Disaster Response Flood Recovery Data for Doña Ana County, New Mexico & Incorporated Areas

FEDERAL EMERGENCY MANAGEMENT AGENCY

Region VI

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Task Order 35

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MAPVI

DISASTER RESPONSE FLOOD RECOVERY DATA
FINAL REPORT

For

Doña Ana County, New Mexico

SUBMITTED BY: MAPVI

DATE SUBMITTED: January 7, 2008

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1. Introduction

MAPVI is under contract to FEMA to provide the Disaster Response Flood Recovery Data for Doña Ana County, New Mexico in response to the flooding that occurred in August 2006. As part of the Flood Recovery Tools, this Technical Support Data Notebook (TSDN) is intended to clearly define the scope of work, methodologies for modeling, any exceptions to the standards outlined in the scope of work, and to summarize the final results.

This TSDN provides a review of the development and results of Flood Recovery Tools including Topographic Data, Field Reconnaissance, Hydrology, Hydraulics, and Flood Recovery Data. This TSDN has been reviewed and approved in accordance with the Quality Assurance Plan (QAP). Copies of all QA forms are provided in Appendix E.

2. Scope of Work

MAPVI has been tasked to produce digital and hard copy Advisory Flood Recovery Tools, which consist of Advisory Flood Recovery Maps, Floodplain Elevation Data Tables, and Advisory Flood Recovery Profiles along with a TSDN report summarizing the findings of and methodologies that were used for development of these tools. Flood Recovery Tools will be available through the FEMA Flood Hazard Mapping website for interested parties.

Collection and assessment of flood data and preparation of flood recovery maps are activities outside of FEMA's normal flood hazard mapping operations. These activities must take place in the immediate aftermath of a disaster. When a flood occurs, valuable data become available that enables FEMA and its Contractors to reassess the estimates of flood risk. Also, rebuilding efforts begin within a short period after the disaster, and timely updated flood risk data are necessary to ensure that the rebuilding will protect properties from future flooding disasters. The new data needs to be evaluated and, if necessary, incorporated into new engineering analyses. Appropriate hazard identification tools (such as flood recovery maps) must be produced quickly. In some cases, there may not be any detailed flood mapping at all, and flood recovery maps may be the only detailed guidance to assist the State and community in planning and managing rebuilding efforts.

The Flood Recovery Tools are developed using an Approximate Study with More Detail. This type of study involves refining effective A zones to provide unpublished flood recovery data for the community to use in floodplain management. An Approximate Study with More Detail requires analysis of only the 1-percent-annual-chance-storm event. The Advisory Flood Recovery Maps produced depict only the 1-percent-annual-chance floodplain boundaries. The Floodplain Elevation Data Tables provide flood elevations and flow velocities. The Advisory Flood Recovery Maps, Floodplain Elevation Data Tables, and Advisory Flood Recovery Profiles can be found in Appendix D.

Changes to the study stream limits are detailed in two Special Problem Reports, which can be found in Appendix F.

MAPVI will perform hydrologic and hydraulic studies to establish flood recovery data for the flooding sources listed in Table 1 in order to assist in proper floodplain management and redevelopment.

Table 1 – Study Reach Names

Study Reach Name	Stream Identifiers
Barcelona	B
Crawford Lateral[1]	CL
Doña Ana Arroyo South	DAAS
Donaldson Arroyo	DA
Faulkner Canyon	FC
Fillmore Arroyo	FA
Foster Canyon	FoC
La Union Arroyo	LUA
Leasburg Canal[2]	
Peña Blanca Arroyo	PBA
Placitas Arroyo	PA
Rodey Canyon Creek	RCC
Spring Canyon Creek	SCC
Unnamed Stream Anthony	USA
Unnamed Stream Berino	USB
Unnamed Stream Leasburg	USL
Unnamed Stream Leasburg A[3]	USLA
Unnamed Stream North	USN
Unnamed Stream South	USS

[1]This reach has been removed from the scope of work and replaced with Unnamed Stream South.
[2] This reach has been removed from the scope of work and replaced with Unnamed Stream Leasburg.
[3]This sub-basin will not be included as part of the hydraulic analysis task.

<u>Field Survey and Reconnaissance</u>

MAPVI will conduct field reconnaissance for the flooding sources to be studied shown in Table 1. The task will include obtaining the physical dimensions of hydraulic and flood control structures and documenting stream conditions.

<u>Topographic Data</u>

MAPVI shall use a terrain model built for the FIRM and FIS Update for Doña Ana County and Incorporate Communities, New Mexico EMT 2002-CO-0052, Task Order 11 for the flooding sources. This terrain model will be used to support the hydrologic and hydraulic analyses and floodplain delineation.

