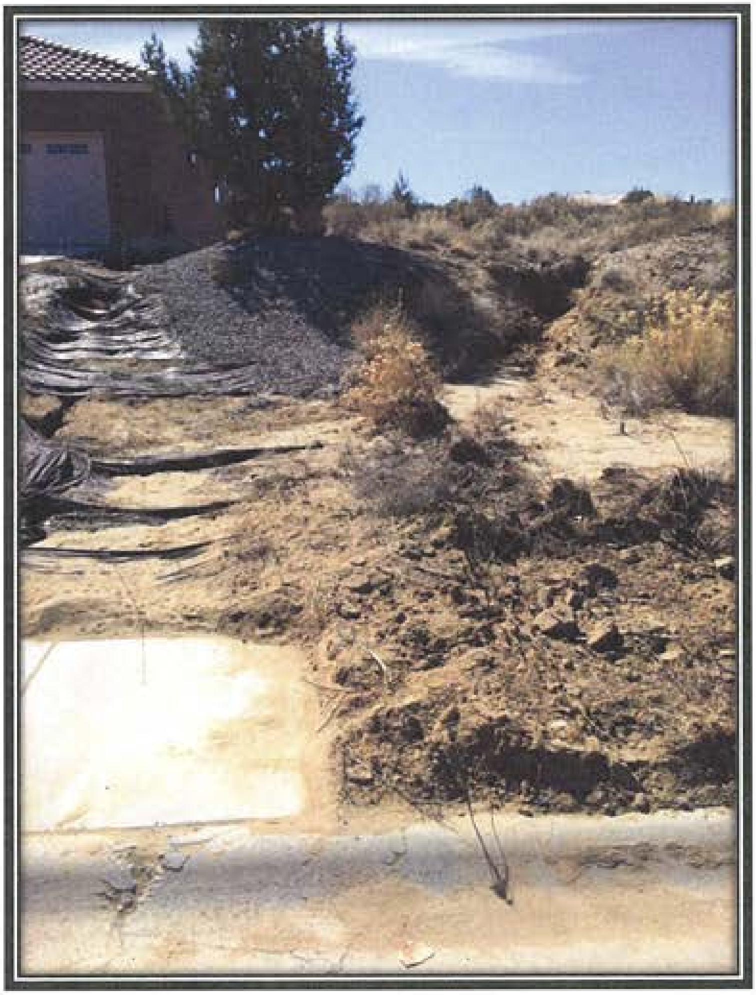
Kokopelli Subdivision

Flood Hazard Assessment and Mitigation Alternatives Report
City of Aztec
San Juan, New Mexico



Prepared for the:

Prepared by:

AECOM

MARC McINTOSH
NEW MEXICO
23532
PROFESSIONAL ENGINEER
06.30.17

June 2017

Table of Contents

MARC MCINTOSH
NEW MEXICO
23532
PROFESSIONAL ENGINEER

Oct. 30, 17

Appendices

Appendix A – FEMA Effective FIRM Panel

Appendix B – Hydrologic and Hydraulic Calculation – FLO-2D Existing Conditions

Appendix C – Alternatives Analysis – Conceptual Layout

Appendix D – Recommended Alternatives Analysis

Appendix E – Recommended Alterative – 30% Design Plans

MARC McINTOSH
NEW MEXICO
23532
PROFESSIONAL ENGINEER

Oct-30,17

Introduction

The Kokopelli Subdivision is an existing single family residential subdivision located in City of Aztec, New Mexico. The subdivision has experienced flooding as recently as August of 2015 due to significant rainfall events and minimal drainage infrastructure. The watershed area includes in part, the Hampton Arroyo watershed which encompasses approximately 4.5 square miles. The upstream portion of the watershed is predominantly undeveloped prior to entering the subdivision, flowing through, and ultimately discharging into the Animas River. Development of the subdivision has provided minimal drainage infrastructure resulting in a reduction of flood conveyance capacity prior to outfall into the arroyo.

Purpose

AECOM Technical Services (AECOM) was contracted to provide professional engineering consulting services to the City of Aztec (Client) for this *Kokopelli Subdivision Flood Hazard Assessment* and the preparation of the Recommended Mitigation Alternative. This report details the existing drainage conditions, the drainage criteria and processes used in calculations and modelling, hydrology, hydraulics, and mitigation alternatives for the Kokopelli Subdivision. The primary goals are to identify areas of concern that contribute to drainage failures, recommend mitigation alternatives to reduce potential flooding, and work with the City of Aztec to help apply for grants to seek funding for future remediation projects.

Location

The Kokopelli Subdivision is located in the north central portion of the City of Aztec in San Juan County, New Mexico. The project location map is shown in **Figure 1**.

The Hampton Arroyo extends northwesterly through the subdivision, beneath U.S. Highway 550, with ultimate outfall into the Animas River. The upper limit of the watershed area is subject to large erosional events due to non-cohesive sand and gravel that easily migrate during high intensity rainfall events.

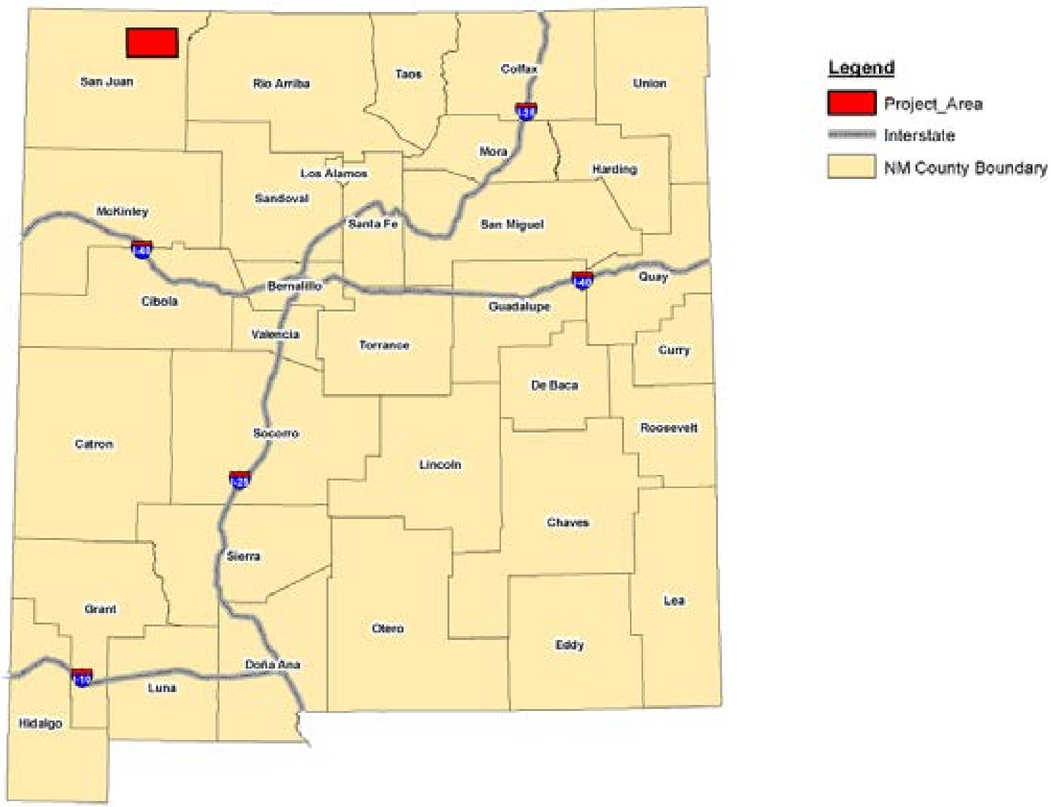


Figure 1: Project Location Map

Background

The City of Aztec area has experienced significant flooding and erosion problems associated with monsoon rainfall events. The most recent rainfall and flooding event was observed in August 2015. The erosion and incision of the upstream areas contribute high sediment loads that are carried downstream into town where the topography becomes shallower. The change in grade causes sedimentation and subsequent flooding throughout the City. Neighborhoods such as the Kokopelli Subdivision and roadways have had significant flooding and sediment deposition.

FEMA Floodplain Classification

The Federal Emergency Management Agency (FEMA) indicates that the Kokopelli subdivision is a part of the Hampton Arroyo watershed and is encompassed by Flood Insurance Rate Map (FIRM) Panel 350065F0730, dated August 5, 2010. The FIRM Panel indicates that the Kokopelli subdivision is located within Flood Zone “A”. Flood Zone “A” is defined by the Federal Emergency Management Agency (FEMA) and the FIRM Panel as follows:

Floodzone "A":

Special Flood Hazard Areas (SFHAs) subject to inundation by the 1% annual chance flood; No Base Flood Elevations determined.

The effective FIRM panel is attached in **Appendix A**.

Survey and Mapping Information

The City of Aztec provided 1-ft contour Light Detection and Ranging (LiDAR) topographic data for use in the watershed delineation and hydrologic/hydraulic analysis. The topographic data provided by the City of Aztec is based on the following datum:

- Horizontal Datum: Re-projected into the New Mexico State Plane West, North American Datum 1983 (NAD83) coordinate system North American Datum 1983 (NAD83), projected to State Plane New Mexico West projection
- Vertical Datum: North American Vertical Datum 1988 (NAVD88)

The contour data was deemed suitable for use in this study due to the high density of point data used in the survey collection process which increases the accuracy and reliability of the data set. The LiDAR data was collected in April 2015. Aerial imagery was also collected and provided by the City of Aztec.

Public Outreach

AECOM assisted Aztec with public outreach and coordination. Several community outreach meetings were conducted to interact with residents. Residents and community leaders expressed their concerns and related their individual flood stories. Large displays were created to show 2D modeling results to the public and explained them to homeowners. Residents reviewed the model results and shared their observations according to flooding events. The observations and input were received and used to calibrate the model results based on resident input.

Engineering Analysis

The engineering support for this study utilized Environmental Systems Research Institute's (ESRI) Arc Geographic Information System (ArcGIS), U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) Version 4.1, Hydrologic Engineering Center River Analysis System (HEC-RAS) Version 4.1.0,FLO-2D Pro and AutoCAD 2016.

Hydrology and Hydraulic Analysis – Existing Conditions Using FLO-2D

FLO-2D Model

A grid-based 2D model was prepared to perform the hydrologic and hydraulic analyses. The grid-based 2D model was necessary to analyze the current conditions (referred as existing conditions) and impact of problematic flood mitigation improvements in future (referred as proposed conditions). A rain-on grid approach was used to simulate the existing conditions using FLO-2D PRO. The project boundary used for the analysis is shown in **Figure 2**.

A multi-frequency hydrologic and hydraulic analysis was prepared for the Kokopelli watershed. The following storm events were computed for the Kokopelli Watershed.

- 2-year, 24-hour
- 10-year, 24-hour
- 25-year, 24-hour
- 50-year, 24-hour
- 100-year, 24-hour

A detailed discussion of the analysis criteria, development of hydrologic and hydraulic parameters, and modeling results are discussed in the following sections.

Rainfall Distribution

AECOM incorporated precipitation data into the hydrologic models in accordance with NMSHTD guidelines coupled with National Oceanic and Atmosperic Administration (NOAA) Atlas 14 precipitation data for each of the storms indicated previously. The precipitation depth, duration, frequency data based on the centroid of the Kokopelli Watershed is summarized in the Table 1.

For hydrologic studies in the State of New Mexico, a modified NOAA-SCS rainfall distribution is used for modelling storm events. This distribution establishes the peak rainfall intensity at hour six in a 24-hour storm event. The procedure for development of the distribution is found in the *NMSHTD Hydrology Manual Volume I* in section 3.3.1.2.3. The rainfall distribution is unique to the Kokopelli Subdivision watershed and developed for each of the 2-, 10-, 25-, 50-, and 100-year; 24-hour events modeled herein. Each frequency specific distribution is summarized in Table 2. The modified rainfall distribution was enter in the FLO-2D model.

The details of the rainfall distribution calculation is attached in **Appendix B**.

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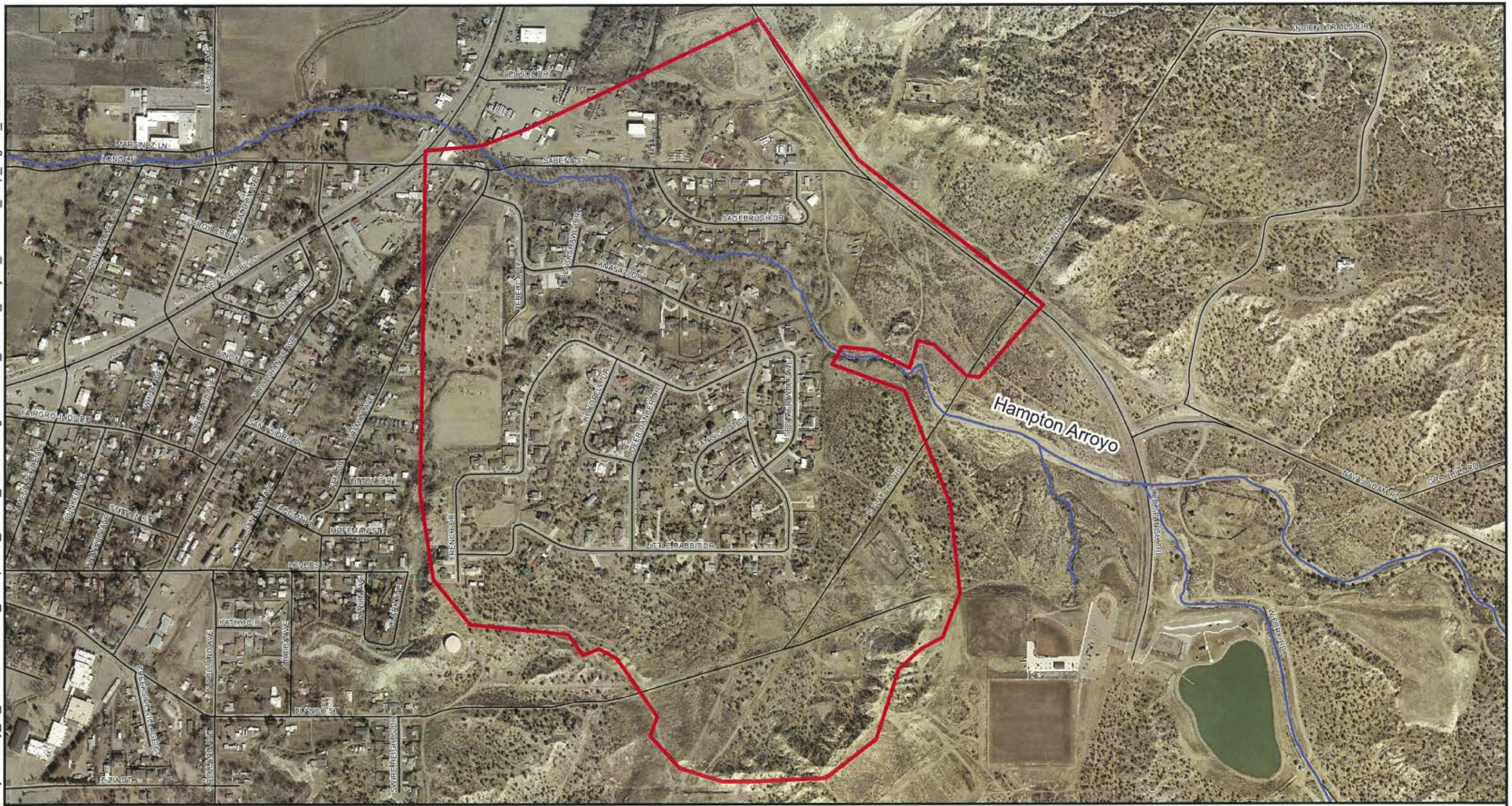


Legend

Hampton Arroyo

Aztec Roads

Project Boundary

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

0 600 1,200 Feet

KokoPelli Sub-Division
Figure 2
Project Boundary

City of Aztec, New Mexico

AECOM

Table 1: NOAA 14 Precipitation Depths

PRECIPITATION DEPTH [inches]								
DURATION	STORM FREQUENCY							
	1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR	500-YR
5-min	0.15	0.19	0.26	0.31	0.39	0.45	0.52	0.71
10-min	0.23	0.29	0.39	0.47	0.59	0.69	0.8	1.08
15-min	0.28	0.36	0.48	0.59	0.73	0.86	0.99	1.33
30-min	0.38	0.48	0.65	0.79	0.99	1.15	1.33	1.80
60-min	0.47	0.6	0.81	0.98	1.22	1.43	1.65	2.22
2-hr	0.54	0.69	0.91	1.10	1.37	1.60	1.84	2.51
3-hr	0.59	0.74	0.95	1.14	1.4	1.62	1.86	2.51
6-hr	0.71	0.88	1.1	1.30	1.57	1.8	2.05	2.70
12-hr	0.84	1.05	1.29	1.49	1.77	1.99	2.21	2.77
24-hr	0.93	1.17	1.48	1.74	2.09	2.37	2.66	3.38

Table 2: Frequency Specific Distribution

DURATION [hours]	CUMULATIVE DEPTH [%]				
	2-YEAR	10-YEAR	25-YEAR	50-YEAR	100-YEAR
0	0	0	0	0	0
0.25	0.025	0.018	0.016	0.013	0.010
0.5	0.050	0.036	0.032	0.027	0.020
0.75	0.074	0.055	0.048	0.040	0.030
1	0.114	0.085	0.075	0.065	0.054
1.25	0.134	0.101	0.089	0.078	0.066
1.5	0.156	0.112	0.096	0.082	0.070
1.75	0.174	0.130	0.114	0.100	0.087
2	0.193	0.147	0.132	0.118	0.105
2.5	0.242	0.201	0.187	0.177	0.165
3	0.549	0.539	0.538	0.539	0.536
3.5	0.656	0.655	0.660	0.662	0.665
4	0.705	0.709	0.715	0.722	0.726
5	0.723	0.727	0.733	0.739	0.743
6	0.742	0.744	0.751	0.757	0.761
7	0.763	0.756	0.758	0.762	0.765
8	0.783	0.771	0.772	0.774	0.777
9	0.823	0.802	0.799	0.800	0.801
10	0.848	0.820	0.815	0.813	0.811
11	0.873	0.838	0.831	0.826	0.821
12	0.897	0.856	0.847	0.840	0.831
14	0.915	0.880	0.872	0.866	0.859
16	0.932	0.904	0.898	0.893	0.887
18	0.949	0.928	0.923	0.920	0.915
20	0.966	0.952	0.949	0.947	0.944
22	0.983	0.976	0.974	0.973	0.972
24	1.000	1.000	1.000	1.000	1.000

Grids

A 10-foot x 10-foot grid size was used for the FLO-2D analysis. The smaller grid size was selected to get a good resolution of the features such as roads and buildings.

Topography

Details of the survey and topography are discussed earlier under Survey and Mapping Information.

Boundary Conditions

A boundary condition based on normal depth flow at the outflow nodes was used in the model to discharge water off the grid system. This prevents water from accumulating in the model, and allows flows to exit the system. The outflow nodes were selected along the west, north and northeast project boundary.

For areas outside the Kokopelli project area the inflow hydrograph were obtained from the Hampton Arroyo HEC-HMS hydrologic model. The HEC-HMS model was developed as part of the Hampton Arroyo Master Drainage Report (Reference 2). **Figure 3** shows the FLO-2D project boundary and inflow node locations that correspond to the HEC-HMS model. The details of the inflow node locations and hydrograph from HEC-HMS model are attached in **Appendix B**.

Land Use

Rainfall loss/soil infiltration parameters were characterized throughout the watershed for existing land use conditions with the use of the Soil Conservation Service (SCS) Curve Number (CN) methodology. A modified land use file was created coupled with the Natural Resources Conservation Service (NRCS) Online Web Soil Survey data. The existing land use condition was based on the Parcel Assessor data obtained from City of Aztec. This data was compared with the aerial imagery to integrate any new changes in the land use. The NRCS Online Web Soil Survey data was obtained to determine the Hydrologic Soil Group (HSG) for each land use. A combined Land Clip data was created with the soils and land use information. The Land Clip data used for the study, and curve numbers used for the project area is attached in Appendix B.

Building Footprints

The building footprints were digitized in ArcGIS for the subdivision and adjacent industrial areas based on aerial photography. The Area Reduction Factors (ARFs) and Width Reduction Factors (WRFs) were used to model the building foot prints. FLO-2D calculates the ARF and WRF based on the percentage of building that falls on each grid element. This assumes that building footprints area not available for conveyance of floods. This is considered a conservative approach to estimate overland flows.

Details of the development of the building footprints are attached in **Appendix B**.

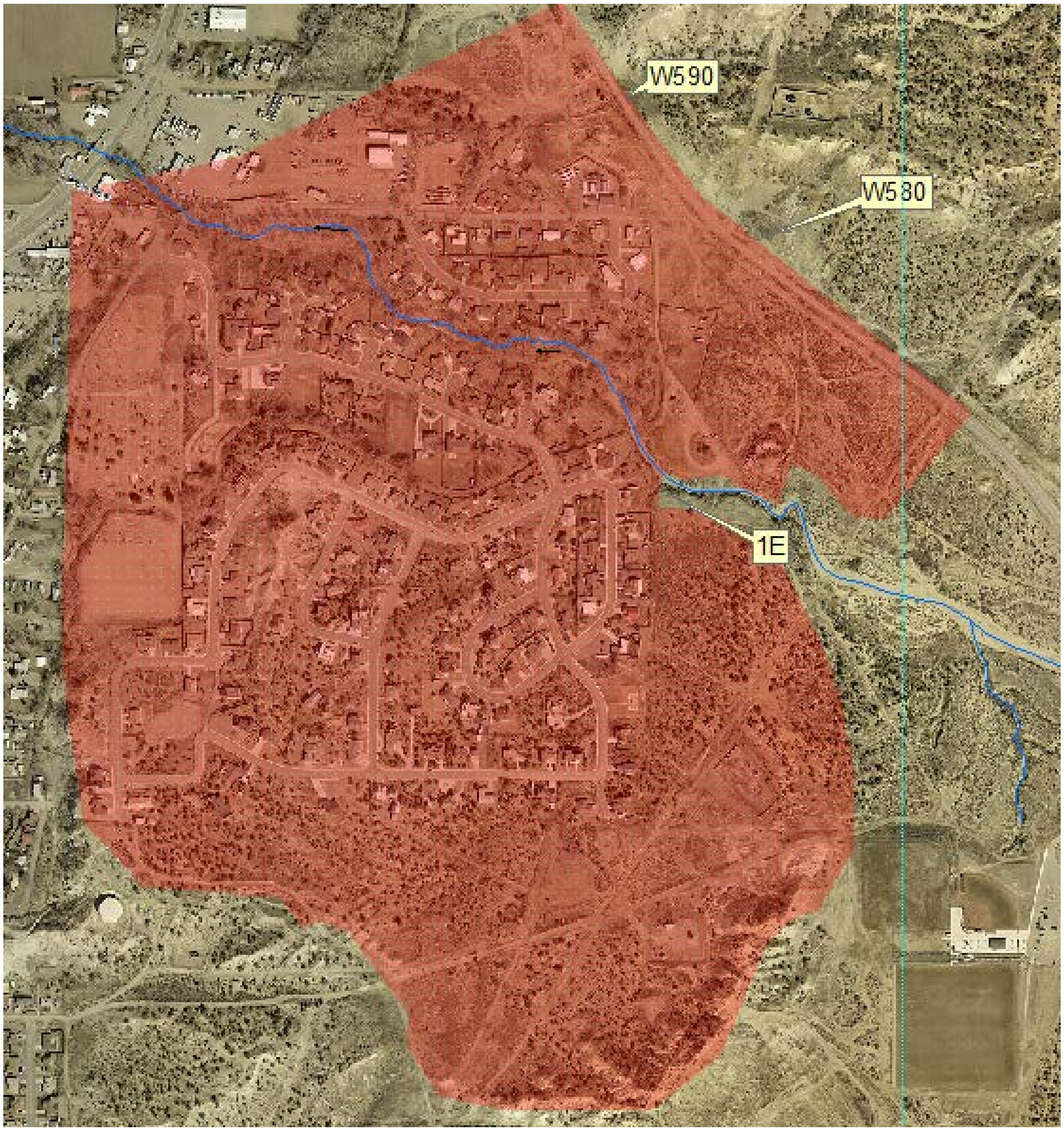


Figure 3: FLO-2D Inflow Node Locations from HEC-HMS

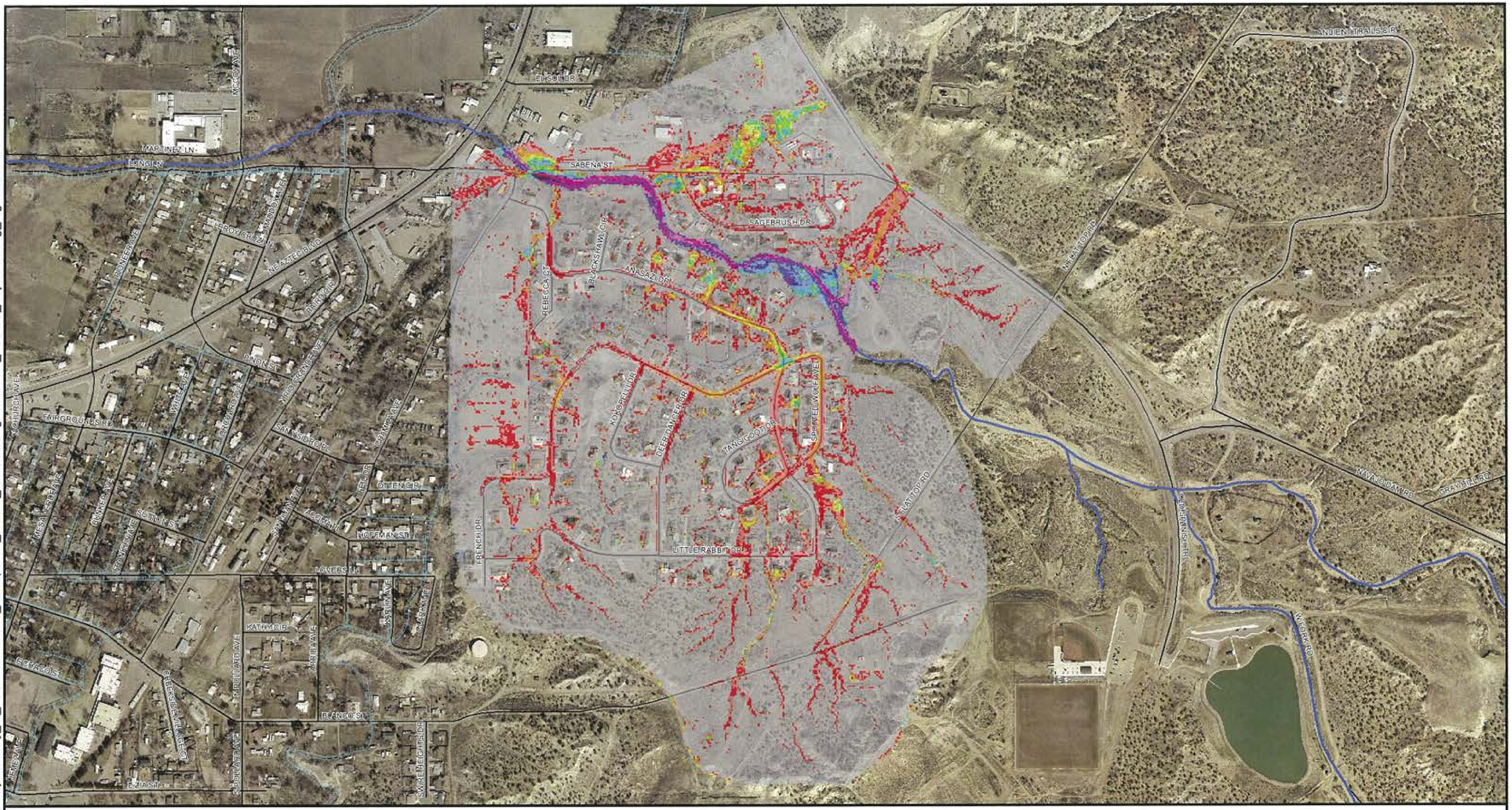
Manning's Roughness Coefficient

Manning's roughness coefficients were established throughout the modeling area based on review of aerial imagery and land use data using an ArcGIS shape file. The area was divided into segments based on the type of land use and extents of vegetation. The representative n-values for the grid elements were based on element roughness coefficients recommended by the FLO-2D manual.

Details of the model parameters and time control variable are discussed in **Appendix B**.

Results

The Simulation Summary from the completion of the FLO-2D model is shown in **Appendix B**. **Figure 4** and **Figure 5** graphically illustrates the maximum flow depth for the Kokopelli Subdivision for a 25-Year storm event and 100-Year storm event, respectively. Maximum flow depths in subdivision range from 0 feet to 1 feet for the 25-year storm event and 0 feet to 1.5 feet for the 100-year storm event except is a few areas with localized flooding issues. 100-year flow depths of up to 2.5 feet were generated in the low-lying areas. The deeper flow depths were found to occur in the low lying area bound by Little Rabbit Drive, French Drive/Anasazi Drive intersection, Spotted Wolf Avenue and a few cul-de-sac areas north of Anasazi Drive.



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Legend

Flow Depth at Cell feet

0.0 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 0.6
0.6 - 0.7
0.7 - 0.8
0.8 - 0.9
0.9 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 4.0
4.0 - 8.0
8.0 - 12.0

Hampton Arroyo
Aztec Roads
Irrigation Ditches

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

0 600 1,200 Feet

KokoPelli Sub-Division
Figure 4
Existing Conditions
25-Year, 24-Hour Maximum Depth

City of Aztec, New Mexico

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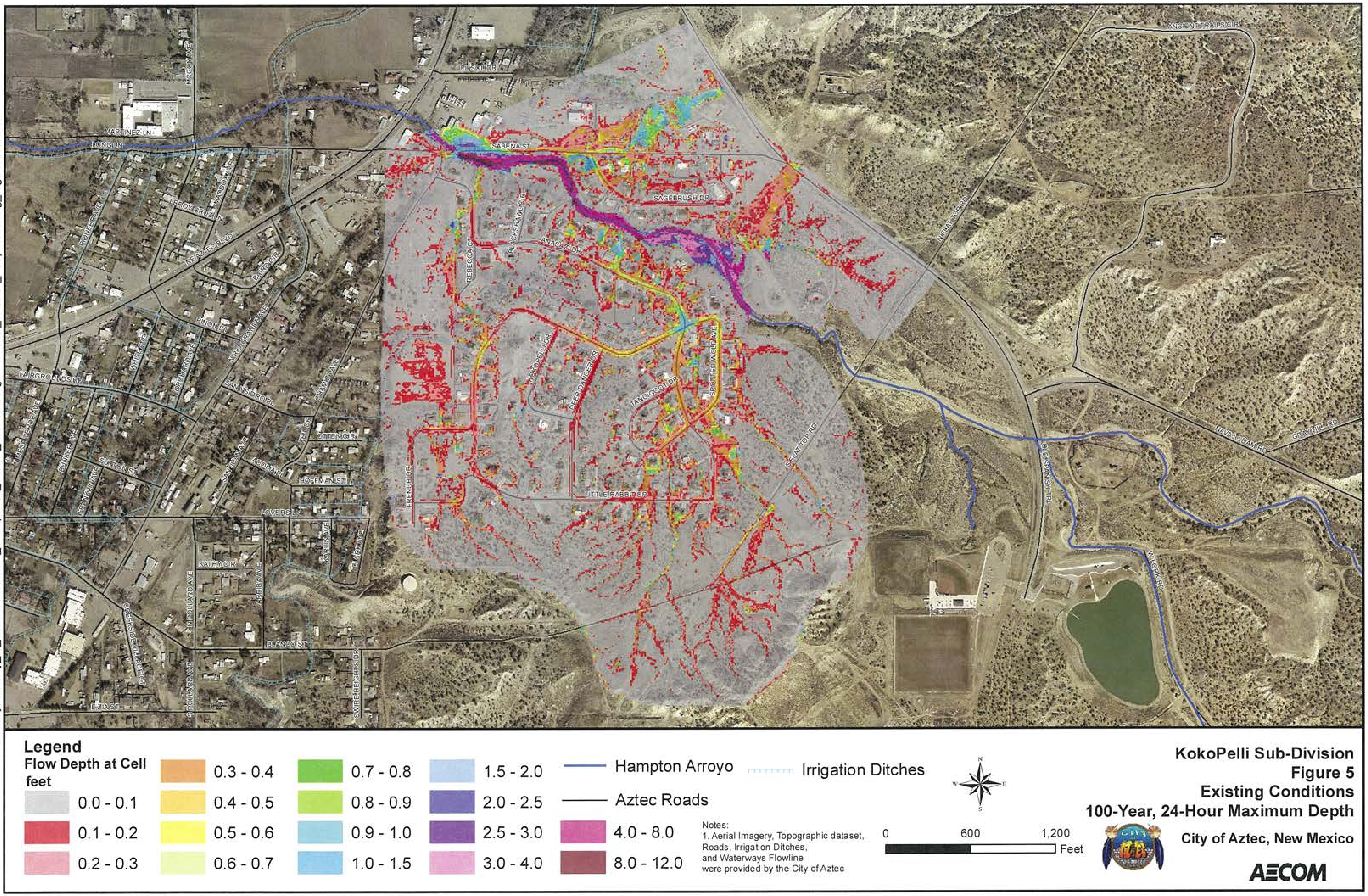

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Alternatives Analysis

The results of the existing conditions drainage analysis was used to identify and prioritize problematic drainage areas in the Kokopelli Subdivision. Four alternatives were developed to mitigate the problematic drainage areas within the subdivision for a 25-year storm event. A 25-year frequency storm event was selected as a target due to its frequent consideration in applications for federal grant funding. The problematic drainage mitigation alternatives consisted of the following elements and/or combinations thereof:

- Storm water storage (e.g., detention basin)
- Hydraulic conveyance (e.g., open channel)
- drainage facilities (e.g., culvert and storm drains)

The four alternatives for mitigation of flooding issues within the Kokopelli Subdivision watershed are discussed in additional detail below. The alternatives were presented to and discussed with City of Aztec staff. The advantages and disadvantages of each alternative were considered in the development of a recommended alternative. The details of the Recommended Alternative are discussed in detail in subsequent sections of this report.

The information presented below in regard to the alternatives is preliminary and conceptual in nature. A detailed analysis and design will be required prior to any implementation of the elements associated with of these alternatives.

Alternative 1

The qualitative conceptual design for Alternative 1 includes the improvement elements identified below:

- Implementation of a proposed diversion channel along the south east and east boundary of the subdivision. The diversion channel will ultimately outfall into the Hampton Arroyo upstream of the subdivision. This prevents localized flooding issues that were prevalent in the southern boundary of the subdivision.
- Add a culvert crossing at the upstream entrance of the channel to convey offsite from the south.

Alternative 2

The qualitative conceptual design for Alternative 2 includes the improvement elements identified below:

- Implementation of a proposed diversion channel along the south east and east boundary of the subdivision. The diversion channel will ultimately outfall into the Hampton Arroyo upstream of the subdivision. This prevents localized flooding issues that were prevalent in the southern boundary of the subdivision.
- A detention basin located just east of the Tangigoot Drive.
- A basin-outfall channel that conveys the excess flows along Spotted Wolf Avenue.

Alternative 3

The qualitative conceptual design for Alternative 3 includes the improvement elements identified below:

- Implementation of a vertical curb and gutter located along Tangigoot Drive alignment at the Little Rabbit Drive intersection.
- A storm drain system along French Drive on the east side of Kokopelli Subdivision that outfalls into the Hampton Arroyo.
- Three channel storm drain outfalls from the cul-de-sac locations along Anasazi Drive that outfall into the Hampton Arroyo.

Alternative 4

The qualitative conceptual design for Alternative 4 includes the improvement elements identified below:

- Implementation of a detention basin located downstream of the Navajo Dam Road, north of Sabena Road Alignment
- Channel improvement north of Sabena Street to convey the flow from the detention basin further south.
- A storm drains system along Sabena Street and cross the road to outfall into the Hampton Arroyo.
- Vertical curb and gutter improvements on the south side of Sabena Street.
- Drainage ditch improvements south of Sabena Street that collects storm water from the proposed curb and gutter to the east.

The conceptual layout for Alternative 1, Alternative 2 Alternative 3 and Alternative 4 are attached in **Appendix C**.

Recommended Alternative

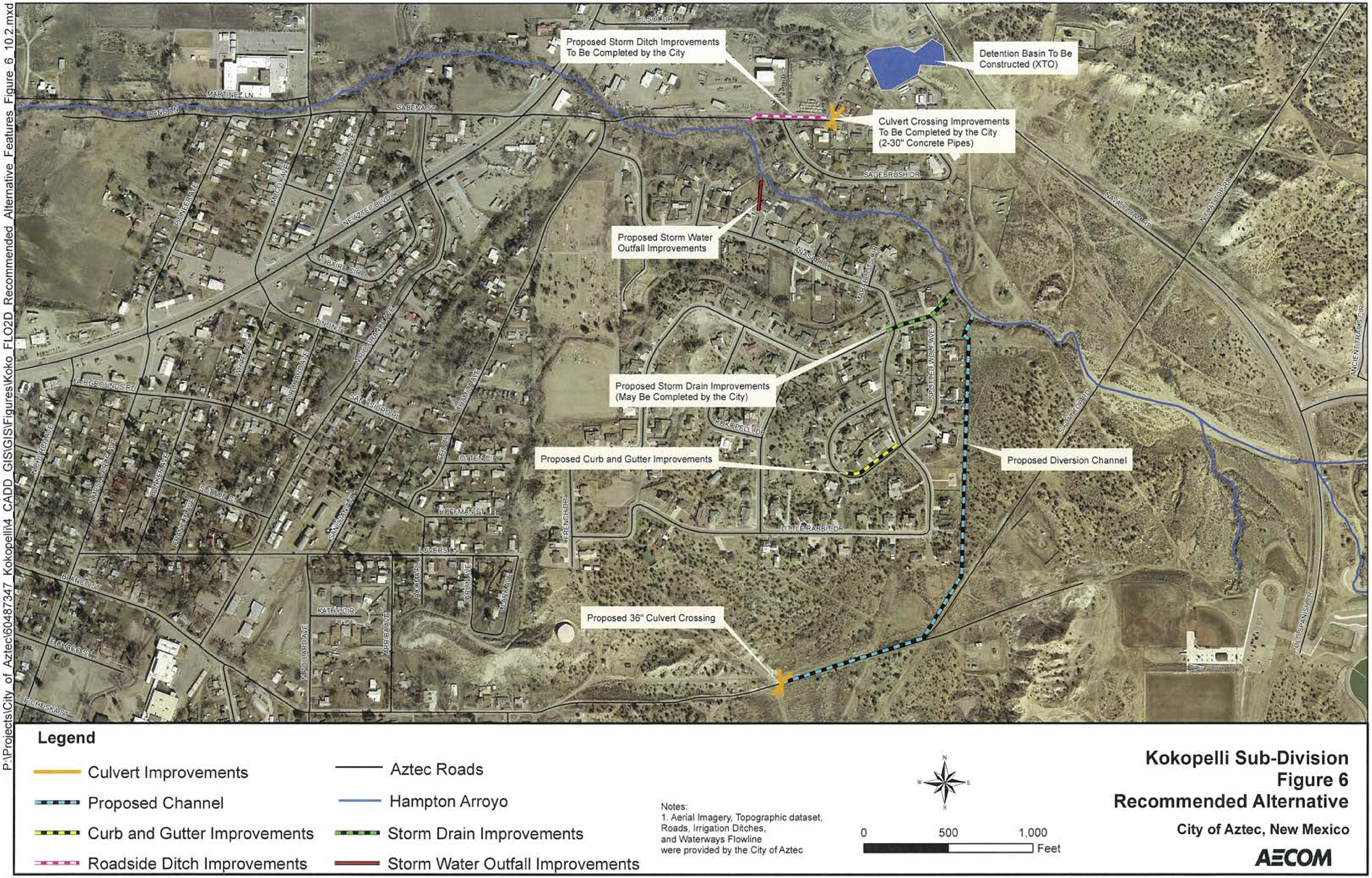
The feasibility of each of the four alternatives was qualitatively determined based on review and discussion with City of Aztec staff. A Recommended Alternative that represents some combination of elements from each of the alternatives was developed based on the results of this assessment. The details of the Recommended Alternative are discussed in the following sections.

Figure 6 graphically illustrates the features associated with the Recommended Alternative for the Kokopelli Subdivision.

Detention Basin

A detention basin (Referred as XTO Basin) is proposed to reduce flooding downstream of the Navajo Dam Road. The design for the XTO basin was obtained from the City of Aztec. The proposed basin has a maximum depth of 6 feet deep. A 36" outlet pipe is to be provided at the bottom of the detention basin to provide a positive drainage outfall.

The design drawings were used to determine the stage-discharge rating table for the outfall from the basin. The outfall discharge rating table was then input into the HEC-HMS (the existing HEC-HMS model was used as the base condition) to obtain an outflow hydrograph from the detention basins. The details of the XTO basin calculation, HEC-HMS results, and outflow hydrograph from the basin outfall are attached in **Appendix D**.


