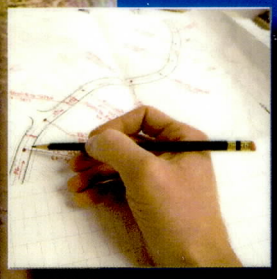
Upper New River Area Drainage Master Plan

June 2008

Flood Control District of Maricopa County

Contract FCD 2005C020
Stantec Project No. 182000418



Project Overview

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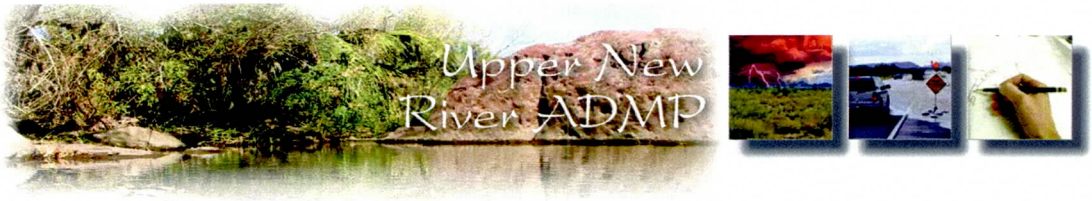

EXECUTIVE SUMMARY

At the request of the City of Phoenix, the Flood Control District of Maricopa County (District), under the authority of Arizona Revised Statutes Title 48, Chapter 21, initiated the Upper New River Area Drainage Master Plan (Upper New River ADMP). The Upper New River ADMP is a regional approach to watershed management. The District prefers a regional approach to watershed and floodplain management because it enables the District to develop flood control strategies that are both sustainable and sensitive to the environment. This approach works to minimize the public cost of protecting citizens from flooding that may result from private and public development's cumulative effect on drainage characteristics. The Upper New River ADMP provides a uniform and coordinated approach to watershed management. A multi-faceted approach will ensure that present and future residents are protected from the damaging effects of flooding.

The Upper New River ADMP watershed encompasses approximately 169 square miles located in the north central part of Maricopa County and lies within the jurisdictions of the City of Phoenix, City of Peoria and Unincorporated Maricopa County. Portions of the project watershed lie within the Tonto National Forest and Yavapai County. The ADMP planning area encompasses approximately 94 square miles. The planning area extends from the Tonto National Forest boundary to New River Dam. Numerous sub-watersheds and associated washes drain the area to New River, including the Gavilan Peak Wash, Sweat Canyon Wash, Black Wash, Deadman Wash and Doe Peak Wash. Approximately 37 linear miles of watercourses are considered in the development of the ADMP. Watercourses in which detailed studies were conducted include New River, Sweat Canyon Wash downstream of New River Road, Gavilan Peak Wash downstream of New River Road and Deadman Wash downstream of Interstate 17 (I-17).

Development of flood control management alternatives and policies that form the foundation of the plan took into account engineering, environmental, landscape, social, and economic considerations. Watershed/watercourse management alternatives were developed to mitigate/minimize the effect of urbanization on storm water runoff and conveyance while recognizing the values of the community and the opportunity to protect the unique characteristics of the region. The primary purpose for flood control management alternative development and evaluation was to develop a range of plans that provide public safety from flood and erosion hazards, determine the cost and benefits of each alternative, qualitatively determine impacts of the alternative on identified environmental resources, and select a recommended management plan.

Flood control management alternatives formulated in a team Brainstorming meeting were grouped into two categories: watercourse-based alternatives and planning area-wide alternatives. Watercourse-based alternatives were developed for areas in which there were specific flood hazards to existing residences, roadways or planned land use. These areas include the New River Planning Area for New River upstream and downstream of I-17; a reach of Sweat Canyon Wash downstream of New River Road to the confluence with New River; Deadman Wash downstream of I-17 (Lower Deadman Planning Area); and Gavilan Peak Wash downstream of New River Road (Gavilian Peak Planning Area). Planning area-wide alternatives were developed for areas that are typically undeveloped or were not covered by the watercourse-based alternatives.

Watercourse-based alternatives evaluated include non-structural, structural, and no action alternatives. Descriptions of the alternatives evaluated are:

- The Non-Structural Alternative defines a corridor that allows the watercourse to function naturally. The corridor defines an area in which development is restricted or limited. Watercourses retain their natural condition and appearance, and are managed by policies, ordinances, property acquisition, and multi-agency planning effort. The Non-Structural Alternative is defined by the limits of the 100-year floodplain, lateral migration zone or buffer, whichever provides the widest setback from the floodplain.

- Structural Alternatives provide protection from floods and erosion through engineered flood control facilities that take into consideration flow depth and erosive velocities. Structural elements of flood control facilities evaluated for the project include channels, levees and associated erosion protection measures. Structural elements are landscape designed (aesthetic treatments) to be context sensitive to the surrounding environment. Landscape aesthetic treatments are intended to create features that fit the form and function of the existing landscape character. Typical landscape aesthetic treatments consist of variations in the form (alignment, profile, side slope) of the structural element, use of color or textural patterns or the use of fill material to hide the structural element.

- The No Action (do nothing) Alternative provides flood control management based on current federal, state, and local floodplain management regulations that allow encroachment into the floodway fringe. Under current regulations encroachments into the floodway fringe are typically allowed on a piece-meal fashion without taking into consideration the effect of the encroachment or collective encroachments on the entire watercourse.

Planning area-wide alternatives evaluated included the No Action Alternative and ADMP Guidelines Alternative.

- No Action - Discussed above.

- The ADMP Guidelines Alternative - Communities develop drainage ordinances, policies, and standards with the intent to mitigate/minimize flooding impacts due to urbanization of a watershed. The purpose of these regulations is to minimize the occurrence of losses, hazards, and conditions adversely affecting the public health, safety, and general welfare that might result from flooding caused by surface runoff of rainfall. ADMP guidelines are developed to support a community's development regulations. Development guidance is based on a set of management goals, objectives, policies, and specific evaluation and design guidance that allows development to occur according to adopted land use plans.

With input from stakeholders and the public, the project team developed weighted, measurable performance criteria to represent the Upper New River ADMP's vision, goals, and objectives. The project team used the performance criteria to evaluate the alternatives and choose the recommended alternatives. The criteria that were developed are: Public Safety and Flood Hazard Mitigation, Scenery Resources, Recreation and Open Space Resources, Natural Resources and Implementation. These criteria were defined to have quantifiable elements so the team could determine a score for each alternative. The alternatives that had the highest scores were selected as the recommended alternatives.

The recommended alternatives are summarized below:

- The preferred alternative selected by the team for the New River Planning Area upstream of I-17 and the Gavilan Peak Wash Planning Area is the Floodprone Property Assistance Program (FPAP) alternative. The FPAP alternative is a non-structural alternative in which the watercourse reach is managed by floodplain and erosion hazard delineations. In locations where there are residential structures located within the floodplain/erosion hazard limits the landowners can apply for the District's Floodprone Property Assistance Program.

- Alternative 2 developed for the New River Planning Area downstream of I-17 was selected for the recommended alternative. Alternative 2 consists of structural and non-structural elements for reaches of Sweat Canyon Wash and New River. Levees make up the structural element for Alternative 2.

- The preferred alternative chosen for Deadman Wash located in the Lower Deadman Planning Area is Alternative 1A. Alternative 1A is predominately non-structural with the exception in

the vicinity of Carefree Highway where a bridge and associated spur dike is proposed to mitigate existing flood hazards.

- ADMP guidelines were selected as the recommended planning area-wide flood control management alternative for all planning areas outside of watercourse specific planning areas. Guidelines included:
  - ADMP guidelines recommend that as development occurs the non-structural alternative be applied to all watercourses.
  - The plan recognizes that there may be situations in which development activities may be required or desired within the erosion hazard zone; for this situation the plan presents a low impact structural alternative.
  - Channelization is not a preferred flood control management alternative, however, the plan also recognizes that there may be situations in which channelization may be required.
  - The preferred storm water storage alternative is the standard practice of retaining the volume from the 100-year, 2-hour rainfall event, however this practice may not be practical for certain portions of the study area. The standard retention practices, if implemented within an entire watershed, would have negative impacts in regards to sustaining native vegetation along watercourses. The plan offers two storm water reduction alternatives to the standard practice. The storm water storage alternatives are based on reducing post-development peak discharges to pre-development magnitudes. The alternatives are referred to as the in-stream, off-line retention alternative and in-stream, in-line detention alternative. The in-stream, off-line retention is the preferred alternative of the two.

An integral part of the preparation of the Upper New River ADMP was public and community participation. A landowner and stakeholder outreach program consisting of public and work group meetings, newsletters, and individual meetings with landowners, and federal, state and local agencies was initiated to obtain public and community participation. Resident's and stakeholders were notified of the development, goals, and progress of the plan through individual mailings of postcards, and public announcements in local newspapers. Public meetings were held in December 2006, November 2007 and June 2008 to obtain public input concerning flood and erosion hazards, to obtain input concerning flood mitigation alternatives and to present the preferred alternative.

Through public and stakeholder meetings, attendees voiced their knowledge of flood and erosion issues in the propjet area and concerns to be addressed in the development of flood control management alternatives. Public and stakeholder input was integrated into the development and selection of the recommend alternative which was presented to the public and stakeholders for comment and acceptance. The City of Phoenix and the Arizona State Land Department prepared letters of endorsement after their review of the Reccomended Alterntive.

An implementation and funding strategy was developed as part of the ADMP to assure that needed future actions for implementation are considered in the planning effort. The implementation and funding strategy plan addresses; funding strategies and opportunities and implementation opportunities and constraints.

Registered Professional Engineer (Civil) CERTIFICATE NO. 31680 PATRICK J. ELLISON Date Signed 6/24/2009 ARIZONA U.S.A.

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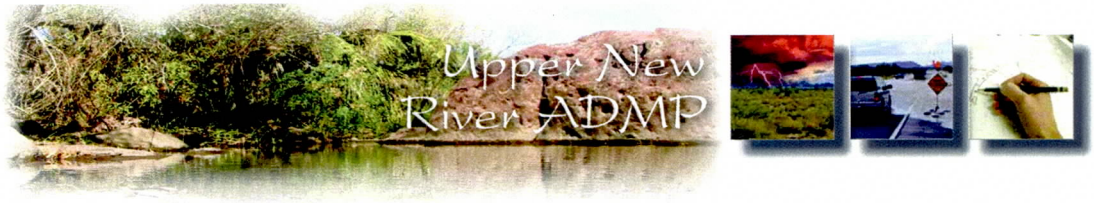

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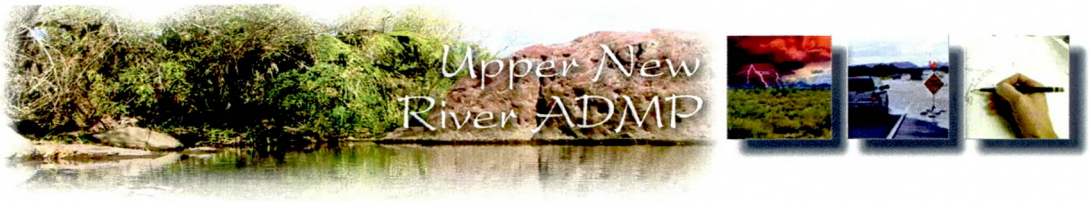

ACKNOWLEDGEMENTS

The success of the Upper New River ADMP development is due to the contributions of numerous individuals and the shared belief that through appropriate planning, public safety and quality of life can be improved for the citizens who live in the Upper New River ADMP project area. The input, perspective, and guidance of the following individuals and organizations is greatly appreciated.

Maricopa County Board of Supervisors

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INTRODUCTION

The Upper New River Area Drainage Master Plan (ADMP) watershed and study area is mostly undeveloped and relatively pristine, undisturbed Sonoran Desert. The ADMP watershed, especially along the New River watercourse downstream of Interstate 17 (I-17), is currently being planned for residential communities and commercial activities in the near future. The City of Phoenix, City of Peoria, and the Arizona State Land Department are currently leading the planning effort in the majority of the project area. Generally, the opportune time to develop an Area Drainage Master Plan is before land development significantly affects or impacts the drainage characteristics of the watershed.

Preparing an ADMP before substantial land development occurs allows the Flood Control District of Maricopa County (District), the consultant and stakeholder team to develop flood mitigation measures that utilize and optimize the natural drainage features, complement the physical and natural environment, and typically cost less compared to implementing post-development flood mitigation measures. Floodplain managers, planners, developers, and landowners can use and implement the Upper New River ADMP for planning and designing flood mitigation solutions, and for guiding or regulating development that either affects drainage or is within the floodplains within the Upper New River watershed.

The District contracted with Stantec Consulting Inc. (Stantec) to develop the ADMP. Stantec assembled a qualified team consisting of engineers, biologists, landscape architects, and planners to assist in the development and evaluations of flood control management alternatives. The team worked with the District, City of Phoenix, City of Peoria, Arizona State Land Department staff, a stakeholder group, and the public in the preparation of the ADMP.

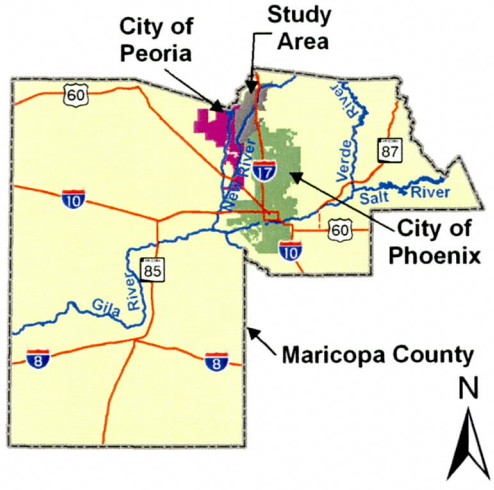


Figure 1

The Upper New River ADMP watershed encompasses approximately 169 square miles located in the north central part of Maricopa County and lies within the jurisdictions of the City of Phoenix, City of Peoria and Unincorporated Maricopa County. Portions of the project watershed lie within the Tonto National Forest and Yavapai County. The ADMP planning area encompasses approximately 97 square miles. The planning area extends from the Tonto National Forest boundary to New River Dam. Numerous sub-watersheds drain the area to New River, including the Gavilan Peak Wash, Sweat Canyon Wash, Black Wash, Deadman Wash and Doe Peak Wash watersheds. Approximately 37 linear miles of watercourses are considered in the development of the ADMP. Watercourses in which detailed studies were conducted include New River, Sweat Canyon Wash downstream of New River Road, Gavilan Peak Wash downstream of New River Road and Deadman Wash downstream of I-17. The location of the project relative to the City of Phoenix, City of Peoria and Maricopa County are depicted in Figure 1.

Development of the Upper New River ADMP includes public coordination, survey and mapping, hydrology, hydraulics, sedimentation and geomorphic evaluations, environmental overview, scenic and recreation resources assessments, identification of flood and erosion hazards and the formulation of flood control management alternatives.

The following reports were developed as part of the Upper New River ADMP study:

- Recommended Alternative Report
- Alternative Formulation Report

- Attachment 1 Data Collection Report (prepared by Stantec Consulting)
- Attachment 2 Environmental Overview (prepared by EcoPlan)
- Attachment 3 Hydrology (prepared by Stantec Consulting)
- Attachment 4 Erosion Hazard Zone Delineation Study (prepared by JE Fuller Geomorphology and Hydrology)
- Attachment 5 Scenery and Recreation Resources Assessment Report (prepared by EDAW)

- Floodplain Delineation Study Technical Data Notebook, Jenny Lin Wash, Deadman Wash Tributary 1A, Deadman Wash Tributary 1, Deadman Wash Tributary 2A, Deadman Wash Tributary 2

PURPOSE AND GOALS

The purpose of the Upper New River ADMP project is to develop a plan that provides flood control management plans and guidelines, which will protect current and future residents and businesses from flood and erosion hazards when implemented. Flood control management plans and guidelines take into consideration the compatibility with the natural environment, scenic recreational resources of the area. The following vision statement developed for the project summarizes the primary purpose of the project:

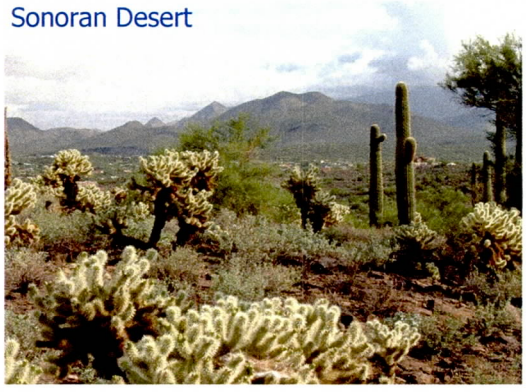
"The Vision for the Upper New River ADMP is that residents and future generations will have the appropriate level of protection from the effects of flooding through fiscally responsible and sustainable flood control solutions and multiple-use facilities that incorporate the stakeholders, and project partners, concerns and preserves, complements, or enhances the beauty and ecological integrity of the desert environment."

Goals of the Upper New River ADMP are summarized below:

- Identity flood and erosion hazards within the project area
- Prepare FEMA floodplain delineations for selected washes
- Develop plans, guidelines and strategies to protect residents from flood and erosion hazards
- Preserve the natural flood control function of the existing washes and channels
- Incorporate public and private interests, issues and concerns
- Consider environmental and landscape characteristics and multi-use activities of the watershed in the development of watershed management alternatives
- Minimize disturbance of existing floodplain and floodway ecosystem and habitats
- Incorporate communities' land use elements into the development and evaluation of flood control management alternatives

BACKGROUND

LANDFORMS


Sonoran Desert

The ADMP planning area is comprised of diverse land forms consisting of mountains, piedmonts, alluvial fans, sheet flow areas and riverine floodplains (Figure 2). The Bradshaw and the New River mountains underlay the northern portions of the planning area. Terrain slopes within the Bradshaw and the New River mountains range from less than 5 percent to greater then 25 percent (see Terrain Slope Map, Figure 3). In the mountainous areas rock outcrop is common; rock fragments typify soil constituents; and channels consist of well defined, low sinuosity tributary streams located in bedrock or mountain canyons. These streams have low lateral erosion potential and have narrow or non-existent floodplains. The piedmont landform consists of mildly sloping alluvial surfaces with dendritic tributary drainage networks. The piedmont areas typically occur as a buffer between the mountain slopes and major riverine floodplains such as New River and sheet flow ares. The watercourses in the piedmont areas consist of moderately steep, well-defined channels with narrow floodplains. These streams generally have low lateral erosion potential due to low peak discharges, relatively resistant boundary materials (cobbles, clay, and/or caliche), and bank vegetation.

Alluvial fans are composed of eroded rock material (alluvium) transported and deposited from the upstream watershed. Alluvial fans have the shape of a fan, either partially or fully extended, with a radial pattern of topographic contours. Alluvial fans are located near a topographic break, which may be expressed either laterally or vertically. The alluvial fan landform occurs within the piedmont area landform. Potential alluvial fans were identified in areas tributary to Sweat Canyon, along Deadman Wash, and near the upper end of Gavilan Peak Wash. Watercourses on alluvial fans consist of poorly defined, distributary channels with broad sheet flow areas. Streams on alluvial fans tend to have high lateral erosion potential due to avulsions, stream piracy, low channel capacity, high velocities, and non-resistant unconsolidated boundary materials (sand and gravel).

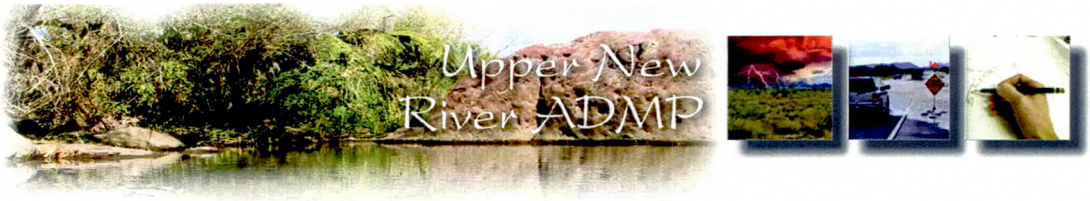
Sheet and unconfined flow occurs where there is no defined drainage network to convey the majority of flood water. The central area of the Upper New River ADMP study area lacks a defined drainage network. This central area is also characterized by broad, flat land surfaces with minimal lateral topographic relief and low slopes. Flow within sheet flow areas tends to have low lateral erosion potential due to shallow depths and low velocities. However, if unconfined flow is concentrated due to urbanization, the concentrated flow area will be subject to high rates of lateral erosion and/or long-term scour.

A major riverine floodplain is a planar surface adjacent to a watercourse that is periodically inundated by flood water. Floodplains consist of relatively fine-grained, unconsolidated alluvium recently deposited by the watercourse. Floodplain surfaces have high lateral erosion potential due to high channel velocities, frequent flood inundation and non-resistant boundary materials.

Landforms were used in the study to help identify locations where erosion and flood hazards occur.

PLANNING AREAS

The Upper New River ADMP was subdivided into ten planning areas based on landform, known flood and erosion hazards, watershed physical characteristics, and geographic location. Figure 4 depicts the name and location of the planning areas.



Land Ownership

Currently, the majority of land in the watershed is owned by public entities with the largest being Arizona State Land Department and federal lands within the Tonto National Forest. Figure 5 depicts the major land holders in the project planning area. Within the planning area the major owners are State Trust Land (71%), private (15%), Bureau of Land Management (8%) and other (6%).

Regional and Local Planning Efforts

Planning documents developed by communities offer guidance for future development that is consistent with the public's vision for their community. Elements of planning documents provide a framework for defining future development patterns. Elements typically include, but are not limited to, Land Use, Environmental Resources, Transportation or Circulation, Recreation, and Public Safety. These elements help guide future growth, revitalization and preservation efforts in the community. An understanding of the community's vision is key to the development of an area drainage master plan. Urbanization of an area typically alters existing rainfall runoff relationships that ultimately could result in flooding impacts which impact public safety.

