**Catalina Foothills Watercourse Studies:
Technical Data Notebook for Hydrologic and Hydraulic Mapping of the
Scotts Knob Wash and its Tributary,
Pima County Arizona.**

FEMA FIRM Panel 04019C-2285 K

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June 2013

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Pima County Regional
FLOOD CONTROL
DISTRICT

Pima County Regional Flood Control District
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Exhibit

Attached CD

Scotts Knob TDN with supporting models and GIS data.

Section 1: Introduction

1.1 Purpose

The purpose of this study is to provide flood and erosion hazard information for the Scotts Knob Wash for use by the Pima County Regional Flood Control District (District) in floodplain use permitting and floodplain management. More specifically, it provides:

- discharge values for sub-basins and important concentration points;
- hydrographs for use with floodplain mapping;
- floodplain mapping for channels with 100-yr discharges greater than 100 cfs.
- floodplain mapping for channels with contributing areas greater than 1 square mile, and channels with 100-yr discharges greater than 2000 cfs, which are treated differently under the Pima County Ordinance.

1.2 Project Authority

The State of Arizona has delegated the responsibility to each county flood control district to adopt floodplain regulations designed to promote the public health, safety and general welfare of its citizenry as provided under the Arizona Revised Statutes, Title 48, Chapter 21, Article 1, Sections 48-3601 through 3627. More specifically, A.R.S. 3609 directs county flood control districts to adopt floodplain regulations that:

> A. Regulate all development of land, construction of residential, commercial or industrial structures or uses of any kind which may divert, retard or obstruct flood water and threaten public health or safety or the general welfare; and
> B. Establish minimum flood protection elevations and flood damage prevention requirements for uses, structures and facilities which are vulnerable to flood damage; and
> C. Comply with state and local land use plans and ordinances, if any.
> In conformance with A.R.S. 3609, this ordinance provides for protection of the public health safety and welfare by regulation of flood and erosion hazard areas to control flood hazards and prevent repetitive loss from flood damage.
> D. The flood hazard areas of Pima County are subject to periodic inundation which may result in loss of life and property, create health and safety hazards, disrupt commerce and governmental services, require extraordinary public expenditures for flood protection and relief, and impair the tax base, all of which adversely affect the public health, safety, and general welfare.
> E. These flood losses are caused by the cumulative effect of obstructions in areas of special flood hazards which increase flood heights, flow velocities, and cause flood and erosion damage. Uses that are inadequately flood-proofed, elevated, or otherwise protected from flood damage, also contribute to the flood loss. (Ord. 2005 FC-2 § 2 (part), 2005).

Section 16 of the Pima County Ordinance describes the provisions for floodplain regulation in Pima County.

1.3 Project Location

The study was performed to provide drainage information for the Scotts Knob Wash. The site includes Sections 01, 02, 11, 12, and 13 of Township 14 South, Range 16 East, Sections 7, 8, 16, 17, 18, and 20 of Township 14 South, Range 17 East, Pima County, Arizona. Entire watershed of the Scotts Knob Wash is in FEMA Zone X, as shown on the current Flood Insurance Rate Map (FIRM) number 04019C-2285 K.

The watershed is 5.05 square mile. The study watershed was divided into seven sub-basins (Fig.1.1). The study limits for the Scotts Knob Wash extends from a junction with Tanque Verde Wash to the boundary of Saguaro National Forest (Fig.1.2).

1.4 Methodologies Used for Hydrology and Hydraulics

Topographic, hydrologic and hydraulic analyses were performed to determine drainage conditions in the Scotts Knob wash. ArcGIS, Version 9.3, HEC-HMS Version 3.4 (HEC-HMS), Pima County Hydrology Procedure (PC-Hydro) Version 5.4.2, Hec-RAS Version 4.0 (HEC-RAS), and HEC-GeoRAS, Version 4.1.1 (HEC-GeoRAS) were used for the analyses.

1.5 Acknowledgements

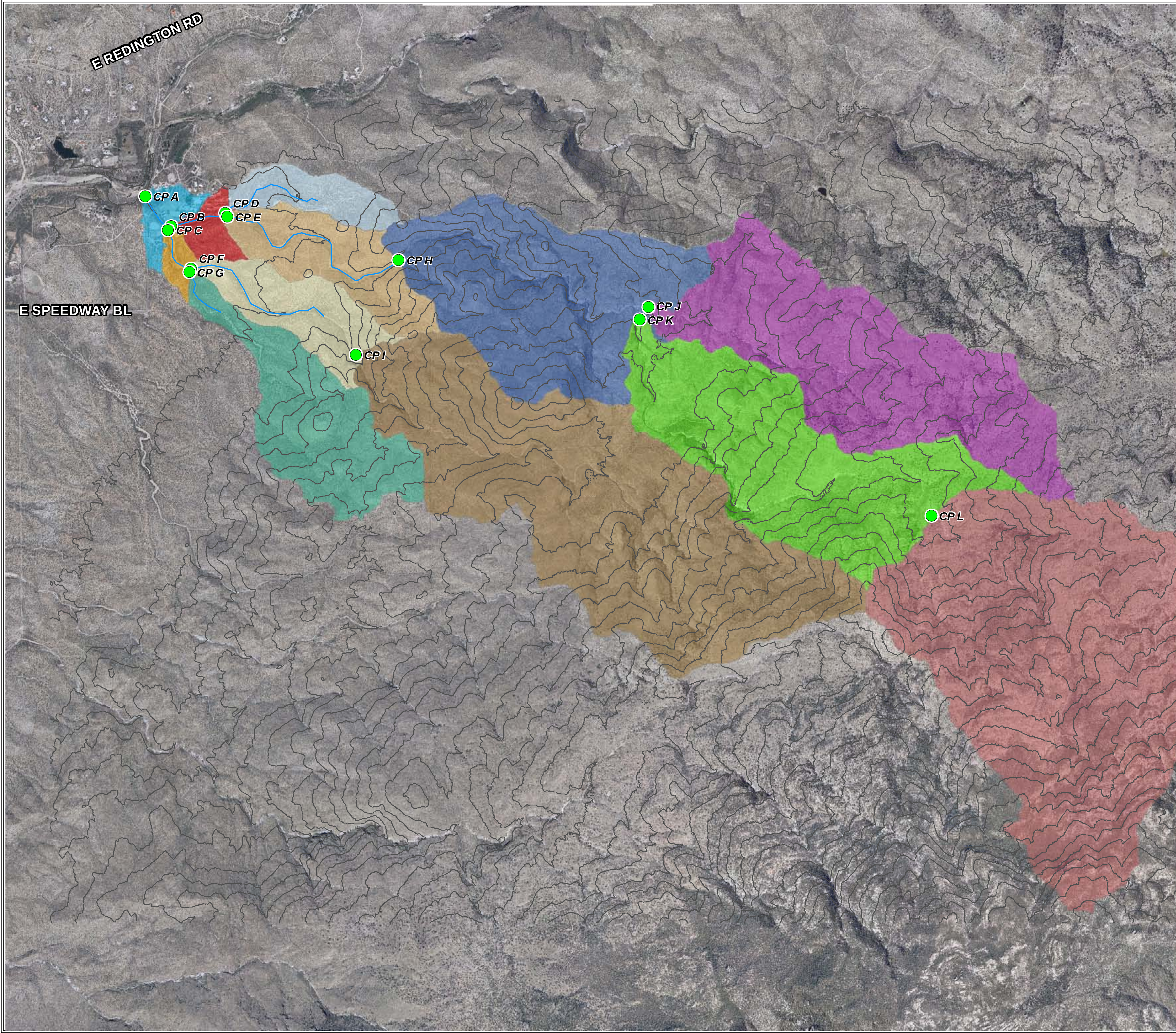
This study relied on assistance of RFCD GIS staff, who were integral to the development of the models and maps.