P:\Projects\City of Aztec\60487347 Kokopelli\4 CADD GIS\GIS\Figures\Koko FLO2D Recommended Alternative Features Figure 6 10.2.mxd
Proposed Storm Ditch Improvements To Be Completed by the City
Detention Basin To Be Constructed (XTO)
Culvert Crossing Improvements To Be Completed by the City (2-30" Concrete Pipes)
Proposed Storm Water Outfall Improvements
Proposed Storm Drain Improvements (May Be Completed by the City)
Proposed Curb and Gutter Improvements
Proposed Diversion Channel
Proposed 36" Culvert Crossing
Legend
Culvert Improvements
Proposed Channel
Curb and Gutter Improvements
Roadside Ditch Improvements
Aztec Roads
Hampton Arroyo
Storm Drain Improvements
Storm Water Outfall Improvements
Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec
0 500 1,000 Feet
Kokopelli Sub-Division
Figure 6
Recommended Alternative
City of Aztec, New Mexico
AECOM

Channel

An earthen channel is proposed along the south and east boundary of the Kokopelli Subdivision that diverts the 25-year storm flows away from the subdivision and outfalls into the Hampton Arroyo. The Rational Method was used to calculate the peak discharge for the diversion channel. The Rational Method calculation for the diversion channel is attached in **Appendix D**.

The diversion channel assumes a 10-feet bottom width, and 3H: 1V side slope. The diversion channel bed slope varies with an average of 0.025 ft/ft and riprap lining with D_{50} size of 9" is assumed along the channel. A series of drop structures are proposed along the channel to account for the steep gradient along the channel.

The calculation for the channel segment is attached in **Appendix D**.

Culverts

A 36" concrete pipe is proposed to capture the storm runoff south of the East Blanco Street and convey the flows to the proposed diversion channel north of the East Blanco Street. The culvert crossing is proposed as an extension to the potential future Blanco Street improvement project. The potential future Blanco Street improvement extends Blanco Street to the east and is assumed to be elevated above existing grading. This will create a drainage divide and prevent any offsite flows south of the street to enter the Kokopelli Subdivision.

The culvert was modeled in Culvert Master using the available topography. The culvert calculation and culvert rating table is attached in **Appendix D**.

Storm Drain System

Conceptual storm drain improvements in the vicinity of the French and Anasazi Drive intersection were developed with input from the City of Aztec staff. The improvements were developed to intercept and convey storm water to the nearby Hampton Arroyo in order to reduce problematic drainage issues occurring downstream.

An existing catch basin and storm drain system is located at the northeast corner of Anasazi and French Drive. The system includes two 3-foot catch basins and 18-inch diameter pipe which extend east with outfall into the Hampton Arroyo. This existing system provides minimal capacity in comparison to 10- and 100-year storm events. Storm water thus overwhelms the system and then drains north along Anasazi Drive and into the Little Sara Circle, Cottonwood Circle, and Mara Boots Circle cul-de-sacs that adjoin the Hampton Arroyo. Drainage facilities at each of the cul-de-sac drainage outfalls are minimal which allows storm flows to drain overland yielding impacts to the neighboring property owners.

The intent of the conceptual design presented herein is to reduce storm water draining toward the existing cul-de-sac drainage outfalls through provision of additional interception capacity for storm flows produced within the subdivision and maintenance of the existing Hampton Arroyo storm drain outfall alignment.

The conceptual storm drain improvements consist of a series of curb-opening inlet catch basins located on each of the 4 sides of the French and Anasazi Drive intersection. A 48-inch storm drain will convey collected storm water from the system and convey it east toward the knuckle at French Drive and Spotted Wolf Avenue. The proposed catch basins are to be based on New Mexico Department of Transportation standard details. The existing catch basins at the northeast corner of French and Anasazi Drive and at the French Drive / Spotted Wolf Avenue knuckle at are to be maintained with outfall accommodated by the retrofitted storm drain system.

The conceptual design of the system was developed by estimation of contributing peak flows estimated with the use of Rational methodology. Hydraulic grade line elevations at all proposed appurtenances (i.e., catch basins, manholes, outlets) and within the proposed storm drain pipes were verified to be below existing grade using Bentley's StormCAD software.

The results of the StormCAD calculations are attached in **Appendix D**.

FLO-2D Model – Recommended Alternative

The recommended flood mitigation alternative was analyzed with FLO-2D to estimate the impacts of the proposed drainage improvements on downstream problematic drainage areas and developed areas. The existing conditions FLO-2D model was used as a base model to develop the recommended alternative.

The proposed detention basin was analyzed using the U.S. Army Corps of Engineer's HEC-HMS model to determine the basin outflow characteristics as mentioned in the previous section. The existing land use condition HEC-HMS model was used as the base condition model and the detention basin was added into the model to estimate the inflow hydrograph for the FLO-2D model.

The proposed diversion channel and culverts were also added into the FLO-2D.

EPA SWIMM

The proposed storm drain network from the storm drain analysis was input into FLO-2D. FLO-2D uses the EPA SWMM 5.0 extension to incorporate the storm drain components. The storm drain components were entered into FLO-2D to understand the impacts of reduction in flow depths.

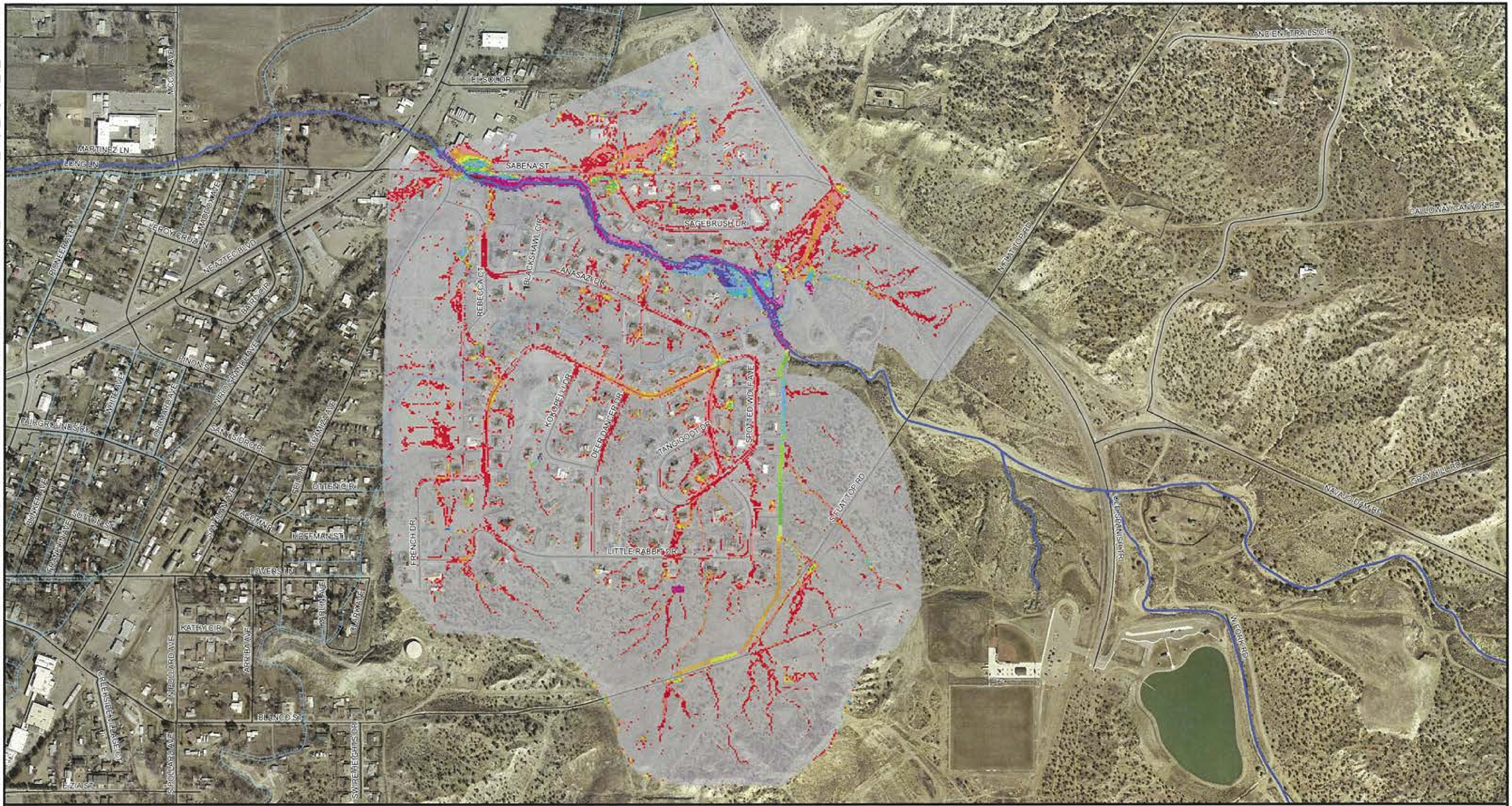
The details of the storm drain inputs that were used in EPA SWMM are discussed in detail and can be found in **Appendix D**.

The other FLO-2D input and output such as the time control, stability co-efficient and simulation summary for the recommended alternative is attached in **Appendix D**.

RESULTS

Figure 7 and **Figure 8** show the maximum flow depths for the recommended alternative for the 25-year storm event and a 100-year storm event, respectively.

The proposed drainage improvements have reduced the flooding issues compared to the existing conditions. The reduction in flow depths generally range from 0 to 0.5 feet for the 25-year storm event and 0 to 1.0 feet for the 100-year storm event.



Legend

Flow Depth at Cell feet

0.0 - 0.1	0.3 - 0.4	0.7 - 0.8	1.5 - 2.0	4.0 - 8.0
0.1 - 0.2	0.4 - 0.5	0.8 - 0.9	2.0 - 2.5	8.0 - 12.0
0.2 - 0.3	0.5 - 0.6	0.9 - 1.0	2.5 - 3.0	
	0.6 - 0.7	1.0 - 1.5	3.0 - 4.0	

Hampton Arroyo

Aztec Roads

Irrigation Ditches

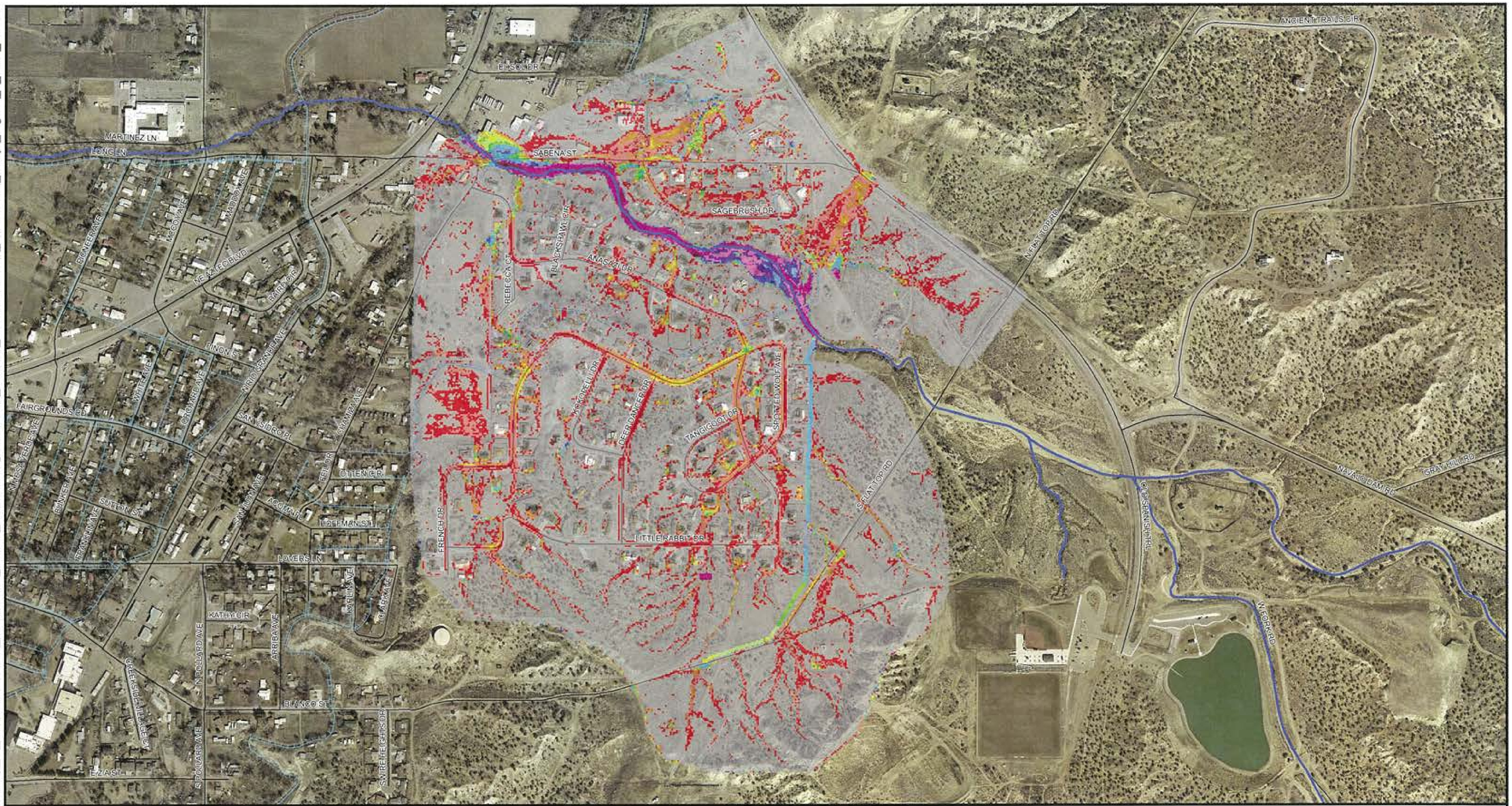
Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

0 600 1,200 Feet

KokoPelli Sub-Division
Figure 7
Recommended Alternative
25-Year, 24-Hour Maximum Depth

City of Aztec, New Mexico

AECOM



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Legend

Flow Depth at Cell feet

0.0 - 0.1	0.3 - 0.4	0.7 - 0.8	1.5 - 2.0	Hampton Arroyo
0.1 - 0.2	0.4 - 0.5	0.8 - 0.9	2.0 - 2.5	Aztec Roads
0.2 - 0.3	0.5 - 0.6	0.9 - 1.0	2.5 - 3.0	4.0 - 8.0
	0.6 - 0.7	1.0 - 1.5	3.0 - 4.0	8.0 - 12.0

Irrigation Ditches

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

0 600 1,200 Feet

N E S W

KokoPelli Sub-Division
Figure 8
Recommended Alternative
100-Year, 24-Hour Maximum Depth

City of Aztec, New Mexico

AECOM

Conclusions

- A proposed XTO detention basin north east of the Kokopelli Subdivision would help reduce the flooding downstream in the subdivision along Sabena Street. The culvert crossing improvement and storm ditch improvements downstream of the detention basin will reduce the flooding issues north of the Sagebrush Drive.

- The proposed riprap channel and culvert crossing south of the Kokopelli Subdivision would help alleviate flooding issues in particular on the south side of the sub-division. The culvert crossing will be part of the proposed potential future Blanco Street improvement that extends west to Highway 550.

- The proposed curb and gutter improvement at Spotted Wolf Avenue would alleviate some of the localized street flooding in the area.

- The proposed storm drain system and outfall improvement along the cul-de-sac will improve the ponding issues along Anasazi Drive and French Drive.

- Periodic maintenance of the diversion channel, culverts and storm drain system will be required to preserve the flow capacity in future.

- The results from the FLO-2D model show that the recommended alternative has reduced the flow depth and inundation limits in Kokopelli Subdivision. The proposed improvements, if implemented will mitigate the flooding issues for a 25-year storm event. The proposed improvements designed for a 25-year storm will also have a reduction in flooding for the 100-year storm event to a certain extent.

- The conceptual 30% design plans will be used to further identify and prioritize permitting and construction project of the proposed facilities. The 30% design plans are attached in **Appendix E**.

References

FLO-2D Software, INC (FLO-2D), 2016. FLO-2D PRO Build 16.06.15, August 2016.

New Mexico State Highway and Transportation Department, Drainage Manual Volume 1, Hydrology, December 1995.

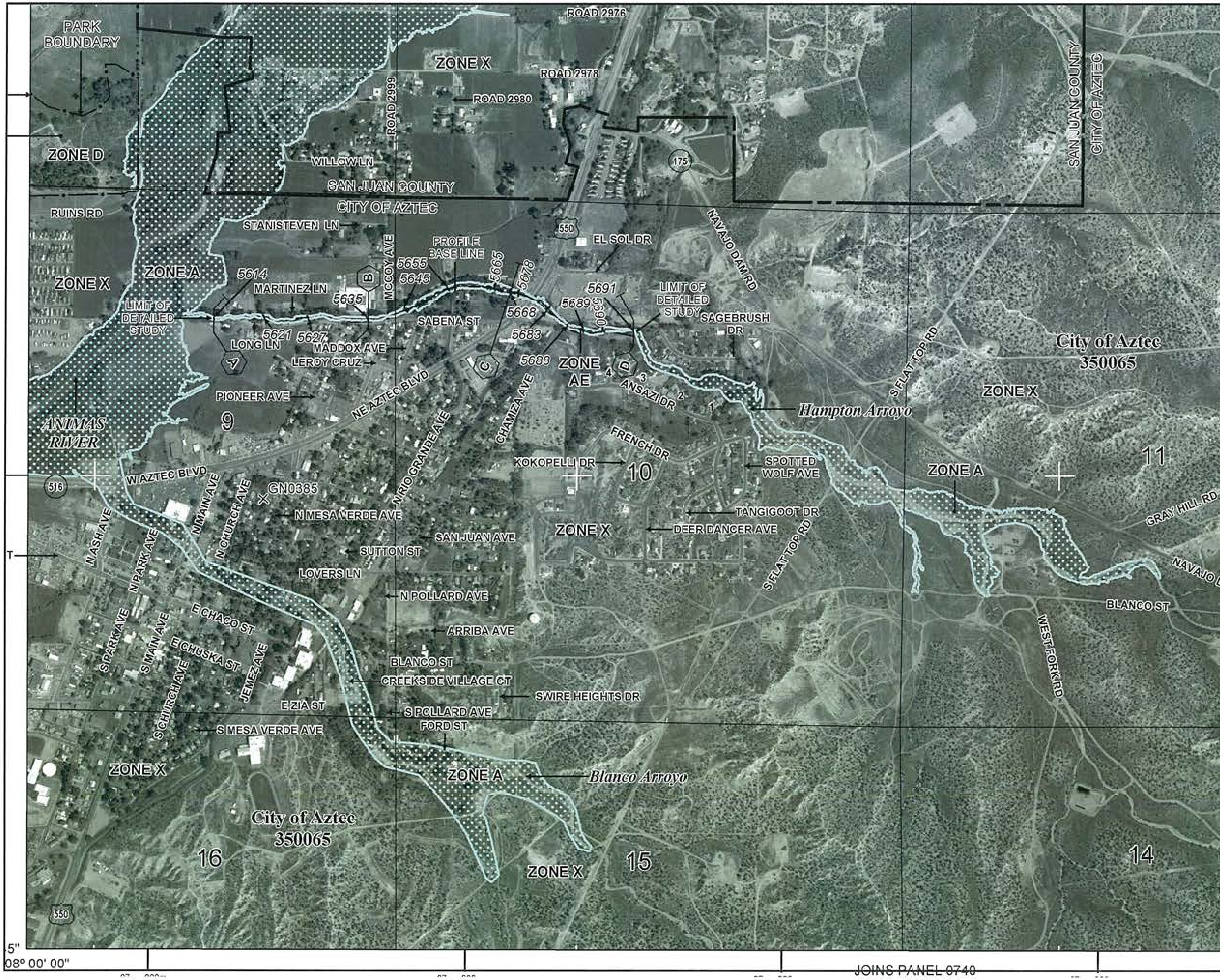
United State Army Corps of Engineers (USACE), 2015. Hydraulic Engineering Center Hydrologic Modeling System (HEC-HMS) Version 4.1, July 2015.

United States Department of Commerce, National Oceanic and Atmospheric Administration, *NOAA Atlas 14, Volume 1, Version 5*, 2009.

United States Department of Agriculture, Natural Resources Conservation Service, *Custom Soil Resource Report,* January 2016

United States Department of Agriculture, Soil Conservation Service, *Urban Hydrology for Small Watersheds*, June 1986.

Appendix A – FEMA Effective FIRM Panel



MAP SCALE 1" = 1000'

0 1000 2000 FEET

0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0730F

FIRM

FLOOD INSURANCE RATE MAP

SAN JUAN COUNTY, NEW MEXICO

AND INCORPORATED AREAS

PANEL 730 OF 2750

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
AZTEC, CITY OF	350065	0730	F
SAN JUAN COUNTY	350064	0730	F

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
35045C0730F

EFFECTIVE DATE
AUGUST 5, 2010

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Appendix B – Hydrologic and Hydraulic Calculation - FLO-2D Existing Conditions

AECOM Calculation Sheet

Project Name:	Kokopelli Sub-division			**Calculation Number:**	0
Client Name:	City of Aztec, New Mexico			**Revision Number:**	0
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	TB / 6-19-2016
	60487347	20000	N/A		
Title:	Hydrologic and Hydraulic Analysis Using FLO-2D – Existing Conditions				

PROBLEM STATEMENT:

The purpose of this calculation package is to document the hydrologic and hydraulic analysis for the watershed draining toward the Kokopelli subdivision for the existing conditions. The quasi two-dimensional program FLO-2D PRO (Reference 1) was used to perform this analysis. The model assumes a rain-on grid approach for the Kokopelli sub-division vicinity. For areas outside the vicinity the inflow hydrograph were obtained from the Hampton Arroyo watershed. HEC-HMS (Reference 2) was used to perform the hydrologic model for the Hampton Arroyo Watershed.

REQUIRED DELIVERABLES:

- Maps showing maximum flow depth and water surface elevations for the Kokopelli watershed obtained from the FLO-2D results for the 2-year, 10-year, 25-year storm, and 50-year and 100-year 24-hour storm events.

DATA /ASSUMPTIONS:

- Aerial survey and topography data were provided by the City of Aztec. The topographic data was processed to remove the buildings and other features to reflect the bare earth topo.
- The FLO-2D analysis was done in horizontal projection – NM State Plane West NAD 83, feet.
- A rain-on grid approach was used to develop the FLO-2D model for the Kokopelli sub-division. Rainfall data for the watershed was obtained from NOAA Atlas 14 (Reference 3).
- Modified NOAA-SCS rainfall distribution was used based on New Mexico Department of Transportation (NMDOT) procedures (Reference 4). The rainfall distribution used for the Kokopelli watershed is attached in Attachment 1.
- SCS Curve Number method was used to calculate the rainfall losses.
- Hydrologic soil groups (HSG) were determined using the USDA NRCS Soil Report for Aztec, New Mexico (Reference 5). The watershed area consists of HSG classes A, B, C and D soil types. The Soils Map for the Kokopelli sub-division watershed with HSG soil group is attached in Attachment 2.

- A "Land Clip" shape file was created using the land use data provided by the City of Aztec. The data provided by the City was verified with aerial imagery and a land use category was assigned. The modified curve number was assigned for each land clip attribute based on the type of land use and the HSG soil type. The curve numbers were selected based on NMDOT Drainage Manual (Reference 4) Table 3-1, 3-3 and 3-4.

- Cover type was selected to be "Desert Shrub" in poor condition for the undeveloped areas due to the lack of vegetative cover observed in the field or visible on readily available aerial imagery.

- Residential properties inside the subdivisions were assumed to be 0.25 to 0.5 acre lots and Residential properties outside the subdivision were assumed to be 1 acre and above lots based on measurements from aerial imagery.
- The inflow hydrographs for the contributing watersheds originating outside the model domain boundary were obtained from the HEC-HMS model developed separately for the Hampton Arroyo. The hydrographs used in FLO-2D are attached in Attachment 3.

METHODOLOGY:

- The FLO-2D model requires topographic data in the form of an ASCII grid surface as input. The input data was obtained by creating a raster grid surface from the dataset provided. The bare earth raster surface was converted to ASCII grids using ArcGIS.

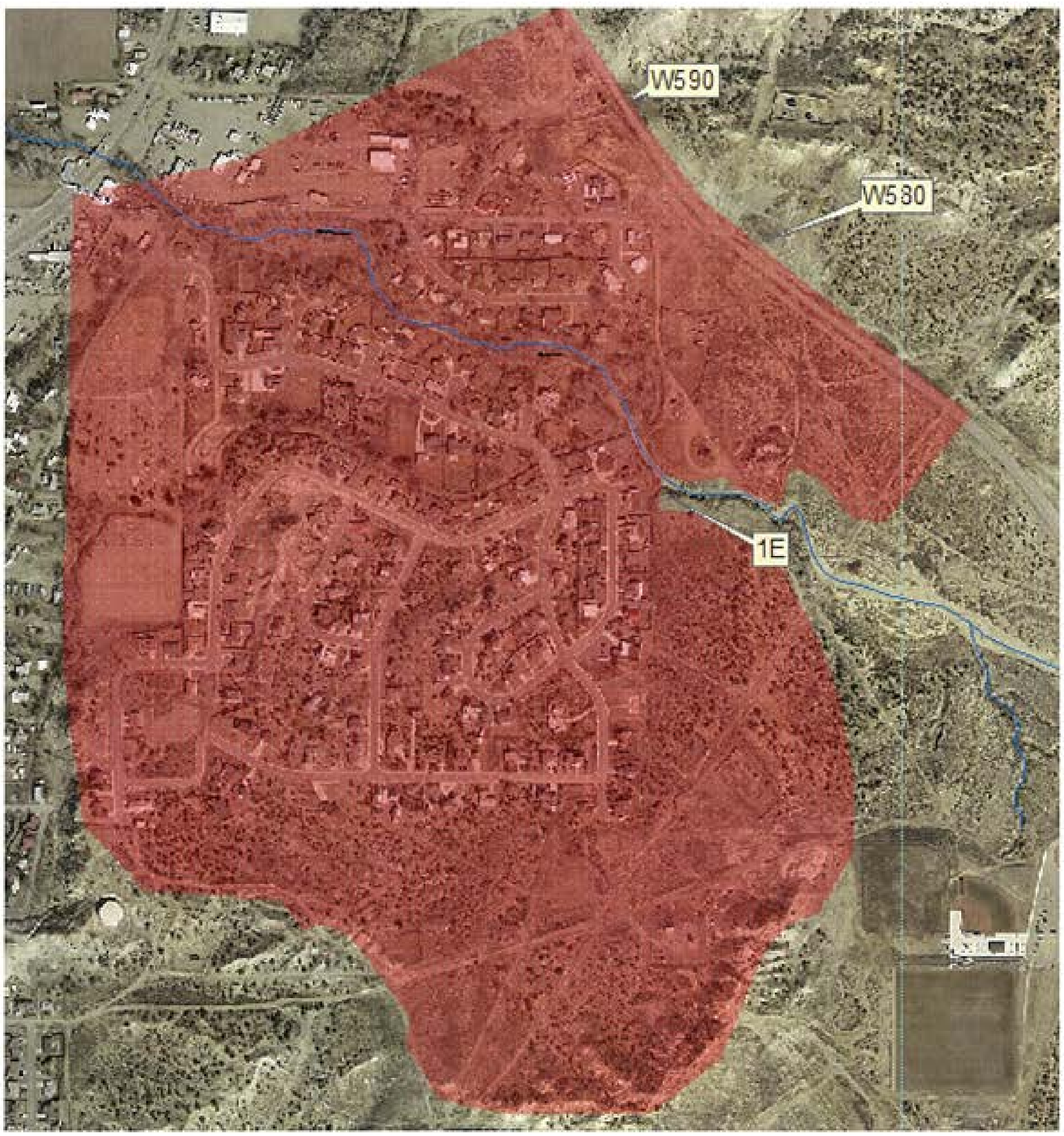
- A 10-foot x 10-foot grid element size was used for the FLO-2D analysis. The smaller grid size was selected to get a good resolution of the features such as roads and buildings.

- The FLO-2D modeling domain was created encompassing the maximum potential floodplain boundary.

- The modified NOAA-SCS rainfall distribution was entered in the FLO-2D model.

- Boundary Conditions – A boundary condition based on normal depth flow at the outflow nodes was used in the model to discharge water off the grid system. This prevents water from accumulating in the model, and allows flows to exit the system. The outflow nodes were selected along the west, north, north east boundaries of the model boundary. Inflow nodes were added along the north east boundary to simulate watershed runoff from the Hampton Arroyo watershed. The inflow hydrographs were selected from the HEC-HMS model from HEC-HMS ID W580, W590 and Junction 1E. The inflow nodes locations are shown in Figure B.1 and attached in Attachment 3.

Figure B.1 – FLO-2D Inflow Node Locations from HEC HMS

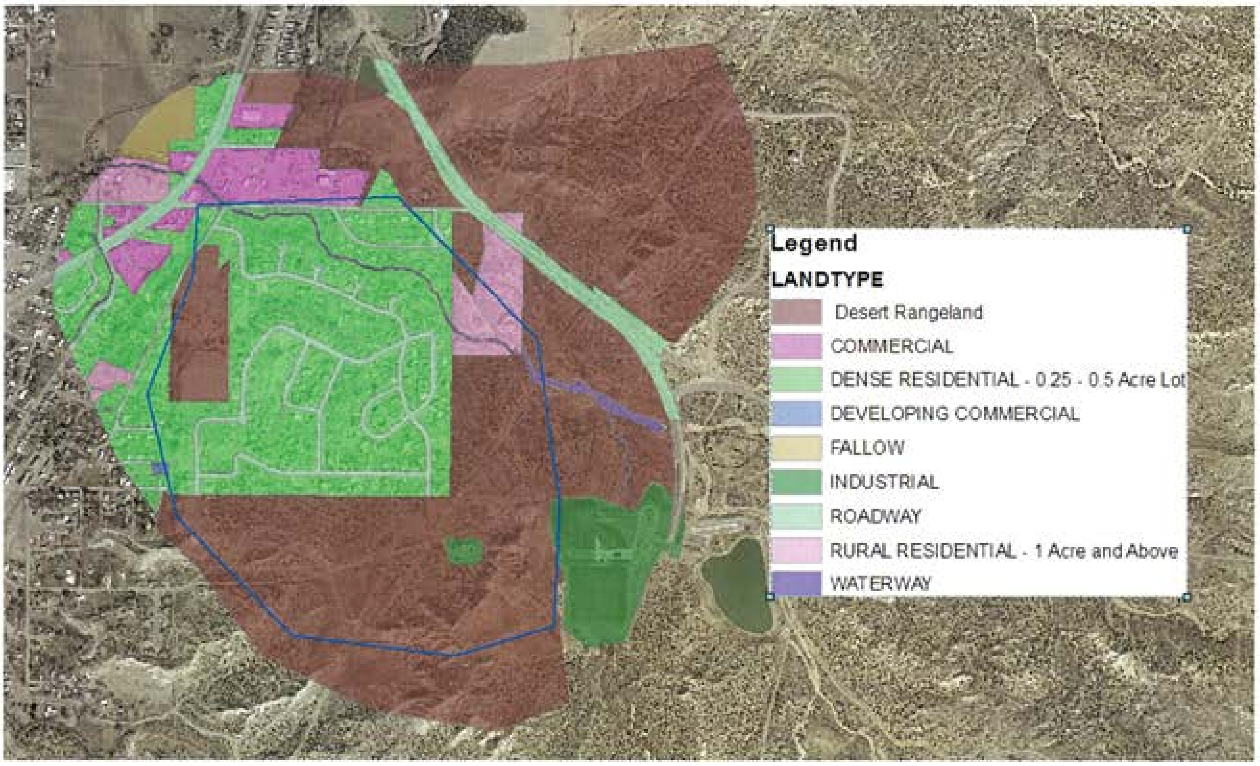


- The land clip data used for the Kokopelli sub-division is shown in Figure B.2.

- The land clip shape file that contains the curve number for the different land use areas and HSG was added to FLO-2D. The model calculates a weighted average Curve number if a grid element encompasses multiple land use.

- Manning's roughness coefficients were set using an ArcGIS shape file. The modeling domain area was divided into segments based on the type of land use and extent of vegetation. The n-values for the grid elements were based on the roughness coefficient recommended by FLO-2D manual for rural areas and similar vegetation coverage. Aerial imagery was used to determine the Manning's roughness coefficient.
- Building Footprints – The building footprints were digitized in ArcGIS for the sub-division and adjacent industrial areas. The Area Reduction Factors (ARFs) and Width Reduction Factors (WRFs) were used to model the building foot prints. FLO-2D calculates the ARF and WRF based on the percentage of building that falls on each grid element. This assumes that building footprints area not available for conveyance of floods. This is considered a conservative approach to estimate overland flows.

Figure B.2 – Land Use Map



FLO-2D MODEL PARAMETERS:

Figure B.3 – FLO-2D Control Variable Window

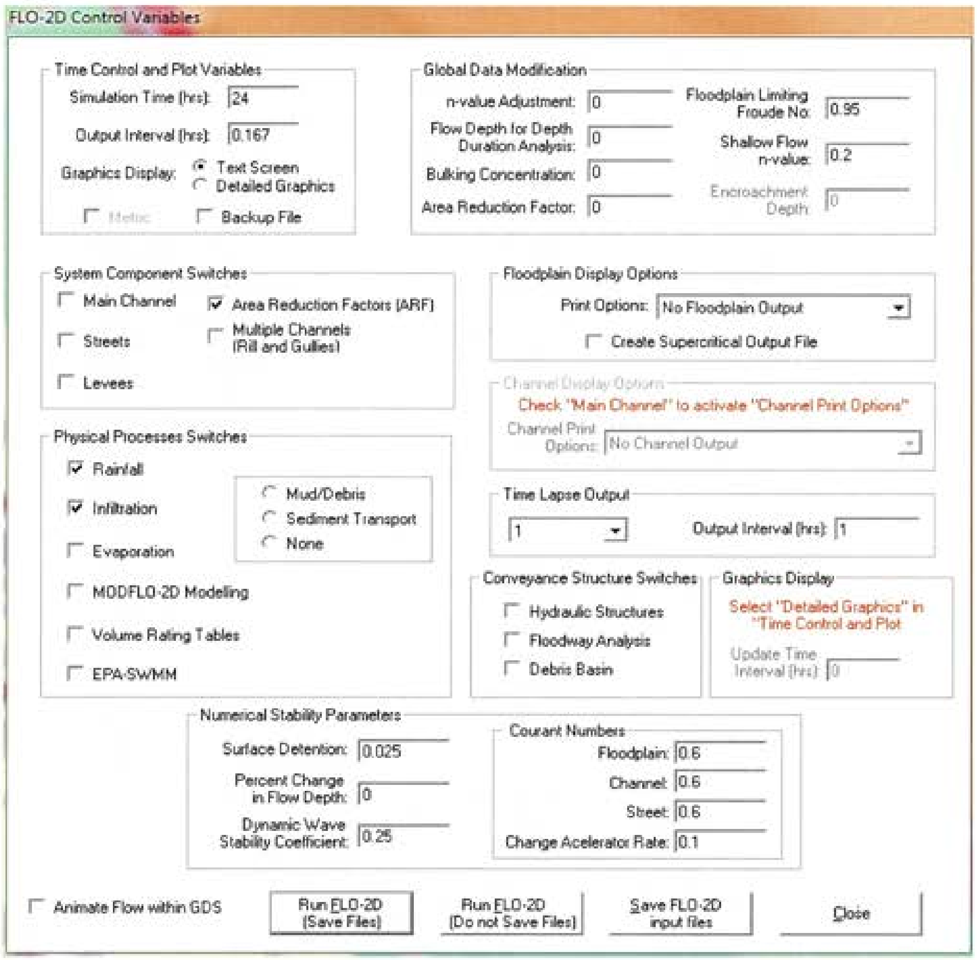


Figure B.3 shows the Control Variable Window used in FLO-2D.

Time Control

To improve the stability and reliability of the simulation, adjustments were made to the model parameters. The simulation time was set to 24 hours to allow the rainfall from the 24-hour storm and hydrograph to cycle completely through the model domain. Inflow hydrographs obtained from the HEC-HMS model had simulation time of 24 hours. Output intervals were set for every 10 minutes.

Numerical Stability Parameters

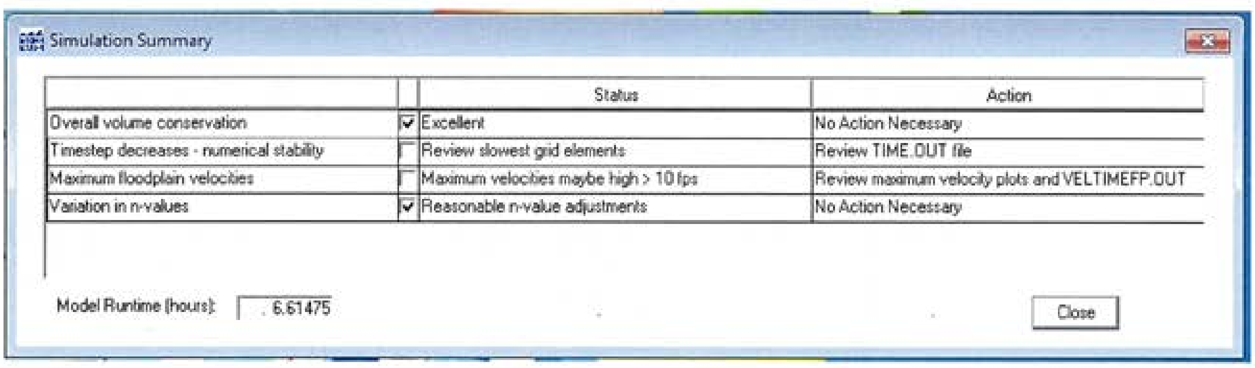
The Dynamic Wave Stability coefficient (Wave Max) for the model was set to 0.25. This is a typical value as reported in the FLO-2D Input Manual. The Surface detention was set to 0.025 feet for rainfall runoff model as reported in the FLO-2D Input Manual.

RESULTS:

Figure B.4.1 and B.4.2 shows the Simulation Summary from the completion of the FLO-2D model. The TIME.OUT file was checked for "sticky grids". The "sticky grids" were within the Hampton Arroyo channel and does not impact in the Kokopelli sub-division flooding issues.

Figures B.5.1 and B.5.2 shows that the maximum flow depth for the 100-year and 25-year storm events respectively.

