North Peoria Area Drainage Master Plan

Prepared for the
Flood Control District
of Maricopa County

and the
City of Peoria

Project No. 82000146
Contract FCD 99-45

Attachment 9
Environmental Regulatory Records Review

Attachment 10
Investigation of Existing Ordinances, Policies, Regulations, & Standards Effecting Stormwater Drainage

Book 1 of 1

January 2002

NORTH PEORIA AREA DRAINAGE MASTER PLAN

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Attachment 9

Environmental Regulatory Records Review

PREPARED FOR:

FLOOD CONTROL DISTRICT
of
Maricopa County

PREPARED BY:

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17 May 2000

STANTEC CONSULTING Inc.
Project No. 82000146

Contract FCD 99-45

FLOOD CONTROL DISTRICT of MARICOPA COUNTY 1959

Stantec

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1. INTRODUCTION

1.1 Purpose and Organization of Report

This Environmental Regulatory Records Review has been conducted in compliance with standards suggested by the American Society for Testing and Materials (ASTM procedure E-1527-97). Its purpose is to identify and document the locations of any regulatory sites within or adjacent to the project area. Sites identified are briefly described with location, type of regulated substance or waste at the site, the extent of the contamination, the status of the site (closed or open), remediation plans for the site, and the named potentially responsible party(s), if available. Stantec was not requested to conduct extensive file review on any identified regulatory sites to obtain this information.

This report includes a description of the project area, a review of regulatory agency records and databases, summary and recommendations. The report has been prepared for the exclusive use of the Clients, the **Flood Control District of Maricopa County** and the **City of Peoria, Arizona**.

1.2 Project Area Description

The North Peoria Drainage Project Area is comprised of approximately 72 square miles and represents the watershed of all the tributaries emptying into the Agua Fria River between the New Waddell Dam and the Beardsley Road alignment. The area is bounded on the east by 87th Avenue, S.R. 74, Lake Pleasant Road, and the west bank of the Agua Fria River. It is bounded on the south by the Beardsley Road alignment. It is bounded on the west by an irregular line, bearing approximately north-northwest, extending from the intersection of Beardsley Road and El Mirage Road to the head of Morgan City Wash at the Maricopa County-Yavapai County Line. It is bounded on the north by the Maricopa County-Yavapai County Line and an irregular line, bearing approximately east-southeast, extending from the Maricopa County-Yavapai County

Line to Lake Pleasant and the New Waddell Dam. Figure 1 shows the location of the North Peoria Area Drainage Project.

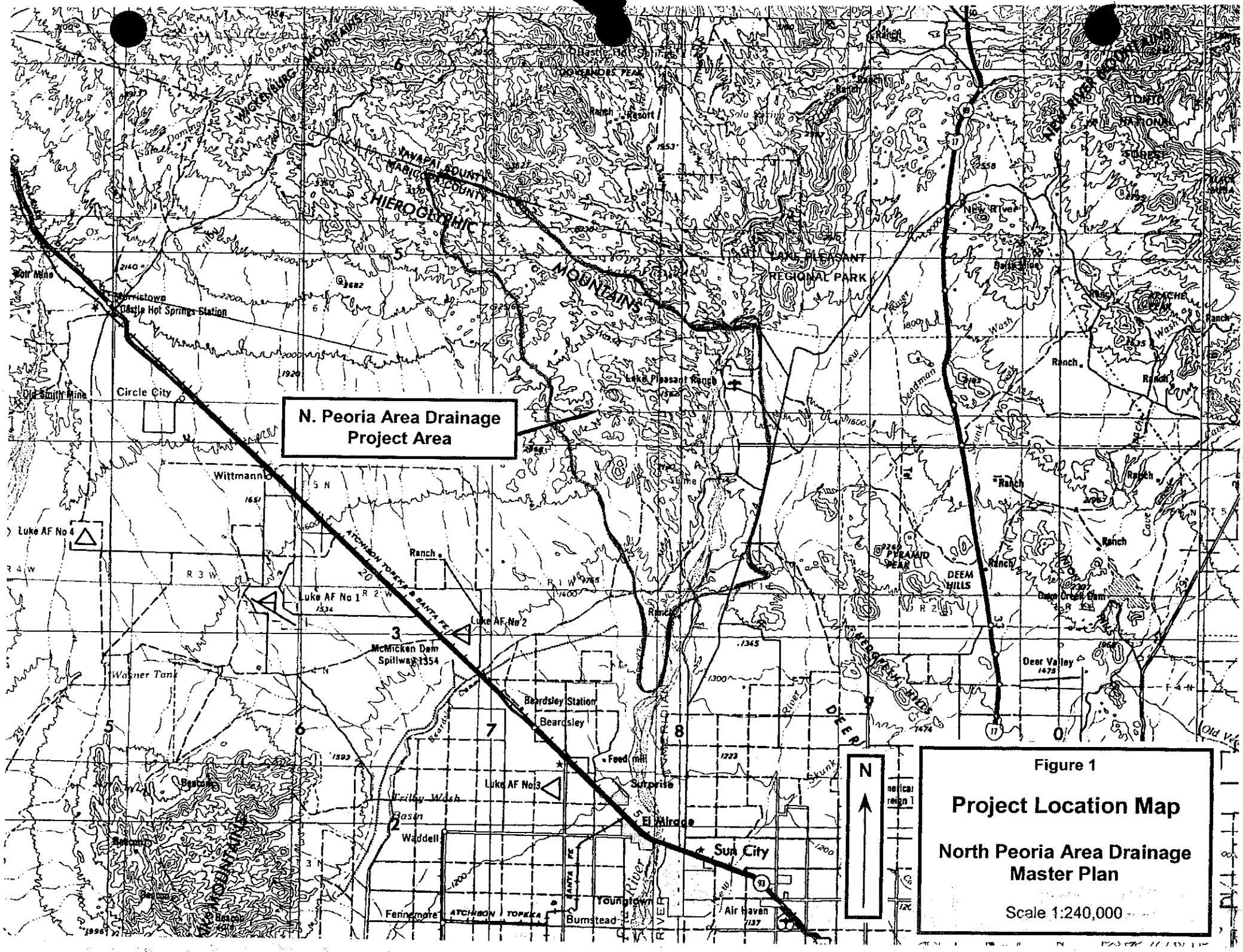

Figure 1

Project Location Map

North Peoria Area Drainage Master Plan

Scale 1:240,000

2. REGULATORY AGENCY RECORD REVIEW

Stantec Consulting contracted with Vista Information Solutions, Inc. of San Diego, California for a review of Federal and State maintained environmental databases that contain records of sites and facilities of environmental interest or concern. The results of the database review conducted by Vista and provided to Stantec are contained in Appendix A of this report. Subsections 2.1 and 2.2 summarize the database review.

The irregular boundaries of private properties located in Section 31, T7N-R1W, and in Sections 8 and 17, T6N-R1W, and the indications on topographic sites of mine workings suggest patented mine claims and mineral exploration activity within the project areas. These activities can impact drainage and mine tailings can contribute to the contamination of surface and ground water. Stantec reviewed the records of the Arizona Department of Mines and Mineral Resources to identify the mining activity and its extent in the North Peoria Drainage area.

2.1 Federal Databases

Federal databases reviewed for listings of the subject site, adjoining sites, and sites within ASTM-prescribed search radii were the National Priority List (NPL); Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS/NFRAP); Resource Conservation and Recovery Information System – Treatment, Storage, and Disposal Facilities (CORRACTS - TSD); Resource Conservation and Recovery Information System – Large and Small Quantity Generators (LG GEN, SM GEN); and Emergency Response Notification System (ERNS).

Neither the subject site nor any adjacent sites were found on any of these lists. No sites were identified within the ASTM-prescribed search radii.

2.2 State Databases

Environmental databases maintained by the State of Arizona that were reviewed for listings of the subject site, adjoining sites, or sites located within the ASTM-prescribed search radii were the Arizona Water Quality Assurance Revolving Fund Site List (WQARF); Arizona CERCLA Information and Data System List (ACIDS); Arizona Solid Waste Facilities List (SWLF); Arizona Leaking Underground Storage Tank List (LUST); Arizona Underground Storage Tank List (UST), and the Arizona Hazardous Materials Logbook (SPILLS).

No listings of the site or any adjoining sites were found as a result of the search of the WQARF, SWLF, LUST, UST, and SPILLS databases. Three site listings were found in the search of the ACIDS database. These sites are the Waddell Dam Project (Sec. 21, T6N-R1E), the Waddell Dam (0.25 mile downstream of the Waddell Dam), and the Clementine Project (99th Avenue and Jomax Road).

2.2.1 Waddell Dam Project and Waddell Dam

According to ADEQ personnel and files, these two listings are for the same site. The site is located approximately 0.25 mile downstream from the old Waddell Dam and upstream of the New Waddell Dam. The site discovery date was 1990. The site consisted of two old landfills. One landfill measured 280'x50' and contained cans, drums, wire, cable, and miscellaneous debris. The second landfill measured 270'x50' and contained soil with wood, concrete, metal, and one drum. Sampling of both sites identified soil contaminated by organochloride pesticide at concentrations less than 1mg/kg. The Bureau of Reclamation excavated the contaminated soils and removed them to a hazardous waste landfill. The non-hazardous contents of the landfills were removed to conventional solid-waste landfills. The excavated landfills were capped. The location of the site is currently inundated by Lake Pleasant. The site was officially closed by the ADEQ on 26 January 1993.

2.2.2 Clementine Project

According to ADEQ personnel, this site dates from a time before ADEQ records were well maintained. Currently, there is no file information available for this site that indicates its discovery date, the facility type, the contaminant, or its status. ADEQ is engaged in an effort to organize and consolidate its files and anticipates that when the effort is complete ambiguous and duplicate site files such as those encountered during this record review will be largely eliminated from its record system.

2.3 Arizona Department of Mines and Mineral Resources

The northwest end of the project area contains a portion of the Pikes Peak Mining District. Two areas of patented claims associated with the Pikes Peak Mining District are located in Section 31, T7N-R1W, and Sections 8 and 17, T6N-R1W.

There are five patented mining claims and two patented mill sites associated with the Morgan City Mine in Section 31, T7N-R1W. The claims date from 1903 and are based on a vein deposit of gold. They contain a 265-foot inclined shaft with approximately 200 feet of drifts at the 100-foot and 200-foot levels. The last recorded activity at the Morgan City Mine site was sampling conducted in 1992.

The patented mine claims in Sections 8 and 17, T6N-R1W, are part of a larger area which includes claims in Sections 18 and 19, T6N-R1W, and Sections 13 and 24, T6N-R2W. The basis for these claims is a large, low-grade iron ore deposit. This area was first systematically explored by Kaiser Steel Corporation in 1942. Kaiser sampled 35 surface trenches, several hundred feet of underground adits, and a 415-foot drill hole. There has not been any recorded production of ore from this site. The last recorded activity at this site was sampling proposed for the autumn of 1975.

2.4 U.S. Bureau of Land Management

Stantec contacted the U.S. Bureau of Land Management (BLM), Phoenix Field Office (refer to Appendix B – Correspondence), to determine if BLM was aware of any sites or activities on Federal Land in the project area that could contribute to pollution of ground

or surface water. BLM's response (Appendix B) indicates that there are no environmental sites on BLM lands within the project area have contaminated, or could potentially contaminate surface or ground water.

2.5 Arizona State Land Department

Stantec contacted the Arizona State Land Department (ASLD) to determine if ASLD was aware of any sites or activities on State Trust Land in the project area that could contribute to pollution of ground or surface water. Mr. Bill Dowdle of ASLD responded by telephone on 24 April 2000 and stated that ASLD was not aware of any such sites or activities within or adjacent to the project area.

3. SUMMARY AND RECOMMENDATIONS

3.1 Summary

Stantec Consulting, Inc. has performed an Environmental Regulatory Records Review in conformance with the scope and limitations of ASTM Practice E 1527-97 of the North Peoria Drainage Master Plan project area in Maricopa County, Arizona. Any exceptions to, or deletions from, this practice are described in Section 6.3 of this report. This assessment has revealed no evidence of recognized environmental conditions in connection with the project area.

3.2 Recommendations

In accordance with ASTM E-1527-97 procedure standards, no further investigation of the subject project area for contamination resulting from its past use or from the past use of adjoining sites is recommended.

3.3 Deviations

There have been no deviations from the suggested procedure and format for Phase I Environmental Site Assessments provided by ASTM E-1527-97.

4. LIMITATIONS

This report was prepared for the exclusive use of the Clients, the **Flood Control District of Maricopa County** and the **City of Peoria, Arizona**. The conclusions are based solely on the information presented in this report. Additional information that was not readily available at the time of this report may result in a modification of the conclusions presented.

The observations described in this report were made under the conditions stated therein. The conditions presented in the report were based solely upon the services describe therein, and not on scientific tasks or procedures beyond the scope of described services or the time and budgetary constraints imposed by the Client(s).

In preparing this report, Stantec has relied on certain information provided by federal, state, and local officials and other parties referenced therein, and on information contained in the files of federal, state, and/or local agencies available at the time of the site assessment. Although there may have been some degree of overlap in the information provided by these various sources, Stantec did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this site assessment.

In the event that counsel or title examiner for Client obtains information on environmental or hazardous waste issues at the site not contained in this report, such information shall be brought to Stantec's attention forthwith. Stantec will evaluate such information and, on the basis of this evaluation, may modify the conclusions stated in this report.

The purpose of this report was to identify and document the locations of any regulatory sites within or adjacent to the project area. Sites identified have been briefly described with location, type of regulated substance or waste at the site, the extent of the contamination, the status of the site (closed or open), remediation plans for the site, and the named potentially responsible party(s), if available. Stantec was not requested to conduct extensive file review on any identified regulatory sites to obtain this information. No specific attempt was made to check on the compliance of present or past owners or operators of the site with federal, state, or local laws and regulations environmental or otherwise. Neither Stantec nor its subcontractors can insure the accuracy of the information, errors occurring in conversion of data, or for Client's use of the data. Stantec and its affiliated companies, officers, agents, employees, and independent contractors cannot be held liable for accuracy, storage, delivery, loss, or expense suffered by the Client resulting directly or indirectly from any information provided by Stantec.

5. PREPARER

This report was prepared by Stephen Powers, Geologist for Stantec Consulting, Inc. Mr. Powers has more than 24 years experience in surface and subsurface geological investigation and interpretation. He holds a Master of Science degree in Geology from the University of Kentucky. He has worked in the petroleum industry, state government, and as an environmental consultant. Mr. Powers has prepared Phase I Environmental Site Assessments for the Resolution Trust Corporation (RTC), the Federal Deposit Insurance Corporation (FDIC) and numerous private clients. He has provided Phase I oversight and review for RTC and FDIC.

This report was reviewed by Robert Larkin, Senior Environmental Scientist/Planner for Stantec Consulting, Inc. Relevant environmental record and database information was provided by Vista Information Solutions, Inc.

6. REFERENCES

Farnham, L.L., and Havens, R., 1957. *Pikes Peak Iron Deposits, Maricopa County, Arizona*. Bureau of Mines Report of Investigations 5319, U.S. Department of Interior, Washington, D.C.

APPENDIX A

ENVIRONMENTAL RECORDS SEARCH

SITE ASSESSMENT - SPECIAL REPORT

PROPERTY INFORMATION	CLIENT INFORMATION
Project Name/Ref #: Not Provided NORTH PEORIA DRAINAGE STUDY SUN CITY SUN CITY, AZ Latitude/Longitude: (33.802183, 112.343850)	STEPHEN POWERS STANTEC CONSULTING, INC 7776 S. POINTE PARKWAY WEST SUITE 290 PHOENIX, AZ 85044

Site Distribution Summary Agency / Database - Type of Records			within 1/8 mile	1/8 to 1/4 mile	1/4 to 1/2 mile	1/2 to 1 mile
A) Databases searched to 1 mile:						
US EPA	NPL	National Priority List	0	0	0	0
US EPA	CORRACTS	RCRA Corrective Actions	0	0	0	0
STATE	SPL	State equivalent priority list	0	0	0	0
B) Databases searched to 1/2 mile:						
US EPA	RCRA-TSD	RCRA permitted treatment, storage, disposal facilities	0	0	0	-
STATE	SCL	State equivalent CERCLIS list	2	0	1	-
US EPA	CERCLIS/ NFRAP	Sites under review by US EPA	0	0	0	-
STATE/ REG/CO	LUST	Leaking Underground Storage Tanks	0	0	0	-
STATE/ REG/CO	SWLF	Solid waste landfills, incinerators, or transfer stations	0	0	0	-
US EPA	TRIS	Toxic Release Inventory database	0	0	0	-
C) Databases searched to 1/4 mile:						
STATE/ CO	UST	Registered underground storage tanks	0	0	-	-
D) Databases searched to 1/8 mile:						
US EPA	GNRTR	RCRA registered small or large generators of hazardous waste	0	-	-	-
US EPA/ STATE	SPILLS	ERNS and state spills lists	0	-	-	-

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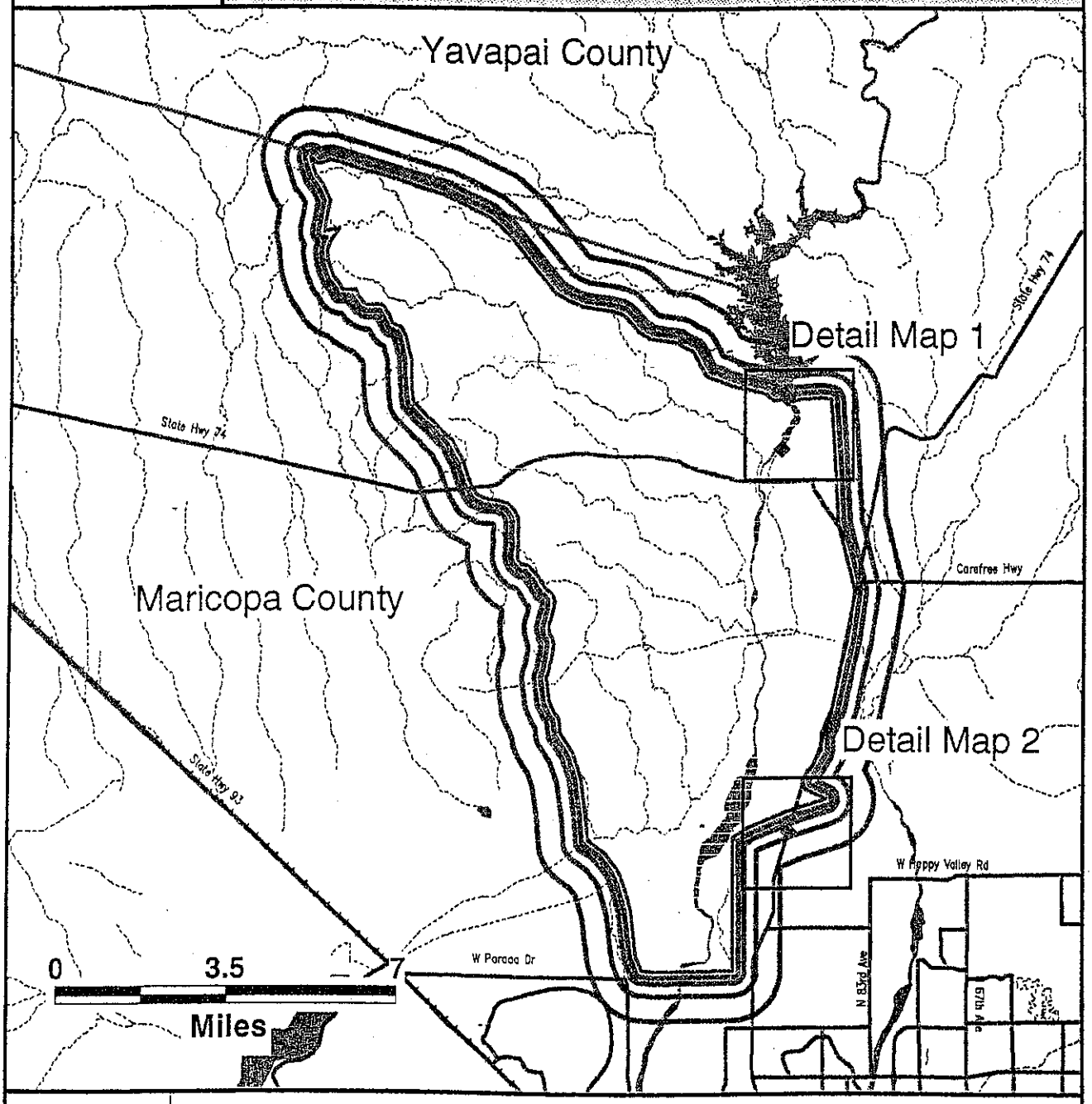
NOTES

