ 100	$ 14,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Misc. Structure Remove/Replace (Light Post)	EA	21	$ 100	$ 2,000
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal			***$***	***41,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
SRP Easement	AC	15.5	$ 24,750	$ 384,000
Land Acquisition Subtotal			***$***	***384,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	NA	$ 150	NA
Landscaped Setback	AC/YEAR	NA	$ 150	NA
O&M Road	AC/YEAR	NA	$ 100	NA
Turf-Lined Channel	AC/YEAR	15.5	$ 9,500	$ 7,363,000
Maintenance Subtotal			***$***	***7,363,000***

Ryan Channel Ellsworth to Rittenhouse Channel Subtotal	***$***	***3,225,000***
Contingency 20%	$	645,000

Ellsworth to Rittenhouse Total	***$ 3,870,000***

Queen Creek Channel

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	21,457	$ 5.00	$ 107,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	16,258	$ 18.96	$ 308,000
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ 308,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	150	$ 1,805	$ 271,000
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	2	$ 118,000	$ 236,000
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				***$ 507,000***
Design and Inspection 15%				$ 138,000
Construction Subtotal				***$ 1,060,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	0.5	$ 1,500	$ 1,000
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	1.8	$ 6,100	$ 11,000
O&M Road	SY	4,138	$ 3.52	$ 15,000
Landscaping Subtotal				***$ 27,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	75	$ 125	$ 9,000
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	220	$ 100	$ 22,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	120	$ 120	$ 14,000
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 45,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	5	$ 49,500	$ 248,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	1	$ 130,000	$ 130,000
Contingency 10%				$38,000
Land Acquisition Subtotal				***$ 416,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	0.5	$ 9,500	$ 238,000
Maintenance Subtotal				***$ 238,000***

Queen Creek Channel Subtotal				***$ 1,548,000***
Contingency 20%				$ 310,000
Queen Creek Channel Total				***$ 1,858,000***

Meridian Channel (to Germann) - Alternative 4

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	53,983	$ 5.00	$ 270,000
Cut-off-Walls (6" Riprap)	CF	51,272	$ 2.41	$ 124,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				$ -
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				$ -
Design and Inspection 15%				$ 59,000
Construction Subtotal				$ ***453,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	8.2	$ 4,500	$ 37,000
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	0.8	$ 6,100	$ 5,000
Landscaped Swale	AC	0.8	$ 13,400	$ 11,000
Landscaped Low Flow Channel	AC	NA	$ 6,100	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	5,678	$ 3.52	$ 20,000
Landscaping Subtotal				$ ***73,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	3,700	$ 100	$ 370,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				$ ***370,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	11	$ 49,500	$ 552,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
Contingency 10%				$55,000
Land Acquisition Subtotal				$ ***607,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	8	$ 150	$ 62,000
Hardened Channel	ML/YEAR	NA	$ 9,500	NA
Maintenance Subtotal				$ ***62,000***

Meridian Channel (to Germann) Subtotal	$	***1,503,000***
Contingency 20%	$	301,000
Meridian Channel (to Germann) Total	$	***1,804,000***

Queen Creek & Crismon Retention Basin

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	18,000	$ 5.00	$ 90,000
Design and Inspection 15% of Excavation Cost				$ 14,000
Construction Subtotal				*$ 104,000*
Land Acq. (Vacant Hold for Investment)	AC	4.5	$ 26,000	$ 117,000
Landscaping	AC	4.5	$ 5,000	$ 23,000
Maintenance	AC/YEAR	4.5	$ 150	$ 34,000
Queen Creek & Crismon Retention Basin				*$ 244,000*
Contingency 20%				$ 49,000
Queen Creek & Crismon Retention Basin				*$ 293,000*

Signal Butte Retention Basin

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	29,000	$ 5.00	$ 145,000
Design and Inspection 15% of Excavation Cost				$ 22,000
Construction Subtotal				*$ 167,000*
Land Acq. (Residential Lots 1-5 acres)	AC	4.5	$ 49,500	$ 223,000
Landscaping	AC	4.5	$ 27,890	$ 126,000
Maintenance	AC/YEAR	4.5	$ 16,400	$ 3,690,000
Signal Butte Retention Basin				*$ 516,000*
Contingency 20%				$ 103,000
Signal Butte Retention Basin Total				*$ 619,000*

Ryan & Ellsworth Retention Basin

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	163,000	$ 5.00	$ 815,000
Design and Inspection 15% of Excavation Cost				$ 122,000
Construction Subtotal				*$ 937,000*
Land Acq. (Residential Lots 1-5 acres)	AC	25.5	$ 49,500	$ 1,262,000
Landscaping	AC	25.5	$ 27,890	$ 711,000
Maintenance	AC/YEAR	25.5	$ 16,400	$ 20,910,000
Ryan & Ellsworth Retention Basin				*$ 2,910,000*
Contingency 20%				$ 582,000
Ryan & Ellsworth Retention Basin Total				*$ 3,492,000*

Rittenhouse Alternative 4 Channel - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Contingency	Total without Maintenance
Meridian to Signal Butte	$ 3,265,000	$ 131,000	$ 61,000	$ 1,139,000	$ 919,000	$ 5,515,000
Queen Creek to Ryan	$ 1,806,000	$ 597,000	$ 158,000	$ 916,000	$ 695,000	$ 4,172,000
Signal Butte to 122nd St	$ 2,384,000	$ 771,000	$ 33,000	$ 1,176,000	$ 873,000	$ 5,237,000
122nd St to Ellsworth	$ 605,000	$ 275,000	$ -	$ 347,000	$ 245,000	$ 1,472,000
Ellsworth to Rittenhouse	$ 2,467,000	$ 333,000	$ 41,000	$ 384,000	$ 645,000	$ 3,870,000
Queen Creek	$ 1,060,000	$ 27,000	$ 45,000	$ 416,000	$ 310,000	$ 1,858,000
Meridian to Germann	$ 453,000	$ 73,000	$ 370,000	$ 607,000	$ 301,000	$ 1,804,000
Totals	$ 12,040,000	$ 2,207,000	$ 708,000	$ 4,985,000	$ 3,988,000	$ 23,928,000

Rittenhouse Alternative 4 Basin - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Contingency	Total
Queen Creek & Crismon Retention Basin	$ 104,000	$ 23,000	$ -	$ 117,000	$ 49,000	$ 293,000
Signal Butte Retention Basin	$ 167,000	$ 126,000	$ -	$ 223,000	$ 103,000	$ 619,000
Ryan & Ellsworth Retention Basin	$ 937,000	$ 711,000	$ -	$ 1,262,000	$ 582,000	$ 3,492,000

Rittenhouse Alternative 4 - Maintenance (50 Year Life)

	Contingency	Maintenance
Meridian to Signal Butte	$ 33,000	$ 167,000
Queen Creek to Ryan	$ 1,856,000	$ 9,278,000
Signal Butte to 122nd St	$ 2,241,000	$ 11,207,000
122nd St to Ellsworth	$ 763,000	$ 3,817,000
Ellsworth to Rittenhouse	$ 1,473,000	$ 7,363,000
Queen Creek	$ 48,000	$ 238,000
Meridian to Germann	$ 12,000	$ 62,000
Queen Creek & Crismon Retention Basin	$ 7,000	$ 34,000
Signal Butte Retention Basin	$ 738,000	$ 3,690,000
Ryan & Ellsworth Retention Basin	$ 4,182,000	$ 20,910,000
Totals	$ 11,353,000	$ 56,766,000
	Rittenhouse Alternative 4 - Maintenance Total	$ 68,119,000

Rittenhouse Alternative 4 - Total Life Cycle Cost (50 year)	*$ 96,451,000*

Rittenhouse Zone - Alternative 5

Merrill Channel - Alternative 5

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	14,573	$ 5.00	$ 73,000
Cut-off-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	7,274	$ 7.00	$ 51,000
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ 51,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	150	$ 1,335	$ 200,000
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	2	$ 111,000	$ 222,000
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				$ 422,000
Design and Inspection 15%				$ 82,000
Construction Subtotal				***$ 628,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	0.3	$ 1,500	$ 1,000
Landscaped Setback	AC	NA	$ 6,100	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	NA	$ 3.52	NA
Landscaping Subtotal				***$ 1,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	140	$ 100	$ 14,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 14,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	3	$ 49,500	$ 149,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
Land Acquisition Subtotal				***$ 149,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	0.3	$ 9,500	$ 143,000
Maintenance Subtotal				***$ 143,000***

Merrill Channel Subtotal		***$ 935,000***
Contingency 20%		$ 187,000
Merrill Channel Total		***$ 1,122,000***

Queen Creek Channel - Alternative 5

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	26,199	$ 5.00	$ 131,000
Cut-offf-Walls (6" Riprap)	CF	NA	$ 2.41	NA
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	18,494	$ 7.00	$ 129,000
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				***$ 129,000***
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	150	$ 1,335	$ 200,000
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	2	$ 111,000	$ 222,000
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				$ 422,000
Design and Inspection 15%				$ 102,000
Construction Subtotal				***$ 784,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	NA	$ 4,500	NA
Riprap Channel Bottom	AC	0.6	$ 1,500	$ 1,000
Landscaped Setback	AC	NA	$ 26,180	NA
Landscaped Swale	AC	NA	$ 13,400	NA
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	NA	$ 3.52	NA
Landscaping Subtotal				***$ 1,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	200	$ 15	$ 3,000
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	3,000	$ 175	$ 525,000
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	3,000	$ 100	$ 300,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	750	$ 120	$ 90,000
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				***$ 918,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Hold for Investment	AC	NA	$ 26,000	NA
Residential Lots 1-5 acres	AC	5	$ 49,500	$ 241,000
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
SRP Easement	AC	NA	$ 24,750	NA
Land Acquisition Subtotal				***$ 241,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	NA	$ 150	NA
Hardened Channel	MI/YEAR	0.6	$ 9,500	$ 285,000
Landscaped Setback	AC/YEAR	NA	$ 16,400	NA
O&M Road	AC/YEAR	NA	$ 100	NA
Maintenance Subtotal				***$ 285,000***
Queen Creek Channel Subtotal				***$ 2,229,000***
Contingency 20%				***$ 446,000***
Queen Creek Channel Total				***$ 2,675,000***

Meridian (to Germann) Channel - Alternative 5

Construction	UM	Quantity	Unit Cost	Budgetary Cost
Excavation[1]	CY	34,201	$ 5.00	$ 171,000
Cut-off-Walls (6" Riprap)	CF	27,144	$ 2.41	$ 65,000
Liner				
Riprap d_{50} = 1"	SY	NA	$ 7.00	NA
Riprap d_{50} = 2"	SY	NA	$ 7.00	NA
Riprap d_{50} = 3"	SY	NA	$ 7.00	NA
Riprap d_{50} = 4"	SY	NA	$ 7.00	NA
Riprap d_{50} = 5"	SY	NA	$ 13.54	NA
Riprap d_{50} = 6"	SY	NA	$ 16.25	NA
Riprap d_{50} = 7"	SY	NA	$ 18.96	NA
Riprap d_{50} = 8"	SY	NA	$ 21.67	NA
Riprap Subtotal				$ -
Culverts				
5'x8' Culvert (Single)	FT	NA	$ 760	NA
5'x8' Culvert (Double)	FT	NA	$ 1,335	NA
5'x8' Culvert (Triple)	FT	NA	$ 1,845	NA
5'x8' Culvert (Quadruple)	FT	NA	$ 2,375	NA
5'x8' Culvert (Five)	FT	NA	$ 2,910	NA
5'x8' Culvert (Six)	FT	NA	$ 3,470	NA
6'x10' Culvert (Single)	FT	NA	$ 1,020	NA
6'x10' Culvert (Double)	FT	NA	$ 1,805	NA
6'x10' Culvert (Triple)	FT	NA	$ 2,540	NA
6'x10' Culvert (Quadruple)	FT	NA	$ 3,215	NA
6'x10' Culvert (Five)	FT	NA	$ 4,000	NA
6'x10' Culvert (Six)	FT	NA	$ 4,735	NA
5'x8' Headwall & Transition (Single)	EA	NA	$ 103,000	NA
5'x8' Headwall & Transition (Double)	EA	NA	$ 111,000	NA
5'x8' Headwall & Transition (Triple)	EA	NA	$ 118,000	NA
5'x8' Headwall & Transition (Quadruple)	EA	NA	$ 126,000	NA
5'x8' Headwall & Transition (Five)	EA	NA	$ 133,000	NA
5'x8' Headwall & Transition (Six)	EA	NA	$ 142,000	NA
6'x10' Headwall & Transition (Single)	EA	NA	$ 108,000	NA
6'x10' Headwall & Transition (Double)	EA	NA	$ 118,000	NA
6'x10' Headwall & Transition (Triple)	EA	NA	$ 127,000	NA
6'x10' Headwall & Transition (Quadruple)	EA	NA	$ 137,000	NA
6'x10' Headwall & Transition (Five)	EA	NA	$ 146,000	NA
6'x10' Headwall & Transition (Six)	EA	NA	$ 155,000	NA
Culverts Subtotal				$ -
Design and Inspection 15%				$ 35,000
Construction Subtotal				$ ***271,000***

Landscaping	UM	Quantity	Unit Cost	Budgetary Cost
Movable Bed Channel	AC	4.8	$ 4,500	$ 21,000
Riprap Channel Bottom	AC	NA	$ 1,500	NA
Landscaped Setback	AC	0.4	$ 26,180	$ 11,000
Landscaped Swale	AC	0.4	$ 13,400	$ 6,000
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	2,800	$ 3.52	$ 10,000
Landscaping Subtotal				$ ***48,000***

Utility Relocation	UM	Quantity	Unit Cost	Budgetary Cost
Distribution OHE Relocation	FT	NA	$ 15	NA
69kV OHE Relocation	FT	NA	$ 185	NA
8" Water Line Relocation	FT	NA	$ 125	NA
12" Water Line Relocation	FT	NA	$ 175	NA
16" Water Line Relocation	FT	NA	$ 300	NA
Water Service Line	EA	NA	$ 10,500	NA
Irrigation Relocation	FT	2,000	$ 100	$ 200,000
2" Gas Line Relocation	FT	NA	$ 100	NA
4" Gas Line Relocation	FT	NA	$ 120	NA
Fiber Optics Relocation	FT	NA	$ 10	NA
Fiber Optics Splice	EA	NA	$ 2,500	NA
Drop Structure	EA	NA	$ -	NA
Existing Fence Relocation	FT	NA	$ 20	NA
Sewer Service Line	EA	NA	$ 24,000	NA
Sewer Line Relocation	FT	NA	$ -	NA
Siphon Irrigation Crossing	EA	NA	$ 40,000	NA
Utility Relocation Subtotal				$ ***200,000***

Land Acquisition	UM	Quantity	Unit Cost	Budgetary Cost
Vacant Held for Investment	AC	7	$ 26,000	$ 179,000
Residential Lots 1-5 acres	AC	NA	$ 49,500	NA
Vacant Undeveloped Commercial	AC	NA	$ 158,000	NA
Residential Home	AC	NA	$ 130,000	NA
SRP Easement (Vacant Undevelped)	AC	NA	$ 79,000	NA
Land Acquisition Subtotal				$ ***179,000***

Maintenance	UM	Quantity	Unit Cost	Budgetary Cost[2]
Movable Bed Channel	AC/YEAR	5	$ 150	$ 36,000
Hardened Channel	MI/YEAR	NA	$ 9,500	NA
Landscaped Setback	AC	0.4	$ 26,180	$ 11,000
Landscaped Swale	AC	0.4	$ 13,400	$ 6,000
Landscaped Buffer Zone	AC	NA	$ 6,100	NA
O&M Road	SY	2,800	$ 3.52	$ 10,000
Maintenance Subtotal				$ ***63,000***

Meridian Channel Subtotal	$	***761,000***
Contingency 20%	$	152,000
Meridian Channel Total	$	***913,000***

Sports Complex Retention Basin

Item	UM	Quantity	Unit Cost	Budgetary Cost
Construction				
Excavation	CY	194,000	$ 5.00	$ 970,000
Design and Inspection 15% of Excavation Cost				$ 146,000
Outlet				
5'x8' Culvert (Double)	FT	50	$ 1,050	$ 53,000
5'x8' Headwall & Transition (Double)	EA	2	$ 79,000	$ 158,000
Construction Subtotal				**$ 1,327,000**
Land Acq. (Residential Lots 1-5 acres)	AC	30	$ 49,500	$ 1,485,000
Landscaping	AC	30	$ 27,890	$ 837,000
Maintenance	AC/YEAR	30	$ 16,400	$ 492,000
Sports Complex Retention Basin				$ 4,141,000
Contingency 20%				$ 828,000
Sports Complex Retention Basin Total				***$ 4,969,000***

Rittenhouse Alternative 5 Channel - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Totals
Merrill Channel	$ 628,000	$ 1,000	$ 14,000	$ 149,000	$ 143,000	$ 187,000	$ 1,122,000
Queen Creek Channel	$ 784,000	$ 1,000	$ 918,000	$ 241,000	$ 285,000	$ 446,000	$ 2,675,000
Meridian Channel (to Germann)	$ 271,000	$ 48,000	$ 200,000	$ 179,000	$ 63,000	$ 152,000	$ 913,000
Totals	$ 1,683,000	$ 50,000	$ 1,132,000	$ 569,000	$ 491,000	$ 785,000	$ 4,710,000

Rittenhouse Alternative 5 Basin - Summary

	Construction	Landscaping	Utility Relocation	Land Acquisition	Maintenance	Contingency	Total
Sports Complex Retention Basin	$ 1,327,000	$ 837,000	$ -	$ 1,485,000	$ 492,000	$ 828,000	$ 4,969,000

UNIT COSTS

East Mesa ADMP - Alternative Analysis

Proposed Alternatives Development and Evaluation

Appendix I - Cost Estimates

Cost Summary

Cost Estimates

Unit Cost Development

Construction (Culverts, Excavation, Riprap)

Landscaping

Land Acquisition

Maintenance

Quantity Estimation

Riprap Cutoff Walls

Channel Excavation

Riprap Liner

East Mesa ADMP - Alternative Analysis

Unit Cost Development

Construction (Culverts, Excavation, Riprap)

Landscaping

Land Acquisition

Maintenance

Quantity Estimation

Riprap Cutoff Walls

Channel Excavation

Riprap Liner

310.057

Culvert Estimate With Pavement Replacement ($/LF)