1.6 Study Results

The modeled discharge for the Scotts Knob Wash at the confluence with the Tanque Verde Wash is 6791 cfs, where the area is 5.05 square miles.

The Scotts Knob Wash watershed is mostly located within Federal land (national forest, FEMA Zone D). The floodplain was mapped in the downstream area of the Scotts Knob Wash. The study found some homes at risk for flooding during the 100-yr flood. A 500-yr floodplain limit was also mapped. In general, the footprint of the 500-yr floodplain is only slightly larger than the 100-yr floodplain.

Figure 1.1
Watershed Map
Scott's Knob Wash



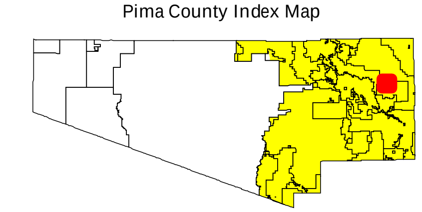
Discharge Point
River
100ft contours

Subbasins

SCK A
SCK B
SCK C
SCK D
SCK E
SCK F
SCK G
SCK H
SCK I
SCK J
SCK K
SCK L

Aerial Photo: 2008 Pima Association of Governments
Topo: 2008 Pima Association of Governments

Pima County Index Map



Index Map Scale 1:5,250,000

The information depicted on this display is the result of digital analyses performed on a variety of databases provided and maintained by several governmental agencies. The accuracy of the information presented is limited to the collective accuracy of these databases on the date of the analysis. The Pima County Regional Flood Control Department makes no claims regarding the accuracy of the information depicted herein.

This product is subject to the Department of Transportation Technical Services Division's Use Restriction Agreement.

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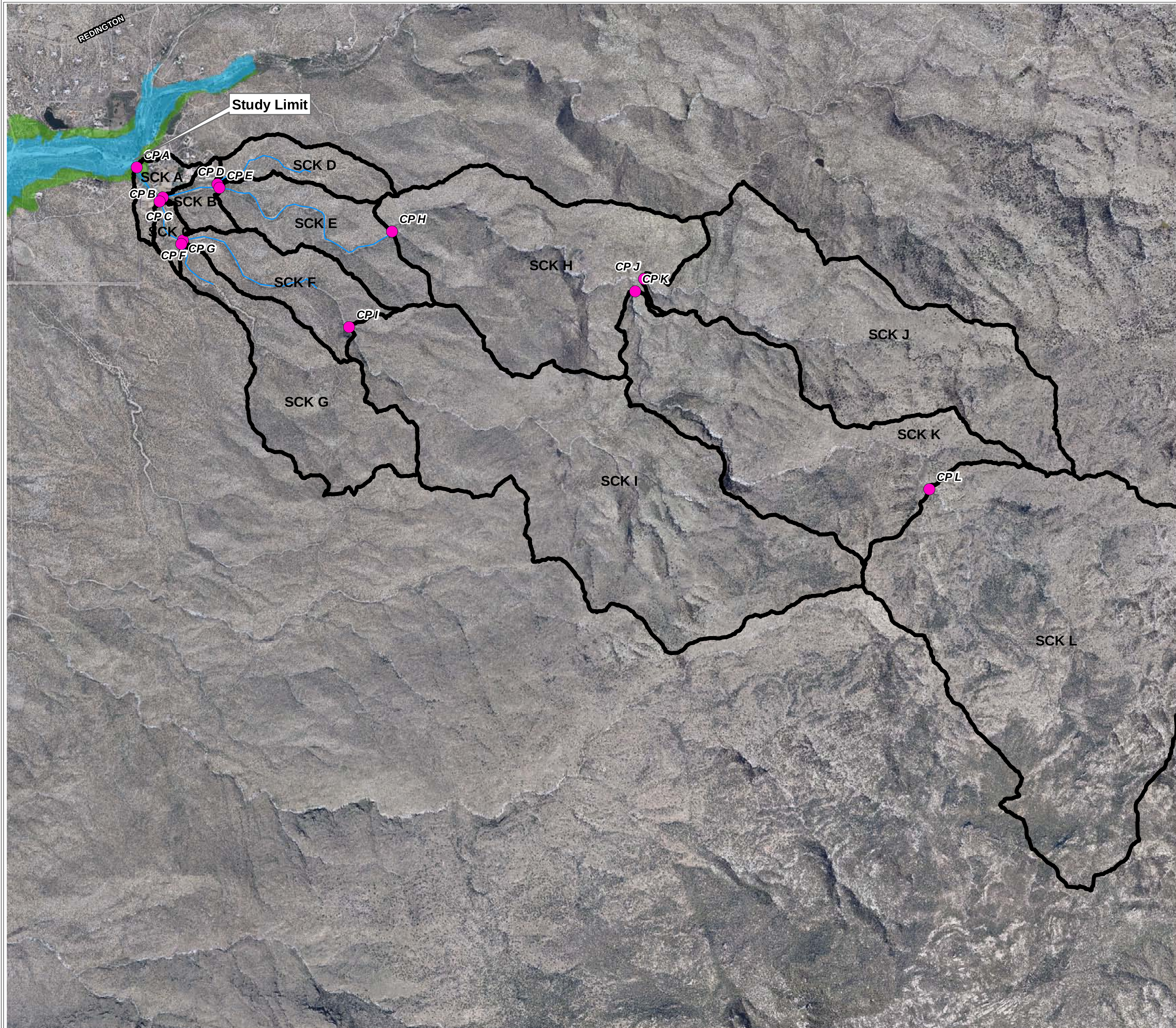
Figure 1.2
Study Limit
Scott's Knob Wash