<u>Hydrologic Analysis</u>

MAPVI shall develop the peak 1-percent-annual-chance flood discharge using the appropriate United States Geological Survey (USGS) regression equations. MAPVI shall develop drainage from USGS 30-meter digital elevation model information, unless preferable topographic data are available. General guidance for performing the hydrologic modeling can be found in Volume 1 and Appendix C of the FEMA *Guidelines and Specifications for Flood Hazard Mapping Partners (G&S)*, as amended.

For flooding sources with dams upstream of the study reach, MAPVI shall estimate the outflow from the dam by determining the hydraulic capacity of the outlet structure assuming the maximum headwater at the top of the dam. MAPVI will not calculate stage-storage discharge or route the 1-percent-annual-chance flood through the dam outlet works.

Hydraulic Analysis

MAPVI shall develop the cross sections to be used in the hydraulic model from USGS 7.5-minute series quadrangle maps, unless better topographic or survey data are available. General guidance for performing the hydraulic modeling can be found in Volume 1 and Appendix C of the *G&S*, as amended. Additionally, water surface elevations and flood velocities shall be determined as part of this hydraulic analysis.

The limits of each study reach are described in Table 2. Figure 1, located at the end of this report, provides a graphical representation of the study stream analysis limits.

Table 2 – Study Reach Analysis Limits

Study Reach Name	Reach Length (miles)	Watershed Area (mi^2)	Downstream Limit of Study	Upstream Limit of Study
Barcelona	1.40	1.62	890 feet DS of Fairway Village Drive	510 feet US of Barcelona Ridge Drive
Doña Ana Arroyo South	1.22	10.48	Confluence with Doña Ana Lateral	Toe of Doña Ana North Dam
Donaldson Arroyo	0.41	2.16	70 feet US of Puerta Drive	2,690 feet US of Puerta Drive
Faulkner Canyon	0.76	24.72	744 feet US of confluence with Rio Grande	4,800 feet US of Confluence with Rio Grande
Fillmore Arroyo	0.95	0.31	DS of Interstate 10	Toe of Fillmore Dam
Foster Canyon	0.34	6.98	Confluence with Rio Grande	1,770 feet US of Confluence with Rio Grande
La Union Arroyo	0.80	3.44	US of Alvarez Drive	Toe of La Union Dam
Peña Blanca Arroyo	2.12	24.78	Confluence with Eastside Canal	Toe of Peña Blanca Dam

Table 2 – Study Reach Analysis Limits, continued

Study Reach Name	Reach Length (miles)	Watershed Area (mi^2)	Downstream Limit of Study	Upstream Limit of Study
Placitas Arroyo	2.19	30.92	Confluence with Rio Grande	5,200 feet US of Highway 26
Rodey Canyon Creek	1.02	3.08	55 feet US of Hall Road	Toe of Rodey Arroyo Dam
Spring Canyon Creek	1.32	6.00	Confluence with Rodey Lateral	3,700 feet DS of Spring Canyon Dam
Unnamed Stream Anthony	1.48	5.30	DS of Fourth Street	Toe of Anthony Arroyo Dam
Unnamed Stream Berino	3.51	3.31	Confluence with Anthony Lateral	9,953 feet US of Interstate 10
Unnamed Stream Leasburg	2.53	3.44	Confluence with Leasburg Canal	6,795 feet US of Interstate 25
Unnamed Stream Leasburg A[1]	1.70	1.91	US of Interstate 25	6,795 feet US of Interstate 25
Unnamed Stream North	1.23	1.03	1,375 feet US of Crawford Drive	5,500 feet US of McNutt Drive
Unnamed Stream South	2.29	1.71	920 feet US of Crawford Drive	DS of Pete V. Domenici International Drive
Total Stream Length	**25.27**			

[1]This sub-basin will not be included as part of the hydraulic analysis task.

<u>Flood Recovery Data</u>

MAPVI shall produce flood recovery data using the best topographic data available on a suitable base map. MAPVI shall ensure all digital mapping files are produced in accordance with the requirements documented in the *G&S*, as amended.

<u>Deliverables</u>

MAPVI will include the deliverables of this task in the TSDN for the Flood Frequency Determination. The deliverables shall include:

- Digital and hard copy flood recovery maps depicting the 1-percent-annual-chance floodplain boundaries generated from the Approximate Study with More Detail.

- Unpublished flood profiles.
- Tabulated peak discharge, water surface elevations, and velocities.
- A report summarizing the findings of and methodologies for the flood recovery data tools task.

The report will be available through the FEMA Flood Hazard Mapping website for interested parties.

Standards

All work under this task order will adhere to the *G&S* as identified in the IDIQ contract.

Scope Changes

Leasburg Canal was removed from the scope of work because it is an agricultural drain. For modeling purposes, it is assumed that the agricultural drain would be full during flooding and have no effective conveyance capacity. Following the topography, water would flow perpendicular to the drain toward the Rio Grande. Unnamed Stream Leasburg was selected as the dominant flowpath to replace Leasburg Canal.

