EAST MESA

DRAINAGE MASTER PLAN

AUGUST 23, 2012

Prepared For:

DONA ANA COUNTY FLOOD COMMISSION
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EXECUTIVE SUMMARY – INTRODUCTION

The East Mesa Drainage Master Plan (DMP), prepared for the Doña Ana County Flood Commission provides the framework for storm water management planning and implementation of drainage improvements within the East Mesa area of Doña Ana County. This DMP provides a comprehensive drainage master plan with strategies for handling drainage in the study area, which covers approximately 60 square miles. The East Mesa watershed generally consists of the area North East of the City of Las Cruces, from the Organ Mountains in the east to Isaack Lake in the west.

Due to the East Mesa's proximity to the City of Las Cruces, it is becoming a center for development within the County. While most of the watershed is undeveloped open space, there are also residential communities and commercial development along US 70. The area remains somewhat rural with only main roads that are paved, and existing drainage structures that provide limited relief from flooding events. In some cases, development has occurred with minimal storm water infrastructure, and as such drainage management is a critical issue in the East Mesa Area. A previous study was completed for the area in 1992 and was considered in the development of this DMP. There have been considerable changes to the area since 1992, and many of the improvements recommended in the 1992 report have not been constructed. Public input was used to gather information and gain insight into the drainage conditions in the area. A summary of the public input received as part of this study, and an outline of the perceived drainage issues is provided in the DMP.

WATERSHED ANALYSIS

An analysis of the watershed was performed for existing and future development conditions. Hydrologic models were developed to analyze the 10-yr and 100-yr, 24-hr storm events for the area. This analysis utilized the United States Army Corps of Engineers (USACE) Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) software. Existing and future flow rates were determined for over a hundred basins in the study area and are tabulated in the DMP. Overall, storm water runoff under the future development conditions will increase. The increase between existing and future conditions is widely varied throughout the watershed, as there are many different levels of development expected, including areas that are expected to remain open space and areas that are expected to develop at a high density of eight dwelling units per acre.

Storm runoff in the East Mesa area is carried predominantly by natural channels and, due to the erosive soils, these channels often carry sediment. A sediment analysis was completed for six major arroyos in the study area. This analysis was used to determine bulking factors, which were applied to the hydrologic models for the area to account for the increase in runoff volume from sediment conveyed with the storm water runoff.

The DMP also includes a hydraulic analysis of existing and future drainage facilities. This analysis was completed using Bentley In-Roads Storm and Sanitary and USACE HEC-RAS software. From this hydraulic analysis, based on the results of the hydrologic analysis, the DMP identifies existing facilities that are currently under capacity and areas where drainage improvements are needed.

WATERSHED MANAGEMENT AND IMPROVEMENT RECOMMENDATIONS

Storm water management is a very important element of providing protection for local residents and downstream properties as development occurs. The DMP includes a section that discusses general storm water management and the importance of maintaining storm water facilities. Development in the East Mesa Area should occur from downstream to upstream. Wherever possible, developers should strive to include low impact development (LID). Recommendations for LID include, but are not limited to: limiting development density; providing open space; using permeable pavements; and storm water harvesting.

Specific improvements recommended for the area have been developed and are presented in the DMP. The improvements have been prioritized as short term (1-5 years) and long term (5-15 years). Five projects have been identified as short term and these projects are the highest priority for completion by Doña Ana County. They are:

1. Wagons East Subdivision Diversion Channel and Regional Ponding Facility
2. Hanger Lake Channel Extension and Regional Ponding Areas
3. Brahman Dam
4. Dragonfly Channel
5. Berry Patch Road Diversion Channel and Culvert Crossing

In addition to the short term recommended improvements, long term improvement recommendations have been identified and are recommended in the DMP. They are:

1. Reconstruction of Arroyo Road with Storm Drain System
2. Brahman Road Diversion Channel & Regional Ponding Facility
3. Moongate Road Regional Ponding Facility
4. Butterfield Diversion Channel and Detention Reservoir
5. Balsam Road Diversion Channel

6. Amber Mesa Regional Pond
7. El Centro Road Diversion Channel and Culvert Crossing
8. Porter Road Diversion Channel and Crossing
9. Hanger Lake Road North Diversion Channel and Culvert Crossing
10. Moongate Road North Diversion Channel and Culvert Crossing
11. Blue Topaz Road Storm Drain Extension

CONCLUSION

The East Mesa DMP provides a complete analysis of the drainage in the East Mesa Area. This DMP establishes the 10-yr and 100-yr flow rates for the area under existing and future conditions. The DMP provides guidance for general watershed management for the area including specific recommended drainage management improvements and associated costs.

1. INTRODUCTION

1.1. PURPOSE OF STUDY

The East Mesa Area Drainage Master Plan (EM-DMP) is a tool to help Doña Ana County develop strategies to manage storm runoff drainage through existing developments and prepare for drainage runoff from future developments. This study identifies areas with significant flood hazards and provides recommendations for eliminating or reducing those risks.

1.2. STUDY AREA DESCRIPTION

The East Mesa study area is located in Doña Ana County just to the east of the City of Las Cruces, along Highway US 70, and encompasses a drainage area of approximately 60 square miles; see Figure 1. The Organ Mountains are one of the most visible landmarks in the study area, and the ridgelines of the mountains define the eastern boundary of the watershed. The western limits of the watershed are defined by Isaack Lake and the surrounding playa. The area between the mountains and the playa is a large plain.

Vegetation throughout the watershed consists primarily of desert grasses and brush. Vegetative cover increases along arroyo channels and near Isaack Lake. Areas with residential and commercial development typically have native xeric landscaping. The peaks of the Organ Mountains are very rocky with a few small pockets of evergreen forest.

The climate in Doña County is semi-arid, with mild winters and hot summers. Significant storm events are often associated with the summer monsoon season from July through October. In addition to intense monsoon events, the area is also subject to periods of prolonged drought.

Due to the East Mesa's proximity to the City of Las Cruces, it has become a center for development within the County. Most of the watershed is undeveloped open-space, but it also includes significant residential communities and commercial development along US 70. The residential areas can be mostly described as low density rural areas (lot sizes greater than ½ acre), but there are also newer planned communities with smaller lot sizes. Due to the rural nature of the area, only main roads are paved, and existing drainage structures provide limited relief from flooding during storm events. Storm runoff is allowed to sheet flow across roads in many areas. In some cases, new development has occurred with minimal infrastructure for storm runoff, making drainage management for the East Mesa area a critical issue.

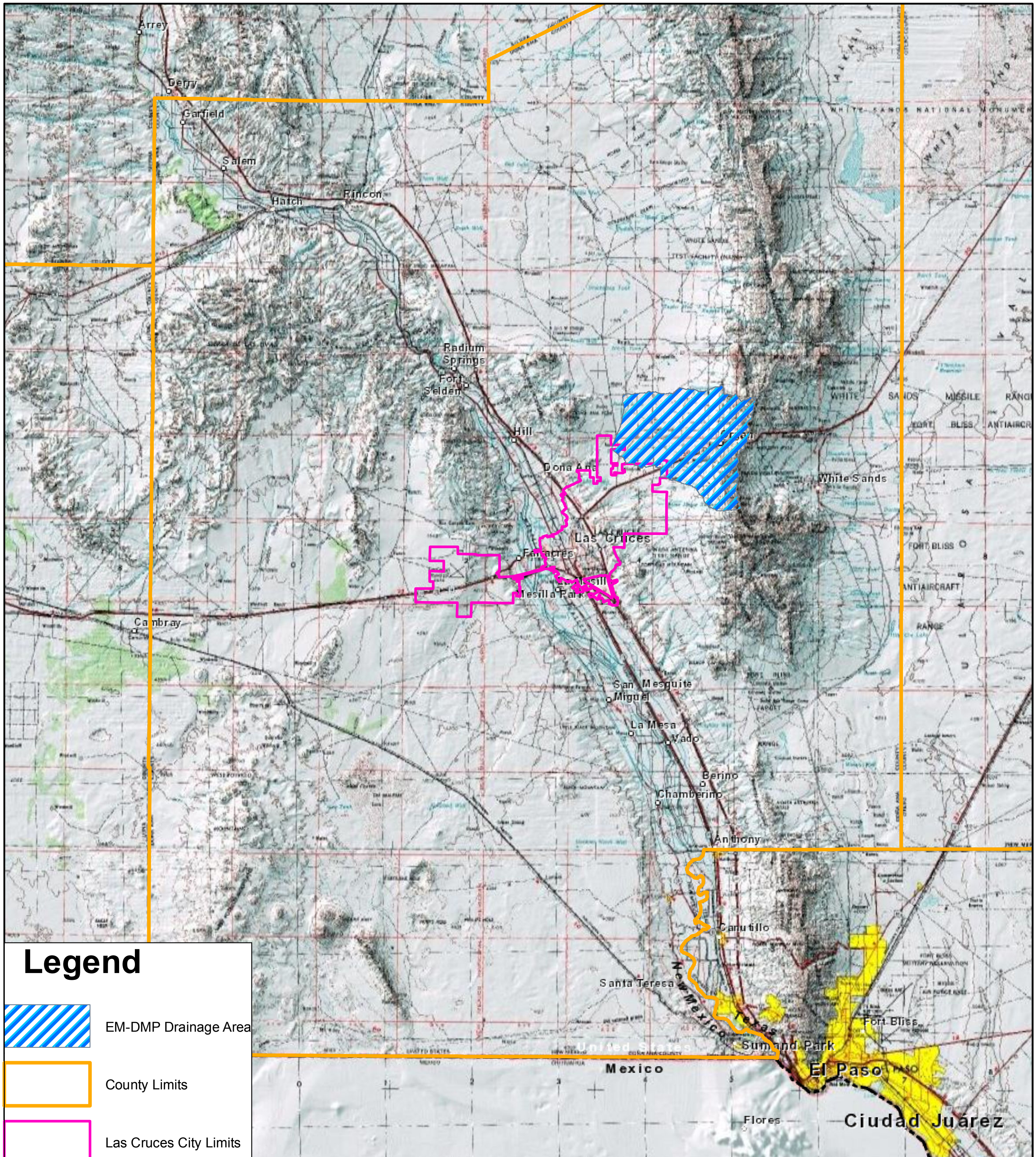

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Figure 1 - Vicinity Map

East Mesa Drainage Master Plan

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2. BACKGROUND INFORMATION

2.1. DRAINAGE PATTERNS

In general, the East Mesa drainage pattern is defined by runoff from the Organ Mountains flowing westward across the East Mesa before finally reaching the Isaack Lake Playa. The highest point in the study area is 7,700 feet (ft) at Baylor Peak; the lowest point is Isaack Lake at 4,300 ft.

Storm runoff travels across the East Mesa area primarily in natural channels. Arroyos are well defined in areas with steeper slopes, near the Organ Mountains; but to the west near Isaack Lake, the terrain is flatter and the arroyos become broad, poorly defined and alluvial. The alluvial nature of the arroyos in the East Mesa area is one of the most important characteristics to note in the area. Runoff from the steeper mountain slopes travels at higher velocities and can carry significant amounts of sediment, especially during large storm events. Once the runoff reaches flatter areas, the runoff velocity decreases and sediment begins to deposit in the arroyo channel. The sediment deposition results in alluvial channels where the natural channels may shift and the future flow paths are unpredictable. Shifts can occur rapidly; the sediment deposited in a single storm event may be enough to push the channel in a new direction. Many arroyo channels that are clearly visible are no longer active, due to sediment blockages that have caused the flow paths to shift. This process of sediment erosion and deposition is ongoing, and the arroyos will continue to shift course in the future. Future drainage management controls upstream of the alluvial arroyos may ultimately be required.

2.2. PREVIOUS ANALYSIS

In 1992 the East Mesa area was analyzed by Leedshill-Herkenhoff, Inc., in the Jornada DMP. Since 1992 considerable changes in the East Mesa area have occurred, which affect the viability of the recommendations made in the Jornada DMP. The area has attracted new development and the development has often proceeded without adequate attention to drainage issues. Many of the recommendations from the Leedshill-Herkenhoff DMP are no longer feasible, or appropriate for the current status of development.

The current statuses of major recommendations made in the Jornada DMP are shown in Figure 2 and are summarized below:

- Detention ponds for Blair and Baylor Canyon Arroyos and for Mine House Spring Arroyo were recommended to control runoff on the south side of US 70. These

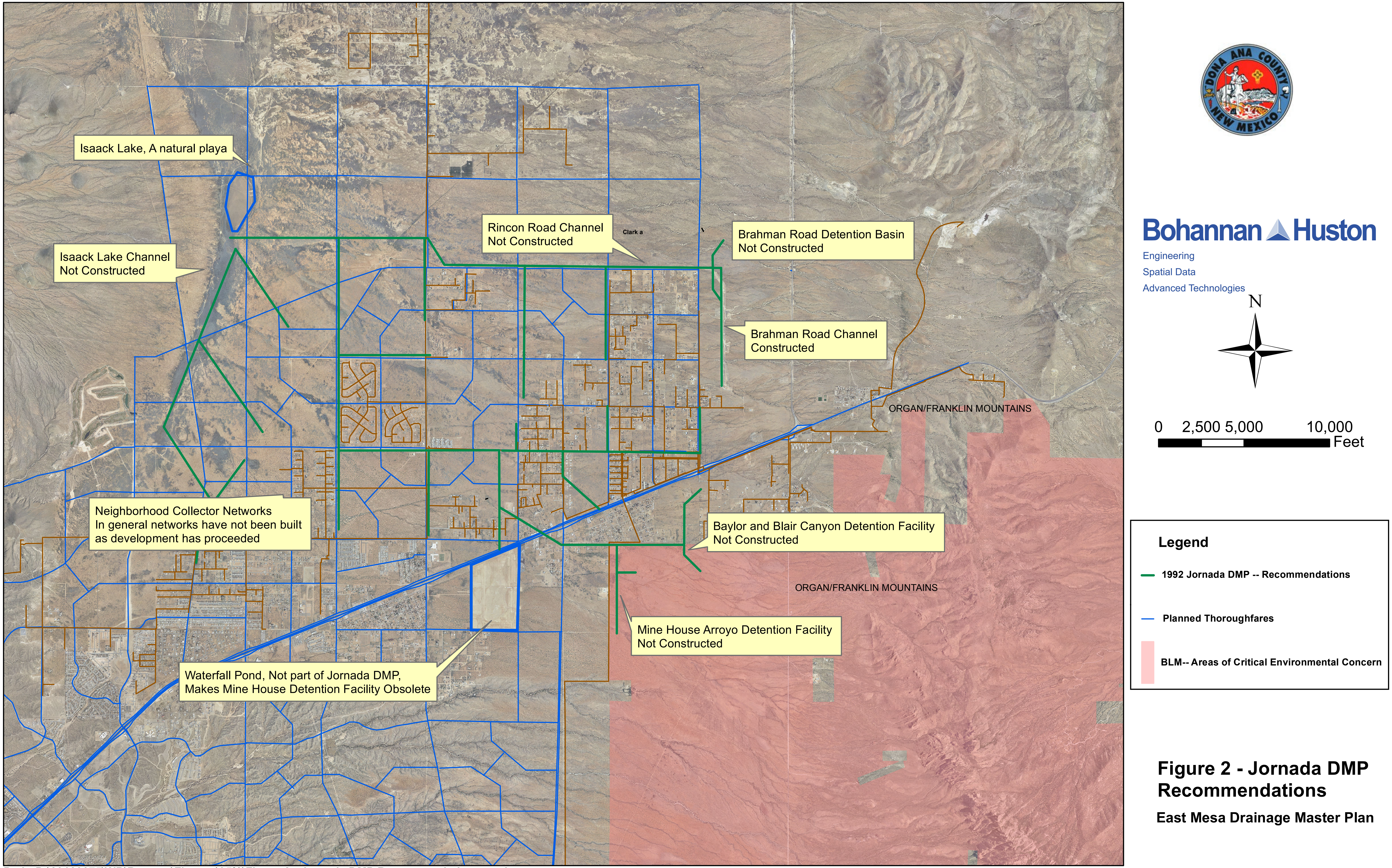


Figure 2 - Jornada DMP Recommendations

East Mesa Drainage Master Plan

Path: P:\20120075\WR\Reports\Figures\95%\Figure 2 - Jornada DMP Recommendations.mxd detention facilities were not constructed. The new Waterfalls Detention Facility takes the place of the Mine House Spring Detention Pond. New development in the Blair Canyon area would not be protected by the Baylor/Blair Arroyo Detention Facility as originally proposed.

- Recommended collector channels to convey storm runoff to Isaack Lake along Rincon Rd., Baylor Canyon Rd., Jornada, and Arroyo Rd. have not been built.
- The Brahman Channel was built, and significant development has occurred in the area protected by the Brahman Channel; however, the Brahman Detention Facility has not been built. The channel turns west and parallels Dragonfly Rd. for approximately one mile before it ends. Flow from the channel freely discharges into open space, the Dragonfly Channel fans out into a multitude of poorly defined flow paths.
- Neighborhood collector networks have not been developed as residential development has proceeded.
- The recommendations originally presented in the Jornada DMP have been reviewed as part of this study and were considered in the development of improvement recommendations to work with existing and planned developments.

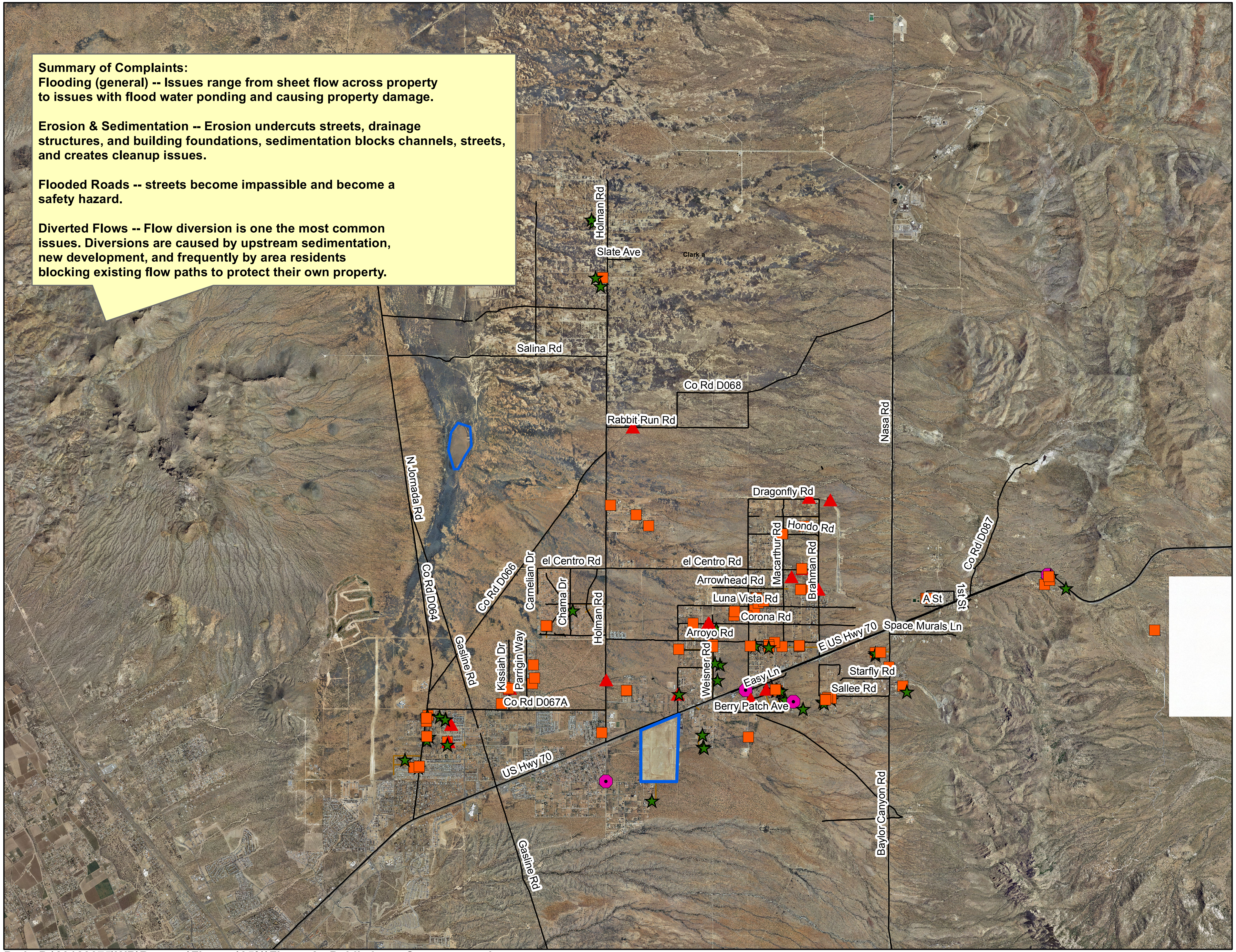
3. PUBLIC INPUT

In an effort to gather information and understand the drainage conditions in the East Mesa area, two public meetings were held. At the first public meeting, comment forms were distributed to the community to request feedback on the flooding issues observed by the East Mesa area citizens. The public meeting and comment process identified many concerns and observations within the East Mesa area. Flooding along roadways and in residential lots, areas of erosion, and sediment deposition were some of the main observations made by the community. A summary of the comments is provided in Table 1.

Table 1 – Comment Summary

PROBLEM	LOCATION
Flooding	McArthur Road
Flooding	Luna Vista Road
Flooding	Weisner Road
Flooding	Moongate Road
Flooding	Weisner Road
Flooding	Butterfield Isaacks Road
Flooding	Berry Patch Road
Flooding, Street Erosion	Luna Vista Road
Flooding	Diamond Road
Sediment Deposits	Mesa Grande Drive
Flooding, Street Erosion	Antares Road
Flooding	Arrowhead Road, McCarther to Moongate
Street Erosion	Fox Road, Arrowhead to Luna Vista
Flooding	McCarthy to Moongate
Flooding, Street Erosion	Fox Road
Flooding	Luna Vista Road
Flooding	Arrowhead & Moongate
Flooding	Weisner Road
Flooding	Butterfield Boulevard
Flooding, Street Erosion	Saromi Lane
Flooding	Cortez Road
Flooding	Dunn Street

In addition to the public meeting and comment forms received, shapefiles of complaints were provided by the County. The complaint shapefiles represent geotagged complaint locations from the County complaints database. These were considered, in addition to the comments provided by the community, in the investigation of the drainage conditions in the East Mesa area. Figure 3 provides a summary of the public input.



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0 3,500 7,000 14,000 Feet

Legend

East Mesa Complaints

Type

- Diverted Flow
- Erosion
- Flooded Road
- Flooding
- EastMesa_Complaints
- Major Roads
- Road_Complaints

Figure 3 - Public Input Summary

East Mesa Drainage Master Plan

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4. WATERSHED ANALYSIS AND EVALUATION

The East Mesa watershed was analyzed to identify existing and future drainage conditions and determine drainage improvements needed in the area. This analysis includes hydrologic and hydraulic analysis. The hydrologic analysis was completed using the U.S. Army Corp of Engineers (USACE) Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS), based on the Soil Conservation Service (SCS) Method. This method was chosen for consistency with Doña Ana County's Design Storm Drainage Criteria and with the Jornada DMP. Several elements need to be considered to build a complete hydrologic model. These elements include storm precipitation, basin boundaries, land usage, soils mapping, SCS Curve numbers, runoff travel time, and channel routing. The hydraulic analysis includes evaluating the existing drainage structures and modeling proposed improvements. The hydraulic structure evaluation was completed using Bentley In-Roads Storm and Sanitary (In-Roads). The hydraulic analysis of the proposed open channel improvements was completed using USACE Hydrologic Engineering Center River Analysis System (HEC-RAS). The watershed analyses and data inputs are discussed in the following sections.

4.1. MODEL STORM AND PRECIPITATION

10-yr and 100-yr, 24-hr storm events (10% and 1% probability events, respectively) were modeled. The precipitation depths, for the analyzed events, were extracted from NOAA Atlas 14. Due to the size and varied topography of the study area, the estimated 100-yr event precipitation varied from approximately 3.5 to 4.1 inches of rainfall. The area near Isaack Lake receives the least precipitation, and rainfall increases in the Organ Mountains. A point near the watershed centroid was used for the model precipitation. The rainfall depth for the 10-yr event is 2.50 inches and for the 100-yr event is 3.86 inches.

NM Type II-75 rainfall distribution was used for the storm hyetograph. This distribution places the storm peak at approximately 6-hrs, and approximately 80% of the precipitation falls within the two hour period around the storm peak. This storm distribution was developed by Natural Resources Conservation Service (NRCS) specifically for modeling storm events in Southern New Mexico. The storm 100-yr event hyetograph is shown in Figure 4; the tabulated distributions for the 10- and 100-yr events are included in Appendix A.

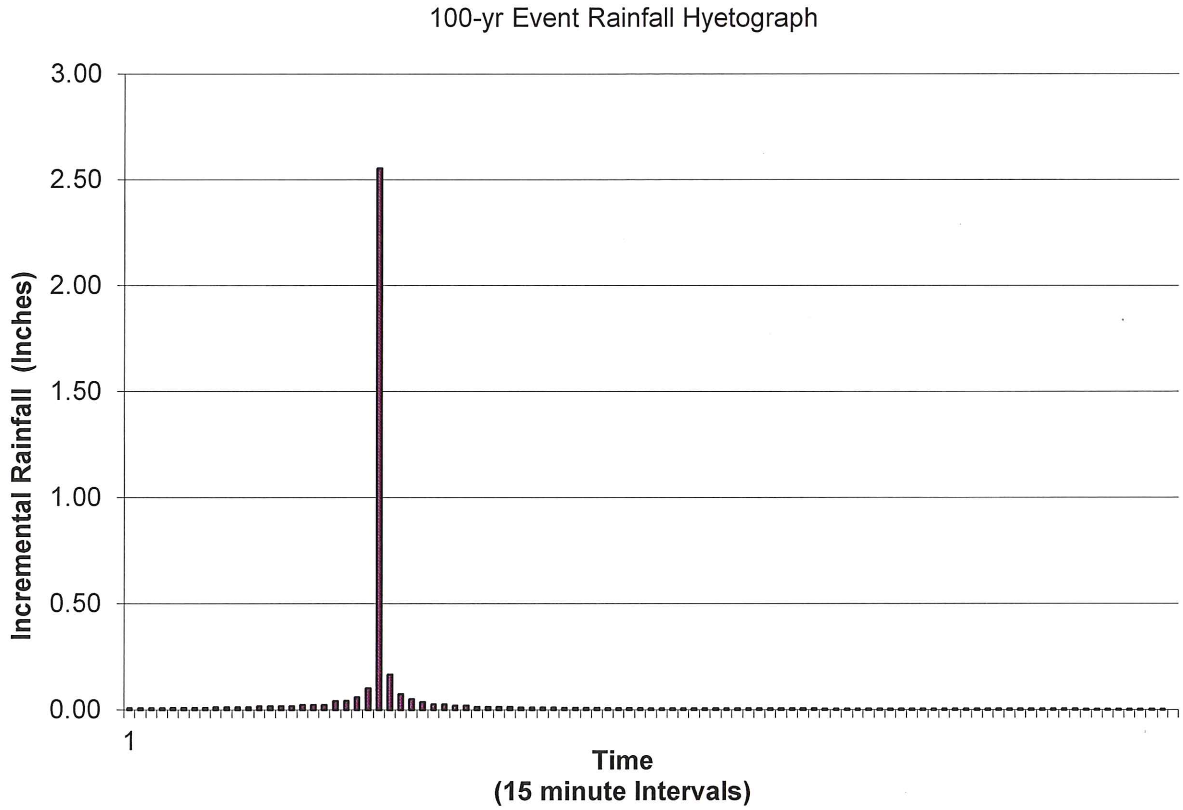

Figure 4 – 100-yr Event Rainfall Hyetograph

4.2. TOPOGRAPHIC DATA

The topographic data used for surface mapping the basin boundaries was taken from 2010 LIDAR aerial mapping of Doña Ana County (2010 DAC Mapping). The data was resampled using a 15 foot grid size within the digital elevation model (DEM). The total area covered by the DEM was approximately 120 square miles.

The Basin boundaries were determined using ArcGIS loaded with HEC-GeoHMS software developed by the USACE. Developing basin boundaries using the HEC-GeoHMS program consists of two main processing routines, DEM preprocessing steps, followed by the subbasin processing steps. In the preprocessing steps, a HydroDEM is created to correct for isolated low points in the RawDEM. Grids for flow direction, flow accumulation, streams, stream links and catchments (basins) are created from the HydroDEM. The raster data is used to create polyline and polygon shape files for streamlines and basin boundaries respectively. The flow direction grid determines the flow direction out of a given cell into one of its eight neighboring cells based on the greatest drop in elevation. The flow accumulation grid determines the number of cells draining into an individual cell. A threshold number of cells, draining into a given point, define the stream grid. Stream links divide the streams into segments (links) based on junctions, outlets, and basin divides. Finally, the Catchment Grid illustrates the area draining to each stream segment.

The basin map is further refined in the subbasin processing steps. These steps allow the basin boundaries to be modified to account for analysis points, such as culverts, roadways, ponds, and storm sewers. In the subbasin processing steps, characteristics such as the subbasin area, the longest flow path, flow path slope, and the basin centroid are all determined. The data generated from the HEC-GeoHMS processing was exported to HEC-HMS, to build the working hydrology models.

The basin boundaries were compared with United States Geological Survey USGS Topographic maps and aerial imagery to verify that the boundaries were in good agreement with other data sources. Information from field investigations was also used to verify the basin boundaries. After reviewing the aerial imagery, many alluvial avulsions were identified. The existing basin boundaries represent the existing conditions, based on the current topography. It should be noted that as the alluvial flow path changes occur, there can be significant impacts downstream. Basin boundaries for the future conditions analysis were refined to reflect recommended improvements. Figure 5 – Existing Subbasin Map and Figure 6 – Future Subbasin Map outline the drainage basins developed in this study.

Topographic data for the HEC-RAS models also utilized the 2010 Doña Ana County (DAC) Mapping. HEC-RAS modeling requires data of a finer resolution; therefore, the original surface data was used without any resampling. The resolution of the 2010 DAC mapping supports two foot contours.

4.3. LOSS METHOD (NRCS CURVE NUMBER)

The loss method provides an estimate of the precipitation that is intercepted, or infiltrates into the soil, and therefore is not part of the total storm runoff. The NRCS unit hydrograph method was used for the loss method in this study. In the NRCS method, a curve number (CN) is developed for each basin. The CN is based upon the soil type, land usage, vegetation, and antecedent moisture conditions. Low CNs are associated with conditions that favor precipitation infiltration and interception such as sandy soils, heavy vegetation, and low levels of development.

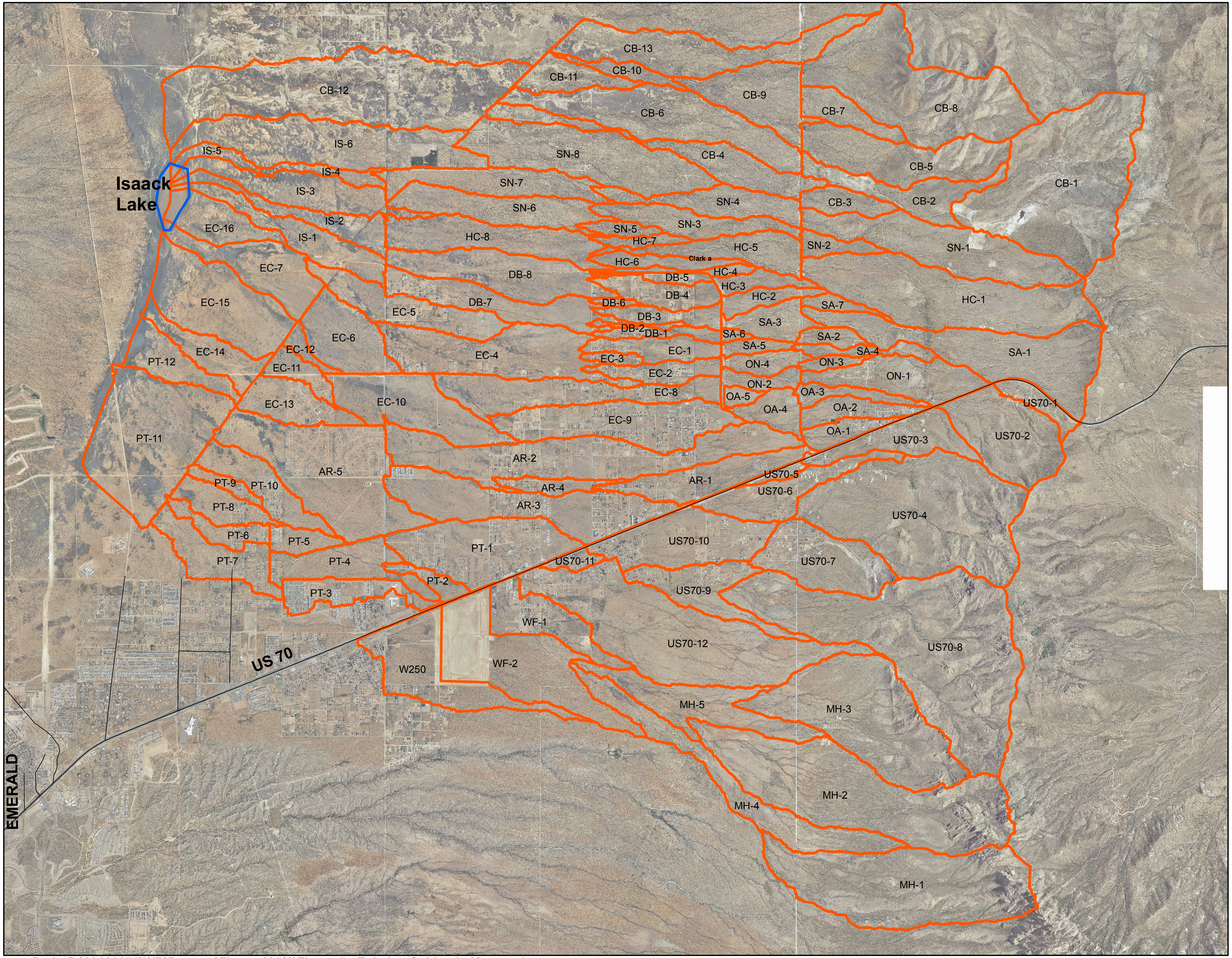

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Figure 5 - Existing Subbasin Map

East Mesa Drainage Master Plan

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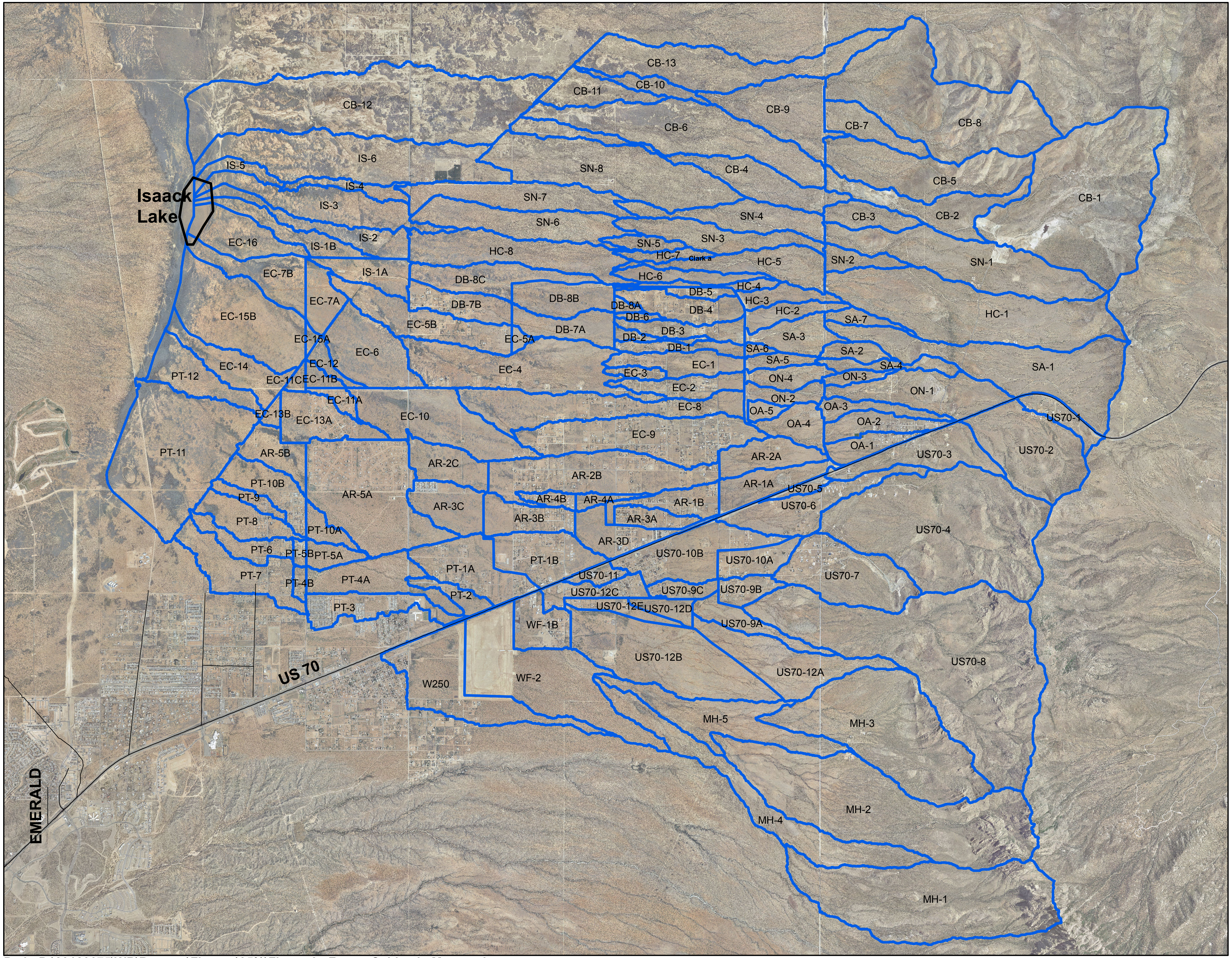

Legend

- US70
- Future Basins

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Figure 6 - Future Subbasin Map

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As the CN value increases, the portion of the storm precipitation converted to runoff also increases. High CN values are typically associated with impervious surfaces such as roadways, high density development, rock outcrops, clay soils, and already saturated soils.

In order to develop CN values for the study, information on soil types and development levels was needed. Soil Survey Geographic Database (SURRGO) and State Soil Geographic Database (STATGO) data from the NRCS was used for the soils data. The soils data is shown in Figure 7, and the existing land usage data is shown in Figure 8. For the existing conditions, land usage assignments were based upon aerial imagery flown in 2010, a USGS land usage grid was also used to verify the aerial images.

A future conditions model was also created based upon anticipated development levels for the area. The County has assigned zoning to privately held land, but zoning has not been assigned to land held publicly, which represents roughly 60% of the land in the study area. In order to model the East Mesa area future developed conditions, assumptions were made about the future development conditions of the publicly held land. These assumptions were made after consultations with representatives from the BLM and the County. The future development levels were based upon ownership, the accessibility of the area, the level of surrounding development, and any special designations assigned to the land. Under developed conditions it is also assumed that significant tracts of land currently held by the BLM and the State of New Mexico will be released for development.

The basis for the final assignments of future development levels are summarized here:

- The BLM owned areas to the south of US 70 are currently designated as an "Area of Critical Environmental Concern" and there are tracts identified as "Wilderness Study Areas". Therefore, it was assumed that these areas will primarily remain open space for the foreseeable future.
- Department of Defense (DOD) land is primarily to the east along the Organ Mountains, but it includes a strip of land along NASA Road. Since the land is held by the DOD we have assumed that none of this land will develop and will remain open space.
- The Land on both sides of NASA Road is owned by the BLM, but access from NASA Road is limited. The DOD may want to discourage development in this area. Additionally the area includes the Brahman Channel, which will need to remain as open space. Therefore, the parcels along NASA Road have been treated as open space in the future conditions model.

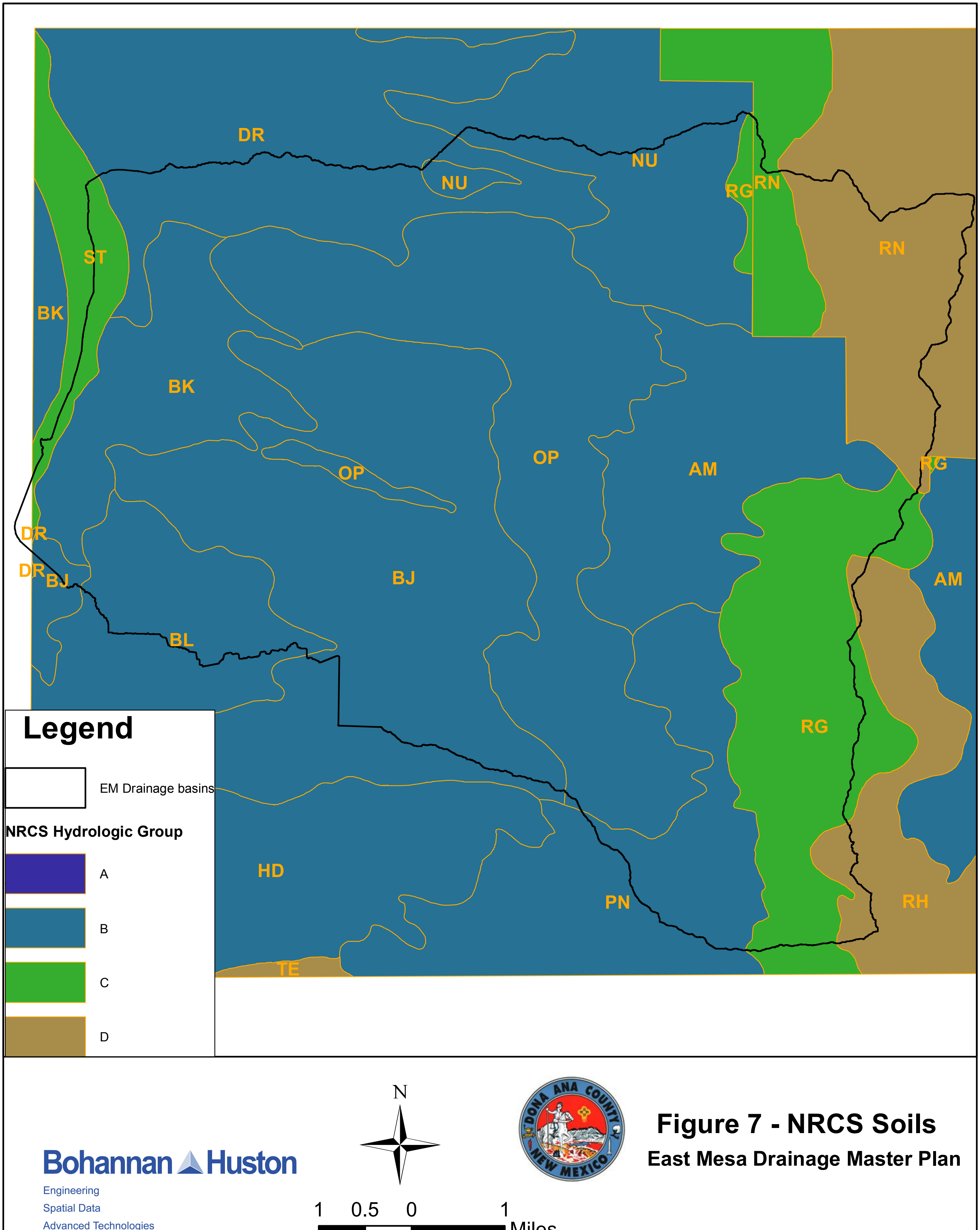

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Figure 7 - NRCS Soils

East Mesa Drainage Master Plan

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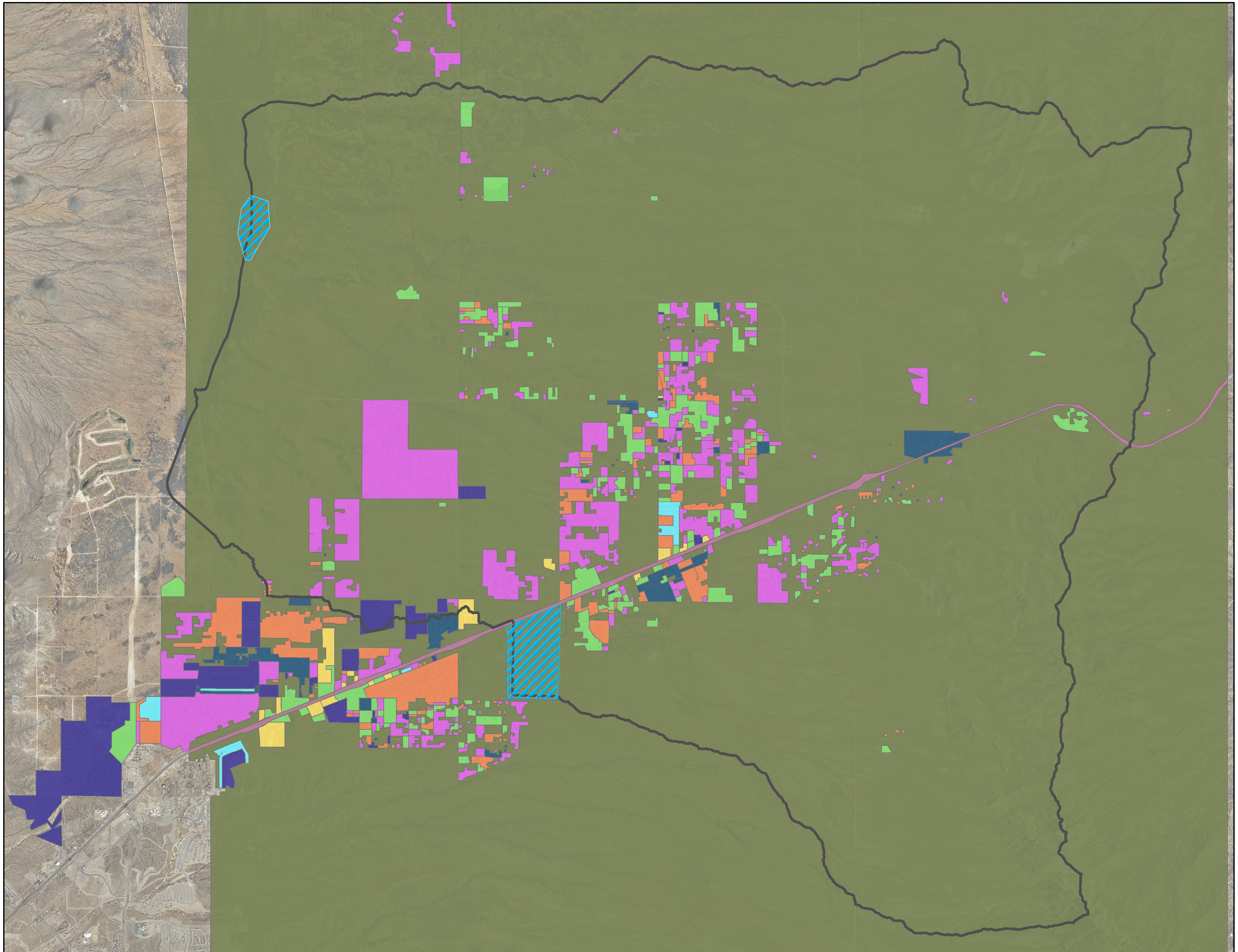

Figure 8 - Existing Land Usage

East Mesa Drainage Master Plan

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- The remaining areas of publicly owned land belong to the BLM or the State of New Mexico and are intermixed with most of the privately held land. Given the proximity of these areas to existing development, we have assumed that they will be developed in the future conditions model. These areas are also listed in the BLMs disposal map for the region, confirming that the tracts may be available for development in the future. The existing zoning in the area includes commercial and industrial parcels and residential zones ranging from low to high density. However, most of the BLM and State land is located away from US 70 in areas that tend to have lower density residential development. Therefore, based on an average level of development, the future land use in the remaining un-zoned areas will be one dwelling unit per acre development.

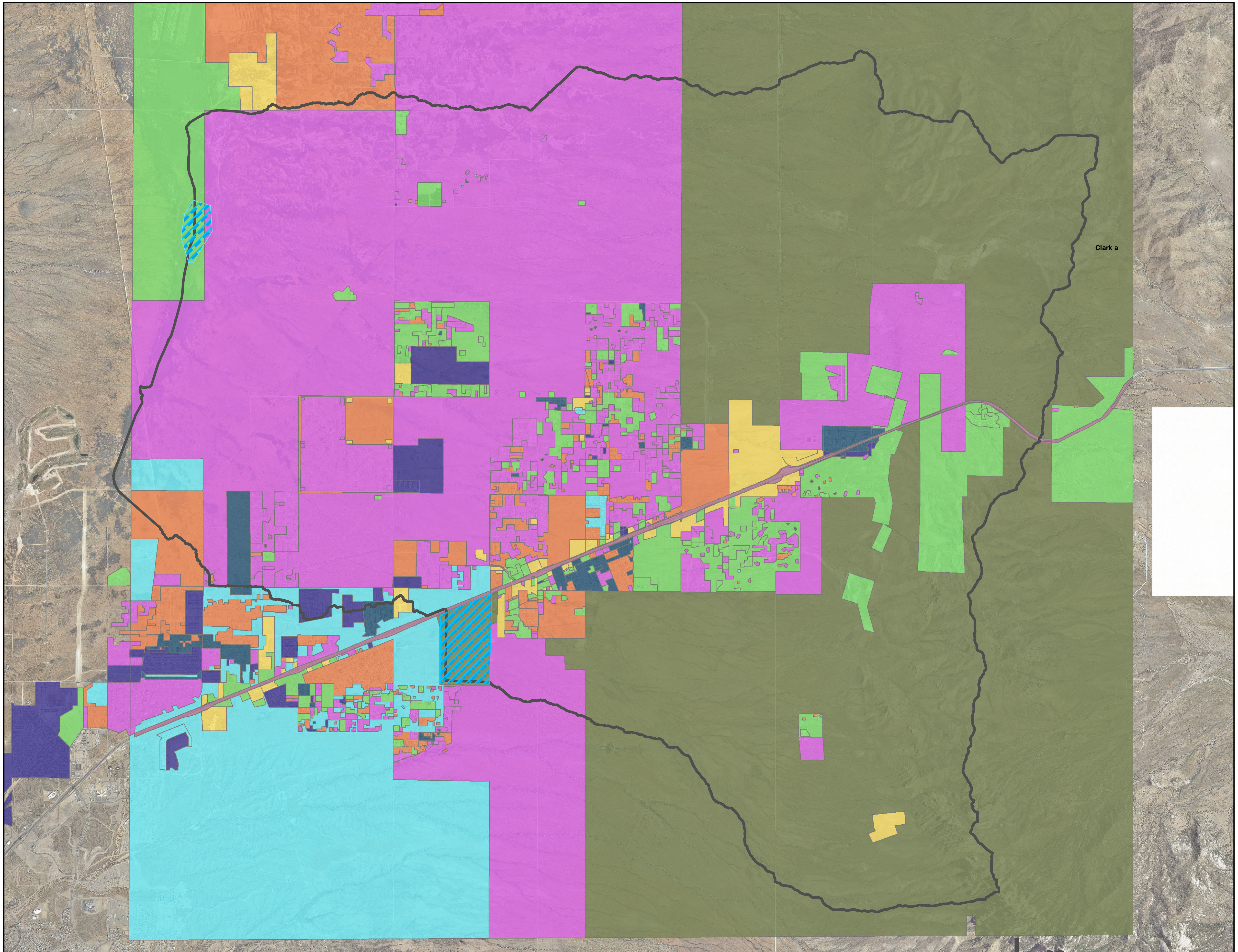
Figure 9 illustrates the final future conditions land treatments per the rationale outlined above.

The NRCS has developed recommended CN values for various types of land usage and soil types, (NRCS TR-55). Typically, the CN values for herbaceous and desert scrub open space are higher than the CN values recommended for residential development. However, the NRCS recommended CN values for developed areas were not derived for residential communities in the arid southwest. The residential CN values listed in Table 2 were derived by using the Open Space CN value and adjusting it for the percentage of impervious land, as shown in Figure 3-9 of the NMDOT Drainage Manual, Vol. 1, Hydrology. A copy of this is included in Appendix A.

Table 2 – CN Values

Usage	A	B	C	D
Herbaceous Grassland (fair)	65	71	81	89
>2 Acre Development	69	75	83	90
1 Acre Development	70	77	85	91
1/2 Acre Development	73	78	86	91
1/3 Acre Development	75	79	87	92
1/4 Acre Development	78	82	88	92
1/8 Acre Development	86	89	93	94
Commercial Development	89	92	94	95
Highway	98	98	98	98

The shapefiles for land usage and soils were combined to create a CN grid using the tools within HEC-geoHMS. A weighted CN value for each subbasin was calculated from the CN grid; grids were developed for the existing conditions and for the projected future conditions.



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0 2,600 5,200 10,400 Feet

Legend

East Mesa Drainage Area

Future Land Usage

- <1 DU/Acre
- 1 DU/Acre
- 2 DU/Acre
- 3 DU/Acre
- 4 DU/Acre
- 8 DU/Acre
- Commercial
- Highway
- Open Space

Figure 9 - Proposed Land Usage

East Mesa Drainage Master Plan

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Pursuant with the scope of work and the County's direction, high antecedent moisture conditions were initially assumed. However, based on review of the hydrologic modeling results, the soil conditions in the area, and discussion with DAC, average moisture conditions were used. Therefore, the analysis and results presented in this report are based on average soil moisture conditions.

4.4. TRANSFORMATION (LAG TIME)

The travel time estimates the time for the peak runoff to travel through the basin. The upland method was used to estimate overland flow and shallow concentrated flow times, while the Kirpich formula was used to estimate flow in defined arroyos.

The Upland Formula is,

$$Tc = \Sigma L_x/V_x$$

The Kirpich Formula is,

$$Tc = 0.0078\ L^{0.77}S^{-0.385}$$

Typically as runoff concentrates, it will transition from overland flow to defined arroyos; however, in the East Mesa area many basins do not follow this pattern. Many of the defined arroyos become poorly defined in alluvial fan formations as the flow paths flatten out near Isaack Lake. In basins with poorly defined arroyos, the upland method was used for the entire flow path. The calculated Tc values were used to determine lag time (T_L) for the HEC-HMS model transformation using the relationship between Tc and T_L, which is: $T_L = 0.6 * Tc$. Tc and T_L calculations are provided in Appendix A.

4.5. ROUTING

The Muskingum-Cunge Routing method was used for this study. This method was appropriate for this study because it accounts for the attenuation of flood waves that occurs over long flow paths with small slopes. The required input for this method includes the cross-section geometry, channel length and slope, and Manning's "n"-values for the main channel and the overbank flow. The routing cross sections were generated from the project DEM, and output from the HEC-geoHMS model was used to estimate the channel lengths and average channel slope. The 3D analyst tool was used in ArcGIS to determine 8-point cross-sections in locations that would represent typical geometries for each primary flow path. The data is used in HEC-HMS with the Muskingum-Cunge routing method. The Manning's "n"-values used were 0.03 for the main channel and 0.04 for the overbank areas based on existing field conditions. The

Manning's values represent a clean natural channel and some vegetation along the overbank areas.

Alluvial avulsions were a special consideration for the routing in this study. Alluvial flow paths are problematic since the flow paths are very unstable and the downstream routing will change overtime. The hydrologic models are routed based on the current downstream routing evident (by aerial imagery and field investigation) at the time of this study. The future conditions hydrologic model routing accounts for changes in how the drainage is conveyed based on the recommended improvements.

4.6. HYDRAULIC ANALYSIS SOFTWARE

The hydraulic modeling performed for this study utilizes software developed by the USACE Hydrologic Engineering Center and Bentley. Modeling parameters include, but are not limited to, allowable headwater depth, culvert dimensions, contraction/expansion coefficients, channel roughness, and reach boundary conditions. The applications used for the hydraulic analysis are described below.

4.6.1. GEOGRAPHIC INFORMATION SYSTEM (GIS) PROCESSING SYSTEM – HEC-GEORAS

The public domain software, HEC-GeoRAS Version 10, was used to create and prepare stream geometry data (i.e. stream centerline, cross sections, etc.) for import into a HEC-RAS model. This is an extension created for use with the ArcView Version 10.0 platform developed by the Environmental Systems Research Institute (ESRI). Terrain data (in TIN or DEM format) is the only dataset required by HEC-GeoRAS. The output from this program can be applied directly to the HEC-RAS model. The data processed by HEC-GeoRAS was reviewed for consistency, accuracy and precision.

4.6.2. HYDRAULIC MODELING SOFTWARE – HEC-RAS

The HEC-RAS program, Version 4.1.0, was used to prepare a hydraulic model of the study area. The USACE developed HEC-RAS to simulate one-dimensional steady/unsteady flow hydraulics, sediment transport and water quality for a full network of natural and constructed channels, based on user-defined inputs. The HEC-RAS models for this DMP were used to predict flow depths, velocities and generate water surface profiles, based on cross-sections developed from topographic information and bulked storm water flows established from the hydrologic analysis. These models were created using data prepared within HEC-GeoRAS as described above. Adjustments were made to the HEC-RAS model to reflect flow obstructions (culverts, detention facilities, etc.), resistance to flow, and expansion and contraction of flow.

4.6.3. HYDRAULIC MODELING SOFTWARE – DRAINAGE STRUCTURE ANALYZER (DSA)

The DSA module contained within Bentley's InRoads Storm & Sanitary V8i SS2, was used to perform hydraulic capacity analyses of the existing and proposed structures within the study area.

4.7. HYDRAULIC ANALYSIS METHODS

The hydraulic analysis performed within the study area consists of two components as discussed below.

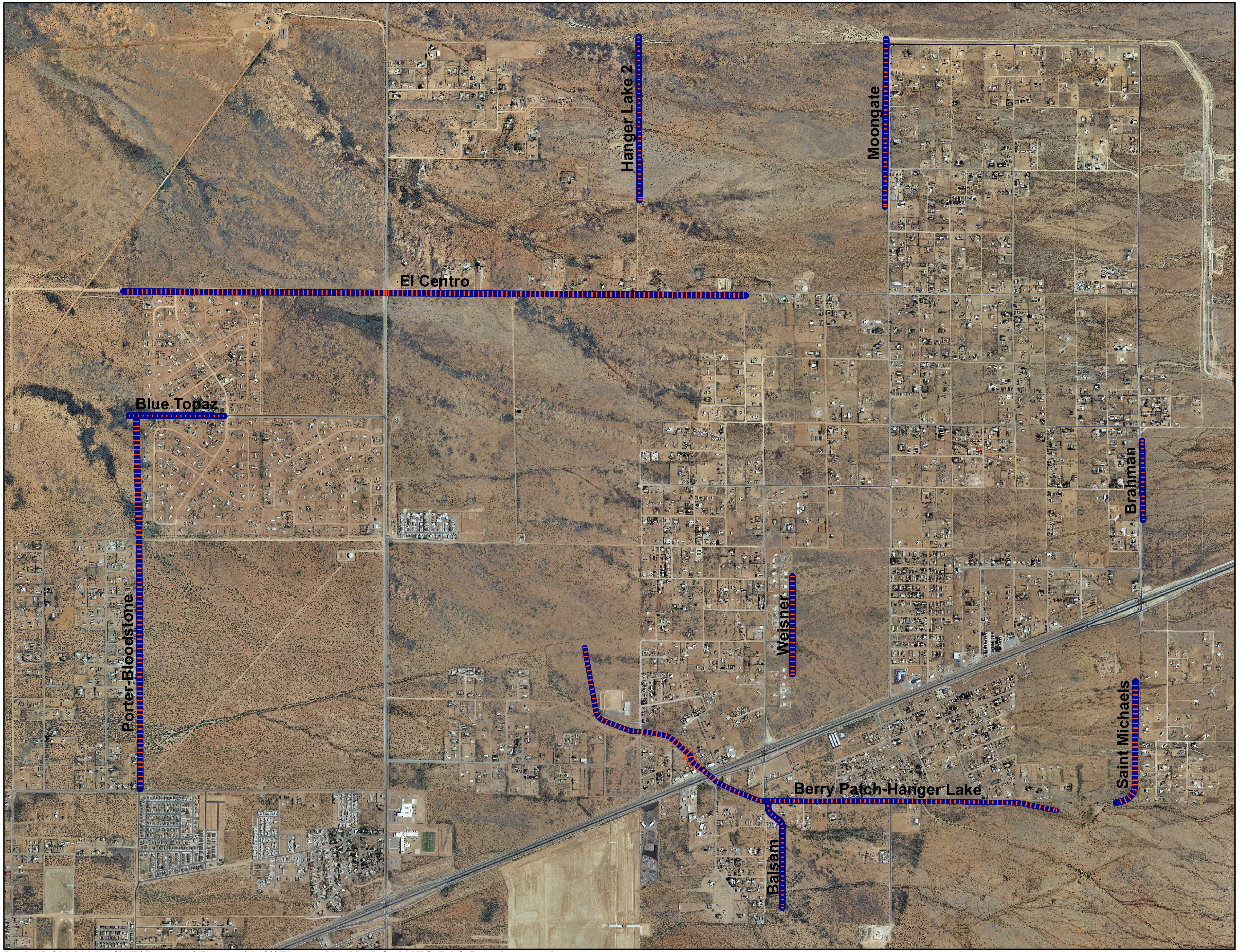
4.7.1. CULVERT AND STORM DRAIN HYDRAULICS

Existing and proposed drainage facilities for the East Mesa area must comply with County drainage design criteria, and thus, convey runoff from the 100-yr, 24-hr storm. Additional capacity is required to accommodate emergency overflow should the primary culvert's capacity be reduced by trash or debris accumulation. Existing crossing locations were evaluated to verify the number and size of existing culverts and determine their existing capacity. To check for compliance with the aforementioned drainage design criteria, the DSA module was used to determine whether or not the existing pipe sizes have enough capacity to pass the 100-yr event.

All existing culverts consist of corrugated metal pipe (CMP) either projecting from the roadway fill or mitered to the slope. According to the Doña Ana County, New Mexico Development Design Standards effective August 22, 2008, inlets and outlets for all designed culverts must be either flared-end sections or headwalls with wing walls; projecting ends are not acceptable. The local regulations further specify that the minimum slope of designed culverts should be limited to 0.5%, the headwater to diameter ratio shall not exceed 1.25 in the 100-yr storm event, and the height of tailwater at outlets shall have a tailwater to diameter ratio of less than one. BHI determined pipe sizes based on field measurements, GIS data, and as-builts where available. Available headwater depth for the crossing structures is also based on measurements taken in the field.

4.7.2. CHANNEL HYDRAULICS

Utilizing flow rates calculated by the HEC-HMS models, BHI has modeled designated portions of arroyo systems where there is known flooding or drainage issues and proposed improvements in HEC-RAS. Please refer to Figure 10 for modeled reaches. The following



DONA ANA COUNTY NEW MEXICO

Bohannan Huston
Engineering
Spatial Data
Advanced Technologies

N

0 1,000 2,000 4,000 Feet

Legend

Channel Cross Sections
Channel Centerline

Figure 10 - Modeled HEC-RAS Reaches

East Mesa Drainage Master Plan

Path: P:\20120075\WR\Reports\Figures\95%\Figure 10 - Modeled HEC-RAS Reaches.mxd sections describe the methods and assumptions used to develop the geometry, discharges, and boundary conditions required for this analysis.

4.7.2.1. CROSS SECTION PLACEMENT

HEC-GeoRAS was used to place cross sections at 100-foot intervals along the targeted reaches, except in reaches where the remaining reach length at either the up or downstream end is shorter than 100 feet. In this case, cross-section stations were placed within five feet of the end of the reach. Cross section stationing increases sequentially from downstream to upstream as required by HEC-RAS. Cross sections have been adjusted to extend across the entire anticipated floodplain width and will be placed perpendicularly to the anticipated direction of flow in both the main channel and the overbank areas.

Additional cross sections have been placed in areas that demonstrate abrupt changes in channel slope or geometry and in the vicinity of structures. HEC-RAS requires five cross sections to appropriately model a structure, such as a bridge or culvert. These five cross sections were placed at the following locations: 1) fully expanded flow, 2) downstream embankment toe, 3) top of structure, 4) upstream embankment toe, 5) and prior to flow contraction.

4.7.2.2. PARAMETER ESTIMATION

Parameters were estimated based on orthophotography, topography, field visits, and proposed improvements.

4.7.2.2.1 CONTRACTION AND EXPANSION COEFFICIENTS

BHI applied contraction and expansion loss coefficients between cross sections to account for losses due to the changing width of the channel. Contraction and expansion coefficients will be assigned values of 0.1 and 0.3, respectively, for all cross sections not associated with structures. The two cross sections immediately upstream and one cross section immediately downstream of each structure have been assigned values of 0.3 and 0.5 for contraction and expansion, respectively. If a structure overtopped, the aforementioned cross section contraction and expansion values were set to 0.1 and 0.3, respectively.

4.7.2.2.2 MANNING'S "N" VALUES

All channels were modeled as bare soil, with a Manning's "n" value of 0.03 for the main channel and overbank areas for each cross section, in accordance with table 4.4 in the Doña Ana County Development Design Standards, effective August 22, 2008. A copy of this table is included in Appendix A.

4.7.2.3. *REACH BOUNDARY CONDITIONS*

The slopes between two consecutive cross sections at the up and downstream end of each study reach were calculated and input into HEC-RAS as the normal depth reach boundary condition.

4.7.2.4 *MODELED REACHES*

For this study, ten different proposed channels have been modeled in the area as seen in Figure 10. The channels were graded using the existing topography in Bentley's InRoads Storm & Sanitary V8i SS2 and channel features were added in HEC-geoRAS, an extension of ArcGIS which prepares data for hydraulic analysis in HEC-RAS. The features added for each model include the river streamline, banks, flow paths, and cross sections as described above. The features were then imported into HEC-RAS where the hydraulic analysis of the channel was conducted. Thus the appropriateness of the geometry and channel surface could be determined.

4.8. SEDIMENT BULKING

Storm runoff in the East Mesa area is carried predominantly by natural channels, and due to the erosive soils, these channels often carry sediment. Sediment carried in storm runoff can significantly increase the total runoff volume.

Soil samples have been collected and analyzed for six major arroyos within the area. The results from the soil testing have been used in estimating the annual sediment yield, which has been used to develop sediment bulking factors for application to the hydrology models for the East Mesa area.

The Revised Universal Soil Loss Equation, Version 2 (RUSLE2) public domain software, was originally used to determine the annual sediment yield. However, due to unreasonably low results from the RUSLE2 program, the analysis approach was revised.

The Modified Soil Loss Equation (MUSLE), as adapted and presented by Mussetter Engineering, Inc. (MEI) in the "Sediment Load Bulking Factors for Four Arroyos in the Overlook Subdivision, Las Cruces, NM" May 9, 2008, was used to determine the annual sediment yield to calculate sediment bulking factors. Calculations for the total sediment yield and sediment bulking factors are provided in Appendix A.

Sediment bulking factors were computed for 100-yr, existing conditions floods for six major arroyos: San Augustin Arroyo, Owl's Nest Arroyo, Organ Arroyo, Blair Canyon Arroyo, Baylor Canyon Arroyo, and Mine House Arroyo. The 100-yr, existing conditions bulking factors are used in all of the hydrology models since the calculations for the 10-yr existing and future conditions and 100-yr future conditions bulking factors were within one-percent of the calculated 100-yr, existing conditions bulking factors.

