Glendale Area
Stormwater Management Plan

Pilot Hydrology Study
For Area 2

North of Happy Valley Road
Between New River and Agua Fria River

Prepared for:
City of Glendale
5850 W. Glendale Ave., Ste. 315
Glendale, AZ 85301

In Association with
Flood Control District of Maricopa County
2801 W. Durango Street
Phoenix, AZ 85009

Prepared by:
Kimley-Horn and Associates, Inc.
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Phoenix, AZ 85020

091910009
November 2009

Kimley-Horn
and Associates, Inc.

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1.0 Introduction

1.1 Purpose

As part of the Glendale Area Stormwater Management Plan (SMP), Kimley-Horn and Associates, Inc. (KHA) is updating the hydrology for the Maryvale Area Drainage Master Study (ADMS) and the Glendale/Peoria Area Drainage Master Plan Update (ADMPU) into new HEC-1 models. The hydrology update will determine the peak flow and runoff for the 10-year and 100-year, 6-hour and 24-hour storm events for two conditions: (1) the existing land use condition; and (2) the future land use condition within the Maryvale and Glendale/Peoria study areas.

KHA previously submitted the *Pilot Hydrology Study for Area 1* (Pilot Area 1) to evaluate and recommend the hydrology methodology that will be utilized in the Glendale Area SMP hydrology update for areas where streets follow a grid pattern. The project area also contains areas where the streets are not developed or do not follow a grid pattern, specifically in areas within Sun City and the City of Peoria.

KHA has prepared this Pilot Study to evaluate and recommend hydrology methodology that will be used in the Glendale Area SMP hydrology update for areas where the streets are not in a grid pattern. These procedures follow the guidelines established in the Flood Control District of Maricopa County's *Drainage Design Manual – Hydrology* (DDM, August 2009). This Pilot Study was conducted for the 100-year, 6-hour storm for the existing land use conditions.

1.2 Contact Information

The City of Glendale is the primary project participant. The Flood Control District of Maricopa County (FCDMC) is a participating agency and will review the hydrology updates. The City of Glendale project number is 089017. The contact information for the project manager representing each agency is provided below.

City of Glendale
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1.3 Location

Pilot Area 2 is located north of Happy Valley Road from the New River to the Agua Fria River. See **Exhibit 1** in **Appendix F** for a vicinity map.

2.0 Hydrologic Parameters

All parameters discussed in this section are typical for locations in the study area that are not characterized by mile streets in a grid format. The Pilot Area 1 study addresses how subbasins and flowpaths will be delineated in locations that are characterized by mile streets in a grid format.

2.1 Rainfall data

This methodology is unchanged from the Pilot Area 1 study. The rainfall depths used are for the entire project area. National Oceanic and Atmospheric Administration (NOAA) 14 was utilized to obtain the rainfall data. The NOAA 14 rainfall depths are approximately 0.35 inches less than the NOAA Atlas 2 rainfall data used in the current Maryvale ADMS and Glendale/Peoria ADMPU. The NOAA 14 data was obtained from the NOAA 14 Index Map included with the FCDMC Drainage Design Management System for Windows (DDMSW) software. The NOAA 14 rainfall data is located in **Appendix A**.

2.2 Nomenclature

This has been updated from the Pilot Area 1 study to include additional nomenclature guidelines. The naming conventions for subbasins, routing reaches, diversions and combination points are based on the intersection that each modeling operation is draining to. This intersection could be the intersection of two streets, a street intersecting a river or wash, or a street intersecting a large structure such as the Grand Canal. The first two characters of each subbasin name refer to the east/west boundary (street, channel or structure) that the subbasin drains to. The second two characters are designated based on the name for the north/south boundary (street, channel or structure). The north/south streets that have three digits will only be designated by the last two digits. For example, the subbasin that drains to Happy Valley Road and Lake Pleasant Road will be identified as HVLP. See **Table 1** for the two letter abbreviation associated with each boundary.

Table 1. Boundary Abbreviations

Boundary Name	Abbr.
Jomax Road	JM
Happy Valley Road	HV
Pinnacle Peak Road	PP
Deer Valley Road	DV
Loop 101	LO
Beardsley Road	BY
Union Hills Drive	UH
Bell Road	BL
Greenway Road	GW
Thunderbird Road	TB
Cactus Road	CT
Peoria Avenue	PE

Boundary Name	Abbr.
Olive Avenue	OL
Northern Avenue	NO
Glendale Avenue	GL
Bethany Home Road	BH
Camelback Road	CB
Indian School Road	IS
Thomas Road	TM
McDowell Road	MD
Interstate 10	IN
Grand Avenue	GR
Westwing Parkway	WW
Yearling Road	YL

Table 1. Boundary Abbreviations - Continued

Boundary Name	Abbr.
Black Rock Road	BR
New River	NR
19th Avenue	19
27th Avenue	27
35th Avenue	35
43rd Avenue	43
51st Avenue	51
59th Avenue	59
67th Avenue	67

Boundary Name	Abbr.
75th Avenue	75
83rd Avenue	83
87th Avenue	87
91st Avenue	91
93rd Avenue	93
Lake Pleasant Road	LP
99th Avenue	99
101st Avenue	01
107th Avenue	07

A one or two letter prefix before the intersection identification (e.g. HVLP) indicates the type of modeling operation to be performed. The type of modeling operation indicated by each prefix is identified in **Table 2**.

Table 2. Prefixes for Modeling Operations

Prefix	Type of Modeling Operation
RW	Routing flow in the west direction
RS	Routing flow in the south direction
C	Combination point for surface flow
CP	Combination point for pipe flow with surface flow
S	Storage routing for regional detention/retention basins
ER	Retention for existing developments (based on NOAA 2)
FR	Retention for future developments (based on NOAA 14)
DW	Divert surface flow to the west
DS	Divert surface flow to the south
DR	Divert retrieval from surface flow
D	Divert surface flow (flow that remains after storm drain divert)
DP	Divert flow to a storm drain pipe
PR	Divert retrieval from a storm drain pipe

2.3 Topographic Mapping

The topography for the Pilot Area 2 study was obtained from the FCDMC and contained topographic data files collected from several different projects ranging in date from 1987 to 2005. This topography includes 2-ft, 4-ft and 10-ft contour data. This is typical of the topography for the Glendale/Peoria ADMPU study area. **Exhibit 2** in **Appendix F** shows the areas covered by different topographic sources and the dates of the mapping.

2.4 Subbasin Delineation

To keep this Pilot Area 2 study consistent with the Pilot Area 1 study, where possible, subbasins were delineated to create approximate one square mile areas. Due to the topography some subbasins were subdivided to be smaller than one square mile.

Subbasin delineations were based on major streets, the topography, and the 2009 aerial orthophotography obtained from FCDMC. The subbasin delineations were also checked against the Northwest Region Update subbasin delineations. The subbasin boundaries of the two models are similar, although the subbasins delineated in the Pilot Area 2 study typically encompass several of the subbasins in the Northwest Region Update.

The total area included in Pilot Area 2 was approximately six square miles with a total of eighteen subbasins. The subbasin delineations are located on **Exhibit 3** in **Appendix F**.

2.5 Flowpaths and Times of Concentration

As in the Pilot 1 Area study, the time of concentration was determined using the Papadakis and Kazan equation per the DDM. The calculation is based on the flowpath length, subbasin slope, watershed resistance coefficient (K_b) and the average rainfall excess intensity. DDMSW was utilized to calculate the time of concentration for each subbasin.

Flowpaths were delineated based on a combination of the composite topography and the 2009 aerial orthophotography. It is assumed the runoff for each subbasin will be conveyed in drainage channels where they are present. In some subbasins the flow is directed in several channels to the downstream subbasin. In these subbasins the longest flowpath was used as the representative flowpath for the subbasin. In some areas, flowpaths transition from sheet flow to channel flow in developed areas. When flowpaths travel through developed areas, the 2009 aerial orthophotography was used to delineate the flowpath through drainage channels or in streets. Flowpath delineations are located on **Exhibit 3** in **Appendix F**.

The slope of the subbasin was assumed to be the slope of the flowpath. Elevations were obtained from the composite two-foot, four-foot, and ten-foot contour data provided by the FCDMC. In locations where two-foot contour data was not available, four-foot and ten-foot contour data was used. For consistency, the upstream and downstream elevations of each flowpath were obtained from the same topographic source.

The selection of the K_b value used in the time of concentration calculation can be subjective. For consistency, Figure 5.5 in the DDM provides K_b values based on watershed size and classification. A composite K_b value is computed for each subbasin in DDMSW according to the land use. According to Table 5.3 in the DDM, residential areas are typically assigned a K_b value of Type A. These applications are intended for small developments where flowpaths may run directly from roofs to streets. Based on discussions with the FCDMC, it is appropriate for large master plan areas to represent residential areas with higher roughness coefficients due to the impact of landscaping, walls, and buildings in proportion to lot sizes.

The K_b values used in the Maryvale ADMS, the Glendale/Peoria ADMPU and the Northwest Region Update were reviewed for this analysis. The Maryvale ADMS used K_b values of Type C for residential areas while the Glendale/Peoria ADMPU and Northwest Region Update assigned the K_b value to Type B for residential areas. Based

on engineering judgment, field observations, and model calibration, the K_b values for this study were set to Type C for all residential areas within the project area.

2.6 Land Use

This methodology is unchanged from the Pilot Area 1 study. Land use was obtained from the City of Glendale and the City of Phoenix. Maricopa Association of Governments (MAG) land use was obtained from the FCDMC and used in areas outside of these municipalities. Because Pilot Area 2 is located in the City of Peoria, the land use for this analysis was based on MAG land use.

Land use data is typically based on zoning or general planning information. Each municipality may have different zoning or planning categories for the same type of land use. Land use descriptions for each municipality were related to a MAG land use category for use in DDMSW. The comparison of City of Glendale and City of Phoenix land use descriptions with the associated MAG land use descriptions is located in **Appendix B**.

Existing and future conditions land use files obtained from municipalities and MAG were reviewed with recent orthophotography obtained from the FCDMC. For areas larger than 160 acres, changes were made to the existing conditions land use data to reflect current conditions. No changes will be made to the future conditions land use files. It is assumed that in the future, all currently empty lots will be built out according to the future conditions land use. **Appendix A** provides the general land use parameters as well as the land use for each subbasin. **Appendix F** provides the Land Use Map for the Pilot Area.

2.7 Soils

This methodology is unchanged from the Pilot Area 1 study. GIS shapefiles were obtained from the FCDMC. The soils in the project area are from the SCS Soil Studies *Aguila-Carefree Area, Part of Maricopa and Pinal Counties, Arizona* and *Maricopa County, Arizona, Central Part*. This data was uploaded directly into DDMSW for analysis. The soil data for each subbasin is located in **Appendix A**. The Soils Map is located in **Appendix F**.

2.8 Rainfall Loss Parameters

This methodology is unchanged from the Pilot Area 1 study. The Green and Ampt method was used to estimate rainfall losses. The procedures are outlined in the DDM. Use of the Green and Ampt method requires the estimation of five parameters for each subbasin: initial loss (IA), saturated hydraulic conductivity (XKSAT), volumetric soil moisture deficit (DTHETA), average wetting front suction (PSIF), and effective impervious area (RTIMP). Default values for each of these parameters are provided in DDMSW for each land use and soil type. The default values were evaluated and revised in accordance with the actual watershed characteristics. In general, the vegetative cover was decreased by comparing land use types with the orthophotography. RTIMP and IA values were also evaluated for each land use type. The values for IA are consistent with

those in Table 4.2 of the DDM. The DTHETA values for "normal" moisture conditions were used in most areas, as is consistent with irrigated or watered areas. In areas of vacant land and passive open space which includes mountain preserves and washes, the DTHETA value for "dry" moisture conditions was utilized. **Appendix A** provides the general land use parameters.

2.9 Retention

Areas developed after 1990 were required to retain the 100-year, 2-hour volume on-site. However, there are several developments built prior to 1990 in the project area that did not need to meet these requirements. Because of this discrepancy in retention requirements, developed areas were divided into pre-1990 and post-1990 areas. Areas developed prior to 1990, such as the Pilot 1 Area, were not modeled with retention. Pilot Area 2 includes areas that were developed after 1990 and provides retention based on the 100-year, 2-hour requirement.

The Pilot Area 2 hydrology model was run with NOAA Atlas 2 rainfall data to determine the 100-year, 2-hour volume that developments would have used to determine retention requirements. According to the percent of pre-1990 developed land in each subbasin, 80% of the 100-year, 2-hour retention volume was diverted out of the existing conditions model. The retention calculations are provided in **Appendix D**.

Aerial photography from 1992 was obtained from the FCDMC to identify locations that were developed prior to 1992. Maps from the 1987 Glendale/Peoria Area Drainage Master Plan (ADMP) were used to further identify areas that may have been developed between 1987 and 1992 by comparing the 1987 ADMP maps to the aerials from 1992. These areas were considered to be developed before 1990 and no retention was modeled for these areas. The pre-1990 development areas were compared with the land use to identify areas where development has occurred after 1990. The following land use categories were considered developed areas: business parks, commercial, educational, golf courses, industrial, institutional, offices, passive open space, public facilities, residential, vacant land, and water (typically associated with golf courses). **Exhibit 6** in **Appendix F** identifies the pre-1990 developments and the post-1990 developments in the Pilot Area 2.

2.10 Routing

Two types of flow routing were identified in the project area. The first routing method was discussed in the Pilot Area 1 study. This type of routing occurs along the streets and may exit the subbasin at any point along the downstream boundary of the subbasin. Because this method was discussed in the Pilot Area 1 study it will not be discussed further here, but it should be noted that all locations in the project area where the streets are in a typical grid pattern will utilize this routing method.

The second routing method utilized in the project area conveys the runoff in channels. This is the routing method used in the Pilot Area 2 study. It should be noted that there

are some subbasins in the Pilot Area 2 where flow is directed down streets. In these instances the streets are acting as channels.

The flow will be routed through the downstream subbasins using the Modified Puls (Normal Depth) routine. The normal depth routing method allows the definition of an eight-point representative cross section for the routing reach with overbank and main channel roughness values.

Four typical channel sizes were created to represent various channel cross sections. Channel sizes were assigned to routing reaches based on 2009 aerial orthophotography and field inspection. In some locations a street may act as a channel for the routing reach. To simplify street calculations, each street was categorized as either arterial, collector, or local. In Pilot Area 2, the mile streets are designated as arterials, the half-mile streets as collectors, and all other streets are local streets. For all areas outside the City of Glendale limits, typical street sections were created based on an average geometry of typical street sections from the City of Phoenix and the City of Peoria. **Appendix C** provides the typical channel and street sections utilized for each channel size and street designation referenced above.

Channel slopes were calculated using the length of the routing reach and upstream and downstream elevation using the composite topographic data provided by the FCDMC. For consistency, the upstream and downstream elevations of each routing reach were obtained from the same topographic source. The Manning's roughness coefficients for channel sections are 0.035 for both the channel and overbank. The street sections have Manning's roughness coefficients of 0.015 in the channel and 0.035 in the overbanks. The Subbasin Delineation Map, **Exhibit 3** in **Appendix F**, shows the location of the routing reaches.

2.11 Diversions

Two primary types of diversions will be utilized in the project area where the streets are not in a grid format: storm drain diversions and subbasin diversions. The storm drain diversions divert flow from the streets into the storm drain. The subbasin diversions estimate the amount of subbasin runoff that will be diverted in each direction. The subbasin diversions that occur in the project area where the streets are not in a grid format typically occur at street intersections. See **Exhibit 3** in **Appendix F** for the diversion located in Pilot Area 2.

2.11.1 Storm Drain Diversions

The storm drain diversions divert the full flow capacity of the storm drain away from the surface flow. Full flow capacities were estimated based on the slope and the diameter of the pipe. There are no storm drains in Pilot Area 2. However storm drain diversions that occur in areas where the streets are not in a grid format will follow the same methodology as storm drains that are located in grid format areas.

Following is a summary of how storm drain diversions were modeled in Pilot Area 1 and will be applied to the entire project area. Storm drain flow was accounted for at each

subbasin location adjacent to a storm drain system with a diameter 24 inches or greater. After each subbasin hydrograph, the full flow capacity of the pipe was diverted into the storm drain. To better facilitate tracking flow in the storm drain, it was retrieved after each combination point. The storm drain retrieval was combined with the surface flow and then the full flow capacity of the pipe was diverted back into the storm drain.

The flow will be routed through the storm drain using the Kinematic Wave routing method. The slope and diameter of the pipe is determined from the GIS storm drain databases received from the City of Glendale, the City of Phoenix, and the City of Peoria.

2.11.2 Subbasin Diversions

The subbasin diversions estimate how much of the runoff in a subbasin will flow in different directions. The subbasin diversions that occur in the project area where the streets are not in a grid format typically occur at street intersections. The diversion is a constant ratio based on normal depth calculations using Manning's equation. The ratio is based on a comparison of the width and the slope of the north/south street with the width and the slope of the east/west street. A more detailed explanation can be found in **Appendix D**.

Similar to routing reaches that occur along streets, the streets utilized in the diversion calculations were categorized as arterial, collector, or local. **Appendix C** provides the typical sections utilized for each street designation referenced above. Calculations for the diversions are located in **Appendix D**.

3.0 Results and Verification

The purpose of the hydrology model developed in this Pilot Area 2 study for the Glendale Stormwater Management Plan is to establish the hydrology methodology that will be utilized to model the Maryvale and Glendale/Peoria study areas where the streets are not in a grid formation. Verification of the results was conducted and the results are reasonable.

The Pilot Area 2 model was run using NOAA Atlas 2 for comparison with previous hydrology models. The 100-year peak discharge generated in each subbasin was compared with the corresponding subbasins in the Northwest Region Update. In order to make the comparison on a subbasin basis, the peak flow from several subbasins in the Northwest Region Update were combined and compared to a comparable subbasin in the Pilot Area 2 study.

Overall, the peak discharges from Pilot Area 2 are 7% higher than the Northwest Region Update. A comparison of land use parameters showed that the Northwest Region Update typically used higher vegetative cover percentages than the Pilot Area 2 study. The land use parameters selected for the Pilot Area 2 study, including vegetative cover and percent impervious, were analyzed based on recent 2009 aerial orthophotography. Documentation is provided in **Appendix B**. HEC-1 model results are located in **Appendix E**.

The peak discharge values for the subbasins and combination points in this Pilot Study were compared with the USGS data derived from *Methods for Estimating Magnitude and Frequency of Floods in the Southwestern United States* provided as part of the DDMSW software. **Figure 1** in **Appendix E** provides the peak discharge values shown with the data for Region 12. The Envelope curve shows the envelope curve for the study area, the Region curve represents the 100-year peak discharge relation for the region, and the Low-Mid Elevation curve is the 100-year peak discharge relation for low to middle-elevation study areas. The graph shows that the values fall within an acceptable range for this region. It should be noted that the USGS data is for undeveloped watersheds. Urbanized watersheds can have can have significantly higher discharges.

4.0 References

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7. Flood Control District of Maricopa County (FCDMC). *Drainage Design Manual for Maricopa County – Volume 1 Hydrology*. Draft edition. 2009.
8. FCDMC. DDMSW version 4.1.9 NOAA 14 Maps.
9. FCDMC. GIS shapefiles including soils and MAG landuse, DTM data and orthophotographic tiles in electronic format for the project area. Extracted from the database July 24, 2009.
10. FCDMC. *Glendale/Peoria Area Drainage Master Plan Update Hydrology Report*. Prepared by Entellus. May 30, 2001.
11. FCDMC. *Glendale/Peoria Area Drainage Master Plan Update Northwest Region Update Hydrology Study*. Prepared by Wood, Patel & Associates, Inc. May 2007.
12. FCDMC. *Maryvale Area Drainage Master Study Hydrology*. Prepared by Wood, Patel & Associates, Inc. February 1997.
13. FCDMC. *Metro Phoenix Area Drainage Master Study/Plan Hydrology Study Report*. Prepared by Wood, Patel & Associates, Inc. October 2006.