Unnamed Stream Leasburg is one of several streams that contributed to the 2006 flooding downstream of Interstate 25 near the town of Radium Springs. In order to gain a better understanding of the amount of water contributing to the flooding of this area, two drainage basins were delineated: one basin upstream of Interstate 25 that includes drainage only from Unnamed Stream Leasburg and one basin that includes flow from Unnamed Stream Leasburg as well as drainage from the adjacent contributing streams. The smaller watershed upstream of Interstate 25 was used solely for hydrologic analysis and was not part of the hydraulic modeling task.

As with Leasburg Canal, Crawford Lateral was removed from the scope of work because it is an agricultural drain. For modeling purposes, it is assumed that the agricultural drain would be full during flooding and have no effective conveyance capacity. Following the topography, water would flow perpendicular to the drain toward the Rio Grande. Unnamed Stream South was selected as the dominant flowpath to replace Crawford Lateral and was, therefore, extended to the confluence with the Rio Grande.

3. Field Reconnaissance

Field Reconnaissance for Task Order 35 was conducted on all sixteen study reaches in Doña Ana County (Table 2). During the week of July 16, 2007, MAPVI personnel visited the identified channel network. Detailed field notes and digital photographs were collected in order to characterize the physical structure and condition of each location. Field reconnaissance notes, photographs, and structure location maps are included in Appendix A.

Along each channel, stream conditions were documented at typical cross sections and the types and numbers of hydraulic structures were identified. At each structure, physical dimensions and conditions were recorded, as well as other parameters needed for the hydrologic and hydraulic modeling. The team specifically looked for any indication of maintenance or lack thereof, as well as damage to channels and structures.

The Approximate Studies with More Detail Surveys for structures were all measured per Watershed Concepts, Inc. Watershed Information System (WISE) Survey Manual Version 3.7 (July 2004) using measuring tapes and hand levels. Twenty-five culverts and six bridges were measured as part of the field reconnaissance.

3.1. Culvert Surveys

For Approximate Studies with More Detail, culvert measurements include the following:

- Height, width, length, number and type of culverts.
- Relative elevations of the culvert invert, the roadway, and the right and left channel banks.
- Top and bottom widths of the channel.

3.2. Bridge Surveys

For Approximate Studies with More Detail, bridge measurements include the following:

- Height, length, and deck thickness of the bridge.
- At the bridge, the width at the top of the channel and the toe of the slope.
- Number of piers and the diameter of each pier.
- Relative elevations of the channel invert, the roadway, and the right and left channel banks.
- Channel top and bottom widths at a representative location outside any transition due to the bridge.

Information regarding structures surveyed can be found in Appendix A.

3.3. Dam and Weir Surveys

Dam and weir surveys were not performed, as there are no dams or weirs present along our study reaches. Information regarding dam outlets at the upper reaches of streams where they existed was collected when possible but were not included in analysis as they existed outside of the study reaches.

4. Topographic Data

Light Detection and Ranging (LIDAR) data (2-foot contour equivalence) obtained from Doña Ana County Flood Commission was used, in conjunction with USGS DEM data, to create a Triangular Irregular Network (TIN) as part of the 2005 Countywide FIRM and FIS Update of Doña Ana County under Task Order 11. The TIN developed under Task Order 11 was used to create the terrain model for this Disaster Response. USGS DEM data was used to supplement the TIN where additional topographic coverage was needed.

5. Hydrology

Hydrologic analyses were completed for the drainage areas of the flooding sources identified in the contract task order (Figure 1). Peak flood discharges were calculated based on the recurrence intervals identified in the contract task order for annual chance storms. These flood discharges were used for the subsequent hydraulic analyses of the subject flooding sources.

Based on limited historical analysis available for the restudy areas, MAPVI reviewed the *G&S*, Section C1.2.1, Sub-Section Choice of Methodology for applicable methods to use for hydrologic analysis. The USGS regression equations are recommended for estimating base flood discharges if a flow hydrograph is not needed and if the regression equations were applicable. With the exception of Fillmore Arroyo, regression equations were applicable to the Doña Ana County study reaches. The Hydrologic Engineering Centerǿs Hydrologic Modeling System (HEC-HMS) software Version 3.1.0, using the Soil Conservation Service (SCS) Methodology, was selected to estimate the 1-percent-annual-chance discharge for Fillmore Arroyo. HEC-HMS is listed as a FEMA approved software. The results of the hydrologic analysis are located in Appendix B.

5.1. Regression Equations

The New Mexico Southwest Desert regional regression equations were applicable for Doña Ana County, which is located within Region 7 for these equations (USGS, 1996; USGS, 2002). The Southwest Desert equations use the drainage area in square miles to develop a flow rate. Drainage basin areas were calculated using ArcView 9.2 software.