The major jurisdictional entities within the Upper New River ADMP watershed that have developed planning documents and/or ordinances are Maricopa County, City of Phoenix, and City of Peoria. Documents reviewed as part of the data collection effort are listed in Table 1. A brief summary of the purpose of the document and relevance to the Upper New River ADMP is provided in the following sections.

Table 1: Regional and Local Documents

Agency	Document
City of Peoria	General Plan
	Loop 303 Specific Area Plan
City of Phoenix	General Plan
	Sonoran Preserve Master Plan
	Desert Character Overlay Districts
	North Black Canyon Overlay District
	FH-Flood Hazard and Erosion Management District
Maricopa County	Eye to the Future 2020, the Maricopa County Comprehensive Plan
	The New River Area Plan
Maricopa Association of Governments	Regional Transportation Plan
	Desert Spaces
	Desert Spaces-Environmentally Sensitive Development Areas

City of Peoria's - General Plan

The Peoria General Plan is the fundamental planning document for the City of Peoria to guide growth and development within the city and its planning areas. The plan was revised in December 2005. Land Use, Recreation and Open Space, Safety, Circulation and Environmental Resources elements of the plan provide policy level guidance for development. This information was used to in the development of hydrologic and hydraulic models and flood control alternatives evaluations.

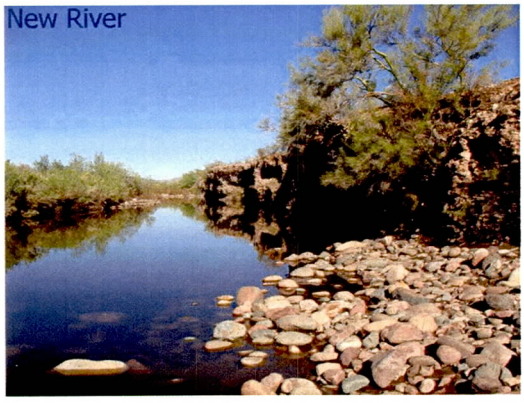
City of Peoria's - Loop 303 Specific Area Plan

Peoria's Loop 303 Specific Area Plan approved by the City Council December 13, 2005, updates Land Use data presented in the General Plan. The plan updates Land Use classifications within a corridor adjacent to the proposed Loop 303 alignment, New River and a freeway alignment referred to as the New River Freeway. The updated Land Use information is used in this study for the development of flood mitigation alternatives and hydrologic models.

City of Phoenix's - General Plan

The City of Phoenix General Plan provides comprehensive direction for growth and redevelopment within the city. The plan, adopted December 5, 2001, provides guidance through a set of goals, policies or regulations for Land Use, Cost Development, Recreation and Open Space, Safety, Circulation and Environmental Resources elements.

City of Phoenix's - Sonoran Preserve Master Plan



The Sonoran Preserve Master Plan adopted by the City of Phoenix in 1998 identifies desert areas around Phoenix for preservation. It stresses maintaining the desert character of the landscape and preserving a variety of vegetative communities. It specifically stresses maintaining washes and buffer areas due to the diverse plants and wildlife that thrive in the washes. As stated in the Sonoran Preserve Master Plan:

> *Preserve Natural Hydrological Process*
>
> *The watercourses or washes are the most biologically diverse and ecologically significant component of the desert landscape. This goal envisions preserving the floodway (actual sandy wash from bank to bank), the definable 100-year floodplains, and sufficient buffers to allow wide enough corridors for wildlife movement and natural meandering of the wash course to occur over time. This represents a significant change in development practices and will ensure long-term preservation of washes, expand the land area within the reserve, and capture a diversity of vegetation communities.*

City of Phoenix's - Desert Character Overlay District

The purpose of the Desert Character Overlay District is to implement land use elements of a specific area plan and to provide development guidance in fragile undisturbed desert. The Desert Character Overlay District does not fall within the planning area of the Upper New River ADMP, however the ordinance provides regulations and design guidance for development within and adjacent to desert washes that could be applicable to the Upper New River ADMP. The following excerpt is an example of the type of regulation provided:

> *Desert washes and related habitat corridors shall be designated according to the following minimum criteria. Allowance is to be made for wash migration over time using the most current*

acceptable method for watercourse management. (It is not the intent of the following criteria to replace requirements by other flood control agencies.)

> *Regional wash corridors: Flows of seven hundred fifty cfs or greater. Characterized as large and picturesque. Designation as drainage/vegetation tract is required along this type of wash at the one hundred-year rainfall inundation as determined by the drainage design manual of Maricopa County or fifty feet from top-of-uppermost bank hinge whichever is greater. The area within this boundary is to be maintained as permanent undisturbed open space with the exception of wash crossings.*

City of Phoenix's - North Black Canyon Overlay District

The North Black Canyon Overlay District is located adjacent to the Upper New River ADMP, south of the Carefree Highway, and east of I-17. The ordinance provides regulations and design guidance for development within North Black Canyon Overlay District. The following excerpt is an example of the type of regulation provided:

Manage storm water via the natural wash system to the greatest extent possible.

- Preserve identified washes as amenities and allow them to serve multi-use functions, including drainage.
- Allow for the natural function of the floodplain where feasible, based on engineering parameters and public safety.
- Construct bridges and culverts to minimize impacts to washes.
- The wash system can provide a place for trails within the setbacks above the wash banks. They become a recreational and visual amenity.

City of Phoenix's - FH-Flood Hazard and Erosion Management District

The purpose of the FH-Flood Hazard and Erosion Management District is to provide regulations for the use and development of lands in an erosion hazard zone developed as part of a Watercourse Master Plan or Area Drainage Master Plan. The ordinance provides permitted uses within and adjacent to erosion hazard zones. The ordinance would help to manage a non-structural alternative.

Maricopa County's - Eye to the Future 2020

The Eye to the Future 2020, the Maricopa County Comprehensive Plan, was adopted in 1997 and amended in August 2002. Goals and objectives of the plan include: conservation of the natural resources of the county, ensure efficient expenditure of public funds, and to promote the health, safety, convenience, and general welfare of the public.

Maricopa County's - The New River Area Plan

The New River Area Plan is an implementation measure of the Comprehensive Plan. The New River Area Plan was developed by the County and adopted in April 1999. The Land-Use element of the plan is utilized in this study in the development of future condition hydrologic models and in the development of flood mitigation alternatives.

MAG's - Regional Transportation Plan

The Regional Transportation Plan for Maricopa County developed by the Maricopa Association of Governments (MAG) provides a vision for a regional transportation system. The plan addresses transportation needs that include freeways, highways, streets, mass transit, airports, bicycle, and pedestrian facilities. Of particular interest to the Upper New River ADMP planning efforts is the potential location of freeways (SR loop 303), arterial roadway network, and a general aviation airport.

MAG's - Desert Spaces Plan

In 1995, the MAG adopted the Desert Spaces Plan. Desert Spaces is a regional open space management plan designed to guide the members of MAG in protecting open space while allowing for future community growth and development. The intent of the plan is to preserve, protect, and enhance significant natural and cultural resources. Natural resources include upland landforms, rivers and washes, and wildlife habitat. The plan also presents a regional network of trails that when implemented would allow the public to enjoy the diversity of open space.

MAG's - Desert Spaces-Environmentally Sensitive Development Areas

Sonoran Desert

The Environmentally Sensitive Development Areas (ESDA) Plan adopted by MAG in June 2000 presents policies and design guidelines for areas identified in the Desert Spaces Plan as "Retention Area and Conservation Area." The purpose of the design guidelines is to provide guidance for both the public and private sectors for development projects within Environmentally Sensitive Development Areas. Environmentally Sensitive Areas presented in the plan include the northern portion of the Upper New River ADMP study area and the area along and adjacent to New River.

Land Use

An Upper New River Planning Elements map (Figure 6) was developed using the City of Phoenix's and City of Peoria's General Plan and Maricopa County's Comprehensive Plan. The map depicts a composite of land use from the county and communities, circulation element and flood and erosion hazards. Information depicted in Figure 6 was used in this study for the development of future condition hydrologic models and the recommended alternative. The circulation element of the plan provides a policy framework for improving the transportation network in the respective cities. Flood Control Management alternatives developed for the Upper New River ADMP considered opportunities and constraints provided by the circulation plan.

FLOOD AND EROSION HAZARD IDENTIFICATION

Natural flood hazards associated with runoff from storm events exist within non-urbanized/rural watersheds. Without sufficient planning and management, natural hazards are compounded as development occurs within a watershed. In order to protect private and public property, naturally occurring environmental hazards and hazards created by urbanization need to be identified. Environmental hazards associated with storm runoff can be categorized into flood hazards and erosion hazards. Under the authority of ARS 48-3605, the Arizona Department of Water Resources (ADWR) has established criteria and standards for determining flood and erosion hazard areas. The Upper New River ADMP considered hydrology, hydraulics and geomorphic evaluations, and criteria established by ADWR in the identification of flood and erosion hazards.

HYDROLOGY

New River Gauge Station

Hydrologic analysis evaluates rainfall-runoff relationships for a given area (watershed) where the volume and rate of run-off is estimated at specific locations. An understanding of the hydrology of an area, both in existing and future watershed conditions is key in determining flood hazards and in identifying potential impacts to watercourses draining the watershed due to urbanization. Eight previous hydrologic studies have been completed in the watershed: three overall hydrology studies and five studies of tributaries to New River. The ADMP hydrologic model is a composite of existing hydrologic models and new, detailed hydrology developed specifically for the ADMP. Table 2 list a summary of peak discharges from the ADMP hydrology model at locations of interest.

The results of hydrologic analyses conducted as part of the Upper New River ADMP are used for:

- Delineation of 100-year floodplain at selected locations.
- Sedimentation engineering and geomorphic analyses.
- Hydraulic evaluation of flood control management alternatives.
- Hydraulic evaluation of storm water storage alternatives.

Table 2: Summary of 100-year PeaK Discharge

Location	ADMP Peak Discharge (cfs)
New River at Old Stagecoach Road	29,034
New River Downstream of West Split	24,040
New River at SR-74 East Bridge	8,000
New River at SR-74 West Bridge	18,000
Sweat Canyon at New River Road	14,940
Deadman Wash At SR-74	9,719

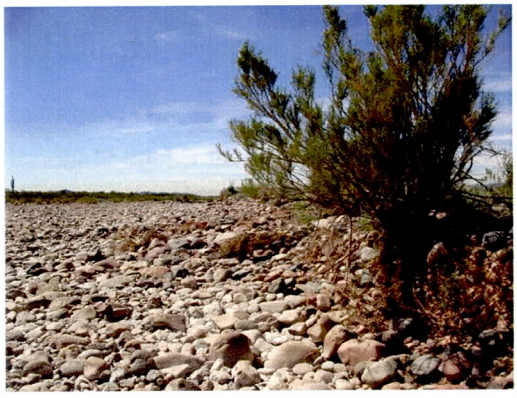
HYDRAULICS

Hydraulic analyses are conducted to determine the physical characteristics of a watercourse during a rainfall-runoff event. Hydraulic computer models facilitate the analysis and are developed to determine extent of flooding, water surface elevations, depth of flow, and velocity of flow for a runoff event. Models are developed for existing natural conditions and to evaluate different flood control management alternatives. Results of models developed to evaluate flood control management alternatives are compared to the results from models that evaluate existing conditions to assess the impacts of an alternative on a watercourse.

Computer models utilized for the Upper New River ADMP were newly developed as part of the ADMP, models developed for pending Federal Emergency Management Agency (FEMA) submittals, are models from effective FEMA 100-year floodplain delineation studies. New hydraulic models were developed for New

River downstream of I-17 to the New River Dam impoundment area, Sweat Canyon Wash downstream of New River Road, reaches of Deadman Wash near the Carefree Highway, Jenny Lin Wash, and Deadman Wash Tributaries 1, 1A, 2, and 2A. A two-dimensional existing conditions hydraulic model was developed for a portion of the Upper New River and the West Split to study the flow dynamics at selected flow split locations and gravel/borrow mine pits within the Upper New River ADMP study area.

Geomorphic Evaluation



Lateral Migration of New River Bank

Geomorphology is the study of landforms, the physical processes that form the land surface and the changes that take place in the evolution of the landform. Geomorphic evaluations conducted for the Upper New River ADMP focused on watercourse landforms and lateral stability of a watercourse. Geomorphic evaluations were based on field observations, aerial photographs (both historic and recent), historical channel position, stream longitudinal profile and allowable velocity guidelines. The results of the evaluation document physical changes to the watercourse that have occurred over time and suggest the types of changes that can be expected in the future. Geomorphic analyses were conducted for New River, reaches of Sweat Canyon and Deadman Wash.

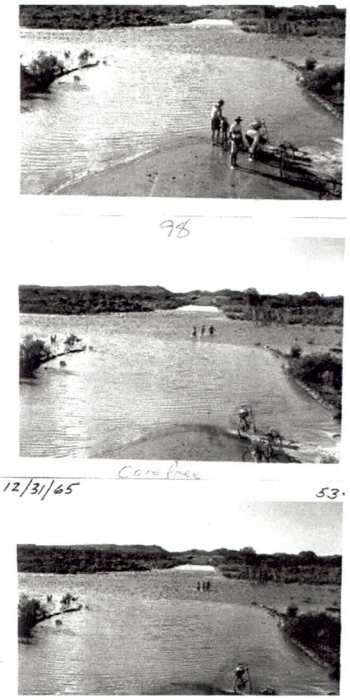
The lateral erosion potential of a wash varies depending on the type of landform the wash is located within. Washes located in mountain and piedmont landform areas generally have low lateral erosion potential because washes are incised in rock, caliche or well-cemented alluvium. Washes in alluvial fan areas tend to have high lateral erosion potential due to avulsions, stream piracy, low channel capacity, high velocities, and non-resistant unconsolidated boundary materials (sand and gravel). Flow within sheet flow areas tends to have low lateral erosion potential due to shallow depths and low velocities. However, if unconfined flow is concentrated due to urbanization, the concentrated flow area will be subject to high rates of lateral erosion and/or long-term scour. Major riverine floodplain surfaces such as New River have high lateral erosion potential due to high channel velocities, frequent flood inundation and non-resistant boundary materials.

Sediment Engineering

Sediment yield is the amount of solid material transported past a given point in a stream system, or alternately, the amount of material deposited in an enclosed basin. Sediment yield includes particles small enough to be carried in suspension by the flowing water (suspended load) and particles moved along the bottom of a channel by rolling, sliding, or bouncing (bed load). When flow velocities are reduced, sediment carried by a stream is deposited. Flow velocities can be reduced by natural or man-made changes in channel slope or channel geometry, or by impoundment in flood control basins. Sediment yield is a major concern for public officials in charge of maintaining the effectiveness of flood control structures because sedimentation behind dams or in floodways reduces the volume of water that can be stored or transported through the system. A reduction in effective storage volume increases the likelihood of a spillover in larger runoff events, increasing the chances of damage to the structure itself, property damage downstream, and possible injuries and loss of human life. Sediment yield estimates were determined for ADMP hydrology sub-basins.

Flood and Erosion Hazards

Floodplain delineation and erosion hazard zones form the basis for the identification of potential public safety hazards associated with the natural process that form the physical characteristics of watercourses within the study area. In addition to floodplain and erosion hazard delineations, potential flood and erosion hazards are identified through field and aerial photography investigations, review of existing drainage documents including Floodplain Insurance Study Reports, drainage complaints, newspaper articles, and conversations with the local population. Identified flood and erosion hazard delineations for the project planning area are depicted in Figure 5, Sheet 1 and 2 and Figure 7, Sheet 1 and 2. Sheet 1 depicts FEMA Effective or FEMA pending floodplain delineations. Sheet 2 depicts floodplain delineation results for New River from a two-dimensional hydraulic model. Existing condition analyses conducted for the ADMP identified that physical changes to New River upstream and downstream of the Carefree Highway have occurred resulting in different floodplain delineation than those presented on Effective FEMA FIRM Panels.



New River at Carefree Highway
1965

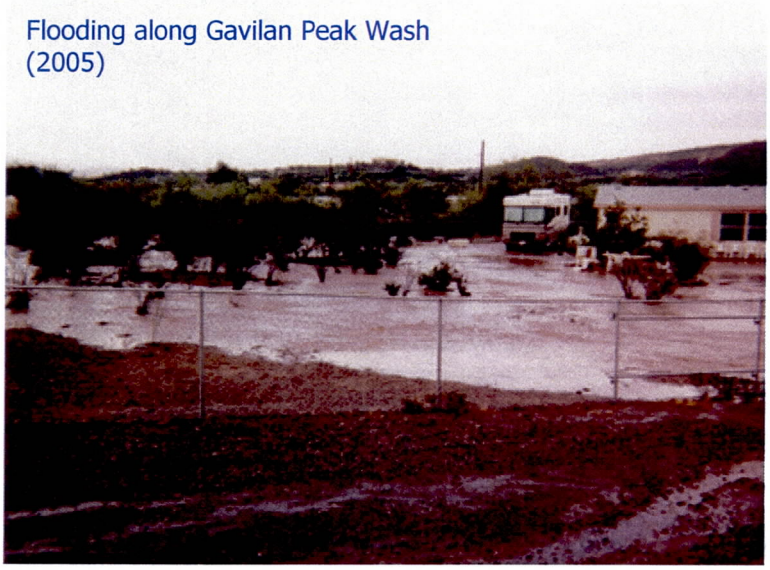
The following observations/comments listed by planning area were derived from field and aerial photography investigations and interviews with the local public.

Gavilan Peak Planning Area

Structures within floodplains - There are approximately 52 structures residential and out building structures within the floodplain limits of Gavilan Peak Wash and tributaries to Gavilan Peak Wash.

Meander Road in the community of New River - The team observed evidence of scour and signs that runoff had overtopped the roadway at culvert locations after summer rains (2005).

Flood issue areas identified in a public meeting - Property owners, residential structures and lots within the Gavilian Peak Wash floodplain have been impacted by a flood events.



Flooding along Gavilan Peak Wash
(2005)

New River Road near Gavilan Peak Wash and roadway crossing of tributaries to Gavilan Peak Wash - The project team observed signs of flow overtopping the road, in some areas causing significant erosion

and undermining of the roadway shoulder. Many culverts are clogged with sediment or debris. A New River resident provided flood photos from a summer of 2005 rainfall event in which flood flow overtopped New River Road and flooded his property.

Sediment filled culvert

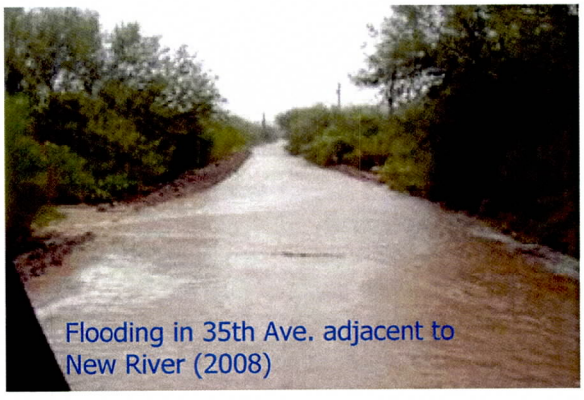
Photo View Wash flow break out - A potential flow breakout occurs along the south bank of Photo View Wash between the roadway alignments of 23rd Drive and 27th Avenue. Linear bands of denser vegetation located in topographic low areas sustained by runoff indicate that there have been historic flow breakouts that have eroded a small drainage swale. There may be a potential for a channel avulsion at this location.

New River Planning Area Upstream of I-17

Old Stage Coach Road at Dip Crossing - There was a fatality at the low flow crossing of New River in August 2005. Residents described the flood as a "15-foot wall of water." The incident was documented by *The Arizona Republic* in the story entitled "1 Dead, 1 lost in Flash Floods." The 100-year ADMP peak discharge at this crossing was estimated at 29,034 cubic feet per second.

Elementary School at New River -The project team received reports of flooding at the New River Elementary School. The flooding is from runoff generated in a watershed located to the west of the school. Runoff drains through the school grounds in a series of box culverts and channels to New River. It was related that the box culverts clogged with debris and runoff overtopped Old Stage Coach Road (35th Ave. alignment) and a pedestrian crossing within the school grounds. Flow that overtopped the culverts and channel impacted school facilities.

Old Stage Coach Road (35th Ave.) adjacent to New River - Flood and public hazard in this area is related to access. Access is cut off for 15 property owners who have homes along Old Stage Coach Road upstream of the road crossing with New River. Old Stage Coach Road located within the New River 100-year floodplain is impacted by flood waters from approximately a 10-year event or greater. Historically, this location has been a flood issue. To help alleviate the problem a training levee was constructed in the watercourse so that runoff in the low flow channel of New River would be directed away from Old Stage Road. The levee will be over topped when a runoff peak discharge of greater than approximately 10,000 cfs (approximately the 10-year event) is being conveyed within New River. Portions of the training levee have been eroded away and eventually it will no longer perform the intended function. It is unknown who constructed the levee.