The sediment bulking factors for these arroyos are summarized in Table 3.

Table 3 – 100-year, Existing Conditions Sediment Bulking Factors

Arroyo	100-year, Existing Conditions Sediment Bulking Factor
San Augustin Arroyo	1.12
Owl's Nest Arroyo	1.09
Organ Arroyo	1.13
Blair Canyon Arroyo	1.15
Baylor Canyon Arroyo	1.08
Mine House Arroyo	1.13

These bulking factors were used to determine the overall sediment bulking factor for each of the basin models based on the relative location, contributing arroyos, and similarity of the basins to these six major arroyos. The bulking factors used for each of the basin models are provided in Table 4.

Table 4 – Basin Model Bulking Factors

Basin Model	Arroyos Used	100-year, Bulking Factor
Brahman Model	San Augustin, Owl's Nest & Organ	1.11
Clark & Brown Model	San Augustin & Owl's Nest	1.11
EM-Overland Model	Baylor & Blair	1.11
Waterfalls Model	Mine House	1.13

5. ANALYSIS RESULTS

Existing and future conditions hydrologic models were developed for this study. 10-yr and 100-yr storm events were modeled for both sets of conditions. The existing conditions model is based on the 2010 DAC aerial imagery and models the current drainage conditions. The Future conditions model is based on anticipated development levels, as outlined in Section 4.3.

The HEC-HMS model was divided into four separate basins; each model reflects the overall routing into Isaack Lake. The models are identified as 1) the Clark and Brown Model, 2) the Brahman Model, 3) the East Mesa Model, and 4) the Waterfalls Pond Model. Figures 5 and 6 outline the model subbasins.

The Clark and Brown model accounts for flow at the north end of the project in the Clark and Brown Arroyo. The area is mostly undeveloped and the runoff from the Clark and Brown Arroyo does not mix with runoff from other basins before entering the Isaack Lake Playa. The Brahman model represents flow from the Organ Mountains reaching Isaack Lake after routing through the Brahman Channel. The main arroyos routed through the Brahman Channel include the Organ, Owl's Nest, San Augustin, and Hawkeye Canyon Arroyos. The runoff from an additional unnamed arroyo to the north of the Hawkeye Arroyo combines with the Brahman discharge en route to Isaack Lake. The unnamed arroyo is labeled "Sin Nombre" for the purposes of this study. The East Mesa model runoff primarily flows to Isaack Lake in flow paths to the west of the Brahman Channel. The East Mesa model includes the historic flow paths of the arroyos cut off by the Brahman Channel. The Waterfalls model includes areas that drain to the Waterfalls Pond, the largest arroyo discharging to the Waterfalls pond is the Mine House Arroyo. The discharge from the Waterfalls Pond is routed westward into the City of Las Cruces, the operation and discharge from the Waterfalls Pond was not modeled for this study.

5.1. BASIN CHARACTERISTICS

Over one hundred drainage subbasins were delineated within the four basin models developed for the East Mesa DMP area, as discussed in the preceding section. The subbasin areas range from 0.03 sq. mi. to 2.6 sq. mi. Tables 5 through 8 outline the basin characteristics for the existing conditions. Tables 9 through 12 outline the basin characteristics for the proposed conditions.

Table 5 – Existing Clark and Brown Model

Basin	Area (Sq Mi)	Curve Number (Existing)	Lag Time (min)
Clark and Brown Basins			
CB-1	1.89	89	21.1
CB-2	0.44	78	21.5
CB-3	0.19	71	15.5
CB-4	0.55	71	44.0
CB-5	0.77	79	24.7
CB-6	1.01	71	44.4
CB-7	0.24	72	15.7
CB-8	1.53	80	26.9
CB-9	0.56	71	24.8
CB-10	0.13	71	40.4
CB-11	0.25	71	41.0
CB-12	2.03	72	226.7
CB-13	0.85	71	48.9

Table 6 – Existing Brahman Basins Model

Basin	Area (Sq Mi)	Curve Number (Existing)	Lag Time (min)
Basins Downstream of Brahman Channel			
DB-1	0.12	73	39.6
DB-2	0.04	74	28.9
DB-3	0.19	72	38.4
DB-4	0.27	73	40.3
DB-5	0.08	74	29.3
DB-6	0.03	72	17.1
DB-7	0.55	72	77.8
DB-8	0.69	71	70.4
Hawkeye Canyon Arroyo Basins			
HC-1	1.39	76	25.5
HC-2	0.15	71	15.2
HC-3	0.14	71	21.9
HC-4	0.08	71	26.0
HC-5	0.39	71	29.0
HC-6	0.17	71	33.8
HC-7	0.08	71	19.6
HC-8	0.64	71	64.1
Isaack Lake Basins			
IS-1	0.45	72	107.7
IS-2	0.33	72	90.8
IS-3	0.55	72	116.5
IS-4	0.12	71	72.8
IS-5	0.11	75	26.5
IS-6	1.12	72	140.5
Organ Arroyo Basins			
OA-1	0.16	74	19.6
OA-2	0.21	74	19.5
OA-3	0.14	71	19.2
OA-4	0.20	71	14.6
OA-5	0.06	71	10.1

Table 6 – Existing Brahman Basins Model (cont.)

Basin	Area (Sq Mi)	Curve Number (Existing)	Lag Time (min)
Owl's Nest Arroyo Basins			
ON-1	0.51	72	29.9
ON-2	0.13	71	22.0
ON-3	0.07	72	16.2
ON-4	0.15	71	18.6
San Augustin Arroyo Basins			
SA-1	1.09	80	28.9
SA-2	0.10	71	16.4
SA-3	0.24	71	17.3
SA-4	0.14	72	20.1
SA-5	0.09	71	12.9
SA-6	0.03	71	9.8
SA-7	0.09	71	15.3
Sin Nombre Arroyo Basins			
SN-1	0.93	79	33.4
SN-2	0.13	71	18.3
SN-3	0.37	71	33.2
SN-4	0.39	71	32.0
SN-5	0.09	71	25.5
SN-6	0.55	71	55.2
SN-7	0.49	71	52.3
SN-8	1.04	71	69.8
US 70 Basins			
US 70-1	0.15	78	14.0
US 70-2	0.73	79	14.3
Arroyo Rd Area Basins			
AR-1	0.47	73	74.0
AR-2	1.30	73	153.9
AR-3	0.98	75	118.9
AR-4	0.14	74	40.2
AR-5	1.32	73	149.4

Table 7 – Existing East Mesa Model

Basin	Area (Sq Mi)	Curve Number (Existing)	Lag Time (min)
El Centro Area Basins			
EC-1	0.25	72	45.5
EC-2	0.21	74	45.9
EC-3	0.06	75	22.3
EC-4	0.91	72	103.0
EC-5	0.52	71	86.6
EC-6	0.49	71	60.1
EC-7	0.54	72	125.3
EC-8	0.69	73	100.2
EC-9	0.81	75	86.8
EC-10	0.70	71	90.7
EC-11	0.17	73	51.5
EC-12	0.08	71	23.1
EC-13	0.35	74	59.0
EC-14	0.33	72	102.9
EC-15	0.89	72	54.1
EC-16	0.35	74	96.2
Peach Tree Area Basins			
PT-1	0.85	74	90.7
PT-2	0.11	73	42.0
PT-3	0.31	81	75.4
PT-4	0.44	71	86.1
PT-5	0.15	72	46.9
PT-6	0.18	72	68.0
PT-7	0.44	72	114.0
PT-8	0.26	72	71.1
PT-9	0.09	73	49.0
PT-10	0.39	72	99.4
PT-11	1.33	72	103.7
PT-12	0.34	73	118.7

Table 7 – Existing East Mesa Model (cont.)

Basin	Area (Sq Mi)	Curve Number (Existing)	Lag Time (min)
US 70 Basins			
US 70-3	0.42	79	24.5
US 70-4	1.96	79	24.3
US 70-5	0.06	81	16.0
US 70-6	0.44	73	40.8
US 70-7	0.64	73	21.2
US 70-8	2.60	78	32.8
US 70-9	0.46	73	40.8
US 70-10	0.72	74	65.8
US 70-11	0.08	80	26.4
US 70-12	1.80	72	61.0

Table 8 – Existing Waterfalls Pond Model

Basin	Area (Sq Mi)	Curve Number (Existing)	Lag Time (min)
Minehouse Arroyo Basins			
MH-1	1.64	77	22.8
MH-2	1.91	75	60.2
MH-3	1.44	75	23.5
MH-4	0.76	71	50.2
MH-5	0.63	71	44.6
Waterfalls Basins			
WF-1	0.45	73	76.1
WF-2	1.06	71	50.0
W250	0.71	72	52.0

Table 9 – Proposed Clark and Brown Model

Basin	Area (Sq Mi)	Curve Number (Proposed)	Lag Time (min)
Clark and Brown Basins			
CB-1	1.89	89	21.1
CB-2	0.44	78	21.5
CB-3	0.19	71	15.5
CB-4	0.55	73	44.0
CB-5	0.77	79	24.7
CB-6	1.01	75	44.4
CB-7	0.24	72	15.7
CB-8	1.53	80	26.9
CB-9	0.56	71	24.8
CB-10	0.13	77	40.4
CB-11	0.25	77	41.0
CB-12	2.03	77	226.7
CB-13	0.85	74	48.9

Table 10 – Proposed Brahman Basins Model

Basin	Area (Sq Mi)	Curve Number (Proposed)	Lag Time (min)
Basins Downstream of Brahman Channel			
DB-1	0.13	75	39.6
DB-2	0.06	77	28.9
DB-3	0.19	75	38.4
DB-4	0.28	75	40.3
DB-5	0.08	76	29.3
DB-6	0.03	77	17.1
DB-7a	0.25	76	31.9
DB-7b	0.26	76	41.9
DB-8a	0.03	77	9.6
DB-8b	0.30	77	70.4
DB-8c	0.36	77	70.4
Hawkeye Canyon Arroyo Basins			
HC-1	1.39	79	25.5
HC-2	0.15	71	15.2
HC-3	0.14	71	21.9
HC-4	0.08	74	26.0
HC-5	0.39	72	29.0
HC-6	0.17	76	33.8
HC-7	0.08	77	19.6
HC-8	0.64	77	64.1
Isaack Lake Basins			
IS-1a	0.23	77	38.6
IS-1b	0.24	77	69.33
IS-2	0.33	78	90.8
IS-3	0.55	78	116.5
IS-4	0.12	77	72.8
IS-5	0.11	80	26.5
IS-6	1.12	77	140.5
Organ Arroyo Basins			
OA-1	0.16	84	19.6
OA-2	0.21	78	19.5
OA-3	0.14	77	19.2
OA-4	0.20	86	14.6
OA-5	0.06	78	10.1

Table 10 – Proposed Brahman Basins Model (cont.)

Basin	Area (Sq Mi)	Curve Number (Proposed)	Lag Time (min)
Owl's Nest Arroyo Basins			
ON-1	0.51	76	29.9
ON-2	0.13	76	22.0
ON-3	0.07	74	16.2
ON-4	0.15	71	18.6
San Augustin Arroyo Basins			
SA-1	1.09	82	28.9
SA-2	0.10	74	16.4
SA-3	0.24	71	17.3
SA-4	0.14	75	20.1
SA-5	0.09	71	12.9
SA-6	0.03	71	9.8
SA-7	0.09	71	15.3
Sin Nombre Arroyo Basins			
SN-1	0.93	80	33.4
SN-2	0.13	71	18.3
SN-3	0.37	74	33.2
SN-4	0.39	73	32.0
SN-5	0.09	77	25.5
SN-6	0.55	77	55.2
SN-7	0.49	77	52.3
SN-8	1.04	77	69.8
US 70 Basins			
US 70-1	0.15	79	14.0
US 70-2	0.73	81	14.3

Table 11 – Proposed East Mesa Model

Basin	Area (Sq Mi)	Curve Number (Proposed)	Lag Time (min)
Arroyo Rd Area Basins			
AR-1a	0.27	82	25.5
AR-1b	0.22	82	34.4
AR-2a	0.26	80	26.4
AR-2b	0.77	80	80.1
AR-2c	0.27	80	39.6
AR-3a	0.14	79	23.7
AR-3b	0.26	79	33.7
AR-3c	0.30	79	30.9
AR-3d	0.27	79	39.6
AR-4a	0.06	78	24.1
AR-4b	0.07	78	15.6
AR-5a	1.07	77	75.3
AR-5b	0.22	77	62.1
El Centro Area Basins			
EC-1	0.25	76	45.5
EC-2	0.21	76	45.9
EC-3	0.06	77	22.3
EC-4	0.91	80	103.0
EC-5a	0.03	77	9.5
EC-5b	0.49	77	81.2
EC-6	0.49	77	60.1
EC-7a	0.19	77	27.6
EC-7b	0.35	77	53.9
EC-8	0.69	76	100.2
EC-9	0.81	77	86.8
EC-10	0.70	78	90.7
EC-11a	0.07	77	51.5
EC-11b	0.06	77	51.5
EC-11c	0.04	77	51.5
EC-12	0.08	77	23.1
EC-13a	0.34	77	59.0
EC-13b	0.04	77	35.0
EC-14	0.33	78	102.9
EC-15a	0.03	78	16.2
EC-15b	0.87	78	99.9
EC-16	0.35	79	96.2

Table 11 – Proposed East Mesa Model (cont.)

Basin	Area (Sq Mi)	Curve Number (Proposed)	Lag Time (min)
Peach Tree Area Basins			
PT-1a	0.45	79	52.7
PT-1b	0.41	79	57.2
PT-2	0.11	81	42.0
PT-3	0.31	85	75.4
PT-4a	0.40	78	53.0
PT-4b	0.04	78	11.4
PT-5a	0.11	77	30.8
PT-5b	0.03	77	14.9
PT-6	0.18	78	68.0
PT-7	0.44	78	114.0
PT-8	0.26	78	71.1
PT-9	0.09	78	49.0
PT-10a	0.11	77	34.9
PT-10b	0.28	77	51.6
PT-11	1.33	79	103.7
PT-12	0.34	78	118.7
US 70 Basins			
US 70-3	0.42	82	24.5
US 70-4	1.96	80	24.3
US 70-5	0.06	94	16.0
US 70-6	0.44	79	40.8
US 70-7	0.64	76	21.2
US 70-8	2.60	79	32.8
US 70-9a	0.20	74	45.2
US 70-9b	0.14	74	17.0
US 70-9c	0.11	74	21.0
US 70-10a	0.20	78	25.5
US 70-10b	0.52	78	51.1
US 70-11	0.08	83	26.4
US 70-12a	0.56	72	51.3
US 70-12b	1.03	72	77.4
US 70-12c	0.19	72	37.0
US 70-12d	0.11	72	15.8
US 70-12e	0.12	72	25.8

Table 12 – Proposed Waterfalls Pond Model

Basin	Area (Sq Mi)	Curve Number (Proposed)	Lag Time (min)
Minehouse Arroyo Basins			
MH-1	1.64	77	22.8
MH-2	1.91	76	60.2
MH-3	1.44	76	23.5
MH-4	0.76	71	50.2
MH-5	0.63	71	44.6
Waterfalls Basins			
WF-1	0.45	77	76.1
WF-2	1.06	74	53.3
W250	0.71	80	52

5.2. HYDROLOGIC ANALYSIS RESULTS

A summary of the existing hydrology for the four basins studied in this DMP is presented in Tables 13 through 16. For each hydrologic element, the tables provide the contributing area in square miles (sq. mi.), peak discharge in cubic feet per second (cfs) and the runoff volume in acre-feet (ac-ft) for the 10 and 100-yr storm events. The largest of the drainage areas is the East Mesa model, which is about 26 sq. mi. and produces 2,203 ac-ft of runoff with a peak flow of 10,045 cfs under the existing conditions. The Brahman Arroyo model has a drainage area of about 16 sq. mi. and produces 1,339 ac-ft of runoff with a peak discharge of 9,763 cfs under the existing conditions. The Clark and Brown Model has a drainage area of 10.45 sq. mi. and produces 1,023 ac-ft of runoff with a peak discharge of 8,762 cfs under the existing conditions. The Waterfalls model has a drainage area of 7.9 sq. mi. and produces a runoff volume of 696 ac-ft with a peak discharge of 5,715 cfs.

Table 13 – Existing Clark and Brown Subbasins HEC-HMS Model Results

		Existing Conditions			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (Q_{100}) (cfs)	Volume (ac-ft)	Peak Discharge (Q_{10}) (cfs)	Volume (ac-ft)
CB-1	1.89	4875.9	295.6	2566.1	162.9
CB-2	0.44	688.4	45.1	285.5	20.5
CB-3	0.19	259.4	14.0	86.9	5.4
CB-4	0.55	339.2	41.2	116.0	15.9
CB-5	0.77	1150.5	82.2	485.6	38.1
CB-6	1.01	612.6	75.1	209.9	29.0
CB-7	0.24	349.3	18.9	121.4	7.5
CB-8	1.53	2211.6	170.3	965.8	80.4
CB-9	0.56	546.4	41.5	183.9	16.1
CB-10	0.13	83.3	9.4	28.5	3.7
CB-11	0.25	165.6	19.0	56.4	7.3
CB-12	2.03	312.4	158.3	113.7	60.3
CB-13	0.85	475.5	63.2	163.1	24.4
CB-J1	2.34	5358.7	341.2	2808.4	183.5
CB-J10	4.08	4592.9	386.6	1868.1	169.8
CB-J3	0.74	528.0	55.0	139.8	21.3
CB-J5	7.67	10601.0	823.6	4788.7	389.5
CB-J9	3.10	4097.0	313.4	1681.0	142.0
CB-R1	1.89	4755.8	296.0	2550.3	163.0
CB-R2	2.34	5348.2	343.0	2762.9	183.6
CB-R3	0.19	250.2	13.8	80.8	5.4
CB-R4	0.74	477.2	55.4	116.3	21.1
CB-R5	0.77	1144.7	82.7	481.1	38.0
CB-R6	7.67	8703.4	809.6	3669.1	376.6
CB-R7	0.24	347.6	19.0	120.2	7.5
CB-R8	1.53	2209.2	170.1	958.5	80.3
CB-R9	3.10	4078.8	313.9	1685.2	141.7
CB-R10	4.08	4498.9	386.5	1853.0	169.5
CB-Total	10.45	8761.9	1023.3	3696.6	458.1

Table 14 – Existing Brahman Channel Subbasins HEC-HMS Model Results

		Existing Conditions			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (Q_{100}) (cfs)	Volume (ac-ft)	Peak Discharge (Q_{10}) (cfs)	Volume (ac-ft)
BR-J2	4.20	4652.6	386.8	1747.0	168.0
BR-J3	4.44	4780.8	405.1	1757.3	174.8
BR-J4	4.58	4827.6	415.9	1769.5	178.9
BR-J5	5.01	5109.7	451.2	1845.4	192.9
BR-R1	0.71	753.7	57.4	258.3	23.1
BR-R2	2.36	2726.6	205.2	996.8	86.6
BR-R3	4.20	4620.9	386.9	1699.8	167.9
BR-R4	4.44	4739.7	405.2	1748.8	174.7
BR-R5	4.58	4802.0	416.2	1750.8	178.7
DB-1	0.12	91.9	10.1	33.4	4.1
DB-2	0.04	38.7	3.2	14.3	1.4
DB-3	0.19	135.4	14.5	47.5	5.8
DB-4	0.27	198.9	22.2	72.5	9.0
DB-5	0.08	77.6	6.6	28.7	2.7
DB-6	0.03	41.7	2.4	14.7	1.0
DB-7	0.55	218.2	42.9	77.7	16.9
DB-8	0.69	283.2	51.3	97.4	19.7
DB-J1	0.38	275.9	30.3	99.2	12.2
DB-J7	0.93	479.7	73.3	176.2	29.0
DB-J8	5.70	5312.8	502.4	1919.0	212.0
DB-R1	0.38	275.8	30.4	98.5	12.1
DB-R6	5.01	5038.7	451.1	1821.6	192.3
DB-R7	0.93	474.0	74.1	173.2	28.3
DB-R8	5.70	5716.4	501.3	1849.4	209.2

Table 14 – Existing Brahman Channel Subbasins (cont.)
HEC-HMS Model Results

		Existing Conditions			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (Q_{100}) (cfs)	Volume (ac-ft)	Peak Discharge (Q_{10}) (cfs)	Volume (ac-ft)
HC-1	1.39	1736.4	130.4	678.2	56.9
HC-2	0.15	214.8	11.4	71.0	4.4
HC-3	0.14	152.8	10.6	51.8	4.1
HC-4	0.08	78.0	6.2	26.5	2.4
HC-5	0.39	336.8	29.0	113.4	11.2
HC-6	0.17	127.2	12.4	43.1	4.8
HC-7	0.08	99.0	6.3	32.9	2.4
HC-8	0.64	285.2	47.7	98.0	18.4
HC-J6	1.94	2188.7	172.0	832.8	72.9
HC-J8	1.13	708.5	84.8	203.6	32.7
HC-J9	2.67	2383.9	226.3	911.8	93.5
HC-R1	1.39	1730.6	130.6	676.7	56.8
HC-R5	0.09	79.2	6.9	28.4	2.6
HC-R6	1.94	2162.5	172.3	822.8	72.7
HC-R7	0.08	89.2	6.3	29.0	2.4
HC-R8	2.67	2359.0	224.5	882.8	90.8
HC-R9	1.13	675.5	85.0	191.2	32.1
IS-1	0.45	135.0	35.3	48.3	13.8
IS-2	0.33	114.7	25.8	41.0	10.1
IS-3	0.55	153.0	42.9	54.8	16.7
IS-4	0.12	49.0	9.2	16.9	3.5
IS-5	0.11	120.7	9.5	46.5	4.0
IS-J	13.69	9556.7	1163.2	3246.4	475.3
IS-J4	1.93	1599.2	174.4	606.8	74.1

Table 14 – Existing Brahman Channel Subbasins (cont.)
HEC-HMS Model Results

		Existing Conditions			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (Q_{100}) (cfs)	Volume (ac-ft)	Peak Discharge (Q_{10}) (cfs)	Volume (ac-ft)
OA-1	0.16	220.4	13.6	81.2	5.7
OA-2	0.21	296.6	18.3	109.3	7.7
OA-3	0.14	172.5	10.8	57.5	4.2
OA-4	0.20	288.5	14.8	96.0	5.8
OA-5	0.06	105.5	4.2	35.1	1.7
OA-J1	0.71	814.7	57.7	283.7	23.3
OA-R1	0.16	212.8	13.6	79.7	5.7
OA-R2	0.21	295.4	18.5	108.8	7.6
OA-R3	0.14	171.2	10.8	56.9	4.2
ON-1	0.51	455.6	40.0	159.6	15.9
ON-2	0.13	142.9	10.0	48.4	3.9
ON-3	0.07	96.8	5.4	34.1	2.2
ON-4	0.15	186.0	11.3	62.3	4.4
ON-J	2.36	2869.7	205.5	1047.1	87.1
ON-R1	1.24	1909.5	117.1	811.9	51.9
ON-R3	0.07	96.2	5.4	30.9	2.1
SA-1	1.09	1495.5	120.6	648.5	56.9
SA-2	0.10	136.7	7.8	46.9	3.0
SA-3	0.24	302.0	17.6	102.6	6.9
SA-4	0.14	168.1	10.8	58.1	4.3
SA-5	0.09	138.0	6.5	47.1	2.5
SA-6	0.03	56.0	2.2	18.7	0.9
SA-7	0.09	121.0	6.4	40.2	2.5

Table 14 – Existing Brahman Channel Subbasins (cont.)
HEC-HMS Model Results

		Existing Conditions			
Hydrologic Element	Drainage Area (mi²)	Peak Discharge (Q_{100}) (cfs)	Volume (ac-ft)	Peak Discharge (Q_{10}) (cfs)	Volume (ac-ft)
SA-J1	1.24	1673.6	136.6	648.8	64.0
SA-J5	0.23	219.5	17.4	72.6	6.8
SA-J7	0.09	121.0	6.4	40.2	2.5
SA-R1	1.24	1650.5	136.6	643.9	63.9
SA-R2	0.10	136.2	7.8	45.9	3.0
SA-R4	0.14	166.1	10.8	57.9	4.3
SA-R7	0.09	137.3	6.9	40.0	2.5
BR-Total	15.96	9762.9	1339.3	3334.0	542.3
SN-1	0.93	1088.6	99.5	461.9	46.0
SN-2	0.13	156.4	9.4	52.6	3.7
SN-3	0.37	286.2	27.5	96.5	10.7
SN-4	0.39	310.9	29.0	105.3	11.2
SN-5	0.09	85.9	6.7	29.1	2.6
SN-6	0.55	277.2	40.8	94.9	15.7
SN-7	0.49	259.6	36.4	88.8	14.1
SN-8	1.04	431.7	77.7	148.3	29.9
SN-J1	1.32	1316.9	128.6	530.5	57.1
SN-J2	0.49	412.0	37.0	128.3	14.4
SN-J4	1.81	1560.3	165.1	607.6	71.0
SN-R1	0.93	1081.8	99.7	459.3	45.9
SN-R2	0.13	153.4	9.5	51.7	3.7
SN-R3	0.49	406.8	37.1	127.6	14.3
SN-R4	1.32	1308.0	128.7	524.9	56.9
SN-R7	1.81	1550.2	165.2	592.2	70.6
SN-R8	1.04	428.9	78.7	145.3	28.8
US 70-1	0.15	329.7	15.7	137.3	7.2
US 70-2	0.73	1619.6	77.7	689.4	36.1
US 70-J2	1.24	1932.9	117.4	826.3	51.9
US 70-R1	0.15	324.4	15.9	130.1	7.1
US 70-R2	0.73	1518.5	77.4	683.9	36.0

Table 15 – Existing East Mesa Subbasins HEC-HMS Model Results

		Existing Conditions			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (Q_{100}) (cfs)	Volume (ac-ft)	Peak Discharge (Q_{10}) (cfs)	Volume (ac-ft)
AR-1	0.47	204.0	38.2	74.8	15.4
AR-2	1.30	298.2	106.5	110.6	42.3
AR-3	0.98	312.7	88.0	122.1	36.8
AR-4	0.14	104.8	11.6	39.3	4.8
AR-5	1.32	312.0	108.5	115.7	43.1
AR-J1	1.38	1257.8	125.5	464.6	54.0
AR-J2	2.82	1368.8	243.9	550.2	100.6
AR-J3	7.36	6933.0	714.0	2879.3	315.6
AR-J4	1.52	1199.5	137.2	485.3	58.7
AR-R1	1.38	1147.1	125.6	471.3	53.9
AR-R2	2.82	1337.6	243.9	540.0	100.2
AR-R3	7.36	6895.7	712.2	2835.5	313.5
AR-R4	1.52	1178.2	137.3	457.1	58.3
EC-1	0.25	156.4	19.4	55.2	7.7
EC-10	0.70	231.5	52.4	80.2	20.1
EC-11	0.17	99.5	13.6	36.2	5.5
EC-12	0.08	77.9	5.6	26.2	2.2
EC-13	0.35	197.4	30.2	74.4	12.5
EC-14	0.33	102.0	25.6	36.5	10.0
EC-15	0.89	484.5	69.8	172.0	27.6
EC-2	0.21	149.1	18.4	55.9	7.6
EC-3	0.06	79.4	5.4	30.5	2.3
EC-4	0.91	284.7	71.5	101.8	28.0
EC-5	0.52	179.7	39.1	62.1	15.0
EC-6	0.49	231.2	36.6	79.3	14.1
EC-7	0.54	140.2	41.9	50.3	16.3
EC-8	0.69	231.2	56.5	85.2	22.7
EC-9	0.81	340.4	72.5	132.4	30.6

Table 15 – Existing East Mesa Subbasins (cont.)
HEC-HMS Model Results

		Existing Conditions			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (Q_{100}) (cfs)	Volume (ac-ft)	Peak Discharge (Q_{10}) (cfs)	Volume (ac-ft)
EC-J10	5.01	2119.0	425.3	821.9	173.1
EC-J13	5.53	2230.3	469.2	842.2	190.9
EC-J3	0.52	338.9	43.2	123.9	17.6
EC-J4	1.44	601.5	114.9	222.5	45.5
EC-J5	1.96	769.2	154.0	275.5	60.2
EC-J8	1.49	571.3	129.0	216.8	53.1
EC-R10	5.01	2110.3	425.4	814.7	172.8
EC-R3	0.52	337.8	43.3	123.3	17.5
EC-R4	1.44	599.9	114.9	222.0	45.2
EC-R8	1.49	570.3	129.0	216.5	52.9
EC-R9	0.81	340.1	72.5	132.1	30.4
Osborn Pond	1.80	930.5	138.6	336.8	53.2
PT-1	0.85	330.1	73.4	125.0	30.3
PT-10	0.39	125.2	30.5	44.8	12.0
PT-11	1.33	412.2	104.3	147.5	40.8
PT-12	0.34	97.3	27.6	36.0	11.0
PT-2	0.11	79.1	9.1	28.7	3.7
PT-3	0.31	194.3	35.4	87.0	16.9
PT-4	0.44	152.6	33.0	52.8	12.6
PT-5	0.15	90.1	11.4	31.7	4.5
PT-6	0.18	82.4	14.4	29.3	5.7
PT-7	0.44	125.6	34.6	45.0	13.5
PT-8	0.26	110.5	20.1	39.3	7.9
PT-9	0.09	56.2	7.4	20.5	3.0

Table 15 – Existing East Mesa Subbasins (cont.)
HEC-HMS Model Results

		Existing Conditions			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (Q_{100}) (cfs)	Volume (ac-ft)	Peak Discharge (Q_{10}) (cfs)	Volume (ac-ft)
PT-J1	2.73	1294.1	221.0	479.4	87.1
PT-J10	9.16	7162.0	858.6	2950.6	371.5
PT-J4	3.59	1672.8	298.7	621.5	119.9
PT-J8	4.62	1969.9	379.3	708.2	150.6
PT-R1	2.73	1280.3	221.2	473.3	86.7
PT-R2	0.11	78.3	9.1	28.4	3.7
PT-R3	0.31	193.7	35.4	86.8	16.8
PT-R4	3.59	1668.2	298.8	615.0	119.0
PT-R5	0.15	89.2	11.4	31.5	4.5
EM-Total	25.61	10044.5	2202.5	4020.9	907.6
US 70-10	0.72	368.3	61.7	138.5	25.6
US 70-11	0.08	113.6	8.6	49.3	4.1
US 70-12	1.80	884.8	140.6	313.1	55.6
US 70-3	0.42	626.7	44.5	264.7	20.6
US 70-4	1.96	2957.6	208.9	1250.2	96.8
US 70-5	0.06	128.1	6.6	56.3	3.2
US 70-6	0.44	322.5	36.3	117.4	14.8
US 70-7	0.64	782.8	52.7	285.1	21.5
US 70-8	2.60	2938.0	266.3	1218.9	120.8
US 70-9	0.46	333.8	37.6	121.5	15.3
US 70-J10	6.38	6961.0	626.8	2873.6	279.2
US 70-J4	2.60	3616.8	261.4	1506.7	118.7
US 70-J8	5.66	6799.8	565.2	2814.6	254.4
US 70-R10	6.38	6819.1	626.1	2834.2	278.8
US 70-R11	0.08	112.4	8.7	48.3	4.0
US 70-R12	1.80	892.8	138.8	318.9	52.8
US 70-R3	0.42	683.1	44.5	262.0	20.6
US 70-R4	1.96	2913.4	208.7	1246.2	97.1
US 70-R5	0.06	122.3	6.5	55.4	3.2
US 70-R6	0.44	322.0	36.4	116.7	14.7
US 70-R7	2.60	3607.6	260.9	1492.3	118.7
US 70-R8	2.60	2922.7	266.7	1203.2	120.5
US 70-R9	5.66	6721.7	565.1	2773.0	253.6

Table 16 – Existing Waterfalls Pond Subbasins HEC-HMS Model Results

		Existing Conditions			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (Q_{100}) (cfs)	Volume (ac-ft)	Peak Discharge (Q_{10}) (cfs)	Volume (ac-ft)
MH-1	1.64	2390.4	163.7	967.7	73.0
MH-2	1.91	1132.9	174.9	438.5	74.1
MH-3	1.44	1863.1	131.9	711.2	56.4
MH-4	0.76	426.9	57.9	146.1	22.4
MH-5	0.63	386.1	47.5	132.3	18.4
MH-J1	2.40	2787.8	221.9	1093.3	94.4
MH-J2	3.35	2038.0	306.8	776.2	130.0
MH-J3	6.38	5031.9	576.2	1922.4	242.7
MH-R1	1.64	2363.7	164.0	948.7	72.0
MH-R2	1.91	1129.1	174.9	436.5	73.9
MH-R3	1.44	1836.2	131.9	704.3	56.2
W250	0.71	408.5	56.6	144.1	22.4
WF-Total	0.71	408.5	56.6	144.1	22.4
Waterfalls	7.90	5715.5	696.1	2156.3	288.6
WF-1	0.45	197.9	37.9	72.6	15.3
WF-2	1.06	565.1	80.8	193.9	31.2
WF-R1	6.38	4978.6	577.4	1904.1	242.1

Each of the four basin models studied were analyzed for future developed 100-yr and 10-yr conditions. These proposed basins models include refined basins and analysis points to determine the flow rates for the recommended improvements. Additionally, recommended ponds are included in the proposed conditions models. As discussed in Section 7 the capital improvement recommendations include two options: Option A and Option B. HEC-HMS models were created for both options. The analysis results presented in this section correspond to Option B. Printouts from HEC-HMS for both options A and B are included in Appendix B. In general, flow in the East Mesa basins will see a percent increase ranging from 5% to 65% due to development. The Brahman basins will see a percent increasing from about 0% to 104% under the future developed conditions. The Clark and Brown Basins will see an increase ranging from 04% to 37% due to the future developed conditions. Finally, the Waterfalls basins will see an increase from about 0% to 49% based on future development. The results of the proposed conditions model for Option B are summarized in Tables 17 through 20 below.

Table 17 – Proposed Clark and Brown Subbasins HEC-HMS Model Results

		Future Conditions			
Hydrologic Element	Drainage Area (mi2)	Peak Discharge (Q100) (cfs)	Volume (ac-ft)	Peak Discharge (Q10) (cfs)	Volume (ac-ft)
CB-1	1.89	4875.9	295.6	2566.1	163.1
CB-10	0.13	114.1	12.4	46.3	5.6
CB-11	0.25	226.2	25.0	92.0	11.2
CB-12	2.03	399.2	199.6	165.5	89.2
CB-13	0.85	560.1	72.9	210.2	30.5
CB-2	0.44	688.4	45.1	285.5	20.6
CB-3	0.19	259.4	14.0	86.9	5.5
CB-4	0.55	378.9	45.4	137.9	18.6
CB-5	0.77	1150.5	82.2	485.6	38.2
CB-6	1.01	760.6	90.6	293.1	38.8
CB-7	0.24	349.3	18.9	121.4	7.5
CB-8	1.53	2211.6	170.3	965.8	80.6
CB-9	0.56	546.4	41.5	183.9	16.2
CB-J1	2.34	5375.8	341.5	2808.7	184.3
CB-J10	4.08	4704.6	399.2	1932.7	179.0
CB-J3	0.74	557.6	59.1	149.3	24.1
CB-J5	7.67	10940.9	858.1	4965.8	413.6
CB-J9	3.10	4097.5	313.4	1681.1	142.9
CB-R1	1.89	4759.6	296.3	2550.6	163.7
CB-R10	4.08	4607.9	399.2	1918.9	178.7
CB-R2	2.34	5370.9	343.3	2763.2	184.9
CB-R3	0.19	250.2	13.8	80.8	5.5
CB-R4	0.74	496.8	59.6	134.9	24.3
CB-R5	0.77	1145.2	82.7	481.2	38.2
CB-R6	7.67	9035.8	845.7	3861.3	403.5
CB-R7	0.24	347.7	19.0	120.2	7.6
CB-R8	1.53	2209.2	170.1	958.5	80.9
CB-R9	3.10	4079.1	313.9	1685.2	142.9
CB-Total	10.45	9120.6	1104.8	3898.8	517.0

Table 18 – Proposed Brahman Channel Subbasins HEC-HMS Model Results

		Future Conditions			
Hydrologic Element	Drainage Area (mi2)	Peak Discharge (Q100) (cfs)	Volume (ac-ft)	Peak Discharge (Q10) (cfs)	Volume (ac-ft)
Brahman Dam	6.44	310.2	627.9	251.3	306.5
BR-J2	4.20	5640.9	450.7	2369.2	211.4
BR-J3	4.44	5719.7	469.1	2364.7	218.2
BR-J4	4.58	5766.2	479.9	2360.6	222.4
BR-J5	7.24	912.6	700.8	462.5	338.0
Br-R1	0.71	1152.0	84.0	482.1	41.3
BR-R2	2.36	3490.9	250.9	1443.2	118.2
Br-R3	4.20	5517.5	450.8	2307.2	211.3
Br-R4	4.44	5678.3	469.3	2334.9	218.2
Br-R5	4.58	5764.8	479.9	2356.8	222.4
DB-1	0.13	111.3	12.0	42.8	5.2
DB-2	0.06	70.4	5.8	28.4	2.6
DB-3	0.19	164.3	17.3	62.9	7.4
DB-4	0.28	224.4	24.7	86.6	10.6
DB-5	0.08	86.1	7.2	33.7	3.1
DB-6	0.03	53.7	3.0	22.0	1.3
DB-7a	0.25	265.1	23.9	104.8	10.4
DB-7b	0.26	213.6	24.0	84.5	10.5
DB-8a	0.03	75.8	2.8	31.0	1.3
DB-8b	0.30	165.5	28.9	67.5	12.9
DB-8c	0.36	201.4	35.2	82.2	15.7
DB-J1	0.39	336.8	35.1	131.0	15.1
DB-J2	0.44	356.9	41.0	138.6	17.8
DB-J7	0.29	279.6	27.2	110.2	11.9
DB-J8	9.55	2256.8	934.1	955.6	447.6
DB-R1	0.44	355.0	41.0	137.5	17.8
DB-R2	0.39	335.7	35.1	129.9	15.2
DB-R6	7.24	904.7	709.5	460.4	347.8
DB-R7	0.29	278.2	27.2	109.2	11.9
DB-R8	9.55	2218.0	947.2	947.6	463.3

Table 18 – Proposed Brahman Channel Subbasins (cont.)
HEC-HMS Model Results

		Future Conditions			
Hydrologic Element	Drainage Area (mi2)	Peak Discharge (Q100) (cfs)	Volume (ac-ft)	Peak Discharge (Q10) (cfs)	Volume (ac-ft)
HC-1	1.39	2013.9	148.1	847.4	68.8
HC-2	0.15	214.8	11.4	71.0	4.4
HC-3	0.14	152.8	10.6	51.8	4.1
HC-4	0.08	91.9	7.2	34.4	3.0
HC-5	0.39	356.4	30.4	123.8	12.2
HC-6	0.17	166.2	15.6	65.2	6.8
HC-7	0.08	136.2	8.3	54.7	3.7
HC-8	0.64	388.6	62.8	158.7	28.1
HC-J6	0.17	166.2	15.6	65.2	6.8
HC-J8	1.13	895.3	103.7	272.0	45.0
HC-R1	1.39	2007.2	148.2	840.7	68.9
HC-R5	0.09	113.9	8.9	46.8	3.9
HC-R6	0.17	164.8	15.7	64.6	6.9
HC-R7	0.08	126.4	8.2	47.9	3.7
HC-R8	0.00	0.0	0.0	0.0	0.0
HC-R9	1.13	850.7	103.9	273.4	45.1
IS-1a	0.23	279.8	22.5	113.0	10.0
IS-1b	0.24	137.4	23.7	56.1	10.6
IS-2	0.33	155.1	33.8	64.9	15.4
IS-3	0.55	206.1	56.1	86.6	25.6
IS-4	0.12	66.8	12.1	27.3	5.4
IS-5	0.11	154.2	11.7	67.0	5.5
IS-6	1.12	341.0	110.3	140.1	49.3
IS-J	13.74	4651.7	1361.4	1940.7	649.1
IS-J4	1.93	1776.5	196.6	713.2	89.1
OA-1	0.16	354.0	20.6	167.9	10.5
OA-2	0.21	363.0	21.8	149.7	9.9
OA-3	0.14	236.9	14.2	95.3	6.3
OA-4	0.20	588.3	27.8	292.9	14.6
OA-5	0.06	151.3	5.8	62.9	2.7

Table 18 – Proposed Brahman Channel Subbasins (cont.)
HEC-HMS Model Results

		Future Conditions			
Hydrologic Element	Drainage Area (mi2)	Peak Discharge (Q100) (cfs)	Volume (ac-ft)	Peak Discharge (Q10) (cfs)	Volume (ac-ft)
OA-J1	0.71	1271.6	84.4	517.2	41.4
OA-R1	0.16	349.4	20.7	163.1	10.5
OA-R2	0.21	357.5	21.7	147.8	10.0
OA-R3	0.14	232.8	14.2	92.9	6.3
ON-1	0.51	563.7	48.0	220.5	21.0
ON-2	0.13	185.6	12.5	73.5	5.5
ON-3	0.07	108.2	5.9	40.3	2.5
ON-4	0.15	186.0	11.3	62.3	4.4
ON-J	2.36	3673.8	251.5	1535.9	118.4
ON-R1	1.24	2150.9	131.8	949.2	61.9
ON-R3	0.07	106.8	5.9	39.8	2.5
SA-1	1.09	1637.6	130.6	743.2	64.1
SA-2	0.10	161.7	9.0	60.6	3.8
SA-3	0.24	341.2	19.9	115.9	7.8
SA-4	0.14	223.4	14.0	84.5	6.0
SA-5	0.09	156.0	7.4	53.2	2.9
SA-6	0.03	56.0	2.2	18.7	0.9
SA-7	0.09	121.0	6.4	40.2	2.5
SA-J1	1.24	1843.5	147.3	743.5	71.7
SA-J5	0.23	294.4	21.4	102.5	8.9
SA-J7	0.09	121.0	6.4	40.2	2.5
SA-R1	1.24	1807.2	147.3	738.1	72.0
SA-R2	0.10	159.2	9.0	59.4	3.8
SA-R4	0.14	219.2	14.0	84.0	6.0
SA-R7	0.09	137.3	6.9	40.0	2.5
BR-Total	16.01	4947.2	1586.3	2073.8	750.4
SN-1	0.93	1140.5	103.6	495.5	49.1
SN-2	0.13	156.4	9.4	52.6	3.7
SN-3	0.37	337.2	31.7	125.3	13.3
SN-4	0.39	346.9	31.9	125.6	13.1
SN-5	0.09	118.5	8.8	47.4	3.9
SN-6	0.55	378.2	53.7	154.2	24.0
SN-7	0.49	355.1	47.9	144.2	21.4

Table 18 – Proposed Brahman Channel Subbasins (cont.)
HEC-HMS Model Results

		Future Conditions			
Hydrologic Element	Drainage Area (mi2)	Peak Discharge (Q100) (cfs)	Volume (ac-ft)	Peak Discharge (Q10) (cfs)	Volume (ac-ft)
SN-8	1.04	588.4	102.2	240.2	45.7
SN-J1	1.32	1402.1	135.7	576.6	62.2
SN-J2	0.49	455.0	41.1	150.4	17.0
SN-J4	1.81	1740.5	183.7	707.4	83.7
SN-R1	0.93	1133.6	103.8	493.1	49.2
SN-R2	0.13	153.3	9.5	51.7	3.7
SN-R3	0.49	447.0	41.2	145.9	17.1
SN-R4	1.32	1390.4	135.8	575.7	62.3
SN-R7	1.81	1709.9	184.6	690.2	83.7
SN-R8	1.04	584.6	102.9	298.1	46.5
US 70-1	0.15	345.4	16.4	147.5	7.6
US 70-2	0.73	1773.3	84.2	791.5	40.6
US 70-J2	1.24	2164.4	132.0	978.3	62.1
US 70-R1	0.15	339.8	16.6	143.3	7.6
US 70-R2	0.73	1680.2	84.0	776.4	41.1

Table 19 – Proposed East Mesa Subbasins
HEC-HMS Model Results

		Future Conditions			
Hydrologic Element	Drainage Area (mi2)	Peak Discharge (Q100) (cfs)	Volume (ac-ft)	Peak Discharge (Q10) (cfs)	Volume (ac-ft)
Amber Mesa Pond	17.51	771.5	755.3	630.4	428.6
AR-1a	0.27	448.8	32.4	202.6	15.9
AR-1b	0.22	285.3	26.2	129.4	12.9
AR-2a	0.26	385.3	29.1	167.2	13.8
AR-2b	0.77	443.7	85.7	194.5	40.6
AR-2c	0.27	282.7	29.6	122.6	14.0
AR-3a	0.14	208.9	14.5	88.6	6.7
AR-3b	0.26	301.0	27.7	127.6	12.9
AR-3c	0.30	369.4	31.8	156.3	14.8
AR-3d	0.27	273.3	28.8	115.7	13.4
AR-4a	0.06	86.9	6.1	35.9	2.8
AR-4b	0.07	135.8	7.0	55.6	3.2
AR-5a	1.07	566.2	105.1	231.1	46.9
AR-5b	0.22	137.7	21.6	56.0	9.6
AR-J2	0.00	0.0	0.0	0.0	0.0
AR-J3 Holman	0.30	369.4	31.8	156.3	14.8
AR-R2	0.00	0.0	0.0	0.0	0.0
AR-R3	0.30	362.3	31.9	153.3	15.0
B-P 1	6.31	613	650.3	192.9	299.2
B-P 2	7.56	927.1	750.1	335.5	340.7
B-P-3	7.86	957.1	774.2	357.2	350.5
Brahman Pond	1.01	218.5	141.2	144	79.6
Brahman SD	1.01	218.5	142.1	144	80.5
Butterfield Aux	0.00	362.4	102	0.0	0.0
Butterfield Reservoir	6.31	250.6	548.3	192.9	299.2

Table 19 – Proposed East Mesa Subbasins (cont.)
HEC-HMS Model Results

		Future Conditions			
Hydrologic Element	Drainage Area (mi2)	Peak Discharge (Q100) (cfs)	Volume (ac-ft)	Peak Discharge (Q10) (cfs)	Volume (ac-ft)
EC-1	0.25	192.4	23.3	76.4	10.2
EC-10	0.70	330.5	72.0	138.4	32.8
EC-11a	0.07	50.0	6.7	20.4	3.0
EC-11b	0.06	44.2	5.9	18.0	2.6
EC-11c	0.04	28.0	3.7	11.4	1.7
EC-12	0.08	106.8	7.4	43.1	3.3
EC-13a	0.34	220.7	33.2	90.0	14.8
EC-13b	0.04	40.8	3.9	16.4	1.8
EC-14	0.33	137.6	33.5	57.7	15.3
EC-15a	0.03	50.2	2.7	20.5	1.2
EC-15b	0.87	373.6	88.6	156.6	40.4
EC-16	0.35	163.8	37.4	70.3	17.4
EC-2	0.21	165.0	20.1	65.4	8.8
EC-3	0.06	87.7	5.9	35.6	2.6
EC-4	0.91	420.8	101.6	184.8	48.1
EC-5b	0.49	242.2	48.1	98.9	21.5
EC-6	0.49	315.4	48.1	128.7	21.5
EC-7a	0.19	234.5	18.6	94.9	8.3
EC-7b	0.35	243.7	33.8	99.1	15.1
EC-8	0.69	269.1	64.7	107.5	28.3
EC-9	0.81	375.6	79.1	153.6	35.3
EC-Channel	18.35	1089.2	837.9	710.6	465.6
EC-J10	2.20	948.9	215.8	383.1	96.5
EC-J13	0.08	65.0	7.7	26.3	3.4
EC-J3	0.52	394.9	49.3	156.7	21.6
EC-J4	1.44	785.7	151.1	336.2	69.9

**Table 19 – Proposed East Mesa Subbasins (cont.)
HEC-HMS Model Results**

		Future Conditions			
Hydrologic Element	Drainage Area (mi2)	Peak Discharge (Q100) (cfs)	Volume (ac-ft)	Peak Discharge (Q10) (cfs)	Volume (ac-ft)
EC-J5	20.28	1941.1	1037.2	1105.9	559.3
EC-J8	1.49	643.8	143.8	260.2	63.7
EC-R10	2.20	948.6	215.8	382.6	96.5
EC-R3	0.52	393.0	49.5	156.1	21.8
EC-R4	1.44	783.0	151.2	335.5	69.9
EC-R8	1.49	643.6	143.8	259.8	63.7
EC-R9	0.81	375.0	79.1	153.5	35.4
Hanger Lake Culvert North	12.09	59.9	214	50.5	184
Hanger Lake Culvert South	8.60	83.1	276.5	68.9	233.5
Hanger Lake North	12.09	59.9	214.3	50.5	184.1
Hanger Lake South	8.60	83.1	276.6	68.9	233.5
Osborn J-Pond	7.94	1003.3	783.8	415.8	355.4
Porter1	1.18	836.4	123.2	342.5	56.7
Porter2	2.55	1729.7	260.2	683.4	118.6
Porter Upper	1.18	834.5	123.2	340.3	56.7
PT-1a	0.45	354.3	47.6	151.0	22.1
PT-1b	0.41	302.7	43.6	129.2	20.3
PT-10a	0.11	109.6	10.5	44.2	4.7
PT-10b	0.28	207.8	27.7	84.5	12.4
PT-11	1.33	582.6	142.2	250.1	66.1
PT-12	0.34	124.4	34.4	52.3	15.7
PT-2	0.11	116.9	12.8	52.2	6.2
PT-3	0.31	230.7	41.3	112.3	21.3
PT-4a	0.40	302.9	41.1	126.0	18.7
PT-4b	0.04	98.2	4.2	40.3	1.9
PT-5a	0.11	127.8	11.1	51.6	5.0
PT-5b	0.03	64.8	3.2	26.0	1.4

Table 19 – Proposed East Mesa Subbasins (cont.)
HEC-HMS Model Results

		Future Conditions			
Hydrologic Element	Drainage Area (mi2)	Peak Discharge (Q100) (cfs)	Volume (ac-ft)	Peak Discharge (Q10) (cfs)	Volume (ac-ft)
PT-6	0.18	111.9	18.9	46.7	8.6
PT-7	0.44	169.3	45.2	71.1	20.6
PT-8	0.26	149.7	26.3	62.5	12.0
PT-9	0.09	72.4	9.2	30.1	4.2
PT-J1	0.45	354.3	47.6	151.0	22.1
PT-J10	0.90	435.0	99.8	180.6	47.6
PT-J4	0.31	230.3	41.3	112.1	21.3
PT-J8	0.96	411.2	97.8	175.4	44.6
PT-R1	0.45	352.8	47.6	150.3	22.1
PT-R2	0.11	115.9	12.8	51.7	6.2
PT-R3	0.31	230.3	41.3	112.1	21.3
PT-R4	0.31	229.4	41.3	111.5	21.4
PT-R5	0.03	59.2	3.3	23.3	1.5
SD Junction 2	2.65	653.2	322.9	444.2	167.1
EM-Total	25.77	4252.2	1615.	2066.1	824.8
ST-MI	2.94	3892.8	310.2	1595.8	143.8
Storm Drain At WEP1	1.80	437.8	230.3	293.9	122.3
Storm Drain Junction	2.65	653.5	320.9	444.4	165
US 70-10a	0.20	277.5	20.5	113.9	9.4
US 70-10b	0.52	402.2	53.0	167.8	24.2
US 70-11	0.08	130.4	9.7	60.1	4.8
US 70-12a	0.56	321.9	44.1	113.6	17.6
US 70-12b	1.03	410.1	80.4	146.2	32.1
US 70-12c	0.19	143.6	15.0	50.4	6.0

Table 19 – Proposed East Mesa Subbasins (cont.)
HEC-HMS Model Results

		Future Conditions			
Hydrologic Element	Drainage Area (mi2)	Peak Discharge (Q100) (cfs)	Volume (ac-ft)	Peak Discharge (Q10) (cfs)	Volume (ac-ft)
US 70-12d	0.11	152.6	8.3	53.2	3.3
US 70-12e	0.12	119.6	9.4	42.1	3.8
US 70-3	0.42	719.5	50.2	325.9	24.7
US 70-4	1.96	3099.5	217.6	1342.0	103.0
US 70-5	0.06	212.0	10.5	124.4	6.3
US 70-6	0.44	435.4	47.2	185.6	21.9
US 70-7	0.64	919.2	60.3	361.9	26.4
US 70-8	2.60	3080.5	277.6	1309.5	129.0
US 70-9a	0.20	143.1	17.4	53.8	7.3
US 70-9b	0.14	208.5	11.9	78.6	5.0
US 70-9c	0.11	138.7	9.2	51.7	3.8
US 70-J10	0.79	601.0	81.8	245.4	37.6
US 70-J4	2.60	3692	277.9	1542.3	129.5
US 70-R10	0.52	400.9	53.0	167.0	24.2
US 70-R11	0.08	128.8	9.6	59.7	4.9
US 70-R12	7.94	1000.9	787.5	415.2	359.8
US 70-R3	0.42	707.9	50.4	317.8	25.0
US 70-R4	1.96	3056.7	217.6	1339.9	103.1
US 70-R5	0.06	204.0	10.6	118.5	6.2
US 70-R6	0.44	434.4	47.3	184.9	22.0
US 70-R7	2.60	3620.0	277.8	1522.5	129.5
US 70-R8	2.60	3058.0	277.6	1291.1	129.2
US 70-R9	6.41	616.7	660.3	194.4	304.8
Wagons Storm Drain	1.80	437.6	231.8	293.8	123.9
Wagons East Pond 1	0.80	219.6	88.2	153.0	41.8
Wagons East Pond 2	0.85	215.8	89.1	151.4	41.1

Table 20 – Proposed Waterfalls Pond Subbasins HEC-HMS Model Results

		Future Conditions			
Hydrologic Element	Drainage Area (mi2)	Peak Discharge (Q100) (cfs)	Volume (ac-ft)	Peak Discharge (Q10) (cfs)	Volume (ac-ft)
MH-1	1.64	2390.4	163.7	967.7	73.2
MH-2	1.91	1190.8	182.8	473.4	80.0
MH-3	1.44	1959.9	137.9	769.6	60.3
MH-4	0.76	426.9	57.9	146.1	22.6
MH-5	0.63	386.1	47.5	132.3	18.5
MH-J1	2.40	2787.8	221.9	1093.2	95.3
MH-J2	3.35	2140.9	320.9	836.8	140.4
MH-J3	6.38	5122.8	590.3	1978.9	254.3
MH-R1	1.64	2363.7	164.0	948.6	72.7
MH-R2	1.91	1188.6	183.0	471.8	80.1
MH-R3	1.44	1935.0	137.8	760.7	60.4
W250	0.71	608.9	80.4	265.9	38.1
Waterfalls	7.70	5862.4	709.6	2234.9	304.6
WF-1B	0.25	283.7	25.3	115.1	11.3
WF-2	1.06	665.1	93.1	249.7	39.0
WF-R1	6.38	5063.7	591.2	1959.0	254.3

5.3. HYDRAULIC ANALYSIS RESULTS

Existing drainage improvements in the East Mesa area include roadway crossing culverts. Culvert capacities in areas of concern for this study are provided below in Table 21. A discussion of how the analysis was completed and how the sizes of the existing culverts were determined is provided in Section 4.

Table 21 – Existing Culvert Capacities

Basin/Analysis Point	Road	Structure	HW (ft)	Capacity (cfs)	Q_{100} (cfs)	Excess Capacity (cfs)
US 70-1	US 70	1-120" CMP mitered to slope	12	913	345	568
US 70-2	US 70	4-102'Sx62"R CMPAs	7	1470	1773	-303
SA-4	Bellsong	3-24" HDPE	3	60	223	-163
AR-1b	Moongate	1-36" CMP	3	39	285	-246
DB-1	Moongate	1-36" CMP	4.5	53	111	-58
US 70-12E	Berry Patch	2-24" CMP/HDPE	2	37	120	-83
PT-1a	Holman Rd	1-36" CMP	9	81	354	-273
Osborn-J	Hanger Lake	5-48" HDPE	6	577	1003	-426

5.3.1. HEC-RAS ANALYSIS RESULTS

As part of the evaluation of the East Mesa area and the development of improvement recommendations, HEC-RAS was used to analyze the proposed improvements. Tables 22 through 31 present the resulting channel parameters. They list the features at significant geometry or flow change locations based on the proposed conditions hydrologic models. The results of the analysis are discussed below.

5.3.1.1. BALSAM

Table 22 – Balsam

Station	Bed Slope (%)	Bottom Width (ft)	Top Width at Water Surface (ft)	Flow Depth (ft)	Surface	Mannings	Flow (cfs)	Velocity (ft/sec)
2370	0.60	10	28.24	3.04	Bare Soil	0.03	410	7.06

Balsam Channel receives flows from East Mesa subbasin US 70-12b. It is a relatively small channel that maintains constant trapezoidal cross sections along the span with a bottom width of 10 feet, a top width averaging 30 feet. The final proposed channel was evaluated in HEC-RAS with subcritical flow and no sections of the channel overflow. However, velocities throughout the channel average 6.6 ft/sec but increase to 11.83 ft/sec at station 700 caused by a decrease in flow area at that section. Although the bed slope is less than 1%, the velocities in this channel are above tolerable limit for an earth-lined channel. A discussion of the suggestions for this improvement can be found in Section 7.

5.3.1.2. BERRY PATCH- HANGER LAKE

Table 23 – Berry Patch-Hanger Lake

Station	Bed Slope (%)	Bottom Width (ft)	Top Width at Water Surface (ft)	Flow Depth (ft)	Surface	Mannings	Flow (cfs)	Velocity (ft/sec)
11755	1.60	15	33.08	3.01	Bare Soil	0.03	613	8.46
8900	1.60	15	37.74	3.79	Bare Soil	0.03	927	9.27
5500	0.78	25	46.57	3.59	Bare Soil	0.03	957	7.45
3500	0.78	30	38.07	3.28	Bare Soil	0.03	1003	9.24

Berry Patch-Hanger Lake Channel receives flows from East Mesa US 70-12 subbasins and outflow from the proposed Butterfield reservoir. Because the flow from these subbasins is variable along the length of the channel, four variations in the flow profile have been determined. In the upper reach the flows average 600 cfs. However, in the lower reach where Hanger Lake crosses interstate US 70, the flows increase to around 900 cfs. These large and variant flows required a change in the cross section at stations 5500 and 3500 where the bottom width of the channel increases from 15 to 25 and 30 feet, respectively. The proposed channel was evaluated in HEC-RAS with subcritical flow. Similar to the flow, the resulting velocities in this channel are highly variant and increase as high as 9.5 ft/sec in some sections. Resulting upstream bed slopes in this channel are also moderately steep at 1.6%. A discussion of the suggestions for this improvement can be found in Section 7.

5.3.1.3. BLUE TOPAZ

Table 24 – Blue Topaz

Station	Bed Slope (%)	Bottom Width (ft)	Top Width at Water Surface (ft)	Flow Depth (ft)	Surface	Mannings	Flow (cfs)	Velocity (ft/sec)
2000	0.10	NA	21.00	1.50	Bare Soil	0.03	77	2.36

Blue Topaz receives residential street flow from Blue Topaz Road and minimal local flows from the area. In efforts to match the dimensions of the proposed Blue Topaz Channel to the existing Blue Topaz Channel, the cross section was modeled as a V-section only 18 inches deep with a top width of 20 feet. The proposed channel was evaluated in HEC-RAS with subcritical flow. Although the bed slope is 0.10% and the maximum velocity in the channel is only 5 ft/sec, the channel overflows at several stations. Based on the results of the model, and in order to minimize the real estate needed for this improvement, and given the small flow of around 80 cfs, this improvement is recommended as a storm drain. A discussion of the suggestions for this improvement can be found in Section 7.

5.3.1.4. BRAHMAN

Table 25 – Brahman

Station	Bed Slope (%)	Bottom Width (ft)	Top Width at Water Surface (ft)	Flow Depth (ft)	Surface	Mannings	Flow (cfs)	Velocity (ft/sec)
1665	0.51	18	36.94	2.67	Bare Soil	0.03	390	5.34

Brahman Channel receives flows from East Mesa subbasin AR-2a. It maintains constant trapezoidal cross sections along the span with a bottom width of 18 feet and a top width averaging 37 feet. The final proposed channel was evaluated in HEC-RAS with subcritical flow and no sections of the channel overflow. Velocities throughout the channel average 5.6 ft/sec, just above the tolerable range for an earth-lined channel of its size. The bed slope is less than 1%. A discussion of the suggestions for this improvement can be found in Section 7.

5.3.1.5. EL CENTRO

Table 26 – El Centro

Station	Bed Slope (%)	Bottom Width (ft)	Top Width at Water Surface (ft)	Flow Depth (ft)	Surface	Mannings	Flow (cfs)	Velocity (ft/sec)
13100	1.38	10	15.32	.89	Bare Soil	0.03	55	4.90
8500	1.38	10	31.31	3.55	Bare Soil	0.03	644	8.77
2900	1.05	18	39.48	3.58	Bare Soil	0.03	949	9.22

El Centro, the longest reach model, receives flows from El Centro Area subbasins EC-8, EC-10, EC-11a which vary from 55 cfs to 1050 cfs. To accommodate the high variation in flow, the trapezoidal cross section increases from a bottom width of 10 feet to 18 feet at station 2900, with top widths averaging 15 to 40 feet respectively, with moderately steep bed slopes of 1.38%. The final proposed channel was evaluated in HEC-RAS with subcritical flow. Velocities in the downstream reach of the channel are around 9.5 ft/sec, outside the tolerable range. A discussion of the suggestions for this improvement can be found in Section 7.

5.3.1.6. HANGER LAKE 2

Table 27 – Hanger Lake Road North Diversion Channel

Station	Bed Slope (%)	Bottom Width (ft)	Top Width at Water Surface (ft)	Flow Depth (ft)	Surface	Mannings	Flow (cfs)	Velocity (ft/sec)
3445	0.40	10	52.78	1.61	Bare Soil	0.03	90	2.35
1900	0.40	10	28.92	3.14	Bare Soil	0.03	280	4.59

Hanger Lake 2 runs parallel to Moongate and receives flow from the downstream subbasins of Brahman. Although the flow profile in the channel changes at station 1900, it maintains a constant trapezoidal cross section along the span with a bottom width of 10 feet and a top width averaging 27 feet. The final proposed channel was evaluated in HEC-RAS with subcritical flow and no sections of the channel overflow. Velocities in this channel are just outside the tolerable range, with the average at 3.8 ft/sec and no station greater than 5 ft/sec. Additionally, bed slopes in this section are less than 1%. A discussion of the suggestions for this improvement can be found in Section 7.

5.3.1.7. MOONGATE

Table 28 – Moongate

Station	Bed Slope (%)	Bottom Width (ft)	Top Width at Water Surface (ft)	Flow Depth (ft)	Surface	Mannings	Flow (cfs)	Velocity (ft/sec)
3535	0.18	40	53.27	2.21	Bare Soil	0.03	360	3.70

Moongate Channel receives flows from the downstream Brahman basins. It maintains constant trapezoidal cross sections along the span with a bottom width of 40 feet and a top width averaging 53 feet. The final proposed channel was evaluated in HEC-RAS with subcritical flow and no sections of the channel overflow. Velocities of around 3.70 ft/sec are within the acceptable range for an earth-lined channel of its size. Additionally, the bed slope of the channel was less than 1%, which is also within the acceptable range. A discussion of the suggestions for this improvement can be found in Section 7.

5.3.1.8. PORTER-BLOODSTONE

Table 29 – Porter-Bloodstone

Station	Bed Slope (%)	Bottom Width (ft)	Top Width at Water Surface (ft)	Flow Depth (ft)	Surface	Mannings	Flow (cfs)	Velocity (ft/sec)
7800	0.50	40	59.61	3.27	Bare Soil	0.03	836	5.13
2400	0.50	80	96.09	2.68	Bare Soil	0.03	1730	7.33

Porter Bloodstone receives flows from the Peach Tree Area subbasins of East Mesa. There is an increase of flow at downstream station 2400 causing the trapezoidal cross section to change from a 40 foot bottom width to an 80 foot bottom width and an increase in top width from approximately 60 to approximately 90 feet. The final proposed channel was evaluated in HEC-RAS with subcritical flow and no sections of the channel overflow. Final channel velocities were outside the acceptable range as they averaged from 5 to 7 ft/sec. The bed slope was 0.50%. A discussion of the suggestions for this improvement can be found in Section 7.

5.3.1.9. SAINT MICHAELS

Table 30 – Saint Michaels

Station	Bed Slope (%)	Bottom Width (ft)	Top Width at Water Surface (ft)	Flow Depth (ft)	Surface	Mannings	Flow (cfs)	Velocity (ft/sec)
2700	0.60	50	59.1	1.52	Bare Soil	0.03	280	3.38
1500	0.60	50	80.77	5.13	Bare Soil	0.03	3893	11.61

The Saint Michaels Channel spans just over 2700 feet and changes direction at station 600. Due to large flows coming from East Mesa Arroyo subbasins US 70-10a and US 70-9b, Saint Michaels Channel requires a large cross section with a bottom width of 50 feet and a top width in some places of nearly 93 feet. The proposed channel was evaluated in HEC-RAS with subcritical flow. Even with a bed slope of 0.60% and large cross sections withstanding, the velocities in this channel are not within a tolerable limit. In some places, such as between stations 1400 to 2200, the velocities are as high as 12 ft/sec. A discussion of the suggestions for this improvement can be found in Section 7.

5.3.1.10. WEISNER

Table 31 – Weisner

Station	Bed Slope (%)	Bottom Width (ft)	Top Width at Water Surface (ft)	Flow Depth (ft)	Surface	Mannings	Flow (cfs)	Velocity (ft/sec)
2070	0.90	30	47.85	2.97	Bare Soil	0.03	400	3.93
1400	0.53	30	45.03	2.51	Bare Soil	0.03	600	7.15

Weisner Channel receives flows from East Mesa subbasin AR-3D. Although the flows in the channel increase from 400 to 600 cfs, the cross sections along the length of the trapezoidal channel remain constant with a bottom width of 30 feet and a top width averaging 45 feet. The final proposed channel was evaluated in HEC-RAS with subcritical flow and no sections of the channel overflow. However, an increase in the bed slope from 0.53 to 0.90% causes sudden velocity change in the channel from approximately 4.0 ft/sec to 7.0 ft/sec at station 1400. These resulting velocities are just outside the allowable limit. A discussion of the suggestions for this improvement can be found in Section 7.

6. STORM WATER MANAGEMENT AND GENERAL RECOMMENDATIONS

Storm water management plays a very important role in developed areas and areas expected to undergo future development, in order to provide a level of protection for downstream properties and local residents. Developers, municipalities and engineers must work closely to provide a means to divert, collect, retain or discharge storm water runoff in a safe and effective manner in order to protect the health, safety and welfare of residents. Generally, drainage systems consist of culvert crossings, open channels, storm drain systems and detention/retention ponds, all of which need to be periodically monitored and maintained in order to function properly and maximize their intended design life. Some of the basic routine tasks involved in typical maintenance of public drainage systems can be completed through the development's "homeowner association" including:

- Maintain unobstructed flow paths for storm water to flow unimpeded through primary drainage ways
- Maintain and clean storm drain inlets, grates and culverts
- Sweep and maintain the condition of street, curb and gutter
- Periodically monitor and repair riprap mats or other form of erosion control for drainage facilities
- Install and maintain storm drains and culverts to resolve localized nuisance flows
- Maintain and remove general litter, large debris and trash after major rainfall events
- Maintain clean cut vegetation line along sloped areas to reduce erosion
- Educate local residents on storm water runoff issues and flood prevention practices

Development in the East Mesa area should logically occur from downstream to upstream so that downstream infrastructure can be in place before upstream development occurs. If any upstream development occurs first, this development cannot adversely impact downstream properties; this development should include temporary or interim facilities, such as detention/retention ponds, to assure that downstream properties are not affected.