The Southwest Desert regression equations for Region 7 are valid for drainage basins less than 2,830 square miles and greater than 0.2 square miles. There are no other restrictions in the modeling for this region. The Southwest Desert regression equation for Region 7 is as follows:

$$Q_{100} = 7.51*10^{2}*A^{0.52}$$

Where: Q100 = Rural 100-year Peak Discharge (cubic feet/second)

A = Drainage Area (square miles)

5.2. Rainfall-Runoff Model

The rainfall-runoff model was developed using HEC-HMS. The model utilized the SCS curve number for the loss rate, the SCS method for the runoff transform, and the SCS unit hydrograph for the precipitation.

5.3. Drainage Basin Area Delineation

The USGS Quadrangle Maps (10-20 foot contour interval) obtained from the New Mexico Resource Geographic Information System (RGIS) website were used to delineate the watershed basin areas (RGIS, 2007). Figure 2, located at the end of this report, shows the extent of the drainage basins.

5.4. Collected Data and Parameter Estimation

Precipitation Data

The centroid of each watershed for the study reaches was approximated based on the watershed delineation. The coordinates of the centroid were input into the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 website. The NOAA Atlas website uses the coordinates of a fixed location to interpolate the average precipitation values for that location. The precipitation value obtained for the Fillmore Arroyo watershed is given in Table 3.

Table 3 – Precipitation Data

Average Recurrence Interval (years)	Precipitation Frequency Estimates 24 Hour Duration (inches)
100	3.62

Watershed Parameters

Watershed characteristics for the Rainfall-Runoff Method were determined from available topographic data and available orthophotogrammetric data.

Runoff Losses

The Natural Resources Conservation Service (NRCS), formerly the SCS, curve number (CN) approach was used to determine the runoff losses for Fillmore Arroyo to account for infiltration and interception. The curve number was based on soil type and landuse classification.

Soil Types and Landuse

Soil types and landuse classifications were used to determine the average curve number for the Fillmore Arroyo watershed. Soil types were obtained from the NRCS web soil survey. A map showing the Soil Types can be found in Appendix B. Landuse classifications were determined by inspecting a digital photograph of the watershed. The average curve number calculation for the Fillmore Arroyo watershed can be found in Appendix B.

Runoff Transform

The time of concentration input parameters for Fillmore Arroyo were hand calculated in accordance with the NRCS (SCS) Technical Report ï 55 method procedures. Channel configurations and runoff coefficients were obtained from orthophotography. The sheet flow segment was limited to the upper 300 feet of the basin. The shallow concentrated flow was limited to the 2000 foot segment downstream of the sheet flow segment. The remainder of the flow path was categorized as channel flow. Utilizing these input parameters, the time of concentration was generated through spreadsheet calculation. The time of concentration calculation can be found in Appendix B. The lag time was calculated to be 60% of time of concentration.

The calculated discharges were compared to the preliminary Flood Insurance Study (FIS) for Doña Ana County (FEMA, 2008). The study reaches for this Disaster Response do not overlap Special Flood Hazard Areas of greater detail than Zone A, therefore there is no comparable discharge. Table 4 shows the 1-percent-annual-chance discharges calculated from the regression equations and Rainfall-Runoff Model. MAPVI has reviewed the results of the hydrologic analysis of the Doña Ana County study reaches and found them reasonable.

Table 4 – Summary of Discharges

Flooding Source	Location	Cumulative Drainage Area (sq. miles)	1-percent-Annual-Chance Peak Flow Rate (cfs)
Barcelona	890 feet DS of Fairway Village Drive	1.62	965
Doña Ana Arroyo South	Confluence with Doña Ana Lateral	10.48	2,550
Donaldson Arroyo	70 feet US of Puerta Drive	2.16	1,120
Faulkner Canyon	744 feet US of confluence with Rio Grande	24.72	3,980
Fillmore Arroyo	DS of Interstate Highway 10	0.31	164
Foster Canyon	Confluence with Rio Grande	6.98	2,060
La Union Arroyo	US of Alvarez Drive	3.44	1,430
Peña Blanca Arroyo	Confluence with Eastside Canal	24.78	3,990
Placitas Arroyo	Confluence with Rio Grande	30.92	4,470
Rodey Canyon Creek	55 feet US of Hall Road	3.08	1,350

Table 4 – Summary of Discharges, continued

Flooding Source	Location	Cumulative Drainage Area (sq. miles)	1-percent-Annual-Chance Peak Flow Rate (cfs)
Spring Canyon Creek	Confluence with Rodey Lateral	6.00	1,910
Unnamed Stream Anthony	DS of Fourth Street	5.30	1,790
Unnamed Stream Berino	Confluence with Anthony Lateral	3.31	1,400
Unnamed Stream Leasburg	Confluence with Leasburg Canal	3.44	1,430
Unnamed Stream Leasburg A	US of Interstate 25	1.91	1,050
Unnamed Stream North	1,375 feet US of Crawford Drive	1.03	763
Unnamed Stream South	920 feet US of Crawford Drive	1.71	993

5.5. Modeling Considerations

Unnamed Stream Leasburg

The Unnamed Stream Leasburg study reach contains two sub-basins. Downstream of their junction at cross section H, the combined flows of both tributaries are incorporated into the model. Upstream of this point, the principal sub-basin and its flows are modeled.