Figure B.4.1 – 100-year; 24-hour FLO-2D Outputs Checklist



Simulation Summary

		Status	Action
Overall volume conservation	☑	Excellent	No Action Necessary
Timestep decreases - numerical stability	☐	Review slowest grid elements	Review TIME.OUT file
Maximum floodplain velocities	☐	Maximum velocities maybe high > 10 fps	Review maximum velocity plots and VELTIMEFP.OUT
Variation in n-values	☑	Reasonable n-value adjustments	No Action Necessary

Model Runtime (hours): 6.61475

Close

Figure B.4.1 – 25-year; 24-hour FLO-2D Outputs Checklist

Simulation Summary

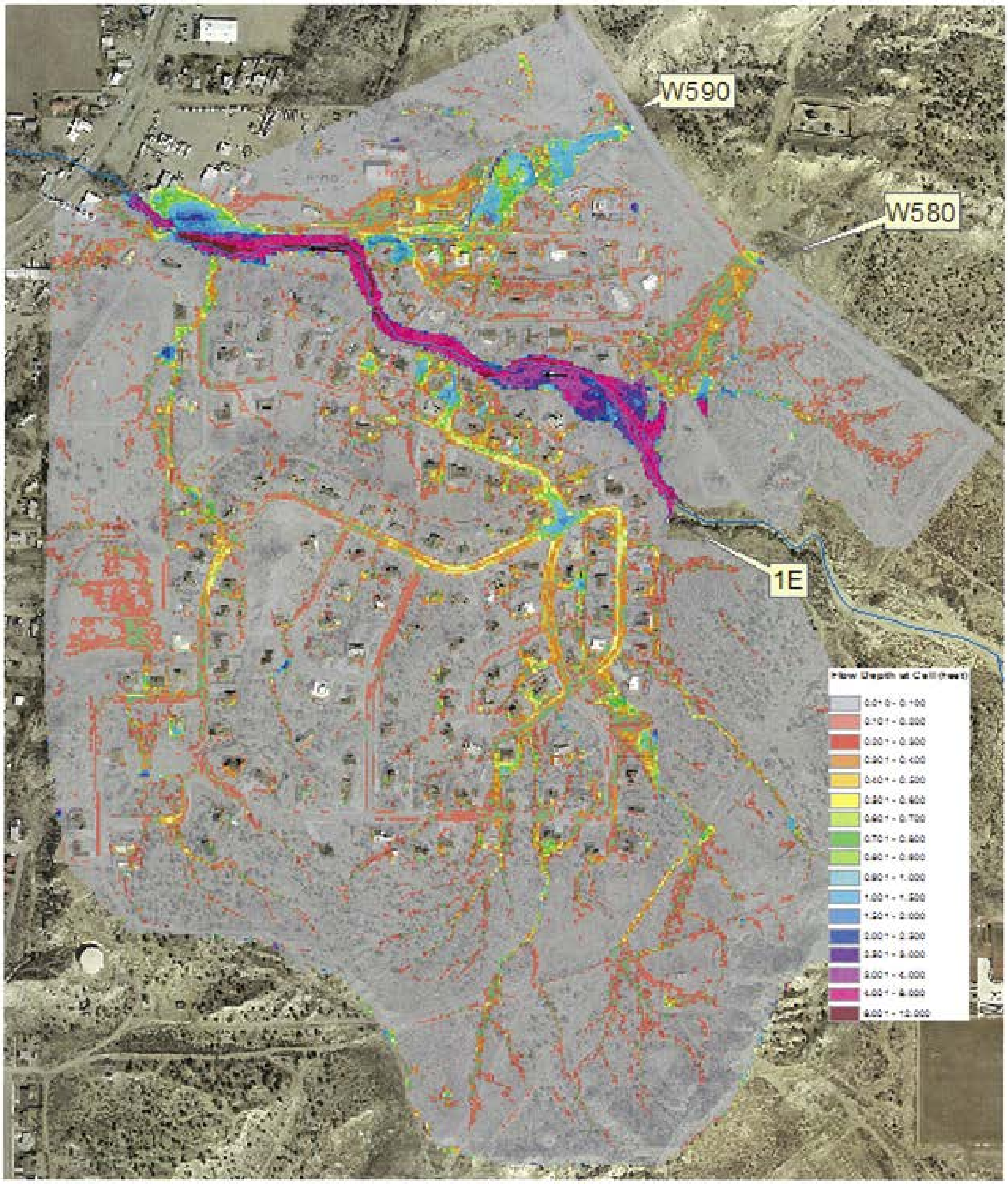
		Status	Action
Overall volume conservation	☑	Satifactory	No Action Necessary
Timestep decreases - numerical stability	☑	Satifactory	No Action Necessary
Maximum floodplain velocities	☐	Maximum velocities maybe high > 10 fps	Review maximum velocity plots and VELTIMEFP.OUT
Variation in n-values	☑	Reasonable n-value adjustments	No Action Necessary

Model Runtime (hours): 10.66406

Close

AECOM	Calculation Sheet				
Project Name:	Kokopelli Sub-division			**Calculation Number:**	0
Client Name:	City of Aztec, New Mexico			**Revision Number:**	0
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	TB / 6-19-2016
	60487347	20000	N/A		
Title:	Hydrologic and Hydraulic Analysis Using FLO-2D – Existing Conditions				

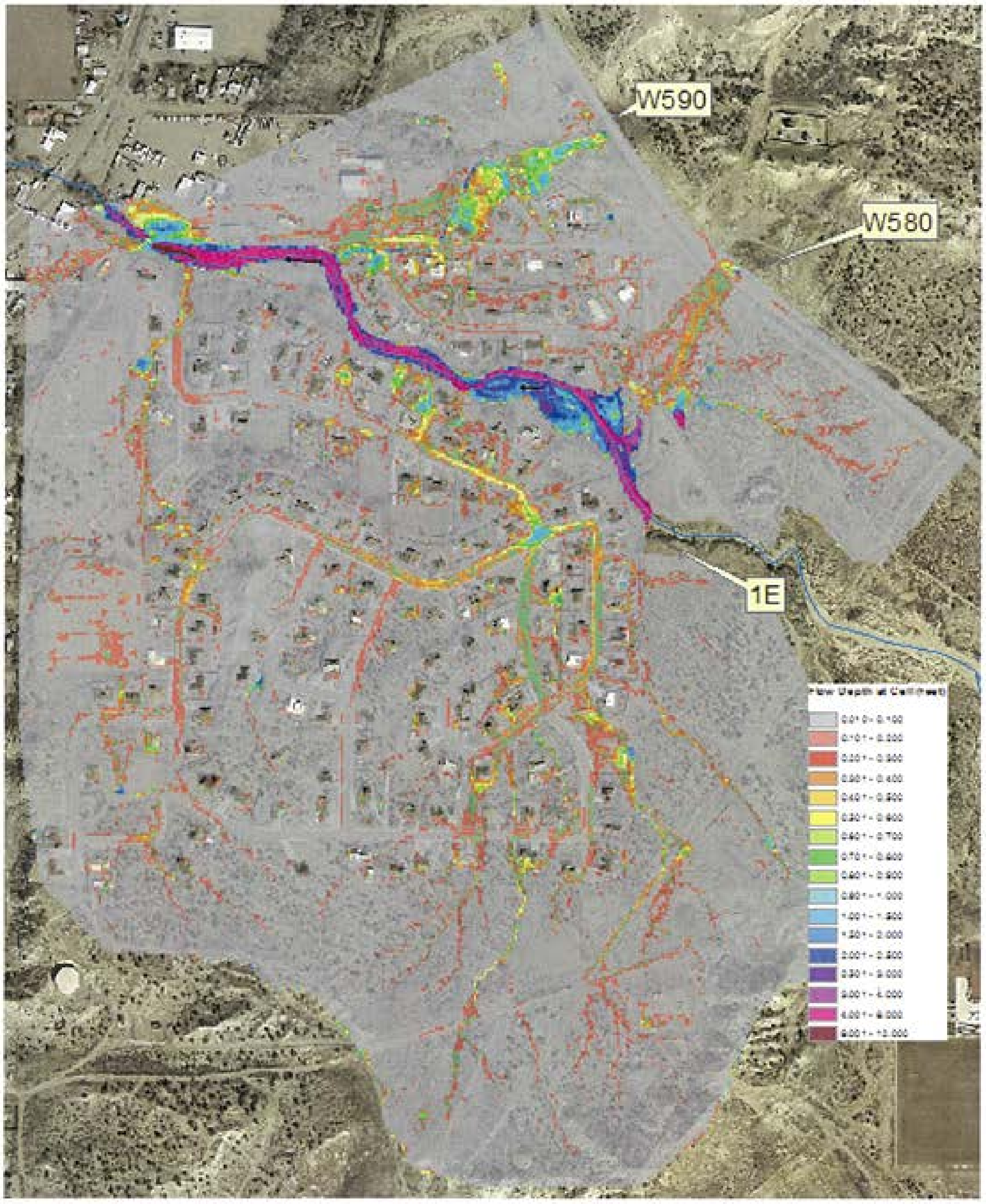
Figure B.5.1 – 100-year; 24-hour FLO-2D Results



AECOM Calculation Sheet

Project Name:	Kokopelli Sub-division			**Calculation Number:**	0
Client Name:	City of Aztec, New Mexico			**Revision Number:**	0
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	TB / 6-19-2016
	60487347	20000	N/A		
Title:	Hydrologic and Hydraulic Analysis Using FLO-2D – Existing Conditions				

Figure B.5.2 – 25-year; 24-hour FLO-2D Results



REFERENCES:

1. FLO-2D INC, FLO-2D PRO Build No. 15.10.13, Accessed in January, 2016.

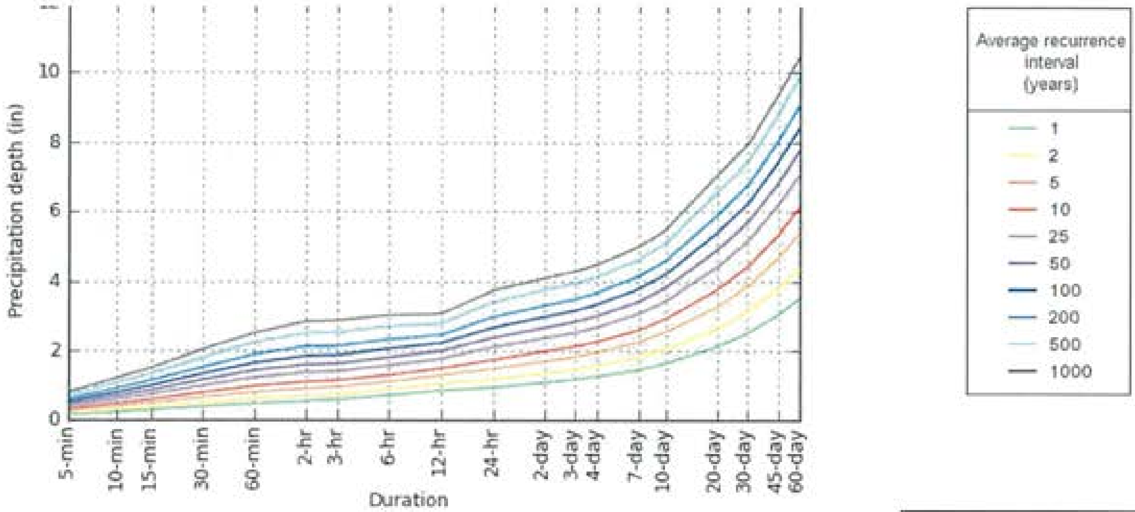
2. United State Army Corps of Engineers (USACE), 2015. Hydraulic Engineering Center Hydrologic Modeling System (HEC-HMS) [software package]. Version 4.1 July 2015.

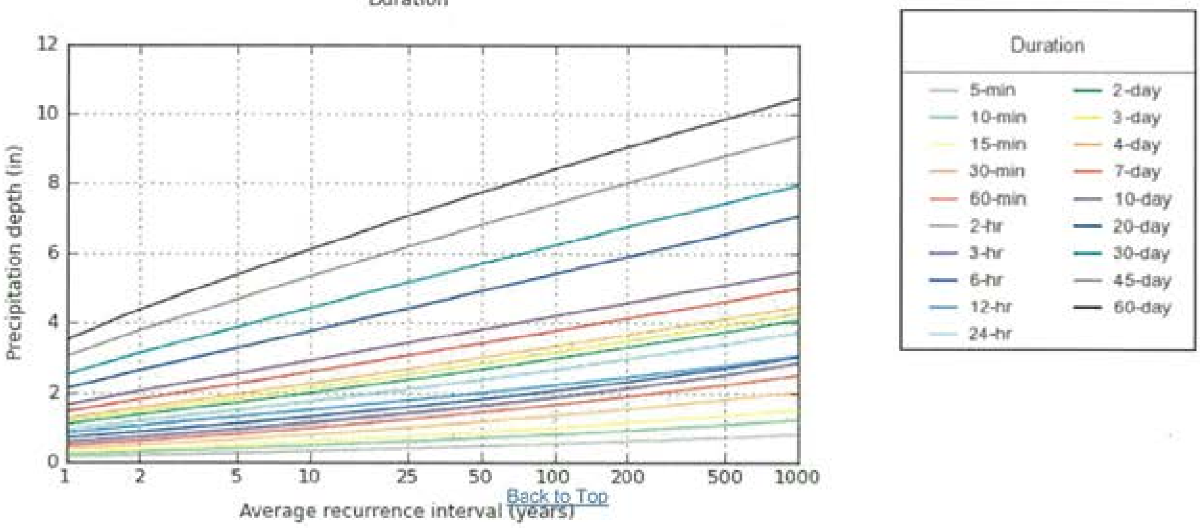
3. United States Department of Commerce, National Oceanic and Atmospheric Administration, *NOAA Atlas 14, Volume 1, Version 5*, 2009.

4. New Mexico State Highway and Transportation Department, Drainage Manual Volume 1, Hydrology, December 1995.

5. United States Department of Agriculture, Natural Resources Conservation Service, *Custom Soil Resource Report,* January 2016.

Attachment 1 – Rainfall Distribution





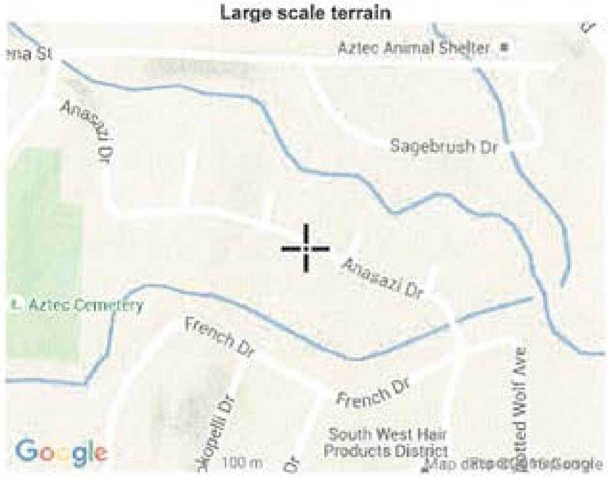
Back to Top

NOAA Atlas 14, Volume 1, Version 5		Created (GMT): Tue Feb 16 21:30:48 2016

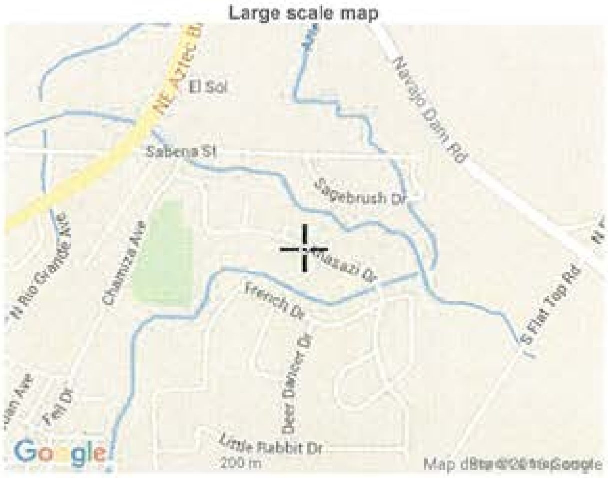
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map



Large scale aerial

Back to Top

NOAA Atlas 14, Volume 1, Version 5
Location name: Aztec, New Mexico, US*
Latitude: 36.8281°, Longitude: -107.9777°
Elevation: 5711 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF tabular | PF graphical | Maps & aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.148 (0.127-0.173)	0.190 (0.164-0.222)	0.256 (0.221-0.298)	0.311 (0.267-0.362)	0.389 (0.331-0.453)	0.454 (0.382-0.528)	0.523 (0.436-0.609)	0.599 (0.492-0.698)	0.707 (0.568-0.826)	0.795 (0.630-0.935)
10-min	0.225 (0.194-0.263)	0.290 (0.250-0.337)	0.390 (0.336-0.454)	0.473 (0.406-0.551)	0.592 (0.504-0.689)	0.691 (0.582-0.803)	0.797 (0.664-0.926)	0.911 (0.749-1.06)	1.08 (0.864-1.26)	1.21 (0.958-1.42)
15-min	0.279 (0.240-0.326)	0.359 (0.309-0.418)	0.483 (0.417-0.563)	0.587 (0.504-0.683)	0.734 (0.624-0.854)	0.857 (0.721-0.995)	0.987 (0.822-1.15)	1.13 (0.928-1.32)	1.33 (1.07-1.56)	1.50 (1.19-1.76)
30-min	0.376 (0.323-0.439)	0.484 (0.417-0.563)	0.651 (0.561-0.758)	0.790 (0.678-0.920)	0.988 (0.841-1.15)	1.15 (0.971-1.34)	1.33 (1.11-1.55)	1.52 (1.25-1.77)	1.80 (1.44-2.10)	2.02 (1.60-2.38)
60-min	0.465 (0.400-0.543)	0.599 (0.516-0.697)	0.805 (0.694-0.938)	0.977 (0.839-1.14)	1.22 (1.04-1.42)	1.43 (1.20-1.66)	1.65 (1.37-1.91)	1.88 (1.55-2.20)	2.22 (1.79-2.60)	2.50 (1.98-2.94)
2-hr	0.539 (0.472-0.627)	0.686 (0.601-0.796)	0.910 (0.797-1.05)	1.10 (0.957-1.27)	1.37 (1.18-1.58)	1.60 (1.36-1.84)	1.84 (1.55-2.13)	2.11 (1.75-2.44)	2.51 (2.03-2.91)	2.83 (2.25-3.30)
3-hr	0.585 (0.517-0.668)	0.736 (0.649-0.843)	0.954 (0.845-1.09)	1.14 (0.999-1.29)	1.40 (1.22-1.59)	1.62 (1.40-1.84)	1.86 (1.58-2.15)	2.12 (1.78-2.46)	2.51 (2.06-2.94)	2.86 (2.28-3.34)
6-hr	0.705 (0.637-0.792)	0.876 (0.790-0.984)	1.10 (0.991-1.24)	1.30 (1.16-1.45)	1.57 (1.40-1.76)	1.80 (1.59-2.02)	2.05 (1.78-2.30)	2.31 (1.98-2.60)	2.70 (2.26-3.06)	3.02 (2.48-3.43)
12-hr	0.841 (0.762-0.932)	1.05 (0.946-1.16)	1.29 (1.17-1.43)	1.49 (1.35-1.65)	1.77 (1.59-1.95)	1.99 (1.77-2.19)	2.21 (1.95-2.44)	2.45 (2.14-2.71)	2.77 (2.38-3.10)	3.06 (2.59-3.47)
24-hr	0.934 (0.865-1.01)	1.17 (1.09-1.26)	1.48 (1.37-1.59)	1.74 (1.61-1.87)	2.09 (1.92-2.24)	2.37 (2.16-2.54)	2.66 (2.42-2.86)	2.96 (2.68-3.19)	3.38 (3.02-3.66)	3.72 (3.29-4.03)
2-day	1.08 (1.01-1.16)	1.35 (1.26-1.45)	1.70 (1.58-1.82)	1.98 (1.85-2.12)	2.36 (2.19-2.52)	2.66 (2.46-2.84)	2.97 (2.72-3.18)	3.30 (3.00-3.54)	3.74 (3.37-4.03)	4.08 (3.65-4.42)
3-day	1.17 (1.09-1.25)	1.46 (1.37-1.57)	1.83 (1.71-1.95)	2.12 (1.98-2.26)	2.52 (2.34-2.69)	2.83 (2.62-3.02)	3.15 (2.90-3.38)	3.48 (3.18-3.74)	3.93 (3.56-4.23)	4.27 (3.84-4.62)
4-day	1.25 (1.17-1.34)	1.57 (1.47-1.68)	1.95 (1.83-2.09)	2.25 (2.11-2.41)	2.67 (2.49-2.86)	3.00 (2.78-3.20)	3.33 (3.07-3.57)	3.66 (3.36-3.93)	4.11 (3.75-4.44)	4.47 (4.04-4.83)
7-day	1.44 (1.35-1.55)	1.81 (1.68-1.94)	2.24 (2.09-2.40)	2.59 (2.41-2.77)	3.06 (2.83-3.26)	3.41 (3.15-3.64)	3.77 (3.47-4.03)	4.13 (3.78-4.42)	4.61 (4.19-4.95)	4.98 (4.49-5.36)
10-day	1.64 (1.53-1.77)	2.04 (1.90-2.20)	2.54 (2.36-2.74)	2.92 (2.71-3.14)	3.42 (3.18-3.69)	3.80 (3.52-4.10)	4.19 (3.86-4.52)	4.58 (4.20-4.95)	5.08 (4.64-5.50)	5.46 (4.95-5.94)
20-day	2.11 (1.96-2.28)	2.64 (2.45-2.84)	3.27 (3.03-3.51)	3.76 (3.49-4.05)	4.41 (4.08-4.75)	4.90 (4.52-5.28)	5.40 (4.95-5.83)	5.90 (5.39-6.38)	6.56 (5.94-7.11)	7.06 (6.35-7.67)
30-day	2.51 (2.34-2.71)	3.13 (2.92-3.38)	3.87 (3.60-4.18)	4.43 (4.11-4.78)	5.15 (4.77-5.57)	5.69 (5.25-6.15)	6.23 (5.72-6.74)	6.76 (6.18-7.33)	7.43 (6.75-8.09)	7.94 (7.17-8.66)
45-day	3.03 (2.83-3.26)	3.79 (3.53-4.08)	4.67 (4.35-5.02)	5.33 (4.96-5.74)	6.18 (5.73-6.66)	6.81 (6.29-7.34)	7.42 (6.82-8.01)	8.02 (7.34-8.68)	8.79 (8.00-9.54)	9.36 (8.46-10.2)
60-day	3.50 (3.26-3.77)	4.38 (4.08-4.72)	5.37 (4.99-5.79)	6.11 (5.66-6.58)	7.06 (6.52-7.60)	7.74 (7.14-8.34)	8.41 (7.73-9.07)	9.04 (8.28-9.76)	9.86 (8.98-10.7)	10.4 (9.48-11.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

Questions?: HDSC.Questions@noaa.gov

Disclaimer

CITY OF AZTEC, NEW MEXICO
KOKOPELLI ARROYO WATERSHED
MODIFIED NOAA-SCS RAINFALL DISTRIBUTION

NOAA 14 Depth Duration Frequency Data [2-YEAR][1] :

DURATION	[hours]	[inches][1]
0	0	0
5-min	0.0833	0.190
10-min	0.1667	0.290
15-min	0.2500	0.359
30-min	0.5000	0.484
	0.7500	0.542
1-hr	1.0000	0.599
	1.2500	0.621
	1.5000	0.643
	1.7500	0.664
2-hr	2.0000	0.686
	2.5000	0.711
3-hr	3.0000	0.736
	3.5000	0.759
	4.0000	0.783
	5.0000	0.829
6-hr	6.0000	0.876
	7.0000	0.905
	8.0000	0.934
	9.0000	0.963
	10.0000	0.992
	11.0000	1.021
12-hr	12.0000	1.050
	14.0000	1.070
	16.0000	1.090
	18.0000	1.110
	20.0000	1.130
	22.0000	1.150
24-hr	24.0000	1.170

Modified NOAA-SCS Rainfall Distribution[2] :

n	TIME [hours]	CUMULATIVE DEPTH [inches]	INCREMENTAL DEPTH [inches]	HYETOGRAPH TIME PERIOD (hrs)	n [REARRANGED]	INCREMENTAL DEPTH [inches]	CUMULATIVE DEPTH [inches]	CUMULATIVE DEPTH [%]
0	0	0.000		0.00 TO 1.00	19	0.029	0.029	0.025
1	0.25	0.359	0.359	1.00 TO 2.00	17	0.029	0.058	0.050
2	0.5	0.484	0.125	2.00 TO 3.00	15	0.029	0.087	0.074
3	0.75	0.542	0.058	3.00 TO 4.00	13	0.047	0.134	0.114
4	1	0.599	0.058	4.00 TO 4.50	11	0.023	0.157	0.134
5	1.25	0.621	0.022	4.50 TO 5.00	9	0.025	0.182	0.156
6	1.5	0.643	0.022	5.00 TO 5.25	7	0.022	0.204	0.174
7	1.75	0.664	0.022	5.25 TO 5.50	5	0.022	0.226	0.193
8	2	0.686	0.022	5.50 TO 5.75	3	0.058	0.283	0.242
9	2.5	0.711	0.025	5.75 TO 6.00	1	0.359	0.642	0.549
10	3	0.736	0.025	6.00 TO 6.25	2	0.125	0.767	0.656
11	3.5	0.759	0.023	6.25 TO 6.50	4	0.058	0.825	0.705
12	4	0.783	0.023	6.50 TO 6.75	6	0.022	0.846	0.723
13	5	0.829	0.047	6.75 TO 7.00	8	0.022	0.868	0.742
14	6	0.876	0.047	7.00 TO 7.50	10	0.025	0.893	0.763
15	7	0.905	0.029	7.50 TO 8.00	12	0.023	0.916	0.783
16	8	0.934	0.029	8.00 TO 9.00	14	0.047	0.963	0.823
17	9	0.963	0.029	9.00 TO 10.00	16	0.029	0.992	0.848
18	10	0.992	0.029	10.00 TO 11.00	18	0.029	1.021	0.873
19	11	1.021	0.029	11.00 TO 12.00	20	0.029	1.050	0.897
20	12	1.050	0.029	12.00 TO 14.00	21	0.020	1.070	0.915
21	14	1.070	0.020	14.00 TO 16.00	22	0.020	1.090	0.932
22	16	1.090	0.020	16.00 TO 18.00	23	0.020	1.110	0.949
23	18	1.110	0.020	18.00 TO 20.00	24	0.020	1.130	0.966
24	20	1.130	0.020	20.00 TO 22.00	25	0.020	1.150	0.983
25	22	1.150	0.020	22.00 TO 24.00	26	0.020	1.170	1.000
26	24	1.170	0.020					

Notes:

1. Precipitation depth, duration, frequency data based on NOAA Atlas 14 Online Precipitation Data Frequency Server.
2. Modified NOAA-SCS rainfall distribution developed based on procedures prescribed by New Mexico State Highway and Transportation Department's *Drainage Manual, Volume I,* 1995.
3. Rainfall data based on Hampton Arroyo watershed centroid located at Latitude 36.8202° N Longitude 107.9537° W

CITY OF AZTEC, NEW MEXICO
KOKOPELLI ARROYO WATERSHED
MODIFIED NOAA-SCS RAINFALL DISTRIBUTION

NOAA 14 Depth Duration Frequency Data [10-YEAR][3] :

DURATION	[hours]	[inches][1]
0	0	0
5-min	0.0833	0.311
10-min	0.1667	0.473
15-min	0.2500	0.587
30-min	0.5000	0.790
	0.7500	0.884
1-hr	1.0000	0.977
	1.2500	1.008
	1.5000	1.039
	1.7500	1.069
2-hr	2.0000	1.100
	2.5000	1.120
3-hr	3.0000	1.140
	3.5000	1.167
	4.0000	1.193
	5.0000	1.247
6-hr	6.0000	1.300
	7.0000	1.332
	8.0000	1.363
	9.0000	1.395
	10.0000	1.427
	11.0000	1.458
12-hr	12.0000	1.490
	14.0000	1.532
	16.0000	1.573
	18.0000	1.615
	20.0000	1.657
	22.0000	1.698
24-hr	24.0000	1.740

Modified NOAA-SCS Rainfall Distribution[2] :

n	TIME [hours]	CUMULATIVE DEPTH [inches]	INCREMENTAL DEPTH [inches]	HYETOGRAPH TIME PERIOD [hrs]			n [REARRANGED]	INCREMENTAL DEPTH [inches]	CUMULATIVE DEPTH [inches]	CUMULATIVE DEPTH [%]
0	0	0.000		0.00	TO	1.00	19	0.032	0.032	0.018
1	0.25	0.587	0.587	1.00	TO	2.00	17	0.032	0.063	0.036
2	0.5	0.790	0.203	2.00	TO	3.00	15	0.032	0.095	0.055
3	0.75	0.884	0.093	3.00	TO	4.00	13	0.053	0.148	0.085
4	1	0.977	0.094	4.00	TO	4.50	11	0.027	0.175	0.101
5	1.25	1.008	0.031	4.50	TO	5.00	9	0.020	0.195	0.112
6	1.5	1.039	0.031	5.00	TO	5.25	7	0.031	0.226	0.130
7	1.75	1.069	0.031	5.25	TO	5.50	5	0.031	0.257	0.147
8	2	1.100	0.031	5.50	TO	5.75	3	0.093	0.350	0.201
9	2.5	1.120	0.020	5.75	TO	6.00	1	0.587	0.937	0.539
10	3	1.140	0.020	6.00	TO	6.25	2	0.203	1.140	0.655
11	3.5	1.167	0.027	6.25	TO	6.50	4	0.094	1.234	0.709
12	4	1.193	0.027	6.50	TO	6.75	6	0.031	1.264	0.727
13	5	1.247	0.053	6.75	TO	7.00	8	0.031	1.295	0.744
14	6	1.300	0.053	7.00	TO	7.50	10	0.020	1.315	0.756
15	7	1.332	0.032	7.50	TO	8.00	12	0.027	1.342	0.771
16	8	1.363	0.032	8.00	TO	9.00	14	0.053	1.395	0.802
17	9	1.395	0.032	9.00	TO	10.00	16	0.032	1.427	0.820
18	10	1.427	0.032	10.00	TO	11.00	18	0.032	1.458	0.838
19	11	1.458	0.032	11.00	TO	12.00	20	0.032	1.490	0.856
20	12	1.490	0.032	12.00	TO	14.00	21	0.042	1.532	0.880
21	14	1.532	0.042	14.00	TO	16.00	22	0.042	1.573	0.904
22	16	1.573	0.042	16.00	TO	18.00	23	0.042	1.615	0.928
23	18	1.615	0.042	18.00	TO	20.00	24	0.042	1.657	0.952
24	20	1.657	0.042	20.00	TO	22.00	25	0.042	1.698	0.976
25	22	1.698	0.042	22.00	TO	24.00	26	0.042	1.740	1.000
26	24	1.740	0.042							

Notes:
1. Precipitation depth, duration, frequency data based on NOAA Atlas 14 Online Precipitation Data Frequency Server.
2. Modified NOAA-SCS rainfall distribution developed based on procedures prescribed by New Mexico State Highway and Transportation Department's *Drainage Manual, Volume I,* 1995.
3. Rainfall data based on Hampton Arroyo watershed centroid located at Latitude 36.8202° N Longitude 107.9537° W

CITY OF AZTEC, NEW MEXICO
KOKOPELLI ARROYO WATERSHED
MODIFIED NOAA-SCS RAINFALL DISTRIBUTION

NOAA 14 Depth Duration Frequency Data [25-YEAR] [(3)] :

DURATION	[hours]	[inches][(1)]
0	0	0
5-min	0.0833	0.389
10-min	0.1667	0.592
15-min	0.2500	0.734
30-min	0.5000	0.988
	0.7500	1.104
1-hr	1.0000	1.220
	1.2500	1.258
	1.5000	1.295
	1.7500	1.333
2-hr	2.0000	1.370
	2.5000	1.385
3-hr	3.0000	1.400
	3.5000	1.428
	4.0000	1.457
	5.0000	1.513
6-hr	6.0000	1.570
	7.0000	1.603
	8.0000	1.637
	9.0000	1.670
	10.0000	1.703
	11.0000	1.737
12-hr	12.0000	1.770
	14.0000	1.823
	16.0000	1.877
	18.0000	1.930
	20.0000	1.983
	22.0000	2.037
24-hr	24.0000	2.090

Modified NOAA-SCS Rainfall Distribution [(2)] :

n	TIME [hours]	CUMULATIVE DEPTH [inches]	INCREMENTAL DEPTH [inches]	HYETOGRAPH TIME PERIOD (hrs)			n [REARRANGED]	INCREMENTAL DEPTH [inches]	CUMULATIVE DEPTH [inches]	CUMULATIVE DEPTH [%]
0	0	0.000		0.00	TO	1.00	19	0.033	0.033	0.016
1	0.25	0.734	0.734	1.00	TO	2.00	17	0.033	0.067	0.032
2	0.5	0.988	0.254	2.00	TO	3.00	15	0.033	0.100	0.048
3	0.75	1.104	0.116	3.00	TO	4.00	13	0.057	0.157	0.075
4	1	1.220	0.116	4.00	TO	4.50	11	0.028	0.185	0.089
5	1.25	1.258	0.038	4.50	TO	5.00	9	0.015	0.200	0.096
6	1.5	1.295	0.037	5.00	TO	5.25	7	0.038	0.238	0.114
7	1.75	1.333	0.038	5.25	TO	5.50	5	0.038	0.275	0.132
8	2	1.370	0.038	5.50	TO	5.75	3	0.116	0.391	0.187
9	2.5	1.385	0.015	5.75	TO	6.00	1	0.734	1.125	0.538
10	3	1.400	0.015	6.00	TO	6.25	2	0.254	1.379	0.660
11	3.5	1.428	0.028	6.25	TO	6.50	4	0.116	1.495	0.715
12	4	1.457	0.028	6.50	TO	6.75	6	0.037	1.533	0.733
13	5	1.513	0.057	6.75	TO	7.00	8	0.038	1.570	0.751
14	6	1.570	0.057	7.00	TO	7.50	10	0.015	1.585	0.758
15	7	1.603	0.033	7.50	TO	8.00	12	0.028	1.613	0.772
16	8	1.637	0.033	8.00	TO	9.00	14	0.057	1.670	0.799
17	9	1.670	0.033	9.00	TO	10.00	16	0.033	1.703	0.815
18	10	1.703	0.033	10.00	TO	11.00	18	0.033	1.737	0.831
19	11	1.737	0.033	11.00	TO	12.00	20	0.033	1.770	0.847
20	12	1.770	0.033	12.00	TO	14.00	21	0.053	1.823	0.872
21	14	1.823	0.053	14.00	TO	16.00	22	0.053	1.877	0.898
22	16	1.877	0.053	16.00	TO	18.00	23	0.053	1.930	0.923
23	18	1.930	0.053	18.00	TO	20.00	24	0.053	1.983	0.949
24	20	1.983	0.053	20.00	TO	22.00	25	0.053	2.037	0.974
25	22	2.037	0.053	22.00	TO	24.00	26	0.053	2.090	1.000
26	24	2.090	0.053							

Notes:

1. Precipitation depth, duration, frequency data based on NOAA Atlas 14 Online Precipitation Data Frequency Server.
2. Modified NOAA-SCS rainfall distribution developed based on procedures prescribed by New Mexico State Highway and Transportation Department's *Drainage Manual, Volume I*, 1995.
3. Rainfall data based on Hampton Arroyo watershed centroid located at Latitude 36.8202° N Longitude 107.9537° W

CITY OF AZTEC, NEW MEXICO
KOKOPELLI ARROYO WATERSHED
MODIFIED NOAA-SCS RAINFALL DISTRIBUTION

NOAA 14 Depth Duration Frequency Data [50-YEAR][1]:

DURATION	[hours]	[inches][1]
0	0	0
5-min	0.0833	0.454
10-min	0.1667	0.691
15-min	0.2500	0.857
30-min	0.5000	1.150
	0.7500	1.290
1-hr	1.0000	1.430
	1.2500	1.473
	1.5000	1.515
	1.7500	1.558
2-hr	2.0000	1.600
	2.5000	1.610
3-hr	3.0000	1.620
	3.5000	1.650
	4.0000	1.680
	5.0000	1.740
6-hr	6.0000	1.800
	7.0000	1.832
	8.0000	1.863
	9.0000	1.895
	10.0000	1.927
	11.0000	1.958
12-hr	12.0000	1.990
	14.0000	2.053
	16.0000	2.117
	18.0000	2.180
	20.0000	2.243
	22.0000	2.307
24-hr	24.0000	2.370

Modified NOAA-SCS Rainfall Distribution[2]:

n	TIME [hours]	CUMULATIVE DEPTH [inches]	INCREMENTAL DEPTH [inches]	HYETOGRAPH TIME PERIOD (hrs)	n [REARRANGED]	INCREMENTAL DEPTH [inches]	CUMULATIVE DEPTH [inches]	CUMULATIVE DEPTH [%]
0	0	0.000		0.00 TO 1.00	19	0.032	0.032	0.013
1	0.25	0.857	0.857	1.00 TO 2.00	17	0.032	0.063	0.027
2	0.5	1.150	0.293	2.00 TO 3.00	15	0.032	0.095	0.040
3	0.75	1.290	0.140	3.00 TO 4.00	13	0.060	0.155	0.065
4	1	1.430	0.140	4.00 TO 4.50	11	0.030	0.185	0.078
5	1.25	1.473	0.043	4.50 TO 5.00	9	0.010	0.195	0.082
6	1.5	1.515	0.043	5.00 TO 5.25	7	0.043	0.238	0.100
7	1.75	1.558	0.043	5.25 TO 5.50	5	0.043	0.280	0.118
8	2	1.600	0.043	5.50 TO 5.75	3	0.140	0.420	0.177
9	2.5	1.610	0.010	5.75 TO 6.00	1	0.857	1.277	0.539
10	3	1.620	0.010	6.00 TO 6.25	2	0.293	1.570	0.662
11	3.5	1.650	0.030	6.25 TO 6.50	4	0.140	1.710	0.722
12	4	1.680	0.030	6.50 TO 6.75	6	0.043	1.753	0.739
13	5	1.740	0.060	6.75 TO 7.00	8	0.043	1.795	0.757
14	6	1.800	0.060	7.00 TO 7.50	10	0.010	1.805	0.762
15	7	1.832	0.032	7.50 TO 8.00	12	0.030	1.835	0.774
16	8	1.863	0.032	8.00 TO 9.00	14	0.060	1.895	0.800
17	9	1.895	0.032	9.00 TO 10.00	16	0.032	1.927	0.813
18	10	1.927	0.032	10.00 TO 11.00	18	0.032	1.958	0.826
19	11	1.958	0.032	11.00 TO 12.00	20	0.032	1.990	0.840
20	12	1.990	0.032	12.00 TO 14.00	21	0.063	2.053	0.866
21	14	2.053	0.063	14.00 TO 16.00	22	0.063	2.117	0.893
22	16	2.117	0.063	16.00 TO 18.00	23	0.063	2.180	0.920
23	18	2.180	0.063	18.00 TO 20.00	24	0.063	2.243	0.947
24	20	2.243	0.063	20.00 TO 22.00	25	0.063	2.307	0.973
25	22	2.307	0.063	22.00 TO 24.00	26	0.063	2.370	1.000
26	24	2.370	0.063					

Notes:

1. Precipitation depth, duration, frequency data based on NOAA Atlas 14 Online Precipitation Data Frequency Server.
2. Modified NOAA-SCS rainfall distribution developed based on procedures prescribed by New Mexico State Highway and Transportation Department's *Drainage Manual, Volume I*, 1995.
3. Rainfall data based on Hampton Arroyo watershed centroid located at Latitude 36.8202° N Longitude 107.9537° W

CITY OF AZTEC, NEW MEXICO
KOKOPELLI ARROYO WATERSHED
MODIFIED NOAA-SCS RAINFALL DISTRIBUTION

NOAA 14 Depth Duration Frequency Data [100-YEAR] [1] *:*

DURATION	[hours]	[inches] [1]
0	0	0
5-min	0.0833	0.523
10-min	0.1667	0.797
15-min	0.2500	0.987
30-min	0.5000	1.330
	0.7500	1.490
1-hr	1.0000	1.650
	1.2500	1.698
	1.5000	1.745
	1.7500	1.793
2-hr	2.0000	1.840
	2.5000	1.850
3-hr	3.0000	1.860
	3.5000	1.892
	4.0000	1.923
	5.0000	1.987
6-hr	6.0000	2.050
	7.0000	2.077
	8.0000	2.103
	9.0000	2.130
	10.0000	2.157
	11.0000	2.183
12-hr	12.0000	2.210
	14.0000	2.285
	16.0000	2.360
	18.0000	2.435
	20.0000	2.510
	22.0000	2.585
24-hr	24.0000	2.660

Modified NOAA-SCS Rainfall Distribution [2] *:*

n	TIME [hours]	CUMULATIVE DEPTH [inches]	INCREMENTAL DEPTH [inches]	HYETOGRAPH TIME PERIOD (hrs)	n [REARRANGED]	INCREMENTAL DEPTH [inches]	CUMULATIVE DEPTH [inches]	CUMULATIVE DEPTH [%]
0	0	0.000		0.00 TO 1.00	19	0.027	0.027	0.010
1	0.25	0.987	0.987	1.00 TO 2.00	17	0.027	0.053	0.020
2	0.5	1.330	0.343	2.00 TO 3.00	15	0.027	0.080	0.030
3	0.75	1.490	0.16	3.00 TO 4.00	13	0.063	0.143	0.054
4	1	1.650	0.16	4.00 TO 4.50	11	0.032	0.175	0.066
5	1.25	1.698	0.0475	4.50 TO 5.00	9	0.010	0.185	0.070
6	1.5	1.745	0.0475	5.00 TO 5.25	7	0.047	0.233	0.087
7	1.75	1.793	0.0475	5.25 TO 5.50	5	0.048	0.280	0.105
8	2	1.840	0.0475	5.50 TO 5.75	3	0.160	0.440	0.165
9	2.5	1.850	0.01	5.75 TO 6.00	1	0.987	1.427	0.536
10	3	1.860	0.01	6.00 TO 6.25	2	0.343	1.770	0.665
11	3.5	1.892	0.031666667	6.25 TO 6.50	4	0.160	1.930	0.726
12	4	1.923	0.031666667	6.50 TO 6.75	6	0.048	1.978	0.743
13	5	1.987	0.063333333	6.75 TO 7.00	8	0.048	2.025	0.761
14	6	2.050	0.063333333	7.00 TO 7.50	10	0.010	2.035	0.765
15	7	2.077	0.026666667	7.50 TO 8.00	12	0.032	2.067	0.777
16	8	2.103	0.026666667	8.00 TO 9.00	14	0.063	2.130	0.801
17	9	2.130	0.026666667	9.00 TO 10.00	16	0.027	2.157	0.811
18	10	2.157	0.026666667	10.00 TO 11.00	18	0.027	2.183	0.821
19	11	2.183	0.026666667	11.00 TO 12.00	20	0.027	2.210	0.831
20	12	2.210	0.026666667	12.00 TO 14.00	21	0.075	2.285	0.859
21	14	2.285	0.075	14.00 TO 16.00	22	0.075	2.360	0.887
22	16	2.360	0.075	16.00 TO 18.00	23	0.075	2.435	0.915
23	18	2.435	0.075	18.00 TO 20.00	24	0.075	2.510	0.944
24	20	2.510	0.075	20.00 TO 22.00	25	0.075	2.585	0.972
25	22	2.585	0.075	22.00 TO 24.00	26	0.075	2.660	1.000
26	24	2.660	0.075					