Developers shall strive to include low impact designs and should be required to have onsite water quality facilities. Low impact watershed management techniques include, but are not limited to:

- Limit development density
  - Current zoning indicates that future development will be of mixed densities up to 8 du/ac in some areas of the watershed. Future development density could be constrained to lower values to limit the amount of increased impermeable area, thus reducing the requirement for larger constructed detention facilities, storm drains, and ponding areas.
- Provide open space
  - To reduce the amount of increased impermeable area within the watershed, areas of open space should be included in future development plans. Decreasing the impermeable area will decrease the future peak runoff rate and runoff volume, again minimizing the drainage impacts to the area thereby reducing the amount of required new constructed drainage improvements.
- Permeable pavements
  - Many alternative materials are available for use in lieu of traditional paved surfaces, such as driveways and roads. Permeable pavement bricks can significantly reduce the amount of impervious area added to the watershed, thereby reducing the need for drainage improvements.
- Storm water harvesting
  - Rainwater runoff from roofs and other impermeable surfaces can be detained (harvested) where it falls for later use in irrigation or other gray water applications. Developers and homeowners should consider rainwater harvesting systems on all buildings to detain runoff and limit peak discharge rates and volumes.

On site water quality facilities should be incorporated as part of any development and drainage improvements within the watershed. As part of this, development should limit the amount of connected impervious area, by draining impervious areas through pervious areas. Connecting parking lot runoff to an on-site pond is an example of this. A "green belt" should be provided next to roadways to filter storm water runoff from impervious areas, such as parking lots. Fence screens should be incorporated into drainage improvement designs to limit debris entering the drainage system. Large developments should include water quality best management practices (BMPs) to remove debris. Storm drain systems within the development area should consider the use of water quality inlets and manholes. Debris removal structures should be incorporated into all detention ponds.

6.1. IMPROVEMENT OPTIONS

6.1.1. STREETS

Roadway corridors can serve many purposes ranging from providing safe traffic movements to the conveyance of storm water runoff. In a typical street section, curb and gutter can work effectively in conveying storm water runoff to appropriate discharge points, such as drop inlets to a storm drain system, or curb openings to an open channel or ponding area. Confined street sections and crossing culverts have the potential to maximize the overall effectiveness of the storm drain system in the East Mesa area by establishing drainage controls that help minimize the meandering effects of the natural alluvial streams in the area. It is recommended that Doña Ana County require developers to include drainage improvements with development roadway improvements.

6.1.2. CULVERTS

Culvert structures, which come in a variety of shapes, sizes and materials, are in some cases necessary to allow storm water runoff to flow unimpeded where a roadway crosses an arroyo. Culverts typically alleviate roadway flooding and provide fixed horizontal and vertical control points that help minimize the adverse effects of the meandering flow paths such as alluvial avulsions. Headwalls may be used at the upstream end of the culvert to increase headwater depth when the hydraulic capacity of the culvert needs to be increased. The installation of a headwall, in areas where the existing roadway embankment does not provide enough headwater, may be all that is necessary to increase the carrying capacity of the culvert. Headwalls would typically be installed flush with the end of the culvert. In order to improve the direct flow into the upstream end of the culvert and protect the area around the inlet from scour, wingwall extensions should be considered to facilitate favorable hydraulics into the culvert. In areas where upstream drainage is increased through development, developers should be required to provide downstream culvert improvement or upgrades. Outlet erosion control measures should be included at all culverts.

6.1.3. REGIONAL PONDING

Regional ponding is an effective method of detaining storm water runoff and allowing for a controlled release in order to minimize downstream impact on property and roadways. Detention ponds can also serve as water quality BMPs by slowing the water flow allowing sediment to settle out and debris be trapped prior to discharging into a surface or subsurface drainage system. The settlement of sediment and trapping of debris helps maintain a clean downstream storm drain system and reduces frequent and costly maintenance of storm drain and channel systems. Ponds also serve as vertical and horizontal control points that help reduce the propagation of alluvial avulsions. As discussed earlier, water quality features can and should be incorporated into regional ponding facilities. Additionally, with proper planning, engineering and construction, these facilities have the opportunity to become multi-use recreational facilities for the nearby communities and surrounding general public. As development occurs within the East Mesa area, it is recommended that Doña Ana County require developers to set aside land for the construction and maintenance of regional ponds.

6.1.4. OPEN CHANNELS

Consideration of open channels is an integral part of any project in which conveyance of large storm water flows is necessary and improvements to natural channels are a primary concern. Open channels are encouraged for use as part of the major drainage systems in the areas that are expected to carry significant volumes of storm water runoff, as channels are the most cost effective means of conveyance. These facilities can have advantages in terms of cost, capacity and multi-use opportunities (such as pedestrian trails paralleling the channel). Open channel facilities need to include sufficient right-of-way for periodic maintenance needs. For any open channel conveyance, channel stability must be evaluated to determine what measures are necessary in order to avoid bank cutting and channel bed erosion. Much of the drainage in the East Mesa area is carried through natural channels that have a tendency to meander, scour, and erode both on their own and due to modifications as part of development. As development occurs, developers should be required to consider erosion control measures and multi-use opportunities for any open channel conveyances. Further, as an engineered network of open channels develops in the East Mesa area, any new development needs to consider the effects on downstream reaches.

6.1.5. CHANNEL PROTECTION

Storm runoff in the East Mesa area is carried predominantly by natural channels, and due to the area's erosive soils and moderately steep slopes, most channels will require protection in order to reduce flow velocities, reduce erosion, and maintain channel stability. This section provides channel protection options for the East Mesa area. Doña Ana County's preference is to maintain channels in as much of a natural condition as possible.

Therefore, concrete lining for channel protection is not presented as an option and should only be considered after other options have been eliminated. Doña Ana County has guidance related to the maximum allowable velocity in a channel based on soil type and slope. This guidance is shown in Table 34 and discussed in Section 6.2.3. The selection of appropriate protection for a specific channel is dependent on factors such as the channel characteristics, construction and maintenance requirements, potential for vandalism, and costs. Options for channel protection that provide a more naturalistic aesthetic include: riprap, gabions, vegetation with erosion control matting, soil cement, cobble lining and grade control structures. Uses, advantages, disadvantages, and relative cost are discussed for each option. Typical sections of various channel protection options are included in Appendix F.

6.1.5.1. RIPRAP

One of the most effective and versatile erosion control options is riprap. One advantage to the use of riprap is that it is relatively flexible, allowing the stones to self-adjust if there is minor, localized subsidence. Additionally, riprap is naturalistic and aesthetically pleasing; over a period of time, vegetation can establish itself between the riprap stones. Even with minor damage, riprap can still continue to function adequately. In addition, riprap can be easily repaired by placing additional stone when needed; assuming access to the channel is available. If proper riprap material is readily available, it can be less expensive than other alternatives for channel protection.

Proper design and construction is required, as poorly consolidated substrate material could lead to significant settlement, and undersized riprap stones could be displaced by high velocity flows, causing downstream damage. Riprap can make access into the channel more difficult, which could pose a problem for maintenance vehicles but also serve as a deterrent to vandalism and four-wheeling activities. These factors should be considered in the design of any riprap channel protection.

6.1.5.2. GABIONS

Gabions are rectangular galvanized wire boxes (baskets) filled with small-sized stones. The stone fill shall be in accordance with an engineer's specification, typically 4 to 6 inch stones. Gabions are used in a similar manner to riprap and suitable for channel stabilization, protection of embankments, and for grade control or drop structures. Gabions are more naturalistic in appearance than concrete and their porous nature allows growth of vegetation.

Gabions are often used if suitable stone sizes for riprap are not available. High velocities may require larger riprap stones than are readily available in the project area, making smaller stone gabions an equivalent protection alternative to riprap. Also, gabions require a reduced volume of stone materials since gabion thickness is roughly one third that of riprap revetment. Because of the use of smaller and less stone, gabion baskets can be built without using heavy equipment. However, gabion installation is labor-intensive, which can increase the construction cost.

It is important to note that the gabion wire baskets are subject to damage if coarse material and debris is transported by high velocity flows in the channel. Also, gabions are more vulnerable to vandalism and are not as flexible as riprap.

Gabions require regular monitoring and maintenance to identify damage before failure occurs. However, gabions can be repaired relatively easily by mending or replacing damaged baskets and refilling them as needed.

6.1.5.3. VEGETATION WITH EROSION CONTROL MATTING

Vegetation as channel protection is undoubtedly naturalistic and aesthetically pleasing. However, establishing and maintaining vegetation for channel protection can be challenging, especially in a semi-arid region like the East Mesa area .

Success of vegetative channel protection can be enhanced with the use of erosion control matting or mattresses. Erosion control matting is a geotextile fabric made of either natural or man-made material with the purpose of providing temporary soil stabilization and protection while vegetative channel protection germinates or roots. The matting is porous, allowing water to permeate while retaining some sediment. The success of matting depends on its strength, durability, and the system used to anchor it.

Erosion control matting is manufactured in many forms, including matting made from coir (coconut) fiber and from wood fiber (curlex). There are also several types of non-biodegradable erosion control matting, including plastic and articulated concrete revetment mats, which would offer increased strength and durability. Properly selected and installed, matting is less noticeable and enhances the aesthetics of the finished channel protection.

A disadvantage of this form of channel protection is that the vegetation can take several years to fully develop and stabilize. During the initial establishment of the vegetation, irrigation, replanting, and maintenance of the erosion control matting may be required. However, once established, vegetation is self-perpetuating, and appropriate selection of the type of vegetation can minimize long term maintenance requirements.

Erosion matting is relatively inexpensive. However, depending on the application, the labor costs for anchoring the matting can be high. In addition, maintenance and potential replacement of matting during the initial establishment of the vegetation could increase overall costs for this option.

6.1.5.4. SOIL CEMENT

One of the main reasons for the development of soil cement for erosion protection in the southwestern United States is the abundance of sandy soils in these areas. These sandy soils are prone to erosion when subjected to storm water flows and require some form of erosion protection. These soils also become part of the solution when cement and water are added to the on-site soils and compacted to produce durable, erosion resistant material called soil cement. Since the sand to be stabilized is on-site, this option is often less expensive than options requiring off-site materials.

In areas where high quality rock is scarce for riprap and gabions, the use of soil cement can provide a practical channel protection alternative. Soil cement can be used for channel erosion protection and for grade control or drop structures. Typically, soil cement is constructed in a stair-step configuration by placing and compacting the soil cement in horizontal layers. Soil cement can also be placed on sloped surfaces up to 3:1 horizontal to vertical to form channel lining or erosion protection features. Soil cement placed in this manner is referred to as "plated soil cement" and has the advantage of requiring significantly less soil cement material than the stair-step configuration. Typically, plated soil cement used for open channel conveyances is placed to achieve an overall channel lining thickness of 18", which being significantly greater than a typical concrete lining allows for some erosion of the soil cement material. Further, soil cement weathers over time providing a more naturalistic appearance. The soil cement can also be buried to provide an even more naturalistic appearance.

6.1.5.5. GRADE-CONTROL STRUCTURES

To prevent degradation of the downstream arroyo channel and to reduce sediment transport in runoff generated by developed conditions, grade-control structures can be installed throughout open channel systems. Grade control structures are a common tool used to help control channel incision by creating a milder bed slope made possible by the grade drop at the structure. Such a structure provides a vertical control point for the degrading channel bottom. Grade control structures also create a fixed horizontal control point to help reduce lateral migration. Grade control structures can be constructed from many different types of materials, such as concrete, grouted rock, gabions, stabilized boulders, riprap, and soil cement. The selection of the material used depends on land use, cost, aesthetics, and maintenance among other factors, but the primary function is to provide sufficient hydraulic performance. To achieve this result, grade control structures must be designed to prevent seepage uplift, scour on the downstream side, and flanking around the outside edges.

6.2. SUMMARIZED DRAINAGE CRITERIA

Doña Ana County has criteria in place that governs drainage design requirements. This criteria is discussed below and should be followed as part of any future development and drainage improvements in the area.

6.2.1. STREETS

Table 32 – Street Capacity Criteria

Street Type		10 Year – 24 Hour	100 Year – 24 Hour
Local	Roadway Swales	Collected flow spread shall allow for 1 -10 ft. lane clear of runoff.	Collected flow shall be contained within right-of-way and/or easements.
	Cross Flow	N/A	Cross flow not to exceed 12" deep above pavement surface.
	Curb and Gutter	Collected flow spread shall allow for 1 -10 ft. lane clear of runoff.	Collected flow shall be contained with curb and gutter. Crossing flow not to exceed 6" deep above pavement surface or gutter flow line.
Collector		Collected flow spread shall allow for 2- 10 ft. lanes clear of runoff. Crossing flow not to exceed 6" deep above pavement surface or gutter flow line.	Collected flow shall be contained with curb and gutter. Crossing flow not to exceed 6" deep above pavement surface or gutter flow line.
Arterial		Collected flow spread shall allow for 2- 10 ft. lanes clear of runoff. No crossing flow allowed on surface.	Collected flow shall not exceed 6" deep above gutter flow line. No crossing flow allowed at arroyo and channel crossings. Crossing flow not to exceed 3" deep at street intersections.

6.2.2. CAPACITY CREDIT FOR CULVERT STRUCTURES

Table 33 – Capacity Credit for Structures

Cross Sectional Area of Structure	Capacity Credit % of Full Flow Capacity	% of Major Storm Flow to be added to Culvert Capacity or Considered as Overflow
≤ 20 ft^2	0%	100%
> 20 ft^2	50%	50%

- For structures that have a cross sectional area of flow less than or equal to 20 ft^2, 2.0 times the theoretical flow rate must pass unimpeded.
- For structures that have a cross sectional area of flow greater than 20 ft^2, 1.50 times the theoretical flow rate must pass unimpeded.
- Appropriate inlet and outlet structures with upstream and downstream erosion control.
- Culvert slope not less than 0.5%.
- Headwater to depth ratios not to exceed 1.0 for the initial 10-yr storm and 1.25 for the major 100-yr storm.

6.2.3. OPEN CHANNELS

- Channels shall be capable of conveying the major (100-yr) storm event.
- Shall have subcritical flow characteristics
- Maximum velocities of unlined channels shall follow the requirement in the following table:

Table 34 – Maximum Velocity of Unlined Channels and Swales

	Classification of Soils	
Cover	Erosion Resistant Soil (Clay)	Easily Erosive Soil (Sandy)
No Cover, Earth Lined	4 ft/sec	2.5 ft/sec
Buffalo Grass, Bluegrass, Smooth Brome Blue Gramma, Native Grass Mix	7 ft/sec	5 ft/sec
Lespedeza, Lovegrass, Kudzu, Alfalfa, Crabgrass	4.5 ft/sec	3 ft/sec

- Lined channels such as concrete, asphalt, riprap set in concrete and mortar may be used.
- For steady and uniform flow in relatively straight channels, the freeboard shall be computed based on the following equation:

$$\text{Freeboard (ft)} = d/4 + 0.025 \times (v) \times (d)^{1/3}$$

Where, v = velocity of flow (ft/sec)

d = depth of flow (ft)

- For meandering channels or channels which consist of abrupt changes in grade, control structures, and obstructions, the freeboard shall be computed based on the following equation:

$$\text{Freeboard (ft)} = 0.5 + (v^2/2 \times G)$$

Where, v = velocity of flow (ft/sec)

G = Gravitational Constant (ft/sec^2)

- Minimum freeboard under bridge structures shall be 2 ft.

6.2.4. REGIONAL PONDING FACILITIES

- Retention and detention facilities may be used to mitigate storm water runoff and offer added protection from property damage while still having the potential to serve the public as a recreational facility.
- Retention and detention facilities shall have banks that are no steeper than 4:1 (H:V); otherwise, additional slope protection surfacing or BMPs are required in order to minimize erosion and bank failure.
- Minimum freeboard shall be 1 ft.
- Any retention / detention facility shall be placed a minimum of 5 ft. from property lines and 10 ft. from any structures.
- For any retention / detention facility that is greater than 4 ft. deep and has side slopes greater than 3:1, a perimeter fence will be required.

7. SPECIFIC IMPROVEMENTS AND RECOMMENDATIONS

In addition to establishing the hydrology for the East Mesa area and outlining general watershed management recommendations for the area, this DMP also details specific drainage improvements developed to manage storm water flows. This section presents a prioritized list of drainage improvements recommended for the East Mesa area. The prioritization groups the proposed improvements into two categories: Short Term (1-5 years) and Long Term (5–15 years). A description of the drainage improvements, along with the anticipated cost for each improvement, is provided in the following sections.

7.1. IMPROVEMENT PROJECTS IN PROGRESS AT THE TIME OF STUDY

During the course of this study there have been drainage improvements to the area to mitigate flooding. The community of Butterfield reported that flooding occurs near the intersection of Bataan Memorial East and Isaacks Ave. In late summer of 2011, this area was improved by incorporating two drop inlets on the east and west shoulders of Isaacks Ave. to intercept accumulated runoff or standing water. This runoff is discharged through a 24" CMP located on the east side of Isaacks Ave. to the adjacent channel, which then discharges through 2- 8' x 6' concrete box culverts under US 70. From there, the storm water runoff travels northwest along its historical flow path.

In late summer of 2011, an underground storm drain system was installed along Arroyo Road, immediately east of Wagons East Subdivision, to the intersection of Hanger Lake Road and Arroyo Road. The project consisted of a new 36" HDPE storm drain with several interconnected storm drain drop inlets located near the intersection of Weisner Road and Arroyo Road. Currently, there is approximately 3,500 linear feet of 36" HDPE pipe which outlets in a dry well manhole located at the northwest corner of the Hanger Lake Road and Arroyo Road intersection. The project was constructed with the intent to minimize localized flooding issues at the Weisner Road and Arroyo Road intersection by directing flows into a subsurface storm drain system where the runoff is carried downstream and ultimately released with minimal impact to downstream properties. The dry well is intended to fill and overflow at the location of one of the proposed reservoirs described in section 7.2.2, Hanger Lake Regional Ponding Areas.

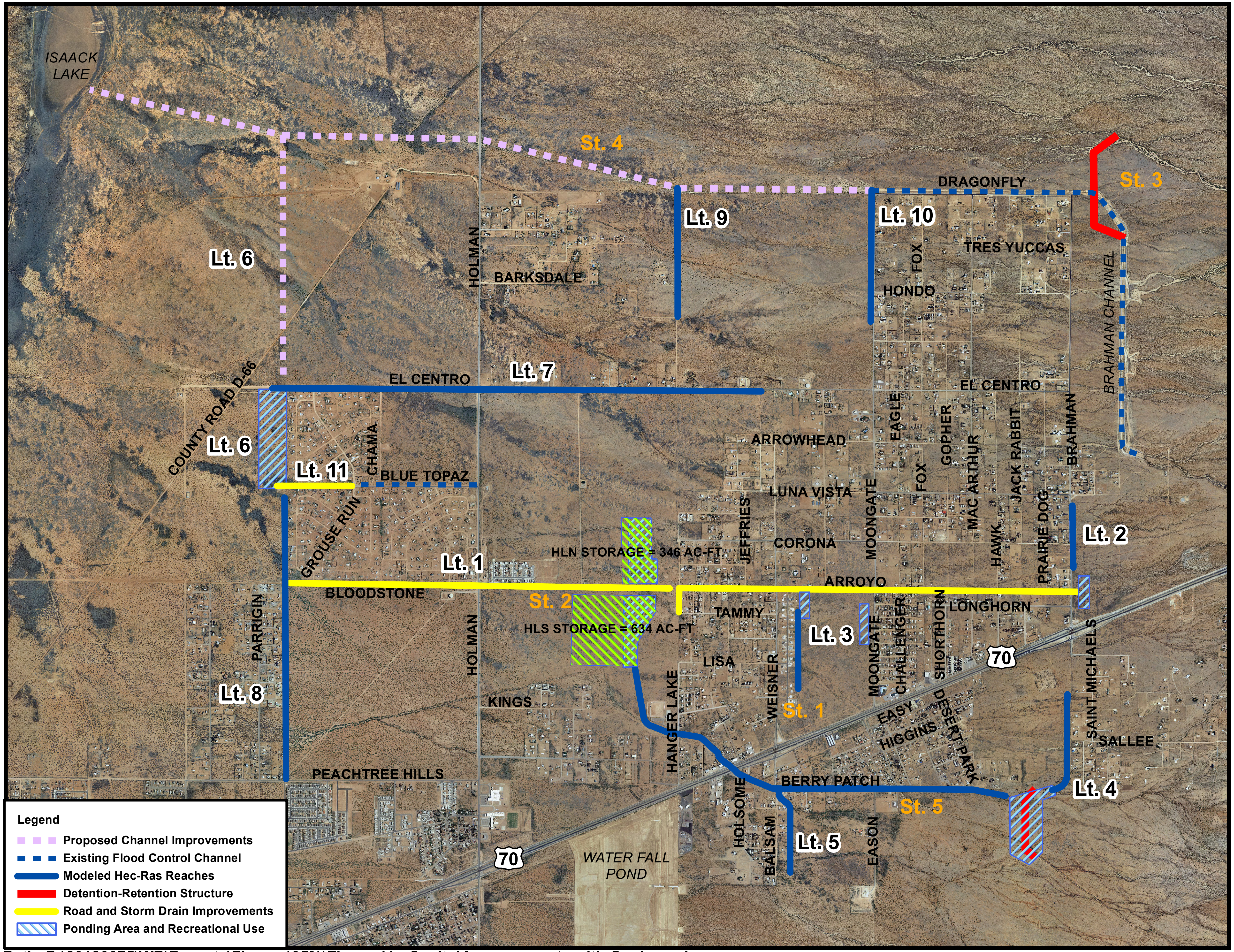
7.2. SHORT TERM IMPROVEMENTS (1-5 YEARS)

The projects summarized below are projects designated as short term due to the County's priority to complete these projects as soon as possible. With the exception of the

Brahman Road Detention Facility and the Dragonfly Channel, which have been designed, the remaining proposed projects are expressed in concept. Additional work, including but not limited to, utility location, verification of property lines, and right-of-way and easement acquisition will be required as part of the design process for these facilities. It is the intent of this report to minimize capital outlay for land purchases of privately owned property, so the use of existing right-of-way, county owned property, state and or federal land was taken into consideration and strongly encouraged. Figures 11 and 12 provide a graphical representation of the areas described for future improvement projects identified to assist in mitigating storm water runoff in the East Mesa area.

7.2.1. WEISNER DIVERSION CHANNEL AND REGIONAL PONDING FACILITY

According to current Doña Ana County public records, lot 1 of Enchanted Mesa Subdivision #1 consists of approximately 37.4 acres and includes drainage easements. This lot provides the potential for a diversion channel and regional ponding area, which would attenuate runoff across Wagons East Subdivision located immediately east of Weisner Road and south of Arroyo Road. This area is currently impacted by storm water runoff generated on the south side of US 70 and east of Moongate Road. The first part of this improvement consists of 2,100 linear feet of earth lined channel to alleviate flooding by intercepting flows in magnitude of 600 cfs. The proposed channel section is 30 ft. wide at the base and 3 ft. deep with 3:1 side slopes. This includes a minimum freeboard of 1 ft. and a channel slope ranging from 0.1% to 0.72%. This slope will produce an average flow velocity of 6.3 ft/sec and a maximum velocity of 7.9 ft/sec. The channel will need moderate erosion control measures to ensure velocities are below erosive levels. Treatments options for erosion control include erosion control matting and seed in order to establish root growth and vegetation in sections with lower velocities (less than 5 ft/sec) and soil cement in sections with velocities over 5 ft/sec. Once captured in the channel, the flow is redirected to a regional ponding facility located immediately east of Wagons East Subdivision and south of Arroyo Road. To limit the overall footprint of the ponding area and avoid the need for slope protection (in order to keep the overall cost down), the side slopes of the pond are intended to be 4:1 with an expected pool depth of nearly 8 ft. The peak storage in the ponding area is approximately 36 ac-ft. Outflow from the ponding facility will discharge through a 48" diameter pipe at a flow rate of 216 cfs. The pond outfall is intended to connect directly to an improved roadway storm drain system as part of the future



Path: P:\20120075\WR\Reports\Figures\95%\Figure 11 - Capital Improvements with Goals.mxd

DONA ANA COUNTY NEW MEXICO

Bohannan Huston

Engineering
Spatial Data
Advanced Technologies

SHORT TERM (ST) KEY:

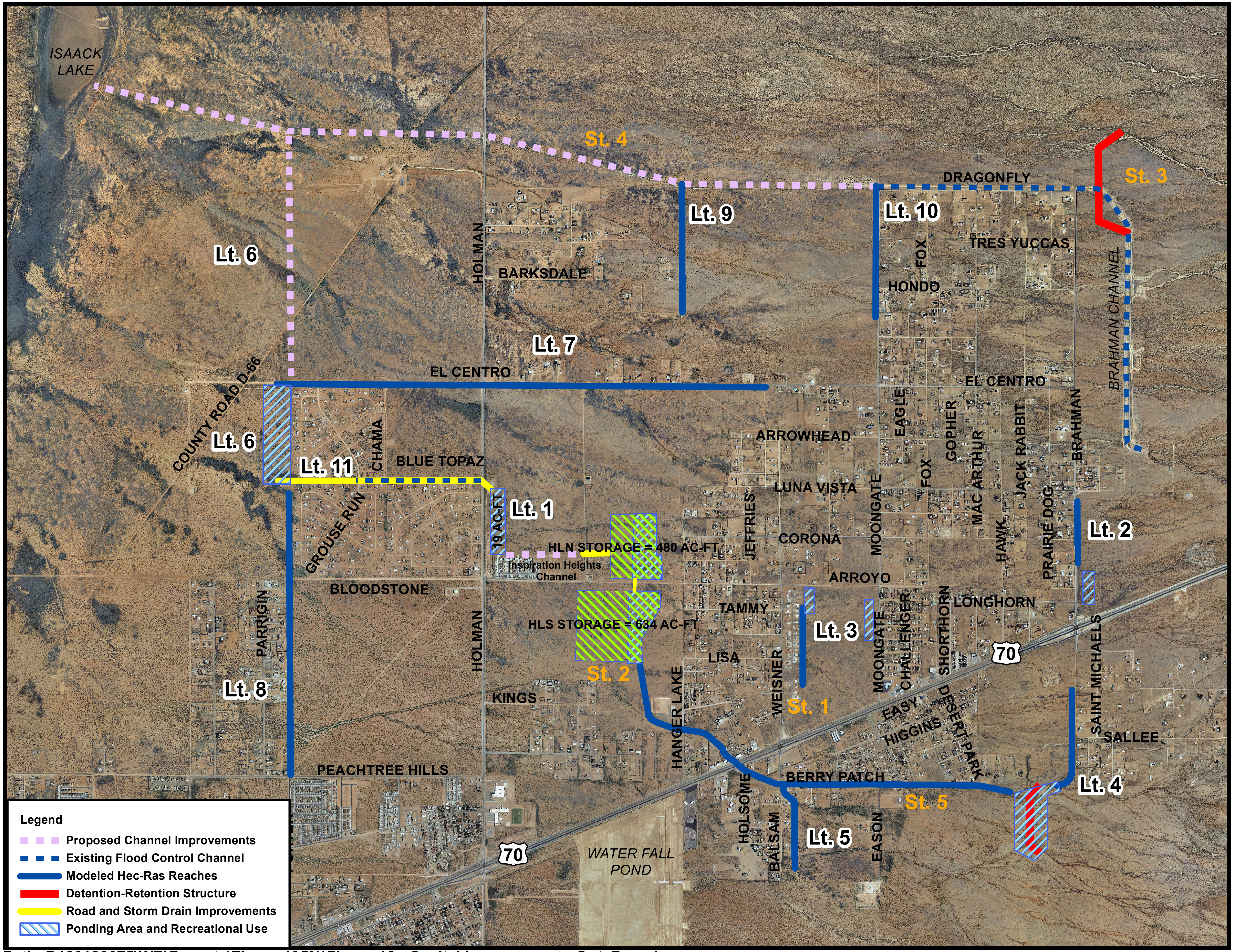
1. Weisner Channel and Ponding
2. Hanger Lake Channel and Regional Ponds Option A
3. Brahman Dam
4. Dragonfly Channel
5. Berry Patch Channel

LONG TERM (LT) KEY:

1. Arroyo Road Storm Drain
2. Brahman Road Channel and Pond
3. Moongate Road Pond
4. Butterfield Channel and Detention Reservoir
5. Balsam Road Channel
6. Amber Mesa Pond and Channel
7. El Centro Road Channel
8. Porter Road Channel
9. Hanger Lake North Channel
10. Moongate North Channel
11. Blue Topaz Storm Drain

Figure 11 - Capital Improvements Option A

East Mesa Drainage Master Plan



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DONA ANA COUNTY NEW MEXICO

Bohannan Huston
Engineering
Spatial Data
Advanced Technologies

SHORT TERM (ST) KEY:

1. Weisner Channel and Ponding
2. Hanger Lake Channel and Regional Ponds Option B
3. Brahman Dam
4. Dragonfly Channel
5. Berry Patch Channel

LONG TERM (LT) KEY:

1. Inspiration Heights Channel and Pond
2. Brahman Road Channel and Pond
3. Moongate Road Pond
4. Butterfield Channel and Detention Reservoir
5. Balsam Road Channel
6. Amber Mesa Pond and Channel
7. El Centro Road Channel
8. Porter Road Channel
9. Hanger Lake North Channel
10. Moongate North Channel
11. Blue Topaz Storm Drain

N

0 1,250 2,500 5,000 Feet

Figure 12 - Capital Improvements Option B

East Mesa Drainage Master Plan

reconstruction of Arroyo Road, which is a long term improvement project discussed in Section 7.3.1. In interim conditions, the pond outfall can be connected to the existing 36" storm drain in Arroyo Road. This interim solution would not accommodate the full 100-yr storm event but provides some protection and functionality until the full system can be completed with the Arroyo Road project. The estimated project cost for the diversion channel and ponding facility is $1,015,000.

7.2.2. HANGER LAKE CHANNEL EXTENSION AND REGIONAL PONDING AREAS

Hanger Lake Road is a roadway corridor that separates heavily populated areas located east of the roadway and sparsely populated areas, which are to the west of the roadway. Hanger Lake Road, which runs north to south bisecting US 70, is designated as a collector south of US 70 and a minor arterial north of US 70. The undeveloped areas west of Hanger Lake Road are expected to develop under future conditions and as such, drainage improvements are recommended in this area. These improvements include extension of the Hanger Lake Channel and two regional ponding areas. The proposed Hanger Lake Channel Extension and Regional Pond Facilities would provide flood protection for the area to the west from storm water runoff that is generated predominantly from US 70 and from the heavily populated area of the East Mesa located immediately east of Hanger Lake Road.

In 2006, an existing earth lined channel located east of Hanger Lake Road and the culvert crossing at Hanger Lake Road were upgraded in order to stabilize and minimize the meandering effects of the channel and improve capacity at the roadway crossing. The channel was widened to 27.5' and the slopes were stabilized at 1.6:1. The roadway crossing incorporated (5) – 48" HDPE pipes with vertical headwalls on both the upstream and downstream end of the crossing. A concrete apron was also provided on the downstream end to minimize head cut and prevent undermining of the structure. Hydraulic analysis using HEC-RAS discovered that the culvert structure is slightly under capacity for the expected 100-yr flow and an additional 48" HDPE pipe is required to meet current Doña Ana County Drainage Design Criteria. Additionally, the channel improvements completed in 2006 need to be extended upstream to the Osborn Pond. The same section used in 2006 may be used. However, it is recommended that this entire channel portion be lined with soil cement to protect against high velocities in the reach.

This improvement includes extending the existing channel west of the culvert crossing in order to safely convey and direct storm water runoff in a northern direction. This channel extension would convey an anticipated flow of 980 cfs to the proposed regional ponding area at the intersection of Hanger Lake Road and Arroyo Road, south of Arroyo Road. The extension of this channel will require 2,400 linear feet of excavated and displaced soil with proper bank and slope protection. The channel section is anticipated to be 40 ft. wide at the base of the channel and 4 ft. deep with 3:1 side slopes. This includes a minimum freeboard of 1 ft. The slope of the channel ranges from 0.36% to 3.32%, which will produce an average flow velocity of 7 ft/sec and a maximum velocity of 9.2 ft/sec. This will require moderate channel stabilization such as a full or partial soil cement section, in an effort to increase path resistance and minimize velocities below erosive levels. Such alterations may require minor adjustments in cross section or longitudinal bed slope. The channel extension is intended to tie to the south side of the proposed downstream ponding facility. The ponding facility will attenuate peak flows and reduce the impact downstream along Arroyo Road, Holman Road, Peachtree Hills Drive, Parrigin Way, and Kissiah Drive.

Two options were developed for the regional ponding configuration at the intersection of the Hanger Lake Road and Arroyo Road. The channel improvements discussed above are required for both options. The two options for the Hanger Lake regional ponds are discussed below.

7.2.2.1. OPTION A

Option A includes Hanger Lake South Pond and Hanger Lake North Pond, with outflow from both ponds carried downstream via a 48" storm drain in Arroyo Rd. This option is shown in Figure 11.

The Hanger Lake South Pond has a footprint of approximately 87 acres and receives an inflow of about 1,300 cfs. This pond will have a peak storage of approximately 634 ac-ft. The pond discharges through a single 30" diameter pipe which connects to a 48" storm drain in Arroyo Road. To limit the overall footprint of the ponding area and avoid the need for slope protection (in order to keep the overall cost down); the side slopes of the pond are intended to be 4:1 with and expected pool depth of nearly 9 ft.

The detention pond proposed on the north side of Arroyo Road, Hanger Lake North Pond, has a footprint of approximately 35 acres and expected to receive 1,080 cfs. This facility has a peak storage of approximately 346 ac-ft and discharges through a single 24" diameter discharge pipe. This outlet connects to the 48" storm drain in Arroyo Road. The overall footprint of the ponding area is dependent on the side slopes of the pond, which are recommended to be 4:1 with an expected pool depth of nearly 11 ft. This detention pond is intended to receive flows from Basin AR-4b, which is the closest upstream contributing basin to the reservoir, along with the flows from the two mile long proposed storm drain system along Arroyo Road; which begins at Brahman Road (see Section 7.3.1). The anticipated project cost for Option A is $10,636,000.

7.2.2.2. *OPTION B*

Option B includes Hanger Lake South Pond and Hanger Lake North Pond, with outflow from the South Pond routed into the North Pond and the North Pond outfalling into the proposed post-development Inspiration Heights Channel. This option is shown in Figure 12.

The size of the Hanger Lake South Pond does not change for Option B and has the same characteristics and approximate project costs as provided in the previous section. However, for this option the 30" outlet pipe ties into the Hanger Lake North Pond.

For Option B, the detention pond proposed on the north side of Arroyo Road, Hanger Lake North Pond, has a footprint of approximately 52 acres. This pond is expected to receive a peak inflow of 1,138 cfs. This facility has a peak storage of approximately 480 ac-ft and discharges through a single 24" diameter discharge pipe. This outlet connects to the proposed post-development Inspiration Heights Channel. The Inspiration Heights Channel drains into the proposed post-development Inspiration Heights Pond. For this option, the peak storage in the Inspiration Heights Pond is 19 ac-ft, which is less than the 28 ac-ft that is planned. The proposed outlet for the Inspiration Heights Pond for this option is a 48" storm drain along Blue Topaz Road. Improvements along Blue Topaz Road are discussed in the Long Term Improvements section (Section 7.3.11.). The anticipated project cost for the Hanger Lake North Pond for Option B is $8,638,000.

7.2.3. BRAHMAN DAM

In November 1995, a notice to proceed was issued for a final design of the Brahman Road Detention Facility, and design plans were completed in December 2004. This project is an East Mesa Phase 1 Flood Control Structures Part II Project, as discussed in the Design Analysis (Andrews, et. al., 1996). This facility will consist of an earth dam constructed of select, on site materials. It is located 600 ft. east of Brahman Road and on the downstream end of the existing Brahman Road Channel, which currently runs parallel with Brahman Road. According to current design drawings, the dam will be situated within Sections 27 and 34 of Township 21 South, Range 3 East. This dam is expected to capture direct flows from the Hawkeye Arroyo. In addition, with the assistance of the Brahman Road

Channel, flows from the San Augustin Arroyo, the Owl's Nest Arroyo, and the Organ Arroyo will be intercepted and directed to the detention facility. These existing flow paths generate substantial amounts of flow that adversely impact the majority of the East Mesa area, north of US 70. The dam is designed to detain runoff from the 100-yr, 24-hr storm event which will be stored below the elevation of the emergency spillway. The runoff will be discharged through the principal spillway, which consists of a vertical intake riser with a 48" diameter RCP pipe outlet with an outfall capacity of 270 cfs. The storage volume behind the dam and below the emergency spillway elevation will be approximately 430 ac-ft, which includes 400 ac-ft of storage for storm water runoff and 30 ac-ft for sediment storage. Outflow from the dam will proceed west, along its historical path, in the existing earth lined channel, which runs parallel to Dragonfly Road and the boundary line of Section 27 and 34, for approximately one mile. At the end of one mile, which is at the intersection of Dragonfly Road and Moongate Road, the geometry of the existing channel dissolves and storm water flows westward in a less concentrated form. The existing earthen channel is proposed to be improved as part of the Dragonfly Channel project; see the following section. The anticipated project cost for the Brahman Dam is $3,253,000.

7.2.4. DRAGONFLY CHANNEL

In May 2005, design plans were completed for the Rincon Road Channel (also known as the Dragonfly Channel), which extends approximately 21,000 linear feet (4 miles) between Isaack Lake (located in Section 26, Township 21 South, Range 3 East) and Moongate Road (located in Section 28, Township 28 South, and Range 3 East). This project is an East Mesa Phase 1 Flood Control Structures Project Part III. The Dragonfly Channel is expected to capture flows from the Brahman Road Detention Facility as described in the previous section, by extending the principal outlet pipe 6,000 linear feet. The 48" diameter RCP principal outlet pipe is extended approximately 1,800 linear feet and transitions to a 54" RCP for approximately 4,200 linear feet. The storm drain pipe then ties into a new vertical concrete baffle wall, which transitions to the Dragonfly Channel. The overall intent is to deliver storm water runoff westward to Isaack Lake through an earth lined channel with a bottom width varying from 40 ft. on the upstream end to 190 ft. on the downstream end. The channel is expected to carry the 100-yr, 24-hr storm event under non-turbulent flow conditions. In doing so, the channel will be constructed with a series of vertical grade control structures in order to accommodate grade transitions and maintain a relatively shallow slope. The depth of the channel will also vary in depth, from 7 ft. on the upstream side to 10 ft. on the downstream side. The outfall section of the channel gradually widens for 1,000 ft. before the immediate approach into Isaack Lake. The anticipated discharge into Isaack Lake ends at a wire enclosed riprap mat that is embedded 42" into the subgrade and anchor driven with steel rods. The anticipated project cost is $4,269,000.

7.2.5. BERRY PATCH ROAD DIVERSION CHANNEL AND CULVERT CROSSING

Berry Patch Road Diversion Channel is a proposed improvement in the Butterfield area of East Mesa and will be the primary outfall structure to accommodate the expected peak discharge from the future Butterfield Detention Reservoir described in the Long Term Improvements section. This channel will require 5,700 linear feet of excavated and displaced soil in a manner that is to provide proper bank and slope protection with minimal impact to the existing grade of the roadway, unless such an alternative to the roadway is required in order to meet flow capacity requirements and provide an overall benefit. The channel is anticipated to be 15 ft. wide at the base and 4-6 ft. in depth with 3:1 side slopes. This includes a minimum freeboard of 1 ft. The slope of the channel ranges from 1.33% to 2%. This will produce an average flow velocity of 8.6 ft/sec and a maximum velocity of 9.3 ft/sec. The channel will require moderate channel stabilization, such as soil cement, in an effort to reduce flow velocities below erosive levels. The channel starts at the northwest side of the proposed Butterfield Detention Facility to be located within BLM land. This reservoir is discussed in greater detail as part of the Long Term Improvements forecasted for projects that are considered to be 5 to 15 years out. This channel includes a bridge crossing at Eason Lane, an access bridge for the Community Center, and a box culvert crossing at the Berry Patch / Balsam intersection. This crossing is a 2-12' span x 5' rise concrete box culverts. The channel cross section increases to 25 ft. wide at the base of the channel and 4 ft. deep just upstream of this crossing. This includes a minimum freeboard of 1 ft. With the slope of the channel ranging from 0.4% to 0.6%, this will produce an average flow velocity of 7 ft/sec and a maximum velocity of 8.9 ft/sec. Again, this will require moderate channel stabilization to keep flow velocities low. This project includes approximately 7,500 linear feet of channel improvements along Berry Patch Road and downstream of Balsam Road to US 70. The anticipated project cost for the channel and crossing culverts is $4,232,000.

7.3. LONG TERM IMPROVEMENTS (5-15 YEARS)

In addition to the projects described in the preceding section, Long Term Improvement projects that are 5-15 years out have been developed for the area. These projects, which are summarized below, are designated as long term due to their potential size, design complexity and review effort by numerous agencies ranging from local, state and federal jurisdiction and due to funding constraints. Additional work, including but not limited to, utility location, verification of property lines, and right-of-way and easement acquisition will be required as part of the design process for these facilities. It is the intent of this report to minimize capital outlay for land purchases of privately owned property, so the use of existing right-of-way, county owned property, state and or federal land was taken into consideration and strongly encouraged. Figures 11 and 12 provide a graphical representation of the areas described for future improvement projects identified to assist in mitigating storm water runoff for the East Mesa area.

7.3.1. RECONSTRUCTION OF ARROYO ROAD WITH STORM DRAIN SYSTEM

Arroyo Road, according to the City of Las Cruces Major Thoroughfare Plan (MPO), is classified as a future Principal Arterial. Arroyo Road spans east to west bound between Brahman Road on the east and North Jornada Road on the west. Throughout this corridor, Arroyo Road bisects several major roadways, such as MacArthur Road, Moongate Road, Weisner Road, Hanger Lake Road, Holman Road, Porter Drive, Mesa Grande and Jornada Road. Between Brahman Road and Weisner Road, Arroyo Road is designated as a Minor Arterial with an anticipated right-of-way width of 100 ft., and between Weisner Road and Jornada Road, Arroyo Road is designated as a Principal Arterial with an anticipated Right-of-way width of 120 feet.

Both roadway corridors, as it pertains to anticipated right-of-way, may provide sufficient width to incorporate two lanes or four lanes with curb and gutter and a subsurface storm drain system. However, over the past several years substantial development has occurred between Brahman Road and Hanger Lake Road. The right-of-way width within this corridor varies from 50 ft. to 60 ft., with residential development, including permanent structures and perimeter walls, situated immediately adjacent to the apparent right-of-way boundary. These conditions drastically limit the extent of road improvements that can be made, such as multiple lanes, pavement surfacing, and sidewalk with curb and gutter, which mitigates local drainage more effectively than roadway without curb and gutter. In addition to right-of-way limitations and encroachment of development on the roadway corridor, there are also utilities in Arroyo Rd. that need to be avoided with any storm drain system.

A new drainage conveyance along Arroyo Road is needed to function as the primary outlet for multiple drainage facilities that are proposed along the roadway corridor, as well as the inlet to other facilities along the corridor. Brahman Road Diversion Channel and Regional Ponding Facility, which will be discussed in the next section, utilizes a 54" outlet pipe as the primary outfall. The 54" outlet would be the beginning of the main trunk line of the Arroyo Road storm drain collection system. As the system proceeds westerly, the main truck line will increase in size as the system accepts additional flow from nearby drainage reservoirs and drainage facilities. With all the nearby drainage reservoirs and diversions in place, the first 5,800 linear feet of pipe will be 54" diameter pipe. The next section will require 72" diameter pipe for 1,780 linear feet. The final section consists of 4,410 linear feet of 84" diameter pipe that outlets into the Hanger Lake North Pond, discussed in the Short Term Improvement section. A conceptual cross section of this option is provided in Appendix F. This 2.3 mile long storm drain system along Arroyo Road is a critical element in conveying upstream flows and connecting ponding areas to minimize surface drainage impacts for downstream properties. Table 35 outlines the storm drain system sizes, flow rates and slopes. The analysis and sizing of this system is based on flowing full capacity of the storm drain and does not account for pressure flow. At the time of design, it may be possible to decrease the sizes of some of the storm drain systems based on a more detailed hydraulic analysis that considers the pipes flowing under pressure.

Table 35 – Arroyo Road Storm Drain Systems

Location	Flow Rate (cfs)	Length (ft)	Slope (%)	Storm Drain Size
Brahman Pond to Wagons East Pond 1	220	5500	1.9%	54"
Wagons East Pond 1 to Wagons East Pond 2	438	1650	1.6%	72"
Wagons East Pond 2 to Hanger Lake North Inlet	654	4400	1.5%	84"

This storm drain system is presented here as a storm drain and roadway project fully constructed with pavement surfacing, local storm drain drop inlets, curb and gutter, etc. However, this project has the opportunity to be completed in phases to spread out capital cost. As mentioned in previous sections, development in the East Mesa area should logically occur from downstream to upstream so that downstream infrastructure is in place before upstream development occurs. As such, if the basic conveyance mechanism is established along Arroyo Road by construction of the main storm drain trunk line, residential development and drainage elements can tie into the system and minimize downstream impacts. Lastly, portions of the roadway section, such as curb and gutter and local drop inlet structures, may follow as resources and funding become available. Overall the anticipated project cost is $9,773,000.

7.3.2. BRAHMAN ROAD DIVERSION CHANNEL & REGIONAL PONDING FACILITY

There is an undeveloped private owned parcel located immediately east of Brahman Road and North of Bataan Memorial West that, according to Doña Ana County records, comprises approximately 58.3 acres. This parcel provides the opportunity for a diversion channel and regional ponding facility. The proposed diversion channel would begin just south of Luna Vista Road, along the east side of Brahman Road, and proceed south terminating into the proposed ponding area, to be located between Arroyo Road and Longhorn Drive. The ponding facility would allow for sediment and debris removal and would function to attenuate the peak runoff flow rate. These facilities would improve runoff conditions across Brahman Road and allow storm water runoff to be discharged in a controlled fashion from the proposed pond into the proposed Arroyo Road storm drain system.

Storm water runoff is currently impacting this area from contributing watersheds immediately adjacent to US 70 and south of the existing Brahman Diversion Channel. Flooding is expected to be alleviated by intercepting flows through 1,700 linear feet of excavated channel, with expected flows in the magnitude of 390 cfs. The proposed channel section is 18 ft. wide at the base and 3.5 ft. deep with 3:1 side slopes. This includes a minimum freeboard of 1 ft. and a channel slope maintained at 0.51%. This slope will produce an average flow velocity of 5.3 ft/sec. The channel will need little to moderate erosion control measures to ensure that velocities are below erosive levels. Treatments include erosion control matting and seed in order to establish root growth and vegetation. Once captured by the channel, the flow enters the ponding facility located immediately south of the diversion channel and east of Brahman Road. This pond has a peak storage of 76 ac-ft. To avoid the need for slope protection, the side slopes of the pond are intended to be 8:1 with an expected pool depth of nearly 6 ft. Outflow from the pond would be discharged through a 54" diameter pipe at a rate of 220 cfs, which is connected directly to an improved roadway storm drain system as part of the long term and future reconstruction of Arroyo Road. The anticipated project cost for the diversion channel and detention facility is expected to be $743,000.

7.3.3. MOONGATE ROAD REGIONAL PONDING FACILITY

According to current Doña Ana County records, Lot 1 of Moongate Estates Subdivision, which is currently undeveloped, comprises 42.3 acres. This property provides the opportunity for a regional ponding area, which would improve runoff conditions across Wagons East Subdivision located immediately east of Weisner Road. Storm water runoff captured in a ponding facility would be discharged into the new storm drain system as part of the reconstruction of Arroyo Road. Once captured, runoff would be detained within a regional ponding facility located immediately west of Moongate Road with a peak storage of 39 ac-ft. The side slopes of the pond are intended to be 4:1 with an expected pool depth of nearly 6 ft. Storm water runoff will be discharged through a 54" diameter pipe at a rate of 220 cfs, which is connected directly to an improved roadway storm drain system as part of the future reconstruction of Arroyo Road. The anticipated project cost for the detention facility and outlet works is expected to be $641,000.

7.3.4. BUTTERFIELD DIVERSION CHANNEL AND DETENTION RESERVOIR

Based on field reconnaissance and aerial photography, a storm water ponding facility currently exists on the northeast corner of Section 16, Township 22 South, Range 16 East, which appears to reside on BLM land. It is recommended that this area be utilized for the Butterfield Detention Reservoir. This reservoir will intercept flow from drainage basins US 70-4, US 70-7, US 70-8, US 70-9, US 70-10a and US 70-12a (see Figure 6). The contributing area among the basins listed above is 6.31 square miles and generates a cumulative volume of 649 ac-ft. for the 100-yr storm event. The community of Butterfield and the surrounding area will see significantly lower volumes of runoff by diverting and capturing offsite flow and expanding the existing facility to a detention structure. Flooding is expected to be alleviated by intercepting flows through 2,700 linear feet of earth lined channel along St. Michaels Road, which receives flows in magnitude of 3,893 cfs. The channel section is 50 ft. wide at the base and 8 ft. deep with 3:1 side slopes. This includes a minimum freeboard of 1 ft. and a channel slope ranging from 0.3% to 0.9%. This slope will produce an average flow velocity of 6.6 ft/sec and a maximum velocity of 11.9 ft/sec. The channel requires significant erosion control measures and slope stabilization due primarily to the large design capacity. Recommended treatments include soil cement or concrete in order to keep velocities from eroding adjacent slopes and maintaining adequate flow capacity. Once captured, the flow results in a peak storage of 466 ac-ft within the Butterfield Detention Reservoir. The slope of the reservoir is intended to be 4:1 with an expected pool depth of nearly 13 ft. Storm water runoff would be discharged through a 54" diameter pipe at a rate of 250 cfs. The facility will also utilize two overflow auxiliary spillways that will generate a peak outflow of 362 cfs. As a result, 613 cfs will proceed west along the proposed channel which runs parallel to Berry Patch Road for approximately 1.25 miles, to the intersection of Berry Patch Road and Balsam Road. This detention facility will consist of an earthen dam constructed of select, on site materials, assuming the material is suitable for such type of construction. This facility is located 1,800 ft. east of the intersection of Berry Patch Road and Desert Park Avenue. The detention facility will accommodate the expected 100-yr storm event volume. The anticipated project cost for the Butterfield Reservoir is $4,949,000.

7.3.5. BALSAM ROAD DIVERSION CHANNEL

The Balsam Rd. Diversion channel is located east of the development along the east side of Balsam Road. The channel will run parallel with Balsam Road for approximately 2,400 feet, and terminate into the Berry Patch Channel discussed in the Short Term Improvements section. This channel intercepts flows from the east and directs the flow, in a controlled manner, to the Berry Patch channel eventually crossing under US 70. The area that contributes runoff to Balsam Rd. comprises basin US 70-12b. Flooding along Balsam Rd and to the west would be alleviated by intercepting the flow from this basin, which reaches a magnitude of 410 cfs. The channel section is 10 ft. wide at the base and 4 ft. deep with 3:1 side slopes. This includes a minimum freeboard of 1 ft. and a channel slope ranging from 0.3% to 2.5%. This slope will produce an average flow velocity of 6.4 ft/sec and a maximum velocity of 7.9 ft/sec. The channel will need to receive moderate erosion control measures, such as soil cement lining. It is intended for this channel to intercept flows from the east in their natural courses and therefore, the slope of this channel needs to follow the existing grade to the north and tie to the existing grade on the east. It is recommended that the property to the east of the channel remain as open space in order for natural flow patterns to pass unimpeded, thereby minimizing any potential backwater effect which could result in flooding of nearby residents. The anticipated project cost is $729,000.

7.3.6. AMBER MESA REGIONAL POND

The Amber Mesa Regional Pond is a recommended drainage improvement to provide flood protection from storm water runoff that is generated east of Porter Road. Porter Road is designated as a principal arterial and runs north to south bisecting US 70 in the western portion of the study area. It is the intent of the facility to serve as a discharge point for the upstream drainage improvements. The facility will attenuate peak flows and reduce the downstream impact along Mesa Grande and future west development. The slope of the reservoir is 4:1 with an expected pool depth of nearly 12 ft. Depending on the option selected for the upstream Hanger Lake ponds, the peak storage in the Amber Mesa Pond varies slightly. The peak storage in Amber Mesa if Hanger Lake Option A is selected is 260 ac-ft. The peak storage in Amber Mesa if Hanger Lake Option B is selected is 235 ac-ft. Storm water runoff is discharged out of the pond through three 48" diameter pipes with a peak of 782 cfs for Option A and 772 cfs for Option B. The outlet pond outfalls to an open channel proposed along the future extension of the Porter Road corridor to the north. This channel is approximately 6,800 feet in length and terminates in the proposed Dragonfly Channel. The channel conveys a maximum flow rate of 1,090 cfs in a trapezoidal channel section with a 40 ft bottom with 3:1 side slopes and a depth of 5 feet. An advantage to ponding facilities of this nature is that it allows particles and debris to settle out prior to discharging into the downstream system. The settlement of particles and debris in the Amber Mesa Pond will help maintain a clean open channel system downstream and reduce frequent maintenance channel along the Porter Road Channel and the Dragonfly Channel. Due to the potential size of the facility, this area provides the opportunity, through proper planning, to become a recreational facility for the nearby communities and surrounding general public. The anticipated project cost for Amber Mesa Pond Option A is $1,701,000. The anticipated project cost for Amber Mesa Pond Option B is $1,553,000.

7.3.7. EL CENTRO ROAD DIVERSION CHANNEL AND CULVERT CROSSING

El Centro Road runs in an east to west direction from Brahman Road to Mesa Grande, according to the City of Las Cruces Major Thoroughfare Plan (MPO), and drainage improvements are recommended along a section of this road. The roadway for El Centro is currently situated within a 60' right-of-way. Throughout this corridor, El Centro Road bisects several major roadways, such as MacArthur Road, Moongate Road, Weisner Road, Hanger Lake Road, Holman Road, Porter Drive, and Mesa Grande. El Centro Road is designated as a Minor Arterial with an anticipated right-of-way width of 100 feet. There is an existing earth lined channel with variable depth and cross section on the south side of El Centro Road, beginning at Weisner Road. In a few locations along El Centro, the roadway profile is lowered, which allows for storm water runoff to flow over to the north side of El Centro Road and impacts residential properties immediately east of Holman Rd. To alleviate potential flooding to the north and provide an east to west conveyance for significant storm water flows, a modified drainage channel approximately 2.5 miles in length on the south side of El Centro Road is recommended. Flows intercepted by this channel reach a magnitude of 950 cfs. The proposed channel section is 18 ft. wide at the base and 5.5 ft. deep with 3:1 side slopes. This includes a minimum freeboard of 1 ft. and a channel slope maintained at 1%. This slope will produce an average flow velocity of 7.5 ft/sec and a maximum velocity of 9.5 ft/sec. The channel improvements includes a culvert crossing at Holman Road that consists of three 9' by 5' box culverts. The channel will need significant erosion control measures and slope stabilization, such as soil cement, in order to keep velocities from eroding adjacent slopes and to maintain adequate flow capacity. It is intended for this channel to discharge into the Amber Mesa Pond for purposes of attenuation and to control the release of flow to the north. The anticipated project cost is $5,598,000.

7.3.8. PORTER ROAD DIVERSION CHANNEL AND CROSSING

The Porter Road Diversion Channel will provide the conveyance for storm water runoff generated from several basins located within a densely populated area of the East Mesa. The Porter Road Diversion Channel will function as an interceptor channel, along the western portion of the study area, located immediately east of Kissiah Subdivision. This channel runs parallel with the future Porter Road extension for approximately 1 mile, beginning near Peachtree Hills to the south and terminating into the proposed Amber Mesa Pond. Flooding will be alleviated by intercepting flows that reach a magnitude of 1,827 cfs (if Hanger Lake Option A is selected). The channel section is 40 ft. wide south of Arroyo Rd. and 80 ft. wide north of Arroyo Rd. at the base and 5 ft. deep with 3:1 side slopes. This includes a minimum freeboard of 1 ft. and a channel slope ranging from 0.28% to 0.66%. This slope will produce an average flow velocity of 6.4 ft/sec and a maximum velocity of 7.9 ft/sec. The channel will need moderate to significant erosion control measures such that velocities are below erosive levels. Treatments would include erosion control matting and seed in order to establish root growth and vegetation, or soil cement. The channel delivers flows to the Amber Mesa Regional Ponding Facility for purposes of peak discharge attenuation and debris settling. A future bridge crossing may be necessary if roadway improvements extend Arroyo Road beyond Porter Road. Therefore, a bridge crossing has been included in the anticipated cost for this improvement. The anticipated project cost is $4,662,000.

7.3.9. Hanger Lake Road North Diversion Channel and Culvert Crossing

The Hanger Lake Road Diversion Channel will provide conveyance for storm water runoff generated from several upstream basins located within the Brahman Arroyo Basin model area. The Hanger Lake Road Diversion Channel will function as an interceptor channel, east of what is intended to be a future extension of Hanger Lake Road. This diversion channel is located east of a populated area that consists of approximately 50 residences. This channel runs parallel with the future Hanger Lake Road extension for approximately 3,500 feet. Flooding in this area will be alleviated by intercepting flows that reach a magnitude of 280 cfs. The channel section is 10 ft. wide at the base and 4.ft. deep with 3:1 side slopes. This includes a minimum freeboard of 1 ft. with a maximum channel slope of 0.40%. This slope will produce an average flow velocity of 3.8 ft/sec with a maximum velocity of 4.6 ft/sec. The channel will need minimal erosion control measures to ensure that velocities are below erosive levels. Treatments include erosion control matting and seed in order to establish root growth and vegetation. The channel will deliver flows to the Dragonfly Channel, which is discussed as a Short Term Improvement Recommendation. The proposed Hanger Lake Diversion Channel assumes that the Moongate Road Diversion Channel, discussed below, is in place capturing flows from the east of Moongate, which is a densely populated area. As the transportation system in the area develops, a culvert crossing may be needed if Hanger Lake Road is extended to the North. A culvert crossing consisting of 4-54" RCP culverts is anticipated and has been included in the cost analysis for this improvement. The anticipated project cost for the Hanger Lake Road North Diversion Channel is $317,000.

7.3.10. Moongate Road North Diversion Channel and Culvert Crossing

Similar to the Hanger Lake Road North Diversion, the Moongate Road Diversion Channel will provide conveyance for storm water runoff generated from several upstream basins located within in the Brahman Arroyo Basin model area. The Moongate Road Diversion Channel will function as an interceptor channel, west of Moongate Road. This diversion channel is located west of a heavily populated area, just west of the existing Brahman Channel. This channel runs parallel with Moongate Rd. and is approximately 3,500 feet. Flooding will be alleviated by intercepting flows that reach a magnitude of 360 cfs. The channel section is 40 ft. wide at the base and 3.5 ft. deep with 3:1 side slopes. This includes a minimum freeboard of 1 ft. with a channel slope maintained at 0.18%. This slope will produce a maximum velocity of 3.6 ft/sec. The channel will need little to no erosion control measures as the velocities appear to be within the allowable range. Available treatments, however, would include erosion control matting and seed in order to establish root growth and vegetation. These channel improvements include a 4-54" RCP culvert crossing of Moongate Road to bring the flow across into the channel on the west side of the road. The channel will deliver flows to the Dragonfly Channel, which is discussed as a Short Term Improvement Recommendation. The anticipated project cost for the Moongate Road North Diversion Channel is $263,000.

7.3.11. BLUE TOPAZ ROAD STORM DRAIN EXTENSION

Blue Topaz Road is the main roadway entrance to the Amber Mesa Subdivision which ties directly to Holman Road. In recent years, approximately 3,300 linear feet was surfaced with asphaltic concrete, providing two 12' driving lanes for nearby residents. The roadway median was constructed with a V-notch swale with a consistent swale depth of not more than 18 inches, also surfaced with asphalt, to minimize flows from impervious surfaces onto adjacent properties. The swale section has a capacity of 31 cfs. As the flow approaches the main intersection of the subdivision, it is carried through two 24" CMP pipes and discharged into an extremely shallow earth lined channel which proceeds westward and eventually discharges into the proposed Amber Mesa Regional Ponding area. Drainage improvements are recommended in this area to alleviate flooding and provide a better conveyance for flows into the Amber Mesa Pond.

The improvements along Blue Topaz are dependent on the selection of the Hanger Lake Pond Options. If Hanger Lake Ponds Options A is selected, the flow from the Hanger Lake ponds is routed downstream in a storm drain in Arroyo Rd. In this case, it is recommended that the existing median swale remain, extending to the existing two 24" CMP pipes. From this point, it is recommended that a drop inlet and 48" diameter pipe be constructed for the remaining 2,000 ft. This pipe will discharge into the proposed Amber Mesa Pond. The anticipated project cost for the Blue Topaz Storm Drain Extension Option A is $873,000.

If Hanger Lake Ponds Options B is selected, the flow from the Hanger Lake ponds is routed downstream through the Inspiration Heights drainage improvements and then along Blue Topaz. In this case, it is recommended that the existing median swale be replaced with a 48" storm drain, originating from the Inspiration Heights Pond. The anticipated project cost for the Blue Topaz Storm Drain Extension Option B is $1,780,000.

8. COST ESTIMATES AND FUNDING

The cost estimates provided in this DMP were developed for the recommended drainage improvements. The accuracy of the cost estimates can be impacted by unpredictable fluctuation in the economic market, the scarcity of materials and the price of gasoline. The cost estimates include a contingency to account for these impacts. The current impacts that have been taken into account include, but are not limited to, the price of gasoline, increased cost in steel and concrete, and shipping of materials. A detailed listing of the cost estimates is provided in Appendix E. All of the cost estimates are based on 2010 or later unit prices. The associated construction cost for each project discussed in previous sections is summarized in Table 36 below.

Table 36 – Cost Estimates

Item	Project Description	Construction Cost (Including Contingency & Soft Cost)
1	Weisner Diversion Channel and Regional Ponding Facility	$1,015,000
2	Hanger Lake Channel Extension and Regional Ponding Areas Option A	$10,636,000
3	Hanger Lake Channel Extension and Regional Ponding Areas Option B	$8,638,000
4	Brahman Dam	$3,253,000
5	Dragonfly Channel	$4,269,000
6	Berry Patch Road Diversion Channel and Culvert Crossing	$4,232,000
7	Reconstruction of Arroyo Road with Storm Drain System	$9,773,000
8	Brahman Road Diversion Channel & Regional Ponding Facility	$743,000
9	Moongate Road Regional Ponding Facility	$641,000
10	Butterfield Diversion Channel and Detention Reservoir	$4,949.000
11	Balsam Road Diversion Channel	$729,000
12	Amber Mesa Regional Pond Option A	$1,701,000
13	Amber Mesa Regional Pond Option B	$1,553,000
14	El Centro Road Diversion Channel and Culvert Crossing	$5,598,000
15	Porter Road Diversion Channel and Culvert Crossing	$4,662,000
16	Hanger Lake Road North Diversion Channel and Culvert Crossing	$317,000
17	Moongate Road North Diversion Channel and Culvert Crossing	$263,000
18	Blue Topaz Road Storm Drain Extension Option A	$873,000
19	Blue Topaz Road Storm Drain Extension Option B	$1,780,000

The improvements recommended by this study will require significant funding to complete. Several sources of funds may be available for funding the proposed facilities, including but not limited to:

- General Fund Contributions
- Assessment District Bonds
- State and Federal Loans and Grants
- Transportation Related Funding
- Developer Exactions

General Fund Contributions are withdrawn from the available funds of the County. Given the present economic trends, undedicated General Funds could be considered scarce, and their use may be limited. In most cases, General Funds are available to cover a variety of projects such as roadway repair or construction and storm drain design and installation.

Assessment District Bond proceeds allow facilities to be constructed with funds obtained by the sale of bonds. They are typically used to construct large public works facilities. The assessments are imposed upon property owners in proportion to the benefit received. For drainage facilities that are required as a result of land development, a more efficient funding method would be Developer Exactions which are described below.

State and Federal Loans and Grants are available at limited times with varying requirements, application procedures, qualification criteria, and matching funds. The lack of reliable funding, and the significant limit in their use for land development, effectively removes them from consideration. However, the County should remain poised to take advantage of opportunities to obtain Federal and State funds. It is recommended that Federal and State funds, if any, be sought in areas where development could have a direct adverse impact on drainage or where drainage facility needs are significant.

Transportation Related Funding, such as the local Transportation Improvement Programs (TIP), is administered through the local metropolitan planning organization or similar agencies. The program allows applications to be submitted for new and unfunded projects. The intent is to secure funding for the proposed projects during two, three or four year cycles. The project's presence in the TIP represents a critical step in the authorization of funding to a project. It does not, however, represent a commitment of funds, an obligation to fund, or a grant of funds. The pursuance of Transportation Related funds will allow for drainage mitigation in most cases and could potentially be a step forward toward a much larger scale project.

Development Exaction is a method or concept where a condition for development is imposed on a parcel of land that requires the developer to mitigate any negative impacts of the development. This includes the requirement for the donation of land dedicated to complete public improvement and/or the requirement to providing funding for improvements. This is similar to impact fees, which are direct payments to local governments instead of conditions on development. Another common form of Development Exaction would be a Dedication of Land and Development Agreement. Outright dedications of land are essentially the setting aside of land by the land owner/developer for public use. Development agreements may also be a method which dictates or allows the local government to conditional development based on compliance with the goals and policies outlined in the government development regulations or specific planning documents.

9. CONCLUSION

The East Mesa watershed has been thoroughly analyzed and drainage improvement options for the area have been investigated. This DMP presents the complete analysis of the drainage in the East Mesa area and establishes the 10-yr and 100-yr flow rates for the area under existing and future conditions. The guidance for general watershed management presented herein should be referenced as development occurs in the area. The specific drainage management improvements developed in this study should be completed to provide flood protection and storm water management for the area.