Study Streams with Upstream Dams

As shown in Table 5, seven of the study reaches have at least one upstream dam. All of the dams were designed to contain the 50-year storm event, with the exception of Fillmore Dam. It is assumed that the dams may not withstand the 100-year peak storm event and will not be included in the modeling.

Table 5 – Study Reaches and Associated Dams

Study Reach	Upstream Dams
Doña Ana Arroyo South	Doña Ana North Dam Doña Ana South Dam
Fillmore Arroyo	Fillmore Dam
La Union Arroyo	La Union Dam A La Union Dam B
Peña Blanca Arroyo	Peña Blanca Dam
Rodey Canyon Creek	Rodey Arroyo Dam
Spring Canyon Creek	Spring Canyon Dam
Unnamed Stream Anthony	Anthony Arroyo Dam

Based on the design plans included in the Fillmore Dam ï Dam Breach and Emergency Spillway Erosion Analysis (2007), Fillmore Dam was designed to contain the 50-year peak storm event. For the county-wide FIRM and FIS update, MAPVI worked closely with the county officials to calibrate the modeling with historical observations such that the results show that the dam does not overflow during the 100-year peak storm event.

The hydrologic analysis included a dam outflow at the Fillmore Dam. The dam output flow rate shown in Table 6 was taken from the Preliminary Flood Insurance Study (FIS) for Doña Ana County, New Mexico. The Rainfall-Runoff Model, SCS Method, was applied to the basin upstream of Fillmore Dam to calculate the flow rate. The flow rate for the basin downstream of the Fillmore Dam was calculated by combining the maximum outfall flow rate from the dam with the flow rate calculated for the downstream basin using the Rainfall-Runoff Model, SCS Method.

Table 6 – Dams 1-Percent-Annual-Chance Discharges

Structure	1-Percent-Annual-Chance Discharge (cfs)
Fillmore Dam	33

6. Hydraulics

All study reaches were modeled in accordance with the *G&S*. The Hydrologic Engineering Centers-River Analysis System (HEC-RAS) software Version 3.1.3, which was developed by the U.S. Army Corps of Engineers (USACE), was used to model all study reaches. HEC-RAS is listed as a FEMA approved software. The hydraulic models are included in Appendix D.

Historical data, such as high water marks, were not available for model calibration. Flood profiles depicting water surface elevations in the preliminary FIS report for Doña Ana County also could not be used for model calibration because the study reaches do not overlap Special Flood Hazard Areas of greater detail than Zone A. Because the downstream ends of the study reaches tie into A zones, normal depth was used as a downstream water surface condition.

6.1. Cross-Sections

A Triangular Irregular Network (TIN) of the study portions of the County was created as part of the 2005 Map Modernization of Doña Ana County under Task Order 11. The TIN, in conjunction with field reconnaissance data, was used within the WISE software platform to obtain all cross-section information.

Cross sections were placed in accordance with the *G&S* and the HEC-RAS manual with the goal of approximately 500-foot spacing. Cross-sections were placed at bridges and culverts and each was categorized as a Top of Road (TOR) cross-section. Additionally, a natural channel cross-section was placed upstream and downstream of each structure. WISE uses these cross-sections to develop the crossing structure information as necessary for HEC-RAS modeling.

6.2. Critical Depth

All Approximate Study with More Detail models were run at subcritical depth as per the *G&S*. Where the models indicated critical depth or supercritical depth, the critical depth results were reported.

6.3. Parameter Estimation

Manningõs ñnò values were entered into the hydraulic model to represent the values that were documented as part of the field reconnaissance, orthophotography, and engineering judgment. Table 7 provides the ñnò values that were used in the HEC-RAS model for each study reach.

Table 7 – Manning's "n" Values

Study Stream Name	Channel n-value	Overbank n-value
Barcelona	0.025 - 0.040	0.030 - 0.050
Doña Ana Arroyo South	0.030	0.035
Donaldson Arroyo	0.017	0.040
Faulkner Canyon	0.045	0.050
Fillmore Arroyo	0.025 - 0.040	0.040 - 0.050
Foster Canyon	0.035	0.045
La Union Arroyo	0.035 - 0.070	0.045 - 0.100
Pena Blanca Arroyo	0.035	0.050
Placitas Arroyo	0.035	0.050
Rodey Canyon Creek	0.040	0.045
Spring Canyon Creek	0.040	0.045
Unnamed Stream Anthony	0.050 - 0.070	0.060 - 0.090
Unnamed Stream Berino	0.040	0.050
Unnamed Stream Leasburg	0.030 - 0.035	0.035 - 0.070
Unnamed Stream North	0.045	0.060
Unnamed Stream South	0.040 - 0.045	0.050 - 0.060

Expansion and contraction loss coefficients were applied to all crossing structures within the HEC-RAS model to account for the additional energy losses. In cases where a structure was overtopped by a flood event, expansion and contraction loss coefficients were set to the default values of 0.1 and 0.3. All crossing structures located along the study reaches consisted of concrete box culverts with concrete wing walls, culvert crossings, or bridges. Expansion and contraction loss coefficients were applied between cross-sections to account for losses to the changing width of the channel. Table 8 provides the loss coefficients that were used for most of the HEC-RAS modeling.