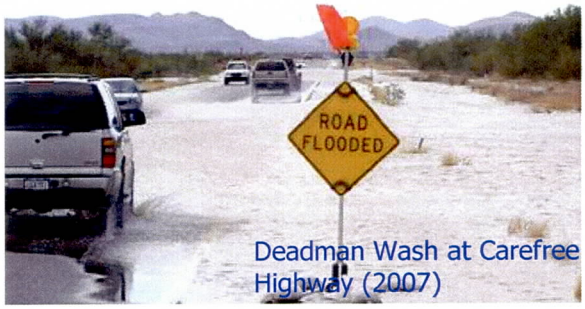

Flooding in 35th Ave. adjacent to New River (2008)

New River levees downstream of New River Road Bridge - New River Road Bridge levees tie into adjacent linear levee features. The linear levee features appear to be man-made, however they are not certified and have not been maintained. Because the feature does not meet FEMA criteria the 100-year floodplain occurs on both sides of the levee (floodplain is based on an assumption that the levee feature will not provide a benefit). The levee feature forming the east bank of New River Road extends downstream from the bridge approximately a quarter of a mile cutting off an old meander channel in the left overbank area. An opening in the levee feature near the end of the old meander channel allows local flow to drain out, however some flow is impounded behind the levee. During runoff events within New River,

flow drains back into this impoundment area. According to a resident in the area, this causes some vector issues.

Flood issue areas identified in a public meeting - Property owners, residential structures and lots within the New River floodplain upstream of the Old Stage Coach Road crossing of New River have been impacted by flooding.

Lower Deadman Planning Area



Deadman Wash at Carefree Highway (2007)

Carefree Highway (SR 74) at Deadman Wash - The Carefree Highway crossing of Deadman Wash consists of a roadway dip section and a 48" culvert structure, which does not have the capacity to carry flood flows. The 100-year ADMP peak discharge at this crossing was estimated at 9,719 cubic feet per second. The existing 48" culvert has a capacity of less than 100 cubic feet per second. Flood flows cross over SR 74 in depths greater than one foot, posing a hazard to the public and emergency vehicles.

Lower Deadman Planning Area, Sheet Flow - The majority of the Lower Deadman Planning Area lacks defined drainage networks. The area is characterized by broad, flat land surfaces with minimal lateral topographic relief. Sheet and unconfined flow occurs where there is no defined drainage network to convey the majority of floodwater. Flow within sheet flow areas tends to have low lateral erosion potential due to shallow depths and low velocities, however broad floodplains are associated with sheet flow areas.

Upper Deadman Planning Area

Structures in Jenny Lin Wash - There are approximately 3 residential structures within the floodplain limits of Jenny Lin Wash.

New River Planning Area Downstream of I-17

Structures in New River - Downstream of I-17 there area approximately 3 residential structures within the floodplain limits of New River.

New River Downstream of I-17 Flow Breakout -Along the reach of New River between I-17 and the Carefree Highway, flood hazards include flow break out and distributary flow areas. Flow break out occurs at locations where the banks of the watercourse are not of sufficient height to contain flow from a 100-year or less event. Flow break out occurs:

- Along the west bank of New River at the West Split located approximately three and one half miles downstream of I-17. During a 100-year event approximately 4,700 cfs breaks out of New River at the West Split. Flow draining to the West Split ultimately combines with flow from Sweat Canyon.
- Along the east bank of New River approximately two miles upstream of SR 74. Flow breaks out of New River to the Deadman Wash Watershed. Approximately 3455 cfs would break out in a 100-year event. Breakout flow ultimately drains to and overtops the Carefree Highway.
- Distributary flow areas are areas in which the primary flow paths for a given runoff event is unpredictable due to the potential for the channel to change during a flood event. The New River Reach just upstream of the Carefree Highway between the east and west bridges is a distributary flow area and is physically characterized by:

- Flow paths in the area between bridges are complex and not easily defined. Multiple channels drain flow to the east bridge, west bridge and to the roadway embankment between the two bridges.

- Flow draining along the roadway embankment has undermined and eroded the embankment.

- The channel invert at the West Bridge is 10-feet lower than the channel invert at the East Bridge. Continued heading cutting from the West Bridge channel to the East Bridge channel will result in all of the flow in New River to drain to the West Bridge.

New River at Carefree Highway (west bridge)

Rock Springs, Sweat Canyon/Doe Peak, West Tributaries, Upper Deadman and Lone Mountain Planning Areas

Rock Springs, Sweat Canyon/Doe Peak, West Tributaries, Upper Deadman and Lone Mountain Planning Flood Hazards -These areas have similar physical characteristics, are located predominately within mountain and piedmont landform areas and are primarily undeveloped. Physical characteristics related to flood and erosion hazards include:

- Watercourses in the piedmont areas consist of moderately steep, well-defined channels with narrow floodplains. These streams generally have low lateral erosion potential due to low peak discharges, relatively resistant boundary materials (cobbles, clay, and/or caliche), and bank vegetation.

- Channels in mountainous areas consist of well-defined, low sinuosity tributary streams located in bedrock or mountain canyons. These streams have low lateral erosion potential and have narrow floodplains.

- Floodplain and erosion hazard delineations have not been developed for all of the washes located in the Rock Springs, West Tributaries, Upper Deadman and Lone Mountain Planning Areas.

- Portions of the Sweat Canyon/Doe Peak Wash Planning Area adjacent to New River Road are located in a sheet flow landform area. Flow within sheet flow areas tends to have low lateral erosion potential due to shallow depths and low velocities, however broad floodplains are associated with sheet flow areas.

ENVIRONMENTAL OVERVIEW

An Environmental Overview was conducted for the planning area in which structural type flood control management alternatives were anticipated to be needed to mitigate known flood hazards. The purpose of the overview was to collect pertinent environmental information that would be used during the development and evaluation of flood control management alternatives and to provide general design guidelines to reduce or eliminate impacts to wildlife and habitat from flood control management alternatives or enhance a chosen alternative to encourage wildlife usage. An ecological resources assessment, identified vegetation communities; quality and type of habitat, including notable or special natural features such as wildlife nesting, foraging, watering, roosting, or denning areas that may warrant protection; and any potential suitable habitat for federally listed or candidate threatened or endangered species. Notable conclusions from the ecological resources assessment are:

- The vegetation community in the study area lies in the Lower Colorado River and the Arizona Upland subdivisions of the Sonoran Desert scrub biome. Vegetation consisting of creosote bush, triangle leaf bursage, and various species of cholla, including teddy bear, chain fruit, buckhorn, and staghorn, dominate areas between the xeroriparian washes. Dominant species associated with those washes include blue paloverde, foothill paloverde, western honey mesquite, velvet mesquite, and ironwood.

- Local raptor populations, such as the Red-tailed Hawk and the Harris' Hawk, may be negatively impacted by the future loss of foraging areas, mature xeroriparian habitat, and saguaros, which serve as observation points.

Study area wildlife

- The larger, more densely vegetated washes should be preserved not only for their habitat values but for the connectivity they provide throughout the project area. The New River serves as a valuable wildlife corridor for wildlife of all sizes, and any structural solution considered should take this function and value into account in the construction and maintenance of such structures.

- The xeroriparian washes in the study area are more densely vegetated than the uplands and provide a higher quality of habitat for wildlife than the somewhat monotypical uplands. Xeroriparian areas, on average, have greater availability of surface and subsurface water than areas not associated with washes. As a result, xeroriparian washes, including the New River corridor in the entire project area, tend to have a higher density and diversity of vegetation and often larger individuals of a particular plant species than adjacent upland areas. This higher density and diversity of trees and shrubs, as well as larger individuals of the species present along xeroriparian washes, provides more resources for wildlife than adjacent upland areas. Resources for wildlife commonly associated with the xeric riparian plant communities supported by these washes include cover, food, nesting substrates, denning areas, and movement corridors. For example, enhanced cover along these washes provides opportunities for movement by larger mammals, such as mule deer, javelina, and coyote, and habitat for smaller mammals, passerine birds, and reptiles.

New River upstream of I-17

- Valuable features of this area are the numerous stock tanks and the wildlife water guzzler. Catchments are valuable to all species of wildlife that inhabit this area and, if they are negatively impacted either directly through destruction resulting from home or road construction or indirectly by encroaching development, should be relocated to an area that will be preserved.

- Stock tanks provide valuable watering areas for wildlife and, if impacted, should be replaced with new stock tanks in areas where wildlife will use them.

- Any structural alternatives considered should take the needs of wildlife into account. If the alternative will directly or indirectly negatively impact wildlife habitat or movement corridors, then the structures should be constructed to be more wildlife friendly. Examples of negative impacts include, but are not limited to, steep drop structures that become a barrier to movement of wildlife in a wash or river corridor, concrete culverts that are undersized and have a non-natural floor material, and side slopes on lined channels that are steeper than 3:1 (horizontal to vertical).

- It appears that all of the xeroriparian washes that exhibit signs of an ordinary high water mark are Waters of the United States (Waters) as defined by the Clean Water Act. These washes would fall under the jurisdiction of the U.S. Army Corps of Engineers and the Environmental Protection Agency.

- A list of endangered, threatened, proposed, candidate and other special status species known to occur in Maricopa County was compiled from information obtained from the U.S. Fish and Wildlife Service (USFWS), the Arizona Game and Fish Department (AGFD), and the Arizona Department of Agriculture (AZDA). In addition, an AGFD On-line Environmental Review Tool was conducted to obtain a list of special status species that may occur in the study area. The USFWS lists species as endangered, threatened, proposed, or candidate; however, there is currently no suitable habitat for endangered or threatened species in the study area. The AGFD lists wildlife species whose existence in Arizona may be in jeopardy. The AZDA lists plant species as highly safeguarded if their future survival in Arizona is in jeopardy. Forty known special status species were identified from the research to occur in Maricopa County. Of the 40, only 13 wildlife and plant species could occur in the study area because there is either suitable habitat or valuable foraging areas for the species.

Study area wildlife

SCENERY AND RECREATION RESOURCES

The District's overall vision is to mitigate the effects of flooding through fiscally responsible context sensitive actions and multi-use facilities. Once identified, these actions and facilities can then complement and enhance the beauty of the desert environment for the residents of Maricopa County and future generations. A primary objective of the District's Board-approved Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects is planning and designing flood control facilities that preserve, enhance and complement the beauty of the natural desert landscapes and character of local communities within Maricopa County. It is the District's goal for aesthetic treatment of flood protection facilities to incorporate features and measures that will:

- Enhance the visual appearance of flood protection facilities by achieving context sensitivity with the surrounding landscapes.
- Help preserve the visual character of natural desert landscapes.
- Protect and enhance local community character.
- Increase aesthetic and public value of the District's flood protection facilities by designing them to incorporate opportunities for year-round recreation, open space linkages and multiple-use areas.

Essentially, the goal of the District is to enhance the public value of the District's flood protection facilities by planning them to include scenery, recreation and multi-use opportunities for use by residents of Maricopa County as an integral part of the structural design.

The assessment of Scenery and Recreation Resources is intended to serve as a tool for existing and future actions and facilities of flood control alternatives and will aid the District in providing context sensitive solutions that preserve and complement the character of the natural, rural, suburban and urban landscapes within Upper New River ADMP project area. The purpose and significance of Scenery and Recreation Resources assessment is described below:

- Scenery Resource Assessment (SRA)

  The SRA serves to identify the surrounding natural and local community visual character within the study area. Predominantly, the SRA helps to guide the design of flood control facilities in order to minimize negative impacts to the valued scenic resources within the study area. The results of the analysis will be utilized to better complement the existing landscape settings as part of the ADMP.

- Recreation Resource Assessment (RRA)

  The RRA serves to identify the regional and local (study area) existing and planned recreational features within the study area. The assessment is conducted to enhance the public value of the District's flood protection facilities by identifying potential opportunities for year-round recreation and open space linkages as an integral part of flood control facilities' design.

As part of the SRA a Future Scenery Resource Compatibility analysis was conducted to determine the compatibility of different methods of flood protection with scenic resources in the project area. Three Compatibility Classes for the project areas where identified. Compatibility Class 1 identified for a small portion of the project planning area denotes that the only method of flood protection that should be considered is the Non-Structural Method. Overall the majority of the land within the study area lies within Compatibility Class 2. Compatibility Class 2 denotes that Non-Structural and Soft Structural Alternatives (Structural Alternatives in which hard structural components are either non-existent or are buried) are compatible with the scenic resources. Some areas lie within Compatibility Class 3, areas compatible with Non-Structural, Soft- and Semi-Soft Structural Alternatives (similar to Soft except that some structural components are visually evident).

The areas of Compatibility Class 1 and 2 depicted on the Future Scenic Resource Compatibility Map (Figure 8) associated with the undeveloped landscapes require that any proposed flood control methods in these areas not modify the visual character of the landscape. This is due to their inherent higher visual quality, and the difficulty of complementing the visual character of these areas using Semi-Soft or other methods that have the potential to visually impact the landscape. The Compatibility Class 3 ratings within the Valley Plains and Industrial Bajada scattered throughout the region, and Suburban Bajada in the northwest region imply that the visual character of the study area is most compatible with natural forms and minimal hard structures that are subordinate to the overall visual character of the landscape. As seen on the map,

the Class 3 areas are surrounded by mountains and valley rivers and washes. The higher visual quality and the difficulty of complementing the visual character of these areas using Soft Structural or other methods which have the potential to visually impact the landscape results in bands and patches of Compatibility Class 1 running throughout the landscape. Flood protection structures planned within these areas should be most compatible with natural forms and landscape aesthetic treatments with no visible hard structures.

New River upstream of I-17

As part of the RRA Parks and Open Space Compatibility maps, Figure 9 and Figure 10 for the regional and local settings of the Upper New River ADMP respectively were developed. There are three flood protection method compatibility classes identified based upon the inventory of existing recreation resources within the study area. These compatibility classes within the Upper New River Study Area predict the types of flood control methods that best complement the desired recreation experience and management direction of the existing and planned recreation features and open spaces. Thus sensitive natural open spaces such as Hell's Canyon Wilderness Area, Lake Pleasant Regional Park, Spur Cross Ranch Recreation Area, Cave Creek Regional Park, Black Mountain Summit Preserve, Thunderbird Adobe Dam Regional Park Recreation Area, areas within the floodplain such as New River and Deadman Wash, and mountain areas located to the north of the study area require context sensitive solutions (Class 1 or 2) to flood control issues that prohibit the presence of visible hard structures. Other recreation areas which include the majority of the study area, such as the County- designated retention areas are less restrictive but require that hard facilities (Class 3) be minimal and subordinate to the overall visual character of the landscape.

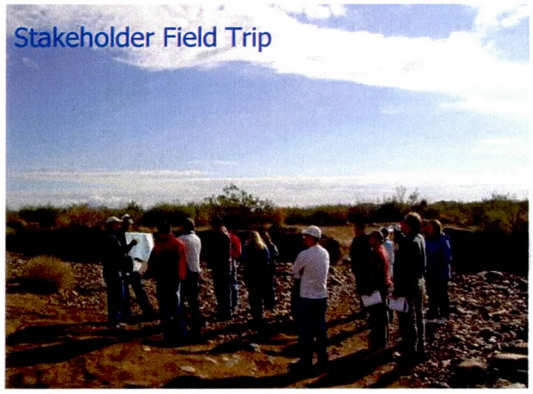
PUBLIC AND STAKEHOLDER INVOLVEMENT

An integral part of the preparation of the Upper New River ADMP was public and community participation. The property in the study area is held by federal, state, county and private interests. The majority of the land within the planning area, approximately 73% is held by the Arizona State Land Department. Private interests hold approximately 16%. Private interest is primarily located in the community of New River and the Anthem development located west of I-17. A landowner and stakeholder outreach program consisting of public and work group meetings, newsletters, and individual meetings with landowners, and federal, state and local agencies was initiated to obtain public and community participation.

Public Meeting

Residence and stakeholders were notified of the development, goals, and progress of the plan through individual mailings of newsletters, and public announcements in local newspapers. Public meetings were held in December 2006, November 2007 and June 2008 to obtain public input concerning flood and erosion hazards, to obtain input concerning flood mitigation alternatives and to present the recommended alternative.

Throughout the term of the project, meetings were held with individuals, engineers and/or planners representing the interests of the Bureau of Land Management, Arizona State Land Department, Arizona Department of Transportation, Arizona Game and Fish, Maricopa County Department of Transportation, City of Phoenix, City of Peoria, New River/ Desert Hills Community Association, Black Canyon Trail Coalition, and the Desert Foothills Land Trust.


Stakeholder Field Trip

Through public and stakeholder meetings, attendees voiced their knowledge of flood and erosion issues in the project area and concerns to be addressed in the development of the flood control alternatives. Public and stakeholder input were integrated into the development and selection of the recommend alternative which was presented to the public and stakeholders for comment and acceptance. The City of Phoenix and the Arizona State Land Department prepared letters of endorsement after their review of the Upper New River ADMP.

RECOMMENDED ALTERNATIVES DEVELOPMENT AND EVALUATION

RECOMMENDED ALTERNATIVES

The purpose for recommended alternative development and evaluation was to examine the benefits, opportunities and impacts of a range of flood control alternatives that address flood and erosion hazards and impending development pressures. The ultimate goal of this evaluation is to recommend a plan for managing flood and erosion hazards. Development of flood control management alternatives and policies that form the foundation of the plan takes into account engineering, environmental, landscape, social and economic considerations. Watershed management alternatives were developed to mitigate/minimize the

effect of urbanization on stormwater runoff and conveyance while recognizing the values of the community and the opportunity to protect the Sonoran Desert. Flood control management alternatives were evaluated on how well each alternative meets the goals of the ADMP.

Formulation of proposed alternatives took into consideration existing flood and erosion hazards, environmental and scenery resources and land use and transportation planning elements. Formulation of alternatives was achieved through a brainstorming meeting. The project team, City of Phoenix and City of Peoria staff, and stakeholders participated in a brainstorming meeting.

Flood control management alternatives formulated in a team brainstorm meeting were grouped into two categories: watercourse-based alternatives and planning area-wide alternatives. Watercourse-based alternatives were developed for areas in which there were specific flood hazards to existing residences, roadways or planned land use. These areas include the New River Planning Area for New River upstream and downstream of I-17 and a reach of Sweat Canyon Wash downstream of New River Road to the confluence with New River; Deadman Wash downstream of I-17 (Lower Deadman Planning Area); and Gavilan Peak Wash downstream of New River Road (Gavilian Peak Planning Area). Planning area-wide alternatives were developed for areas that are typically undeveloped or were not covered by the watercourse-based alterntives.

Alternatives developed for the ADMP are organized in general alternative categories. Those categories are the Non-Structural Alternative, Structural Alternative, No-Action Alternative and ADMP Guidelines. Structural Alternatives include channel and/or levee elements that provide opportunities for environmental enhancements; landscape treatments that are context sensitive to scenic resource and land use; and multi-use recreation opportunities.

NON-STRUCTURAL ALTERNATIVE

The Non-Structural Alternative defines a corridor that allows the watercourse to function naturally. The corridor defines an area in which development is restricted. Watercourses retain their natural condition and appearance, and are managed by policies, ordinances, property acquisition, and multi-agency planning efforts. The Non- Structural Alternative is defined by the limits of the 100-year floodplain, lateral migration zone or buffer, whichever provides the furthest setback from the 100-year floodplain limit.

STRUCTURAL ALTERNATIVE

Structural alternatives provide protection from floods and erosion through engineered flood control facilities that take into consideration flow depth and erosive velocities. Structural elements of flood control facilities evaluated for the project included channels, levees and associated erosion protection measures. Structural elements are designed (aesthetic treatments and landscape) to be context sensitive to the surrounding environment. Landscaping and aesthetic treatments are intended to create features that fit the form and function of the existing landscape character. Typical treatments consist of variations in the form (alignment, profile, side slope) of the structural element, use of color or textual patterns or the use of fill material and vegetation to hide the structural element. Under the channel option, the entire channel would require landscape treatment, whereas under the levee option the area between the levees (area where the natural channel is located) would not require a method of treatment though the levees would. Figure 11 depicts a typical section for a natural landscape channel. The structural elements (bank armoring) of the channel have been buried and the over fill has been landscaped. Figure 12 depicts a photograph of a channel where the natural landscape theme has been applied. Figure 13 depicts a typical landscaped levee section.

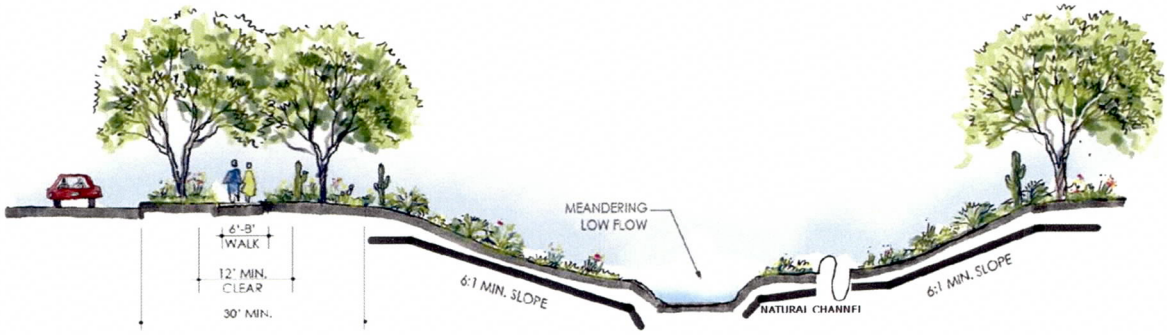


Figure 11: Soft Structural Channel Alternative

Figure 12: Picture of a Soft Structural Channel Alternative

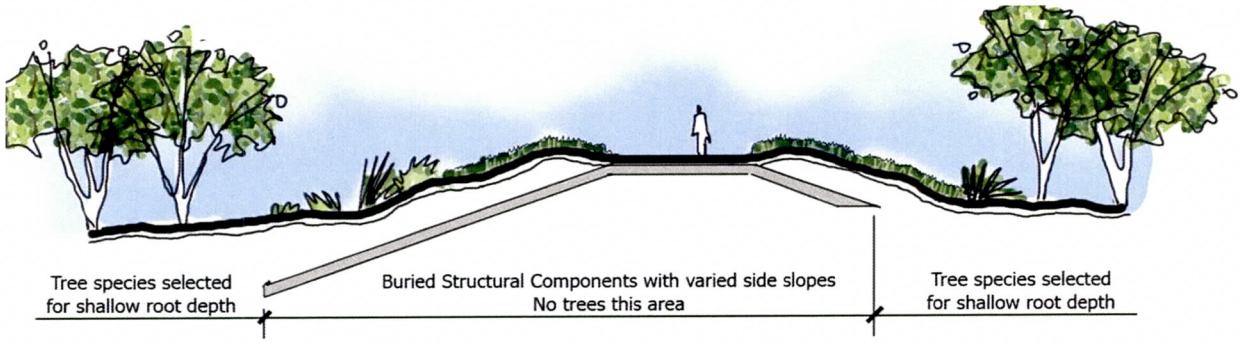


Figure: 13 Soft Structural Levee Alternative

No-Action Alternative

The No-Action Alternative provides flood control management based on current federal, state, and local floodplain management regulations that allow encroachment into the floodway fringe. Typically under current regulations, encroachments into the floodway fringe are allowed in a piecemeal fashion without taking into consideration the effect of the encroachment or collective encroachments on the entire watercourse or environmental and scenic resources.