Appendix A DDMSW Data

Rainfall Data

Land Use Default Data

Land Use by Subbasin

Soils by Subbasin

Subbasin Data

City of Glenale and FCDMC
Drainage Design Management System
RAINFALL DATA
Project Reference: GLENDALE SMP-PILOT2

11/3/2009

ID	Method	Duration	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
DEFAULT	NOAA14	5 MIN	0.274	0.370	0.445	0.544	0.620	0.699
	NOAA14	10 MIN	0.417	0.564	0.677	0.828	0.944	1.064
	NOAA14	15 MIN	0.517	0.699	0.839	1.026	1.170	1.319
	NOAA14	30 MIN	0.696	0.941	1.130	1.382	1.576	1.776
	NOAA14	1 HOUR	0.861	1.165	1.398	1.710	1.951	2.198
	NOAA14	2 HOUR	0.992	1.322	1.577	1.921	2.184	2.457
	NOAA14	3 HOUR	1.030	1.353	1.609	1.961	2.240	2.532
	NOAA14	6 HOUR	1.193	1.524	1.787	2.151	2.434	2.730
	NOAA14	12 HOUR	1.345	1.697	1.975	2.349	2.635	2.931
	NOAA14	24 HOUR	1.557	2.007	2.362	2.853	3.242	3.647

City of Glenale and FCDMC
Drainage Design Management System
Agency: FCDMC - LAND USE DEFAULTS
Project Reference: GLENDALE SMP-PILOT2

Code	Description	Initial Abstraction IA	Percent Impervious RTIMP	Vegetation Cover	Moisture Deficit DTHETA	Resistance Coefficient Kb
Agriculture						
750	Agriculture	0.50	-	85.0	ORMAL	LOW
Commercial						
200	General Commercial (Commercial where no detail available)	0.10	80	5.0	ORMAL	MIN
220	Neighborhood Commercial (50,000 to 100,000 sq. ft.)	0.10	80	10.0	ORMAL	MIN
230	Community Commercial (100,000 to 500,000 sq. ft.)	0.10	80	10.0	ORMAL	MIN
240	Regional Commercial (500,000 to 1,000,000 sq. ft.)	0.10	85	5.0	ORMAL	MIN
250	Super-Regional Commercial (>= 1,000,000 sq. ft.)	0.10	80	0.0	ORMAL	MIN
Industrial						
320	Industrial	0.15	80	0.0	ORMAL	MIN
Institutional						
500	Educational (Universities)	0.29	45	30.0	ORMAL	MIN
520	Educational (Schools)	0.29	45	40.0	ORMAL	MIN
530	Institutional (Includes hospitals and churches)	0.10	80	5.0	ORMAL	HI
550	Public Facilities (comm centers, libraries, etc)	0.10	80	10.0	ORMAL	MIN
555	Public Facilities (sub-stations)	0.10	5	0.0	DRY	MIN
Office						
400	Office General (Office where no detail available)	0.10	75	5.0	ORMAL	HI
810	Business Park (enclosed industrial, office or retail)	0.10	80	5.0	ORMAL	HI
Open Space						
710	Active Open Space (Includes parks)	0.10	5	80.0	ORMAL	MIN
720	Golf courses	0.10	5	90.0	ORMAL	MIN
730	Passive Open Space (Includes mountain preserves and washes)	0.10	-	5.0	DRY	HI
740	Water	0.00	-	0.0	WET	MIN
900	Vacant (Existing land use database only)	0.30	-	5.0	DRY	LOW
Residential						
120	Estate Residential (1/5 du per acre to 1 du per acre)	0.30	5	50.0	ORMAL	HI
130	Large Lot Residential - Single Family (1-2 du per acre)	0.30	15	30.0	ORMAL	HI
140	Medium Lot Residential - Single Family (2-4 du per acre)	0.25	30	15.0	ORMAL	HI
150	Small Lot Residential - Single Family (4-6 du per acre)	0.25	30	15.0	ORMAL	HI
170	Medium Density Residential - Muli Family (5-10 du per acre)	0.25	45	10.0	ORMAL	HI
180	High Density Residential - Multi Family (10-15 du per acre)	0.25	45	5.0	ORMAL	HI
190	Very High Density Residential - Multi Family (>15 du per ac)	0.25	45	5.0	ORMAL	HI
Transportation						
610	Transportation (railways, transit centers, freeways)	0.10	80	5.0	ORMAL	MIN
620	Airports (Includes public use airports)	0.15	55	5.0	ORMAL	MIN

Note: Land use default values have been revised for the project area.

Sub Basin	Land Use Code	Area (sq mi)	AreaInitial Loss (IA) (%)	Percent Impervious (RTIMP)	Vegetable Cover (%)	DTHETA	Kb
Major Basin ID: P2							
83RS	140	0.336	52.7	0.25	30	15.0 NORMAL	0.085
	730	0.301	47.3	0.10	0	5.0 DRY	0.085
		0.638	**100.0**				
HV01	140	0.348	78.4	0.25	30	15.0 NORMAL	0.089
	240	0.074	16.7	0.10	85	5.0 NORMAL	0.025
	900	0.022	4.9	0.30	0	5.0 DRY	0.046
		0.444	**100.0**				
HV07	140	0.106	34.7	0.25	30	15.0 NORMAL	0.093
	730	0.002	0.5	0.10	0	5.0 DRY	0.093
	900	0.197	64.8	0.30	0	5.0 DRY	0.049
		0.304	**100.0**				
HV83	730	0.035	100.0	0.10	0	5.0 DRY	0.116
		0.035	**100.0**				
HV87	130	0.000	0.1	0.30	15	30.0 NORMAL	0.093
	730	0.285	99.9	0.10	0	5.0 DRY	0.093
		0.285	**100.0**				
HV93	130	0.125	72.5	0.30	15	30.0 NORMAL	0.099
	730	0.047	27.5	0.10	0	5.0 DRY	0.099
		0.172	**100.0**				
HVAF	730	0.085	39.6	0.10	0	5.0 DRY	0.097
	900	0.130	60.4	0.30	0	5.0 DRY	0.051
		0.215	**100.0**				
HVLP	130	0.054	27.2	0.30	15	30.0 NORMAL	0.097
	140	0.053	27.0	0.25	30	15.0 NORMAL	0.097
	240	0.085	43.2	0.10	85	5.0 NORMAL	0.027
	730	0.005	2.5	0.10	0	5.0 DRY	0.097
		0.198	**99.9**				
HVRS	140	0.014	2.2	0.25	30	15.0 NORMAL	0.085
	730	0.616	97.8	0.10	0	5.0 DRY	0.085
	900	0.000		0.30	0	5.0 DRY	0.044
		0.630	**100.0**				
JM99	140	0.411	72.4	0.25	30	15.0 NORMAL	0.086
	730	0.033	5.7	0.10	0	5.0 DRY	0.086
	900	0.124	21.9	0.30	0	5.0 DRY	0.045
		0.568	**100.0**				
JMAF	730	0.061	41.3	0.10	0	5.0 DRY	0.101
	900	0.086	58.7	0.30	0	5.0 DRY	0.053
		0.147	**100.0**				
JMLP	130	0.071	10.0	0.30	15	30.0 NORMAL	0.084
	140	0.491	69.6	0.25	30	15.0 NORMAL	0.084
	150	0.066	9.4	0.25	30	15.0 NORMAL	0.084
	710	0.000		0.10	5	80.0 NORMAL	0.023
	730	0.077	11.0	0.10	0	5.0 DRY	0.084
		0.705	**100.0**				
JMNR	150	0.054	32.7	0.25	30	15.0 NORMAL	0.099
	730	0.008	4.6	0.10	0	5.0 DRY	0.099
	900	0.103	62.7	0.30	0	5.0 DRY	0.052

Sub Basin	Land Use Code	Area (sq mi)	AreaInitial Loss (IA) (%)		Percent Impervious (RTIMP)	Vegetable Cover (%)	DTHETA	Kb
Major Basin ID: P2								
		0.164	**100.0**					
JMRS	140	0.289	50.9	0.25	30	15.0	NORMAL	0.086
	730	0.118	20.9	0.10	0	5.0	DRY	0.086
	900	0.160	28.2	0.30	0	5.0	DRY	0.045
		0.567	**100.0**					
WWBR	140	0.152	82.8	0.25	30	15.0	NORMAL	0.098
	730	0.032	17.2	0.10	0	5.0	DRY	0.098
		0.184	**100.0**					
WWLP	140	0.095	69.6	0.25	30	15.0	NORMAL	0.102
	730	0.041	30.4	0.10	0	5.0	DRY	0.102
		0.136	**100.0**					
WWRS	140	0.021	14.3	0.25	30	15.0	NORMAL	0.101
	150	0.043	30.2	0.25	30	15.0	NORMAL	0.101
	520	0.025	17.3	0.29	45	40.0	NORMAL	0.028
	710	0.038	26.5	0.10	5	80.0	NORMAL	0.028
	730	0.017	11.7	0.10	0	5.0	DRY	0.101
		0.144	**100.0**					
YLLP	130	0.367	61.6	0.30	15	30.0	NORMAL	0.085
	140	0.110	18.4	0.25	30	15.0	NORMAL	0.085
	240	0.055	9.2	0.10	85	5.0	NORMAL	0.024
	730	0.064	10.8	0.10	0	5.0	DRY	0.085
		0.595	**100.0**					

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)
Major Basin ID: P2								
HV01	651	BE	6512228	0.008	1.80	0.24	-	100
	651	PT	6515058	0.046	10.30	0.40	-	100
	651	Vf	6516231	0.076	17.20	0.01	-	100
	651	PWB	651506422	0.314	70.70	0.38	-	100
HV07	651	CF	6512430	0.041	13.50	0.50	-	100
	651	PT	6515058	0.230	75.70	0.40	-	100
	651	PWB	651506422	0.031	10.10	0.38	-	100
	651	TPB	651585022	0.002	0.70	0.12	-	100
HV83	645	18	64518	0.011	1.70	0.33	15.00	100
	645	118	645118	0.017	2.60	0.42	-	100
	651	AL	6512042	0.069	10.70	0.40	-	100
	651	CO	6512448	0.060	9.40	0.29	20.00	100
	651	RS	6515456	0.197	30.90	0.40	65.00	100
	651	GWD	651326426	0.101	15.80	0.35	-	100
	651	PWB	651506422	0.040	6.20	0.38	-	100
	651	TSC	651585624	0.144	22.60	0.14	-	100
HV87	651	RS	6515456	0.152	53.30	0.40	65.00	100
	651	GWD	651326426	0.040	13.80	0.35	-	100
	651	PWB	651506422	0.094	32.90	0.38	-	100
HV93	651	CO	6512448	0.001	0.70	0.29	20.00	100
	651	GN	6513246	0.014	8.00	0.25	-	100
	651	RS	6515456	0.051	29.70	0.40	65.00	100
	651	GWD	651326426	0.000	0.10	0.35	-	100
	651	GYD	651326826	0.008	4.90	0.26	-	100
	651	PWB	651506422	0.097	56.60	0.38	-	100
HVAF	645	10	64510	0.002	0.70	0.94	-	100
	651	CF	6512430	0.127	59.20	0.50	-	100
	651	GM	6513244	0.083	38.50	0.29	-	100
	651	PT	6515058	0.004	1.70	0.40	-	100
HVLP	651	BE	6512228	0.009	4.60	0.24	-	100
	651	CV	6512462	0.076	38.30	0.39	-	100
	651	GN	6513246	0.001	0.30	0.25	-	100
	651	GYD	651326826	0.058	29.20	0.26	-	100
	651	PWB	651506422	0.055	27.60	0.38	-	100
HVRS	645	3	6453	0.002	0.30	0.58	-	100
	645	115	645115	0.001	0.20	0.39	-	100
	645	118	645118	0.001	0.10	0.42	-	100
	651	AL	6512042	0.123	19.50	0.40	-	100
	651	GM	6513244	0.081	12.80	0.29	-	100
	651	GN	6513246	0.011	1.80	0.25	-	100
	651	AGB	651203222	0.365	57.90	0.40	-	100
	651	GWD	651326426	0.013	2.00	0.35	-	100
	651	PWB	651506422	0.027	4.30	0.38	-	100
	651	TSC	651585624	0.006	1.00	0.14	-	100
JM99	645	13	64513	0.322	56.60	0.01	-	100
	645	18	64518	0.029	5.20	0.33	15.00	100
	645	21	64521	0.002	0.40	0.38	-	100
	645	53	64553	0.011	1.90	0.02	-	100
	645	110	645110	0.190	33.50	0.13	-	100
	651	PT	6515058	0.002	0.30	0.40	-	100
	651	Vf	6516231	0.003	0.50	0.01	-	100
	651	PWB	651506422	0.009	1.60	0.38	-	100
JMAF	645	10	64510	0.005	3.10	0.94	-	100
	645	18	64518	0.050	33.90	0.33	15.00	100
	645	110	645110	0.061	41.60	0.13	-	100
	651	CF	6512430	0.003	2.20	0.50	-	100
	651	PT	6515058	0.028	19.20	0.40	-	100
JMLP	645	13	64513	0.104	14.80	0.01	-	100
	645	18	64518	0.041	5.80	0.33	15.00	100
	645	21	64521	0.136	19.30	0.38	-	100

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)
Major Basin ID: P2								
JMLP	645	110	645110	0.225	31.90	0.13	-	100
	645	112	645112	0.075	10.60	0.39	-	100
	651	CO	6512448	0.114	16.20	0.29	20.00	100
	651	PT	6515058	0.010	1.40	0.40	-	100
JMNR	645	3	6453	0.073	44.60	0.58	-	100
	645	10	64510	0.001	0.30	0.94	-	100
	645	18	64518	0.045	27.20	0.33	15.00	100
	645	21	64521	0.008	4.90	0.38	-	100
	645	55	64555	0.007	4.00	0.27	-	100
	645	75	64575	0.010	6.30	0.23	-	100
	645	100	645100	0.009	5.20	0.40	20.00	100
	645	110	645110	0.001	0.80	0.13	-	100
	645	115	645115	0.011	6.70	0.39	-	100
JMRS	645	13	64513	0.024	4.20	0.01	-	100
	645	18	64518	0.023	4.10	0.33	15.00	100
	645	21	64521	0.021	3.70	0.38	-	100
	645	100	645100	0.067	11.90	0.40	20.00	100
	645	110	645110	0.278	49.10	0.13	-	100
	645	112	645112	0.016	2.90	0.39	-	100
	645	115	645115	0.082	14.50	0.39	-	100
	645	118	645118	0.053	9.30	0.42	-	100
	651	AL	6512042	0.001	0.10	0.40	-	100
	651	TSC	651585624	0.002	0.30	0.14	-	100
WWBR	645	13	64513	0.026	14.30	0.01	-	100
	645	100	645100	0.018	9.50	0.40	20.00	100
	645	110	645110	0.137	74.20	0.13	-	100
	645	112	645112	0.004	2.00	0.39	-	100
WWLP	645	13	64513	0.026	19.30	0.01	-	100
	645	100	645100	0.023	17.20	0.40	20.00	100
	645	110	645110	0.086	63.50	0.13	-	100
WWRS	645	18	64518	0.091	63.30	0.33	15.00	100
	645	21	64521	0.007	4.70	0.38	-	100
	645	110	645110	0.004	2.60	0.13	-	100
	645	112	645112	0.039	26.80	0.39	-	100
	651	CO	6512448	0.004	2.60	0.29	20.00	100
YLLP	651	CO	6512448	0.228	38.30	0.29	20.00	100
	651	CV	6512462	0.030	5.00	0.39	-	100
	651	PT	6515058	0.049	8.20	0.40	-	100
	651	RS	6515456	0.045	7.60	0.40	65.00	100
	651	GWD	651326426	0.157	26.40	0.35	-	100
	651	GYD	651326826	0.025	4.20	0.26	-	100
	651	PWB	651506422	0.062	10.40	0.38	-	100

Area ID	Sub Basin Parameters: Area (sq mi)	Length (mi)	Slope (ft/mi)	Adj Slope	Time-Area	Kb	Rainfall Losses: IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)		Return Period Parameters: 2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
Major Basin ID: P2																		
JM99	0.568	1.10	44.7	44.7	Urban	0.077	0.25	0.15	10.10	0.03	23	**Tc (Hrs)**	0.910	0.910	0.874	0.803	0.761	0.724
												Vel (f/s)	1.77	1.77	1.85	2.01	2.12	2.23
												R (Hrs)	0.497	0.497	0.475	0.432	0.407	0.385
83RS	0.638	0.91	472.6	299.3	Urban	0.085	0.18	0.30	4.50	0.30	38	**Tc (Hrs)**	0.546	0.546	0.523	0.475	0.443	0.416
												Vel (f/s)	2.44	2.44	2.55	2.81	3.01	3.21
												R (Hrs)	0.226	0.226	0.216	0.194	0.180	0.167
HV01	0.444	1.09	50.1	50.1	Urban	0.076	0.23	0.26	5.30	0.21	38	**Tc (Hrs)**	0.944 *	0.944 *	0.905	0.821	0.769	0.724
												Vel (f/s)	1.69	1.69	1.77	1.95	2.08	2.21
												R (Hrs)	0.591	0.591	0.563	0.506	0.470	0.440
HV07	0.304	0.62	139.0	139.0	Urban	0.064	0.28	0.32	3.92	0.41	10	**Tc (Hrs)**	0.577	0.577	0.542	0.479	0.443	0.413
												Vel (f/s)	1.58	1.58	1.68	1.90	2.05	2.20
												R (Hrs)	0.270	0.270	0.252	0.220	0.202	0.186
HV83	0.035	0.38	736.8	313.0	Urban	0.116	0.10	0.35	4.15	0.37	20	**Tc (Hrs)**	0.436	0.436	0.416	0.373	0.348	0.325
												Vel (f/s)	1.28	1.28	1.34	1.49	1.60	1.71
												R (Hrs)	0.459	0.459	0.435	0.386	0.357	0.331
HV87	0.285	0.52	796.9	313.0	Urban	0.093	0.10	0.35	4.00	0.39	35	**Tc (Hrs)**	0.429	0.429	0.411	0.373	0.350	0.329
												Vel (f/s)	1.78	1.78	1.86	2.04	2.18	2.32
												R (Hrs)	0.175	0.175	0.167	0.150	0.140	0.131
HV93	0.172	0.67	512.6	304.0	Urban	0.099	0.25	0.28	4.15	0.43	30	**Tc (Hrs)**	0.526	0.526	0.501	0.453	0.424	0.398
												Vel (f/s)	1.87	1.87	1.96	2.17	2.32	2.47
												R (Hrs)	0.359	0.359	0.340	0.304	0.282	0.263
HVAF	0.215	0.45	52.2	52.2	Urban	0.069	0.22	0.35	3.92	0.41		**Tc (Hrs)**	0.738	0.738	0.688	0.601	0.552	0.511
												Vel (f/s)	0.89	0.89	0.96	1.10	1.20	1.29
												R (Hrs)	0.335	0.335	0.310	0.267	0.243	0.222
HVLP	0.198	1.05	69.2	69.2	Urban	0.067	0.19	0.25	4.30	0.36	49	**Tc (Hrs)**	0.771	0.771	0.742	0.679	0.640	0.604
												Vel (f/s)	2.00	2.00	2.08	2.27	2.41	2.55
												R (Hrs)	0.726	0.726	0.695	0.630	0.590	0.553

* Non default value or value out of range

Area ID	Sub Basin Parameters						Rainfall Losses						Return Period Parameters					
	Area (sq mi)	Length (mi)	Slope (ft/mi)	Adj Slope	Time-Area	Kb	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)		2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
Major Basin ID: P2																		
HVRS	0.630	1.45	37.3	37.3	NATURAL	0.085	0.10	0.35	4.10	0.38	1	**Tc (Hrs)**	1.500*	1.500*	1.500*	1.334*	1.224*	1.122*
												Vel (f/s)	1.42	1.42	1.42	1.59	1.74	1.90
												R (Hrs)	1.017	1.017	1.017	0.893	0.811	0.737
JMAF	0.147	0.84	252.6	241.4	Urban	0.073	0.22	0.35	4.90	0.24	5	**Tc (Hrs)**	0.581	0.581	0.550	0.487	0.448	0.415
												Vel (f/s)	2.12	2.12	2.24	2.53	2.75	2.97
												R (Hrs)	0.525	0.525	0.494	0.432	0.394	0.361
JMLP	0.705	1.26	103.6	103.6	Urban	0.084	0.24	0.27	6.00	0.16	29	**Tc (Hrs)**	0.892	0.892	0.848	0.759	0.709	0.667
												Vel (f/s)	2.07	2.07	2.18	2.43	2.61	2.77
												R (Hrs)	0.479	0.479	0.453	0.400	0.371	0.347
JMNR	0.164	0.67	118.3	118.3	Urban	0.070	0.27	0.32	3.88	0.42	15	**Tc (Hrs)**	0.640	0.640	0.604	0.538	0.499	0.465
												Vel (f/s)	1.54	1.54	1.63	1.83	1.97	2.11
												R (Hrs)	0.459	0.459	0.430	0.378	0.348	0.322
JMRS	0.567	1.37	400.3	288.5	Urban	0.074	0.23	0.31	5.30	0.20	18	**Tc (Hrs)**	0.662	0.662	0.630	0.562	0.520	0.485
												Vel (f/s)	3.04	3.04	3.19	3.58	3.86	4.14
												R (Hrs)	0.416	0.416	0.394	0.347	0.318	0.295
WWBR	0.184	0.64	792.4	313.0	Urban	0.098	0.22	0.18	7.00	0.10	27	**Tc (Hrs)**	0.450	0.450	0.430	0.391	0.368	0.348
												Vel (f/s)	2.09	2.09	2.18	2.40	2.55	2.70
												R (Hrs)	0.280	0.280	0.266	0.239	0.224	0.211
WWLP	0.136	0.51	689.0	313.0	Urban	0.102	0.20	0.21	7.00	0.10	24	**Tc (Hrs)**	0.415	0.415	0.396	0.359	0.337	0.319
												Vel (f/s)	1.80	1.80	1.89	2.08	2.22	2.34
												R (Hrs)	0.253	0.253	0.240	0.216	0.201	0.189
WWRS	0.144	0.76	125.4	125.4	Urban	0.069	0.20	0.26	4.30	0.44	32	**Tc (Hrs)**	0.601	0.601	0.574	0.520	0.487	0.458
												Vel (f/s)	1.85	1.85	1.94	2.14	2.29	2.43
												R (Hrs)	0.509	0.509	0.484	0.434	0.404	0.377
YLLP	0.595	1.53	309.4	266.6	Urban	0.080	0.25	0.26	4.35	0.38	35	**Tc (Hrs)**	0.727	0.727	0.695	0.630	0.591	0.553
												Vel (f/s)	3.09	3.09	3.23	3.56	3.80	4.06
												R (Hrs)	0.491	0.491	0.467	0.419	0.390	0.362

* Non default value or value out of range

Appendix B Land Use Data

Comparison of Glendale and Phoenix Land Use with MAG Land Use Parameters Documentation

Kimley-Horn and Associates, Inc.