Table 8 – Expansion and Contraction Coefficients

Structure	Contraction Loss Coefficient	Expansion Loss Coefficient
Cross-Sections	0.1	0.3
Bridge/Culvert (not overtopped)	0.3	0.5
Culvert (significantly narrower than channel width)	0.6	0.8

6.4. Modeling Considerations

All models prepared for FEMA assume that all structures are maintained and have no obstructions.

<u>La Union Arroyo</u>

Permanent ineffective flow areas were used at cross sections A through D because there are homes in the left overbank.

<u>Spring Canyon Creek</u>

The east end of cross sections A through F bends to reach a higher elevation in order to contain the flow in the study stream while excluding the flow area of other streams that are not included in the scope of work.

At various cross sections along the stream, the ineffective flow is higher than the topographic data (ground level). The ineffective flow areas were placed to show consistency between the upstream and downstream cross sections.

<u>Placitas Arroyo</u>

The east end of cross sections A through P bends to reach a higher elevation in order to contain the flow in the study stream while excluding the flow area of other streams that are not included in the scope of work.

Placitas Arroyo, Spring Canyon Creek, Rodey Canyon Creek

Placitas Arroyo, Spring Canyon Creek and Rodey Canyon Creek flow into a flat, agricultural area. When the streams reach this low-lying area, flooding fans out and the floodplains converge upon each other. The flooding in each stream is affected by the conditions of the other two streams. Therefore, the three streams were modeled jointly. The downstream cross sections on Placitas Arroyo and Spring Canyon Creek were extended to capture the flooding from the upstream study streams.

7. Floodplain Delineation

The cross-sections modeled in HEC-RAS were based on the terrain model. An ArcMap shape file containing the floodplain boundaries for the modeled study reaches was then generated in WISE using the HEC-RAS model results. A majority of the resulting floodplain boundaries are in agreement with the modeling results for all study reaches. In some instances, the terrain model did not pick-up the full depth or shape of the channel or the true height of the channel banks as noted in the field reconnaissance. For example, the terrain model may not pick up data within steep slopes or steep banks. For cases where there was a difference between the terrain model and the contour data, engineering judgment was used to determine the floodplain boundary based on field reconnaissance and contour data.

The flood elevations developed using HEC-RAS and shown on the Advisory Flood Recovery Profiles and Floodplain Elevation Data Tables are applicable only to the channels. The overbank areas were set as ineffective flow areas on many of the study streams in order to designate the channel as the primary flowpath. Therefore, the flood elevations do not apply to the overbank areas.

The results of this study must tie into the effective studies upstream and downstream of the study reach limits. To ensure consistency between the preliminary maps and this study, the floodplain boundaries generated in this study were tied into the floodplain boundaries developed as part of the countywide update. Any deviations between the floodplain boundaries and the modeling results are discussed in detail below.

Barcelona

Between cross sections M and O, the stream bifurcates into two branches. The HEC-RAS model at cross section N only depicts the flow in one of the branches, but the contours, orthographic photos, and data provided from Doña Ana County indicates that the tributary is part of the flooded region.

Doña Ana Arroyo South

The HEC-RAS model indicates that flooding is contained within the channel at cross sections R and S, however, both upstream and downstream cross sections show flooding in the overbanks. The floodplain boundary was, therefore, mapped in the overbank area of cross sections R and S to maintain consistency between upstream and downstream cross sections.

Because the floodplain boundary at cross sections M and N is wider than the width indicated by the HEC-RAS model, the floodplain was mapped based on the contours and orthophotos as this approach better reflects current conditions.

The HEC-RAS model shows cross section A with a large flooding area. The floodplain was mapped based on the contours and orthophotos, which are in agreement with each other resulting in a smaller floodplain.

Faulkner Canyon

At cross section E, the ineffective flow on the right side is included in the floodplain because the topography of the area will allow flooding in the low-lying area to the right. At cross section D, the floodplain is wider than the flooding shown in the HEC-RAS model in order to maintain continuity between the upstream and downstream cross sections. Cross section E has flooding in the left overbank and there is no topographic feature that would force flooding back into the channel at cross section D.

Fillmore Arroyo

The first cross section in the HEC-RAS model is not included in the floodplain because the limit of the study ends downstream of Interstate Highway 10. The first cross section was included in the model in order to accurately model the structure, but is not required for floodplain mapping. The downstream end of the floodplain was adjusted to tie into the preliminary floodplain.