5'x8' Culvert (single)

	Qty	Cost	Ext
Steel	126.2	$ 0.85	$ 107.27
Concrete	1.016	$ 75.00	$ 76.20
		Total Materials	$ 183.47
		Equipment & Labor	$ 366.94
		Remove AC Pavement ($11/SY)	$ 23.63
		4" AC on 8" ABC ($48/SY)	$ 103.11
		Traffic Control (3%)	$ 22.02
		Excavation ($4.50/CY)	$ 26.00
		Structural Backfill (8.00/CY)	$ 30.81
		Total Cost	**$ 755.98**

6'x10' Culvert (single)

	Qty	Cost	Ext
Steel	190.7	$ 0.85	$ 162.10
Concrete	1.317	$ 75.00	$ 98.78
		Total Materials	$ 260.87
		Equipment & Labor	$ 521.74
		Remove AC Pavement ($11/SY)	$ 24.44
		4" AC on 8" ABC ($48/SY)	$ 106.67
		Traffic Control (3%)	$ 29.61
		Excavation ($4.50/CY)	$ 34.67
		Structural Backfill (8.00/CY)	$ 38.52
		Total Cost	**$ 1,016.51**

5'x8' Culvert (double)

	Qty	Cost	Ext
Steel	265.3	$ 0.85	$ 225.51
Concrete	1.597	$ 75.00	$ 119.78
		Total Materials	$ 345.28
		Equipment & Labor	$ 690.56
		Remove AC Pavement ($11/SY)	$ 26.89
		4" AC on 8" ABC ($48/SY)	$ 117.33
		Traffic Control (3%)	$ 38.81
		Excavation ($4.50/CY)	$ 52.00
		Structural Backfill (8.00/CY)	$ 61.63
		Total Cost	**$ 1,332.50**

6'x10' Culvert (double)

	Qty	Cost	Ext
Steel	377.3	$ 0.85	$ 320.71
Concrete	2.171	$ 75.00	$ 162.83
		Total Materials	$ 483.53
		Equipment & Labor	$ 967.06
		Remove AC Pavement ($11/SY)	$ 28.52
		4" AC on 8" ABC ($48/SY)	$ 124.44
		Traffic Control (3%)	$ 52.50
		Excavation ($4.50/CY)	$ 69.33
		Structural Backfill (8.00/CY)	$ 77.04
		Total Cost	**$ 1,802.42**

5'x8' Culvert (triple)

	Qty	Cost	Ext
Steel	368.6	$ 0.85	$ 313.31
Concrete	2.292	$ 75.00	$ 171.90
		Total Materials	$ 485.21
		Equipment & Labor	$ 970.42
		Remove AC Pavement ($11/SY)	$ 30.15
		4" AC on 8" ABC ($48/SY)	$ 131.56
		Traffic Control (3%)	$ 53.63
		Excavation ($4.50/CY)	$ 78.00
		Structural Backfill (8.00/CY)	$ 92.44
		Total Cost	**$ 1,841.41**

6'x10' Culvert (triple)

	Qty	Cost	Ext
Steel	540.2	$ 0.85	$ 459.17
Concrete	3.086	$ 75.00	$ 231.45
		Total Materials	$ 690.62
		Equipment & Labor	$ 1,381.24
		Remove AC Pavement ($11/SY)	$ 32.59
		4" AC on 8" ABC ($48/SY)	$ 142.22
		Traffic Control (3%)	$ 73.99
		Excavation ($4.50/CY)	$ 104.00
		Structural Backfill (8.00/CY)	$ 115.56
		Total Cost	**$ 2,540.22**

5'x8' Culvert (quad)

	Qty	Cost	Ext
Steel	479.9	$ 0.85	$ 407.92
Concrete	2.986	$ 75.00	$ 223.95
		Total Materials	$ 631.87
		Equipment & Labor	$ 1,263.73
		Remove AC Pavement ($11/SY)	$ 33.41
		4" AC on 8" ABC ($48/SY)	$ 145.78
		Traffic Control (3%)	$ 69.06
		Excavation ($4.50/CY)	$ 104.00
		Structural Backfill (8.00/CY)	$ 123.26
		Total Cost	**$ 2,371.10**

6'x10' Culvert (quad)

	Qty	Cost	Ext
Steel	679	$ 0.85	$ 577.15
Concrete	4.001	$ 75.00	$ 300.08
		Total Materials	$ 877.23
		Equipment & Labor	$ 1,754.45
		Remove AC Pavement ($11/SY)	$ 36.67
		4" AC on 8" ABC ($48/SY)	$ 160.00
		Traffic Control (3%)	$ 93.63
		Excavation ($4.50/CY)	$ 138.67
		Structural Backfill (8.00/CY)	$ 154.07
		Total Cost	**$ 3,214.71**

5'x8' Culvert (five)

	Qty	Cost	Ext
Steel	593.8	$ 0.85	$ 504.73
Concrete	3.681	$ 75.00	$ 276.08
		Total Materials	$ 780.81
		Equipment & Labor	$ 1,561.61
		Remove AC Pavement ($11/SY)	$ 36.67
		4" AC on 8" ABC ($48/SY)	$ 160.00
		Traffic Control (3%)	$ 84.69
		Excavation ($4.50/CY)	$ 130.00
		Structural Backfill (8.00/CY)	$ 154.07
		Total Cost	**$ 2,907.85**

6'x10' Culvert (five)

	Qty	Cost	Ext
Steel	860.3	$ 0.85	$ 731.26
Concrete	4.915	$ 75.00	$ 368.63
		Total Materials	$ 1,099.88
		Equipment & Labor	$ 2,199.76
		Remove AC Pavement ($11/SY)	$ 40.74
		4" AC on 8" ABC ($48/SY)	$ 177.78
		Traffic Control (3%)	$ 116.52
		Excavation ($4.50/CY)	$ 173.33
		Structural Backfill (8.00/CY)	$ 192.59
		Total Cost	**$ 4,000.61**

5'x8' Culvert (six)

	Qty	Cost	Ext
Steel	715.8	$ 0.85	$ 608.43
Concrete	4.375	$ 75.00	$ 328.13
		Total Materials	$ 936.56
		Equipment & Labor	$ 1,873.11
		Remove AC Pavement ($11/SY)	$ 39.93
		4" AC on 8" ABC ($48/SY)	$ 174.22
		Traffic Control (3%)	$ 100.94
		Excavation ($4.50/CY)	$ 156.00
		Structural Backfill (8.00/CY)	$ 184.89
		Total Cost	**$ 3,465.64**

6'x10' Culvert (six)

	Qty	Cost	Ext
Steel	1021.8	$ 0.85	$ 868.53
Concrete	5.83	$ 75.00	$ 437.25
		Total Materials	$ 1,305.78
		Equipment & Labor	$ 2,611.56
		Remove AC Pavement ($11/SY)	$ 44.81
		4" AC on 8" ABC ($48/SY)	$ 195.56
		Traffic Control (3%)	$ 137.90
		Excavation ($4.50/CY)	$ 208.00
		Structural Backfill (8.00/CY)	$ 231.11
		Total Cost	**$ 4,734.73**

Notes:

Qty's derived from ADOT Details

Assume 30% Over-Excavation for Trench and Subgrade

Excavation & Backfill Includes 10' of cover

Excludes general conditions (mobilization, construction water, materials testing etc.)

310.057

Outlet Headwall Estimate ($/EA)

5'x8' Culvert (single)

	Qty	Cost	Ext
Steel	1083	$ 0.85	$ 920.55
Concrete	15.06	$ 75.00	$ 1,129.50
		Total Materials	$ 2,050.05
		Equipment & Labor	$ 4,100.10
		Handrail ($40/LF)	$ 1,520.00
		Total Cost	**$ 7,670.15**

6'x10' Culvert (single)

	Qty	Cost	Ext
Steel	1396	$ 0.85	$ 1,186.60
Concrete	19.14	$ 75.00	$ 1,435.50
		Total Materials	$ 2,622.10
		Equipment & Labor	$ 5,244.20
		Handrail ($40/LF)	$ 1,800.00
		Total Cost	**$ 9,666.30**

5'x8' Culvert (double)

	Qty	Cost	Ext
Steel	1260	$ 0.85	$ 1,071.00
Concrete	17.08	$ 75.00	$ 1,281.00
		Total Materials	$ 2,352.00
		Equipment & Labor	$ 4,704.00
		Handrail ($40/LF)	$ 1,840.00
		Total Cost	**$ 8,896.00**

6'x10' Culvert (double)

	Qty	Cost	Ext
Steel	1616	$ 0.85	$ 1,373.60
Concrete	21.65	$ 75.00	$ 1,623.75
		Total Materials	$ 2,997.35
		Equipment & Labor	$ 5,994.70
		Handrail ($40/LF)	$ 2,200.00
		Total Cost	**$ 11,192.05**

5'x8' Culvert (triple)

	Qty	Cost	Ext
Steel	1437	$ 0.85	$ 1,221.45
Concrete	19.1	$ 75.00	$ 1,432.50
		Total Materials	$ 2,653.95
		Equipment & Labor	$ 5,307.90
		Handrail ($40/LF)	$ 2,160.00
		Total Cost	**$ 10,121.85**

6'x10' Culvert (triple)

	Qty	Cost	Ext
Steel	1836	$ 0.85	$ 1,560.60
Concrete	24.16	$ 75.00	$ 1,812.00
		Total Materials	$ 3,372.60
		Equipment & Labor	$ 6,745.20
		Handrail ($40/LF)	$ 2,600.00
		Total Cost	**$ 12,717.80**

5'x8' Culvert (quad)

	Qty	Cost	Ext
Steel	1614	$ 0.85	$ 1,371.90
Concrete	21.12	$ 75.00	$ 1,584.00
		Total Materials	$ 2,955.90
		Equipment & Labor	$ 5,911.80
		Handrail ($40/LF)	$ 2,480.00
		Total Cost	**$ 11,347.70**

6'x10' Culvert (quad)

	Qty	Cost	Ext
Steel	2056	$ 0.85	$ 1,747.60
Concrete	26.67	$ 75.00	$ 2,000.25
		Total Materials	$ 3,747.85
		Equipment & Labor	$ 7,495.70
		Handrail ($40/LF)	$ 3,000.00
		Total Cost	**$ 14,243.55**

5'x8' Culvert (five)

	Qty	Cost	Ext
Steel	1791	$ 0.85	$ 1,522.35
Concrete	23.14	$ 75.00	$ 1,735.50
		Total Materials	$ 3,257.85
		Equipment & Labor	$ 6,515.70
		Handrail ($40/LF)	$ 2,800.00
		Total Cost	**$ 12,573.55**

6'x10' Culvert (five)

	Qty	Cost	Ext
Steel	2276	$ 0.85	$ 1,934.60
Concrete	29.18	$ 75.00	$ 2,188.50
		Total Materials	$ 4,123.10
		Equipment & Labor	$ 8,246.20
		Handrail ($40/LF)	$ 3,400.00
		Total Cost	**$ 15,769.30**

5'x8' Culvert (six)

	Qty	Cost	Ext
Steel	1968	$ 0.85	$ 1,672.80
Concrete	25.16	$ 75.00	$ 1,887.00
		Total Materials	$ 3,559.80
		Equipment & Labor	$ 7,119.60
		Handrail ($40/LF)	$ 3,120.00
		Total Cost	**$ 13,799.40**

6'x10' Culvert (six)

	Qty	Cost	Ext
Steel	2496	$ 0.85	$ 2,121.60
Concrete	31.69	$ 75.00	$ 2,376.75
		Total Materials	$ 4,498.35
		Equipment & Labor	$ 8,996.70
		Handrail ($40/LF)	$ 3,800.00
		Total Cost	**$ 17,295.05**

Notes

Qty's derived from ADOT Details

Assume no skew and 4:1 Slopes

Excavation Not Included

Excludes general conditions (mobilization, construction water, materials testing etc.)

310.057

Inlet Headwall Estimate ($/EA)

5'x8' Culvert (single)

	Qty	Cost	Ext
Steel	691	$ 0.85	$ 587.35
Concrete	9.62	$ 75.00	$ 721.50
		Total Materials	$ 1,308.85
		Equipment & Labor	$ 2,617.70
		Handrail ($40/LF)	$ 1,240.00
		Total Cost	**$ 5,166.55**

5'x8' Culvert (double)

	Qty	Cost	Ext
Steel	796	$ 0.85	$ 676.60
Concrete	10.75	$ 75.00	$ 806.25
		Total Materials	$ 1,482.85
		Equipment & Labor	$ 2,965.70
		Handrail ($40/LF)	$ 1,560.00
		Total Cost	**$ 6,008.55**

5'x8' Culvert (triple)

	Qty	Cost	Ext
Steel	901	$ 0.85	$ 765.85
Concrete	11.88	$ 75.00	$ 891.00
		Total Materials	$ 1,656.85
		Equipment & Labor	$ 3,313.70
		Handrail ($40/LF)	$ 1,880.00
		Total Cost	**$ 6,850.55**

5'x8' Culvert (quad)

	Qty	Cost	Ext
Steel	1006	$ 0.85	$ 855.10
Concrete	13.01	$ 75.00	$ 975.75
		Total Materials	$ 1,830.85
		Equipment & Labor	$ 3,661.70
		Handrail ($40/LF)	$ 2,200.00
		Total Cost	**$ 7,692.55**

5'x8' Culvert (five)

	Qty	Cost	Ext
Steel	1111	$ 0.85	$ 944.35
Concrete	14.14	$ 75.00	$ 1,060.50
		Total Materials	$ 2,004.85
		Equipment & Labor	$ 4,009.70
		Handrail ($40/LF)	$ 2,520.00
		Total Cost	**$ 8,534.55**

5'x8' Culvert (six)

	Qty	Cost	Ext
Steel	1216	$ 0.85	$ 1,033.60
Concrete	15.27	$ 75.00	$ 1,145.25
		Total Materials	$ 2,178.85
		Equipment & Labor	$ 4,357.70
		Handrail ($40/LF)	$ 2,840.00
		Total Cost	**$ 9,376.55**

6'x10' Culvert (single)

	Qty	Cost	Ext
Steel	960	$ 0.85	$ 816.00
Concrete	12.56	$ 75.00	$ 942.00
		Total Materials	$ 1,758.00
		Equipment & Labor	$ 3,516.00
		Handrail ($40/LF)	$ 1,480.00
		Total Cost	**$ 6,754.00**

6'x10' Culvert (double)

	Qty	Cost	Ext
Steel	1090	$ 0.85	$ 926.50
Concrete	13.96	$ 75.00	$ 1,047.00
		Total Materials	$ 1,973.50
		Equipment & Labor	$ 3,947.00
		Handrail ($40/LF)	$ 1,880.00
		Total Cost	**$ 7,800.50**

6'x10' Culvert (triple)

	Qty	Cost	Ext
Steel	1220	$ 0.85	$ 1,037.00
Concrete	15.36	$ 75.00	$ 1,152.00
		Total Materials	$ 2,189.00
		Equipment & Labor	$ 4,378.00
		Handrail ($40/LF)	$ 2,280.00
		Total Cost	**$ 8,847.00**

6'x10' Culvert (quad)

	Qty	Cost	Ext
Steel	1350	$ 0.85	$ 1,147.50
Concrete	16.76	$ 75.00	$ 1,257.00
		Total Materials	$ 2,404.50
		Equipment & Labor	$ 4,809.00
		Handrail ($40/LF)	$ 2,680.00
		Total Cost	**$ 9,893.50**

6'x10' Culvert (five)

	Qty	Cost	Ext
Steel	1480	$ 0.85	$ 1,258.00
Concrete	18.16	$ 75.00	$ 1,362.00
		Total Materials	$ 2,620.00
		Equipment & Labor	$ 5,240.00
		Handrail ($40/LF)	$ 3,080.00
		Total Cost	**$ 10,940.00**

6'x10' Culvert (six)

	Qty	Cost	Ext
Steel	1610	$ 0.85	$ 1,368.50
Concrete	19.56	$ 75.00	$ 1,467.00
		Total Materials	$ 2,835.50
		Equipment & Labor	$ 5,671.00
		Handrail ($40/LF)	$ 3,480.00
		Total Cost	**$ 11,986.50**

Notes

Qty's derived from ADOT Details

Assume no skew and 4:1 Slopes

Excavation Not Included

Excludes general conditions (mobilization, construction water, materials testing etc.)