ADMP Guidelines

Communities develop drainage ordinances, policies, and standards with the intent to mitigate/minimize flooding impacts due to urbanization of a watershed. The purpose of these regulations is to minimize the

occurrence of losses, hazards, and conditions adversely affecting the public health, safety, and general welfare that might result from flooding caused by surface runoff of rainfall. ADMP guidelines are developed to support a community's development regulations. Development guidance is based on a set of management goals, objectives, policies and specific evaluation and design guidance that allows development to occur according to adopted land use plans.

ADMP Guidelines developed for the Upper New River ADMP are intended to implement and manage alternatives recommended for specific river reaches (watercourse-based alternative) and as a management alternative for planning areas in which flood hazards will be addressed as development occurs.

Alternative Evaluation & Evaluation Criteria

The project team evaluated the alternatives using a value analysis approach. With input from stakeholders and the public, the project team developed weighted, measurable performance criteria to represent the Upper New River ADMP's vision, goals, and objectives. The project team used the performance criteria to evaluate the alternatives and choose the recommended alternatives. The criteria that were developed are: Public Safety and Flood Hazard Mitigation, Scenery Resources, Recreation and Open Space Resources, Natural Resources and Implementation, which are defined and described in detail below.

These criteria were defined to have quantifiable elements so the team could determine a score for each alternative. The assigned values for each criterion ranged from one to ten. A value of one indicated that the alternative "performed" poorly or ranked low with respect to that criterion; a value of ten indicated that alternative "performed" really well or ranked high with respect to that criterion. Each criterion also had a weight assigned to it, which represented the "relative importance" of each criterion in the evaluation process. The weights were assigned by using a paired comparison matrix (Table 3) by select members of the project team. One team member representing the various disciplines or areas of expertise (e.g., engineering, landscape architect, environmental, stakeholder involvement, etc.) took part in assigning the weights. Weighting factors of 0.5 for Recreation and Open Space Resources, 1.5 for Scenery Resources, 2.0 for Implementation, 2.5 for Natural Resources and 3.5 for Public Safety and Flood Hazard Mitigation were utilized in the evaluation. The total scores are depicted in Table 4. The detailed evaluation matrices are in the Alternative Formulation Report.

Costs were also considered in the evaluation process for the alternatives that had implementation costs that could be reasonably estimated, which were the structural alternatives. For the structural alternatives, the total score was divided by the costs; the alternative with the highest value was selected as the recommended alternative (See Table 9.27 in the Alternative Formulation Report). For the alternatives where costs could not be reasonably estimated, the alternative with the highest score was selected as the recommended alternative.

Table 3: Paired Comparison Matrix

										Score	
Criteria:		**Preference**		**Preference**		**Preference**		**Preference**		**Value**	**% Total**
A.	Public Safety and Flood Hazard Mitigation	A or	B	A or	C	A or	D	A or	E		
		A		A		A		**A/E**		**3.5**	35
B.	Scenery Resources	B or	C	B or	D	B or	E				
		B			D	**B/E**				**1.5**	15
C.	Recreation & Open Spaces	C or	D	C or	E						
		D		**C/E**						**0.5**	5
D.	Natural Resources	D or	E								
		D/E								**2.5**	25
E.	Implementation									**2**	20
								Totals		**10**	**100**

Criteria Definitions

Public Safety & Flood Hazard Mitigation Criteria & Goals

- Solve Existing Flood Hazards

  This element measures an alternative's function to remove existing structures from the 100-year floodplain/floodway or reduce the potential for damage to existing structures due to lateral migration, bank erosion, flow breakouts, sediment deposition or local scour while providing/maintaining emergency access to existing facilities. An alternative that removes or reduces the potential for damage to existing structures would rank high over an alternative that did not.

- Adverse Consequences/Consequences of Failure (Risk)

  This element measures an alternative's potential for being an attractive nuisance, for failure, and for causing an increase in the risk of loss of life and damage to property (Adverse Impact). An alterative that does not have adverse impacts would receive a high score.

- Reclaimed Floodplain

  This element measures the opportunity for the maximization of developable property. Large reduction in floodplain area results in a high score.

Implementation Criteria & Goals

- Multiple Funding Sources

The element accesses the funding probability and sources of funding. An alternative with multiple funding sources and a high funding probability would rank high.

- Complexity of Implementation

  This element measures the degree of complexity of implementation when considering land ownership, physical constraints, and number and types of IGAs or MOUs required. An alternative that is not complex to implement would receive a high score.

- Community Support

  This element accounts for the input received from the public involvement process. The effectiveness of an alternative in meeting community acceptance is measured by the public's response to an alternative. A positive response results in a high score, whereas a negative response would result in a low score.

- Stakeholders' Support

  This element evaluates stakeholder's willingness to support, approve and adopt the alternative. Additionally, this element considers the general consensus of the multiple stakeholders for such support, approval and adoption of the alternative. Approval of an alternative through stakeholder consensus results in a high score.

- Compatibility with other Agency Plans

  This element ranks how well an alternative accommodates other Agency Plans (i.e., land use, parks, trails, transportation, etc.). Accommodating other Agency Plans has a positive effect on gaining consensus toward a recommended alternative. The more an alternative accommodates other Agency Plans the higher the score.

- Regulatory Permits

  This element evaluates the level of difficulty or complexity for local, state and federal permitting required for an alternative. Regulatory permitting can make an alternative less desirable or less feasible if it creates increased cost, project delays, insurmountable mitigation requirements, or a denial of the permit. An alternative that has the least relative difficulty or complexity in gaining regulatory permits receives the higher score.

- Optimize the Timing & Phasing

  This element evaluates whether there are meaningful opportunities to phase the alternative or elements of the alternative. The public safety and flood hazard mitigation alternatives might be implemented, however, the accompanying aesthetics and recreational elements might have the ability to be deferred. The opportunity for phasing improves the overall implementation of the more critical functions of the alternative.

Scenery Resources Criteria & Goals

- Degree to which an Alternative is Compatible with Scenic Resources

  This element evaluates the relative degree of contrast between the various components of the alternatives and their setting in the landscape. Visual contrast is based on spatial dominance, visual compatibility, color, line, and form. The greater an alternative's compatibility with scenery resources as recommended in the composite scenery resources compatibility analysis the greater the ranking.

- Degree to which an Alternative Improves or Restores Landscapes

  This element evaluates an alternative's ability to improve and restore landscapes with visual disturbances to a condition that is complementary to the valued character of the surrounding landscape.

Recreation and Open Space Resources Criteria & Goals

- Degree to which an Alternative is compatible with existing Recreation and Open Space Resources

  This element is an indicator of the multi-use and open space opportunities of an alternative. The effectiveness of the criterion is based on the extent of multi-use opportunities that result from implementing a given alternative. The greater the opportunity that the alternative is compatible with recreation and open space resources as recommended in the recreation and open space resources compatibility analysis the higher the score.

- Maximize opportunities to meet future needs for passive and active recreation

  Alternatives are assessed on their ability to accommodate multi-use trails/pathways, their compatibility with other potential recreation facilities in terms of access, and user's experience on the trail/pathway. The standard used to evaluate the alternatives is whether an alternative provides opportunity for recreation. Opportunity is equated to the amount of area potentially available for recreational activities-the greater the area, the higher the score.

- Maximize opportunities to implement the Maricopa Regional Trail Master Plan and meet local community need for trails

  This element measures the compatibility of the alternatives with the Maricopa Regional Trail Master Plan. Alternatives that are compatible receive higher scores than those that are not.

Natural Resources Criteria & Goals

- Impact to Riparian Habitat

  This element measures an alternative's impact on stream-side habitat, including ephemeral washes; stock tanks; mesquite bosques. An alternative that impacts riparian habitat would rank low whereas an alternative that enhances habitat would rank high.

- Impact to Wildlife Corridors

  This element measures an alternative's impact on areas of dense vegetation and cover that are utilized for wildlife movement. An alternative that impacts wildlife corridors would rank low whereas an alternative that enhances wildlife corridors would rank high.

- Impact to Waters of the U.S.

  This element analyzes an alternative's impact to Jurisdictional Waters (JD) of the United States. An alternative that impacts a large JD area would receive a low score.

- Impact to Upland Habitat

  This element measures an alternative's impact on upland habitat. An alternative that impacts upland habitat would rank low whereas an alternative that enhances upland habitat would rank high.

Summary of Evaluation Results

Recommended Watercourse-Based Alternatives

Recommended watercourse base flood control management alternatives were developed for the New River Planning Area, Gavilan Peak Wash Planning Area, and the Deadman Wash Planning Area. Table 4 lists the watercourse evaluated within the specific planning areas, alternative types evaluated and a summary of the evaluation results. The alternative for the New River Planning Area Upstream of I-17 and the Gavilan Peak Wash Planning area is the Floodprone Property Assistance Program (FPAP) alternative. The FPAP alternative is a non-structural alternative in which the watercourse reach is managed by floodplain and erosion hazard delineations. In locations where there are residential structures located within the floodplain/erosion hazard limits, the landowners can apply for the District's Floodprone Property Assistance Program. Alternative 2 developed for the New River Planning Area Downstream of I-17 was selected for the recommended alternative. Alternative 2 consists of structural and non-structural elements for reaches of Sweat Canyon Wash and New River. Levees make up the structural element for Alternative 2. Typical levee sections are depicted in Figures 14, 15, and 16. The recommended alternative chosen for Deadman Wash located in the Lower Deadman Planning Area is Alternative 1A. Alternative 1A is predominately non-structural with the exception in the vicinity of Carefree Highway where a bridge and associated spur dike is proposed to mitigate existing flood hazards. Alignment of the recommended alternative for the subject watercourses are depicted on Figure 17 and 18. Fifteen percent-level design drawings for the recommended alternatives are presented in the Upper New River ADMP report.

The reader will note that Table 4 presents alternatives with levee and channel options. These alternatives differ in that the alignment of the levee and/or channel options are different.

Recommended Planning Area-Wide Flood Control Management Alternative

Table 5 lists a summary of the evaluation of alternatives developed for area-wide planning effort. ADMP guidelines were selected as the recommended planning area-wide flood control management alternative for all planning areas outside of watercourse specific planning areas. ADMP guidelines recommend that as development occurs the non-structural alternative be applied to all watercourses. The non-structural alternative defines a corridor that allows the watercourse to function naturally and is defined by the 100-year floodplain, erosion hazard zone and a buffer, if applicable, between human activity and a wash corridor. The plan recognizes that there may be situations in which development activities may be required or desired within the erosion hazard zone; for this situation the plan presents a low-impact structural alternative. Channelization is not a recommended flood control management alternative; however, the plan also recognizes that there may be situations in which channelization may be required. The recommended storm water storage alternative is the standard practice of retaining the volume from the 100-year, 2-hour rainfall event, however this practice may not be practical for certain portions of the study area. The standard retention practices, if implemented within an entire watershed, would have negative impacts in regard to sustaining native vegetation along watercourses. The plan offers two storm water reduction alternatives to the standard practice. The storm water storage alternatives are based on reducing post-development peak discharges to pre-development magnitudes. The alternatives are referred to as the in-stream, off-line retention alternative and in-stream, in-line detention alternative. The in-stream, off-line retention is the recommended alternative of the two.

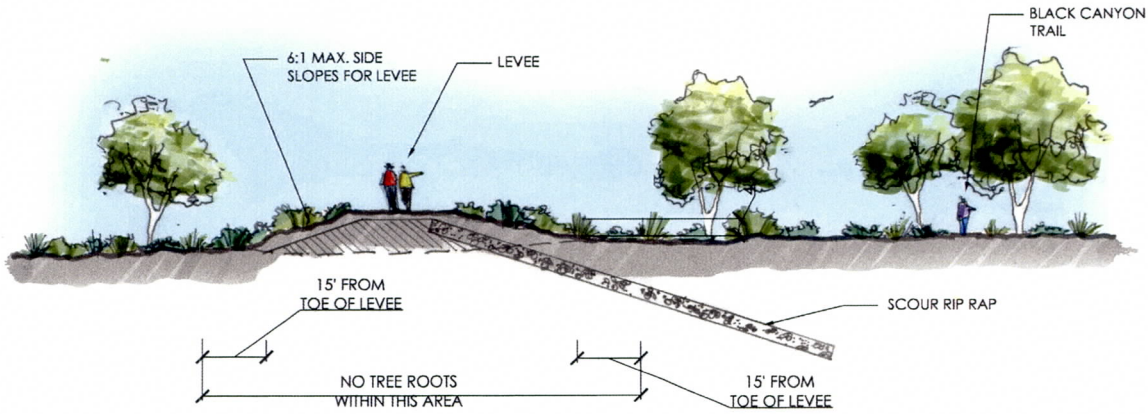


Figure 14: Typical Levee Section at West Split

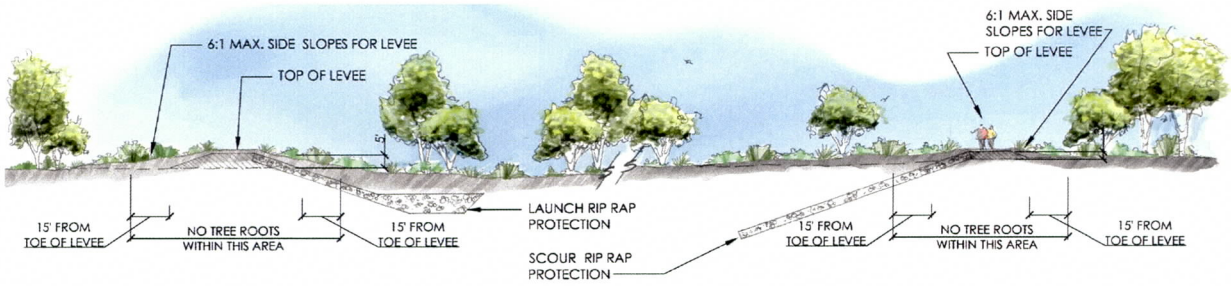


Figure 15: Typical Levee Section at New River Levee Reach

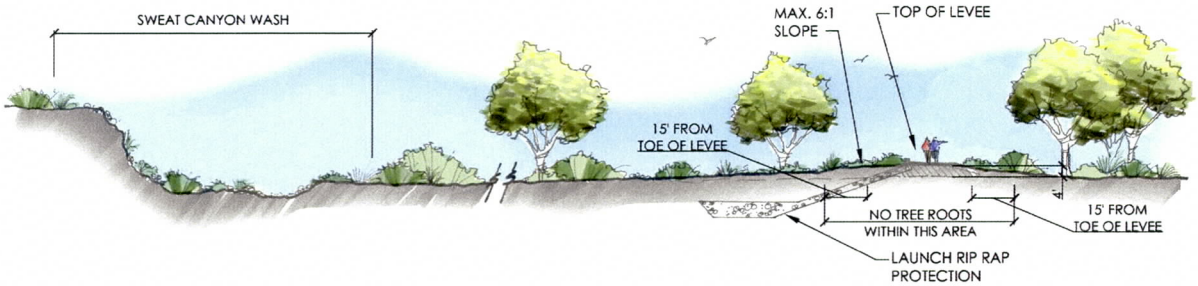


Figure 16: Typical Levee Section at Sweat Canyon Reach

Table 4: Watercourse Base Alternative Evaluation Summary

Planning Area	Alternative	Scenery Resources Criteria	Recreation and Open Space Resources Criteria	Natural Resources Criteria	Public Safety and Flood Hazard Mitigation Criteria	Implementation Criteria	Total Score
Gavilan Peak	Alternative 1 ADMP Guidelines	150	50	121	243	176	**739**
	Alternative 4 No Action Alternative	66	10	108	131	124	439
	Alternative 2 Non-Structural Gavilan Peak Wash (FPAP)	150	50	173	265	163	**801**
	Alternative 3 -Structural Alternative (levees)	114	39	115	189	50	507
New River Upstream of I-17	Alternative 1 Levee along Old Stage Coach Rd.	114	45	99	173	38	469
	Alternative 2 Channel adjacent to Old Stage Coach Rd.	15	18	79	227	34	373
	Alternative 3 Floodprone Property Assistance Program	150	50	173	278	183	**834**
	Alternative 5 ADMP Guidelines	150	50	121	242	176	**738**
	Alternative 6 No Action	66	10	108	131	124	439

Table 4: Watercourse Base Alternative Evaluation Summary, Continued

Planning Area	Alternative	Scenery Resources Criteria	Recreation and Open Space Resources Criteria	Natural Resources Criteria	Public Safety and Flood Hazard Mitigation Criteria	Implementation Criteria	Total Score
New River Downstream of I-17	Alternative 1-Levee Option	116	41	114	185	129	584
	Alternative 1-Channel Option	36	24	105	190	32	387
	Alternative 2-Levee Option	110	41	110	185	157	**601**
	Alternative 2-Channel Option	30	24	101	190	32	377
	Alternative 3-Levee Option	135	41	124	175	100	574
	Alternative 4-Retention Basin	90	21	91	178	154	533
	Alternative 5 - No Action	66	10	108	131	124	439
Lower Deadman Planning Area	Alternative 1A	150	47	164	217	180	**757**
	Alternative 1B	36	34	123	222	77	492
	Alternative 2A	26	18	122	183	88	436
	Alternative 2B	15	13	103	192	77	400
	Alternative 3 - ADMP Guidelines	150	50	121	232	176	**728**
	Alternative 4 - No Action	66	10	110	131	124	441
	Alternative 2 - No Action	66	10	108	131	124	439

Table 5: Planning Area-Wide Flood Control Management Alternative Evaluation Summary

Planning Area	Alternative	Scenery Resources Criteria	Recreation and Open Space Resources Criteria	Natural Resources Criteria	Public Safety and Flood Hazard Mitigation Criteria	Implementation Criteria	Total Score
All Planning Areas	ADMP Guidelines	150	50	121	243	176	**739**
	No Action	66	10	108	131	124	439

ADMP DESIGN GUIDELINES

INTRODUCTION

Communities develop drainage ordinances, policies, and standards with the intent to mitigate/minimize flooding impacts due to urbanization of a watershed. The purpose of these regulations is to minimize the occurrence of losses, hazards, and conditions that might result from flooding caused by surface runoff of rainfall which could adversely affect the health, safety, and general welfare of the public. Potential rainfall runoff impacts to a watershed and impacts to a watercourse due to urbanization are:

- Decrease of storm water infiltration capacity within a watershed due to urbanization increases peak discharge from a watershed unless measures are undertaken to reduce post development peak discharges.
- Because more land area is covered by homes, streets and landscaping as a watershed urbanizes, the natural sediment supply to streams is decreased, which causes floods to be more erosive. This erosion can lead to loss of homes and land due to riverine bank erosion, scour damage to bridges, and adverse impacts to flood control facilities and natural river habitat.
- Floodplain encroachment can change the natural function of a watercourse. Channel conveyance and storage capacity of a river system is reduced resulting in increased channel velocities, and changes in the timing of when tributary flow joins peak flow in a watercourse potently resulting in increase peak discharges downstream.
- An increase of peak discharge, frequency, and runoff volume due to urbanization in a watershed increases the potential for erosion and sedimentation within watercourses.
- Increased erosion due to increased flood peaks and reduced sediment supply leads to degraded habitat along river corridors, with adverse impacts to wildlife and public recreation.
- Due to an increase in peak discharge, existing drainage structures downstream of newly urbanized areas will become inadequate and have a greater risk of failure.

- Increase in peak discharge does not increase property, increases size of floodplain. Existing structures within or adjacent to the pre-development floodplain or downstream properties are at risk of a greater flood impact.
- Increased flood peaks and flow diversion increase floodwater elevations and expand floodplain widths, inundating properties previously safe from flooding and expanding the number of homes and business at risk for future flood damage.
- Disruption of natural flow paths 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.

ADMP Guidelines developed for the Upper New River ADMP are presented in the following Planning Elements and Design and Planning Guideline Sections. The Planning Element Section presents the major elements of the plan and guidance in the form of goals, objectives and policies. The Design and Planning Guideline Section presents design/planning guidelines to aid designers and planners in their effort to meet the goals objectives and policies of the Upper New River ADMP.

PLANNING ELEMENTS

The Upper New River ADMP is one of the many tools created to guide growth and development in the study area so that impacts of urbanization on the environment are minimized. The focus of the Upper New River ADMP is on flood and erosion control management; however, the plan takes into consideration the impacts of different flood control management alternatives on environmental, scenic resources and multi-use recreational opportunities. The intent of this plan is to work in conjunction with other planning documents and ordinances developed by the City of Phoenix, City of Peoria and Maricopa County. The plan is to be used by policy makers in the City of Phoenix, City of Peoria and Maricopa County, future residents, and developers when making decisions concerning development in the area.