SITE ASSESSMENT - SPECIAL REPORT

Overview Map



Subject Centerline

Search Area

Risk Sites

Risk Sites Plotted as Polygons

N W E S

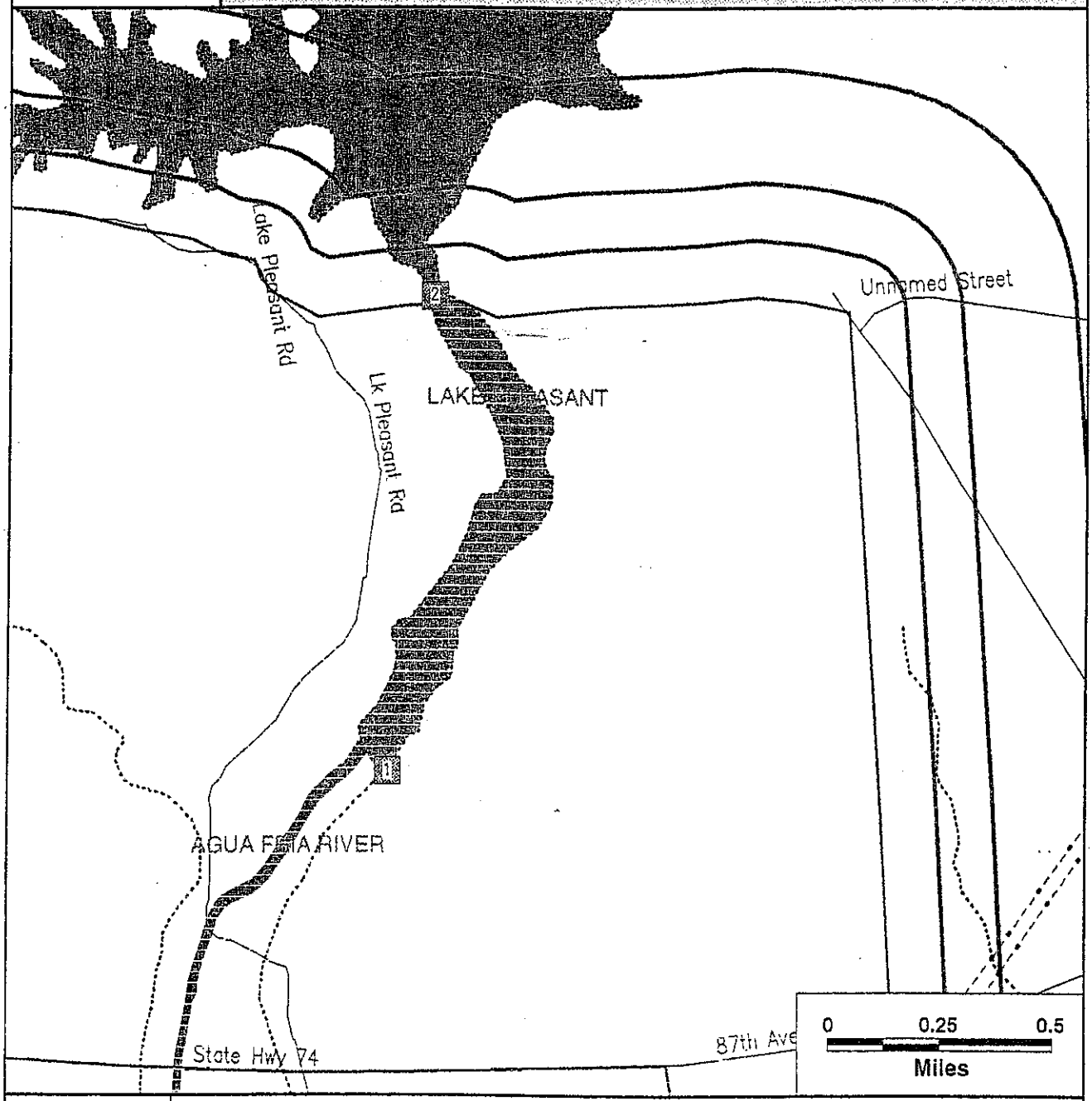
Highways and Major Roads

Rivers or Water Bodies

Categories correspond to database searches described in the Site Distribution Summary, beginning on Page #1.

SITE ASSESSMENT - SPECIAL REPORT

Detail Map 1



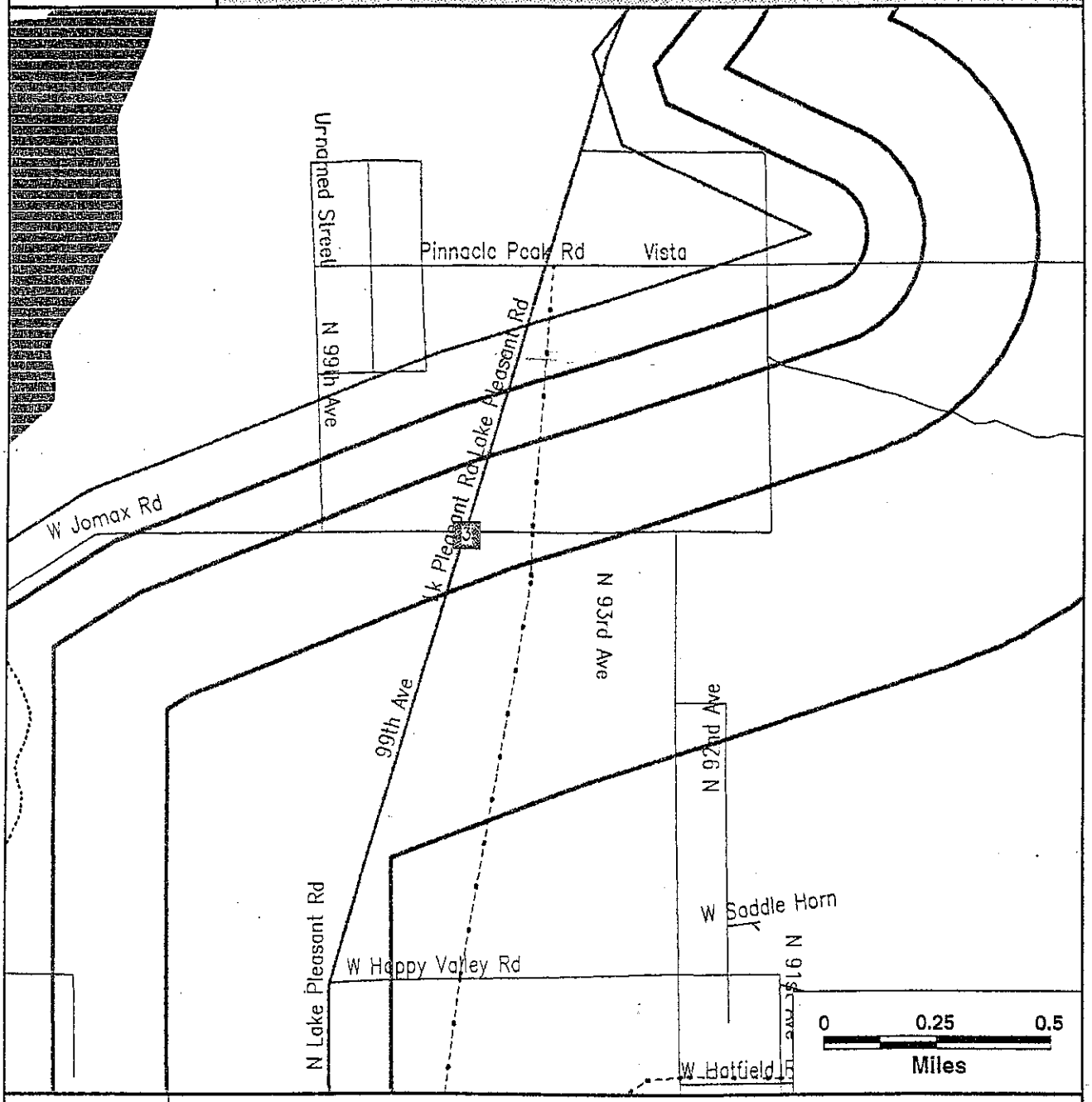
Subject Centerline	Category:	A	B	C	D	Risk Sites Plotted as Polygons
Search Area	Single Sites	◆	■	▲	○	▦
	Multiple Sites	◆	■	▲	●	

- Highways and Major Roads
- Roads
- Railroads
- Rivers or Water Bodies
- Utilities

Categories correspond to database searches described in the Site Distribution Summary, beginning on Page #1.

SITE ASSESSMENT - SPECIAL REPORT

Detail Map 2



Subject Centerline	Category:	A	B	C	D	Risk Sites Plotted as Polygons
Search Area	Single Sites	◆	■	▲	●	▦
	Multiple Sites	◆	■	▲	●	

Highways and Major Roads
Roads
Railroads
Rivers or Water Bodies
Utilities

Categories correspond to database searches described in the Site Distribution Summary, beginning on Page #1.

SITE ASSESSMENT - SPECIAL REPORT

SITE INVENTORY

MAP ID	PROPERTY AND THE ADJACENT AREA (within 1/8 mile)	VISTA ID / DISTANCE / DIRECTION	A			B						C	D	
			NPL	CORRACTS	SPL	TSD	SCL	CERCLIS/NFRAP	LUST	SWLF	TRIS	UST	GNRTR	SPILLS
1	WQ-WADDELL DAM PROJECT T. 6N, R.1E SEC. 21 PHOENIX, AZ	3261143 0.00 MI NA					X							
2	WADDELL DAM 1/4 MI DOWNSTREAM OF WADDELL DAM PHOENIX, AZ 85027	6600516 0.02 MI NE					X							

MAP ID	SITES IN THE SURROUNDING AREA (within 1/8 - 1/4 mile)	VISTA ID / DISTANCE / DIRECTION	A			B						C	D	
			NPL	CORRACTS	SPL	TSD	SCL	CERCLIS/NFRAP	LUST	SWLF	TRIS	UST	GNRTR	SPILLS

No Records Found

MAP ID	SITES IN THE SURROUNDING AREA (within 1/4 - 1/2 mile)	VISTA ID / DISTANCE / DIRECTION	A			B						C	D	
			NPL	CORRACTS	SPL	TSD	SCL	CERCLIS/NFRAP	LUST	SWLF	TRIS	UST	GNRTR	SPILLS
3	CLEMENTINE PROJECT 99TH AVE AND JOMAX PHOENIX, AZ 85374	1831961 0.40 MI SE					X							

MAP ID	SITES IN THE SURROUNDING AREA (within 1/2 - 1 mile)	VISTA ID / DISTANCE / DIRECTION	A			B						C	D	
			NPL	CORRACTS	SPL	TSD	SCL	CERCLIS/NFRAP	LUST	SWLF	TRIS	UST	GNRTR	SPILLS

No Records Found

UNMAPPED SITES	VISTA ID	A			B						C	D	
		NPL	CORRACTS	SPL	TSD	SCL	CERCLIS/NFRAP	LUST	SWLF	TRIS	UST	GNRTR	SPILLS
R.R. FREIJE GRANITE VALLEY MEEKER R SUN CITY WEST, AZ 85375	5638965												X
UNKNOWN 28003 NO. 147TH AVE. SUN CITY WEST, AZ 85375	2315619												X
40202 N 87TH AVE SLIP: 474 PEORIA, AZ 85382	12718203												X
DEL WEBB CORPORATION LITCHFIELD BEARDSLEY SUN CITY WEST, AZ 85375	5638320												X
GILA BEND AUXILIARY AIR FIELD GLENDALE, AZ	12643107					X							
AWAC MINING AND EXPLORATION TWSHP 11N RNG 2E ST QTR SEC 34 PHOENIX, AZ 85027	8470940												X
EMPIRE SOUTHWEST CO BUTTERFIELD STAGE RD 491ST AVE PHOENIX, AZ 85062	6809967										X		
PHOENIX CITY OF-91ST AVE CSWLF WEST SIDE OF 91ST AVE OPPOSITE 91ST PHOENIX, AZ	6606324								X				
LAKE PLEASANT REG PARK 41000 N 99TH AVE PHOENIX, AZ 85027	2911298											X	
WQ-WELL CONST. STUDY AREA WIDE PHOENIX, AZ	3260423					X							
BOOTHILL CSWLF , AZ	3255411								X				
YAVAPAI COUNTY-MAYER CSWLF TURN ON MAIN ST, LEFT BEHIND BLACK C , AZ	6606354								X				
BALDWIN METALS (ASLD) 355 AVE AND SOUTHERN PACIFIC RAILROA CONGRESS, AZ 85332	6636214					X							
YAVAPAI COUNTY-BAGDAD MSWLF .8 MI E OF HIGH SCHOOL: LEFT AT MINE , AZ	6606253								X				
S N STOP SHOP/LEON MOSER HWY 71 PO BOX 555 CONGRESS, AZ 85332	7294229										X		
CHEMICAL NELSON PLAN LANDFILL INSIDE NELSON PLANT OF CHEMICAL LIME , AZ	6606293								X				

UNMAPPED SITES	VISTA ID	A			B						C	D	
		NPL	CORRACTS	SPL	TSD	SCL	CERCLIS/NFRAP	LUST	SWLF	TRIS	UST	GNRTR	SPILLS
YAVAPAI COUNTY-CONGRESS CSWLF .1 MILE N OF MILEPOST 271 ON W SIDE , AZ	6606281								X				
CYPRUS BAGDAD PSWLF E AT RADAR TOWER 2.7 M TO CULVER LEF , AZ	6606315								X				
TOWN OF WICKENBURG MSWLF 4.6 MI W OF INTERSEC. US 60 AND AZ. BURG, AZ	6606392								X				

SITE ASSESSMENT - SPECIAL REPORT

DETAILS

PROPERTY AND THE ADJACENT AREA (within 1/8 mile)

VISTA Address*:	WQ-WADDELL DAM PROJECT T. 6N, R.1E SEC. 21 PHOENIX, AZ	VISTA ID#:	3261143	Map ID
		Distance/Direction:	0.00 MI / NA	1
		Plotted as:	Point	
SCL - State Equivalent CERCLIS List / SRC# 6547		Agency ID:	820	

Agency Address:	*SAME AS ABOVE*
Status:	*UNKNOWN*
Facility Type:	*NOT AVAILABLE*
Lead Agency:	*NOT AVAILABLE*
State Status:	*STATE LEAD*
Pollutant 1:	*UNKNOWN*
Pollutant 2:	*UNKNOWN*
Pollutant 3:	*UNKNOWN*

VISTA Address*:	WADDELL DAM 1/4 MI DOWNSTREAM OF WADDELL DAM PHOENIX, AZ 85027	VISTA ID#:	6600516	Map ID
		Distance/Direction:	0.02 MI / NE	2
		Plotted as:	Point	
SCL - State Equivalent CERCLIS List / SRC# 6073		Agency ID:	4020	

Agency Address:	*WADDELL DAM* *1/4 MI DOWNSTREAM OF WADDELL DAM* *AZ*
Status:	*UNKNOWN*
Facility Type:	*NOT AVAILABLE*
Lead Agency:	*NOT AVAILABLE*
State Status:	*INACTIVE SITE*
Pollutant 1:	*OTHER*
Pollutant 2:	*OTHER*
Pollutant 3:	*OTHER*

SITES IN THE SURROUNDING AREA (within 1/8 - 1/4 mile)

No Records Found

SITES IN THE SURROUNDING AREA (within 1/4 - 1/2 mile)

VISTA Address*:	CLEMENTINE PROJECT 99TH AVE AND JOMAX PHOENIX, AZ 85374	VISTA ID#:	1831961	Map ID
		Distance/Direction:	0.40 MI / SE	3
		Plotted as:	Point	
SCL - State Equivalent CERCLIS List / SRC# 6547		Agency ID:	418	

Agency Address:	*SAME AS ABOVE*
Status:	*UNKNOWN*
Facility Type:	*NOT AVAILABLE*
Lead Agency:	*NOT AVAILABLE*
State Status:	*UNKNOWN*
Pollutant 1:	*UNKNOWN*
Pollutant 2:	*UNKNOWN*
Pollutant 3:	*UNKNOWN*

SITES IN THE SURROUNDING AREA (within 1/2 - 1 mile)

No Records Found

UNMAPPED SITES

VISTA Address*:	GILA BEND AUXILIARY AIR FIELD GLENDALE, AZ	VISTA ID#:	12643107
SCL - State Equivalent CERCLIS List / SRC# 6073		Agency ID:	5470

Agency Address:	*SAME AS ABOVE*
Status:	*UNKNOWN*
Facility Type:	*NOT AVAILABLE*
Lead Agency:	*NOT AVAILABLE*
State Status:	*REMEDIAL INVESTIGATION*
Pollutant 1:	*OTHER*
Pollutant 2:	*OTHER*
Pollutant 3:	*OTHER*

VISTA Address*:	PHOENIX CITY OF-91ST AVE CSWLF WEST SIDE OF 91ST AVE OPPOSITE 91ST PHOENIX, AZ	VISTA ID#:	6606324
STATE SWLF - Solid Waste Landfill / SRC# 6072		EPA/Agency ID:	N/A

Agency Address:	*SAME AS ABOVE*
Facility Type:	*MUNICIPAL FACILITY*
Facility Status:	*CLOSED*
Permit Status:	*NOT AVAILABLE*

VISTA Address*:	WQ-WELL CONST. STUDY AREA WIDE PHOENIX, AZ	VISTA ID#:	3260423
SCL - State Equivalent CERCLIS List / SRC# 6547		Agency ID:	437

Agency Address:	*SAME AS ABOVE*
Status:	*UNKNOWN*
Facility Type:	*NOT AVAILABLE*
Lead Agency:	*NOT AVAILABLE*
State Status:	*STATE LEAD*
Pollutant 1:	*UNKNOWN*
Pollutant 2:	*UNKNOWN*
Pollutant 3:	*UNKNOWN*

VISTA Address*:	BOOTHILL CSWLF AZ	VISTA ID#:	3255411
STATE SWLF - Solid Waste Landfill / SRC# 6072		EPA/Agency ID:	N/A

Agency Address:	*SAME AS ABOVE*
Facility Type:	*MUNICIPAL FACILITY*
Facility Status:	*CLOSED*
Permit Status:	*NOT AVAILABLE*

UNMAPPED SITES CONT.