La Union Arroyo

A ñLimit of Studyò line was designated between cross sections B and C on the left side and at the downstream end where the floodplain ties into the preliminary floodplain.

Pena Blanca Arroyo

Between cross sections A and K, the floodplain was adjusted based on the contours and orthophotos. The HEC-RAS model shows inconsistent flooding in the right overbank. Because the area is uniformly agricultural and residential, the entire right overbank was included in the floodplain.

Upstream of cross section K, Pena Blanca Arroyo is a braided stream. The floodplain was adjusted based on the orthophotos and contours to show consistent flooding in the overbanks.

Placitas Arroyo

At various cross sections between A and P, the ineffective flow is higher than the topographic data (ground level). The ineffective flow areas were placed to show consistency between the upstream and downstream cross sections.

Rodey Canyon Creek

Between cross sections K and L is a confluence with a tributary on the southwestern side. This tributary is out of the scope of this study, therefore, a ñLimit of Studyò line was designated between cross sections K and L. Further analysis is required in this area.

Spring Canyon Creek

The flooding shown in the HEC-RAS model at cross section B is not consistent with the upstream and downstream cross sections, contours, and orthophotos. Therefore, the floodplain was adjusted based on the orthophotos and contours to maintain consistency between cross sections.

Placitas Arroyo, Spring Canyon Creek, Rodey Canyon Creek

Placitas Arroyo, Spring Canyon Creek, and Rodey Canyon Creek flow into a flat, agricultural area. When the streams reach this low-lying area, flooding fans out and the floodplains converge upon each other. The flooding in each stream is affected by the conditions of the others, therefore the floodplains of these three streams were mapped as one floodplain.

Unnamed Stream Berino

Upstream of cross section R, the floodplain is wider than shown in the HEC-RAS model. The floodplain was mapped according to contours to show consistency between the adjacent cross sections.

The floodplain between cross sections G and J does not agree with the HEC-RAS model because the area is primarily a flat agricultural area. The topographically high points shown to contain flow in the HEC-RAS model do not exist, so the floodplains were drawn according to the contours.

Unnamed Stream North

At cross sections H and I, the HEC-RAS model shows lower channel bottom elevations than is supported by the contours. The difference, however, is within the tolerance of the contours.

At cross section L, the HEC-RAS model does not show overbank flooding. Based on the orthophotos and contours, the floodplain was adjusted and overbank flooding shown to maintain consistency between upstream and downstream cross sections. At cross sections B and C, the floodplain is wider than shown in the HEC-RAS model. The floodplain was extended to include a pond at the downstream end of the study reach. Small tributary streams enter the main channel between cross section F and G and between D and E. These are not included in limit of study or incorporated into the floodplain. There are various cross sections along the stream that were extended past the basin boundary in order to ensure that flow is contained within the cross section. A ñLimit of Studyò line was designated at the downstream end of the stream where the floodplain ties into the effective floodplain.

8. Exceptions

I. MAPVI uses ESRI ArcMap version 9.2. For compatibility reasons, MAPVI will not be providing a Georeferenced database.

II. In some cases, structures were located too closely together to be modeled separately. Therefore several structures may have been combined and others were not modeled. However, data was collected for these structures and is included in Appendix A.

III. To ensure that all spatial and database files could be used/and or modified by the WISE software, no data fields that were created by WISE were deleted from the final spatial file being submitted as part of this task. The result is that not all data fields are in absolute conformance to the specifications outlined in Appendix L. A Data field that WISE created that served the same function as a similar data field listed in the specifications was left in the format WISE created them. These data fields were re-populated in the guidelines and specifications format, so there is some duplicate data. Additionally, lookup reference fields (LID fields) were replaced with the final data field that the LID referenced. The following is a list of data fields that were impacted:

1. S_XS Spatial file
    a. STREAM_STN from the specification is equivalent to STRM_STA
    b. WTR_NM from the specifications is equivalent to STRM_NAM
2. S_FLD_HAZ_AR Spatial file
    a. ZONE_LID from the specification is equivalent to FLD_ZONE
    b. V_DATM_LID from the specification is equivalent to V_DATUM
    c. LEN_LID from the specification is equivalent to LEN_UNIT
    d. VEL_LID from the specification is equivalent to VEL_UNIT
3. S_FLD_HAZ_LN Spatial file
    a. LN_LID from the specification is equivalent to LN_TYP
4. S_WTR_LN Spatial file
    a. WTR_NM from the specification is equivalent to STREAM

IV. In the S_XS spatial file, the TOR cross-sections (see TYPE field) are developed by WISE to create the HEC-RAS structure.

V. When calculating top widths, HEC-RAS does not account for braided stream morphology and therefore, underestimates the total top width. In a braided stream cross-section, HEC-RAS adds the top widths of the individual channels instead of computing the width of the entire channel.