APPENDICES

APPENDIX A – WATERSHED ANALYSIS SUPPORTING INFORMATION

Rainfall Pnt # 2

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

New Mexico 32.433 N 106.599 W 5062 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Thu Jun 9 2011

Confidence Limits | Seasonality | Related Info | GIS data | Maps | Docs | Return to State Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.23	0.35	0.44	0.59	0.73	0.85	0.90	1.04	1.18	1.29	1.40	1.63	1.91	2.15	2.81	3.42	4.22	4.91
2	0.30	0.46	0.57	0.77	0.95	1.11	1.16	1.33	1.51	1.64	1.77	2.08	2.44	2.76	3.61	4.37	5.38	6.28
5	0.41	0.62	0.77	1.03	1.28	1.49	1.55	1.74	1.95	2.12	2.30	2.72	3.21	3.64	4.70	5.65	6.89	8.03
10	0.49	0.74	0.92	1.24	1.53	1.79	1.84	2.05	2.28	2.50	2.71	3.22	3.81	4.33	5.53	6.62	8.01	9.29
25	0.59	0.90	1.12	1.51	1.87	2.19	2.25	2.47	2.73	3.01	3.29	3.91	4.64	5.30	6.65	7.91	9.48	10.92
50	0.68	1.03	1.28	1.73	2.13	2.51	2.58	2.80	3.07	3.43	3.76	4.45	5.31	6.07	7.52	8.89	10.60	12.12
100	0.77	1.17	1.45	1.95	2.41	2.84	2.92	3.14	3.42	3.86	4.26	5.01	6.01	6.88	8.41	9.89	11.72	13.32
200	0.86	1.30	1.62	2.18	2.70	3.19	3.27	3.48	3.77	4.31	4.78	5.61	6.75	7.73	9.32	10.91	12.85	14.51
500	0.98	1.50	1.85	2.50	3.09	3.66	3.75	3.95	4.23	4.95	5.51	6.47	7.79	8.93	10.59	12.27	14.38	16.07
1000	1.09	1.65	2.05	2.76	3.41	4.04	4.14	4.32	4.60	5.47	6.13	7.18	8.62	9.88	11.58	13.34	15.56	17.27

* These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

*** Upper bound of the 90% confidence interval**
Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.27	0.40	0.50	0.67	0.83	0.97	1.02	1.17	1.32	1.42	1.53	1.79	2.10	2.37	3.08	3.74	4.61	5.37
2	0.34	0.53	0.65	0.88	1.09	1.26	1.32	1.50	1.68	1.80	1.94	2.29	2.69	3.04	3.95	4.79	5.89	6.86
5	0.46	0.70	0.87	1.17	1.45	1.69	1.75	1.95	2.17	2.33	2.52	2.99	3.52	4.01	5.15	6.20	7.55	8.78
10	0.55	0.84	1.04	1.40	1.74	2.02	2.08	2.29	2.54	2.75	2.98	3.55	4.20	4.79	6.09	7.28	8.81	10.19
25	0.67	1.02	1.27	1.71	2.11	2.47	2.54	2.76	3.04	3.36	3.66	4.35	5.16	5.89	7.36	8.76	10.48	12.02
50	0.77	1.17	1.45	1.95	2.41	2.82	2.89	3.13	3.41	3.86	4.22	4.99	5.96	6.81	8.39	9.91	11.79	13.43
100	0.87	1.32	1.63	2.20	2.72	3.19	3.27	3.50	3.80	4.42	4.86	5.70	6.83	7.81	9.47	11.14	13.15	14.86
200	0.97	1.48	1.83	2.46	3.05	3.58	3.67	3.89	4.20	5.03	5.54	6.46	7.76	8.89	10.62	12.42	14.57	16.33
500	1.11	1.69	2.10	2.83	3.50	4.11	4.21	4.41	4.72	5.96	6.57	7.64	9.16	10.46	12.27	14.23	16.56	18.36
1000	1.23	1.87	2.32	3.13	3.87	4.54	4.64	4.83	5.14	6.78	7.50	8.65	10.33	11.79	13.63	15.72	18.14	19.95

* The **upper** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **greater** than.
** These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval.

Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

*** Lower bound of the 90% confidence interval**
Precipitation Frequency Estimates (inches)

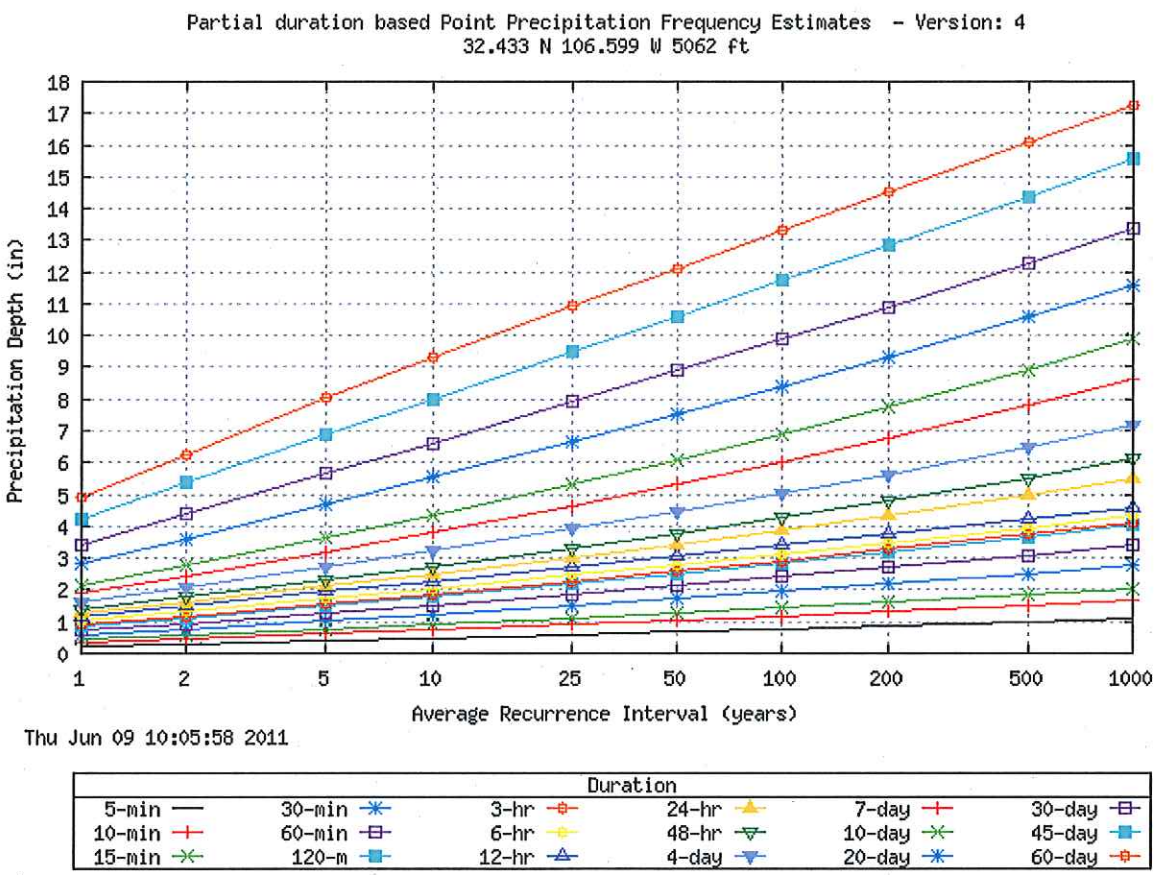
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.20	0.31	0.38	0.52	0.64	0.75	0.80	0.93	1.06	1.18	1.28	1.49	1.74	1.96	2.57	3.12	3.85	4.48
2	0.27	0.41	0.50	0.68	0.84	0.97	1.03	1.19	1.35	1.50	1.62	1.90	2.23	2.51	3.29	3.98	4.93	5.74
5	0.36	0.54	0.67	0.91	1.12	1.31	1.37	1.55	1.74	1.93	2.09	2.47	2.91	3.30	4.27	5.14	6.30	7.33
10	0.42	0.65	0.80	1.08	1.34	1.56	1.62	1.82	2.03	2.26	2.45	2.91	3.43	3.90	5.00	5.99	7.29	8.45
25	0.52	0.79	0.97	1.31	1.62	1.90	1.97	2.18	2.41	2.70	2.94	3.49	4.14	4.71	5.95	7.09	8.56	9.85

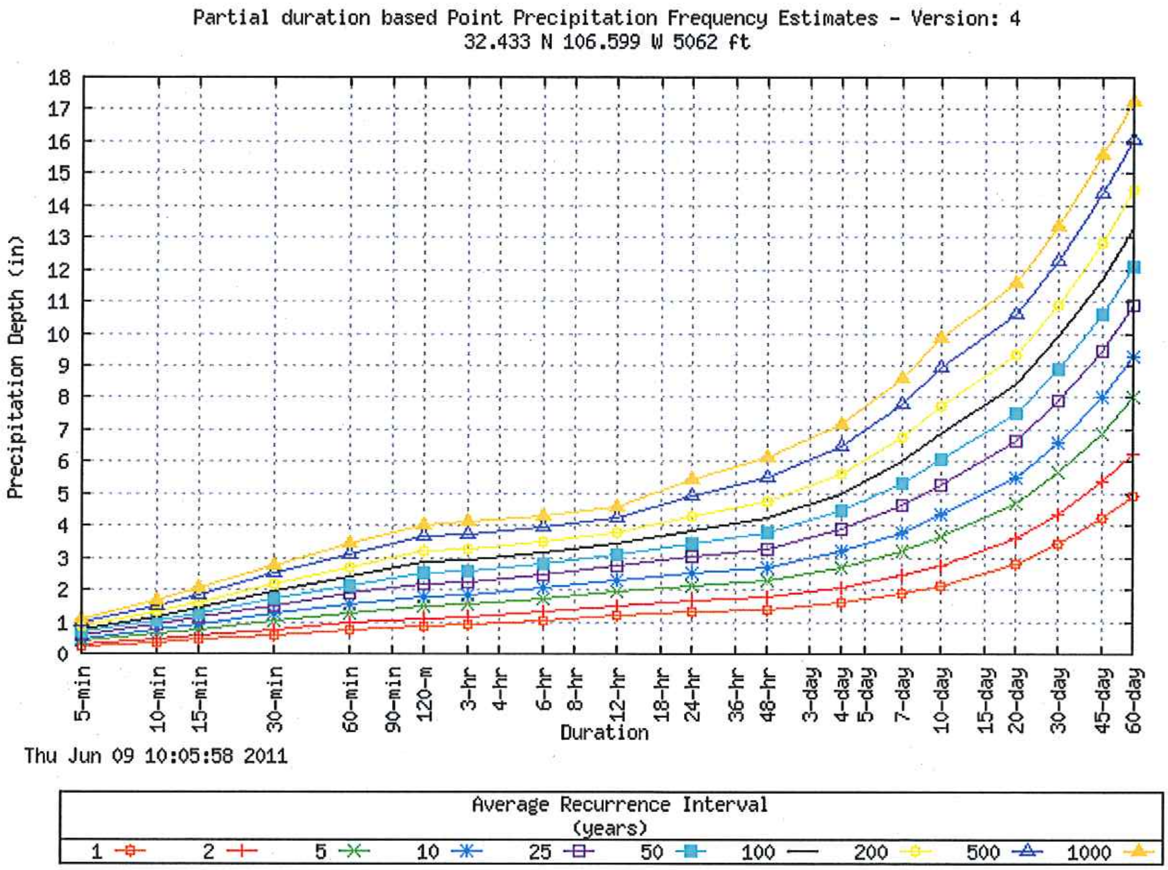
50	0.59	0.89	1.11	1.49	1.85	2.16	2.24	2.45	2.70	3.03	3.32	3.93	4.67	5.33	6.66	7.90	9.48	10.86
100	0.66	1.00	1.24	1.68	2.07	2.43	2.51	2.73	3.00	3.37	3.70	4.37	5.21	5.95	7.37	8.69	10.39	11.83
200	0.73	1.12	1.39	1.87	2.31	2.71	2.79	3.01	3.29	3.70	4.08	4.80	5.76	6.58	8.06	9.46	11.27	12.75
500	0.83	1.27	1.57	2.12	2.62	3.07	3.16	3.37	3.65	4.15	4.58	5.42	6.49	7.42	8.97	10.45	12.40	13.91
1000	0.92	1.39	1.73	2.33	2.88	3.35	3.45	3.66	3.94	4.48	4.99	5.90	7.05	8.06	9.66	11.20	13.23	14.77

* The **lower** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **less** than.
** These precipitation frequency estimates are based on a partial duration maxima series. **ARI** is the Average Recurrence Interval.

Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Text version of tables





Related Information

Maps & Aerials

Click here to see topographic maps and aerial photographs available for this location from Microsoft Research Maps

Watershed/Streamflow Information

Click here to see watershed and streamflow information available for this location from the U.S. Environmental Protection Agency's site

Climate Data Sources

National Climatic Data Center (NCDC) database

Locate NCDC climate stations within:

+/-30 minutes or +/-1 degree of this location. Digital ASCII data can be obtained directly from NCDC.

Note: Precipitation frequency results are based on analysis of precipitation data from a variety of sources, but largely NCDC. The following links provide general information about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study, please refer to the matching documentation available at the PF Document page

Natural Resources Conservation Service's (NRCS) SNOTEL dataset

At present, there are more than 700 SNOTEL sites typically located in the mountainous regions of the Western U.S. that report daily and/or hourly precipitation, air temperture, snow water equivalent and snow depth data.

US Department of Commerce
National Oceanic and Atmospheric Administration

National Weather Service
Office of Hydrologic Development
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

East Mesa Total NOAA Atlas
14 Depths (in)

100-yr, 24-hr depth =	3.86
10-yr, 24-hr depth =	2.50
2-yr, 24-hr depth =	1.64

Tabulation of the rainfall power curves for NM type IIa storms			Type II-75 y=0.75 * x^0.090521	
	hours	time	inches	rainfall
n	x	delta x	y	delta y
1	0.00		0.000	
2	0.25	0.250	0.662	0.662
3	0.50	0.250	0.704	0.043
4	0.75	0.250	0.731	0.026
5	1.00	0.250	0.750	0.019
6	1.25	0.250	0.765	0.015
7	1.50	0.250	0.778	0.013
8	1.75	0.250	0.789	0.011
9	2.00	0.250	0.799	0.010
10	2.50	0.500	0.815	0.016
11	3.00	0.500	0.828	0.014
12	3.50	0.500	0.840	0.012
13	4.00	0.500	0.850	0.010
14	5.00	1.000	0.868	0.017
15	6.00	1.000	0.882	0.014
16	7.00	1.000	0.894	0.012
17	8.00	1.000	0.905	0.011
18	9.00	1.000	0.915	0.010
19	10.00	1.000	0.924	0.009
20	11.00	1.000	0.932	0.008
21	12.00	1.000	0.939	0.007
22	14.00	2.000	0.952	0.013
23	16.00	2.000	0.964	0.012
24	18.00	2.000	0.974	0.010
25	20.00	2.000	0.984	0.009
26	22.00	2.000	0.992	0.009
27	24.00	2.000	1.000	0.008

100 Yr
Type II-75

y=0.75 * x^0.090521	
inches	rainfall
y	delta y
0	
2.55358	2.554
2.718936	0.165
2.820584	0.102
2.895	0.074
2.954071	0.059
3.00323	0.049
3.04543	0.042
3.082465	0.037
3.145361	0.063
3.197703	0.052
3.242636	0.045
3.282068	0.039
3.349038	0.067
3.404769	0.056
3.452611	0.048
3.494598	0.042
3.532056	0.037
3.565903	0.034
3.596802	0.031
3.625243	0.028
3.676184	0.051
3.720889	0.045
3.760773	0.040
3.796812	0.036
3.829711	0.033
3.859994	0.030

10 Yr
Type II-75

y=0.75 * x^0.090521	
inches	rainfall
y	delta y
0	
1.653873	1.654
1.760969	0.107
1.826803	0.066
1.875	0.048
1.913259	0.038
1.945097	0.032
1.972429	0.027
1.996415	0.024
2.037151	0.041
2.071051	0.034
2.100153	0.029
2.125692	0.026
2.169066	0.043
2.205161	0.036
2.236147	0.031
2.26334	0.027
2.287601	0.024
2.309523	0.022
2.329535	0.020
2.347955	0.018
2.380948	0.033
2.409902	0.029
2.435734	0.026
2.459075	0.023
2.480383	0.021
2.499996	0.020

NRCS-NM Type II Rainfall Distrbutions

Rearranged	delta x	Accum x	delta y	II-75	Type II
		0.00		0.0000	0.0000
19	1.00	1.00	0.0080	0.0080	0.0105
17	1.00	2.00	0.0097	0.0177	0.0220
15	1.00	3.00	0.0124	0.0301	0.0345
13	1.00	4.00	0.0173	0.0475	0.0480
11	0.50	4.50	0.0116	0.0591	0.0553
9	0.50	5.00	0.0163	0.0754	0.0630
7	0.25	5.25	0.0109	0.0863	0.0670
5	0.25	5.50	0.0153	0.1016	0.0712
3	0.25	5.75	0.0263	0.1280	0.0756
1	0.25	6.00	0.6615	0.7895	0.0800
2	0.25	6.25	0.0428	0.8323	0.0846
4	0.25	6.50	0.0193	0.8516	0.0892
6	0.25	6.75	0.0127	0.8644	0.0940
8	0.25	7.00	0.0096	0.8740	0.0990
10	0.50	7.50	0.0136	0.8875	0.1093
12	0.50	8.00	0.0102	0.8977	0.1200
14	1.00	9.00	0.0144	0.9122	0.1470
16	1.00	10.00	0.0109	0.9230	0.1810
18	1.00	11.00	0.0088	0.9318	0.2350
20	1.00	12.00	0.0074	0.9392	0.6630
21	2.00	14.00	0.0132	0.9524	0.8200
22	2.00	16.00	0.0116	0.9640	0.8800
23	2.00	18.00	0.0103	0.9743	0.9210
24	2.00	20.00	0.0093	0.9836	0.9520
25	2.00	22.00	0.0085	0.9922	0.9770
26	2.00	24.00	0.0078	1.0000	1.0000

delta y	II-75	Step (hr)
	0	0
0.030898	0.030898	1
0.037458	0.068356	2
0.047843	0.116199	3
0.066969	0.183168	4
0.044933	0.228101	4.5
0.062896	0.290998	5
0.0422	0.333198	5.25
0.059071	0.392269	5.5
0.101647	0.493917	5.75
2.55358	3.047497	6
0.165356	3.212853	6.25
0.074416	3.287269	6.5
0.049158	3.336428	6.75
0.037035	3.373462	7
0.052342	3.425804	7.5
0.039433	3.465237	8
0.055731	3.520968	9
0.041986	3.562954	10
0.033848	3.596802	11
0.028442	3.625243	12
0.050941	3.676184	14
0.044705	3.720889	16
0.039884	3.760773	18
0.036039	3.796812	20
0.032899	3.829711	22
0.030283	3.859994	24

delta y	II-75	Step (hr)
	0	0
0.020012	0.020012	1
0.02426	0.044272	2
0.030986	0.075258	3
0.043374	0.118632	4
0.029102	0.147734	4.5
0.040736	0.18847	5
0.027332	0.215802	5.25
0.038259	0.25406	5.5
0.065834	0.319894	5.75
1.653873	1.973767	6
0.107096	2.080863	6.25
0.048197	2.12906	6.5
0.031838	2.160899	6.75
0.023986	2.184885	7
0.0339	2.218785	7.5
0.025539	2.244324	8
0.036095	2.280419	9
0.027193	2.307613	10
0.021922	2.329535	11
0.018421	2.347955	12
0.032993	2.380948	14
0.028954	2.409902	16
0.025831	2.435734	18
0.023342	2.459075	20
0.021308	2.480383	22
0.019614	2.499996	24

delta y	II-75	Accum x
0	0	0
0.030898	0.030898	1
0.037458	0.068356	2
0.047843	0.116199	3
0.066969	0.183168	4
0.044933	0.228101	4.5
0.062896	0.290998	5
0.0422	0.333198	5.25
0.059071	0.392269	5.5
0.101647	0.493917	5.75
2.55358	3.047497	6
0.165356	3.212853	6.25
0.074416	3.287269	6.5
0.049158	3.336428	6.75
0.037035	3.373462	7
0.052342	3.425804	7.5
0.039433	3.465237	8
0.055731	3.520968	9
0.041986	3.562954	10
0.033848	3.596802	11
0.028442	3.625243	12
0.050941	3.676184	14
0.044705	3.720889	16
0.039884	3.760773	18
0.036039	3.796812	20
0.032899	3.829711	22
0.030283	3.859994	24

100-Year Rainfall Distribution
East Mesa DMP

Duration (hr)	Cumulative Depth (inch)	Incremental Depth (inch)
0	0	0
0.25	0.007725	0.007725
0.5	0.015449	0.007725
0.75	0.023174	0.007725
1	0.030898	0.007725
1.25	0.040263	0.009365
1.5	0.049627	0.009365
1.75	0.058992	0.009365
2	0.068356	0.009365
2.25	0.080317	0.011961
2.5	0.092278	0.011961
2.75	0.104238	0.011961
3	0.116199	0.011961
3.25	0.132941	0.016742
3.5	0.149684	0.016742
3.75	0.166426	0.016742
4	0.183168	0.016742
4.25	0.205635	0.022467
4.5	0.228101	0.022467
4.75	0.250568	0.022467
5	0.290998	0.040430
5.25	0.333198	0.042200
5.5	0.392269	0.059071
5.75	0.493917	0.101647
6	3.047497	2.553580
6.25	3.212853	0.165356
6.5	3.287269	0.074416
6.75	3.336428	0.049158
7	3.373462	0.037035
7.25	3.399633	0.026171
7.5	3.425804	0.026171
7.75	3.445520	0.019716
8	3.465237	0.019716
8.25	3.479169	0.013933
8.5	3.493102	0.013933
8.75	3.507035	0.013933
9	3.520968	0.013933
9.25	3.531464	0.010497
9.5	3.541961	0.010497
9.75	3.552457	0.010497
10	3.562954	0.010497
10.25	3.571416	0.008462
10.5	3.579878	0.008462
10.75	3.588340	0.008462
11	3.596802	0.008462
11.25	3.603912	0.007110
11.5	3.611022	0.007110
11.75	3.618133	0.007110
12	3.625243	0.007110
12.25	3.631611	0.006368

Duration (hr)	Cumulative Depth (inch)	Incremental Depth (inch)
12.5	3.637978	0.006368
12.75	3.644346	0.006368
13	3.650713	0.006368
13.25	3.657081	0.006368
13.5	3.663449	0.006368
13.75	3.669816	0.006368
14	3.676184	0.006368
14.25	3.681772	0.005588
14.5	3.687360	0.005588
14.75	3.692948	0.005588
15	3.698536	0.005588
15.25	3.704125	0.005588
15.5	3.709713	0.005588
15.75	3.715301	0.005588
16	3.720889	0.005588
16.25	3.725874	0.004985
16.5	3.730860	0.004985
16.75	3.735845	0.004985
17	3.740831	0.004985
17.25	3.745816	0.004985
17.5	3.750802	0.004985
17.75	3.755787	0.004985
18	3.760773	0.004985
18.25	3.765278	0.004505
18.5	3.769783	0.004505
18.75	3.774287	0.004505
19	3.778792	0.004505
19.25	3.783297	0.004505
19.5	3.787802	0.004505
19.75	3.792307	0.004505
20	3.796812	0.004505
20.25	3.800924	0.004112
20.5	3.805037	0.004112
20.75	3.809149	0.004112
21	3.813262	0.004112
21.25	3.817374	0.004112
21.5	3.821486	0.004112
21.75	3.825599	0.004112
22	3.829711	0.004112
22.25	3.833496	0.003785
22.5	3.837282	0.003785
22.75	3.841067	0.003785
23	3.844853	0.003785
23.25	3.848638	0.003785
23.5	3.852424	0.003785
23.75	3.856209	0.003785
24	3.859994	0.003785

delta y	II-75	Accum x
0	0	0
0.030898	0.020012	1
0.037458	0.044272	2
0.047843	0.075258	3
0.066969	0.118632	4
0.044933	0.147734	4.5
0.062896	0.18847	5
0.0422	0.215802	5.25
0.059071	0.25406	5.5
0.101647	0.319894	5.75
2.55358	1.973767	6
0.165356	2.080863	6.25
0.074416	2.12906	6.5
0.049158	2.160899	6.75
0.037035	2.184885	7
0.052342	2.218785	7.5
0.039433	2.244324	8
0.055731	2.280419	9
0.041986	2.307613	10
0.033848	2.329535	11
0.028442	2.347955	12
0.050941	2.380948	14
0.044705	2.409902	16
0.039884	2.435734	18
0.036039	2.459075	20
0.032899	2.480383	22
0.030283	2.499996	24

10-Year Rainfall Distribution
East Mesa DMP

Duration (hr)	Cummulative Depth (inch)	Incremental Depth (inch)
0	0	0
0.25	0.005003	0.005003
0.5	0.010006	0.005003
0.75	0.015009	0.005003
1	0.020012	0.005003
1.25	0.026077	0.006065
1.5	0.032142	0.006065
1.75	0.038207	0.006065
2	0.044272	0.006065
2.25	0.052019	0.007747
2.5	0.059765	0.007747
2.75	0.067512	0.007747
3	0.075258	0.007747
3.25	0.086102	0.010843
3.5	0.096945	0.010843
3.75	0.107789	0.010843
4	0.118632	0.010843
4.25	0.133183	0.014551
4.5	0.147734	0.014551
4.75	0.162285	0.014551
5	0.188470	0.026185
5.25	0.215802	0.027332
5.5	0.254060	0.038259
5.75	0.319894	0.065834
6	1.973767	1.653873
6.25	2.080863	0.107096
6.5	2.129060	0.048197
6.75	2.160899	0.031838
7	2.184885	0.023986
7.25	2.201835	0.016950
7.5	2.218785	0.016950
7.75	2.231555	0.012770
8	2.244324	0.012770
8.25	2.253348	0.009024
8.5	2.262372	0.009024
8.75	2.271396	0.009024
9	2.280419	0.009024
9.25	2.287218	0.006798
9.5	2.294016	0.006798
9.75	2.300814	0.006798
10	2.307613	0.006798
10.25	2.313093	0.005480
10.5	2.318574	0.005480
10.75	2.324054	0.005480
11	2.329535	0.005480
11.25	2.334140	0.004605
11.5	2.338745	0.004605
11.75	2.343350	0.004605
12	2.347955	0.004605
12.25	2.352079	0.004124

Duration (hr)	Cummulative Depth (inch)	Incremental Depth (inch)
12.5	2.356204	0.004124
12.75	2.360328	0.004124
13	2.364452	0.004124
13.25	2.368576	0.004124
13.5	2.372700	0.004124
13.75	2.376824	0.004124
14	2.380948	0.004124
14.25	2.384567	0.003619
14.5	2.388187	0.003619
14.75	2.391806	0.003619
15	2.395425	0.003619
15.25	2.399044	0.003619
15.5	2.402664	0.003619
15.75	2.406283	0.003619
16	2.409902	0.003619
16.25	2.413131	0.003229
16.5	2.416360	0.003229
16.75	2.419589	0.003229
17	2.422818	0.003229
17.25	2.426047	0.003229
17.5	2.429276	0.003229
17.75	2.432505	0.003229
18	2.435734	0.003229
18.25	2.438651	0.002918
18.5	2.441569	0.002918
18.75	2.444487	0.002918
19	2.447404	0.002918
19.25	2.450322	0.002918
19.5	2.453240	0.002918
19.75	2.456157	0.002918
20	2.459075	0.002918
20.25	2.461739	0.002663
20.5	2.464402	0.002663
20.75	2.467066	0.002663
21	2.469729	0.002663
21.25	2.472392	0.002663
21.5	2.475056	0.002663
21.75	2.477719	0.002663
22	2.480383	0.002663
22.25	2.482835	0.002452
22.5	2.485286	0.002452
22.75	2.487738	0.002452
23	2.490190	0.002452
23.25	2.492641	0.002452
23.5	2.495093	0.002452
23.75	2.497545	0.002452
24	2.499996	0.002452

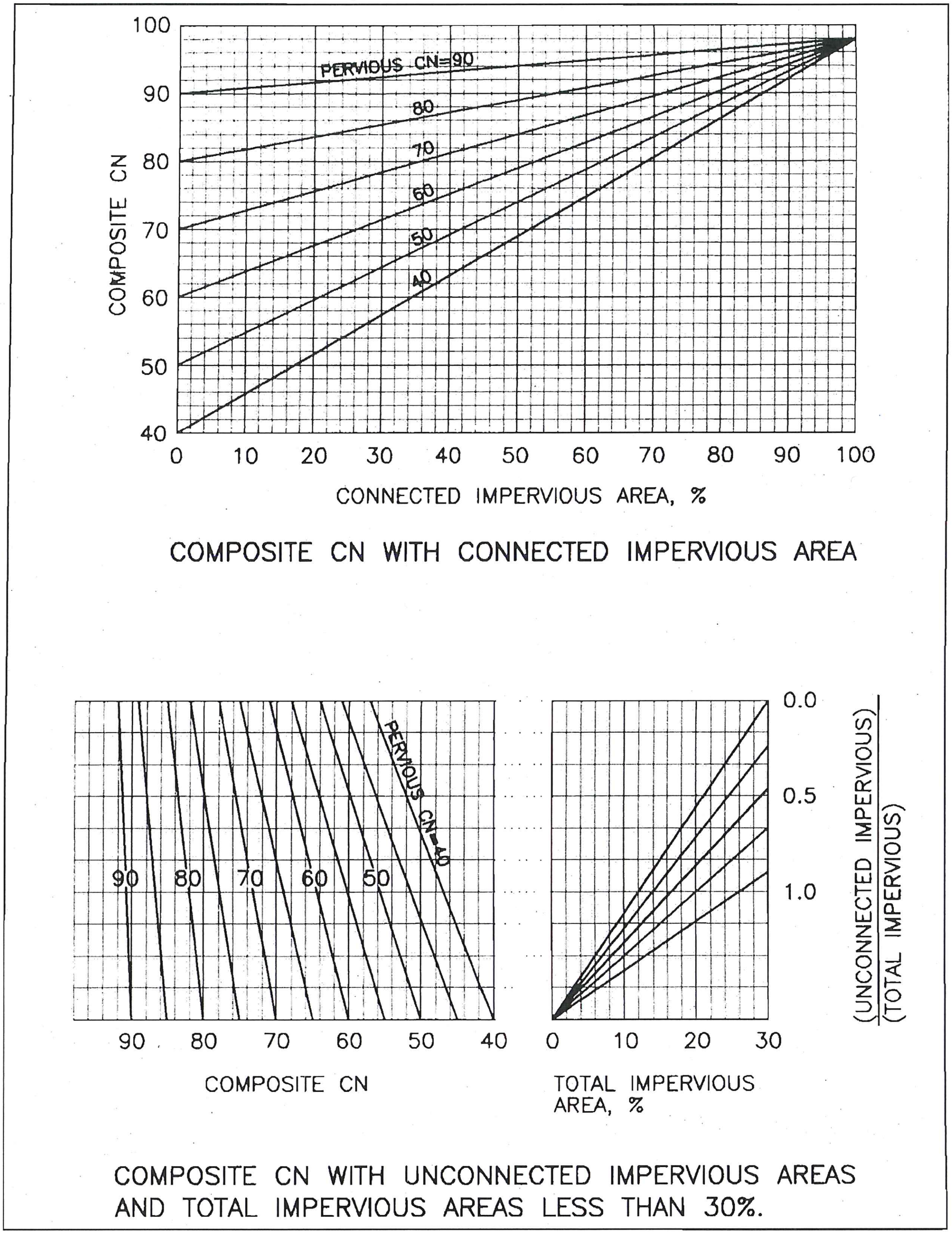


Figure 3-9
Composite CN for Urban Areas with Connected and Unconnected Impervious Areas

Adapted from SCS, TR-55, 1986

Table 3–5 — Conversion from Average Antecedent Moisture Conditions to Dry and Wet Conditions
Source: USDA SCS, TR–55, 1986

CN for Average Conditions	Corresponding CN's for	
	Dry	Wet
100	100	100
95	87	98
90	78	96
85	70	94
80	63	91
75	57	88
70	51	85
65	45	82
60	40	78
55	35	74
50	31	70
45	26	65
40	22	60
35	18	55
30	15	50
25	12	43
15	6	30
5	2	13

Table 4.3. Maximum Allowable Manhole Spacing

Pipe Diameter	Maximum Allowable Spacing Between Manholes
24" – 36"	400'
42" – 60"	500'
Greater than 60"	750'

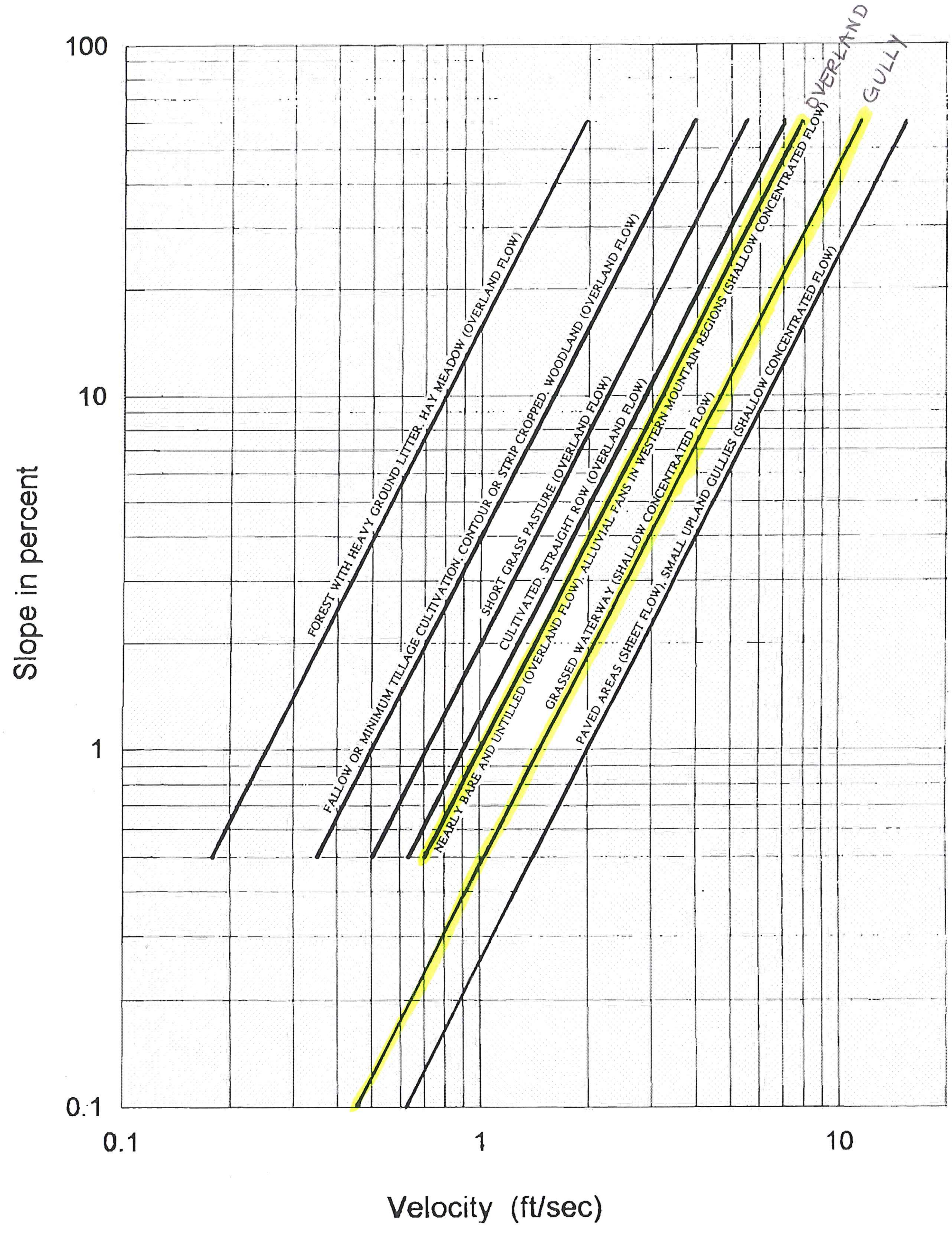
Note: Additional manholes will be required with a change in vertical or horizontal deflection greater than the manufacturer's installation specifications.

6. Calculation Flow Capacities in Drainage Conduits. The capacities of conduits shall be computed using Manning's formula with flow nomographs, recognized accepted standards or computer analysis. The value of the roughness coefficient (n) to be used shall not be less than those specified in Table 4.4. Included in the table are roughness coefficients that can be used in open channel flow calculations. The average full-flow velocity in conduits shall not be less than two-feet per second (2 fps).

Table 4.4. Values for n for the Manning Formula

	Flow Condition	Roughness Coefficient (n)
Conduits	Plastic Pipe, PVC, HDPE	0.009
	Smooth Metal	0.010
	Ordinary Concrete	0.013
	Concrete Pipe	0.015
	Corrugated Metal Pipe	0.023
Natural Channels	Clean, straight, no pools	0.029
	As above with weeds & stones	0.035
	Winding, pools and shallows, clean	0.039
	Very weedy	0.040
Lined Channels	Smooth finish	0.015
	Unfinished	0.017
	Brick, Dressed Stone	0.016
	Smooth Earth	0.018
	Firm Gravel	0.020
	Mortared stone	0.020
	Dry rubble or rip-rap	0.033
	Rough asphalt	0.016
	Smooth asphalt	0.013

7. Storm Drainage Inlets. Storm drainage inlets may be a combination curb/gutter or curb opening inlet or off-road sump inlet. Combination curb/gutter inlets or off road sump inlets shall be used at all points where ponding or sump conditions exist. The theoretical capacity and spacing of storm inlets will be analyzed using the criteria outlined in these Standards. The allowable capacity will be determined using the reduction factors listed in Table 4.5. These reduction factors compensate for debris plugging, pavement overlaying, variations in design assumptions and other factors that decrease capacities. The size of outlet pipes from storm water inlets shall be based upon the theoretical capacity on the inlet, but in no case shall pipes be smaller than twenty-four inches (24") in diameter.



Note: For watercourses with slopes less than 0.5 percent, use the overland flow velocity given for 0.5 percent, except for shallow concentrated flow where a flatter slope may be considered.

Figure 3–10
Flow Velocities for Overland and Shallow Concentrated Flows

Modified from SCS, NEH–4, 1972

Clark & Brown

Basin Name	Overland Slope (%)	Gully Slope (%)	Arroyo Slope (%)	Channel Length (ft)	Overland Length (ft)	Gully Length (ft)	Arroyo Length (ft)	Overland Velocity (ft/sec)	Gully Velocity (ft/sec)	Overland T_C (min)	Shallow T_C (min)	Arroyo T_C (min)	Total T_C (min)	Adjusted T_C (min)	Lag Time (min)
CB-1	36.80%	36.80%	6.70%	14200	400	1500	12300	6.0	8.4	1.11	2.98	31.14	35.22	35.22	21.10
CB-2	33.00%	33.00%	4.50%	12000	400	100	11500	5.9	8.3	1.13	0.20	34.46	35.79	35.79	21.50
CB-3	4.50%	4.50%	3.30%	5700	400	600	4700	2.2	3.1	3.03	3.23	19.50	25.75	25.75	15.50
CB-4	3.50%	3.50%	2.20%	19000	400	1300	17300	1.9	2.8	3.51	7.74	62.17	73.41	73.41	44.00
CB-5	25.00%	25.00%	4.40%	14100	400	600	13100	5.0	7.4	1.33	1.35	38.48	41.16	41.16	24.70
CB-6	2.90%	2.90%	2.10%	17000	400	2200	14400	1.8	2.4	3.70	15.28	54.95	73.93	73.93	44.40
CB-7	15.80%	15.80%	3.40%	6850	400	520	5930	3.9	5.9	1.71	1.47	23.05	26.23	26.23	15.70
CB-8	21.80%	21.80%	4.00%	15000	400	2680	11920	4.9	6.9	1.36	6.47	36.96	44.80	44.80	26.90
CB-9	3.60%	3.60%	2.40%	9000	400	1000	7600	1.9	2.8	3.51	5.95	31.91	41.37	41.37	24.80
CB-10	1.90%	1.90%	0.00%	7900	400	7500	0	1.4	2.0	4.76	62.50	0.00	67.26	67.26	40.40
CB-11	1.70%	1.70%	0.00%	7600	400	7200	0	1.3	1.9	5.13	63.16	0.00	68.29	68.29	41.00
CB-12	0.90%	0.90%	0.00%	25000	400	20200	0	1.0	1.5	6.67	224.44	0.00	377.78	377.78	226.70
CB-13	3.50%	3.50%	2.10%	19330	400	3300	15630	1.9	2.8	3.51	19.64	58.42	81.58	81.58	48.90

Waterfall

Basin Name	Overland Slope (%)	Gully Slope (%)	Arroyo Slope (%)	Channel Length (ft)	Overland Length (ft)	Gully Length (ft)	Arroyo Length (ft)	Overland Velocity (ft/sec)	Gully Velocity (ft/sec)	Overland T_C (min)	Shallow T_C (min)	Arroyo T_C (min)	Total T_C (min)	Adjusted T_C (min)	Lag Time (min)
MH-1	65.40%	9.33%	9.30%	18675	400	2200	16075	8.2	10.3	0.81	3.56	33.68	37.80	38.06	22.83
MH-2	70.80%	13.24%	51.21%	23190	400	21390	1400	9.0	5.1	0.74	69.90	2.67	100.25	100.25	60.15
MH-3	137.00%	23.13%	5.60%	14500	400	4800	9300	8.0	7.0	0.83	11.43	26.94	39.00	39.20	23.52
MH-4	11.70%	2.03%	2.00%	22750	400	5600	16750	3.3	4.9	2.02	19.05	62.55	83.40	83.61	50.17
MH-5	3.90%	1.80%	1.80%	16530	400	2600	13530	2.0	2.8	3.33	15.48	55.58	74.40	74.39	44.63
WF-1	1.20%	0.39%	0.00%	12000	400	11600	0	1.1	1.6	6.06	120.83	0.00	126.60	126.89	76.14
WF-2	1.10%	1.42%	1.40%	13350	400	3100	9850	1.0	1.5	6.67	34.44	47.69	88.80	88.80	53.28
W250	1.50%	1.18%	1.20%	16000	400	1300	14300	1.2	1.9	5.56	11.40	68.24	85.20	85.20	51.12

EM Overland

Basin Name	Overland Slope (%)	Gully Slope (%)	Arroyo Slope (%)	Channel Length (ft)	Overland Length (ft)	Gully Length (ft)	Arroyo Length (ft)	Overland Velocity (ft/sec)	Gully Velocity (ft/sec)	Overland T_C (min)	Shallow T_C (min)	Arroyo T_C (min)	Total T_C (min)	Adjusted T_C (min)	Lag Time (min)
AR-1	2.74%	2.74%	0.00%	15000	400	7700	6900	1.8	2.3	3.70	55.80	-	0.00	0.00	0.00
AR-1A	5.00%	3.74%	2.18%	8600	400	1952	6248	2.4	2.9	2.78	11.22	28.50	42.49	42.49	25.50
AR-1B	2.00%	1.57%	1.38%	6400	400	5348	652	1.5	1.9	4.44	46.91	5.96	57.32	57.32	34.40
AR-2	2.28%	2.28%	0.00%	26875	400	14600	0	1.5	2.2	4.44	110.61	0.00	115.05	115.05	69.00
AR-2A	3.75%	2.79%	0.00%	6500	400	6100	0	2.0	2.5	3.33	40.67	0.00	44.00	44.00	26.40
AR-2B	2.25%	1.49%	0.00%	14400	400	14000	0	1.7	1.8	3.92	129.63	0.00	133.55	133.55	80.10
AR-2C	1.00%	0.96%	0.00%	6100	400	5700	0	1.0	1.6	6.67	59.38	0.00	66.04	66.04	39.60
AR-3	1.32%	1.32%	0.00%	20000	400	19600	0	1.1	1.7	6.06	192.16	0.00	198.22	198.22	118.90
AR-3A	8.00%	1.44%	0.00%	4600	400	4200	0	1.5	2.0	4.44	35.00	0.00	39.44	39.44	23.70
AR-3B	1.25%	1.17%	0.00%	5600	400	5200	0	1.3	1.7	5.13	50.98	0.00	56.11	56.11	33.70
AR-3C	1.00%	1.02%	0.00%	4700	400	4300	0	1.0	1.6	6.67	44.79	0.00	51.46	51.46	30.90

Basin Name	Overland Slope (%)	Gully Slope (%)	Arroyo Slope (%)	Channel Length (ft)	Overland Length (ft)	Gully Length (ft)	Arroyo Length (ft)	Overland Velocity (ft/sec)	Gully Velocity (ft/sec)	Overland T_C (min)	Shallow T_C (min)	Arroyo T_C (min)	Total T_C (min)	Adjusted T_C (min)	Lag Time (min)
AR-3D	7.80%	1.40%	0.00%	9790	400	9390	0	2.0	2.5	3.33	62.60	0.00	65.93	65.93	39.60
AR-4	1.57%	1.57%	0.00%	7400	400	7000	0	1.2	1.9	5.56	61.40	0.00	66.96	66.96	40.20
AR-4A	1.75%	1.59%	0.00%	4250	400	3850	0	1.5	1.8	4.44	35.65	0.00	40.09	40.09	24.10
AR-4B	1.71%	1.44%	0.00%	3340	400	2940	0	1.4	2.3	4.76	21.30	0.00	26.07	26.07	15.60
AR-5	0.77%	0.77%	0.00%	17800	400	17400	0	0.9	1.2	7.41	241.67	0.00	249.07	249.07	149.40
AR-5A	1.20%	0.87%	0.00%	11200	400	10800	0	1.2	1.5	5.56	120.00	0.00	125.56	125.56	75.30
AR-5B	0.59%	0.59%	0.00%	6500	400	6100	0	0.6	1.1	11.11	92.42	0.00	103.54	103.54	62.10
EC-1	2.02%	2.02%	0.00%	8930	400	8530	0	1.4	2.0	4.76	71.08	0.00	75.85	75.85	45.50
EC-2	2.01%	2.01%	0.00%	9000	400	8600	0	1.4	2.0	4.76	71.67	0.00	76.43	76.43	45.90
EC-3	1.82%	1.82%	0.00%	4060	400	3660	0	1.3	1.9	5.13	32.11	0.00	37.23	37.23	22.30
EC-4	1.45%	1.45%	0.00%	17300	400	16900	0	1.1	1.7	6.06	165.69	0.00	171.75	171.75	103.00
EC-5	1.17%	1.17%	0.00%	14500	400	14100	0	1.1	1.7	6.06	138.24	0.00	144.30	144.30	86.60
EC-5A	1.75%	1.57%	0.00%	1670	400	1270	0	1.4	1.9	4.76	11.14	0.00	15.90	15.90	9.50
EC-5B	1.50%	1.07%	0.00%	12900	400	12500	0	1.3	1.6	5.13	130.21	0.00	135.34	135.34	81.20
EC-6	0.91%	0.91%	0.00%	8250	400	7850	0	1.0	1.4	6.67	93.45	0.00	100.12	100.12	60.10
EC-7	0.62%	0.62%	0.00%	12250	400	11850	0	0.8	1.2	8.33	164.58	0.00	172.92	172.92	103.80
EC-7A	0.91%	0.73%	0.00%	3415	400	3015	0	0.9	1.3	7.41	38.65	0.00	46.06	46.06	27.60
EC-7B	0.71%	0.77%	0.00%	7734	400	7334	0	0.8	1.5	8.33	81.49	0.00	89.82	89.82	53.90
EC-8	1.62%	1.62%	0.00%	18800	400	18400	0	1.2	1.9	5.56	161.40	0.00	166.96	166.96	100.20
EC-9	1.76%	1.76%	0.00%	16300	400	15900	0	1.3	1.9	5.13	139.47	0.00	144.60	144.60	86.80
EC-10	1.07%	1.07%	0.00%	13400	400	13000	0	1.0	1.5	6.67	144.44	0.00	151.11	151.11	90.70
EC-11	0.83%	0.83%	0.00%	6050	400	5650	0	0.9	1.2	7.41	78.47	0.00	85.88	85.88	51.50
EC-11A	1.35%	0.80%	0.00%	4630	400	4230	0	1.2	1.4	5.56	50.36	0.00	55.91	55.91	33.50
EC-11B	1.05%	0.92%	0.00%	2500	400	2100	0	1.0	1.4	6.67	25.00	0.00	31.67	31.67	19.00
EC-11C	0.85%	0.72%	0.00%	1430	400	1030	0	0.9	1.3	7.41	13.21	0.00	20.61	20.61	12.40
EC-12	0.90%	0.90%	0.00%	3050	400	2650	0	1.0	1.4	7.02	31.55	0.00	38.57	38.57	23.10
EC-13	0.86%	0.86%	0.00%	8100	400	7700	0	1.0	1.4	6.67	91.67	0.00	98.33	98.33	59.00
EC-13A	0.70%	0.87%	0.00%	8100	400	7700	0	1.0	1.4	6.67	91.67	0.00	98.33	98.33	59.00
EC-13B	0.78%	1.08%	0.00%	1309	400	909	0	0.8	1.6	8.33	9.47	0.00	17.80	17.80	10.70
EC-14	0.66%	0.66%	0.00%	9100	400	8700	0	0.6	0.9	10.42	161.11	0.00	171.53	171.53	102.90
EC-15	0.80%	0.80%	0.00%	7350	400	6950	0	0.9	1.4	7.41	82.74	0.00	90.15	90.15	54.10
EC-15A	0.44%	0.79%	0.00%	1551	400	1151	0	0.5	1.4	13.33	13.70	0.00	27.04	27.04	16.20
EC-15B	0.67%	0.60%	0.00%	11700	400	11300	0	0.7	1.2	9.52	156.94	0.00	166.47	166.47	99.90
EC-16	0.62%	0.62%	0.00%	8400	400	8000	0	0.8	1.2	8.33	111.11	0.00	119.44	119.44	71.70
PT-1	1.10%	1.10%	0.00%	13400	400	13000	0	1.0	1.5	6.67	144.44	0.00	151.11	151.11	90.70
PT-1A	1.50%	1.11%	0.00%	8340	400	7940	0	1.3	1.6	5.13	82.71	0.00	87.84	87.84	52.70
PT-1B	2.50%	0.97%	0.00%	9170	400	8770	0	1.7	1.6	3.92	91.35	0.00	95.28	95.28	57.20
PT-2	1.05%	1.05%	0.00%	6100	400	5700	0	1.0	1.5	6.67	63.33	0.00	70.00	70.00	42.00
PT-3	0.93%	0.93%	0.00%	10400	400	10000	0	1.0	1.4	6.67	119.05	0.00	125.71	125.71	75.40
PT-4	0.92%	0.92%	0.00%	11900	400	11500	0	1.0	1.4	6.67	136.90	0.00	143.57	143.57	86.10
PT-4A	1.75%	0.93%	0.00%	10430	400	10030	0	1.4	2.0	4.76	83.58	0.00	88.35	88.35	53.00
PT-4B	1.00%	0.63%	0.00%	1360	400	960	0	1.0	1.3	6.67	12.31	0.00	18.97	18.97	11.40
PT-5	0.78%	0.78%	0.00%	5500	400	5100	0	0.9	1.2	7.41	70.83	0.00	78.24	78.24	46.90
PT-5A	1.00%	0.83%	0.00%	4150	400	3750	0	1.0	1.4	6.67	44.64	0.00	51.31	51.31	30.80
PT-5B	1.00%	0.34%	0.00%	1270	400	870	0	1.0	0.8	6.67	18.13	0.00	24.79	24.79	14.90
PT-6	0.69%	0.69%	0.00%	8000	400	7600	0	0.9	1.2	7.84	105.56	0.00	113.40	113.40	68.00

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PT-7	0.65%	0.65%	0.00%	11300	400	10900	0	0.8	1.0	8.33	181.67	0.00	190.00	190.00	114.00
PT-8	0.71%	0.71%	0.00%	8400	400	8000	0	0.9	1.2	7.41	111.11	0.00	118.52	118.52	71.10
PT-9	0.73%	0.73%	0.00%	5750	400	5350	0	0.9	1.2	7.41	74.31	0.00	81.71	81.71	49.00
PT-10	0.74%	0.74%	0.00%	11800	400	11400	0	0.9	1.2	7.41	158.33	0.00	165.74	165.74	99.40
PT-10A	1.00%	0.81%	0.00%	4720	400	4320	0	1.0	1.4	6.67	51.43	0.00	58.10	58.10	34.90
PT-10B	1.00%	0.69%	0.00%	7070	400	6670	0	1.0	1.4	6.67	79.40	0.00	86.07	86.07	51.60
PT-11	0.48%	0.48%	0.00%	10200	400	9800	0	0.7	1.0	9.52	163.33	0.00	172.86	172.86	103.70
PT-12	0.71%	0.71%	0.00%	11400	400	11000	0	0.9	1.2	7.41	152.78	0.00	160.19	160.19	96.10
US70-1	16.50%	0.00%	6.70%	6000	400	600	3500	4.0	6.0	1.67	1.67	11.86	23.26	23.26	14.00
US70-2	34.60%	7.68%	7.70%	9268	400	1600	7268	6.0	8.9	1.11	3.00	19.70	23.81	23.81	14.30
US70-3	12.50%	4.44%	4.40%	12500	400	2800	9300	3.5	5.0	1.90	9.33	29.52	40.76	40.76	24.50
US70-4	58.70%	17.33%	6.70%	16000	400	1100	11500	7.8	10.2	0.85	1.80	29.62	40.47	40.47	24.30
US70-5	3.30%	3.30%	0.00%	4280	400	3880	0	1.9	2.8	3.51	23.10	0.00	26.60	26.60	16.00
US70-6	8.30%	3.00%	2.10%	12700	400	3600	2900	2.9	4.3	2.30	13.95	15.89	67.95	67.95	40.80
US70-7	46.00%	11.90%	2.80%	9650	400	850	6650	6.9	9.9	0.97	1.43	27.10	35.33	35.33	21.20
US70-8	41.70%	12.90%	4.20%	21300	400	2600	9300	6.6	9.6	1.01	4.51	30.05	54.60	54.60	32.80
US70-9	6.00%	3.10%	1.60%	12580	400	800	7250	2.5	3.6	2.67	3.70	36.21	68.08	68.08	40.80
US70-9A	6.50%	2.60%	0.00%	10420	400	10020	0	2.4	2.3	2.78	72.61	0.00	75.39	75.39	45.20
US70-9B	2.90%	2.40%	1.80%	3930	400	1625	1905	1.8	2.2	3.70	12.31	12.32	28.34	28.34	17.00
US70-9C	1.70%	1.60%	1.20%	4140	400	1942	1798	1.4	1.8	4.76	17.98	12.27	35.02	35.02	21.00
US70-10	1.70%	1.70%	0.00%	12310	400	11910	0	1.3	1.9	5.13	104.47	0.00	109.60	109.60	65.80
US70-10A	2.30%	2.10%	0.00%	5500	400	5100	0	1.7	2.2	3.92	38.64	0.00	42.56	42.56	25.50
US70-10B	5.70%	1.70%	0.00%	9800	400	9400	0	2.4	1.9	2.78	82.46	0.00	85.23	85.23	51.10
US70-11	1.30%	1.30%	0.00%	4050	400	3650	0	1.1	1.6	6.06	38.02	0.00	44.08	44.08	26.40
US70-12	12.30%	3.70%	1.40%	25000	400	1400	15000	3.5	5.0	1.90	4.67	66.29	72.86	72.86	43.70
US70-12A	9.30%	3.20%	0.00%	13900	400	13500	0	3.0	2.7	2.22	83.33	0.00	85.56	85.56	51.30
US70-12B	2.00%	1.60%	0.00%	14570	400	14170	0	1.4	1.9	4.76	124.30	0.00	129.06	129.06	77.40
US70-12C	1.50%	1.30%	0.00%	6414	400	6014	0	1.1	1.8	6.06	55.69	0.00	61.75	61.75	37.00
US70-12D	2.00%	3.20%	0.00%	3900	400	3500	0	1.4	2.7	4.76	21.60	0.00	26.37	26.37	15.80
US70-12E	2.00%	3.20%	0.00%	6920	400	6880	0	1.4	2.7	0.48	42.47	0.00	42.95	42.95	25.80

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HC-1	58.30%	58.30%	6.50%	18200	400	1400	16400	7.8	10.2	0.85	2.29	39.27	42.41	42.41	25.45
HC-2	3.20%	3.20%	2.60%	5100	400	100	4600	1.8	2.7	3.70	0.62	21.05	25.37	25.37	15.22
HC-3	3.00%	3.00%	2.50%	6700	400	2100	4200	1.8	2.7	3.70	12.96	19.78	36.44	36.44	21.87
HC-4	3.10%	3.10%	2.40%	9100	400	1400	7300	1.8	2.7	3.70	8.64	30.94	43.28	43.28	25.97
HC-5	2.40%	2.40%	2.40%	12000	400	0	11600	1.6	-	4.17	0.00	44.12	48.29	48.29	28.97
HC-6	2.80%	2.80%	1.90%	9630	400	3600	5630	1.7	2.4	3.92	25.00	27.49	56.41	56.41	33.85
HC-7	2.50%	2.50%	2.10%	5750	400	900	4450	1.7	2.3	3.92	6.52	22.21	32.65	32.65	19.59
HC-8	1.70%	1.70%	0.00%	12000	400	11600	0	1.3	1.9	5.13	101.75	0.00	106.88	106.88	64.13
IS-1	0.70%	0.70%	0.00%	16090	400	13350	0	0.8	1.3	8.33	171.15	0.00	179.49	179.49	107.69
IS-1A	1.30%	1.30%	0.00%	6800	400	6400	0	1.3	1.8	5.13	59.26	0.00	64.39	64.90	38.63

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IS-1B	1.10%	1.10%	0.00%	10400	400	10000	0	1.5	1.5	4.44	111.11	0.00	115.56	115.56	69.33
IS-2	0.80%	0.80%	0.00%	15030	400	12090	0	0.9	1.4	7.41	143.93	0.00	151.34	151.34	90.80
IS-3	0.70%	0.70%	0.00%	17980	400	14500	0	0.8	1.3	8.33	185.90	0.00	194.23	194.23	116.54
IS-4	0.80%	0.80%	0.00%	8600	400	8200	0	0.9	1.2	7.41	113.89	0.00	121.30	121.30	72.78
IS-5	0.60%	0.60%	0.00%	6500	400	2800	0	0.8	1.3	8.33	35.90	0.00	44.23	44.23	26.54
IS-6	0.60%	0.60%	0.00%	21450	400	17610	0	0.8	1.3	8.33	225.77	0.00	234.10	234.10	140.46
ON-1	5.40%	5.40%	3.80%	11800	400	4600	6800	2.4	3.4	2.78	22.55	24.52	49.84	49.84	29.90
ON-2	2.80%	2.80%	0.20%	5630	400	4600	630	1.5	2.1	4.44	36.51	13.30	54.26	54.26	32.60
ON-3	4.60%	4.60%	1.90%	4650	400	1600	2650	2.2	3.1	3.03	8.60	15.39	27.02	27.02	16.20
ON-4	3.70%	3.70%	2.30%	5500	400	1600	3500	1.9	2.8	3.51	9.52	18.01	31.04	31.04	18.60
SA-1	5.10%	5.10%	5.10%	19000	400	1300	17300	7.3	10.1	0.91	2.15	45.04	48.10	48.10	28.90
SA-2	4.00%	4.00%	2.80%	5500	400	850	4250	2.0	3.0	3.33	4.72	19.22	27.28	27.28	16.40
SA-3	3.90%	3.90%	2.60%	5500	400	1100	4000	2.0	2.8	3.33	6.55	18.93	28.81	28.81	17.30
SA-4	6.00%	6.00%	3.80%	8800	400	1000	7400	2.5	3.6	2.67	4.63	26.25	33.54	33.54	20.10
SA-5	4.00%	4.00%	2.80%	4250	400	100	3750	2.0	2.8	3.33	0.60	17.50	21.43	21.43	12.90
SA-6	2.80%	2.80%	0.00%	2180	400	1780	0	1.7	2.4	3.92	12.36	0.00	16.28	16.28	9.80
SA-7	3.80%	3.80%	3.80%	5240	400	1100	3740	2.0	2.8	3.33	6.55	15.55	25.43	25.43	15.30
SN-1	48.50%	48.50%	2.70%	18200	400	1900	8200	7.0	10.0	0.95	3.17	32.15	55.68	55.68	33.40
SN-2	3.40%	3.40%	2.80%	5550	400	1900	3250	1.9	2.8	3.51	11.31	15.63	30.45	30.45	18.30
SN-3	3.00%	3.00%	2.20%	13625	400	200	13025	1.8	2.7	3.70	1.23	50.41	55.34	55.34	33.20
SN-4	3.70%	3.70%	2.20%	13200	400	200	12600	1.9	2.8	3.51	1.19	48.62	53.32	53.32	32.00
SN-5	2.10%	2.10%	0.00%	5200	400	4800	0	1.5	2.1	4.44	38.10	0.00	42.54	42.54	25.50
SN-6	1.60%	1.60%	0.00%	10250	400	9850	0	1.2	1.9	5.56	86.40	0.00	91.96	91.96	55.20
SN-7	1.90%	1.90%	0.00%	10250	400	9850	0	1.3	2.0	5.13	82.08	0.00	87.21	87.21	52.30
SN-8	2.10%	2.10%	0.00%	14500	400	14100	0	1.5	2.1	4.44	111.90	0.00	116.35	116.35	69.80
DB-1	2.10%	2.10%	0.00%	8150	400	7750	0	1.5	2.1	4.44	61.51	0.00	65.95	65.95	39.60
DB-2	2.10%	2.10%	0.00%	5900	400	5500	0	1.5	2.1	4.44	43.65	0.00	48.10	48.10	28.90
DB-3	2.10%	2.10%	0.00%	7900	400	7500	0	1.5	2.1	4.44	59.52	0.00	63.97	63.97	38.40
DB-4	2.10%	2.10%	0.00%	8300	400	7900	0	1.5	2.1	4.44	62.70	0.00	67.14	67.14	40.30
DB-5	2.50%	2.50%	0.00%	6600	400	6200	0	1.7	2.3	3.92	44.93	0.00	48.85	48.85	29.30
DB-6	1.90%	1.90%	0.00%	3250	400	2850	0	1.4	2.0	4.76	23.75	0.00	28.51	28.51	17.10
DB-7	1.70%	1.70%	0.00%	14600	400	14200	0	1.3	1.9	5.13	124.56	0.00	129.69	129.69	77.80
DB-7A	1.75%	1.80%	0.00%	6200	400	5800	0	1.4	2.0	4.76	48.33	0.00	53.10	53.10	31.90
DB-7B	1.50%	1.24%	0.00%	7000	400	6600	0	1.3	1.7	5.13	64.71	0.00	69.83	69.83	41.90
DB-8	1.70%	1.70%	0.00%	13200	400	12800	0	1.3	1.9	5.13	112.28	0.00	117.41	117.41	70.40
DB-8A	2.20%	2.20%	0.00%	1897	400	1497	0	1.6	2.1	4.17	11.88	0.00	16.05	16.05	9.60
DB-8B	2.00%	2.00%	1.70%	5961	400	2100	3461	1.5	1.9	4.44	18.42	19.89	42.75	42.75	25.70
DB-8C	2.30%	2.30%	1.30%	9820	400	8920	500	1.7	2.0	3.92	74.33	4.97	83.23	83.23	49.90
OA-1	3.80%	3.80%	3.80%	6950	400	3000	3550	3.8	3.1	1.75	16.13	14.85	32.73	32.73	19.60
OA-2	4.80%	4.80%	4.10%	7535	400	2000	5135	2.3	3.2	2.90	10.42	19.16	32.48	32.48	19.50
OA-3	5.20%	5.20%	4.20%	7674	400	1900	5374	2.4	3.3	2.78	9.60	19.65	32.02	32.02	19.20
OA-4	6.30%	6.30%	2.70%	5200	400	400	4400	2.8	3.5	2.38	1.90	19.99	24.28	24.28	14.60
OA-5	2.90%	2.90%	0.00%	2300	400	1900	0	1.8	2.4	3.70	13.19	0.00	16.90	16.90	10.10

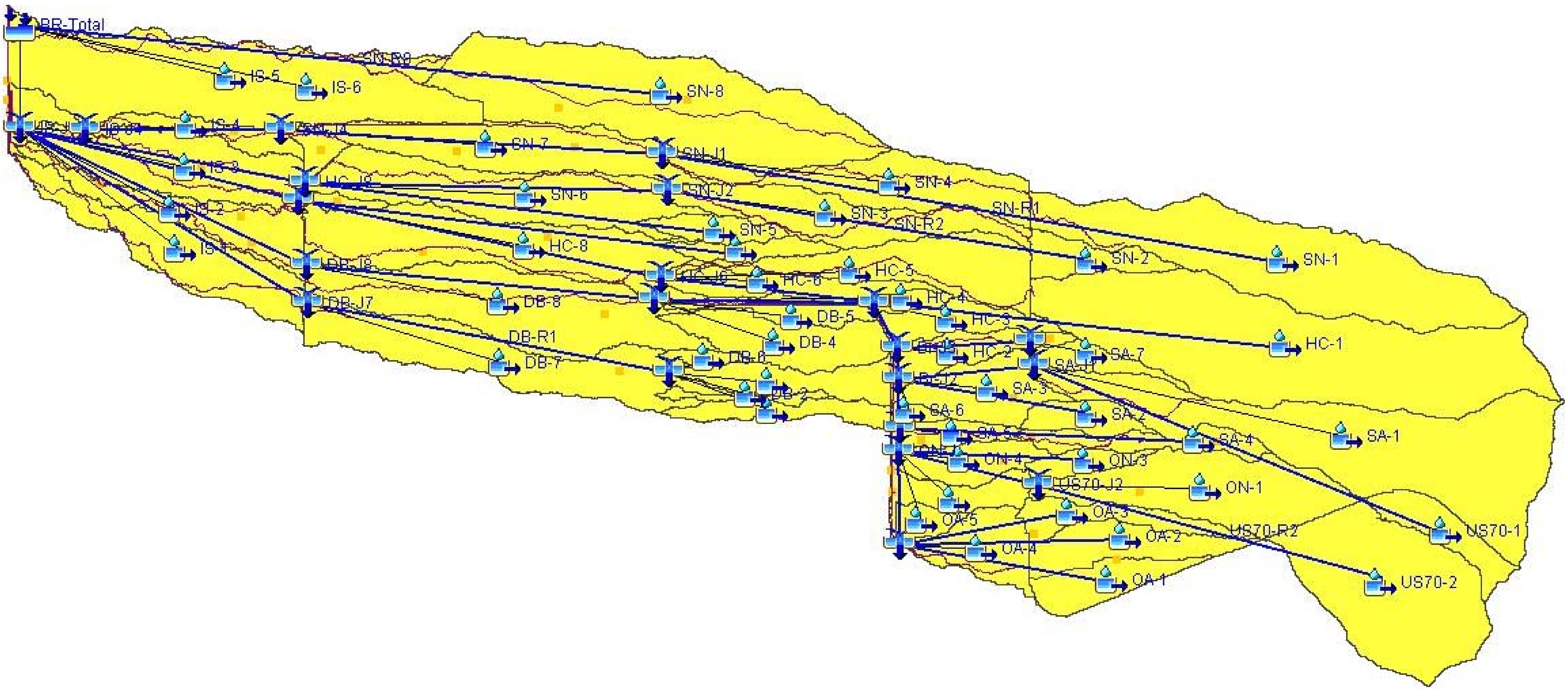
Bulking Factor
Using Mussetter calculation for Ys:

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
				Existing Conditions				Proposed Conditions			Existing Conditions		Proposed Conditions									Existing Conditions		Proposed Conditions		Existing Conditions		Proposed Conditions	
Basin	Area (sq. Mi.)	Area (ac)	Qp 100 yr (cfs)	Vol. 100 yr (ac-ft)	Qp 10 yr (cfs)	Vol. 10 yr (ac-ft)	Qp 100 yr (cfs)	Vol. 100 yr (ac-ft)	Qp 10 yr (cfs)	Vol. 10 yr (ac-ft)	R 100 yr - using alpha=285 and beta=0.56	R 10 yr - using alpha=285 and beta=0.56	R 100 yr - using alpha=285 and beta=0.56	R 10 yr - using alpha=285 and beta=0.56	Ave. OL length (ft)	Ave. OL slope (%)	n	LS	K	C	P	100 yr Ys (tons)	10 yr Ys (tons)	100 yr Ys (tons)	10 yr Ys (tons)	100 yr Bulking Factor	10 yr Bulking Factor	100 yr Bulking Factor	10 yr Bulking Factor
Mine House Arroyo																													
MH-1	1.64	1049.3	1832.2	144.9	725.2	64.6	2115.4	144.9	856.4	64.6	310676	117607	336715	129084	620	24	0.5	14.3	0.05	0.3	1	66711	25254	72303	27718				
MH-2	1.91	1223.2	1360.6	154.8	516	65.9	1590.7	161.7	628.4	70.4	272901	98289	305219	113893	541	8	0.5	2.4	0.05	0.3	1	9858	3550	11025	4114				
MH-3	1.44	922.6	1412.8	116.7	528.4	49.9	1734.5	122	681	53.3	237930	85239	273618	101947	558	12	0.5	4.3	0.05	0.3	1	15288	5477	17581	6550				
MH-4	0.76	488.4	346.9	51.3	117.4	19.8	377.8	51.3	129.3	19.8	68395	21877	71743	23093	779	4	0.4	0.8	0.05	0.3	1	866	277	908	292				
MH-5	0.63	400.7	308.8	42	105.2	16.3	341.7	42	117	16.3	57291	18450	60633	19582	525	2	0.3	0.3	0.05	0.3	1	283	91	299	97				
Total				**509.7**		**216.5**		**521.9**		**224.4**												**93005**	**34649**	**102116**	**38772**	**1.13**	1.12	1.14	1.13
Baylor Arroyo																													
US70-7	0.64	410.9	614.1	47.4	216.4	19.4	962	61.7	405	28.6	90094	30462	134271	53776	553	9	0.5	2.8	0.05	0.3	1	3731	1262	5561	2227				
US70-8	2.60	1665.2	1823.1	192.3	654.2	78.3	2400.4	220.2	945.5	95.9	363017	123637	456858	170229	578	16	0.5	6.9	0.05	0.3	1	37709	12843	47457	17683				
US70-9	0.46	293.3	344.9	42.3	141.4	19.1	0	0	0	0	61193	23794	0	0	723	4	0.4	0.8	0.05	0.3	1	734	285	0	0				
US70-9a	0.21	136.8	0	0	0	0	174	20.5	74.2	9.5	0	0	27806	11215	723	4	0.4	0.8	0.05	0.3	1	0	0	334	135				
US70-9b	0.14	88.3	0	0	0	0	239.5	13.3	102.7	6.2	0	0	26098	10594	723	4	0.4	0.8	0.05	0.3	1	0	0	313	127				
US70-9c	0.11	68.2	0	0	0	0	161.3	10.2	67.6	4.8	0	0	18028	7263	723	4	0.4	0.8	0.05	0.3	1	0	0	216	87				
US70-10	0.72	459.9	309.2	55.6	115.6	23	0	0	0	0	67084	23587	0	0	840	2	0.3	0.4	0.05	0.3	1	433	152	0	0				
US70-10a	0.20	128.4	0	0	0	0	250	18.5	102.6	8.4	0	0	32159	12551	840	2	0.3	0.4	0.05	0.3	1	0	0	207	81				
US70-10b	0.52	331.5	0	0	0	0	362.3	47.8	151.2	21.6	0	0	67360	26466	840	2	0.3	0.4	0.05	0.3	1	0	0	435	171				
US70-11	0.08	49.5	87.3	7.7	37.2	3.7	117.5	8.7	54.1	4.3	10921	4493	13810	6028	760	2	0.3	0.4	0.05	0.3	1	60	25	76	33				
US70-12	1.80	1150.5	744.4	126.7	262.7	50.1	0	0	0	0	174025	57763	0	0	806	4	0.4	1.0	0.05	0.3	1	2567	852	0	0				
US70-12a	0.78	499.0	0	0	0	0	278.5	55	99.2	21.6	0	0	62885	20902	806	4	0.4	1.0	0.05	0.3	1	0	0	927	308				
US70-12b	1.03	657.3	0	0	0	0	369.5	72.4	131.7	28.5	0	0	85934	28611	806	4	0.4	1.0	0.05	0.3	1	0	0	1267	422				
US70-12c	0.19	122.3	0	0	0	0	129.3	13.5	45.4	5.4	0	0	18635	6208	806	4	0.4	1.0	0.05	0.3	1	0	0	275	92				
Total				**472**		**193.6**		**541.8**		**234.8**												**45234**	**15419**	**57069**	**21366**	**1.07**	1.06	1.08	1.07
Blair Arroyo																													
US70-3	0.42	267.1	811.8	62.9	443.2	35.8	619.6	43.5	274.4	20.9	123419	64138	86294	36276	460	13	0.5	4.4	0.1	0.3	1	16344	8494	11428	4804				
US70-4	1.96	1253.1	2282.9	188.2	950.7	87.2	3058	212.3	1386.3	104	406803	161897	512604	220711	520	11	0.5	3.4	0.1	0.3	1	41695	16594	52539	22622				
US70-5	0.06	36.4	81.5	5.5	34.2	2.5	110.2	5.7	47.3	2.7	8704	3441	10514	4309	420	4	0.4	0.6	0.1	0.3	1	160	63	193	79				
US70-6	0.44	283.3	384.6	46.1	169.4	15.1	721.3	73.9	421.2	44	68253	23081	126424	69967	675	8	0.5	2.6	0.1	0.3	1	5271	1782	9763	5403				
Total				**302.7**		**140.6**		**335.4**		**171.6**												**63470**	**26933**	**73923**	**32908**	**1.15**	1.14	1.16	1.14
Organ Arroyo																													
OA-1	0.16	101.6	169.40	12.30	61.80	5.10	318.90	18.60	151.20	9.40	20577	7146	36967	16609	760	5	0.5	1.4	0.15	0.3	1	1264	439	2271	1020				
OA-2	0.21	136.2	227.70	16.50	83.00	6.90	327.00	19.60	134.90	8.90	28626	9984	38606	15112	647	5	0.5	1.3	0.15	0.3	1	1623	566	2188	857				
OA-3	0.14	92.4	131.30	9.70	43.30	3.80	213.40	12.80	85.90	5.70	15619	4965	23946	9145	530	5	0.5	1.2	0.15	0.3	1	863	274	1323	505				
OA-4	0.20	126.9	184.80	13.30	61.90	5.20	530.00	25.00	263.90	13.10	22571	7230	57981	27323	650	4	0.4	0.8	0.15	0.3	1	786	252	2019	951				
OA-5	0.06	36.5	71.10	3.80	22.90	1.50	136.30	5.30	56.70	2.40	6555	2065	11370	4464	530	4	0.4	0.7	0.15	0.3	1	198	62	344	135				
US70-2	0.73	465.9	1025.60	70.00	432.40	32.50	1597.60	75.90	713.10	36.60	149365	59923	200319	84754	580	9	0.5	2.7	0.15	0.3	1	18085	7256	24255	10262				
Total				**125.6**		**55**		**157.2**		**76.1**					616	5						**22820**	**8849**	**32401**	**13731**	**1.13**	1.12	1.15	1.13
Owl's Nest Arroyo																													
ON-1	0.51	326.8	354.10	36.00	123.70	14.30	507.80	43.20	198.60	18.80	56739	18774	76896	28526	385	7	0.5	1.6	0.15	0.3	1	3965	1312	5373	1993				
ON-2	0.13	85.4	110.60	9.00	36.30	3.50	167.20	11.30	66.20	4.90	13606	4296	19480	7262	550	4	0.4	0.7	0.15	0.3	1	418	132	598	223				
ON-3	0.07	44.1	68.60	4.90	23.60	1.90	97.50	5.30	36.30	2.20	7408	2398	9425	3312	350	6	0.5	1.3	0.15	0.3	1	418	135	532	187				
ON-4	0.15	97.3	139.70	10.20	46.20	4.00	167.50	10.20	56.20	4.00	16633	5299	18412	5914	430	5	0.4	0.9	0.15	0.3	1	643	205	712	229				
US70-1	0.15	98.2	204.90	14.20	84.40	6.40	311.10	14.80	132.90	6.90	24808	9662	32079	12995	410	11	0.5	3.2	0.15	0.3	1	3584	1396	4634	1877				
Total				**74.3**		**30.1**		**84.8**		**36.8**												**9028**	**3180**	**11850**	**4509**	**1.09**	1.08	1.10	1.09
San Augustin Arroyo																													
SA-1	1.09	694.7	1137.20	108.70	493.70	51.30	1475.30	117.70	669.60	57.60	202489	83339	244936	105472	600	8	0.5	2.4	0.15	0.3	1	22114	9102	26750	11519				
SA-2	0.10	66.8	98.10	7.00	32.60	2.70	145.70	8.10	54.60	3.40	11052	3498	14967	5313	485	6	0.5	1.3	0.15	0.3	1	657	208	890	316				
SA-3	0.24	151.1	220.70	15.90	73.20	6.20	272.00	15.90	92.40	6.20	27552	8764	30973	9985	700	4	0.4	0.9	0.15	0.3	1	1076	342	1210	390				
SA-4	0.14	88.3	129.70	9.70	44.30	3.90	178.10	11.20	67.40	4.80	15513	5103	20081	7251	460	5	0.4	1.0	0.15	0.3	1	664	218	860	310				
SA-5	0.09	56.1	82.50	5.90	26.60	2.30	124.30	5.90	42.40	2.30	9115	2853	11466	3705	860	3	0.3	0.5	0.15	0.3	1	224	70	281	91				
SA-6	0.03	18.9	37.70	2.00	12.10	0.80	50.40	2.00	16.90	0.80	3208	1016	3774	1225	450	3	0.3	0.4	0.15	0.3	1	65	21	76	25				
SA-7	0.09	55.3	81.20	5.80	27.10	2.30	109.00	5.80	36.20	2.30	8948	2883	10552	3391	580	5	0.4	1.0	0.15	0.3	1	420	135	496	159				
Total				**155**		**69.5**		**166.6**		**77.4**												**25220**	**10096**	**30562**	**12810**	**1.12**	1.11	1.13	1.12

Notes:

1. Spreadsheet based on Mussetter Engineering (MEI) use of the Modified Universal Soil Loss Equation (MUSLE) as proved in Musseter "Sediment Load Bulking Factors for Four Arroyos in the Overlook Subdivision, Las Cruces, NM", May 9, 2008 (note - several errors appear in equations in this report - reference Musseter "Sediment and Erosion Design Guide for SSCAFCA", November 2008 for correct formulas.)
2. Area, Qp, and Vol. (columns 2 through 11) are from P:\20120075\WR\Calculations\Misc Calcs\Results Table.xlsx.
3. R=storm runoff energy factor =285*(V x Qp)^0.56, where V=storm clear water runoff volume (ac-ft) and Qp=clear water peak discharge (cfs).
4. Average OL (overland) length and slope from average of data collected for each basin - summarized in P:\20120075\WR\Calculations\Misc Calcs\Sediment Transport\East Mesa Sediment Notes.docx.
5. LS= (Length of slope in feet/72.6)^n x (0.065 + (0.0454*Slope in %) + (0.0065* (Slope in %)^2)). Also provided in tablular format, from USDA, Table A.2.3, Musseter "Sediment and Erosion Design Guide for SSCAFCA", November 2008.
6. Soil erodibility factor, K, determined using "Geotechnical Engineering Report, East Mesa Drainage Plan, Sediment Analysis", Terracon, Nov. 15, 2011 and table A.2.1 and Figure A.2.1 from Musseter "Sediment and Erosion Design Guide for SSCAFCA", November 2008. Mine House Arroyo/gravelly sand/K=0.05; Balyor Arroyo/gravelly sand/K=0.05; Blair Arroyo/normal sand/K=0.1; Organ Arroyo/normal loamy course sand/K=0.15; Owl's Nest Arroyo/normal loamy course sand/K=0.15; San Augustin Arroyo/normal loamy course sand/K=0.15.
7. BF = ((storm volume runoff in ac-ft)*(43560 sq. ft./ac)*(62.4 lb/cu. Ft.) + (Ys tons*2000lb/ton))/((storm volume runoff in ac-ft)*(43560 sq. ft./ac)*(62.4 lb/cu. Ft.))

APPENDIX B – HYDROLOGIC ANALYSIS RESULTS


BR-Total
IS-5
IS-6
SN-8
IS-4
SN-7
SN-J1
IS-3
HC-J2
SN-6
SN-J2
SN-4
SN-3
SN-R1
SN-R2
IS-2
SN-5
HC-8
SN-2
SN-1
IS-1
DB-J8
HC-6
HC-5
HC-4
DB-J7
DB-8
DB-5
HC-3
HC-1
DB-R1
DB-4
HC-2
SA-7
DB-7
DB-6
SA-3
SA-6
SA-2
SA-1
SA-4
ON-4
ON-3
US70-J2
ON-1
OA-3
OA-5
US70-1
OA-2
US70-R2
OA-4
OA-1
US70-2

Project: East_Mesa_Existing Simulation Run: BA10

Start of Run:	01Jan2000, 00:00	Basin Model:	Brahman Arroyos
End of Run:	02Jan2000, 00:00	Meteorologic Model:	10-yr
Compute Time:	21Aug2012, 13:51:40	Control Specifications:	24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Br-J2	4.198887	1747.0	01Jan2000, 06:40	168.0
Br-J3	4.437877	1757.3	01Jan2000, 06:40	174.8
Br-J4	4.580317	1769.5	01Jan2000, 06:45	178.9
BR-J5	5.010947	1845.4	01Jan2000, 06:50	192.9
Br-R1	0.714310	258.3	01Jan2000, 06:45	23.1
BR-R2	2.364320	996.8	01Jan2000, 06:40	86.6
Br-R3	4.198887	1699.8	01Jan2000, 06:40	167.9
Br-R4	4.437877	1748.8	01Jan2000, 06:45	174.7
Br-R5	4.580317	1750.8	01Jan2000, 06:50	178.7
BR-Total	15.956848	3334.0	01Jan2000, 07:50	542.3
DB-1	0.122970	33.4	01Jan2000, 06:40	4.1
DB-2	0.037731	14.3	01Jan2000, 06:25	1.4
DB-3	0.185590	47.5	01Jan2000, 06:40	5.8
DB-4	0.270750	72.5	01Jan2000, 06:40	9.0
DB-5	0.076590	28.7	01Jan2000, 06:25	2.7
DB-6	0.030740	14.7	01Jan2000, 06:15	1.0
DB-7	0.548690	77.7	01Jan2000, 07:20	16.9
DB-8	0.688210	97.4	01Jan2000, 07:15	19.7
DB-J1	0.377031	99.2	01Jan2000, 06:35	12.2
DB-J7	0.925721	176.2	01Jan2000, 07:20	29.0
DB-J8	5.699157	1919.0	01Jan2000, 07:15	212.0
DB-R1	0.377031	98.5	01Jan2000, 07:20	12.1
DB-R6	5.010947	1821.6	01Jan2000, 07:15	192.3
DB-R7	0.925721	173.2	01Jan2000, 08:55	28.3
DB-R8	5.699157	1849.4	01Jan2000, 07:55	209.2
HC-1	1.387700	678.2	01Jan2000, 06:25	56.9

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HC-2	0.152540	71.0	01Jan2000, 06:15	4.4
HC-3	0.142440	51.8	01Jan2000, 06:20	4.1
HC-4	0.083290	26.5	01Jan2000, 06:25	2.4
HC-5	0.388660	113.4	01Jan2000, 06:30	11.2
HC-6	0.166190	43.1	01Jan2000, 06:35	4.8
HC-7	0.084120	32.9	01Jan2000, 06:15	2.4
HC-8	0.640220	98.0	01Jan2000, 07:05	18.4
HC-J6	1.942550	832.8	01Jan2000, 06:30	72.9
HC-J8	1.132010	203.6	01Jan2000, 07:20	32.7
HC-J9	2.666890	911.8	01Jan2000, 06:50	93.5
HC-R1	1.387700	676.7	01Jan2000, 06:30	56.8
HC-R5	0.090050	28.4	01Jan2000, 07:40	2.6
HC-R6	1.942550	822.8	01Jan2000, 06:50	72.7
HC-R7	0.084120	29.0	01Jan2000, 07:40	2.4
HC-R8	2.666890	882.8	01Jan2000, 07:35	90.8
HC-R9	1.132010	191.2	01Jan2000, 08:25	32.1
IS-1	0.451140	48.3	01Jan2000, 07:55	13.8
IS-2	0.330300	41.0	01Jan2000, 07:35	10.1
IS-3	0.547960	54.8	01Jan2000, 08:05	16.7
IS-4	0.122870	16.9	01Jan2000, 07:15	3.5
IS-5	0.105360	46.5	01Jan2000, 06:25	4.0
IS-6	1.124420	95.6	01Jan2000, 08:30	34.1
IS-J	13.685298	3246.4	01Jan2000, 07:50	475.3
IS-J4	1.932120	606.8	01Jan2000, 07:40	74.1
OA-1	0.158760	81.2	01Jan2000, 06:15	5.7
OA-2	0.212880	109.3	01Jan2000, 06:15	7.7
OA-3	0.144390	57.5	01Jan2000, 06:15	4.2
OA-4	0.198280	96.0	01Jan2000, 06:10	5.8
OA-5	0.056980	35.1	01Jan2000, 06:05	1.7
OA-J1	0.714310	283.7	01Jan2000, 06:30	23.3
OA-R1	0.158760	79.7	01Jan2000, 06:30	5.7

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
OA-R2	0.212880	108.8	01Jan2000, 06:30	7.6
OA-R3	0.144390	56.9	01Jan2000, 06:30	4.2
ON-1	0.510650	159.6	01Jan2000, 06:30	15.9
ON-2	0.133490	48.4	01Jan2000, 06:20	3.9
ON-3	0.068890	34.1	01Jan2000, 06:15	2.2
ON-4	0.152100	62.3	01Jan2000, 06:15	4.4
ON-J	2.364320	1047.1	01Jan2000, 06:30	87.1
ON-R1	1.238550	811.9	01Jan2000, 06:30	51.9
ON-R3	0.068890	30.9	01Jan2000, 06:35	2.1
SA-1	1.085410	648.5	01Jan2000, 06:25	56.9
SA-2	0.104390	46.9	01Jan2000, 06:15	3.0
SA-3	0.236140	102.6	01Jan2000, 06:15	6.9
SA-4	0.137980	58.1	01Jan2000, 06:20	4.3
SA-5	0.087657	47.1	01Jan2000, 06:10	2.5
SA-6	0.029510	18.7	01Jan2000, 06:05	0.9
SA-7	0.086450	40.2	01Jan2000, 06:15	2.5
SA-J1	1.238890	648.8	01Jan2000, 06:25	64.0
SA-J5	0.225637	72.6	01Jan2000, 06:30	6.8
SA-J7	0.086450	40.2	01Jan2000, 06:15	2.5
SA-R1	1.238890	643.9	01Jan2000, 06:35	63.9
SA-R2	0.104390	45.9	01Jan2000, 06:30	3.0
SA-R4	0.137980	57.9	01Jan2000, 06:30	4.3
SA-R7	0.086450	40.0	01Jan2000, 06:40	2.5
SN-1	0.932260	461.9	01Jan2000, 06:30	46.0
SN-2	0.126400	52.6	01Jan2000, 06:15	3.7
SN-3	0.368430	96.5	01Jan2000, 06:30	10.7
SN-4	0.388700	105.3	01Jan2000, 06:30	11.2
SN-5	0.090050	29.1	01Jan2000, 06:25	2.6
SN-6	0.547130	94.9	01Jan2000, 06:55	15.7
SN-7	0.488290	88.8	01Jan2000, 06:55	14.1
SN-8	1.041770	148.3	01Jan2000, 07:15	29.9

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
SN-J1	1.320960	530.5	01Jan2000, 06:50	57.1
SN-J2	0.494830	128.3	01Jan2000, 06:45	14.4
SN-J4	1.809250	607.6	01Jan2000, 07:05	71.0
SN-R1	0.932260	459.3	01Jan2000, 06:50	45.9
SN-R2	0.126400	51.7	01Jan2000, 06:50	3.7
SN-R3	0.494830	127.6	01Jan2000, 07:20	14.3
SN-R4	1.320960	524.9	01Jan2000, 07:05	56.9
SN-R7	1.809250	592.2	01Jan2000, 07:40	70.6
SN-R8	1.041770	145.3	01Jan2000, 09:40	28.8
US70-1	0.153480	137.3	01Jan2000, 06:10	7.2
US70-2	0.727900	689.4	01Jan2000, 06:10	36.1
US70-J2	1.238550	826.3	01Jan2000, 06:20	51.9
US70-R1	0.153480	130.1	01Jan2000, 06:40	7.1
US70-R2	0.727900	683.9	01Jan2000, 06:20	36.0

Project: East_Mesa_Existing Simulation Run: BA100

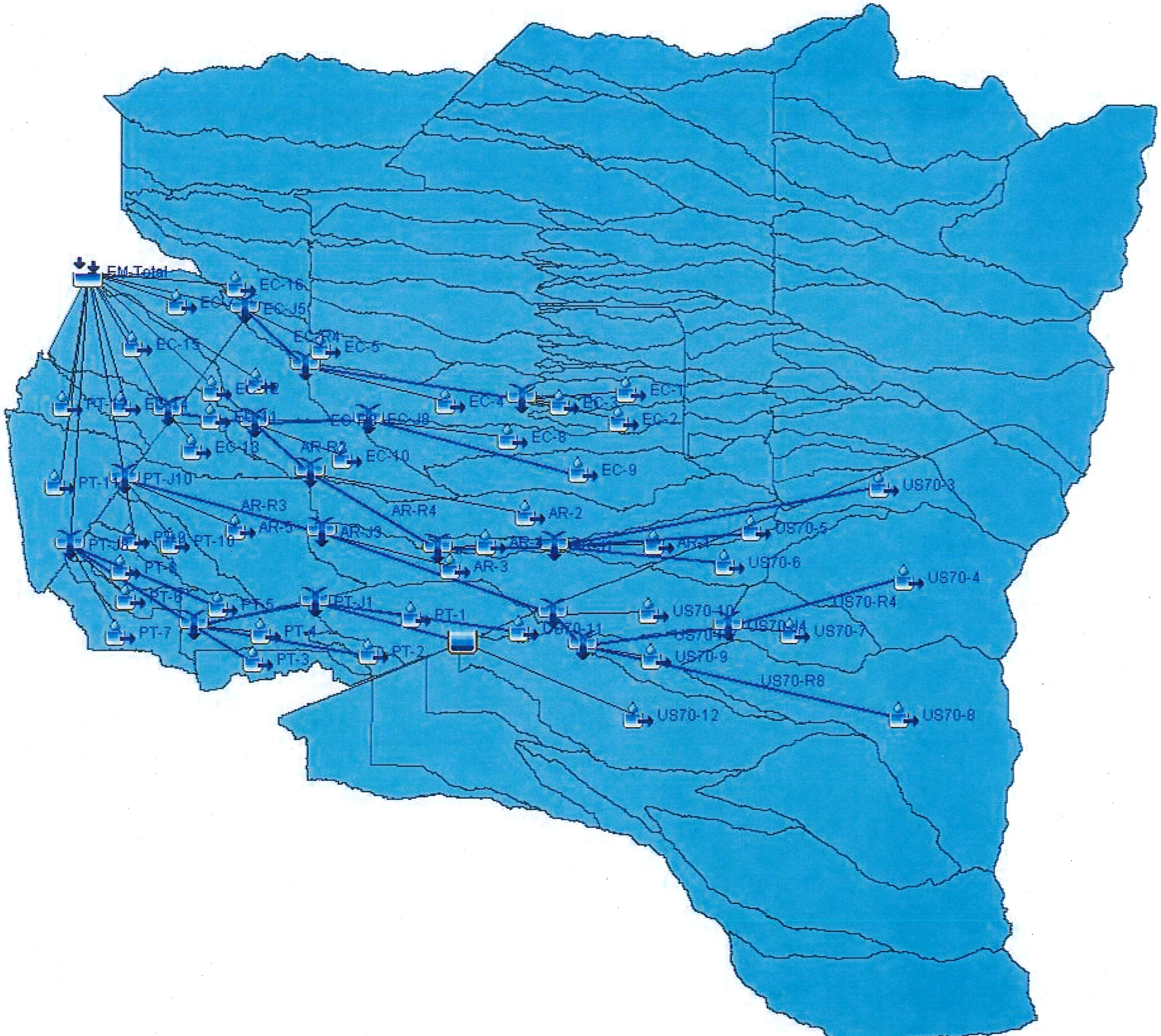
Start of Run:	01Jan2000, 00:00	Basin Model:	Brahman Arroyos
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100-yr
Compute Time:	21Aug2012, 13:50:01	Control Specifications:	24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Br-J2	4.198887	4652.6	01Jan2000, 06:30	386.8
Br-J3	4.437877	4780.8	01Jan2000, 06:35	405.1
Br-J4	4.580317	4827.6	01Jan2000, 06:35	415.9
BR-J5	5.010947	5109.7	01Jan2000, 06:40	451.2
Br-R1	0.714310	753.7	01Jan2000, 06:35	57.4
BR-R2	2.364320	2726.6	01Jan2000, 06:30	205.2
Br-R3	4.198887	4620.9	01Jan2000, 06:35	386.9
Br-R4	4.437877	4739.7	01Jan2000, 06:35	405.2
Br-R5	4.580317	4802.0	01Jan2000, 06:40	416.2
BR-Total	15.956848	9762.9	01Jan2000, 07:30	1339.3
DB-1	0.122970	91.9	01Jan2000, 06:35	10.1
DB-2	0.037731	38.7	01Jan2000, 06:25	3.2
DB-3	0.185590	135.4	01Jan2000, 06:35	14.5
DB-4	0.270750	198.9	01Jan2000, 06:40	22.2
DB-5	0.076590	77.6	01Jan2000, 06:25	6.6
DB-6	0.030740	41.7	01Jan2000, 06:15	2.4
DB-7	0.548690	218.2	01Jan2000, 07:20	42.9
DB-8	0.688210	283.2	01Jan2000, 07:10	51.3
DB-J1	0.377031	275.9	01Jan2000, 06:30	30.3
DB-J7	0.925721	479.7	01Jan2000, 07:05	73.3
DB-J8	5.699157	5312.8	01Jan2000, 07:00	502.4
DB-R1	0.377031	275.8	01Jan2000, 07:00	30.4
DB-R6	5.010947	5038.7	01Jan2000, 07:00	451.1
DB-R7	0.925721	474.0	01Jan2000, 08:05	74.1
DB-R8	5.699157	5716.4	01Jan2000, 07:30	501.3
HC-1	1.387700	1736.4	01Jan2000, 06:20	130.4

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HC-2	0.152540	214.8	01Jan2000, 06:10	11.4
HC-3	0.142440	152.8	01Jan2000, 06:20	10.6
HC-4	0.083290	78.0	01Jan2000, 06:25	6.2
HC-5	0.388660	336.8	01Jan2000, 06:25	29.0
HC-6	0.166190	127.2	01Jan2000, 06:30	12.4
HC-7	0.084120	99.0	01Jan2000, 06:15	6.3
HC-8	0.640220	285.2	01Jan2000, 07:05	47.7
HC-J6	1.942550	2188.7	01Jan2000, 06:25	172.0
HC-J8	1.132010	708.5	01Jan2000, 07:15	84.8
HC-J9	2.666890	2383.9	01Jan2000, 06:40	226.3
HC-R1	1.387700	1730.6	01Jan2000, 06:25	130.6
HC-R5	0.090050	79.2	01Jan2000, 07:20	6.9
HC-R6	1.942550	2162.5	01Jan2000, 06:40	172.3
HC-R7	0.084120	89.2	01Jan2000, 07:15	6.3
HC-R8	2.666890	2359.0	01Jan2000, 07:10	224.5
HC-R9	1.132010	675.5	01Jan2000, 08:00	85.0
IS-1	0.451140	135.0	01Jan2000, 07:50	35.3
IS-2	0.330300	114.7	01Jan2000, 07:30	25.8
IS-3	0.547960	153.0	01Jan2000, 08:00	42.9
IS-4	0.122870	49.0	01Jan2000, 07:15	9.2
IS-5	0.105360	120.7	01Jan2000, 06:25	9.5
IS-6	1.124420	265.7	01Jan2000, 08:25	87.9
IS-J	13.685298	9556.7	01Jan2000, 07:30	1163.2
IS-J4	1.932120	1599.2	01Jan2000, 07:15	174.4
OA-1	0.158760	220.4	01Jan2000, 06:15	13.6
OA-2	0.212880	296.6	01Jan2000, 06:15	18.3
OA-3	0.144390	172.5	01Jan2000, 06:15	10.8
OA-4	0.198280	288.5	01Jan2000, 06:10	14.8
OA-5	0.056980	105.5	01Jan2000, 06:05	4.2
OA-J1	0.714310	814.7	01Jan2000, 06:25	57.7
OA-R1	0.158760	212.8	01Jan2000, 06:30	13.6

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
OA-R2	0.212880	295.4	01Jan2000, 06:25	18.5
OA-R3	0.144390	171.2	01Jan2000, 06:25	10.8
ON-1	0.510650	455.6	01Jan2000, 06:25	40.0
ON-2	0.133490	142.9	01Jan2000, 06:20	10.0
ON-3	0.068890	96.8	01Jan2000, 06:10	5.4
ON-4	0.152100	186.0	01Jan2000, 06:15	11.3
ON-J	2.364320	2869.7	01Jan2000, 06:25	205.5
ON-R1	1.238550	1909.5	01Jan2000, 06:25	117.1
ON-R3	0.068890	96.2	01Jan2000, 06:25	5.4
SA-1	1.085410	1495.5	01Jan2000, 06:25	120.6
SA-2	0.104390	136.7	01Jan2000, 06:15	7.8
SA-3	0.236140	302.0	01Jan2000, 06:15	17.6
SA-4	0.137980	168.1	01Jan2000, 06:15	10.8
SA-5	0.087657	138.0	01Jan2000, 06:10	6.5
SA-6	0.029510	56.0	01Jan2000, 06:05	2.2
SA-7	0.086450	121.0	01Jan2000, 06:10	6.4
SA-J1	1.238890	1673.6	01Jan2000, 06:30	136.6
SA-J5	0.225637	219.5	01Jan2000, 06:20	17.4
SA-J7	0.086450	121.0	01Jan2000, 06:10	6.4
SA-R1	1.238890	1650.5	01Jan2000, 06:40	136.6
SA-R2	0.104390	136.2	01Jan2000, 06:25	7.8
SA-R4	0.137980	166.1	01Jan2000, 06:25	10.8
SA-R7	0.086450	137.3	01Jan2000, 06:25	6.9
SN-1	0.932260	1088.6	01Jan2000, 06:30	99.5
SN-2	0.126400	156.4	01Jan2000, 06:15	9.4
SN-3	0.368430	286.2	01Jan2000, 06:30	27.5
SN-4	0.388700	310.9	01Jan2000, 06:30	29.0
SN-5	0.090050	85.9	01Jan2000, 06:20	6.7
SN-6	0.547130	277.2	01Jan2000, 06:55	40.8
SN-7	0.488290	259.6	01Jan2000, 06:50	36.4
SN-8	1.041770	431.7	01Jan2000, 07:10	77.7

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
SN-J1	1.320960	1316.9	01Jan2000, 06:40	128.6
SN-J2	0.494830	412.0	01Jan2000, 06:40	37.0
SN-J4	1.809250	1560.3	01Jan2000, 06:55	165.1
SN-R1	0.932260	1081.8	01Jan2000, 06:45	99.7
SN-R2	0.126400	153.4	01Jan2000, 06:40	9.5
SN-R3	0.494830	406.8	01Jan2000, 07:15	37.1
SN-R4	1.320960	1308.0	01Jan2000, 07:00	128.7
SN-R7	1.809250	1550.2	01Jan2000, 07:15	165.2
SN-R8	1.041770	428.9	01Jan2000, 08:35	78.7
US70-1	0.153480	329.7	01Jan2000, 06:10	15.7
US70-2	0.727900	1619.6	01Jan2000, 06:10	77.7
US70-J2	1.238550	1932.9	01Jan2000, 06:20	117.4
US70-R1	0.153480	324.4	01Jan2000, 06:35	15.9
US70-R2	0.727900	1518.5	01Jan2000, 06:15	77.4


EM-Total
EC-16
EC-J5
EC-R4
EC-5
EC-15
EC-12
EC-13
EC-J9
EC-4
EC-1
EC-2
EC-8
EC-9
EC-10
AR-R2
PT-J10
AR-R3
AR-5
AR-J3
AR-R4
AR-2
AR-3
PT-10
PT-6
PT-8
PT-5
PT-J1
PT-1
PT-7
PT-4
PT-3
PT-2
US70-3
US70-5
US70-6
US70-4
US70-R4
US70-10
US70-11
US70-7
US70-9
US70-R8
US70-12
US70-8

Project: East_Mesa_Existing Simulation Run: EM10

Start of Run: 01Jan2000, 00:00 Basin Model: EM-Overland
End of Run: 02Jan2000, 00:00 Meteorologic Model: 10-yr
Compute Time: 21Aug2012, 13:45:10 Control Specifications: 24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
AR-1	0.46509	74.8	01Jan2000, 07:15	15.4
AR-2	1.29928	110.6	01Jan2000, 08:45	42.3
AR-3	0.97860	122.1	01Jan2000, 08:05	36.8
AR-4	0.13502	39.3	01Jan2000, 06:40	4.8
AR-5	1.32347	115.7	01Jan2000, 08:40	43.1
AR-J1	1.38193	464.6	01Jan2000, 07:10	54.0
AR-J2	2.81623	550.2	01Jan2000, 07:55	100.6
AR-J3	7.35735	2879.3	01Jan2000, 06:50	315.6
AR-J4	1.51695	485.3	01Jan2000, 07:25	58.7
AR-R1	1.38193	471.3	01Jan2000, 07:25	53.9
AR-R2	2.81623	540.0	01Jan2000, 08:10	100.2
AR-R3	7.35735	2835.5	01Jan2000, 07:20	313.5
AR-R4	1.51695	457.1	01Jan2000, 07:55	58.3
EC-1	0.24783	55.2	01Jan2000, 06:45	7.7
EC-10	0.70325	80.2	01Jan2000, 07:35	20.1
EC-11	0.16568	36.2	01Jan2000, 06:50	5.5
EC-12	0.07521	26.2	01Jan2000, 06:20	2.2
EC-13	0.35175	74.4	01Jan2000, 07:00	12.5
EC-14	0.32746	36.5	01Jan2000, 07:50	10.0
EC-15	0.89197	172.0	01Jan2000, 06:55	27.6
EC-16	0.35052	48.7	01Jan2000, 07:40	12.4
EC-2	0.21386	55.9	01Jan2000, 06:45	7.6
EC-3	0.06041	30.5	01Jan2000, 06:20	2.3
EC-4	0.91444	101.8	01Jan2000, 07:50	28.0
EC-5	0.52394	62.1	01Jan2000, 07:30	15.0
EC-6	0.49049	79.3	01Jan2000, 07:00	14.1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
EC-7	0.53534	50.3	01Jan2000, 08:15	16.3
EC-8	0.68832	85.2	01Jan2000, 07:45	22.7
EC-9	0.80625	132.4	01Jan2000, 07:30	30.6
EC-J10	5.01405	821.9	01Jan2000, 08:10	173.1
EC-J13	5.53148	842.2	01Jan2000, 08:20	190.9
EC-J3	0.52210	123.9	01Jan2000, 06:40	17.6
EC-J4	1.43654	222.5	01Jan2000, 07:35	45.5
EC-J5	1.96048	275.5	01Jan2000, 08:00	60.2
EC-J8	1.49457	216.8	01Jan2000, 07:50	53.1
EC-R10	5.01405	814.7	01Jan2000, 08:20	172.8
EC-R3	0.52210	123.3	01Jan2000, 07:35	17.5
EC-R4	1.43654	222.0	01Jan2000, 08:00	45.2
EC-R8	1.49457	216.5	01Jan2000, 08:05	52.9
EC-R9	0.80625	132.1	01Jan2000, 07:50	30.4
EM-Total	25.61126	4020.9	01Jan2000, 07:20	907.6
Osborn Pond	1.79766	336.8	01Jan2000, 07:05	53.2
PT-1	0.85492	125.0	01Jan2000, 07:35	30.3
PT-10	0.38997	44.8	01Jan2000, 07:45	12.0
PT-11	1.33291	147.5	01Jan2000, 07:50	40.8
PT-12	0.33649	36.0	01Jan2000, 08:05	11.0
PT-2	0.11084	28.7	01Jan2000, 06:40	3.7
PT-3	0.30571	87.0	01Jan2000, 07:15	16.9
PT-4	0.44284	52.8	01Jan2000, 07:30	12.6
PT-5	0.14612	31.7	01Jan2000, 06:45	4.5
PT-6	0.18459	29.3	01Jan2000, 07:10	5.7
PT-7	0.44164	45.0	01Jan2000, 08:00	13.5
PT-8	0.25655	39.3	01Jan2000, 07:15	7.9
PT-9	0.08993	20.5	01Jan2000, 06:50	3.0
PT-J1	2.72990	479.4	01Jan2000, 07:25	87.1
PT-J10	9.16072	2950.6	01Jan2000, 07:20	371.5
PT-J4	3.58929	621.5	01Jan2000, 07:45	119.9

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
PT-J8	4.61819	708.2	01Jan2000, 08:10	150.6
PT-R1	2.72990	473.3	01Jan2000, 07:45	86.7
PT-R2	0.11084	28.4	01Jan2000, 07:15	3.7
PT-R3	0.30571	86.8	01Jan2000, 07:25	16.8
PT-R4	3.58929	615.0	01Jan2000, 08:10	119.0
PT-R5	0.14612	31.5	01Jan2000, 07:25	4.5
US70-10	0.71855	138.5	01Jan2000, 07:05	25.6
US70-11	0.07732	49.3	01Jan2000, 06:25	4.1
US70-12	1.79766	313.1	01Jan2000, 07:05	55.6
US70-3	0.41730	264.7	01Jan2000, 06:20	20.6
US70-4	1.95800	1250.2	01Jan2000, 06:20	96.8
US70-5	0.05682	56.3	01Jan2000, 06:10	3.2
US70-6	0.44272	117.4	01Jan2000, 06:40	14.8
US70-7	0.64200	285.1	01Jan2000, 06:20	21.5
US70-8	2.60190	1218.9	01Jan2000, 06:30	120.8
US70-9	0.45830	121.5	01Jan2000, 06:40	15.3
US70-J10	6.37875	2873.6	01Jan2000, 06:40	279.2
US70-J4	2.60000	1506.7	01Jan2000, 06:25	118.7
US70-J8	5.66020	2814.6	01Jan2000, 06:35	254.4
US70-R10	6.37875	2834.2	01Jan2000, 06:50	278.8
US70-R11	0.07732	48.3	01Jan2000, 07:10	4.0
US70-R12	1.79766	318.9	01Jan2000, 07:35	52.8
US70-R3	0.41730	262.0	01Jan2000, 07:15	20.6
US70-R4	1.95800	1246.2	01Jan2000, 06:25	97.1
US70-R5	0.05682	55.4	01Jan2000, 06:45	3.2
US70-R6	0.44272	116.7	01Jan2000, 07:05	14.7
US70-R7	2.60000	1492.3	01Jan2000, 06:35	118.7
US70-R8	2.60190	1203.2	01Jan2000, 06:35	120.5
US70-R9	5.66020	2773.0	01Jan2000, 06:40	253.6

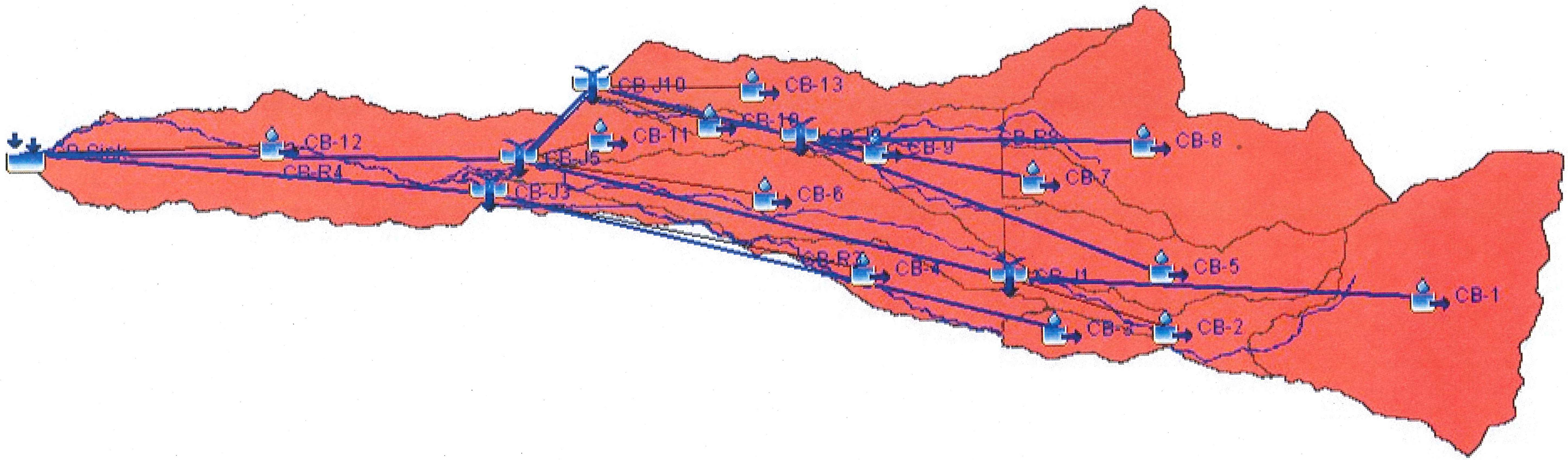
Project: East_Mesa_Existing Simulation Run: EM100

Start of Run:	01Jan2000, 00:00	Basin Model:	EM-Overland
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100-yr
Compute Time:	21Aug2012, 13:43:54	Control Specifications:	24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
AR-1	0.46509	204.0	01Jan2000, 07:15	38.2
AR-2	1.29928	298.2	01Jan2000, 08:40	106.5
AR-3	0.97860	312.7	01Jan2000, 08:00	88.0
AR-4	0.13502	104.8	01Jan2000, 06:35	11.6
AR-5	1.32347	312.0	01Jan2000, 08:35	108.5
AR-J1	1.38193	1257.8	01Jan2000, 06:55	125.5
AR-J2	2.81623	1368.8	01Jan2000, 07:30	243.9
AR-J3	7.35735	6933.0	01Jan2000, 06:50	714.0
AR-J4	1.51695	1199.5	01Jan2000, 07:10	137.2
AR-R1	1.38193	1147.1	01Jan2000, 07:10	125.6
AR-R2	2.81623	1337.6	01Jan2000, 07:45	243.9
AR-R3	7.35735	6895.7	01Jan2000, 07:05	712.2
AR-R4	1.51695	1178.2	01Jan2000, 07:30	137.3
EC-1	0.24783	156.4	01Jan2000, 06:45	19.4
EC-10	0.70325	231.5	01Jan2000, 07:35	52.4
EC-11	0.16568	99.5	01Jan2000, 06:50	13.6
EC-12	0.07521	77.9	01Jan2000, 06:20	5.6
EC-13	0.35175	197.4	01Jan2000, 07:00	30.2
EC-14	0.32746	102.0	01Jan2000, 07:45	25.6
EC-15	0.89197	484.5	01Jan2000, 06:55	69.8
EC-16	0.35052	128.5	01Jan2000, 07:40	30.1
EC-2	0.21386	149.1	01Jan2000, 06:45	18.4
EC-3	0.06041	79.4	01Jan2000, 06:20	5.4
EC-4	0.91444	284.7	01Jan2000, 07:45	71.5
EC-5	0.52394	179.7	01Jan2000, 07:30	39.1
EC-6	0.49049	231.2	01Jan2000, 07:00	36.6

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
EC-7	0.53534	140.2	01Jan2000, 08:10	41.9
EC-8	0.68832	231.2	01Jan2000, 07:40	56.5
EC-9	0.80625	340.4	01Jan2000, 07:25	72.5
EC-J10	5.01405	2119.0	01Jan2000, 07:45	425.3
EC-J13	5.53148	2230.3	01Jan2000, 07:50	469.2
EC-J3	0.52210	338.9	01Jan2000, 06:40	43.2
EC-J4	1.43654	601.5	01Jan2000, 07:25	114.9
EC-J5	1.96048	769.2	01Jan2000, 07:45	154.0
EC-J8	1.49457	571.3	01Jan2000, 07:45	129.0
EC-R10	5.01405	2110.3	01Jan2000, 07:50	425.4
EC-R3	0.52210	337.8	01Jan2000, 07:20	43.3
EC-R4	1.43654	599.9	01Jan2000, 07:45	114.9
EC-R8	1.49457	570.3	01Jan2000, 07:55	129.0
EC-R9	0.80625	340.1	01Jan2000, 07:45	72.5
EM-Total	25.61126	10044.5	01Jan2000, 07:10	2202.5
Osborn Pond	1.79766	930.5	01Jan2000, 07:00	138.6
PT-1	0.85492	330.1	01Jan2000, 07:30	73.4
PT-10	0.38997	125.2	01Jan2000, 07:40	30.5
PT-11	1.33291	412.2	01Jan2000, 07:45	104.3
PT-12	0.33649	97.3	01Jan2000, 08:05	27.6
PT-2	0.11084	79.1	01Jan2000, 06:40	9.1
PT-3	0.30571	194.3	01Jan2000, 07:15	35.4
PT-4	0.44284	152.6	01Jan2000, 07:30	33.0
PT-5	0.14612	90.1	01Jan2000, 06:45	11.4
PT-6	0.18459	82.4	01Jan2000, 07:10	14.4
PT-7	0.44164	125.6	01Jan2000, 08:00	34.6
PT-8	0.25655	110.5	01Jan2000, 07:10	20.1
PT-9	0.08993	56.2	01Jan2000, 06:45	7.4
PT-J1	2.72990	1294.1	01Jan2000, 07:20	221.0
PT-J10	9.16072	7162.0	01Jan2000, 07:05	858.6
PT-J4	3.58929	1672.8	01Jan2000, 07:30	298.7

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
PT-J8	4.61819	1969.9	01Jan2000, 07:50	379.3
PT-R1	2.72990	1280.3	01Jan2000, 07:35	221.2
PT-R2	0.11084	78.3	01Jan2000, 07:05	9.1
PT-R3	0.30571	193.7	01Jan2000, 07:20	35.4
PT-R4	3.58929	1668.2	01Jan2000, 07:50	298.8
PT-R5	0.14612	89.2	01Jan2000, 07:15	11.4
US70-10	0.71855	368.3	01Jan2000, 07:05	61.7
US70-11	0.07732	113.6	01Jan2000, 06:20	8.6
US70-12	1.79766	884.8	01Jan2000, 07:00	140.6
US70-3	0.41730	626.7	01Jan2000, 06:20	44.5
US70-4	1.95800	2957.6	01Jan2000, 06:20	208.9
US70-5	0.05682	128.1	01Jan2000, 06:10	6.6
US70-6	0.44272	322.5	01Jan2000, 06:40	36.3
US70-7	0.64200	782.8	01Jan2000, 06:15	52.7
US70-8	2.60190	2938.0	01Jan2000, 06:30	266.3
US70-9	0.45830	333.8	01Jan2000, 06:40	37.6
US70-J10	6.37875	6961.0	01Jan2000, 06:35	626.8
US70-J4	2.60000	3616.8	01Jan2000, 06:20	261.4
US70-J8	5.66020	6799.8	01Jan2000, 06:30	565.2
US70-R10	6.37875	6819.1	01Jan2000, 06:45	626.1
US70-R11	0.07732	112.4	01Jan2000, 07:00	8.7
US70-R12	1.79766	892.8	01Jan2000, 07:20	138.8
US70-R3	0.41730	683.1	01Jan2000, 06:55	44.5
US70-R4	1.95800	2913.4	01Jan2000, 06:25	208.7
US70-R5	0.05682	122.3	01Jan2000, 06:40	6.5
US70-R6	0.44272	322.0	01Jan2000, 06:55	36.4
US70-R7	2.60000	3607.6	01Jan2000, 06:30	260.9
US70-R8	2.60190	2922.7	01Jan2000, 06:35	266.7
US70-R9	5.66020	6721.7	01Jan2000, 06:35	565.1


CB-J10
CB-13
CB-12
CB-11
CB-10
CB-9
CB-8
CB-J5
CB-R4
CB-J3
CB-7
CB-6
CB-4
CB-5
CB-1
CB-3
CB-2

Project: East_Mesa_Existing Simulation Run: CB10

Start of Run: 01Jan2000, 00:00 Basin Model: Clark & Brown
End of Run: 02Jan2000, 00:00 Meteorologic Model: 10-yr
Compute Time: 09Aug2012, 16:12:25 Control Specifications: 24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
CB-1	1.89443	2566.1	01Jan2000, 06:15	162.9
CB-10	0.12669	28.5	01Jan2000, 06:40	3.7
CB-11	0.25441	56.4	01Jan2000, 06:40	7.3
CB-12	2.03426	113.7	01Jan2000, 10:05	60.3
CB-13	0.84804	163.1	01Jan2000, 06:50	24.4
CB-2	0.44105	285.5	01Jan2000, 06:20	20.5
CB-3	0.18752	86.9	01Jan2000, 06:15	5.4
CB-4	0.55311	116.0	01Jan2000, 06:45	15.9
CB-5	0.77055	485.6	01Jan2000, 06:20	38.1
CB-6	1.00767	209.9	01Jan2000, 06:45	29.0
CB-7	0.24111	121.4	01Jan2000, 06:15	7.5
CB-8	1.53184	965.8	01Jan2000, 06:25	80.4
CB-9	0.55717	183.9	01Jan2000, 06:25	16.1
CB-J1	2.33548	2808.4	01Jan2000, 06:25	183.5
CB-J10	4.07540	1868.1	01Jan2000, 06:40	169.8
CB-J3	0.74063	139.8	01Jan2000, 07:20	21.3
CB-J5	7.67296	4788.7	01Jan2000, 06:40	389.5
CB-J9	3.10067	1681.0	01Jan2000, 06:35	142.0
CB-R1	1.89443	2550.3	01Jan2000, 06:25	163.0
CB-R10	4.07540	1853.0	01Jan2000, 06:45	169.5
CB-R2	2.33548	2762.9	01Jan2000, 06:40	183.6
CB-R3	0.18752	80.8	01Jan2000, 07:20	5.4
CB-R4	0.74063	116.3	01Jan2000, 08:40	21.1
CB-R5	0.77055	481.1	01Jan2000, 06:35	38.0
CB-R6	7.67296	3669.1	01Jan2000, 07:20	376.6
CB-R7	0.24111	120.2	01Jan2000, 06:25	7.5

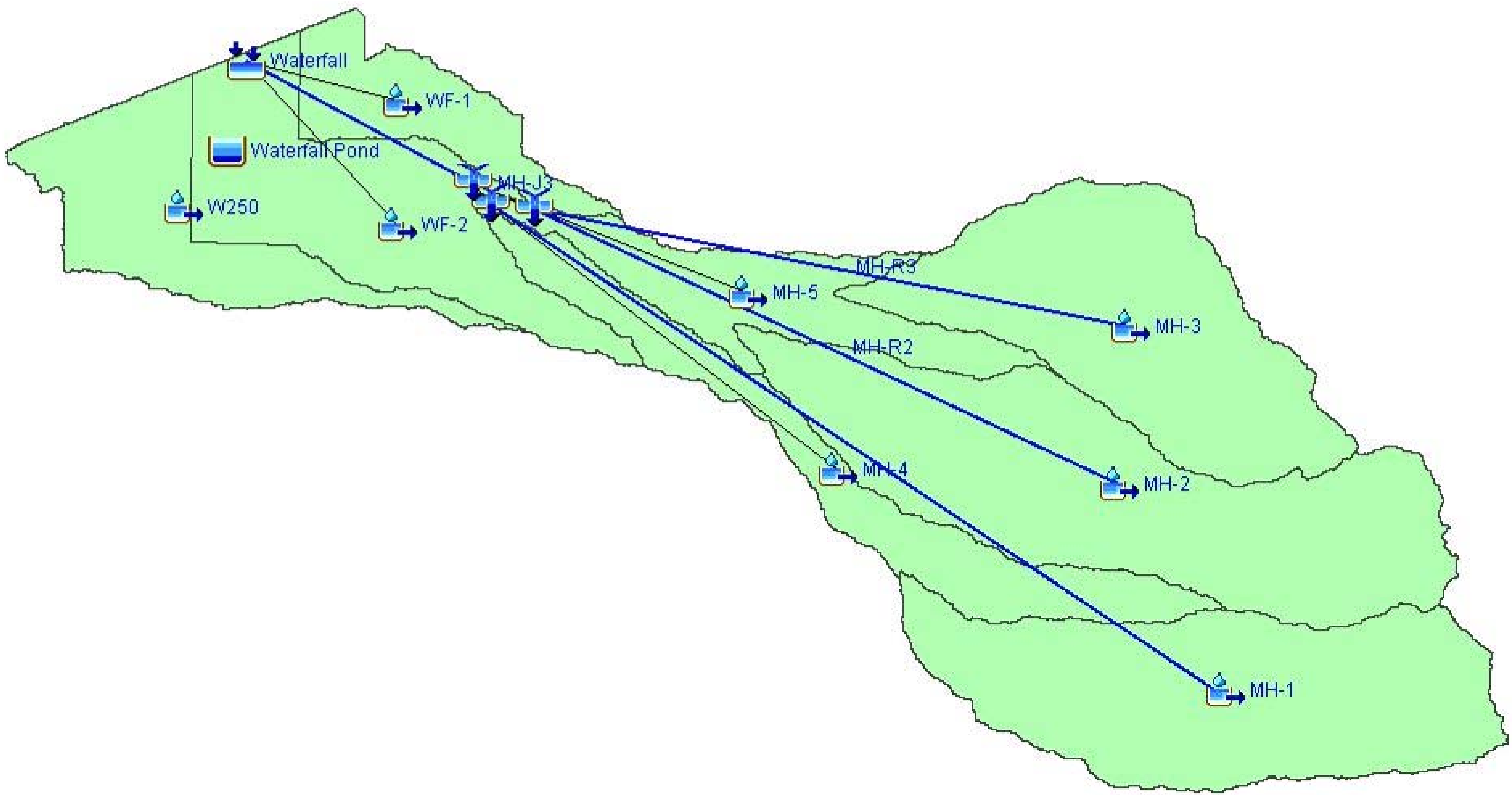
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
CB-R8	1.53184	958.5	01Jan2000, 06:35	80.3
CB-R9	3.10067	1685.2	01Jan2000, 06:40	141.7
CB-Sink	10.44785	3696.6	01Jan2000, 07:20	458.1

Project: East_Mesa_Existing Simulation Run: CB100

Start of Run:	01Jan2000, 00:00	Basin Model:	Clark & Brown
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100-yr
Compute Time:	09Aug2012, 16:12:34	Control Specifications:	24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
CB-1	1.89443	4875.9	01Jan2000, 06:15	295.6
CB-10	0.12669	83.3	01Jan2000, 06:40	9.4
CB-11	0.25441	165.6	01Jan2000, 06:40	19.0
CB-12	2.03426	312.4	01Jan2000, 10:00	158.3
CB-13	0.84804	475.5	01Jan2000, 06:45	63.2
CB-2	0.44105	688.4	01Jan2000, 06:15	45.1
CB-3	0.18752	259.4	01Jan2000, 06:10	14.0
CB-4	0.55311	339.2	01Jan2000, 06:40	41.2
CB-5	0.77055	1150.5	01Jan2000, 06:20	82.2
CB-6	1.00767	612.6	01Jan2000, 06:40	75.1
CB-7	0.24111	349.3	01Jan2000, 06:10	18.9
CB-8	1.53184	2211.6	01Jan2000, 06:25	170.3
CB-9	0.55717	546.4	01Jan2000, 06:20	41.5
CB-J1	2.33548	5358.7	01Jan2000, 06:20	341.2
CB-J10	4.07540	4592.9	01Jan2000, 06:35	386.6
CB-J3	0.74063	528.0	01Jan2000, 07:00	55.0
CB-J5	7.67296	10601.0	01Jan2000, 06:35	823.6
CB-J9	3.10067	4097.0	01Jan2000, 06:30	313.4
CB-R1	1.89443	4755.8	01Jan2000, 06:25	296.0
CB-R10	4.07540	4498.9	01Jan2000, 06:35	386.5
CB-R2	2.33548	5348.2	01Jan2000, 06:35	343.0
CB-R3	0.18752	250.2	01Jan2000, 07:00	13.8
CB-R4	0.74063	477.2	01Jan2000, 07:45	55.4
CB-R5	0.77055	1144.7	01Jan2000, 06:30	82.7
CB-R6	7.67296	8703.4	01Jan2000, 07:00	809.6
CB-R7	0.24111	347.6	01Jan2000, 06:20	19.0

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
CB-R8	1.53184	2209.2	01Jan2000, 06:30	170.1
CB-R9	3.10067	4078.8	01Jan2000, 06:35	313.9
CB-Sink	10.44785	8761.9	01Jan2000, 07:00	1023.3


Waterfall
WF-1
Waterfall Pond
MH-J3
W250
WF-2
MH-R3
MH-5
MH-3
MH-R2
MH-4
MH-2
MH-1

Project: East_Mesa_Existing Simulation Run: WF10

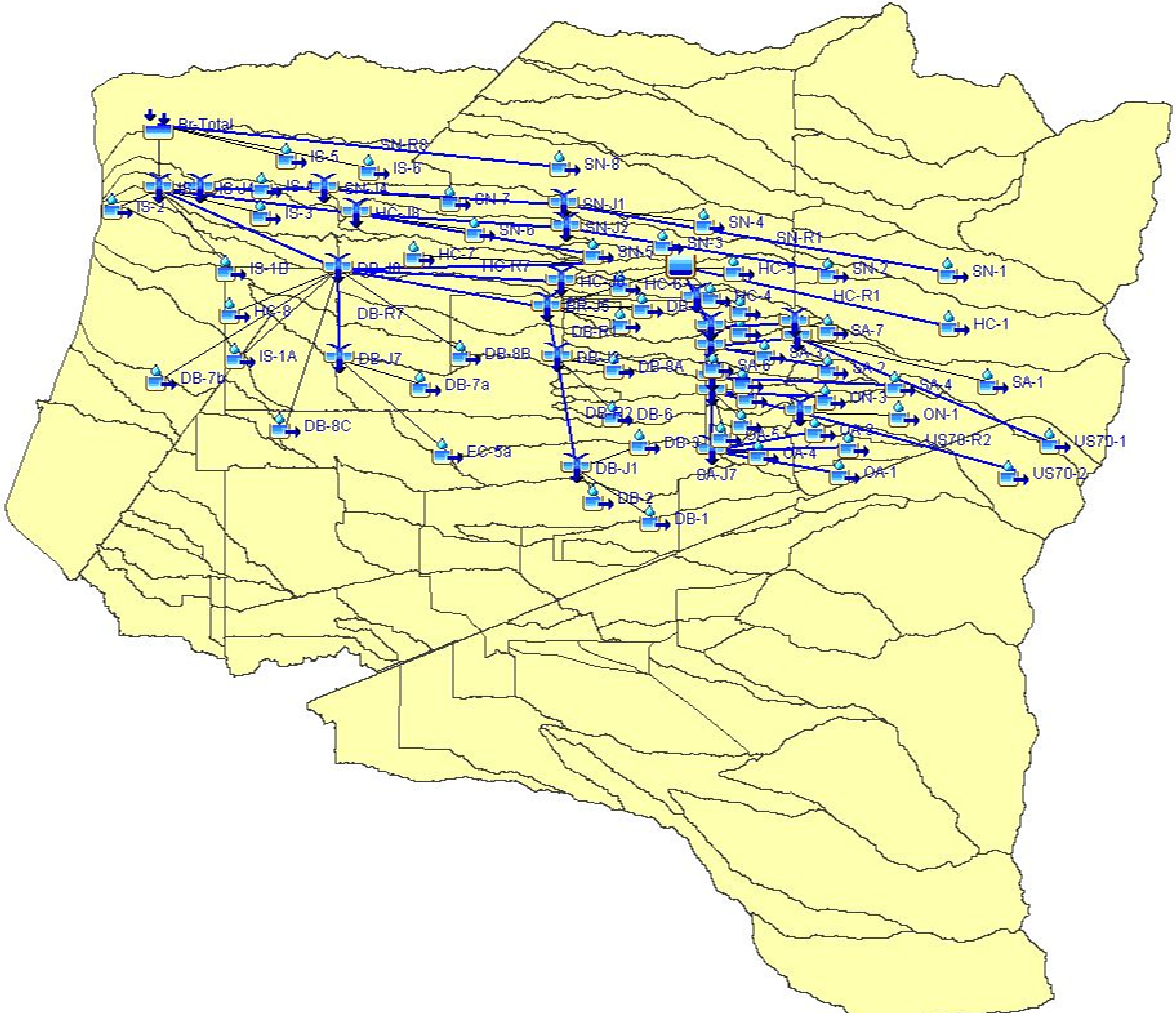
Start of Run: 01Jan2000, 00:00 Basin Model: Waterfall
End of Run: 02Jan2000, 00:00 Meteorologic Model: 10-yr
Compute Time: 21Aug2012, 14:20:17 Control Specifications: 24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
MH-1	1.6396	967.7	01Jan2000, 06:20	73.0
MH-2	1.9112	438.5	01Jan2000, 07:00	74.1
MH-3	1.4416	711.2	01Jan2000, 06:20	56.4
MH-4	0.7632	146.1	01Jan2000, 06:50	22.4
MH-5	0.6261	132.3	01Jan2000, 06:45	18.4
MH-J1	2.4028	1093.3	01Jan2000, 06:55	94.4
MH-J2	3.3528	776.2	01Jan2000, 06:40	130.0
MH-J3	6.3817	1922.4	01Jan2000, 06:50	242.7
MH-R1	1.6396	948.7	01Jan2000, 06:55	72.0
MH-R2	1.9112	436.5	01Jan2000, 07:20	73.9
MH-R3	1.4416	704.3	01Jan2000, 06:35	56.2
W250	0.7104	144.1	01Jan2000, 06:55	22.4
Waterfall	7.9001	2156.3	01Jan2000, 07:05	288.6
Waterfall Pond	0.0000	0.0	01Jan2000, 00:00	0.0
WF-1	0.4542	72.6	01Jan2000, 07:20	15.3
WF-2	1.0642	193.9	01Jan2000, 06:55	31.2
WF-R1	6.3817	1904.1	01Jan2000, 07:05	242.1

Project: East_Mesa_Existing Simulation Run: WF100

Start of Run:	01Jan2000, 00:00	Basin Model:	Waterfall
End of Run:	02Jan2000, 00:00	Meteorologic Model:	100-yr
Compute Time:	21Aug2012, 14:15:24	Control Specifications:	24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
MH-1	1.6396	2390.4	01Jan2000, 06:20	163.7
MH-2	1.9112	1132.9	01Jan2000, 07:00	174.9
MH-3	1.4416	1863.1	01Jan2000, 06:20	131.9
MH-4	0.7632	426.9	01Jan2000, 06:50	57.9
MH-5	0.6261	386.1	01Jan2000, 06:45	47.5
MH-J1	2.4028	2787.8	01Jan2000, 06:45	221.9
MH-J2	3.3528	2038.0	01Jan2000, 06:35	306.8
MH-J3	6.3817	5031.9	01Jan2000, 06:45	576.2
MH-R1	1.6396	2363.7	01Jan2000, 06:45	164.0
MH-R2	1.9112	1129.1	01Jan2000, 07:20	174.9
MH-R3	1.4416	1836.2	01Jan2000, 06:30	131.9
W250	0.7104	408.5	01Jan2000, 06:50	56.6
Waterfall	7.9001	5715.5	01Jan2000, 06:55	696.1
Waterfall Pond	0.0000	0.0	01Jan2000, 00:00	0.0
WF-1	0.4542	197.9	01Jan2000, 07:15	37.9
WF-2	1.0642	565.1	01Jan2000, 06:50	80.8
WF-R1	6.3817	4978.6	01Jan2000, 06:55	577.4



Br-Total
SN-R8
IS-5
IS-6
SN-8
IS-4
SN-7
SN-J1
IS-2
IS-3
SN-6
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SN-4
SN-R1
SN-3
SN-5
HC-7
HC-R7
HC-5
SN-2
SN-1
IS-1B
HC-6
HC-4
HC-R1
HC-8
DB-R7
HC-1
SA-7
IS-1A
DB-J7
DB-8B
DB-8A
SA-6
SA-2
SA-4
SA-1
DB-7b
DB-7a
ON-3
ON-1
DB-8C
DB-R2
DB-6
US70-R2
US70-1
EC-5a
OA-4
OA-1
DB-J1
SA-J7
US70-2
DB-2
DB-1

Project: EM Proposed Opt A + Opt B Simulation Run: Brahman10

Start of Run: 01Jan2000, 00:00 Basin Model: Brahman Arroyos
End of Run: 03Jan2000, 00:00 Meteorologic Model: 10-yr
Compute Time: 23Aug2012, 07:55:47 Control Specifications: 24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Brahman Dam	6.439967	251.3	01Jan2000, 08:10	306.5
Br-J2	4.198887	2369.2	01Jan2000, 06:35	211.4
Br-J3	4.437877	2364.7	01Jan2000, 06:40	218.2
Br-J4	4.580317	2360.6	01Jan2000, 06:40	222.4
BR-J5	7.236297	462.5	01Jan2000, 06:45	338.0
Br-R1	0.714310	482.1	01Jan2000, 06:35	41.3
BR-R2	2.364320	1443.2	01Jan2000, 06:35	118.2
Br-R3	4.198887	2307.2	01Jan2000, 06:40	211.3
Br-R4	4.437877	2334.9	01Jan2000, 06:40	218.2
Br-R5	4.580317	2356.8	01Jan2000, 06:40	222.4
BR-Total	16.009698	2092.0	01Jan2000, 07:55	750.3
DB-1	0.134000	42.8	01Jan2000, 06:40	5.2
DB-2	0.059000	28.4	01Jan2000, 06:25	2.6
DB-3	0.192000	62.9	01Jan2000, 06:35	7.4
DB-4	0.275000	86.6	01Jan2000, 06:40	10.6
DB-5	0.076590	33.7	01Jan2000, 06:25	3.1
DB-6	0.030740	22.0	01Jan2000, 06:15	1.3
DB-7a	0.254000	104.8	01Jan2000, 06:30	10.4
DB-7b	0.255915	84.5	01Jan2000, 06:40	10.5
DB-8A	0.029000	31.0	01Jan2000, 06:05	1.3
DB-8B	0.295000	67.5	01Jan2000, 07:10	12.9
DB-8C	0.359000	82.2	01Jan2000, 07:10	15.7
DB-J1	0.385000	131.0	01Jan2000, 06:35	15.1
DB-J2	0.444740	138.6	01Jan2000, 06:40	17.8
DB-J7	0.288016	110.2	01Jan2000, 06:30	11.9
DB-J8	9.553758	971.4	01Jan2000, 07:10	447.6