VISTA Address*:	YAVAPAI COUNTY-MAYER CSWLF TURN ON MAIN ST, LEFT BEHIND BLACK C AZ	VISTA ID#:	6606354
STATE SWLF - Solid Waste Landfill / SRC# 6072		EPA/Agency ID:	N/A

Agency Address:	*SAME AS ABOVE*
Facility Type:	*MUNICIPAL FACILITY*
Facility Status:	*CLOSED*
Permit Status:	*NOT AVAILABLE*

VISTA Address*:	BALDWIN METALS (ASLD) 355 AVE AND SOUTHERN PACIFIC RAILROA CONGRESS, AZ 85332	VISTA ID#:	6636214
SCL - State Equivalent CERCLIS List / SRC# 6547		Agency ID:	1409

Agency Address:	*BALDWIN METALS (ASLD)* *355 AVE AND SOUTHERN PACIFIC RAILROA* *ARLINGTON, AZ 85332*
Status:	*UNKNOWN*
Facility Type:	*NOT AVAILABLE*
Lead Agency:	*NOT AVAILABLE*
State Status:	*RP VOLUNTARY CLEANUP/REMEDIAL ACTION*
Pollutant 1:	*UNKNOWN*
Pollutant 2:	*UNKNOWN*
Pollutant 3:	*UNKNOWN*

VISTA Address*:	YAVAPAI COUNTY-BAGDAD MSWLF .8 MI E OF HIGH SCHOOL; LEFT AT MINE AZ	VISTA ID#:	6606253
STATE SWLF - Solid Waste Landfill / SRC# 6072		EPA/Agency ID:	N/A

Agency Address:	*SAME AS ABOVE*
Facility Type:	*MUNICIPAL FACILITY*
Facility Status:	*CLOSED*
Permit Status:	*NOT AVAILABLE*

VISTA Address*:	CHEMICAL NELSON PLAN LANDFILL INSIDE NELSON PLANT OF CHEMICAL LIME AZ	VISTA ID#:	6606293
STATE SWLF - Solid Waste Landfill / SRC# 6072		EPA/Agency ID:	N/A

Agency Address:	*SAME AS ABOVE*
Facility Type:	*MUNICIPAL FACILITY*
Facility Status:	*CLOSED*
Permit Status:	*NOT AVAILABLE*

UNMAPPED SITES CONT.

VISTA Address*:	YAVAPAI COUNTY-CONGRESS CSWLF .1 MILE N OF MILEPOST 271 ON W SIDE AZ	VISTA ID#:	6606281
STATE SWLF - Solid Waste Landfill / SRC# 6072		EPA/Agency ID:	N/A

Agency Address:	*SAME AS ABOVE*
Facility Type:	*MUNICIPAL FACILITY*
Facility Status:	*CLOSED*
Permit Status:	*NOT AVAILABLE*

VISTA Address*:	CYPRUS BAGDAD PSWLF E AT RADAR TOWER 2.7 M TO CULVER LEF AZ	VISTA ID#:	6606315
STATE SWLF - Solid Waste Landfill / SRC# 6072		EPA/Agency ID:	N/A

Agency Address:	*SAME AS ABOVE*
Facility Type:	*OTHER*
Facility Status:	*ACTIVE*
Permit Status:	*NOT AVAILABLE*

VISTA Address*:	TOWN OF WICKENBURG MSWLF 4.6 MI W OF INTERSEC. US 60 AND AZ. BURG, AZ	VISTA ID#:	6606392
STATE SWLF - Solid Waste Landfill / SRC# 6072		EPA/Agency ID:	N/A

Agency Address:	*SAME AS ABOVE*
Facility Type:	*MUNICIPAL FACILITY*
Facility Status:	*INACTIVE*
Permit Status:	*NOT AVAILABLE*

SITE ASSESSMENT - SPECIAL REPORT

DESCRIPTION OF DATABASES SEARCHED

A) DATABASES SEARCHED TO 1 MILE

NPL
SRC#: 6558

VISTA conducts a database search to identify all sites within 1 mile of your property.
The agency release date for NPL was January, 2000.

The National Priorities List (NPL) is the EPA's database of uncontrolled or abandoned hazardous waste sites identified for priority remedial actions under the Superfund program. A site must meet or surpass a predetermined hazard ranking system score, be chosen as a state's top priority site, or meet three specific criteria set jointly by the US Dept of Health and Human Services and the US EPA in order to become an NPL site.

SPL
SRC#: 6074

VISTA conducts a database search to identify all sites within 1 mile of your property.
The agency release date for WQARF Registry List was May, 1999.

This database is provided by the Department of Environmental Quality. The agency may be contacted at: 602-207-2202.

CORRACTS
SRC#: 6556

VISTA conducts a database search to identify all sites within 1 mile of your property.
The agency release date for HWDMS/RCRIS was December, 1999.

The EPA maintains this database of RCRA facilities which are undergoing "corrective action". A "corrective action order" is issued pursuant to RCRA Section 3008 (h) when there has been a release of hazardous waste or constituents into the environment from a RCRA facility. Corrective actions may be required beyond the facility's boundary and can be required regardless of when the release occurred, even if it predates RCRA.

B) DATABASES SEARCHED TO 1/2 MILE

CERCLIS
SRC#: 6474

VISTA conducts a database search to identify all sites within 1/2 mile of your property.
The agency release date for CERCLIS was October, 1999.

The CERCLIS List contains sites which are either proposed to or on the National Priorities List(NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL. The information on each site includes a history of all pre-remedial, remedial, removal and community relations activiies or events at the site, financial funding information for the events, and unrestricted enforcement activities.

NFRAP
SRC#: 6475

VISTA conducts a database search to identify all sites within 1/2 mile of your property.
The agency release date for CERCLIS-NFRAP was October, 1999.

NFRAP sites may be sites where, following an initial investigation, no contamination was found, contamination was removed quickly, or the contamination was not serious enough to require Federal Superfund action or NPL consideration.

SCL
SRC#: 6073

VISTA conducts a database search to identify all sites within 1/2 mile of your property.
The agency release date for Former WQARF Priority List Sites was June, 1999.

This database is provided by the Department of Environmental Quality. The agency may be contacted at: 602-207-4186.

SCL
SRC#: 6547

VISTA conducts a database search to identify all sites within 1/2 mile of your property.
The agency release date for Cercla Information Data System (ACIDS) was November, 1999.

This database is provided by the Department of Environmental Quality. The agency may be contacted at: 602-207-2202.

The ACIDS list is an inventory of facilities subject to investigations concerning possible contamination of soil, surface water, or groundwater. The state cautions that inclusion of any facility or site on the listing does not mean that the location is contaminated, is causing contamination, or is in violation of State or Federal statutes or regulations.

RCRA-TSD
SRC#: 6556

VISTA conducts a database search to identify all sites within 1/2 mile of your property.
The agency release date for HWDMS/RCRIS was December, 1999.

The EPA's Resource Conservation and Recovery Act (RCRA) Program identifies and tracks hazardous waste from the point of generation to the point of disposal. The RCRA Facilities database is a compilation by the EPA of facilities which report generation, storage, transportation, treatment or disposal of hazardous waste. RCRA TSDs are facilities which treat, store and/or dispose of hazardous waste.

SWLF
SRC#: 5793

VISTA conducts a database search to identify all sites within 1/2 mile of your property.
The agency release date for USGS Solid Waste Landfill Sites was December, 1991.

This database is provided by the United States Geological Survey. The agency may be contacted at: 703-648-5613.

SWLF
SRC#: 6072

VISTA conducts a database search to identify all sites within 1/2 mile of your property.
The agency release date for Active Landfills List was June, 1999.

This database is provided by the Department of Environmental Quality, Solid Waste Dept.. The agency may be contacted at: 602-207-4123.

The inventories of solid waste facilities mentioned above contain information regarding the following sites: Closed Solid Waste Landfills, Closed Solid Waste Dumps, Municipal Solid Waste Landfills, Rubbish Landfills, and Private Solid Waste Landfills. The inventory does not provide a facility street address and what addresses are given may be cut off due to space constraints. Further information may be obtained by contacting us at (800)877-3824.

SWLF
SRC#: 6072

VISTA conducts a database search to identify all sites within 1/2 mile of your property.
The agency release date for Inactive Landfills List was June, 1999.

This database is provided by the Department of Environmental Quality, Solid Waste Dept.. The agency may be contacted at: 602-207-4123.

LUST
SRC#: 6299

VISTA conducts a database search to identify all sites within 1/2 mile of your property.
The agency release date for LUST File Listing was July, 1999.

This database is provided by the Department of Environmental Quality, UST Compliance Unit. The agency may be contacted at: 602-207-4345.

TRIS
SRC#: 4946

VISTA conducts a database search to identify all sites within 1/2 mile of your property.
The agency release date for TRIS was January, 1998.

Section 313 of the Emergency Planning and Community Right-to-Know Act (also known as SARA Title III) of 1986 requires the EPA to establish an inventory of Toxic Chemicals emissions from certain facilities(Toxic Release Inventory System). Facilities subject to this reporting are required to complete a Toxic Chemical Release Form(Form R) for specified chemicals.

C) DATABASES SEARCHED TO 1/4 MILE

UST's
SRC#: 6070

VISTA conducts a database search to identify all sites within 1/4 mile of your property.
The agency release date for Ust-DMS Facility Tank Data Listing was April, 1999.

This database is provided by the Department of Environmental Quality, UST Compliance Unit. The agency may be contacted at: 602-207-4345; Caution-Many states do not require registration of heating oil tanks, especially those used for residential purposes.

D) DATABASES SEARCHED TO 1/8 MILE

ERNS
SRC#: 6181

VISTA conducts a database search to identify all sites within 1/8 mile of your property.
The agency release date for was August, 1999.

The Emergency Response Notification System (ERNS) is a national database containing records from October 1986 to the release date above and is used to collect information for reported releases of oil and hazardous substances. The database contains information from spill reports made to federal authorities including the EPA, the US Coast Guard, the National Response Center and the Department of Transportation. The ERNS hotline number is (202) 260-2342.

RCRA-LgGen
SRC#: 6556

VISTA conducts a database search to identify all sites within 1/8 mile of your property.
The agency release date for HWDMS/RCRIS was December, 1999.

The EPA's Resource Conservation and Recovery Act (RCRA) Program identifies and tracks hazardous waste from the point of generation to the point of disposal. The RCRA Facilities database is a compilation by the EPA of facilities which report generation, storage, transportation, treatment or disposal of hazardous waste. RCRA Large Generators are facilities which generate at least 1000 kg./month of non-acutely hazardous waste (or 1 kg./month of acutely hazardous waste).

RCRA-SmGen
SRC#: 6556

VISTA conducts a database search to identify all sites within 1/8 mile of your property.
The agency release date for HWDMS/RCRIS was December, 1999.

The EPA's Resource Conservation and Recovery Act (RCRA) Program identifies and tracks hazardous waste from the point of generation to the point of disposal. The RCRA Facilities database is a compilation by the EPA of facilities which report generation, storage, transportation, treatment or disposal of hazardous waste. RCRA Small and Very Small generators are facilities which generate less than 1000 kg./month of non-acutely hazardous waste.

SPILL
SRC#: 6366

VISTA conducts a database search to identify all sites within 1/8 mile of your property.
The agency release date for Hazardous Materials Logbook was July, 1999.

This database is provided by the Department of Environmental Quality. The agency may be contacted at: 602-207-2202.

Due to inconsistency in agency reporting, some city fields in the current status of the Arizona Department of Environmental Quality Hazardous Materials Logbook may also contain address information.

End of Report

APPENDIX B

CORRESPONDENCE

Stantec Consulting Inc.
7776 Pointe Parkway W. Suite 290
Phoenix AZ 85044 USA
Tel: (602) 438-2200 Fax: (602) 431-9562
www.stantec.com

Stantec

17 April 2000
File: 81398001

U.S. Bureau of Land Management
Phoenix Field Office
2015 W. Deer Valley Road
Phoenix, Arizona 85027

Attention: Mr. Mike Taylor, Field Manager

Dear Mr. Taylor:

Reference: NORTH PEORIA AREA DRAINAGE MASTER PLAN – ENVIRONMENTAL REVIEW

As a preliminary to the preparation of a drainage master plan for the City of Peoria, Stantec is preparing an environmental review of the area indicated on the attached map. Is BLM aware of any environmental sites on U.S. lands within the project area that have contaminated, or potentially could contaminate, surface or ground water? Your rapid response to this inquiry will be greatly appreciated. If you have any questions, please contact me at (602) 438-2200.

Thank you very much for your assistance.

Sincerely,

STANTEC CONSULTING INC.

Stephen J. Powers
Geologist
spowers@stantec.com

c. file

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Buildings
Environment
Industrial
Management Systems
Transportation
Urban Land

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Phoenix Field Office
2015 West Deer Valley Road
Phoenix, AZ 85027

IN REPLY REFER TO:

1000 (020)

May 4, 2000

Mr. Stephen J. Powers, Geologist
Stantec Consulting, Inc.
7776 Point Parkway West, Suite 290
Phoenix, Arizona 85044

Dear Mr. Powers:

This is in response to your letter dated April 17, 2000, regarding the North Peoria Drainage Master Plan - Environmental Review.

We have reviewed all applicable records and discussed the issues presented in your letter with the appropriate Bureau of Land Management (BLM) staff. It is our conclusion that there are no environmental sites on lands administered by the BLM that have contaminated, or could potentially contaminate surface or ground water within your project area.

If you have any questions, please contact Jim Andersen at (623) 580-5570.

Sincerely,

for Michael A. Taylor
Field Manager

Stantec Consulting Inc.
7776 Pointe Parkway W. Suite 290
Phoenix AZ 85044 USA
Tel: (602) 438-2200 Fax: (602) 431-9562
www.stantec.com

Stantec

17 April 2000

File: 81398001

Arizona State Land Department
Natural Resources Division
1616 W. Adams St.
Phoenix, Arizona 85007

Attention: Mr. Bill Dowdle, Director

Dear Mr. Dowdle:

Reference: NORTH PEORIA AREA DRAINAGE MASTER PLAN – ENVIRONMENTAL REVIEW

As a preliminary to the preparation of a drainage master plan for the City of Peoria, Stantec is preparing an environmental review of the area indicated on the attached map. Is ASLD aware of any environmental sites on State Trust lands within the project area that have contaminated, or potentially could contaminate, surface or ground water? Your rapid response to this inquiry will be greatly appreciated. If you have any questions, please contact me at (602) 438-2200.

Thank you very much for your assistance.

Sincerely,

STANTEC CONSULTING INC.

Stephen J. Powers
Geologist
spowers@stantec.com

c. file

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Buildings
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Management Systems
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Jane Dee Hull
Governor

Michael E. Anable
State Land
Commissioner

Arizona
State Land Department

1616 West Adams Street Phoenix, AZ 85007 www.land.state.az.us

RECEIVEI
MAY 3 2000
STANTEC

May 1, 2000

Stephen J. Powers, Geologist
Stantec Consulting, Inc.
7776 Pointe Parkway West, Suite 3290
Phoenix, AZ 85044

Dear Mr. Powers:

I apologize for the delay in responding to your letter. Moving offices caused a greater disruption that I expected.

I reviewed the Department's environmental files and my memory of actual or potential environmental impacts in the area of your project. I find nothing that would indicate actual or potential surface or groundwater contamination.

If you have any questions, please contact me at (602) 542-2692.

Sincerely,

William Dowdle, Director
Natural Resources Division

c: Chuck Hudson

WD/kl
05/01/00

NORTH PEORIA AREA DRAINAGE MASTER PLAN

Attachment 10

Investigation of Existing Ordinances, Policies, Regulations and Standards Effecting Stormwater Drainage

PREPARED FOR:

FLOOD CONTROL DISTRICT
of
Maricopa County

PREPARED BY:

STANTEC CONSULTING INC.
8211 South 48th Street
Phoenix, Arizona 85044
(602) 438-2200

June 2000

STANTEC CONSULTING Inc.
Project No. 82000146

Contract FCD 99-45

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1.0 Introduction

The North Peoria Area Drainage Master Plan (ADMP) considers approximately 73 square miles north of the alignment for Beardsley Road including the Morgan City Wash, Caterpillar Tank, Twin Buttes Washes and three unnamed washes west of the Agua Fria River. A major objective of the Master Plan study is to identify sustainable non-structural flood control solutions for the study area (e.g., guidelines for development in hillside and wash terrain) to prevent/minimize flood damage within the study area that may be a result of development. Before recommending new goals, objective and policies for the North Peoria Area Drainage Master Plan an examination of existing general plans, area plans, specific plans, land use plans, ordinances, design standards and design criteria is undertaken so that recommendations are coordinated and tied together with these existing documents.

An investigation of potential drainage problems for the North Peoria Area ADMP study area that might occur if existing ordinances, policies, regulations, and criteria are not sufficient to mitigate potential flooding due to development is also conducted. Ordinances, policies, regulations, and criteria from communities that have areas similar to the North Peoria ADMP study area, along with interviewing individuals from these communities, forms the basis of this investigation. Documents from Pima County, the City of Tucson, the City of Mesa, the City of Scottsdale, the City of Peoria and Maricopa County are used in the investigation. Much of the information presented in this report is taken directly or is summarized from one of the communities' documents. References are listed in Section 7 of this report.

The investigation focused on current drainage regulations, and ordinances and policies that support non-structural flood control solutions. The intent of ordinances and policies that support non-structural solutions is to maintain overall watershed drainage patterns in their natural state.

To help understand the relationship between Master Plans, Ordinances, Regulations and Design Standards/Criteria the following generalities are offered:

- Master Plans – Goals, objectives and policies are developed for a specific topic and area. Goals are long term and define a desired end. Objectives are short term and when combined with other objectives a goal is achieved. Polices give guidance and direction to achieve an objective.

- Ordinances and Regulations – Ordinances, goals, objectives and policies of a master or general plan are implemented through ordinances and regulations (Floodplain/Drainage Regulations for Maricopa County) such as zoning, subdivision, hillside development, drainage, environmental

- Design Standards/Criteria – Offer specific details describing how a project should be designed/evaluated in order to meet the intent of an ordinance or regulation.

This investigation and report is a product for North Peoria Area Drainage Master Plan scope Task 2.1.3 and 2.1.4.

2.0 Hydraulic Problems Likely to Occur if Regulations are not Implemented or are not Sufficient

Historically communities have developed drainage ordinances, policies and standards with the intent to mitigate flooding impacts due to urbanization of a watershed. The purpose is to minimize the occurrence of losses, hazards and conditions adversely affecting the public health, safety and general welfare, which might result from flooding caused by surface runoff of rainfall. Potential impacts if guidelines are not sufficient or are not followed are listed below:

- Decrease of stormwater infiltration capacity within a watershed due to urbanization increases peak discharge from a watershed.
- An increase of peak discharge due to urbanization in a watershed increases the potential for erosion and sedimentation within watercourses.
- An increase in erosion potential can result in loss of riparian habitat.
- Due to an increase in peak discharge existing drainage structures downstream of newly urbanized area will be undersized.
- Increase in peak discharge can result in greater flooding depth, which may result in access limitations due to roadway flooding.
- Increase in peak discharge increases the amount of property within floodplain. Existing structures within or adjacent to predevelopment floodplain are at risk to a greater flood impact.
- Disruption of natural flow paths causing unnatural diversion of storm water runoff can disrupt the natural system equilibrium and induce bank erosion and long-term degradation of the channel bed.
- An increase in bank erosion and long-term channel bed degradation can result in the need of grade control structures and bank stabilization.
- Increased erosion and deposition will result in greater costs for future structures, higher potential damage and likelihood of failure of existing structures, and increased maintenance cost.
- Increased deposition results in loss of channel capacity and increased flood levels.

3.0 Summary of Existing Drainage Related Guidelines for Maricopa County and the City of Peoria

The North Peoria ADMP study area lies within Maricopa County and the City of Peoria. Both communities have developed drainage regulations and policies to help guide development. Drainage regulations, policies, etc., are typically applied to the entire community and are not area or site specific. However, through Zoning and Land Use Master Plans there are ordinances and/or policies that are area specific, drainage related and help guide development to meet the intent of the master plan.