Total Culvert Approach and Headwall Costs/Each

5'x8' Culvert					
No. of Barrels	Inlet	Outlet	Upstream Rip-Rap	Downstream Rip-Rap	Total Cost
Single	$ 5,166.55	$ 7,670.15	$ 19,555.56	$ 70,888.89	$ 103,000.00
Double	$ 6,008.55	$ 8,896.00	$ 20,740.74	$ 75,185.19	$ 111,000.00
Triple	$ 6,850.55	$ 10,121.85	$ 21,925.93	$ 79,481.48	$ 118,000.00
Quadruple	$ 7,692.55	$ 11,347.70	$ 23,111.11	$ 83,777.78	$ 126,000.00
Five	$ 8,534.55	$ 12,573.55	$ 24,296.30	$ 88,074.07	$ 133,000.00
Six	$ 9,376.55	$ 13,799.40	$ 25,777.78	$ 92,580.00	$ 142,000.00

6'x10' Culvert					
No. of Barrels	Inlet	Outlet	Upstream Rip-Rap	Downstream Rip-Rap	Total Cost
Single	$ 6,754.00	$ 9,666.30	$ 19,851.85	$ 71,962.96	$ 108,000.00
Double	$ 7,800.50	$ 11,192.05	$ 21,333.33	$ 77,333.33	$ 118,000.00
Triple	$ 8,847.00	$ 12,717.80	$ 22,814.81	$ 82,703.70	$ 127,000.00
Quadruple	$ 9,893.50	$ 14,243.55	$ 24,296.30	$ 88,074.07	$ 137,000.00
Five	$ 10,940.00	$ 15,769.30	$ 25,777.78	$ 93,444.44	$ 146,000.00
Six	$ 11,986.50	$ 17,295.05	$ 27,259.26	$ 98,814.81	$ 155,000.00

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Downstream Rip-Rap ($/EA)

5'x8' Culvert (single)

	Qty	Cost	Ext
Fine Grading (SY)	1467	$ 5.00	$ 7,333.33
Placed Rip-Rap (CY)	978	$ 65.00	$ 63,555.56
		Total Cost	**$ 70,888.89**

5'x8' Culvert (double)

	Qty	Cost	Ext
Fine Grading (SY)	1556	$ 5.00	$ 7,777.78
Placed Rip-Rap (CY)	1037	$ 65.00	$ 67,407.41
		Total Cost	**$ 75,185.19**

5'x8' Culvert (triple)

	Qty	Cost	Ext
Fine Grading (SY)	1644	$ 5.00	$ 8,222.22
Placed Rip-Rap (CY)	1096	$ 65.00	$ 71,259.26
		Total Cost	**$ 79,481.48**

5'x8' Culvert (quad)

	Qty	Cost	Ext
Fine Grading (SY)	1733	$ 5.00	$ 8,666.67
Placed Rip-Rap (CY)	1156	$ 65.00	$ 75,111.11
		Total Cost	**$ 83,777.78**

5'x8' Culvert (five)

	Qty	Cost	Ext
Fine Grading (SY)	1822	$ 5.00	$ 9,111.11
Placed Rip-Rap (CY)	1215	$ 65.00	$ 78,962.96
		Total Cost	**$ 88,074.07**

5'x8' Culvert (six)

	Qty	Cost	Ext
Fine Grading (SY)	1915	$ 5.00	$ 9,575.00
Placed Rip-Rap (CY)	1277	$ 65.00	$ 83,005.00
		Total Cost	**$ 92,580.00**

6'x10' Culvert (single)

	Qty	Cost	Ext
Fine Grading (SY)	1489	$ 5.00	$ 7,444.44
Placed Rip-Rap (CY)	993	$ 65.00	$ 64,518.52
		Total Cost	**$ 71,962.96**

6'x10' Culvert (double)

	Qty	Cost	Ext
Fine Grading (SY)	1600	$ 5.00	$ 8,000.00
Placed Rip-Rap (CY)	1067	$ 65.00	$ 69,333.33
		Total Cost	**$ 77,333.33**

6'x10' Culvert (triple)

	Qty	Cost	Ext
Fine Grading (SY)	1711	$ 5.00	$ 8,555.56
Placed Rip-Rap (CY)	1141	$ 65.00	$ 74,148.15
		Total Cost	**$ 82,703.70**

6'x10' Culvert (quad)

	Qty	Cost	Ext
Fine Grading (SY)	1822	$ 5.00	$ 9,111.11
Placed Rip-Rap (CY)	1215	$ 65.00	$ 78,962.96
		Total Cost	**$ 88,074.07**

6'x10' Culvert (five)

	Qty	Cost	Ext
Fine Grading (SY)	1933	$ 5.00	$ 9,666.67
Placed Rip-Rap (CY)	1289	$ 65.00	$ 83,777.78
		Total Cost	**$ 93,444.44**

6'x10' Culvert (six)

	Qty	Cost	Ext
Fine Grading (SY)	2044	$ 5.00	$ 10,222.22
Placed Rip-Rap (CY)	1363	$ 65.00	$ 88,592.59
		Total Cost	**$ 98,814.81**

Notes:

6-in Rip-Rap Placed By Machine 24" Deep

Rip-Rap extends 100' Downstream

4:1 Slopes

Excludes general conditions (mobilization, construction water, materials testing etc.)

12/9/2013

310.037

Upstream Rip-Rap ($/EA)

5'x8' Culvert (single)

	Qty	Cost	Ext
Fine Grading (SY)	733	$ 5.00	$ 3,666.67
Placed Rip-Rap (CY)	244	$ 65.00	$ 15,888.89
		Total Cost	**$ 19,555.56**

5'x8' Culvert (double)

	Qty	Cost	Ext
Fine Grading (SY)	778	$ 5.00	$ 3,888.89
Placed Rip-Rap (CY)	259	$ 65.00	$ 16,851.85
		Total Cost	**$ 20,740.74**

5'x8' Culvert (triple)

	Qty	Cost	Ext
Fine Grading (SY)	822	$ 5.00	$ 4,111.11
Placed Rip-Rap (CY)	274	$ 65.00	$ 17,814.81
		Total Cost	**$ 21,925.93**

5'x8' Culvert (quad)

	Qty	Cost	Ext
Fine Grading (SY)	867	$ 5.00	$ 4,333.33
Placed Rip-Rap (CY)	289	$ 65.00	$ 18,777.78
		Total Cost	**$ 23,111.11**

5'x8' Culvert (five)

	Qty	Cost	Ext
Fine Grading (SY)	911	$ 5.00	$ 4,555.56
Placed Rip-Rap (CY)	304	$ 65.00	$ 19,740.74
		Total Cost	**$ 24,296.30**

5'x8' Culvert (six)

	Qty	Cost	Ext
Fine Grading (SY)	967	$ 5.00	$ 4,833.33
Placed Rip-Rap (CY)	322	$ 65.00	$ 20,944.44
		Total Cost	**$ 25,777.78**

6'x10' Culvert (single)

	Qty	Cost	Ext
Fine Grading (SY)	744	$ 5.00	$ 3,722.22
Placed Rip-Rap (CY)	248	$ 65.00	$ 16,129.63
		Total Cost	**$ 19,851.85**

6'x10' Culvert (double)

	Qty	Cost	Ext
Fine Grading (SY)	800	$ 5.00	$ 4,000.00
Placed Rip-Rap (CY)	267	$ 65.00	$ 17,333.33
		Total Cost	**$ 21,333.33**

6'x10' Culvert (triple)

	Qty	Cost	Ext
Fine Grading (SY)	856	$ 5.00	$ 4,277.78
Placed Rip-Rap (CY)	285	$ 65.00	$ 18,537.04
		Total Cost	**$ 22,814.81**

6'x10' Culvert (quad)

	Qty	Cost	Ext
Fine Grading (SY)	911	$ 5.00	$ 4,555.56
Placed Rip-Rap (CY)	304	$ 65.00	$ 19,740.74
		Total Cost	**$ 24,296.30**

6'x10' Culvert (five)

	Qty	Cost	Ext
Fine Grading (SY)	967	$ 5.00	$ 4,833.33
Placed Rip-Rap (CY)	322	$ 65.00	$ 20,944.44
		Total Cost	**$ 25,777.78**

6'x10' Culvert (six)

	Qty	Cost	Ext
Fine Grading (SY)	1022	$ 5.00	$ 5,111.11
Placed Rip-Rap (CY)	341	$ 65.00	$ 22,148.15
		Total Cost	**$ 27,259.26**

Notes:

6-in Rip-Rap Placed By Machine 12" Deep

Rip-Rap extends 50' Downstream

4:1 Slopes

Excludes general conditions (mobilization, construction water, materials testing etc.)

12/9/2013

310.057

Mass Excavation Estimate

Equipment	CAT365C
Bucket	5.2
Fill Factor	0.9
Actual Capacity	4.68
Cycle Time (Sec)	30
Truck Capacity (CY)	25
Cycles to Fill Truck	6
Time to Fill Truck (Sec)	180
Haul Time (sec)	1200
Dump Time	60
Return Time	1200
Truck Cycle Time	**2640**
Trucks Needed	15
Production (CY/HR)	500
80% Efficiency (CY/HR)	**400**

Equipment/Labor	Cost	Qty	Ext	
CAT 365C	$133.38	1	$	133.38
18-Wheel End Dump	$58.00	15	$	870.00
Operator Level III	$36.09	1	$	36.09
Truck Driver	$23.92	15	$	358.77
8000 Gallon Water Truck	$79.25	2	$	158.50
Water Truck Driver	$23.92	2	$	47.84
Motor Grader	$50.00	1	$	50.00
Operator Level II	$35.01	1	$	35.01
Dirt Foreman	$23.56	1	$	23.56
Superintendent	$40.16	1	$	40.16
1/2 Ton Truck	$14.00	2	$	28.00
Total			**$**	**1,781.30**

Cost ($/CY)	**$ 4.45**

Assumptions

1. Haul and disposal within 5 Miles of site
2. 80% Job efficiency
3. Average haul speed of 15mph
4. Davis-Bacon Wages
5. Below Avg digging conditions (70% Depth & 90° Swing)
6. Average Skill Operators
7. Excludes General Conditions

NOTES:

Based on recent bid tabs, mass excavation should be in the range of $4.45 & $5.00 per CY. Values in this range were utilized for cost estimating.

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Slurry Trench Estimate (1'x5')

Equipment	Vermeer Trenching Machine			
Trenching Machine	56.25	$/Hr		
Operator Level III	$36.09	$/Hr		
4k Gallon Water Truck	31.25	$/Hr		
Truck Driver	$23.92	$/Hr		
Dirt Foreman	$23.56	$/Hr		
1/2 Ton Truck	$14.00	$/Hr		
Front Loader	$36.84	$/Hr		
Operator Level II	$35.01	$/Hr		
Subtotal	$ 256.92	$/Hr		
Production (80% Job Efficiency)	144	LF/HR		
Trenching Cost	**$ 1.78**	**$/LF**		
Purchase Slurry	$ 72.50	$/CY	10.5YD/Truck	
1-Sack Slurry	0.18518519	CY/LF	(5.4LF/YD)	
Concrete Finisher	$ 0.11	$/LF	56.7	Ft/Truck
Laborer	$ 0.09	$/LF	170.1	3 Trucks per Hour gives (LF/HR)
Slurry Cost	**$ 13.63**	**$/LF**		
Total Trench Cost	**$ 15.41**	**$/LF**		

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Unit Cost Development -
Riprap

D50	Required Thickness*	Unit Cost/Volume	Unit Cost/Area
(inches)	(inches)	($/CY)	($/SY)
1			$7.00
2			$7.00
3			$7.00
4			$7.00
5	7.5	$65.00	$13.54
6	9	$65.00	$16.25
7	10.5	$65.00	$18.96
8	12	$65.00	$21.67

* Required riprap thickness is 1.5 times the D50 per the Hydraulics Manual

East Mesa ADMP - Alternative Analysis

Unit Cost Development

Construction (Culverts, Excavation, Riprap)

Landscaping

Land Acquisition

Maintenance

Quantity Estimation

Riprap Cutoff Walls

Channel Excavation

Riprap Liner

Landscape Aesthetics and Environmental Costs Assumptions and Costing Criteria

Summary

Landscape costs for the proposed channels, setbacks, and basins are based on the following assumptions:

Item	Unit	Costs
Moveable Bed Channel	Acre	$4,500 per acre
Rip-Rap Channel Bottoms	Acre	$1,500 per acre
Landscape Setback	Acre	$6,100 per acre
Low-Flow Channel	Acre	$6,100 per acre
Swale	Acre	$13,400 per acre
Buffer	Acre	$6,100 per acre
Basin	Acre	$5,000 per acre

The assumptions and sub-unit costs associated with these items are described in more detail below.

Moveable Bed Channels (Landscape Only)

The moveable bed channels are planned to include a Natural Sonoran Desert Wash Landscape Design Theme. This will complement the proposed equestrian trail multi-use and is compatible with the existing as well as future settings. This landscape design theme will be achieved through the use of tall pot trees and hydroseed.

Item	Unit Cost	Unit Cost
Tall Pot Trees	$100 each, (20) trees per acre	$2,000/acre
Hydroseeding, Native Riparian Seed Mix	$2,500 per acre	$2,500/acre
	Total	$4,500/acre

Trees

Tree costs for the moveable bed channel are based on the number of tall pot trees required to reflect the density of a natural wash in the same area.

A 1000 feet length of Siphon Draw was selected to represent a vegetated natural wash. (See Figure below). 44 trees total were identified along both sides of the wash, averaging one tree every 23 feet of wash.

The channel top-widths for the Meridian channel alternatives ranged from 78 feet to 132 feet, giving an area range between 330 feet to 560 feet of channel length per acre. Using the basis of 1 tree for every 23 feet of channel would require between 14 to 24 trees per acre to represent the same density found in the Siphon Draw example.

For the purposes of this analysis, a total of 20 trees per acre were selected from this range for calculating the approximate costs resulting in a per acre cost of $2,000 for tall pot trees.

Hydroseed

Other plant material will be established using hydraulically applied native plant seed, or hydroseeding. Typical hydroseed bids for recent flood control design projects ranged from $1,500 per acre to $2,500 per acre. For the purposes of this analysis, the higher value was used of $2,500 per acre.

Rip-Rap Channel Bottoms

A dust control hydroseed application will be required as a minimum treatment for those locations where the rip-rap for a channels extends only to the bottom of the channel side-slopes. This will be the only landscape item proposed in this condition.

Item	Unit Cost	Unit Cost
Hydroseeding, Dust Control Mix	$1,500 per acre	$1,500/acre
	Total	$1,500/acre

Hydroseed

Typical hydroseed bids for recent flood control design projects ranged from $1,500 per acre to $2,500 per acre. For this analysis, the lower value of $1,500 per acre is used for hydroseed intended only for dust control purposes.

Landscape Setback

All channel landscape setbacks are intended to have a Semi-Natural Sonoran Desert Landscape Design Theme though this does not preclude a cost-share partner implementing

a more intensive landscape design theme where appropriate. This landscape design theme will complement the majority of landscape treatments in the East Mesa ADMP planning area and be easily integrated into streetscape designs where channels follow arterial roadway alignments. The implementation of this landscape design theme will be achieved through the use of tall pot trees and hydroseed, consistent with District standards and direction received from the project partners.

Item	Unit Cost	Unit Cost
Tall Pot Trees	$100 each, (36) trees per acre	$3,600/acre
Hydroseeding, Native Flowering Shrub Seed Mix	$2,500 per acre	$2,500/acre
	Total	$6,100/acre

Trees

Tree costs for the landscape setback are based on the number of tall pot trees required to provide one tree every 30 linear feet of setback on a 40 foot wide setback. This tree spacing is based on the common spacing for municipal streetscapes. This equals 36 trees per acre for a 40 foot setback.

Hydroseed

Other plant material will be established using hydraulically applied native plant seed, or hydroseeding. For the purposes of this analysis as noted above, $2,500 per acre is being used for cost estimating purposes based on recent project bid pricing.

Low-Flow Channels (Overbank Water-Harvesting)

The low-flow channels are intended to have a Semi-Natural Sonoran Desert Landscape Design Theme though this does not preclude a cost-share partner implementing a more intensive landscape design theme where appropriate. This landscape design theme will complement the majority of landscape treatments in the East Mesa ADMP planning area and be easily integrated into streetscape designs where channels follow arterial roadway alignments. The implementation of this landscape design theme will be achieved through the use of tall pot trees and hydroseed, consistent with District standards and direction received from the project partners.

Item	Unit Cost	Unit Cost
Tall Pot Trees	$100 each, (36) trees per acre	$3,600/acre
Hydroseeding, Native Flowering Shrub Seed Mix	$2,500 per acre	$2,500/acre
	Total	$6,100/acre

Trees

Tree costs for the low-flows are the same as for the landscape setbacks, which are based on the number of tall pot trees required to provide one tree every 30 linear feet of setback on a 40 foot wide "buffer". This tree spacing is based on the common spacing for municipal streetscapes. This equals 36 trees per acre for a 40 foot setback.

Hydroseed

Other plant material will be established using hydraulically applied native plant seed, or hydroseeding. For the purposes of this analysis as noted above, $2,500 per acre is being used for cost estimating purposes based on recent project bid pricing.

Swale

The swale designed to collect upstream nuisance flows is intended to have a Semi-Natural Sonoran Desert Landscape Design Theme though, as with the other landscape features, this does not preclude a cost-share partner implementing a more intensive landscape design theme where appropriate. The implementation of this landscape design theme will be achieved through the use of tall pot trees and hydroseed, consistent with District standards and direction received from the project partners.

Item	Unit Cost	Unit Cost
Tall Pot Trees	$100 each, (109) trees per acre	$10,900/acre
Hydroseeding, Native Flowering Shrub Seed Mix	$2,500 per acre	$2,500/acre
	Total	$13,400/acre

Trees

Tree costs for the swales are based on the number of tall pot trees required to provide one tree every 40 linear feet of swale. This equals 109 trees per acre for a 10 foot swale.

Hydroseed

Other plant material will be established using hydraulically applied native plant seed, or hydroseeding. For the purposes of this analysis as noted above, $2,500 per acre is being used for cost estimating purposes based on recent project bid pricing.

Landscape Buffer

All landscape buffers are intended to have a Semi-Natural Sonoran Desert Landscape Design Theme though this does not preclude a cost-share partner implementing a more intensive landscape design theme where appropriate. This landscape design theme will complement the majority of landscape treatments in the East Mesa ADMP planning area and be easily integrated into streetscape designs where channels follow arterial roadway alignments. The

implementation of this landscape design theme will be achieved through the use of tall pot trees and hydroseed, consistent with District standards and direction received from the project partners.

Item	Unit Cost	Unit Cost
Tall Pot Trees	$100 each, (36) trees per acre	$3,600/acre
Hydroseeding, Native Flowering Shrub Seed Mix	$2,500 per acre	$2,500/acre
	Total	$6,100/acre

Trees

Tree costs for the landscape buffers are similar to the landscape setbacks, and are based on the number of tall pot trees required to provide one tree every 30 linear feet of buffer on a 40 foot wide maximum buffer width. This tree spacing is based on the common spacing for municipal streetscapes and equals 36 trees per acre.

Hydroseed

Other plant material will be established using hydraulically applied native plant seed, or hydroseeding. For the purposes of this analysis as noted above, $2,500 per acre is being used for cost estimating purposes based on recent project bid pricing.

Basins

Proposed basins are planned to include a Semi-Natural Sonoran Desert Landscape Design Theme. This will complement the range of multi-use facilities that might be planned for the basins or allow the basin to serve as passive open space in the event that no multi-use function is implemented during project design. This landscape design theme provides great flexibility and is compatible with all existing as well as future settings. This landscape design theme will be achieved through the use of tall pot trees and hydroseed.

Item	Unit Cost	Unit Cost
Tall Pot Trees	$100 each, (25) trees per acre	$2,500/acre
Hydroseeding, Native Riparian Seed Mix	$2,500 per acre	$2,500/acre
	Total	$5,000/acre

Trees

Tree costs for basin landscaping are based on the number of tall pot trees required to reflect the density of a natural or semi-natural retention area near the undeveloped portions of eastern Maricopa County. One of the many stock ponds located in the Pinal County portion of the study area was selected to represent a semi-natural basin.

The figure at left shows a 1 acre square that includes the selected man-made stock pond. Approximately 25 trees can be counted in this representative acre, which was used to establish the costs for the basin treatments. At a cost of $100 per tree, this results in a per acre cost of $2,500 for tall pot trees.