Discharge Point

River

Subbasins

Existing FEMA Floodplain

ZONE A

ZONE AE

ZONE X - SHADED

Aerial Photo: 2008 Pima Association of Governments

Pima County Index Map

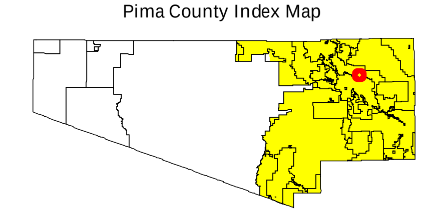


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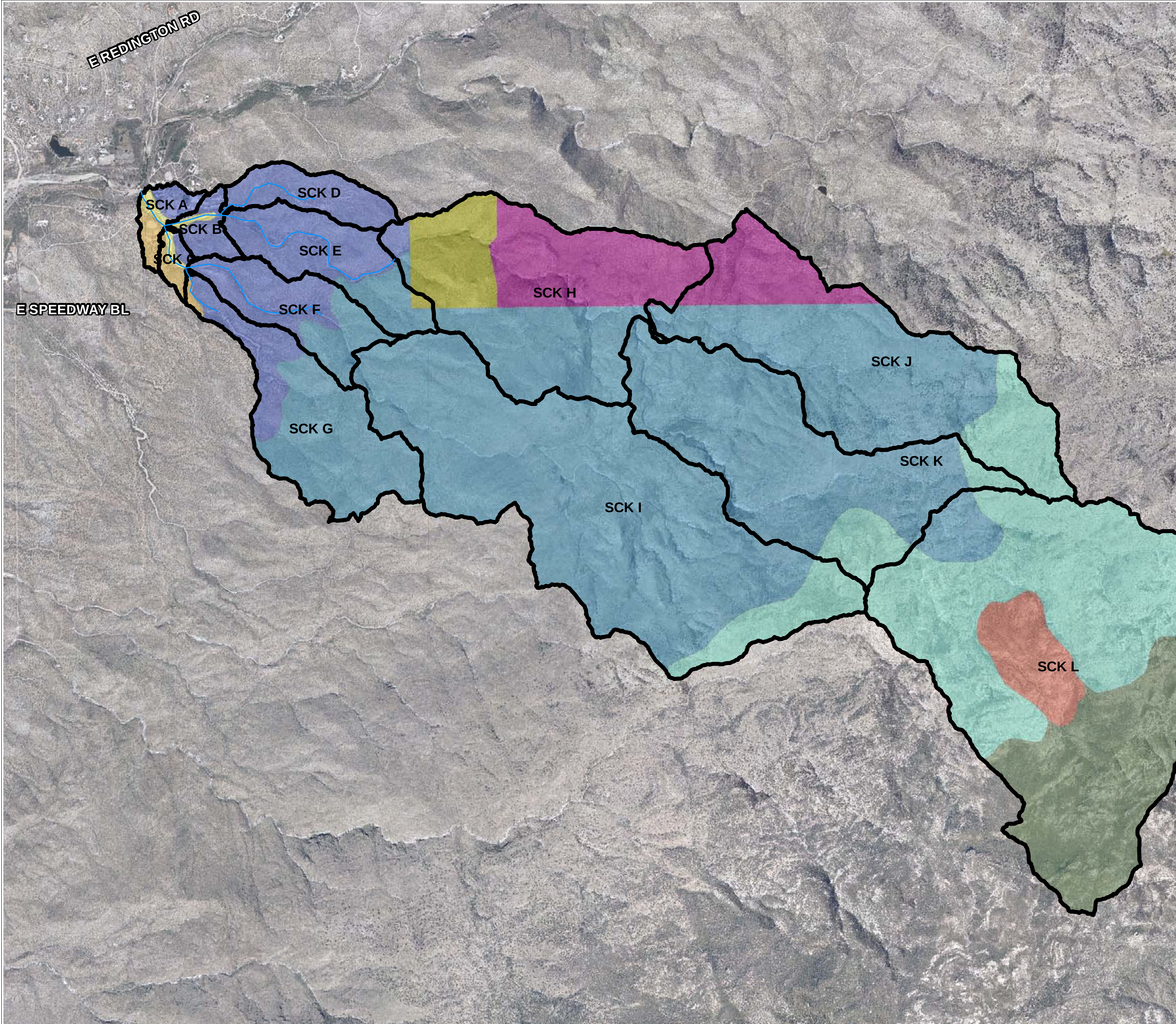
Figure 1.3
Soil Map
Scott's Knob Wash