Project: ***Glendale Stormwater Management Plan***
Subject: **City of Glendale and Phoenix Land Uses Associated with MAG Land Use**
Designed by: **MAF** Date 8/20/2009 KHA Project No. 091910009
Checked by: Date City of Glendale No. 089017

City of Glendale Land Use Types Associated with MAG Land Use Types

City of Glendale Code	City of Glendale Land Use Description	MAG Code	MAG Land Use Description
0-1	Low Density Residential: 0 - 1 du/ac	120	Estate Residential (1/5 du per acre to 1 du per acre)
1-2.5	Low Density Residential: 1 - 2.5 du/ac	130	Large Lot Residential (1-2 du per acre)
2.5-3.5	Medium Density Residential: 2.5 - 3.5 du/ac	140	Medium Lot Residential - Single Family (2-4 du per acre)
2.5-3.5	Medium Density Residential: 2.5 - 3.5 du/ac	140	Medium Lot Residential - Single Family (2-4 du per acre)
3.5-5	Medium Density Residential: 3.5 - 5.0 du/ac	150	Small Lot Residential - Single Family (4-6 du per acre)
5-8	Medium-High Density Residential: 5.0 - 8.0 du/ac	170	Medium Density Residential - Multi Family (5-10 du per acre)
8-12	Medium-High Density Residential: 8.0 - 12.0 du/ac	180	High Density Residential - Multi Family (10-15 du per acre)
12-20	High Density Residential: 12.0 - 20.0 du/ac	190	Very High Density Residential - Multi Family (>15 du per acre)
20-30	High Density Residential: 20.0 - 30.0 du/ac	190	Very High Density Residential - Multi Family (>15 du per acre)
OFC	Office	400	Office
BP	Business Park	810	Business Park (enclosed industrial, office or retail)
CCC	Corporate Commerce Center	810	Business Park (enclosed industrial, office or retail)
EMU	Entertainment Mixed-Use (Residential Commercial)	220	Neighborhood Commercial (50,000 to 100,000 sq. ft.)
EMU	Entertainment Mixed-Use (Regional Commercial)	250	Super-Regional Commercial (>= 100,000 sq. ft.)
GC	General Commercial	200	General Commercial (Commercial where no detail available)
PC	Planned Commercial		*Review - Commercial or Vacant Land
EDU	Educational (Glendale Community College)	500	Educational (Universities)
EDU	Educational	520	Educational (Schools)
INST	Institutional	530	Institutional (Includes hospitals and churches)
LI	Light Industrial	320	Industrial
HI	Heavy Industrial	320	Industrial
LUCU	Luke Compatible Land Use Area	750	Agriculture
P/OS	Parks and Open-Space	710	Active open space (Includes parks)
PF	Public Facility (public buildings)	550	Public Facilities (comm centers, libraries, etc.)
PF	Public Facility (sub-stations)	555	Public Facilities (sub-stations)
PF	Public Facility (airport)	620	Airports (includes public use airports)

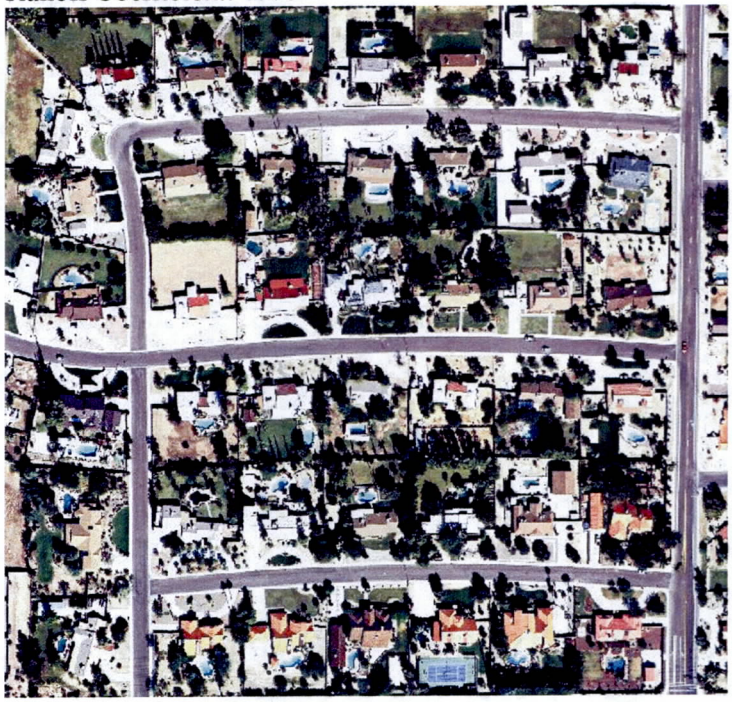
City of Phoenix Land Use Types Associated with MAG Land Use Types

City of Phoenix Code	City of Phoenix Land Use Description	MAG Code	MAG Land Use Description
20	Residential 0 to 2 du / acre	120	Estate Residential (1/5 du per acre to 1 du per acre)
24	Residential 1 to 2 du / acre	130	Large Lot Residential (1-2 du per acre)
35	Residential 2 to 3.5 du / acre	140	Medium Lot Residential - Single Family (2-4 du per acre)
38	Residential 3.5 to 5 du / acre	150	Small Lot Residential - Single Family (4-6 du per acre)
40	Residential 5 to 10 du / acre	170	Medium Density Residential - Multi Family (5-10 du per acre)
41	Residential 5 to 15 du / acre	180	High Density Residential - Multi Family (10-15 du per acre)
47	Residential 10 to 15 du / acre	180	High Density Residential - Multi Family (10-15 du per acre)
50	Residential 15+ du / acre	190	Very High Density Residential - Multi Family (>15 du per acre)
70	Commercial	200	General Commercial (Commercial where no detail available)
110	Industrial	320	Industrial
120	Commerce / Business Park	810	Business Park (enclosed industrial, office or retail)
140	Public / Quasi-Public	520	Educational (Schools)
180	Transportation	600	Transportation (railways, transit centers, freeways)
190	Airport	620	Airports (includes public use airports)
200	Parks / Open Space-Public		*Review - Public Facilities or Passive Open Space
201	Parks / Open Space-Private	720	Passive Open Space (includes mountain preserves and washes)
204	Parks / Open Space - Future 1 du	730	Passive Open Space (includes mountain preserves and washes)
247	MU (Commercial / Commerce- Business Park)	200	General Commercial (Commercial where no detail available)
971	Preserves / 0-1 & 1-2 du / acre	730	Passive Open Space (includes mountain preserves and washes)
983	Preserves / Water	730	Passive Open Space (includes mountain preserves and washes)

Vegetative Cover and Runoff Coefficients per Land Use Type

LU 120: Estate Residential
Vegetative Cover: 50%
Runoff Coefficient: 5%

LU 130: Large Lot Residential
Vegetative Cover: 30%
Runoff Coefficient: 15%



LU 140: Medium Lot Residential
Vegetative Cover: 15%
Runoff Coefficient: 30%

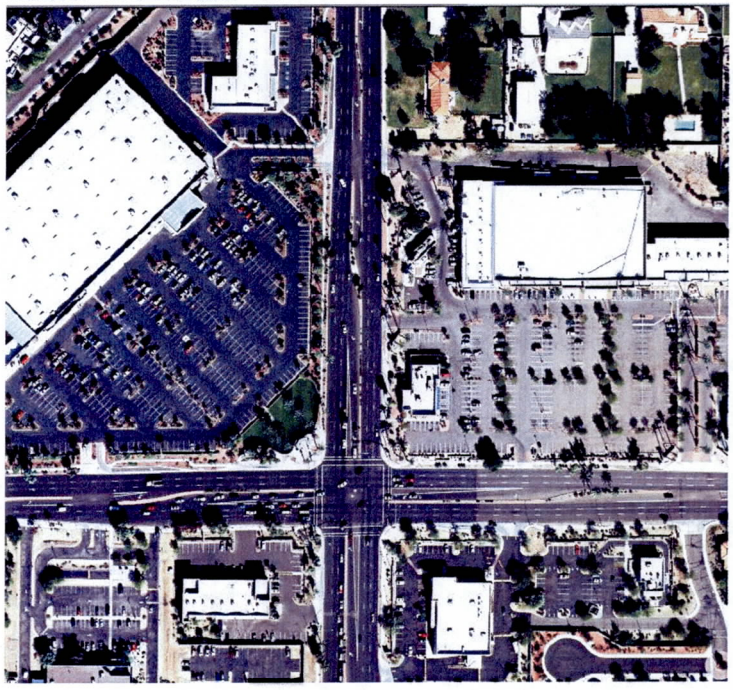
LU 150: Medium Density Residential
Vegetative Cover: 15%
Runoff Coefficient: 30%

LU 170: Medium High Density Residential
Vegetative Cover: 5-10%
Runoff Coefficient: 45%

LU 180: High Density Residential
Vegetative Cover: 5%
Runoff Coefficient: 45%

LU 190: Very High Density Residential
Vegetative Cover: 5%
Runoff Coefficient: 45%

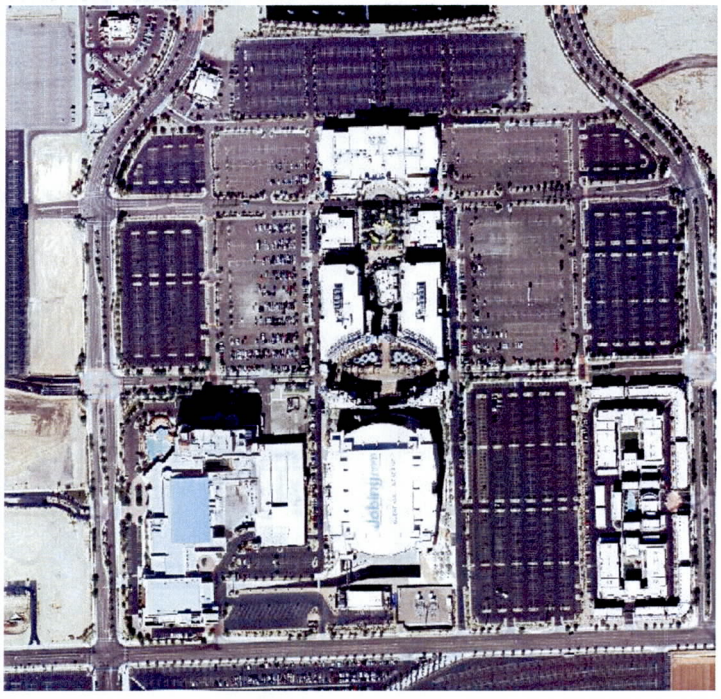
LU 200: General Commercial
Vegetative Cover: 0-5%
Runoff Coefficient: 80%



LU 220: Neighborhood Commercial (mixed use)
Vegetative Cover: 5-10%
Runoff Coefficient: 75%

LU 240: Regional Commercial
Vegetative Cover: 5%
Runoff Coefficient: 85%

LU 250: Super-Regional Commercial (mixed use)
Vegetative Cover: 0%
Runoff Coefficient: 85%

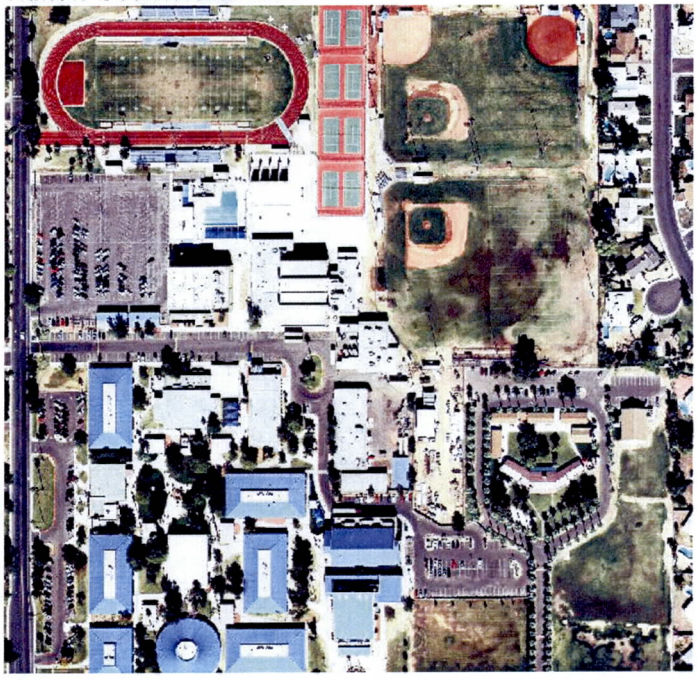


LU 320: Industrial
Vegetative Cover: 0%
Runoff Coefficient: 80%

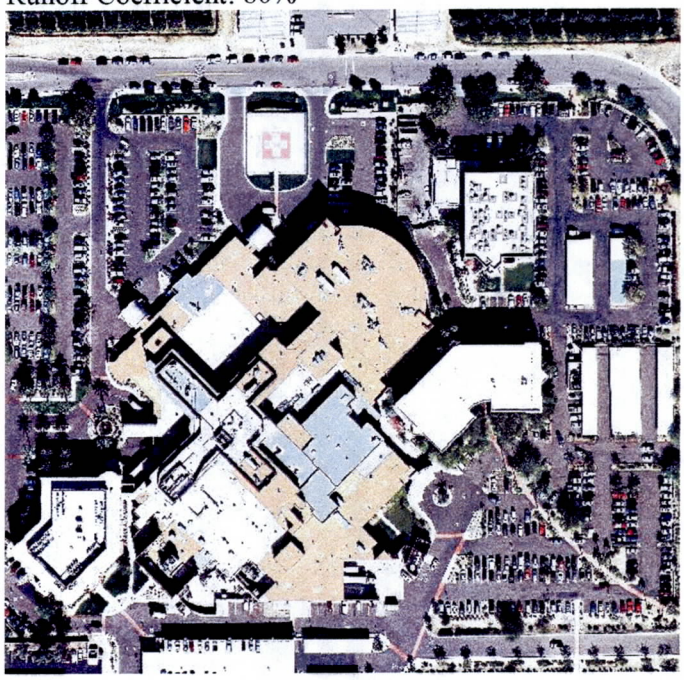
LU 400: Office
Vegetative Cover: 5%
Runoff Coefficient:80%

LU 500: Educational (universities)
Vegetative Cover: 30%
Runoff Coefficient: 45%

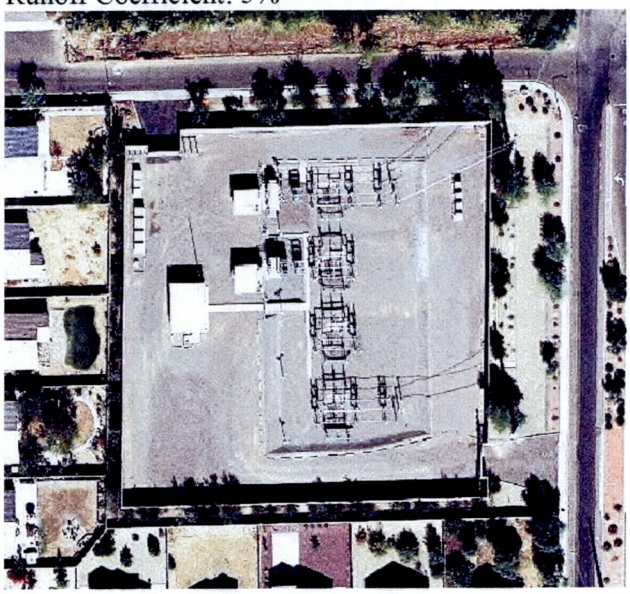
LU 520: Educational (schools)
Vegetative Cover: 40%
Runoff Coefficient: 40%



LU 530: Institutional
Vegetative Cover: 5%
Runoff Coefficient: 80%



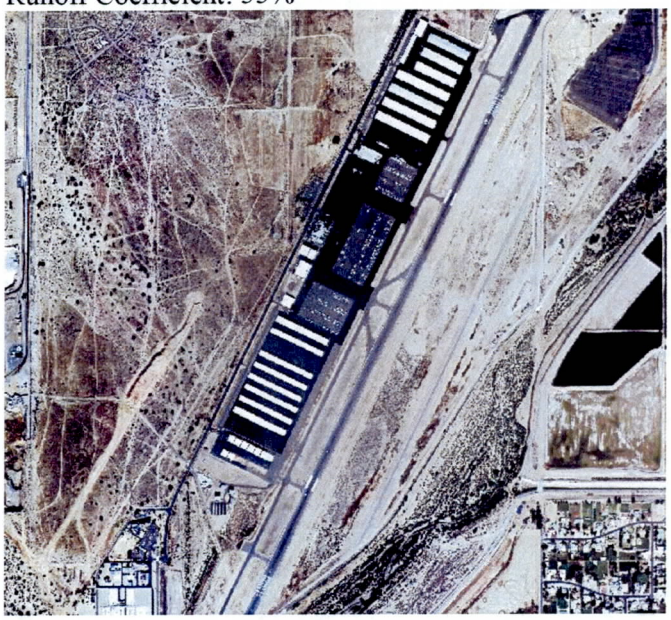
LU 550: Public Facility (substations)
Vegetative Cover: 0%
Runoff Coefficient: 5%



LU 550: Public Facility (community buildings)
Vegetative Cover: 5-10%
Runoff Coefficient: 80%

LU 610: Transportation
Vegetative Cover: 0-5%
Runoff Coefficient: 80%

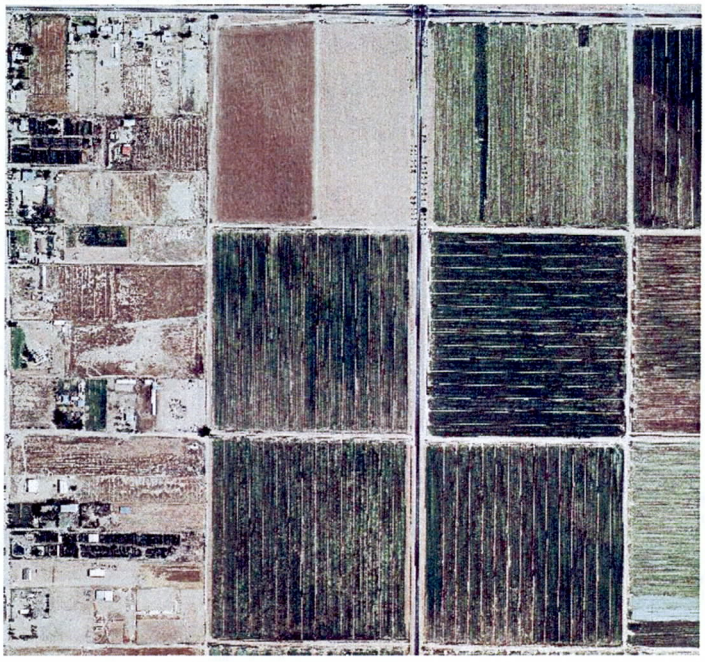
LU 620: Airports (public facility)
Vegetative Cover: 5%
Runoff Coefficient: 55%



LU 710: Parks and Open Space (active)
Vegetative Cover: 80%
Runoff Coefficient: 5%

LU 730: Open Space (passive)
Vegetative Cover: 5%
Runoff Coefficient: 0%

LU 750: Agriculture (Luke Compatible)
Vegetative Cover: 85%
Runoff Coefficient: 0%



LU 810: Business Park (Business/Commerce Center)
Vegetative Cover: 5%
Runoff Coefficient: 80%

Appendix C Typical Street and Channel Sections

Typical Channel Sections Summary

Typical Street Sections Summary

City of Phoenix Typical Street Sections

City of Peoria Typical Street Sections

Kimley-Horn and Associates, Inc.

Project: ***Glendale Stormwater Management Plan***
Subject: **City of Glendale Typical Channel Sections**
Designed by: **LAT** Date 10/12/2009 KHA Project No. 091910009
Checked by: Date City of Glendale No. 089017

City of Glendale Typical Channel Sections

		Width (ft)				Depth
Channel Size	**Abbrev.**	**Total**	**Channel**	**LOB**	**ROB**	**(ft)**
Extra Large	XL	700	50	325	325	15
Large	L	150	30	60	60	10
Medium	M	100	20	40	40	8
Small	S	50	10	20	20	5

Notes:
Typical channel sizes estimated from aerial photographs, topographic data, and field visits.

Kimley-Horn and Associates, Inc.

Project: ***Glendale Stormwater Management Plan***
Subject: **City of Glendale Typical Street Sections**
Designed by: **LAT** Date 10/27/2009 KHA Project No. 091910009
Checked by: Date City of Glendale No. 089017

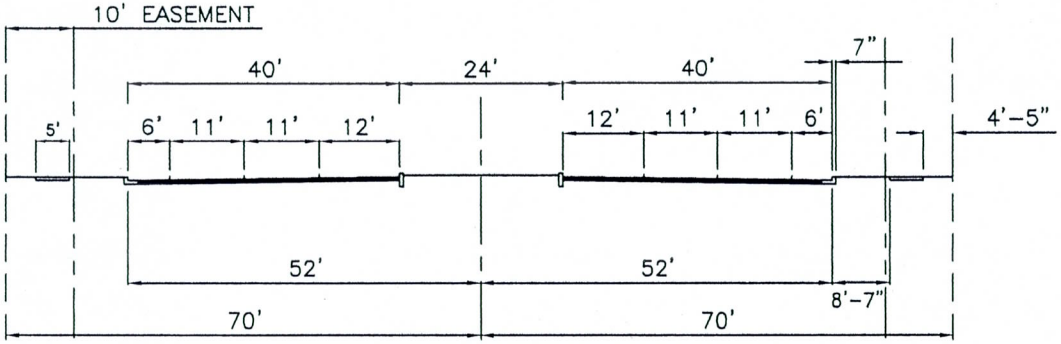
Typical Street Sections used outside of the City of Glendale

Street Designation			Width (ft)			
Type	**Detail**	**Section**	**ROW**	**Street**	**LOB**	**ROB**
Arterial	P1010	A	140	104	18	18
Arterial	P1010	B	110	74	18	18
Arterial	P1010	C	130	94	18	18
Major Arterial	PE-010-2		130	104	13	13
Minor Arterial	PE-010-3		110	78	16	16
Areterial - average*	**NA***		**124**	**91**	**17**	**17**
Collector	P1013	D	100	64	18	18
Collector	P1013	E	80	50	15	15
Collector	P1013	F	60	40	10	10
Major Collector	PE-010-4		80	64	8	8
Minor Collector	PE-010-5		60	36	12	12
Minor Collector	PE-010-5		70	48	11	11
Collector - average*	**NA***		**75**	**50**	**12**	**12**
Local	P1014	G	50	36	7	7
Local	P1014	H	50	32	9	9
Local	P1014	I	50	28	11	11
Local	PE-010-6		50	26	12	12
Local - average*	**NA***		**50**	**31**	**10**	**10**

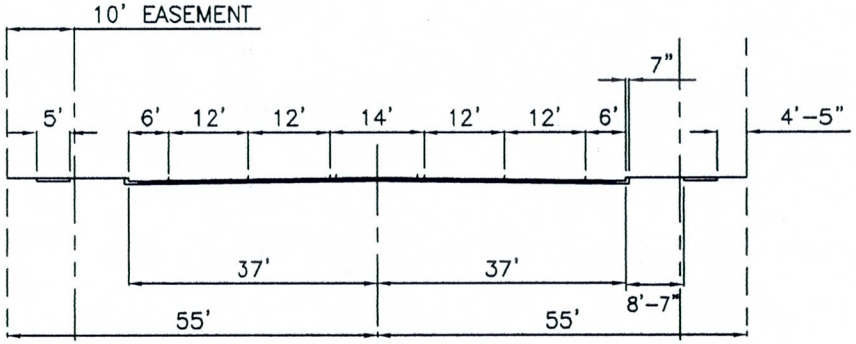
Notes:
Taken from City of Phoenix and City of Peoria *Standard Details*.
*average is an average of the City of Phoenix and City of Peoria typical sections for each street type.