Implementation of and guidance provided by the plan is based on a set of management goals, objectives, and policies for each of the four elements of the plan. The elements are Flood and Erosion Hazards Identification, Development and Planning Considerations, Biological Resources, and Multiple-Use Opportunities. The following definitions of goal, objective, and policy are offered as a guide for the users of the plan.

Goal: *A statement that describes in general terms a desired future condition.*

Objective: *A statement that describes a specific condition to be attained.*

Policy: *A course of action or rule of conduct to be used to achieve the goals, and objectives of the plan.*

PURPOSE

The plan area for the Upper New River ADMP lies within three jurisdictional areas: Maricopa County, City of Phoenix and the City of Peoria. The specific guidance that is offered by each of the governmental bodies within their adopted planning programs vary depending on their needs and their vision for managing growth. The goals, objectives and policies developed for the Upper New River ADMP are applicable to the

jurisdictions; however, reference is made to other planning documents that offer development guidance. The user of this document should also take into consideration specific goals, objectives and policies developed for the area by all jurisdictions within their area of interest.

Upper New River ADMP elements, goals and accompanying objectives and policies that are similar or the same as guidance/direction provided in adopted planning documents and/or ordinances are presented or repeated for this plan because they are instrumental to the implementation and maintenance of the recommended flood control management alternatives of the plan.

Flood and Erosion Hazards Identification

Within non-urbanized/rural watersheds, natural hazards associated with runoff from storm events exist. Without sufficient planning and management, natural hazards are compounded as development occurs within a watershed. In order to protect private and public property and the health and general welfare of the public, naturally occurring environmental hazards and hazards created by development need to be identified. Environmental hazards associated with storm water runoff can be categorized into natural flood hazards, erosion hazards, sediment deposition hazards, and flood hazards associated with development.

The following hazard identification Goals, Objectives, and Policies seek to advance the intent of federal, state, county, City of Phoenix, and City of Peoria guidelines for the treatment of identified environmental hazards.

Goal EH1 - Identify environmental hazards associated with storm water runoff.

Objective EH.1.1

Identify special flood hazard zones per the guidelines of FEMA and the District and City of Phoenix.

Policy EH.1.1.1

Require all development to use at least the regulatory 100-year floodplain delineation identified by FEMA and/or the District and associated 100-year peak discharges in their planning and design effort.

Policy EH.1.1.2

All development is required to delineate floodplain and floodway zones for areas not covered by delineation conducted by FEMA or Maricopa County. Floodplain delineations shall be conducted in conformance with FEMA Guidelines, ADWR State Standard 2-96 Guidelines, or local subdivision regulations.

Objective EH1.2

Identify potential flood hazards associated with existing man-made structures within the planning area. Possible examples of man-made structures include, but are not limited to, stock tanks, dams, drainage crossings at roadways and canals, levees, bridges, and retention basins.

Policy EH1.2.1

Evaluate the structural integrity and possible failure of existing earthen dams along watercourses. Determine flood hazard potential associated with dam failure.

Policy EH1.2.2

Delineate flood hazard ponding limits upstream of a watercourse crossing of roadways, embankments, and canals. Impoundment areas will be considered flood hazard up to top of embankment elevation.

Objective EH1.3

In the desert Southwest, severe erosion is a significant hazard that accompanies large floods.

Erosion hazard zones are delineated in order to protect the health, safety and property of citizens in Maricopa County.

Policy EH1.3.1
Require all new development to use the erosion hazard zone identified by the District in their planning and design efforts.

Policy EH1.3.2
Require all new development to delineate erosion hazard zones for areas not covered by delineations conducted by the District.

Objective EH1.4
Identify stream reaches that have experienced historical and/or recent long-term degradation.

Policy EH1.4.1
Require all new development to take into account the effect of aggradation and degradation on drainage facilities (such as retention/detention, off-line/in-line facilities). Drainage facilities constructed in the watercourse shall strive to maintain the watercourse sediment continuity.

DEVELOPMENT/PLANNING CONSIDERATIONS

The following development/planning Goal, Objectives, and Policies provide guidance to minimize potential impacts to a watershed due to development.

Goal DP1 - Establish area-specific Design and Planning Standards to promote development that acknowledges environmental hazards associated with storm water runoff, preserves the natural integrity and function of watercourses within a watershed and minimizes the potential to increase the magnitude of the hazards due to urbanization.

Objective DP1.1
Discourage development in 100-year floodplain and associated erosion hazard setbacks.

Policy DP1.1.1
Encourage non-structural flood control techniques over typical structural flood control techniques.

Policy DP1.1.2
Where non-structural techniques are applied erosion hazard boundaries shall establish development limits along a watercourse.

Policy DP1.1.3
Where structural control measures are deemed necessary, such as at roadway crossings, encourage the use of low impact structural flood control techniques. Low impact structural measures shall not adversely affect the stability of a watercourse or adversely alter flooding and erosion conditions on adjacent property. Low impact structural alternatives shall be context sensitive to the environmental characteristics of the area.

Policy DP1.1.4
Development in, or modification of, the floodplain is discouraged. Should there be a need to modify the floodplain, the modifications shall result in minimum disruption of the natural sediment transport capacity of the channel and floodplain.

Objective DP1.2
Encourage design and planning efforts that mitigate potential disruptions to the pre-development function of a watershed due to development.

Policy DP1.2.1

Discourage changes to natural drainage patterns in rural and low-density residential land use areas.

Policy DP1.2.2

In areas where the non-structural alternative is applied, preserve vegetation on and adjacent to the channel banks, and in the floodplain in order to maintain the stability of existing channel banks and minimize the potential for lateral channel movement.

Policy DP1.2.3

Design roadway alignments in such a manner that runoff collected by the roadway is conveyed to historic flow paths within the pre-development watershed.

Policy DP1.2.4

Design roadway watercourse crossings such that the alignment of the roadway is perpendicular to the watercourse alignment and at locations where the floodplain and erosion hazard limits are narrow.

Policy DP1.2.5

Discourage roadway crossing of watercourses at locations where the watercourse is braided.

Policy DP1.2.6

Provide access roads to culvert or bridge roadway crossings of watercourses to facilitate access by maintenance vehicles.

Policy DP1.2.7

Culvert/bridge crossings shall minimize disruption to the natural channel form and function.

Policy DP1.2.8

Design culvert crossings to account for potential clogging due to the accumulation of sediment and debris.

Policy DP1.2.9

Design drainage crossings to minimize downstream scour, minimize the risk of erosion of roadway approaches, and maintain sediment continuity up to the bank full discharge.

Policy DP1.2.10

At-grade roadway crossings of watercourses should only be considered for watercourses that are characterized by shallow flow conditions. At-grade roadway crossings in rural and low-density residential land use areas are acceptable (specific design criteria such as allowable depth of flow over the roadway will need to be met) with agency approval.

Policy DP1.2.11

The standard practice for retaining the volume of runoff from the 100-year, 2-hour storm event should be employed unless it is demonstrated not to be practicable. The standard retention practice is encouraged for commercial, business park/industrial and high-density residential land use areas. An acceptable alternative to the standard practice is a facility that reduces post-development peak discharges to pre-development magnitudes.

Policy DP1.2.12

Encourage the use of in-stream, in-line detention or in-stream, off-line retention (basin adjacent to low flow channel) where it can be demonstrated through engineering analyses that infiltration rates, and/or topography does not merit incorporating storm water retention facilities, and where reducing post-development peak discharges and runoff volumes to pre-development conditions

can be achieved. These storm water storage facilities inherently do not have water quality benefits for managing pollutants in storm water. Storm water quality best management practices will need to be employed in the watershed within or upstream of the receiving facility. Typically, the first flush from a runoff event will need to be retained and treated.

Biological Resources

The project area for Upper New River ADMP offers a unique biological resource and aesthetic character, and is rich in natural resources. The plan offers guidelines for future development in a comprehensive manner that strives to identify and integrate environmental features such as the existing biology, visual resources, watersheds and drainage patterns and cultural resources for the purpose of watershed and watercourse management.

Goal BR1 - Preserve sensitive habitats and wildlife corridors within the Upper New River ADMP project area.

Objective BR1.1 Preserve Natural Hydrological Process

The watercourses or washes are the most biologically diverse and ecologically significant component of the desert landscape. This objective envisions preserving the floodway (actual sandy wash from bank to bank), the definable 100-year floodplains, and sufficient buffers to allow wide enough corridors for wildlife movement and natural meandering of the watercourse to occur over time.

Policy BR 1.1.1

Encourage the use of erosion hazard set backs, floodplain delineations and buffers as flood control management methods. Flood protection methods such as erosion control setbacks and zoning regulations can, if fully implemented, provide for the preservation of habitats associated with ephemeral and/or perennial washes and streams. The retention of these areas will, in addition to providing flood protection, preserve wildlife habitat and movement corridors. Preservation of as many of these areas as possible will also serve to provide connectivity between various wildlife habitats and foraging and watering areas.

Objective BR1.2

Riparian vegetation habitats should be preserved along major wash areas to enhance bank stability, to decrease lateral erosion, and to maintain the existing sediment balance of streams.

Policy BR1.2.1

Recommend that vegetation and an adjacent buffer zone be preserved along major washes, including New River, Gavilan Peak Wash, Sweat Canyon, Doe Peak Wash, Deadman Wash and washes located within mountain and piedmont landform units.

Objective BR1.3

Flood control facilities and roadway drainage structures at wash crossings shall not affect wildlife movement negatively.

Policy BR1.3.1

Any structural alternatives considered should take the needs of wildlife into account. If the proposed facility will directly or indirectly negatively impact wildlife habitat or movement corridors, then the structures should be constructed to be more wildlife-friendly. Examples of negative impacts include, but are not limited to, steep drop structures that become a barrier to movement of wildlife in a wash or river corridor, concrete culverts that are undersized and have a non-natural floor material, and side-slopes on lined channels that are steeper than 3:1 (horizontal to vertical).

Policy BR1.3.2

Stock tanks provide valuable watering areas for wildlife and, if impacted, should be replaced with new stock tanks in areas where wildlife will use them.

Other applicable policies and guidelines for preservation of sensitive habitats, buffer areas adjacent to riparian corridors, preservation of significant stands of representative plant communities and revegetation of disturbed areas are presented in the Comprehensive Plan-Maricopa County Eye to the Future 2020 (1997), the City of Phoenix's General Plan (December 2001), and Sonoran Preserve Master Plan (1998), City of Peoria's General Plan (June 2001), Desert Lands Conservation Master Plan (August 1999), and the Loop 303 Specific Area Plan (December 2005).

Scenic Resources

The planning and design of flood control facilities to preserve the natural beauty of Sonoran Desert landscapes and protect local community character is a primary goal of the landscaping and aesthetic treatment policy of the Flood Control District of Maricopa County. The identification of landscape design themes based upon the character of the landscape is an important early step in the planning and design of flood control facilities to be context sensitive with the visual environments of Maricopa County. Landscape design themes identify the desired overall "look" for flood control projects for specific landscape settings.

Goal VC1 - Preserve the natural beauty of Sonoran Desert landscapes.

Objective VC1.1

Design of flood control facilities to be context sensitive. Design of facilities shall preserve, enhance and complement the beauty of the natural desert landscapes and character of local communities within the planning area.

Policy VC1.1.1

Encourage that storm water storage facilities be designed to appear in conformance with the natural contours and alignment of the terrain.

Policy VC1.1.2

Enhance the visual appearance of flood protection facilities by achieving context sensitivity with the surrounding landscapes.

Policy VC1.1.3

Where constructed, flood control facilities and side-slope stabilization measures should match the adjacent terrain in color and texture.

Policy VC1.1.4

The District's "Landscape Design Themes Handbook, Guidelines for Identification and Selection of Landscape Design Themes for Application to Flood Control Projects" shall be used for the identification and application of landscape design themes that will enable District flood control projects to become context sensitive with the landscape settings found in Maricopa County.

Objective VC1.2

Minimize the number of roadway wash crossings in order to prevent disrupting views up or down the watercourse.

Policy VC1.2.1

Where utility, trails, or roadway crossings are necessary, cross perpendicular to wash, at the narrowest point and/or at the point of least vegetation disturbance.

Policy VC1.2.2

Re-plant disturbed areas using existing native plant species types and densities that are consistent with natural conditions.

Other applicable policies and guidelines for preservation of scenic resources are presented in the Maricopa County's Comprehensive Plan-Maricopa County Eye to the Future 2020 (1997); Maricopa Association of Government's, Environmentally Sensitive Development Areas (ESDA) Plan adopted by MAG in June 2000; the City of Phoenix's General Plan (December 2001); Sonoran Preserve Master Plan (1998); North Black Canyon Overlay District and the Desert Overlay District; City of Peoria's General Plan (June 2001); Desert Lands Conservation Master Plan (August 1999); and the Loop 303 Specific Area Plan (December 2005).

Multiple-Use Opportunities

As an element of the Upper New River ADMP, a Recreational Resources Assessment (RRA) was conducted. The RRA serves to identify the regional and local recreational features within the study area. The assessment is conducted to enhance the public value of flood protection facilities by identifying potential opportunities for year-round recreation and open space linkages as an integral part of flood control facilities' design.

Planning efforts for multiple-use recreational facilities in the Upper New River ADMP shall include where merited the incorporation of guidelines and standards developed for the City of Phoenix's General Plan (December 2001), and Sonoran Preserve Master Plan (1998); City of Peoria's General Plan (June 2001), Trails Master Plan (January 1999), River Master Plan, (1999) and the Loop 303 Specific Area Plan (December 2005); and, Maricopa County's Parks and Recreation Department, Maricopa County Regional Trail System Plan (August, 16, 2004) or such future planning documents that supersede these mentioned above.

The following general goals are offered as opportunities to meet local community needs for recreation and open space. Specific objectives and policies are not developed as part of the Upper New River ADMP. Users of the Upper New River ADMP should consult with the appropriate jurisdiction concerning specific planning elements, design criteria, and standards for multiple-use recreational needs. Discussion concerning opportunities and constraints for multiple-use recreation, identified as part of the Upper New River ADMP, is located in the document "Upper New River ADMP, Alternatives Formulation Report, Attachment 5-Scenery and Recreation Resources Assessment Report."

Goal RR1 - Promote continuous trails and vistas of scenic areas along accessible washes.

Goal RR2 - Promote connectivity between possible wash corridor trail systems to the Black Canyon Trail, the county's Regional Trail System and to development, area destinations, and other shared-use recreational facilities.

Goal RR3 - Protect the integrity of washes while providing opportunities for recreation and the enjoyment of the natural environment and scenic areas.

Goal RR4 - Increase aesthetic and public value of flood protection facilities by designing them to incorporate opportunities for year-round recreation, open space linkages and multiple-use areas.

Cultural Resources

Our cultural resources inform us of prehistoric and historic cultures and cultural change through time. Maricopa County, the City of Phoenix and the City of Peoria recognize the importance of cultural resources and have adopted conservation and preservation policies that strive to protect our cultural resources. Applicable policies and guidelines for the identification, protection and conservation of cultural resources are presented in the City of Phoenix's General Plan (December 2001), City of Peoria's General Plan (June 2001), Comprehensive Plan-Maricopa County Eye to the Future 2020 (1997), and Maricopa County's Desert Spaces Plan (1995).

DESIGN/PLANNING GUIDELINES

The following design/planning guidelines are presented to aid designers and planners in their efforts. The guidelines are in part from and in addition to guidelines and criteria presented in the District's Drainage Policies and Standards for Maricopa County (February 7, 2007) and Floodplain Regulations for Maricopa County, City of Phoenix's Storm Water Policies and Standards (March, 2004), state standards developed by the Arizona Department of Water Resources and the City of Peoria Infrastructure Development Guidelines.

FLOOD HAZARDS

According to ARS 48-3609A and under the authority outlined in ARS 48-3605A, floodplain delineations for submittal to FEMA shall be conducted on all watercourses with drainage areas more than one-quarter of a square mile or having a 100-year estimated flow rate of more than 500 cfs. This minimum criteria is consistent with guidelines developed by Maricopa County, City of Phoenix and City of Peoria.

As part of a subdivision and/or drainage review, the County may require that non-FEMA floodplains be delineated for areas that have a watershed area of one-quarter of a square mile or a 100-year peak discharge of 50 cfs or more.

EROSION HAZARDS

In addition to establishing 100-year floodplain limits, erosion hazard zone delineations shall be conducted for structures that could fail or incur significant damage as a result of erosion or deposition; proposed structures that, if built, could result in adverse impacts to adjacent properties; watercourses that do not have erosion hazard zones approved by the District; watercourses within existing or proposed subdivisions, including residential and non-residential; watercourses identified by the District as having significant potential flood hazards; and watercourses with drainage areas equal to or greater than 30 acres or a 100-year peak discharge estimate of more than 50 cfs. Erosion hazard delineation shall be conducted at a minimum in conformance with State Standard for Watercourse System Sedimentation Balance (State Standard 5-96 or future updates to this document) guidelines.

Depending on the level of detail needed, State Standard 5-96 presents three levels of evaluation.

- Level I evaluation assumes that the results of the evaluation will be more conservative than results from a Level II or III evaluation. This assumption may be generally true, but may not be valid in areas of potential channel avulsion or lateral migration.
- Level II and Level III evaluations are technically more rigorous and the results may or may not indicate reduced erosion hazard zones relative to the results of a Level I evaluation. Caution should be used in interpreting and applying the results of a Level I evaluation.
- Watercourses characterized with wide, geologic floodplains, multiple or braided channels, highly erosive banks, poorly vegetated banks, and potential for channel avulsions should be evaluated at a higher level than Level I.

Areas located within the recommended erosion hazard zones developed as part of the Upper New River ADMP may be subject to increased risks to public safety that warrant specific development restrictions. Given the level of detail used to develop the recommended erosion hazard zones the developer/landowner is given the option of completing a more detailed erosion hazard zone evaluation.

EARTHEN DAMS (STOCK TANKS)

There are a number of stock tanks in the Upper New River ADMP study area. Stock tanks typically consist of a non-engineered earthen dam of varying height placed across a watercourse to impound storm water runoff. Vegetation typically lines the impoundment area. Should downstream areas become urbanized these earthen dams would present a hazard. The ADWR Dam Safety Section has legal jurisdiction over

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 the storage capacity or does not store more than 15 acre-feet regardless of height, it is not jurisdictional." Even though a structure may not be considered jurisdictional, all dams (embankments) in an urban environment are considered as having high hazard potential.

The structural integrity and safety of existing stock tanks shall be evaluated to access downstream impacts to existing or proposed development due to a dam break. Criteria for the design and evaluation of dams can be found in the book entitled "Design of Small Dams," third edition (1987, Bureau of Reclamation). A professional engineer registered under the laws of Arizona, and having proficiency in civil engineering as related to dam technology, shall conduct evaluation and/or design of an earthen structure.

RETENTION/DETENTION FACILITIES

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 when a detention only facility is allowed, the requirement to retain the 100-year, 2-hour runoff volume may be waived; however, the post-development peak discharge leaving the site cannot exceed pre-development conditions. In addition to the 100-year event, the effects of more frequent events (2- and 10-year events) of using a detention-only facility must be determined.

Standard Retention Practice

Guidelines for the standard practice of retaining the volume of runoff from the 100-year, 2-hour event can be found in "Drainage Regulations for Maricopa County, Maricopa County Drainage Design Manual Volume II-Hydraulics", City of Phoenix's Storm Water Policies and Standards and City of Peoria Infrastructure Development Guidelines.

In-stream, In-Line Detention Basins

In-stream, in-line detention basins are storm water peak reduction facilities, which could be employed with authorization from the reviewing agency, instead of the standard practices of retaining the volume of run-off from the 100-year, 2-hour event. The detention facility is typically located in a watercourse and functions only to reduce post-development peak discharges. The facility typically consists of an encroachment into the 100-year floodplain (possibly at a roadway crossing), an outlet structure sized to convey runoff from frequent events such that the natural form and function of the watercourse is not disturbed (sediment transport capabilities are maintained), and to impound runoff sufficiently, so that there is enough storage provided to reduce peak discharges. The following guidelines/consideration should be addressed in the design of such a facility:

- *Basin Outlet (Culvert).* The basin outlet structure should be sized to convey the 100-year existing (pre-development) condition peak discharge without disrupting the sediment transport capabilities of the channel for the 2-year and 10-year events. If the basin is to be located at a roadway crossing (collector and arterial roadways), then at a minimum the 100-year future (post development) condition water surface elevation must not be more than 0.5 feet above the minimum roadway elevation and flow from the 50-year future condition event must not overflow the roadway. Other design guidelines for culverts such as sediment deposition, scour holes and long-term degradation must also be considered and these guidelines are presented in subsequent sections.

- *Basin Volume.* The storage volume that is required to satisfy the discharge requirements stated above must consider the potential loss of storage due to sediment deposition. Sediment deposition could potentially impact the hydraulic operation of the basin ultimately effecting the maximum water surface elevation. The storage volume must also be checked in conjunction

with the embankment height in regard to the jurisdictional classification. Structures that meet jurisdictional dam classification requirements must be designed in conformance with ADWR requirements, and the design must be approved by ADWR. Jurisdictional classification is discussed previously in the earthen dam guideline section.

- *Drain Time.* The basin must be drained within 36 hours after the end of the design storm.
- *Downstream Impacts.* Hydrologic modeling shall be done to determine if the detainment of runoff or the increased runoff due to development worsens existing conditions. Modeling of multiple storm frequencies (at a minimum 2-, 10-, and 100-year events) may be required.

In-stream, in-line detention basins should not be considered for areas that are characterized by wide floodplains, significant conveyance in the overbank area or multiple channels.

The opportunity to enhance storm water quality is minimal for an in-stream, in-line detention basin and is not recommended for watersheds in which the land use is high density or the percent of impervious cover is greatly increased unless storm water quality concerns have been addressed within the watershed draining to the site.