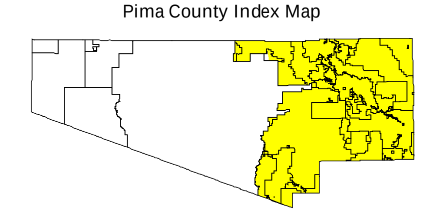
River
Subbasins

Soil Types

- Soil Group: A (100%)
- Soil Group: B (100%)
- Soil Group: C (100%)
- Soil Group C (25%) D (75%)
- Soil Group: C (50%), D (50%)
- Soil Group: C (53%) D (47%)
- Soil Group: C (56%) D (44%)
- Soil Group: D (100%)
- Soil Group: D (100%)

Aerial Photo: 2008 Pima Association of Governments

Pima County Index Map



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Pima County Regional Flood Control District

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Section 2.0 Summary of Key Facts

Section 2.1: General Information

2.1.1 Community: Pima County Regional Flood Control
2.1.2 Community Number: NFIP Community Number 04019C
2.1.3 County: Pima
2.1.4 State: Arizona
2.1.5 Date Study Accepted: Not Accepted –
2.1.6 Study Contractor: Pima County Regional Flood Control District – Akitsu Kimoto
2.1.7 State Technical Reviewer: Not Applicable
2.1.8 Local Technical Reviewer: Suzanne Shields
2.1.9 River or Stream Name: Scotts Knob Wash
2.1.10 Reach Description: Scotts Knob Wash
2.1.11 Study Type: Hydrology and Hydraulics study of a Riverene System

Section 2.2: Mapping Information

2.2.1 FIRM Panels: 04019C-2285 K
2.2.2 Mapping for Hydrologic Study: Lidar based on 2008 flight used to derive 20' contour interval maps using ARC-GIS 9.2
2.2.3 Mapping for Hydraulic Study: Lidar based on 2008 flight used to derive a DEM (5-ft cell size) for use with GeoRAS

Section 2.3: Hydrology

2.3.1 Model or Method Used: HEC-HMS (v. 3.2) model parameterized using methods of RFCD Draft Tech Policy 018 (October 10, 2008)
2.3.2 Storm Duration: 3-hr
2.3.3 Hydrograph Type: SCS Unit Hydrograph
2.3.4 Frequencies Determined: 100 yr
2.3.5 List of Gages used in Frequency Analysis or Calibration: None
2.3.6 Rainfall Amounts and Reference: SCS Type II, NOAA 14 Upper 90% Confidence Interval
2.3.7 Unique Conditions and Problems: None
2.3.8 Coordination of Q's: Comparison with previous studies on file with RFCD and discharge estimates

Section 2.4: Hydraulics

2.4.1 Model or Method Used: HEC-RAS 4.0, GeoRAS to parameterize
2.4.2 Regime: Modeled as subcritical
2.4.3 Frequencies for which Profiles were Computed: 100 yr
2.4.4 Method of Floodway Calculation: No Floodway
2.4.5 Unique Conditions and Problems: Boundary set at normal depth.

Section 2.5: Additional Study Information:

None

Section 3: Survey and Mapping Information

3.1 Field Survey Information

No field survey was used.

3.2 Mapping

The 2008 Light Detection and Ranging (LiDAR) data was used for the analysis. Coordinates were in Pima County projection:

Projection = State Plane, Arizona Central Zone
Datum = NAD83 HARN
Units = International Feet
North American Vertical Datum of 1988 (NAVD, 1988)

The LiDAR was used to derive a Digital Elevation Model (DEM) and a contour map. DEM derived on 5’ centers provided the basis for delineating the watershed and sub-basins. DEM was also used to characterize the topography along channels used for the floodplain mapping process. Contour map derived from the DEM allowed modelers to visualize topographic differences in making decisions on how to model different areas.

Section 4: Hydrology

4.1 Method description.

For the floodplain mapping, a 100-yr discharge is required. The 100-year peak discharges for the sub-basins of the Scotts Knob Wash (SCK A, B, C, D, E, F and G; Figure 3) were calculated using U.S. Army Corps of Engineers Computer Hydrologic Modeling System, (HEC-HMS) version 3.1.0. The HEC-HMS model requires the parameters regarding rainfall, topography, soil, vegetation, and channel characteristics to determine runoff volume and peak discharge. Those parameters were determined according to the Pima County Regional Flood Control District Technical Policy 018 (Tech-018). Tech-018 is included in Appendix A.

4.2 Parameter estimation.

Methods are summarized in Table 4.1. The data processing methods are summarized in Fig. 4.

Table 4.1 - Methods used for a HEC-HMS analysis

	Selected Method
Rainfall Depth	NOAA 14, upper 90% Confidence Interval
Rainfall Distribution	3-hr SCS Type II Storm
Rainfall Loss	SCS Curve number
Time of Concentration	SCS Segmental Method
Transform	SCS Unit Hydrograph
Routing	Modified-Puls