Global guidelines cited in drainage regulations/policies/standards developed by Maricopa County and the City of Peoria so that drainage impacts due to development are minimized include but are not limited to the following:

- Delineation of the100-year floodplain.
- Keep structures out of the 100-year floodplain and associated erosion-hazardous area.
- Limit development activity within the 100-year floodplain to the floodway fringe area.
- Encroachments into the floodplain of a watercourse are to be analyzed according to FEMA requirements.
- Unless bank stabilization is provided, development will be located outside of any erosion hazardous areas which border a natural wash.
- Encroachments into the floodplain shall not adversely affect the stability of a watercourse or adversely alter flooding conditions on adjacent properties.
- Minimize the disruption to natural flow paths within a watershed.
- All drainage entrance and exit points in the proposed development must remain in the original location and as near as possible in the original condition.
- To control increased peaks and volumes from development areas, provisions to retain the peak flow and volume of runoff from rainfall events up to and including the 100-year 2-hour duration storm falling within the development boundaries shall be made.

- Under certain conditions the requirement of storm water retention may be waived.
    1) Maricopa County-In the special case of when a detention only facility is allowed, the requirement to retain the 100-year, 2-hour runoff volume may be waived. However, the peak discharge requirement must still be met, and the effects of using a detention only facility on more frequent events must be determined.

    2) City of Peoria- The requirement for onsite retention may be waived by the Public Works Director if he determines, based upon a written request, that said retention is impractical because of, but not limited to steep terrain, poor percolation, or incompatibility with existing or surrounding improvements. The Public Works Director may require additional drainage studies or reports in such cases to determine if a critical drainage problem will be created on adjacent or downstream properties. All development shall not increase the 100-year two (2) hour peak runoff, change the time of peak, nor increase the total runoff from its predevelopment values.

Guidlines cited in Zoning Ordinances, Subdivision Ordinances for the City of Peoria and policies cited in Land Use Master Plans / General Plans, Area Plans, etc., developed by the City of Peoria and Maricopa County help guide development to achieve the intent of the Ordinance or Master/Area Plan. Many of the policies are related to drainage and environmental preservation. Many of the environmental preservation policies are also related to drainage. Goals and objectives of drainage and environmental related policies include but are not limited to the following:

MARICOPA COUNTY COMPREHENSIVE PLAN 2020 EYE TO THE FUTURE

- Encourage preservation of significant mountainous areas with slopes over 15 % for park, open space/or compatible recreation use.

- Promote development that is compatible with the visual character and quality of site.

- Promote the appreciation and preservation of significant archeological and historic resources within the framework of state and federal laws, regulations and guidelines.

- Encourage the protection of habitat within the framework of state and federal laws, regulations and guidelines.

- Promote the protection and preservation of riparian areas within the framework of state and federal laws, regulations and guidelines.

- Discourage new development in major 100-year floodplains.

MARICOPA COUNTY WHITE TANK/GRAND AVENUE AREA PLAN

- Encourage developments that successfully coexist and are compatible with significant natural features.
- Preserve significant natural and cultural resources.
- Preserve significant open space and habitat areas for wildlife and desert plant species.
- Support adequate opportunities for outdoor recreation that are sensitive to the environment.

CITY OF PEORIA-GENERAL PLAN

- Create and maintain a high level of environmental quality consistent with healthy, safe and enjoyable living environment in Peoria.
- Promote the preservation of the natural environment in and around Peoria.
- The City shall minimize natural and man-made environmental hazards.
- The City shall limit developments in areas that may pose natural man-made environmental hazards such as steep slopes and floodplains.

PEORIA DESERT LANDS CONSERVATION MASTER PLAN (RECOMMENDATIONS)

- Increase public awareness of the importance of desert conservation.
- Coordinate desert conservation goals, objectives, policies and programs with other land use codes, jurisdictions, agencies and private interest groups.
- Promote the establishment of large intact areas of native vegetation by preventing fragmentation of those areas by development.
- Maintain appropriate or sufficient buffers between areas dominated by human activities and environmentally sensitive areas (open space corridors or buffers must be at least 25' wide).

- Preserve features of the natural local landscape in developed areas.
- Protect Environmentally Sensitive Lands.
    - Riparian areas and wash corridors should be protected whenever possible.
    - Changes in natural drainage patterns should be avoided.
    - Balance the opportunity for recreation by the public with the habitat needs of wildlife.

4.0 Summary of Area Specific Drainage/Enviromental Related Guidelines Developed by Other Communities

Communities have developed guidelines to mitigate potential flooding hazard and to preserve the natural integrity and function of watercourses within a watershed. Some communities have developed specific guidelines in addition to blanket guidelines for watersheds that have been identified as having the potential for a severe increase in flood hazards, or that do have severe flooding hazards as a result of urbanization pressure on a watershed. Some communities recognizing areas within watersheds that are environmentally sensitive have developed guidelines specific to an area with the intent of preserving the natural quality of the area. Pima County, the City of Scottsdale and the City of Tucson have developed ordinances that are specific to an area. Ordinances and objectives of drainage and environmental related guidelines include but are not limited to the following:

PIMA COUNTY – FLOODPLAIN AND EROSION HAZARD MANAGEMENT ORDINANCE

- ***Watercourse and Riparian Habitat Protection and Mitigation Requirements.***

  The purpose of this article is to enhance wildlife and recreation values where appropriate by preserving riparian vegetation along watercourses and floodplains.

  "Riparian Habitat" is defined as plant communities occurring in association with any spring, cienega, lake, watercourse, river, stream, creek, wash arroyo, or other body of water, either surface or subsurface, or channel having banks and bed through which waters flow at least periodically. These habitats are generally characterized or distinguished by a difference in plant species composition or an increase in the size and/or density of vegetation as compared to upland areas. These communities represent a continuum of plant species response to available moisture and can be subdivided into hydroriparian, mesoriparian, and xeroriparian.

  Pima County has developed riparian habitat maps which delineate riparian corridors that fall under the ordinance.

- ***Runoff Detention and Retention Systems***

  Pima County has developed specific stormwater storage requirements for drainage basins (basin specific) in which it has been determined that continued development within the drainage basin would adversely increase

flooding or erosion. These drainage basins are referred to as "balanced" or "critical" basins.

"Balanced" and "critical" basins are defined as basins that have been identified by the county engineer as unsuitable for added development because of the high probability of increased flooding, or ponding of floodwater, and may be developed further only upon the incorporation of adequate detention/retention systems or flood control facilities, as reviewed and approved by the county engineer.

Pima County has prepared maps designating balanced and critical basins.

- ***Erosion Hazard Areas and Building Setbacks***

  In erosion hazard areas where watercourses are subject to flow-related erosion hazards and approved bank protection is not provided, building setback from the watercourse is required. Erosion hazard setbacks developed by Pima County are categorized into two categories, major and minor washes. Pima County has set the building setback distance primarily based on peak discharge.

CITY OF TUCSON FLOODPLAIN AND EROSION HAZARD ORDINANCE

- ***Runoff Detention Retention Systems***

  Similar to Pima County's guidelines.

- ***Erosion Hazard Areas and Building Setbacks***

  The banks of watercourses constitute an erosion hazard zone which is subject to channel widening and/or meandering. Guidelines for such studies and for determining setbacks are found in the Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona (Standards Manual). Equations are provided to calculate erosion hazard setback distance.

  The City of Tucson has established minimum setback requirements for stabilized banks.

CITY OF TUCSON CODE, CHAPTER 23, DIVISION 34. RESOURCE ZONE (ERZ)ENVIRONMENTAL

- ***Purpose***

  These regulations are intended to recognize the value of Tucson's natural open space resources, particularly the critical and sensitive wildlife habitat of eastern Pima County associated with public monuments, forests and preserves. These regulations relate to areas associated with Tucson's public lands and preserves, including Saguaro National Monument, Coronado National Forest and Tucson Mountain Park. It is the intent of these regulations to protect valuable habitat resources to the greatest extent possible. Development, compatible with these public resources, is allowed.

  A. Recognize the social, economic, environmental, biologic and cultural importance of Saguaro National Monument and Tucson Mountain Park to the City of Tucson;

  B. Buffer Saguaro National Monument and Tucson Mountain Park from the impact of new development by allowing development which is compatible with preservation of critical wildlife habitat and Park and Monument environs;

  C. Conserve certain designated washes which extend from the Monument and Park as areas of natural and scenic resources and provide valuable wildlife habitat;

  D. Complement the City of Tucson Interim Watercourse Improvement Policy which calls for the preservation of Tucson's significant natural areas along designated watercourses where identified in adopted area and neighborhood plans.

CITY OF TUCSON WATERCOURSE AMENITIES, SAFETY, AND HABITAT (W.A.S.H) ORDINANCE

- ***Purpose***

  Washes within the urbanized areas of the City in which existing vegetation is maintained are valuable natural resources that contribute to the health and well-being of the residents of the City. Such washes assist in groundwater recharge, support wildlife habitat, and provided natural open space areas. These regulations are specifically intended to accomplish the following:

A. Maximize opportunities for groundwater recharge through the preservation of specific washes with earthen channels and banks.

B. Protect existing vegetation found within and near specific washes.

C. Provide for the restoration of vegetation disturbed as a result of development in and adjacent to specific washes.

CITY OF SCOTTSDALE ENVIRONMENTALLY SENSITIVE LANDS ORDINANCE

- ***Purpose***

The purpose of the Environmentally Sensitive Lands Ordinance is to identify and protect environmentally sensitive lands in the City and to promote the public health, safety and welfare by providing appropriate and reasonable controls for the development of such lands. The ordinance lists procedures and/or guidance in regards to the Scope of Regulations, Review Procedures, Submittal Requirements, and Environmentally Sensitive Lands Use Restriction and Development Standards. Use Restriction and Development Standards relate to intensity of development, open space requirements, design standards, density transfer, cluster development options, and site planning standards and guidelines.

Further guidance for development in environmentally sensitive lands are listed the Design Guidelines & Policies for Environmentally Sensitive Lands and in the City of Scottsdale's Floodplain and Drainage Ordinance.

CITY OF SCOTTSDALE -FLOODPLAIN AND DRAINAGE ORDINANCE

- ***Special considerations in environmentally Sensitive areas.***

1) Existing watercourses with a capacity of fifty (50) cubic feet per second or greater, disregarding any estimated peak discharge values, shall be maintained in their natural state unless it is determined that alterations are required to meet other provisions of this ordinance.

2) A drainage and flood control easement will be dedicated to the city which encompasses the area required to convey the base flood in the watercourse described in section 37-42(14)a.

3) Road/wash crossings may disrupt the natural channel beyond the right-of-way limits if engineering investigations determine the need, and are approved by the director of project review.

4) Stormwater storage facilities may not be required in areas zoned for environmentally sensitive development if the city staff determines that such facilities cannot be built without conflicting with the city's Environmentally Sensitive Lands ordinance requirements. If on-site stormwater storage facilities requirements are waived the development may be required to contribute to the cost of drainage works at another location on the basis of runoff contribution.

5) All drainage structures and detention facilities shall be constructed in such a manner as to minimize the impact on the natural environment, promote recharge when in conformance with the approved groundwater recharge master plan and, when finished, shall be revegetated to be compatible with nearby natural areas.

CITY OF SCOTTSDALE- DESIGN GUIDELINES & POLICIES FOR ENVIRONMENTALLY SENSITIVE LANDS

- Floodplain Delineation – Hydraulic and sediment transport analyses are required to quantify floodplain dimensions and the potential for scour and bank erosion.

- Sediment Transport Considerations - The engineer shall address sediment transport issues in order that potential problems associated with bed-scour, bank erosion, and sediment deposition can be identified, quantified, and mitigated.

- Natural Washes - The design of any improvements to natural washes shall be done in a manner that will compliment the natural function and appearance of the site. It is preferable to leave the washes in an undisturbed state and use sufficient building setbacks to preclude the need for artificial bank protection.

  Every effort should be made to avoid any disruption of the natural geometry and bed-profile of washes in this region. This includes any unnatural diversion of water into these washes. Such diversion could upset the system equilibrium and induce accelerated bank erosion and long-term degradation of the channel bed.

- Residential Development - Upper desert areas and the steep slopes of hillside areas can create unique drainage problems for residential development.

All drainage solutions shall be designed to use materials, colors, textures and forms which blend with the natural setting and terrain.

Residential street systems should be designed to avoid diversion of the historical drainage patterns. The streets should be contoured and aligned so that the water they do collect is directed into its historical drainage course.

5.0 Planning Considerations

Based on the investigation and review of existing master plans, area plans, general plans, design standards for Maricopa County, the City of Peoria and other communities and experience gained on other projects (Middle New River Watercourse and Skunk Creek Watercourse Master Plan) that the following planning considerations are offered.

- There are goals, objectives and policies listed in the Maricopa County Comprehensive Plan 2020 Eye to the Future, the Maricopa County White Tank/Grand Avenue Area Plan, the City of Peoria General Plan and the Peoria Desert Lands Conservation Plan that support the concept of a nonstructural approach to drainage/floodplain management. The supporting goals are typically part of the Environmental Element, of a plan. Objectives of the supporting goals encourage or promote preservation of significant archeological and historic resources (primarily are located adjacent to watercourses), riparian habitat, scenic and rural character, development that is compatible with visual character and quality of a site, open spaces, support adequate opportunities for outdoor recreation that are sensitive to the environment, and discourage new development in major 100-year floodplains.

- Riparian habitats generally occur within a watercourse channel, along banks and overbank areas. A nonstructural solution supports preservation of riparian habitat in that the use of bank protection to minimize or prevent erosion can impact the density and distribution of the riparian habitat and thus may not be allowed. However, the preservation of the riparian habitat may not eliminate the need or usefulness of structural protection in a watercourse. In areas where bank protection is not a integral element of a development plan, erosion hazard building setbacks would be required. The erosion hazard setback may lie outside of the riparian habitat. To minimize the erosion hazard setback structures outside of the riparian habitat but within the erosion hazard area may be proposed.

- Objectives of area plans suggest the protection of riparian habitat within the framework of state and federal laws, regulations and guidelines. Protection of habitat under existing laws is typically tied to an endangered species or a jurisdictional boundary (waters of the U.S.). Unless there is an endangered species tied to the riparian habitat or the site lies with in a jurisdictional boundary the intent of the policy will not be met.

- There are no specific ordinances for Maricopa County or the City of Peoria that would implement goals, objectives and policies encouraging riparian habitat protection. However, both communities follow the U.S. Army Corps of Engineers guidelines concerning the 404 permitting process. Corps

guidelines tend to recognize the impacts of development to riparian habitat within their jurisdictional boundaries.

- The communities of Pima County and the City of Tucson have developed ordinances as instruments to implement the preservation and protection of riparian habitat. The communities have mapped riparian habitat corridors that are to be perserved, developed development guidelines to be used within the corridor and have developed mitigation requirements should development impact the corridor.

- In an interview with Pima County, the interviewee related that existing riparian delineation maps are not detailed enough to manage from and the existing ordinance is not a public safety issue and thus more difficult to enforce.

- The City of Scottsdale has developed a specific ordinance for the preservation of Environmentally Sensitive Lands. An element of the plan that supports a non-structural approach is to leave a natural desert watercourse with a conveyance capacity of 50 cfs are greater in their natural state. Drainage easements are dedicated to the city for washes that have a capacity of 50 cfs or greater. Erosion hazard setbacks are to be developed for structures located adjacent to watercourses. Delineation of floodplains is to include lateral migration consideration.

- To decrease the impact of increased runoff in a watershed due to development, communities require storm water storage. For communities within Maricopa County, the storm water storage requirement is to retain the peak and volume of the 100-year, 2-hour storm event. In all communities, under special consideration the retention requirement can be waived. Under situations where the requirement is waived, there still must be a reduction in future condition peak discharge in relation to existing condition peak discharge. Maricopa County guidelines suggest a peak reduction for all events whereas the City of Peoria requires a reduction in only the 100-year, 2-hour event. Peak reduction is generally obtained by some form of storm water detention. A general statement about the City of Peoria requirement is that post development peak discharges for events less than and greater than the 100-year, 2-hour event would lead to problems listed in Section 2 of this report.

- Retention waivers should be analyzed on a watershed basis and not just a site basis so that the total impact of the waiver can be quantified. Some communities require the applicant of a waiver to contribute to the cost of potential downstream drainage works that would be required because of the waiver.

- In an interview with Pima County, the interviewee related that a problem that they are experiencing with their retention basins is downstream clear water scour.

- In an interview with the City of Tucson, the interviewee related that detained flows from small sites may actually increase peaks on larger washes.

- Erosion hazard building setback requirements have been established by communities. The purpose of the setback requirement is to provide a safe distance from a watercourse that a structure could be located so that it is out of harms way during a series of runoff events or a single runoff event. The setback area becomes a maintenance area. Should the setback distance be diminished due to erosion the distance of the setback should be reclaimed. Erosion hazard setbacks are typically used instead of bank protection. If erosion hazard setbacks and bank protection is allowed within the same watercourse reach, a piecemeal approach to watercourse management is taken. The piecemeal approach leads to a dramatic change to watercourse river mechanics resulting in reflective scour, increased lateral migration and the potential that bank protected segments are undersized.

- In an interview with the City of Tucson, the interviewee related that erosion hazard set backs should only be utilized in documented areas (don't make everyone pay for a few problem areas).

- In an interview with the Pima County, the interviewee related that the counties riparian habitat and erosion hazard setback ordinance encourages development outside of the floodplains, reducing erosion and maintaining continuity of sediment supply.

- Guidelines developed by the Federal Emergency Management Agency (FEMA) define 100-year floodplains (based on existing condition peak discharges) and the development that can occur within the floodplain. The floodplain is sometimes divided into two areas; a floodway and a floodway fringe. Development within the floodway is more restrictive than development in the floodway fringe. Development in the floodplain is allowed when specific design criteria are followed. Even though design criteria may be followed, through encroachments that are allowed the river mechanics of a encroached reached are changed and the change could result in adverse impacts downstream. When a river reach is encroached, should the reach be of significant length the overall watershed characteristics and the timing of hydrographs from sub-basin of the watershed could be changed resulting in higher peak discharges and a greater frequency of concentrated flow. The higher peak discharge would be translated down stream.

- FEMA guidelines do not require a master plan or total reach approach, which can lead to piecemeal development along a watercourse; some areas encroached, others not. Piecemeal development can lead to a dramatic change in watercourse river mechanics resulting in channel and bank scour, increased lateral migration and the potential that downstream structures would ultimately be undersized.

- Through design criteria, communities offer guidelines that it would be best that development stay out of the floodplain. When the instrument for implementing guidelines are FEMA criteria the intent of the guideline can be ignored.

- Guidelines offered by FEMA find their roots in floodplain management (protection of human life and property) but are not always consistent with guidelines offered by other Federal Agencies. One should have an understanding of a guideline and should research the inconsistency of guidelines from different agencies before applying a guideline to a plan. An example would be the use of vegetation to minimize erosion potential, but not having the ability to maintain the vegetation as it matures and thus the mature vegetation impacts the hydraulic of the watercourse.

- The City of Peoria within their Zoning Ordinance has a Floodplain District. The Floodplain District is based on floodplains being delineated utilizing a 50-year peak discharge. This criterion is inconsistent with Maricopa County and FEMA's criteria. However, through experience we know that the city uses the 100-year peak discharge for floodplain delineation. The Floodplain District may be outdated, however, it is still in the ordinance. This inconsistency could lead to confusion.

- In Maricopa County's land use plan, "Maricopa County 2020, Eye To The Future" a statement is made in the economic development section that the exploration of sand and gravel for construction is the most important mining activity within the county and at present no coordinated efforts exists to evaluate this potential. Sand and gravel mining operations do impact hydrologic and hydraulic elements of a watershed. The potential for sand and gravel operations should be addressed so that the impacts to proposed elements of a plan can qualitatively or quantitatively be addressed.

- Any plan is not complete with out an implementation strategy for achieving the objectives of the plan. Typically, ordinances are used as a tool to implement a plan. Within a community's governmental structure, an ordinance can be a stand alone ordinance, lie within in a zoning ordinance or drainage ordinance, or be tied to an ordinance through an overlay district. The location and the owner of the ordinance can impact the success of

implementation. Within the City of Peoria "Peoria Desert Lands Conservation Master Plan" there is a good section concerning implementation strategies.