Typical Street Sections used outside of the City of Glendale

Street Type	Width (ft)			
	ROW	**Street**	**LOB**	**ROB**
Arterial	124	91	16.5	16.5
Collector	75	50	12.5	12.5
Local	50	31	9.5	9.5

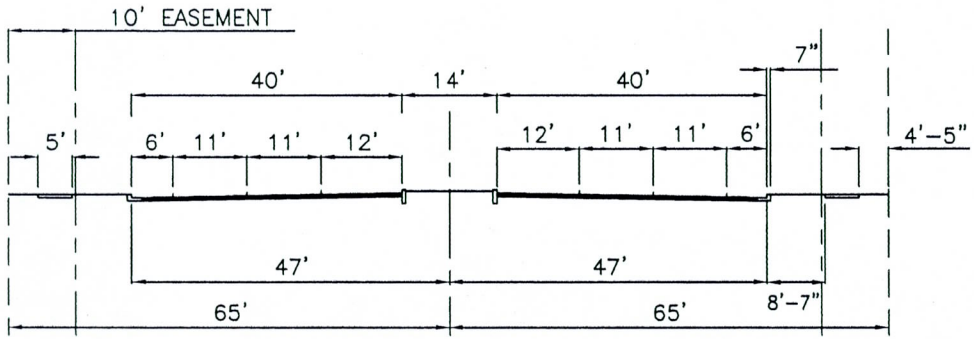


CROSS SECTION A

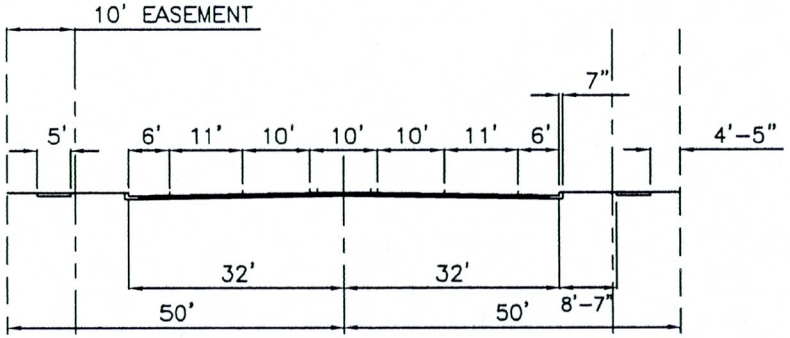


CROSS SECTION C

CROSS SECTION C-M. (SEE NOTE 3)



CROSS SECTION B



CROSS SECTION D

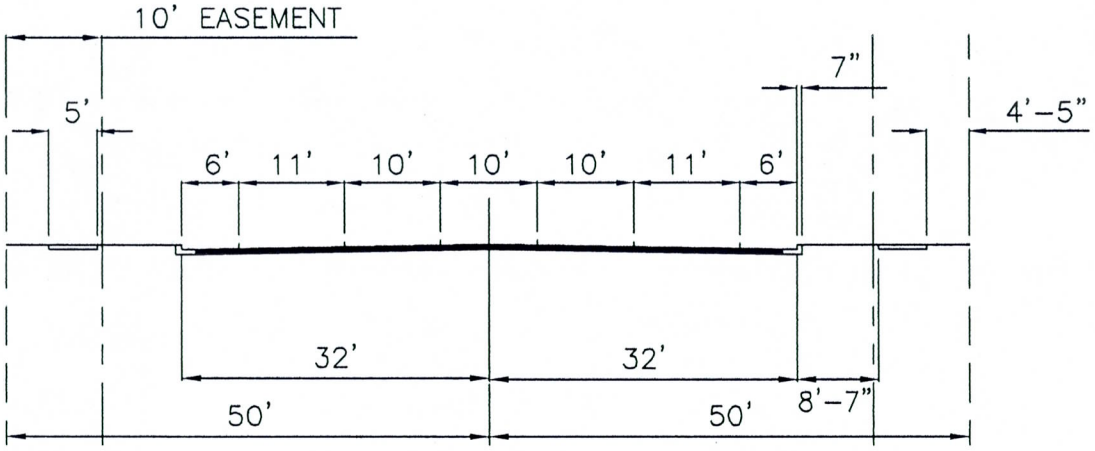
NOTES:

1. TEN (10) FOOT EASEMENTS MAY BE ALLOWED IN LIEU OF RIGHT-OF-WAY ON CROSS SECTIONS A, B, C, D, AT THE DISCRETION OF THE STREET TRANSPORTATION DEPARTMENT OR DEVELOPMENT SERVICES DEPARTMENT.
2. ADDITIONAL RIGHT-OF-WAY MAY BE REQUIRED FOR DRAINAGE, UTILITIES, SLOPE RIGHTS, IRRIGATION FACILITIES OR TRAILS.**
3. CROSS SECTION "C" HAS A 14' TWO WAY LEFT TURN LANE. CROSS SECTION C-M HAS A 14' RAISED MEDIAN.

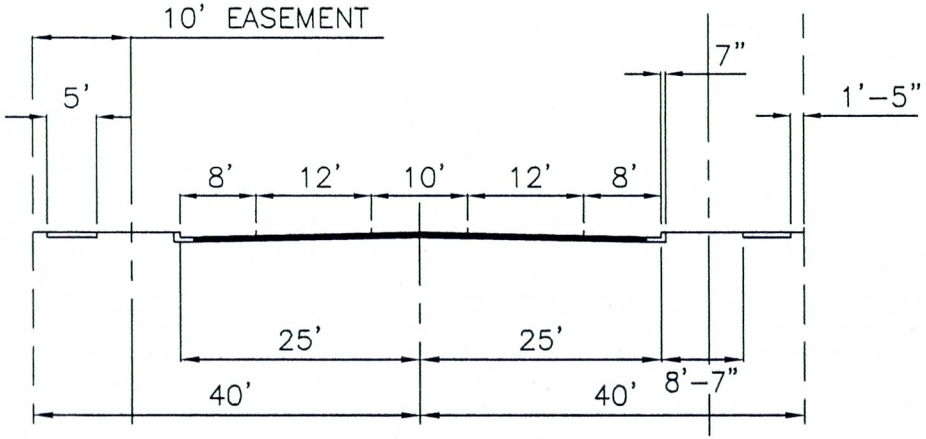
** ACCORDING TO THE TRAILS PLAN, A - 10 FOOT SIDEWALK MAY BE REQUIRED ON CROSS SECTIONS A,B,C,D,E,F, & G.

ALL DIMENSIONS ARE TO THE FACE OF CURB.

DETAIL NO.	City of Phoenix STANDARD DETAIL	MINIMUM ARTERIAL STREET CROSS SECTION	APPROVED Mario Saldamando CITY ENGINEER 2-11-02 DATE	DETAIL NO.
P1010				P1010



CROSS SECTION D



CROSS SECTION E

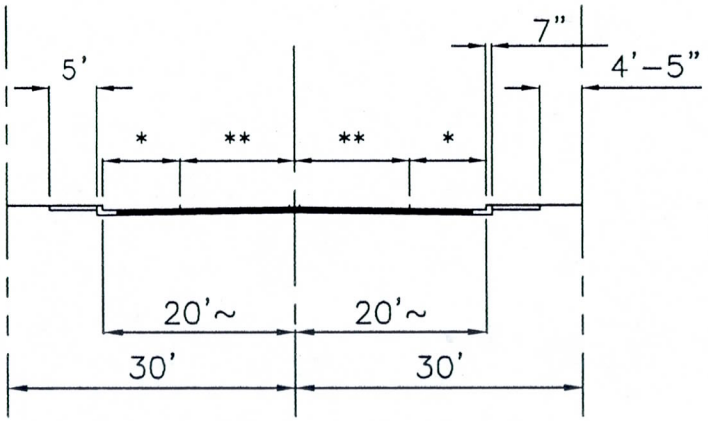
NOTES:

TEN (10) FOOT EASEMENTS MAY BE ALLOWED IN LIEU OF RIGHT-OF-WAY ON CROSS SECTIONS A, B, C, D, AND E; AT THE DISCRETION OF THE STREET TRANSPORTATION DEPARTMENT OR DEVELOPMENT SERVICES DEPARTMENT.

ADDITIONAL RIGHT-OF-WAY MAY BE REQUIRED FOR DRAINAGE, UTILITIES, SLOPE RIGHTS, IRRIGATION FACILITIES OR TRAILS.

ALL DIMENSIONS ARE TO THE FACE OF CURB.

FINAL LANE CONFIGURATION AND WIDTHS TO BE DETERMINED BY STREET TRANSPORTATION. LANE WIDTHS SHOWN ARE FOR INFORMATION ONLY AND MAY NOT REFLECT APPROVED STRIPING PLANS.



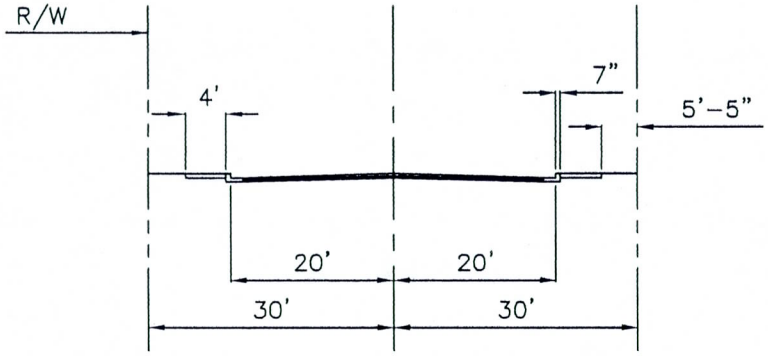
CROSS SECTION F

* 6' or 8' VARIES

** 12' or 14' VARIES

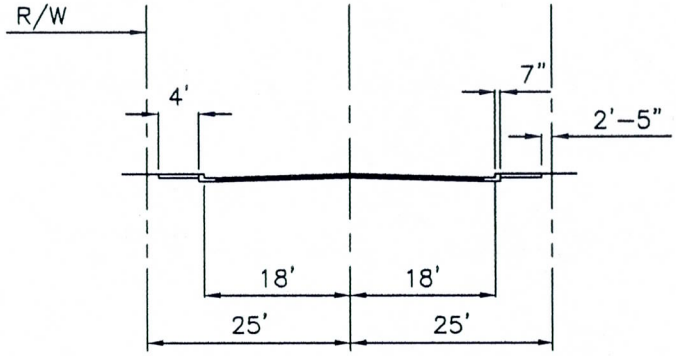
~ COLLECTORS WITH RESIDENTIAL BACKUP TREATMENT ONLY.

DETAIL NO.			APPROVED		DETAIL NO.
P1013	City of Phoenix STANDARD DETAIL	MINIMUM COLLECTOR STREET CROSS SECTION	Mario SaDamando FOR CITY ENGINEER	2-11-02 DATE	P1013



CROSS SECTION F

INDUSTRIAL LAND USE
VERTICAL CURB AND ADJACENT SIDEWALK

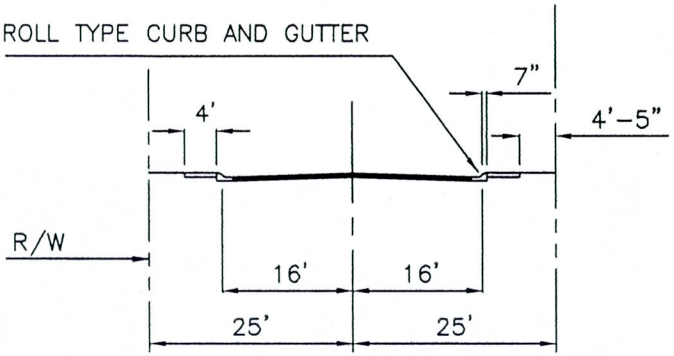


CROSS SECTION G

COMMERCIAL & MULTI FAMILY
RESIDENTIAL LAND USE
VERTICAL CURB AND ADJACENT SIDEWALK

NOTES:

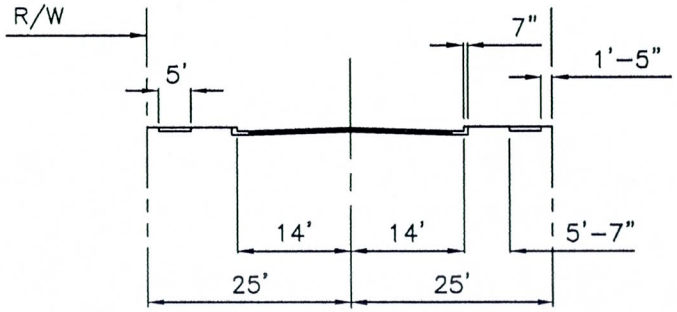
ADDITIONAL RIGHT–OF–WAY MAY BE REQUIRED FOR DRAINAGE, UTILITIES, SLOPE RIGHTS, IRRIGATION FACILITIES, OR TRAILS.



CROSS SECTION H

SINGLE FAMILY RESIDENTIAL LAND USE

OPTION A:
ROLL CURB AND ADJACENT SIDEWALK



CROSS SECTION I

SINGLE FAMILY RESIDENTIAL LAND USE

OPTION B:
VERTICAL CURB AND SET BACK SIDEWALK

ALL DIMENSIONS ARE TO THE FACE OF CURB.

ALL CURBS ARE VERTICAL UNLESS NOTED.

DETAIL NO. P1014	City of Phoenix STANDARD DETAIL	MINIMUM LOCAL STREET CROSS SECTIONS	APPROVED Mario DeAdamado FOR CITY ENGINEER — 2-11-02 DATE	DETAIL NO. P1014

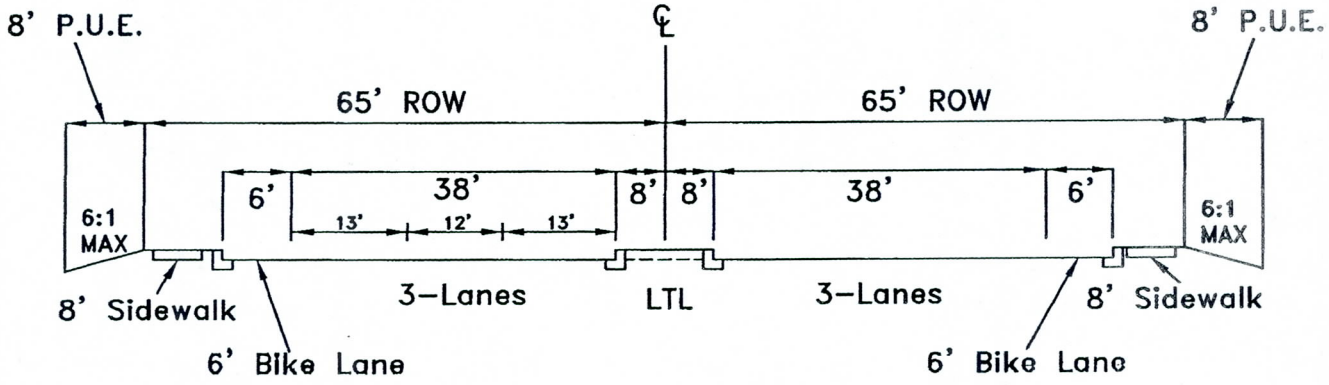
CITY OF PEORIA
STANDARD DETAIL PE-010-2
MAJOR ARTERIAL STREET

APPROVALS:

CITY ENGINEER — DATE 8/2/07

FIRE CHIEF — DATE 8-16-07

MULTI-LANE ROADWAY 130' ROW
Divided – 6 Travel Lanes
(6-Plus Right and Left Turn Lanes)



Notes:

- At intersections, ROW increases to 150' for the first 500', measured from the centerline of the intersection.
- Additional R.O.W. may be required where additional turn lanes are required.
- Sidewalks shall be meandering.

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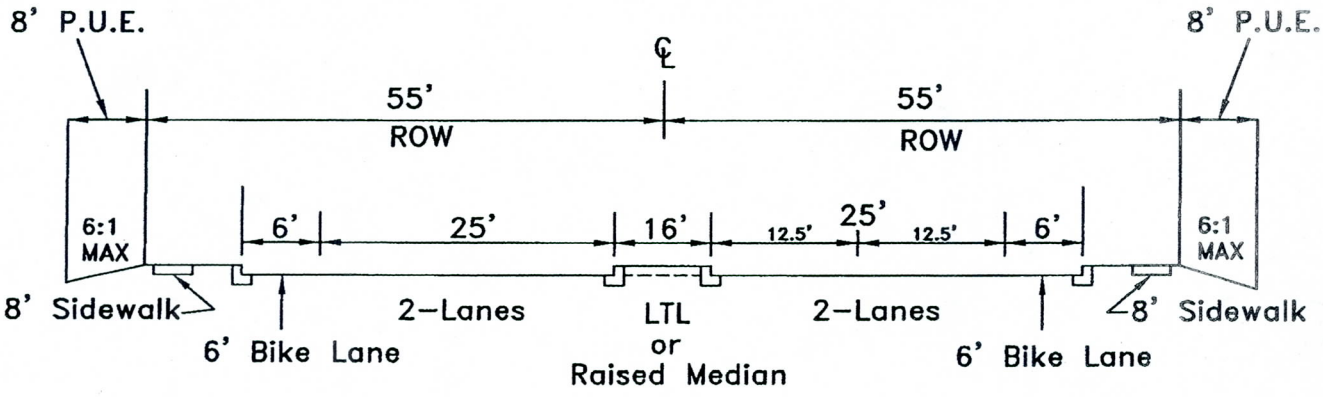
08/16/2007

CITY OF PEORIA
STANDARD DETAIL PE-010-3
MINOR ARTERIAL STREET

APPROVALS:

CITY ENGINEER — DATE — FIRE CHIEF — 8-16-07 DATE



Notes:

- At intersections, ROW increases to 130' for the first 500', measured from the centerline of the intersection.
- Additional ROW may be required where additional turn lanes are needed.
- Sidewalks shall be meandering.