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
DB-R1	0.444740	137.5	01Jan2000, 06:45	17.8
DB-R2	0.385000	129.9	01Jan2000, 06:40	15.2
DB-R6	7.236297	460.4	01Jan2000, 07:20	347.8
DB-R7	0.288016	109.2	01Jan2000, 06:45	11.9
DB-R8	9.553758	963.3	01Jan2000, 08:00	463.2
EC-5a	0.034016	36.6	01Jan2000, 06:05	1.5
HC-1	1.387700	847.4	01Jan2000, 06:20	68.8
HC-2	0.152540	71.0	01Jan2000, 06:15	4.4
HC-3	0.142440	51.8	01Jan2000, 06:20	4.1
HC-4	0.083290	34.4	01Jan2000, 06:25	3.0
HC-5	0.388660	123.8	01Jan2000, 06:30	12.2
HC-6	0.166190	65.2	01Jan2000, 06:30	6.8
HC-7	0.084120	54.7	01Jan2000, 06:15	3.7
HC-8	0.640220	158.7	01Jan2000, 07:05	28.1
HC-J6	0.166190	65.2	01Jan2000, 06:30	6.8
HC-J8	1.132010	272.0	01Jan2000, 07:00	45.0
HC-J9	0.000000	0.0	01Jan2000, 00:00	0.0
HC-R1	1.387700	840.7	01Jan2000, 06:30	68.9
HC-R5	0.090050	46.8	01Jan2000, 07:30	3.9
HC-R6	0.166190	64.6	01Jan2000, 07:10	6.9
HC-R7	0.084120	47.9	01Jan2000, 07:30	3.7
HC-R8	0.000000	0.0	01Jan2000, 00:00	0.0
HC-R9	1.132010	273.4	01Jan2000, 08:00	45.1
IS-1A	0.229000	87.0	01Jan2000, 06:35	10.0
IS-1B	0.242000	56.1	01Jan2000, 07:10	10.6
IS-2	0.330300	64.9	01Jan2000, 07:35	15.4
IS-3	0.547960	86.6	01Jan2000, 08:00	25.6
IS-4	0.122870	27.3	01Jan2000, 07:15	5.4
IS-5	0.105360	67.0	01Jan2000, 06:25	5.5
IS-6	1.124420	140.1	01Jan2000, 08:30	49.3
IS-J	13.738148	1958.9	01Jan2000, 07:55	649.0

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
IS-J4	1.932120	713.2	01Jan2000, 07:40	89.1
OA-1	0.158760	167.9	01Jan2000, 06:15	10.5
OA-2	0.212880	149.7	01Jan2000, 06:15	9.9
OA-3	0.144390	95.3	01Jan2000, 06:15	6.3
OA-4	0.198280	292.9	01Jan2000, 06:10	14.6
OA-5	0.056980	62.9	01Jan2000, 06:05	2.7
OA-J1	0.714310	517.2	01Jan2000, 06:25	41.4
OA-R1	0.158760	163.1	01Jan2000, 06:30	10.5
OA-R2	0.212880	147.8	01Jan2000, 06:30	10.0
OA-R3	0.144390	92.9	01Jan2000, 06:25	6.3
ON-1	0.510650	220.5	01Jan2000, 06:30	21.0
ON-2	0.133490	73.5	01Jan2000, 06:20	5.5
ON-3	0.068890	40.3	01Jan2000, 06:15	2.5
ON-4	0.152100	62.3	01Jan2000, 06:15	4.4
ON-J	2.364320	1535.9	01Jan2000, 06:30	118.4
ON-R1	1.238550	949.2	01Jan2000, 06:30	61.9
ON-R3	0.068890	39.8	01Jan2000, 06:30	2.5
SA-1	1.085410	743.2	01Jan2000, 06:25	64.1
SA-2	0.104390	60.6	01Jan2000, 06:15	3.8
SA-3	0.236140	115.9	01Jan2000, 06:15	7.8
SA-4	0.137980	84.5	01Jan2000, 06:15	6.0
SA-5	0.087657	53.2	01Jan2000, 06:10	2.9
SA-6	0.029510	18.7	01Jan2000, 06:05	0.9
SA-7	0.086450	40.2	01Jan2000, 06:15	2.5
SA-J1	1.238890	743.5	01Jan2000, 06:25	71.7
SA-J5	0.225637	102.5	01Jan2000, 06:25	8.9
SA-J7	0.086450	40.2	01Jan2000, 06:15	2.5
SA-R1	1.238890	738.1	01Jan2000, 06:35	72.0
SA-R2	0.104390	59.4	01Jan2000, 06:25	3.8
SA-R4	0.137980	84.0	01Jan2000, 06:30	6.0
SA-R7	0.086450	40.0	01Jan2000, 06:40	2.5

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
SN-1	0.932260	495.5	01Jan2000, 06:30	49.1
SN-2	0.126400	52.6	01Jan2000, 06:15	3.7
SN-3	0.368430	125.3	01Jan2000, 06:30	13.3
SN-4	0.388700	125.6	01Jan2000, 06:30	13.1
SN-5	0.090050	47.4	01Jan2000, 06:25	3.9
SN-6	0.547130	154.2	01Jan2000, 06:55	24.0
SN-7	0.488290	144.2	01Jan2000, 06:50	21.4
SN-8	1.041770	240.2	01Jan2000, 07:10	45.7
SN-J1	1.320960	576.6	01Jan2000, 06:45	62.2
SN-J2	0.494830	150.4	01Jan2000, 06:45	17.0
SN-J4	1.809250	707.4	01Jan2000, 07:05	83.7
SN-R1	0.932260	493.1	01Jan2000, 06:50	49.2
SN-R2	0.126400	51.7	01Jan2000, 06:50	3.7
SN-R3	0.494830	145.9	01Jan2000, 07:20	17.1
SN-R4	1.320960	575.7	01Jan2000, 07:05	62.3
SN-R7	1.809250	690.2	01Jan2000, 07:40	83.7
SN-R8	1.041770	298.1	01Jan2000, 09:00	46.5
US70-1	0.153480	147.5	01Jan2000, 06:10	7.6
US70-2	0.727900	791.5	01Jan2000, 06:10	40.6
US70-J2	1.238550	978.3	01Jan2000, 06:20	62.1
US70-R1	0.153480	143.3	01Jan2000, 06:40	7.6
US70-R2	0.727900	776.4	01Jan2000, 06:20	41.1

Project: EM Proposed Opt A +Opt B Simulation Run: Brahman 100

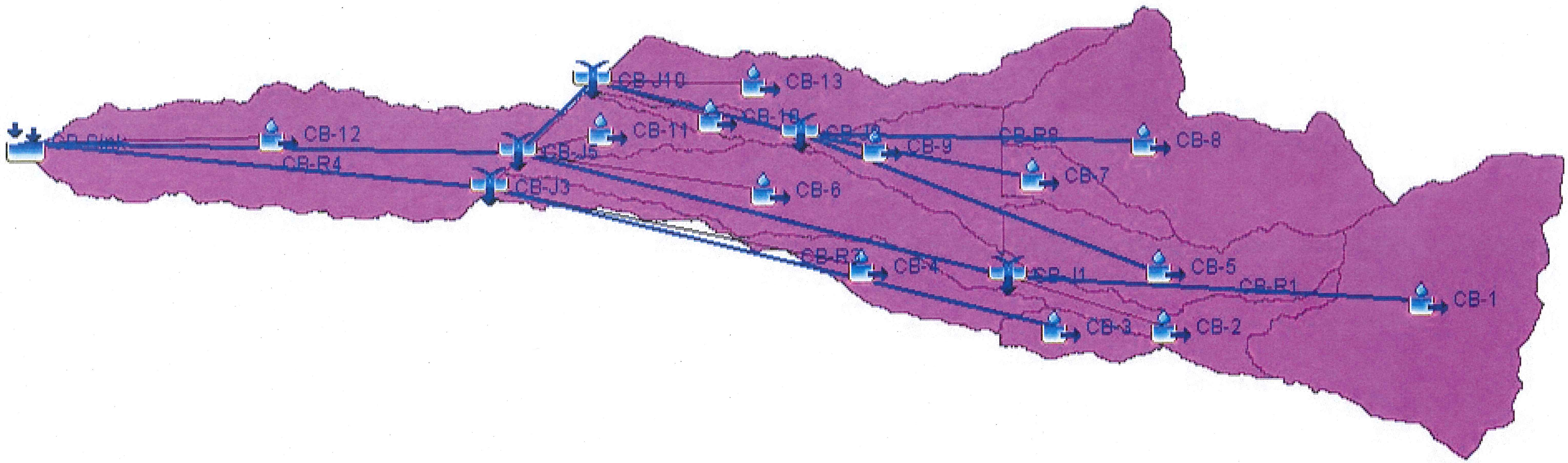
Start of Run: 01Jan2000, 00:00 Basin Model: Brahman Arroyos
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100-yr
Compute Time: 23Aug2012, 07:56:08 Control Specifications: 24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Brahman Dam	6.439967	310.2	01Jan2000, 07:45	627.9
Br-J2	4.198887	5640.9	01Jan2000, 06:30	450.7
Br-J3	4.437877	5719.7	01Jan2000, 06:30	469.1
Br-J4	4.580317	5766.2	01Jan2000, 06:35	479.9
BR-J5	7.236297	912.6	01Jan2000, 06:40	700.8
Br-R1	0.714310	1152.0	01Jan2000, 06:30	84.0
BR-R2	2.364320	3490.9	01Jan2000, 06:30	250.9
Br-R3	4.198887	5517.5	01Jan2000, 06:30	450.8
Br-R4	4.437877	5678.3	01Jan2000, 06:35	469.3
Br-R5	4.580317	5764.8	01Jan2000, 06:35	479.9
BR-Total	16.009698	4998.7	01Jan2000, 07:40	1586.2
DB-1	0.134000	111.3	01Jan2000, 06:35	12.0
DB-2	0.059000	70.4	01Jan2000, 06:25	5.8
DB-3	0.192000	164.3	01Jan2000, 06:35	17.3
DB-4	0.275000	224.4	01Jan2000, 06:35	24.7
DB-5	0.076590	86.1	01Jan2000, 06:25	7.2
DB-6	0.030740	53.7	01Jan2000, 06:15	3.0
DB-7a	0.254000	265.1	01Jan2000, 06:30	23.9
DB-7b	0.255915	213.6	01Jan2000, 06:40	24.0
DB-8A	0.029000	75.8	01Jan2000, 06:05	2.8
DB-8B	0.295000	165.5	01Jan2000, 07:10	28.9
DB-8C	0.359000	201.4	01Jan2000, 07:10	35.2
DB-J1	0.385000	336.8	01Jan2000, 06:35	35.1
DB-J2	0.444740	356.9	01Jan2000, 06:35	41.0
DB-J7	0.288016	279.6	01Jan2000, 06:25	27.2
DB-J8	9.553758	2294.5	01Jan2000, 07:10	934.1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
DB-R1	0.444740	355.0	01Jan2000, 06:40	41.0
DB-R2	0.385000	335.7	01Jan2000, 06:40	35.1
DB-R6	7.236297	904.7	01Jan2000, 07:10	709.5
DB-R7	0.288016	278.2	01Jan2000, 06:40	27.2
DB-R8	9.553758	2261.3	01Jan2000, 07:45	947.1
EC-5a	0.034016	89.5	01Jan2000, 06:05	3.3
HC-1	1.387700	2013.9	01Jan2000, 06:20	148.1
HC-2	0.152540	214.8	01Jan2000, 06:10	11.4
HC-3	0.142440	152.8	01Jan2000, 06:20	10.6
HC-4	0.083290	91.9	01Jan2000, 06:20	7.2
HC-5	0.388660	356.4	01Jan2000, 06:25	30.4
HC-6	0.166190	166.2	01Jan2000, 06:30	15.6
HC-7	0.084120	136.2	01Jan2000, 06:15	8.3
HC-8	0.640220	388.6	01Jan2000, 07:00	62.8
HC-J6	0.166190	166.2	01Jan2000, 06:30	15.6
HC-J8	1.132010	895.3	01Jan2000, 07:10	103.7
HC-J9	0.000000	0.0	01Jan2000, 00:00	0.0
HC-R1	1.387700	2007.2	01Jan2000, 06:25	148.2
HC-R5	0.090050	113.9	01Jan2000, 07:10	8.9
HC-R6	0.166190	164.8	01Jan2000, 07:00	15.7
HC-R7	0.084120	126.4	01Jan2000, 07:10	8.2
HC-R8	0.000000	0.0	01Jan2000, 00:00	0.0
HC-R9	1.132010	850.7	01Jan2000, 07:50	103.9
IS-1A	0.229000	215.5	01Jan2000, 06:35	22.5
IS-1B	0.242000	137.4	01Jan2000, 07:10	23.7
IS-2	0.330300	155.1	01Jan2000, 07:30	33.8
IS-3	0.547960	206.1	01Jan2000, 08:00	56.1
IS-4	0.122870	66.8	01Jan2000, 07:10	12.1
IS-5	0.105360	154.2	01Jan2000, 06:20	11.7
IS-6	1.124420	341.0	01Jan2000, 08:25	110.3
IS-J	13.738148	4703.2	01Jan2000, 07:40	1361.3

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
IS-J4	1.932120	1776.5	01Jan2000, 07:15	196.6
OA-1	0.158760	354.0	01Jan2000, 06:15	20.6
OA-2	0.212880	363.0	01Jan2000, 06:15	21.8
OA-3	0.144390	236.9	01Jan2000, 06:15	14.2
OA-4	0.198280	588.3	01Jan2000, 06:10	27.8
OA-5	0.056980	151.3	01Jan2000, 06:05	5.8
OA-J1	0.714310	1271.6	01Jan2000, 06:20	84.4
OA-R1	0.158760	349.4	01Jan2000, 06:25	20.7
OA-R2	0.212880	357.5	01Jan2000, 06:25	21.7
OA-R3	0.144390	232.8	01Jan2000, 06:25	14.2
ON-1	0.510650	563.7	01Jan2000, 06:25	48.0
ON-2	0.133490	185.6	01Jan2000, 06:20	12.5
ON-3	0.068890	108.2	01Jan2000, 06:10	5.9
ON-4	0.152100	186.0	01Jan2000, 06:15	11.3
ON-J	2.364320	3673.8	01Jan2000, 06:25	251.5
ON-R1	1.238550	2150.9	01Jan2000, 06:25	131.8
ON-R3	0.068890	106.8	01Jan2000, 06:25	5.9
SA-1	1.085410	1637.6	01Jan2000, 06:25	130.6
SA-2	0.104390	161.7	01Jan2000, 06:10	9.0
SA-3	0.236140	341.2	01Jan2000, 06:15	19.9
SA-4	0.137980	223.4	01Jan2000, 06:15	14.0
SA-5	0.087657	156.0	01Jan2000, 06:10	7.4
SA-6	0.029510	56.0	01Jan2000, 06:05	2.2
SA-7	0.086450	121.0	01Jan2000, 06:10	6.4
SA-J1	1.238890	1843.5	01Jan2000, 06:30	147.3
SA-J5	0.225637	294.4	01Jan2000, 06:20	21.4
SA-J7	0.086450	121.0	01Jan2000, 06:10	6.4
SA-R1	1.238890	1807.2	01Jan2000, 06:40	147.3
SA-R2	0.104390	159.2	01Jan2000, 06:25	9.0
SA-R4	0.137980	219.2	01Jan2000, 06:25	14.0
SA-R7	0.086450	137.3	01Jan2000, 06:25	6.9

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
SN-1	0.932260	1140.5	01Jan2000, 06:30	103.6
SN-2	0.126400	156.4	01Jan2000, 06:15	9.4
SN-3	0.368430	337.2	01Jan2000, 06:30	31.7
SN-4	0.388700	346.9	01Jan2000, 06:30	31.9
SN-5	0.090050	118.5	01Jan2000, 06:20	8.8
SN-6	0.547130	378.2	01Jan2000, 06:55	53.7
SN-7	0.488290	355.1	01Jan2000, 06:50	47.9
SN-8	1.041770	588.4	01Jan2000, 07:10	102.2
SN-J1	1.320960	1402.1	01Jan2000, 06:40	135.7
SN-J2	0.494830	455.0	01Jan2000, 06:40	41.1
SN-J4	1.809250	1740.5	01Jan2000, 06:55	183.7
SN-R1	0.932260	1133.6	01Jan2000, 06:45	103.8
SN-R2	0.126400	153.3	01Jan2000, 06:40	9.5
SN-R3	0.494830	447.0	01Jan2000, 07:10	41.2
SN-R4	1.320960	1390.4	01Jan2000, 06:55	135.8
SN-R7	1.809250	1709.9	01Jan2000, 07:15	184.6
SN-R8	1.041770	584.6	01Jan2000, 08:25	102.9
US70-1	0.153480	345.4	01Jan2000, 06:10	16.4
US70-2	0.727900	1773.3	01Jan2000, 06:10	84.2
US70-J2	1.238550	2164.4	01Jan2000, 06:20	132.0
US70-R1	0.153480	339.8	01Jan2000, 06:35	16.6
US70-R2	0.727900	1680.2	01Jan2000, 06:15	84.0



CB-J10
CB-13
CB-10
CB-12
CB-11
CB-R8
CB-8
CB-J5
CB-9
CB-R4
CB-7
CB-J3
CB-6
CB-5
CB-4
CB-R1
CB-1
CB-3
CB-2

Project: EM Proposed Opt A + Opt B Simulation Run: ClarkBrown 10

Start of Run:	01Jan2000, 00:00	Basin Model:	Clark & Brown
End of Run:	03Jan2000, 00:00	Meteorologic Model:	10-yr
Compute Time:	23Aug2012, 07:57:57	Control Specifications:	24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
CB-1	1.89443	2566.1	01Jan2000, 06:15	163.1
CB-10	0.12669	46.3	01Jan2000, 06:40	5.6
CB-11	0.25441	92.0	01Jan2000, 06:40	11.2
CB-12	2.03426	165.5	01Jan2000, 10:05	89.2
CB-13	0.84804	210.2	01Jan2000, 06:50	30.5
CB-2	0.44105	285.5	01Jan2000, 06:20	20.6
CB-3	0.18752	86.9	01Jan2000, 06:15	5.5
CB-4	0.55311	137.9	01Jan2000, 06:45	18.6
CB-5	0.77055	485.6	01Jan2000, 06:20	38.2
CB-6	1.00767	293.1	01Jan2000, 06:45	38.8
CB-7	0.24111	121.4	01Jan2000, 06:15	7.5
CB-8	1.53184	965.8	01Jan2000, 06:25	80.6
CB-9	0.55717	183.9	01Jan2000, 06:25	16.2
CB-J1	2.33548	2808.7	01Jan2000, 06:25	184.3
CB-J10	4.07540	1932.7	01Jan2000, 06:40	179.0
CB-J3	0.74063	149.3	01Jan2000, 07:20	24.1
CB-J5	7.67296	4965.8	01Jan2000, 06:40	413.6
CB-J9	3.10067	1681.1	01Jan2000, 06:35	142.9
CB-R1	1.89443	2550.6	01Jan2000, 06:25	163.7
CB-R10	4.07540	1918.9	01Jan2000, 06:45	178.7
CB-R2	2.33548	2763.2	01Jan2000, 06:40	184.9
CB-R3	0.18752	80.8	01Jan2000, 07:20	5.5
CB-R4	0.74063	134.9	01Jan2000, 07:50	24.3
CB-R5	0.77055	481.2	01Jan2000, 06:35	38.2
CB-R6	7.67296	3861.3	01Jan2000, 07:15	403.5
CB-R7	0.24111	120.2	01Jan2000, 06:25	7.6

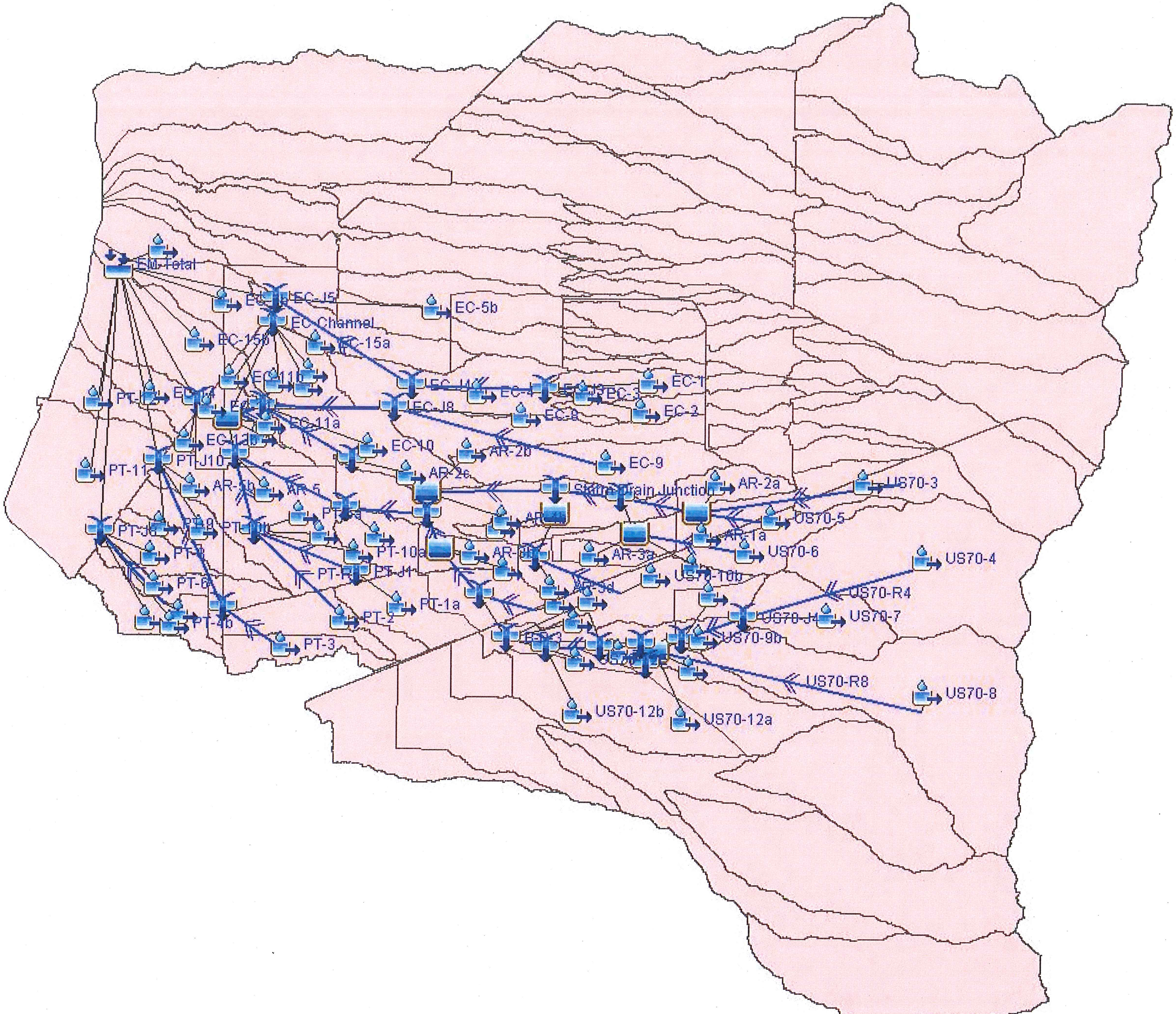
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
CB-R8	1.53184	958.5	01Jan2000, 06:35	80.9
CB-R9	3.10067	1685.2	01Jan2000, 06:40	142.9
CB-Sink	10.44785	3898.8	01Jan2000, 07:15	517.0

Project: EM Proposed Opt A + Opt B Simulation Run: ClarkBrown100

Start of Run: 01Jan2000, 00:00 Basin Model: Clark & Brown
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100-yr
Compute Time: 23Aug2012, 07:58:08 Control Specifications: 24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
CB-1	1.89443	4875.9	01Jan2000, 06:15	295.6
CB-10	0.12669	114.1	01Jan2000, 06:35	12.4
CB-11	0.25441	226.2	01Jan2000, 06:40	25.0
CB-12	2.03426	399.2	01Jan2000, 10:00	199.6
CB-13	0.84804	560.1	01Jan2000, 06:45	72.9
CB-2	0.44105	688.4	01Jan2000, 06:15	45.1
CB-3	0.18752	259.4	01Jan2000, 06:10	14.0
CB-4	0.55311	378.9	01Jan2000, 06:40	45.4
CB-5	0.77055	1150.5	01Jan2000, 06:20	82.2
CB-6	1.00767	760.6	01Jan2000, 06:40	90.6
CB-7	0.24111	349.3	01Jan2000, 06:10	18.9
CB-8	1.53184	2211.6	01Jan2000, 06:25	170.3
CB-9	0.55717	546.4	01Jan2000, 06:20	41.5
CB-J1	2.33548	5375.8	01Jan2000, 06:20	341.5
CB-J10	4.07540	4704.6	01Jan2000, 06:35	399.2
CB-J3	0.74063	557.6	01Jan2000, 07:00	59.1
CB-J5	7.67296	10940.9	01Jan2000, 06:35	858.1
CB-J9	3.10067	4097.5	01Jan2000, 06:30	313.4
CB-R1	1.89443	4759.6	01Jan2000, 06:25	296.3
CB-R10	4.07540	4607.9	01Jan2000, 06:35	399.2
CB-R2	2.33548	5370.9	01Jan2000, 06:35	343.3
CB-R3	0.18752	250.2	01Jan2000, 07:00	13.8
CB-R4	0.74063	496.8	01Jan2000, 07:45	59.6
CB-R5	0.77055	1145.2	01Jan2000, 06:30	82.7
CB-R6	7.67296	9035.8	01Jan2000, 07:00	845.7
CB-R7	0.24111	347.7	01Jan2000, 06:20	19.0

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
CB-R8	1.53184	2209.2	01Jan2000, 06:30	170.1
CB-R9	3.10067	4079.1	01Jan2000, 06:35	313.9
CB-Sink	10.44785	9120.6	01Jan2000, 07:00	1104.8



EM-Total
EC-J5
EC-5b
EC Channel
EC-15b
EC-15a
EC-J4
EC-4
EC-1
EC-3
EC-2
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EC-11a
EC-10
AR-2b
EC-9
AR-2c
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PT-J10
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US70-6
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PT-1a
PT-2
PT-3
PT-6
PT-7
AR-3a
US70-R4
US70-7
US70-9b
US70-R8
US70-8
US70-12b
US70-12a

Project: EM Proposed Opt A Simulation Run: EMoverland10

Start of Run:	01Jan2000, 00:00	Basin Model:	EM-Overland
End of Run:	03Jan2000, 00:00	Meteorologic Model:	10-yr
Compute Time:	23Aug2012, 07:58:31	Control Specifications:	24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Amber Mesa Pond	17.5108350	643.7	01Jan2000, 08:40	647.3
AR-1a	0.2690000	202.6	01Jan2000, 06:20	15.9
AR-1b	0.2180000	129.4	01Jan2000, 06:30	12.9
AR-2a	0.2622500	167.2	01Jan2000, 06:25	13.8
AR-2b	0.7705910	194.5	01Jan2000, 07:20	40.6
AR-2c	0.2664450	122.6	01Jan2000, 06:35	14.0
AR-3a	0.1360000	88.6	01Jan2000, 06:20	6.7
AR-3b	0.2594850	127.6	01Jan2000, 06:30	12.9
AR-3c	0.2977350	156.3	01Jan2000, 06:30	14.8
AR-3d	0.2700000	115.7	01Jan2000, 06:35	13.4
AR-4a	0.0600000	35.9	01Jan2000, 06:20	2.8
AR-4b	0.0680000	55.6	01Jan2000, 06:10	3.2
AR-5	1.0710000	231.1	01Jan2000, 07:15	46.9
AR-5b	0.2200000	56.0	01Jan2000, 07:00	9.6
AR-J2	0.2664450	122.6	01Jan2000, 06:35	14.0
AR-J3 Holman	12.3904360	237.1	01Jan2000, 06:30	417.4
AR-R2	0.2664450	122.3	01Jan2000, 07:00	14.0
AR-R3	12.3904360	233.2	01Jan2000, 07:20	414.4
Arroyo Rd Channel	12.0927010	113.8	02Jan2000, 01:50	402.9
Arroyo Rd Reach	12.0927010	113.8	02Jan2000, 02:00	402.7
B-P 1	6.3076000	192.9	01Jan2000, 08:35	299.2
B-P-1A	6.4136000	194.4	01Jan2000, 08:35	302.5
B-P 2	7.5606000	335.5	01Jan2000, 07:25	340.7
B-P-3	7.8583300	357.2	01Jan2000, 07:15	350.5
Brahman Pond	1.0053700	144.0	01Jan2000, 07:50	79.6
Brahman SD	1.0053700	144.0	01Jan2000, 07:55	80.5

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Butterfield Aux	0.0000000	0.0	01Jan2000, 00:00	0.0
Butterfield Reservoir	6.3076000	192.9	01Jan2000, 08:35	299.2
EC-1	0.2478300	76.4	01Jan2000, 06:45	10.2
EC-10	0.7032500	138.4	01Jan2000, 07:35	32.8
EC-11a	0.0680000	20.4	01Jan2000, 06:50	3.0
EC-11b	0.0600000	18.0	01Jan2000, 06:50	2.6
EC-11c	0.0380000	11.4	01Jan2000, 06:50	1.7
EC-12	0.0752100	43.1	01Jan2000, 06:20	3.3
EC-13	0.3380000	90.0	01Jan2000, 07:00	14.8
EC-13b	0.0400000	16.4	01Jan2000, 06:35	1.8
EC-14	0.3274600	57.7	01Jan2000, 07:45	15.3
EC-15a	0.0260000	20.5	01Jan2000, 06:15	1.2
EC-15b	0.8660000	156.6	01Jan2000, 07:45	40.4
EC-16	0.3505200	70.3	01Jan2000, 07:40	17.4
EC-2	0.2138600	65.4	01Jan2000, 06:45	8.8
EC-3	0.0604100	35.6	01Jan2000, 06:20	2.6
EC-4	0.9144400	184.8	01Jan2000, 07:45	48.1
EC-5b	0.4899700	98.9	01Jan2000, 07:25	21.5
EC-6	0.4904900	128.7	01Jan2000, 07:00	21.5
EC-7a	0.1900000	94.9	01Jan2000, 06:25	8.3
EC-7b	0.3450000	99.1	01Jan2000, 06:55	15.1
EC-8	0.6883200	107.5	01Jan2000, 07:45	28.3
EC-9	0.8062500	153.6	01Jan2000, 07:30	35.3
EC-Channel	18.3525350	722.1	01Jan2000, 07:20	684.3
EC-J10	2.4642650	426.2	01Jan2000, 07:45	110.5
EC-J13	0.0780000	26.3	01Jan2000, 06:40	3.4
EC-J3	0.5221000	156.7	01Jan2000, 06:40	21.6
EC-J4	1.4365400	336.2	01Jan2000, 07:35	69.9
EC-J5	20.2790450	1120.0	01Jan2000, 07:50	775.7
EC-J8	1.4945700	260.2	01Jan2000, 07:50	63.7
EC-R10	2.4642650	425.7	01Jan2000, 07:55	110.6

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
EC-R3	0.5221000	156.1	01Jan2000, 07:30	21.8
EC-R4	1.4365400	335.5	01Jan2000, 07:55	69.9
EC-R8	1.4945700	259.8	01Jan2000, 08:05	63.7
EC-R9	0.8062500	153.5	01Jan2000, 07:50	35.4
EM-Total	25.7703855	2080.5	01Jan2000, 07:45	1041.2
Hanger Lake Culvert North	3.4885810	47.6	01Jan2000, 13:10	169.5
Hanger Lake Culvert South	8.6041200	68.9	02Jan2000, 04:30	233.5
Hanger Lake North	3.4885810	47.6	01Jan2000, 13:10	169.5
Hanger Lake South	8.6041200	68.9	02Jan2000, 04:25	233.5
Osborn J-Pond	7.9356500	415.8	01Jan2000, 07:10	355.4
Porter1	1.1791340	342.5	01Jan2000, 07:05	56.7
Porter2	14.6405700	793.8	01Jan2000, 07:20	518.1
Porter Upper	1.1791340	340.3	01Jan2000, 07:10	56.7
PT-10a	0.1072950	44.2	01Jan2000, 06:35	4.7
PT-10b	0.2826645	84.5	01Jan2000, 06:50	12.4
PT-11	1.3329100	250.1	01Jan2000, 07:45	66.1
PT-12	0.3364900	52.3	01Jan2000, 08:05	15.7
PT-1a	0.4459240	151.0	01Jan2000, 06:50	22.1
PT-1b	0.4089850	129.2	01Jan2000, 06:55	20.3
PT-2	0.1108400	52.2	01Jan2000, 06:40	6.2
PT-3	0.3057100	112.3	01Jan2000, 07:15	21.3
PT-4a	0.4018610	126.0	01Jan2000, 06:50	18.7
PT-4b	0.0409740	40.3	01Jan2000, 06:10	1.9
PT-5a	0.1132140	51.6	01Jan2000, 06:30	5.0
PT-5b	0.0329020	26.0	01Jan2000, 06:10	1.4
PT-6	0.1845900	46.7	01Jan2000, 07:10	8.6
PT-7	0.4416400	71.1	01Jan2000, 08:00	20.6
PT-8	0.2565500	62.5	01Jan2000, 07:10	12.0
PT-9	0.0899300	30.1	01Jan2000, 06:50	4.2
PT-J1	0.4459240	151.0	01Jan2000, 06:50	22.1
PT-J10	0.8983045	180.6	01Jan2000, 07:40	47.6

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
PT-J4	0.3057100	112.1	01Jan2000, 07:25	21.3
PT-J8	0.9566560	175.4	01Jan2000, 07:15	44.6
PT-R1	0.4459240	150.3	01Jan2000, 07:15	22.1
PT-R2	0.1108400	51.7	01Jan2000, 07:10	6.2
PT-R3	0.3057100	112.1	01Jan2000, 07:25	21.3
PT-R4	0.3057100	111.5	01Jan2000, 08:00	21.4
PT-R5	0.0329020	23.3	01Jan2000, 06:55	1.5
SD Junction 2	2.6499900	444.2	01Jan2000, 07:45	167.1
ST-MI	2.9387000	1595.8	01Jan2000, 06:45	143.8
Storm Drain At WEP1	1.8020900	293.9	01Jan2000, 07:45	122.3
Storm Drain Junction	2.6499900	444.4	01Jan2000, 07:45	165.0
US70-10a	0.2007000	113.9	01Jan2000, 06:20	9.4
US70-10b	0.5179000	167.8	01Jan2000, 06:50	24.2
US70-11	0.0773200	60.1	01Jan2000, 06:25	4.8
US70-12a	0.5640000	113.6	01Jan2000, 06:50	17.6
US70-12b	1.0270000	146.2	01Jan2000, 07:20	32.1
US70-12c	0.1911300	50.4	01Jan2000, 06:35	6.0
US70-12D	0.1060000	53.2	01Jan2000, 06:15	3.3
US70-12E	0.1200000	42.1	01Jan2000, 06:25	3.8
US70-3	0.4173000	325.9	01Jan2000, 06:20	24.7
US70-4	1.9580000	1342.0	01Jan2000, 06:20	103.0
US70-5	0.0568200	124.4	01Jan2000, 06:10	6.3
US70-6	0.4427200	185.6	01Jan2000, 06:40	21.9
US70-7	0.6420000	361.9	01Jan2000, 06:20	26.4
US70-8	2.6019000	1309.5	01Jan2000, 06:30	129.0
US70-9a	0.2030000	53.8	01Jan2000, 06:45	7.3
US70-9b	0.1380000	78.6	01Jan2000, 06:15	5.0
US70-9c	0.1066000	51.7	01Jan2000, 06:20	3.8
US70-J10	0.7879000	245.4	01Jan2000, 06:55	37.6
US70-J4	2.6000000	1542.3	01Jan2000, 06:35	129.5
US70-R10	0.5179000	167.0	01Jan2000, 07:05	24.2

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
US70-R11	0.0773200	59.7	01Jan2000, 07:10	4.9
US70-R12	7.9356500	415.2	01Jan2000, 07:25	359.8
US70-R3	0.4173000	317.8	01Jan2000, 07:15	25.0
US70-R4	1.9580000	1339.9	01Jan2000, 06:35	103.1
US70-R5	0.0568200	118.5	01Jan2000, 06:35	6.2
US70-R6	0.4427200	184.9	01Jan2000, 07:00	22.0
US70-R7	2.6000000	1522.5	01Jan2000, 06:45	129.5
US70-R8	2.6019000	1291.1	01Jan2000, 06:45	129.2
US70-R9	6.4136000	194.4	01Jan2000, 08:45	304.8
Wagans SD	1.8020900	293.8	01Jan2000, 07:45	123.9
Wagons East Pond 1	0.7967200	153.0	01Jan2000, 07:25	41.8
Wagons East Pond 2	0.8479000	151.4	01Jan2000, 07:35	41.1

Project: EM Proposed Opt A Simulation Run: EMoverland100

Start of Run: 01Jan2000, 00:00 Basin Model: EM-Overland
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100-yr
Compute Time: 23Aug2012, 07:59:23 Control Specifications: 24-yr storm

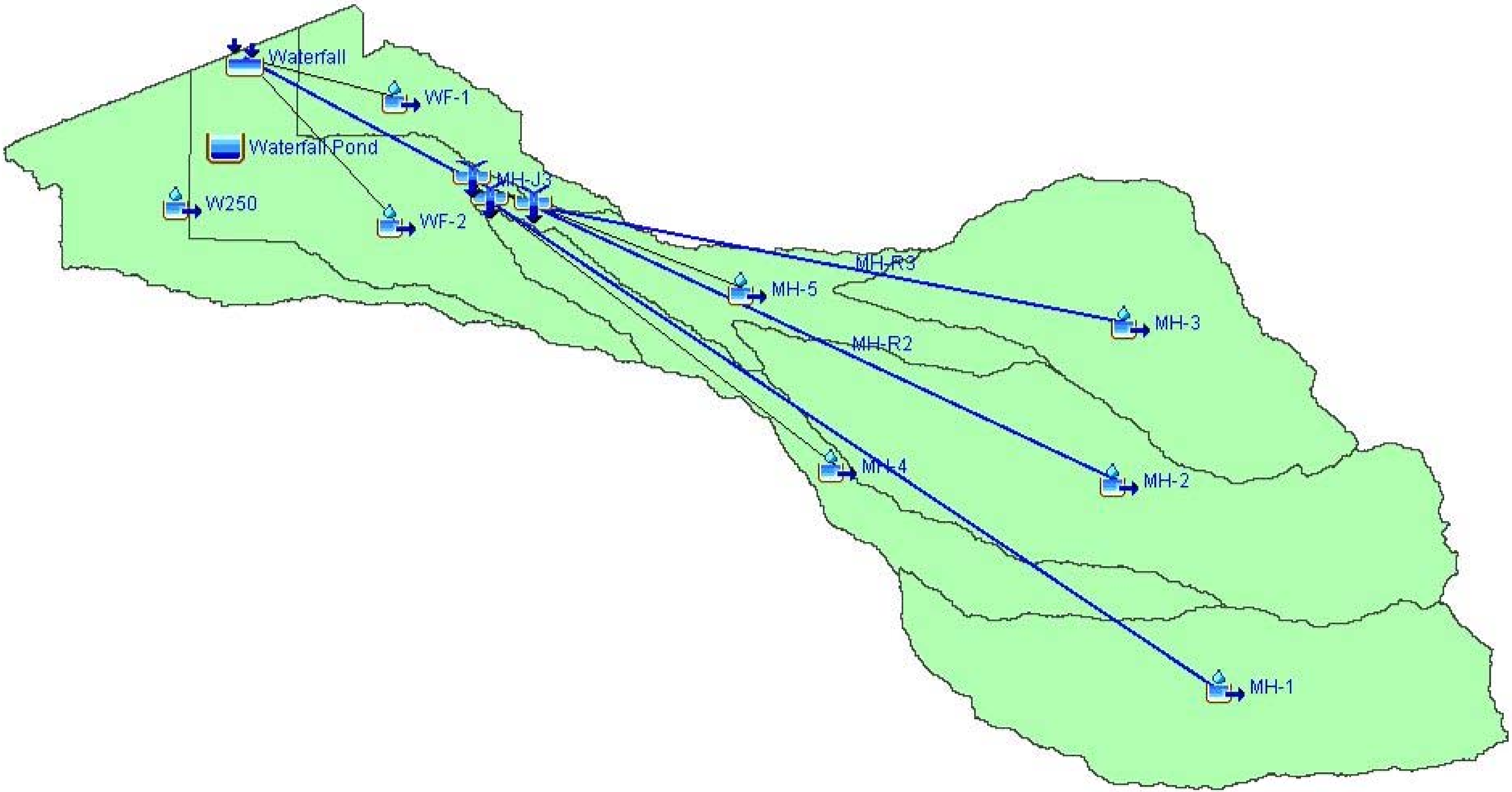
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Amber Mesa Pond	17.5108350	781.9	01Jan2000, 09:20	1026.9
AR-1a	0.2690000	448.8	01Jan2000, 06:20	32.4
AR-1b	0.2180000	285.3	01Jan2000, 06:30	26.2
AR-2a	0.2622500	385.3	01Jan2000, 06:20	29.1
AR-2b	0.7705910	443.7	01Jan2000, 07:20	85.7
AR-2c	0.2664450	282.7	01Jan2000, 06:35	29.6
AR-3a	0.1360000	208.9	01Jan2000, 06:20	14.5
AR-3b	0.2594850	301.0	01Jan2000, 06:30	27.7
AR-3c	0.2977350	369.4	01Jan2000, 06:25	31.8
AR-3d	0.2700000	273.3	01Jan2000, 06:35	28.8
AR-4a	0.0600000	86.9	01Jan2000, 06:20	6.1
AR-4b	0.0680000	135.8	01Jan2000, 06:10	7.0
AR-5	1.0710000	566.2	01Jan2000, 07:15	105.1
AR-5b	0.2200000	137.7	01Jan2000, 07:00	21.6
AR-J2	0.2664450	282.7	01Jan2000, 06:35	29.6
AR-J3 Holman	12.3904360	452.8	01Jan2000, 06:25	517.7
AR-R2	0.2664450	281.0	01Jan2000, 06:55	29.7
AR-R3	12.3904360	444.6	01Jan2000, 07:10	512.0
Arroyo Rd Channel	12.0927010	137.9	02Jan2000, 06:10	486.5
Arroyo Rd Reach	12.0927010	137.9	02Jan2000, 06:15	486.0
B-P 1	6.3076000	613.0	01Jan2000, 08:10	650.3
B-P-1A	6.4136000	616.8	01Jan2000, 08:10	658.6
B-P 2	7.5606000	927.1	01Jan2000, 07:45	750.1
B-P-3	7.8583300	957.1	01Jan2000, 07:45	774.2
Brahman Pond	1.0053700	218.5	01Jan2000, 07:45	141.2
Brahman SD	1.0053700	218.5	01Jan2000, 07:50	142.1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Butterfield Aux	0.0000000	362.4	01Jan2000, 08:10	102.0
Butterfield Reservoir	6.3076000	250.6	01Jan2000, 08:10	548.3
EC-1	0.2478300	192.4	01Jan2000, 06:45	23.3
EC-10	0.7032500	330.5	01Jan2000, 07:30	72.0
EC-11a	0.0680000	50.0	01Jan2000, 06:50	6.7
EC-11b	0.0600000	44.2	01Jan2000, 06:50	5.9
EC-11c	0.0380000	28.0	01Jan2000, 06:50	3.7
EC-12	0.0752100	106.8	01Jan2000, 06:20	7.4
EC-13	0.3380000	220.7	01Jan2000, 06:55	33.2
EC-13b	0.0400000	40.8	01Jan2000, 06:30	3.9
EC-14	0.3274600	137.6	01Jan2000, 07:45	33.5
EC-15a	0.0260000	50.2	01Jan2000, 06:10	2.7
EC-15b	0.8660000	373.6	01Jan2000, 07:40	88.6
EC-16	0.3505200	163.8	01Jan2000, 07:35	37.4
EC-2	0.2138600	165.0	01Jan2000, 06:45	20.1
EC-3	0.0604100	87.7	01Jan2000, 06:20	5.9
EC-4	0.9144400	420.8	01Jan2000, 07:45	101.6
EC-5b	0.4899700	242.2	01Jan2000, 07:20	48.1
EC-6	0.4904900	315.4	01Jan2000, 07:00	48.1
EC-7a	0.1900000	234.5	01Jan2000, 06:25	18.6
EC-7b	0.3450000	243.7	01Jan2000, 06:50	33.8
EC-8	0.6883200	269.1	01Jan2000, 07:40	64.7
EC-9	0.8062500	375.6	01Jan2000, 07:25	79.1
EC-Channel	18.3525350	1089.1	01Jan2000, 06:50	1109.6
EC-J10	2.4642650	1046.0	01Jan2000, 07:40	245.5
EC-J13	0.0780000	65.0	01Jan2000, 06:35	7.7
EC-J3	0.5221000	394.9	01Jan2000, 06:40	49.3
EC-J4	1.4365400	785.7	01Jan2000, 07:25	151.1
EC-J5	20.2790450	1952.7	01Jan2000, 07:35	1308.8
EC-J8	1.4945700	643.8	01Jan2000, 07:45	143.8
EC-R10	2.4642650	1044.7	01Jan2000, 07:45	245.6

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
EC-R3	0.5221000	393.0	01Jan2000, 07:20	49.5
EC-R4	1.4365400	783.0	01Jan2000, 07:45	151.2
EC-R8	1.4945700	643.6	01Jan2000, 07:55	143.8
EC-R9	0.8062500	375.0	01Jan2000, 07:45	79.1
EM-Total	25.7703855	4264.0	01Jan2000, 07:30	1884.2
Hanger Lake Culvert North	3.4885810	60.1	01Jan2000, 17:15	209.9
Hanger Lake Culvert South	8.6041200	83.1	02Jan2000, 16:15	276.5
Hanger Lake North	3.4885810	60.1	01Jan2000, 17:10	209.9
Hanger Lake South	8.6041200	83.1	02Jan2000, 16:15	276.6
Osborn J-Pond	7.9356500	1003.3	01Jan2000, 07:40	783.8
Porter1	1.1791340	836.4	01Jan2000, 07:00	123.2
Porter2	14.6405700	1827.3	01Jan2000, 07:10	740.3
Porter Upper	1.1791340	834.5	01Jan2000, 07:05	123.2
PT-10a	0.1072950	109.6	01Jan2000, 06:30	10.5
PT-10b	0.2826645	207.8	01Jan2000, 06:50	27.7
PT-11	1.3329100	582.6	01Jan2000, 07:45	142.2
PT-12	0.3364900	124.4	01Jan2000, 08:00	34.4
PT-1a	0.4459240	354.3	01Jan2000, 06:50	47.6
PT-1b	0.4089850	302.7	01Jan2000, 06:55	43.6
PT-2	0.1108400	116.9	01Jan2000, 06:40	12.8
PT-3	0.3057100	230.7	01Jan2000, 07:15	41.3
PT-4a	0.4018610	302.9	01Jan2000, 06:50	41.1
PT-4b	0.0409740	98.2	01Jan2000, 06:05	4.2
PT-5a	0.1132140	127.8	01Jan2000, 06:25	11.1
PT-5b	0.0329020	64.8	01Jan2000, 06:10	3.2
PT-6	0.1845900	111.9	01Jan2000, 07:05	18.9
PT-7	0.4416400	169.3	01Jan2000, 07:55	45.2
PT-8	0.2565500	149.7	01Jan2000, 07:10	26.3
PT-9	0.0899300	72.4	01Jan2000, 06:45	9.2
PT-J1	0.4459240	354.3	01Jan2000, 06:50	47.6
PT-J10	0.8983045	435.0	01Jan2000, 07:25	99.8

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
PT-J4	0.3057100	230.3	01Jan2000, 07:20	41.3
PT-J8	0.9566560	411.2	01Jan2000, 07:15	97.8
PT-R1	0.4459240	352.8	01Jan2000, 07:10	47.6
PT-R2	0.1108400	115.9	01Jan2000, 07:05	12.8
PT-R3	0.3057100	230.3	01Jan2000, 07:20	41.3
PT-R4	0.3057100	229.4	01Jan2000, 07:50	41.3
PT-R5	0.0329020	59.2	01Jan2000, 06:45	3.3
SD Junction 2	2.6499900	653.2	01Jan2000, 07:55	322.9
ST-MI	2.9387000	3892.8	01Jan2000, 06:35	310.2
Storm Drain At WEP1	1.8020900	437.8	01Jan2000, 07:45	230.3
Storm Drain Junction	2.6499900	653.5	01Jan2000, 07:50	320.9
US70-10a	0.2007000	277.5	01Jan2000, 06:20	20.5
US70-10b	0.5179000	402.2	01Jan2000, 06:50	53.0
US70-11	0.0773200	130.4	01Jan2000, 06:20	9.7
US70-12a	0.5640000	321.9	01Jan2000, 06:50	44.1
US70-12b	1.0270000	410.1	01Jan2000, 07:20	80.4
US70-12c	0.1911300	143.6	01Jan2000, 06:35	15.0
US70-12D	0.1060000	152.6	01Jan2000, 06:10	8.3
US70-12E	0.1200000	119.6	01Jan2000, 06:20	9.4
US70-3	0.4173000	719.5	01Jan2000, 06:20	50.2
US70-4	1.9580000	3099.5	01Jan2000, 06:20	217.6
US70-5	0.0568200	212.0	01Jan2000, 06:10	10.5
US70-6	0.4427200	435.4	01Jan2000, 06:35	47.2
US70-7	0.6420000	919.2	01Jan2000, 06:15	60.3
US70-8	2.6019000	3080.5	01Jan2000, 06:30	277.6
US70-9a	0.2030000	143.1	01Jan2000, 06:45	17.4
US70-9b	0.1380000	208.5	01Jan2000, 06:15	11.9
US70-9c	0.1066000	138.7	01Jan2000, 06:15	9.2
US70-J10	0.7879000	601.0	01Jan2000, 06:50	81.8
US70-J4	2.6000000	3692.0	01Jan2000, 06:30	277.9
US70-R10	0.5179000	400.9	01Jan2000, 07:00	53.0

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
US70-R11	0.0773200	128.8	01Jan2000, 07:00	9.6
US70-R12	7.9356500	1000.9	01Jan2000, 07:50	787.5
US70-R3	0.4173000	707.9	01Jan2000, 06:55	50.4
US70-R4	1.9580000	3056.7	01Jan2000, 06:30	217.6
US70-R5	0.0568200	204.0	01Jan2000, 06:35	10.6
US70-R6	0.4427200	434.4	01Jan2000, 06:55	47.3
US70-R7	2.6000000	3620.0	01Jan2000, 06:35	277.8
US70-R8	2.6019000	3058.0	01Jan2000, 06:40	277.6
US70-R9	6.4136000	616.7	01Jan2000, 08:15	660.3
Wagans SD	1.8020900	437.6	01Jan2000, 07:50	231.8
Wagons East Pond 1	0.7967200	219.6	01Jan2000, 07:40	88.2
Wagons East Pond 2	0.8479000	215.8	01Jan2000, 07:50	89.1


Waterfall
WF-1
Waterfall Pond
W250
WF-2
MH-J3
MH-R3
MH-5
MH-3
MH-R2
MH-4
MH-2
MH-1

Project: EM Proposed Opt A + Opr B Simulation Run: Waterfall10

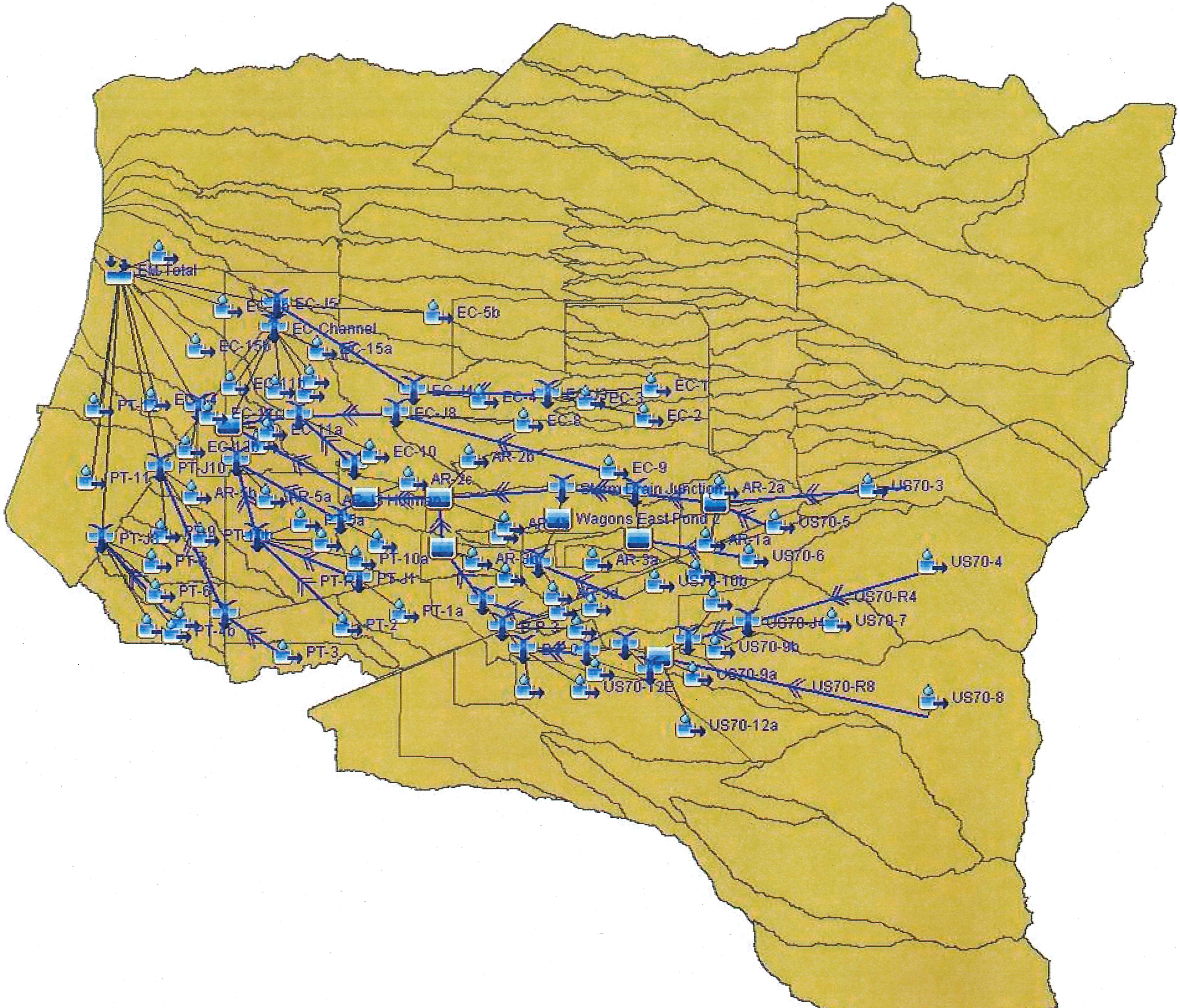
Start of Run: 01Jan2000, 00:00 Basin Model: Waterfall
End of Run: 03Jan2000, 00:00 Meteorologic Model: 10-yr
Compute Time: 23Aug2012, 07:59:39 Control Specifications: 24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
MH-1	1.6396	967.7	01Jan2000, 06:20	73.2
MH-2	1.9112	473.4	01Jan2000, 07:00	80.0
MH-3	1.4416	769.6	01Jan2000, 06:20	60.3
MH-4	0.7632	146.1	01Jan2000, 06:50	22.6
MH-5	0.6261	132.3	01Jan2000, 06:45	18.5
MH-J1	2.4028	1093.2	01Jan2000, 06:55	95.3
MH-J2	3.3528	836.8	01Jan2000, 06:40	140.4
MH-J3	6.3817	1978.9	01Jan2000, 06:50	254.3
MH-R1	1.6396	948.6	01Jan2000, 06:55	72.7
MH-R2	1.9112	471.8	01Jan2000, 07:20	80.1
MH-R3	1.4416	760.7	01Jan2000, 06:35	60.4
W250	0.7104	265.9	01Jan2000, 06:50	38.1
Waterfall	7.6995	2234.9	01Jan2000, 07:05	304.6
Waterfall Pond	0.0000	0.0	01Jan2000, 00:00	0.0
WF-1B	0.2536	115.1	01Jan2000, 06:30	11.3
WF-2	1.0642	249.7	01Jan2000, 06:55	39.0
WF-R1	6.3817	1959.0	01Jan2000, 07:05	254.3

Project: EM Proposed Opt A + Opt B Simulation Run: Waterfall100

Start of Run:	01Jan2000, 00:00	Basin Model:	Waterfall
End of Run:	03Jan2000, 00:00	Meteorologic Model:	100-yr
Compute Time:	23Aug2012, 08:00:10	Control Specifications:	24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
MH-1	1.6396	2390.4	01Jan2000, 06:20	163.7
MH-2	1.9112	1190.8	01Jan2000, 07:00	182.8
MH-3	1.4416	1959.9	01Jan2000, 06:20	137.9
MH-4	0.7632	426.9	01Jan2000, 06:50	57.9
MH-5	0.6261	386.1	01Jan2000, 06:45	47.5
MH-J1	2.4028	2787.8	01Jan2000, 06:45	221.9
MH-J2	3.3528	2140.9	01Jan2000, 06:35	320.9
MH-J3	6.3817	5122.8	01Jan2000, 06:45	590.3
MH-R1	1.6396	2363.7	01Jan2000, 06:45	164.0
MH-R2	1.9112	1188.6	01Jan2000, 07:20	183.0
MH-R3	1.4416	1935.0	01Jan2000, 06:30	137.8
W250	0.7104	608.9	01Jan2000, 06:50	80.4
Waterfall	7.6995	5862.4	01Jan2000, 06:55	709.6
Waterfall Pond	0.0000	0.0	01Jan2000, 00:00	0.0
WF-1B	0.2536	283.7	01Jan2000, 06:30	25.3
WF-2	1.0642	665.1	01Jan2000, 06:50	93.1
WF-R1	6.3817	5063.7	01Jan2000, 06:55	591.2


EC-J5
EC Channel
EC-5b
EC-15b
EC-15a
EC-J8
EC-8
EC-2
EC-11a
EC-10
EC-9
AR-2b
AR-2c
AR-2a
AR-5a
AR-1a
AR-3a
Wagons East Pond 2
US70-3
US70-5
US70-6
US70-4
US70-R4
US70-7
US70-9b
US70-9a
US70-R8
US70-8
US70-10b
US70-12E
US70-12a
PT-J10
PT-11
PT-J8
PT-6
PT-10a
PT-J1
PT-1a
PT-2
PT-3

Project: EM Proposed Option B Simulation Run: EMoverland10

Start of Run: 01Jan2000, 00:00   Basin Model: EM-Overland
End of Run: 03Jan2000, 00:00   Meteorologic Model: 10-yr
Compute Time: 23Aug2012, 10:24:54   Control Specifications: 24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Amber Mesa Pond	17.5108350	630.4	01Jan2000, 08:35	430.7
AR-1a	0.2690000	202.6	01Jan2000, 06:20	15.9
AR-1b	0.2180000	129.4	01Jan2000, 06:30	12.9
AR-2a	0.2622500	167.2	01Jan2000, 06:25	13.8
AR-2b	0.7705910	194.5	01Jan2000, 07:20	40.6
AR-2c	0.2664450	122.6	01Jan2000, 06:35	14.0
AR-3a	0.1360000	88.6	01Jan2000, 06:20	6.7
AR-3b	0.2594850	127.6	01Jan2000, 06:30	12.9
AR-3c	0.2977350	156.3	01Jan2000, 06:30	14.8
AR-3d	0.2700000	115.7	01Jan2000, 06:35	13.4
AR-4a	0.0600000	35.9	01Jan2000, 06:20	2.8
AR-4b	0.0680000	55.6	01Jan2000, 06:10	3.2
AR-5a	1.0710000	231.1	01Jan2000, 07:15	46.9
AR-5b	0.2200000	56.0	01Jan2000, 07:00	9.6
AR-J2	0.0000000	0.0	01Jan2000, 00:00	0.0
AR-J3 Holman	0.2977350	156.3	01Jan2000, 06:30	14.8
AR-R2	0.0000000	0.0	01Jan2000, 00:00	0.0
AR-R3	0.2977350	153.3	01Jan2000, 07:30	15.0
B-P 1	6.3076000	192.9	01Jan2000, 08:35	299.2
B-P-1A	6.4136000	194.4	01Jan2000, 08:35	302.5
B-P 2	7.5606000	335.5	01Jan2000, 07:25	340.7
B-P-3	7.8583300	357.2	01Jan2000, 07:15	350.5
Brahman Pond	1.0053700	144.0	01Jan2000, 07:50	79.6
Brahman SD	1.0053700	144.0	01Jan2000, 07:55	80.4
Butterfield Aux	0.0000000	0.0	01Jan2000, 00:00	0.0
Butterfield Reservoir	6.3076000	192.9	01Jan2000, 08:35	299.2

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
EC-1	0.2478300	76.4	01Jan2000, 06:45	10.2
EC-10	0.7032500	138.4	01Jan2000, 07:35	32.8
EC-11a	0.0680000	20.4	01Jan2000, 06:50	3.0
EC-11b	0.0600000	18.0	01Jan2000, 06:50	2.6
EC-11c	0.0380000	11.4	01Jan2000, 06:50	1.7
EC-12	0.0752100	43.1	01Jan2000, 06:20	3.3
EC-13a	0.3380000	90.0	01Jan2000, 07:00	14.8
EC-13b	0.0400000	16.4	01Jan2000, 06:35	1.8
EC-14	0.3274600	57.7	01Jan2000, 07:45	15.3
EC-15a	0.0260000	20.5	01Jan2000, 06:15	1.2
EC-15b	0.8660000	156.6	01Jan2000, 07:45	40.4
EC-16	0.3505200	70.3	01Jan2000, 07:40	17.4
EC-2	0.2138600	65.4	01Jan2000, 06:45	8.8
EC-3	0.0604100	35.6	01Jan2000, 06:20	2.6
EC-4	0.9144400	184.8	01Jan2000, 07:45	48.1
EC-5b	0.4899700	98.9	01Jan2000, 07:25	21.5
EC-6	0.4904900	128.7	01Jan2000, 07:00	21.5
EC-7a	0.1900000	94.9	01Jan2000, 06:25	8.3
EC-7b	0.3450000	99.1	01Jan2000, 06:55	15.1
EC-8	0.6883200	107.5	01Jan2000, 07:45	28.3
EC-9	0.8062500	153.6	01Jan2000, 07:30	35.3
EC-Channel	18.3525350	710.6	01Jan2000, 07:10	467.6
EC-J10	2.1978200	383.1	01Jan2000, 07:55	96.5
EC-J13	0.0780000	26.3	01Jan2000, 06:40	3.4
EC-J3	0.5221000	156.7	01Jan2000, 06:40	21.6
EC-J4	1.4365400	336.2	01Jan2000, 07:35	69.9
EC-J5	20.2790450	1105.9	01Jan2000, 07:50	559.0
EC-J8	1.4945700	260.2	01Jan2000, 07:50	63.7
EC-R10	2.1978200	382.6	01Jan2000, 08:05	96.5
EC-R3	0.5221000	156.1	01Jan2000, 07:30	21.8
EC-R4	1.4365400	335.5	01Jan2000, 07:55	69.9

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
EC-R8	1.4945700	259.8	01Jan2000, 08:05	63.7
EC-R9	0.8062500	153.5	01Jan2000, 07:50	35.4
EM-Total	25.7703855	2066.1	01Jan2000, 07:45	824.5
Hanger Lake Culvert North	12.0927010	50.5	03Jan2000, 00:00	183.6
Hanger Lake Culvert South	8.6041200	68.9	02Jan2000, 04:30	233.5
Hanger Lake North	12.0927010	50.5	03Jan2000, 00:00	183.8
Hanger Lake South	8.6041200	68.9	02Jan2000, 04:25	233.5
Inspiration Heights	12.3591460	68.6	01Jan2000, 07:35	196.4
Inspiration Heights SD	12.3591460	68.6	01Jan2000, 07:40	195.9
Osborn J-Pond	7.9356500	415.8	01Jan2000, 07:10	355.4
Porter1	1.1791340	342.5	01Jan2000, 07:05	56.7
Porter2	2.5478690	683.4	01Jan2000, 07:25	118.6
Porter Upper	1.1791340	340.3	01Jan2000, 07:10	56.7
PT-10a	0.1072950	44.2	01Jan2000, 06:35	4.7
PT-10b	0.2826645	84.5	01Jan2000, 06:50	12.4
PT-11	1.3329100	250.1	01Jan2000, 07:45	66.1
PT-12	0.3364900	52.3	01Jan2000, 08:05	15.7
PT-1a	0.4459240	151.0	01Jan2000, 06:50	22.1
PT-1b	0.4089850	129.2	01Jan2000, 06:55	20.3
PT-2	0.1108400	52.2	01Jan2000, 06:40	6.2
PT-3	0.3057100	112.3	01Jan2000, 07:15	21.3
PT-4a	0.4018610	126.0	01Jan2000, 06:50	18.7
PT-4b	0.0409740	40.3	01Jan2000, 06:10	1.9
PT-5a	0.1132140	51.6	01Jan2000, 06:30	5.0
PT-5b	0.0329020	26.0	01Jan2000, 06:10	1.4
PT-6	0.1845900	46.7	01Jan2000, 07:10	8.6
PT-7	0.4416400	71.1	01Jan2000, 08:00	20.6
PT-8	0.2565500	62.5	01Jan2000, 07:10	12.0
PT-9	0.0899300	30.1	01Jan2000, 06:50	4.2
PT-J1	0.4459240	151.0	01Jan2000, 06:50	22.1
PT-J10	0.8983045	180.6	01Jan2000, 07:40	47.6

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
PT-J4	0.3057100	112.1	01Jan2000, 07:25	21.3
PT-J8	0.9566560	175.4	01Jan2000, 07:15	44.6
PT-R1	0.4459240	150.3	01Jan2000, 07:15	22.1
PT-R2	0.1108400	51.7	01Jan2000, 07:10	6.2
PT-R3	0.3057100	112.1	01Jan2000, 07:25	21.3
PT-R4	0.3057100	111.5	01Jan2000, 08:00	21.4
PT-R5	0.0329020	23.3	01Jan2000, 06:55	1.5
SD Junction 2	2.6499900	444.8	01Jan2000, 07:45	165.4
ST-MI	2.9387000	1595.8	01Jan2000, 06:45	143.8
Storm Drain At WEP1	1.8020900	294.0	01Jan2000, 07:45	122.2
Storm Drain Junction	2.6499900	444.9	01Jan2000, 07:40	163.7
US70-10a	0.2007000	113.9	01Jan2000, 06:20	9.4
US70-10b	0.5179000	167.8	01Jan2000, 06:50	24.2
US70-11	0.0773200	60.1	01Jan2000, 06:25	4.8
US70-12a	0.5640000	113.6	01Jan2000, 06:50	17.6
US70-12b	1.0270000	146.2	01Jan2000, 07:20	32.1
US70-12c	0.1911300	50.4	01Jan2000, 06:35	6.0
US70-12D	0.1060000	53.2	01Jan2000, 06:15	3.3
US70-12E	0.1200000	42.1	01Jan2000, 06:25	3.8
US70-3	0.4173000	325.9	01Jan2000, 06:20	24.7
US70-4	1.9580000	1342.0	01Jan2000, 06:20	103.0
US70-5	0.0568200	124.4	01Jan2000, 06:10	6.3
US70-6	0.4427200	185.6	01Jan2000, 06:40	21.9
US70-7	0.6420000	361.9	01Jan2000, 06:20	26.4
US70-8	2.6019000	1309.5	01Jan2000, 06:30	129.0
US70-9a	0.2030000	53.8	01Jan2000, 06:45	7.3
US70-9b	0.1380000	78.6	01Jan2000, 06:15	5.0
US70-9c	0.1066000	51.7	01Jan2000, 06:20	3.8
US70-J10	0.7879000	245.4	01Jan2000, 06:55	37.6
US70-J4	2.6000000	1542.3	01Jan2000, 06:35	129.5
US70-R10	0.5179000	167.0	01Jan2000, 07:05	24.2