- In an interview with the City of Tucson, the interviewee related that blanket ordinances (city wide) are not as effective as basin management studies. Ordinances should be more flexible.

6.0 Existing Regulatory Methods to Circumvent Hydraulic Problems (By Community)

This section offers to the reader a listing of ordinances, goals, objectives, policies and design criteria utilized by communities to manage impacts of development. The listing primarily focuses on drainage related topics.

PIMA COUNTY

ORDINANCE NO. 1988-FC2

Article XII Erosion Hazard Areas and Building Setback Requirements

In erosion hazard areas where watercourses are subject to flow related erosion hazards, building setbacks are required as follows:

A. Major Watercourses

For major watercourses, with base flood peak discharges of 2,000 cfs or greater, the following building setbacks shall be required where approved bank protection is not provided:

1. Along the following major natural watercourses where no unusual conditions exist, a minimum building setback, as indicated below shall be provided at the time of the development unless an engineering analysis which establishes safe limits is performed by an Arizona Registered Professional Civil Engineer and is approved by the County Engineer.

   a. The building setback shall be one-hundred feet along all other major watercourses with base flood peak discharges of 10,000 cfs or less, but more than 2,000 cfs.

B. Minor Washes

For minor washes with a base flood peak discharge of 2,000 cfs or less, the following building setback shall be required where approved bank protection is not provided.

1. Along minor watercourse where no unusual conditions exist, a minimum setback of fifty feet shall be provided.

Article XIV, Detention/Retention Systems

All proposed residential densities of three or more units per acre and all proposed commercial and industrial developments greater than one acre in size shall provide some method of peak or volumetric runoff reduction. The amount of reduction is stipulated within the Pima County Stormwater Detention/Retention Manual.

Pima County Stormwater Detention/Retention Manual

A Balanced Drainage Basin is one which has been identified as having the potential for a severe increase in flood hazards as a result of increased urbanization within the basin. Stormwater detention/retention facilities shall be incorporated within all new developments to the extent necessary to ensure that, at a minimum, the post development 2-, 10-, and 100-year peak discharges from the site will not exceed the predevelopment values.

A Critical Drainage Basin is one which has been identified as already having severe flooding problems as a result of existing watershed conditions. Stormwater detention/retention facilities shall be incorporated with all new developments to the extent necessary to ensure a reduction in the existing 2-, 10- and 100-year peak discharges from the site. The amount of reduction required shall be determined by the regulatory agency which has jurisdiction (i.e., either Pima County or the City of Tucson), and shall typically be based upon the flow capacity of a critical channel reach or critical drainage structure located downstream of the stormwater detention/retention facilities.

Threshold retention systems which retain, at a minimum, the volumetric difference between the developed and existing 2-year runoff or the difference in peak discharges, whichever is greater, shall be incorporated with all new developments which meet the following criterion: Any residential development larger that one acre in size which has a density three to six units per developed acre, and that are located within a watershed which has not been classified as a critical or balanced basin.

Threshold retention systems which retain, at a minimum, the volumetric difference between the developed and existing 5-year runoff or the difference in peak discharge, whichever is greater, shall be incorporated within all new developments which meet the following criteria: All commercial or industrial developments larger than one acre in size. Any residential development larger than one acre in size which has a density greater than six units per developed acre. Any residential development larger than one acre in size which has a density greater than three units per developed acre, and that are located within a watershed which has been classified as a critical or balanced basin.

ORDINANCE NO. 1998-FC1

Article X, Watercourse and Riparian Habitat Protection and Mitigation Requirements

Purpose

The purpose of this chapter is to enhance wildlife and recreation values where appropriate by preserving riparian vegetation along watercourses and floodplains and:

A. Protect the valuable, limited and endangered natural riparian habitat resources of Pima County;
B. Provide an ecologically sound transition between riparian habitat communities and developed areas;
C. Assure the continuation of existing or natural functions, values and benefits provided by riparian habitat resources;
D. Promote an economic benefit to Pima County by providing the aesthetic, recreation and wildlife values of riparian habitat for the enjoyment of residents and visitors;
E. Promote natural erosion control; and
F. Promote continuity of xeroriparian habitat. (Ord. 1999-FC-1 § 1 (part) 1999; Ord. 1994-FC2 (part), 1994: Ord. 1988-FC2 Art. 10 (A), 1988)

Description

For purposes of this chapter, "riparian habitat" is defined as plant communities occurring in association with any spring, cienega, lake, watercourse, river, stream, creek, wash, arroyo, or other body of water, either surface or subsurface, or channel having banks and bed through which waters flow at least periodically. These habitats are generally characterized or distinguished by a difference in plant species composition or an increase in the size and/or density of vegetation as compared to upland areas. These communities represent a continuum of plant species' response to available moisture and can be subdivided into hydroriparian, mesoriparian, and xeroriparian.

A. Hydroriparian. Riparian habitats generally associated with perennial watercourses. Plant communities are dominated by obligate or preferential wetland plant species such as willow and cottonwood. The Cottonwood/Willow Forest is a typical example of this habitat type.
B. Mesoriparian. Riparian habitats generally associated with perennial or intermittent watercourses or shallow ground water. Plant communities may be dominated by species that are also found in drier habitats (e.g. mesquite) but contain some preferential riparian plant species such as ash or netleaf hackberry. The mesquite bosque and sycamore-ash association are examples of this community type.

C. Xeroriparian. Riparian habitats generally associated with an ephemeral water supply. These communities typically contain plant species also found in upland habitats, however, these plants are typically larger and/or occur at higher densities than adjacent uplands. Xeroriparian habitat is further divided into four sub-classes based on total vegetative volume (TVV):

1. Xeroriparian A: TVV greater than 0.850 cubic meters per square meter (m3/m2).
2. Xeroriparian B: TVV less than or equal to 0.850 m3/m2 and greater than 0.675 m3/m2.
3. Xeroriparian C: TVV less than or equal to 0.675 m3/m2 and greater than 0.500 m3/m2.
4. Xeroriparian D: TVV less than or equal to 0.500 m3/m2. (Ord. 1999-FC-1 § 1 (part) 1999; Ord. 1994-FC2 (part), 1994: Ord. 1988-FC2 Art. 10 (B), 1988)

Applicability

This chapter shall apply to all properties within unincorporated Pima County which contains riparian habitat as delineated on riparian habitat maps adopted by the floodplain management board. This chapter shall apply to Pima County and parties acting on behalf of Pima County. This chapter shall apply to individual building permits issued under zoning existing as of the effective date of the ordinance codified in this chapter or lot splits which are not subject to subdivision regulation. All requirements of this chapter shall apply to hydroriparian, mesoriparian and xeroriparian Classes A, B, and C. Xeroriparian Class D habitat shall not be included in the riparian habitat areas which, when altered, will trigger mitigation plan requirements under Section 16.54.050 of this chapter. At the option of the property owner, xeroriparian Class D habitat may be included in the preserved area for the purpose of relying on flexible development standards identified in Section 18.07.080 of the Pima County Zoning Code. (Ord. 1999-FC-1 § 1 (part) 1999; Ord. 1998-FC1 Section 3, 1998; Ord. 1994-FC2 (part), 1994: Ord. 1988-FC2 Art. 10 (C), 1988)

Permits (Section D)

A Floodplain Use Permit shall be required:

a. when a total of 1/3 acre of the riparian area of a subject property is to be altered, or when any hydroriparian and/or mesoriparian habitat is to be altered;

Permits for disturbance of hydroriparian and/or mesoriparian habitat will require a habitat mitigation plan approved by the Flood Control District Board of Directors prior to issuance of the required permits(s).

Article XII , Subdivision and Development Requirements

Drainage Channels (Section L)

Drainage channels shall not be fully lined. Improved channel bottoms shall remain natural. Perimeter channels that route flow around the outer edge of the development should be prohibited in all areas where there is an established natural channel. In unusual conditions on a case-by-case basin, lined and/or perimeter channels may be approved for use by the County Engineer.

CITY OF TUCSON

ARTICLE I, FLOODPLAIN AND EROSION HAZARD MANAGEMENT ORDINANCE

Sec. 26-7 Erosion Hazard Areas and Setbacks From Watercourses.

The banks of watercourses constitute an erosion hazard zone which is subject to channel widening and/or meandering. Setback distances are best determined by a detailed engineering study performed by an Arizona Registered Professional Civil Engineer. Guidelines for such studies and for determining setbacks are found in the Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona (Standards Manual).

Setbacks from unstabilized banks may be determined by use of methodology found in the Standards Manual.

Sec. 26-7.1 Setbacks on Regional Watercourses.

If a detailed engineering study is not performed, the minimum setback to structures shall be as indicated in Table I or from the appropriate formulas from the Standards Manual unless the banks are stabilized. When banks are stabilized to the level of the base flood (plus an appropriate freeboard) the setback to structures shall be fifty (50) feet.

Sec. 26-7.2 Setbacks On All Other Watercourses.

When the banks are stabilized to the level of the base flood (plus an appropriate freeboard) the setback to structures shall be a minimum of twenty (20) feet for access and maintenance. When access and maintenance easements are not required by the City Engineer the minimum setback may be reduced to ten (10) feet at the discretion of the City Engineer. When banks are not stabilized, the

setback to structures shall be as calculated from guidelines in the Standards Manual.

Sec. 26-10 Detention/Retention Systems.

When deemed necessary by the City Engineer, flood detention/retention systems shall be employed in lieu of or in combination with structural flood control measures to reduce flooding potential or restrict it to a level no greater than pre-platting and/or pre-development conditions.

All proposed residential net densities of three or more units per acre and all proposed commercial and industrial developments greater than one acre in size shall provide some method of peak and volumetric runoff reduction. The amount of reduction is stipulated within the Pima County Stormwater Detention/Retention Manual, which was approved for use by the City Engineer as Development Standard 10-01.0.

STANDARDS MANUAL FOR DRAINAGE DESIGN AND FLOODPLAIN MANAGEMENT IN TUCSON, ARIZONA

Setbacks

Equation to Compute Setbacks

To compute a setback to guard against lateral migration of a channel which has either engineered or natural, unstabilized banks, the following formulas can be used:

For regional watercourses (e.g., the Santa Cruz River, Rillito River, Tanque Verde Creek, Pantano Wash, and the Cañada del Oro Wash) use:

$$SB \geq 2\,(Q_{p100})^{0.5}, \text{ for } r_c/T_w \geq 10; \qquad (7.7a)$$

$$\text{or, } SB \geq 3.4\,(Q_{p100})^{0.5}, \text{ for } 5 < r_c/T_w < 10; \qquad (7.7b)$$

$$\text{or, } SB \geq 5\,(Q_{p100})^{0.5}, \text{ for } r_c/T_w \leq 5; \qquad (7.7c)$$

Where:

SB = Minimum setback, in feet, measured from the top edge of the highest channel bank or from the edge of the 100-year water-surface elevation, whichever is closer to the channel centerline.

Q_{p100} = Peak discharge of 100-year flood, in cubic feet per second;

r_c = Radius of curvature of channel centerline, in feet; and,

T_w = Top width of channel, in feet.

For all other watercourses (i.e., watercourses which have drainage areas less than 30 square miles in size, or times of concentration less than three hours during a 100-year flood) use:

$$SB \geq 1\ (Q_{p100})^{0.5}, \text{ for } r_c/T_w \geq 10; \qquad (7.8a)$$

$$\text{or, } SB \geq 1.7\ (Q_{p100})^{0.5}, \text{ for } r_c/T_w < 10; \qquad (7.8b)$$

$$\text{or, } SB \geq 2.5\ (Q_{p100})^{0.5}, \text{ for } r_c/T_w \leq 5. \qquad (7.8c)$$

Where all terms are as previously defined.

Lesser setbacks than those determined from Equations 7.7 and 7.8 *may* be allowed, but only if they can be justified by use of one of the following methods, listed in order of preference, which would indicate that a lesser setback is appropriate:

1. A detailed sediment-transport analysis, prepared by an Arizona Registered Professional Civil Engineer; or,

2. The Allowable-Velocity Approach, Tractive-Stress Approach, or Tractive-Power Approach, any or all of which must indicate that the channel banks are *not* erosive for the flow conditions associated with runoff events up to and including a 100-year flood on the affected watercourse.

However, under no circumstances shall the setback be less than 50 feet from an unprotected bank of any regional watercourse, or less than 10 feet from an unprotected bank of any other watercourse. Access requirements may make the effective setback greater than the values just noted.

ARTICLE VIII. WATERCOURSE AMENITIES, SAFETY, AND HABITAT (W.A.S.H) ORDINANCE

Sec. 29-12. Purpose and Intent.

'Washes within the urbanized areas of the City in which existing vegetation is maintained are valuable natural resources that contribute to the health and well-being of the residents of the City. Such washes assist in groundwater recharge, support wildlife habitat, and provided natural open space areas. These regulations are specifically intended to accomplish the following:

A. Maximize opportunities for groundwater recharge through the preservation of specific washes with earthen channels and banks.

B. Protect existing vegetation found within and near specific washes.

C. Provided for the restoration of vegetation disturbed as a result of development in and adjacent to specific washes.

Sec. 29-15. Development in the Study Area.

A Study Area Established. A study area consisting of the channel, the banks, and the land area extending fifty (50) feet from the banks of the washes listed in Table 1, is hereby established.

B. Required Study Area Information. If alterations to the study area are proposed, the following information shall be submitted to the City Engineer prior to the issuance of a permit for development in the study area:

1. Hydrology/Hydraulic Study. A study of the wash and its hydrology and hydraulics is required.

2. Plant/Habitat Inventory. All development proposals shall be accompanied by an inventory of the existing vegetation and wildlife habitats within the study area.

3. A copy of the plant/habitat inventory shall be submitted to the Planning Director for review.

C. Basin Management Plan. Development on a lot or parcel which is located within the boundaries of an approved Basin Management Plan shall be in conformance with the Plan.

Sec. 29-16. Development Requirements for Resource Areas.

A. Resource Area. The resource area consists of the channel and banks of a wash, and those portions of the study area containing vegetative resources and wildlife habitat areas. Where alteration to any portion of the resource area is proposed, the applicant for a development permit is required to demonstrate why the resource area cannot be left in its natural condition.

B. Alteration of Resource Area. No development, including grubbing, grading, removal of vegetation, channelization, or other type of alteration of the land, shall occur in the resource area unless a mitigation plan, which includes a plan for the proposed wash treatment and a preservation/revegetation plan, is submitted to the City Engineer and approved as provided.

TUCSCON CODE, CHAPTER 23, DIVISION 34. RESOURCE ZONE (ERZ)ENVIRONMENTAL

Sec. 23-472. Environmental Resource Zone.

Sec 23-472.1 Purpose and Intent.

These regulations are intended to recognize the value of Tucson's natural open space resources, particularly the critical and sensitive wildlife habitat of eastern Pima County associated with public monuments, forests and preserves. These regulations relate to areas associated with Tucson's public lands and preserves, including Saguaro National Monument, Coronado National Forest and Tucson Mountain Park. It is the intent of these regulations to protect valuable habitat resources to the greatest extent possible. Development, compatible with these public resources, is allowed.

A Recognize the social, economic, environmental, biologic and cultural importance of Saguaro Nation Monument and Tucson Mountain Park to the City of Tucson;

B. Buffer Saguaro National Monument and Tucson Mountain Park from the impact of new development by allowing development which is compatible with preservation of critical wildlife habitat and Park and Monument environs;

C. Conserve certain designated washes which extend from the Monument and Park as areas of natural and scenic resources and provide valuable wildlife habitat;

D. Complement the City of Tucson Interim Watercourse Improvement Policy which call for the preservation of Tucson's significant natural areas along designated watercourses where identified in adopted area and neighborhood plans.

Sec. 23-472.2 Applicability.

A. Areas mapped. Parcels which may contain critical riparian habitat are shown on a series of maps approved by the Mayor and Council called the Environmental Resource Zone overlay maps (ERZ Maps) which are an exhibit to this ordinance incorporated herein by reference and kept on file in the Planning Department. These maps are based on the Critical and Sensitive Wildlife Habitat map which the Mayor and Council adopted by Resolution #15149.

B. Resource corridors. Critical riparian habitat is associated with resource corridors along the flowing washes which are shown on the ERZ maps: 1) Agua Caliente; 2) Ajo; 3) Anklam; 4) Coronado Ridge; 5) Enchanted Hills; 6) Escalante; 7) Este; 8) Greasewood; 9) Painted Hills; 10) Reyes; 11) San Juan; 12) Silvercroft; 13) Tanque Verde Creek; and 14) portions of the West Branch of the Santa Cruz.

C. New development. New development which occurs on parcels shown on the ERZ maps will be reviewed for compliance with these regulations.

D. Rezoning. Rezoning applications for parcels adjacent to the washes listed above, but not shown on the ERZ maps, are subject to these regulations.

E. Approved Subdivisions. Where a recorded plat shown on the ERZ maps is resubdivided, it must comply with these regulations.

F. Annexation. As annexation occurs, additional resource corridors or extensions of resource corridors may be added to the ERZ maps.

Sec. 23-472.5 Development Regulations.

A. Preservation of critical riparian habitat. Preservation of 100 percent of critical riparian habitat areas within the resource corridors for parcels shown on the ERZ maps is required except as provided in 23-472.4 and 23-472.6. The critical riparian habitat area may be included as part of any required open space on the site.

B. Residential development. Residential development is allowed only as a Residential Cluster Project (RCP) except as provided in Sec. 23-472.3. Use of

the RCP provides for the maximum amount of critical riparian habitat preservation while preserving density options.

C. Nonresidential development. Nonresidential development is allowed based on underlying zoning.

D. Mitigation Plan. Where preservation of the critical riparian habitat area cannot be accomplished as provided in these regulations the owner is required to submit a mitigation plan.

CITY OF SCOTTSDALE

FLOODPLAIN AND DRAINAGE ORDINANCE, CHAPTER 37, (CODE 1972, & 5-611; ORD, NO. 1993, 2-29-88)

Sec. 37-42. Development requirements to be met for permit issuance.

Stormwater storage facilities (Subsection 12)

a. Except as noted below, development of all land within the city must include provisions for the management of stormwater runoff from the property which is to be developed. This management shall consist of constructing storm water storage facilities, which includes detention basins. Stormwater storage facilities will provide reduced peak rates of outlet flow from the developed property onto downstream property in comparison to the peak rates of runoff flow from the same property under natural conditions with no development. As a minimum, all development will make provisions to store runoff from rainfall events up to and including the one-hundred-year two-hour duration event. If a suitable outlet for a detention basin is not available, or if engineering analysis indicates that available outlet systems would be overtaxed by a detention basin outflow, or groundwater recharge is indicated by an approved master groundwater recharge plan a retention basin shall be constructed in lieu of a detention basin.

The requirement for construction of a detention system or a retention basin all types of stormwater storage facilities may be is waived in the following cases:

1. The runoff has been included in a storage facility at another location.

2. An application for a building permit to construct a single-family residential structure.

3. Development adjacent to a floodway or a watercourse drainage channel which as been determined by the project review manager using engineering analyses provided by the development to have been designed and constructed to handle the additional runoff flow without increasing the potential for flood damage on any other downstream property.

4. Development of a parcel under one-half acre in an area where it can be demonstrated by engineering analyses that no significant increase in the potential for flood damage will be created by the development.

If storage is waived, the development shall be required to contribute to the cost of drainage works on the basis of runoff contribution.

b. Stormwater storage facilities shall be designed and constructed according to the procedures and criteria established by the city including the following:

1. The extent of the area to be used to estimate development storage requirements is the entire proposed development including: streets, alleys, easements and rights-of-way, and one-half or other fractional parts of street, alleys, easements and rights-of-way.