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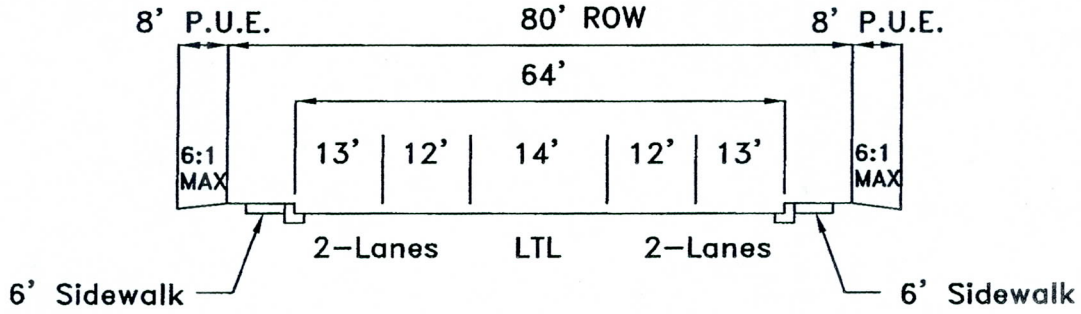
08/16/2007

CITY OF PEORIA
STANDARD DETAIL PE-010-4
MAJOR COLLECTOR ROADWAY

APPROVALS:

CITY ENGINEER — DATE — FIRE CHIEF — DATE 8-16-07

FOUR-LANE ROADWAY
Undivided
(Residential areas with backage and adjacent commercial and industrial areas)



Note: Corner radii will equal 30'

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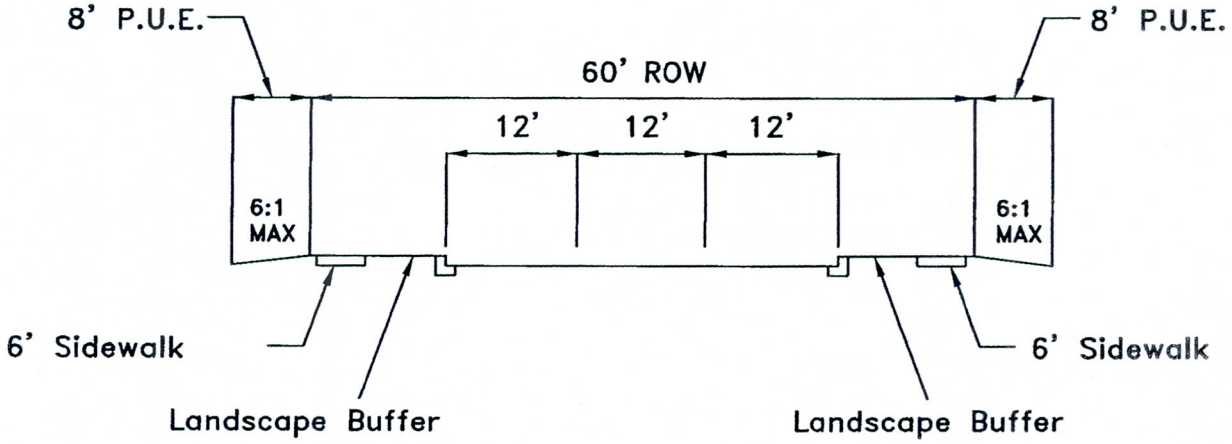
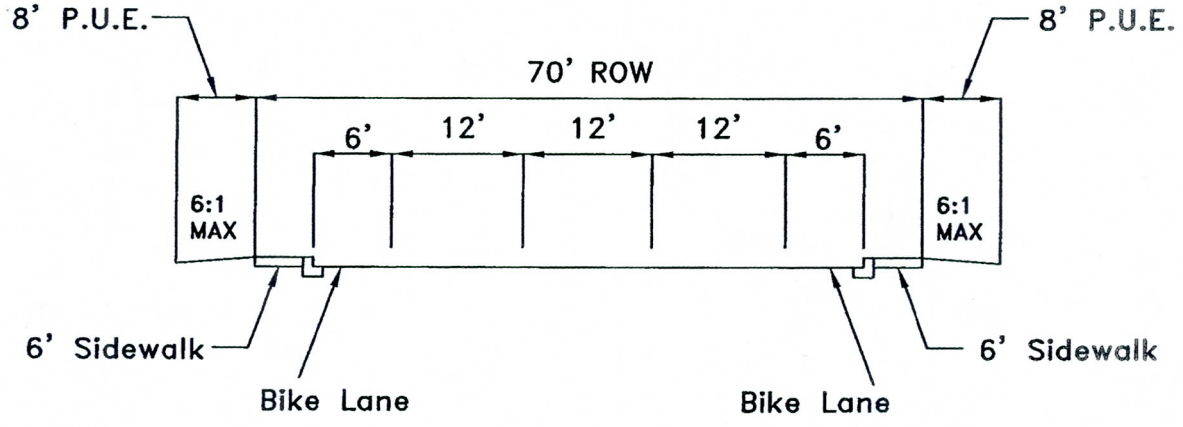
08/16/2007

CITY OF PEORIA
STANDARD DETAIL PE-010-5
MINOR COLLECTOR ROADWAYS

APPROVALS:

CITY ENGINEER	DATE	FIRE CHIEF	DATE
	8/20/07		8-16-07





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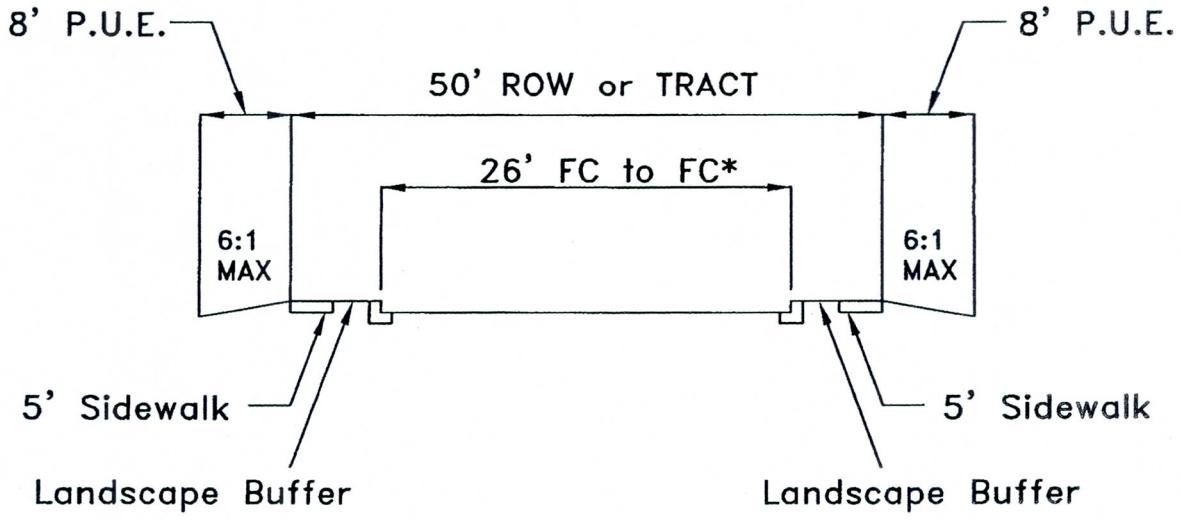
08/16/2007

CITY OF PEORIA
STANDARD DETAIL PE-010-6
PRIVATE AND PUBLIC ROADWAY

APPROVALS:

CITY ENGINEER 8/20/07 DATE

FIRE CHIEF 8-16-07 DATE



*parking on one side only
32' pavement provides parking on both sides

Note: Private Streets for Subdivisions with:
10 Lots or less, Sidewalk not required, Tract 40' + 8' P.U.E. on each side
10-20 Lots, Sidewalk required one side, Tract 45' + 8' P.U.E. on each side
More than 20 Lots,Sidewalk required both sides,Tract 50' + 8' P.U.E. on each side

GENERAL PLAN CIRCULATION ELEMENT
Policy B-3e:
The City shall discourage private streets unless the Peoria City Council determines that the streets meet the adopted standards and that the benefit to the City exceeds the liability.

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08/16/2007

Appendix D Routing and Diversion Data

Diversion Data Description

The intersection diversions estimate how much of the runoff in will flow south and how much will flow west at the intersection. The diversion is a constant ratio based on normal depth calculations using Manning's equation. The ratio is based on the width and the slope of the north/south street compared to the width and the slope of the east/west street.

According to Manning's Equation:

$$Q = \frac{1.49}{n} A\, R^{2/3} S^{1/2}$$

Where:

Q = Discharge, cfs

n = Manning's roughness coefficient

A = Cross-sectional area of flow, sq ft

R = Hydraulic radius, $\frac{A}{P_w}$

S = Slope, ft/ft

P_w= Wetted perimeter, ft

Assuming a rectangular street section, $A = W \times d$

Where:

W = Width, ft

d = depth, ft

Assuming the depth is negligible compared to the width, $P_w \cong W$

Manning's Equation becomes:

$$Q = \frac{1.49}{n} Wd \left(\frac{Wd}{W}\right)^{2/3} S^{1/2}$$

Which simplifies to:

$$Q = \frac{1.49}{n} W\, d^{5/3} S^{1/2}$$

The total discharge will equal the sum of the discharge diverted west and the discharge diverted south. The following equation shows this relationship, where the subscript T indicates the total discharge, W indicates the parameters for the flow diverted west, and S indicates the parameters for the flow diverted south.

$$Q_T = \frac{1.49}{n_w} W_w \, {d_w}^{5/3} {S_w}^{1/2} + \frac{1.49}{n_S} W_s \, {d_s}^{5/3} {S_s}^{1/2}$$

Assuming that $n \cong n_W \cong n_S$ and $d \cong d_W \cong d_S$, this becomes:

$$Q_T = \frac{1.49 d^{5/3}}{n} \left(W_w \, {S_w}^{1/2} + W_s \, {S_s}^{1/2} \right)$$

It is evident that Q_w depends on W_w and S_w and that Q_s depends on W_s and S_s, so the ratio for the discharge diverted west is $\frac{Q_w}{Q_T}$ or:

$$\frac{W_w \, {S_w}^{1/2}}{W_w \, {S_w}^{1/2} + W_s \, {S_s}^{1/2}}$$

And the ratio for the discharge diverted south is $\frac{Q_S}{Q_T}$ or:

$$\frac{W_s \, {S_s}^{1/2}}{W_w \, {S_w}^{1/2} + W_s \, {S_s}^{1/2}}$$

Kimley-Horn and Associates, Inc.

Project: ***Glendale Stormwater Management Plan***
Subject: **Diversion Parameters**
Designed by: **MAF** Date 8/20/2009 KHA Project No. 091910009
Checked by: Date City of Glendale No. 089017

Objective: To determine the percent of subbasin flow that will be diverted in the south and west directions

Diversion Records		Location of Diversion		East/West Street Information						North/South Street Information						Percent Diverted	
Diversion ID[1]	Retrieval ID[1]	E/W Street Name[2]	N/S Street Name[2]	Street Type	Width[3] (ft)	Length (ft)	USGE[4] (ft)	DSGE[4] (ft)	Slope (ft/ft)	Street Type	Width[3] (ft)	Length (ft)	USGE[4] (ft)	DSGE[4] (ft)	Slope (ft/ft)	West[5]	South[5]
DWHVLP	DSPPLP	Happy Valley Road	93rd Avenue	Arterial	124	4020	1395.75	1339.55	0.0140	Local	50	5280	1395.75	1314	0.0155	70%	30%

Notes:

1. The IDs correspond to KK and DT cards in HEC-1.
2. The streets at the southwest corner of the subbasin to be diverted.
3. The width of the right-of-way of the street in the indicated direction.
4. Elevation data was obtained from the Flood Control District of Maricopa County and represents either 2-ft or 10-ft topo data.
5. Percent diverted west = $W_w * S_w^{0.5} / (W_w * S_w^{0.5} + W_s * S_s^{0.5})$
   Percent diverted south = $W_s * S_s^{0.5} / (W_w * S_w^{0.5} + W_s * S_s^{0.5})$
   Where W_w = Width of west street
   W_s = Width of south street
   S_w = Slope of west street
   S_s = Slope of south street

Kimley-Horn
and Associates, Inc.

Project: ***Glendale Stormwater Management Plan***
Subject: **Routing Reach Parameters**
Designed by: **LAT** Date 10/12/2009 KHA Project No. 091910009
Checked by: Date City of Glendale No. 089017

Objective: To determine the routing reach parameters that will be entered into the HEC-1 model, namely: length, slope, and the RX and RY values

Routing Flows in the West Direction

Routing ID[1]	E/W Street Name[2]	N/S Street Name[2]	Length (ft)	USGE[3] (ft)	DSGE[3] (ft)	Slope (ft/ft)	Channel Size[4]	Width (ft)				RX[8]								RY[8]							
								Channel[5]	LOB[6]	ROB[6]	Total[7]	X1	X2	X3	X4	X5	X6	X7	X8	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
RHVAF	Happy Valley Road	Agua Fria River	2397	1270.45	1246.77	0.0099	S	10	20	20	50	0	0	20	30	40	50	70	70	6.1	5.1	5	0	0	5	5.1	6.1
RHV01A	Happy Valley Road	101st Avenue	5774	1370.80	1316.00	0.0095	L	30	60	60	150	0	0	60	80	110	130	190	190	11.2	10.2	10	0	0	10	10.2	11.2
RJMLP	Jomax Road	Lake Pleasant Road	5526	1420.00	1373.94	0.0083	S	10	20	20	50	0	0	20	30	40	50	70	70	6.1	5.1	5	0	0	5	5.1	6.1
RHV01B	Happy Valley Road	101st Avenue	5774	1370.80	1316.00	0.0095	L	30	60	60	150	0	0	60	80	110	130	190	190	11.2	10.2	10	0	0	10	10.2	11.2
RHV01C	Happy Valley Road	101st Avenue	2022	1337.94	1316.00	0.0109	L	30	60	60	150	0	0	60	80	110	130	190	190	11.2	10.2	10	0	0	10	10.2	11.2
RHVLP	Happy Valley Road	Lake Pleasant Road	3994	1362.00	1340.00	0.0055	S	10	20	20	50	0	0	20	30	40	50	70	70	6.1	5.1	5	0	0	5	5.1	6.1
RHV01D	Happy Valley Road	101st Avenue	1112	1340.00	1316.00	0.0216	L	30	60	60	150	0	0	60	80	110	130	190	190	11.2	10.2	10	0	0	10	10.2	11.2
RHVRSA	Happy Valley Road	Rock Springs Wash	6393	1379.48	1334.30	0.0071	XL	50	325	325	700	0	0	325	355	405	435	760	760	17.3	16.3	15	0	0	15	16.3	17.3
RWWRS	Westwing Parkway	Rock Springs Wash	2655	1404.50	1388.06	0.0062	L	30	60	60	150	0	0	60	80	110	130	190	190	11.2	10.2	10	0	0	10	10.2	11.2
RJMRS	Jomax Road	Rock Springs Wash	3881	1388.06	1364.00	0.0062	M	20	40	40	100	0	0	40	56	76	92	132	132	9.2	8.2	8	0	0	8	8.2	9.2
RHVRSB	Happy Valley Road	Rock Springs Wash	5791	1364.00	1334.30	0.0051	XL	50	325	325	700	0	0	325	355	405	435	760	760	17.3	16.3	15	0	0	15	16.3	17.3

Notes:
1. The Routing ID corresponds to the KK card in HEC-1.
2. Streets correspond to streets downstream of Routing ID.
3. Elevations taken from 2-ft contour data obtained from the Flood Control District of Maricopa County, taken in 1994 for the Maryvale ADMS.
4. For this study four channel sizes were used: small, medium, large, and extra large.
5. The width of the channel is based on aerial photographs, field visits, and available topographic data.
6. The left overbank and right overbank are based on composite channel widths. The overbanks were calculated by subtracting the channel width from the total.
7. The total width is the composite width for the channel sections.
8. The RX and RY represent the 8-point cross section used in the Normal Depth routing method from HEC-1.

Kimley-Horn
and Associates, Inc.

Project: ***Glendale Stormwater Management Plan***
Subject: **100-year, 2-hour Volumes of Post 1990 Developed Areas**
Designed by: **LAT** Date 11/4/2009 KHA Project No. 091910009
Checked by: Date City of Glendale No. 089017

Subbasin ID	Divert ID	Subbasin Volume[1] (ac-ft)	Percent Developed[2] (%)	Reduction[3] (%)	Developed Volume[4] (ac-ft)
HVLP	ERHVLP	20.49	97	80	16.0
HV93	ERHV93	15.43	73	80	9.0
83RS	ER83RS	64.57	53	80	27.2
HV07	ERHV07	22.29	100	80	17.8
YLLP	ERYLLP	54.85	89	80	38.9
HV01	ERHV01	46.41	70	80	26.0
HVRS	ERHVRS	44.33	2	80	0.8
HVAF	ERHVAF	13.40	100	80	10.7
WWRS	ERWWRS	13.19	62	80	6.5
JMAF	ERJMAF	11.73	50	80	4.7
JMNR	ERJMNR	12.69	66	80	6.7
JMRS	ERJMRS	52.43	62	80	26.0
WWBR	ERWWBR	19.91	83	80	13.2
JMLP	ERJMLP	71.09	89	80	50.6
JM99	ERJM99	66.58	89	80	47.5
WWLP	ERWWLP	13.80	70	80	7.7

Notes:

[1] The 100-year, 2-hour volume based on NOAA 2 rainfall values for the entire subbasin. The volumes were computed using DDMSW.

[2] The percent of the subbasin that was developed after 1990.

[3] A 20% reduction is applied to the required volume resulting in 80% of the required capacity.

[4] The volume to be diverted out of the model. It is the subbasin volume times the percent developed and the reduction value.

Appendix E HEC-1 Model Results

HEC-1 Schematic

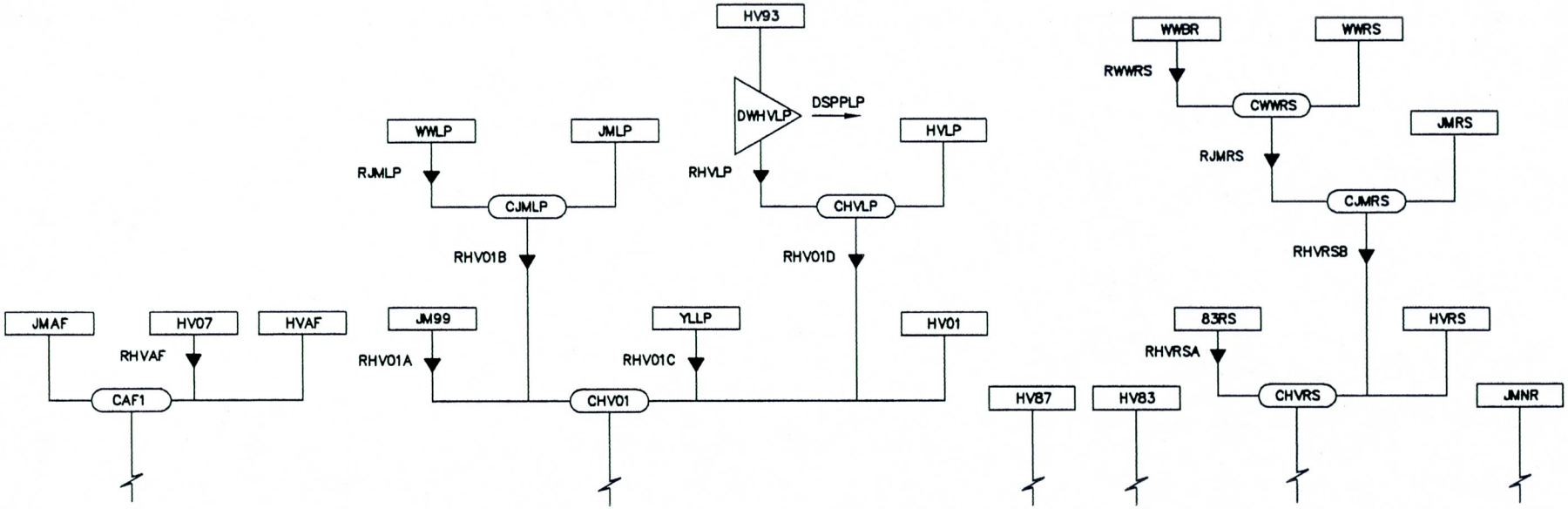
HEC-1 Output

Figure 1. Comparison of 100-Year Peak Discharge Values with USGS Data

SHEET NO. 1 OF 1

JOB GLENDALE SMP SUBJECT PILOT AREA 2 HEC-1 SCHEMATIC JOB NO. 091910009

DESIGNED BY LAT DATE 10/6/2009 CHECKED BY MAF DATE 10/12/2009



DIVERT RETURN ID
COMBINATION POINT
SUBBASIN
ROUTING REACH
DIVERT OUT ID
DIVERT RETURN
DIVERT OUT

K:\PHX_WaterResources\091910009\CADD\HEC-1_Schematics\Pilot.dwg Nov 06, 2009 elizabeth.thiele
XREFS:

Kimley-Horn and Associates, Inc.