In-stream, Off-line Retention Basin

In-stream, off-line retention basins are storm water storage basins that could be employed, with authorization from the reviewing agency, instead of the standard retention practice. In-stream, off-line retention basins function to reduce post development peak discharge and volume to pre-development values. Major elements of the facility are channelization and grade control structures to control the hydraulics of the flow; inlet works (typically a weir) to direct flow to the basin; low level outlet to drain the basin and a basin of sufficient volume to reduce peak discharges. The following guidelines/consideration should be addressed in the design of such a facility:

- *Modeling Software.* The current recommended modeling software is the U.S. Corps of Engineers HEC-RAS v3.0 using the unsteady flow module.
- *Flow Regime.* The flow regime in the watercourse at the lateral weir structure should be subcritical. This may require the channelization and/or construction of grade control structures. Design guidelines for channelization must also be considered and those guidelines are presented in following sections.
- *Grade Control Structures.* Grade control structures or drop structures may be required to control flow in the natural channel to subcritical flow conditions. The armored length of the structure should be sufficient to eliminate development of a scour hole downstream of the structure.
- *Lateral Weir.* The lateral weir must be sized such that the remaining peak flow and total runoff volume is equivalent to existing conditions for the design storm. The weir crest elevation must be sufficiently high enough to eliminate potential backwater conditions caused by the ponded water in the basin that would reduce the efficiency of the weir. The potential for scour at the downstream toe of the weir must be addressed. Sediment deposition within the channel at the toe of the weir could significantly alter the hydraulic operation of the weir and thus the basin. Sediment deposition at the toe of the weir must be regularly removed.
- *Drain Time.* The basin must be drained within 36 hours after the end of the design storm. To accomplish this, it may be necessary to provide a small bleed-off culvert. For this situation, the minimum practical culvert size should be used. Design guidelines for culverts must also be considered and those guidelines are presented in subsequent sections.

- *Basin Volume.* The storage volume that is required must consider the potential loss of storage due to sediment deposition. Sediment deposition could potentially impact the hydraulic operation of the basin ultimately effecting the maximum water surface elevation. The storage volume must also be checked in conjunction with the embankment height in regard to the jurisdictional classification. Structures that meet jurisdictional dam classification requirements must be designed in conformance with ADWR requirements, and the design must be approved by ADWR. Jurisdictional classification is discussed previously in the earthen dam guideline section.

- *Downstream Impacts.* Hydrologic modeling shall be done to validate that the detainment of runoff or the increased runoff due to development does not worsen existing conditions. Modeling of multiple storm frequencies (i.e. 2-yr., 10-yr., 100-yr.) may be required.

- *An in-stream, off-line retention basin* reduces peak discharge in a watercourse by capturing flow near the peak of the hydrograph and, therefore, offers minimal opportunities for enhancement of storm water quality. Storm water quality enhancement deals with managing flow at the beginning of the ascending limb of a hydrograph. Storm water quality concerns and best management practices shall be addressed/employed upstream of the facility.

Floodplain Encroachment

Where floodway fringe areas exist in the Upper New River ADMP study area, floodplain encroachment should be avoided except where it meets the low-impact criteria defined below. Encroachment that exceeds the low-impact criteria should be allowed only where it can be demonstrated that no long-term or short-term off-site impacts to channel stability occur, the encroachment is adequately protected from erosion and flooding, and a long-term maintenance and inspection program is adopted.

Low Impact Criteria

For the purposes of the Upper New River ADMP, a "low-impact" drainage facility is defined as any activity within the floodway fringe or erosion hazard zone that does not significantly alter the natural form and function of the watercourse. The following standards are proposed to quantify the definition of "low impact":

- Minimal velocity increase.
  - The average 10-year velocity in the channel or overbank should not change (± 0.0 fps).
  - The average 100-year velocity in the channel or overbank should not change (increase or decrease) by more than 10 percent or one foot per second (fps), whichever is less.
- Minimal water surface elevation increase.
  - The 10-year water surface elevation should not change (± 0.0 ft.).
  - The 100-year water surface elevation should not increase or decrease by more than 0.1 foot.
- Minimal disturbance of the main channel.
  - No decrease in the bankfull width of the main channel.
  - No excavation or deepening of the streambed in the main channel.

- No removal of bank vegetation. Where bank vegetation is temporarily disturbed by construction, it should be replaced, monitored for health, and irrigated, if required to enhance its survival.
- No relocation of the low-flow channel within the floodplain.

- No offsite impacts.
  - No erosion, sedimentation, or flood impacts to adjacent properties without written permission of affected property owners.
  - Engineering and geomorphic analysis required to demonstrate no long-term, short-term, or 100-year off-site impacts.
- Preservation of natural landscape character and habitat within the floodplain.

Alternatives that exceed the standards listed above are not considered low-impact alternatives. Such alternatives may be acceptable methods of mitigating flood and erosion hazards, if properly engineered and approved.

LEVEE/BANK ARMORING

A major watercourse element of the recommended alternative for New River and Sweat Canyon Washes are levees. Levees and bank armoring, when properly designed, constructed and maintained, provide a flood control facility that mitigates flood hazards, provides public safety and minimizes impacts to the natural desert environment. The following minimum guidelines should be addressed in the design of levee and bank armoring:

- Design Event. At a minimum, the 100-year peak discharge will be utilized as the design event for levee and bank protection design. A levee risk analysis and/or hydraulic evaluation for a greater event may be required. Designers shall contact the Flood Control District of Maricopa County for design/evaluation guidance.
- Design procedures that have been established by the U.S. Army Corps of Engineers (USACE Levee Design- EM110-2-1913) and FEMA (FEMA NFIP Regulations, Part 65.10) are generally accepted as sound engineering practice. The more stringent of the two documents should be used in the design of levees.
- Due to the Hurricane Katrina disaster, the federal government is in the process of revising levee design, inspection and maintenance criteria and there is a developing trend that levees should be treated with the same standard of care as dams. Engineers designing levees as part of a flood control plan should verify that the most current levee criteria are being used.
- A Failure Modes and Effects Analysis (FMEA) shall be conducted to evaluate levee design and to understand the sequence of events that potentially could lead to failure, the consequences of failure and to develop mitigation measures that would reduce risk. The analysis and mitigation measures should take into consideration the following:
  - Evaluation of multiple design events including the 100-year, SPF, PMF and 500-year events.
  - Land use in regard to minimizing impacts to the public should a failure occur.
  - Downstream hazard zones based on flow depths and velocities to define the consequence of levee failure.
  - Development of an Emergency Action Plan.

- Levee design features such as but not limited to height, top width, soils condition, embankment and foundation design.
- Loss of freeboard due to subsidence or collapsible soils.
- The need for erosion protection on the land-side of the levee as a safety factor incase of overtopping.

- Due to the dry Southwest climate, soil moisture content can be problematic leading to desiccation cracks in a levee system. The designer shall take into consideration the need of a central filter to mitigate potential cracking.
- The top of the levee embankment should be level so that flows are not concentrated at low areas, thus facilitating erosion and potential failure.
- Economic Life. The rate of subsidence should be analyzed to determine the economic life of the levee.
- Utility Crossings. Utility crossings of levee embankments should be treated the same way they are treated for dams. Use District guidelines for penetration of dams to design utility crossings. If the locations of future utility crossings are known, include utility conduits in the design of the levee.
- Topographic Mapping and Survey. Detailed topographic mapping and survey will be required for the design reach and shall extend upstream and downstream of the project for hydraulic analysis purposes.
- Hydraulic Analysis. The hydraulic models developed for planning purposes for the Upper New River ADMP recommended plan are based on available topographic information. New topographic data and hydraulic analysis will be required for detailed levee and bank protection design. In addition to new topographic data, Manning's roughness coefficients shall be revised to be consistent with existing channel form and vegetation densities. If resource vegetation enhancements are an element of the project, roughness coefficients shall be consistent with proposed enhancements.
- Alignment. Deviation from the proposed levee/bank armoring alignment is not encouraged, however the plan recognizes that there may be special conditions which merit alignment adjustment. Hydraulic analyses are required to demonstrate that the alignment adjustments do not have adverse impacts to flow and sediment conveyance, both upstream and downstream. Alignment may impact Jurisdictional Waters of the United States. Impacts to the jurisdictional waters of the United States shall be mitigated.
- Bank Armoring. The plan recommends dumped riprap for bank armoring. In lieu of providing armoring to the toe down depth, placement of launchable riprap at the toe in a trench is proposed for locations in which preservation of unique vegetation, scenic resource or wildlife habitat is desired. Design procedures for riprap armor can be found in "The WES Stream Investigation and Streambank Stabilization Handbook" (October 1997) and the District's Hydraulic Design Manual. From an operations and maintenance (O&M) perspective, gabion mattress type bank protection is not recommended as an erosion protection measure.
- Scour Calculations. Scour depths calculated for the Upper New River ADMP are for planning purposes only. Project specific total scour calculations based on new topographic, geotechnical and hydraulic data are required for all levee design. When a levee transitions to a bridge abutment, abutment scour shall be calculated.

- Levee Freeboard. The minimum levee height will be set at FEMA requirements or by a levee risk analysis, whichever is greater.

- Levee Internal Drainage. Design of levees will require a detailed evaluation and solution for offsite storm water runoff that will accumulate on the landward side of a levee. Provisions to discharge this storm water to the adjacent watercourse without adverse impacts to properties shall be made. Inlet drains for internal drainage should include flap gates. Penetration of drains through the levee should follow dam penetration guidelines.

- Levee Transitions. Design of levees will require transitions to existing and future structures and will need to provide "key ins" when transitioning to natural ground (when project design reach does not tie into an existing levee). Examples of structure transitions are:

  - At bridges

  - At tributary storm drains and channels

- Planning and Construction. Flood control management projects should be constructed in a manner that minimizes impacts to adjacent properties. In areas where there is a floodway fringe that can be removed by the implementation of a levee, the lateral extent of the levee shall extend the total length of the floodway fringe area. This may require multi-landowner and agency coordination.

- A 16′ wide O&M road shall be provided along the top of the levee. Access to the O&M road shall be at 1-mile intervals. As urbanization occurs access and turn-around locations to and along the levee system shall not be eliminated.

- A 4" to 6" thick layer of gravel mulch should be placed on the top of the embankment (O&M road) to facilitate maintenance vehicle access. The mulch can also be used on the landside of the levee to prevent erosion and rodent inhabitation.

- O&M access ramps from the landward side to the top of levee and from top of levee to the river-side shall be provided at one mile intervals and at the ends of the levee system. Maximum ramp slope shall be 6:1 (horizontal:vertical)

- O&M vehicle turn-out and turn-around points shall be provided per the owner/operators′ recommendation.

- Deep-rooted landscape vegetation shall not be planted in the no deep root zone. The zone is defined as the area from 15 feet away from the toe of slope on the river-side of the levee to 15 feet from the toe of slope on the landward side of the levee.

- From an O&M perspective, gabion mattress type bank protection is not recommended as an erosion protection measure.

- A maintenance plan shall be developed for all structural type improvements. The plan will document required maintenance to be provided by the owner/owners. The plan shall include the following discussions as applicable:

  - Type of facility.

  - Owner of facility.

  - Required maintenance activity.

  - Vegetation maintenance.

- Bank protection maintenance.
- Removal of debris and sediment from structures.
- Required permits for maintenance activity.
- Required inspection/monitoring activity.
- Schedule for inspection and monitoring activity.
- Required agency notification.

CHANNELIZATION

Channelization is defined as construction of an engineered channel with bank protection and grade control structures. Channelization is generally known to have the following impacts on natural channel stability:

- *Velocity.* Channelization generally increases channel velocities. Velocity is exponentially related to sediment transport rate and erosion potential.
- *Depth.* Channelization can increase the flow depth by eliminating the floodplain area available for conveyance. Increased depths result in greater scour depths and higher velocities.
- *Discharge.* Channelization eliminates the area available for storage of floodwaters on the floodplain, resulting in decreased attenuation and increased peak discharges downstream. Increased peak discharges are directly related to increased sediment transport rates and erosion.
- *Design Standard.* Engineered flood control channels are typically designed to a 100-year standard. Therefore, damage may occur to development adjacent to a 100-year channel (or to the channelization itself) if flow rates greater than the 100-year event occur. If design discharges change due to watershed changes or revisions to hydrologic modeling standards, retrofit solutions are required to maintain the same standard of protection.
- *Design Life.* Engineered structures have a limited design life, and require regular maintenance and inspection, and eventual replacement.
- *Equilibrium Slope.* Because of the increase in discharge, velocity, and depth, the stable slope is generally flatter than the existing channel slope, which will cause long-term scour and require grade control to prevent undercutting of bank protection.
- *Habitat.* Channelization typically eliminates most of the natural floodplain and stream bank habitat, and requires mitigation measures.
- *Sediment Supply.* Bank erosion is an important source of sediment supply for the streams in the study area. Construction of bank protection eliminates this source of sediment, increasing the likelihood of erosion of adjacent and downstream reaches.
- *Downstream Impacts.* Excessive instability should be expected at the outlet of a channelized reach due to the changes in velocity, sediment supply, and discharge. Depending on the channel geometry, the expected response can range from lateral erosion and scour to sediment deposition and overbank flooding.
- *Vegetation Management,* Channelization typically eliminates the natural vegetation, if the channel is not designed to accommodate vegetation to pre-construction densities vegetation management will be required.

Channelization, a structural flood control measure, is not recommended as a development alternative in the Upper New River ADMP study area. Channelization should be allowed only where it can be demonstrated that no long-term or short-term off-site impacts to channel stability occur, that downstream reaches are adequately protected from erosion and flooding, and a long-term maintenance and inspection program is adopted. Where structural flood control measures are necessary, the design and installation of such structures should complement the environment and be accomplished with the least disturbance to the natural setting. Design guidelines and standards for structural flood control improvements are provided in the District's Drainage Policies and Standards for Maricopa County (February 7, 2007) and Floodplain Regulations for Maricopa County, City of Phoenix's Storm Water Policies and Standards (March 2004), State Standards developed by the Arizona Department of Water Resources and the City of Peoria Infrastructure Development Guidelines.

Roadway Crossing Drainage Structures

At-Grade Crossings

"At-grade crossings" typically have only minimal or localized impacts on channel stability. More commonly, the streams impact the at-grade crossing, rather than vice versa. Flow over the at-grade crossing can cause erosion of the pavement and subgrade, deposition of sediment in the road section, and disruption of traffic flow. Channel stability impacts commonly observed near "at-grade crossings" include the following including recommendations for mitigation:

- A scour hole often forms on the downstream side of an "at-grade crossing" due to acceleration of flow over the hydraulically smooth pavement surface and increased turbulence as flow transitions back at the natural channel bed. In most cases, formation of a scour hole doesn't impact the stream reach away from the "at-grade crossing," however the development of a scour hole could undermine the "at-grade crossing," leading to failure of the facility. Upstream and downstream cut-off walls shall be designed for at grade crossings.

- An "at-grade crossing" of a watercourse reach which is experiencing degradation will ultimately function as a grade control structure. Until equilibrium is achieved, degradation will continue increasing the drop immediately downstream of the "at-grade crossing." Long term degradation shall be considered in determining the depth of cut-off walls.

- Because of hydrologic and hydraulic conditions that could occur at an "at-grade crossing" that impacts public safety the need for a warning device that warns the public to proceed with caution or not to cross at all should be investigated.

If the "at-grade crossing" is constructed at an elevation slightly above the natural channel bed, deposition will occur upstream of the crossing. Deposition leads to expansion of the floodplain, and may increase the risk of avulsions and accelerate formation of the downstream scour hole. The minimum elevation of an "at-grade crossing" shall not be higher than the existing channel invert.

"At-grade crossing" is not a recommended watercourse/roadway crossing in the City of Peoria.

Culverts

The design of culvert structures takes into consideration public safety, long-term function and maintenance, and impacts to the natural channel form and function. Typically, the impact of culvert crossings on a watercourse system is primarily a function of their size in relationship to design discharge, natural channel and floodplain morphology, clogging potential, sediment transport capacity and scour potential.

Undersized (relative to natural channel and floodplain geometry) culverts and culverts that create headwater ponding can have detrimental impacts to both upstream and downstream properties. The impacts of undersized culverts on channel stability include the following:

- *Sediment Deposition.* Much of the stream's sediment load will be deposited in the headwater pool at the culvert inlet. The volume of sediment deposited depends on the culvert capacity relative to the discharge, the duration of the ponding condition, the geometry of the ponding area, and the size of the sediment in transport. Sediment deposition decreases channel (and culvert) capacity, increases the potential for overbank flooding and avulsions, and requires maintenance to restore natural conditions. Culvert rise (height) at a minimum should be as high as the average main channel bank height. In the event of width and height limitations due to natural conditions and the structure does not convey the design event, increasing the height dimension or providing relief culvert structures in the overbank areas should be considered before increasing the width. Culverts that do not obstruct the main channel will have less frequent impacts on channel stability.

- *Floodplain Encroachment.* A culvert is a form of floodplain encroachment, with the same types of encroachment impacts described in the floodplain encroachment discussion above.

- *Scour Hole.* A scour hole may form at the culvert outlet due to accelerated velocity through the culvert, discharge of sediment-deprived water, and turbulence at the culvert/natural channel interface. Design of culvert structures shall include an evaluation of the scour potential at the outlet of the structure and provisions for channel protection at the outlet shall be provided.

- *Long-term Degradation.* Where a significant percentage of the sediment load is deposited upstream of a culvert due to headwater ponding, discharge of clear water may result in degradation downstream until the channel slope adjusts to the new sediment supply. Culverts shall be designed so that the disruptions to the natural sediment transport capabilities of the wash are minimized.

Oversized (relative to natural channel and floodplain geometry) culvert structures, which increase the width of the natural channel in order to minimize the height or depth of ponding, can also have detrimental impacts to both upstream and downstream properties.

The impacts of oversized culverts on channel stability include the following:

- *Long-term Aggradation.* Increasing the natural width of a channel to accommodate a culvert structure would change the sediment transport capacity of the channel. During frequent events or events lesser than the design capacity of the culvert structure sediment would be deposited in the section of channel that has been widened. Accumulation of sediment would decrease both the capacity of the channel and the capacity of the structure ultimately resulting in flooding impacts to adjacent properties. Culvert span (width) should be as wide as the main channel (top of left bank to top of right bank) where channels are well defined. Culverts that do not obstruct the main channel will have less frequent impacts on channel stability than culverts that block the main channel.

Bridges

Bridges that span the floodplain typically have no measurable impact on channel stability. Bridges with narrow openings are functionally like a culvert, and have the impacts on channel stability described above.

Based on their likely impacts on channel stability, the following guidelines for roadway crossing design are recommended for watercourses in the Upper New River ADMP study area:

- Bridges are preferable to culverts. Bridges typically have less impact on channel stability than culverts due to the wider opening and decreased likelihood of headwater ponding.

- Bridge span (width) at a minimum should be as wide as the channel or floodway limits, preferably as wide as the floodplain or erosion hazard zone where channels are well defined. Bridges that do not obstruct the main channel will have less frequent impacts on channel stability than culverts that block the main channel.

- Where braided or multiple channels exist, relief structures outside of the main channel should be provided to maintain overbank flow paths, preserve overbank conveyance, and prevent floodplain sedimentation, instead of widening one of the multiple channels to provide conveyance of the design event at one location.

- Bridge crossings should be regularly maintained and inspected to identify potential problems and impacts to channel stability, and to assure structure performance.

- The need for erosion protection should be evaluated at all bridge crossings of watercourses.

Utility Crossings

Utility crossings, if properly constructed, have no inherent impact on channel stability since they are typically buried beneath the channel or extended overhead. Direct impacts on channel stability can occur during utility construction due to disturbance of bank and floodplain vegetation. Where vegetation is removed, the underlying soils are more vulnerable to erosion and scour. If floods occur before the vegetation is re-established, erosion of the construction alignment may occur and initiate erosion of adjacent channel reaches.

The following guidelines for utility construction in the floodplain and erosion hazard zone are recommended:

- Bank and floodplain vegetation removed or damaged during construction should be replaced immediately. Irrigation, inspection, and maintenance may be required to assure survival of the replacement vegetation.

- Underground utilities should be buried below the 100-year general scour depth in the main channel plus the long-term scour depth. Utility lines have been damaged due to exposure by long-term scour on numerous streams in Arizona.

- Where the potential for lateral movement exists, underground utilities should be buried at the same depth in the overbank areas or erosion hazard zone as in the main channel, to prevent exposure after movement of the main channel.

- Support structures for overhead utilities should not be located within the floodplain or erosion hazard zone. Where the length of the span requires that support structures be constructed within the floodplain or erosion hazard zone, the structures should be designed using the 100-year general scour plus long-term scour in the main channel burial depth. No structures should be placed in the main channel.

Landscape Design Theme and Aesthetic Design Guidelines

Recommended Alternative (Watercourses)

Aesthetic guidelines are developed as a tool to be used by planners and designers to incorporate aesthetic quality into their design that is sensitive and consistent with the natural environment. As part of the Upper New River ADMP, landscape character themes are developed for the Recommended Alternative. Landscape design and guidelines developed for the ADMP are located in Appendix A

Recommended Alternative (Planning Area-Wide)

The planning and design of flood control facilities to preserve the natural beauty of Sonoran Desert landscapes and protect local community character is a primary goal of the landscaping and aesthetic treatment policy of the Flood Control District of Maricopa County. The identification of landscape design themes based upon the character of the landscape is an important early step in the planning and design of flood control facilities to be context sensitive with the visual environments of Maricopa County. Landscape design themes identify the desired overall "look" for flood control projects for specific landscape settings.

The District's "Landscape Design Themes Handbook, Guidelines for Identification and Selection of Landscape Design Themes for Application to Flood Control Projects" shall be used for the identification and application of landscape design themes that will enable District flood control projects to become context sensitive with the landscape settings found in Maricopa County.