Hydroseed

Other basin plant material and cover will be established using hydraulically applied native plant seed, or hydroseeding. Typical hydroseed bids for recent flood control design projects ranged from $1,500 per acre to $2,500 per acre. For the purposes of this analysis, the higher value was used of $2,500 per acre.

Multi-Use Costs

Multi-use functions associated with each basin are not reflected in the costs. It is assumed that any multi-use function will require a cost share partner in order to implement. The implementation of a multi-use function in a basin would take place under the conditions it would not interfere with the primary flood protection function of the basin.

East Mesa ADMP - Alternative Analysis

Unit Cost Development

Construction (Culverts, Excavation, Riprap)

Landscaping

Land Acquisition

Maintenance

Quantity Estimation

Riprap Cutoff Walls

Channel Excavation

Riprap Liner

Notes by Jan Schaefer 11/14/12

Hernan Aristizabal

From: Jennifer Pokorski - FCDX [jmp@mail.maricopa.gov]
Sent: Wednesday, October 10, 2012 8:47 AM
To: Hernan Aristizabal
Subject: FW: Land Prices

Land prices for the alternative analysis...

From: Gary Scott - FCDX
Sent: Wednesday, October 10, 2012 8:06 AM
To: Jennifer Pokorski - FCDX
Subject: RE: Land Prices

Hi Jen – Here is what we are seeing for sales information in the area of the East Mesa ADMP Update. I have provided a range in types of value, primarily because this area was hit pretty hard by the Recession and saw a lot of Bank Sales (REO's) which affected the market, there are still some REO's going on, but now we are starting to see secondary activity coming along. Let me know if you need anything else. Thanks. Gary Scott

Vacant Hold for Investment (future land development parcels) - $17,000 to $35,000 per acre — $26,000 used in cost estimates (mid-range)
Residential Lots 1-5 acres - $27,000 - $45,000 — $36,000 used in cost estimates (mid-range)
Vacant Undeveloped Commercial - $2.75 - $4.50 — $3.72/SF x 43,560 SF/AC = $158,000/AC
Residential Home - $90,000 - $170,000 (this is a pretty wide range, because there are still REO's and short sales taking place, and a wide variety of home types in this study area).

→ Only one home impacted by alternatives. Assumed to be $180,000/AC.

East Mesa ADMP - Alternative Analysis

Unit Cost Development

Construction (Culverts, Excavation, Riprap)

Landscaping

Land Acquisition

Maintenance

Quantity Estimation

Riprap Cutoff Walls

Channel Excavation

Riprap Liner

East Mesa ADMP
Retention Basin
Maintenance - Unit
Cost Development

- Jacob Greeting 11/12/12

Rittenhouse FRS
Fiscal Years 2005 - 2009
52.52 Acres

Average Cost Per Acre ~~$1921.90~~ - includes elements not relevant to retention basins, see breakdown.

Functional Description: This structure collects runoff water from a 51 sq. mile area and conveys it north to a 33" principal outlet pipe and into the reservoir area of Vineyard FRS.

Typical maintenance performed on this structure: Debris & trash removal, sediment removal, erosion repair, vegetation control (weeds), mower operations, rodent control, fence/gates repair and replacement, motor grader work on access roads and ramps, sign maintenance includes refurbishing placards, and staff gages. Vandalism maintenance includes; gate /fence repair, sign replacement, illegal dumping, and damaged caused by unauthorized vehicle access.

Retention Basin Maintenance Costs

Labor	$ 285.87 / year/acre
Equipment	$ 41.40 / year/acre
Materials	$ 44.56 / year/acre
	$ 371.83 / year/acre

O&M Labor Costs for Rittenhouse FRS 5 Years

Average Yearly Cost: $46,795.43
Average Yearly Cost Per Acre: $891.00
Average Yearly Hours: 1,224.90

DR	DEBRIS REMOVAL	$154.59
DSP	DAM SAFETY PROGRAM	$146,885.01
ER	EROSION REPAIR	$6,889.71
FM	FLOODWAY MAINTENANCE	$9,790.70
GOM	GATED OUTLET MAINTENANCE	$12,023.83
MA	MOSQUITO ABATEMENT	$1,498.17
PO	PRINCIPAL OUTLET MAINTENANCE	$10,751.34
RD	ROAD, DIRT	$379.51
RT	RODENT/ANT/INSECT TREATMENT	$7,833.65
SD	SILT DEPOSIT REMOVAL	$4,176.48
SM	SIGN MAINTENANCE	$4,846.84
SS	STORM SURVEILLANCE	$1,386.74
VR	VEGETATION REMOVAL	$16,513.29
WC	WEED CONTROL	$10,847.27
	Total Hours: 6,124.50	**$ 233,977.14**

Retention Basin Total Cost = $ 75,068.29
Average Yearly Cost = $ 15,013.66
Average Yearly Cost Per Acre = $ 285.87

Highlighted items assumed to be relevant to retention basins.

O&M Equipment Costs for Rittenhouse FRS 5 Years

Average Yearly Cost $11,956.14
Average Yearly Cost Per Acre: $227.65

DR	DEBRIS REMOVAL	$71.74
DSP	DAM SAFETY PROGRAM	$47,502.01
ER	EROSION REPAIR	$1,149.11
FM	FLOODWAY MAINTENANCE	$819.00
GOM	GATED OUTLET MAINTENANCE	$1,406.34
MA	MOSQUITO ABATEMENT	$361.62
PO	PRINCIPAL OUTLET MAINTENANCE	$1,552.75
RD	ROAD, DIRT	$131.20
RT	RODENT/ANT/INSECT TREATMENT	$1,251.18
SD	SILT DEPOSIT REMOVAL	$1,181.81
SM	SIGN MAINTENANCE	$464.35
SS	STORM SURVEILLANCE	$187.61
VR	VEGETATION REMOVAL	$1,460.48
WC	WEED CONTROL	$2,241.50
		$59,780.69

Retention Basin Total Cost = $ 10,872.35
Average Cost Per Year = $ 2,174.47
Average Cost Per Year Per Acre = $ 41.40

Highlighted items assumed to be relevant to retention basins.

O&M Material Costs for Rittenhouse FRS 5 Years

Average Yearly Cost $42,186.49
Average Yearly Cost Per Acre: $803.25

DSP	DAM SAFETY PROGRAM	199,135.33
ER	EROSION REPAIR	$6.00
FM	FLOODWAY MAINTENANCE	$231.78
GOM	GATED OUTLET MAINTENANCE	$95.38
MA	MOSQUITO ABATEMENT	$2,035.55
PO	PRINCIPAL OUTLET MAINTENANCE	$46.08
RT	RODENT/ANT/INSECT TREATMENT	$272.98
SD	SILT DEPOSIT REMOVAL	$87.46
SM	SIGN MAINTENANCE	$1,044.88
SS	STORM SURVEILLANCE	$36.25
VR	VEGETATION REMOVAL	$146.49
WC	WEED CONTROL	$7,794.29
		$ 210,932.46

Movable Bed Total Cost = $ 11,701.76
Total Cost Per Year = $ 2,340.35
Total Cost Per Year Per Acre = $ 44.56

Highlighted items assumed to be relevant to retention basins.

East Mesa ADMP
Movable Bed Channel
Maintenance Unit Cost
Development

-Steve Sweeting 11/13/12

Rittenhouse FRS
Fiscal Years 2005 - 2009
52.52 Acres

Average Cost Per Acre ~~$1921.90~~ → Includes elements not related to Movable Bed Channels See breakdowns.

Functional Description: This structure collects runoff water from a 51 sq. mile area and conveys it north to a 33" principal outlet pipe and into the reservoir area of Vineyard FRS.

Typical maintenance performed on this structure: Debris & trash removal, sediment removal, erosion repair, vegetation control (weeds), mower operations, rodent control, fence/gates repair and replacement, motor grader work on access roads and ramps, sign maintenance includes refurbishing placards, and staff gages. Vandalism maintenance includes; gate /fence repair, sign replacement, illegal dumping, and damaged caused by unauthorized vehicle access.

Movable Bed Unit Cost

Labor	$ 117.57/year/acre
Equipment	$ 19.55/year/acre
Material	$ 13.42/year/acre
	$ 150.54/year/acre

O&M Labor Costs for Rittenhouse FRS 5 Years

Average Yearly Cost: $45,795.43
Average Yearly Cost Per Acre: $891.00
Average Yearly Hours: 1,224.90

DR	DEBRIS REMOVAL	$154.59
DSP	DAM SAFETY PROGRAM	$146,885.01
ER	EROSION REPAIR	$6,889.71
FM	FLOODWAY MAINTENANCE	$9,790.70
GOM	GATED OUTLET MAINTENANCE	$12,023.83
MA	MOSQUITO ABATEMENT	$1,498.17
PO	PRINCIPAL OUTLET MAINTENANCE	$10,751.34
RD	ROAD, DIRT	$379.51
RT	RODENT/ANT/INSECT TREATMENT	$7,833.65
SD	SILT DEPOSIT REMOVAL	$4,176.48
SM	SIGN MAINTENANCE	$4,846.84
SS	STORM SURVEILLANCE	$1,386.74
VR	VEGETATION REMOVAL	$16,513.29
WC	WEED CONTROL	$10,847.27
	Total Hours: 6,124.50	**$ 233,977.14**

Movable Bed Total = $ 30,872.73
Average Yearly Cost = $ 6,174.55
Average Yearly Cost Per Acre = $ 117.57

Highlighted Elements are relevant to movable bed channels

O&M Equipment Costs for Rittenhouse FRS 5 Years

Average Yearly Cost $11,956.14
Average Yearly Cost Per Acre: $227.65

DR	DEBRIS REMOVAL	$71.74
DSP	DAM SAFETY PROGRAM	$47,502.01
ER	EROSION REPAIR	$1,149.11
FM	FLOODWAY MAINTENANCE	$819.00
GOM	GATED OUTLET MAINTENANCE	$1,406.34
MA	MOSQUITO ABATEMENT	$361.62
PO	PRINCIPAL OUTLET MAINTENANCE	$1,552.75
RD	ROAD, DIRT	$131.20
RT	RODENT/ANT/INSECT TREATMENT	$1,251.18
SD	SILT DEPOSIT REMOVAL	$1,181.81
SM	SIGN MAINTENANCE	$464.35
SS	STORM SURVEILLANCE	$187.61
VR	VEGETATION REMOVAL	$1,460.48
WC	WEED CONTROL	$2,241.50
		$59,780.69

Movable Bed Total Cost = $ 5,133.52
Average Cost Per Year = $ 1,026.70
Average Cost Per Year Per Acre = $ 19.55

Highlighted elements are relevant to movable bed channels.

O&M Material Costs for Rittenhouse FRS 5 Years

Average Yearly Cos$42,186.49
Average Yearly Cost Per Acre: $803.25

DSP	DAM SAFETY PROGRAM	199,135.33
ER	EROSION REPAIR	$6.00
FM	FLOODWAY MAINTENANCE	$231.78
GOM	GATED OUTLET MAINTENANCE	$95.38
MA	MOSQUITO ABATEMENT	$2,035.55
PO	PRINCIPAL OUTLET MAINTENANCE	$46.08
RT	RODENT/ANT/INSECT TREATMENT	$272.98
SD	SILT DEPOSIT REMOVAL	$87.46
SM	SIGN MAINTENANCE	$1,044.88
SS	STORM SURVEILLANCE	$36.25
VR	VEGETATION REMOVAL	$146.49
WC	WEED CONTROL	$7,794.29
		$ 210,932.46

Movable Bed Total Cost = $ 3,523.20
Total Cost Per Year = $ 704.64
Total Cost Per Year Per Acre = $ 13.42

Highlighted elements are relevant to movable bed channels.

East Mesa ADMP
Hardened Channel
Maintenance Unit
Cost Development

-Used Surveying 11/13/12

East Maricopa Floodway
Fiscal Years 2005 - 2009
27.5 Miles

Average Cost Per Mile $9,488.70

assume this cost is representative of hardened channel maintenance cost/mile

Functional Description: Reach 6 of the floodway is the outlet reach and empties into the Gila River midway between SR93 and I-10. It carries runoff water from the upper 5 reaches, Queen Creek Channel entering the floodway just north of Chandler Heights Road, Powerline Floodway, and local runoff.

Typical maintenance performed on this structure: Debris & trash removal, vegetation control (weeds), rodent control, sediment removal, bulldozer sour and erosion repair in floodway invert, mower operations, fence/gates repair and replacement, concrete repair, motor grader work on access roads and ramps, sign maintenance refurbishing placards and staff gages, erosion repair from sheet runoff, and grouted riprap repair. Landscape maintenance includes irrigation, tree and plant care, and routine grounds maintenance. Vandalism maintenance includes; graffiti removal, gate /fence repair, sign replacement and damaged caused by unauthorized vehicle access.

O&M Labor Costs for East Maricopa Floodway- 5 Years

Average Yearly Hours: 7,611.58
Average Yearly Cost: $171,716.69
Average Cost Per Mile: $6,244.24

BF	BACK FLOW ASSEMBLEY TESTING/REPAIR	$1,966.69
CC	CITIZEN CONCERN	$137.40
CCV	Code Compliance Violations (City, County, State, et	$9,943.50
CR	CONCRETE REPAIR	$17,043.23
DR	DEBRIS REMOVAL	$12,089.78
ER	EROSION REPAIR	$111,943.21
ET	EQUIPMENT TRANSPORT	$175.79
FI	FENCE INSTALLATION	$2,649.83
FM	FLOODWAY MAINTENANCE	$237,315.98
FR	FENCE REPAIR	$30,606.73
GI	GATE INSTALLATION	$2,466.08
GM	GROUNDS MAINTENANCE	$119,583.22
GOM	GATED OUTLET MAINTENANCE	$720.90
GR	GRAFFITI REMOVAL	$1,947.61
IM	IRRIGATION MAINTENANCE	$13,678.12
KB	KILLER BEES	$2,027.69
LAN	WORK FOR LAND MANAGEMENT DIVISION	$70,799.26
MA	MOSQUITO ABATEMENT	$61,348.45
MW	MOWER OPERATIONS	$285,265.44
PM	PLANT MAINTENANCE	$47,970.60
PO	PRINCIPAL OUTLET MAINTENANCE	$3,436.87
RD	ROAD, DIRT	$67,056.83
RT	RODENT/ANT/INSECT TREATMENT	$9,468.00
RV	REVEGETATION	$1,193.37
SA	STRUCTURE ADDITION	$15,904.29
SD	SILT DEPOSIT REMOVAL	$1,774.26
SG	STAFF GAUGES	$1,704.86
SI	SIGN INSTALLATION	$9,626.56
SM	SIGN MAINTENANCE	$5,553.69
SR	STRUCTURE REPAIR	$4,544.78
SS	STORM SURVEILLANCE	$7,068.41
SSM	STRUCTURE STORM MAINTENANCE	$36,611.02
VF	VANDALISM FENCE	$20,808.16
VG	VANDALISM GATE	$11,060.15
VR	VEGETATION REMOVAL	$91,544.75
VS	VANDALISM SIGN	$14,353.94
VT	VANDALISM TRASH	$13,167.38
WC	WEED CONTROL	$200,891.36
	Total Hours:38,057.90	**$ 1,545,450.19**

O&M Equipment Costs for East Maricopa Floodway- 5 Years

Average Yearly Cost: $37,572.03
Average Yearly Cost Per Mile: $1,366.26

AF	ADMINISTRATIVE FUNCTIONS	$474.45
AT	ANT TREATMENT	$56.55
BL	BLUE STAKE	$9.36
BM	BUILDING MAINTENANCE	$99.04
CC	CITIZEN CONCERN	$86.10
CDL	CDL PHYSICAL	$31.20
CON	CONTRACTOR\CONSULTANT MEETING	$461.54
CR	CONCRETE REPAIR	$2,159.76
CS	CHEMICAL SUPPORT	$1,273.08
CT	CHEMICAL TRUCK	$664.20
DG	GRANITE EROSION REPAIR	$781.33
DR	DEBRIS REMOVAL	$5,155.70
DSP	DAM SAFETY PROGRAM	$3,550.95
DT	DRUG TESTING	$40.34
EC	EQUIPMENT CLEANUP	$186.00
EF	EQUIPMENT DOWN TIME-FIELD	$1,372.91
EI	EQUIPMENT INSPECTION	$107.50
EN	WORK FOR ENGINEERING	$52.42
EP	EVALUATION PREP.	$21.16
ER	EROSION REPAIR	$30,636.33
ET	EQUIPMENT TRANSPORT	$4,297.58
FI	FENCE INSTALLATION	$6,039.97
FM	FLOODWAY MAINTENANCE	$10,488.09
FR	FENCE REPAIR	$2,196.72
GM	GROUNDS MAINTENANCE	$2,341.73
GR	GRAFFITI REMOVAL	$76.59
IM	IRRIGATION MAINTENANCE	$774.00
JP	JOB PLANNING	$22.34
JT	ON THE JOB TRAINING	$264.09
KB	KILLER BEES	$400.28
LAN	WORK FOR LAND MANAGEMENT DIVIS	$2,818.78
MA	MOSQUITO ABATEMENT	$4,617.07
MI	MITIGATION	$137.92
MS	MOSQUITO SUPPORT	$288.02
MT	MATERIALS TRANSPORT	$332.15
MW	MOWER OPERATIONS	$14,714.83
OI	OPERATIONAL INSPECTIONS	$499.48
OM	OTHER MAINTENANCE	$1,439.21
PE	WORK RELATED TO PERMITS	$39.90
PM	PLANT MAINTENANCE	$5,994.71
PPM	PLANNING AND PROJECT MANAGEMEI	$24.00
PS	PLANT STORM DAMAGE	$1,274.61
RD	ROAD, DIRT	$15,276.00
RE	RODENT EROSION	$2,240.16
RH	RODENT HOLE REPAIR	$459.70
RS	RODENT TREATMENT SUPPORT	$754.98
RT	RODENT/ANT/INSECT TREATMENT	$4,915.14
RV	REVEGETATION	$62.40
SA	STRUCTURE ADDITION	$1,961.60
SD	SILT DEPOSIT REMOVAL	$2,954.09
SF	SUPERVISOR FUNCTIONS	$516.83
SG	STAFF GAUGES	$4.68
SI	SIGN INSTALLATION	$276.78
SM	SIGN MAINTENANCE	$422.66
SR	STRUCTURE REPAIR	$49.14
SS	STORM SURVEILLANCE	$766.61
SW	SCHEDULED MEETINGS	$8.00
TP	TRUCK PREP	$106.67
TR	TRAINING	$422.90
TT	TRAVEL TIME	$720.08