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *               JUN  1998               *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   12NOV09  TIME  15:13:41   *
 *                                       *
 *****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*            (916) 756-1104             *
*                                       *
*****************************************
```


```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
          LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

            1           ID      GLENDALE STORMWATER MANAGEMENT PLAN
            2           ID      Model for Pilot Study - Area 2
            3           ID
            4           ID      Prepared for the City of Glendale
            5           ID      In association with the Flood Control District of Maricopa County
            6           ID      City Project Number 089017
            7           ID
            8           ID      Prepared by Kimley-Horn and Associates, Inc.
            9           ID      KHA Project Number 091910009
           10           ID      November 2009
           11           ID
           12           ID      MODELING PARAMETERS
           13           ID      100 YEAR 6 Hour Storm Event
           14           ID      NOAA 14 Rainfall Data
           15           ID      Clark Unit Hydrograph
           16           ID      Green and Ampt Rainfall Loss Method
           17           ID      Modified Puls (Normal Depth) Channel Routing Method for surface flow
           18           ID      Kinematic Wave Channel Routing Method for storm drain flow
           19           ID
           20           ID      Topo data extracted from Flood Control District database July 24, 2009
           21           ID      Land use obtained from City of Glendale General Plan August 2009, City
           22           ID         of Phoenix General Plan August 2009, and MAG General Plan 2007
           23           ID
           24           ID    ***************************************************************************
           25           ID
           26           ID      MODELING NOMENCLATURE
           27           ID      SUBBASIN HYDROGRAPH:
           28           ID         Example: OL51   - the subbasin northeast of Olive and 51st Avenue
           29           ID         Example: JMRS   - the subbasin upstream of Jomax and Rock Springs Wash
           30           ID
           31           ID      STORM DRAIN DIVERSION:
           32           ID         Example: DOL51  - flow from subbasin OL51 is diverted to a storm drain
           33           ID
           34           ID      SUBBASIN DIVERSION:
           35           ID         Example: DWOL59 - flow is diverted west towards Olive and 59th Avenue
           36           ID         Example: DSNO51 - flow is diverted south towards Northern and 51st Ave
           37           ID      ROUTE HYDROGRAPH:
           38           ID         Example: RWOL59 - flow is routed west towards Olive and 59th Avenue
           39           ID         Example: RSNO59 - flow is routed south towards Northern and 59th Ave
           40           ID
           41           ID      COMBINE HYDROGRAPH:
           42           ID         Example: COL59  - combine flow at Olive and 59th Avenue
           43           ID         Example: CJMRS  - combine flow at Jomax and Rock Springs Wash
           44           ID
           45           ID      STREET NAME ABBREVIATIONS
           46           ID         Jomax Road            JM
           47           ID         Happy Valley Road     HV
           48           ID         Pinnacle Peak Road    PP
           49           ID         Deer Valley Road      DV
           50           ID         Loop 101              LO
           51           ID         Beardsley Road        BY
           52           ID         Union Hills Drive     UH
           53           ID         Bell Road             BL
           54           ID         Greenway Road         GW
           55           ID         Thunderbird Road      TB
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  56      ID         Cactus Road            CT
  57      ID         Peoria Avenue          PE
  58      ID         Olive Avenue           OL
  59      ID         Northern Avenue        NO
  60      ID         Glendale Avenue        GL
  61      ID         Bethany Home Road      BH
  62      ID         Camelback Road         CB
  63      ID         Indian School Road     IS
  64      ID         Thomas Road            TM
  65      ID         McDowell Road          MD
  66      ID         Interstate 10          IN
  67      ID         Grand Avenue           GR
  68      ID
  69      ID      PREFIXES FOR MODELING OPERATIONS
  70      ID         RW     Routing flow in the west direction
  71      ID         RS     Routing flow in the south direction
  72      ID         C      Combination point for surface flow
  73      ID         CP     Combination point for pipe flow with surface flow
  74      ID         S      Storage routing
  75      ID         DW     Divert flow to the west
  76      ID         DS     Divert flow to the south
  77      ID         DR     Divert retrieval from surface flow
  78      ID         D      Divert surface flow (flow that remains after storm drain divert)
  79      ID         DP     Divert flow to a storm drain pipe
  80      ID         PR     Divert retrieval from a storm drain pipe
  81      ID         ER     Existing retention to be diverted from subbasin
  82      ID         X      Existing retention diverted out of model and will not be retriev
  83      ID
  84      ID   ********************************************************************************
  85      ID
  86      IT       5       0       0    2000
  87      IN      15
  88      IO       5
          *DIAGRAM
          *
  89      JD   2.730  0.0001
  90      PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  91      PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  92      PC   0.962   0.972   0.983   0.991   1.000
  93      JD   2.714  0.5000
  94      PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
  95      PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
  96      PC   0.962   0.972   0.983   0.991   1.000
  97      JD   2.662     2.8
  98      PC   0.000   0.009   0.016   0.025   0.034   0.042   0.051   0.059   0.068   0.077
  99      PC   0.088   0.101   0.121   0.164   0.253   0.451   0.694   0.836   0.900   0.938
 100      PC   0.950   0.963   0.975   0.988   1.000
 101      JD   2.517    16.0
 102      PC   0.000   0.015   0.020   0.030   0.048   0.063   0.076   0.090   0.105   0.119
 103      PC   0.135   0.152   0.175   0.222   0.304   0.472   0.670   0.796   0.868   0.912
 104      PC   0.946   0.960   0.973   0.987   1.000
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 105      KK    JMAF   BASIN
 106      KM   RUNOFF HYDROGRAPH FOR SUBBASIN JMAF NORTH OF JOMAX ROAD AND EAST OF THE AGUA
 107      KM   FRIA RIVER
 108      BA   0.147
 109      LG    0.19    0.35    4.90    0.24       5
 110      UC   0.430   0.376
 111      UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 112      UA     100
          *

 113      KK  ERJMAF  DIVERT
 114      KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
 115      KM   RETENTION IN SUBBASIN JMAF
 116      DT   XJMAF     4.7     0.0
 117      DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
 118      DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
          *

 119      KK    HV07   BASIN
 120      KM   RUNOFF HYDROGRAPH FOR SUBBASIN HV07 NORTHEAST OF THE INTERSECTION OF HAPPY
 121      KM   VALLEY ROAD AND 107TH AVENUE
 122      BA   0.304
 123      LG    0.28    0.32    3.92    0.41      11
 124      UC   0.408   0.184
 125      UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
 126      UA     100
          *

 127      KK  ERHV07  DIVERT
 128      KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
 129      KM   RETENTION IN SUBBASIN HV07
 130      DT   XHV07    17.8     0.0
```

```
          131          DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
          132          DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
                       *

          133          KK   RHVAF   ROUTE
          134          KM   ROUTE RUNOFF HYDROGRAPH FROM SUBBASIN HV07 WEST THROUGH SUBBASIN HVAF TO
          135          KM   COMBINATION POINT CAF1
          136          RS       4    FLOW
          137          RC   0.035   0.035   0.035    2397  0.0099    0.00
          138          RX    0.00    0.00   20.00   30.00   40.00   50.00   70.00   70.00
          139          RY    6.08    5.08    5.00    0.00    0.00    5.00    5.08    6.08
                       *

          140          KK    HVAF   BASIN
          141          KM   RUNOFF HYDROGRAPH FOR SUBBASIN HVAF NORTH OF HAPPY VALLEY ROAD AND EAST OF
          142          KM   THE AGUA FRIA RIVER
          143          BA   0.215
          144          LG    0.30    0.35    3.92    0.41       0
          145          UC   0.441   0.189
          146          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          147          UA     100
                       *

1                                                  HEC-1 INPUT                                          PAGE  4

        LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          148          KK  ERHVAF  DIVERT
          149          KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
          150          KM   RETENTION IN SUBBASIN HVAF
          151          DT   XHVAF    10.7     0.0
          152          DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
          153          DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
                       *

          154          KK    CAF1 COMBINE
          155          KM   COMBINE ROUTE RHVAF AND SUBBASINS HVAF AND JMAF
          156          HC       3
                       *

          157          KK    JM99   BASIN
          158          KM   RUNOFF HYDROGRAPH FOR SUBBASIN JM99 NORTH OF THE INTERSECTION OF JOMAX ROAD
          159          KM   AND 99TH AVENUE
          160          BA   0.568
          161          LG    0.23    0.16   10.10    0.03      21
          162          UC   0.734   0.391
          163          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          164          UA     100
                       *

          165          KK  ERJM99  DIVERT
          166          KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
          167          KM   RETENTION IN SUBBASIN JM99
          168          DT   XJM99    47.5     0.0
          169          DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
          170          DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
                       *

          171          KK  RHV01A   ROUTE
          172          KM   ROUTE RUNOFF HYDROGRAPH FROM SUBBASIN JM99 SOUTH THROUGH SUBBASIN HV01 TO
          173          KM   COMBINATION POINT CHV01
          174          RS       4    FLOW
          175          RC   0.035   0.035   0.035    5774  0.0095    0.00
          176          RX    0.00    0.00   60.00   80.00  110.00  130.00  190.00  190.00
          177          RY   11.24   10.24   10.00    0.00    0.00   10.00   10.24   11.24
                       *

          178          KK    WWLP   BASIN
          179          KM   RUNOFF HYDROGRAPH FOR SUBBASIN WWLP NORTHEAST OF THE INTERSECTION OF WESTWING
          180          KM   PARKWAY AND LAKE PLEASANT PARKWAY
          181          BA   0.136
          182          LG    0.16    0.27    7.00    0.10      15
          183          UC   0.324   0.192
          184          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          185          UA     100
                       *

1                                                  HEC-1 INPUT                                          PAGE  5

        LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          186          KK  ERWWLP  DIVERT
          187          KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
          188          KM   RETENTION IN SUBBASIN WWLP
          189          DT   XWWLP     7.7     0.0
          190          DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
          191          DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
                       *

          192          KK   RJMLP   ROUTE
          193          KM   ROUTE RUNOFF HYDROGRAPH FROM SUBBASIN WWLP SOUTH THROUGH SUBBASIN JMLP TO
          194          KM   COMBINATION POINT CJMLP
          195          RS       4    FLOW
```

```
196          RC   0.035   0.035   0.035    5526  0.0083    0.00
197          RX    0.00    0.00   20.00   30.00   40.00   50.00   70.00   70.00
198          RY    6.08    5.08    5.00    0.00    0.00    5.00    5.08    6.08
             *

199          KK    JMLP   BASIN
200          KM   RUNOFF HYDROGRAPH FOR SUBBASIN JMLP NORTHEAST OF THE INTERSECTION OF JOMAX
201          KM   ROAD AND LAKE PLEASANT PARKWAY
202          BA   0.705
203          LG    0.22    0.28    6.00    0.16      27
204          UC   0.669   0.348
205          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
206          UA     100
             *

207          KK  ERJMLP  DIVERT
208          KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
209          KM   RETENTION IN SUBBASIN JMLP
210          DT   XJMLP    50.6     0.0
211          DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
212          DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

213          KK   CJMLP COMBINE
214          KM   COMBINE ROUTE RJMLP AND SUBBASIN JMLP
215          HC       2
             *

216          KK  RHV01B   ROUTE
217          KM   ROUTE RUNOFF HYDROGRAPH FROM COMBINATION POINT CJMLP SOUTH THROUGH SUBBASIN
218          KM   HV01 TO COMBINATION POINT CHV01
219          RS       4    FLOW
220          RC   0.035   0.035   0.035    5774  0.0095    0.00
221          RX    0.00    0.00   60.00   80.00  110.00  130.00  190.00  190.00
222          RY   11.24   10.24   10.00    0.00    0.00   10.00   10.24   11.24
             *
1                                      HEC-1 INPUT                                    PAGE  6

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

223          KK    YLLP   BASIN
224          KM   RUNOFF HYDROGRAPH FOR SUBBASIN YLLP EAST OF LAKE PLEASANT PARKWAY NEAR
225          KM   YEARLING ROAD
226          BA   0.595
227          LG    0.22    0.28    4.35    0.37      30
228          UC   0.559   0.366
229          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
230          UA     100
             *

231          KK  ERYLLP  DIVERT
232          KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
233          KM   RETENTION IN SUBBASIN YLLP
234          DT   XYLLP    38.9     0.0
235          DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
236          DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

237          KK  RHV01C   ROUTE
238          KM   ROUTE RUNOFF HYDROGRAPH FROM SUBBASIN YLLP SOUTHWEST THROUGH SUBBASIN HV01 TO
239          KM   COMBINATION POINT CHV01
240          RS       4    FLOW
241          RC   0.035   0.035   0.035    2022  0.0109    0.00
242          RX    0.00    0.00   60.00   80.00  110.00  130.00  190.00  190.00
243          RY   11.24   10.24   10.00    0.00    0.00   10.00   10.24   11.24
             *

244          KK    HV93   BASIN
245          KM   RUNOFF HYDROGRAPH FOR SUBBASIN HV93 NORTHEAST OF THE INTERSECTION OF HAPPY
246          KM   VALLEY ROAD AND 93RD AVENUE
247          BA   0.172
248          LG    0.24    0.28    4.15    0.42      30
249          UC   0.397   0.262
250          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
251          UA     100
             *

252          KK  ERHV93  DIVERT
253          KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
254          KM   RETENTION IN SUBBASIN HV93
255          DT   XHV93     9.0     0.0
256          DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
257          DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

258          KK  DWHVLP  DIVERT
259          KM   DIVERT PORTION OF RUNOFF HYDROGRAPH FROM SUBBASIN HV93 WEST THROUGH SUBBASIN
260          KM   HVLP AND THE REMAINING SOUTH
261          DT  DSPPLP     0.0     0.0
262          DI     0.0   100.0   200.0   500.0  1000.0  2000.0  4000.0 10000.0 20000.0 50000.0
263          DQ     0.0    30.0    60.0   150.0   300.0   600.0  1200.0  3000.0  6000.0 15000.0
             *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  264     KK   RHVLP   ROUTE
  265     KM   ROUTE RUNOFF HYDROGRAPH FROM DIVERT DWHVLP WEST THROUGH SUBBASIN HVLP TO
  266     KM   COMBINATION POINT CHVLP
  267     RS       4    FLOW
  268     RC   0.035   0.035   0.035    3994  0.0055    0.00
  269     RX    0.00    0.00   20.00   30.00   40.00   50.00   70.00   70.00
  270     RY    6.08    5.08    5.00    0.00    0.00    5.00    5.08    6.08
          *

  271     KK    HVLP   BASIN
  272     KM   RUNOFF HYDROGRAPH FOR SUBBASIN HVLP NORTHEAST OF THE INTERSECTION OF HAPPY
  273     KM   VALLEY ROAD AND LAKE PLEASANT PARKWAY
  274     BA   0.198
  275     LG    0.19    0.26    4.30    0.36      43
  276     UC   0.612   0.561
  277     UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  278     UA     100
          *

  279     KK  ERHVLP  DIVERT
  280     KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
  281     KM   RETENTION IN SUBBASIN HVLP
  282     DT   XHVLP    16.0     0.0
  283     DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
  284     DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
          *

  285     KK   CHVLP COMBINE
  286     KM   COMBINE ROUTE RHVLP AND SUBBASIN HVLP
  287     HC       2
          *

  288     KK  RHV01D   ROUTE
  289     KM   ROUTE RUNOFF HYDROGRAPH FROM COMBINATION POINT CHVLP WEST THROUGH SUBBASIN
  290     KM   HV01 TO COMBINATION POINT CHV01
  291     RS       4    FLOW
  292     RC   0.035   0.035   0.035    1112  0.0216    0.00
  293     RX    0.00    0.00   60.00   80.00  110.00  130.00  190.00  190.00
  294     RY   11.24   10.24   10.00    0.00    0.00   10.00   10.24   11.24
          *

  295     KK    HV01   BASIN
  296     KM   RUNOFF HYDROGRAPH FOR SUBBASIN HV01 WEST OF THE LAKE PLEASANT PARKWAY NEAR
  297     KM   101ST AVENUE
  298     BA   0.444
  299     LG    0.15    0.30    5.30    0.20      35
  300     UC   0.674   0.407
  301     UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  302     UA     100
          *
```



```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  303     KK  ERHV01  DIVERT
  304     KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
  305     KM   RETENTION IN SUBBASIN HV01
  306     DT   XHV01    26.0     0.0
  307     DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
  308     DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
          *

  309     KK   CHV01 COMBINE
  310     KM   COMBINE ROUTES RHV01A, RHV01B, RHV01C, RHV01D AND SUBBASIN HV01
  311     HC       5
          *

  312     KK    HV87   BASIN
  313     KM   RUNOFF HYDROGRAPH FOR SUBBASIN HV87 NORTH OF HAPPY VALLEY ROAD NEAR ALIGNMENT
  314     KM   OF 87TH AVENUE
  315     BA   0.285
  316     LG    0.10    0.35    4.00    0.39      35
  317     UC   0.329   0.131
  318     UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  319     UA     100
          *

  320     KK    HV83   BASIN
  321     KM   RUNOFF HYDROGRAPH FOR SUBBASIN HV83 NORTHWEST OF THE INTERSECTION OF 83RD
  322     KM   AVENUE AND HAPPY VALLEY ROAD
  323     BA   0.035
  324     LG    0.10    0.35    4.15    0.37      20
  325     UC   0.325   0.331
  326     UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
  327     UA     100
          *
```

```
328          KK    83RS   BASIN
329          KM   RUNOFF HYDROGRAPH FOR SUBBASIN 83RS WEST OF THE 83RD AVENUE DRAINING TO ROCK
330          KM   SPRINGS WASH
331          BA   0.638
332          LG    0.18    0.30    4.50    0.30      38
333          UC   0.416   0.167
334          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
335          UA     100
             *

336          KK  ER83RS  DIVERT
337          KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
338          KM   RETENTION IN SUBBASIN 83RS
339          DT   X83RS    27.2     0.0
340          DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
341          DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
             *
1                                        HEC-1 INPUT                                        PAGE  9

        LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

342          KK  RHVRSA   ROUTE
343          KM   ROUTE RUNOFF HYDROGRAPH FROM SUBBASIN HV83 SOUTHEAST THROUGH SUBBASIN HVRS TO
344          KM   COMBINATION POINT CHVRS
345          RS       4    FLOW
346          RC   0.035   0.035   0.035    6393  0.0071    0.00
347          RX    0.00    0.00  325.00  355.00  405.00  435.00  760.00  760.00
348          RY   17.30   16.30   15.00    0.00    0.00   15.00   16.30   17.30
             *

349          KK    WWBR   BASIN
350          KM   RUNOFF HYDROGRAPH FOR SUBBASIN WWBR DRAINING TOWARD THE INTERSECTION OF
351          KM   WESTWING PARKWAY AND BLACK ROCK BOULEVARD
352          BA   0.184
353          LG    0.22    0.19    7.00    0.10      25
354          UC   0.349   0.211
355          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
356          UA     100
             *

357          KK  ERWWBR  DIVERT
358          KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
359          KM   RETENTION IN SUBBASIN WWBR
360          DT   XWWBR    13.2     0.0
361          DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
362          DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

363          KK   RWWRS   ROUTE
364          KM   ROUTE RUNOFF HYDROGRAPH FROM SUBBASIN WWBR EAST THROUGH SUBBASIN WWRS TO
365          KM   COMBINATION POINT CWWRS
366          RS       4    FLOW
367          RC   0.035   0.035   0.035    2655  0.0062    0.00
368          RX    0.00    0.00   60.00   80.00  110.00  130.00  190.00  190.00
369          RY   11.24   10.24   10.00    0.00    0.00   10.00   10.24   11.24
             *

370          KK    WWRS   BASIN
371          KM   RUNOFF HYDROGRAPH FOR SUBBASIN WWRS DRAINING TOWARD THE CROSSING OF ROCK
372          KM   SPRINGS WASH AT WESTWING PARKWAY
373          BA   0.144
374          LG    0.20    0.26    4.30    0.44      32
375          UC   0.458   0.377
376          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
377          UA     100
             *

378          KK  ERWWRS  DIVERT
379          KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
380          KM   RETENTION IN SUBBASIN WWRS
381          DT   XWWRS     6.5     0.0
382          DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
383          DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
             *
1                                        HEC-1 INPUT                                        PAGE 10

        LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

384          KK   CWWRS COMBINE
385          KM   COMBINE ROUTE RWWRS AND SUBBASIN WWRS
386          HC       2
             *

387          KK   RJMRS   ROUTE
388          KM   ROUTE RUNOFF HYDROGRAPH FROM COMBINATION POINT CWWRS SOUTHEAST THROUGH
389          KM   SUBBASIN JMRS TO COMBINATION POINT CJMRS
390          RS       4    FLOW
391          RC   0.035   0.035   0.035    3881  0.0062    0.00
392          RX    0.00    0.00   40.00   56.00   76.00   92.00  132.00  132.00
393          RY    9.16    8.16    8.00    0.00    0.00    8.00    8.16    9.16
             *
```

```
          394          KK    JMRS   BASIN
          395          KM   RUNOFF HYDROGRAPH FOR SUBBASIN JMRS DRAINING TOWARD THE CROSSING OF ROCK
          396          KM   SPRINGS WASH AT JOMAX ROAD
          397          BA   0.567
          398          LG    0.20    0.31    5.30    0.20      18
          399          UC   0.504   0.307
          400          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          401          UA     100
                       *

          402          KK  ERJMRS  DIVERT
          403          KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
          404          KM   RETENTION IN SUBBASIN JMRS
          405          DT   XJMRS    26.0     0.0
          406          DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
          407          DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
                       *

          408          KK   CJMRS COMBINE
          409          KM   COMBINE ROUTE RJMRS AND SUBBASIN JMRS
          410          HC       2
                       *

          411          KK  RHVRSB   ROUTE
          412          KM   ROUTE RUNOFF HYDROGRAPH FROM COMBINATION POINT CJMRS SOUT THROUGH SUBBASIN
          413          KM   HVRS TO COMBINATION POINT CHVRS
          414          RS       4    FLOW
          415          RC   0.035   0.035   0.035    5791  0.0051    0.00
          416          RX    0.00    0.00  325.00  355.00  405.00  435.00  760.00  760.00
          417          RY   17.30   16.30   15.00    0.00    0.00   15.00   16.30   17.30
                       *

          418          KK    HVRS   BASIN
          419          KM   RUNOFF HYDROGRAPH FOR SUBBASIN HVRS DRAINING TOWARD THE CROSSING OF ROCK
          420          KM   SPRINGS WASH AT HAPPY VALLEY ROAD
          421          BA   0.630
          422          LG    0.10    0.35    4.10    0.38       1
          423          UC   1.122   0.737
          424          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          425          UA     100
                       *
1                                                HEC-1 INPUT                                                PAGE 11

        LINE           ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          426          KK  ERHVRS  DIVERT
          427          KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
          428          KM   RETENTION IN SUBBASIN HVRS
          429          DT   XHVRS     0.8     0.0
          430          DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
          431          DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
                       *

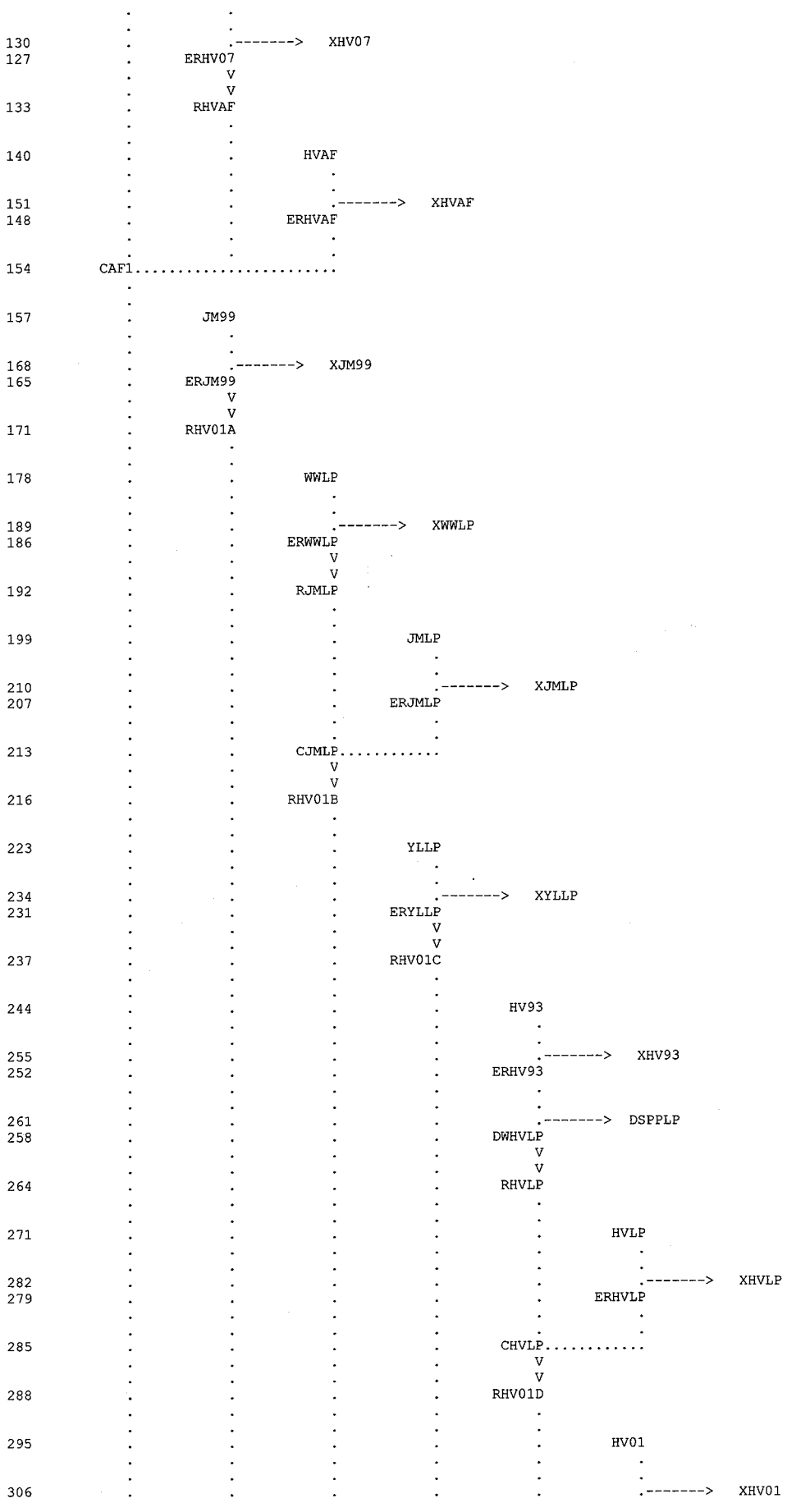
          432          KK   CHVRS COMBINE
          433          KM   COMBINE ROUTES RHVRSA AND RHVRSB AND SUBBASIN HVRS
          434          HC       3
                       *