4.2.1 Drainage area boundaries.

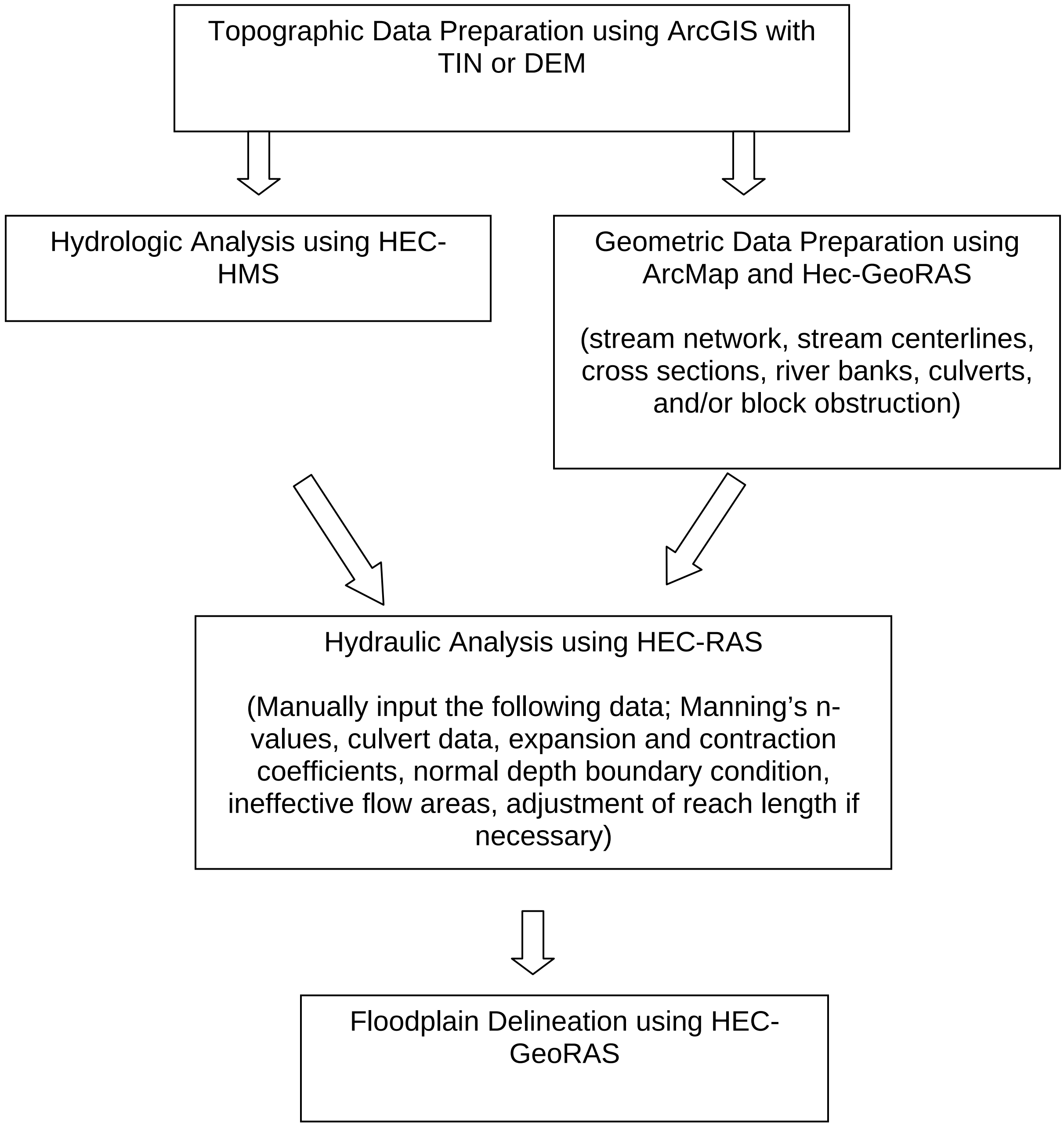
The limits of this study are shown in Fig.1.2. The Scotts Knob Wash watershed is mostly located within Federal land (national forest, FEMA Zone D). The floodplain was mapped in the downstream area of the Scotts Knob Wash.

The watershed is 5.05 square mile. The study watershed was divided into seven sub-basins (Fig.1.1). The upstream study limits is the boundary of the national forest, while the downstream limit is the confluence with the Tanque Verde Wash (Fig.1.2).

4.2.2 Watershed work maps

The boundary of the watershed and internal sub-basins were determined using Hydrology function in ArcGIS (Fig.1.1) with DEM derived from the 2008 Lidar. The sub-basins reflected predominant topographic, soils, cover and development conditions, so that the sub-basins would represent hydrologic response from the sub-basin. The locations of the stream centerline, cross-sections, culverts, and other physical attributes of the wash were determined by using the 20-ft interval contour map and 2008 aerial photo.

Figure 4.1 – Flow Chart of Mapping Process



4.2.3 Gage Data.

None Available

4.2.4 Statistical parameters

None Available

4.2.5 Precipitation.

Rainfall depth was selected from the NOAA 14 Upper 90% rainfall data used in PC Hydro. The point rainfall depth for the 3-hour storm was obtained, based on the coordinates of the centroid of the watershed (Latitude: 32.229, Longitude: 110.653). Areal reduction factor was applied to watersheds larger than 1 square mile as noted in Tech-018. The 3-hr, SCS Type II rainfall distribution described in Haan et al (1994) was used.

4.2.6 Physical parameters.

A hydrologic soils group map for the study watershed is presented in Fig.3.1. The study watershed is mostly covered with Desert brush. Hydrologic Soil Groups D are the dominant soil types in the Scotts Knob Wash watershed. The SCS Curve Number was determined using maps obtained from NRCS (http://soildatamart.nrcs.usda.gov/) as a basis for preparing a Hydrologic Soil Group Map for Pima County. The CN charts in the PC Hydro Manual (Arroyo Engineering, 2007) were the basis for CN selection. A vegetation cover density of 30% was used to select the SCS Curve Number for the hydrologic calculation of the mountainous watersheds. Impervious cover percentage from 5-30%, were selected based on lot size, the fraction of the sub-basin that is developed and the tables in the PC Hydro manual. Sub-basin characteristics are summarized in Table 4.2 The detail of the CN calculation is included in Appendix D. The CN selections and impervious cover selections are summarized in Table D1.