VF	VANDALISM FENCE	$973.69
VG	VANDALISM GATE	$165.62
VO	VANDALISM OTHER	$12.04
VR	VEGETATION REMOVAL	$28,207.07
VS	VANDALISM SIGN	$99.43
VT	VANDALISM TRASH	$216.80
VV	VANDALISM VEHICLE	$106.80
WC	WEED CONTROL	$18,844.55
YM	YARD MAINTENANCE	$13.65
		$187,860.14

O&M Material Costs for East Maricopa Floodway- 5 Years

Average Yearly Cost: $51,650.39
Average Yearly Cost Per Mile: $1,878.20

AT	ANT TREATMENT	$36.00
BM	BUILDING MAINTENANCE	$165.92
CC	CITIZEN CONCERN	$3.13
CR	CONCRETE REPAIR	$3,171.87
CS	CHEMICAL SUPPORT	$444.32
CT	CHEMICAL TRUCK	$4,806.15
DG	GRANITE EROSION REPAIR	$418.43
DR	DEBRIS REMOVAL	$324.30
DSP	DAM SAFETY PROGRAM	$8,634.71
EC	EQUIPMENT CLEANUP	$770.38
EP	EVALUATION PREP.	$1,248.00
ER	EROSION REPAIR	$1,301.92
ET	EQUIPMENT TRANSPORT	$2.48
FI	FENCE INSTALLATION	$10,535.17
FM	FLOODWAY MAINTENANCE	$2,645.74
FR	FENCE REPAIR	$5,332.95
GM	GROUNDS MAINTENANCE	$8,649.01
GR	GRAFFITI REMOVAL	$438.57
IM	IRRIGATION MAINTENANCE	$197.56
KB	KILLER BEES	$7.10
LAN	WORK FOR LAND MANAGEMENT DIVISION	$6,376.11
MA	MOSQUITO ABATEMENT	$14,872.01
MI	MITIGATION	$42.34
MS	MOSQUITO SUPPORT	$26.59
MT	MATERIALS TRANSPORT	$440.91
MW	MOWER OPERATIONS	$1,337.77
OM	OTHER MAINTENANCE	$1,453.81
PM	PLANT MAINTENANCE	$8,518.89
PS	PLANT STORM DAMAGE	$449.86
RD	ROAD, DIRT	$7,920.12
RE	RODENT EROSION	$479.40
RH	RODENT HOLE REPAIR	$12.00
RS	RODENT TREATMENT SUPPORT	$18.63
RT	RODENT/ANT/INSECT TREATMENT	$2,882.54
SA	STRUCTURE ADDITION	$6,706.32
SD	SILT DEPOSIT REMOVAL	$141.64
SG	STAFF GAUGES	$20.00
SI	SIGN INSTALLATION	$2,663.62
SM	SIGN MAINTENANCE	$1,435.43
SR	STRUCTURE REPAIR	$31.00
TT	TRAVEL TIME	$22.72
VF	VANDALISM FENCE	$238.25
VG	VANDALISM GATE	$135.96
VR	VEGETATION REMOVAL	$2,240.37
VS	VANDALISM SIGN	$315.34
VT	VANDALISM TRASH	$19.70
WC	WEED CONTROL	150,316.93
		$ 258,251.94

East Mesa ADMP - Alternative Analysis

Unit Cost Development

Construction (Culverts, Excavation, Riprap)

Landscaping

Land Acquisition

Maintenance

Quantity Estimation

Riprap Cutoff Walls

Channel Excavation

Riprap Liner

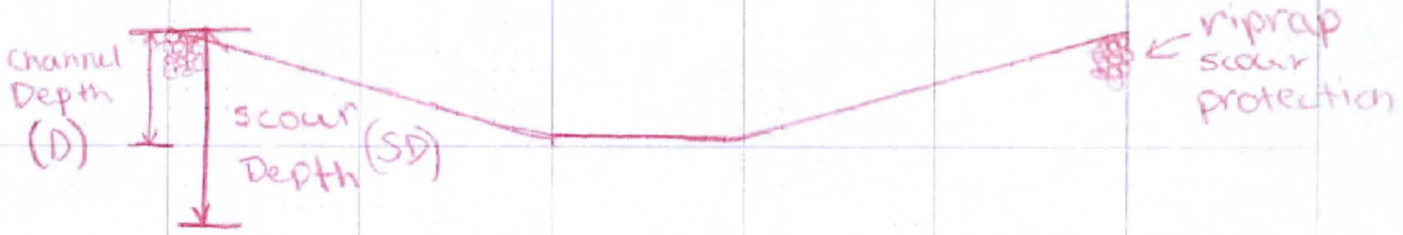
Entellus

SHEET 1 OF
BY RCJ DATE 10/16/12
CHECK DATE

CLIENT FCDMC

JOB NAME East Mesa ADMP/M JOB NO 310057

Movable Bed Riprap Scour Protection Volume



Riprap d_{50} = 6 inches = 0.5 FT

Thickness (T) = 2 * d_{50} = 2 * 0.5 FT = 1 FT

Length (L) = Length of Channel Segment

Safety Factor (FS) = 1.3

Volume (V) = SD * T * L * FS = **1.3 * SD * L = V**

East Mesa ADMP - Alternative Analysis

Unit Cost Development

Construction (Culverts, Excavation, Riprap)

Landscaping

Land Acquisition

Maintenance

Quantity Estimation

Riprap Cutoff Walls

Channel Excavation

Riprap Liner

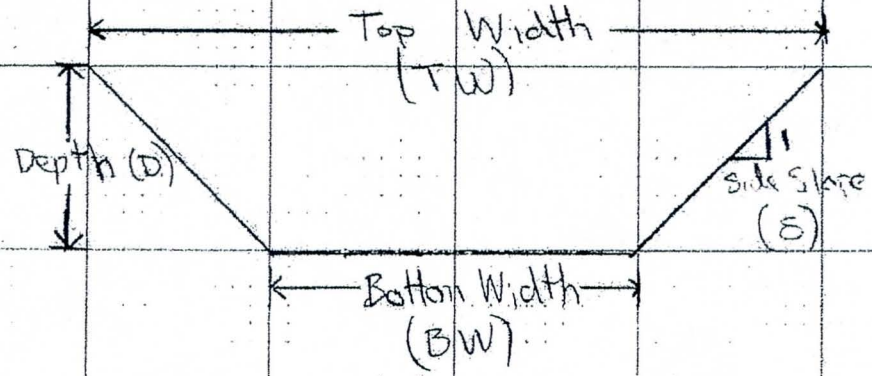
Entellus

SHEET 1 OF 1
BY FILJ DATE 10/16/12
CHECK _____ DATE _____

CLIENT FCDMC

JOB NAME East Mesa ADMP U JOB NO 310.057

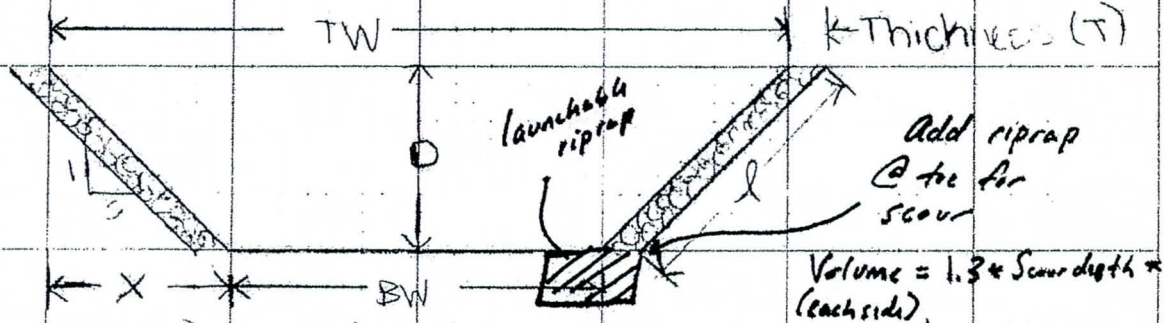
Channel Excavation Calculation



Area (A) = $D*(BW + D*S)$

Volume = Area * Length (L) = $\boxed{D*(BW + D*S)*L = V}$

Riprap Excavation Calculation



Thickness (T) = $2*d_{50}$ + 1 foot over excavation

$X = D*S$

$l = \sqrt{D^2 + X^2} = \sqrt{D^2 + (D*S)^2}$

$A = l*T = \sqrt{D^2 + (D*S)^2} * (2*d_{50} + 1)$

$V = A*L = \boxed{\left[\sqrt{D^2 + (D*S)^2} * (2*d_{50} + 1)\right] * L = V}$

East Mesa ADMP - Alternative Analysis

Unit Cost Development

Construction (Culverts, Excavation, Riprap)

Landscaping

Land Acquisition

Maintenance

Quantity Estimation

Riprap Cutoff Walls

Channel Excavation

Riprap Liner

Entellus

SHEET 1 OF
BY RLJ DATE 10/19/12
CHECK DATE

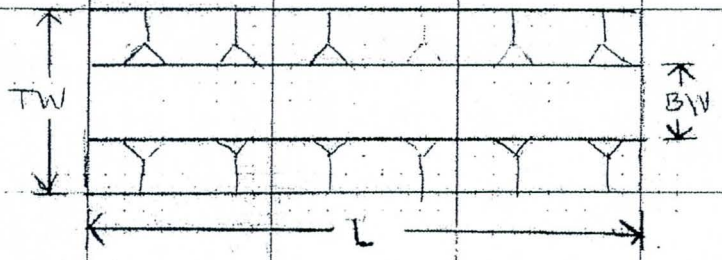
CLIENT FCDMC

JOB NAME East Mesa ADMP4 JOB NO 310.077

Riprap Channel "Bed Area"

Top Width Area (A_T) = known
Bottom Width Area (A_B) = "Bed Area" = unknown

Length (L) = unknown
Bottom Width (BW) = known
Top Width (TW) = known



$A_T = TW * L \rightarrow L = A_T / TW$

$A_B = BW * L \rightarrow \boxed{A_B = \frac{BW * A_T}{TW}}$

Check: Ellsworth Zone, Pecos Channel, Reach E1524B

$A_T = 7.4 ac$
$BW = 25 ft$
$TW = 85 ft$

$L = \frac{A_T}{TW} = \frac{7.4 ac}{85 ft} * \frac{43,560 ft^2}{ac} = 3792.3 ft$

$A_B = 3792.3 ft * 25 ft * \frac{ac}{43,560 ft^2} = 2.2 ac$

EAST MESA AREA DRAINAGE MASTER PLAN UPDATE
FCD 2011C017

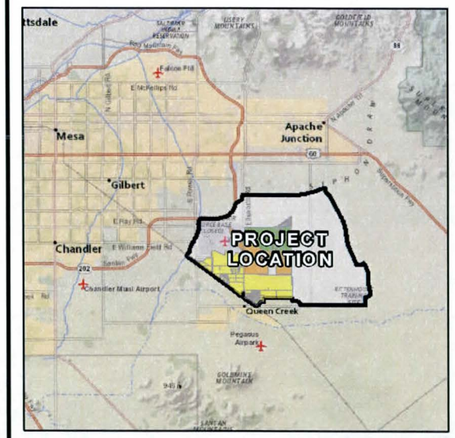
Flood Control District of Maricopa County

LEGEND

- Project Boundary
- Future SR 24 Alignment
- Drainage Zones

ZONE	Area Acres	Value
SR 24 Zone	2512	$330,083,982
Ellsworth Zone	3278	$430,759,551
Rittenhouse Zone	5612	$737,467,069

LOCATION MAP



NORTH 0 1 2 Miles

Entellus
2255 N. 44th Street Suite 125
Phoenix, Arizona 85008.3299
Tel. 602.244.2566
Fax. 602.244.8947
Web. www.entellus.com

epg · LEM Engineering Inc. · Ninyo & Moore · JE FULLER

NO FURTHER ACTION
LAND VALUATION

Sossaman Rd
Meridian Rd
Ray Rd
Powerline Floodway
Ellsworth Channel
East Maricopa Floodway
Rittenhouse Channel
Ellsworth Rd
Germann Rd
Ocotillo Rd
Maricopa County
Pinal County
Loop 202
SR 24 ZONE
ELLSWORTH ZONE
RITTENHOUSE ZONE
Future ADOT SR 24
Assumed Alignment
Recker Rd
Power Rd
Sossaman Rd
Hawes Rd
Ellsworth Rd
Crismon Rd
Signal Butte Rd
Meridian Rd
Ironwood Rd
Kenworthy Rd
Schnepf Rd
Sierra Vista Dr
Quail Run Ln
Guadalupe Rd
Elliot Rd
Warner Rd
Ray Rd
Williams Field Rd
Pecos Rd
Germann Rd
Queen Creek Rd
Ocotillo Rd
Chandler Heights Rd

Path: P:\0003.1902.10\Maps_ADMP\Deliverables\Proposed Alternatives\MVD Report_Figures\No Further Action Land Valuation.mxd - Date: 1/31/2014