          435          KK    JMNR   BASIN
          436          KM   RUNOFF HYDROGRAPH FOR SUBBASIN JMNR NORTH OF JOMAX ROAD DRAINING INTO NEW
          437          KM   RIVER
          438          BA   0.164
          439          LG    0.23    0.32    3.88    0.42      15
          440          UC   0.500   0.349
          441          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
          442          UA     100
                       *

          443          KK  ERJMNR  DIVERT
          444          KM   DIVERT 80% OF 100-YR, 2-HR VOLUME BASED ON NOAA2 RAINFALL FOR EXISTING
          445          KM   RETENTION IN SUBBASIN JMNR
          446          DT   XJMNR     6.7     0.0
          447          DI     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
          448          DQ     0.0 10000.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
                       *
          449          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   105        JMAF
                 .
                 .
   116           .-------->   XJMAF
   113       ERJMAF
                 .
                 .
   119           .        HV07
```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127
ERHV07
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RHVAF
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HVAF
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XHVAF
148
ERHVAF
154
CAF1
157
JM99
168
XJM99
165
ERJM99
171
RHV01A
178
WWLP
189
XWWLP
186
ERWWLP
192
RJMLP
199
JMLP
210
XJMLP
207
ERJMLP
213
CJMLP
216
RHV01B
223
YLLP
234
XYLLP
231
ERYLLP
237
RHV01C
244
HV93
255
XHV93
252
ERHV93
261
DSPPLP
258
DWHVLP
264
RHVLP
271
HVLP
282
XHVLP
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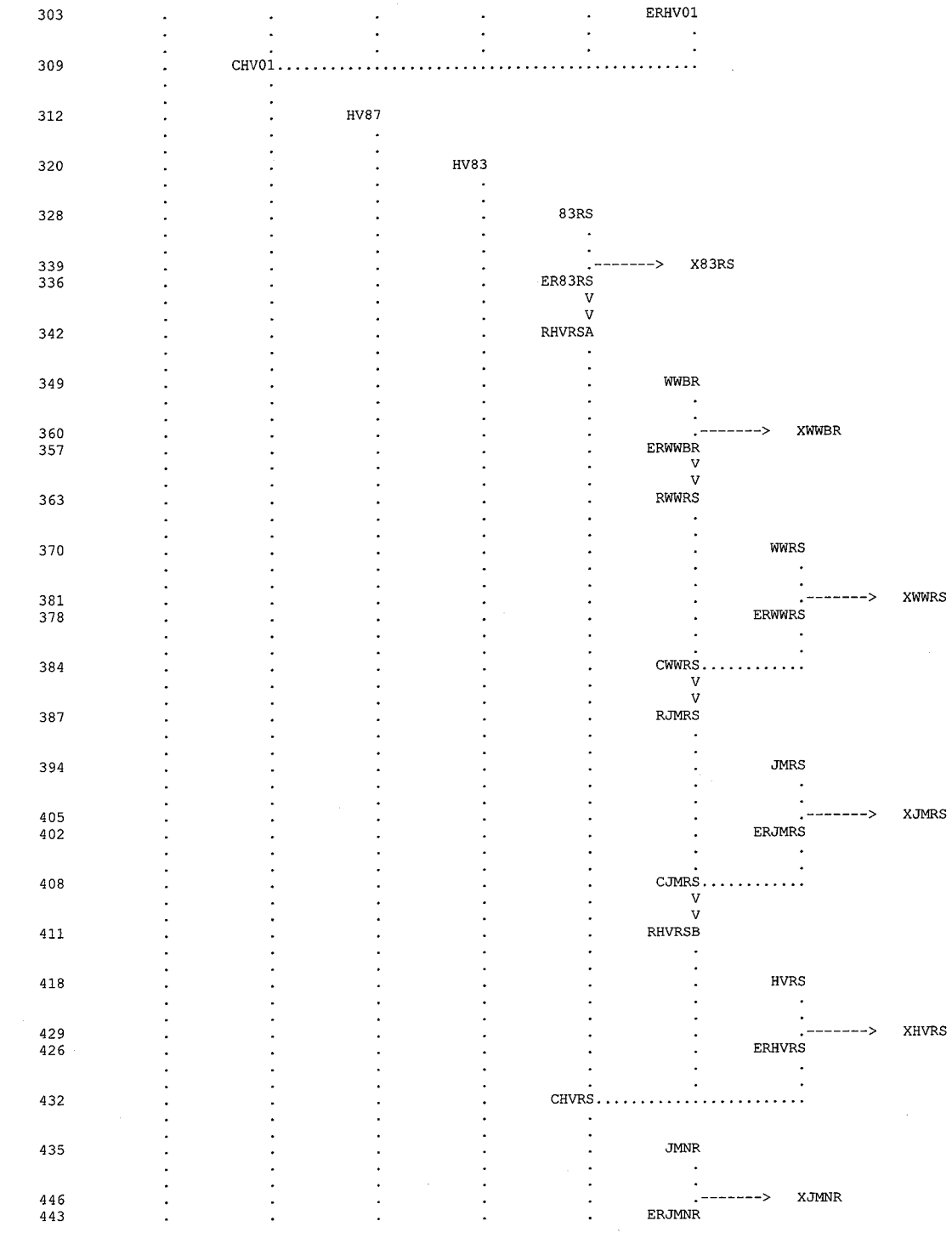
ERHVLP
285
CHVLP
288
RHV01D
295
HV01
306
XHV01



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN   1998               *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   12NOV09  TIME  15:13:41   *
 *                                       *
 *****************************************
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```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

GLENDALE STORMWATER MANAGEMENT PLAN
Model for Pilot Study - Area 2

Prepared for the City of Glendale

```
                    In association with the Flood Control District of Maricopa County
                    City Project Number 089017

                    Prepared by Kimley-Horn and Associates, Inc.
                    KHA Project Number 091910009
                    November 2009

                    MODELING PARAMETERS
                    100 YEAR 6 Hour Storm Event
                    NOAA 14 Rainfall Data
                    Clark Unit Hydrograph
                    Green and Ampt Rainfall Loss Method
                    Modified Puls (Normal Depth) Channel Routing Method for surface flow
                    Kinematic Wave Channel Routing Method for storm drain flow

                    Topo data extracted from Flood Control District database July 24, 2009
                    Land use obtained from City of Glendale General Plan August 2009, City
                       of Phoenix General Plan August 2009, and MAG General Plan 2007

                  ********************************************************************************

                    MODELING NOMENCLATURE
                    SUBBASIN HYDROGRAPH:
                       Example: OL51   - the subbasin northeast of Olive and 51st Avenue
                       Example: JMRS   - the subbasin upstream of Jomax and Rock Springs Wash

                    STORM DRAIN DIVERSION:
                       Example: DOL51  - flow from subbasin OL51 is diverted to a storm drain

                    SUBBASIN DIVERSION:
                       Example: DWOL59 - flow is diverted west towards Olive and 59th Avenue
                       Example: DSNO51 - flow is diverted south towards Northern and 51st Ave
                    ROUTE HYDROGRAPH:
                       Example: RWOL59 - flow is routed west towards Olive and 59th Avenue
                       Example: RSNO59 - flow is routed south towards Northern and 59th Ave

                    COMBINE HYDROGRAPH:
                       Example: COL59  - combine flow at Olive and 59th Avenue
                       Example: CJMRS  - combine flow at Jomax and Rock Springs Wash

                    STREET NAME ABBREVIATIONS
                       Jomax Road             JM
                       Happy Valley Road      HV
                       Pinnacle Peak Road     PP
                       Deer Valley Road       DV
                       Loop 101               LO
                       Beardsley Road         BY
                       Union Hills Drive      UH
                       Bell Road              BL
                       Greenway Road          GW
                       Thunderbird Road       TB
                       Cactus Road            CT
                       Peoria Avenue          PE
                       Olive Avenue           OL
                       Northern Avenue        NO
                       Glendale Avenue        GL
                       Bethany Home Road      BH
                       Camelback Road         CB
                       Indian School Road     IS
                       Thomas Road            TM
                       McDowell Road          MD
                       Interstate 10          IN
                       Grand Avenue           GR

                    PREFIXES FOR MODELING OPERATIONS
                       RW     Routing flow in the west direction
                       RS     Routing flow in the south direction
                       C      Combination point for surface flow
                       CP     Combination point for pipe flow with surface flow
                       S      Storage routing
                       DW     Divert flow to the west
                       DS     Divert flow to the south
                       DR     Divert retrieval from surface flow
                       D      Divert surface flow (flow that remains after storm drain divert)
                       DP     Divert flow to a storm drain pipe
                       PR     Divert retrieval from a storm drain pipe
                       ER     Existing retention to be diverted from subbasin
                       X      Existing retention diverted out of model and will not be retriev

                  ********************************************************************************


88 IO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                      NMIN          5  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1   0  STARTING DATE
                     ITIME       0000  STARTING TIME
                        NQ       2000  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      7   0  ENDING DATE
```

```
                    NDTIME        2235  ENDING TIME
                    ICENT           19  CENTURY MARK

                 COMPUTATION INTERVAL      .08 HOURS
                     TOTAL TIME BASE  166.58 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT

    89 JD        INDEX STORM NO. 1
                       STRM        2.73  PRECIPITATION DEPTH
                       TRDA         .00  TRANSPOSITION DRAINAGE AREA

    90 PI          PRECIPITATION PATTERN
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .01       .01       .01       .01       .01       .01       .03
                      .03       .03       .05       .05       .05       .15       .15       .15       .03       .03
                      .03       .01       .01       .01       .01       .01       .01       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00

    93 JD        INDEX STORM NO. 2
                       STRM        2.71  PRECIPITATION DEPTH
                       TRDA         .50  TRANSPOSITION DRAINAGE AREA

    94 PI          PRECIPITATION PATTERN
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .01       .01       .01       .01       .01       .01       .03
                      .03       .03       .05       .05       .05       .15       .15       .15       .03       .03
                      .03       .01       .01       .01       .01       .01       .01       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00

    97 JD        INDEX STORM NO. 3
                       STRM        2.66  PRECIPITATION DEPTH
                       TRDA        2.80  TRANSPOSITION DRAINAGE AREA

    98 PI          PRECIPITATION PATTERN
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .01       .01       .01       .01       .01       .01       .03
                      .03       .03       .07       .07       .07       .08       .08       .08       .05       .05
                      .05       .02       .02       .02       .01       .01       .01       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00

   101 JD        INDEX STORM NO. 4
                       STRM        2.52  PRECIPITATION DEPTH
                       TRDA       16.00  TRANSPOSITION DRAINAGE AREA

   102 PI          PRECIPITATION PATTERN
                      .01       .01       .00       .00       .00       .00       .00       .00       .00       .01
                      .01       .01       .00       .01       .00       .00       .00       .00       .00       .00
                      .00       .00       .01       .00       .00       .00       .00       .01       .01       .01
                      .01       .01       .01       .01       .01       .01       .02       .02       .02       .03
                      .03       .03       .06       .06       .06       .07       .07       .07       .04       .04
                      .04       .02       .02       .02       .01       .01       .01       .01       .01       .01
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00
1
                                                  RUNOFF SUMMARY
                                              FLOW IN CUBIC FEET PER SECOND
                                            TIME IN HOURS,  AREA IN SQUARE MILES

                                    PEAK    TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION      STATION    FLOW     PEAK                                           AREA      STAGE     MAX STAGE
+                                                        6-HOUR     24-HOUR     72-HOUR