VI. The flood recovery data provided as part of this study falls outside the FEMA Map Modernization Program. As directed by FEMA, the computed flood elevations are provided in the Floodplain Elevation Data Table.

9. Conclusions

The floodplain boundaries generated in this study were generally similar to the preliminary flood boundaries. In rural areas, variations in the flood boundaries occurred because some study streams have changed course. Changes in land use have also affected the flood boundaries.

10. Result Locations

The database tables and spatial files provided as part of this submittal can be found in digital format in Appendix G of this TSDN. The flood recovery data developed as part of this study falls outside of FEMAós normal flood hazard mapping operations, therefore many of the spatial files and database files required for a normal FEMA flood hazard mapping submittal are not included in this submittal. The database tables and spatial files included in this submittal were developed in accordance with the *G&S;* Appendix L (dated April 2004) and any exceptions are listed in the Exceptions section.

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Figure 1. Study Stream Reaches Doña Ana County, NM

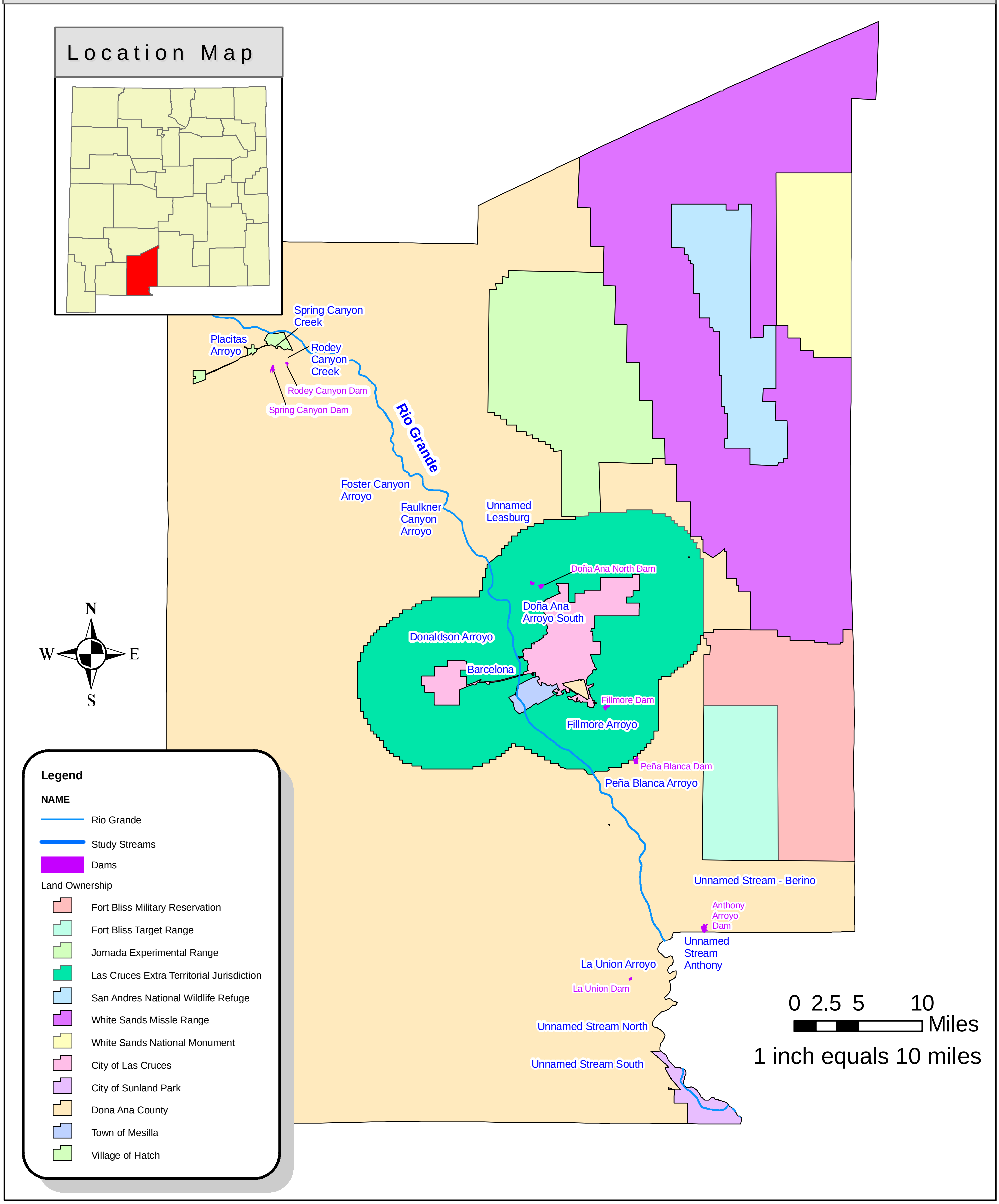

Figure 2. Study Basins
Doña Ana County, NM