APPENDIX G. MASTER LIST OF REFERENCES

Project: **East Mesa ADMP Update**
FCD Contract **FCD2011C017**

Data Collection Tracking Sheet

Item Number	Type	Number of Copies	Title	Description	Prepared			Received From		Date Received	Stored/Location	Entered by
					By	Agency	Date	Contact	Agency			
Flood Control Distric of Maricopa County												
5	PDF	1	East Mesa ADMP Project Phasing Map	ADMP Map	Dibble & Associates Consulting Engineers	FCDMC	7/23/1998	-	FCDMC		Entellus	MAN
80	JPG	1	East Mesa ADMP Field Photos	Field Photos	Unkown	FCDMC	8/17/2009	-	FCDMC	3/8/2012	Entellus	RLJ
81	PDF	1	East Mesa ADMPU Hydrology	Field Photos	Unkown	FCDMC	9/9/2006	-	FCDMC	3/8/2012	Entellus	RLJ
82	JPG	1	Stock tank West of BMX	Field Photos	Unkown	FCDMC	4/22/2009	-	FCDMC	3/8/2012	Entellus	RLJ
91	DAT	1	EMF HEC-1 Models	Modified Hydrology Models	FCDMC	FCDMC	5/9/2002	-	FCDMC	3/8/2012	Entellus	RLJ
92	PDF	1	EMF HEC-1 Schematics	Modified Hydrology Schematics	J2 Engineering and Environmental Design	FCDMC	6/8/2009	-	FCDMC	3/8/2012	Entellus	RLJ
93	XLS	1	Williams Gateway Freeway HEC-1 Results Summary	Hydrology Flows	J2 Engineering and Environmental Design	FCDMC	10/20/2009	-	FCDMC	3/8/2012	Entellus	RLJ
94	PDF	1	Southeast Mesa Area Drainage Master Plan	Hydrology Schematic	FCDMC	FCDMC	6/8/2008	-	FCDMC	3/8/2012	Entellus	RLJ
96	PRJ	1	Ellsworth Channel HEC-RAS Model	HEC-RAS Model	Unkown	FCDMC	8/3/2006	-	FCDMC	3/8/2012	Entellus	RLJ
99	PDF	1	East Mesa Area Drainage Master Plan Update	ADMPU	FCDMC	FCDMC	8/11/2011	-	Unkown	2/16/2012	Entellus	RLJ
100	PDF	1	East Mesa ADMPU Project Landscape Inventory & Analysis (LIA)	Landscape Report	FCDMC	FCDMC	2/12/2012	-	Unkown	2/16/2012	Entellus	RLJ
101	PDF	1	MCDOT Corridor Studies Book of Summaries 1997-2010	Corridor Study	Maricopa County	MCDOT	10/1/2012	-	Unkown	2/16/2012	Entellus	RLJ
102	PDF	1	Powerline Floodway Final Survey Report	Survey Report	FCDMC	FCDMC	1/19/2012	-	Unkown	2/16/2012	Entellus	RLJ
103	PDF	1	Powerline and Vineyard Road FRS 2010-2011 Instrumentation Monitoring Report	Subsidence Report	AMEC Infrastructure, Inc	FCDMC	4/29/2011	-	Unkown	2/16/2012	Entellus	RLJ
107	PDF	1	East Mesa ADMP Recommended Design Report	Master Drainage Plan	Dibble & Associates Consulting Engineers	FCDMC	7/23/1998	-	Unkown	2/16/2012	Entellus	RLJ
108	PDF	1	A class I Cultural Resources Literature Review for the East Mesa ADMP, Maricopa and Pinal Counties, Arizona	Literature Review	Archaeological Consulting Services	FCDMC	6/10/2011	-	Unkown	2/16/2012	Entellus	RLJ
109	PDF	1	East Mesa Area Drainage Master Plan Preliminary Biological Survey	Biological Survey	EcoPlan Associates, Inc.	FCDMC	6/24/2011	-	Unkown	2/16/2012	Entellus	RLJ
111	PDF	1	Annual Monitoring Inspection Report Earth Fissure Site Investigation Siphon Draw Wash Drainage Improvements Project	Earth Fissure Report	AMEC Earth & Environmental, Inc.	FCDMC	8/23/2011	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
112	PDF	1	Initial Subsidence and Earth Fissure Report Powerline Vineyard Road and Rittenhouse Flood Retarding Structures Rehabilitation or Replacement Project	Subsidence and Earth Fissure Report	AMEC Earth & Environmental, Inc.	FCDMC	8/10/2010	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
113	PDF	1	Preliminary Design Report Site Evaluation of Interim Dam Safety Measure Powerline Flood Retarding Structure	Preliminary Dam Design Report	AMEC Earth & Environmental, Inc.	FCDMC	7/15/2009	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
114	PDF	1	Geologic/Geotechnical Investigation Report Site Evaluation of Interim Dam Safety Measure Powerline Flood Retarding Structure	Geotechnical Report	AMEC Earth & Environmental, Inc.	FCDMC	7/15/2009	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
115	PDF	1	Powerline and Vineyard Road FRS 2008-2009 Instrumentation Monitoring Report	Subsidence Report	AMEC Earth & Environmental, Inc.	FCDMC	5/5/2009	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
116	PDF	1	Siphon Draw Drainage Improvement Project Geologic Hazard Assessment and Geotechnical Characterization Report	Geotechnical Report	AMEC Earth & Environmental, Inc.	FCDMC	9/3/2008	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
117	PDF	1	Powerline Flood Retarding Structure Earth Fissure Failure Modes and Effects Analysis - Planning Phase	Earth Fissure Report	AMEC Earth & Environmental, Inc.	FCDMC	6/5/2008	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
118	PDF	1	Supplemental Earth Fissure/Ground Subsidence Investigation Report Powerline Flood Retarding Structure	Subsidence and Earth Fissure Report	AMEC Earth & Environmental, Inc.	FCDMC	6/4/2008	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
119	PDF	1	Earth Fissure/Ground Subsidence Instrumentation Installation Report and Monitoring Plan Powerline & Vineyard Road Flood Retarding Structures	Subsidence and Earth Fissure Report	AMEC Earth & Environmental, Inc.	FCDMC	6/29/2007	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
120	PDF	1	Preliminary Earth Fissure Risk Zone Investigation Report Hawk Rock Study Area	Earth Fissure Report	AMEC Earth & Environmental, Inc.	FCDMC	9/25/2006	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
121	PDF	1	Earth Fissure Risk Zone Investigation Report Powerline and Vineyard Flood Retarding Structures	Earth Fissure Report	AMEC Earth & Environmental, Inc.	FCDMC	5/25/2006	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
198	PDF	1	Floodplain Regulations for Maricopa County	Regulatons		FCDMC	11/1/2011	-	MC		JE Fuller	
224	PDF	1	Supplemental Earth Fissure Risk Report, Powerline FRS Interim Dam Safety Design Measure Project	Earth Fissure Report	AMEC Earth & Environmental, Inc.	FCDMC	12/6/2010	-	FCDMC	3/28/2012	Ninyo & Moore	HAH
225	PDF	1	Powerline and Vineyard Road FRS, 2009-2010 Instrumentation Monitoring Report	Subsidence Report	AMEC Earth & Environmental, Inc.	FCDMC	6/25/2010	-	FCDMC	3/28/2012	Ninyo & Moore	HAH
226	PDF	1	Survey Report Manual for Powerline and Vineyard FRS Subsidence Surveys 2008	Survey Report	A Team Professional Associates, Inc.	FCDMC	10/1/2008	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
227	PDF	1	Structures Assessment Phase II Investigation of Ground Subsidence and Earth Fissures Assignment 2 - Vineyard FRS (Volumes I, II, and III)	Subsidence and Earth Fissure Report	AMEC Earth & Environmental, Inc.	FCDMC	4/29/2002	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
228	PDF	1	Procedural Documents for Land Subsidence and Earth Fissure Appraisals	Subsidence and Earth Fissure Report	AMEC Earth & Environmental, Inc.	FCDMC	5/27/2011	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
231	PDF	1	East Mesa Area Drainage Master Plan Hydrologic Analysis Vol 1 of 2	Hydrology Report	FCDMC	FCDMC	10/1/1998	-	FCDMC	4/6/2012	Entellus	RLJ
232	PDF	1	East Mesa Area Drainage Master Plan Hydrologic Analysis Vol 2 of 2	Hydrology Report	FCDMC	FCDMC	10/1/1998	-	FCDMC	4/6/2012	Entellus	RLJ
233	PDF	1	Southeast Mesa Area Drainage Master Plan Data Collection Report	Data Collection Report	Dibble & Associates Consulting Engineers	FCDMC	5/3/1997	-	FCDMC	4/6/2012	Entellus	RLJ
234	PDF	1	East Mesa Area Drainage Master Plan Recommended Design Report	Drainage Report	Dibble & Associates Consulting Engineers	FCDMC	6/23/1998	-	FCDMC	4/6/2012	Entellus	RLJ
235	PDF	1	Geotechnical Engineering Report Southeast Mesa Area Drainage Master Plan	Geotechnical Report	Ricker, Atkinson, McBee & Associates, Inc.	FCDMC	5/7/1998	-	FCDMC	4/6/2012	Entellus	RLJ
236	PDF	1	DRAFT Phase 1 Environmental Site Assessment Southeast Mesa Area Drainage Master Plan	Environmental Assessment	Western Technologies Inc.	FCDMC	4/15/1998	-	FCDMC	4/6/2012	Entellus	RLJ
237	PDF	1	East Mesa Area Drainage Master Plan - Preliminary Plan	Preliminary Drainage Plan Map	Dibble & Associates Consulting Engineers	FCDMC		-	FCDMC	4/6/2012	Entellus	RLJ
247	PDF	1	Rittenhouse Channel LOMR	LOMR	FCDMC	FCDMC	10/28/1999	Jennifer Pokorski	FCDMC	5/2/2012	Entellus	RAS
248	PDF	1	Letter of Map revision for Rittenhouse Road Channel - Technical Data Notebook	Technical Data Notebook	FCDMC	FCDMC	1/1/1999	Jennifer Pokorski	FCDMC	5/2/2012	Entellus	RAS
249	PDF	1	Final Conceptual Design Report For Rittenhouse Channel From Signal Butte Road to the East Maricopa Floodway	Design Concept report	Gannett Fleming, Inc.	FCDMC	8/19/1993	Jennifer Pokorski	FCDMC	5/2/2012	Entellus	RAS
258		1	Appendix HEC - 1 Schematic - North and South of the Superstition Freeway	FCDMC East Mesa Area Drainage Master Plan	Dibble & Associates Consulting Engineering	FCDMC	-	-	FCDMC	6/16/12	Entellus	ATC
259	PDF	1	Siphon Draw Drainage Improvements Phase 1	Plans for the Siphon Draw Drainage Improvements	Stanley Consultants, Inc.	FCDMC	1/19/2009	-	FCDMC	6/18/12	Entellus	ATC
261	PDF	1	East Mesa Area Drainage Master Plan	Preliminary Design Plans	Dibble & Associates Consulting Engineering	FCDMC	6/18/1998	-	FCDMC	6/18/12	Entellus	ATC
Development												
1	PDF	1	Master Drainage Report for Mesa Proving Grounds (Redline Version)	Redline Version	Wood-Patel		9/30/2008	Shahir Safi	City of Mesa	12/15/2008	Entellus	MAN
2	PDF	1	Final Drainage Report for Ironwood Crossing	Drainage Report	CMX		1/16/2006	Elise Moore	Pinal County	12/13/2009	Entellus	MAN
3	PDF	1	Preliminary Drainage Report for Ironwood/Pima Subdivision	Drainage Report	CAN-AM		10/27/2004	Elise Moore	Pinal County	12/13/2009	Entellus	MAN
12	PDF	1	Final Drainage Report for Gila River Ranches Sub Division	Final Drainage Report	CMX		1/25/2005	Shahir Safi	City of Mesa	3/2/2009	Entellus	MAN

Project: **East Mesa ADMP Update**
FCD Contract **FCD2011C017**

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Item Number	Type	Number of Copies	Title	Description	Prepared			Received From		Date Received	Stored/Location	Entered by
					By	Agency	Date	Contact	Agency			
13	PDF	1	Final Drainage Report for Mountain Heights Sub division	Final Drainage Report	Infinity Engineering Services		9/12/2001	Shahir Safi	City of Mesa	3/2/2009	Entellus	MAN
14	PDF	1	Final Drainage Report for Mountain Horizons Sub Division 1 of 2	Final Drainage Report - 1st Submittal	CMX		9/20/2005	Shahir Safi	City of Mesa	3/2/2009	Entellus	MAN
15	PDF	1	Final Drainage Report for Mountain Horizons Sub Division 2 of 2	Final Drainage Report - 2nd Submittal	CMX		1/18/2006	Shahir Safi	City of Mesa	3/2/2009	Entellus	MAN
18	PDF	1	Master Drainage Plan for Mountain Ranch Sub Division	Drainage Report	DEI Professional Services		12/8/1999	Shahir Safi	City of Mesa	3/2/2009	Entellus	MAN
21	PDF	1	Offsite Flow Management for Gila River Ranches Sub Division 1 of 2	Offsite Drainage Report - 2nd Submittal	CMX		6/15/2005	Shahir Safi	City of Mesa	3/2/2009	Entellus	MAN
22	PDF	1	Offsite Flow Management for Gila River Ranches Sub Division 2 of 2	Offsite Drainage Report - 1st Submittal	CMX		12/2/2004	Shahir Safi	City of Mesa	3/2/2009	Entellus	MAN
25	PDF	1	Drainage Master Plan for Leslie Estates	Master Drainage Report	Community Science Corporation		6/29/2000	-	Town of Queen Creek	3/16/2009	Entellus	MAN
26	PDF	1	Final Drainage Report for Charleston Estates	Final Drainage Report	Sunrise Engineering		6/5/2007	-	Town of Queen Creek	3/16/2009	Entellus	MAN
27	PDF	1	Final Drainage Report for ALC Builders	Final Drainage Report	D & M Engineering		5/10/2005	-	Town of Queen Creek	3/16/2009	Entellus	MAN
28	PDF	1	Final Drainage Report for Langley Gateway Estates	Final Drainage Report	AMEC Infrastructure, Inc		1/18/2005	-	Town of Queen Creek	3/16/2009	Entellus	MAN
29	PDF	1	Final Drainage Report for Nauvoo Station	Final Drainage Report	Fleet-Fisher Engineering, Inc		6/7/2006	-	Town of Queen Creek	3/16/2009	Entellus	MAN
30	PDF	1	Final Drainage Report for Grismon Heights	Final Drainage Report	Fleet-Fisher Engineering, Inc		9/24/2004	-	Town of Queen Creek	3/16/2009	Entellus	MAN
54	PDF	1	Gila River Ranches - Offsite Improvement Plans for South Meridian Drive	As-Built	CMX		10/30/2006	-	FCDMC	3/9/2012	Entellus	RLJ
55	PDF	1	Gila River Ranches Unit 2 - Grading Plans	As-Built	CMX		6/30/2005	-	FCDMC	3/8/2012	Entellus	RLJ
56	PDF	1	Gila River Ranches Unit 3 - Final Plat	As-Built	CMX		1/21/2005	-	FCDMC	3/8/2012	Entellus	RLJ
57	PDF	1	Gila River Ranches: Offsite Water Plans - S. Mountain Road	As-Built	CMX		7/9/2004	-	FCDMC	3/8/2012	Entellus	RLJ
60	PDF	1	Mountain Horizons Improvement Plans - Unit 5	Plans	CMX		1/26/2006	-	FCDMC	3/8/2012	Entellus	RLJ
61	PDF	1	Mountain Horizons Improvement Plans - Unit 6	Plans	CMX		1/25/2006	-	FCDMC	3/8/2012	Entellus	RLJ
62	PDF	1	Mountain Horizons Improvement Plans - Unit 8	As-Built	CMX		1/25/2006	-	FCDMC	3/8/2012	Entellus	RLJ
63	PDF	1	Final Plat of Mountain Horizons Unit 5	Plat	CMX		2/15/2006	-	FCDMC	3/8/2012	Entellus	RLJ
64	PDF	1	Final Plat of Mountain Horizons Unit 2	Plat	CMX		2/15/2006	-	FCDMC	3/8/2012	Entellus	RLJ
65	PDF	1	Mountain Horizons Offsite Improvement Plans - Phase 2	Plans	CMX		3/3/2008	-	FCDMC	3/8/2012	Entellus	RLJ
66	PDF	1	Mountain Horizons Improvement Plans - Unit 1	Plans	CMX		9/14/2006	-	FCDMC	3/8/2012	Entellus	RLJ
67	PDF	1	Mountain Horizons Improvement Plans - Unit 9	Plans	CMX		3/28/2007	-	FCDMC	3/8/2012	Entellus	RLJ
68	PDF	1	Mountain Horizons Improvement Plans - Unit 4	Plans	CMX		9/7/2007	-	FCDMC	3/8/2012	Entellus	RLJ
69	PDF	1	Mountain Horizons Water Meter Plans - Unit 7	Plans	CMX		8/23/2007	-	FCDMC	3/8/2012	Entellus	RLJ
70	PDF	1	Mountain Horizons Improvement Plans - Unit 10	Plans	CMX		2/7/2008	-	FCDMC	3/8/2012	Entellus	RLJ
71	PDF	1	Mountain Horizons South Offsite Water & Sewer Plans - Phase 2	Plans	CMX		11/19/2007	-	FCDMC	3/8/2012	Entellus	RLJ
72	PDF	1	Mountain Ranch Unit 2 Improvement Plans	As-Built	DEI Professional Services		12/30/1999	-	FCDMC	3/8/2012	Entellus	RLJ
73	PDF	1	Nova Vista Arterial Improvement Plans	As-Built	CMX		6/30/2006	-	FCDMC	3/8/2012	Entellus	RLJ
74	PDF	1	Nova Vista Collector Improvement Plans	As-Built	CMX		8/25/2006	-	FCDMC	3/8/2012	Entellus	RLJ
75	PDF	1	Nova Vista Improvement Plans - Unit C	As-Built	CMX		7/12/2006	-	FCDMC	3/8/2012	Entellus	RLJ
76	PDF	1	Nova Vista Improvement Plans - Unit A	As-Built	CMX		8/25/2006	-	FCDMC	3/8/2012	Entellus	RLJ
77	PDF	1	Nova Vista Improvement Plans - Unit B	As-Built	CMX		8/26/2006	-	FCDMC	3/8/2012	Entellus	RLJ
78	PDF	1	Nova Vista Improvement Plans - Unit D	Plans	CMX		5/25/2007	-	FCDMC	3/8/2012	Entellus	RLJ
79	PDF	1	Offsite Improvements for Stratford Estates	As-Built	Infinity Engineering Services		9/29/2000	-	FCDMC	3/8/2012	Entellus	RLJ
106	PDF	1	Master Drainage Report for Development Unit 7 at Mesa Proving Grounds	Drainage Report	Wood-Patel		9/29/2011	-	Unkown	2/16/2012	Entellus	RLJ
205	PDF	1	Community Plan for Mesa Proving Grounds-Section 4- Regulatory Framework	Guide			10/1/2008	-	Mesa		JE Fuller	
206	PDF	1	Community Plan for Mesa Proving Grounds-Section 9- Applicability of Mesa Engineering & Design Standards	Guide			10/1/2008	-	Mesa		JE Fuller	
207	PDF	1	Community Plan for Mesa Proving Grounds-Section 12- Landscape Standards	Guide			10/1/2008	-	Mesa		JE Fuller	
208	PDF	1	Community Plan for Mesa Proving Grounds-Section 13- Stormwater Drainage & Ret Stds	Guide			10/1/2008	-	Mesa		JE Fuller	
213	Hard Copy	1	Eastmark Thematic Design Guidelines	Eastmark Thematic Design Guidelines	DMB		10/1/2011	Trevor Barger	DMB	3/22/2012	EPG	JJG
229	PDF	1	Pacific Proving Grounds Master Drainage Report	Drainage Report	EPS Group, Inc.		1/1/2012	-	FCDMC	4/6/2012	Entellus	RLJ
241	PDF	1	Master Drainage Report for Mesa Proving Grounds	Drainage Report	Wood-Patel		9/15/2011	-			Entellus	RLJ
262	PDF	1	MGC Pure Chemicals America Warehouse & Isotainer Parking Additions	Plans	Wood-Patel	MGC Pure Chemicals	01/112	Ashok Patel	Wood-Patel	41088	Entellus	RLJ
Williams Gateway Airport												
11	PDF	1	Drainage Master Plan for Phoenix Mesa Gateway Airport	Drainage Master Plan	Dibble Engineering		2/11/2008	Shahir Safi	City of Mesa	3/2/2009	Entellus	MAN
16	PDF	1	Hydrology & Drainage Plan for Williams Gateway Airport Apr 1999	Supplement to Master Drainage Report	Gilbertson Associates, Inc		4/30/1999	Shahir Safi	City of Mesa	3/2/2009	Entellus	MAN
17	PDF	1	Hydrology Study-Drainage Master Plan for Williams Gateway Airport Oct 2001	Hydrology Study	Gilbertson Associates, Inc		10/10/2001	Shahir Safi	City of Mesa	3/2/2009	Entellus	MAN
19	PDF	1	North Area Drainage Evaluation for Williams Gateway Airport	Drainage Report	Dibble & Associates Consulting Engineers		10/31/2006	Shahir Safi	City of Mesa	3/2/2009	Entellus	MAN
20	PDF	1	North General Aviation Area Drainage Improvements & Cul-de-sac Design for Williams Gateway Airport	Final Drainage Report	Dibble & Associates Consulting Engineers		6/14/2007	Shahir Safi	City of Mesa	3/2/2009	Entellus	MAN
85	PDF	1	Drainage Report for Gateway Airport Commerce Center	Drainage Report	Allen Consulting Engineers, Inc.		4/26/2007	-	FCDMC	3/8/2012	Entellus	RLJ
87	PDF	1	Master Drainage Plan for Williams Gateway Airport	Master Drainage Report	Dibble & Associates Consulting Engineers		4/19/1996	-	FCDMC	3/8/2012	Entellus	RLJ
88	PDF	1	Supplement to Williams Gateway Airport Hydrology Study and Master Drainage Plan	Master Drainage Report Supplement	Gilbertson Associates, Inc		6/12/2002	-	FCDMC	3/8/2012	Entellus	RLJ
Arizona State Land Department												
4	PDF	1	Desert Drive Study	Hydrology & Sediment Yield Study	JE Fuller	ASLD	12/10/2007	-	ASLD		Entellus	MAN
33	PDF	1	Desert Drive Area Study Volume I - Existing Conditions Hydrology	Area Study	JE Fuller	ASLD	12/10/2007	-	ASLD	3/8/2012	Entellus	RLJ
34	PDF	1	Desert Drive Area Study Volume II - Book 1	Area Study	JE Fuller	ASLD	4/28/2008	-	ASLD	3/8/2012	Entellus	RLJ
35	PDF	1	Desert Drive Area Study Volume II - Book 2	Area Study	JE Fuller	ASLD	4/29/2008	-	ASLD	3/8/2012	Entellus	RLJ
City of Mesa												
32	PDF	1	City of Mesa Storm Drain Master Plan	Storm Drain Master Plan	Entellus, Inc	City of Mesa	1/14/2010	-	FCDMC	3/8/2012	Entellus	RLJ
58	PDF	1	City of Mesa Improvement Plans for Keighley Place	As-Built	Landaide, Inc.	City of Mesa	3/19/2007	-	FCDMC	3/8/2012	Entellus	RLJ