          HYDROGRAPH AT
+                          JMAF      174.    4.17          21.          5.          2.        .15

          DIVERSION TO
+                         XJMAF      174.    4.17           9.          2.          1.        .15

          HYDROGRAPH AT
+                        ERJMAF      144.    4.33          12.          3.          1.        .15

          HYDROGRAPH AT
+                          HV07      463.    4.08          40.         10.          3.        .30

          DIVERSION TO
+                         XHV07      463.    4.08          36.          9.          3.        .30
```

+	HYDROGRAPH AT	ERHV07	76.	4.58	4.	1.	0.	.30
+	ROUTED TO	RHVAF	63.	4.75	4.	1.	0.	.30
+	HYDROGRAPH AT	HVAF	297.	4.17	23.	6.	2.	.22
+	DIVERSION TO	XHVAF	297.	4.17	22.	5.	2.	.22
+	HYDROGRAPH AT	ERHVAF	45.	4.58	2.	0.	0.	.22
+	3 COMBINED AT	CAF1	142.	4.67	17.	4.	1.	.67
+	HYDROGRAPH AT	JM99	756.	4.33	126.	31.	10.	.57
+	DIVERSION TO	XJM99	756.	4.33	96.	24.	8.	.57
+	HYDROGRAPH AT	ERJM99	324.	4.83	30.	8.	3.	.57
+	ROUTED TO	RHV01A	231.	5.17	30.	8.	3.	.57
+	HYDROGRAPH AT	WWLP	271.	4.08	26.	6.	2.	.14
+	DIVERSION TO	XWWLP	271.	4.08	16.	4.	1.	.14
+	HYDROGRAPH AT	ERWWLP	198.	4.25	10.	3.	1.	.14
+	ROUTED TO	RJMLP	112.	4.58	10.	3.	1.	.14
+	HYDROGRAPH AT	JMLP	858.	4.25	130.	33.	11.	.70
+	DIVERSION TO	XJMLP	858.	4.25	102.	26.	9.	.70
+	HYDROGRAPH AT	ERJMLP	316.	4.75	29.	7.	2.	.70
+	2 COMBINED AT	CJMLP	348.	4.75	37.	9.	3.	.84
+	ROUTED TO	RHV01B	255.	5.00	37.	9.	3.	.84
+	HYDROGRAPH AT	YLLP	691.	4.25	101.	25.	8.	.60
+	DIVERSION TO	XYLLP	691.	4.25	78.	20.	7.	.60
+	HYDROGRAPH AT	ERYLLP	241.	4.75	23.	6.	2.	.60
+	ROUTED TO	RHV01C	247.	4.83	23.	6.	2.	.60
+	HYDROGRAPH AT	HV93	253.	4.17	29.	7.	2.	.17
+	DIVERSION TO	XHV93	253.	4.17	18.	5.	2.	.17
+	HYDROGRAPH AT	ERHV93	179.	4.33	11.	3.	1.	.17
+	DIVERSION TO	DSPPLP	54.	4.33	3.	1.	0.	.17
+	HYDROGRAPH AT	DWHVLP	125.	4.33	8.	2.	1.	.17
+	ROUTED TO	RHVLP	73.	4.67	8.	2.	1.	.17
+	HYDROGRAPH AT	HVLP	200.	4.25	39.	10.	3.	.20
+	DIVERSION TO	XHVLP	200.	4.25	32.	8.	3.	.20

+	HYDROGRAPH AT	ERHVLP	56.	5.17	7.	2.	1.	.20
+	2 COMBINED AT	CHVLP	78.	5.17	14.	4.	1.	.37
+	ROUTED TO	RHV01D	76.	5.33	14.	4.	1.	.37
+	HYDROGRAPH AT	HV01	537.	4.25	87.	22.	7.	.44
+	DIVERSION TO	XHV01	537.	4.25	52.	13.	4.	.44
+	HYDROGRAPH AT	ERHV01	382.	4.58	36.	9.	3.	.44
+	5 COMBINED AT	CHV01	562.	5.33	96.	24.	8.	2.82
+	HYDROGRAPH AT	HV87	594.	4.08	51.	13.	4.	.28
+	HYDROGRAPH AT	HV83	46.	4.17	5.	1.	0.	.04
+	HYDROGRAPH AT	83RS	1128.	4.08	121.	30.	10.	.64
+	DIVERSION TO	X83RS	917.	4.00	55.	14.	5.	.64
+	HYDROGRAPH AT	ER83RS	1082.	4.17	66.	17.	6.	.64
+	ROUTED TO	RHVRSA	684.	4.50	66.	17.	6.	.64
+	HYDROGRAPH AT	WWBR	357.	4.08	38.	9.	3.	.18
+	DIVERSION TO	XWWBR	357.	4.08	27.	7.	2.	.18
+	HYDROGRAPH AT	ERWWBR	219.	4.33	11.	3.	1.	.18
+	ROUTED TO	RWWRS	150.	4.58	11.	3.	1.	.18
+	HYDROGRAPH AT	WWRS	175.	4.17	25.	6.	2.	.14
+	DIVERSION TO	XWWRS	175.	4.17	13.	3.	1.	.14
+	HYDROGRAPH AT	ERWWRS	129.	4.42	12.	3.	1.	.14
+	2 COMBINED AT	CWWRS	237.	4.58	23.	6.	2.	.33
+	ROUTED TO	RJMRS	208.	4.75	23.	6.	2.	.33
+	HYDROGRAPH AT	JMRS	763.	4.17	96.	24.	8.	.57
+	DIVERSION TO	XJMRS	763.	4.17	52.	13.	4.	.57
+	HYDROGRAPH AT	ERJMRS	534.	4.42	44.	11.	4.	.57
+	2 COMBINED AT	CJMRS	453.	4.50	61.	15.	5.	.89
+	ROUTED TO	RHVRSB	367.	4.92	61.	15.	5.	.89
+	HYDROGRAPH AT	HVRS	362.	4.83	74.	19.	6.	.63
+	DIVERSION TO	XHVRS	33.	4.17	2.	0.	0.	.63
+	HYDROGRAPH AT	ERHVRS	362.	4.83	73.	18.	6.	.63
+	3 COMBINED AT	CHVRS	774.	4.83	166.	41.	14.	2.16

	HYDROGRAPH AT							
+		JMNR	183.	4.17	23.	6.	2.	.16
	DIVERSION TO							
+		XJMNR	183.	4.17	14.	3.	1.	.16
	HYDROGRAPH AT							
+		ERJMNR	126.	4.42	10.	2.	1.	.16

*** NORMAL END OF HEC-1 ***

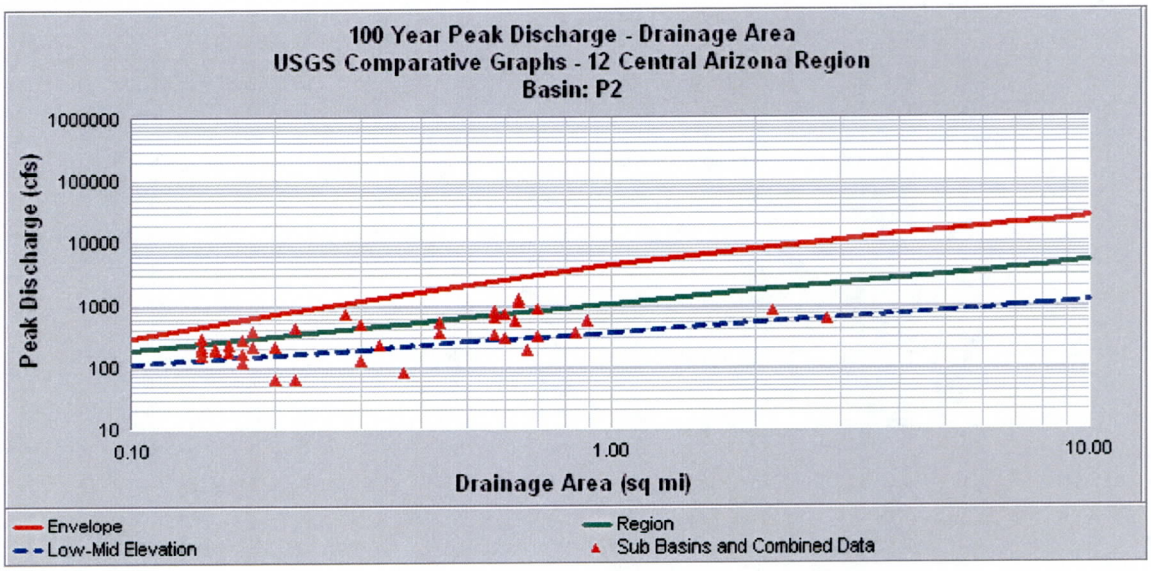


Figure 1. Comparison of 100-Year Peak Discharge Values with USGS Data

Appendix F Exhibits

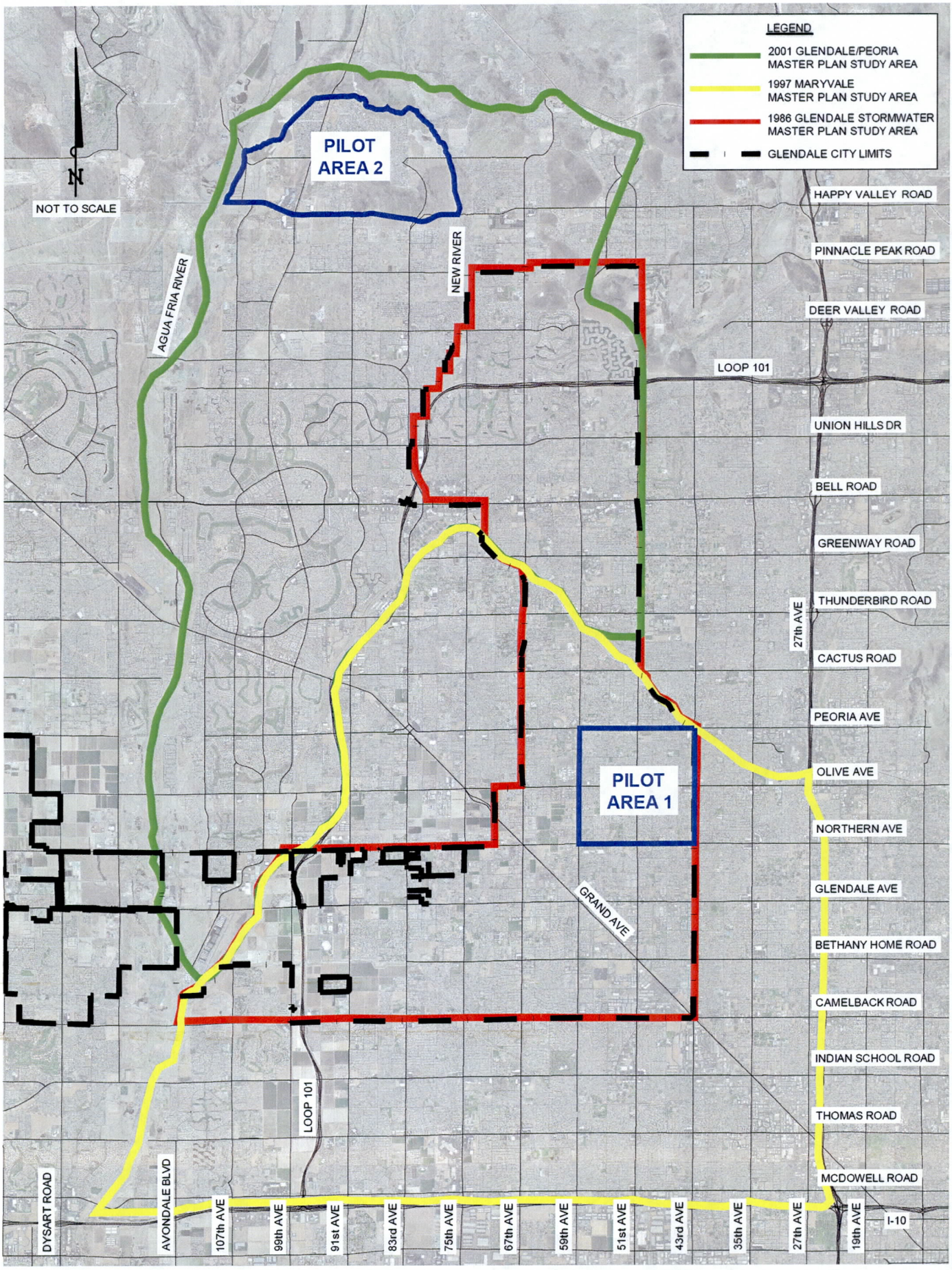
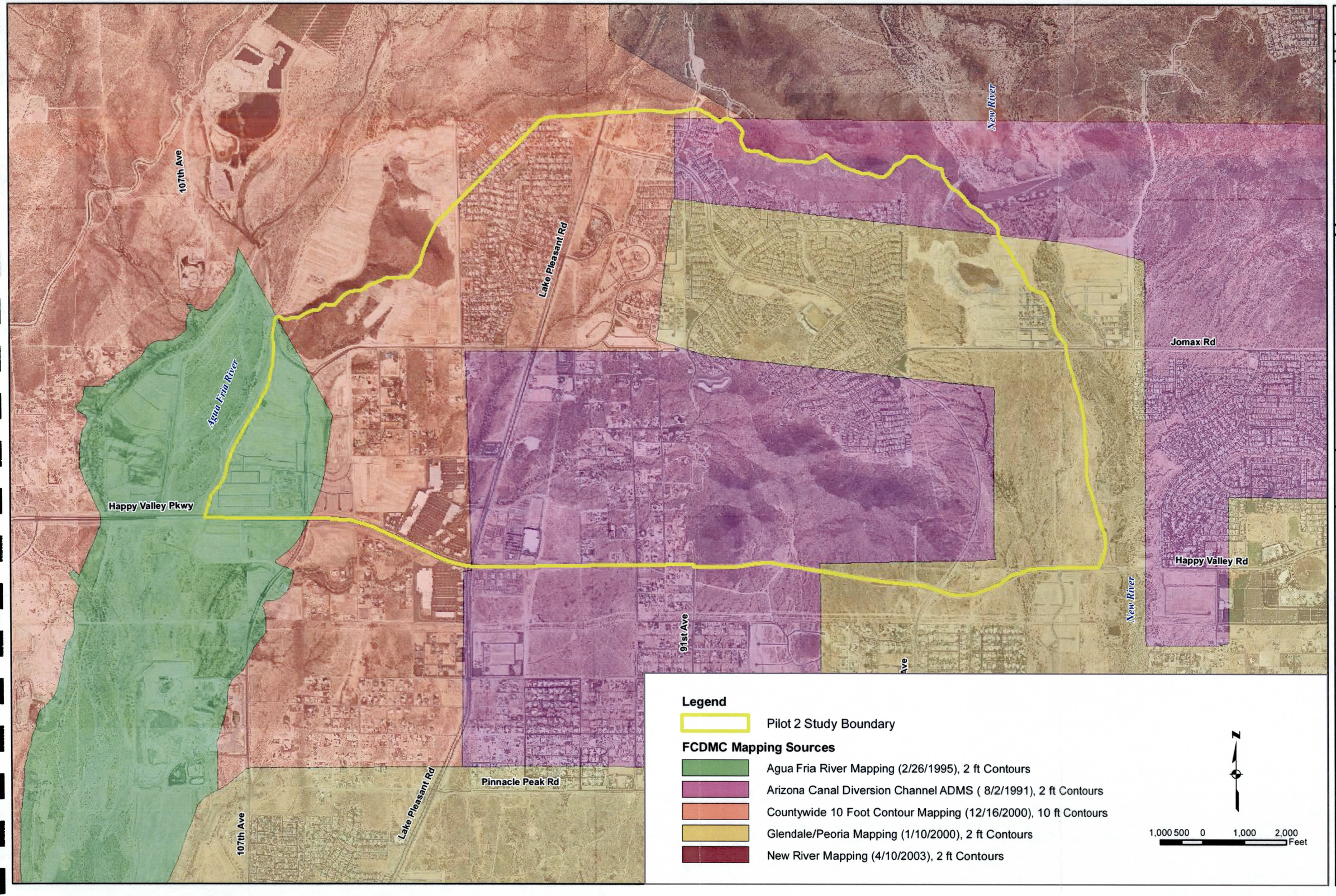


EXHIBIT 1 VICINITY MAP

Kimley-Horn and Associates, Inc.



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Engineering, Planning and Environmental Consultants
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NO	REVISION	BY	DATE	APPR.

SCALE(H):1"=2000'
SCALE(V): NONE
DESIGNED BY: MAF
DRAWN BY: A.T.
CHECKED BY: DEJ
DATE: NOV 2009

GLENDALE AREA STORMWATER MANAGEMENT PLAN
EXHIBIT 2
FCDMC MAPPING SOURCES

PROJECT NO. 091910009

DRAWING NAME EXHIBIT 2

SHEET 1 OF 1

GLENDALE AREA
STORMWATER MANAGEMENT PLAN
EXHIBIT 3
SUBBASIN DELINEATION MAP

SCALE(H):1"=2000'
SCALE(V): NONE
DESIGNED BY: MAF
DRAWN BY: LAT
CHECKED BY: DEJ
DATE: NOV 2009

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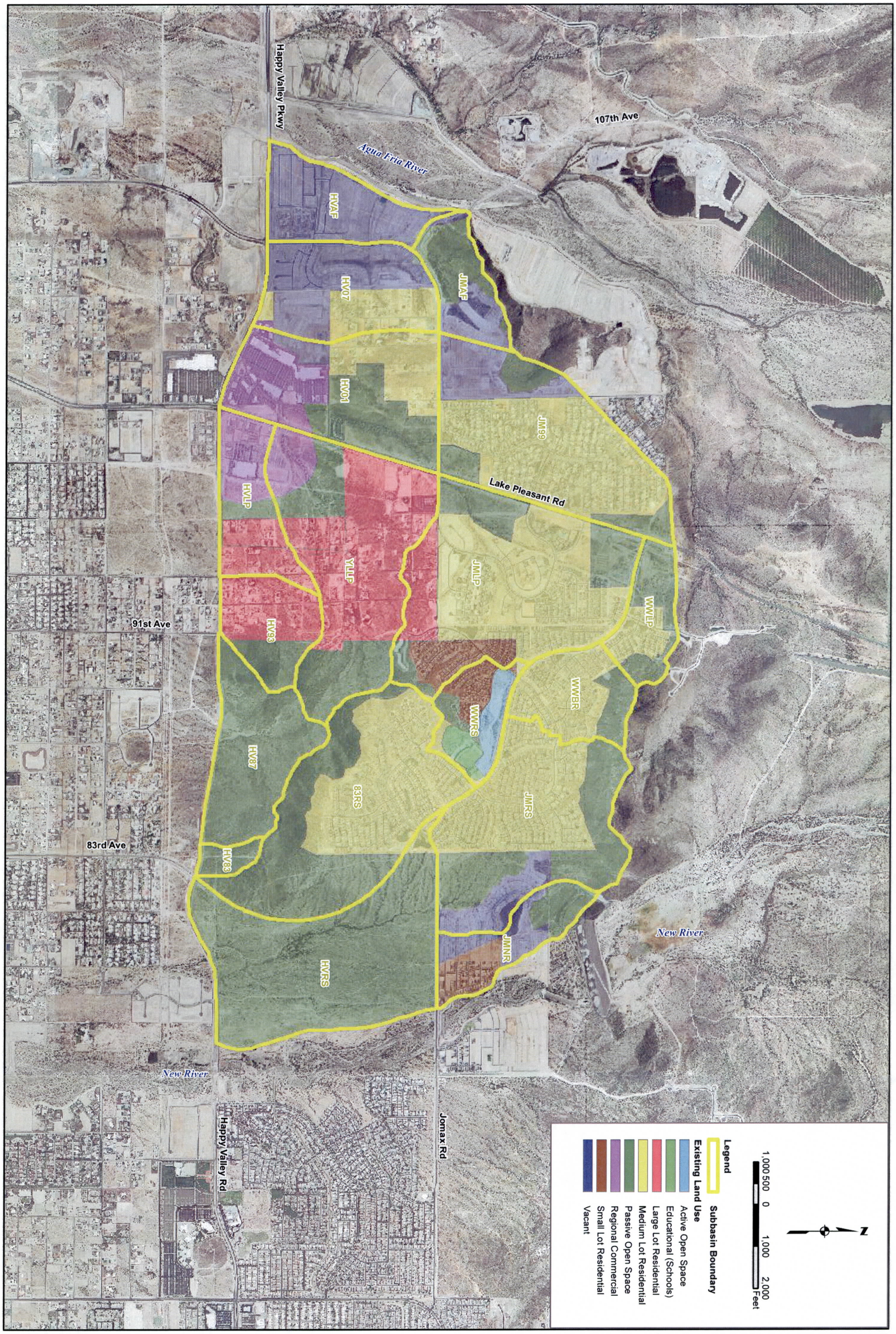
Phoenix, Arizona 85020 (602) 944-5500

PROJECT NO. 091910009
DRAWING NAME EXHIBIT 3
SHEET 1 OF 1

NO | REVISION | BY | DATE | APPR



SHEET 1 OF 1	DRAWING NAME: EXHIBIT 4	PROJECT NO. 061910000	GLENDALE AREA STORMWATER MANAGEMENT PLAN EXHIBIT 4 EXISTING CONDITIONS LAND USE MAP	SCALE(H): 1"=2000' SCALE(V): NONE DESIGNED BY: MAF DRAWN BY: LAT CHECKED BY: DEJ DATE: NOV 2009	Kimley-Horn and Associates, Inc.	NO.	REVISION BY DATE APPR.

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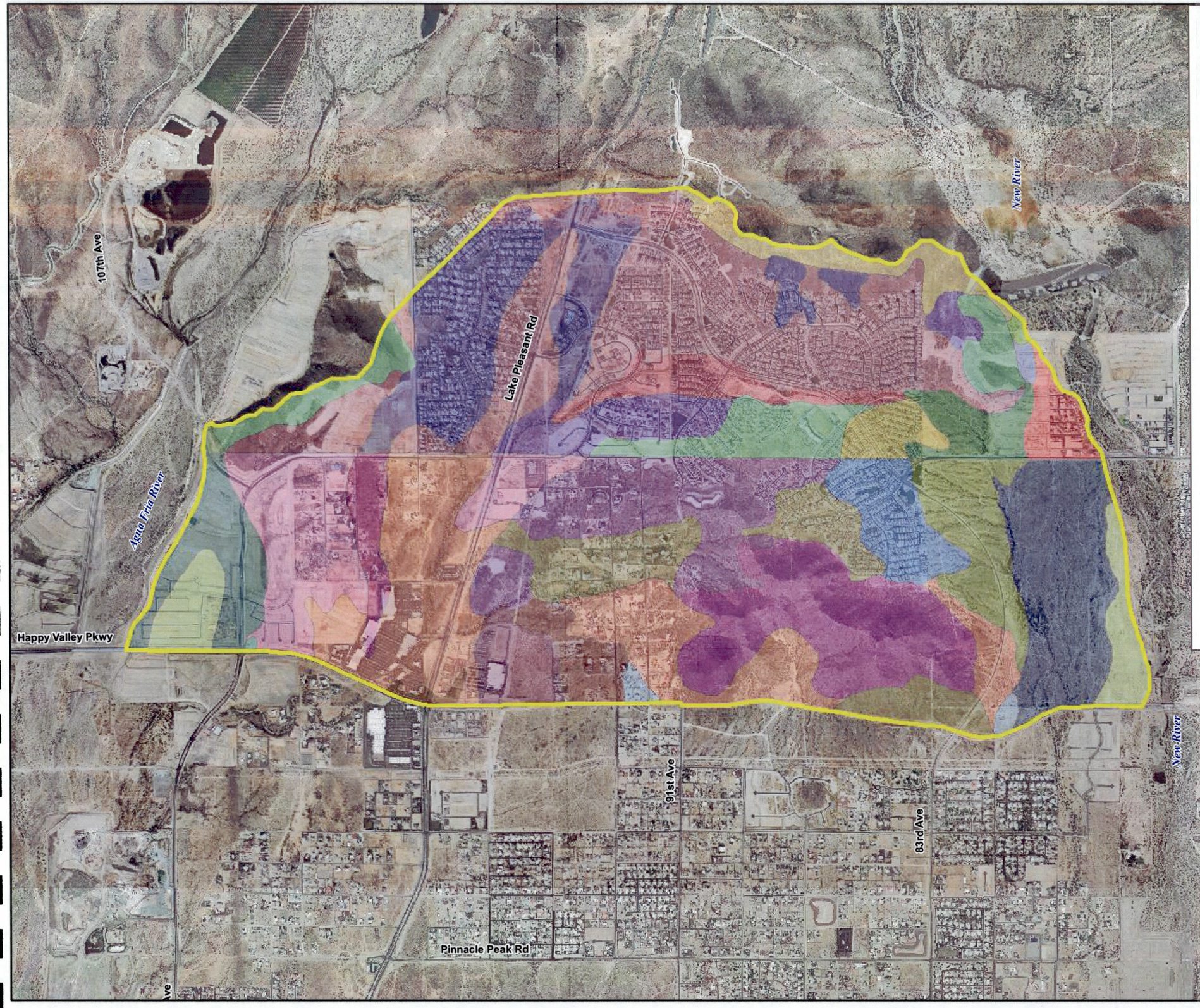
Phoenix, Arizona 85020 (602) 944-5500



N

1,000 500 0 1,000 2,000 Feet

Legend

Pilot 2 Study Boundary

Soil Types

- 10
- 100
- 110
- 112
- 115
- 118
- 13
- 18
- 21
- 3
- 53
- 55
- 75
- AGB
- AL
- BE
- CF
- CO
- CV
- GM
- GN
- GWD
- GYD
- PT
- PWB
- RS
- TPB
- TSC
- Vf

BY | DATE | APPR.

REVISION NO

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7878 North 16th Street, Suite 300
Phoenix, Arizona 85020 (602) 944-5500

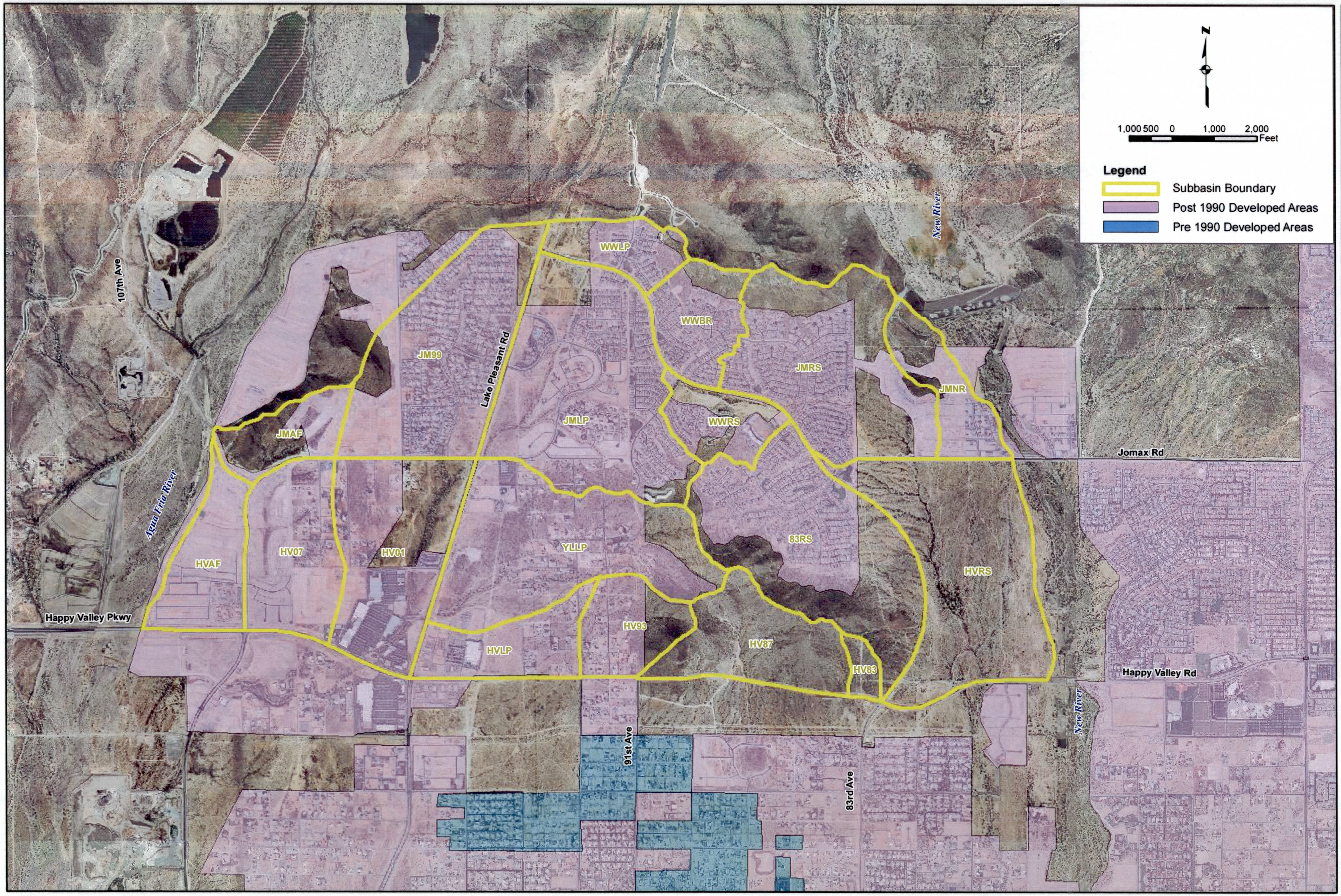
SCALE(H):1"=2000'
SCALE(V): NONE
DESIGNED BY: MAF
DRAWN BY: LAT
CHECKED BY: DEJ
DATE: NOV 2009

GLENDALE AREA STORMWATER MANAGEMENT PLAN EXHIBIT 5 SOILS MAP

PROJECT NO.
091910009

DRAWING NAME
EXHIBIT 5

SHEET 1 OF 1



GLENDALE AREA
STORMWATER MANAGEMENT PLAN
EXHIBIT 6
PRE AND POST 1990 DEVELOPED AREAS

SCALE(H): 1"=2000'
SCALE(V): NONE
DESIGNED BY: MAF
DRAWN BY: LAT
CHECKED BY: DEJ
DATE: NOV 2009

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PROJECT NO. 091910009
DRAWING NAME EXHIBIT 6
SHEET 1 OF 1

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