Biological Considerations and Design Guidelines

Special Status Species Recommendations

- Though most of the study area does not contain suitable habitat for wading and shore birds, areas adjacent to the numerous stock tanks serve as foraging areas. Impacts to foraging areas should be mitigated.
- Occupied caves and mines should be protected, and openings should be secured with suitable fencing to allow bats ingress and egress while providing public safety. Though no mines and caves have been located in the study area, a more complete survey of rock outcropping areas should be conducted to determine whether mines or caves are present and whether they are being used. It is unlikely, however, that caves are present due to the relatively flat terrain and lack of cliffs. The only areas that may contain caves are the hills at the southern end of the study area near the CAP canal and the hills just north of the AGFD Ben Avery Shooting Facility.
- Desert tortoise surveys of suitable habitat in the study area should be conducted prior to disturbance.
- Though no crested saguaros were located in the study area during the surveys, specimens located during the course of future development should be avoided or salvaged carefully.
- Though no Hohokam agave were located in the study area during the surveys, specimens located during the course of future development should be avoided or salvaged carefully.

General Wildlife Habitat Recommendations

The xeroriparian washes in the study area are more densely vegetated than the uplands and provide a higher quality of habitat for wildlife than the somewhat monotypical uplands. Xeroriparian areas, on average, have greater availability of surface and subsurface water than areas not associated with washes. As a result, xeroriparian washes, including the New River corridor in the entire project area, tend to have a higher density and diversity of vegetation and often larger individuals of a particular plant species than adjacent upland areas. This higher density and diversity of trees and shrubs, as well as larger individuals of the species present along xeroriparian washes, provides more resources for wildlife than adjacent upland areas. Resources for wildlife commonly associated with the xeric riparian plant communities supported by these washes include cover, food, nesting substrates, denning areas, and movement corridors. For example, enhanced cover along these washes provides opportunities for movement by larger mammals, such as mule deer, javelina, and coyote, and habitat for smaller mammals, passerine birds, and reptiles.

- The larger, more densely vegetated washes should be preserved not only for their habitat values but for the connectivity they provide throughout the project area. The New River serves as a valuable wildlife corridor for wildlife of all sizes, and any structural solution considered

should take this function and value into account in the construction and maintenance of such structures.

- Catchments are valuable to all species of wildlife that inhabit this area and, if they are negatively impacted either directly through destruction resulting from home or road construction or indirectly by encroaching development, should be relocated to an area that will be preserved.
- Stock tanks provide valuable watering areas for wildlife and, if impacted, should be replaced with new stock tanks in areas where wildlife will use them.
- Any structural alternatives considered should take the needs of wildlife into account. If the alternative will directly or indirectly negatively impact wildlife habitat or movement corridors, then the structures should be constructed to be more wildlife friendly. Examples of negative impacts include, but are not limited to, steep drop structures that become a barrier to movement of wildlife in a wash or river corridor, concrete culverts that are undersized and have a non-natural floor material, and side slopes on lined channels that are steeper than 3:1 (horizontal to vertical).
- Recommended flood control alternatives may have affects on wildlife, wildlife movement, and associated habitats in different ways. Methodologies and/or design specifications can be employed that not only minimize adverse effects of a particular alternative on wildlife but may enhance the alternative. Enhancements to the methodologies of employing the alternative or designing and maintaining the alternative may provide additional habitat, movement cover, and/or foraging and watering opportunities. The following sections provide recommendations to enhance each of the recommended alternatives.

Alternative Specific Recommendations

Non-structural

This type of alternative may provide enhancement possibilities for wildlife if ADMP guidelines are followed and perhaps new wildlife enhancement guidelines are added to current guidelines. Flood protection methods such as erosion control setbacks and zoning regulations can, if fully implemented, provide for the preservation of habitats associated with ephemeral and/or perennial washes and streams. The retention of these areas will, in addition to providing flood protection, preserve wildlife habitat and movement corridors. Preservation of as many of these areas as possible will also serve to provide connectivity between various wildlife habitats and foraging and watering areas.

Structural (with landscape aesthetic treatment)

Of the alternatives recommended for this ADMP, the alternatives with levee elements have the greatest potential for negative impacts to wildlife movement and habitats and the greatest potential for enhancement.

The vegetative community affected by levee element will be the Lower Colorado River and the Arizona Upland subdivisions of the Sonoran Desert scrub biome. The vegetation that will be affected consists of creosote bush, triangle leaf bursage, and various species of cholla, including teddy bear, chain fruit, buckhorn, and staghorn. Other species which will be affected as the structures impact areas within or adjacent to the wash corridors include blue paloverde, foothill paloverde, western honey mesquite, velvet mesquite, and ironwood.

Based on the current proposed levee alignments, it appears that the Sweat Canyon levee will have the least effect on the wash corridor species since the alignment appears to traverse upland areas that are devoid of major wash corridors. All of the other alignments have some impact on these species due to

their potential impact on various wash corridors or braids of the New River. The following considerations should be taken into account in the design of flood control management alternatives:

- Channels
  - The main function of channels is to convey flows as efficiently as possible during normal and peak events. This function can at times be at odds with the preservation and/or enhancement of wildlife habitat and movement corridors. For channels and associated buffer areas to be viable as wildlife habitat or a movement corridor, areas of contiguous dense cover must be retained in the channel. Depending on the species and density of vegetation, flow conveyance may be negatively affected by increasing resistance, slowing flow rates and increasing the amount of sediment drop.
  - If a sufficient low-flow channel can be maintained, preferably centered on the channel corridor, escape cover should be provided on both sides.
  - Low-flow channels should be centered to provide habitat and escape cover on both sides of the channel (watering area).
  - If the entire channel width is not adequate to convey peak flows while retaining tree and shrub vegetation, vegetation with a lower Manning's roughness coefficient, such as native grasses and forbs, should be allowed to flourish.
  - Unless channel areas are used for active recreation, such as for athletic fields, they should not be denuded of vegetation by mowing. This not only eliminates the majority of habitat but can result in the destruction of nests of ground-nesting birds and the collapse of animal dens.
- Levees
  - Levees, if not constructed with wildlife in mind, can create localized habitat fragmentation and be an impediment to wildlife movement.
  - Finished levee slopes should be less than 4:1 side slopes.
  - Levees and other structures should not have perimeter fencing. If specific areas need to be protected, fencing use should be limited.
  - If fencing is absolutely necessary, it should be wildlife fencing that allows for wildlife movement while still providing exclusionary benefits.
  - Uncovered riprap should not be used on the face of the levees. This creates a hazardous walking substrate for some wildlife species.
  - Runoff from the faces of the levees could provide temporary watering sites for wildlife if the water was funneled into gravity-fed guzzlers. The levee faces could serve as the runoff apron similar to the aprons for created wildlife guzzlers. Gravity-fed guzzlers could be placed periodically along the inside face of a levee in areas that would be least affected by scour during a high river flow event. Locations that have pockets of dense vegetation should be chosen for the guzzler location, and the above ground or underground storage tank could be placed downstream and adjacent to the vegetation, which would provide natural protection against scour if it occurred.
  - Guzzlers could be placed on the protected side (opposite side of the river) of the levee but in an area where natural vegetation provides cover. Otherwise, enhanced vegetation should be planted (i.e., tall pot plantings).

- Artificial burrows for western burrowing owls could be placed in the faces of the levees at various locations to prevent future degradation of the integrity of the structure from naturally created burrows. Encouraging occupation by burrowing owls would assist in protecting the structure from burrowing rodents.

■ Grade Control Structures and Associated Erosion Protection

- If riprap erosion control is used in areas where mule deer or javelina may be found, the gaps between the riprap should be filled with concrete or other scour-resistant substance. Hooved species try to avoid areas of riprap due to the possibility of leg or ankle breakage. However, if the riprap spans the width of the wash or channel, it becomes an impediment to movement or a hazard for these species.

- If drop structures are needed to control channel grade, they should not extend from channel bank to channel bank. Most drop structures are too high to allow unimpeded movement of all types of wildlife, especially small or immature mammals and reptiles and amphibians. A travel corridor(possibly a ramp incorporated into the drop structure) should be provided that will allow wildlife to use the channel for movement.

- If possible, perhaps drop structures and/or energy dissipaters could be constructed of natural materials, such as large boulders secured in place instead of concrete structures.

■ General Environmental Considerations

- Communities should consider adopting a riparian habitat protection ordinance similar to Pima County.

- Communities should develop an implementation handbook that would outline mitigation standards and guidelines, similar to the one adopted in Pima County.

- As properties are bought out as part of the FPAP program, a site-specific analysis should be done to assess how the property could be best reintegrated into the natural environment and enhanced if necessary.

- The area that was revegetated after being used as a material source to construct the New Waddell Dam may provide an enhancement opportunity. Though revegetation was attempted, much of the vegetation has either failed to become established, has died, or was eaten by cattle or feral burros before it could mature. If irrigation water was not available or was impractical, this area may be an excellent candidate for tall-pot-type plantings so that supplemental watering is not necessary.

- During construction activities, the first 24" of soil should be salvaged, stockpiled and reused (e.g. as soil on top of riprap) on the structures. This helps preserve the native seed bank in the soil and therefore, helps revegetation efforts.

- One constraint when considering restoration/enhancement opportunities in the project area is that active cattle grazing leases exist in the project area. As long as these are active, the stock tank areas need to remain open for cattle. Another constraint is that numerous herds of feral burros are in and adjacent to the Lake Pleasant area and the Agua Fria and New River corridors. These species are extremely non-selective in their grazing habits, are prolific, and have only one natural predator--mountain lions--which are rare in the central and southern portions of the project area.

- Newly planted vegetation would need to be protected from cattle and feral burro grazing with exclusionary fencing to allow it to mature. However, as long as there are active grazing leases in the area, the stock tanks, which were most likely built by a rancher, would

have to remain open for cattle. Though feral burros do not belong in the natural landscape and compete with native wildlife for forage, many animal rights groups aggressively protect the right of the burros to exist on open range. It is possible, however, to allow cattle, burros, and wildlife access to water while protecting newly planted vegetation. Exclusionary fencing of some type could be installed around the newly enhanced areas, with a separately defined corridor that would allow access to water. These types of arrangements, however, would have to be negotiated with the lessee.

- The main sources of degradation in the area would need to be controlled. These are wildcat dumping, shooting, and off-highway vehicle use. Due to the numerous public access points, restricting access on a large scale may be impossible. Public access restrictions would need to be focused on restoration areas such as the stock tanks. Pole fencing, as opposed to traditional wire fencing, may need to be employed in these areas to prevent public access while protecting the restored areas.

IMPLEMENTATION AND FUNDING STRATEGIES

The implementation and funding strategy is developed as part of the ADMP to assure that needed future actions for implementation are considered in the planning effort. Extensive non-structural and structural development activities have been proposed in the Recommended Alternative. Public safety improvements in the form of levees, grade control, bridges, culvert construction/replacement, and ongoing maintenance of existing and future improvements are proposed. Millions of dollars of benefit in reclaimed floodplain property are expected to be realized from these improvements. Several recreation opportunities in the form of trails and trail amenity projects will be coordinated with flood control improvements. Habitat preservation will focus on maintaining wildlife corridors along drainage corridors.

Although no specific schedules are proposed at this time for the wide ranging activities, some are implied to permit appropriate staging of projects. In this implementation and funding strategy some general guidelines are proposed for scheduling to accommodate appropriate planning, permitting, staging and funding of projects. Implementation and funding strategies incorporate key proposals for four differing elements as follows:

- Community Outreach

  The overall project will require a continued public and community outreach strategy through planning and implementation stages, to engage political, development, environmental, community and other interest groups in this rapidly developing area of the county and cities of Peoria and Phoenix. The implementation strategy for outreach emphasizes education, input, participation, and funding support for the various proposed programs in the ADMP.

- Program and Policies

  Programs and policies in the implementation strategy include adoption of the ADMP by local governments as guidance for future public and private development activity. Public activities proposed include locating facilities such as drainage and transportation improvements in conformity with the ADMP. Site development considerations such as location of commercial and residential facilities related to private development should be recommended in accordance with ADMP requirements. Necessary action by the Cities of Peoria and Phoenix as well as Maricopa County include adoption or conformance to the ADMP's Design Guidelines. Additional strengthening of the implementation strategy includes incorporation of the Recommended Alternative in the cities General plans, as well as any area specific plans or parks plans.

- Regulatory Compliance

  Compliance with various laws and ordinances are implied as part of a successful implementation strategy for the ADMP. These include federal laws such as the Endangered Species Act (ESA), the Clean Water Act (Section 404 permitting) and the National Environmental Policy Act (NEPA). Responding to state regulations such as the Arizona Pollutant Discharge Elimination System program (AZPDES) and local floodplain and zoning ordinances will also be required. Proposed public and private activities must comply with these regulations, and while they impose constraints on certain activities, they also present opportunities for implementation. As an example, mitigation of disturbance to waters of the US is often required as part of a 404 permit. Areas identified as non-structural reaches of the Recommended Alternative could be purchased in their natural condition by a developer or public agency satisfying their 404 permit and the mitigation area could be donated to an appropriate government or land trust agency. Dedication of non-structural reaches as open space through development agreements is feasible and should continue to be utilized as the area develops.

- Funding Opportunities

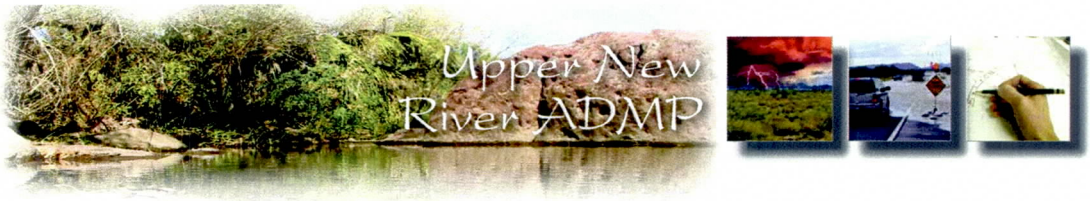
  Funding for activities proposed in the Area Drainage Master Plan is a critical aspect of the implementation strategy and will occur over the next few decades. The various alternatives will require differing programs and selective funding from multiple sources. Funding consideration may be separated into flood control activities and multi-purpose enhancement activities and will draw on both public and private sources. Examples of how flood control facilities can be built using public funding include use of Flood Control District tax revenues and bond funding from local governments as budgeted in annual Capital Improvement Programs. In addition, cost share programs with state, local and private agencies such as the Arizona State Land Department and private developers can be utilized. An example might be to utilize Developer, District, and City of Phoenix funds to construct a portion of the Recommended Alternative utilizing an easement from the Arizona State Land Department (ASLD). An example of how both flood control and recreation enhancements can be built exclusively by private funding includes construction of facilities by private developers as part of their project infrastructure and open space set-asides as required by local ordinances.

A Funding Strategy for the Recommended Alternative

The Recommended Alternative presents multiple activities for responding to the vision articulated for the ADMP. Significant funding capability will be necessary over a 2-20 -year period to effectively implement all the proposed projects in the Recommended Alternative. A funding strategy and follow up funding program will greatly assist the effort.

Funding of activities is proposed to address issues, opportunities and concerns identified by stakeholders in the public and stakeholder involvement process, including the need for:

- Flood control and property protection,
- Multi-use programs,
- Environmental protection/management of flora and fauna, cultural, and physical resources,
- Incorporation of established existing uses, and
- Expanded recreation programs.



Defining Approaches to the Funding Strategy

Funding the ADMP should and does involve the broadest cross section of interests and affected partners in outreach development and planning. Many of the same parties that have involvement with other previous District ADMPs are being engaged, informed and approached for funding support of the UNRADMP.An effective funding strategy for this type of project requires support from partners who are not funding entities, as well as those who are approached for funding. A developmental funding package for this size of project involves collaboration and partnerships with diverse federal/state/local entities because of broad objectives sought, and also because of the diverse interests within the watershed.

A funding strategy for implementing and maintaining the project must embrace fully all the above diverse groups across an extended time horizon. It must also present a logical approach for identifying viable funding entities and potential partnerships. Following are elements of the strategy proposed for funding the ADMP.

- Define activities included in the Recommended Alternative requiring funding support across a 2-20 plus-year time line.
- Identify potential funding entities/sources that traditionally fund projects or project components in the Recommended Alternative.

Planning, implementation and funding was initiated in year one by the Flood Control District of Maricopa County (District) in developing the ADMP. In the second year the ADMP has been finished. In the third year programming of certain high priority projects may begin at the Capital Improvement Program level. Also in year three formal adoption of the ADMP by the District and the cities should occur. After that adoption in years four thru twenty many of the components should be implemented by both public and private sector developers.

The schedule for most of the ADMP RA individual site implementation will be determined based upon private sector growth in the planning area. This schedule will directly impact and be impacted by the disposition of State Trust Lands for much of the planning area; particularly in the City of Phoenix.

Identifying Funding

Funding opportunities for the ADMP exist at the city, county and state levels of government, as well as among local private landowners and developers. Funding opportunities of a project are often defined by the components of the overall program, and the ability to establish partnerships for the components.

The ADMP Funding Opportunity Spectrum

The following areas of project activity briefly capture the ADMP Funding Opportunity Spectrum.

- Flood control, health and safety, property protection
- Environmental preservation
- Recreation enhancement, recreation development
- Multiple use protection/enhancement/development

In selected funding venues, several of these areas can be grouped, but parts of each will remain to form these clearly separate categories. Each area will spawn multiple project activities in the plan. The multiple activities/projects associated with each have identifiable funding venues from various divisions of government and areas in the private sector.

Specifying Funding Needs for ADMP Implementation

The ADMP has funding needs in several key areas over a 20-year development period. The areas and expected annual costs are as follows:

- Coordination and management of ADMP implementation
- Support for a funding program
- Funding to support ADMP project activities
- Funds to support project maintenance

Managing ADMP Implementation

No costs are proposed to support ADMP implementation except those already incurred by staff at the District and the cities.

Annual Maintenance Costs

Maintenance must be assured for any Structural components of the Recommended Alternative. These costs will be refined in later stages of implementation and these costs along with the entities that support them should be specified in detailed funding plans.

Potential Funding Entities of the Public and Private Sector

Due to the size of the projects funds to support the broad-based activities proposed for the ADMP are generally not sought from one entity, but from multiple public and private entities. And, most often funding is staged across time, with large multi-year investments for infrastructure or resource base changes obtained in the first phase(s). This would include investments in flood control structures or improvement in specific wildlife or multi-purpose enhancements. Activities such as recreation facilities and community enhancements are included in the construction phase of the entire Recommended Alternative.

Potential Funding Sources

Many of the proposed ADMP activities are designed to have benefits to natural resources in general, as well as to the developing local communities and the public at large. As such benefits from individual projects may justify expenditures of state and local public funds as well as private funds in addition to flood control needs. The following general sources of funds are most appropriate for many of the ADMP activities.

- Cities of Peoria and Phoenix Development Impact Fees. The results of the ADMP will be made available to the cities as a guideline for anticipated implementation costs. Impact fees can be used for applicable capital costs but are not allowed to be used for maintenance costs per Arizona statute
- Many of the improvements that are identified in the Recommended Alternative are on land that is currently owned by the Arizona State Land Department (ASLD). Currently the typical method to secure the ability to construct improvements on ASLD land is to apply for purchase of the land or for an easement for the construction of facilities. ASLD has been involved as a stakeholder since the beginning of the ADMP and is currently conducting Preliminary Planning Studies of many of the lands in the ADMP. There exists a possibility that if improvements are needed prior to disposition of ASLD lands that will benefit non ASLD as well as ASLD lands, dedication of those lands needed for construction could occur.

- The District has funded the ADMP and has the ability to fund further DCR's and design plans for portions of the implementation of the ADMP. In addition there may be several component pieces of the ADMP that the District has the ability to fund as part of its Capital Improvement Program (CIP) such as improvements in the New River Area. There is also the possibility that the District could cost-share on other specific projects as further site specific benefit analysis and cost-share opportunities are developed.

- There will most likely be many large private sector Master Planned Communities that will be built and planned within the ADMP. Most if not all of these developments will utilize and benefit from the regional flood control system identified in the Recommended Alternative of the ADMP. Private sector funding contributions to implementation can vary from dedication of necessary easements, to cost-sharing of improvements that benefit not only that development but also the region, to solely funding components that benefit them exclusively. Another nuance of developer funding is the possibility that the developer could build a portion of the Recommended Alternative and be reimbursed some of those costs as other up and downstream users who benefit from those improvements come online.

- Multiple Community Facility Districts are also a possibility in the incorporated areas due to the physical size of the area and the significant costs involved. These Districts would be formed as development was occurring to pay for the needed infrastructure including flood and drainage components.

Funding Summary

The capital and maintenance costs identified to implement the comprehensive flood control system identified in the Upper New River ADMP will be significant. The costs will be considerable due to the sheer size of the area being planned (approximately 97 square miles) and the type and size of facilities needed. The recommendation to utilize private sector contributions, city and county impact fees and Flood Control District of Maricopa County CIP when applicable is the most likely funding scenario. The issue of maintenance responsibilities will also need to be addressed for the structural components of the Recommended Alternative.

Implementing Summary

The Recommended Alternative for this project is comprised of structural and non-structural solutions at various locations. These locations are distributed throughout the project area and include construction and non-construction activities that will ultimately be funded in one of three ways:

- Funded solely or in partnership among private and/or public agencies not including the District.

- Solely funded by the District.

- Funded solely or in partnership among private and/or public agencies including the District.