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Item Number	Type	Number of Copies	Title	Description	Prepared			Received From		Date Received	Stored/Location	Entered by
					By	Agency	Date	Contact	Agency			
59	PDF	1	City of Mesa Improvement Plans for Mountain Heights	As-Built	Infinity Engineering Services	City of Mesa	3/5/2001	-	FCDMC	3/8/2012	Entellus	RLJ
110	PDF	1	City of Mesa Engineering and Design Standards 2009	Design Standards	City of Mesa	City of Mesa	2/1/2009	-	Unkown	3/8/2012	Entellus	RLJ
203	PDF	1	Mesa Storm Water Management Plan	Guide		City of Mesa	9/1/2011	-	Mesa		JE Fuller	
204	PDF	1	Mesa Stormwater Annual Report to ADEQ 2010-2011	Guide		City of Mesa	9/1/2011	-	Mesa		JE Fuller	
209	PDF	1	Mesa Subdivision Regulations	Reg		City of Mesa	11/1/2006	-	Mesa		JE Fuller	
215	GIS	1	City of Mesa Utilities	GIS utility files	City of Mesa	City of Mesa	3/24/2012		City of Mesa	3/24/2012	Entellus	HAA
Town of Queen Creek												
7	PDF	1	Town of Queen Creek General Plan	General Plan Update 2008	Town of Queen Creek	Town of Queen Creek	5/21/2008	Chris Dovel	Town of Queen Creek	1/14/2009	Entellus	MAN
8	PDF	1	Town of Queen Creek Landuse Plan	Landuse Plan Amendment	Town of Queen Creek	Town of Queen Creek	5/21/2008	Chris Dovel	Town of Queen Creek	1/14/2009	Entellus	MAN
9	PDF	1	Town of Queen Creek Parks, Trails & Open Space Master Plan	Parks, Trails & Open Space Master Plan	Town of Queen Creek	Town of Queen Creek	11/30/2005	Chris Dovel	Town of Queen Creek	1/14/2009	Entellus	MAN
10	PDF	1	Town of Queen Creek Five Parks Master Plan	Five Parks Master Plan	Town of Queen Creek	Town of Queen Creek	9/30/2007	Chris Dovel	Town of Queen Creek	1/14/2009	Entellus	MAN
210	PDF	1	Queen Creek Subdivision Ordinance - Chapter 6 Subdivision Design Standards and Principles	Ord		Town of Queen Creek	10/1/2007	-	Town of Queen Creek		JE Fuller	
211	PDF	1	Queen Creek Design Standards and Procedures Manual Final Drainage Report Review Checklist	Guide		Town of Queen Creek	10/1/2007	-	Town of Queen Creek		JE Fuller	
212	PDF	1	Queen Creek Flood Control Ordinance	Ord		Town of Queen Creek	8/1/2007	-	Town of Queen Creek		JE Fuller	
214	GIS	1	Queen Creek Utilities	GIS utility files	Town of Queen Creek	Town of Queen Creek	4/23/2012	-	Town of Queen Creek	4/23/2012	Entellus	HAA
257	PDF	1	Germann Road Corridor Improvement Study	Slideshow Slides from Technical Advisory Group Meeting #3	Town of Queen Creek	Town of Queen Creek	3/28/2012	-	Town of Queen Creek	3/28/12	Entellus	ATC
Pinal County												
6	PDF	1	Draft Pinal County ADMP - Phase C - Queen Creek Watershed	Draft ADMP	Entellus, Inc	Pinal County	10/31/2008	Elise Moore	Pinal County	Unkown	Entellus	MAN
23	PDF	1	Final Drainage Report for Germann Road Between Ironwood Drive and Kenworthy Road	Improvement Drainage Report	Jacobs	Pinal County	3/10/2009	Elise Moore	Pinal County	3/12/2009	Entellus	MAN
24	PDF	1	Final Pavement Drainage Memorandum East West Arterial Widening Between Ironwood and Meridian, Combs Rd, Ocotillo Rd, Pecos Rd (Phase I) Pima Rd, Germann Rd (Phase II)	Drainage Report	Carter Burgess	Pinal County	6/7/2007	Elise Moore	Pinal County	3/12/2009	Entellus	MAN
31	PDF	1	Apache Junction Watershed (Pinal County)	Final Drainage Report	Entellus, Inc	Pinal County	10/25/2006	Andrea Betts	Pinal County	4/1/2009	Entellus	MAN
43	PDF	1	Ironwood Drive Paving Plans Phase B1	Paving Plans	Kimley-Horn and Associates, Inc.	Pinal County	12/7/2006	-	FCDMC	3/8/2012	Entellus	RLJ
44	PDF	1	Ironwood Drive Paving Plans Phase B2	Paving Plans	Kimley-Horn and Associates, Inc.	Pinal County	12/2/2006	-	FCDMC	3/8/2012	Entellus	RLJ
45	PDF	1	Ironwood Drive Paving Plans Phase B3 and B4	Paving Plans	Kimley-Horn and Associates, Inc.	Pinal County	1/22/2007	-	FCDMC	3/8/2012	Entellus	RLJ
83	PDF	1	Pinal County Comprehensive Plan	Comprehensive Plan	Pinal County	Pinal County	11/18/2009	-	FCDMC	3/8/2012	Entellus	RLJ
97	TIF	1	Ironwood Drive - Ocotillo Road	Plans/As-Built	Kimley-Horn and Associates, Inc.	Pinal County	1/29/2007	-	FCDMC	3/8/2012	Entellus	RLJ
255	Hard Copy	1	Pinal County Area Drainage Master Plan Phase A - Apache Junction (Final)	Area Drainage Master Plan	Entellus, Inc	Pinal County	10/25/2006	-	Entellus Library		Entellus	RLJ
256	Hard Copy	1	Pinal County Area Drainage Master Plan Phase C - Queen Creek (Final)	Area Drainage Master Plan	Entellus, Inc	Pinal County	5/15/2009	-	Entellus Library		Entellus	RLJ
MCDOT												
36	PDF	1	Final Drainage Report for Ellsworth Road - Phase I - Germann Road to Ray Road	Final Drainage Report	AMEC Infrastructure, Inc	MCDOT	5/23/2005	-	FCDMC	3/8/2012	Entellus	RLJ
37	PDF	1	Plans for the Construction of Ellsworth Road - Phase I - Germann Road to Ray Road	As-Built	AMEC Infrastructure, Inc	MCDOT	4/19/2005	-	FCDMC	3/8/2012	Entellus	RLJ
46	PDF	1	Signal Butte Corridor Improvement Study: US 60 to Rittenhouse Road	Draft Roadway Improvements Study	EPS Group, Inc.	MCDOT	12/1/2009	-	FCDMC	3/8/2012	Entellus	RLJ
47	PDF	1	Signal Butte Corridor Improvement Study: US 60 to Rittenhouse Road - Technical Memorandum No. 1: Purpose and Need	Draft Roadway Improvements Study	EPS Group, Inc.	MCDOT	1/2/2009	-	FCDMC	3/8/2012	Entellus	RLJ
48	PDF	1	Signal Butte Corridor Improvement Study: US 60 to Rittenhouse Road - Technical Memorandum No. 5: Conceptual Drainage report	Draft Roadway Improvements Study	JE Fuller	MCDOT	4/6/2009	-	FCDMC	3/8/2012	Entellus	RLJ
49	PDF	1	Signal Butte Corridor Improvement Study: US 60 to Rittenhouse Road - Technical Memorandum No. 8: Design Features & Access Management Guidelines	Draft Roadway Improvements Study	EPS Group, Inc.	MCDOT	11/1/2009	-	FCDMC	3/8/2012	Entellus	RLJ
50	PDF	1	MCDOT RightToads Program Summary of Public Involvement - Signal Butte Corridor Improvement Study: US 60 to Rittenhouse Road	Final Roadway Improvements Study	MCDOT	MCDOT	12/1/2009	-	FCDMC	3/8/2012	Entellus	RLJ
51	PDF	1	Signal Butte Corridor Improvement Study: US 60 to Rittenhouse Road - Draft Technical Memorandum No. 2: Corridor Characteristics	Draft Roadway Improvements Study	EPS Group, Inc.	MCDOT	2/1/2009	-	FCDMC	3/8/2012	Entellus	RLJ
52	PDF	1	Signal Butte Corridor Improvement Study: US 60 to Rittenhouse Road - Draft Technical Memorandum No. 5: Conceptual Drainage report	Draft Roadway Improvements Study	JE Fuller	MCDOT	2/1/2009	-	FCDMC	3/8/2012	Entellus	RLJ
53	PDF	1	Signal Butte Corridor Improvement Study: US 60 to Rittenhouse Road - Draft Technical Memorandum No.4: Environmental Overview	Draft Roadway Improvements Study	Logan Simpson Design Inc.	MCDOT	1/1/2009	-	FCDMC	3/8/2012	Entellus	RLJ
98	DAT	1	Signal Butte Corridor HEC-1	Hydrology Models	Unkown	MCDOT	1/14/2009	-	FCDMC	3/8/2012	Entellus	RLJ
191	PDF	1	Pavement Design Summary, Ironwood-Gantzel, Roadway Improvement Project, Pinal County, Arizona N&M Project No. 600948002	Pavement Design Report	Ninyo & Moore	Pinal County	9/13/2005	-	Ninyo & Moore		Ninyo & Moore	HAH
192	PDF	1	Geotechnical Evaluation, Ironwood Drive Improvements, Ocotillo Road to US 60, Pinal County, Arizona N&M Project No. 600948001	Geotechnical Evaluation Report	Ninyo & Moore	Pinal County	3/11/2005	-	Ninyo & Moore		Ninyo & Moore	HAH
238	PDF	1	Ellsworth Rd Phase I - Germann Rd to Ray Road	As-Built	MCDOT	MCDOT	6/6/2007	-	FCDMC	4/6/2012	Entellus	RLJ
239	PDF	1	Erie Street Drainage Improvements	Drainage Report	Prestige Engineering Consultants	MCDOT	6/1/2008	-	FCDMC	4/6/2012	Entellus	RLJ
250	PDF	1	Meridian Road Access Control and Corridor Improvement Study - Final Report	Corridor Study	URS	MCDOT	1/1/2006	-	Baker	5/17/2012	Entellus	RLJ
251	PDF	1	Meridian Road Access Control and Corridor Improvement Study - Appendices 1 - 7	Corridor Study	URS	MCDOT	1/1/2006	-	Baker	5/17/2012	Entellus	RLJ
252	PDF	1	Meridian Road Access Control and Corridor Improvement Study - Appendices 8 - 9	Corridor Study	URS	MCDOT	1/1/2006	-	Baker	5/17/2012	Entellus	RLJ
253	PDF	1	Meridian Road Access Control and Corridor Improvement Study - Technical Memo No. 9	Corridor Study	URS	MCDOT	1/1/2006	-	Baker	5/17/2012	Entellus	RLJ
254	PDF	1	Meridian Road Access Control and Corridor Improvement Study - Appendix 10	Corridor Study	URS	MCDOT	1/1/2006	-	Baker	5/17/2012	Entellus	RLJ

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FEMA												
38	JPG	1	FIRM Maricopa County, Arizona - Panel 2685 of 4350	Flood Insurance Rate Map	FEMA	FEMA	9/30/2005	-	FCDMC	3/8/2012	Entellus	RLJ
39	JPG	1	FIRM Maricopa County, Arizona - Panel 2690 of 4350	Flood Insurance Rate Map	FEMA	FEMA	9/30/2005	-	FCDMC	3/8/2012	Entellus	RLJ
40	JPG	1	FIRM Maricopa County, Arizona - Panel 2695 of 4350	Flood Insurance Rate Map	FEMA	FEMA	9/30/2005	-	FCDMC	3/8/2012	Entellus	RLJ
41	PDF	1	FIRM Pinal County, Arizona - Panel 200 of 2575 (Rittenhouse Air Force Auxiliary Field)	Flood Insurance Rate Map	FEMA	FEMA	10/4/2007	-	FCDMC	3/8/2012	Entellus	RLJ
42	PDF	1	FIRM Pinal County, Arizona - Panel 200 of 2575	Flood Insurance Rate Map	FEMA	FEMA	10/4/2007	-	FCDMC	3/8/2012	Entellus	RLJ
ADOT												
89	PDF	1	SR 802 Williams Gateway Freeway - Powerline Floodway Overpass	Preliminary Plans	AECOM	ADOT	10/9/2012	-	FCDMC	3/8/2012	Entellus	RLJ
90	PDF	1	SR 802 Williams Gateway Freeway - Ironwood Drive	Draft Roll Plot	Unkown	ADOT	9/29/2009	-	FCDMC	3/8/2012	Entellus	RLJ
95	PDF	1	SR 802 Williams Gateway Freeway Corridor Study: SR 202L to Florence Junction Location/Design Concept Study & Environmental Assessment	Draft SR802 Alignments	ADOT	ADOT	5/9/2012	-	FCDMC	3/8/2012	Entellus	RLJ
230	PDF	1	Germann Road Corridor Improvement Study Technical Advisory Group Meeting #3	Roadway Study	ADOT/Town of Queen Creek	ADOT	11/3/2011		FCDMC	4/6/2012	Entellus	RLJ
240	PDF	1	Germann Road Corridor Improvement Study Power Road to Ironwood Road	Drainage Report	Wilson & Company	ADOT	3/1/2012	Jennifer Pokorski	FCDMC	4/11/2012	Entellus	RLJ
242	Hard copy	1	Project Plans State Highway Getaway Freeway (SR -24)	Construction Plans	Stantec Consultants Inc.	ADOT	11/3/2011	Jennifer Pokorski	FCDMC	3/24/2012	Entellus	HAA
242	PDF	1	Final Materials Design Memorandum - State Route 24 - Gateway Freeway - State Route 202L to Ellsworth Road	Final Materials Design Memorandum	AMEC Earth & Environmental, Inc.	ADOT	10/7/2011	-	ADOT	4/13/2012	Ninyo & Moore	HAH
243	PDF	1	Final Foundation Investigation Report - State Route 24 - Gateway Freeway - State Route 202L to Ellsworth Road	Final Foundation Investigation Report	AMEC Earth & Environmental, Inc.	ADOT	8/12/2011	-	ADOT	4/13/2012	Ninyo & Moore	HAH
244	PDF	1	Final Design Concept Report (Volume 1 of 2) SR 24, Gateway Freeway (SR 202L - Ironwood Road)	Final Design Concept Report	AECOM	ADOT	4/1/2011	-	ADOT	4/13/2012	Ninyo & Moore	HAH
245	PDF	1	Final Geotechnical Investigation Report - State Route 24 - Gateway Freeway - State Route 202L to Ellsworth Road	Final Geotechnical Investigation Report	AMEC Earth & Environmental, Inc.	ADOT	8/12/2011	-	ADOT	4/13/2012	Ninyo & Moore	HAH
260	PDF	1	State Highway Gateway Freeway (SR 24)	SR 24: SR 202L to Ellsworth Road	Stanley Consultants, Inc.	ADOT	11/1/2011	-	ADOT	6/18/12	Entellus	ATC
ADWR												
105	PDF	1	Land Subsidence Maps	Subsidence Maps	ADWR	ADWR	Varies	-	Unkown	2/16/2012	Entellus	RLJ
167	PDF	1	Land Subsidence in the Hawk Rock Area of East Mesa and Apache Junction 2/22/2006 to 4/2/2008	Land Subsidence Map	Arizona Dept of Water Resources	ADWR	6/30/1905	-	ADWR		Ninyo & Moore	HAH
168	PDF	1	Land Subsidence in the Hawk Rock Area of East Mesa and Apache Junction 2/7/2007 to 4/2/2008	Land Subsidence Map	Arizona Dept of Water Resources	ADWR	7/1/1905	-	ADWR		Ninyo & Moore	HAH
169	PDF	1	Land Subsidence in the Hawk Rock Area of East Mesa and Apache Junction 2/7/2007 to 3/18/2009	Land Subsidence Map	Arizona Dept of Water Resources	ADWR	7/2/1905	-	ADWR		Ninyo & Moore	HAH
170	PDF	1	Land Subsidence in the Hawk Rock Area of East Mesa and Apache Junction 2/11/2009 to 3/3/2010	Land Subsidence Map	Arizona Dept of Water Resources	ADWR	7/1/1905	-	ADWR		Ninyo & Moore	HAH
171	PDF	1	Land Subsidence in the Hawk Rock Area of East Mesa and Apache Junction 1/23/2008 to 2/11/2009	Land Subsidence Map	Arizona Dept of Water Resources	ADWR	7/2/1905	-	ADWR		Ninyo & Moore	HAH
172	PDF	1	Land Subsidence in the Hawk Rock Area of East Mesa and Apache Junction 1/23/2008 to 3/3/2010	Land Subsidence Map	Arizona Dept of Water Resources	ADWR	7/2/1905	-	ADWR		Ninyo & Moore	HAH
173	PDF	1	Land Subsidence in the Hawk Rock Area of East Mesa and Apache Junction 5/15/2010 to 5/10/2011	Land Subsidence Map	Arizona Dept of Water Resources	ADWR	7/3/1905	-	ADWR		Ninyo & Moore	HAH
174	PDF	1	Land Subsidence in the Hawk Rock Area of East Mesa and Apache Junction 10/20/2004 to 9/29/2010	Land Subsidence Map	Arizona Dept of Water Resources	ADWR	7/2/1905	-	ADWR		Ninyo & Moore	HAH
175	PDF	1	Land Subsidence in the Hawk Rock Area of East Mesa and Apache Junction 5/17/1992 to 4/19/2000	Land Subsidence Map	Arizona Dept of Water Resources	ADWR	6/22/1905	-	ADWR		Ninyo & Moore	HAH
176	PDF	1	East Mesa Change in Water Level from 1900 to 2002	Water Level Map	Arizona Dept of Water Resources	ADWR	6/24/1905	-	ADWR		Ninyo & Moore	HAH
177	PDF	1	ADWR Hydrologic Map Series Report No. 35 Depth to Water and Water-Level Altitude	Water Level Map	Arizona Dept of Water Resources	ADWR	2/1/2003	-	ADWR		Ninyo & Moore	HAH
AZGS												
104	PDF	1	Suggested Guidelines for Investigating Land-Subsidence and Earth Fissure Hazards in Arizona	Subsidence Report	Arizona Geological Survey	AZGS	8/1/2011	-	Unkown	2/16/2012	Entellus	RLJ
155	PDF	1	AZGS DGM-52 Estimated Depth to Bedrock in Arizona	Geologic Map	rd, S.M., Shipman, T.C., Greene, L., & Harris	AZGS	4/1/2007	-	AZGS		Ninyo & Moore	HAH
156	PDF	1	AZGS DM-EF-17 Earth Fissure Map of Maricopa County, Arizona	Earth Fissure Map	Arizona Geological Survey	AZGS	12/1/2009	-	AZGS		Ninyo & Moore	HAH
157	PDF	1	AZGS DM-EF-21 Earth Fissure Map of Pinal County, Arizona	Earth Fissure Map	Arizona Geological Survey	AZGS	3/1/2011	-	AZGS		Ninyo & Moore	HAH
158	PDF	1	AZGS DM-EF-2 Earth Fissure Map of the Apache Junction Study Area: Pinal and Maricopa Counties, Arizona	Earth Fissure Map	Arizona Geological Survey	AZGS	4/1/2008	-	AZGS		Ninyo & Moore	HAH
159	PDF	1	AZGS DM-EF-1 Earth Fissure Map of the Chandler Heights Study Area: Pinal and Maricopa Counties, Arizona	Earth Fissure Map	Arizona Geological Survey	AZGS	8/1/2008	-	AZGS		Ninyo & Moore	HAH
160	PDF	1	AZGS OFR 96-23 Geologic Map of the Mesa 30' x 60' Quadrangle, East-Central Arizona	Geologic Map	pencer, J.E., Richard, S.M., & Pearthree, P.A	AZGS	9/1/1996	-	AZGS		Ninyo & Moore	HAH
161	PDF	1	AZGS OFR 94-24 Surficial Geologic Map of the Mesa 30' x 60' Quadrangle, Arizona	Geologic Map	Pearthree, P.A. and Huckleberry, G.	AZGS	11/1/1994	-	AZGS		Ninyo & Moore	HAH
162	PDF	1	AZGS OFR 94-10 Surficial Geology of the Apache Junction Area, Northern Pinal and Eastern Maricopa Counties, Arizona	Geologic Map and Report	Huckleberry, Gary	AZGS	6/1/1994	-	AZGS		Ninyo & Moore	HAH
163	PDF	1	AZGS OFR 07-01 Earth Fissure Mapping Program 2006 Progress Report	Earth Fissure Report	Allison, M.L., and Shipman, T.C.	AZGS	6/1/2007	-	AZGS		Ninyo & Moore	HAH
164	PDF	1	AZGS OFR 08-02 Earth Fissure Mapping Program 2007 Progress Report	Earth Fissure Report	Allison, M.L., and Shipman, T.C.	AZGS	3/20/2008	-	AZGS		Ninyo & Moore	HAH