Table 4.2 - Sub-basin Characteristics

Sub-Basin	Area (sq mi)	CN	Impervious Area (%)	Vegetation Cover (%)	Lag Time (min)
SCK A	0.04	91.2	30	30	4.4
SCK B	0.04	91.0	20	30	6.6
SCK C	0.02	88.5	10	30	4.9
SCK D	0.09	90.6	7	30	9.3
SCK E	0.19	90.3	7	30	7.1
SCK F	0.16	90.2	5	30	6.2
SCK G	0.31	89.9	5	30	13.6
SCK H	0.58	87.9	5	30	9.1
SCK I	1.08	89.5	5	30	15.4
SCK J	0.68	89.3	5	30	15.1
SCK K	0.62	89.4	5	30	15.3
SCK L	1.24	86.3	5	30	11.1

The SCS TR-55 segmental Time of Concentration (Tc) method with a combination of kinematic wave method was used. The hydraulically most distant point on the sub-basin was identified. The length of sheetflow was estimated at 100', the distance from the end of the sheetflow to a well-defined channel was selected as the shallow concentrated portion of the flow path, and the channel portion was the path from the well-defined channel to the sub-basin outlet was the 'channel flow' portion of the flow path.

Tc is the sum of the travel time for sheetflow, shallow concentrated flow and channel flow. The travel time for sheetflow was calculated using kinematic wave method. The travel time for shallow concentrated flow was calculated using the methods described in the TR-55 manual (USDA-1986). The travel time for channels used estimates from a HEC-RAS model. The lag time was calculated as 0.6 Tc. The detail of the Tc calculation is included in Appendix D (Table D2).

The SCS unit hydrograph method was used to produce hydrographs at the outlet of the sub-basin in HEC-HMS. Runoff from sub-basins was routed using the Modified-Puls method. A storage discharge table for the channel routing was developed using the cross sections and slopes derived from HEC-HMS. Modified puls routing employed the methods described in the HMS manual. The detail of the calculation of the number of subreach is included in Appendix D. Sub-basin discharges are summarized on Table 4.3.

Table 4.3 - Sub-basin 100-yr discharges

Sub-Basin	Area (sq mi)	Rainfall Depth (in)	Runoff Volume (in)	Peak Discharge (cfs)
SCK A	0.04	3.57	2.63	164
SCK B	0.04	3.57	2.61	149
SCK C	0.02	3.57	2.38	75
SCK D	0.09	3.57	2.57	297
SCK E	0.19	3.57	2.54	678
SCK F	0.16	3.57	2.53	590
SCK G	0.31	3.57	2.51	845.7
SCK H	0.58	3.57	2.32	1768.2
SCK I	1.08	3.57	2.47	2708.6
SCK J	0.68	3.57	2.45	1715
SCK K	0.62	3.57	2.46	1556.6
SCK L	1.24	3.57	2.18	3289.7

4.3 Problems encountered during the study.

None

4.3.1 Special problems and solutions

4.3.2 Modeling warning and error messages

The time interval of the rainfall data used in this study is 5 minutes, while the simulation time interval is 1 minute. The HEC-HMS model interpolated the 5-minute time interval of the rainfall data to 1-minute time interval.

4.4 Calibration

No Calibration

4.5 Final results

4.5.1 Hydrologic analysis results

As described above, this study mainly focuses on drainage information in the downstream of the Scotts Knob Wash. The 100-year peak discharge at CP A was determined using the HEC-HMS. Twenty four hours were simulated on a 1 minute time step with rainfall occurring in the first three hours. The following discharges were obtained from the hydrologic analysis:

Table 4.4 – Summary of 100-yr Peak Discharge Values

Concentration Point	Location	Area (sq mile)	Rainfall Depth (in)	Runoff Volume (in)	Q100 HMS or PC-Hydro(cfs)	Time to Peak
CP A	**Confluence with Tanque Verde Wash**	5.05	3.27	1.93	6790	1:55
CP B	**Section 02, Township 14S, Range 16E**	3.44	3.23	2.03	5289	1:55
CP C	**Section 02, Township 14S, Range 16E**	1.57	3.41	2.34	3326	1:42
CP D	**Section 02, Township 14S, Range 16E**	0.09	NA	NA	397	NA
CP E	**Section 02, Township 14S, Range 16E**	3.31	3.24	2.03	5264	1:54
CP F	**Section 02, Township 14S, Range 16E**	1.24	3.45	2.36	2669	1:43
CP G	**Section 02, Township 14S, Range 16E**	0.31	NA	NA	1169	NA

Table 4.5 – Summary of 25-yr Peak Discharge Values

Concentration Point	Location	Area (sq mile)	Rainfall Depth (in)	Runoff Volume (in)	Q25 HMS or PC-Hydro(cfs)	Q25 RRE (cfs)	Time to Peak
CP A	**Confluence with Tanque Verde Wash**	5.05	2.38	1.3	4325	1886	1:57
CP B	**Section 02, Township 14S, Range 16E**	3.44	2.50	1.4	3408	1524	2:11
CP C	**Section 02, Township 14S, Range 16E**	1.57	2.65	1.6	2315	961	1:43
CP D	**Section 02, Township 14S, Range 16E**	0.09	NA	NA	259	127	NA
CP E	**Section 02, Township 14S, Range 16E**	3.31	2.51	1.4	3394	1491	1:58
CP F	**Section 02, Township 14S, Range 16E**	1.24	2.67	1.65	1868	830	1:44
CP G	**Section 02, Township 14S, Range 16E**	0.31	NA	NA	741	327	NA

Table 4.6 – Summary of 500-yr Peak Discharge Values

Concentration Point	Location	Area (sq mile)	Rainfall Depth (in)	Runoff Volume (in)	Q500 HMS (cfs)	Time to Peak
CP A	**Confluence with Tanque Verde Wash**	5.05	3.97	2.76	10286	1:51
CP B	**Section 02, Township 14S, Range 16E**	3.44	4.18	2.9	7726	1:55
CP C	**Section 02, Township 14S, Range 16E**	1.57	4.42	3.28	4672	1:42
CP D	**Section 02, Township 14S, Range 16E**	0.09	NA	NA	577	NA
CP E	**Section 02, Township 14S, Range 16E**	3.31	4.19	2.91	7677	1:54
CP F	**Section 02, Township 14S, Range 16E**	1.24	4.46	3.32	3731	1:42
CP G	**Section 02, Township 14S, Range 16E**	0.31	NA	NA	1723	NA

4.5.2 Verification of results.

Results are reasonable when compared with USGS Regression Equation 13 (Thomas et al, 1997, Table 4.7). The equation 13 results were lower than the HMS results, which would be expected, because these steep watersheds could be expected to produce higher than average discharge on average. No regulatory discharge point data is available along the Scotts Knob Wash.