2. If possible, storage facilities are to be located so they can intercept the flow from the entire development;

3. If portions of the area cannot drain to a primary storage facility then additional facilities are to be added for these areas as approved by the director of project review;

4. Individual lot facilities are prohibited except when a clear unobstructed access from a public rights-of-way, for maintenance purposes, is conveyed by dedication or easement to the city;

5. No stormwater storage facility shall detain or retain standing water longer than thirty-six (36) hours if the basin has not been designed and constructed to be a permanent body of water with appropriate health, safety, and water quality measures for such a body of water.

c. Stormwater storage facilities are to be drained by either controlled bleed-off, discharge pump and, in limited cases, by infiltration or dry well or injection wells. Controlled bleed-off or pumping to a recognized water course is the preferred method. Methods which discharge stored stormwater to the underground must be in accordance with the approved groundwater master

plan and approved by the floodplain administrator, the director of project review and the water resources director. In addition, the development must provide the director of project review the state and federal permits required to discharge stormwaters to the underground prior to the issuance of any other development permit.

Special considerations in environmentally Sensitive areas (Subsection 14)

a. Existing watercourses with a capacity of fifty (50) cubic feet per second or greater, disregarding any estimated peak discharge values, shall be maintained in their natural state unless it is determined that alterations are required to meet other provisions of this ordinance.

b. A drainage and flood control easement will be dedicated to the city which encompasses the area required to convey the base flood in the watercourse described in section 37-42(14)a.

c. Road-wash crossings may disrupt the natural channel beyond the right-of-way natural channel beyond the right-of-way limits if engineering investigations determine the need, and are approved by the director of project review.

d. Stormwater storage facilities may not be required in areas zoned for environmentally sensitive development if the city staff determines that such facilities cannot be built without conflicting with the city's environmentally sensitive lands ordinance requirements. If on-site stormwater storage facilities requirements are waived the development may be required to contribute to the cost of drainage works at another location on the basis of runoff contribution.

e. All drainage structures and detention facilities shall be constructed in such a manner as to minimize the impact on the natural environment, promote recharge when in conformance with the approved groundwater, recharge master plan and, when finished, shall be revegetated to be compatible with nearby natural areas.

DESIGN GUIDELINES & POLICIES FOR ENVIRONMENTALLY SENSITIVE LANDS

Section 301 General

The purpose of this section is to establish minimum design guidelines for drainage control and improvements within ESL areas. It is the intent that these Design Guidelines supplement all other standard policies of the City of Scottsdale. These Guidelines

promote both a consistent approach to analysis of hydrologic and hydraulic conditions and also offer an indication of the magnitude and interrelationship of hydrologic/hydraulic impact in ESL areas.

Although these guidelines are focused on the ESL Landforms, it is imperative that the analysis of hydrologic and hydraulic hazards within this region consider impacts to downstream areas. Failure to consider these impacts may result in hazardous diversions of flow, increases in peak discharge flow rates, and disruption of the transport equilibrium. Any of these phenomena could increase the flooding and erosion potential to downstream properties and create a liability.

Drainage facilities should be designed to maintain the natural runoff characteristics. Development must be very careful to not adversely impact drainage patterns, watershed boundaries, reparian habitat and sediment movements.

Section 302 Master Planning Studies

Ideally, a "Master Plan" which outlines a comprehensive drainage system for the entire watershed should be developed. Under such a plan, all developers in the watershed would have a prescribed drainage plan to which they could adhere.

In the absence of such "Master Plans", the engineer must demonstrate to the City that on-site drainage solutions do not adversely impact neighboring properties.

302-2 Development Impact Considerations

Within the Hillside and Upper Desert Landforms, care must be exercised to avoid any disruption of natural drainage patterns that might create an adverse impact to an adjacent property.

The engineer must predict the general system response to any proposed land use alterations in order to forecast downstream problems and develop an appropriate mitigation plan.

Section 304 Hydraulic and Sediment transport Analysis

304-1 Floodplain Delineation

Hydraulic and sediment transport analyses are required to quantify floodplain dimensions and the potential for scour and bank erosion.

Slopes on the Upper Desert surface generally lie within the 5 to 15 percent range, although higher values may be encountered near the mountain slopes. Such slopes are sufficiently steep to generate high flow velocities and large sediment transport capacities within the washes traversing this landform area.

The ephemeral washes on the Upper Desert surface are not generally characterized by deep vertical incisements. Accordingly, overbank flooding in Upper Desert areas should be anticipated during large runoff events.

Due to the generally steep slopes that exist in the Hillside Landform, high flow velocities and large sediment transport capacity should be expected in the mountain washes.
The incised nature of these washes would suggest that overbank flooding is a rare occurrence in the Hillside areas, i.e., most flows should be confined within the channel banks.

As part of any planning for these regions, hydraulic calculations shall be performed to determine the extent of floodwater inundation. Many methods by which these analyses can be done exist. The Corps of Engineers Water Surface Profile Program, HEC-2, is one such method which is widely used and accepted. No attempt will be made in these guidelines to dictate specific design procedures. It is assumed that all hydraulic analyses submitted for City review and approval have been prepared by a Professional Engineer who has a thorough understanding of the principles and fundamentals of hydraulic design.

304-2 Sediment Transport Considerations

The engineer shall address sediment transport issues in order that potential problems associated with bed-scour, bank erosion, and sediment deposition can be identified, quantified, and mitigated.

Proposed changes to the profile and alignment of a natural wash shall be evaluated with regard to following phenomena:

1. Long-term aggradation/degradation
2. Short-term general scour/deposition
3. Local scour (due to local obstructions)
4. Bend scour
5. Bed-form troughs (dunes, anti-dunes)

6. Low-flow incisement

The analysis of these phenomena should be part of the design phase for the drainage facilities.

The design of any structure located near the bank of a wash shall include an evaluation of the potential for lateral bank erosion and provide protective measures, or a sufficient setback, if this phenomena is determined to pose a threat to bank stability.

A thorough and well-documented set of hydraulic and sediment transport calculations may be required as part of the technical analysis for any proposed project.

Section 305 Flooding and Erosion Potential

305-1 Natural Washes

The design of any improvements to natural washes shall be done in a manner that will compliment the natural function an appearance of the site. It is preferable to leave the washes in an undisturbed state and use sufficient building setbacks to preclude the need for artificial bank protection.

Every effort should be made to avoid any disruption of the natural geometry and bed-profile of washes in this region. This includes any unnatural diversion of water into these washes. Such diversion could upset the system equilibrium and induce accelerated ban erosion and long-term degradation of the channel bed.

The relatively steep slopes in the Upper Desert Landform, and the steep slopes in the Hillside Landform promote very high velocity flows. This creates a potential for bank erosion and bed scour.

Due to bedrock outcrops and relatively large diameter sediment particles found in these washes, bed scour may be arrested by channel armoring., This phenomenon should be evaluated on a case-by-case basis.

Structure that might form an artificial grade control should be avoided to the maximum extent possible. Clear span bridges should be considered for crossings where multiple barrel culverts impede flow.

305-2 Residential Development

Upper desert areas and the steep slopes of hillside areas can create unique drainage problems for residential development.

All drainage solutions shall be designed to use materials, colors, textures and forms which blend with the natural setting and terrain.

Residential street systems should be designed to avoid diversion of the historical drainage patterns. The streets should be contoured and aligned so that the water they do collect is directed into its historical drainage course.

During the construction phase of residential development, precautions shall be taken to minimize erosion that will tend to occur on disturbed ground surfaces (utility alignments, street cuts, etc).

All applications for residential building permits should include information which assures that flows are being properly managed and certification that the occupied space is protected from inundation by the 100-year storm.

305-3 Utility Installations

The installation of underground utilities must be completed in a manner which will not create conditions that could lead to the alteration of historical drainage patterns.
Utility crossings in natural or man-made channels should be placed below the maximum expected scour depth of such channels. Scour depth calculations should address the considerations previously outlined in Section 304-2.

305-4 Culverts and Grade Crossings

Culvert design capacities should account for potential clogging due to sediment and debris. Headwalls and wingwalls shall be constructed at both the culvert entrances. In addition to headwalls and wingwalls, an erosion resistant aprons may also be necessary when analysis indicates the need. The size these outlet apron/headwall/wingwall structures should be specified on the construction plans. The Federal Highway Administration has several useful manuals which address the design of such facilities.

The design of culverted roadway crossings shall consider the possibility of flow over the roadway and provide erosion resistant bank protection on both the upstream and downstream side-slopes as needed.

Where "wet" crossings of washes are considered acceptable, a concrete road surface may be necessary for that portion of the street, which will be inundated during a 25-year storm. Concrete cutoff walls shall be designed and constructed on both the upstream and downstream sides of the roadway. All "wet" crossings shall be posted.

DESIGN STANDARDS AND POLICIES, CHAPTER 2 DRAINAGE, SECTION 2.3 HYDRAULICS

Subsection 2-302 Hydrology

The determination of flood hydrology for designing stormwater facilities in the City of Scottsdale shall be performed according to the procedures set forth in the City Design Standards Manual, Section 2.2. The following Table 2.1 outlines the minimum hydrology design criteria for stormwater management and drainage facilities within the City of Scottsdale.

Table 2.1
Hydrology Design Criteria

Peak Frequencies			
Drainage Feature	**10 Year**	**50 Year**	**100 Year**
treet With Curb & utter	unoff (the flow of ater) contained within treet curbs. or major collector and ll arterial streets one 2-foot dry lane must be aintained in each irection.	/A	*unoff to be confined to road right f way or to drainage easement 37-42, (4)]* aximum depth for water d_{max})d_{max} = 8 " above (low pot) the street. [37-42, (4)] unoff to be contained below the inished floor of adjacent uildings.
treet Without Curb & utter	/A	/A	ame as Street with Curb and utter
treet with Storm Drain ystem	ipes or roadway hannels are added if he 10-year runoff xceeds street capacity.	/A	torm drain systems are used if 00-year runoff inundates the uilding's first floor. torm drain systems: *catch asins, scuppers, etc. to be rovided to remove water so as ot to exceed d_{max} = 8 "*
ross Road Culvert *or ridge* for *Major* ollector & Arterial treets	/A	unoff to be conveyed y culvert *or bridge* nder road with no flow vertopping the road. 37-42, (3)a.2]	unoff to be conveyed by culvert nd by flow over the road with aximum 6-inch flow depth over he road. [37-42, (3)a.2] inimum Freeboard for Bridges .0 ft.
ross Road Culvert or ridges for Local and inor Collector Streets	*unoff to be conveyed y culvert or bridge nder road with no flow vertopping the road.*	*or a 25 year frequency torm* runoff to be onveyed by culvert *or ridge* and by flow over he road with maximum " flow depth over the oad.	aximum depth flow over road 2 inches.
ny street crossing a ater course that rovides the only access o residential areas.	/A	/A	ll lots and structures must be ccessible by at least one route ith the depth of flow no greater han one foot over the road during he 100-year run off event.
EMA Floodplain hannel	/A	/A	00-year peak discharge.
hannel to Convey ffsite Flow Through evelopment	/A	/A	00-year peak discharge.
tormwater Storage	/A	/A	00-year 2-hour runoff for etermining on-site storage olume.

Section 7.800 Environmentally Sensitive Lands

SECTION 7.810 PURPOSE

A. The purpose of the Environmentally Sensitive Lands regulations is to identify and protect environmentally sensitive lands in the City and to promote the public health, safety and welfare by providing appropriate and reasonable controls for the development of such lands. Specifically, the Environmentally Sensitive Lands regulations are intended to:

1. Protect people and property from hazardous conditions characteristic of environmentally sensitive lands and their development. Such hazards include rockfalls, rolling boulders, other unstable slopes, flooding, flood related mud slides, subsidence, erosion and sedimentation, range fires, radon exposure, soils with high shrink-swell capacity, foundation instability and air pollution.

2. Protect and conserve significant natural and visual resources. Such resources include major boulder outcrops, major ridges and peaks, prime wildlife habitat, unique vegetation specimens, and significant riparian habitats.

3. Protect renewable and non-renewable resources, such as water quality, air quality, soils and natural vegetation from incompatible land uses.

4. Minimize the public costs of providing public services and facilities, such as streets, water, sewer, emergency services, sanitation services, parks and recreation.

5. Conserve the character of the natural desert landscape. The desert is an important tourist attraction which contributes to Scottsdale's economy.

6. Recognize and preserve the economic, educational, recreational, and cultural assets of the environment that provide amenities and services for residents and visitors. These interdependent assets include preserving the natural environment for desert tours, horseback riding, hiking, rock-climbing and western theme activities. In addition, the

area contains historic and archaeological sites, which reflect the lives of cowboys, miners, pioneers and native Americans.

7. Assure that decisions regarding development in environmentally sensitive areas are based on complete and accurate information about the environmental conditions and probable development impacts.

8. Minimize the impacts of development by controlling the location, intensity, pattern, design, construction techniques, and materials of development and construction.

9. Retain the visual character of the natural landscape to the greatest extent feasible by regulating building mass, location, colors, and materials; grading location, design and treatment; and landscaping design and materials.

10. Maintain significant open spaces, which provide view corridors and land use buffers, protect landmarks and prime wash habitats, and maintain the City's unique desert setting.

11. Protect environmentally sensitive lands, while also recognizing the legitimate expectations of property owners, and the City's overall economic goals.

12. Encourage innovative planning, design and construction techniques for development in environmentally sensitive areas.

CITY OF MESA

DESERT UPLANDS GUIDELINES

Environmental Conservation

Goal A: Preserve and Enhance the Desert Environment in the Desert Uplands Area.

Objective A.1: To preserve existing desert vegetation, and augment where appropriate, as part of the development process.

Policy A.1a: Development within the Desert Uplands area will maintain undisturbed or enhanced natural open space. New projects will be encouraged to create or maintain, where appropriate, linkage

and natural pathways between open space areas in order to support the existing wildlife habitat.

Policy A.1b: Proposed Development Master Plans, Subdivision Plats, and Building permit applications must include a comprehensive landscaping plan, including a description of the proposed efforts to preserve and retain existing vegetation, and the proposed plant list for landscaping and revegetation.

Policy A.1c: Proposed Development Master Plans, Subdivision Plats, and Building Permit application must also describe the manner in which vegetation that has to be relocated will be transplanted, maintained, and replanted on site to the extent possible, as part of the development concept. Where it is not possible to replant vegetation on site, plants should be made available for replanting in the Desert Uplands and other areas.

Objective A.3: To maintain, preserve and enhance existing drainage ways and channel where possible.

Policy A.3a: Detailed drainage studies and hydrology reports showing existing drainage channels which are to remain, and proposed new facilities, will be submitted for review and approval in conjunction with all Site Plans and Subdivision Plats.

Policy A.3b: Angular concrete, gunite or other impervious surface drainage channels will be discouraged, particularly when visible from the street. Where the use of gunite is necessary, the gunite shall have an earth tone color and meander/undulate to emulate natural

features. Rock outcroppings and natural vegetation shall be incorporated where appropriate, to enhance the "natural" character of the channel.

Policy A.3c Additional landscaping along natural drainage channels may be required and the use of natural materials including rocks and soil cement, where appropriate, will be encouraged.

Goal B: Protect the Integrity and Appearance of Steeply Sloping Hillside Areas.

Objective B.1: To minimize development on steeper slopes and to preserve scenic view corridors.

Policy B.1a: Development shall be discouraged on fifteen percent slopes or greater.

Policy B.1b Wherever possible in hillside areas, intrusion into skyline vistas shall be avoided.

Policy B.1c: Development Master Plans in hillside areas shall identify existing scenic view corridors and proposed methods to preserve them.

Desert Uplands Development Standards

15% Slope/Open Space:

1. Slopes of 15% or greater should remain in undeveloped natural open space.

2. The open space within the lots, common open space areas with slopes of 15% or greater, or natural area washes that may carry drainage, should be identified and secured by an open space and/or drainage easement and be maintained by the lot owner or homeowners association.

3. Ridge lines should remain as undeveloped natural open space.

Washes/Drainage:

1. Retained washes and new drainage channels shall be given a "natural" desert character where possible in accordance with the City's Engineering requirements. Requirements may include landscaping with rock and native plant materials, use of integral colored gunite, contouring of the manmade surface and preservation of existing natural features.

2. Non-turfed storm water retention basins are allowed in the Desert Uplands Area subject to conditions, locations and the City Engineer's approval.

3. Storm water retention basins shall be landscaped/revegetated with existing vegetation and native plant materials where appropriate in accordance with the approved landscape plan. Terracing, berming and contouring will be encouraged to naturalize and enhance the aesthetics of the basin and to blend with the surrounding terrain.

4. Random sized rock (six inches (6") and larger) may be utilized to create a natural appearing desert wash within the basin bottom. Basins are encouraged to provide up to twenty-five percent (25%) more land area than the minimum area necessary to retain their specified volume of water in order to allow for the creation of peninsulas, more "natural" contouring, and the placement of boulders and rock outcroppings.

5. Basin slopes shall not exceed a six to one (6 – 1, horizontal to vertical) slope adjacent to public streets. Remaining slopes shall not exceed a four to one (4 –1) slope. Deviations may be approved by the City Engineer if the lesser slope creates excessive grading of the existing desert environment.

6. The use of native materials in the construction of headwalls, flow retardant structures and devices, culverts and drainage channel bottoms is encouraged in the Desert Uplands area (see Figure 30).

7. Low Density Development Standards:

    a. Non-turfed drainage swales are allowed in the Desert Uplands Area.

b. Erosion protection of drainage swales will be encouraged through the use of native rocks and native plant materials. Where runoff velocities necessitate additional erosion protection, the use of integral colored gunite or alternative material may be approved by the City Engineer.

CITY OF PEORIA

GRADING & DRAINAGE - ORDINANCE NO. 98-95

Sec 20-272 Grading and drainage regulations; Infrastructure Development Guidelines Manual

The Public Works Director shall develop, revise and publish an Infrastructure Development Guidelines Manual which shall contain, Specifications and standards on procedures and practices necessary to establish compliance with this chapter. The infrastructure manual shall be amended from time to time by the Public Works Director as determined to be necessary. The Infrastructure Development Guidelines shall govern all drainage requirements for development, public and private, within the City of Peoria. The manual shall be available for public inspection in the Department of Public Works, Department of the City Clerk and the Office of the City of Attorney.

Sec. 20-273. Grading and drainage regulations; design standards for on-site retention of stormwater.

On-site retention of storm water shall be required for all developments equal to or exceeding 0.5 acres in size. The NPDES Program may require on-site retention for parcels less than 0.5 acres. The retention may be waived if the site is served by a channel or natural drainage way having an adequate outlet capacity from the development of a major drainage outfall such as, but not limited to a natural watercourse approved by the Public Works Director as a safe place to deposit such waters. On-site storm water retention areas shall be adequate to contain the volume of water required by the Infrastructure Manual. The tributary area used in the computation shall be the area of the site. The method of water volume computation shall be in accordance with the standards available to the public and on file with the Public Works Director.

Exception:

(1) The requirement for onsite retention may be waived by the Public Works Director if he determines, based upon a written request, that said retention is impractical because of, but not limited to steep terrain, poor percolation, or incompatibility with existing or surrounding

improvements. The Public Works Director may require additional drainage studies or reports in such cases to determine if a critical drainage problem will be created on adjacent or downstream properties. All development shall not increase the 100-year two (2) hour peak runoff, change the time of peak, nor increase the total runoff from its predevelopment values.

Sec. 20-274. Grading and drainage regulations; design standards for on-lot detention of storm drainage.

On-lot detention shall be granted based on the criteria established in the Infrastructure Guide on file with the City Clerk and Public Works Director.