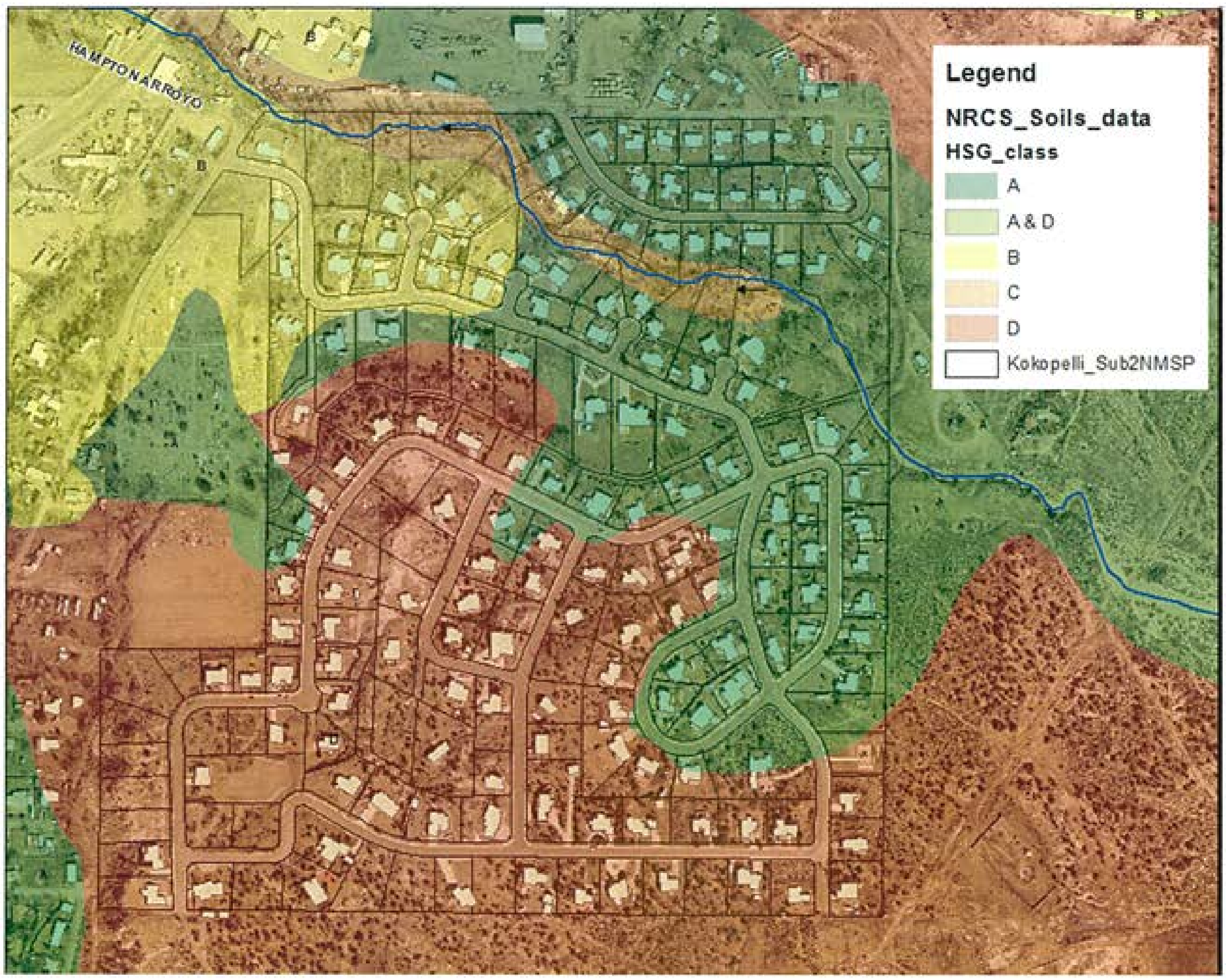
Notes:

1. Precipitation depth, duration, frequency data based on NOAA Atlas 14 Online Precipitation Data Frequency Server.
2. Modified NOAA-SCS rainfall distribution developed based on procedures prescribed by New Mexico State Highway and Transportation Department's *Drainage Manual, Volume I,* 1995.
3. Rainfall data based on Hampton Arroyo watershed centroid located at Latitude 36.8202° N Longitude 107.9537° W

AECOM	**Calculation Sheet**				
Project Name:	Kokopelli Sub-division			**Calculation Number:**	0
Client Name:	City of Aztec, New Mexico			**Revision Number:**	0
Project Number:	Job No. 60487347	Cost Code 20000	Parent (if any) N/A	**Prepared By/Date:**	TB / 6-19-2016
Title:	Hydrologic and Hydraulic Analysis Using FLO-2D – Existing Conditions				

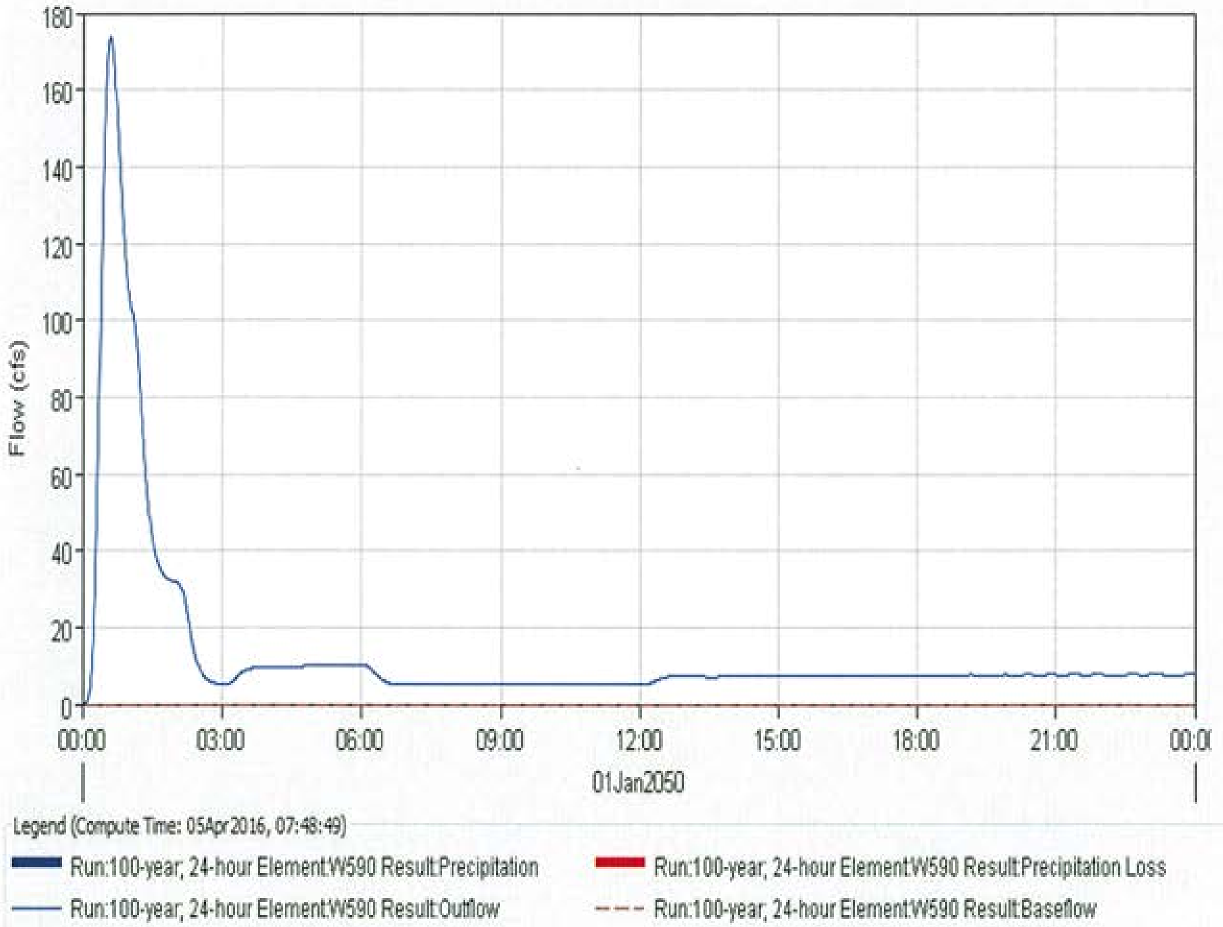
Attachment 2 – Soils Map

USDA NRCS Soil Map

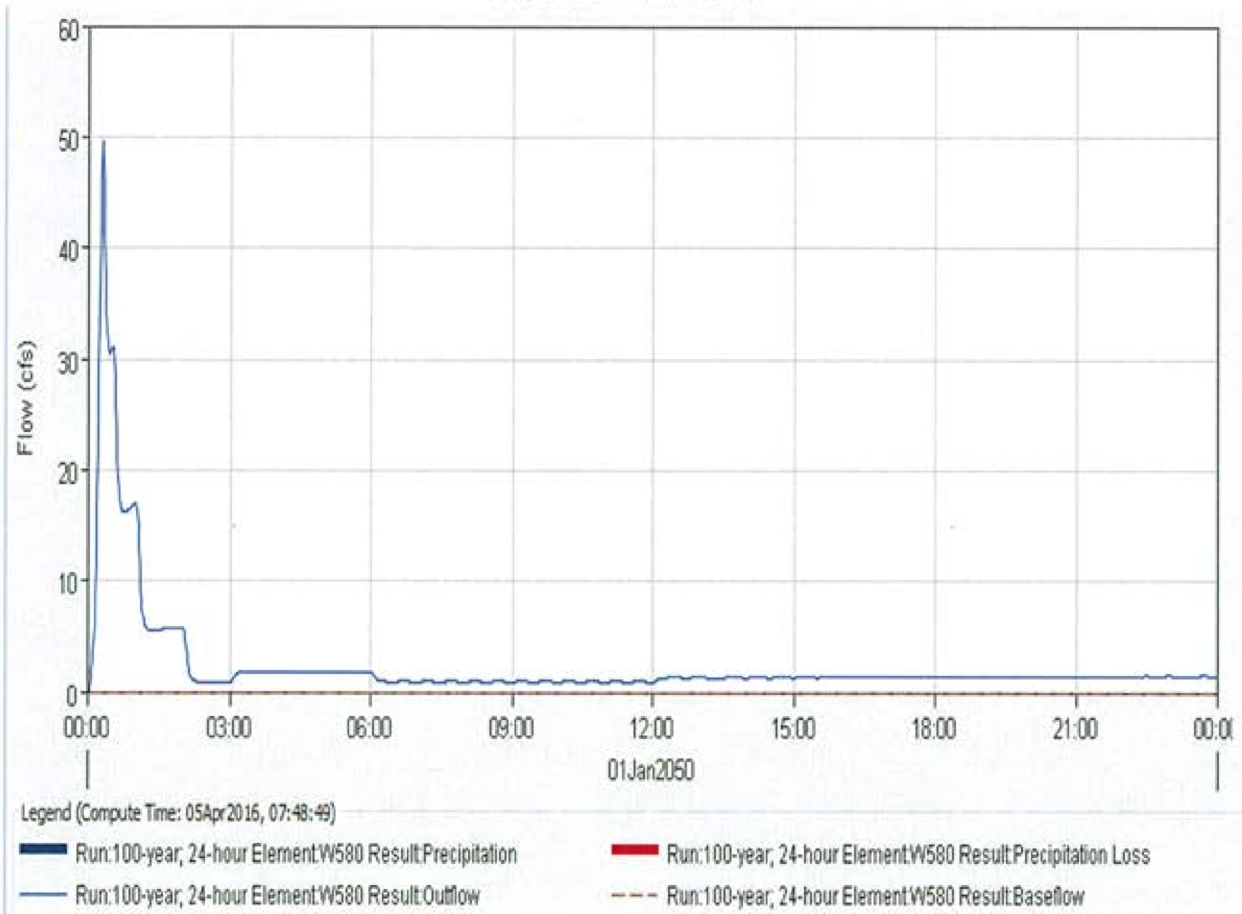


Attachment 3 – Inflow Hydrograph

Node W590



Node W580



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50
40
30
20
10
0
Flow (cfs)
00:00
03:00
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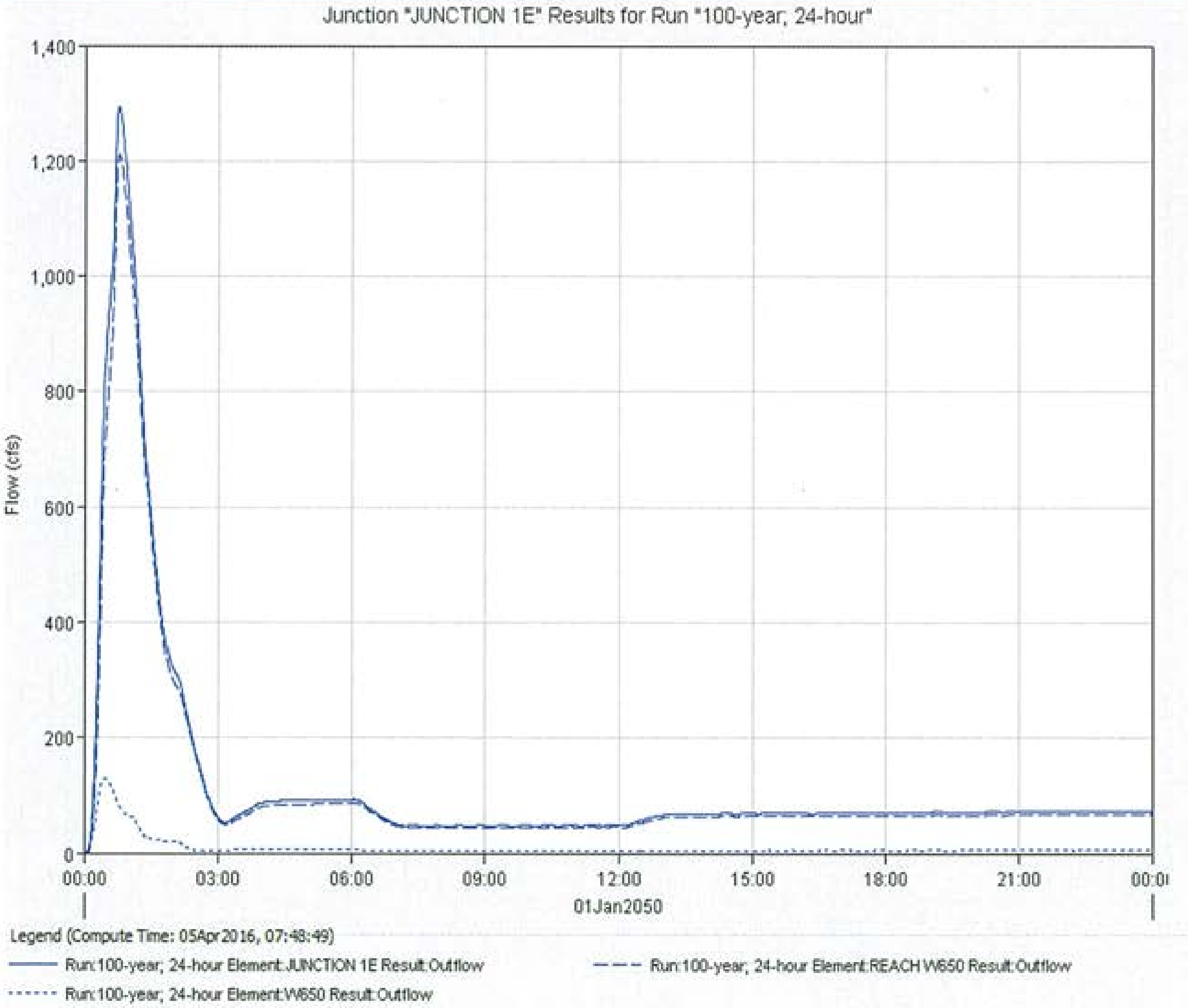
12:00
15:00
18:00
21:00
00:0(
01Jan2050
Legend (Compute Time: 05Apr2016, 07:48:49)
Run:100-year; 24-hour Element:W580 Result:Precipitation
Run:100-year; 24-hour Element:W580 Result:Precipitation Loss
Run:100-year; 24-hour Element:W580 Result:Outflow
Run:100-year; 24-hour Element:W580 Result:Baseflow

AECOM

Calculation Sheet

Project Name:	Kokopelli Sub-division			**Calculation Number:**	0
Client Name:	City of Aztec, New Mexico			**Revision Number:**	0
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	TB / 6-19-2016
	60487347	20000	N/A		
Title:	Hydrologic and Hydraulic Analysis Using FLO-2D – Existing Conditions				

Node 1E



AECOM

Calculation Sheet

Project Name:	Kokopelli Sub-division			**Calculation Number:**	0
Client Name:	City of Aztec, New Mexico			**Revision Number:**	0
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	TB / 6-19-2016
	60487347	20000	N/A		
Title:	Hydrologic and Hydraulic Analysis Using FLO-2D – Existing Conditions				

Attachment 4 – Reference

Curve Number Table

	FID	Shape *	LANDTYPE	curven	HSG_Soil_A
▸	28	Polygon	Desert Rangeland	77	B
	29	Polygon	Desert Rangeland	88	B & D
	30	Polygon	Desert Rangeland	88	A & D
	31	Polygon	Desert Rangeland	77	B
	37	Polygon	Desert Rangeland	88	D
	38	Polygon	Desert Rangeland	88	D
	39	Polygon	Desert Rangeland	88	D
	0	Polygon	COMMERCIAL	94	C
	2	Polygon	COMMERCIAL	90	A & B
	4	Polygon	COMMERCIAL	92	B
	5	Polygon	COMMERCIAL	92	A & B
	7	Polygon	COMMERCIAL	92	B
	8	Polygon	COMMERCIAL	92	A&B&C
	9	Polygon	COMMERCIAL	89	A
	11	Polygon	COMMERCIAL	92	B
	12	Polygon	COMMERCIAL	92	B
	13	Polygon	COMMERCIAL	92	B
	14	Polygon	COMMERCIAL	92	B
	15	Polygon	COMMERCIAL	92	B
	16	Polygon	COMMERCIAL	92	B
	17	Polygon	COMMERCIAL	92	B
	18	Polygon	COMMERCIAL	92	B
	19	Polygon	COMMERCIAL	92	B
	21	Polygon	COMMERCIAL	92	B
	23	Polygon	COMMERCIAL	89	A
	24	Polygon	COMMERCIAL	89	A
	25	Polygon	COMMERCIAL	92	A, B & C
	33	Polygon	DENSE RESIDENTIAL - 0.25 - 0.5 Acre Lot	87	A ,B,C&D
	1	Polygon	DEVELOPING COMMERCIAL	86	D
	27	Polygon	FALLOW	83	A & C
	35	Polygon	INDUSTRIAL	91	B & D
	36	Polygon	INDUSTRIAL	93	D
	32	Polygon	ROADWAY	98	D
	3	Polygon	RURAL RESIDENTIAL - 1 Acre and Above	68	A&B
	6	Polygon	RURAL RESIDENTIAL - 1 Acre and Above	51	A
	10	Polygon	RURAL RESIDENTIAL - 1 Acre and Above	68	B
	20	Polygon	RURAL RESIDENTIAL - 1 Acre and Above	84	A & D
	22	Polygon	RURAL RESIDENTIAL - 1 Acre and Above	68	B
	26	Polygon	RURAL RESIDENTIAL - 1 Acre and Above	84	D
	34	Polygon	WATERWAY	91	D

Table 3-1 — Runoff Curve Numbers for Arid and Semiarid Rangelands[1]
Source: USDA SCS, TR-55, 1986

Cover Description		Curve Numbers for Hydrologic Soil Group –			
Cover Type	Hydrologic Condition[2]	A[3]	B	C	D
Herbaceous—mixture of grass, weeds, and low growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak–aspen—mountain brush mixture of oak	Poor				
brush,	Fair		66	74	79
aspen, mountain mahogany, bitter brush, maple,	Good		48	57	63
and other brush.			30	41	48
Piñon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

[1] Average runoff condition.

[2] Poor: <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: >70% ground cover.

[3] Curve numbers for group A have been developed only for desert shrub.

Table 3-3 — Runoff Curve Numbers for Other Agricultural Lands[1]
Source: USDA SCS, TR-55, 1986

Cover Description		Curve Numbers for Hydrologic Soil Group –			
Cover Type	Hydrologic Condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush–weed–grass mixture with brush the major element.[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30[4]	48	65	73
Woods—grass combination (orchard or tree farm).[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods.[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30[4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

[1] Average runoff condition.

[2] Poor: <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.

[3] Poor: <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

[4] Actual curve number is less than 30; use CN = 30 for runoff computations.

[5] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6] Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Table 3–4 — Runoff Curve Numbers Urban Areas[1]
Source: USDA SCS, TR–55, 1986

Cover Description		Curve Numbers for Hydrologic Soil Group –			
Cover Type and Hydrologic Condition	Average Percent Impervious Area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right–of–way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right–of–way)		98	98	98	98
Paved; open ditches (including right–of–way)		83	89	92	93
Gravel (including right–of–way)		76	85	89	91
Dirt (including right–of–way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1– to 2–inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94
Vacant lands (CN's are determined using cover types similar to those in **Table 3–3**).					

[1] Average runoff condition.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using Figure 3.9.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using Figure 3.9 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using Figure 3.9, based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n [1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n , consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overtop and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \qquad \text{[eq. 3-3]}$$

where:

T_t = travel time (hr),
n = Manning's roughness coefficient (table 3-1)
L = flow length (ft)
P_2 = 2-year, 24-hour rainfall (in)
s = slope of hydraulic grade line (land slope, ft/ft)

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

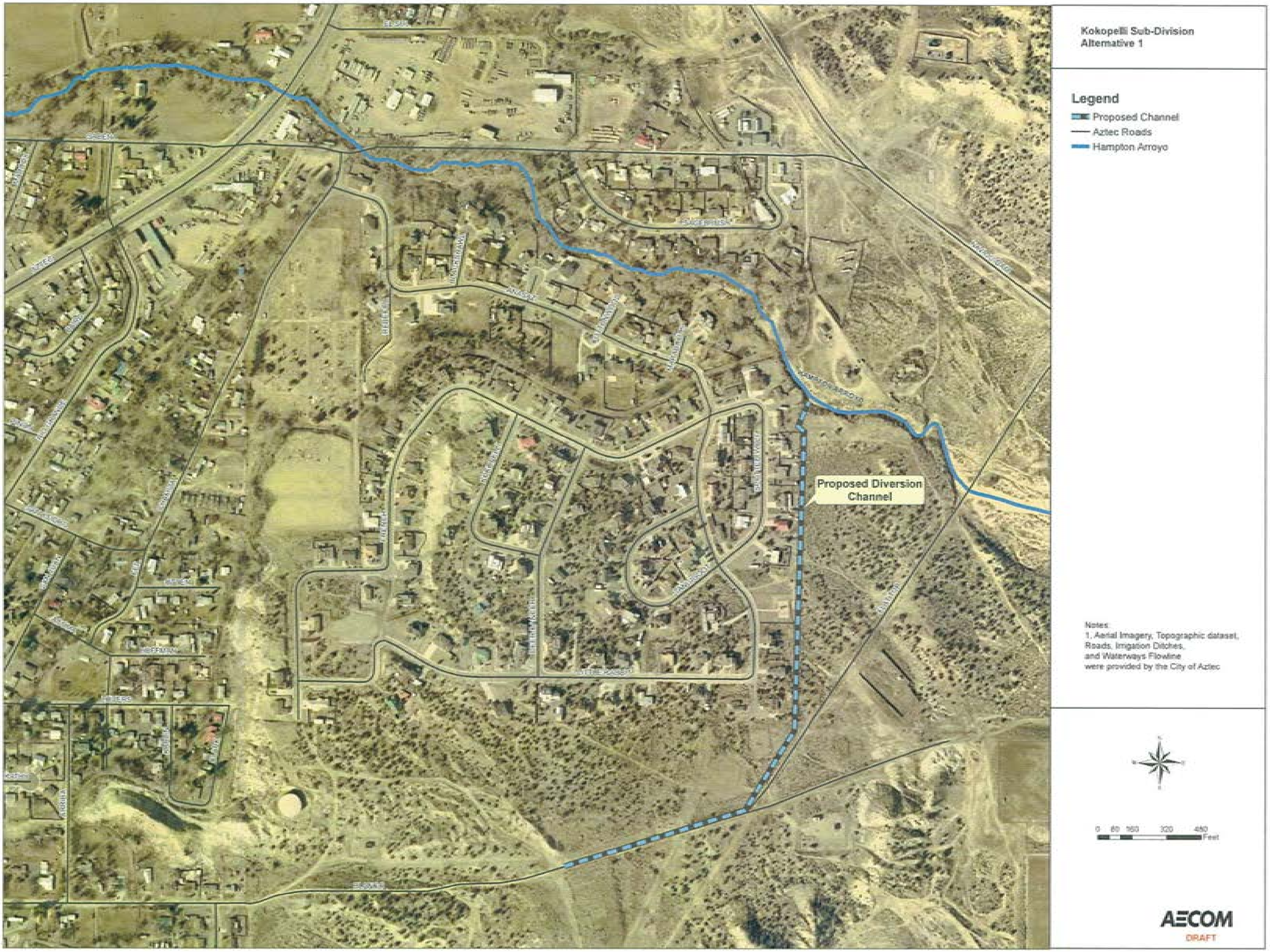
After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

Appendix C – Alternatives Analysis – Conceptual Layout


Kokopelli Sub-Division
Alternative 1
Legend
Proposed Channel
Aztec Roads
Hampton Arroyo
Proposed Diversion Channel
Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec
0 80 160 320 480
Feet
AECOM
DRAFT

Kokopelli Sub-Division
Alternative 2

Legend

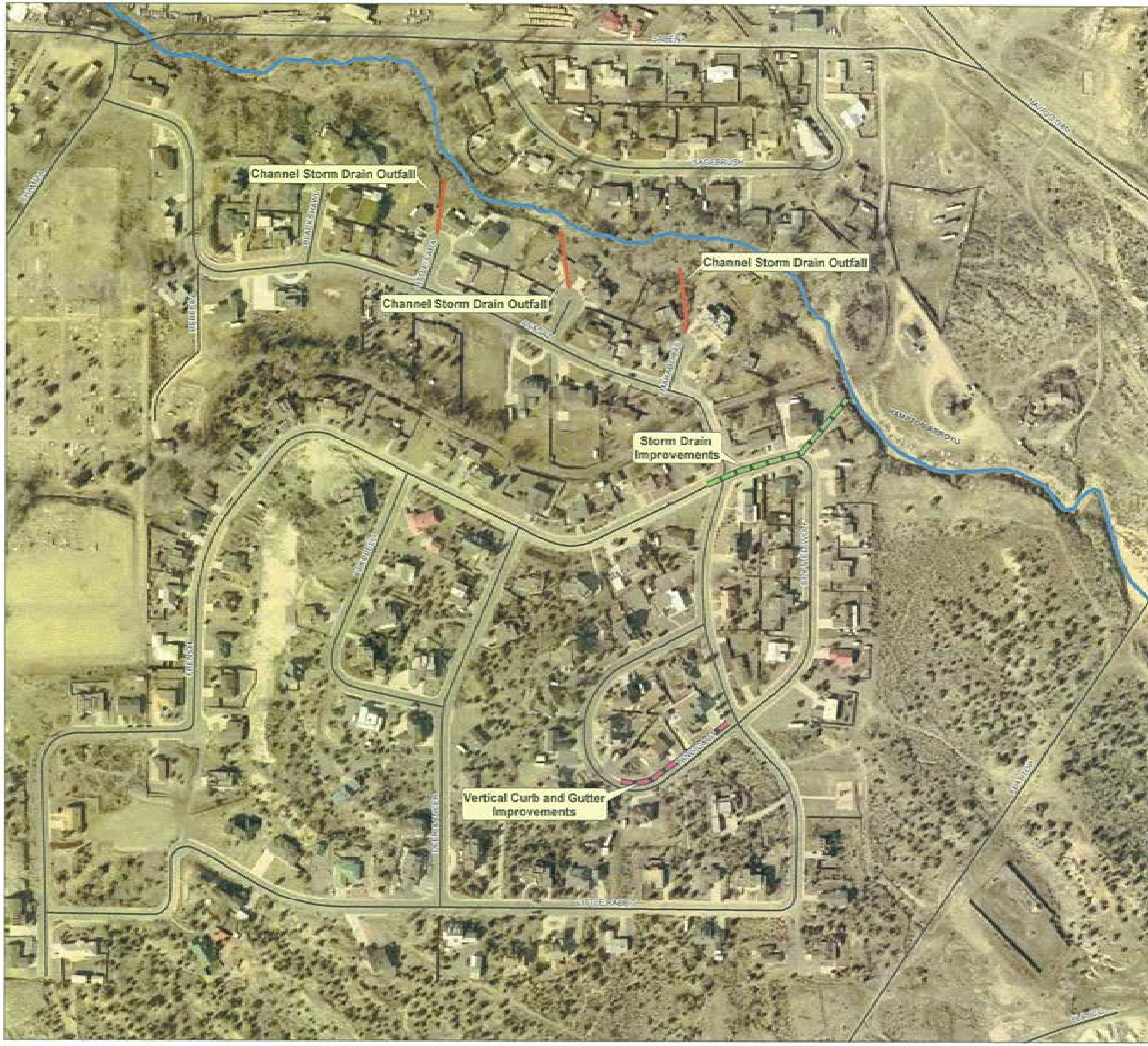
- Detention Basin
- Proposed Channel
- Aztec Roads
- Hampton Arroyo

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

0 80 160 320 480 Feet

AECOM

DRAFT



Kokopelli Sub-Division
Alternative 3

Legend

- Channel Storm Drain Outfall
- Storm Drain Improvements
- Vertical Curb and Gutter Improvements
- Aztec Roads
- Hampton Arroyo

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

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Kokopelli Sub-Division
Alternative 4

Legend

- Detention Basin
- Drainage Ditch Improvements
- Proposed Channel
- Storm Drain Improvements
- Vertical Curb and Gutter Improvements
- Hampton Arroyo
- Aztec Roads

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

0 40 80 160 240 Feet

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Appendix D – Recommended Alternatives Analysis

AECOM

Calculation Sheet

<table>
<tr><td>Project Name:</td><td colspan="3">Kokopelli Sub-division</td><td>Calculation Number:</td><td>0</td></tr>
<tr><td>Client Name:</td><td colspan="3">City of Aztec, New Mexico</td><td>Revision Number:</td><td>0</td></tr>
<tr><td rowspan="2">Project Number:</td><td>Job No.</td><td>Cost Code</td><td>Parent (if any)</td><td rowspan="2">Prepared By/Date:</td><td rowspan="2">TB / 9/06/2016</td></tr>
<tr><td>60487347</td><td>30000</td><td>N/A</td></tr>
<tr><td>Title:</td><td colspan="5">Proposed Conditions – FLO-2D Model</td></tr>
</table>

PROBLEM STATEMENT:

The purpose of this calculation package is to analyze the proposed conditions for the Kokopelli sub-division using FLO-2D PRO.

REQUIRED DELIVERABLES:

- Maps showing reduced flow depth for the proposed conditions for the 25-year storm events.

DATA /ASSUMPTIONS:

- The existing conditions FLO-2D model was used as the base condition to develop the proposed drainage improvements for Kokopelli sub-divisions.
- All input data to the FLO-2D model is discussed in detail in the existing conditions model unless otherwise specified.

PROPOSED CONDITIONS:

Figure D.1 shows the proposed drainage improvements to mitigate the flooding issues for the Kokopelli sub-division for a 25-year 24-hour storm event. The following sections discuss the various drainage improvements that are proposed:

Channel

An earthen channel is proposed along the south and east boundary of the Kokopelli sub-division that diverts the 25-year storm flows away from the sub-division and outfalls into the Hampton Arroyo. Rational method was used to calculate the peak discharge for the channel. The rational calculation for the diversion channel is attached in Attachment A.

The channel assumes a 10-feet bottom width, 1.25 feet depth and 3H: 1V side slope. The channel bed slope varies with an average 0.025 ft./ft. and 6" riprap lining is assumed along the channel banks.

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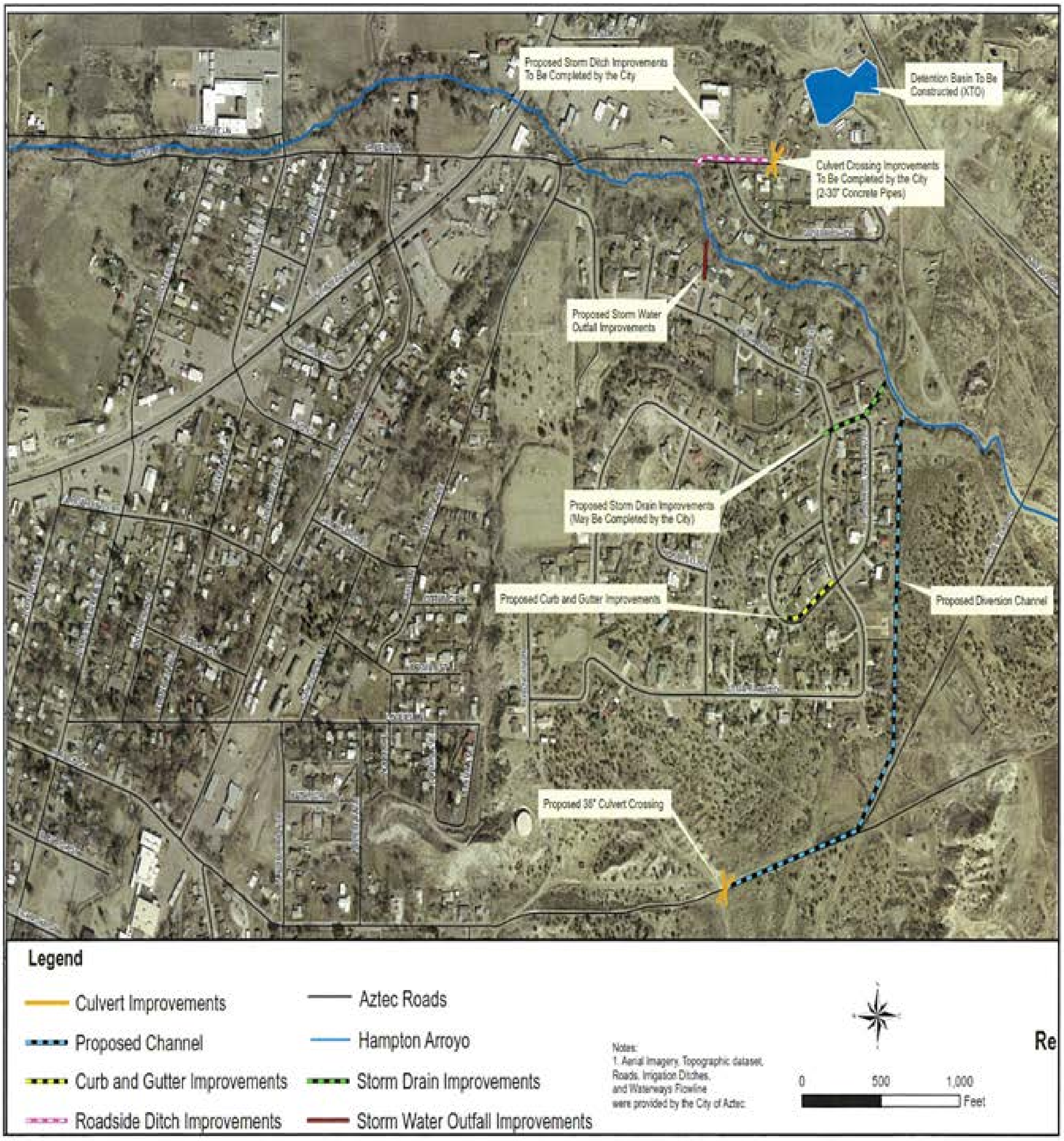
Calculation Sheet

Project Name:	Kokopelli Sub-division			**Calculation Number:**	0
Client Name:	City of Aztec, New Mexico			**Revision Number:**	0
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	TB / 9/06/2016
	60487347	30000	N/A		
Title:	Proposed Conditions – FLO-2D Model				

Figure D.1 – Recommended Mitigation Concept – Kokopelli Sub-division



Culvert

A 36" concrete pipe is proposed to capture the storm runoff south of the East Blanco Street and convey the flows to the proposed channel north of the East Blanco Street. The culvert was modeled in CulvertMaster using the available topography. The Culvert calculation and culvert rating table is attached in Attachment B.

Detention Basin

A detention basin (Referred as XTO Basin) is proposed to reduce flooding downstream of the Navajo Dam Road. The design for the XTO basin was obtained from the City (City of Aztec) and was used to determine the stage-discharge rating table for the outfall from the basin.

The outfall discharge rating table was then input into the HEC-HMS (the existing HEC-HMS model was used as the base condition) to obtain an outflow hydrograph from the detention basins. This outflow hydrograph was used as input into the FLO-2D model.

The details of the XTO basin calculation, HEC-HMS results, and outflow hydrograph from the basin outfall are attached in Attachment C.

Storm Drain System

A storm drain system is proposed at the intersection of French Drive and Anasazi Drive to reduce storm water ponding. The storm drain system captures portion of the 25-year storm runoff and diverts it into the Hampton Arroyo. Rational method was used to calculate the 25-year peak discharge at the intersection. The rational method calculation for the intersection is attached in Attachment D.

The storm drain system was modeled in StormCAD. The details of the assumptions and output summary are attached in Attachment D.

EPA SWIMM

The storm drain components were then input into EPA SWMM 5.0 (EPA SWMM) which is component of the FLO-2D PRO (FLO-2D, 2016). The following data was input into the EAP SWMM model:

1. SubCatchment Basin
2. Rain gage

3. Junctions and Manholes
4. Conduits
5. Outfall

Sub-catchment Basin:

The Sub-catchment areas represent the surface area of the inlet grid element. The SWMM model requires that each of the inlets have a sub-catchment component. Below is a screenshot of the Sub-catchment data input. Approximate values were entered to represent the sub-catchment basin parameters.

Subcatchment 1

Property	Value
Name	1
X-Coordinate	2681417.268
Y-Coordinate	2120380.452
Description	
Tag	
Rain Gage	Gage
Outlet	CB-6
Area	5
Width	500
% Slope	0.5
% Imperv	25
N-Imperv	0.01
N-Perv	0.1
Dstore-Imperv	0.05
Dstore-Perv	0.05
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	HORTON
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Area of subcatchment (ac)

AECOM	Calculation Sheet				
Project Name:	Kokopelli Sub-division			**Calculation Number:**	0
Client Name:	City of Aztec, New Mexico			**Revision Number:**	0
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	TB / 9/06/2016
	60487347	30000	N/A		
Title:	Proposed Conditions – FLO-2D Model				

Rain Gages:

The SWMM component requires a rain gage to be entered for the model to work. So a dummy rain gage was entered as input as shown in the below screenshot.

Junction and Manholes:

The Junctions and Manholes mainly represent the storm drain inlet inverts and relative ground elevations. The screenshot below represents the Junction input into the EPA SWMM model. The Maximum depth represents the distance from the drain inlet to the ground. The maximum depth was adjusted to match the ground elevation in the FLO-2D grid for the inlet.

Junction CB-6

Property	Value
Name	CB-6
X-Coordinate	2681473.946
Y-Coordinate	2120376.460
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	5733
Max. Depth	4
Initial Depth	0
Surcharge Depth	0
Ponded Area	0

Maximum water depth (i.e., distance from invert to ground surface or 0 to use distance from invert to top of highest connecting link) (ft)

Conduits:

The input to the storm drain conduit representing the inlet and outlet nodes is entered in this module. Other conduit properties such as length, roughness and maximum flow are entered. The screenshot below represents the Conduit input into the EPA SWMM model.

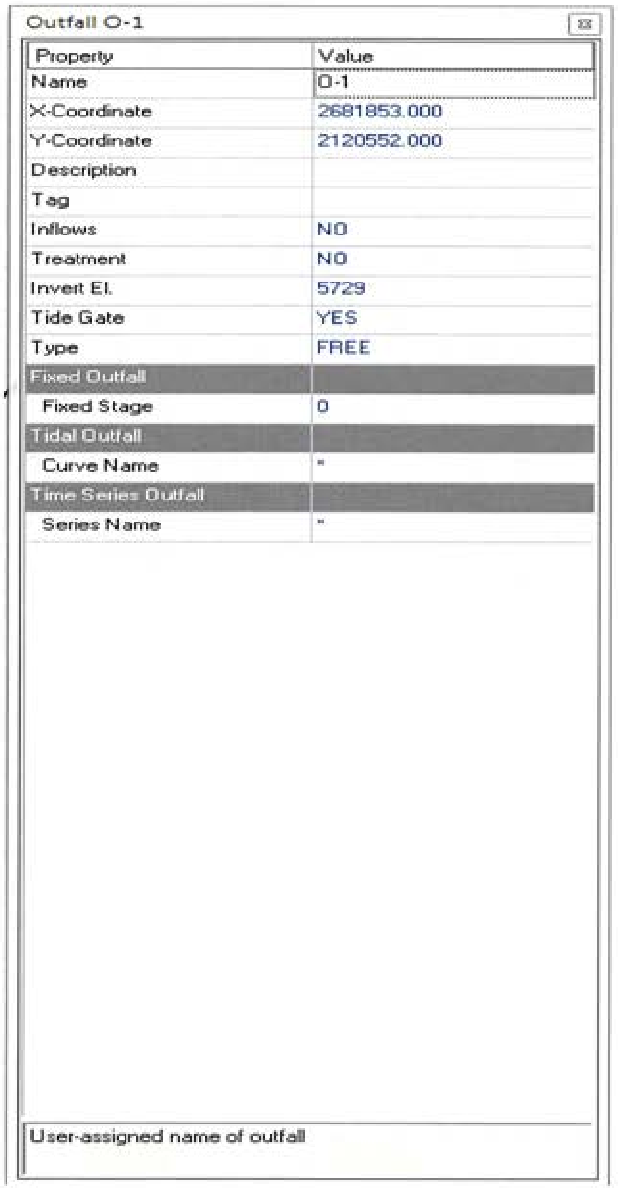
Conduit CO-12

Property	Value
Name	CO-12
Inlet Node	CB-6
Outlet Node	MH-6
Description	
Tag	
Shape	CIRCULAR
Max. Depth	2
Length	28.4
Roughness	0.013
Inlet Offset	0
Outlet Offset	0
Initial Flow	0
Maximum Flow	10
Entry Loss Coeff.	0
Exit Loss Coeff.	0
Avg. Loss Coeff.	0
Flap Gate	YES
Culvert Code	

Manning's roughness coefficient

Outfall:

The outfall to the storm drain is entered in this module. The storm drain system was assumed to outfall into the Hampton Arroyo. The outfall data is stored in the "SWMMOUTF.DAT" file. The flap gate switch was turned on to avoid backflow into the storm drain system from the Hampton Arroyo. Below screenshot shows the outfall module in SWMM and FLO-2D.