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165	PDF	1	AZGS OFR 08-03 Arizona's Earth Fissure Mapping Program: Protocols, Procedures and Products	Earth Fissure Report	Shipman, T.C., and Diaz, M.	AZGS	5/1/2008	-	AZGS		Ninyo & Moore	HAH
166	PDF	1	AZGS OFR 94-11 A Reconnaissance of Earth Fissures Near Apache Junction, Chandler Heights, and Southwestern Picacho Basin	Earth Fissure Report	Harris, R.C.	AZGS	6/1/1994	-	AZGS		Ninyo & Moore	HAH
CAP												
122	PDF & TIF	1	Salt-Gila Aqueduct - Various Plan Sheets	Plans/As-Built	Central Arizona Project	CAP	Varies	-	CAP	3/21/2012	Ninyo & Moore	HAH
123	PDF	1	Earth Fissure Investigations for Reaches 2A Salt-Gila Aqueduct	Earth Fissure Report	Central Arizona Project	CAP	1/1/1985	-	CAP	3/21/2012	Ninyo & Moore	HAH
124	PDF	1	Execution of Earth Fissure Repair Contract, Reach 2, Salt-Gila Aqueduct	Earth Fissure Report	Central Arizona Project	CAP	8/16/1985	-	CAP	3/21/2012	Ninyo & Moore	HAH
126	PDF	1	Salt-Gila Aqueduct Reaches 1, 2 and 3 Subsidence Study	Subsidence Report	Geodetic Surveying Services, LLC	CAP	1/4/2002	-	CAP	3/21/2012	Ninyo & Moore	HAH
127	PDF	1	PXAO Library Database Keyword "Subsidence"	Library List	Central Arizona Project	CAP	11/8/2007	-	CAP	3/21/2012	Ninyo & Moore	HAH
128	PDF	1	PXAO Library Database Keyword "Earth Fissure"	Library List	Central Arizona Project	CAP	11/8/2007	-	CAP	3/21/2012	Ninyo & Moore	HAH
129	PDF	1	PXAO Library Database Keyword "Compaction"	Library List	Central Arizona Project	CAP	11/8/2007	-	CAP	3/21/2012	Ninyo & Moore	HAH
130	PDF	1	PXAO Library Database Keyword "Tension"	Library List	Central Arizona Project	CAP	11/8/2007	-	CAP	3/21/2012	Ninyo & Moore	HAH
135	PDF	1	Superstition Mountains Recharge Project	Article	Central Arizona Project	CAP	Unknown	-	CAP Website	3/21/2012	Ninyo & Moore	HAH
USBR												
125	PDF	1	Final Environmental Statement Salt-Gila Aqueduct Central Arizona Project	Environmental Statement	U.S. Bureau of Reclamation	USBR	11/13/1979	-	CAP	3/21/2012	Ninyo & Moore	HAH
131	PDF	1	Subsidence Test Well No. 1 Joint USGS-USBR Earth Fissure and Subsidence Study Bid Documents	Specifications/Bid Docs	U.S. Bureau of Reclamation	USBR	5/19/1978	-	CAP	3/21/2012	Ninyo & Moore	HAH
132	PDF	1	Geohyrdrologic Data Along the Salt-Gila Aqueduct of the Central Arizona Project in Maricopa and Pinal Counties, Arizona, USGS OFR 86-236	Technical Paper	U.S. Geological Survey	USGS	5/1/1986	-	CAP	3/21/2012	Ninyo & Moore	HAH
133	PDF	1	Ground-Water Depletion and Land Subsidence in Western Pinal County, Arizona	Technical Paper	U.S. Geological Survey	USGS	10/1/1986	-	CAP	3/21/2012	Ninyo & Moore	HAH
134	PDF	1	Salt-Gila Aqueduct Earth Fissure Repair Modifications-Reach 2	Specifications/Bid Docs	U.S. Bureau of Reclamation	USBR	6/7/1905	-	CAP	3/21/2012	Ninyo & Moore	HAH
USGS												
178	PDF	1	Desert Well, AZ USGS Topographic Quadrangle 7.5-Minute Series 2011	Topographic Map	United States Geological Survey	USGS	7/3/1905	-	USGS		Ninyo & Moore	HAH
179	PDF	1	Desert Well, AZ USGS Topographic Quadrangle 7.5-Minute Series 2009	Topographic Map	United States Geological Survey	USGS	7/1/1905	-	USGS		Ninyo & Moore	HAH
180	PDF	1	Desert Well, AZ USGS Topographic Quadrangle 7.5-Minute Series 1971	Topographic Map	United States Geological Survey	USGS	5/24/1905	-	USGS		Ninyo & Moore	HAH
181	PDF	1	Desert Well, AZ USGS Topographic Quadrangle 7.5-Minute Series 1956	Topographic Map	United States Geological Survey	USGS	5/9/1905	-	USGS		Ninyo & Moore	HAH
182	PDF	1	Desert Well, AZ USGS Topographic Quadrangle 7.5-Minute Series 1906 (Reprinted 1946)	Topographic Map	United States Geological Survey	USGS	3/20/1905	-	USGS		Ninyo & Moore	HAH
183	PDF	1	Higley, AZ USGS Topographic Quadrangle 7.5-Minute Series 2011	Topographic Map	United States Geological Survey	USGS	7/3/1905	-	USGS		Ninyo & Moore	HAH
184	PDF	1	Higley, AZ USGS Topographic Quadrangle 7.5-Minute Series 2009	Topographic Map	United States Geological Survey	USGS	7/1/1905	-	USGS		Ninyo & Moore	HAH
185	PDF	1	Higley, AZ USGS Topographic Quadrangle 7.5-Minute Series 1971	Topographic Map	United States Geological Survey	USGS	5/24/1905	-	USGS		Ninyo & Moore	HAH
186	PDF	1	Higley, AZ USGS Topographic Quadrangle 7.5-Minute Series 1956	Topographic Map	United States Geological Survey	USGS	5/9/1905	-	USGS		Ninyo & Moore	HAH
187	PDF	1	Mesa, AZ USGS Topographic Map 30 x 60 Minute Series	Topographic Map	United States Geological Survey	USGS	6/16/1905	-	USGS		Ninyo & Moore	HAH
Others												
84	PDF	1	Town of Gilbert General Plan Land Use Map	Land Use Map	Town of Gilbert	Town of Gilbert	2/10/2010	-	FCDMC	3/8/2012	Entellus	RLJ
86	PRJ	1	Ocotillo Channel HEC-RAS Model	HEC-RAS Model	Unkown		4/17/2006	-	FCDMC	3/8/2012	Entellus	RLJ
136	PDF	1	Land Subsidence, Earth Fissures, and Water-Level Change in Southern Arizona, AZGS OFR 86-14	Technical Paper/Map	Schumann, H.H. and Genualdi, R.B.		6/8/1905	-	N&M Library		Ninyo & Moore	HAH
137	PDF	1	Land Subsidence and Earth Fissures in Arizona	Technical Paper	Slaff, Steven		6/15/1905	-	AZGS	3/19/2012	Ninyo & Moore	HAH
138	PDF	1	Ground-Water Pumping Causes Arizona to Sink, Arizona Geology, Vol. 29, No. 3	Technical Paper	Fellows, Larry		6/21/1905	-	N&M Library		Ninyo & Moore	HAH
139	PDF	1	Use of Low-Sun Angle Photography for Identification of Subsidence-Induced Earth Fissures, IAHS Publication No. 200	Technical Paper	eckwith, G.H., Slemmons, D.B., &Weeks, R. E.		6/13/1905	-	N&M Library		Ninyo & Moore	HAH
140	PDF	1	South Central Arizona, Earth Fissures and Subsidence Complicate Development of Desert Water Resources, USGS	Technical Paper	Carpenter, M.C.		Unknown	-	N&M Library		Ninyo & Moore	HAH
141	PDF	1	Land Subsidence, Earth Fissures Change Arizona's Landscape, Arroyo, Summer 1992, Vol. 6, No. 2	Technical Paper	Gelt, Joe		6/14/1905	-	N&M Library		Ninyo & Moore	HAH
142	PDF	1	Impacts of Land Subsidence Caused by Withdrawal of Underground Fluids in the United States, GSA, Reviews in Engineering Geology, Volume XVI	Technical Paper	Holzer, T.L. and Galloway, D.L.		6/27/1905	-	N&M Library		Ninyo & Moore	HAH
143	PDF	1	Methods for Prediction of Earth Fissures and Surface Faults Caused by Groundwater Withdrawal, International Conference	Technical Paper	Holzer, T.L.		6/22/1905	-	N&M Library		Ninyo & Moore	HAH
144	PDF	1	Earth Fissures and Localized Differential Subsidence, Water Resources Research, Vol. 17, No. 1, Pgs. 223-227	Technical Paper	Holzer. T.L. and Pampeyan, E.H.		2/1/1981	-	N&M Library		Ninyo & Moore	HAH
145	PDF	1	Faulting Caused by Groundwater Extraction in South-central Arizona, Journal of Geophysical Research, Vol. 84, No. 82	Technical Paper	Holzer, T.L., Davis, S.N., and Lofgren, B.E.		2/10/1979	-	N&M Library		Ninyo & Moore	HAH
146	PDF	1	Geophysical Investigations of Ground Failure Related to Ground-Water Withdrawal - Picacho Basin, Arizona, Ground Water, Vol. 17, No. 6	Technical Paper	Jachens, R.C. and Holzer, T.L.		12/1/1979	-	N&M Library		Ninyo & Moore	HAH
147	PDF	1	Land Subsidence and Earth Fissuring on the Central Arizona Project, Arizona, IAHS Publication No. 200	Technical Paper	Sandoval, J.P. and Bartlett, S.R.		6/13/1905	-	N&M Library		Ninyo & Moore	HAH
148	PDF	1	Notes on Earth Fissures in Southern Arizona, Geological Survey Circular 466	Technical Paper	Robinson, G.M. and Peterson, D.E.		5/15/1905	-	N&M Library		Ninyo & Moore	HAH
149	PDF	1	Land Subsidence, Earth Fissures and Groundwater Withdrawal in South-Central Arizona, U.S.A.	Technical Paper	Schumann, H.H. and Poland, J.F.		5/22/1905	-	N&M Library		Ninyo & Moore	HAH

Project: **East Mesa ADMP Update**
FCD Contract **FCD2011C017**

Data Collection Tracking Sheet

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150	PDF	1	Land Subsidence in Central Arizona, Second International Symposium on Land Subsidence	Technical Paper	Winikka, C.C. and Wold, P.D.		12/1/1976	-	FCDMC	3/22/2012	Ninyo & Moore	HAH
151	PDF	1	Field Trip Guidebook for the 2011 AEG Shlemon Specialty Conference, Opportunities for Alternative Energy Development in Arizona and the Southwest	Technical Paper	AEG and ALSG		10/1/2011	-	N&M Library		Ninyo & Moore	HAH
152	PDF	1	Ground Subsidence and Earth Fissuring: Investigations, Solutions and Monitoring, 2011 AEG Shlemon Specialty Conference Presentation	Technical Presentation	Rucker, M.R.		10/1/2011	-	N&M Library		Ninyo & Moore	HAH
153	PDF	1	Land Subsidence and Cracking Due to Ground-Water Depletion, Ground Water, Vol. 15, No. 5	Technical Paper	Bouwer, Herman		10/1/1977	-	N&M Library		Ninyo & Moore	HAH
154	PDF	1	Subsidence Areas and Earth-Fissure Zones, Field notes Publication	Technical Paper	Unknown		6/9/1905	-	N&M Library		Ninyo & Moore	HAH
188	PDF	1	Investigation of Earth Fissure Across San Tan Boulevard, Queen Creek, Arizona	Earth Fissure Report	Shi, John and Perera, Yugantha		7/26/2007	-	MCDOT		Ninyo & Moore	HAH
189	PDF	1	Arizona State Hazard Mitigation Plan 2010, Chapter 5, Section 5.4.5 Fissures	Hazard Mitigation Planning Report	AZ Division of Emergency Management	AZDEM	7/2/1905	-	AZDEM		Ninyo & Moore	HAH
190	PDF	1	Arizona State Hazard Mitigation Plan 2010, Chapter 5, Section 5.4.10 Subsidence	Hazard Mitigation Planning Report	AZ Division of Emergency Management	AZDEM	7/2/1905	-	AZDEM		Ninyo & Moore	HAH
193	PDF	1	Limited Fissure Evaluation, Lost Dutchman Heights UPP, Pinal County, Arizona N&M Project No. 601700001	Earth Fissure Report	Ninyo & Moore		1/14/2009	-	Ninyo & Moore		Ninyo & Moore	HAH
194	PDF	1	Limited Subsidence Evaluation, Lost Dutchman Heights UPP, Pinal County, Arizona N&M Project No. 601700001	Subsidence Report	Ninyo & Moore		1/14/2009	-	Ninyo & Moore		Ninyo & Moore	HAH
195	PDF	1	Initial Geotechnical Evaluation, Desert Drive Planning Area, Pinal County, Arizona N&M Project No. 601702001	Geotechnical Evaluation Report	Ninyo & Moore		6/19/2007	-	Ninyo & Moore		Ninyo & Moore	HAH
196	PDF	1	Earth Fissure Mitigation Plan, Affordable Storage, Apache Junction, Arizona	Earth Fissure Report	Ray Harris Consulting, LLC		3/22/2010	-	Pinal County		Ninyo & Moore	HAH
197	PDF	1	Draft Memorandum Geotechnical Assessment North-South Corridor Study US 60 to I-10, Pinal County, Arizona	Geotechnical Evaluation Report	NCS Consultants, LLC		6/1/2011	-	Pinal County		Ninyo & Moore	HAH
199	PDF	1	Maricopa County Subdivision Regulations	Regulations			3/1/2011	-	MC		JE Fuller	
200	PDF	1	Drainage Regulations for Maricopa County	Regulations		FCDMC	11/1/2010	-	MC		JE Fuller	
201	PDF	1	Clarification of Drainage Regulations	Regulations		FCDMC	9/1/2001	-	MC		JE Fuller	
202	PDF	1	Maricopa County Land Use Plan - Queen Creek Planning Area	Study		MAG	4/1/1992	-	MC		JE Fuller	
218	PDF	1	2nd Gateway-are home plan - 3,500 dwellings would occupy part of former GM test site	Article	Arizona Republic		3/9/2012	Jennifer Pokorski	FCDMC	3//13/2012	Entellus	RLJ
219	PDF	1	On the Ground-Arizona is Cracking Up, Southwest Hydrology, pp. 8 and 9	Technical Paper	Harris, Ray		2/1/2006	-	N&M Library		Ninyo & Moore	HAH
220	PDF	1	Water-Level Declines, Land Subsidence, and Specific Compaction Near Apache Junction, South-Central Arizona	Technical Paper	Carpenter, M.C.		1/1/1987	-	N&M Library		Ninyo & Moore	HAH
221	PDF	1	Geotechnical Evaluation, East Maricopa Floodway, Rittenhouse Detention Basin, Maricopa County, Arizona N&M Project No. 600198002	Geotechnical Evaluation Report	Ninyo & Moore		10/10/2002	-	Ninyo & Moore		Ninyo & Moore	HAH
222	Hard Copy	1	Land Subsidence and Earth Fissures in Alluvial Deposits in the Phoenix Area, Arizona USGS Map I-845-H	Land Subsidence Map	Schumann, H.H.		5/27/1905	-	N&M Library		Ninyo & Moore	HAH
223	PDF	1	Mechanisms of Earth Fissuring Caused by Groundwater Withdrawal, Environmental & Engineering Geoscience, Vol. IX, No. 4, pp. 351-362	Technical Paper	Sheng, Z., Helm, D.C., & Li, J.		11/1/2003	-	N&M Library		Ninyo & Moore	HAH