Sec. 20-275. Grading and drainage regulations; hillside lots/mountain preserves.

a) Lots in the hillside development area as regulated by the Subdivision Ordinance and Zoning Ordinance of the City Code shall have an individual grading and drainage plan per each lot. The grading and drainage plan shall be approved and permit issued before a house permit can be obtained.

b) All lots (plats) adjacent to the Peoria preserve(s) shall show the boundary of the Peoria preserve(s) as determined by the survey prepared for the City of Peoria; conflicts between the private deed description and the City's survey shall be resolved prior to obtaining approval of the grading and drainage plan and/or building safety building permit

HILLSIDE DEVELOPMENT OVERLAY DISTRICT (ZONING ORDINANCE)

Article 14-22A

Section 14-22a-1 Intent (Ord. No. 99-105)

A. It is the purpose of this Section to establish regulations which recognize that development of land in hilly or mountainous areas involves special considerations and unique situations which result from the slope of the land. These special considerations and unique situations include but are not limited to increased hazards to development from rock falls, storm water runoff, geologic hazards, increased limitations on vehicular travel, and increased difficulties in providing public services. In addition, steeply sloped lands introduce design limitations to roadways, cuts and fills, and building sites. In

general, the more steeply the land slopes, the greater the hazard and development limitation.

B. The Hillside Development Overlay District is and overlay district that applies to all land wherever the natural terrain of any lot or parcel or any portion thereof has a slope of ten percent (10%) or greater. The Hillside Development Overlay District shall apply to all lots or parcels less than five (5) gross acres in size which have over fifty percent (50%) of the gross area of the lot or parcel having a slope of ten percent (10%) or greater. For those lots or parcels not having fifty percent (50%) or greater of the gross lot or parcel area within a Hillside Development Area or those lots or parcels in excess of five (5) gross acres in size, the requirements of the Hillside Development Overlay District shall be applied only to that portion of the lot containing slopes of ten percent (10%) or greater. Commercial, Office, Industrial and Resort Developments shall comply with all applicable provisions of the Hillside Development Overlay District unless otherwise permitted by the code.

Section 14-22A-2 Density

The maximum number of residential lots or units permitted within hillside development areas shall be the sum of the number of lots allowed by the zoning district, or the sum of the number of lots allowed in each slope category of land as shown by the following table, whichever is the lesser number.

Table – 1
Density Allocation

Slope of Land	Maximum Number of Lots Per Gross Acre
10% to 15%	1.50
15% to 20%	1.00
20% to 25%	0.70
25% to 30%	0.50
30% to 35%	0.30
35% to 40%	0.20
40% & Over	0.10

Section 4. Storm Drainage Facilities - Design and Construction

Section 4-1 General Information

Requirement for Storm Drainage (Section B)

All developments within the City shall provide such storm drainage facilities as are necessary to insure that all improvements, structures and properties, both within the development and those located up and downstream of the development, shall be protected from the adverse impact of storm water due to the proposed development.

Drainage Facilities Components (Section D)

Retention/Detention Facilities:

This portion of the system is intended to retain/detain sufficient volumes of runoff to minimize the adverse impact of new developments on downstream area. All developments must provide retention/detention facilities, except as noted below, which consist of one or both of the following:

a. "On-Site" facilities, for private property to be maintained by the property owner or owners association are required for any or all of the following types of developments.

    (1) Apartment complexes.

    (2) Town homes, Condos, Patio Homes and/or locations where a Homeowners Association will maintain the common area and drainage facilities.

    (3) Large lot Single Family Development including Subdivisions, where every lot is at least one acre or larger. (Note: this is an option in lieu of "off-site or public facilities").

    (4) Industrial Developments including Subdivisions (Note: this is an option in lieu of "off-site or public facilities").

    (5) Commercial Developments including Commercial Subdivisions.

b. "Off-Site" facilities, for projects in a separate tract dedicated to the City and to be maintained by an association of owners, are typically required of the following types of development:

(1) Single-Family Development, including Subdivision, when any one lot is less than one acre in area.

(2) Planned Area Developments (PAD) or other large master planned developments.

Conveyance Systems:

Conveyance systems are storm drains, channels, washes, rivers and retention/detention basins designed to provide regional storm drainage protection in accordance with approved Master Drainage Studies and Drainage Master Plans. Conveyance systems shall carry off-site drainage around and/or through the development, and/or the discharge of on-site storm water generated by the development, in accordance with the requirements herein.

Direct Discharge:

If a development has access to a major drainway, and discharge of drainage from the development to the major drainway can be demonstrated not to adversely affect other properties nor the intended parameters of the drainway, and the Flood Control District of Maricopa County acknowledges and approves of such a discharge, a retention/detention basin may not be required, with the approval of the City Engineer and the County Engineer. The Developer will be required to obtain any agency approvals required. The requirements to provide appropriate sediment control in conformance with the NPDES are in full force and effect Such provisions are in addition to the retention/detention requirements.

Hydraulics (Section G)

Retention/Detention Areas:

a. The design engineer shall determine and present calculations on each retention/detention facility required for their project. The retention/detention volume for the 100-year, two hour event, actually achieved shall be provided. Basin volume which exceeds the contribution from the subarea it serves will not be considered as volume provided.

b. All retention/detention basins and basin systems are required to provide sufficient volume to retain one hundred percent of the one hundred year, two hour storm for the subbasin that it serves. The routing of storm drainage for the development shall be through the retention/detention facilities.

4-2. Technical Design Requirements - Storm Drains

Drainage (Section A)

Underground Storm Drains:

a. Underground storm drains shall be provided whenever the capacity of the pavement section or maximum depth is exceeded, per section 4-2.A.1.a and b., by the design storm event. Additionally, storm drains are required when the flow in the right-of-way exceeds 100 cfs.

Open Channels

a. Natural Channels: Whenever possible and appropriate it is the City's preference that existing drainage channels be left in a natural state. When this is the case, a drainage easement or right-of-way shall be dedicated, at a minimum, over the 100-year floodplains of the natural drainageway. Design shall be in accordance with the Arizona Department of Water Resources, Delineation of Riverine Floodplains and Floodways in Arizona State Standard Attachment SSA2-96 dated July 1996.

b. Man-made Channels: When man-made channels are required the emphasis would be placed on a "natural" appearance and safety. Grass lining will be allowed with side slopes 6:1 or flatter with specific City approval only.

c. Maximum Velocities/Erosion Protection: In general the maximum velocity shall not exceed the scouring velocity of the soil (with natural cover), When the sour velocity is exceeded additional erosion protection shall be provided. The protection may consist of one or more of the following:

1. Concrete or gunnite lining, reinforced with 4 inch x 4 inch WWF-12GA.

2. Natural stone grouted rip rap 4" to 12 " diameter stones – leave a minimum ¼ diameter exposed.

3. Gabion Baskets/Gabion Mattresses.

4. Soil Cement.

4-3 Technical Design Requirements - Retention/Detention Facilities

Sizing (Section A)

1. Basis of Design
   i. Retention/Detention facilities located within a drain-way, channel-way, or floodway are prohibited.

GENERAL PLAN

Goal A: Create and maintain a high level of environmental quality consistent with a healthy, safe and enjoyable living environment in Peoria.

Objective A-5: Promote the preservation of the natural environment in and around Peoria.

Policy A-5a: The City shall minimize natural and man-made environmental hazards.

Policy A-5b: The City shall limit development in areas that may pose natural or man-made environmental hazards such as steep slopes and floodplains.

DESERT LANDS CONSERVATION MASTER PLAN

Goal A Maintain the vitality of the unique Sonoran Desert environment by providing high quality passive and active open space areas, while encouraging development that is sustainable and supportive of that environment.

Objective A-3 Promote the establishment of large, intact areas of native vegetation by preventing fragmentation of those areas by development.

Policy A-3.2: New development should promote the conservation of contiguous

open space areas which contain stands of native vegetation.

Policy A-3.4: Significant stands of vegetation should be identified, inventoried and a method of probable protecting these areas should be defined during the early phases of a project design.

Policy A -3.5: An area designated for natural open space should be of adequate size to support the natural ecological systems required to maintain the vigor and the habitat conditions for the existing flora and fauna.

Policy A-3.7: Recognize and protect areas of significant natural vegetation such as areas along washes around natural spring areas on slopes which are advantageous to the increase densities of the native desert vegetation.

Policy A-3.9: Promote the restoration and revegetation of disturbed areas with native plant species and; match the plant densities of these revegetated areas to be consistent with the undisturbed setting.

Policy A-3.10: Impacts to riparian areas should be limited to utility, infrastructure and road crossings all disturbed areas should be restored to their pre-disturbed condition.

Objective A-5: Maintain appropriate or sufficient buffers between areas dominated by human activities and environmentally sensitive areas. (open space corridors or buffers must be at least 25' wide).

Objective A-7: Protect Environmentally Sensitive Lands

Policy A-7.3: Riparian areas and wash corridors should be protected whenever possible.

Policy A-7.4: Changes in natural drainage patterns should be avoided. Where changes to the natural drainage patterns are necessary, a master drainage plan showing how the altered flows will be handled shall be prepared.

Objective A-8: Maintain connections between wildlife habitats by identifying and protecting corridors for unimpeded movement.

Policy A-8.3: Limit development in areas that may pose natural or man-made environmental hazards, such as steep slopes and floodplains.

Master Drainage Planning

According to the Uniform drainage Policies and Standards for Maricopa County, Arizona (25 February 1987), all development shall make provisions to retain the peak flow and volume of runoff from rainfall events up to and including the 100-year, 2-hour duration storm falling within the boundaries of the proposed development. The criteria to be applied to the 2-hour storm is provided in the Hydrology Manual. Table 2.1 of this manual outlines the minimum hydrology design criteria for drainage features.

According to the *Uniform Drainage Policies and Standards for Maricopa County, Arizona*, master drainage planning shall be done in the earliest stages of the planning process. A master drainage plan incorporates the hydrological analysis for on-site and off-site runoff and outlines the recommended plan for handling storm water runoff.

Master drainage planning can be encountered on both basin-wide and local scales. When undertaking a basin-wide plan, the designer must comprehensively evaluate practical alternatives to find the most cost-effective solution for the general public. Modifications can result from land-use driven decisions that are more costly; however, these additional costs are considered "developer costs" by most agencies. When preparing master drainage plans for local development, the designer shall illustrate conformance with basin-wide master drainage plans where they exist, or shall demonstrate that the plan will not increase extraordinarily the cost of providing basin-wide drainage for the local agency or the District.

All drainageway entrance and exit points in the proposed development must remain in the original location and—as near as possible—in the original condition.

Table 2.1
Hydrology Design Criteria

Drainage Feature	Peak Frequencies		
	10 Year	50 Year	100 Year
Street with Curb and Gutter (longitudinal flow)	Runoff contained within street curbs. For collector and arterial streets one 12-foot dry driving lane must be maintained in each direction.	N/A	Runoff to be contained below the finished floor of building. Q_{max} = 100 cfs V_{max} = 10 fps d_{max} = 8 inches
Street without Curb and Gutter (longitudinal flow)	Runoff contained within the roadside channels with the water surface elevation below the subgrade.	N/A	Same as Street with Curb and Gutter.
Street with Storm Drain System (longitudinal flow)	Pipes or roadside channels are added if the 10-year runoff exceeds street capacity.	N/A	Storm drains are needed if 100-year runoff inundates the building's finished floor.
Cross Road Culvert for Collector and Arterial Streets	N/A	Runoff to be conveyed by culvert under road with no flow overtopping the road. V_{max} = 15 fps V_{min} = 3.0 fps	Runoff to be conveyed by culvert and by flow over the road with a maximum depth over the road of 6 inches.
FEMA Floodplain Channel (1)	N/A	N/A	100-year peak storm
Channel to Convey Offsite Flow Through Development	N/A	N/A	100-year peak storm
Lowest floor elevation for buildings within a FEMA Floodplain Area	N/A	N/A	Lowest floor elevation to be a minimum of 1 foot above the floodplain water surface elevation.
Lowest floor not in a FEMA Designated Floodplain	N/A	N/A	The lowest floor will be free from inundation for the 100-year peak storm event.
Retention Basin	N/A	N/A	100-year 2-hour storm for determining on-site retention volume.

(1) Per ARS 48-3609.A, ADWR has established that during the course of the Master Planning process, the 100-year runoff will be used to delineate a floodplain for major channels with discharges more than 500cfs and should be processed through the local government, ADWR, and FEMA.

Open Channel-General

An open channel is a conveyance in which water flows with a free surface and may be natural or artificial. Natural streams usually consist of a normal or low flow channel and adjacent floodplains. For purposes of this guideline, the term open channel will include the total conveyance facility, floodplain, and stream channel.

Open channel hydraulics is of particular importance to design because of the interrelationship of channels to street and urbanization drainage. In the hydraulic analysis and design of bridges and culverts, open channel hydraulic principles are used to evaluate the effects of proposed structures on water surface profiles, flow and velocity distributions, lateral and vertical stability of the channel, stream regime, flood risk, and the potential reaction of channels to changes in variables such as urbanization; structure type, shape, and location; and scour control measures.

The hydraulic design process for open channels consists of establishing criteria, developing and evaluating alternatives, and selecting the alternative which best satisfies the established criteria. Elements that should be considered in the design process include capital investment and probable future costs, such as maintenance and flood damages to properties; traffic requirements; and impacts on the stream and floodplain environment.

If the proposed project will impact Waters of the U.S., the designer shall take into account requirements of the Clean Water Act (CWA), Section 404

The Corps of Engineers, the permitting authority for the 404 permit, will require the designer to first avoid any impacts, second to limit impacts, and finally, to reduce impacts consistent with 404 b(1) Guidelines (National Archives and Records Administration, 1990). If the designer cannot avoid impacting Waters of the U.S., a requirement of the permit will be mitigation of impacted areas. The Corps of Engineers will also ensure compliance of the project with Section 401 of the Clean Water Act and will not issue a 404 permit without this certification. Section 401 of the Clean Water Act is the certification process by which the Arizona Department of Environmental Quality confirms that the federally permitted project meets state water quality standards.

Urban Open Channels

Urbanization causes an increase in both the volume and rate of stormwater runoff. The current practice in Maricopa County is to use storm sewers and open channels to convey stormwater to detention or, more commonly, retention facilities. This practice substantially reduces the impacts from urbanization; however, the volume of runoff carried by natural streams will

usually be increased. The increase in the volume of runoff can cause a change in the overall stability of both natural and artificial channels.

When land is developed, runoff from urban areas is concentrated to control stormwaters and provide a healthy environment. Even for small basins, concentrated runoff cannot simply be turned loose on adjacent grounds. Such action will result in erosion and the creation of a "new" urban channel; therefore, planning and design for urbanization needs to include approved disposal of newly created runoff from a development site. It is important to note that interfaces between natural and artificial channels are critical and require specific attention during design. In addition, sediment management and stream geomorphology are critical to both natural and artificial channels.
The preceding discussion simply illustrates a few requirements for design of urban channels. On larger scales, the designer may be faced with analysis or design of "non-rigid" channels; however, many urban applications employ "rigid channel" design concepts in order to gain sufficient control of urbanized stormwaters, often within a limited right of way.

Floodplains

Maricopa County has naturally occurring floodplains as well as those that have been created, or expanded, due to urbanization. Some of these floodplains have been identified and are being regulated by local municipalities, the Flood Control District, the Arizona Department of Water Resources (ADWR), and the Federal Emergency Management Agency (FEMA). The Flood Control District and most municipalities issue floodplain use permits for activities within FEMA designated floodplains, and drainage permits for activities located outside them. This system has evolved due to two separate statutory authorities resulting in two separate regulations. When developing projects in flood-prone areas be aware that even though the project is located in what a geomorphologist would classify as a floodplain, if it has not been mapped and published by FEMA, then—from a regulatory standpoint—it is not considered a floodplain. In that case, the developer would be required to obtain a drainage permit instead of a floodplain use permit.

Regulation of floodplains has been undertaken by authority contained in the National Flood Insurance Program. Engineers designing open channels or analyzing floodplains are faced with the provisions of the program; therefore, the following short description of the program and its requirements is included.

Special Flood Hazard Areas (SFHA) have been delineated on Flood Insurance Rate Maps (FIRMs) which can be obtained from the local jurisdictional agency (i.e., the Flood Control District of Maricopa County, City of Phoenix,

etc.). The 100-year flood boundaries, flood insurance rate zones, and regulatory flood elevations are shown on the FIRMs. All new development and significant modifications to existing uses must be approved by the jurisdictional agency responsible for regulating floodplains in the channel reach in which the development or modifications are to occur.

Natural Channels

In Maricopa County, floodplains tend to be wide, braided, and not permanently fixed in one location. Furthermore, velocities tend to be high, causing difficulties for channel modifications to be effective. Designers working in Maricopa County are, therefore, interested in the course of natural channels, especially where development will occur. Other design interests include the existing washes into which drainage from development will empty, and changes that occur in natural channels due to increases in the volume of runoff that occurs from urbanization.

Floodplain analysis tends to be very complex; however, a basic understanding of the behavior of natural channels and the methods of analysis can be very useful in the overall approach to drainage design. A common requirement for many projects is determining water surface profiles.

Natural channels tend to be in a steady state of change. Mountainous streams can be rigid, yet, in a geologic framework, are in a constant state of headcutting. While some mountainous regime channels exist, the natural channels that most commonly occur in Maricopa County lie within alluvial materials that have been deposited over long periods of time.

At transitions from natural to artificial channels, an array of problems can occur. Erosion can occur where the artificial channel has a substantial increase in conveyance compared to an upstream, natural channel. Because of their steep nature, the most common problem associated with mountainous streams is the sedimentation that predictably occurs where the natural channel interfaces with artificial channels which confine flows through development. Low flow channel sections may be required in the artificial channels to move sediment. Sedimentation can be expected where attempts are made to sharply deflect the direction of flow from the naturally steep channels. This condition should be avoided.

In the more common alluvial cases, natural channels tend to deposit sediment and meander during low flow periods (which is most of the time) and to erode and straighten channel alignments during rare events. It is in this manner that the alluvial fans have been formed. Generally, if alluvial material exists, then there is some potential for the stream to reoccupy the alluvial areas resulting

from a period of high flows. Therefore, it is necessary to acknowledge the potential for a natural channel to be 'non-rigid'.

Floodplain analyses tend to overlook this tendency for a natural channel to move, and, in many instances, this is an acceptable approach; however, the strict use of this approach within urbanized areas can lead to unfortunate results. As a result, there is often a need to utilize bank protection and hydraulic structures to selectively transform a non-rigid, natural channel into a more rigid channel.

Unless a natural channel is steadily aggrading or degrading, the construction of roads with adequately sized and protected bridges will significantly limit the lateral movement capability of most channels. Notable exceptions in Maricopa County are the extensive alluvial fan areas, which are outside the scope of this manual. Combined with bridges, the selective use of bank protection and grade control structures can prevent a natural channel from moving over a wide range of flow rates.

The entire hydrological approach to converting a natural waterway which has historically transported water from rural lands to an urban major drainage channel is so complex that applicable design criteria cannot be presented completely in this manual. It will suffice here to state that the planning for use of such channels must be undertaken with the full benefit of engineers with adequate experience in open channel flow, bed stability, and sediment transport, together with experts in related fields.

Analysis of Natural Channels

The investigations necessary to insure that a natural channel will be adequate are different for every waterway. Supercritical flow usually does not occur in natural channels and frequent checks should be made during the course of the backwater computations to insure that the computations do not reflect supercritical flow.

Because of the advantages which are available to a community by utilizing natural waterways for urban storm drainage purposes, the designer should consult with experts in related fields as to the methods of development. Where natural channels are used, the usual rules of freeboard depth, curvature, and other rules applicable to artificial channels do not apply. For instance, when laid out and developed for the purpose of being inundated during the major runoff peak, there can be significant advantages if the designer incorporates into the planning the overtopping of the channel and localized flooding of adjacent areas. Using natural channels requires that primary attention be given to erosive tendencies and carrying capacity adequacy. The floodplain of the

waterway must be defined so that adequate zoning can take place to protect the waterway from encroachment to maintain its capacity and storage potential.