Table 4.7 – Comparison of 100-yr Peak Discharge Values

Concentration Point	Location	Area (sq mile)	Q100 HMS (cfs)	Q100 RRE (cfs)
CP A	**Confluence with Tanque Verde Wash**	5.05	6790	3368
CP B	**Section 02, Township 14S, Range 16E**	3.44	5289	2713
CP C	**Section 02, Township 14S, Range 16E**	1.57	3326	1689
CP D	**Section 02, Township 14S, Range 16E**	0.09	397	195
CP E	**Section 02, Township 14S, Range 16E**	3.31	5264	2653
CP F	**Section 02, Township 14S, Range 16E**	1.24	2669	1451
CP G	**Section 02, Township 14S, Range 16E**	0.31	1169	543

Section 5: Hydraulics

5.1 Method description.

Steady flow analysis was performed to determine 100-year water surface elevations in the study area by using HEC-RAS with the discharge obtained from HEC-HMS. Floodplain boundary outside of the national forest boundary was mapped in this study.

5.2 Work study maps

As described above, geometric data for HEC-RAS including stream centerline, cross-sections, and culverts, were obtained from HEC-GeoRAS. The locations of cross sections and channels used for the 100-yr floodplain analysis are show in Exhibit 1. The 100-yr and 500-yr floodplain limits are also shown in Exhibit 1.

5.3 Parameter estimation.

The watershed was modeled using methods consistent with the District Tech Policy 019.

5.3.1 Roughness coefficients.

Manning's roughness coefficients for the channel and the over-bank areas were determined by using a 2008 aerial photo. Differentiation of channel and overbank 'n' values should be done only when channel flow is at least twice as deep as overbank flow (Phillips and Tadayon, 2006). Most reaches within the study area is wide. Rather than assign a channel and overbank Manning's n, an average n for the whole cross-section of 0.04 or 0.045 was assigned except the downstream end of the reach in Subbasin A.

5.3.2 Expansion and contraction coefficients.

Default HEC RAS expansion (0.3) and contraction (0.1) coefficients were used for the most cross sections.

5.4 Cross section description.

A 20-foot interval contour map derived from 2008 LiDAR data was used to select the location of cross sections. Cross-section locations were determined primarily based on the channel topography. The cross-section lines were drawn to be perpendicular to flow paths in Geo-RAS and ArcGIS.

5.5 Modeling considerations.

5.5.1 Hydraulic Jump and drop analysis.

No hydraulic jumps were encountered.

5.5.2 Bridges and culverts.

There are no culverts along the study reaches of the Scotts Knob Wash.

5.5.3 Levees and dikes.

None.

5.5.4 Islands and flow splits.

None.

5.5.5 Ineffective flow areas.

Ineffective flow areas were noted on the study reach of the Scotts Knob Wash.
In general these ineffective flow areas were disconnected overbank areas that would not convey flow to the next downstream cross-section.

5.5.6 Supercritical flow.

No supercritical reaches.

5.6 Floodway modeling

No encroachment calculations were performed.

5.7 Problems encountered during the study.

5.7.1 Special problems and solutions.

None.

5.7.2 Modeling warning and error messages.

No errors occurred. The following warning messages occurred:

- Divided flow
- Energy loss greater than 1.0
- Energy equation could not be balanced and defaulted to critical.
- Cross-section extended vertically.
- Multiple critical depths calculated.
- Conveyance ratio is less than 0.7 or greater than 1.4.

Inspection indicated that the modeling is accurate given the steep channel conditions. Most of these errors force a critical solution which is reasonable for these steep watercourses. A summary of errors is available in Appendix E.

5.8 Calibration.

None.

5.9 Final results.

5.9.1 Hydraulic analysis results.

The HEC-RAS modeling results were summarized in Appendix E.

5.9.2 Verification of results.

Existing floodplain maps are not available along the Scotts Knob Wash. The new map tends to follow the floodplain topography. The results suggest that the mapping is reasonable.

Section 6: Erosion and Sediment Transport

6.1 Method description.

None – not applicable

6.2 Parameter estimation.

None – not applicable

6.4 Modeling considerations.

None – not applicable

6.5 Problems encountered during the study.

6.5.1 Special problems and solutions.

None – not applicable

6.5.2 Modeling warning and error messages.

None – not applicable

6.6 Calibration.

None – not applicable.

6.7 Final results.

6.7.1 Erosion and sediment transport analysis results.

None – not applicable

6.7.2 Verification of results.

None – not applicable

Section 7: Ratio of the top width of 100-yr and 25-yr floodplain

The ratio of 100-yr to 25-yr floodplain topwidth for the reach with peak discharge over 2000 cfs was calculated. The average ratios of 100-yr to 25-yr floodplain topwidth for the Reach A, B, C, E and F are 3.19, 1.17, 1.13, 1.15 and 1.14. Cross sections with the ratio less than 1.25, which are defined as “Canyon Wash”. A map showing the cross sections with the ratio of the topwidth less than 1.25 is included in Addendum 1.