Outfall O-1

Property	Value
Name	O-1
X-Coordinate	2681853.000
Y-Coordinate	2120552.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	5729
Tide Gate	YES
Type	FREE
Fixed Outfall	
Fixed Stage	0
Tidal Outfall	
Curve Name	*
Time Series Outfall	
Series Name	*

User-assigned name of outfall

The SWMM data input are saved in the SWMM.ini module.

FLO-2D MODELING

The existing conditions FLO-2D model was used as the base model to develop the proposed drainage improvements. The following sections discuss the FLO-2D modeling of the proposed conditions.

FLO-2D SWMM Inlet Data:

After entering the input data in EPA SWMM the inlets and other storm drain components are connected to the FLO-2D grid system. The inlet properties are entered in the "SWMM FLO-2D Inlets Dialogue" in FLO-2D under "Tools". The type of drain inlets and properties of the inlets are entered in this module. The data is stored in "SWMMFLO.DAT" file. The screen shot below summaries the inlet properties as enter in FLO-2D.

SWMM FLO-2D Inlets

Drain Type: Curb Inlet (no sag)=1; Curb Inlet (w/sag)=2; Grate (gutter) (w/sag)=3; Manhole=5

	Node	SWMM Code	Drain Type	Length(1 or 2) Perimeter(3 or 5)	Width(2) Area(3 or 5)	Height(1) Area(2) Surcharge(5)	Inlet Weir Coeff.	Feature	Curb Height
1	77394	CB-6	2	20	3	6	2.3	0	0.67
2	79320	CB-9	2	20	3	6	2.3	0	0.67
3	79311	CB-11	2	20	3	6	2.3	0	0.67
4	76424	CB-3	2	20	3	6	2.3	0	0.67
5	74990	CB-4	2	20	3	6	2.3	0	0.67
6	74515	CB-1	2	20	3	6	2.3	0	0.67
7	80763	CB12	2	20	3	6	2.3	0	0.67
8	88726	CB-2	2	20	3	6	2.3	0	0.67

Edit Current Selection

Notes:
i. For Drain Type 1: Width=0.
ii. For Drain Type 3:
Perimeter does not include curb side.
Area = clear flow area in grate.
Height = sag height difference.
iii. Weir Drain Coefficients:
Type 1, 3, and 5: Range 2.8 to 3.2
Type 2: Typically 2.3
iv. For Drain Type 4: rating table required.
Length=0, Width=0, Height=0, Weir Coefficiente=0
v. For Drain Type 5: Range 0 to5 (see guidelines)

Save to SWMMFLO.DAT

Close

The outfall discharge rating table from the detention was input into the FLO-2D model. The outflow hydrograph used in FLO-2D is attached in Attachment C.

The channel was modeled using the channel option in FLO-2D. The grid elevations were artificially adjusted along the channel and overbanks to model the required channel bed slope. The channel bed profile used in the FLO-2D model is attached in Attachment A.

The proposed culvert crossing on East Blanco Street was modeled using the "Hydraulic Structure" option in FL0-2D. The discharge rating table developed using CulvertMaster were input into the FLO-2D model.

FLO-2D MODEL PARAMETERS:

Figure D.2 – FLO-2D Control Variable Window

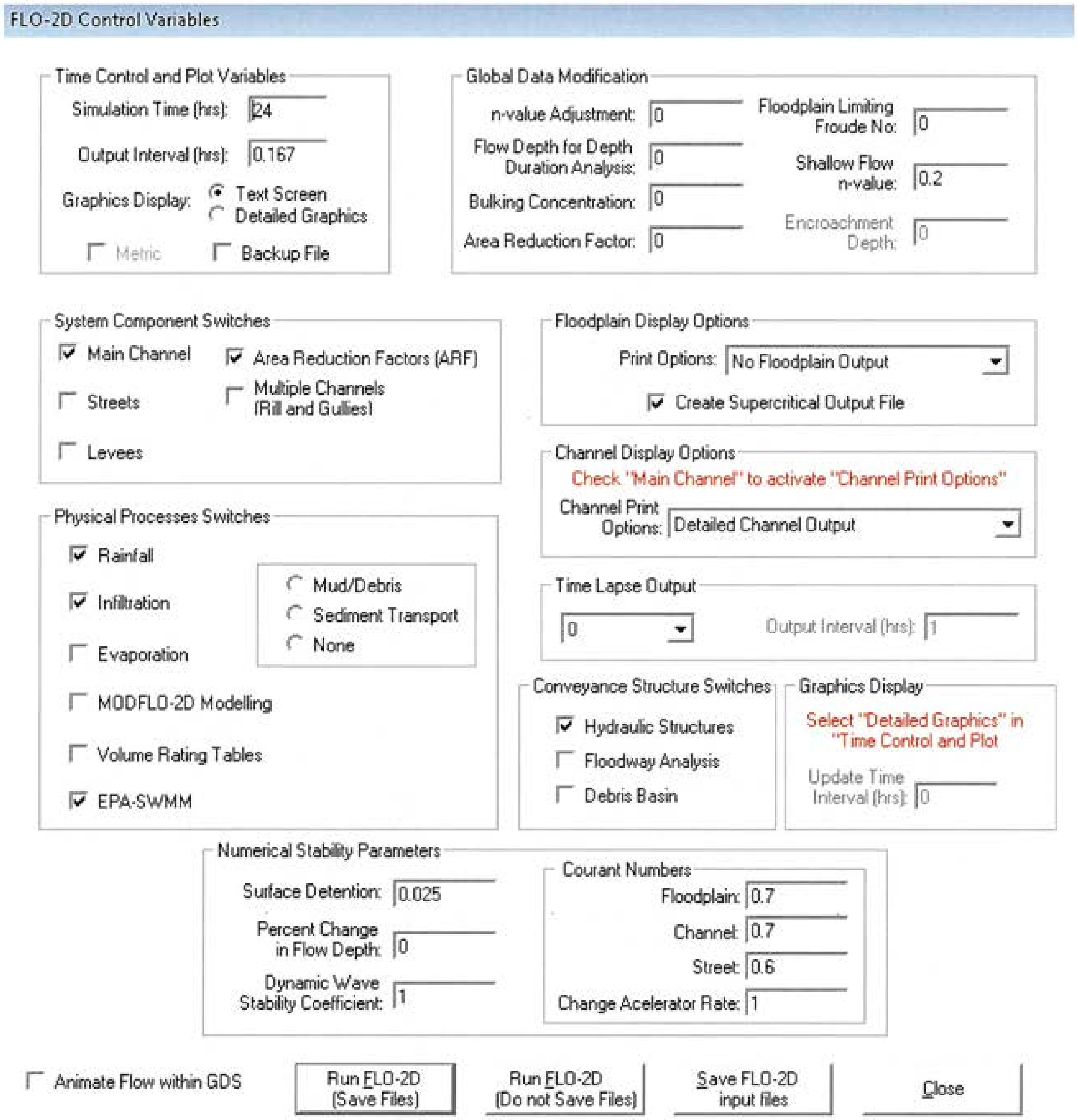


Figure D.2 shows the Control Variable Window in FLO-2D used to adjust the default input parameters.

Time Control

To improve the stability and reliability of the simulation, adjustments were made to the model parameters. The simulation time was set to 24 hours to allow the rainfall from the 24-hour storm and hydrograph to cycle completely through the model domain. Inflow hydrographs obtained from the HEC-HMS model had simulation time of 24 hours. Output intervals were set for every 10 minutes or 0.1 hours.

Numerical Stability Parameters

The Dynamic Wave Stability coefficient (Wave Max) for the model was set to 1. This is within the typical range as per the Data Input Manual. Also the Surface detention was set to 0.025 feet for rainfall runoff model as reported in the FLO-2D Input Manual.

RESULTS:

Figure D.3.1 and D.3.2 shows the Simulation Summary from the completion of the FLO-2D model for the 25-year and 100-year storm event for the proposed conditions model. The VELTIMEC.OUT file was checked for the Maximum Channel velocities in both models. The high velocities were observed at the outfall to the Hampton Arroyo. Additional erosion protection is proposed at the outfall to reduce high velocities. The TIME.OUT file in the 100-year storm event was checked for "sticky grids". The "sticky grids" were within the Hampton Arroyo channel and does have any impact in the Kokopelli sub-division flooding issues.

Figure D.4.1 and D.4.2 shows that the maximum flow depth for the 25-year and 100-year storm event for the proposed conditions model respectively. The proposed drainage improvements have reduced the flooding issues compared to the existing conditions. The reduction flow depth is in the range of 0 to 0.5 feet for the 25-year storm event and 0-0.8 feet for the 100-year storm event.

Figure D.3.1 – 25-year; 24-hour FLO-2D Outputs Checklist

Simulation Summary

		Status	Action
Overall volume conservation	☑	Satifactory	No Action Necessary
Channel volume conservation	☑	Excellent	No Action Necessary
Timestep decreases - numerical stability	☑	Good	No Action Necessary
Maximum floodplain velocities	☑	Reasonable	No Action Necessary
Maximum channel velocities	☐	Maximum velocities maybe high > 10 fps	Review maximum velocity plots and VELTIMEC.OUT
Variation in n-values	☑	Reasonable n-value adjustments	No Action Necessary

Model Runtime (hours): 4.38672

Close

Figure D.3.2 – 100-year; 24-hour FLO-2D Results

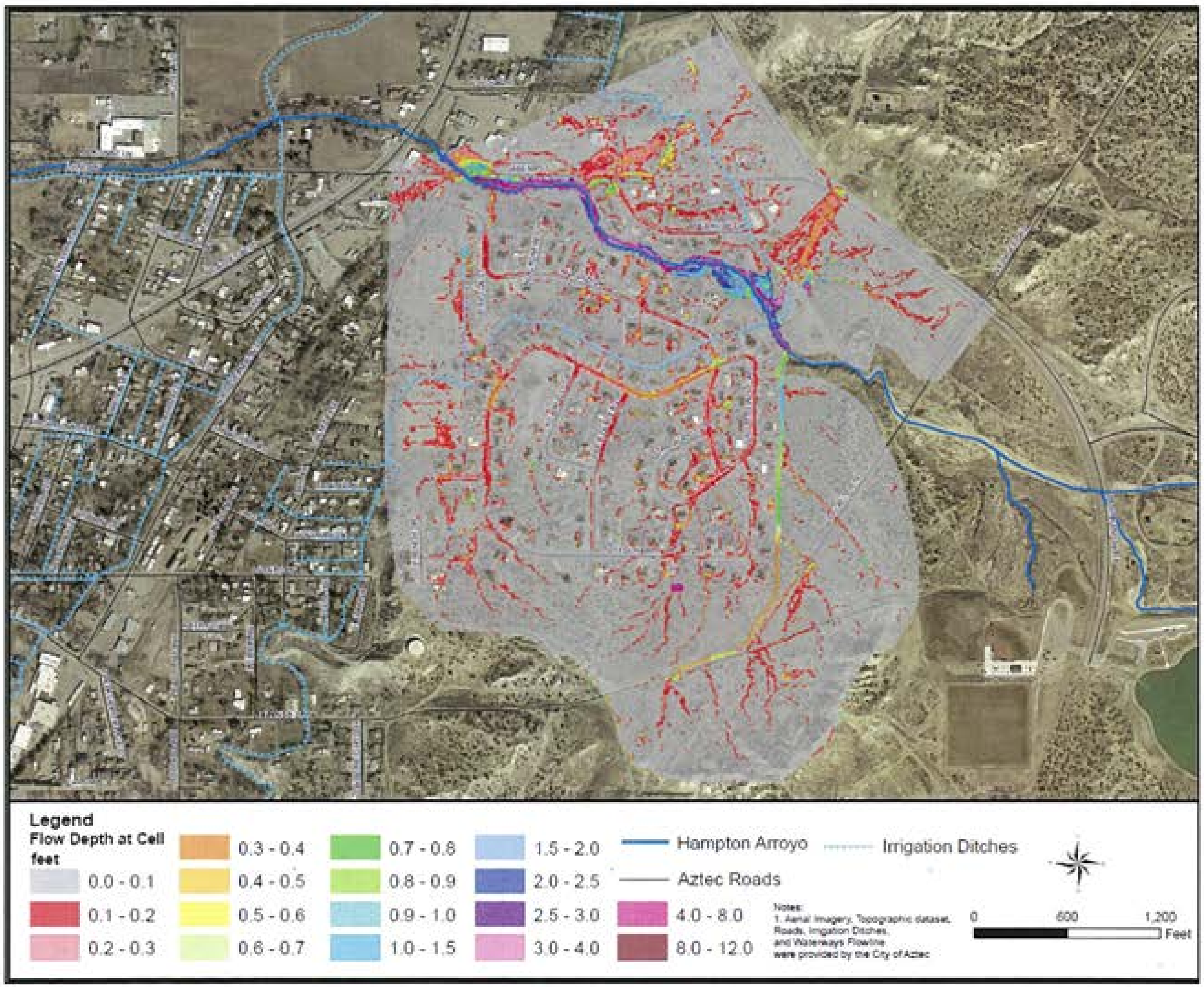
Simulation Summary

		Status	Action
Overall volume conservation	☑	Excellent	No Action Necessary
Channel volume conservation	☑	Excellent	No Action Necessary
Timestep decreases - numerical stability	☐	Review slowest grid elements	Review TIME.OUT file
Maximum floodplain velocities	☑	Reasonable	No Action Necessary
Maximum channel velocities	☐	Maximum velocities maybe high > 10 fps	Review maximum velocity plots and VELTIMEC.OUT
Variation in n-values	☑	Reasonable n-value adjustments	No Action Necessary

Model Runtime (hours): 6.05029

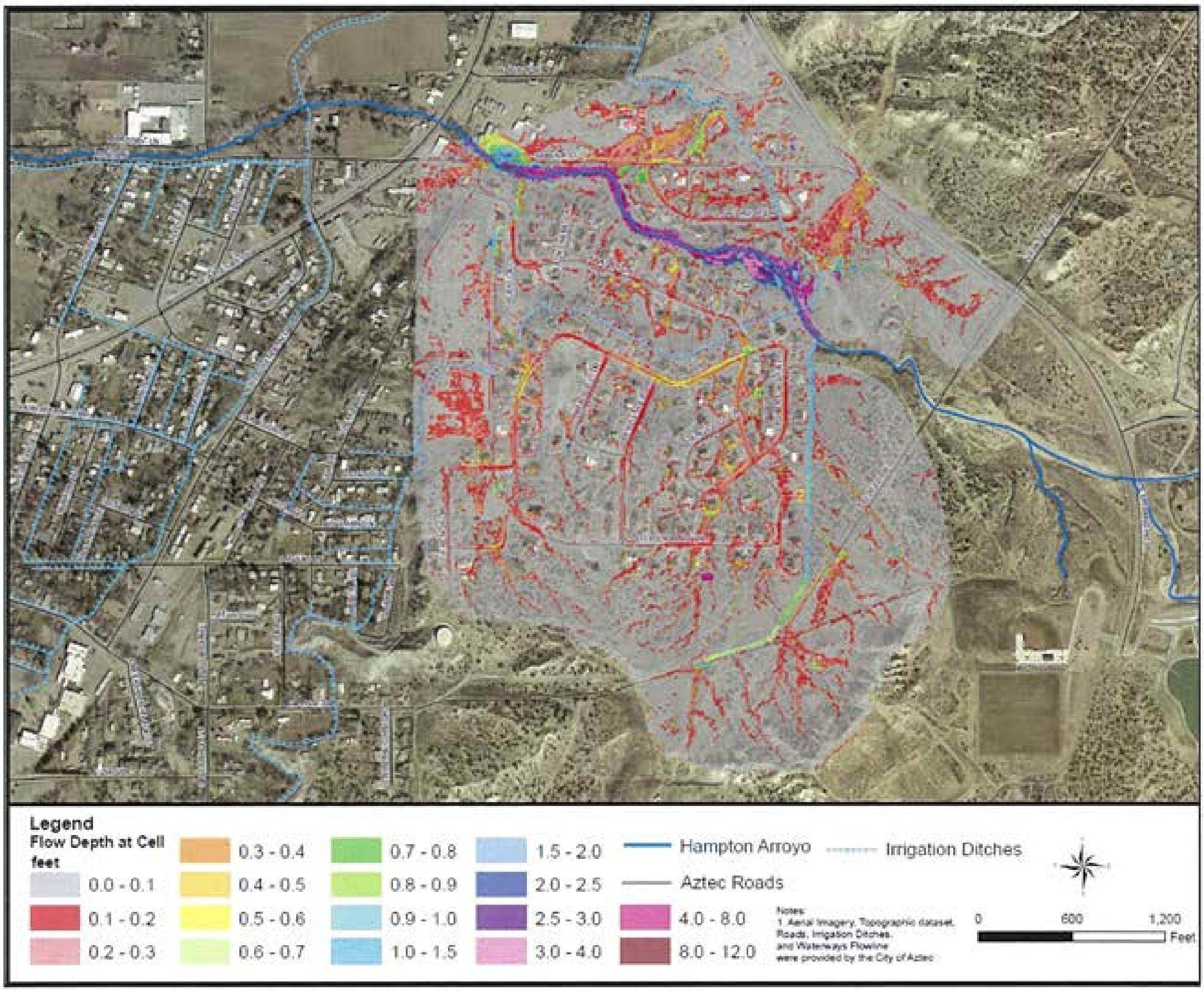
Close

Figure D.4.1 – 25-year; 24-hour FLO-2D Results



AECOM	Calculation Sheet		
Project Name:	Kokopelli Sub-division	**Calculation Number:**	0
Client Name:	City of Aztec, New Mexico	**Revision Number:**	0
Project Number:	Job No.: 60487347; Cost Code: 30000; Parent (if any): N/A	**Prepared By/Date:**	TB / 9/06/2016
Title:	Proposed Conditions – FLO-2D Model		

Figure D.4.2 – 100-year; 24-hour FLO-2D Results



REFERENCES:

1. FLO-2D INC, FLO-2D PRO Build No. 16.06.15, Accessed in August, 2016.

2. United State Army Corps of Engineers (USACE), 2015. Hydraulic Engineering Center Hydrologic Modeling System (HEC-HMS) [software package]. Version 4.1 July 2015.

3. United States Department of Commerce, National Oceanic and Atmospheric Administration, *NOAA Atlas 14, Volume 1, Version 5*, 2009.

4. New Mexico State Highway and Transportation Department, Drainage Manual Volume 1, Hydrology, December 1995.

5. U.S. Environmental Protection Agency (EPA) Storm Water Management Model (SWMM), EPA SWMM Version 5.0, Build 5.0.022.

Attachment A – Channel Data

Rational Calculation – Diversion Channel

Q=CIA

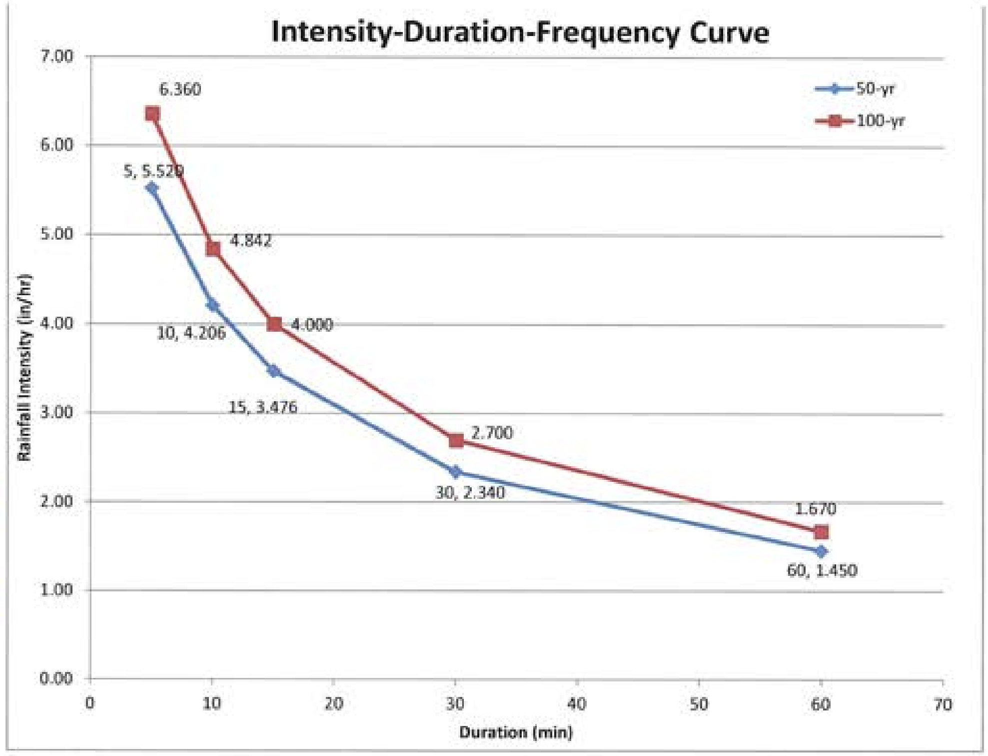
Basin ID	C	I		Area		Peak Flow -Q	
		25-yr	100-yr	(ac)	(sq mi)	25-yr (cfs)	100-yr (cfs)
Proposed Contributing Basin	0.54	3.606	4.842	48.95	0.076484	**95.32**	**127.99**

*Assuming a Tc of 10 mins

Depth-Duration-Frequency-DDF* (in)						
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-min	0.194	0.261	0.316	0.395	0.460	0.530
10-min	0.295	0.397	0.481	0.601	0.701	0.807
15-min	0.366	0.493	0.596	0.745	0.869	1.000
30-min	0.493	0.663	0.803	1.000	1.170	1.350
1-hr	0.610	0.821	0.994	1.240	1.450	1.670
2-hr	0.697	0.924	1.110	1.390	1.620	1.870
3-hr	0.752	0.974	1.160	1.430	1.650	1.900
6-hr	0.892	1.120	1.320	1.600	1.830	2.080
12-hr	1.070	1.320	1.530	1.810	2.030	2.260
24-hr	1.220	1.540	1.810	2.170	2.460	2.760

* From NOAA 14, Aztec, NM; Lat: 36.8202, Long:-107.9537 Ele: 5902 ft

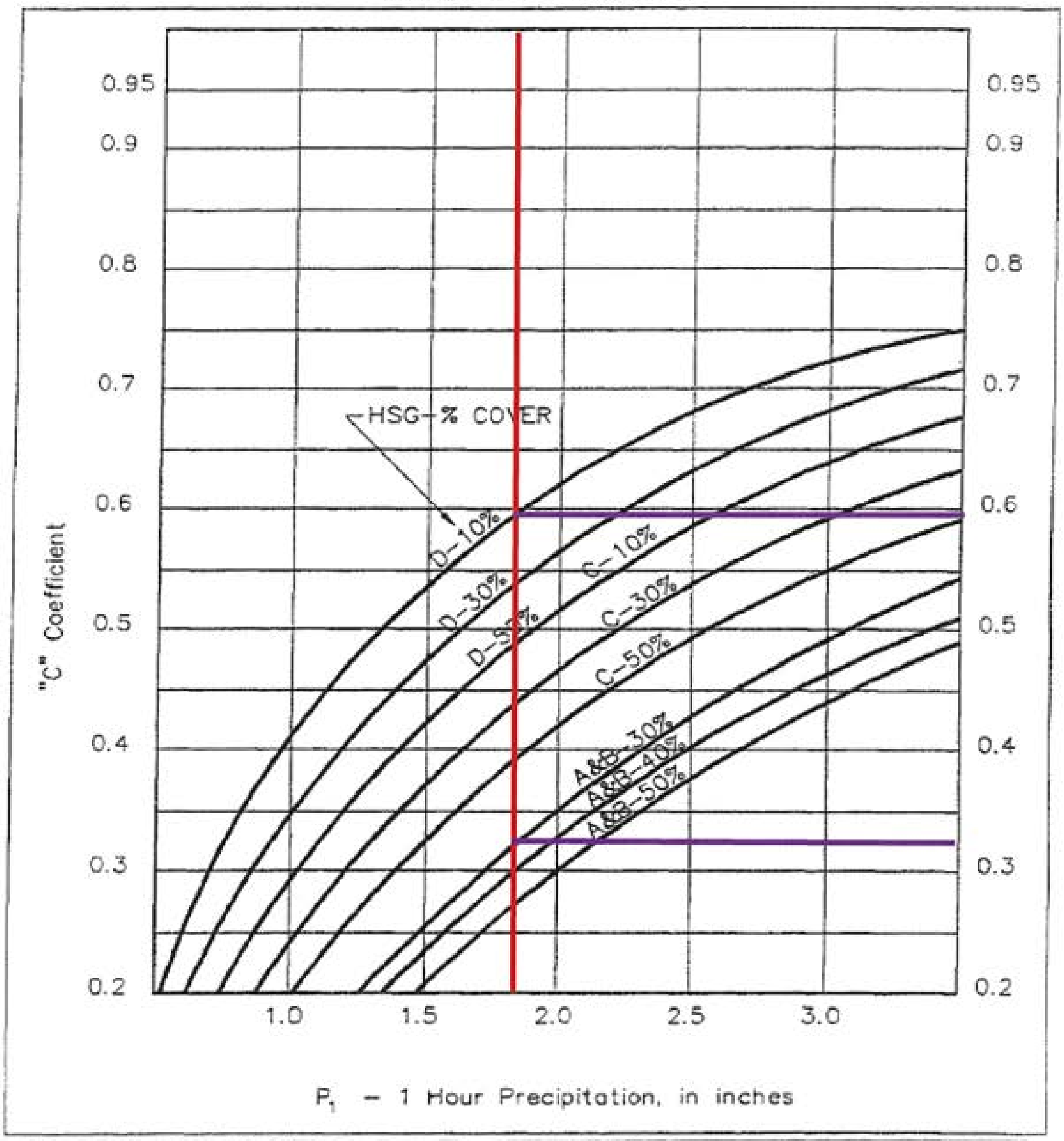
	Intensity-Duration-Frequency-IDF* (in/hr)						
Duration		2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5	5-min	2.328	3.132	3.792	4.740	5.520	6.360
10	10-min	1.770	2.382	2.886	3.606	4.206	4.842
15	15-min	1.464	1.972	2.384	2.980	3.476	4.000
30	30-min	0.986	1.326	1.606	2.000	2.340	2.700
60	1-hr	0.610	0.821	0.994	1.240	1.450	1.670
	2-hr	0.349	0.462	0.555	0.695	0.810	0.935
	3-hr	0.251	0.325	0.387	0.477	0.550	0.633
	6-hr	0.149	0.187	0.220	0.267	0.305	0.347
	12-hr	0.089	0.110	0.128	0.151	0.169	0.188
	24-hr	0.051	0.064	0.075	0.090	0.103	0.115



Basin ID	Soil Group	% In Area	C	Soil Group	% In Area	C	Composite C
Proposed Contributing Basin	A	20%	0.32	D	80%	0.60	0.54

FIGURE 2-4
RATIONAL "C" COEFFICIENT
DESERT
(CACTUS, GRASS & BRUSH)

AS A FUNCTION OF RAINFALL DEPTH, HYDROLOGIC SOIL GROUP (HSG), AND % OF VEGETATION COVER.



Diversion Channel_Kokopelli

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040	
Channel Slope	0.02800	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	95.00	ft³/s

Results

Normal Depth	1.19	ft
Flow Area	16.14	ft²
Wetted Perimeter	17.52	ft
Hydraulic Radius	0.92	ft
Top Width	17.14	ft
Critical Depth	1.24	ft
Critical Slope	0.02425	ft/ft
Velocity	5.88	ft/s
Velocity Head	0.54	ft
Specific Energy	1.73	ft
Froude Number	1.07	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

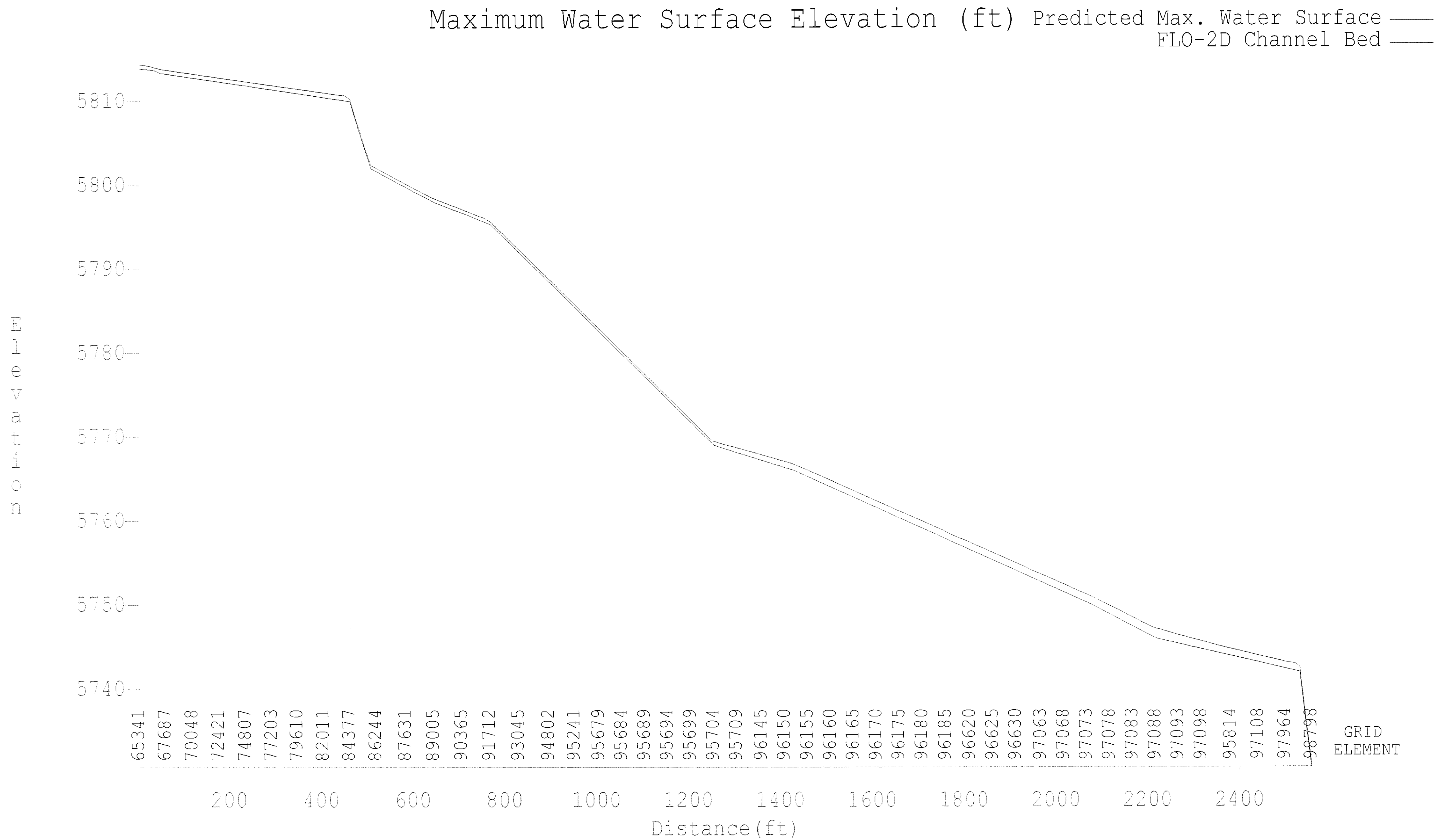
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.19	ft
Critical Depth	1.24	ft
Channel Slope	0.02800	ft/ft

Diversion Channel_Kokopelli

GVF Output Data

Critical Slope	0.02425	ft/ft



Maximum Water Surface Elevation (ft)
Predicted Max. Water Surface
FLO-2D Channel Bed
Elevation
5810
5800
5790
5780
5770
5760
5750
5740
65341 67687 70048 72421 74807 77203 79610 82011 84377 86244 87631 89005 90365 91712 93045 94802 95241 95679 95684 95689 95694 95699 95704 95709 96145 96150 96155 96160 96165 96170 96175 96180 96185 96620 96625 96630 97063 97068 97073 97078 97083 97088 97093 97098 95814 97108 97964 98798
GRID ELEMENT
200 400 600 800 1000 1200 1400 1600 1800 2000 2200 2400
Distance(ft)

Attachment B – Culvert Calculations

Culvert Calculator Report
East_Blanco_St_props_Culvert_kokopelli

Solve For: Discharge

Culvert Summary			
Allowable HW Elevation	5,821.00 ft	Headwater Depth/Height	1.61
Computed Headwater Eleva	5,821.00 ft	Discharge	59.91 cfs
Inlet Control HW Elev.	5,821.00 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	5,820.78 ft	Control Type	Inlet Control

Grades			
Upstream Invert	5,816.17 ft	Downstream Invert	5,815.14 ft
Length	40.00 ft	Constructed Slope	0.025750 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	1.88 ft
Slope Type	Steep	Normal Depth	1.60 ft
Flow Regime	Supercritical	Critical Depth	2.50 ft
Velocity Downstream	12.81 ft/s	Critical Slope	0.007839 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	3.00 ft
Section Size	36 inch	Rise	3.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	5,820.78 ft	Upstream Velocity Head	1.41 ft
Ke	0.50	Entrance Loss	0.70 ft

Inlet Control Properties			
Inlet Control HW Elev.	5,821.00 ft	Flow Control	N/A
Inlet Type	Square edge w/headwall	Area Full	7.1 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

Rating Table Report
East_Blanco_St_props_Culvert_kokopelli

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	5,816.17	5,821.17	1.00 ft

HW Elev. (ft)	Discharge (cfs)
5,816.17	0.00
5,817.17	4.39
5,818.17	15.96
5,819.17	32.04
5,820.17	49.61
5,821.17	61.66

Attachment C – Detention Basin and HEC-HMS Calculation

1. **Detention Basin Calculation**
2. **HEC-HMS model – Proposed Condition**

AECOM Calculation Sheet

Project Name:	Kokopelli Alternatives			**Calculation Number:**	2A
Client Name:	City of Aztec, New Mexico			**Revision Number:**	1
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	PDC / 8-8-2016
	60487360	30000	N/A		
Title:	Hydrologic Analysis Using HEC-HMS				

PROBLEM STATEMENT:

The purpose of this calculation package is to document the addition of the XTO Pond to the hydrologic analysis and was prepared by AECOM for the watershed draining toward the Hampton Arroyo using HEC-HMS version 4.1.

REQUIRED DELIVERABLES:

- Multi-frequency (25; 100-year; and 24-hour) peak flows along the Hampton Arroyo.

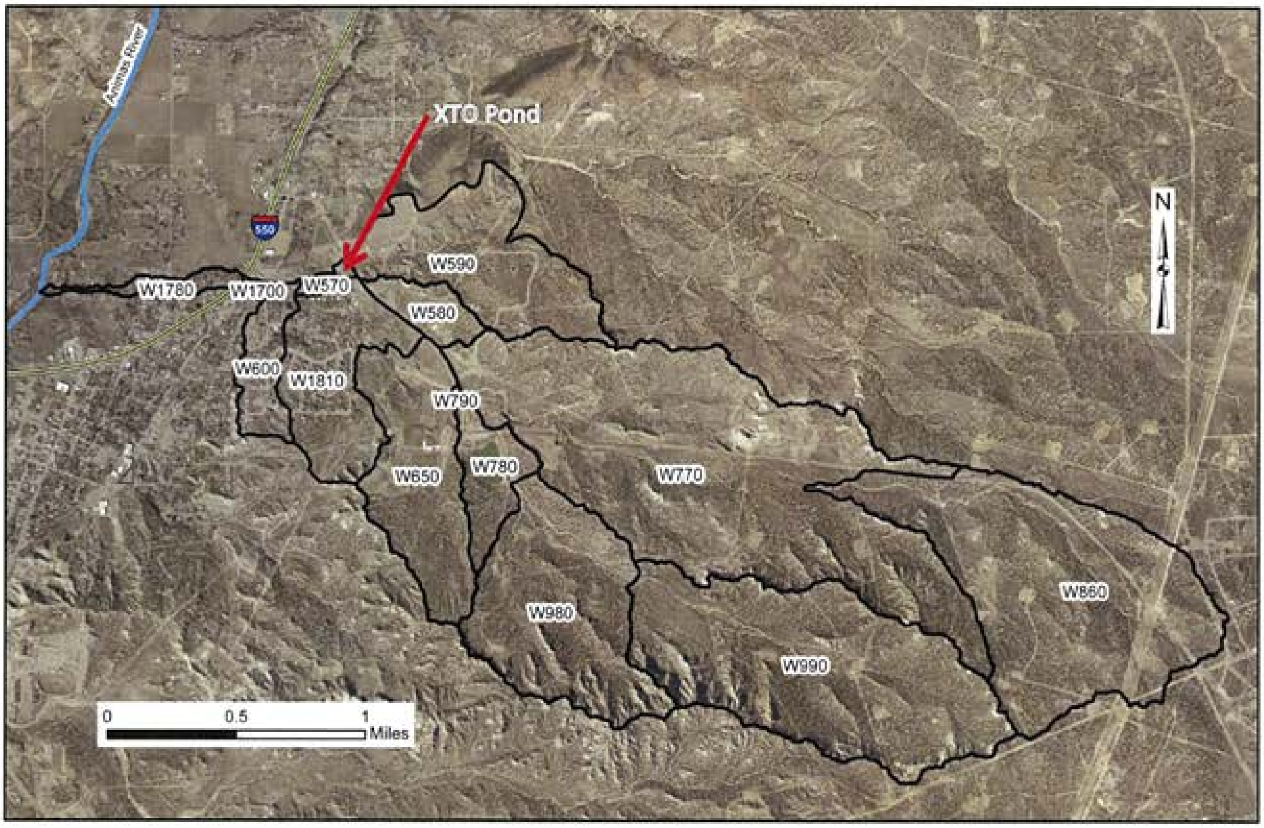
DATA /ASSUMPTIONS:

- Drainage area was delineated using 1-ft contour LiDAR data provided by the City of Aztec.
- Rainfall data for the watershed was obtained from NOAA Atlas 14, Volume 1; Version 5.
- SCS Unit Hydrograph Methodology.
- Modified NOAA-SCS rainfall distribution based on New Mexico Department of Transportation (NMDOT) procedures.
- Rainfall loss methodology based on the SCS Curve Number methods.
- Hydrologic soil group (HSG) was determined using the USDA NRCS Soil Report for Aztec, New Mexico. The watershed area consists of HSG classes A, B, C and D soil types.
- Soil impervious area percentages were estimated from readily available aerial imagery.
- Cover type was selected to be "Desert Shrub" in poor condition for the undeveloped areas due to the lack of vegetative cover observed in the field or visible on readily available aerial imagery. One area in the project areas is a cemetery and is marked as fair condition due to the percentage of vegetative cover. Runoff curve numbers were selected using TR-55 Table 2-2a and 2-2d.
- Residential properties outside of the subdivision were assumed to be 1/3 acre lots. Residential properties inside the subdivisions were assumed to be 1/4 acre lots.

Variable Definitions

T_c	Time of Concentration	P_2	2-year, 24-hour rainfall	V	*Velocity*
T_{tn}	Travel time for location 'n'	n	Manning's n value	T_t	Lag time
L	Length of drainage segment	CN	Curve Number	s	Channel slope
r	Hydraulic radius	I_a	Initial abstraction		

Figure D.5 – Watershed Delineation Map



HYDROLOGIC ANALYSIS

METHODOLOGY:

Watershed Delineation: The contributing watershed shown in Figure D.5 was delineated using 10ft contour data provided by the City of Aztec.

Time of Concentration: Time required for water to flow from the hydraulically furthest point in the watershed to the concentration point. The time of concentration can be represented by sheet flow, shallow concentrated flow, and open channel flow components.

$$T_c = T_{t1} + T_{t2} + T_{t3}$$

Sheet flow: According to TR-55 Methodology, the first 300ft of the drainage area can be modeled as sheet flow. The sheet flow travel time can be determined using the following equation.

$$T_{t1} = \frac{0.007 * (nL)^{0.8}}{P_2^{0.5} * s^{0.4}}$$

Shallow Concentrated Flow: After the 300ft of sheet flow, shallow concentrated flow begins and continues until a defined channel is reached. The travel time for this segment of the drainage area is estimated using Figure 3-1 from TR-55 along with the calculated slope to find the corresponding T_{t2}.