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
US70-R11	0.0773200	59.7	01Jan2000, 07:10	4.9
US70-R12	7.9356500	415.2	01Jan2000, 07:25	359.8
US70-R3	0.4173000	317.8	01Jan2000, 07:15	25.0
US70-R4	1.9580000	1339.9	01Jan2000, 06:35	103.1
US70-R5	0.0568200	118.5	01Jan2000, 06:35	6.2
US70-R6	0.4427200	184.9	01Jan2000, 07:00	22.0
US70-R7	2.6000000	1522.5	01Jan2000, 06:45	129.5
US70-R8	2.6019000	1291.1	01Jan2000, 06:45	129.2
US70-R9	6.4136000	194.4	01Jan2000, 08:45	304.8
Wagans SD	1.8020900	294.0	01Jan2000, 07:45	122.6
Wagons East Pond 1	0.7967200	153.0	01Jan2000, 07:25	41.8
Wagons East Pond 2	0.8479000	151.4	01Jan2000, 07:35	41.1

Project: EM Proposed Option B Simulation Run: EMoverland100

Start of Run: 01Jan2000, 00:00 Basin Model: EM-Overland
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100-yr
Compute Time: 23Aug2012, 09:54:54 Control Specifications: 24-yr storm

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Amber Mesa Pond	17.5108350	771.5	01Jan2000, 09:15	757.5
AR-1a	0.2690000	448.8	01Jan2000, 06:20	32.4
AR-1b	0.2180000	285.3	01Jan2000, 06:30	26.2
AR-2a	0.2622500	385.3	01Jan2000, 06:20	29.1
AR-2b	0.7705910	443.7	01Jan2000, 07:20	85.7
AR-2c	0.2664450	282.7	01Jan2000, 06:35	29.6
AR-3a	0.1360000	208.9	01Jan2000, 06:20	14.5
AR-3b	0.2594850	301.0	01Jan2000, 06:30	27.7
AR-3c	0.2977350	369.4	01Jan2000, 06:25	31.8
AR-3d	0.2700000	273.3	01Jan2000, 06:35	28.8
AR-4a	0.0600000	86.9	01Jan2000, 06:20	6.1
AR-4b	0.0680000	135.8	01Jan2000, 06:10	7.0
AR-5a	1.0710000	566.2	01Jan2000, 07:15	105.1
AR-5b	0.2200000	137.7	01Jan2000, 07:00	21.6
AR-J2	0.0000000	0.0	01Jan2000, 00:00	0.0
AR-J3 Holman	0.2977350	369.4	01Jan2000, 06:25	31.8
AR-R2	0.0000000	0.0	01Jan2000, 00:00	0.0
AR-R3	0.2977350	362.3	01Jan2000, 07:15	31.9
B-P 1	6.3076000	613.0	01Jan2000, 08:10	650.3
B-P-1A	6.4136000	616.8	01Jan2000, 08:10	658.6
B-P 2	7.5606000	927.1	01Jan2000, 07:45	750.1
B-P-3	7.8583300	957.1	01Jan2000, 07:45	774.2
Brahman Pond	1.0053700	218.5	01Jan2000, 07:45	141.2
Brahman SD	1.0053700	218.4	01Jan2000, 07:50	141.9
Butterfield Aux	0.0000000	362.4	01Jan2000, 08:10	102.0
Butterfield Reservoir	6.3076000	250.6	01Jan2000, 08:10	548.3

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
EC-1	0.2478300	192.4	01Jan2000, 06:45	23.3
EC-10	0.7032500	330.5	01Jan2000, 07:30	72.0
EC-11a	0.0680000	50.0	01Jan2000, 06:50	6.7
EC-11b	0.0600000	44.2	01Jan2000, 06:50	5.9
EC-11c	0.0380000	28.0	01Jan2000, 06:50	3.7
EC-12	0.0752100	106.8	01Jan2000, 06:20	7.4
EC-13a	0.3380000	220.7	01Jan2000, 06:55	33.2
EC-13b	0.0400000	40.8	01Jan2000, 06:30	3.9
EC-14	0.3274600	137.6	01Jan2000, 07:45	33.5
EC-15a	0.0260000	50.2	01Jan2000, 06:10	2.7
EC-15b	0.8660000	373.6	01Jan2000, 07:40	88.6
EC-16	0.3505200	163.8	01Jan2000, 07:35	37.4
EC-2	0.2138600	165.0	01Jan2000, 06:45	20.1
EC-3	0.0604100	87.7	01Jan2000, 06:20	5.9
EC-4	0.9144400	420.8	01Jan2000, 07:45	101.6
EC-5b	0.4899700	242.2	01Jan2000, 07:20	48.1
EC-6	0.4904900	315.4	01Jan2000, 07:00	48.1
EC-7a	0.1900000	234.5	01Jan2000, 06:25	18.6
EC-7b	0.3450000	243.7	01Jan2000, 06:50	33.8
EC-8	0.6883200	269.1	01Jan2000, 07:40	64.7
EC-9	0.8062500	375.6	01Jan2000, 07:25	79.1
EC-Channel	18.3525350	1089.2	01Jan2000, 06:40	840.2
EC-J10	2.1978200	948.9	01Jan2000, 07:45	215.8
EC-J13	0.0780000	65.0	01Jan2000, 06:35	7.7
EC-J3	0.5221000	394.9	01Jan2000, 06:40	49.3
EC-J4	1.4365400	785.7	01Jan2000, 07:25	151.1
EC-J5	20.2790450	1941.1	01Jan2000, 07:35	1039.5
EC-J8	1.4945700	643.8	01Jan2000, 07:45	143.8
EC-R10	2.1978200	948.6	01Jan2000, 07:55	215.8
EC-R3	0.5221000	393.0	01Jan2000, 07:20	49.5
EC-R4	1.4365400	783.0	01Jan2000, 07:45	151.2

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
EC-R8	1.4945700	643.6	01Jan2000, 07:55	143.8
EC-R9	0.8062500	375.0	01Jan2000, 07:45	79.1
EM-Total	25.7703855	4252.2	01Jan2000, 07:30	1614.8
Hanger Lake Culvert North	12.0927010	59.8	03Jan2000, 00:00	213.8
Hanger Lake Culvert South	8.6041200	83.1	02Jan2000, 16:15	276.5
Hanger Lake North	12.0927010	59.9	03Jan2000, 00:00	214.0
Hanger Lake South	8.6041200	83.1	02Jan2000, 16:15	276.6
Inspiration Heights	12.3591460	81.7	01Jan2000, 07:55	240.7
Inspiration Heights SD	12.3591460	81.7	01Jan2000, 08:00	240.1
Osborn J-Pond	7.9356500	1003.3	01Jan2000, 07:40	783.8
Porter1	1.1791340	836.4	01Jan2000, 07:00	123.2
Porter2	2.5478690	1729.7	01Jan2000, 07:10	260.2
Porter Upper	1.1791340	834.5	01Jan2000, 07:05	123.2
PT-10a	0.1072950	109.6	01Jan2000, 06:30	10.5
PT-10b	0.2826645	207.8	01Jan2000, 06:50	27.7
PT-11	1.3329100	582.6	01Jan2000, 07:45	142.2
PT-12	0.3364900	124.4	01Jan2000, 08:00	34.4
PT-1a	0.4459240	354.3	01Jan2000, 06:50	47.6
PT-1b	0.4089850	302.7	01Jan2000, 06:55	43.6
PT-2	0.1108400	116.9	01Jan2000, 06:40	12.8
PT-3	0.3057100	230.7	01Jan2000, 07:15	41.3
PT-4a	0.4018610	302.9	01Jan2000, 06:50	41.1
PT-4b	0.0409740	98.2	01Jan2000, 06:05	4.2
PT-5a	0.1132140	127.8	01Jan2000, 06:25	11.1
PT-5b	0.0329020	64.8	01Jan2000, 06:10	3.2
PT-6	0.1845900	111.9	01Jan2000, 07:05	18.9
PT-7	0.4416400	169.3	01Jan2000, 07:55	45.2
PT-8	0.2565500	149.7	01Jan2000, 07:10	26.3
PT-9	0.0899300	72.4	01Jan2000, 06:45	9.2
PT-J1	0.4459240	354.3	01Jan2000, 06:50	47.6
PT-J10	0.8983045	435.0	01Jan2000, 07:25	99.8

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
PT-J4	0.3057100	230.3	01Jan2000, 07:20	41.3
PT-J8	0.9566560	411.2	01Jan2000, 07:15	97.8
PT-R1	0.4459240	352.8	01Jan2000, 07:10	47.6
PT-R2	0.1108400	115.9	01Jan2000, 07:05	12.8
PT-R3	0.3057100	230.3	01Jan2000, 07:20	41.3
PT-R4	0.3057100	229.4	01Jan2000, 07:50	41.3
PT-R5	0.0329020	59.2	01Jan2000, 06:45	3.3
SD Junction 2	2.6499900	653.3	01Jan2000, 07:50	321.2
ST-MI	2.9387000	3892.8	01Jan2000, 06:35	310.2
Storm Drain At WEP1	1.8020900	437.8	01Jan2000, 07:45	230.1
Storm Drain Junction	2.6499900	653.3	01Jan2000, 07:45	319.6
US70-10a	0.2007000	277.5	01Jan2000, 06:20	20.5
US70-10b	0.5179000	402.2	01Jan2000, 06:50	53.0
US70-11	0.0773200	130.4	01Jan2000, 06:20	9.7
US70-12a	0.5640000	321.9	01Jan2000, 06:50	44.1
US70-12b	1.0270000	410.1	01Jan2000, 07:20	80.4
US70-12c	0.1911300	143.6	01Jan2000, 06:35	15.0
US70-12D	0.1060000	152.6	01Jan2000, 06:10	8.3
US70-12E	0.1200000	119.6	01Jan2000, 06:20	9.4
US70-3	0.4173000	719.5	01Jan2000, 06:20	50.2
US70-4	1.9580000	3099.5	01Jan2000, 06:20	217.6
US70-5	0.0568200	212.0	01Jan2000, 06:10	10.5
US70-6	0.4427200	435.4	01Jan2000, 06:35	47.2
US70-7	0.6420000	919.2	01Jan2000, 06:15	60.3
US70-8	2.6019000	3080.5	01Jan2000, 06:30	277.6
US70-9a	0.2030000	143.1	01Jan2000, 06:45	17.4
US70-9b	0.1380000	208.5	01Jan2000, 06:15	11.9
US70-9c	0.1066000	138.7	01Jan2000, 06:15	9.2
US70-J10	0.7879000	601.0	01Jan2000, 06:50	81.8
US70-J4	2.6000000	3692.0	01Jan2000, 06:30	277.9
US70-R10	0.5179000	400.9	01Jan2000, 07:00	53.0

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
US70-R11	0.0773200	128.8	01Jan2000, 07:00	9.6
US70-R12	7.9356500	1000.9	01Jan2000, 07:50	787.5
US70-R3	0.4173000	707.9	01Jan2000, 06:55	50.4
US70-R4	1.9580000	3056.7	01Jan2000, 06:30	217.6
US70-R5	0.0568200	204.0	01Jan2000, 06:35	10.6
US70-R6	0.4427200	434.4	01Jan2000, 06:55	47.3
US70-R7	2.6000000	3620.0	01Jan2000, 06:35	277.8
US70-R8	2.6019000	3058.0	01Jan2000, 06:40	277.6
US70-R9	6.4136000	616.7	01Jan2000, 08:15	660.3
Wagans SD	1.8020900	437.8	01Jan2000, 07:45	230.6
Wagons East Pond 1	0.7967200	219.6	01Jan2000, 07:40	88.2
Wagons East Pond 2	0.8479000	215.8	01Jan2000, 07:50	89.1

APPENDIX C – HYDRAULIC ANALYSIS RESULTS

Analyzer Report

Hanger Lake

==
Drainage Structure Analyzer

Culvert Hydraulic Analysis

Date: Tuesday, July 17, 2012 11:17:11 AM
==

Input Data

Shape	Circular
Material	RC C76-A
Roughness	0.011000
Entrance Edge	Square edge w/ headwall
Number of Barrels	5
Length	34.00 ft
Slope	1.980%
Tailwater	0.00 ft
Inlet Control Equation	Entrance Loss
Size (W x T):	48.00 x 4.0000
Headwater	6.00 ft

Output Results

Flow Rate	577.3 cfs
Control	Inlet
Capacity	1194.4 cfs
Manning's Velocity	18.84 ft/s
Headwater	6.00 ft
Critical Depth	3.24 ft
Normal Depth	1.96 ft
Size (W x T):	48.00 x 4.0000

Moongate / Pluto
Existg AR-1B
Q_{100}= 285

Analyzer Report

==
Drainage Structure Analyzer

Culvert Hydraulic Analysis

Date: Wednesday, July 18, 2012 8:24:39 AM
==

Input Data

Shape	Circular
Material	CMP-16G EX CUL
Roughness	0.022000
Entrance Edge	Headwall
Number of Barrels	1
Length	70.0000 ft
Slope	1.0000%
Tailwater	0.0000 ft
Inlet Control Equation	Entrance Loss
Size (W x T):	36.00 x 0.0640
Headwater	3.0000 ft

Output Results

Flow Rate	36.3620 cfs
Control	Inlet
Capacity	39.4127 cfs
Manning's Velocity	6.3254 ft/s
Headwater	3.0000 ft
Critical Depth	1.9600 ft
Normal Depth	2.2730 ft
Size (W x T):	36.00 x 0.0640

Moorgate Rd.
@ Hondo
DB-1
Q100 = 111

Analyzer Report

==
Drainage Structure Analyzer

Culvert Hydraulic Analysis

Date: Wednesday, July 18, 2012 8:25:58 AM
==

Input Data

Shape	Circular
Material	CMP-16G EX CUL
Roughness	0.022000
Entrance Edge	Headwall
Number of Barrels	1
Length	60.0000 ft
Slope	1.0000%
Tailwater	0.0000 ft
Inlet Control Equation	Entrance Loss
Size (W x T):	36.00 x 0.0640
Headwater	4.5000 ft

Output Results

Flow Rate	53.2180 cfs
Control	Outlet
Capacity	39.4127 cfs
Outlet Velocity	7.9638 ft/s
Depth At Outlet	2.6850 ft
Headwater	4.5001 ft
Critical Depth	2.3700 ft
Normal Depth	3.0000 ft
Size (W x T):	36.00 x 0.0640

Analyzer Report

==
Drainage Structure Analyzer

Culvert Hydraulic Analysis

Date: Tuesday, July 26, 2011 14:11:08
==

Input Data

Shape	Circular
Material	CMP-12G
Roughness	0.022000
Entrance Edge	Mitered to slope
Number of Barrels	1
Length	160.00 ft
Slope	1.000%
Tailwater	3.00 ft
Inlet Control Equation	Entrance Loss
Size (W x T):	120.00 x 0.1090
Headwater	12.00 ft

Output Results

Flow Rate	912.8 cfs
Control	Outlet
Capacity	977.2 cfs
Outlet Velocity	12.65 ft/s
Depth At Outlet	8.64 ft
Headwater	12.00 ft
Critical Depth	7.28 ft
Normal Depth	7.66 ft
Size (W x T):	120.00 x 0.1090

Analyzer Report

==
Drainage Structure Analyzer

Culvert Hydraulic Analysis

Date: Thursday, July 21, 2011 16:41:35
==

Input Data

Shape	Pipe-Arch
Material	RC C506
Roughness	0.013000
Entrance Edge	Square edge with headwall
Number of Barrels	4
Length	200.00 ft
Slope	1.000%
Tailwater	0.00 ft
Inlet Control Equation	Entrance Loss
Size (S x R x T):	102.00 x 62.00 x 8.0000
Headwater	8.00 ft

Output Results

Flow Rate	1469.8 cfs
Control	Inlet
Capacity	2120.1 cfs
Manning's Velocity	16.65 ft/s
Headwater	8.00 ft
Critical Depth	3.96 ft
Normal Depth	2.91 ft
Size (S x R x T):	102.00 x 62.00 x 8.0000

Analyzer Report

==
Drainage Structure Analyzer

Culvert Hydraulic Analysis

Date: Thursday, September 29, 2011 15:40:05
==

Input Data

Shape	Circular
Material	CMP-16G
Roughness	0.022000
Entrance Edge	Headwall
Number of Barrels	3
Length	20.00 ft
Slope	1.000%
Tailwater	1.00 ft
Inlet Control Equation	Entrance Loss
Size (W x T):	24.00 x 0.0640
Headwater	3.00 ft

Output Results

Flow Rate	60.0 cfs
Control	Outlet
Capacity	40.1 cfs
Outlet Velocity	6.69 ft/s
Depth At Outlet	1.80 ft
Headwater	3.00 ft
Critical Depth	1.61 ft
Normal Depth	2.00 ft
Size (W x T):	24.00 x 0.0640

Analyzer Report

==
Drainage Structure Analyzer

Channel Hydraulic Analysis

Date: Thursday, July 26, 2012 11:14:45 AM
==

Input Data

Shape	Trapezoidal
Material	Bare Soil
Roughness	0.030000
Bottom Width	30.0000 ft
Left Slope	33.3333%
Right Slope	33.3333%
Bed Slope	0.3000%
Flow Rate	1088.0000 cfs

Output Results

Flow Rate	1088.0000 cfs
Depth	4.3025 ft
Velocity	5.8935 ft/s
Top Width	55.8149 ft
Critical Depth	3.0890 ft

Subcritical

EXISTING 36" CMP
HOLMAN

Analyzer Report

==
Drainage Structure Analyzer

Culvert Hydraulic Analysis

Date: Tuesday, July 10, 2012 2:53:20 PM
==

Input Data

Shape	Circular
Material	CMP-16G EX CUL
Roughness	0.022000
Entrance Edge	Headwall
Number of Barrels	1
Length	90.0000 ft
Slope	0.7500%
Tailwater	1.0000 ft
Inlet Control Equation	Entrance Loss
Size (W x T):	36.00 x 0.0640
Headwater	9.0000 ft

Output Results

Flow Rate	80.6790 cfs
Control	Outlet
Capacity	34.1324 cfs
Outlet Velocity	11.5595 ft/s
Depth At Outlet	2.8850 ft
Headwater	9.0001 ft
Critical Depth	2.7700 ft
Normal Depth	3.0000 ft
Size (W x T):	36.00 x 0.0640

Berry Path / Community Center

Analyzer Report

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Drainage Structure Analyzer

Culvert Hydraulic Analysis

Date: Wednesday, July 18, 2012 8:27:06 AM

===

Input Data

Shape	Circular
Material	CMP-16G EX CUL
Roughness	0.022000
Entrance Edge	Headwall
Number of Barrels	2
Length	50.0000 ft
Slope	1.0000%
Tailwater	0.0000 ft
Inlet Control Equation	Entrance Loss
Size (W x T):	24.00 x 0.0640
Headwater	3.0000 ft

Output Results

Flow Rate	36.6690 cfs
Control	Outlet
Capacity	26.7356 cfs
Outlet Velocity	6.2344 ft/s
Depth At Outlet	1.7700 ft
Headwater	3.0001 ft
Critical Depth	1.5400 ft
Normal Depth	2.0000 ft
Size (W x T):	24.00 x 0.0640

```
Reach #1
Brahman Pond to Wagons East Pond 1
Length = 5500 ft
Slope = 1.9%
Q = 220 cfs

=====================================================================
Drainage Structure Analyzer

Pipe Hydraulic Analysis

Date:  Wednesday, August 22, 2012 11:26:39 AM
=====================================================================

Input Data
----------
Shape                                   Circular
Material                                RC C76-A
Roughness                               0.013000
Method                                   Manning
Flow Rate                               220.0000 cfs
Slope                                    1.9000%
Max d/D                                   1.0000

Output Results
--------------
Flow Rate                               220.0000 cfs
Slope                                    1.9000%
d/D                                       0.6838
Capacity                                271.0621 cfs
Velocity                                 18.9850 ft/s
Depth                                     3.0770 ft
Critical Depth                            4.1500 ft
Size (W x T):                     54.00 x 4.5000

Successful completion


Reach #2
Wagons East Pond 1 to Wagons East Pond 2
Length = 1650 ft
Slope = 1.6%
Q = 438 cfs

=====================================================================
Drainage Structure Analyzer

Pipe Hydraulic Analysis

Date:  Wednesday, August 22, 2012 11:27:33 AM
=====================================================================

Input Data
----------
Shape                                   Circular
Material                                RC C76-A
Roughness                               0.013000
Method                                   Manning
Flow Rate                               438.0000 cfs
Slope                                    1.6000%
Max d/D                                   1.0000

Output Results
--------------
Flow Rate                               438.0000 cfs
```

Slope	1.6000%
d/D	0.6875
Capacity	535.7004 cfs
Velocity	21.1334 ft/s
Depth	4.1250 ft
Critical Depth	5.4900 ft
Size (W x T):	72.00 x 6.0000

Successful completion

Reach #3
Wagons East Pond 2 to Outlet into Hanger Lake North
Length = 4400 ft
Slope = 1.4%
Q = 654 cfs

==
Drainage Structure Analyzer

Pipe Hydraulic Analysis

Date: Wednesday, August 22, 2012 11:28:10 AM
==

Input Data

Shape	Circular
Material	RC C76-A
Roughness	0.013000
Method	Manning
Flow Rate	654.0000 cfs
Slope	1.4000%
Max d/D	1.0000

Output Results

Flow Rate	654.0000 cfs
Slope	1.4000%
d/D	0.7181
Capacity	755.8764 cfs
Velocity	22.1082 ft/s
Depth	5.0270 ft
Critical Depth	6.4300 ft
Size (W x T):	84.00 x 7.0000

Successful completion

HEC-RAS Plan: Plan 02 River: BalsamChannel Reach: Entire Reach Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire Reach	2370	PF 1	410.00	4579.47	4582.51		4583.28	0.008145	7.06	58.04	28.24	0.87
Entire Reach	2300	PF 1	410.00	4578.90	4581.93	4581.70	4582.71	0.008174	7.07	57.97	28.22	0.87
Entire Reach	2200	PF 1	410.00	4578.08	4581.11	4580.89	4581.89	0.008176	7.07	57.96	28.21	0.87
Entire Reach	2100	PF 1	410.00	4577.26	4580.30		4581.08	0.008095	7.05	58.13	28.21	0.87
Entire Reach	2000	PF 1	410.00	4576.45	4579.48	4579.26	4580.26	0.008196	7.08	57.90	28.19	0.87
Entire Reach	1900	PF 1	410.00	4575.63	4578.67		4579.44	0.008100	7.05	58.15	28.25	0.87
Entire Reach	1800	PF 1	410.00	4574.82	4577.85	4577.63	4578.63	0.008208	7.08	57.88	28.20	0.87
Entire Reach	1700	PF 1	410.00	4574.00	4577.12		4577.84	0.007337	6.80	60.29	28.70	0.83
Entire Reach	1600	PF 1	410.00	4573.19	4576.70		4577.20	0.004480	5.68	72.23	31.10	0.66
Entire Reach	1500	PF 1	410.00	4572.72	4576.28		4576.76	0.004249	5.57	73.64	31.36	0.64
Entire Reach	1400	PF 1	410.00	4572.28	4575.87		4576.34	0.004116	5.50	74.51	31.54	0.63
Entire Reach	1300	PF 1	410.00	4571.85	4575.48		4575.93	0.003913	5.40	75.90	31.79	0.62
Entire Reach	1200	PF 1	410.00	4571.41	4575.13		4575.55	0.003547	5.21	78.70	32.32	0.59
Entire Reach	1100	PF 1	410.00	4571.07	4574.75		4575.19	0.003721	5.30	77.33	32.07	0.60
Entire Reach	999.9999	PF 1	410.00	4570.73	4574.33		4574.79	0.004089	5.49	74.68	31.55	0.63
Entire Reach	899.9999	PF 1	410.00	4570.40	4573.57		4574.25	0.006821	6.62	61.92	29.04	0.80
Entire Reach	799.9999	PF 1	410.00	4569.58	4572.39	4572.39	4573.36	0.011173	7.93	51.72	26.84	1.01
Entire Reach	699.9999	PF 1	410.00	4567.11	4569.92	4569.92	4570.89	0.011224	7.94	51.63	26.82	1.01
Entire Reach	599.9998	PF 1	410.00	4564.64	4567.45	4567.45	4568.43	0.011192	7.93	51.68	26.83	1.01
Entire Reach	500	PF 1	410.00	4563.44	4567.29		4567.67	0.003074	4.94	82.93	33.08	0.55
Entire Reach	400.0001	PF 1	410.00	4563.15	4566.96		4567.35	0.003214	5.02	81.59	32.85	0.56
Entire Reach	300	PF 1	410.00	4562.87	4566.59		4567.01	0.003549	5.21	78.67	32.31	0.59
Entire Reach	200	PF 1	410.00	4562.59	4565.40	4565.40	4566.37	0.011212	7.94	51.65	26.84	1.01
Entire Reach	99.99998	PF 1	410.00	4561.52	4564.79	4564.33	4565.41	0.006007	6.32	64.86	29.64	0.75

HEC-RAS Plan: PLAN 08 River: BP-HL Channel Reach: Entire Reach Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire Reach	11755	PF 1	613.00	4655.08	4658.09	4658.09	4659.21	0.010668	8.46	72.44	33.08	1.01
Entire Reach	11700	PF 1	613.00	4654.22	4657.23	4657.23	4658.35	0.010668	8.46	72.44	33.08	1.01
Entire Reach	11600	PF 1	613.00	4652.65	4655.70	4655.70	4656.78	0.010198	8.33	73.63	33.30	0.99
Entire Reach	11500	PF 1	613.00	4651.08	4654.12	4654.12	4655.21	0.010311	8.36	73.33	33.23	0.99
Entire Reach	11400	PF 1	613.00	4649.52	4652.54	4652.54	4653.65	0.010653	8.46	72.48	33.09	1.01
Entire Reach	11300	PF 1	613.00	4647.95	4650.96	4650.96	4652.08	0.010733	8.48	72.29	33.05	1.01
Entire Reach	11200	PF 1	613.00	4646.38	4649.43	4649.43	4650.51	0.010197	8.33	73.63	33.30	0.99
Entire Reach	11100	PF 1	613.00	4644.82	4647.83	4647.83	4648.95	0.010660	8.46	72.47	33.08	1.01
Entire Reach	11000	PF 1	613.00	4643.25	4646.27	4646.27	4647.38	0.010668	8.46	72.45	33.08	1.01
Entire Reach	10900	PF 1	613.00	4641.68	4644.68	4644.68	4645.81	0.010924	8.54	71.82	32.95	1.02
Entire Reach	10800	PF 1	613.00	4640.12	4643.16	4643.16	4644.24	0.010363	8.37	73.23	33.25	0.99
Entire Reach	10700	PF 1	613.00	4638.55	4641.57	4641.57	4642.68	0.010634	8.45	72.51	33.06	1.01
Entire Reach	10600	PF 1	613.00	4636.98	4640.00	4640.00	4641.11	0.010638	8.45	72.52	33.79	1.01
Entire Reach	10500	PF 1	613.00	4635.42	4638.46	4638.46	4639.54	0.010354	8.37	73.23	33.22	0.99
Entire Reach	10400	PF 1	613.00	4633.85	4636.89	4636.89	4637.98	0.010367	8.37	73.20	33.22	0.99
Entire Reach	10300	PF 1	613.00	4632.28	4635.29	4635.29	4636.41	0.010712	8.47	72.35	33.07	1.01
Entire Reach	10200	PF 1	613.00	4630.72	4633.77	4633.77	4634.85	0.010253	8.34	73.49	33.28	0.99
Entire Reach	10100	PF 1	613.00	4629.15	4632.17	4632.17	4633.27	0.010645	8.45	72.50	33.09	1.01
Entire Reach	10000	PF 1	613.00	4627.58	4630.60	4630.60	4631.71	0.010627	8.45	72.55	33.11	1.01
Entire Reach	9900	PF 1	613.00	4626.02	4629.03	4629.03	4630.14	0.010672	8.46	72.46	33.10	1.01
Entire Reach	9800	PF 1	613.00	4624.45	4627.47	4627.47	4628.57	0.010624	8.45	72.55	33.10	1.01
Entire Reach	9700	PF 1	613.00	4622.88	4625.90	4625.90	4627.01	0.010667	8.46	72.44	33.07	1.01
Entire Reach	9600	PF 1	613.00	4621.32	4624.33	4624.33	4625.44	0.010678	8.46	72.42	33.08	1.01
Entire Reach	9500	PF 1	613.00	4619.75	4622.77	4622.77	4623.88	0.010652	8.46	72.48	33.08	1.01
Entire Reach	9400	PF 1	613.00	4618.18	4621.20	4621.20	4622.31	0.010665	8.46	72.45	33.08	1.01
Entire Reach	9300	PF 1	613.00	4616.62	4619.63	4619.63	4620.75	0.010686	8.47	72.41	33.08	1.01
Entire Reach	9200	PF 1	613.00	4615.05	4618.07	4618.07	4619.18	0.010636	8.45	72.52	33.09	1.01
Entire Reach	9100	PF 1	613.00	4613.48	4616.50	4616.50	4617.61	0.010631	8.45	72.52	33.08	1.01
Entire Reach	9000	PF 1	613.00	4611.92	4615.65		4616.26	0.004659	6.28	97.64	37.37	0.68
Entire Reach	8900	PF 1	927.00	4610.35	4614.14	4614.14	4615.48	0.009978	9.27	99.98	37.74	1.00
Entire Reach	8799.999	PF 1	927.00	4608.78	4612.60	4612.60	4613.91	0.009688	9.17	101.07	37.92	0.99
Entire Reach	8700	PF 1	927.00	4607.22	4611.05	4611.05	4612.35	0.009611	9.15	101.35	37.96	0.99
Entire Reach	8600	PF 1	927.00	4605.65	4609.44	4609.44	4610.78	0.010044	9.29	99.75	37.71	1.01
Entire Reach	8500	PF 1	927.00	4604.08	4607.87	4607.87	4609.21	0.009981	9.27	99.98	37.75	1.00
Entire Reach	8400	PF 1	927.00	4602.52	4606.31	4606.31	4607.65	0.009979	9.27	99.98	37.75	1.00
Entire Reach	8300	PF 1	927.00	4600.95	4604.74	4604.74	4606.08	0.009979	9.27	99.98	37.75	1.00
Entire Reach	8255	PF 1	927.00	4600.25	4604.63	4604.04	4605.51	0.005272	7.55	123.09	41.28	0.75
Entire Reach	8235		Bridge									

HEC-RAS Plan: PLAN 08 River: BP-HL Channel Reach: Entire Reach Profile: PF 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire Reach	8218	PF 1	927.00	4599.71	4603.50	4603.50	4604.84	0.009978	9.27	99.98	37.75	1.00
Entire Reach	8200	PF 1	927.00	4599.47	4603.26	4603.26	4604.60	0.009985	9.27	99.96	37.75	1.00
Entire Reach	8100	PF 1	927.00	4598.12	4601.91	4601.91	4603.25	0.009979	9.27	99.98	37.75	1.00
Entire Reach	8000	PF 1	927.00	4596.77	4600.56	4600.56	4601.90	0.009989	9.27	99.96	37.75	1.00
Entire Reach	7900	PF 1	927.00	4595.43	4599.22	4599.22	4600.55	0.009970	9.27	100.00	37.74	1.00
Entire Reach	7800	PF 1	927.00	4594.08	4597.87	4597.87	4599.21	0.009975	9.27	100.00	37.75	1.00
Entire Reach	7700	PF 1	927.00	4592.73	4596.52	4596.52	4597.86	0.009979	9.27	99.98	37.75	1.00
Entire Reach	7600	PF 1	927.00	4591.38	4595.17	4595.17	4596.51	0.009992	9.27	99.95	37.75	1.00
Entire Reach	7500	PF 1	927.00	4590.04	4593.83	4593.83	4595.17	0.010033	9.29	99.78	37.71	1.01
Entire Reach	7400	PF 1	927.00	4588.69	4592.47	4592.47	4593.82	0.010056	9.30	99.72	37.72	1.01
Entire Reach	7300	PF 1	927.00	4587.34	4591.16	4591.16	4592.47	0.009686	9.17	101.07	37.92	0.99
Entire Reach	7200	PF 1	927.00	4586.00	4589.80	4589.80	4591.12	0.009894	9.24	100.31	37.81	1.00
Entire Reach	7100	PF 1	927.00	4584.65	4588.47	4588.47	4589.78	0.009701	9.18	101.01	37.91	0.99
Entire Reach	7000	PF 1	927.00	4583.30	4587.12	4587.12	4588.43	0.009677	9.17	101.10	37.93	0.99
Entire Reach	6900	PF 1	927.00	4581.95	4585.78	4585.78	4587.08	0.009620	9.15	101.33	37.97	0.99
Entire Reach	6800	PF 1	927.00	4580.61	4584.43	4584.43	4585.73	0.009652	9.16	101.18	37.93	0.99
Entire Reach	6700	PF 1	927.00	4579.26	4583.08	4583.08	4584.39	0.009659	9.16	101.16	37.93	0.99
Entire Reach	6600	PF 1	927.00	4577.91	4581.73	4581.73	4583.04	0.009683	9.17	101.08	37.93	0.99
Entire Reach	6500	PF 1	927.00	4576.09	4579.91	4579.91	4581.22	0.009737	9.19	100.88	37.89	0.99
Entire Reach	6400	PF 1	927.00	4574.10	4577.93	4577.93	4579.23	0.009611	9.15	101.35	37.96	0.99
Entire Reach	6300	PF 1	927.00	4572.11	4575.88	4575.88	4577.24	0.010228	9.35	99.09	37.61	1.02
Entire Reach	6200	PF 1	927.00	4570.12	4573.94	4573.94	4575.25	0.009692	9.17	101.05	37.92	0.99
Entire Reach	6100	PF 1	927.00	4568.13	4571.96	4571.96	4573.25	0.009598	9.14	101.41	37.98	0.99
Entire Reach	6000	PF 1	927.00	4566.14	4569.96	4569.96	4571.27	0.009667	9.16	101.16	37.95	0.99
Entire Reach	5900	PF 1	927.00	4564.15	4567.97	4567.97	4569.27	0.009702	9.18	101.03	37.93	0.99
Entire Reach	5800	PF 1	927.00	4562.16	4565.95	4565.95	4567.29	0.009962	9.27	100.04	37.77	1.00
Entire Reach	5700	PF 1	927.00	4560.17	4563.57	4563.57	4564.84	0.010042	9.06	102.31	40.39	1.00
Entire Reach	5600	PF 1	927.00	4558.18	4563.37		4563.68	0.001239	4.47	210.67	56.25	0.38
Entire Reach	5585	PF 1	927.00	4557.88	4563.39	4560.94	4563.65	0.000967	4.14	228.66	58.13	0.34
Entire Reach	5575		Culvert									
Entire Reach	5538	PF 1	927.00	4556.94	4560.00	4560.00	4561.22	0.010161	8.85	104.72	43.36	1.00
Entire Reach	5500	PF 1	957.00	4556.19	4559.78		4560.64	0.006053	7.45	128.39	46.57	0.79
Entire Reach	5400	PF 1	957.00	4555.55	4559.25		4560.05	0.005408	7.17	133.56	47.21	0.75
Entire Reach	5300	PF 1	957.00	4555.01	4558.71		4559.51	0.005417	7.17	133.46	47.17	0.75
Entire Reach	5200	PF 1	957.00	4554.46	4558.16		4558.96	0.005450	7.18	133.21	47.17	0.75
Entire Reach	5100	PF 1	957.00	4553.92	4557.62		4558.42	0.005408	7.17	133.53	47.18	0.75
Entire Reach	5000	PF 1	957.00	4553.38	4557.08	4556.52	4557.88	0.005426	7.17	133.39	47.17	0.75
Entire Reach	4900	PF 1	957.00	4552.83	4556.23	4555.98	4557.23	0.007425	8.01	119.47	45.36	0.87

HEC-RAS Plan: PLAN 08 River: BP-HL Channel Reach: Entire Reach Profile: PF 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire Reach	4800	PF 1	957.00	4552.00	4555.16	4555.12	4556.36	0.009708	8.80	108.81	43.95	0.99
Entire Reach	4700	PF 1	957.00	4551.04	4554.68		4555.51	0.005721	7.31	130.94	46.87	0.77
Entire Reach	4600	PF 1	957.00	4550.44	4554.17	4553.57	4554.95	0.005229	7.08	135.14	47.40	0.74
Entire Reach	4500	PF 1	957.00	4549.84	4552.96	4552.96	4554.20	0.010171	8.94	107.06	43.72	1.01
Entire Reach	4400	PF 1	957.00	4545.66	4552.10		4552.24	0.000446	3.19	325.24	72.37	0.24
Entire Reach	4388.387	PF 1	957.00	4545.62	4552.07	4548.74	4552.23	0.000492	3.35	306.06	70.90	0.25
Entire Reach	4236.196		Culvert									
Entire Reach	4117.822	PF 1	957.00	4543.77	4547.54	4547.48	4548.81	0.009221	9.03	106.23	40.57	0.97
Entire Reach	4100	PF 1	957.00	4543.70	4547.43	4547.43	4548.58	0.010097	8.62	111.54	50.61	0.99
Entire Reach	4000	PF 1	957.00	4543.16	4546.95		4547.30	0.001935	4.88	200.83	60.98	0.47
Entire Reach	3900	PF 1	957.00	4540.85	4547.03		4547.16	0.000402	2.98	338.29	76.81	0.23
Entire Reach	3800	PF 1	957.00	4538.67	4547.09		4547.11	0.000055	1.43	763.14	157.31	0.09
Entire Reach	3700	PF 1	957.00	4536.03	4547.09	4538.25	4547.11	0.000021	1.11	996.42	124.64	0.06
Entire Reach	3600	PF 1	957.00	4541.78	4545.89	4545.58	4546.99	0.007283	8.41	113.80	101.30	0.86
Entire Reach	3500	PF 1	1003.00	4541.51	4544.79	4544.76	4546.14	0.009433	9.32	107.66	38.07	0.98
Entire Reach	3400	PF 1	1003.00	4540.56	4543.84	4543.82	4545.19	0.009471	9.33	107.52	38.06	0.98
Entire Reach	3300	PF 1	1003.00	4539.61	4542.89	4542.87	4544.25	0.009477	9.33	107.49	38.06	0.98
Entire Reach	3200	PF 1	1003.00	4538.67	4541.97	4541.93	4543.30	0.009279	9.26	108.26	38.12	0.97
Entire Reach	3100	PF 1	1003.00	4537.72	4540.98	4540.98	4542.35	0.009669	9.39	106.77	38.00	0.99
Entire Reach	3000	PF 1	1003.00	4535.59	4538.85	4538.85	4540.22	0.009695	9.40	106.67	37.99	0.99
Entire Reach	2900	PF 1	1003.00	4533.46	4536.72	4536.72	4538.09	0.009695	9.40	106.67	37.99	0.99
Entire Reach	2800	PF 1	1003.00	4531.33	4534.60	4534.60	4535.96	0.009639	9.38	106.89	38.01	0.99
Entire Reach	2700	PF 1	1003.00	4529.20	4532.46	4532.46	4533.83	0.009699	9.40	106.66	37.99	0.99
Entire Reach	2600	PF 1	1003.00	4527.07	4530.70	4530.32	4531.77	0.006697	8.30	120.84	39.17	0.83
Entire Reach	2500	PF 1	1003.00	4524.94	4531.01	4528.20	4531.32	0.001086	4.44	226.13	47.02	0.36
Entire Reach	2475.025	PF 1	1003.00	4524.41	4531.08	4527.34	4531.25	0.000695	3.34	301.15	77.51	0.28
Entire Reach	2454.118		Culvert									
Entire Reach	2400	PF 1	1003.00	4523.73	4526.68	4526.68	4528.01	0.010163	9.27	108.23	40.96	1.00
Entire Reach	2300	PF 1	1003.00	4520.42	4522.94	4522.94	4524.04	0.010433	8.39	119.49	55.09	1.00
Entire Reach	2200	PF 1	1003.00	4518.58	4521.32	4521.09	4522.22	0.007707	7.59	132.18	56.44	0.87
Entire Reach	2100	PF 1	1003.00	4517.81	4520.60		4521.46	0.007209	7.42	135.17	56.76	0.85
Entire Reach	2000	PF 1	1003.00	4517.01	4519.60	4519.52	4520.62	0.009449	8.12	123.49	55.52	0.96
Entire Reach	1900	PF 1	1003.00	4516.07	4518.67	4518.58	4519.68	0.009213	8.05	124.53	55.63	0.95
Entire Reach	1800	PF 1	1003.00	4515.14	4517.73	4517.64	4518.75	0.009448	8.12	123.50	55.52	0.96
Entire Reach	1700	PF 1	1003.00	4514.20	4517.32		4517.98	0.004917	6.53	153.71	58.68	0.71
Entire Reach	1600	PF 1	1003.00	4513.59	4516.98		4517.52	0.003651	5.90	170.01	60.33	0.62
Entire Reach	1500	PF 1	1003.00	4513.22	4516.61		4517.15	0.003683	5.92	169.54	60.30	0.62
Entire Reach	1400	PF 1	1003.00	4512.86	4516.24		4516.78	0.003687	5.92	169.46	60.28	0.62

HEC-RAS Plan: PLAN 08 River: BP-HL Channel Reach: Entire Reach Profile: PF 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire Reach	1300	PF 1	1003.00	4512.49	4515.87		4516.42	0.003682	5.92	169.53	60.29	0.62
Entire Reach	1200	PF 1	1003.00	4512.12	4515.50		4516.05	0.003676	5.91	169.62	60.28	0.62
Entire Reach	1100	PF 1	1003.00	4511.76	4515.13		4515.68	0.003735	5.94	168.74	60.23	0.63
Entire Reach	999.9998	PF 1	1003.00	4511.39	4514.75		4515.30	0.003776	5.97	168.10	60.15	0.63
Entire Reach	900.0002	PF 1	1003.00	4511.02	4514.35		4514.92	0.003882	6.02	166.51	59.98	0.64
Entire Reach	800	PF 1	1003.00	4510.65	4513.93		4514.51	0.004119	6.15	163.19	59.63	0.65
Entire Reach	700.0002	PF 1	1003.00	4510.29	4513.35		4514.04	0.005213	6.65	150.74	58.39	0.73
Entire Reach	600.0001	PF 1	1003.00	4509.76	4512.52	4512.27	4513.40	0.007507	7.52	133.33	56.55	0.86
Entire Reach	500.0002	PF 1	1003.00	4509.01	4511.77	4511.52	4512.65	0.007488	7.52	133.46	56.58	0.86
Entire Reach	400	PF 1	1003.00	4508.26	4511.02	4510.78	4511.90	0.007510	7.52	133.33	56.58	0.86
Entire Reach	300.0002	PF 1	1003.00	4507.50	4510.26	4510.02	4511.15	0.007566	7.54	133.02	56.56	0.87
Entire Reach	200	PF 1	1003.00	4506.75	4509.52	4509.27	4510.39	0.007437	7.50	133.77	56.62	0.86
Entire Reach	99.99986	PF 1	1003.00	4506.00	4508.75		4509.64	0.007608	7.56	132.75	56.51	0.87
Entire Reach	4.999968	PF 1	1003.00	4505.29	4508.01	4507.79	4508.91	0.007815	7.59	132.15	57.06	0.88

HEC-RAS Plan: Plan 01 River: BT2Channel Reach: Entire Reach Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire Reach	2000	PF 1	77.00	4392.02	4394.38	4393.53	4394.47	0.001216	2.36	33.12	21.00	0.33
Entire Reach	1900	PF 1	77.00	4391.90	4394.26		4394.35	0.001231	2.37	33.00	21.00	0.33
Entire Reach	1800	PF 1	77.00	4391.78	4394.14		4394.22	0.001241	2.38	32.91	21.00	0.33
Entire Reach	1700	PF 1	77.00	4391.66	4394.01		4394.10	0.001259	2.39	32.77	21.00	0.33
Entire Reach	1600	PF 1	77.00	4391.55	4393.88		4393.97	0.001313	2.42	32.35	21.00	0.34
Entire Reach	1500	PF 1	77.00	4391.43	4393.75		4393.84	0.001354	2.44	32.05	21.00	0.34
Entire Reach	1400	PF 1	77.00	4391.31	4393.60		4393.70	0.001424	2.48	31.56	21.00	0.35
Entire Reach	1300	PF 1	77.00	4391.20	4393.45		4393.55	0.001564	2.55	30.66	21.00	0.37
Entire Reach	1200	PF 1	77.00	4391.08	4393.27		4393.38	0.001785	2.65	29.45	21.00	0.39
Entire Reach	1100	PF 1	77.00	4390.96	4393.05		4393.18	0.002263	2.85	27.37	21.00	0.43
Entire Reach	1000	PF 1	77.00	4390.84	4392.56		4392.80	0.006863	3.98	19.45	21.00	0.71
Entire Reach	899.9999	PF 1	77.00	4389.92	4391.44	4391.44	4391.83	0.014491	4.98	15.54	21.00	1.00
Entire Reach	800	PF 1	77.00	4388.49	4390.01	4390.01	4390.40	0.014977	5.03	15.38	21.00	1.01
Entire Reach	700.0001	PF 1	77.00	4387.07	4388.54	4388.59	4388.98	0.017812	5.34	14.46	20.42	1.10
Entire Reach	599.9999	PF 1	77.00	4385.61	4387.17	4387.13	4387.52	0.012578	4.77	16.24	21.00	0.94
Entire Reach	500	PF 1	77.00	4384.54	4386.19		4386.47	0.008572	4.25	18.28	21.00	0.79
Entire Reach	400.0002	PF 1	77.00	4383.68	4385.33		4385.61	0.008763	4.28	18.16	21.00	0.80
Entire Reach	299.9999	PF 1	77.00	4382.82	4384.48		4384.76	0.008299	4.21	18.46	21.00	0.78
Entire Reach	200.0001	PF 1	77.00	4381.97	4383.62		4383.90	0.008587	4.25	18.27	21.00	0.79
Entire Reach	99.99987	PF 1	77.00	4381.11	4382.76		4383.04	0.008795	4.28	18.14	21.00	0.80
Entire Reach	4.999354	PF 1	77.00	4380.30	4381.97	4381.82	4382.24	0.008005	4.16	18.68	21.00	0.76

HEC-RAS Plan: Plan 1 River: BraFRiver Reach: Entire Reach Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire Reach	1665	PF 1	390.00	4709.54	4712.21	4711.66	4712.65	0.004797	5.34	73.10	36.94	0.67
Entire Reach	1600	PF 1	390.00	4709.21	4711.87		4712.33	0.005020	5.47	71.27	35.82	0.68
Entire Reach	1500	PF 1	390.00	4708.70	4711.43		4711.85	0.004429	5.19	75.13	37.25	0.64
Entire Reach	1400	PF 1	390.00	4708.19	4710.30	4710.30	4711.13	0.011682	7.31	53.32	32.79	1.01
Entire Reach	1300	PF 1	390.00	4706.42	4709.06	4708.52	4709.51	0.004967	5.38	72.44	37.08	0.68
Entire Reach	1200	PF 1	390.00	4705.92	4708.55		4709.01	0.005070	5.44	71.76	36.77	0.69
Entire Reach	1100	PF 1	390.00	4705.42	4708.07		4708.51	0.004853	5.32	73.32	37.59	0.67
Entire Reach	1000	PF 1	390.00	4704.92	4707.55		4708.01	0.005091	5.45	71.62	36.71	0.69
Entire Reach	900.0001	PF 1	390.00	4704.42	4707.08		4707.51	0.004767	5.27	73.95	37.89	0.67
Entire Reach	800.0001	PF 1	390.00	4703.91	4706.59		4707.03	0.004756	5.32	73.24	36.88	0.67
Entire Reach	700.0002	PF 1	390.00	4703.41	4706.06		4706.53	0.005121	5.53	70.58	35.48	0.69
Entire Reach	600.0001	PF 1	390.00	4702.91	4705.53		4706.01	0.005338	5.59	69.74	35.55	0.70
Entire Reach	500.0002	PF 1	390.00	4702.38	4705.00		4705.48	0.005298	5.57	70.05	35.74	0.70
Entire Reach	400.0002	PF 1	390.00	4701.85	4704.48		4704.95	0.005224	5.54	70.46	35.89	0.70
Entire Reach	300.0003	PF 1	390.00	4701.32	4703.96		4704.43	0.005125	5.51	70.83	35.83	0.69
Entire Reach	200.0002	PF 1	390.00	4700.79	4703.40		4703.90	0.005453	5.67	68.80	34.87	0.71
Entire Reach	100.0003	PF 1	390.00	4700.26	4702.87		4703.36	0.005365	5.60	69.65	35.57	0.71
Entire Reach	5.000127	PF 1	390.00	4699.76	4702.39	4701.88	4702.85	0.005102	5.46	71.44	36.53	0.69

HEC-RAS Plan: 3 River: El Centro River Reach: El Centro Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
El Centro	13100	PF 1	55.00	4522.39	4523.28	4523.28	4523.65	0.015156	4.90	11.23	15.32	1.01
El Centro	13000	PF 1	55.00	4520.87	4521.76	4521.76	4522.13	0.015237	4.90	11.21	15.32	1.01
El Centro	12900	PF 1	55.00	4519.35	4520.24	4520.23	4520.61	0.015245	4.91	11.21	15.32	1.01
El Centro	12800	PF 1	55.00	4517.83	4518.72	4518.72	4519.09	0.015094	4.89	11.25	15.33	1.01
El Centro	12700	PF 1	55.00	4516.31	4517.20	4517.20	4517.57	0.014942	4.87	11.29	15.35	1.00
El Centro	12600	PF 1	55.00	4514.79	4515.67	4515.67	4516.05	0.015333	4.92	11.19	15.31	1.01
El Centro	12500	PF 1	55.00	4513.27	4514.16	4514.16	4514.53	0.014939	4.87	11.29	15.35	1.00
El Centro	12400	PF 1	55.00	4511.75	4512.64	4512.64	4513.01	0.015095	4.89	11.25	15.33	1.01
El Centro	12300	PF 1	55.00	4510.23	4511.12	4511.12	4511.49	0.015151	4.90	11.24	15.33	1.01
El Centro	12200	PF 1	55.00	4508.71	4509.60	4509.60	4509.97	0.015060	4.88	11.26	15.34	1.00
El Centro	12100	PF 1	55.00	4507.19	4508.08	4508.08	4508.45	0.014916	4.87	11.29	15.35	1.00
El Centro	12000	PF 1	55.00	4505.67	4506.56	4506.56	4506.93	0.014823	4.86	11.32	15.37	1.00
El Centro	11900	PF 1	55.00	4504.15	4505.04	4505.04	4505.41	0.015094	4.89	11.25	15.33	1.01
El Centro	11800	PF 1	55.00	4502.63	4503.52	4503.51	4503.89	0.015217	4.90	11.23	15.35	1.01
El Centro	11700	PF 1	55.00	4501.11	4502.00	4502.00	4502.37	0.015086	4.89	11.25	15.34	1.01
El Centro	11600	PF 1	55.00	4499.59	4500.48	4500.48	4500.85	0.015080	4.89	11.26	15.35	1.01
El Centro	11500	PF 1	55.00	4498.07	4498.96	4498.96	4499.33	0.014823	4.86	11.32	15.37	1.00
El Centro	11400	PF 1	55.00	4496.55	4497.44	4497.44	4497.81	0.015124	4.89	11.24	15.33	1.01
El Centro	11300	PF 1	55.00	4495.03	4495.92	4495.92	4496.29	0.015061	4.89	11.26	15.33	1.00
El Centro	11200	PF 1	55.00	4493.51	4494.40	4494.40	4494.77	0.014798	4.85	11.33	15.37	1.00
El Centro	11100	PF 1	55.00	4491.99	4492.87	4492.87	4493.25	0.015423	4.93	11.17	15.30	1.02
El Centro	11000	PF 1	55.00	4490.47	4491.36	4491.36	4491.73	0.014886	4.87	11.30	15.35	1.00
El Centro	10900	PF 1	55.00	4488.95	4489.83	4489.83	4490.21	0.015390	4.92	11.18	15.30	1.01
El Centro	10800	PF 1	55.00	4487.43	4488.32	4488.32	4488.69	0.015012	4.88	11.27	15.36	1.00
El Centro	10700	PF 1	55.00	4485.91	4486.80	4486.80	4487.17	0.015097	4.89	11.25	15.33	1.01
El Centro	10600	PF 1	55.00	4484.39	4485.28	4485.28	4485.65	0.015061	4.89	11.26	15.34	1.00
El Centro	10500	PF 1	55.00	4482.87	4483.76	4483.75	4484.13	0.014976	4.88	11.28	15.34	1.00
El Centro	10400	PF 1	55.00	4481.35	4482.23	4482.23	4482.61	0.015412	4.92	11.17	15.31	1.02
El Centro	10300	PF 1	55.00	4479.83	4480.72	4480.72	4481.09	0.014929	4.87	11.29	15.36	1.00
El Centro	10200	PF 1	55.00	4478.31	4479.20	4479.20	4479.57	0.014926	4.87	11.29	15.36	1.00
El Centro	10100	PF 1	55.00	4476.79	4477.67	4477.67	4478.05	0.015393	4.92	11.17	15.30	1.02
El Centro	10000	PF 1	55.00	4475.27	4476.16	4476.16	4476.53	0.015116	4.89	11.24	15.33	1.01
El Centro	9900	PF 1	55.00	4473.75	4474.64	4474.64	4475.01	0.015091	4.89	11.25	15.33	1.01
El Centro	9800	PF 1	55.00	4472.23	4473.12	4473.12	4473.49	0.014998	4.88	11.28	15.35	1.00
El Centro	9700	PF 1	55.00	4470.71	4471.60	4471.60	4471.97	0.014887	4.87	11.30	15.35	1.00
El Centro	9600	PF 1	55.00	4469.19	4470.08	4470.08	4470.45	0.015250	4.91	11.21	15.30	1.01
El Centro	9500	PF 1	55.00	4467.67	4468.56	4468.56	4468.93	0.015121	4.89	11.24	15.33	1.01
El Centro	9400	PF 1	55.00	4466.15	4467.04	4467.04	4467.41	0.015059	4.88	11.26	15.34	1.00

HEC-RAS Plan: 3 River: El Centro River Reach: El Centro Profile: PF 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
El Centro	9300	PF 1	55.00	4464.63	4465.52	4465.52	4465.89	0.015153	4.90	11.23	15.32	1.01
El Centro	9200	PF 1	55.00	4463.11	4464.00	4464.00	4464.37	0.015057	4.88	11.26	15.34	1.00
El Centro	9100	PF 1	55.00	4461.59	4462.48	4462.48	4462.85	0.015024	4.88	11.27	15.35	1.00
El Centro	9000	PF 1	55.00	4460.07	4460.96	4460.96	4461.33	0.015126	4.89	11.24	15.33	1.01
El Centro	8900	PF 1	55.00	4458.55	4459.44	4459.44	4459.81	0.014886	4.87	11.30	15.35	1.00
El Centro	8800	PF 1	55.00	4457.03	4457.92	4457.92	4458.29	0.014916	4.87	11.29	15.35	1.00
El Centro	8700	PF 1	55.00	4455.51	4456.40	4456.40	4456.77	0.015027	4.88	11.27	15.35	1.00
El Centro	8600	PF 1	55.00	4453.90	4456.31		4456.34	0.000366	1.32	41.60	24.47	0.18
El Centro	8500	PF 1	644.00	4450.89	4454.44	4454.44	4455.64	0.010573	8.77	73.41	31.31	1.01
El Centro	8400	PF 1	644.00	4449.67	4453.23	4453.23	4454.42	0.010511	8.75	73.57	31.36	1.01
El Centro	8300	PF 1	644.00	4448.45	4452.01	4452.01	4453.20	0.010444	8.73	73.74	31.38	1.00
El Centro	8200	PF 1	644.00	4447.23	4450.79	4450.79	4451.98	0.010544	8.76	73.48	31.33	1.01
El Centro	8100	PF 1	644.00	4446.01	4449.57	4449.57	4450.76	0.010539	8.76	73.50	31.34	1.01
El Centro	8000	PF 1	644.00	4444.79	4448.35	4448.35	4449.54	0.010530	8.76	73.53	31.35	1.01
El Centro	7900	PF 1	644.00	4443.57	4447.13	4447.13	4448.32	0.010537	8.76	73.50	31.34	1.01
El Centro	7800	PF 1	644.00	4442.35	4445.91	4445.91	4447.10	0.010520	8.76	73.54	31.34	1.01
El Centro	7700	PF 1	644.00	4441.13	4444.69	4444.69	4445.88	0.010523	8.76	73.54	31.34	1.01
El Centro	7600	PF 1	644.00	4439.91	4443.47	4443.47	4444.66	0.010489	8.75	73.62	31.36	1.01
El Centro	7500	PF 1	644.00	4438.69	4442.25	4442.25	4443.44	0.010532	8.76	73.51	31.34	1.01
El Centro	7400	PF 1	644.00	4437.47	4441.03	4441.03	4442.22	0.010542	8.76	73.49	31.33	1.01
El Centro	7300	PF 1	644.00	4436.25	4439.81	4439.81	4441.00	0.010516	8.76	73.55	31.35	1.01
El Centro	7200	PF 1	644.00	4435.03	4438.59	4438.59	4439.78	0.010539	8.76	73.50	31.34	1.01
El Centro	7100	PF 1	644.00	4433.81	4437.37	4437.37	4438.56	0.010528	8.76	73.52	31.33	1.01
El Centro	7000	PF 1	644.00	4432.59	4436.15	4436.15	4437.34	0.010543	8.76	73.48	31.33	1.01
El Centro	6900	PF 1	644.00	4431.37	4434.93	4434.93	4436.12	0.010526	8.76	73.53	31.34	1.01
El Centro	6800	PF 1	644.00	4430.15	4433.71	4433.71	4434.90	0.010503	8.75	73.58	31.35	1.01
El Centro	6700	PF 1	644.00	4428.93	4432.49	4432.49	4433.68	0.010489	8.75	73.63	31.37	1.01
El Centro	6600	PF 1	644.00	4427.71	4431.27	4431.27	4432.46	0.010527	8.76	73.52	31.34	1.01
El Centro	6500	PF 1	644.00	4426.49	4430.05	4430.05	4431.24	0.010486	8.75	73.62	31.35	1.01
El Centro	6400	PF 1	644.00	4425.27	4428.83	4428.83	4430.02	0.010507	8.75	73.56	31.33	1.01
El Centro	6300	PF 1	644.00	4424.05	4427.61	4427.61	4428.80	0.010491	8.75	73.62	31.35	1.01
El Centro	6200	PF 1	644.00	4422.83	4426.39	4426.39	4427.58	0.010529	8.76	73.51	31.33	1.01
El Centro	6100	PF 1	644.00	4421.61	4425.17	4425.17	4426.36	0.010539	8.76	73.50	31.34	1.01
El Centro	6000	PF 1	644.00	4420.39	4423.95	4423.95	4425.14	0.010494	8.75	73.61	31.36	1.01
El Centro	5900	PF 1	644.00	4419.17	4422.73	4422.73	4423.92	0.010496	8.75	73.61	31.36	1.01
El Centro	5800	PF 1	644.00	4417.95	4421.51	4421.51	4422.70	0.010560	8.77	73.44	31.32	1.01
El Centro	5700	PF 1	644.00	4416.73	4420.29	4420.29	4421.48	0.010535	8.76	73.48	31.31	1.01
El Centro	5600	PF 1	644.00	4415.53	4419.38		4419.99	0.004711	6.29	102.39	39.36	0.69

HEC-RAS Plan: 3 River: El Centro River Reach: El Centro Profile: PF 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
El Centro	5560.647	PF 1	644.00	4415.12	4419.40	4417.27	4419.67	0.001220	4.23	154.17	36.13	0.36
El Centro	5544		Culvert									
El Centro	5527.549	PF 1	644.00	4415.00	4418.55		4418.98	0.002662	5.25	122.59	34.50	0.49
El Centro	5500	PF 1	644.00	4414.45	4418.15		4418.81	0.004848	6.55	98.36	36.12	0.70
El Centro	5400	PF 1	644.00	4414.11	4417.00	4416.99	4418.09	0.010444	8.36	77.00	35.31	1.00
El Centro	5300	PF 1	644.00	4413.06	4415.94	4415.93	4417.03	0.010604	8.41	76.60	35.26	1.01
El Centro	5200	PF 1	644.00	4412.00	4414.88	4414.88	4415.98	0.010576	8.40	76.65	35.25	1.00
El Centro	5100	PF 1	644.00	4410.95	4413.85	4413.84	4414.92	0.010348	8.34	77.26	35.38	0.99
El Centro	5000	PF 1	644.00	4409.89	4412.77	4412.77	4413.87	0.010572	8.40	76.67	35.26	1.00
El Centro	4900	PF 1	644.00	4408.84	4411.73	4411.72	4412.82	0.010475	8.37	76.92	35.30	1.00
El Centro	4800	PF 1	644.00	4407.78	4410.66	4410.66	4411.76	0.010599	8.41	76.61	35.26	1.01
El Centro	4700	PF 1	644.00	4406.73	4409.62	4409.61	4410.71	0.010477	8.37	76.92	35.31	1.00
El Centro	4600	PF 1	644.00	4405.68	4408.56	4408.56	4409.65	0.010590	8.40	76.65	35.29	1.00
El Centro	4500	PF 1	644.00	4404.62	4407.51	4407.49	4408.60	0.010488	8.38	76.88	35.29	1.00
El Centro	4400	PF 1	644.00	4403.57	4406.45	4406.45	4407.54	0.010599	8.41	76.62	35.27	1.01
El Centro	4300	PF 1	644.00	4402.51	4405.40	4405.38	4406.48	0.010432	8.36	77.04	35.33	1.00
El Centro	4200	PF 1	644.00	4401.46	4404.34	4404.33	4405.43	0.010604	8.41	76.60	35.26	1.01
El Centro	4100	PF 1	644.00	4400.40	4403.28	4403.28	4404.38	0.010525	8.39	76.79	35.28	1.00
El Centro	4000	PF 1	644.00	4399.35	4402.24	4402.23	4403.32	0.010479	8.37	76.93	35.32	1.00
El Centro	3900	PF 1	644.00	4398.29	4401.17	4401.17	4402.27	0.010517	8.38	76.82	35.29	1.00
El Centro	3800	PF 1	644.00	4397.24	4400.13	4400.12	4401.21	0.010471	8.37	76.94	35.31	1.00
El Centro	3700	PF 1	644.00	4396.18	4399.06	4399.05	4400.16	0.010519	8.38	76.81	35.28	1.00
El Centro	3600	PF 1	644.00	4395.13	4398.01	4398.01	4399.10	0.010542	8.39	76.76	35.29	1.00
El Centro	3500	PF 1	644.00	4394.07	4396.96	4396.95	4398.05	0.010428	8.36	77.05	35.33	1.00
El Centro	3400	PF 1	644.00	4393.02	4395.89	4395.89	4396.99	0.010634	8.41	76.54	35.27	1.01
El Centro	3300	PF 1	644.00	4391.96	4394.85	4394.84	4395.94	0.010402	8.35	77.10	35.32	1.00
El Centro	3200	PF 1	644.00	4390.91	4393.78	4393.78	4394.88	0.010661	8.42	76.46	35.24	1.01
El Centro	3100	PF 1	644.00	4389.85	4392.98	4392.72	4393.86	0.007689	7.50	85.84	36.79	0.87
El Centro	3000	PF 1	644.00	4388.80	4392.85		4393.28	0.002875	5.27	122.09	42.30	0.55
El Centro	2900	PF 1	949.00	4387.74	4391.32	4391.32	4392.64	0.010033	9.22	102.94	39.48	1.01
El Centro	2800	PF 1	949.00	4386.69	4390.27	4390.27	4391.59	0.010025	9.21	102.99	39.51	1.01
El Centro	2700	PF 1	949.00	4385.63	4389.22	4389.22	4390.53	0.009995	9.21	103.06	39.47	1.00
El Centro	2600	PF 1	949.00	4384.58	4388.16	4388.16	4389.48	0.010045	9.22	102.91	39.49	1.01
El Centro	2500	PF 1	949.00	4383.52	4387.10	4387.10	4388.42	0.010043	9.22	102.88	39.44	1.01
El Centro	2400	PF 1	949.00	4382.47	4386.05	4386.05	4387.37	0.010033	9.22	102.96	39.50	1.01
El Centro	2300	PF 1	949.00	4381.41	4385.00	4385.00	4386.32	0.010038	9.22	102.95	39.50	1.01
El Centro	2200	PF 1	949.00	4380.36	4383.95	4383.95	4385.26	0.009999	9.21	103.07	39.50	1.00
El Centro	2100	PF 1	949.00	4379.31	4382.89	4382.89	4384.21	0.010086	9.23	102.78	39.48	1.01

HEC-RAS Plan: 3 River: El Centro River Reach: El Centro Profile: PF 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
El Centro	2000	PF 1	949.00	4378.25	4381.83	4381.83	4383.15	0.010043	9.22	102.91	39.48	1.01
El Centro	1900	PF 1	949.00	4377.20	4380.79	4380.79	4382.10	0.009986	9.20	103.14	39.53	1.00
El Centro	1800	PF 1	949.00	4376.14	4379.72	4379.72	4381.04	0.010058	9.23	102.85	39.47	1.01
El Centro	1700	PF 1	949.00	4375.09	4378.67	4378.67	4379.99	0.010038	9.22	102.94	39.49	1.01
El Centro	1600	PF 1	949.00	4374.03	4377.61	4377.61	4378.93	0.010058	9.23	102.84	39.45	1.01
El Centro	1500	PF 1	949.00	4372.98	4376.56	4376.56	4377.88	0.010058	9.23	102.87	39.48	1.01
El Centro	1400	PF 1	949.00	4371.92	4375.50	4375.50	4376.82	0.010026	9.22	102.96	39.47	1.01
El Centro	1300	PF 1	949.00	4370.87	4374.45	4374.45	4375.77	0.010048	9.22	102.90	39.48	1.01
El Centro	1200	PF 1	949.00	4369.81	4373.40	4373.40	4374.71	0.010020	9.21	103.01	39.50	1.01
El Centro	1100	PF 1	949.00	4368.76	4372.34	4372.34	4373.66	0.010033	9.22	102.96	39.50	1.01
El Centro	999.9999	PF 1	949.00	4367.70	4371.28	4371.28	4372.60	0.010093	9.24	102.72	39.44	1.01
El Centro	900.0001	PF 1	949.00	4366.65	4370.23	4370.23	4371.55	0.010006	9.21	103.06	39.51	1.00
El Centro	800	PF 1	949.00	4365.59	4369.17	4369.17	4370.49	0.010045	9.22	102.89	39.46	1.01
El Centro	699.9999	PF 1	949.00	4364.54	4368.12	4368.12	4369.44	0.010088	9.24	102.75	39.46	1.01
El Centro	600.0001	PF 1	949.00	4363.48	4367.06	4367.06	4368.38	0.010050	9.22	102.87	39.46	1.01
El Centro	499.9999	PF 1	949.00	4362.43	4366.01	4366.01	4367.33	0.010049	9.22	102.90	39.49	1.01
El Centro	400.0002	PF 1	949.00	4361.37	4364.95	4364.95	4366.27	0.010047	9.22	102.88	39.46	1.01
El Centro	300	PF 1	949.00	4360.32	4363.90	4363.90	4365.22	0.010035	9.22	102.96	39.50	1.01
El Centro	199.9999	PF 1	949.00	4359.26	4362.85	4362.85	4364.17	0.010031	9.22	102.98	39.51	1.01
El Centro	99.99979	PF 1	949.00	4358.21	4361.80	4361.80	4363.11	0.010003	9.21	103.05	39.49	1.00