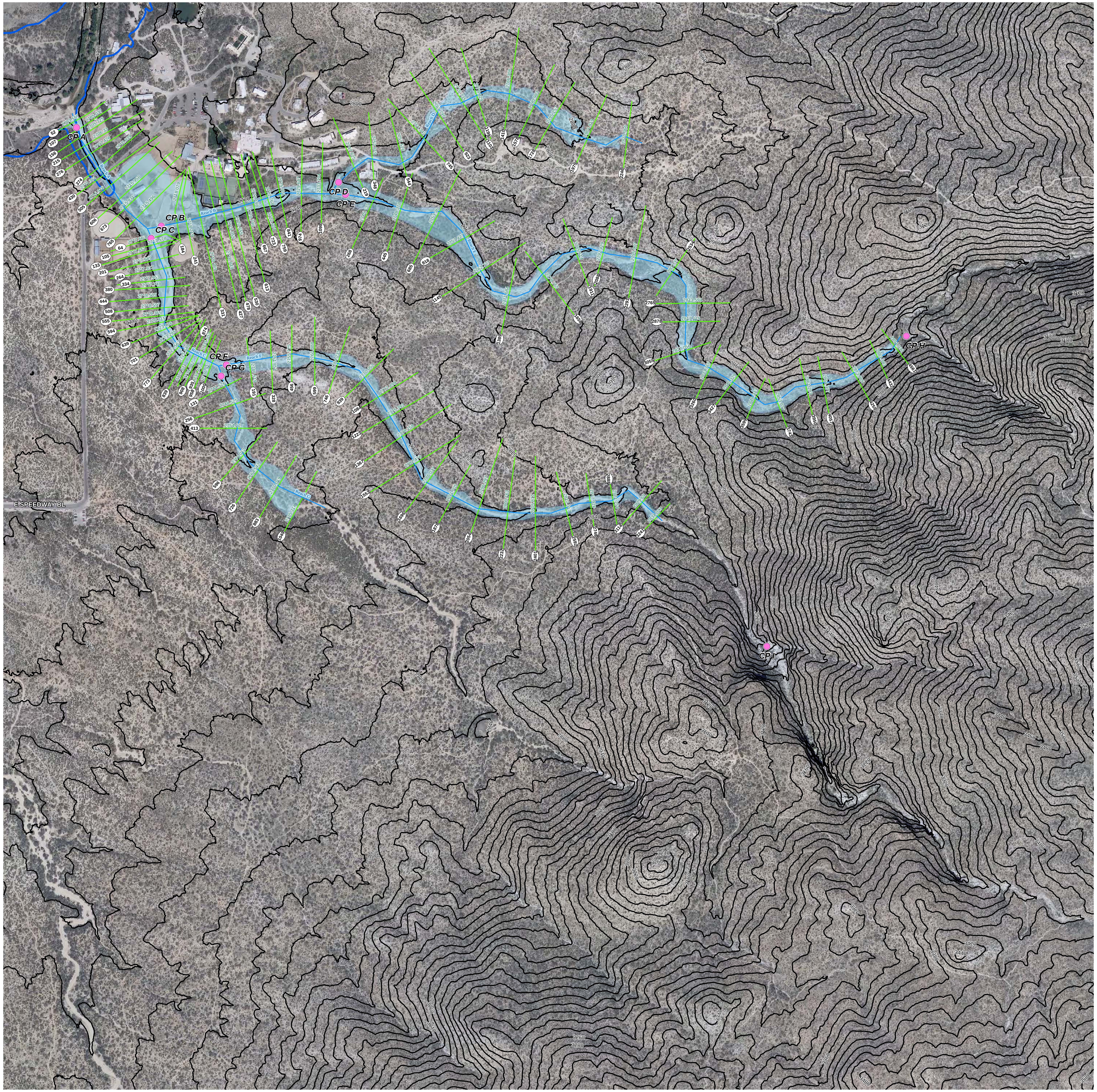
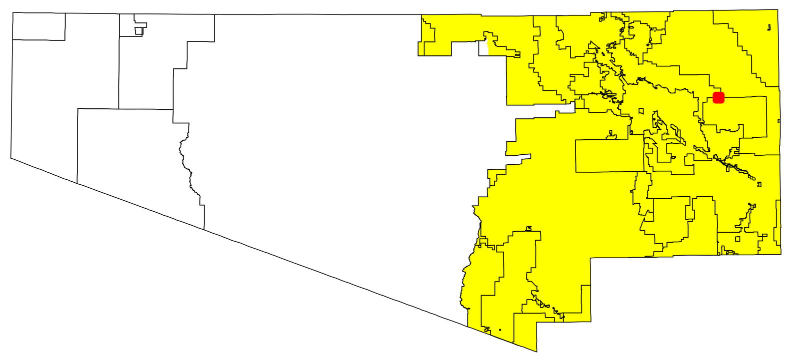


Exhibit 1
100-year Floodplain with cross sections
Scott's Knob Wash

- Discharge Point
- River
- Cross Sections
- Contour 5 foot
- Contour 20 foot
- Existing Zone AE
- Proposed Floodplain

Aerial Photo: 2008 Pima Association of Governments
Topo: 2005 Pima Association of Governments
Vertical Datum: NAVD 1988

Pima County Index Map



Index Map Scale 1:1,500,000

Pima County Regional Flood Control District

N

0 100 200 400 Feet

Pima County Regional Flood Control
97 East Congress Street - 3rd Floor
Tucson. Arizona 85701-1207
(520)243-1800 - FAX (520)243-1821
http://www.rfcd.pima.gov

12/2010

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Appendix A: References

A.1 Data collection summary.

Include a list of previous studies, other applicable studies, published and unpublished historical
flood information, and research contacts.

A.2 Referenced documents.

Arizona Department of Water Resources, Flood Mitigation Section
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Appendix B: General Documentation & Correspondence

None.

Appendix C: Survey Field Notes

C.1 Survey field notes for aerial mapping control.
C.2 Survey field notes for hydrologic modeling.
C.3 Survey field notes for hydraulic modeling.