Open Channels: Once a defined channel is reached, the flow transitions from Shallow Concentrated Flow to Open Channel Flow. Open channel flow is modeled with a variation of Manning's equation in which velocity is the unknown. Velocity is estimated using the following equation.

$$V = \frac{1.49 * r^{\frac{2}{3}} * s^{\frac{1}{2}}}{n}$$

The estimated velocity is then used in the following equation to determine the travel time for Open Channel Flow.

$$T_{t3} = \frac{L}{3600 * V}$$

Lag Time: When modeling the drainage area in HEC-HMS using the SCS Unit Hydrograph transform, a lag time is needed for the model to run. Lag time is determined using the following equation.

$$T_l = 0.6 * T_c$$

Initial Abstraction: Storm water that is lost to the environment before rainfall-runoff occurs is referred to as initial abstraction. This value I_a determined using the following equation.

$$I_a = 0.2 * X$$

Where:

$$X = \frac{1000}{CN} - 10$$

Engineering judgement was used in consideration of precipitation values in the area and runoff estimates to apply a global cap of 0.350 inches for initial abstraction in the HEC-HMS model. This better reflects the drainage conditions encountered in the Hampton Arroyo watershed and provides a more conservative estimate of peak storm flows.

All inputs regarding impervious area, CN runoff numbers, and Lag Time calculations are provided in Appendix A.

Hydrologic Results:

Table 1: Sub-Basin Parameters Summary

Sub-basin	A (mi^2)	Length (ft)	Tc (hrs)	Lag Time (mins)	CN	I_A (inches)	Impervious Area (%)
W570	0.015	1,482	0.195	7.02	80	0.350	10%
W580	0.070	2,248	0.114	4.10	81	0.350	3%
W590	0.350	7,665	0.452	16.27	84	0.350	5%
W600	0.096	3,398	0.387	13.93	77	0.350	45%
W650	0.328	7,168	0.362	13.03	70	0.350	10%
W770	1.229	3,383	0.372	13.39	78	0.350	10%
W780	0.111	4,440	0.356	12.82	75	0.350	20%
W790	0.003	300	0.037	1.33	72	0.350	30%
W860	0.799	10,676	0.440	15.84	78	0.350	5%
W980	0.468	6,458	0.445	16.02	83	0.350	1%
W990	0.756	8,650	0.583	20.99	82	0.350	2%
W1700	0.006	693	0.090	3.24	88	0.273	80%
W1780	0.038	4,364	0.159	5.72	73	0.350	25%
W1810	0.257	3,229	0.189	6.80	77	0.350	60%

Table 1 summarizes the sub-basin parameters used for the watershed area that were input into the HEC HMS model. The details of the hydrologic calculations for each of sub-basins are attached in Attachment A. Tables 2a through 2b summarize the HEC HMS summary table with the peak discharge from the sub-basins and concentration points.

Table 2a: 100-year; 24-hour HEC HMS Summary

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time to Peak
W990	0.756	292.7	01Jan2050, 00:42
REACH W980	0.756	292.3	01Jan2050, 00:49
W980	0.468	206.4	01Jan2050, 00:36
JUNCTION 1B	1.224	462.6	01Jan2050, 00:45
REACH W780	1.224	462.3	01Jan2050, 00:49
W780	0.111	65.9	01Jan2050, 00:26
JUNCTION 1C	1.335	496.6	01Jan2050, 00:48
W860	0.799	318	01Jan2050, 00:35
REACH W770	0.799	317.5	01Jan2050, 00:50
W770	1.229	591.4	01Jan2050, 00:29
JUNCTION 1A	3.363	1209.4	01Jan2050, 00:44
REACH W790	3.363	1209.4	01Jan2050, 00:45
W790	0.003	3.5	01Jan2050, 00:15
JUNCTION 1D	3.366	1210.1	01Jan2050, 00:45
REACH W650	3.366	1209.5	01Jan2050, 00:47
W650	0.328	129.6	01Jan2050, 00:28
JUNCTION 1E	3.694	1293.4	01Jan2050, 00:46
REACH W1810A	3.694	1292.8	01Jan2050, 00:47
W580	0.07	49.7	01Jan2050, 00:17
REACH W1810B	0.07	49.1	01Jan2050, 00:20
JUNCTION 1EA	3.764	1309	01Jan2050, 00:47
REACH W1810C	3.764	1307.9	01Jan2050, 00:48
W1810	0.257	403.1	01Jan2050, 00:18
JUNCTION 1F	4.021	1396.6	01Jan2050, 00:48
W590	0.35	173.7	01Jan2050, 00:35
REACH W570	0.35	86.1	01Jan2050, 01:14
XTO Pond	0.35	86.1	01Jan2050, 01:12
W570	0.015	10	01Jan2050, 00:20
JUNCTION 1FA	4.386	1468.6	01Jan2050, 00:49
REACH W600	4.386	1467.7	01Jan2050, 00:50
W600	0.096	92.3	01Jan2050, 00:25
JUNCTION 1G	4.482	1509.8	01Jan2050, 00:49
REACH W1700	4.482	1508.6	01Jan2050, 00:50
W1700	0.006	13.5	01Jan2050, 00:15
JUNCTION 1H	4.488	1511	01Jan2050, 00:50
REACH W1780	4.488	1508.4	01Jan2050, 00:55
W1780	0.038	33.6	01Jan2050, 00:18
JUNCTION 1I	4.526	1517.4	01Jan2050, 00:55

Table 2b: 25-year; 24-hour HEC HMS Summary

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time to Peak
W990	0.756	149.8	01Jan2050, 00:43
REACH W980	0.756	149.6	01Jan2050, 00:52
W980	0.468	104.3	01Jan2050, 00:38
JUNCTION 1B	1.224	235.8	01Jan2050, 00:49
REACH W780	1.224	235.7	01Jan2050, 00:54
W780	0.111	40.9	01Jan2050, 00:25
JUNCTION 1C	1.335	254.7	01Jan2050, 00:53
W860	0.799	166.4	01Jan2050, 00:36
REACH W770	0.799	166	01Jan2050, 00:55
W770	1.229	326.3	01Jan2050, 00:29
JUNCTION 1A	3.363	618.9	01Jan2050, 00:50
REACH W790	3.363	618.8	01Jan2050, 00:50
W790	0.003	2.3	01Jan2050, 00:15
JUNCTION 1D	3.366	619.3	01Jan2050, 00:50
REACH W650	3.366	619.1	01Jan2050, 00:53
W650	0.328	73.5	01Jan2050, 00:28
JUNCTION 1E	3.694	660.4	01Jan2050, 00:53
REACH W1810A	3.694	660.4	01Jan2050, 00:53
W580	0.07	24	01Jan2050, 00:18
REACH W1810B	0.07	23.8	01Jan2050, 00:21
JUNCTION 1EA	3.764	670.1	01Jan2050, 00:53
REACH W1810C	3.764	669.8	01Jan2050, 00:55
W1810	0.257	286.4	01Jan2050, 00:18
JUNCTION 1F	4.021	730	01Jan2050, 00:55
W590	0.35	91.8	01Jan2050, 00:37
REACH W570	0.35	50.3	01Jan2050, 01:16
XTO Pond	0.35	50.3	01Jan2050, 01:13
W570	0.015	5.4	01Jan2050, 00:20
JUNCTION 1FA	4.386	778.3	01Jan2050, 00:56
REACH W600	4.386	778.1	01Jan2050, 00:57
W600	0.096	63.8	01Jan2050, 00:25
JUNCTION 1G	4.482	801.6	01Jan2050, 00:56
REACH W1700	4.482	801.2	01Jan2050, 00:57
W1700	0.006	9.8	01Jan2050, 00:15
JUNCTION 1H	4.488	802.9	01Jan2050, 00:57
REACH W1780	4.488	802.3	01Jan2050, 01:03
W1780	0.038	21.4	01Jan2050, 00:18
JUNCTION 1I	4.526	807.9	01Jan2050, 01:03

AECOM

Calculation Sheet

Project Name:	Kokopelli Alternatives			**Calculation Number:**	2A
Client Name:	City of Aztec, New Mexico			**Revision Number:**	1
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	PDC / 8-8-2016
	60487360	30000	N/A		
Title:	Hydrologic Analysis Using HEC-HMS				

AECOM prepared a hydrologic analysis to estimate the impact of adding the XTO Pond to the storm water runoff and peak discharge for the Hampton arroyo. The effects of the XTO Pond are observed in the peak discharge of Reach W570, which is immediately downstream from the XTO Pond. In the existing model for the 100-yr;24-hr storm event, Reach W570 shows a peak discharge of 173.7 cfs. With the addition of the XTO Pond, the model indicates a reduction to 86.1 cfs which is equal to about 50% of the existing peak discharge. In the existing model for the 25-yr;24-hr storm event, Reach W570 shows a peak discharge of 91.8 cfs. With the addition of the XTO Pond, the model indicates a reduction to 50.3 cfs which is equal to about 55% of the existing peak discharge.

REFERENCES:

United State Army Corps of Engineers (USACE), 2015. Hydraulic Engineering Center Hydrologic Modeling System (HEC-HMS) [software package]. Version 4.1 July 2015.

United States Department of Commerce, National Oceanic and Atmospheric Administration, *NOAA Atlas 14, Volume 1, Version 5*, 2009.

United States Department of Agriculture, Natural Resources Conservation Service, *Custom Soil Resource Report,* January 2016

United States Department of Agriculture, Soil Conservation Service, *Urban Hydrology for Small Watersheds*, June 1986.

Table 1: Sub-basin Inventory

Basin Name	Area (sq. ft)	Area (sq. Mi)	Impervious Area Estimated From Aerial (%)
W570	431,304.561	0.015	10%
W580	1,961,005.211	0.070	3%
W590	9,746,153.481	0.350	5%
W600	2,687,261.479	0.096	45%
W650	9,155,415.474	0.328	10%
W770	34,262,389.653	1.229	10%
W780	3,107,575.041	0.111	20%
W790	86,269.786	0.003	30%
W860	22,265,260.162	0.799	5%
W980	13,060,458.342	0.468	1%
W990	21,062,524.723	0.756	2%
W1700	165,546.014	0.006	80%
W1780	1,063,010.834	0.038	25%
W1810	7,176,971.733	0.257	60%

NOAA Atlas 14, Volume 1, Version 5
Location name: Aztec, New Mexico, US*
Latitude: 36.8202°, Longitude: -107.9537°
Elevation: 5902 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF tabular | PF graphical | Maps & aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.151 (0.129-0.176)	0.194 (0.167-0.226)	0.261 (0.225-0.303)	0.316 (0.271-0.368)	0.395 (0.336-0.459)	0.460 (0.388-0.534)	0.530 (0.442-0.616)	0.606 (0.498-0.706)	0.714 (0.574-0.835)	0.804 (0.637-0.944)
10-min	0.229 (0.197-0.267)	0.295 (0.255-0.343)	0.397 (0.342-0.461)	0.481 (0.413-0.560)	0.601 (0.512-0.699)	0.701 (0.590-0.813)	0.807 (0.673-0.938)	0.923 (0.758-1.07)	1.09 (0.874-1.27)	1.22 (0.969-1.44)
15-min	0.284 (0.244-0.331)	0.366 (0.316-0.426)	0.493 (0.424-0.572)	0.596 (0.512-0.694)	0.745 (0.634-0.866)	0.869 (0.731-1.01)	1.00 (0.833-1.16)	1.14 (0.940-1.33)	1.35 (1.08-1.58)	1.52 (1.20-1.78)
30-min	0.383 (0.329-0.446)	0.493 (0.425-0.573)	0.663 (0.570-0.770)	0.803 (0.689-0.934)	1.00 (0.854-1.17)	1.17 (0.985-1.36)	1.35 (1.12-1.57)	1.54 (1.27-1.79)	1.82 (1.46-2.12)	2.04 (1.62-2.40)
60-min	0.474 (0.407-0.552)	0.610 (0.526-0.709)	0.821 (0.706-0.953)	0.994 (0.853-1.16)	1.24 (1.06-1.44)	1.45 (1.22-1.68)	1.67 (1.39-1.94)	1.91 (1.57-2.22)	2.25 (1.81-2.63)	2.53 (2.00-2.97)
2-hr	0.548 (0.480-0.636)	0.697 (0.610-0.809)	0.924 (0.809-1.07)	1.11 (0.971-1.29)	1.39 (1.20-1.60)	1.62 (1.38-1.86)	1.87 (1.57-2.15)	2.14 (1.77-2.47)	2.53 (2.06-2.94)	2.86 (2.28-3.34)
3-hr	0.597 (0.528-0.681)	0.752 (0.663-0.860)	0.974 (0.862-1.11)	1.16 (1.02-1.32)	1.43 (1.25-1.62)	1.65 (1.43-1.88)	1.90 (1.61-2.16)	2.16 (1.81-2.47)	2.55 (2.09-2.97)	2.87 (2.31-3.37)
6-hr	0.718 (0.647-0.806)	0.892 (0.805-1.00)	1.12 (1.01-1.26)	1.32 (1.18-1.48)	1.60 (1.42-1.79)	1.83 (1.61-2.05)	2.08 (1.81-2.33)	2.35 (2.01-2.64)	2.74 (2.29-3.10)	3.06 (2.51-3.48)
12-hr	0.860 (0.779-0.952)	1.07 (0.967-1.18)	1.32 (1.19-1.46)	1.53 (1.37-1.68)	1.81 (1.62-1.99)	2.03 (1.81-2.24)	2.26 (1.99-2.49)	2.50 (2.18-2.77)	2.83 (2.43-3.16)	3.12 (2.64-3.50)
24-hr	0.972 (0.895-1.06)	1.22 (1.12-1.32)	1.54 (1.42-1.67)	1.81 (1.66-1.95)	2.17 (1.97-2.35)	2.46 (2.23-2.66)	2.76 (2.49-2.99)	3.07 (2.75-3.34)	3.51 (3.11-3.82)	3.86 (3.38-4.21)
2-day	1.14 (1.05-1.23)	1.42 (1.31-1.54)	1.79 (1.65-1.93)	2.08 (1.92-2.25)	2.48 (2.28-2.68)	2.80 (2.56-3.03)	3.14 (2.84-3.39)	3.48 (3.13-3.78)	3.95 (3.52-4.31)	4.33 (3.82-4.73)
3-day	1.23 (1.13-1.33)	1.53 (1.42-1.66)	1.92 (1.78-2.08)	2.23 (2.06-2.41)	2.65 (2.44-2.87)	2.99 (2.74-3.23)	3.33 (3.03-3.61)	3.68 (3.33-4.00)	4.17 (3.73-4.54)	4.54 (4.03-4.97)
4-day	1.32 (1.22-1.42)	1.65 (1.53-1.78)	2.05 (1.91-2.22)	2.38 (2.20-2.57)	2.82 (2.60-3.05)	3.17 (2.91-3.43)	3.53 (3.22-3.82)	3.88 (3.53-4.22)	4.38 (3.94-4.77)	4.76 (4.25-5.20)
7-day	1.52 (1.41-1.65)	1.91 (1.76-2.06)	2.37 (2.19-2.57)	2.75 (2.53-2.97)	3.25 (2.98-3.51)	3.63 (3.32-3.92)	4.02 (3.66-4.35)	4.42 (4.00-4.79)	4.95 (4.44-5.38)	5.37 (4.77-5.85)
10-day	1.73 (1.60-1.88)	2.16 (2.00-2.34)	2.68 (2.48-2.92)	3.09 (2.85-3.36)	3.64 (3.35-3.95)	4.05 (3.71-4.40)	4.47 (4.08-4.86)	4.89 (4.45-5.33)	5.45 (4.92-5.96)	5.88 (5.27-6.45)
20-day	2.24 (2.07-2.43)	2.80 (2.58-3.04)	3.46 (3.19-3.76)	3.99 (3.67-4.33)	4.69 (4.29-5.09)	5.21 (4.76-5.67)	5.75 (5.22-6.26)	6.29 (5.69-6.86)	7.00 (6.28-7.67)	7.55 (6.73-8.29)
30-day	2.68 (2.48-2.91)	3.35 (3.09-3.64)	4.13 (3.81-4.49)	4.73 (4.35-5.15)	5.52 (5.06-6.00)	6.10 (5.58-6.65)	6.69 (6.08-7.30)	7.27 (6.58-7.95)	8.02 (7.20-8.80)	8.59 (7.67-9.44)
45-day	3.25 (3.01-3.52)	4.06 (3.76-4.40)	5.00 (4.62-5.42)	5.72 (5.28-6.21)	6.65 (6.11-7.22)	7.34 (6.72-7.99)	8.03 (7.30-8.74)	8.71 (7.87-9.51)	9.59 (8.61-10.5)	10.3 (9.15-11.3)
60-day	3.76 (3.47-4.08)	4.71 (4.35-5.11)	5.77 (5.32-6.27)	6.57 (6.04-7.14)	7.60 (6.96-8.26)	8.35 (7.63-9.09)	9.09 (8.28-9.90)	9.81 (8.89-10.7)	10.7 (9.67-11.8)	11.4 (10.2-12.5)

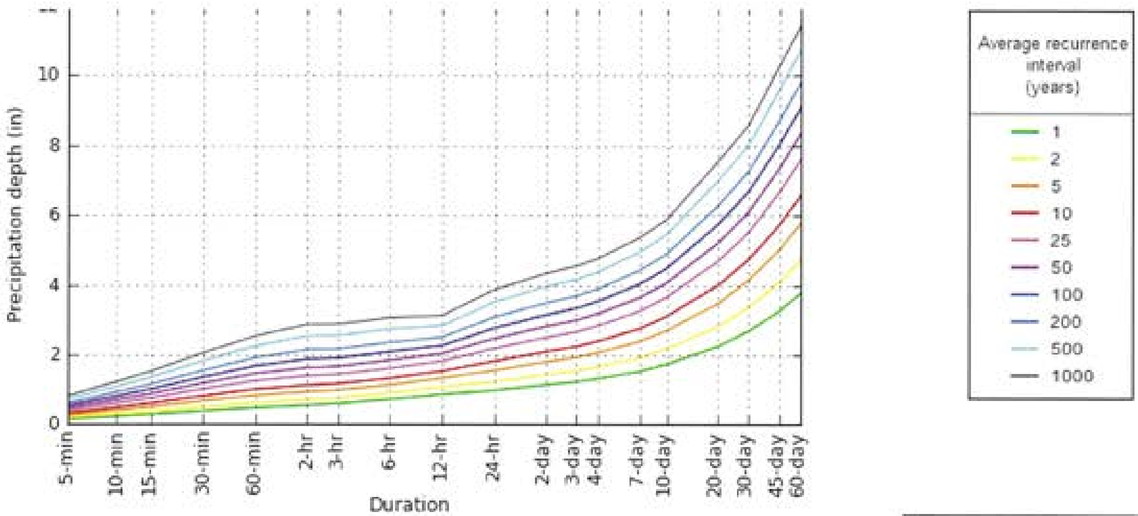
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

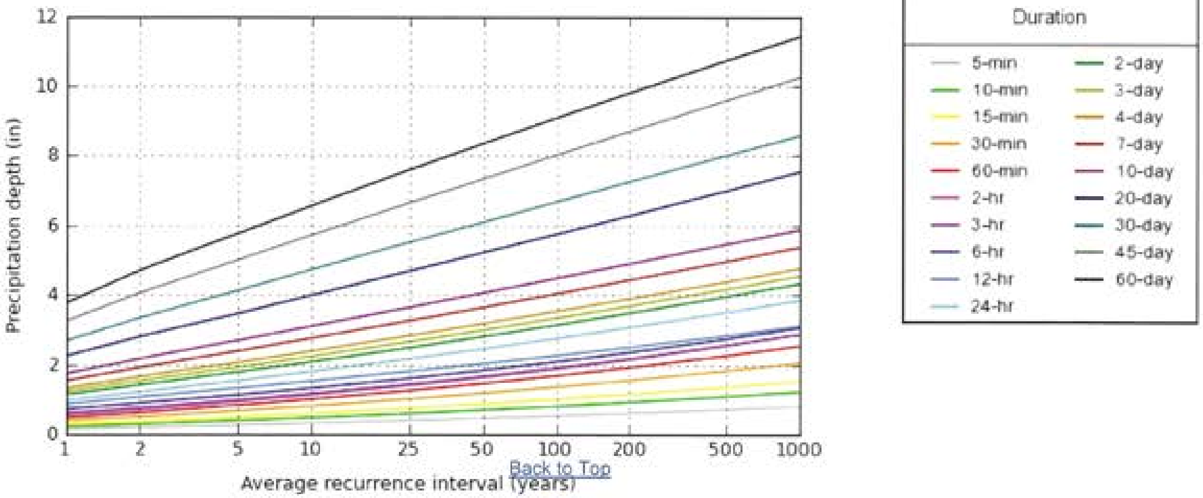
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical





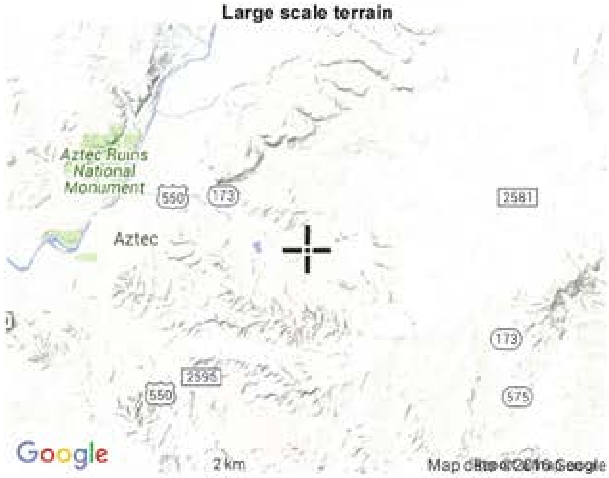
Back to Top

NOAA Atlas 14, Volume 1, Version 5 Created (GMT): Tue Mar 22 21:40:49 2016

Maps & aerials

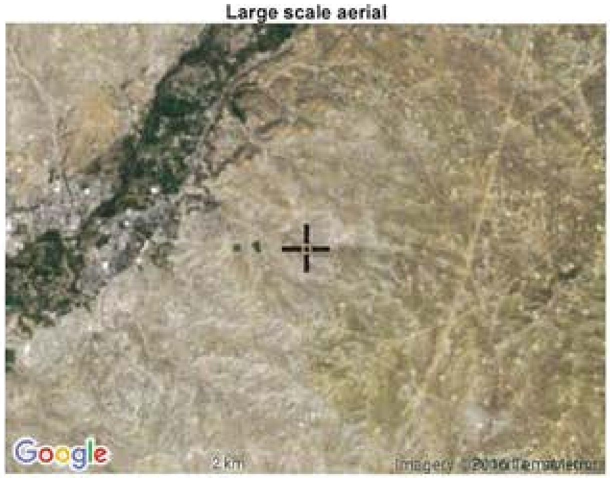
Small scale terrain

Large scale terrain



Large scale map

Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910

Questions?: HDSC.Questions@noaa.gov

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CITY OF AZTEC, NEW MEXICO
HAMPTON ARROYO WATERSHED
MODIFIED NOAA-SCS RAINFALL DISTRIBUTION

NOAA 14 Depth Duration Frequency Data [100-YEAR] [1] *:*

DURATION	[hours]	[inches][1]
0	0	0
5-min	0.0833	0.530
10-min	0.1667	0.807
15-min	0.2500	1.000
30-min	0.5000	1.350
	0.7500	1.510
1-hr	1.0000	1.670
	1.2500	1.720
	1.5000	1.770
	1.7500	1.820
2-hr	2.0000	1.870
	2.5000	1.885
3-hr	3.0000	1.900
	3.5000	1.930
	4.0000	1.960
	5.0000	2.020
6-hr	6.0000	2.080
	7.0000	2.110
	8.0000	2.140
	9.0000	2.170
	10.0000	2.200
	11.0000	2.230
12-hr	12.0000	2.260
	14.0000	2.343
	16.0000	2.427
	18.0000	2.510
	20.0000	2.593
	22.0000	2.677
24-hr	24.0000	2.760

Modified NOAA-SCS Rainfall Distribution [2] *:*

n	TIME [hours]	CUMULATIVE DEPTH [inches]	INCREMENTAL DEPTH [inches]	HYETOGRAPH TIME PERIOD (hrs)	n [REARRANGED]	INCREMENTAL DEPTH [inches]	CUMULATIVE DEPTH [inches]	CUMULATIVE DEPTH [%]
0	0	0		0.00 TO 1.00	19	0.03	0.03	0.011
1	0.25	1	1	1.00 TO 2.00	17	0.03	0.06	0.022
2	0.5	1.35	0.35	2.00 TO 3.00	15	0.03	0.09	0.033
3	0.75	1.51	0.16	3.00 TO 4.00	13	0.06	0.15	0.054
4	1	1.67	0.16	4.00 TO 4.50	11	0.03	0.18	0.065
5	1.25	1.72	0.05	4.50 TO 5.00	9	0.01	0.19	0.071
6	1.5	1.77	0.05	5.00 TO 5.25	7	0.05	0.24	0.089
7	1.75	1.82	0.05	5.25 TO 5.50	5	0.05	0.29	0.107
8	2	1.87	0.05	5.50 TO 5.75	3	0.16	0.45	0.165
9	2.5	1.885	0.015	5.75 TO 6.00	1	1.00	1.46	0.527
10	3	1.9	0.015	6.00 TO 6.25	2	0.35	1.81	0.654
11	3.5	1.93	0.03	6.25 TO 6.50	4	0.16	1.97	0.712
12	4	1.96	0.03	6.50 TO 6.75	6	0.05	2.02	0.730
13	5	2.02	0.06	6.75 TO 7.00	8	0.05	2.07	0.748
14	6	2.08	0.06	7.00 TO 7.50	10	0.01	2.08	0.754
15	7	2.11	0.03	7.50 TO 8.00	12	0.03	2.11	0.764
16	8	2.14	0.03	8.00 TO 9.00	14	0.06	2.17	0.786
17	9	2.17	0.03	9.00 TO 10.00	16	0.03	2.20	0.797
18	10	2.2	0.03	10.00 TO 11.00	18	0.03	2.23	0.808
19	11	2.23	0.03	11.00 TO 12.00	20	0.03	2.26	0.819
20	12	2.26	0.03	12.00 TO 14.00	21	0.08	2.34	0.849
21	14	2.343	0.083	14.00 TO 16.00	22	0.08	2.43	0.879
22	16	2.427	0.084	16.00 TO 18.00	23	0.08	2.51	0.909
23	18	2.51	0.083	18.00 TO 20.00	24	0.08	2.59	0.939
24	20	2.593	0.083	20.00 TO 22.00	25	0.08	2.68	0.970
25	22	2.677	0.084	22.00 TO 24.00	26	0.08	2.76	1.000
26	24	2.76	0.083					

Notes:

1. Precipitation depth, duration, frequency data based on NOAA Atlas 14 Online Precipitaiton Data Frequency Server.
2. Modified NOAA-SCS rainfall distribution developed based on procedures prescribed by New Mexico State Highway and Transportation Department's *Drainage Manual, Volume I*, 1995.
3. Rainfall data based on Hampton Arroyo watershed centroid located at Latitude 36.8202 °N Longitude 107.9537° W

NOAA 14 Depth Duration Frequency Data [25-YEAR] [1] *:*

DURATION	[hours]	[inches][3]
0	0	0
5-min	0.0833	0.395
10-min	0.1667	0.601
15-min	0.2500	0.745
30-min	0.5000	1.000
	0.7500	1.120
1-hr	1.0000	1.240
	1.2500	1.278
	1.5000	1.315
	1.7500	1.353
2-hr	2.0000	1.390
	2.5000	1.410
3-hr	3.0000	1.430
	3.5000	1.458
	4.0000	1.487
	5.0000	1.543
6-hr	6.0000	1.600
	7.0000	1.635
	8.0000	1.670
	9.0000	1.705
	10.0000	1.740
	11.0000	1.775
12-hr	12.0000	1.810
	14.0000	1.870
	16.0000	1.930
	18.0000	1.990
	20.0000	2.050
	22.0000	2.110
24-hr	24.0000	2.170

Modified NOAA-SCS Rainfall Distribution [2] *:*

n	TIME [hours]	CUMULATIVE DEPTH [inches]	INCREMENTAL DEPTH [inches]	HYETOGRAPH TIME PERIOD (hrs)			n [REARRANGED]	INCREMENTAL DEPTH [inches]	CUMULATIVE DEPTH [inches]	CUMULATIVE DEPTH [%]
0	0	0.000		0.00	TO	1.00	19	0.035	0.035	0.016
1	0.25	0.745	0.745	1.00	TO	2.00	17	0.035	0.070	0.032
2	0.5	1.000	0.255	2.00	TO	3.00	15	0.035	0.105	0.048
3	0.75	1.120	0.120	3.00	TO	4.00	13	0.057	0.162	0.075
4	1	1.240	0.120	4.00	TO	4.50	11	0.028	0.190	0.088
5	1.25	1.278	0.037	4.50	TO	5.00	9	0.020	0.210	0.097
6	1.5	1.315	0.038	5.00	TO	5.25	7	0.038	0.248	0.114
7	1.75	1.353	0.038	5.25	TO	5.50	5	0.037	0.285	0.131
8	2	1.390	0.037	5.50	TO	5.75	3	0.120	0.405	0.187
9	2.5	1.410	0.020	5.75	TO	6.00	1	0.745	1.150	0.530
10	3	1.430	0.020	6.00	TO	6.25	2	0.255	1.405	0.647
11	3.5	1.458	0.028	6.25	TO	6.50	4	0.120	1.525	0.703
12	4	1.487	0.028	6.50	TO	6.75	6	0.038	1.563	0.720
13	5	1.543	0.057	6.75	TO	7.00	8	0.037	1.600	0.737
14	6	1.600	0.057	7.00	TO	7.50	10	0.020	1.620	0.747
15	7	1.635	0.035	7.50	TO	8.00	12	0.028	1.648	0.760
16	8	1.670	0.035	8.00	TO	9.00	14	0.057	1.705	0.786
17	9	1.705	0.035	9.00	TO	10.00	16	0.035	1.740	0.802
18	10	1.740	0.035	10.00	TO	11.00	18	0.035	1.775	0.818
19	11	1.775	0.035	11.00	TO	12.00	20	0.035	1.810	0.834
20	12	1.810	0.035	12.00	TO	14.00	21	0.060	1.870	0.862
21	14	1.870	0.060	14.00	TO	16.00	22	0.060	1.930	0.889
22	16	1.930	0.060	16.00	TO	18.00	23	0.060	1.990	0.917
23	18	1.990	0.060	18.00	TO	20.00	24	0.060	2.050	0.945
24	20	2.050	0.060	20.00	TO	22.00	25	0.060	2.110	0.972
25	22	2.110	0.060	22.00	TO	24.00	26	0.060	2.170	1.000
26	24	2.170	0.060							

Notes:

1. Precipitation depth, duration, frequency data based on NOAA Atlas 14 Online Precipitation Data Frequency Server.
2. Modified NOAA-SCS rainfall distribution developed based on procedures prescribed by New Mexico State Highway and Transportation Department's *Drainage Manual, Volume I*, 1995.
3. Rainfall data based on Hampton Arroyo watershed centroid located at Latitude 36.8202° N Longitude 107.9537° W

Project	***Kokopelli***
Subject	**Detention Basin Calculations**
Designed by	**PDC**
Date	**6/29/2016**
Checked by	**TB**
Date	
Job No.	
Client Ref. No.	

Objective: to determine the storage-flow relationship for small detention basins

Detention Basin - Outlet #1

Drains in 2.49 hours

Outlet Diameter	3.00 ft	Outlet X-Sect Area	7.069 ft^2
Outlet Elevation	5743.48 ft	No. of Outlet Barrels	1
Overflow Weir Length	0 ft	Outlet Pipe Slope	0.0105 ft/ft

Elevation [ft]	Surface Storage Area [ft^2]	Surface Storage Area [acre]	Average Area [acre]	Δ Elev [ft]	Δ Vol [ac-ft]	Σ Vol [ac-ft]	Δ Time to Drain [hr]	*Q_{pipe} [cfs]	~~Q_{weir} [cfs]~~	Total Q_{out} [cfs]
5744	43,124	0.99				0		0	~~0~~	0
			1.02	1.0	1.02		1.19			
5745	45,302	1.04				1.02		20.65	~~0~~	20.65
			1.06	1.0	1.06		0.41			
5746	47,045	1.08				2.08		41.23	~~0~~	41.23
			1.11	1.0	1.11		0.28			
5747	49,223	1.13				3.18		55.06	~~0~~	55.06
			1.15	1.0	1.15		0.22			
5748	50,965	1.17				4.33		68.72	~~0~~	68.72
			1.20	1.0	1.20		0.21			
5749	53,143	1.22				5.53		88.48	~~0~~	88.48
			1.25	1.0	1.25		0.17			
5750	55,321	1.27				6.77		104.57	~~0~~	104.57
					~~*Overtopping*~~					
			~~1.27~~	~~1.0~~	~~1.27~~					
~~5751~~	~~55,321~~	~~1.27~~				~~8.04~~		~~83.51~~	~~#REF!~~	~~#REF!~~

Notes:

* Q_{pipe} was calculated using Flowmaster ®
Circular Pipe through elevation 5746. Pressure pipe flow from elevation 5747-5750.

Rating Table for Pressure Pipe - 1

Project Description

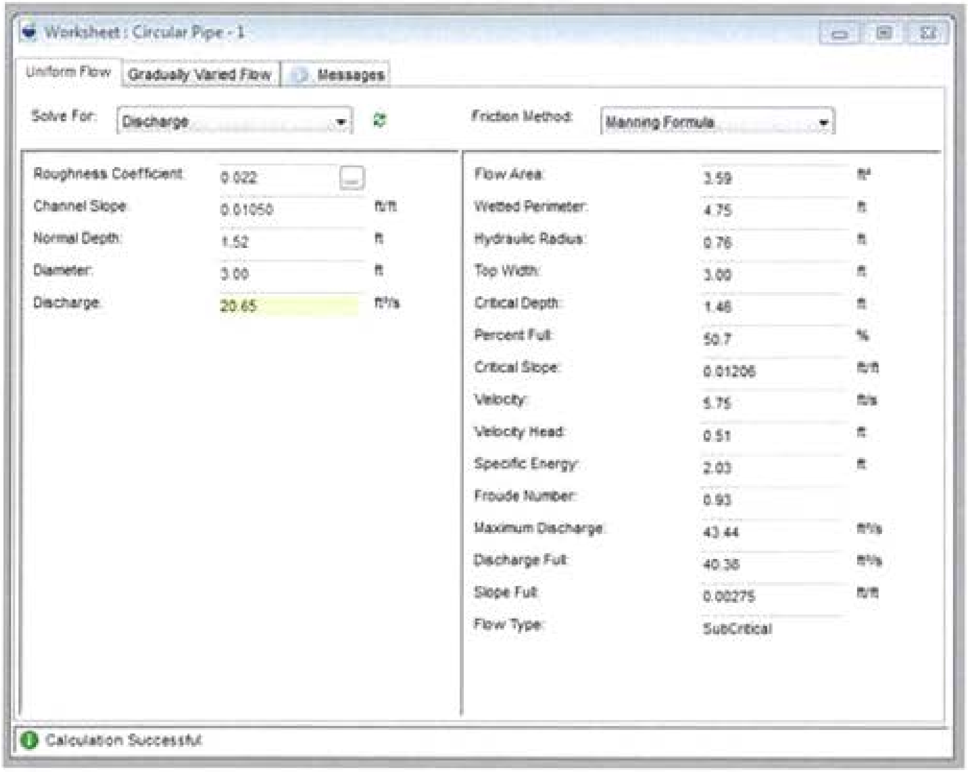
Friction Method	Manning Formula
Solve For	Discharge

Input Data

Pressure 1	3.52	feet H2O
Pressure 2	6.52	feet H2O
Elevation 1	5750.00	ft
Elevation 2	5743.48	ft
Length	50.00	ft
Roughness Coefficient	0.022	
Diameter	3.00	ft

Elevation at 1 (ft)	Discharge (ft^3/s)
5744.00	-87.77
5745.00	-67.80
5746.00	-38.61
5747.00	40.20
5748.00	68.72
5749.00	88.48
5750.00	104.57

The normal depth is the depth of the pond surface minus the outlet elevation so @ 5745-ft level, normal depth is 5745-5743.48 = 1.52. 1.52 normal depth in FlowMaster is 20.65 cfs.