HEC-RAS Plan: Plan 01   River: HL2 Channel   Reach: Entire Reach   Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire Reach	3445	PF 1	90.00	4487.64	4489.25	4488.80	4489.32	0.001597	2.35	46.74	52.78	0.36
Entire Reach	3400	PF 1	90.00	4487.46	4489.14		4489.24	0.002092	2.72	41.29	53.56	0.41
Entire Reach	3300	PF 1	90.00	4487.07	4488.75		4488.95	0.003929	3.55	25.32	20.14	0.56
Entire Reach	3200	PF 1	90.00	4486.68	4488.35		4488.55	0.003971	3.57	25.24	20.13	0.56
Entire Reach	3100	PF 1	90.00	4486.28	4487.96		4488.16	0.003921	3.55	25.34	20.13	0.56
Entire Reach	3000	PF 1	90.00	4485.89	4487.57		4487.76	0.003978	3.57	25.22	20.12	0.56
Entire Reach	2900	PF 1	90.00	4485.49	4487.17		4487.37	0.003914	3.55	25.36	20.14	0.56
Entire Reach	2800	PF 1	90.00	4485.10	4486.78		4486.98	0.003937	3.56	25.31	20.13	0.56
Entire Reach	2700	PF 1	90.00	4484.70	4486.40		4486.59	0.003827	3.52	25.56	20.19	0.55
Entire Reach	2600	PF 1	90.00	4484.31	4486.03		4486.22	0.003587	3.44	26.16	20.39	0.54
Entire Reach	2500	PF 1	90.00	4483.91	4485.72		4485.88	0.002951	3.21	28.03	20.92	0.49
Entire Reach	2400	PF 1	90.00	4483.52	4485.50		4485.63	0.002104	2.84	31.64	21.94	0.42
Entire Reach	2300	PF 1	90.00	4483.12	4485.36		4485.45	0.001313	2.40	37.46	23.48	0.34
Entire Reach	2200	PF 1	90.00	4482.73	4485.28		4485.34	0.000785	1.99	45.13	25.38	0.26
Entire Reach	2100	PF 1	90.00	4482.34	4485.23		4485.28	0.000474	1.66	54.22	27.46	0.21
Entire Reach	2000	PF 1	90.00	4481.94	4485.21		4485.24	0.000291	1.39	64.83	29.69	0.17
Entire Reach	1900	PF 1	280.00	4481.61	4484.75		4485.07	0.003318	4.59	61.03	28.92	0.56
Entire Reach	1800	PF 1	280.00	4481.28	4484.42		4484.74	0.003320	4.59	61.02	28.93	0.56
Entire Reach	1700	PF 1	280.00	4480.94	4484.09		4484.41	0.003269	4.56	61.36	28.98	0.55
Entire Reach	1600	PF 1	280.00	4480.61	4483.76		4484.09	0.003246	4.55	61.52	29.01	0.55
Entire Reach	1500	PF 1	280.00	4480.28	4483.44		4483.76	0.003205	4.53	61.81	29.08	0.55
Entire Reach	1400	PF 1	280.00	4479.96	4483.12		4483.44	0.003205	4.53	61.82	29.09	0.55
Entire Reach	1300	PF 1	280.00	4479.64	4482.80		4483.12	0.003196	4.53	61.87	29.09	0.55
Entire Reach	1200	PF 1	280.00	4479.32	4482.48		4482.80	0.003198	4.53	61.87	29.11	0.55
Entire Reach	1100	PF 1	280.00	4479.00	4482.16		4482.48	0.003200	4.53	61.87	29.12	0.55
Entire Reach	1000	PF 1	280.00	4478.68	4481.84		4482.16	0.003197	4.53	61.88	29.11	0.55
Entire Reach	899.9999	PF 1	280.00	4478.36	4481.52		4481.84	0.003200	4.53	61.84	29.09	0.55
Entire Reach	799.9998	PF 1	280.00	4478.04	4481.21		4481.52	0.003186	4.52	62.01	29.19	0.55
Entire Reach	700.0001	PF 1	280.00	4477.72	4480.89		4481.20	0.003190	4.52	61.93	29.11	0.55
Entire Reach	599.9999	PF 1	280.00	4477.39	4480.57		4480.88	0.003189	4.52	61.93	29.12	0.55
Entire Reach	499.9998	PF 1	280.00	4477.08	4480.25		4480.56	0.003186	4.52	61.95	29.11	0.55
Entire Reach	400.0001	PF 1	280.00	4476.76	4479.93		4480.25	0.003183	4.52	61.99	29.14	0.55
Entire Reach	300	PF 1	280.00	4476.43	4479.61		4479.93	0.003170	4.51	62.06	29.13	0.54
Entire Reach	200.0002	PF 1	280.00	4476.11	4479.30		4479.61	0.003128	4.49	62.35	29.18	0.54
Entire Reach	100.0001	PF 1	280.00	4475.79	4478.99		4479.30	0.003066	4.46	62.81	29.28	0.54
Entire Reach	5.000038	PF 1	280.00	4475.49	4478.71	4477.77	4479.01	0.003001	4.42	63.32	29.39	0.53

HEC-RAS Plan: Plan 01 River: Moongate Reach: Entire Reach Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire Reach	3535	PF 1	360.00	4586.44	4588.65	4587.76	4588.85	0.001931	3.70	103.16	53.27	0.44
Entire Reach	3500	PF 1	360.00	4586.38	4588.65		4588.84	0.001757	3.59	106.43	53.71	0.42
Entire Reach	3400	PF 1	360.00	4586.20	4588.48		4588.66	0.001747	3.58	106.61	53.70	0.42
Entire Reach	3300	PF 1	360.00	4586.03	4588.30		4588.49	0.001759	3.59	106.39	53.70	0.42
Entire Reach	3200	PF 1	360.00	4585.85	4588.13		4588.31	0.001718	3.56	107.69	54.51	0.41
Entire Reach	3100	PF 1	360.00	4585.68	4587.95		4588.14	0.001757	3.59	106.44	53.70	0.42
Entire Reach	3000	PF 1	360.00	4585.50	4587.78		4587.96	0.001742	3.58	106.71	53.71	0.42
Entire Reach	2900	PF 1	360.00	4585.33	4587.60		4587.79	0.001757	3.59	106.44	53.71	0.42
Entire Reach	2800	PF 1	360.00	4585.15	4587.43		4587.61	0.001746	3.58	106.62	53.71	0.42
Entire Reach	2700	PF 1	360.00	4584.98	4587.25		4587.44	0.001762	3.59	106.33	53.70	0.42
Entire Reach	2600	PF 1	360.00	4584.80	4587.08		4587.26	0.001749	3.58	106.57	53.70	0.42
Entire Reach	2500	PF 1	360.00	4584.62	4586.90		4587.09	0.001761	3.59	106.36	53.69	0.42
Entire Reach	2400	PF 1	360.00	4584.45	4586.72		4586.91	0.001755	3.59	106.45	53.68	0.42
Entire Reach	2300	PF 1	360.00	4584.27	4586.55		4586.74	0.001749	3.58	106.56	53.70	0.42
Entire Reach	2200	PF 1	360.00	4584.10	4586.37		4586.56	0.001758	3.59	106.39	53.68	0.42
Entire Reach	2100	PF 1	360.00	4583.92	4586.20		4586.38	0.001744	3.58	106.67	53.71	0.42
Entire Reach	2000	PF 1	360.00	4583.75	4586.02		4586.21	0.001756	3.59	106.47	53.71	0.42
Entire Reach	1900	PF 1	360.00	4583.57	4585.85		4586.03	0.001745	3.58	106.63	53.69	0.42
Entire Reach	1800	PF 1	360.00	4583.40	4585.67		4585.86	0.001754	3.59	106.51	53.72	0.42
Entire Reach	1700	PF 1	360.00	4583.22	4585.50		4585.69	0.001745	3.58	106.63	53.71	0.42
Entire Reach	1600	PF 1	360.00	4583.05	4585.32		4585.51	0.001755	3.59	106.49	53.72	0.42
Entire Reach	1500	PF 1	360.00	4582.87	4585.15		4585.33	0.001746	3.58	106.62	53.69	0.42
Entire Reach	1400	PF 1	360.00	4582.70	4584.97		4585.16	0.001758	3.59	106.43	53.72	0.42
Entire Reach	1300	PF 1	360.00	4582.52	4584.80		4584.98	0.001744	3.58	106.67	53.72	0.42
Entire Reach	1200	PF 1	360.00	4582.35	4584.62		4584.81	0.001759	3.59	106.41	53.72	0.42
Entire Reach	1100	PF 1	360.00	4582.17	4584.45		4584.63	0.001748	3.58	106.59	53.71	0.42
Entire Reach	1000	PF 1	360.00	4582.00	4584.27		4584.46	0.001764	3.59	106.31	53.70	0.42
Entire Reach	900.0002	PF 1	360.00	4581.82	4584.09		4584.28	0.001752	3.58	106.51	53.70	0.42
Entire Reach	799.9999	PF 1	360.00	4581.65	4583.92		4584.11	0.001771	3.60	106.16	53.69	0.42
Entire Reach	699.9999	PF 1	360.00	4581.47	4583.74		4583.93	0.001762	3.59	106.35	53.70	0.42
Entire Reach	599.9998	PF 1	360.00	4581.29	4583.56		4583.75	0.001753	3.59	106.49	53.70	0.42
Entire Reach	500.0002	PF 1	360.00	4581.12	4583.39		4583.58	0.001774	3.60	106.09	53.66	0.42
Entire Reach	400.0001	PF 1	360.00	4580.94	4583.21		4583.40	0.001766	3.59	106.24	53.68	0.42
Entire Reach	300.0001	PF 1	360.00	4580.77	4583.04		4583.22	0.001757	3.58	106.89	54.40	0.42
Entire Reach	199.9997	PF 1	360.00	4580.59	4582.86		4583.04	0.001776	3.60	106.03	53.65	0.42
Entire Reach	99.9997	PF 1	360.00	4580.42	4582.68	4581.74	4582.87	0.001800	3.61	105.65	53.72	0.42

HEC-RAS Plan: Updated River: Porter Channel Reach: Entire Reach Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire Reach	7800	PF 1	836.00	4414.81	4418.08		4418.49	0.002881	5.13	162.83	59.61	0.55
Entire Reach	7700	PF 1	836.00	4414.52	4417.79		4418.20	0.002876	5.13	162.94	59.63	0.55
Entire Reach	7600	PF 1	836.00	4414.23	4417.50		4417.91	0.002872	5.13	162.95	59.58	0.55
Entire Reach	7500	PF 1	836.00	4413.95	4417.21		4417.62	0.002906	5.15	162.36	59.57	0.55
Entire Reach	7400	PF 1	836.00	4413.66	4416.92		4417.33	0.002910	5.15	162.26	59.54	0.55
Entire Reach	7300	PF 1	836.00	4413.37	4416.63		4417.04	0.002927	5.16	161.93	59.50	0.55
Entire Reach	7200	PF 1	836.00	4413.09	4416.32		4416.74	0.002994	5.20	160.74	59.41	0.56
Entire Reach	7100	PF 1	836.00	4412.80	4416.01		4416.44	0.003064	5.24	159.48	59.28	0.56
Entire Reach	7000	PF 1	836.00	4412.51	4415.69		4416.13	0.003194	5.32	157.22	59.02	0.57
Entire Reach	6900	PF 1	836.00	4412.21	4415.35		4415.80	0.003335	5.39	154.97	58.81	0.59
Entire Reach	6800	PF 1	836.00	4411.88	4415.01		4415.46	0.003360	5.41	154.58	58.78	0.59
Entire Reach	6700	PF 1	836.00	4411.54	4414.68		4415.13	0.003342	5.40	154.86	58.80	0.59
Entire Reach	6600	PF 1	836.00	4411.21	4414.34		4414.79	0.003363	5.41	154.57	58.80	0.59
Entire Reach	6500	PF 1	836.00	4410.87	4414.00		4414.46	0.003341	5.40	154.88	58.82	0.59
Entire Reach	6400	PF 1	836.00	4410.54	4413.67		4414.12	0.003376	5.42	154.35	58.77	0.59
Entire Reach	6300	PF 1	836.00	4410.20	4413.33		4413.78	0.003362	5.41	154.56	58.78	0.59
Entire Reach	6200	PF 1	836.00	4409.86	4413.00		4413.45	0.003336	5.40	154.96	58.82	0.59
Entire Reach	6100	PF 1	836.00	4409.53	4412.66		4413.11	0.003362	5.41	154.57	58.79	0.59
Entire Reach	6000	PF 1	836.00	4409.19	4412.33		4412.78	0.003342	5.40	154.85	58.79	0.59
Entire Reach	5900	PF 1	836.00	4408.86	4411.99		4412.44	0.003358	5.41	154.64	58.80	0.59
Entire Reach	5800	PF 1	836.00	4408.52	4411.65		4412.11	0.003348	5.40	154.76	58.79	0.59
Entire Reach	5700	PF 1	836.00	4408.19	4411.32		4411.77	0.003369	5.41	154.47	58.80	0.59
Entire Reach	5600	PF 1	836.00	4407.85	4410.98		4411.43	0.003362	5.41	154.56	58.78	0.59
Entire Reach	5500	PF 1	836.00	4407.51	4410.65		4411.10	0.003336	5.40	154.95	58.82	0.59
Entire Reach	5400	PF 1	836.00	4407.18	4410.31		4410.76	0.003366	5.41	154.50	58.77	0.59
Entire Reach	5300	PF 1	836.00	4406.84	4409.97		4410.43	0.003348	5.40	154.77	58.79	0.59
Entire Reach	5200	PF 1	836.00	4406.51	4409.64		4410.09	0.003376	5.42	154.36	58.78	0.59
Entire Reach	5100	PF 1	836.00	4406.17	4409.30		4409.75	0.003368	5.41	154.45	58.75	0.59
Entire Reach	5000	PF 1	836.00	4405.84	4408.95		4409.41	0.003418	5.44	153.72	58.71	0.59
Entire Reach	4900	PF 1	836.00	4405.50	4408.60		4409.07	0.003460	5.46	153.04	58.61	0.60
Entire Reach	4800	PF 1	836.00	4405.17	4408.23		4408.71	0.003623	5.55	150.71	58.39	0.61
Entire Reach	4700	PF 1	836.00	4404.83	4407.83		4408.33	0.003901	5.69	147.00	58.00	0.63
Entire Reach	4600	PF 1	836.00	4404.49	4407.31		4407.89	0.004879	6.13	136.33	56.86	0.70
Entire Reach	4500	PF 1	836.00	4404.01	4406.79		4407.39	0.005127	6.24	134.06	56.60	0.71
Entire Reach	4400	PF 1	836.00	4403.50	4406.27		4406.87	0.005186	6.26	133.60	56.60	0.72
Entire Reach	4300	PF 1	836.00	4402.98	4405.75		4406.36	0.005169	6.25	133.73	56.59	0.72
Entire Reach	4200	PF 1	836.00	4402.46	4405.24		4405.84	0.005132	6.24	134.03	56.61	0.71
Entire Reach	4100	PF 1	836.00	4401.95	4404.72		4405.32	0.005189	6.26	133.59	56.61	0.72

HEC-RAS Plan: Updated River: Porter Channel Reach: Entire Reach Profile: PF 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire Reach	4000	PF 1	836.00	4401.43	4404.20		4404.80	0.005195	6.26	133.51	56.58	0.72
Entire Reach	3900	PF 1	836.00	4400.91	4403.68		4404.29	0.005169	6.25	133.75	56.62	0.72
Entire Reach	3800	PF 1	836.00	4400.39	4403.17		4403.77	0.005127	6.23	134.09	56.63	0.71
Entire Reach	3700	PF 1	836.00	4399.88	4402.65		4403.25	0.005193	6.26	133.55	56.60	0.72
Entire Reach	3600	PF 1	836.00	4399.36	4402.13		4402.74	0.005165	6.25	133.78	56.62	0.72
Entire Reach	3500	PF 1	836.00	4398.84	4401.62		4402.22	0.005122	6.23	134.14	56.64	0.71
Entire Reach	3400	PF 1	836.00	4398.33	4401.10		4401.70	0.005196	6.26	133.52	56.59	0.72
Entire Reach	3300	PF 1	836.00	4397.81	4400.58		4401.18	0.005186	6.26	133.60	56.60	0.72
Entire Reach	3200	PF 1	836.00	4397.29	4400.06		4400.67	0.005176	6.25	133.68	56.60	0.72
Entire Reach	3100	PF 1	836.00	4396.77	4399.55		4400.15	0.005124	6.23	134.12	56.63	0.71
Entire Reach	3000	PF 1	836.00	4396.26	4399.03		4399.64	0.005164	6.25	133.79	56.62	0.72
Entire Reach	2900	PF 1	836.00	4395.74	4398.52		4399.12	0.005092	6.22	134.43	56.70	0.71
Entire Reach	2800	PF 1	836.00	4395.22	4398.03		4398.62	0.004911	6.14	136.05	56.85	0.70
Entire Reach	2700	PF 1	836.00	4394.71	4397.57	4396.95	4398.13	0.004588	6.01	139.22	57.21	0.68
Entire Reach	2600	PF 1	836.00	4394.19	4396.44	4396.44	4397.42	0.010724	7.97	104.93	53.47	1.00
Entire Reach	2500	PF 1	836.00	4393.58	4396.65		4396.79	0.000987	3.06	273.58	98.39	0.32
Entire Reach	2400	PF 1	1730.00	4392.92	4395.60		4396.44	0.006688	7.33	236.03	96.09	0.82
Entire Reach	2300	PF 1	1730.00	4392.25	4394.94		4395.77	0.006600	7.30	237.01	96.13	0.82
Entire Reach	2200	PF 1	1730.00	4391.59	4394.28		4395.11	0.006588	7.29	237.15	96.14	0.82
Entire Reach	2100	PF 1	1730.00	4390.93	4393.62		4394.45	0.006609	7.30	236.92	96.15	0.82
Entire Reach	2000	PF 1	1730.00	4390.27	4392.95		4393.79	0.006677	7.33	236.17	96.12	0.82
Entire Reach	1900	PF 1	1730.00	4389.60	4392.29		4393.12	0.006600	7.30	237.01	96.13	0.82
Entire Reach	1800	PF 1	1730.00	4388.94	4391.63		4392.46	0.006596	7.30	237.06	96.14	0.82
Entire Reach	1700	PF 1	1730.00	4388.28	4390.97		4391.80	0.006605	7.30	236.96	96.15	0.82
Entire Reach	1600	PF 1	1730.00	4387.62	4390.30		4391.14	0.006677	7.33	236.17	96.12	0.82
Entire Reach	1500	PF 1	1730.00	4386.95	4389.64		4390.47	0.006600	7.30	237.01	96.13	0.82
Entire Reach	1400	PF 1	1730.00	4386.29	4388.98		4389.81	0.006600	7.30	237.01	96.13	0.82
Entire Reach	1300	PF 1	1730.00	4385.63	4388.32		4389.15	0.006601	7.30	237.01	96.15	0.82
Entire Reach	1200	PF 1	1730.00	4384.97	4387.65		4388.49	0.006681	7.33	236.13	96.12	0.82
Entire Reach	1100	PF 1	1730.00	4384.30	4386.99		4387.82	0.006596	7.30	237.06	96.14	0.82
Entire Reach	1000	PF 1	1730.00	4383.64	4386.33		4387.16	0.006596	7.30	237.06	96.14	0.82
Entire Reach	900	PF 1	1730.00	4382.98	4385.67		4386.50	0.006610	7.30	236.92	96.15	0.82
Entire Reach	799.9999	PF 1	1730.00	4382.32	4385.00		4385.84	0.006673	7.32	236.21	96.12	0.82
Entire Reach	700.0001	PF 1	1730.00	4381.65	4384.34		4385.17	0.006596	7.30	237.06	96.14	0.82
Entire Reach	600	PF 1	1730.00	4380.99	4383.68		4384.51	0.006596	7.30	237.06	96.14	0.82
Entire Reach	499.9999	PF 1	1730.00	4380.33	4383.02		4383.85	0.006609	7.30	236.92	96.15	0.82
Entire Reach	400.0001	PF 1	1730.00	4379.67	4382.35		4383.19	0.006677	7.33	236.17	96.12	0.82
Entire Reach	300	PF 1	1730.00	4379.00	4381.69		4382.52	0.006600	7.30	237.01	96.13	0.82

HEC-RAS Plan: Updated River: Porter Channel Reach: Entire Reach Profile: PF 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire Reach	199.9999	PF 1	1730.00	4378.34	4381.03		4381.86	0.006600	7.30	237.01	96.13	0.82
Entire Reach	100.0001	PF 1	1730.00	4377.68	4380.37		4381.20	0.006626	7.31	236.73	96.14	0.82
Entire Reach	13.36411	PF 1	1730.00	4377.10	4379.79	4379.46	4380.62	0.006607	7.30	236.94	96.14	0.82

HEC-RAS Plan: plan 01 River: Saint Michael Reach: Entire Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire	2700	PF 1	278.00	4687.93	4689.44	4688.90	4689.62	0.003005	3.37	82.43	59.06	0.50
Entire	2600	PF 1	278.00	4687.63	4689.14		4689.32	0.003012	3.38	82.37	59.05	0.50
Entire	2500	PF 1	278.00	4687.33	4688.84		4689.02	0.003035	3.38	82.18	59.04	0.51
Entire	2400	PF 1	278.00	4687.03	4688.53		4688.71	0.003095	3.40	81.66	58.99	0.51
Entire	2300	PF 1	278.00	4686.73	4688.20		4688.39	0.003295	3.47	80.06	58.83	0.52
Entire	2200	PF 1	278.00	4686.42	4687.54		4687.88	0.008406	4.67	59.51	56.68	0.80
Entire	2100	PF 1	278.00	4685.51	4687.42		4687.53	0.001346	2.61	106.66	61.48	0.35
Entire	2000	PF 1	278.00	4684.56	4687.41		4687.45	0.000344	1.67	166.55	67.06	0.19
Entire	1900	PF 1	278.00	4683.62	4687.40		4687.42	0.000128	1.20	231.92	72.69	0.12
Entire	1800	PF 1	278.00	4682.67	4687.40		4687.41	0.000058	0.92	303.49	78.36	0.08
Entire	1700	PF 1	278.00	4681.72	4687.40		4687.41	0.000030	0.73	380.51	84.04	0.06
Entire	1600	PF 1	278.00	4680.77	4687.40		4687.40	0.000017	0.60	462.66	89.74	0.05
Entire	1500	PF 1	3893.00	4679.83	4684.96	4684.96	4687.05	0.008472	11.61	335.18	80.77	1.00
Entire	1400	PF 1	3893.00	4678.88	4684.33	4684.00	4686.13	0.006811	10.77	361.34	82.68	0.91
Entire	1300	PF 1	3893.00	4678.14	4683.82		4685.44	0.005855	10.23	380.73	84.08	0.85
Entire	1200	PF 1	3893.00	4677.55	4683.24		4684.86	0.005826	10.21	381.38	84.12	0.84
Entire	1100	PF 1	3893.00	4676.96	4682.66		4684.27	0.005774	10.18	382.59	84.21	0.84
Entire	999.9998	PF 1	3893.00	4676.37	4682.11		4683.69	0.005628	10.09	385.98	84.45	0.83
Entire	900.0002	PF 1	3893.00	4675.78	4681.60		4683.13	0.005361	9.92	392.56	84.93	0.81
Entire	799.9999	PF 1	3893.00	4675.19	4681.15		4682.59	0.004927	9.63	404.22	85.74	0.78
Entire	700	PF 1	3893.00	4674.60	4680.77		4682.09	0.004326	9.21	422.91	87.04	0.74
Entire	600.0001	PF 1	3893.00	4674.11	4680.39		4681.65	0.004058	9.00	432.45	87.69	0.71
Entire	500.0003	PF 1	3893.00	4673.70	4679.99		4681.24	0.004045	8.99	432.90	87.71	0.71
Entire	400.0002	PF 1	3893.00	4673.29	4679.59		4680.84	0.004027	8.98	433.61	87.77	0.71
Entire	299.9998	PF 1	3893.00	4672.88	4679.18		4680.43	0.004007	8.96	434.34	87.81	0.71
Entire	200.0002	PF 1	3893.00	4672.47	4678.79		4680.03	0.003971	8.93	435.71	87.91	0.71
Entire	100.0002	PF 1	3893.00	4672.08	4678.39	4677.21	4679.63	0.004003	8.96	434.49	87.83	0.71

HEC-RAS Plan: Plan 01 River: Weisner Channel Reach: Entire Reach Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Entire Reach	2070	PF 1	400.00	4568.37	4571.34	4570.04	4571.54	0.001471	3.93	115.75	47.85	0.40
Entire Reach	2000	PF 1	400.00	4568.30	4571.23		4571.43	0.001553	4.00	113.60	47.56	0.41
Entire Reach	1900	PF 1	400.00	4568.11	4571.08		4571.28	0.001471	3.93	115.72	47.83	0.40
Entire Reach	1800	PF 1	400.00	4568.02	4570.92		4571.13	0.001620	4.05	112.00	47.38	0.42
Entire Reach	1700	PF 1	400.00	4567.88	4570.74		4570.96	0.001685	4.10	110.52	47.19	0.43
Entire Reach	1600	PF 1	400.00	4567.79	4570.54		4570.78	0.001947	4.29	105.26	46.51	0.46
Entire Reach	1500	PF 1	400.00	4567.50	4570.38		4570.59	0.001655	4.08	111.20	47.28	0.42
Entire Reach	1400	PF 1	600.00	4567.05	4569.56		4570.22	0.006128	7.15	94.01	45.03	0.80
Entire Reach	1300	PF 1	600.00	4566.39	4568.70	4568.54	4569.50	0.008170	7.83	85.41	43.89	0.91
Entire Reach	1200	PF 1	600.00	4565.57	4567.88	4567.73	4568.68	0.008229	7.85	85.18	43.84	0.91
Entire Reach	1100	PF 1	600.00	4564.76	4567.16	4566.92	4567.89	0.007202	7.53	89.04	44.34	0.86
Entire Reach	999.9999	PF 1	600.00	4564.04	4566.45		4567.18	0.007090	7.49	89.51	44.41	0.85
Entire Reach	900	PF 1	600.00	4563.33	4565.73	4565.48	4566.46	0.007195	7.52	89.10	44.39	0.86
Entire Reach	800.0001	PF 1	600.00	4562.61	4565.01		4565.74	0.007195	7.52	89.09	44.37	0.86
Entire Reach	699.9999	PF 1	600.00	4561.89	4564.29	4564.05	4565.02	0.007204	7.52	89.05	44.37	0.86
Entire Reach	600	PF 1	600.00	4561.17	4563.57	4563.32	4564.30	0.007195	7.52	89.09	44.38	0.86
Entire Reach	500.0001	PF 1	600.00	4560.45	4562.86	4562.60	4563.58	0.007098	7.49	89.50	44.43	0.85
Entire Reach	399.9999	PF 1	600.00	4559.74	4562.15	4561.89	4562.87	0.007097	7.49	89.51	44.44	0.85
Entire Reach	300	PF 1	600.00	4559.02	4561.59		4562.22	0.005581	6.95	97.00	45.43	0.76
Entire Reach	200.0001	PF 1	600.00	4558.45	4561.07		4561.67	0.005228	6.81	99.15	45.71	0.74
Entire Reach	99.99989	PF 1	600.00	4557.93	4560.54		4561.14	0.005317	6.84	98.61	45.66	0.75
Entire Reach	9.999989	PF 1	600.00	4557.45	4560.06	4559.60	4560.66	0.005305	6.84	98.67	45.65	0.75

APPENDIX D – CD of HEC-HMS MODELS, HEC-RAS MODELS and DIGITAL FILES

APPENDIX E – COST ESTIMATES

Dragonfly Channel

Mobilization/ Demobilization	LS	1	$69,745.00	$69,745.00
Clearing And Grubbing	AC	45	$1,300.00	$58,500.00
Channel excavation	CY	165,000	$2.00	$330,000.00
Channel Over-excavation Backfill & Compaction	CY	60,000	$4.00	$240,000.00
Finish Grading	AC	45	$7,500.00	$337,500.00
Gabion Erosion Control Structure	CY	2,900	$300.00	$870,000.00
Rock Riprap	CY	5,000	$200.00	$1,000,000.00
Filter Material	CY	3,700	$30.00	$111,000.00
Geotextile Filter Fabric	SY	22,000	$5.00	$110,000.00
Gravel Mulch-4" Thick	SY	64,600	$4.00	$258,400.00
Gravel Surfacing on Roads-4" Thick	SY	30,000	$5.00	$150,000.00
Reinforced Concrete	CY	22	$500.00	$11,000.00
18" Diameter DI Storm Drain Pipe	LF	210	$35.00	$7,350.00
Intake Structure	LS	1	$3,500.00	$3,500.00
			SUBTOTAL	$3,556,995
			Contingency 10%	$355,700
			Total Construction Cost	$3,912,695
			Total	**$4,268,394**

Arroyo Road Storm Drain Improvements

Mobilization/ Demobilization	LS	1	$127,743.31	$127,743.31
Clearing And Grubbing	AC	32	$1,300.00	$41,363.64
Excavation/ Cut/ Fill	CY	82,593	$2.00	$165,185.19
Subgrade	SY	61,600	$1.50	$92,400.00
Base Course	SY	61,600	$6.00	$369,600.00
Primecoat	SY	61,600	$0.75	$46,200.00
Pavement surfacing	SY	61,600	$16.00	$985,600.00
Curb and Gutter	LF	23,100	$14.00	$323,400.00
Sidewalk (optional)	SF	115,500	$4.00	$462,000.00
Storm Drain Manhole	EA	15	$10,000.00	$150,000.00
54" RCP Class IV	LF	5,500	$250.00	$1,375,000.00
72" RCP Class IV	LF	1,650	$355.00	$585,750.00
84" RCP Class IV	LF	4,400	$375.00	$1,650,000.00
Structural Concrete for Storm Drain Vaults	CY	181	$500.00	$90,666.67
Storm Drain Roadway Drop Inlets	EA	20	$2,500.00	$50,000.00
			SUBTOTAL	$6,514,909
			Contingency 20%	$1,302,982
			Total Construction Cost	$7,817,891
			Soft Cost 25%	$1,954,473
			Total	**$9,772,363**

El Centro Diversion Channel and Crossing Culverts

Mobilization/ Demobilization	LS	1	$73,171.03	$73,171.03
Clearing And Grubbing	AC	15	$1,300.00	$19,500.00
Channel Excavation	CY	79,011	$2.00	$158,022.00
Erosion Contal Matting and Seed	SY	14,177	$13.50	$191,389.50
Soil Cement	CY	23,528	$130.00	$3,058,640.00
Amber Mesa 2-9'x5' Box Culvert Crossing	LF	240	$550.00	$132,000.00
Holman Road 3-9'x5' Box Culvert Crossing	LF	180	$550.00	$99,000.00
			SUBTOTAL	$3,731,723
			Contingency 20%	$746,345
			Total Construction Cost	$4,478,067
			Soft Cost 25%	$1,119,517
			Total	**$5,597,584**

Berry Patch Road Diversion Channel and Crossing Culverts

Mobilization/ Demobilization	LS	1	$55,315.20	$55,315.20
Clearing And Grubbing	AC	7	$1,300.00	$9,100.00
Channel Excavation	CY	34,300	$2.00	$68,600.00
Soil Cement	CY	15,270	$130.00	$1,985,100.00
Erosion Control Matting and Seeding	SY	3,360	$13.50	$45,360.00
Balsam 2-12' X 5' Box Culvert	LF	160	$735.00	$117,600.00
Eason Lane Bridge Culvert	SF	1,800	$150.00	$270,000.00
Community Center Access Bridge Culvert Crossing	LF	1,800	$150.00	$270,000.00
			SUBTOTAL	$2,821,075
			Contingency 20%	$564,215
			Total Construction Cost	$3,385,290
			Soft Cost 25%	$846,323
			Total	**$4,231,613**

Balsam Diversion Channel

Mobilization/ Demobilization	LS	1	$9,520.50	$9,520.50
Clearing And Grubbing	AC	2	$1,300.00	$2,600.00
Channel Excavation	CY	10,700	$2.00	$21,400.00
Soil Cement	CY	3,150	$130.00	$409,500.00
Erosion Control Matting and Seeding	SY	3,150	$13.50	$42,525.00
			SUBTOTAL	$485,546
			Contingency 20%	$97,109
			Total Construction Cost	$582,655
			Soft Cost 25%	$145,664
			Total	**$728,318**

Moongate Diversion Channel and Crossing Culverts

Mobilization/ Demobilization	LS	1	$3,437.72	$3,437.72
Clearing And Grubbing	AC	6	$1,300.00	$7,800.00
Channel Excavation	CY	48,368	$2.00	$96,736.00
Rock Riprap	CY	35	$200.00	$7,000.00
Geotextile Filter Fabric	SY	70	$5.00	$350.00
4-54" RCP Culvert	LF	240	$250.00	$60,000.00
			SUBTOTAL	$175,324
			Contingency 20%	$35,065
			Total Construction Cost	$210,388
			Soft Cost 25%	$52,597
			Total	**$262,986**

Hanger Lake North Diversion Channel and Crossing Culverts

Mobilization/ Demobilization	LS	1	$4,141.87	$4,142
Clearing And Grubbing	AC	3	$1,300.00	$3,900
Channel Excavation	CY	18,528	$2.00	$37,056
Erosion Control Matting and Seeding	SY	7,475	$13.50	$100,913
Rock Riprap	CY	25	$200.00	$5,000
Geotextile Filter Fabric	SY	45	$5.00	$225
4-54" RCP Culvert	LF	240	$250.00	$60,000
			SUBTOTAL	$211,235
			Contingency 20%	$42,247
			Total Construction Cost	$253,482
			Soft Cost 25%	$63,371
			Total	**$316,853**

Blue Topaz Storm Drain Extension Option A

Mobilization/ Demobilization	LS	1	$10,230.50	$10,231
Clearing And Grubbing	AC	3	$1,300.00	$3,900
Channel excavation	CY	4,480	$2.00	$0
Rock Riprap	CY	12	$200.00	$2,400
Geotextile Filter Fabric	SY	25	$5.00	$125
Drop Inlet Structure	EA	1	$3,500.00	$3,500
48" RCP Class IV	LF	2,640	$190.00	$501,600
Storm Drain Manhole	EA	6	$10,000.00	$60,000
			SUBTOTAL	$581,756
			Contingency 20%	$116,351
			Total Construction Cost	$698,107
			Soft Cost 25%	$174,527
			Total	**$872,633**

Blue Topaz Storm Drain Extension Option B

Mobilization/ Demobilization	LS	1	$21,098.50	$21,099
Clearing And Grubbing	AC	3	$1,300.00	$3,900
Channel excavation	CY	4,480	$2.00	$0
Rock Riprap	CY	12	$200.00	$2,400
Geotextile Filter Fabric	SY	25	$5.00	$125
Drop Inlet Structure	EA	1	$3,500.00	$3,500
48" RCP Class IV	LF	5,500	$190.00	$1,045,000
Storm Drain Manhole	EA	11	$10,000.00	$110,000
			SUBTOTAL	$1,186,024
			Contingency 20%	$237,205
			Total Construction Cost	$1,423,228
			Soft Cost 25%	$355,807
			Total	**$1,779,035**

Porter North Diversion Channel

Mobilization/ Demobilization	LS	1	$48,556.40	$48,556
Clearing And Grubbing	AC	11	$1,300.00	$14,300
Channel excavation	CY	69,260	$2.00	$138,520
Soil Cement	CY	17,500	$130.00	$2,275,000
Erosion Control Matting and Seeding	SY	19,093	$13.50	$257,756
			SUBTOTAL	$2,734,132
			Contingency 20%	$546,826
			Total Construction Cost	$3,280,958
			Soft Cost 25%	$820,240
			Total	**$4,101,198**

Porter Diversion Channel and Culvert Crossing

Mobilization/ Demobilization	LS	1	$60,937.66	$60,938
Clearing And Grubbing	AC	12	$1,300.00	$15,600
Channel excavation	CY	56,549	$2.00	$113,098
Rock Riprap	CY	25	$200.00	$5,000
Soil Cement	CY	16,100	$130.00	$2,093,000
Geotextile Filter Fabric	SY	45	$5.00	$225
Erosion Control Matting and Seeding	SY	42,960	$13.50	$579,960
Bridge Culvert	SF	1,600	$150.00	$240,000
			SUBTOTAL	$3,107,821
			Contingency 20%	$621,564
			Total Construction Cost	$3,729,385
			Soft Cost 25%	$932,346
			Total	**$4,661,731**

East Mesa DMP Reservoir Project Construction Cost Estimate

Brahman Dam

Clearing and Grubbing, CIP	AC	36	$ 1,300.00	$46,800
Scarify, compact pre wet and compact of subgrade (5 ft. Depth), CIP	SY	67,600	$ 3.00	$202,800
Over-excavation and compact backfill for cutoff trench and principal spillway, CIP	SY	56,650	$ 4.00	$226,600
Subgrade Compaction, CIP	SY	3,500	$ 1.00	$3,500
In Situ Material Excavation, placement of material in embankment, and compaction, CIP	CY	407,000	$ 2.00	$814,000
Granular fill slope protection, CIP	SY	61,500	$ 4.00	$246,000
Gravel Surfacing, CIP	SY	12,000	$ 5.00	$60,000
Soil Cement, CIP	CY	2,690	$ 130.00	$349,700
Gabion Erosion Control Structures, CIP	CY	380	$ 200.00	$76,000
Reno Mattress Erosion Control Structures, CIP	CY	320	$ 150.00	$48,000
Rock Riprap, CIP	CY	920	$ 300.00	$276,000
Filter Material, CIP	CY	600	$ 30.00	$18,000
Geotextile Filter Fabric, CIP	SY	3,380	$ 1.00	$3,380
Reinforced Concrete, CIP	CY	334	$ 600.00	$200,400
Primary Intake Structure, CIP	CY	42	$ 400.00	$16,800
Outlet Structure, CIP	CY	15	$ 350.00	$5,250
48" Diamter, Class IV RCP w/ Class A Bedding, CIP	LF	282	$ 190.00	$53,580
66" Diamter, Class IV RCP w/ Class B Bedding, CIP	LF	32	$ 315.00	$10,080
Mobilization / Demobilization	LS	1	2%	$53,138
			SUBTOTAL	$2,710,028
			Contingency (10%)	$271,002.78
			Total Construction Cost	$2,981,031
			Total	**$3,252,033**

Butterfield Diversion Channel and Detention Reservoir

Clearing and Grubbing, CIP	AC	57	$1,300.00	$74,100
In Situ Material Excavation, placement of material in embankment, and compaction, CIP	CY	827,000	$2.00	$1,654,000
Subgrade Compaction, CIP	SY	92,000	$1.00	$92,000
Primary Intake Structure, CIP	CY	42	$400.00	$16,800
Primary Outlet 48" Pipe, Class IV RCP, CIP	LF	500	$190.00	$95,000
Rip Rap, CIP	CY	175	$200.00	$35,000
Secondary Spillway, Soil Cement, CIP	CY	320	$130.00	$41,600
St. Micheals Channel Excavation	CY	68,000	$2.00	$136,000
St. Micheals Channel Soil Cement	CY	8,385	$130.00	$1,090,050
Mobilization / Demobilization	LS	1	2%	$64,691
			Construction Cost Subtotal	$3,299,241
			Contingency (20%)	$659,848.20
			Total Construction Cost	$3,959,089
			Soft Cost (25%)	$989,772
			Total	**$4,948,862**

Hanger Lake Channel Extension and South Reservoir - Option A

Clearing and Grubbing, CIP	AC	111	$1,300.00	$144,300
In Situ Material Excavation, placement of material in embankment, and compaction, CIP	CY	1,125,000	$2.00	$2,250,000
Subgrade Compaction, CIP	SY	125,000	$1.00	$125,000
Primary Intake Structure, CIP	CY	30	$400.00	$12,000
Primary Outlet 30" Pipe, Class IV RCP, CIP	LF	300	$100.00	$30,000
Additional 4' HDPE Culvert Crossing	LF	34	$100.00	$3,400
Hanger Lake Channel Excavation	CY	20,439	$2.00	$40,878
Soil Cement	CY	7,073	$130.00	$919,490
Errosion Control Matting and Seed	SY	7,993	$13.50	$107,906
Storm Drain Manhole	EA	18	$10,000.00	$180,000
48" RCP Class IV	LF	9,500	$190.00	$1,805,000
Mobilization / Demobilization	LS	1	2%	$52,112
			Construction Cost Subtotal	$5,670,085
			Contingency (20%)	$1,134,017
			Total Construction Cost	$6,804,102
			Soft Cost (25%)	$1,701,026
			Total	**$8,505,128**

Hanger Lake Channel Extension and South Reservoir - Option B

Clearing and Grubbing, CIP	AC	111	$1,300.00	$144,300
In Situ Material Excavation, placement of material in embankment, and compaction, CIP	CY	1,125,000	$2.00	$2,250,000
Subgrade Compaction, CIP	SY	125,000	$1.00	$125,000
Primary Intake Structure, CIP	CY	30	$400.00	$12,000
Primary Outlet 30" Pipe, Class IV RCP, CIP	LF	500	$100.00	$50,000
Additional 4' HDPE Culvert Crossing	LF	34	$100.00	$3,400
Hanger Lake Channel Excavation	CY	20,439	$2.00	$40,878
Soil Cement	CY	7,073	$130.00	$919,490
Errosion Control Matting and Seed	SY	7,993	$13.50	$107,906
Mobilization / Demobilization	LS	1	2%	$52,512
			Construction Cost Subtotal	$3,705,485
			Contingency (20%)	$741,097
			Total Construction Cost	$4,446,582
			Soft Cost (25%)	$1,111,646
			Total	**$5,558,228**

Hanger Lake North Reservoir Option A

Clearing and Grubbing, CIP	AC	44	$1,300.00	$57,200
In Situ Material Excavation, placement of material in embankment, and compaction, CIP	CY	614,000	$2.00	$1,228,000
Subgrade Compaction, CIP	SY	68,000	$1.00	$68,000
Primary Inlet Tower, CIP	CY	30	$400.00	$12,000
Primary Outlet 24" Pipe, Class IV RCP, CIP	LF	200	$75.00	$15,000
Rip Rap, CIP	CY	60	$200.00	$12,000
Mobilization / Demobilization	LS	1	2%	$27,844
			Construction Cost Subtotal	$1,420,044
			Contingency (20%)	$284,009
			Total Construction Cost	$1,704,053
			Soft Cost (25%)	$426,013
			Total	**$2,130,066**

Hanger Lake North Reservoir Option B

Clearing and Grubbing, CIP	AC	62	$1,300.00	$80,600
In Situ Material Excavation, placement of material in embankment, and compaction, CIP	CY	852,000	$2.00	$1,704,000
Subgrade Compaction, CIP	SY	95,000	$1.00	$95,000
Primary Inlet Tower, CIP	CY	30	$400.00	$12,000
Primary Outlet 24" Pipe, Class IV RCP, CIP	LF	1,050	$75.00	$78,750
Storm Drain Manhole	EA	3	$10,000.00	$30,000
Rip Rap, CIP	CY	60	$200.00	$12,000
Mobilization / Demobilization	LS	1	2%	$40,247
			Construction Cost Subtotal	$2,052,597
			Contingency (20%)	$410,519
			Total Construction Cost	$2,463,116
			Soft Cost (25%)	$615,779
			Total	**$3,078,896**

Brahman Road Diversion Channel and Reservior

Clearing and Grubbing, CIP	AC	14	$1,300.00	$18,200
In Situ Material Excavation, placement of material in embankment, and compaction, CIP	CY	135,000	$2.00	$270,000
Subgrade Compaction, CIP	SY	15,000	$1.00	$15,000
Primary Inlet Tower, CIP	CY	30	$400.00	$12,000
Primary Outlet 54" Pipe, Class IV RCP, CIP	LF	270	$250.00	$67,500
Rip Rap, CIP	CY	55	$200.00	$11,000
Channel Excavation	CY	7,077	$3.00	$21,231
Erosion Control Matting and Seed	SY	5,204	$13.50	$70,254
Mobilization / Demobilization	LS	1	2%	$9,704
			Construction Cost Subtotal	$494,889
			Contingency (20%)	$98,978
			Total Construction Cost	$593,866
			Soft Cost (25%)	$148,467
			Total	**$742,333**

Moongate Road Regional Ponding Facility

Clearing and Grubbing, CIP	AC	8	$1,300.00	$9,750
In Situ Material Excavation, placement of material in embankment, and compaction, CIP	CY	69,000	$2.00	$138,000
Subgrade Compaction, CIP	SY	7,700	$1.00	$7,700
Primary Inlet Tower, CIP	CY	30	$400.00	$12,000
Primary Outlet 48" Pipe, Class IV RCP, CIP	LF	380	$190.00	$72,200
Rip Rap, CIP	CY	35	$200.00	$7,000
Mobilization / Demobilization	LS	1	2%	$4,933
			Construction Cost Subtotal	$251,583
			Contingency (20%)	$50,317
			Total Construction Cost	$301,900
			Soft Cost (25%)	$75,475
			Total	**$377,375**

Wagons East Diversion Channel and Regional Ponding Facility

Clearing and Grubbing, CIP	AC	7	$1,300.00	$9,100
In Situ Material Excavation, placement of material in embankment, and compaction, CIP	CY	64,000	$2.00	$128,000
Subgrade Compaction, CIP	SY	7,200	$1.00	$7,200
Primary Inlet Tower, CIP	CY	30	$400.00	$12,000
Primary Outlet 48" Pipe, Class IV RCP, CIP	LF	110	$190.00	$20,900
Erosion Control Matting and Seed	SY	13,200	$1.50	$19,800
Rip Rap, CIP	CY	70	$200.00	$14,000
Channel Excavation	CY	4,732	$3.00	$14,196
Soil Cement	CY	3,190	$130.00	$414,700
Erosion Control Matting and Seed	SY	1,740	$13.50	$23,490
Mobilization / Demobilization	LS	1	2%	$13,267.72
			Construction Cost Subtotal	$676,654
			Contingency (20%)	$135,331
			Total Construction Cost	$811,984
			Soft Cost (25%)	$202,996
			Total	**$1,014,981**

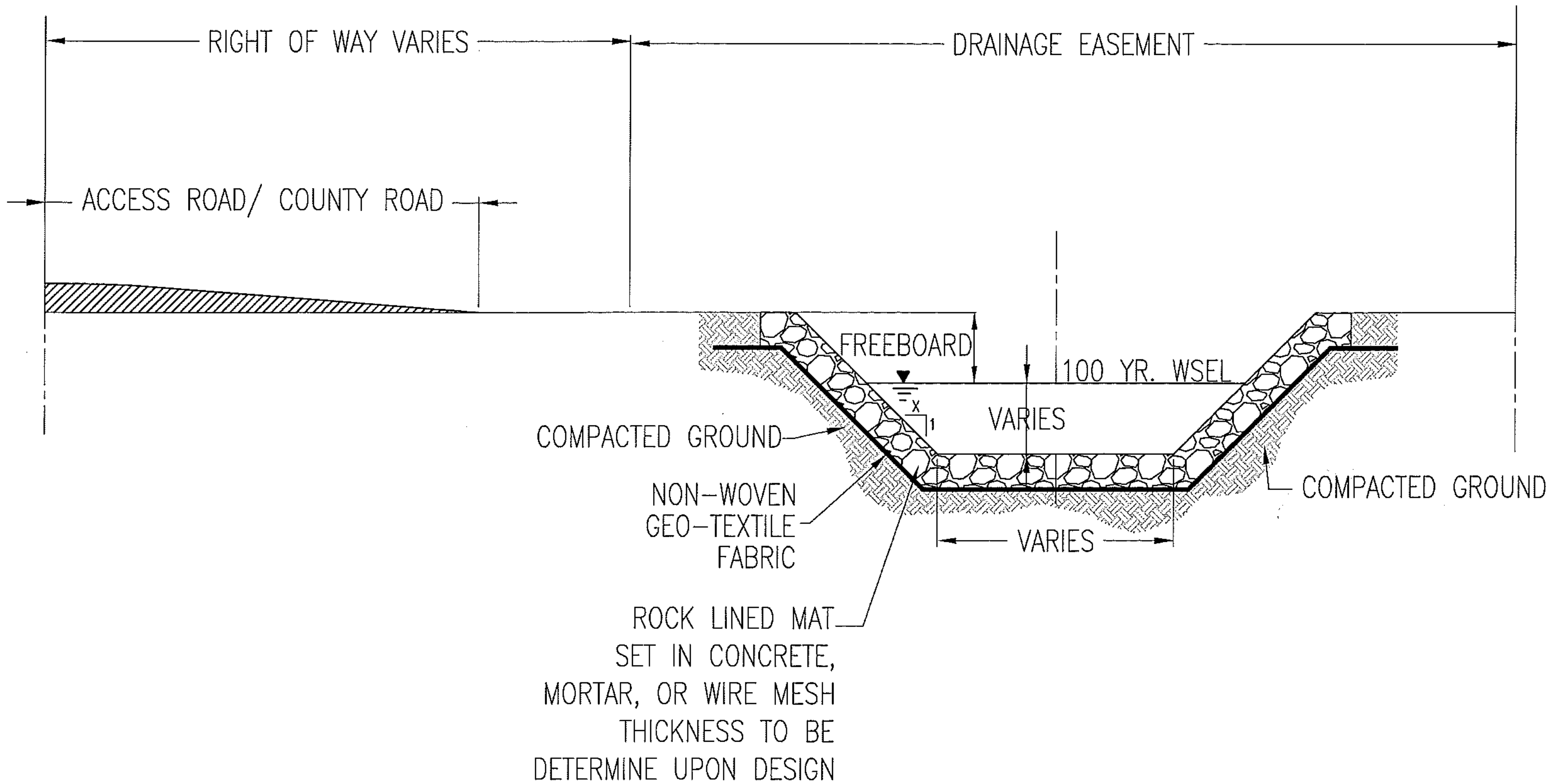
Amber Mesa Reservoir Option A

Clearing and Grubbing, CIP	AC	28	$1,300.00	$36,400
In Situ Material Excavation, placement of material in embankment, and compaction, CIP	CY	462,000	$2.00	$924,000
Subgrade Compaction, CIP	SY	51,000	$1.00	$51,000
Primary Inlet Tower, CIP	CY	30	$400.00	$12,000
Primary Outlet 48" Pipe, Class IV RCP, CIP	LF	120	$190.00	$22,800
Rip Rap, CIP	CY	325	$200.00	$65,000
Mobilization / Demobilization	LS	1	2%	$22,224
			Construction Cost Subtotal	$1,133,424
			Contingency (20%)	$226,685
			Total Construction Cost	$1,360,109
			Soft Cost (25%)	$340,027
			Total	**$1,700,136**

Amber Mesa Reservoir Option B

Clearing and Grubbing, CIP	AC	26	$1,300.00	$33,800
In Situ Material Excavation, placement of material in embankment, and compaction, CIP	CY	417,000	$2.00	$834,000
Subgrade Compaction, CIP	SY	47,000	$1.00	$47,000
Primary Inlet Tower, CIP	CY	30	$400.00	$12,000
Primary Outlet 48" Pipe, Class IV RCP, CIP	LF	120	$190.00	$22,800
Rip Rap, CIP	CY	325	$200.00	$65,000
Mobilization / Demobilization	LS	1	2%	$20,292
			Construction Cost Subtotal	$1,034,892
			Contingency (20%)	$206,978
			Total Construction Cost	$1,241,870
			Soft Cost (25%)	$310,468
			Total	**$1,552,338**

APPENDIX F – TYPICAL SECTIONS



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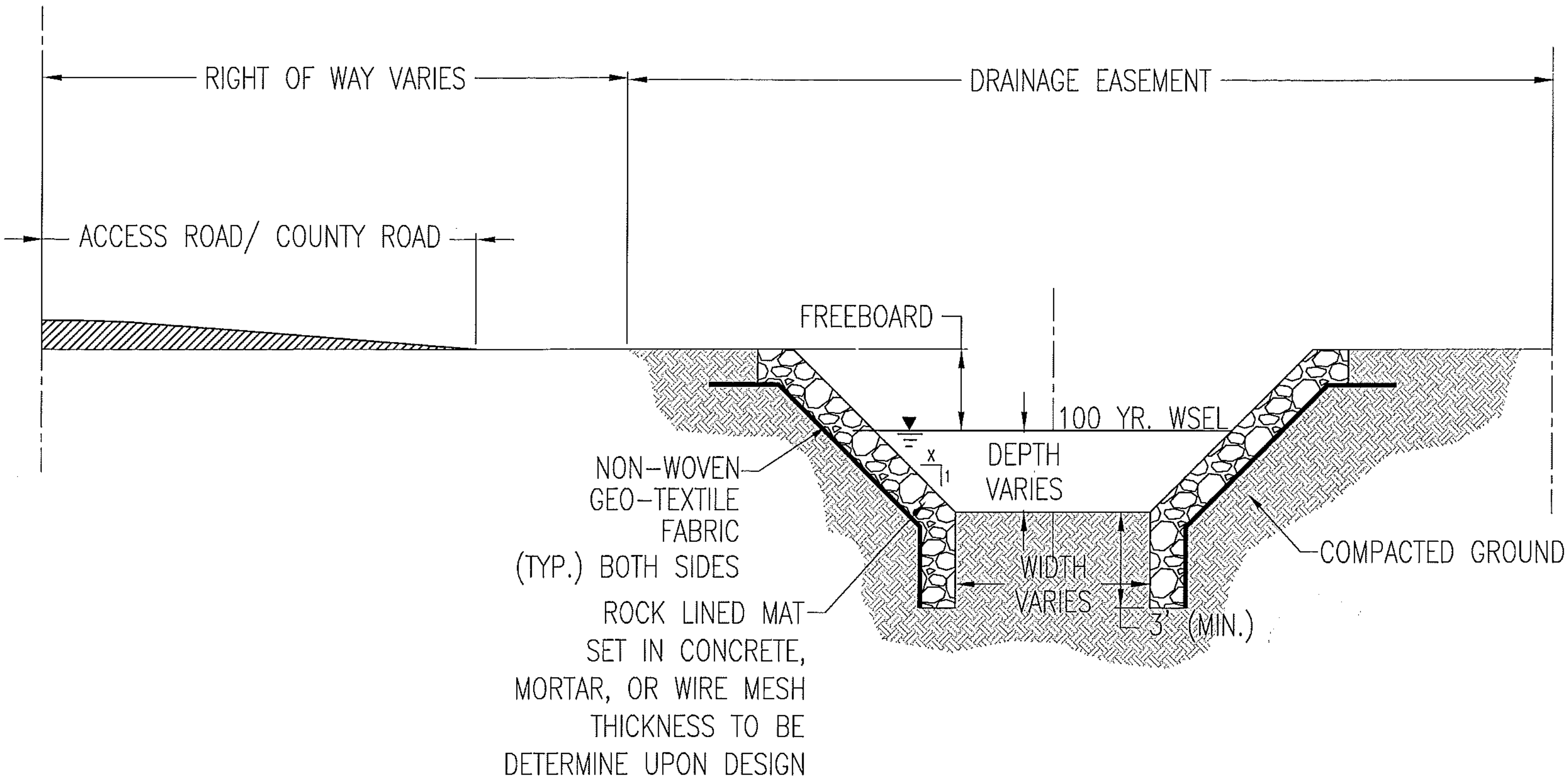
Bohannan Huston

FULL ROCK LINED CHANNEL SECTION
EAST MESA DRAINAGE MASTER PLAN

425 S. Telshor Blvd., Suite C-103 Las Cruces, NM 88011-8237 575.532.8670



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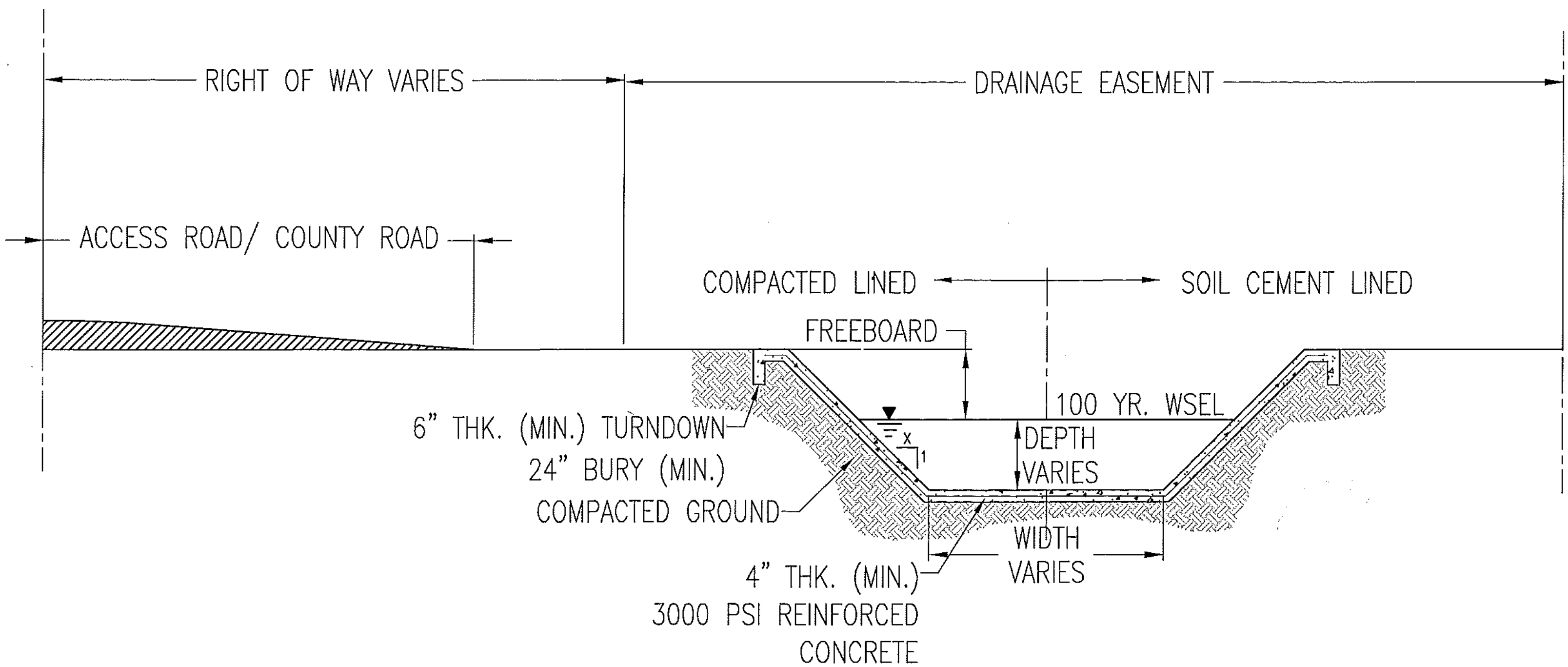
425 S. Telshor Blvd., Suite C-103 Las Cruces, NM 88011-8237 575.532.8670

PARTIAL ROCK LINED CHANNEL SECTION

EAST MESA DRAINAGE MASTER PLAN



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CONCRETE LINED/ SOIL CEMENT LINED CHANNEL SECTION
EAST MESA DRAINAGE MASTER PLAN

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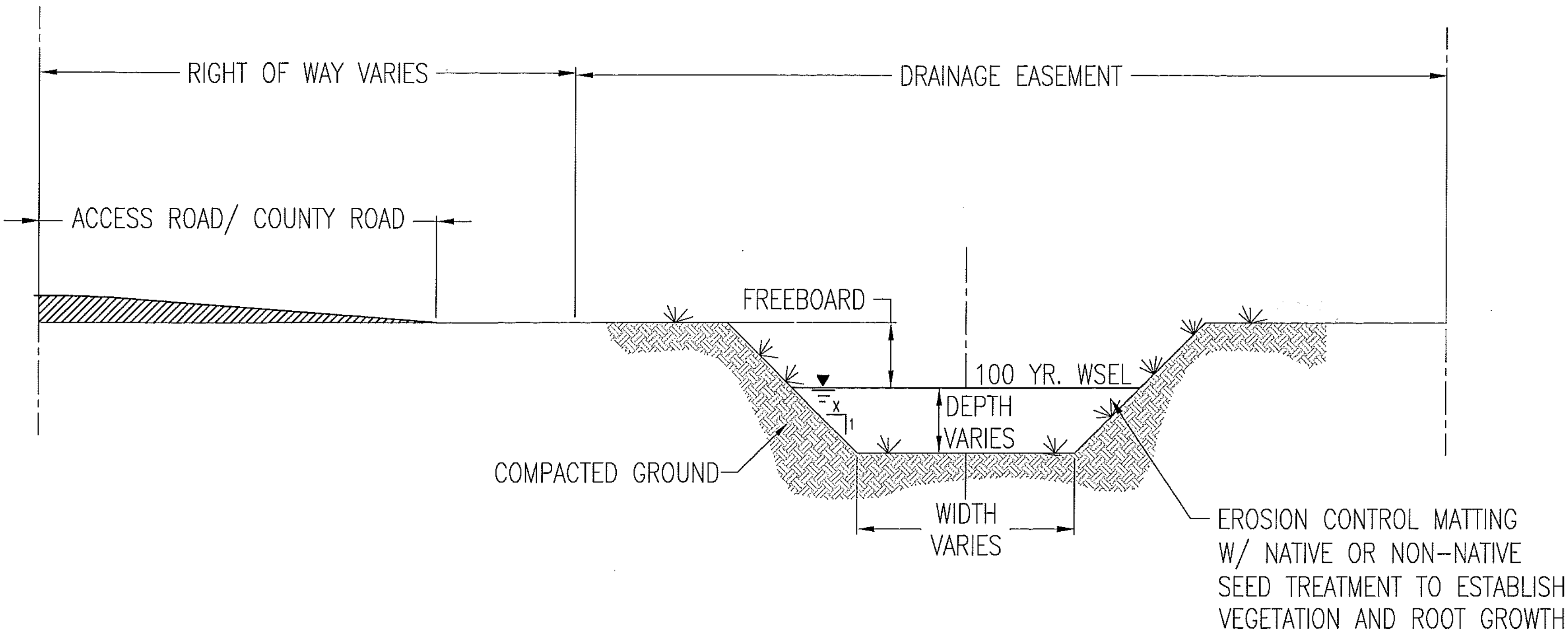

EARTH LINED CHANNEL SECTION

EAST MESA DRAINAGE MASTER PLAN

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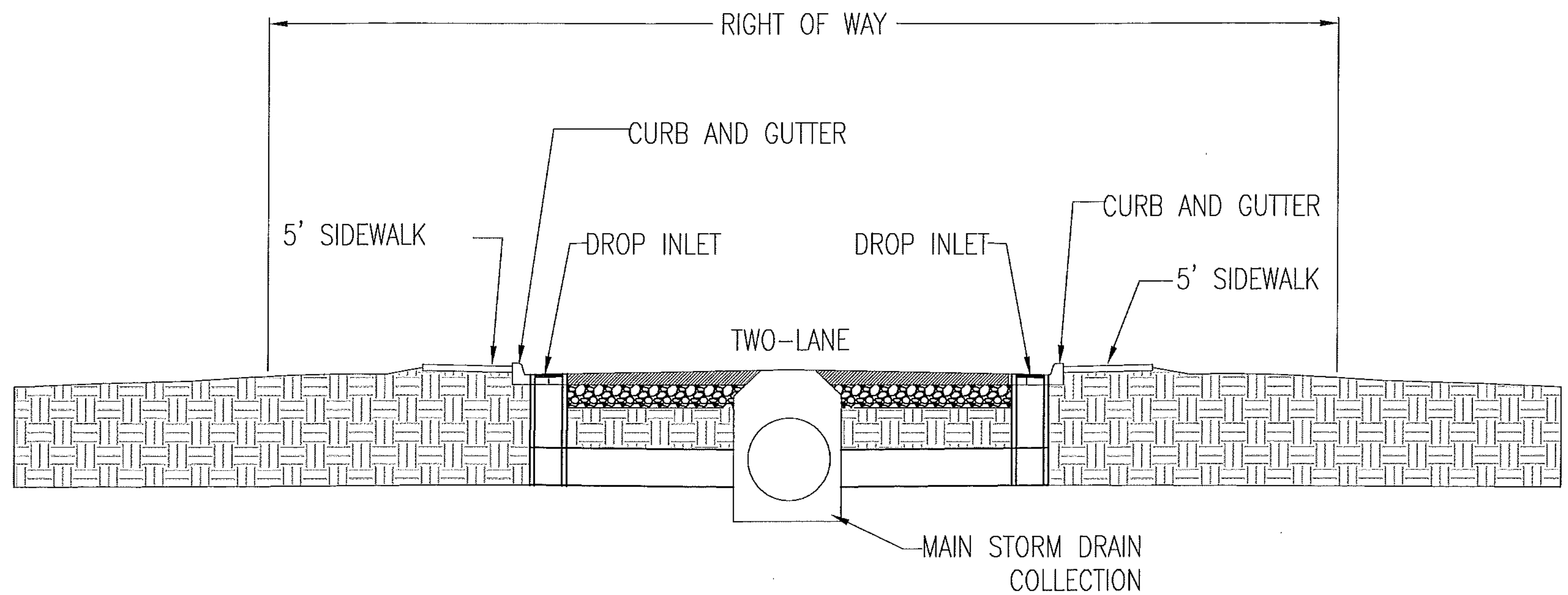
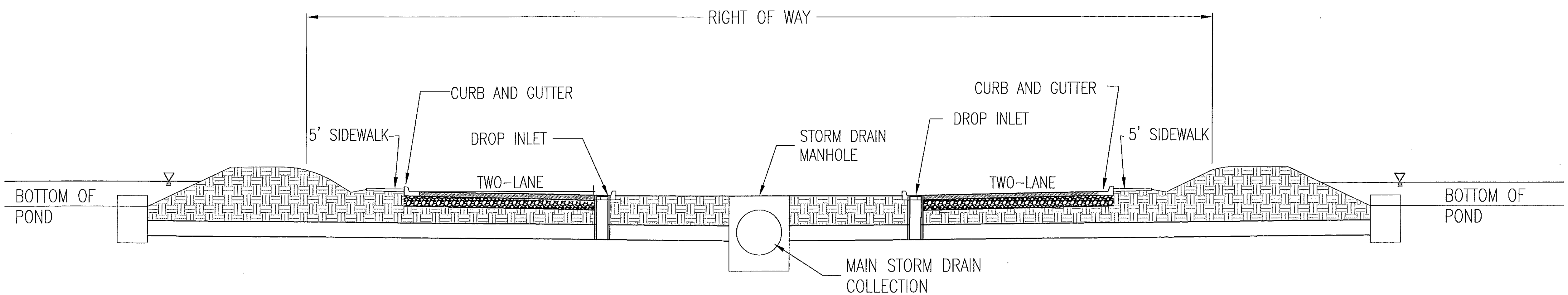


TWO LANE-TWO WAY (COLLECTOR STREET)



FOUR LANE-TWO WAY (PRINCIPAL ARTERIAL)

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FUTURE ARROYO ROAD DRAINAGE CROSS SECTION
EAST MESA DRAINAGE MASTER PLAN