Requirements for Natural Channels: Washes which traverse land designated for a proposed development may be left in their natural state provided that doing so would not be in conflict with an approved master drainage plan for the area—if one exists—and provided that the development is adequately protected from flooding and erosion.

According to ARS 48-3609.A, during the course of the Master Planning process, the 100-year runoff will be used to delineate a floodplain for major channels with discharges of more than 500 cfs and will be processed through the local jurisdictional agency, ADWR, and FEMA.

One method of developing in the vicinity of a natural wash is to keep all structures out of its 100-year floodplain, as well as its attendant erosion-hazardous areas. Another possible method of developing in the vicinity of natural washes is to utilize part of the floodplain for development, while leaving the channel in its natural state. However, the approach would involve demonstrating that: 1) the encroachment would not adversely affect adjacent properties; and 2) the development would be located outside of any erosion-hazard areas which border the natural wash.

Encroachments into the floodplain of a natural watercourse are to be analyzed according to FEMA requirements

The maximum rise in water surface shall not exceed those listed for the local regulating entity. As with all floodplain encroachments, the development must be adequately protected from flooding and erosion, and must not violate restrictions imposed by master drainage plans.

At no time should an encroachment adversely affect the stability of a water course or adversely alter flooding conditions on adjacent properties. When encroachment is proposed within the floodplain of a major watercourse, the regulating entity may, at its discretion, request that a detailed study be performed to determine if a reduction in overbank flood storage will significantly affect downstream flood peaks.

Detention/Retention-Introduction

Detention/retention facilities are man-made storage structures intended to mitigate the negative impacts of urbanization on storm drainage, which include:

- Increased peak flow rates.
- Loss of natural depression storage.
- Reduction of infiltration capacity in a drainage basin.
- Reduction of natural vegetation, which, in a natural state, reduces storm runoff through the process of interception.
- Increased pollutant load in surface runoff.

Detention Basin: A basin or reservoir where water is stored for regulating stormwater runoff. A detention basin uses gravity-flow outlets for discharging the stored runoff. Detention facilities do not reduce the volume of runoff, they do however lengthen the time flow will be present in the watercourse downstream of the facility. Due to the longer duration of flow downstream of detention basins, their use requires greater analysis to ensure that peak discharges are not increased downstream. Also, the impact a detention basin has on reducing the peak discharge tends to decline as the frequency of the event increases. Therefore, care must be taken not to size the outlet too large, and a range of events should be considered in the analysis.

Retention Basin: A basin or reservoir where water is stored for regulating a flood, however, it does not have gravity-flow outlets for discharging stored runoff as detention basins do. The stored water is disposed by other means such as infiltration into the soil, evaporation, injection (or dry) wells, or pumping systems.

This chapter presents the engineering methodologies and details associated with the planning, analysis and design of detention and retention facilities within Maricopa County. The guidelines herein are intended to achieve the following goals:

1. Design of detention/retention facilities that satisfy the ordinance provisions of Maricopa County and/or the individual jurisdictional agencies within the County with regard to hydraulic function and maintainability;

2. Design of detention/retention facilities that are amenities, and, where possible, incorporate multiple-use concepts; and

3. Design of facilities that will not jeopardize the quality of surface water or groundwater resources.

Interaction with Other Components of a Drainage System

Detention/retention facilities are components of an overall stormwater management system that is also comprised of natural and man-made channels, storm sewers, inlets, streets and other drainage structures. Their purpose is to provide temporary storage of the stormwater runoff from developed areas and to control the increased peak rates of runoff. Proper planning and design of detention/retention facilities must consider the interaction of storage with the other components of the drainage system.

The greater the number of storage facilities in a system, the more complex is the analysis of the interaction of the various discharges. Often the increased costs of construction and maintenance of a large number of smaller storage facilities offset any savings in reduced sizes of storm sewers downstream. Planning efforts should be oriented toward minimizing the number of storage facilities in a drainage basin.

As part of the planning and design process, the engineer must verify that releases from the detention/retention facility will not adversely impact downstream conditions in terms of both manner and quantity of flow. Conditions such as peak flow, velocity, flow concentration, prolongation of flow and quality of discharge are factors to be considered.

Limitations on Use of Detention/Retention Facilities

The requirement for a development to provide storage of runoff by detention or retention facilities will not be waived unless determined otherwise by the jurisdictional agency on a case by case basis.

In general, storage facilities are to be located so they can intercept the flow from the entire development area. If portions of the area cannot drain to a single storage facility, then additional facilities may be added to provide control of those areas as approved by the appropriate jurisdictional agency. The objective is to provide storage of runoff with a minimum number of detention/retention facilities located at optimum points within a development area. Whenever possible, the facilities shall be designed for multiple uses, such as parks or other recreational facilities, to offset the cost of open space and to encourage improved maintenance.

Residential developments shall have no single lot storage, and the design of common facilities shall not assume any individual lot on-site storage, unless approved by the jurisdictional agency. Developments with Homeowner's Associations will locate their facilities in private drainage tracts or in public sites dedicated by the developer, in accordance with the jurisdictional

agency's requirements. The Homeowner's Association will maintain the private facilities, and the jurisdictional agency will usually maintain the public tracts. Common storage facilities for single family developments without a Homeowner's Association and with public streets will have maintenance provisions determined by the jurisdictional agency. The number and location of storage facilities within a development are to be approved by the jurisdictional agency. Dedication to the public may require the inclusion of recreational facilities or other features deemed necessary by the jurisdictional agency.

Single lot, non-residential developments that are not served by a public storage facility will provide the required storage on the lot itself and outside the right-of-way area.

Regional Detention/Retention Facilities: Regional detention/retention facilities are large storage facilities located at strategic sites within a drainage basin to provide control of runoff. The advantages of this type of facility are:

- The siting and design of regional storage facilities are normally incorporated as part of an overall drainage master plan. Thus, alternative siting combinations and their respective hydraulic routing effects can be investigated. Storage alternatives can be evaluated with other factors (i.e., conveyance system, land and maintenance costs), to arrive at an optimal solution for the drainage basin.

- Operation and maintenance costs are reduced. Maintenance of regional facilities is typically the responsibility of a jurisdictional agency. The reduced cost of operation and maintenance can often offset the increased cost of tributary storm sewers which must be sized to carry higher peak rates of flow.

- Regional facilities are more effective and reliable because they are planned, designed and maintained as part of a total drainage system. On-site facilities can be less reliable and less effective because they are constructed randomly as a basin develops and because maintenance efforts can vary. The result of on-site facilities is a higher percentage of malfunctions.

Advance planning is the key element in the regional approach to stormwater detention/retention. The jurisdictional agencies within Maricopa County have agreed that basin-wide master drainage planning is necessary for the development of cost-effective systems for

stormwater management. Planning for regional detention/retention facilities for a drainage basin typically includes:

1. Development of an optimum drainage master plan for the basin in order to achieve an efficient and cost-effective drainage systems, and to ensure that multiple use opportunities are preserved.

2. Multi-jurisdictional cooperation, because natural drainage basins do not necessarily follow jurisdictional boundaries.

3. Participation by property owners, developers, engineers and the general public.

4. A plan for implementation that incorporates construction phasing of facilities.

5. Establishing a framework for fair and equitable financing of capital and maintenance costs.

Detention/Retention Design Criteria

This section presents certain guidelines, procedures and criteria to be used in the analysis and design of detention and retention facilities. Because specific policies and criteria vary, the designer must contact the jurisdictional agency for the area in which the basin will be located before beginning design.

Criteria for Detention/Retention Facilities

The following general criteria apply to the design of stormwater detention/retention facilities.

Design Frequency:

All detention/retention facilities incorporated within new developments will be designed to retain the peak flow and volume of runoff from the 100-year, 2-hour duration storm event. In the special case of when a detention only facility is allowed, the requirement to retain the 100-year 2-hour runoff volume may be waived. However, the peak discharge requirement must still be met, and the effects of using a detention only facility on more frequent events must be determined.

In jurisdictions where multi-frequency control is required, the design will be prepared to regulate the peak discharge rates for one or more

storm events in addition to the 100-year storm. Specific multi-frequency events shall be verified with the appropriate jurisdiction.

Criteria for Special Detention/Retention Methods

Special methods for stormwater detention/retention include underground storage, conveyance storage, roadway embankment storage, and storage in parking lots, pedestrian plazas, courtyards and common areas.

The use of rooftops as storage areas for runoff is not permitted in Maricopa County

Application of the special measures discussed below is regulated according to specific jurisdictions within Maricopa County. Contact the local jurisdiction before beginning to design using any of these methods.

Since the following methods often result in facilities near buildings, it should be emphasized that the finished floor elevation of a structure shall be a minimum of one foot above the 100-year water surface of the detention/retention facility. The finish floor elevation needs also to be above the emergency outfall of the basin.

Underground Storage: This type of storage involves the construction of underground tanks, pipes, or vaults which accept stormwater runoff by means of inlets and storm drain pipes. Due to the high cost of this type of installation, it is generally limited to high-density developments, where surface storage is not feasible due either to the scarcity or high cost of land—or both.

Underground storage facilities must be provided with some method of drainage (i.e. gravity drains, pumps, or infiltration). In all cases, manholes (or some other means of access to the underground storage facilities) must be provided for maintenance purposes.

Conveyance Storage: During the period that channels and floodplains are filling with runoff, the stormwater is being stored in transient form. This type of storage is known as conveyance storage. Construction of slow velocity channels with large cross sectional areas assists in the accomplishment of such storage. Conveyance storage systems are usually feasible only on large projects, and require detailed dynamic modeling for analysis.

Roadway Embankment Storage: When feasible, use of roadway fill slopes as an embankment for a detention basin provides an economical means of stormwater storage. Special considerations must be given both to the stability of the embankment and to the protection of the embankment from erosion. Additionally, State of Arizona dam safety requirements may need to be addressed if the embankment height and/or the potential storage volume exceeds certain limits (see Section 8.3.3.1).

Parking Lot Storage: Using parking lots for detention/retention is a special case of surface storage. It is an economical option for meeting detention/retention requirements in high density commercial and industrial developments. Planning of areas within a parking lot which will accept ponding should be such that pedestrians are inconvenienced as little as possible.

Refer to local jurisdictional standards on the percentage of the parking lot to be used as retention area and the allowable ponded depth. The maximum depth of ponded water within any parking lot location shall be one foot (1 ft). Deeper ponding should be confined to remote areas of parking lots, whenever possible.

Drainage of parking lots can be accomplished by means of dry wells (if permitted), curb openings, weirs, storm drains, orifices in walls, or gated outlets.

The minimum longitudinal slope permitted within parking lot storage facilities is 0.005 ft/ft, unless concrete valley gutters are provided. With concrete valley gutters, a minimum longitudinal slope of 0.002 ft/ft may be permitted

Storage in Plazas, Courtyards and Common Areas: Landscaped common areas, pedestrian plazas and courtyards, which are typically provided in conjunction with high density residential, commercial and office developments, provide opportunities for multiple use as stormwater detention/retention facilities. Such facilities should be designed to minimize public inconvenience, especially during frequent storm events. Public safety issues are also very important with this type of facility (see Section 8.4).

Embankment Design Criteria

Whenever possible, detention/retention facilities should be constructed with the storage volume located entirely below the natural ground

surface adjacent to the basin. However, in some instances this may not be possible, and embankments may be necessary to provide the required storage volume. Since the use of embankments may create a potential downstream flood hazard due to failure of the embankment, the following design considerations must be addressed in conjunction with their use. For additional information and guidelines for the design of embankments for detention/retention facilities, refer to *Design of Small Dams* (USBR, 1987).

State Dam Safety Requirements: The Arizona Department of Water Resources (ADWR), Division of Safety of Dams, has legal jurisdiction over all dams (embankments) which exceed certain height and storage limits. ADWR defines a jurisdictional dam as "either 25 feet or more in height or stores more than 50 acre-feet. If it is less than six feet in height regardless of storage capacity or does not store more than 15 acre-feet regardless of height, it is not in jurisdiction."

Figure 8.8 illustrates the difference between a jurisdictional and a non-jurisdictional dam. ADWR should be contacted regarding specific dam-safety requirements in conjunction with the design of any embankment which might come under their jurisdiction. Those which do fall within the jurisdiction of ADWR shall comply with their applicable design requirements.

Non-Jurisdictional Dam Design: Embankments for detention/retention facilities in Maricopa County that are "non-jurisdictional" according to the state criteria will generally be classified by the state as small dams with an associated hazard potential. The hazard potential classification is related to the conditions downstream of the dam. In the urban environment of Maricopa County, the potential for probable loss of life and excessive damage to development downstream (existing or future) is great. Therefore, all dams for detention/retention facilities will be considered as having high hazard potential.

The design reports, calculations, plans and specifications for construction of an embankment for a detention or retention facility shall be prepared by, or under the direction of, a professional engineer registered under the laws of Arizona, and having proficiency in civil engineering as related to dam technology. The engineer should check with the appropriate

jurisdiction for specific submittal requirements for embankment dam designs.

Environment Plan Element

Goal: Promote development that considers adverse environmental impacts on the natural and cultural environment, preserves highly valued open space, and remediates areas contaminated with hazardous materials

Objective E1 Encourage preservation of significant mountainous areas with slopes over 15% park, open space, and/or compatible recreation use.

Policy E1.1 Conduct site evaluations in the planning stage.

Policy E1.2 Explore incentives and options for preservation.

Policy E1.3 Refine existing topographic classification system.

Objective E2 Promote development that is compatible with the visual character and quality of the site.

Policy E2.1 Encourage guidelines for building construction, modification, and landscaping that reflect community or regional character.

Policy E2.2 Encourage preservation of scenic corridors and vistas.

Objective E3 Promote the appreciation and preservation of significant archeological and historic resources within the framework of state and federal laws, regulations, and guidelines.

Policy E3.1 Conduct surveys and evaluations for cultural resources as required by the Arizona Antiquities Act, the State Historic Preservation Act, the National Historic Preservation Act, and other

applicable laws, regulations and guidelines.

Policy E3.2 Implement mitigation measures for cultural resources as required by the Arizona Antiquities Act, the State Historic Preservation Act, the National Historic Preservation Act, and other applicable law, regulations and guidelines.

Policy E3.3 Consider alternative funding sources for impact avoidance or mitigation of impacts to significant cultural resources.

Objective E4 Encourage the protection of habitat within the framework of state and federal laws, regulations, and guidelines.

Policy E4.1 Identify priority habitat areas subject to development in compliance with the Endangered Species Act and other applicable laws, regulations and guidelines.

Policy E4.2 Participate in the inventory and classification of habitat for noted important species in priority areas if required by state or federal laws, regulations and/or guidelines.

Policy E4.3 Develop habitat conservation plans for protected species if required by state or federal laws, regulations and/or guidelines.

Policy E4.4 Explore incentives to preserve habitat.

Policy E4.5 Explore methods to acquire lands classified as priority habitat areas as part of an open space plan.

Objective E5 Promote the protection and preservation of riparian areas within the framework of state and federal laws, regulations, and guidelines.

Policy E5.1 Encourage site evaluation and classification of riparian areas as required by the U.S. Corps of Engineers 404 permit program or by other state or federal laws, regulations and/or guidelines.

Policy E5.2 Consider incentives and options for preservation.

Objective E6 Encourage the reduction of pollutants in rivers and streams within the framework of state and federal laws, regulations, and guidelines.

Policy E6.1 Cooperate with the Arizona Department of Environmental Quality biannual Water Quality Assessment Report in accordance with the Clean Water Act.

Policy E6.2 Apply the National Pollutant Discharges Elimination System (NPDES) Urban Stormwater Control Program as required by the Clean Water Act.

Objective E7 Discourage new development in major 100-year floodplains.

Policy E7.1 Ensure that local floodplain management regulations remain in conformance with state flood control statutes and the National Flood Insurance Program (NFIP) Rules and Guidelines.

Policy E7.2 Review proposed floodplain uses and issue only appropriate permits and clearances.

Policy E7.3 Review existing 100-year floodplains as necessary against changed conditions and obtain revisions through the Federal

Emergency Management Agency (FEMA) where necessary.

Policy E7.4 Encourage flood identification studies in areas where development is imminent or ongoing to identify 100-year flood hazard areas.

Policy E7.5 Continue public education efforts pertaining to the judicious uses of flood-prone properties.

Environment Plan Element

Land Use

Goal L3: Define future policies for subareas.

Objective L3.4: Preserve the scenic and rural character of the Northwest Valley Subarea.

Policy L3.4.1 Maintain areas north of State Route 74 as either proposed or dedicated open space, allowing for residential densities of up to 1 dwelling unit per acre, provided that development of environmentally sensitive areas, such as steep slopes and floodplains, are in compliance with applicable federal, state and county regulations.

Policy L3.4.2 Support Bureau of Land Management policies to maintain areas north of State Route 74 as resource and conservation areas.

Policy L3.4.3 Establish and maintain scenic corridor overlay along Castle Hot Springs Road.

Environment

Goal E1: Promote development that considers adverse environmental impacts on the natural and cultural environment, preserves highly valued open space, and remediates areas contaminated with hazardous materials.

Objective E1.1: Encourage developments that successfully coexist and are compatible with significant natural features.

Policy E1.1.1 Continue supporting the hillside development standards in the Maricopa County Zoning Ordinance.

Policy E1.1.2 Encourage land uses and development designs that are compatible with environmentally sensitive areas such as floodplains, hillsides, wildlife habitat, scenic areas, and unstable geologic and soil conditions.

Policy E1.1.3 Discourage small lot residential and commercial development on land with hillside slopes of 10% or greater.

Policy E1.1.4 Adequate control of on and off-site drainage should be required prior to development.

Policy E1.1.5 Control land use and development within the 100-yearfloodplain to minimize the threat to life and property.

Policy E1.1.6 Discourage the location of structures which increase water ponding and sheetflow in floodprone areas.

Objective E1.2: Preserve significant natural and cultural resources

Policy E1.2.1 Preserve the scenic quality of the Hieroglyphic, White Tank Estrella, and other surrounding mountains in the review of applications for land development, and develop other preservation programs and strategies as necessary.

Policy E1.2.2 Support regional efforts to promote and preserve open space.

Policy E1.2.3 Encourage efforts to establish an open space trails system between Estrella Regional Park, White Tank Regional Park, and Lake Pleasant Regional Park.

Policy E1.2.4 Support regional and statewide efforts to implement effective groundwater management programs.

Policy E1.2.5 To help reduce water use, irrigation of golf courses, neighborhood and community parks, roadway right-of-ways and other large common areas shall be accomplished entirely with treated effluent.

Policy E1.2.6 Proof of adequate future water supply will be required prior to development approval.

Policy E1.2.7 Support and foster federal, state and logical groundwater quality management programs.

Policy E1.2.8 Support and encourage local and region-wide efforts to preserve air quality.

Policy E1.2.9 Prior to development, excavation or grading, require the applicant to submit a letter from the Arizona State Historic Preservation Officer starting that the proposed land development will have no effect on historical or cultural resources.

Objective E1.3: Preserve significant existing open space and habitat areas for wildlife and desert plant species.

Policy E1.3.1 Encourage the protection of threatened or endangered plant and animal species.

Policy E1.3.2 Encourage the use of replacement vegetation that is primarily indigenous to the Palo Verde-Saguaro plant community for any land development that disturbs that

community. In addition, promote active efforts that discourage establishment and proliferation of on and off-site noxious weeds.

Objective E1.4: Support adequate opportunities for outdoor recreation that are sensitive to the environment.

Policy E1.4.1 Enhance opportunities for outdoor recreation offered in Maricopa County parks and recreation areas.

Policy E1.4.2 Support the use of canals and floodplains as recreation corridors.

Policy E1.4.3 Encourage developers to provide outdoor recreation facilities and amenities in their projects, including linear parks which provide for the joint use of flood control facilities.

Policy E1.4.4 Support establishing a scenic corridor overlay on Castle Hot Springs Road from State Route 74 to the Maricopa/Yavapai County border.

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