Worksheet : Circular Pipe - 1

Uniform Flow | Gradually Varied Flow | Messages

Solve For: Discharge

Friction Method: Manning Formula

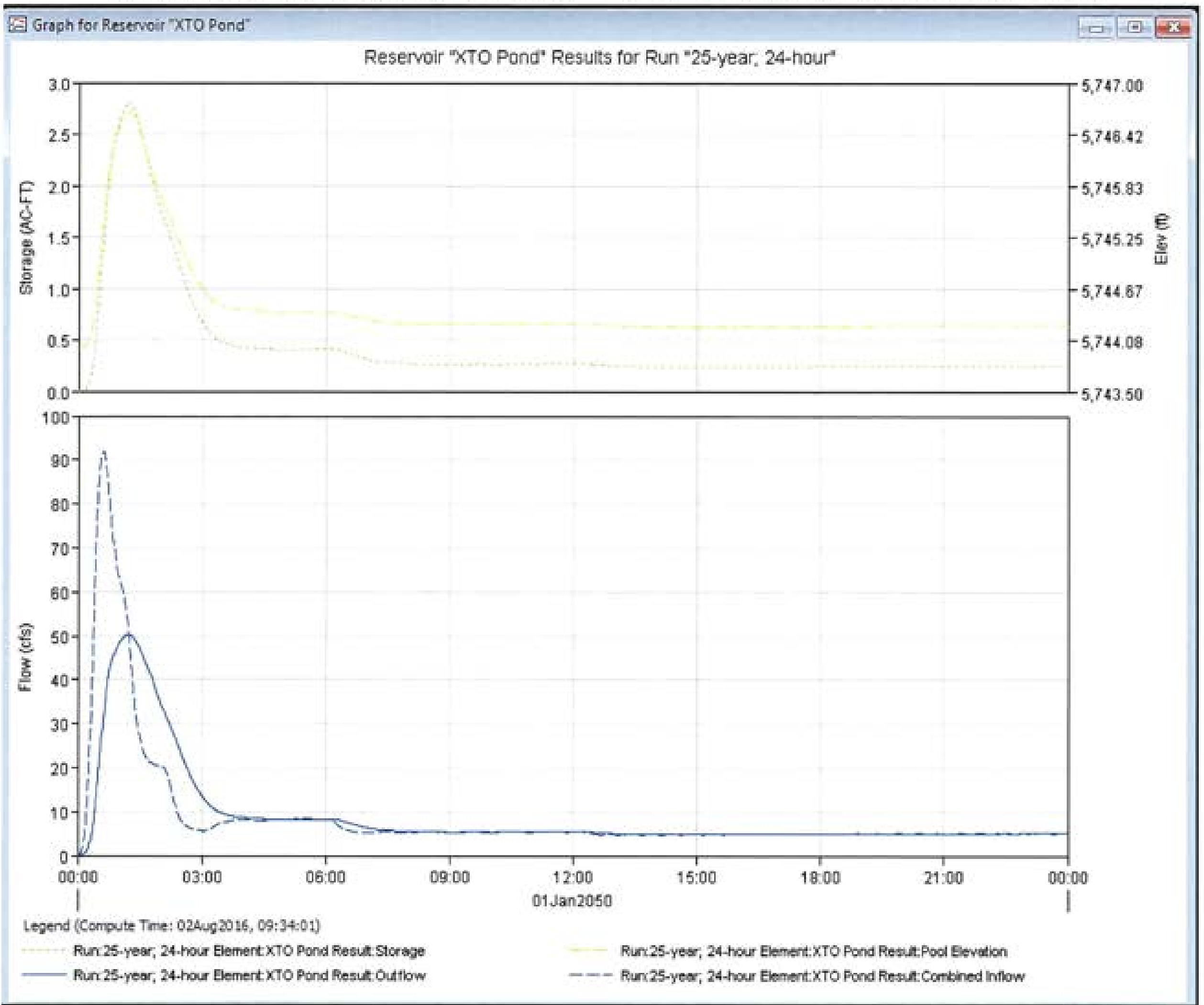
Roughness Coefficient:	0.022	
Channel Slope:	0.01050	ft/ft
Normal Depth:	1.52	ft
Diameter:	3.00	ft
Discharge:	20.65	ft³/s

Flow Area:	3.59	ft²
Wetted Perimeter:	4.75	ft
Hydraulic Radius:	0.76	ft
Top Width:	3.00	ft
Critical Depth:	1.46	ft
Percent Full:	50.7	%
Critical Slope:	0.01206	ft/ft
Velocity:	5.75	ft/s
Velocity Head:	0.51	ft
Specific Energy:	2.03	ft
Froude Number:	0.93	
Maximum Discharge:	43.44	ft³/s
Discharge Full:	40.38	ft³/s
Slope Full:	0.00275	ft/ft
Flow Type:	SubCritical	

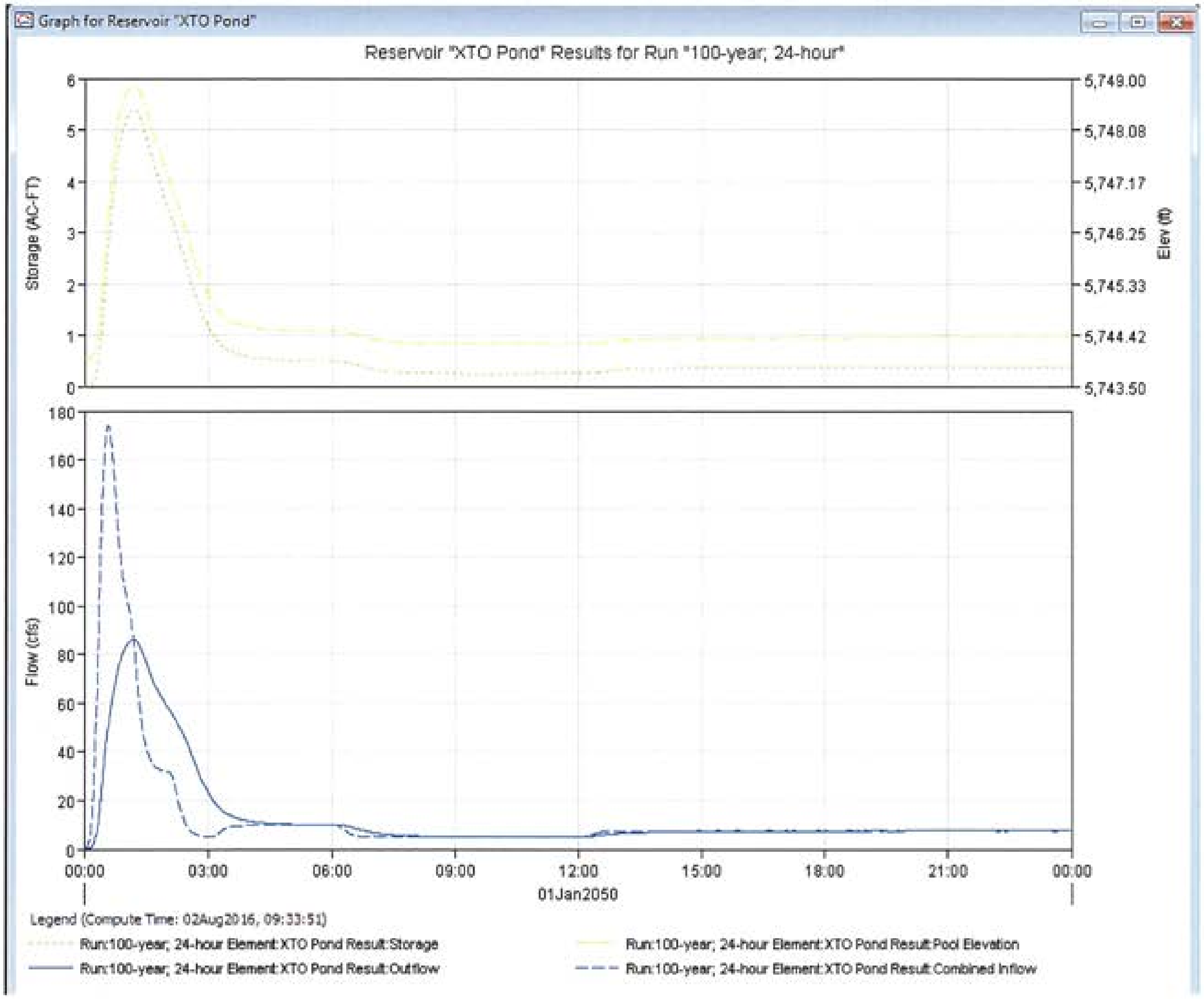
Calculation Successful

Inflow Hydrograph – HEC-HMS

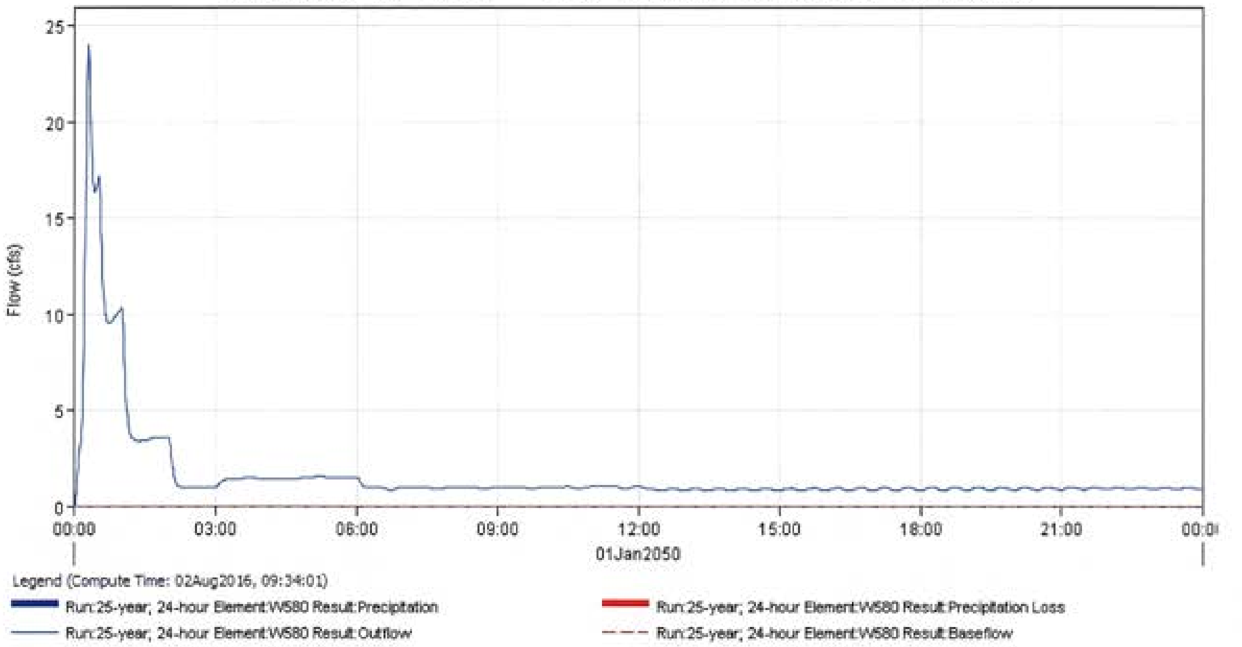
XTO Detention Basin – 25-Year Storm Event



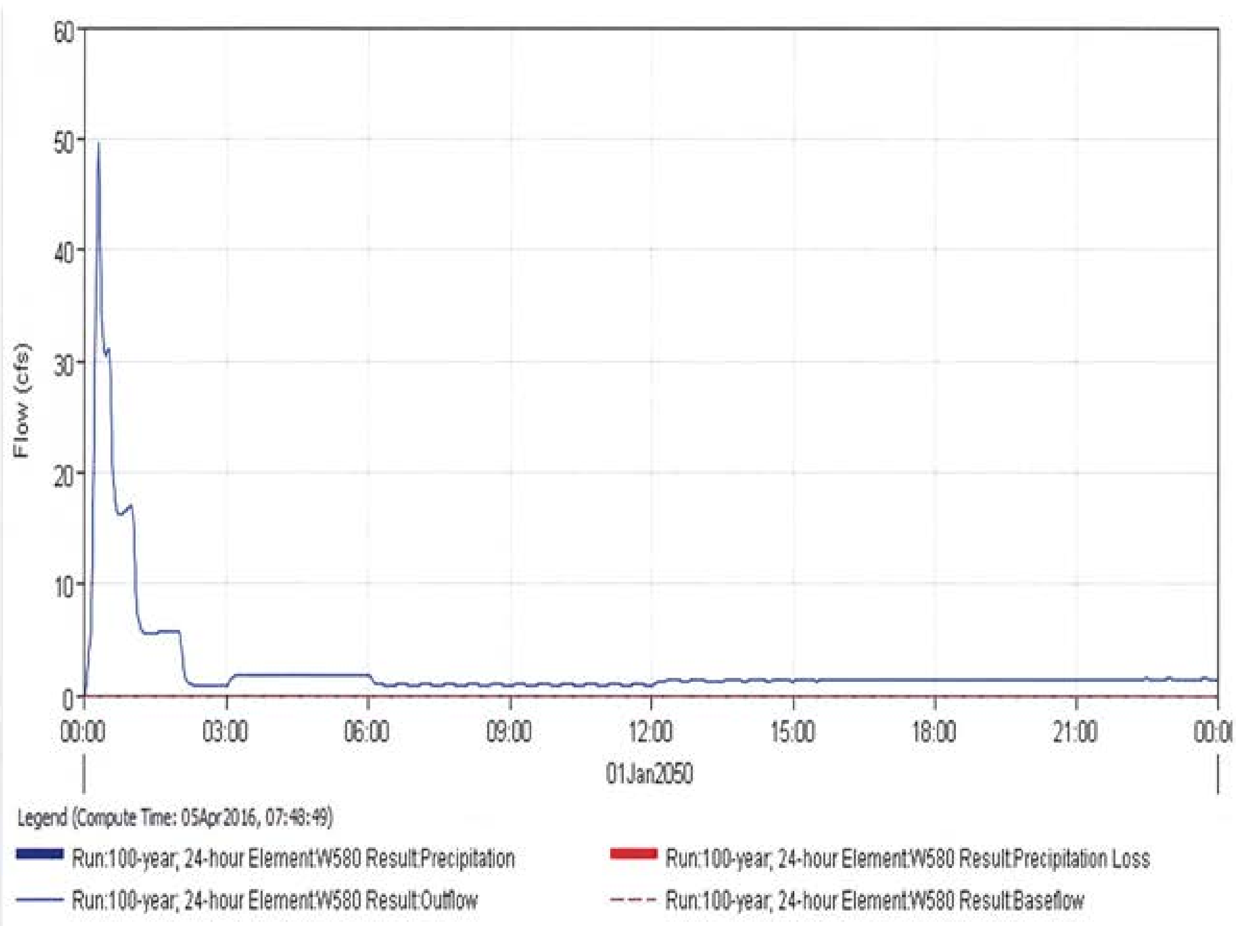
XTO Detention Basin – 100-Year Storm Event



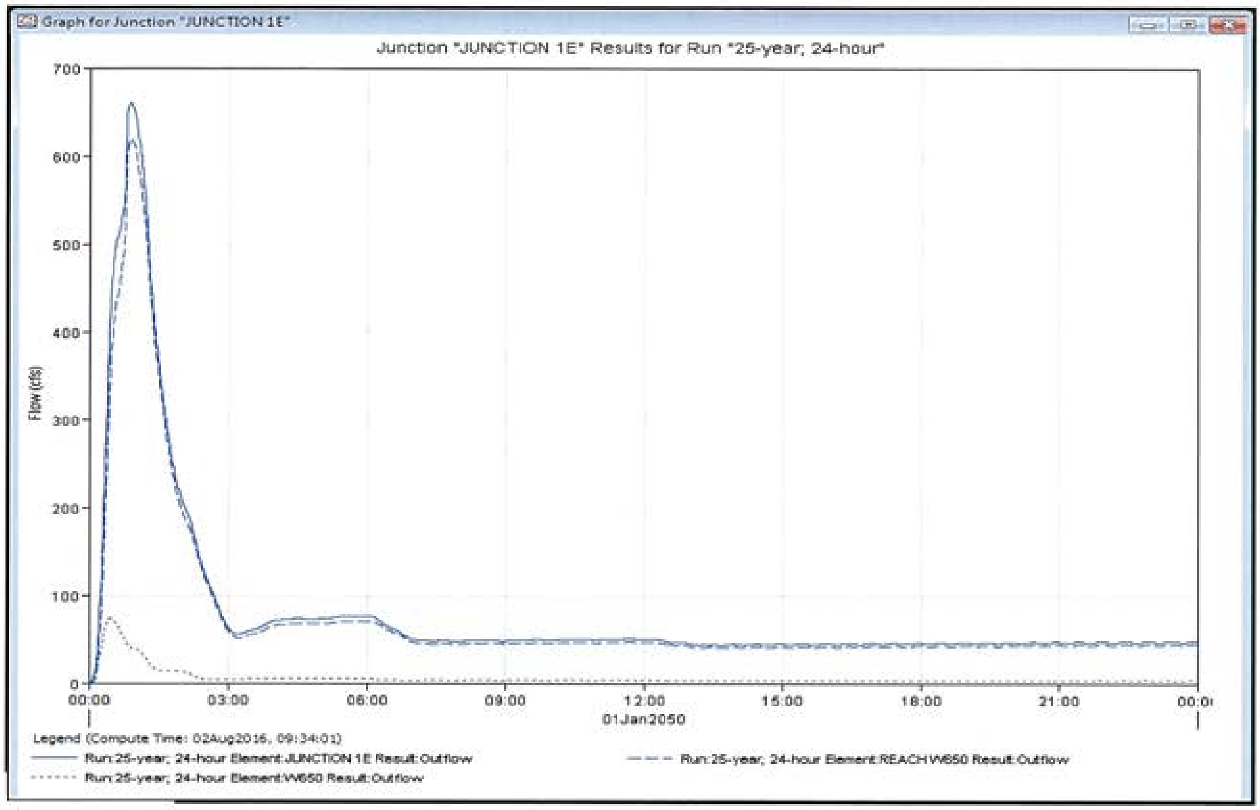
Node W580 - 25-Year Storm Event



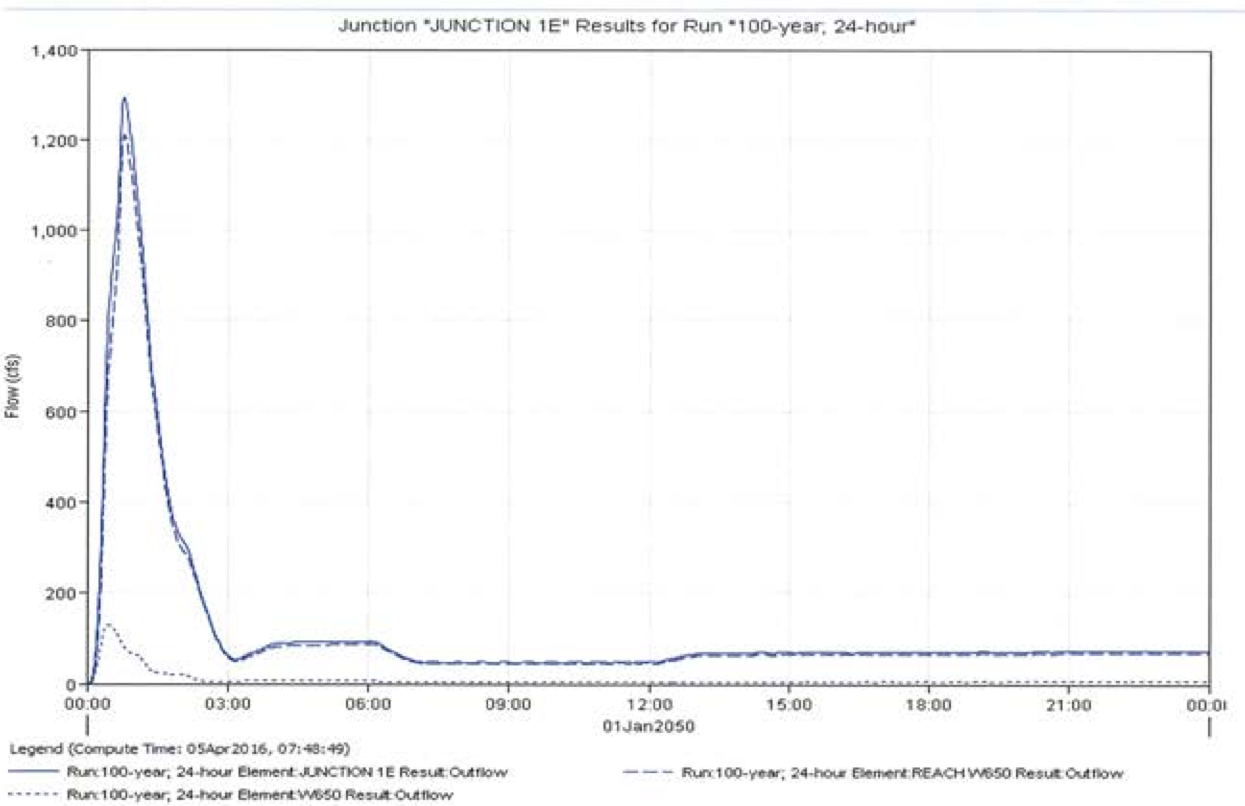
Node W580 - 100-Year Storm Event



Node 1E - 25-Year Storm Event



Node 1E - 100-Year Storm Event



Attachment D – Storm Drain Calculations

1. **Peak Flow Calculation for the Storm Drains – Rational Method**

2. **Storm Drain Model Calculation – StormCAD**

Table 3: Time of Concentration and Lag Time Calculations

Basin Name	Sheet Flow Distance (ft)	Upslope Elevation (ft)	Downslope Elevation (ft)	Slope	Shallow Concentrated Flow (ft)	Upslope Elevation (ft)	Downslope Elevation (ft)	Slope	Channelized Flow (ft)	Channel Width (ft)	Depth (ft)	Upslope Elevation (ft)	Downslope Elevation (ft)	Wetted Perimeter (ft)	Flow Area (ft^2)	Slope	Tc (hours)	Lag Time (mins)
W570	142.00	5,772.00	5,756.00	0.11	180.00	5,756.00	5,746.00	0.06	1,160.00	13.36	3.00	5,746.00	5,694.00	26.78	58.08	0.045	0.195	7.02
W580	245.00	5,916.00	5,896.00	0.08	386.00	5,896.00	5,848.00	0.12	1,617.00	21.54	1.00	5,848.00	5,764.00	26.01	23.54	0.052	0.114	4.10
W590	101.00	5,989.00	5,980.00	0.09	216.00	5,980.00	5,965.00	0.07	7,348.00	18.66	1.00	5,965.00	5,694.00	23.13	20.66	0.037	0.452	16.27
W600	180.00	5,858.00	5,840.00	0.10	3,062.00	5,840.00	5,700.00	0.05	156.00	10.26	5.00	5,700.00	5,697.00	32.62	101.30	0.019	0.387	13.93
W650	248.00	6,005.00	5,971.00	0.14	503.00	5,971.00	5,940.00	0.06	6,417.00	51.08	5.00	5,940.00	5,732.00	73.44	305.40	0.032	0.362	13.03
W770	265.00	6,300.00	6,260.00	0.15	1,920.00	6,260.00	6,137.00	0.06	1,198.00	56.97	3.00	6,137.00	5,796.00	70.39	188.91	0.285	0.372	13.39
W780	167.00	5,951.00	5,935.00	0.10	972.00	5,935.00	5,881.00	0.06	3,301.00	29.12	2.00	5,881.00	5,787.00	38.06	66.24	0.028	0.356	12.82
W790	99.00	5,796.00	5,792.00	0.04	172.00	5,792.00	5,781.00	0.06	29.00	86.82	3.00	5,781.00	5,778.00	100.23	278.45	0.103	0.037	1.33
W860	197.00	6,458.00	6,441.00	0.09	869.00	6,441.00	6,380.00	0.07	9,610.00	39.95	4.00	6,380.00	5,989.00	57.84	191.80	0.041	0.440	15.84
W980	162.00	6,156.00	6,150.00	0.04	1,457.00	6,150.00	5,995.00	0.11	4,839.00	36.28	3.00	5,995.00	5,839.00	49.70	126.84	0.032	0.445	16.02
W990	279.00	6,379.00	6,320.00	0.21	3,328.00	6,320.00	6,085.00	0.07	5,043.00	27.46	2.00	6,085.00	5,927.00	36.40	62.92	0.031	0.583	20.99
W1700	300.00	5,696.00	5,690.00	0.02	74.00	5,690.00	5,680.00	0.14	319.00	44.02	5.00	5,680.00	5,675.00	66.38	270.08	0.016	0.090	3.24
W1780	222.00	5,688.00	5,680.00	0.04	39.00	5,680.00	5,662.00	0.46	4,103.00	9.25	7.00	5,662.00	5,600.00	40.55	162.75	0.015	0.159	5.72
W1810	154.00	5,797.00	5,776.00	0.14	1,320.00	5,776.00	5,731.00	0.03	1,755.00	33.60	5.00	5,731.00	5,694.00	55.96	218.00	0.021	0.189	6.80

Table 2: Sub-basin Runoff Curve Numbers

Basin Name	Soil Type Group A			Soil Type Group B			Soil Type Group C			Soil Type Group D			Composite CN	I_a (inches)
	Cover Type	Percent within Subbasin	CN	Cover Type	Percent within Subbasin	CN	Cover Type	Percent within Subbasin	CN	Cover Type	Percent within Subbasin	CN		
W570	Urban District: Industrial	70%	81	Desert shrub	30%	77							80	0.500
W580	Streets and roads: Paved; open ditches	2%	83							Streets and roads: Paved; open ditches	2%	93	81	0.469
	Desert shrub	31%	63							Desert shrub	66%	88		
W590				Urban District: Industrial	1%	88				Residential: 1/3 acre	1%	86	84	0.381
				Desert shrub	44%	77				Desert shrub	54%	88		
W600	Open space: Cemetery Fair condition (30-70% vegetative cover)	15%	49	Residential: 1/4 acre	20%	75				Desert shrub	25%	88	77	0.597
	Residential: 1/4 acre	5%	61	Open space: Fair condition	10%	69				Residential: 1/4 acre	25%	87		
W650	Desert shrub	50%	63							Desert shrub	16%	88	70	0.857
	Open space: Cemetery Fair condition (30-70%)	17%	49							Urban Districts: Commercial and business	17%	95		
W770	Desert shrub	40%	63							Desert Scrub	60%	88	78	0.564
W780	Desert shrub	55%	63							Desert Scrub	45%	88	75	0.667
W790	Streets and roads: Paved; open ditches	35%	83										72	0.778
	Graded areas: Pervious; no vegetation	15%	77											
	Desert shrub	50%	63											
W860	Desert shrub	40%	63							Desert Scrub	60%	88	78	0.564
W980	Desert shrub	20%	63							Desert Scrub	80%	88	83	0.410
W990	Desert shrub	25%	63							Desert Scrub	75%	88	82	0.439
W1700				Urban District: Industrial	100%	88							88	0.273
W1780	Desert shrub	40%	63	Desert shrub	45%	77	Desert Shrub	5%	85				73	0.740
	Urban District: Industrial	5%	81	Urban District: Industrial	5%	88								
W1810	Residential: 1/4 acre	20%	61	Residential: 1/4 acre	5%	75				Residential: 1/4 acre	30%	87	77	0.597
	Desert shrub	20%	63							Desert scrub	25%	88		

Notes:

1. Initial abstraction is capped at 0.35 inches

AECOM

Calculation Sheet

Project Name:	Kokopelli Sub-division			**Calculation Number:**	0
Client Name:	City of Aztec, New Mexico			**Revision Number:**	0
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	TN-SC / 9-12-2016
	60487347	20000	N/A		
Title:	Preliminary Storm Drain Concept – Kokopelli Subdivision				

PROBLEM STATEMENT:

The purpose of this calculation package is to document the assumptions associated with a preliminary storm drain design concept intended to reduce storm water ponding at the intersection of French Drive and Anasazi Drive within the Kokopelli Subdivision. The storm drain concept is based on localized storm flows developed with the use of rational methodology as implemented by the New Mexico Department of Transportation, within the Kokopelli Sub-division.

REQUIRED DELIVERABLES:

- Preliminary storm drain design concept.
- The preliminary storm drain concept will be incorporated into a separate FLO-2D hydrologic and hydraulic model prepared as part of this project to identify decreases in ponding downstream of the intersection.

DATA /ASSUMPTIONS:

- Aerial survey and topography data was provided by the City of Aztec.
- Peak flows have been estimated based on rational method hydrology within the Kokopelli Subdivision.
- No detailed storm drain inlet calculations have been performed as part of this conceptual storm drain design.
- All storm drain facility lengths, alignments, manhole rim/invert elevations are approximate in nature and subject to change based on more detailed information.

METHODOLOGY:

- Rational method peak flows for the 25- and 100-year storm events were developed within the Kokopelli Subdivision based on procedures established by the *New Mexico State Highway and Transportation Department's Drainage Manual Volume 1, Hydrology, 1995*. Runoff coefficients of 0.95, 0.66, and 0.51 were used for roadway, moderately urban residential, and rural desert rangeland respectively for the purposes of this analysis. 25- and 100-year rainfall intensities of 3.606 and 4.842 inches respectively were based on a minimum time of concentration of 10-minutes.

Figure 1 – Contributing Storm Drain Watersheds

- Preliminary storm drain hydraulic models using Bentley's Storm CAD computer program, based on both pressurized and normal depth storm flow characteristics were used for purposes of these concepts.
- The preliminary storm drain layout at the French Drive and Anasazi Drive intersection was developed along an existing storm drain alignment within Spotted Wolf Avenue with outfall into the Hampton Arroyo. The layout was based on maintaining the existing curb opening catch basins located at the northeast corner of French Drive and Anasazi Drive.
- A series of conceptual storm drain inlets were located within French Drive and Anasazi Drive and modeled to capture approximately 25% of the estimated 100—year peak flow rates. These reduced flow rates are considered to represent approximate 2- to 5-year peak flows. Conceptual storm drain inlets are assumed to intercept 100% of the reduced flow rates.
- The standard method of head loss was used herein with coefficients of 1.0 at the storm drain inlets and 0.9 elsewhere for conservative estimates of head loss.
- Headwater depths were assumed to be at or below ground elevations.
- No coincident peak flows are assumed within the conceptual storm drain outfall or the Hampton Arroyo due to the size of the Arroyo watershed.

RESULTS:

Estimated 25- and 100-year peak flows are summarized in the following table. The hydrologic calculations are included in attachment.

BASIN ID	RUNOFF COEFFICIENT (C)	Rainfall Intensity (i) [inches/hour]		Area (A) [acres]	Peak Flow [ft^3/sec]	
		25-year	100-year		25-year	100-year
W_Anasazi_1	0.70	3.606	4.842	5.572	14	19
W_Anasazi_2	0.70	3.606	4.842	8.721	22	30
W_Anasazi_3	0.74	3.606	4.842	2.269	6	8
W_French	0.71	3.606	4.842	17.764	45	61
W_little_rabbit_1	0.63	3.606	4.842	35.01	80	107
W_little_rabbit_2	0.71	3.606	4.842	9.736	25	33

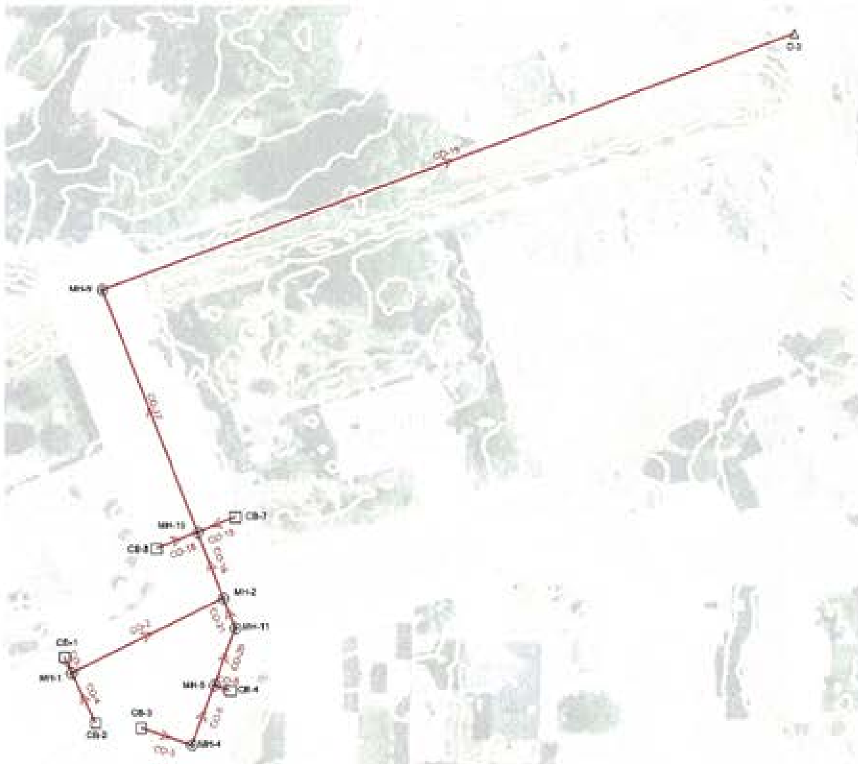
AECOM

Calculation Sheet

Project Name:	Kokopelli Sub-division			**Calculation Number:**	0
Client Name:	City of Aztec, New Mexico			**Revision Number:**	0
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	TN-SC / 9-12-2016
	60487347	20000	N/A		
Title:	Preliminary Storm Drain Concept – Kokopelli Subdivision				

The preliminary storm drain network concept is graphically illustrated on the following figure.

Figure 1 – Preliminary Storm Drain Hydraulic Model at French Dr. and Anasazi Dr. Intersection



A peak flow of approximately 100 cfs is assumed to be intercepted by the series of 6 storm drain inlets located near the intersection of French Drive and Anasazi Drive. The hydraulic grade lines and hydraulic analysis summary are graphically shown on the preliminary storm drain profiles attached.

AECOM

Calculation Sheet

Project Name:	Kokopelli Sub-division			**Calculation Number:**	0
Client Name:	City of Aztec, New Mexico			**Revision Number:**	0
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	TN-SC / 9-12-2016
	60487347	20000	N/A		
Title:	Preliminary Storm Drain Concept – Kokopelli Subdivision				

REFERENCES:

1. Bentley StormCAD V8i (Select Series 3), December 18, 2012.

2. United States Department of Commerce, National Oceanic and Atmospheric Administration, *NOAA Atlas 14, Volume 1, Version 5*, 2009.

3. New Mexico State Highway and Transportation Department, Drainage Manual Volume 1, Hydrology, December 1995.

Attachments

1. **Hydrologic Calculations**
2. **Preliminary Storm Drain Hydraulic Analysis**

Q=CIA

Basin ID	C	I		Area		Peak Flow -Q		Notes for field
		25-yr	100-yr	(ac)	(sq mi)	25-yr (cfs)	100-yr (cfs)	
W_Anasazi_1	0.70	3.606	4.842	5.572	0.00870625	14.14	18.98	
W_Anasazi_2	0.70	3.606	4.842	8.721	0.01362656	22.12	29.71	
W_Anasazi_3	0.74	3.606	4.842	2.269	0.00354531	6.04	8.11	
W_French	0.71	3.606	4.842	17.764	0.02775625	45.44	61.01	
W_little_rabbit_1	0.63	3.606	4.842	35.01	0.05470313	79.60	106.88	
W_little_rabbit_2	0.71	3.606	4.842	9.736	0.0152125	24.84	33.35	

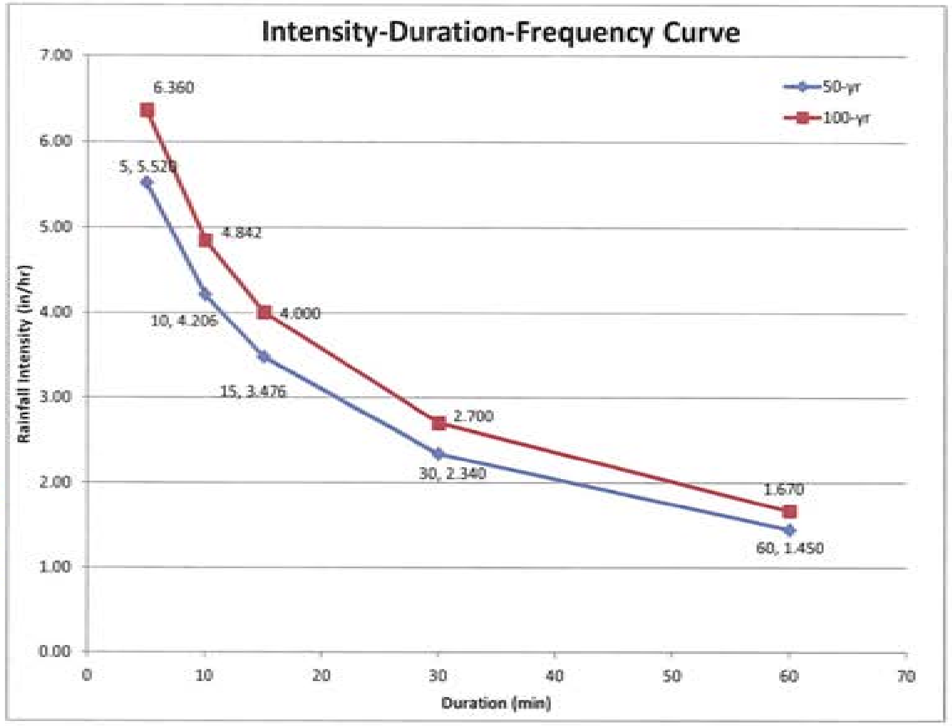
*Assuming a Tc of 10 mins

Basin ID	Land Use	% In Area	C	Land Use	% In Area	C	Land Use	% In Area	C	Land Use	% In Area	C	Composite C
W_Anasazi_1	Roadway	15%	0.95	Residential (Moderate Urban)	85%	0.66							0.7035
W_Anasazi_2	Roadway	15%	0.95	Residential (Moderate Urban)	85%	0.66							0.7035
W_Anasazi_3	Roadway	27%	0.95	Residential (Moderate Urban)	73%	0.66							0.7383
W_French	Roadway	17%	0.95	Residential (Moderate Urban)	83%	0.66							0.7093
W_little_rabbit_1	Roadway	10%	0.95	Residential (Moderate Urban)	51%	0.66	Desert Rangeland (rural)	39%	0.51				0.6305
W_little_rabbit_2	Roadway	20%	0.95	Residential (Moderate Urban)	73%	0.66	Desert Rangeland (rural)	7%	0.51				0.7075
Intensity, P1 (in/hr)= 1.67													

Depth-Duration-Frequency-DDF* (in)						
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-min	0.194	0.261	0.316	0.395	0.460	0.530
10-min	0.295	0.397	0.481	0.601	0.701	0.807
15-min	0.366	0.493	0.596	0.745	0.869	1.000
30-min	0.493	0.663	0.803	1.000	1.170	1.350
1-hr	0.610	0.821	0.994	1.240	1.450	1.670
2-hr	0.697	0.924	1.110	1.390	1.620	1.870
3-hr	0.752	0.974	1.160	1.430	1.650	1.900
6-hr	0.892	1.120	1.320	1.600	1.830	2.080
12-hr	1.070	1.320	1.530	1.810	2.030	2.260
24-hr	1.220	1.540	1.810	2.170	2.460	2.760

* From NOAA 14, Aztec, NM; Lat: 36.8202, Long:-107.9537 Ele: 5902 ft

	Intensity-Duration-Frequency-IDF* (in/hr)						
Duration		2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5	5-min	2.328	3.132	3.792	4.740	5.520	6.360
10	10-min	1.770	2.382	2.886	3.606	4.206	4.842
15	15-min	1.464	1.972	2.384	2.980	3.476	4.000
30	30-min	0.986	1.326	1.606	2.000	2.340	2.700
60	1-hr	0.610	0.821	0.994	1.240	1.450	1.670
	2-hr	0.349	0.462	0.555	0.695	0.810	0.935
	3-hr	0.251	0.325	0.387	0.477	0.550	0.633
	6-hr	0.149	0.187	0.220	0.267	0.305	0.347
	12-hr	0.089	0.110	0.128	0.151	0.169	0.188
	24-hr	0.051	0.064	0.075	0.090	0.103	0.115



Label	Start Node	Length (Unified) (ft)	Elevation Ground (Start) (ft)	Invert (Start) (ft)	Hydraulic Grade Line (In) (ft)	Stop Node	Elevation Ground (Stop) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Slope (Calculated) (ft/ft)	Section Type	Diameter (in)	Manning's n	Flow (cfs)	Flow / Capacity (Design) (%)	Velocity (ft/s)
CO-1	CB-1	19.9	5,737.00	5,733.00	5,734.50	MH-1	5,737.00	5,732.50	5,734.35	0.025	Circle	24	0.013	20	55.7	9.08
CO-2	MH-1	102.3	5,737.00	5,732.50	5,733.97	MH-2	5,736.00	5,731.20	5,733.88	0.013	Circle	30	0.013	50	108.1	7.98
CO-3	MH-2	40.4	5,736.00	5,730.50	5,733.44	CB-12	5,736.00	5,730.30	5,733.04	0.005	Circle	42	0.013	51	72.1	5.67
CO-4	CB-12	173.7	5,736.00	5,730.30	5,732.21	CB-2	5,739.00	5,729.90	5,731.26	0.002	Circle	42	0.013	52	107.7	7.72
CO-5	CB-2	201.1	5,739.00	5,729.90	5,734.84	O-1	5,742.00	5,729.00	5,734.81	0.004	Circle	42	0.013	10	14.9	9.33
CO-6	CB-4	22.7	5,737.00	5,733.00	5,734.42	MH-1	5,737.00	5,732.50	5,734.35	0.022	Circle	24	0.013	20	59.5	6.09
CO-10	MH-6	44.8	5,737.00	5,732.50	5,734.77	MH-2	5,736.00	5,732.30	5,734.76	0.004	Circle	30	0.013	10	36.5	10.8
CO-11	CB-9	15.1	5,737.00	5,733.00	5,734.80	MH-6	5,737.00	5,732.50	5,734.76	0.033	Circle	24	0.013	10	24.3	8.59
CO-12	CB-6	28.4	5,737.00	5,733.00	5,734.53	MH-6	5,737.00	5,732.50	5,734.55	0.018	Circle	24	0.013	5	16.7	5.03
CO-13	CB-10	29.4	5,737.50	5,733.50	5,734.45	MH-7	5,737.50	5,733.30	5,734.49	0.007	Circle	24	0.013	5	26.8	8.39
CO-14	MH-7	49.4	5,737.50	5,733.30	5,734.43	MH-8	5,736.50	5,731.90	5,734.42	0.028	Circle	24	0.013	10	26.3	2.04
CO-15	MH-8	24.1	5,736.50	5,731.40	5,734.36	MH-9	5,736.50	5,731.30	5,734.35	0.004	Circle	30	0.013	10	37.9	2.04
CO-16	MH-9	12.4	5,736.50	5,731.30	5,734.50	MH-2	5,736.00	5,731.20	5,734.49	0.008	Circle	30	0.013	5	13.6	1.59
CO-17	CB-11	10.7	5,736.50	5,732.00	5,734.81	MH-8	5,736.50	5,731.90	5,735.01	0.009	Circle	24	0.013	2.03	9.3	0

Appendix E – Recommended Alternative – 30% Design Plans

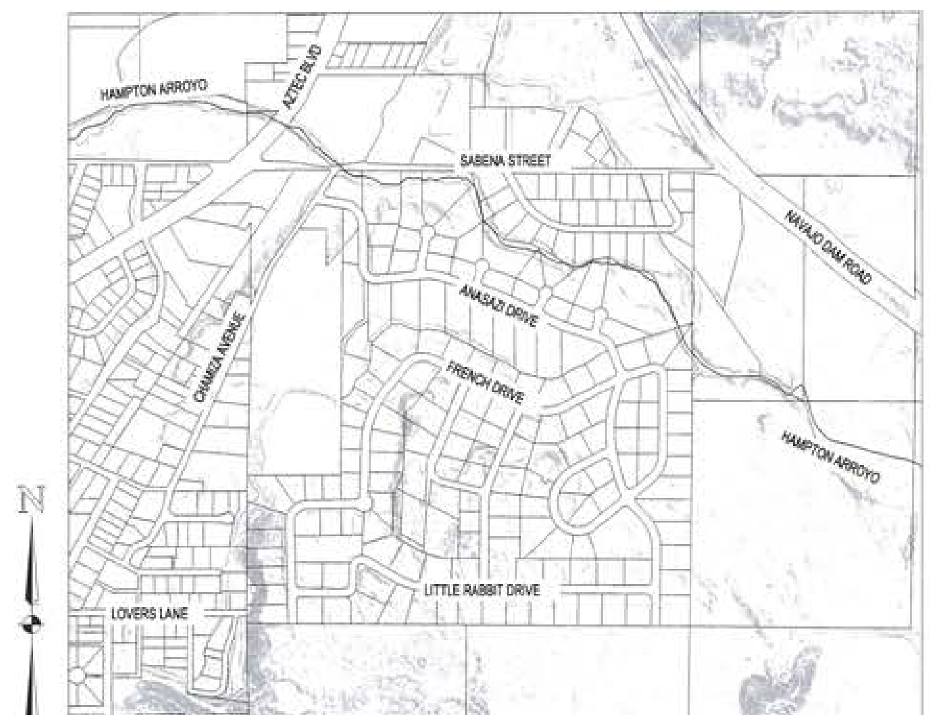
CITY OF AZTEC
KOKOPELLI SUB-DIVISION
PRELIMINARY 30% DRAINAGE IMPROVEMENT PLAN
AZTEC, NM 87410
SAN JUAN COUNTY

PREPARED FOR:

CITY OF AZTEC (OWNER)
610 WESTERN DRIVE.
AZTEC, NM 87410
PUBLIC WORKS DIRECTOR:
WILLIAM WATSON , PE, PTOE
PHONE: (505) 334-7660
EMAIL: WWATSON@AZTECNM.GOV

PREPARED BY:

AECOM
7720 NORTH 16TH STREET, SUITE 100
PHOENIX, AZ 85020
PHONE: (602)371-1100



PROJECT SITE MAP
SCALE: 1" = 500'

QUANTITIES SUMMARY		
ITEM	QTY.	UNIT
24" CMP	182	LF
30" CMP	353	LF
42" CMP	416	LF
36" CONCRETE PIPE	40	LF
CATCH BASIN	7	EA
MANHOLE	6	EA
PIPE HEADWALL	2	EA
EXCAVATION CHANNEL	53,000	CY
EXCAVATION SED BASIN	17,000	CY
DROP STRUCTURES	7	EA
RIPRAP	6,000	CY
FILTER FABRIC	13,000	SY

NOTE:
THESE IMPROVEMENT PLANS ARE A 30% SET OF PLANS AND ARE NOT TO BE USED AS THE BASIS FOR CONSTRUCTION OR AS A BASIS FOR MAJOR CAPITAL DECISIONS. PLEASE BE ADVISED THESE IMPROVEMENT PLANS ARE STILL UNDERGOING INTERNAL REVIEWS BY AECOM. YOUR COMMENTS, TOGETHER WITH THOSE OF AECOM WILL BE INCORPORATED INTO A FINAL DRAFT OF THIS DOCUMENT.

AECOM
7720 North 16th Street
Suite 100
Phoenix, AZ 85020
(602)371-1100 (phone)
(602)371-1615 (fax)

NO.	REVISIONS	BY	DATE

PREPARED FOR:

610 Western Drive
Aztec, NM 87410
(505) 334-7660

PRELIMINARY
NOT FOR CONSTRUCTION

PROJ. NO.:	60487347
DESIGNED BY:	LP
DRAWN BY:	LP
CHECKED BY:	MCM
DATE CREATED:	5/9/2017
PLOT DATE:	5/9/2017

CITY OF AZTEC
KOKOPELLI SUB-DIVISION
PRELIMINARY 30% DRAINAGE PLAN

COVER SHEET

SHEET: C-1

GENERAL NOTES:

1. GOVERNING SPECIFICATIONS FOR THIS PROJECT SHALL BE THE NEW MEXICO STATE DEPARTMENT OF TRANSPORTATION (NMDOT) STANDARD SPECIFICATIONS FOR HIGHWAY AND BRIDGE CONSTRUCTION, 2014 EDITION.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR PREPARING ROAD BASE MATERIAL CONSISTING OF EXISTING AND IMPORTED MATERIAL.
3. NEW ASPHALT PAVING SHALL BE 3 INCHES OF COMPACTED SUPERPAVE-IV (SP-IV). HOT MIX ASPHALT SHALL COMPLY W/NMDOT STANDARD FOR SP-IV.
4. CONTRACTOR SHALL SAW CUT, TACK AND MATCH EXISTING PAVEMENT..
5. IN AREAS ADJACENT TO THE EXISTING TRAVEL LANE, THE CONTRACTOR SHALL ASSURE THAT NO PAVEMENT DROP-OFFS ARE LEFT EXPOSED DURING NON-WORKING HOURS. THE CONTRACTOR SHALL INITIATE CORRECTIVE MEANS PER THE "NMDOT PAVEMENT DROP-OFF GUIDELINE" TO ACHIEVE A MINIMUM 3:1 SLOPE. THIS WORK SHALL BE INCIDENTAL TO PAVEMENT OPERATIONS ADJACENT TO EXISTING TRAVELED LANES.
6. THE CONTRACTOR SHALL PROVIDE INGRESS AND EGRESS TO LOCAL RESIDENCES FOR THE DURATION OF THE PROJECT. THE CONTRACTOR SHALL ADVISE PROPERTY OWNERS AND THE CITY ENGINEER OF ANY SCHEDULED ACCESS MODIFICATIONS AT LEAST 24 HOURS IN ADVANCE. THIS WORK SHALL BE CONSIDERED INCIDENTAL TO THE COMPLETION OF THE PROJECT AND NO SEPARATE MEASUREMENT OR PAYMENT SHALL BE MADE THEREFOR.
7. OVERNIGHT PARKING OF THE CONTRACTOR'S EQUIPMENT SHALL NOT OBSTRUCT DRIVEWAY OPENINGS OR DESIGNATED TRAFFIC LANES. THE CONTRACTOR IS ADVISED THE CITY IS NOT RESPONSIBLE FOR THEFT OR DAMAGE TO EQUIPMENT REMAINING ON-SITE DURING OR AFTER WORK HOURS. CONTRACTOR TAKES ALL RESPONSIBILITIES FOR EQUIPMENT LEFT ON-SITE.
8. THE CONTRACTOR SHALL NOTIFY ALL EMERGENCY PROVIDERS 24 HOURS BEFORE CONSTRUCTION ACTIVITIES BEGIN.
9. TRANSPORTING MATERIALS SHALL NOT BE MEASURED OR PAID SEPARATELY. THE COST OF MATERIAL TRANSPORTATION SHALL BE INCLUDED WITH THE ITEM HAULED.
10. THE CONTRACTOR WILL NOTIFY THE AZTEC PUBLIC WORKS DIRECTOR AT LEAST 48 HOURS PRIOR TO PAVING.
11. EMERGENCY ACCESS SHALL REMAIN OPEN AT ALL TIMES.
12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPORTING AND CLEAN UP OF SPILLS ASSOCIATED WITH PROJECT CONSTRUCTION AND SHALL REPORT AND RESPOND TO SPILLS OF HAZARDOUS MATERIAL SUCH AS GASOLINE, DIESEL, MOTOR OILS, SOLVENTS, SEWER CHEMICALS, TOXIC AND CORROSIVE SUBSTANCES, AND OTHER MATERIALS WHICH MAY BE A THREAT TO PUBLIC HEALTH OR THE ENVIRONMENT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPORTING PAST SPILLS ENCOUNTERED DURING CONSTRUCTION AND OF CURRENT SPILLS NOT ASSOCIATED WITH CONSTRUCTION. REPORTS SHALL BE MADE IMMEDIATELY TO THE NM ENVIRONMENT DEPARTMENT AT (505) 827-9329, (866) 428-6535.
13. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ALL CONFLICTS DURING CONSTRUCTION.
14. CONTRACTOR SHALL KEEP WORK SITE IN AN ORDERLY CONDITION. DURING CONSTRUCTION, AT COMPLETION OF WORK, CONTRACTOR SHALL REMOVE ALL DEBRIS AND LEAVE WORK SITE IN A CONDITION ACCEPTABLE TO THE CITY ENGINEER
15. THE CONTRACTOR IS RESPONSIBLE FOR REPORTING ANY DISCREPANCIES DISCOVERED IN THE PLANS AND/OR SPECIFICATIONS PROMPTLY TO THE CITY ENGINEER IN WRITING.
16. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING AND PROTECTING ALL UNDERGROUND, SURFACE AND AERIAL UTILITIES, CONSTRUCTIONS AND STRUCTURES WHETHER ON PUBLIC OR PRIVATE PROPERTY. DAMAGES THERETO BY THE CONTRACTOR SHALL BE REPLACED IN KIND OR BETTER AT NO EXPENSE TO THE PROJECT.
17. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL REMOVALS REQUIRED TO COMPLETE THIS PROJECT.
18. PAVEMENT MARKINGS ARE NOT REQUIRED FOR THIS PROJECT.

CONSTRUCTION TESTING:

1. THE PROJECT WILL HAVE VERIFICATION, AND DENSITY TESTS COMPLETED BY A GEOTECHNICAL ENGINEERING COMPANY TO VERIFY COMPACTION.
2. THE CITY WILL USE GEOMAT TO PROVIDE QUALITY ASSURANCE (QA) TESTING. THE CONTRACTOR SHALL COORDINATE WITH GEOMAT FOR REQUIRED TESTING. CONTRACTOR SHALL PROVIDE QUALITY CONTROL TESTING AS NECESSARY TO PROVIDE ACCEPTABLE WORK QUALITY THAT CONFORMS TO THE GOVERNING SPECIFICATIONS. NECESSARY RETESTING BY GEOMAT WILL BE CHARGED BACK TO THE CONTRACTOR. GEOMAT CONTACT PHONE – (505)327-7928.
3. ROAD BASE MATERIAL SHALL BE COMPACTED TO 95% OF MAXIMUM DENSITY PER NMDOT SPECIFICATIONS SECTION 203.3.8 "MOISTURE AND DENSITY CONTROL".
4. SP-IV ASPHALT SHALL BE COMPACTED TO A MEAN DENSITY OF 93% OF THE THEORETICAL MAXIMUM DENSITY, REFER TO NMDOT SPECIFICATION DIVISION 423.
5. ASPHALT MIX DESIGN SHALL BE PER NMDOT SP-IV DESIGN. ASPHALT MIX SHALL BE TESTED BY GEOMAT.
6. GRADATION OF PROPOSED IMPORTED ROADBASE MATERIAL SHALL BE SUBMITTED TO GEOMAT FOR APPROVAL PRIOR TO IMPORT. AND TO THE AZTEC PUBLIC WORKS DIRECTOR.
7. NO MATERIAL PITS HAVE BEEN DESIGNATED FOR THIS PROJECT. THE CONTRACTOR MAY OBTAIN SPECIFICATION BORROW AND SURFACING MATERIAL (SP-IV) FROM ANY ACCEPTABLE SOURCE. ALL MATERIAL SHALL BE GOVERNED BY APPROPRIATE SECTIONS OF THE NMDOT STANDARD.

TRAFFIC CONTROL:

1. ALL TRAFFIC CONTROL DEVICES SHALL COMPLY WITH NMDOT STANDARD SPECIFICATIONS FOR HIGHWAY AND BRIDGE CONSTRUCTION, 2014 EDITION AND THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES, LATEST EDITION (MUTCD).
2. ALL ROADS SHALL BE SERVICEABLE AND MAINTAINED FOR FIRE PROTECTION AND EMERGENCY VEHICLES DURING CONSTRUCTION.
3. THE CONTRACTOR SHALL PROVIDE REASONABLE ACCESS TO PROPERTY OWNERS AFFECTED BY THE CONSTRUCTION DURING THE PERIOD OF ROAD BASE ADJUSTMENT AND COMPACTION.
4. ALL AFFECTED RESIDENTS SHALL BE INFORMED OF THE ROAD CLOSURE AT LEAST 48 HOURS PRIOR TO CLOSURE. ACCESS TO RESIDENCIES SHALL NOT BE DENIED WITHOUT THE APPROVAL OF THE CITY ENGINEER.
5. TRAFFIC CONTROL PLANS MAY VARY AS FIELD CONDITIONS DICTATE. THE CONTRACTOR WILL BE PAID A LUMP SUM FOR PLACING, RELOCATING AND MAINTENANCE OF TRAFFIC CONTROL DEVICES THROUGHOUT THE LIFE OF THE PROJECT.
6. THE CONTRACTOR SHALL SUBMIT A TRAFFIC CONTROL PLAN PREPARED BY A CERTIFIED TRAFFIC CONTROL SUPERVISOR TO THE CITY ENGINEER FOR APPROVAL AT LEAST 7 DAYS PRIOR TO THE BEGINNING OF ANY WORK.
7. THE CONTRACTOR SHALL HAVE A RESPONSIBLE PERSON ON SITE DURING WORKING HOURS AND ON CALL DURING NON-WORKING HOURS TO INSPECT AND MAINTAIN PROJECT TRAFFIC CONTROL NEEDED OR AS DIRECTED BY THE CITY ENGINEER.
8. THE CONTRACTOR SHALL KEEP THE CITY ENGINEER AND RESIDENTS INFORMED OF ROAD AND ACCESS CLOSURES. NO MEASUREMENT OR PAYMENT WILL BE MADE FOR THESE ADVISORIES.
9. FLAGGING SHALL BE PROVIDED FOR SAFETY WHERE NEEDED AND REQUIRED BY THE MUTCD OR AS DIRECTED BY THE CITY ENGINEER. ALL FLAGGING OPERATIONS SHALL COMPLY WITH THE REQUIREMENTS OF THE MUTCD. FLAGGERS SHALL BE CONSIDERED INCIDENTAL TO PAYMENT FOR TRAFFIC CONTROL AND NO MEASUREMENT OR PAYMENT WILL BE MADE FOR THIS SERVICE.
10. TRAFFIC CONTROL DEVICES SHALL REMAIN IN OPERATION AT ALL TIMES DURING CONSTRUCTION.

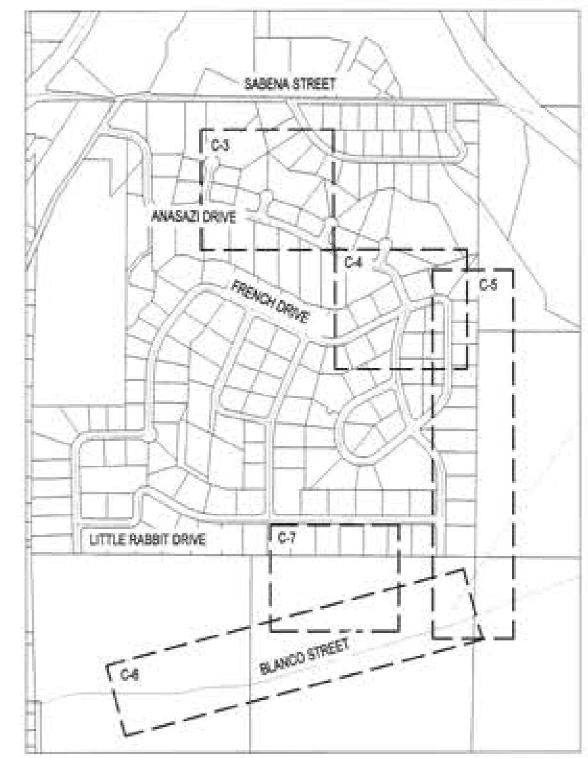
UTILITIES

1. THE EXISTENCE AND LOCATION OF UNDERGROUND UTILITY PIPES, CONDUITS AND STRUCTURES ARE WELL DOCUMENTED FROM A PREVIOUS UTILITY PROJECT. CONTRACTOR SHALL CONFIRM THE LOCATION OF ALL UTILITIES PRIOR TO START OF CONSTRUCTION AND SHALL TAKE PRECAUTIONARY MEASURES TO PROTECT ALL UTILITIES.
2. UTILITY CONFLICTS ARE NOT ANTICIPATED ON THIS PROJECT SINCE EXCAVATIONS WILL BE VERY LIMITED. IF UTILITIES ARE ENCOUNTERED, THE CONTRACTOR SHALL COORDINATE AND COOPERATE WITH ALL UTILITY COMPANIES AND THE CITY OF AZTEC WITH REGARDS TO RELOCATING, ADJUSTING, REPLACING, AND/OR REPAIRING UTILITIES DURING CONSTRUCTION.
3. THE CONTRACTOR SHALL BE RESTRICTED TO A 35-TON (MAXIMUM) NON-VIBRATORY ROLLER FOR COMPACTION IN AREAS WHERE THE USE OF HEAVIER EQUIPMENT COULD DAMAGE UNDERGROUND UTILITIES OR ADJACENT STRUCTURES.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ADJUSTING ANY EXISTING MANHOLES, VALVES, OR ANY OTHER UTILITY ITEMS TO GRADE PRIOR TO ACCEPTANCE OF THE IMPROVEMENTS BY THE CITY ENGINEER.

EROSION CONTROL & SWPPP

1. EROSION CONTROL WILL NOT BE REQUIRED FOR THIS PROJECT.
2. A STORM WATER PREVENTION PLAN WILL NOT BE REQUIRED FOR THIS PROJECT.

INDEX OF SHEETS



INDEX SHEET GRAPHIC (NTS)

AECOM
7720 North 16th Street
Suite 100
Phoenix, AZ 85020
(602)371-1100 (phone)
(602)371-1615 (fax)

NO	REVISIONS	BY	DATE

PREPARED FOR:

610 Western Drive
Aztec, NM 87410
(505) 334-7660

PRELIMINARY
NOT FOR
CONSTRUCTION

PROJ. NO.:	60487347
DESIGNED BY:	LP
DRAWN BY:	LP
CHECKED BY:	MCM
DATE CREATED:	11/22/2016
PLOT DATE:	5/9/2017

CITY OF AZTEC
KOKOPELLI SUB-DIVISION
PRELIMINARY 30% DRAINAGE PLAN

GENERAL NOTES

SHEET:
C-2

CONSTRUCTION NOTES

1. INSTALL CATCH BASIN PER CITY OF FARMINGTON STD DETAIL D-504.
2. REMOVE AND REPLACE EXISTING STORM DRAIN PIPE WITH NEW 30" Ø CMP STORM DRAIN (182 LF) AT INVERT ELEVATIONS SHOWN.
3. INSTALL OUTLET HEADWALL PER NMDOT STD DETAIL 511-03.
4. PROPOSED PIPE LOCATION IS PRELIMINARY IN NATURE. ACTUAL LOCATION OF EXISTING PIPE IS TO BE VERIFIED IN FIELD PRIOR TO START OF ANY CONSTRUCTION. NEW PIPE TO BE INSTALLED WITHIN EXISTING PIPE ALIGNMENT.

PROPOSED ANASAZI DR. DRAINAGE OUTFALL
PLAN VIEW

0 25 50 100
SCALE: 1" = 50'

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7720 North 16th Street
Suite 100
Phoenix, AZ 85020
(602)371-1100 (phone)
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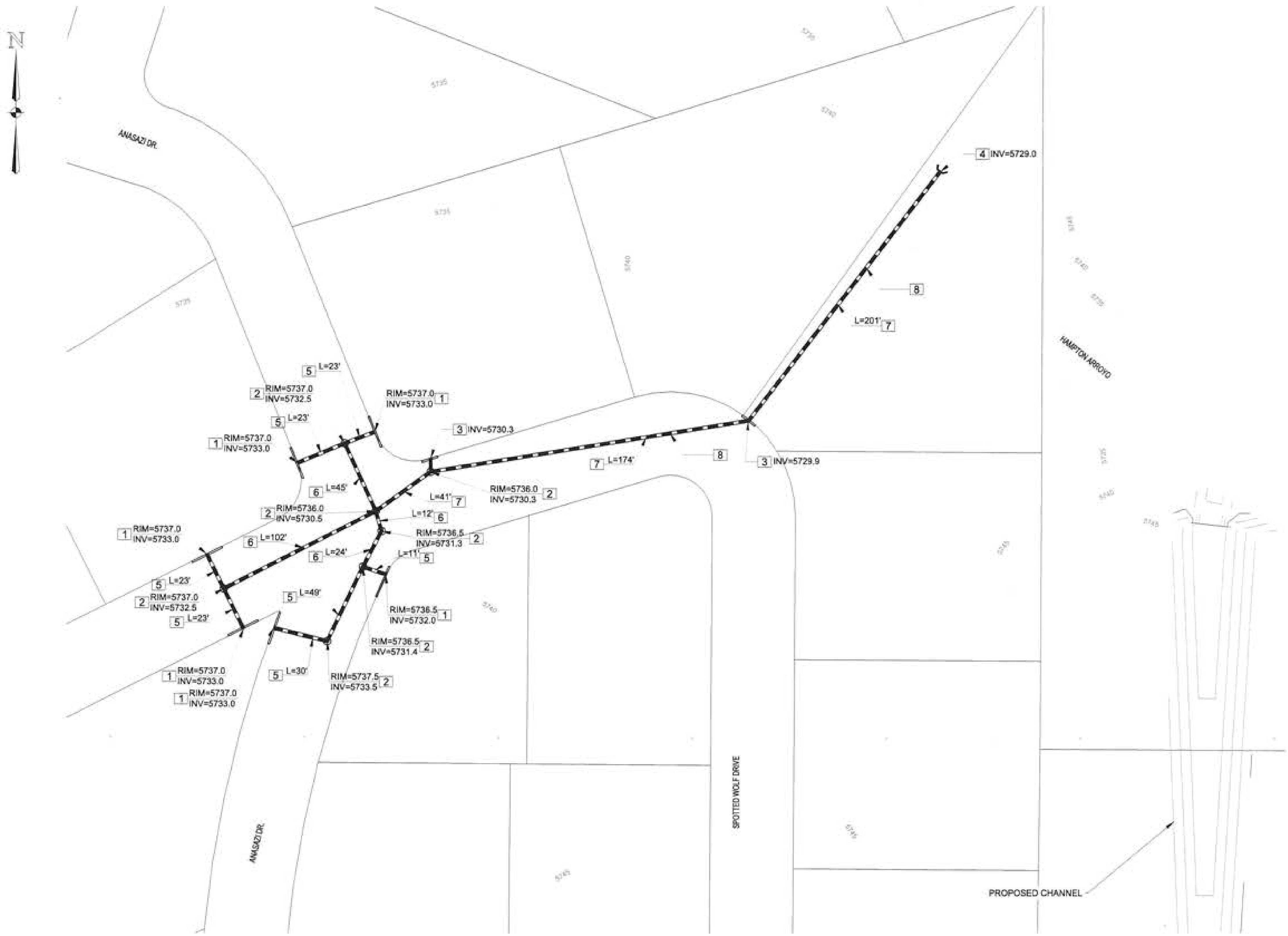
CITY OF AZTEC
KOKOPELLI SUB-DIVISION
PRELIMINARY 30% DRAINAGE PLAN

ANASAZI DRIVE DRAINAGE OUTFALL

SHEET: C-3

CONSTRUCTION NOTES

1. INSTALL CATCH BASIN PER CITY OF FARMINGTON STD DETAIL D-504.
2. INSTALL MANHOLE PER NMDOT STD DETAIL 662.
3. PROTECT EXISTING CATCH BASIN IN PLACE.
4. INSTALL OUTLET HEADWALL PER NMDOT STD DETAIL 511-03.
5. INSTALL 24" Ø RCP PIPE.
6. INSTALL 30" Ø RCP PIPE.
7. INSTALL 42" Ø RCP PIPE.
8. PROPOSED PIPE LOCATION IS PRELIMINARY IN NATURE. ACTUAL LOCATION OF EXISTING PIPE IS TO BE VERIFIED IN FIELD PRIOR TO START OF ANY CONSTRUCTION. NEW PIPE TO BE INSTALLED WITHIN EXISTING PIPE ALIGNMENT.



PROPOSED STORM DRAIN PLAN

SCALE: 1" = 30'

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Phoenix, AZ 85020
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Aztec, NM 87410
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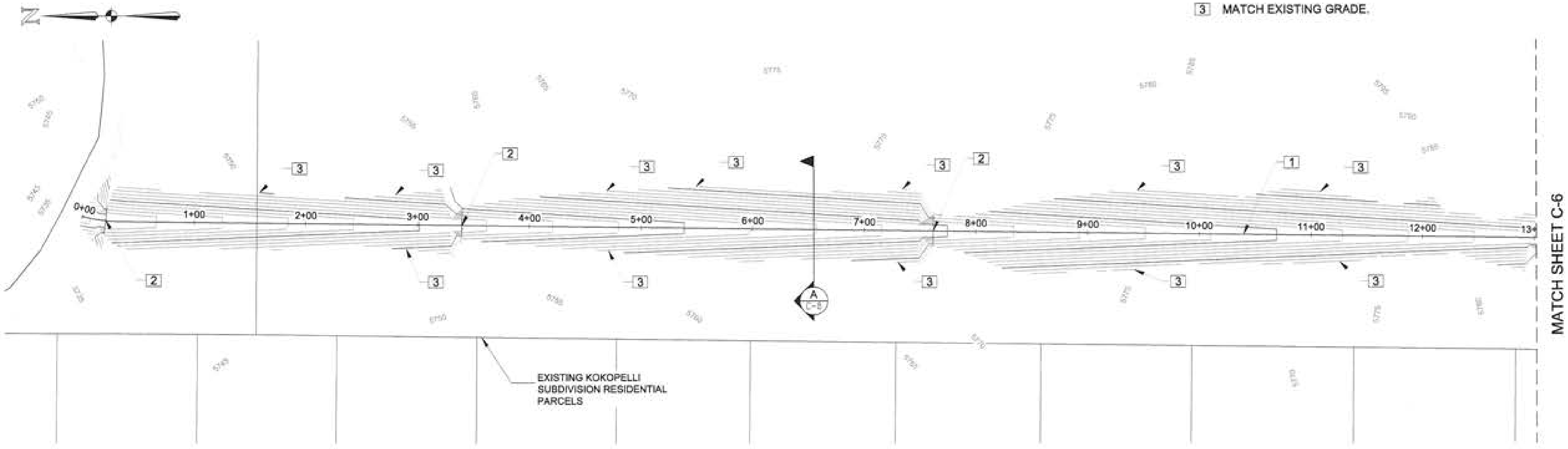
CITY OF AZTEC
KOKOPELLI SUB-DIVISION
PRELIMINARY 30% DRAINAGE PLAN

FRENCH AND ANASAZI INTERSECTION STORM DRAIN

SHEET: C-4

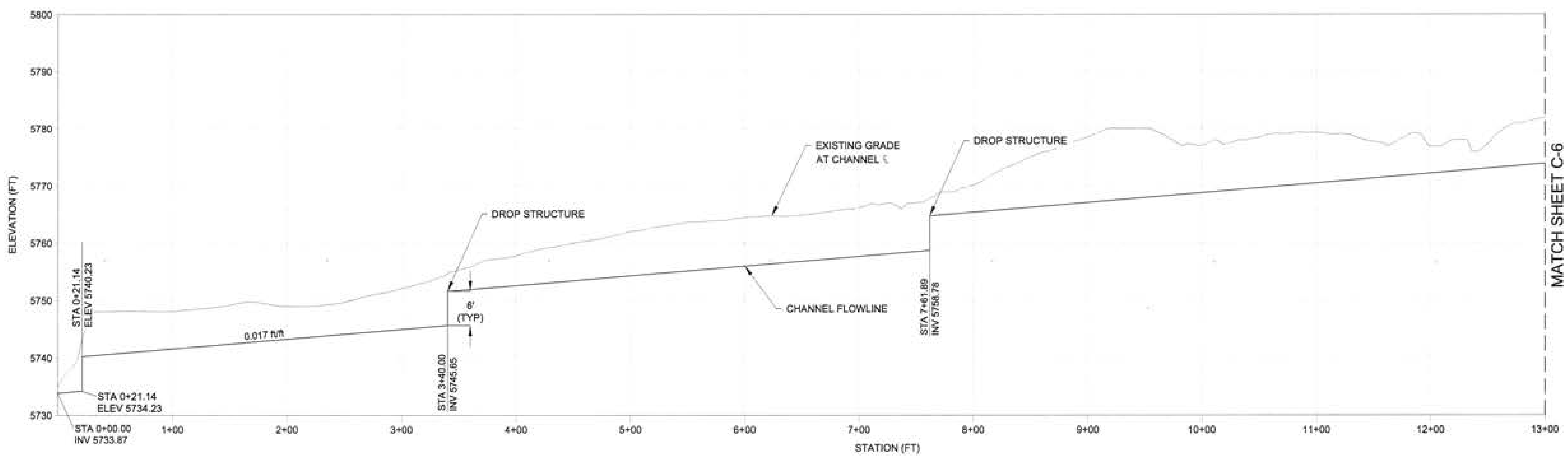
CONSTRUCTION NOTES

1. CONSTRUCT TRAPEZOIDAL CHANNEL PER DETAILS SHOWN ON THIS SHEET.PROPOSED CHANNEL ALIGNMENT IS PRELIMINARY IN NATURE. ACTUAL LOCATION OF PROPOSED CHANNEL MAY VARY BASED ON LAND CONSTRAINTS.
2. CONSTRUCT CHANNEL DROP STRUCTURE.
3. MATCH EXISTING GRADE.



PROPOSED CHANNEL PLAN

SCALE: 1"= 50'



PROPOSED CHANNEL PROFILE STA 0+00 TO 13+00

SCALE: 1"= 50'
HORIZONTAL

SCALE: 1"= 10'
VERTICAL

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Phoenix, AZ 85020
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610 Western Drive
Aztec, NM 87410
(505) 334-7660

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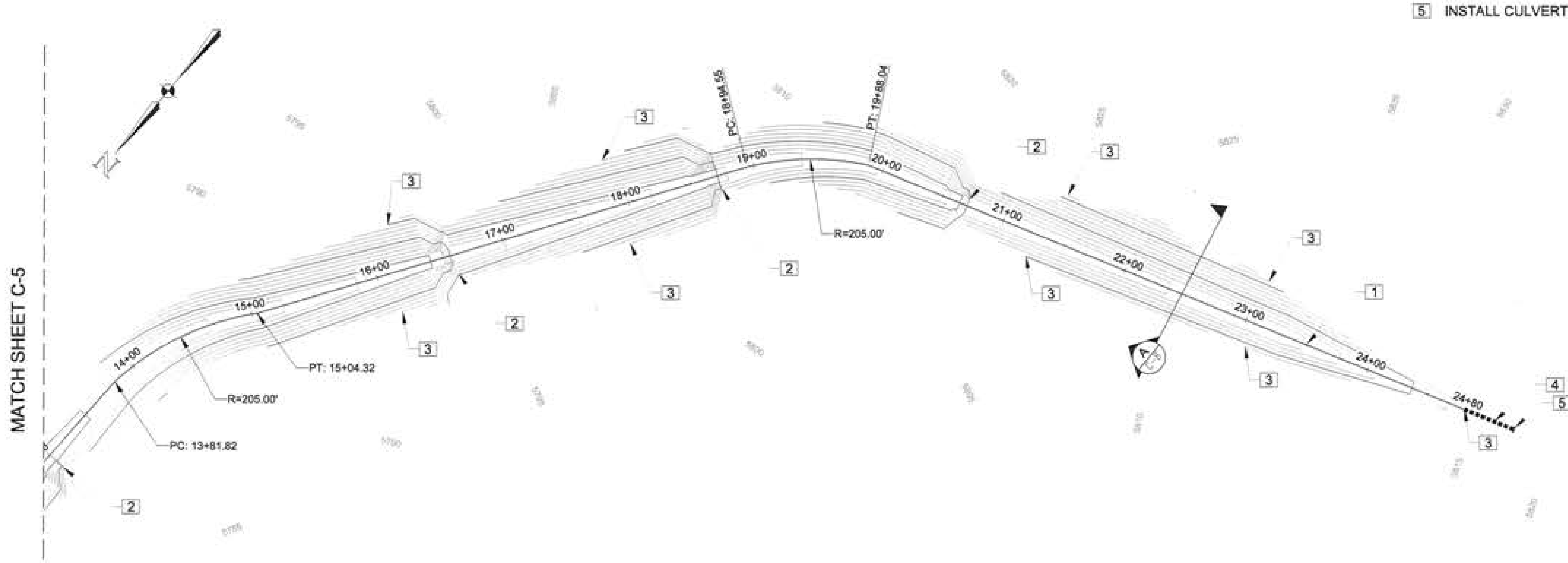
CITY OF AZTEC
KOKOPELLI SUB-DIVISION
PRELIMINARY 30% DRAINAGE PLAN

PROPOSED CHANNEL PLAN AND PROFILE

SHEET: C-5

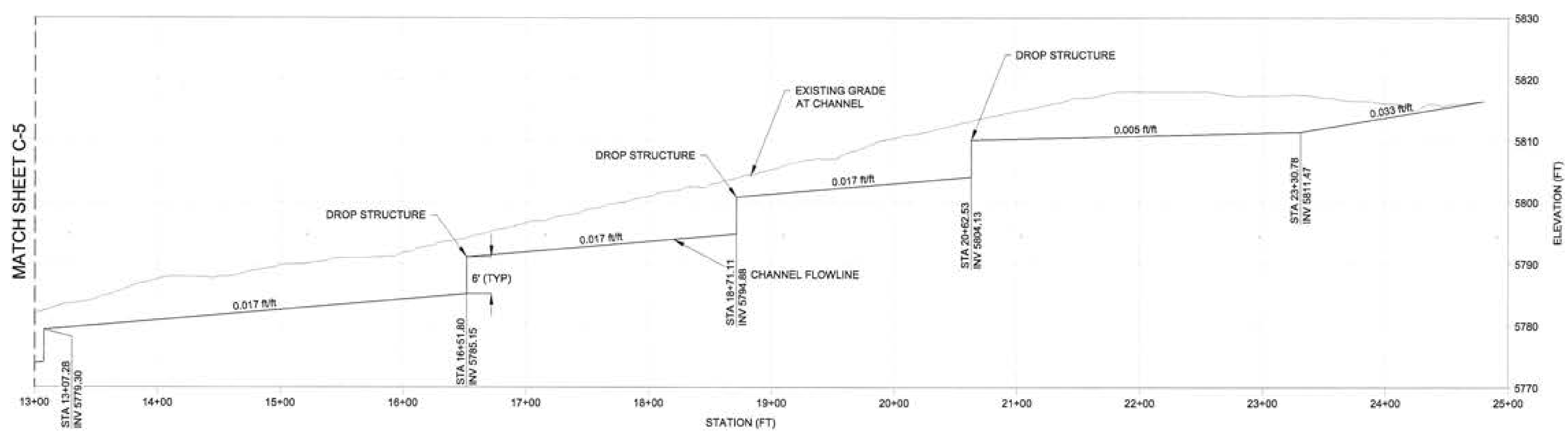
CONSTRUCTION NOTES

1. CONSTRUCT TRAPEZOIDAL CHANNEL PER DETAILS SHOWN ON THIS SHEET.PROPOSED CHANNEL ALIGNMENT IS PRELIMINARY IN NATURE. ACTUAL LOCATION OF PROPOSED CHANNEL MAY VARY BASED ON LAND CONSTRAINTS.
2. CONSTRUCT CHANNEL DROP STRUCTURE.
3. MATCH EXISTING GRADE.
4. INSTALL 36" Ø CONCRETE PIPE (40 LF).
5. INSTALL CULVERT HEADWALL.



PROPOSED CHANNEL PLAN

SCALE 1" = 50



PROPOSED CHANNEL PROFILE STA 13+00 TO 25+60

SCALE 1" = 50 HORIZONTAL

SCALE 1" = 10 VERTICAL

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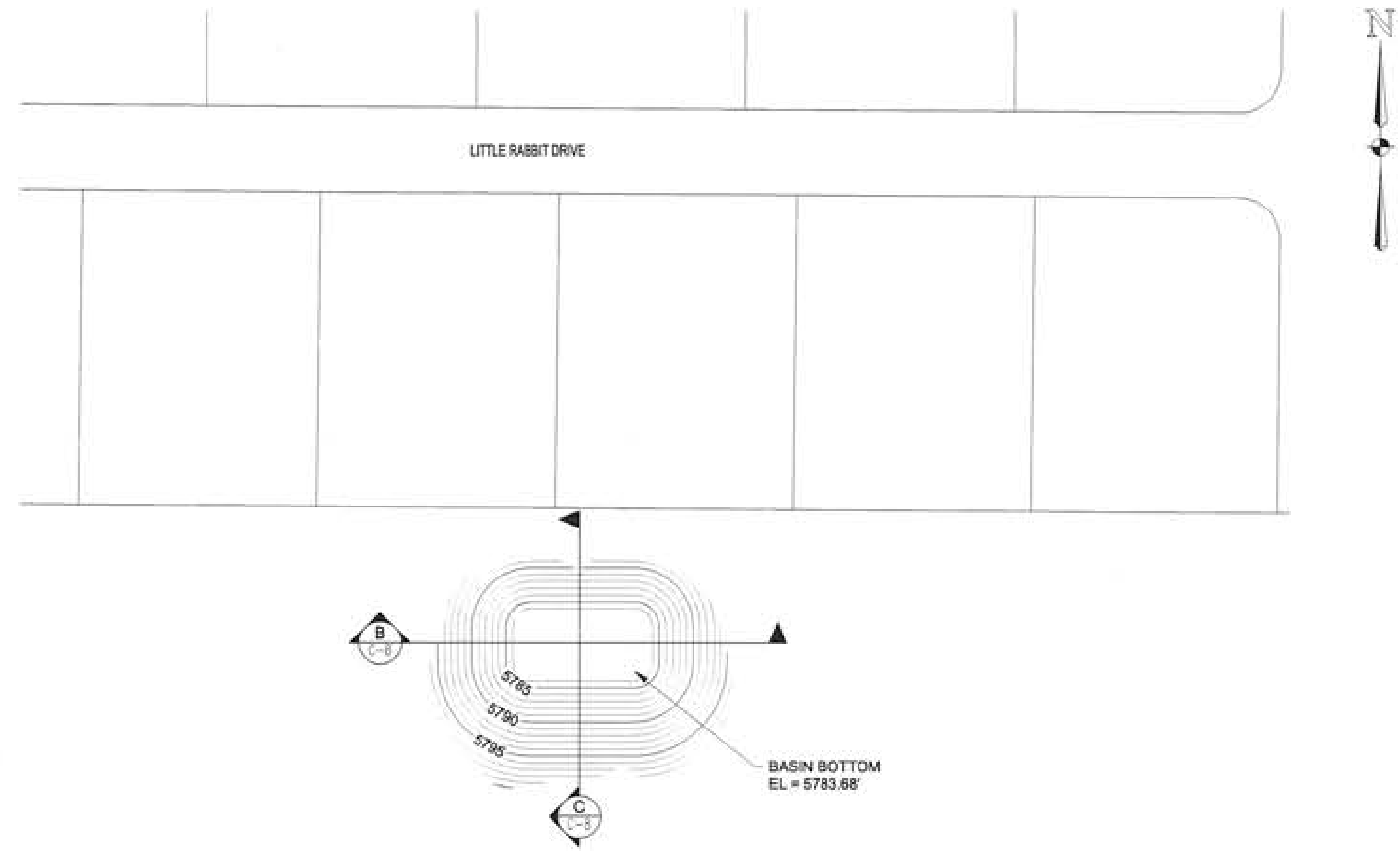
CITY OF AZTEC
KOKOPELLI SUB-DIVISION
PRELIMINARY 30% DRAINAGE PLAN

PROPOSED CHANNEL PLAN AND PROFILE 2

SHEET: C-6

CONSTRUCTION NOTES

1. CONSTRUCT 11 AC.FT. STORM WATER DETENTION BASIN.



PROPOSED SEDIMENTATION BASIN

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7720 North 16th Street
Suite 100
Phoenix, AZ 85020
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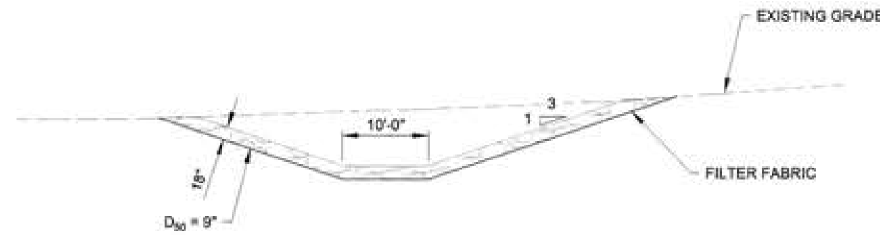
CITY OF AZTEC
KOKOPELLI SUB-DIVISION
PRELIMINARY 30% DRAINAGE PLAN

PROPOSED BASIN PLAN

SHEET: C-7



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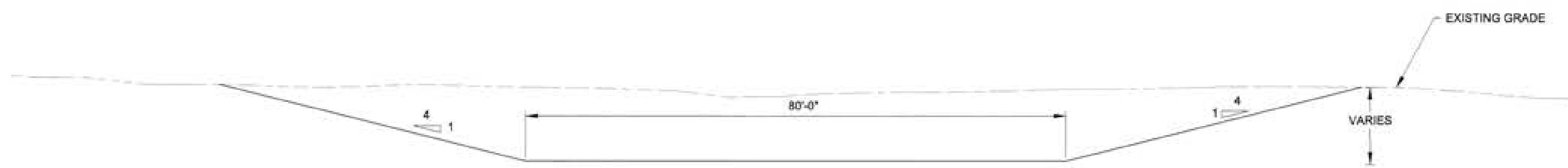
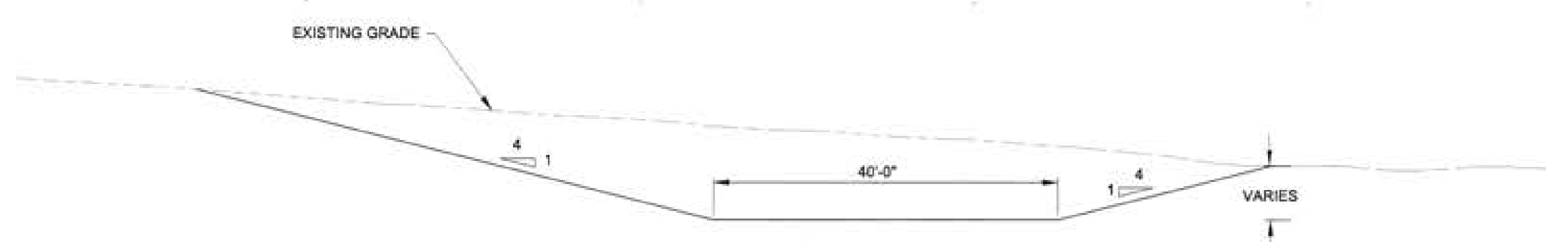


SECTION B SCALE: 1"= 10



SECTION C SCALE: 1"= 10

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Phoenix, AZ 85020
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CITY OF AZTEC
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PRELIMINARY 30% DRAINAGE PLAN

MISCELLANEOUS DETAILS

SHEET: C-8