The Recommended Alternative was developed after extensive technical review of the drainage, infrastructure and land use conditions in the project area. Significant effort was also put forth by the project team to involve the general public, as well as public and private sector stakeholders, in development of the Recommended Alternatives. Included within the ADMP Report is documentation of the public and stakeholder activities and responses. The stakeholder effort was designed and carried out as to maximize development of a Recommended Alternatives that could be implemented as efficiently and cost-effectively as possible. Following is a summary of the key opportunities and constraints for implementation of the Recommended Alternatives.

RECOMMENDED ALTERNATIVE OPPORTUNITIES AND CONSTRAINTS

The Recommended Alternatives is organized into the 10 regions of the project with specific sites in each region. The Regions (in capital letters) and primary sites/problems addressed by the Recommended Alternative within each Region are as follows:

GAVILAN PEAK

- Residential structures in the Floodplain and Floodway

NEW RIVER UPSTREAM OF I-17

- Residential structures within Floodplain and Erosion Hazard Zones
- Road access issues and dip crossing at Old Stage Road and the New River

NEW RIVER DOWNSTREAM OF I-17

- Flow break out at three different locations:
  - Along the west bank of New River at the West Split located approximately three and half miles downstream of I-17. Flow draining to the West Split ultimately combines with flow from Sweat Canyon.
  - Along the east bank of New River approximately 2 miles upstream of SR 74
  - Along the east bank of Sweat Canyon approximately one mile downstream of New River Road
- Distributive flow area just upstream of SR 74:
  - Invert of New River channel at the west bridge is approximately 10 feet lower than the invert at the east bridge. The east channel will have a tendency to laterally migrate to the west, resulting in changes to flow quantity, depth and velocities.
  - The area upstream of the east bridges is mapped by FEMA as the East Split. Flow paths in the area between the East Split and New River are complex and not easily defined.
- Flooding at roadway/wash crossings:
  - Sweat Canyon Wash at New River Road

LOWER DEADMAN WASH

- SR 74 is used by the public for ingress and egress to the area. The roadway includes one 48" culvert crossing, which does not have the capacity to carry flood flows. Flood flows currently cross over SR 74 in depths greater than one foot, posing a hazard to the public and emergency vehicles.

LONE MOUNTAIN, UPPER DEADMAN, NEW RIVER DAM, ROCK SPRINGS, SWEAT CANYON & WEST TRIBUTARIES

- Undefined 100-year floodplains throughout these planning areas.
- Flooding at roadway dip sections and culvert wash crossings with insufficient capacity to convey the 100-year flow.

UNMAPPED FLOODPLAINS

- Identification of flood hazards in locations that are not currently mapped.

A narrative of opportunities and constraints for each of the sites contained within the Recommended Alternative follows.

GAVILAN PEAK

Twenty-eight properties have a primary residence structure located within the floodplain. Three of these structures are located within the floodway. Twenty-four of these are located along Gavilan Peak Wash, downstream of New River Road, and two of those 24 are located in the floodway.

One of the recommended alternatives for this area was to develop a culvert maintenance/improvement plan that could be used by MCDOT. Another Recommended Alternative chosen for this planning area was to utilize the District's voluntary Floodprone Properties Assistance Program (FPAP). The FPAP is available county-wide for residences living in a FEMA adopted or pending floodplain. This program considers property acquisition and floodproofing. Funding for the FPAP is evaluated on an annual basis and acquisition is subject to funding availability. This planning area is in unincorporated county and no unusual permitting or regulatory requirements are anticipated. There was no negative feedback from the public regarding this component of the Recommended Alternative. The District will be the lead agency for implementation of this alternative and the residents themselves will be responsible for pursuing the FPAP if funding is available. Typical time lines for FPAP are from one to three years from date of application assuming funding availability and program acceptance. Probable construction costs for the FPAP are estimated to be $6.7 million. This estimated cost is based on acquiring all 24 of the properties in the 100-year floodplain.

NEW RIVER UPSTREAM OF I-17

The Recommended Alternative chosen for this planning area was to utilize the District's voluntary Floodprone Properties Assistance Program (FPAP) and evaluating the feasibility of a low water crossing warning device at New River and Old Stage Road. This planning area is unincorporated county and no unusual permitting or regulatory requirements are anticipated. There was no negative feedback from the public regarding this component of the Recommended Alternative. The District will be the lead agency for implementation of this alternative and the residents themselves will be responsible for pursuing the FPAP if funding is available. Typical time lines for FPAP are from one to three years from date of application assuming funding availability and program acceptance. Probable construction costs for the FPAP are estimated to be $3.5 million. This estimated cost is based on acquiring all 16 properties that are in the 100-year floodplain and erosion hazard zones (6 parcels) or property (10 parcels in which access is problematic during a runoff event.

NEW RIVER DOWNSTREAM OF I-17

This is a complex drainage system that will most likely be constructed in multiple phases. The City of Phoenix will likely be the lead agency for implementation of this Alternative and will be responsible for coordinating with the Arizona State Land Department (ASLD) which is the primary property owner in this planning area. ASLD has conceptually agreed with this Recommended Alternative via letter to the District. Private developers will most likely fund the majority of the Recommended Alternative since they will benefit from the increased value of the floodplain land being removed from the floodplain. The City of Phoenix will ultimately control implementation of this through it's General Plan amendments and Zoning process (e.g., regulating the erosion hazards zones). Expanding the City of Phoenix's Sonoran Preserve to include the non-structural reaches of New River identified in the recommended alternative would assure that these reaches remained non-structural. There will be COE 404 permitting as well as compliance with FEMA levee certification requirements. It is anticipated that this Recommended Alternative will occur over a five to

twenty year time frame as disposition and development of ASLD lands occur. There was no negative feedback from the public regarding this component of the Recommended Alternative. Cost of this Recommended Alternative is estimated at $61.5 million.

LOWER DEADMAN WASH

The Recommended Alternatives for this site is construction of a bridge to carry flows from Deadman Wash under SR 74. ADOT will likely be the lead agency since the roadway is currently under their jurisdiction. The City of Phoenix should stay involved since partial funding of the bridge might occur from development impact fees. The City of Phoenix will ultimately control implementation of this through it's General Plan amendments and Zoning process..There should only be minor COE 404 permit issues associated with this construction and there are no other significant regulatory issues. It is anticipated that construction will occur in 5-7 years however should funds become available sooner this project should be moved forward since road closures due to roadway flooding occurs on a regular basis at this location. The public was supportive of this Recommended Alternative. Cost of the bridge is estimated to be $3.3 million.

LONE MOUNTAIN, UPPER DEADMAN, NEW RIVER DAM, ROCK SPRINGS, SWEAT CANYON & WEST TRIBUTARIES

The Recommended Alternative for these planning areas is implementation of ADMP development and design guidelines by the county and the two cities. These guidelines are found within the ADMP report. There should be minimal COE 404 permitting or other regulatory issues associated with these guidelines. The public was supportive of this Recommended Alternative since the guidelines will help prevent future flooding and drainage problems associated with development and infrastructure growth. Due to the unknown nature of any improvements it was not possible to generate costs for This Recommended Alternative.

FLOODPLAIN DELINEATION STUDIES

As part of the non-structural component of the Recommended Alternative, Floodplain Delineation Studies (FDS) were conducted and included in the ADMP. These FDS were conducted in both unincorporated Maricopa County and City of Phoenix jurisdictions. A total of approximately 8.5 watercourse miles of new FDS will be submitted to the Federal Emergency Management Agency (FEMA) for their review and approval. Typically the FEMA review takes from twelve to twenty four months. In the interim the FDS will be used as "Best Available Information" by the District regulatory staff.

In addition to the FDS activities approximately thirty five miles of Erosion Hazard Zones (HZ) were identified as part of the ADMP. These EHZ will be regulated as "Best Available Information" by District regulatory staff.

DESIGN AND PLANNING CONSIDERATIONS AND RECOMMENDATIONS

GENERAL

The following planning/design considerations/recommendations are offered as guidance for future projects within the study area:

GAVILAN PEAK PLANNING AREA

- Based on review of aerial photography, field reconnaissance and team collaboration a potential flow break out area was identified in the Gavilan Peak Planning Area. The potential break-

out occurs along the south bank of Photo View Wash between the roadway alignments of 23rd Drive and 27th Avenue. The results of a hydraulic model for Photo View Wash indicates that the wash has the capacity to contain the 100-year event of approximately 500 cfs to within a half foot of the top of bank, however linear bands of denser vegetation obviously being sustained by runoff indicate that there is a potential for flow breakout. At this location, there may be a potential for a channel avulsion. Detail analyses should be conducted to determine if the breakout occurs and to delineate the resultant flood hazard due to the break out.

- Tributaries to Gavilian Peak Wash in the community of New River cross private and public roadways that provide access for residents. Roadway/wash crossings consist of culvert structures and dip crossings. Field investigations identified that many culvert structures are clogged with sediment or were insufficient to convey runoff that occurred in the summer of 2005. Development of an emergency access plan is recommended. The plan would identify an ingress/egress route for residents and emergency vehicles to use during a flood event and the improvements that would be required to roadway/wash crossings to provide all weather access.

New River Planning Area (Upstream of I-17)

- The recommended alternative for New River Planning Area upstream of I-17 was the Non-Structural Alternative. For residents who live within or adjacent to the New River floodplain, whose access is limited to their properties in a runoff event, are offered assistance through the District's Floodprone Property Assistance Program. An evaluation should be made to determine if a Flood Warning Plan is merited. The merits of a Flood Warning Plan would be based on the ability, within rainfall runoff relationships predictability, to provide sufficient warning for the residents of the area to properly react.

- Old Stage Coach Road "at-grade crossing" of New River is flooded during frequent events. Flood depth and flow velocities vary from event to event and within an event making it difficult to judge whether the crossing is passable. A warning device that warns the public to proceed with caution or not to cross at all should be investigated.

- The project team received reports of flooding at the New River Elementary School. The flooding is from runoff generated in a watershed located to the west of the school. Runoff drains through the school grounds in a series of box culverts and channels to New River. It was related that the box culverts clogged with debris and runoff overtopped the Black Canyon Highway and a pedestrian crossing within the school grounds. Flow that overtopped the culverts and channel impacted school facilities. It is recommended that assistance be provided to the school to determine options for mitigating existing flood hazard.

- New River levees downstream of New River Road Bridge tie into a linear levee features. The linear levee features appear to be man-made, however they are not engineered and have not been maintained. Because the feature does not meet FEMA criteria the 100-year floodplain occurs on both sides of the levee (floodplain is based on an assumption that the levee feature will not provide a benefit). The levee features forming the east bank of New River Road extends downstream from the bridge some distance (maybe a quarter mile or so) cutting off an old meander channel in the left overbank area. There is an opening in the levee feature near the end of the old meander channel that allows local flow to drain out, however, some flow is impounded behind the levee and during runoff events within New River, flow drains back into this impoundment area. According to a resident in the area, this causes some vector issues. A public education/outreach program concerning the potential flooding and vector issues associated with this levee feature is recommended.

NEW RIVER PLANNING AREA (DOWNSTREAM OF I-17)

- Along the west bank of New River downstream of the I-17 Bridge there are a number of residences within the floodway, floodplain and erosion hazard limits. A structural alternative was not considered at this location because the presumed cost of the structure would be greater than the value of the property and the residents have been notified about the District's Flood-prone Property Assistance Program. A public education/outreach program that identifies the hazards and potential mitigating solutions to the residents is recommended.

- The recommended watercourse alternatives provided by the Upper New River ADMP are developed based on low resolution planning and engineering analysis and should be revised during design of any elements of the recommended alternative. Detailed hydrologic, hydraulic and total scour, site specific analyses should be conducted based on current data obtained during the design effort.

- Existing condition analyses conducted for the ADMP identified that physical changes to New River upstream and downstream of the Carefree Highway has occurred resulting in different floodplain delineations than those presented on Effective FEMA FIRM Panels. Planning and design of recommended alternatives elements should include development of a Conditional Letter of Map Revision (CLOMR) submittal. The submittal should define the floodplain limits based on existing conditions and proposed conditions.

- Three different bank protection methods were developed for the proposed levees embankments. An application of a particular type was based on the preservation of a unique landscape features, such as vertical banks comprised of well cemented alluvium (Trench-Fill Riprap), preservation of natural wash corridor by minimizing construction impact (Launched Riprap) and the potential need to armor to the total scour depth to protect the water-side levee embankment if the fill for the embankment is placed below natural grade (over excavation). Final design of levee erosion protection measures should include a value engineering analyses to determine the most appropriate type of erosion protection to be used. The analyses should take into consideration, soil conditions (determine over excavation requirements), material type and source, and impacts to scenic and environmental resources.

REFERENCES

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Figures

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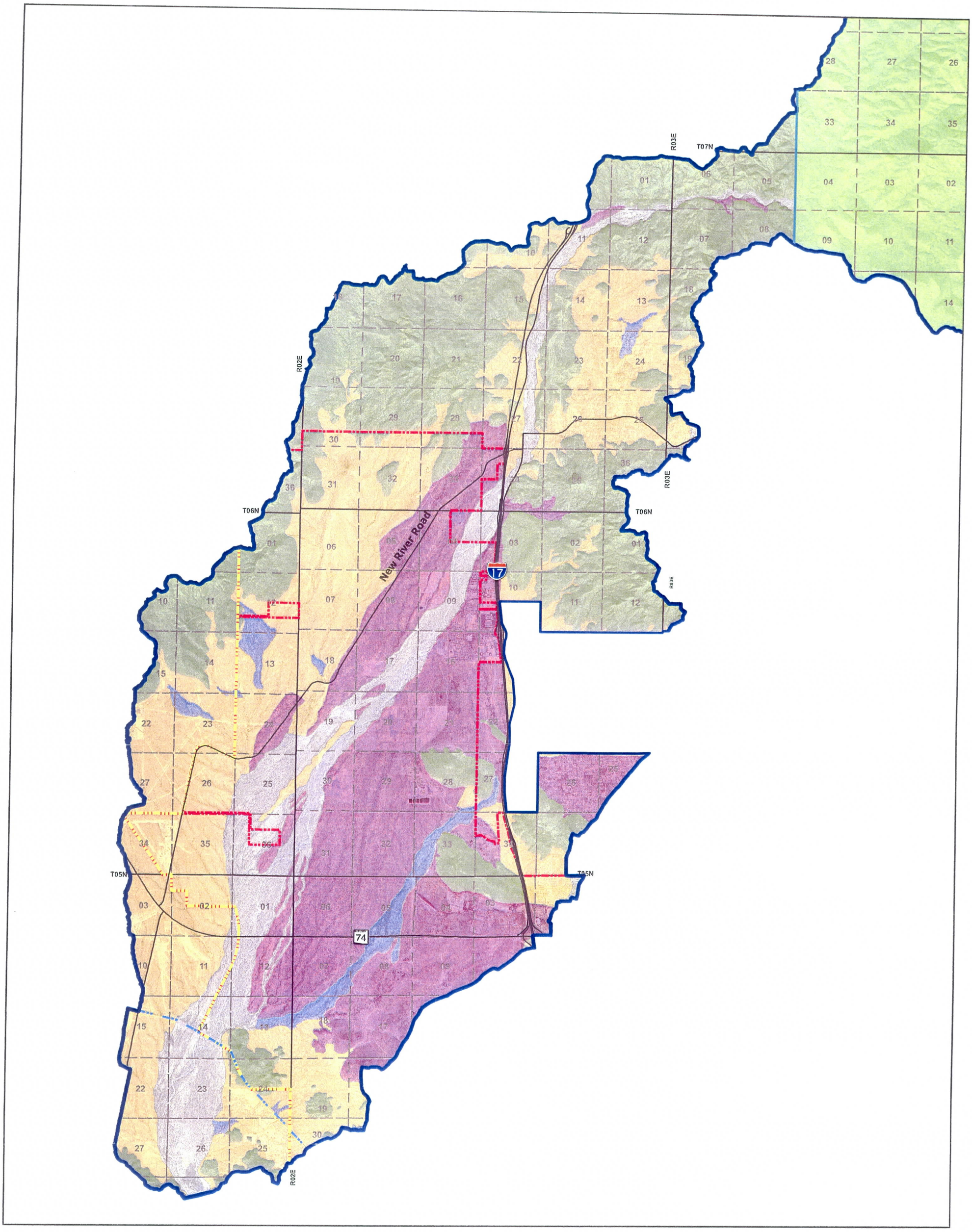

Location Map:

Notes:

Legend:

N

1" = 8000'

- Roadway
- CAP Canal
- Peoria Corporate Boundary
- Phoenix Corporate Boundary
- Township & Range Lines
- Sections
- Tonto National Forest
- Upper New River ADMP Planning Area Boundary
- Upper New River ADMP Project Boundary

Landform

- Alluvial Fans
- Major Riverine Floodplain
- Mountains
- Piedmont - Tributary Systems
- Sheet Flow

Flood Control District of Maricopa County

Flood Control District of Maricopa County
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Phoenix, AZ 85009

Upper New River ADMP
FCD 2005C020
Figure 2
Landform Map

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JE FULLER HYDROLOGY & GEOMORPHOLOGY, INC

Project No.
182000418

Prepared By:
RKJ
4 January 2006

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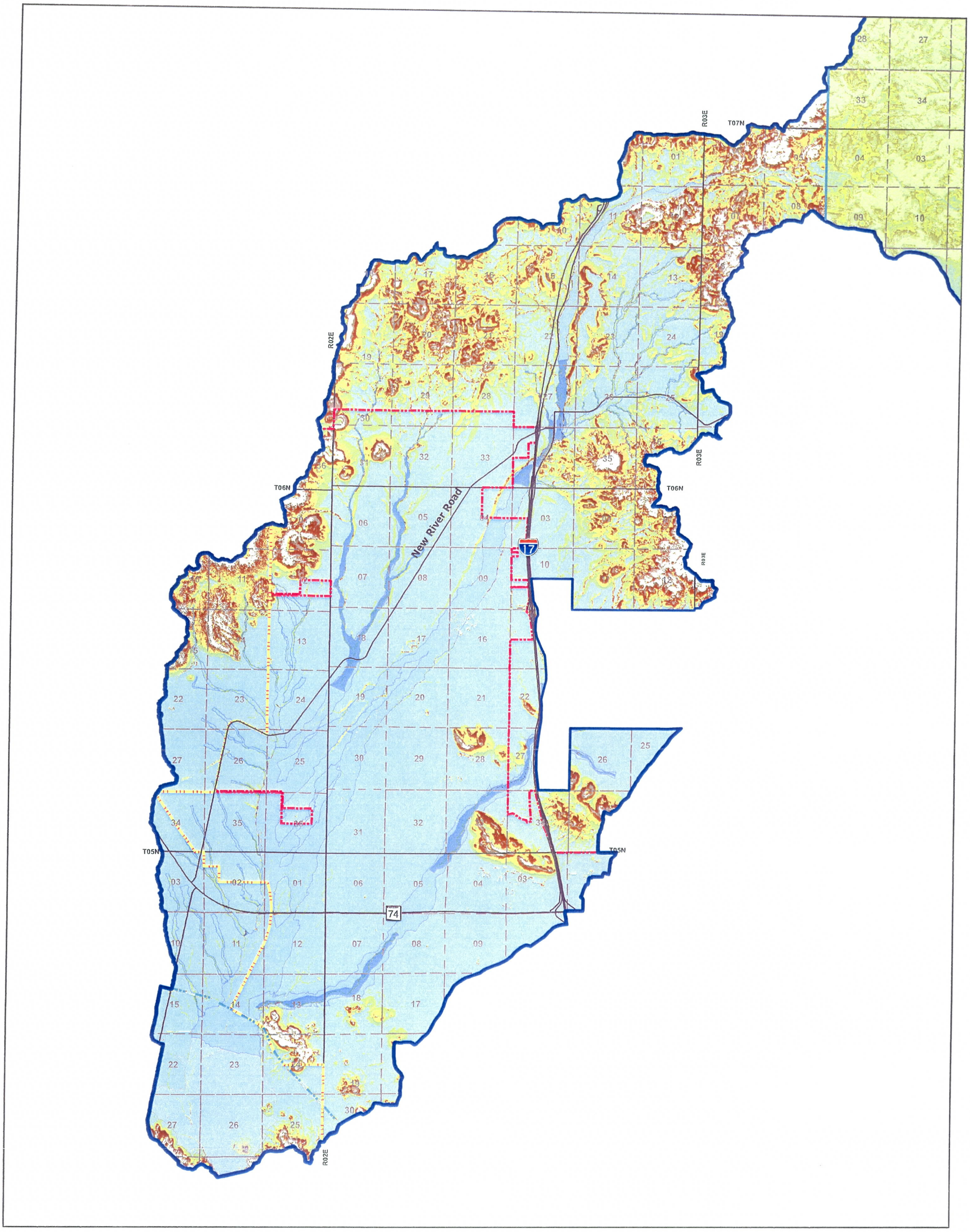

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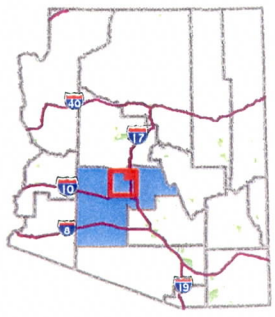

Notes:

Legend:

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1" = 8000'

- Roadway
- CAP Canal
- Peoria Corporate Boundary
- Phoenix Corporate Boundary
- Township & Range Lines
- Sections
- Pending FEMA Floodplain
- Reservoir Floodplain
- FEMA Floodplain
- FEMA Floodway
- Tonto National Forest
- Upper New River ADMP Planning Area Boundary
- Upper New River ADMP Project Boundary

Slope Intervals

- 0 - 5%
- 5 - 10%
- 10 - 15%
- 15 - 20%
- 20 - 25%
- >25%

Flood Control District of Maricopa County

Flood Control District
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Upper New River ADMP
FCD 2005CO20
Figure 3
Terrain Slope Map

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Phoenix, AZ U.S.A. 85044

Project No.
182000418

Prepared By:
AMG
April 2008

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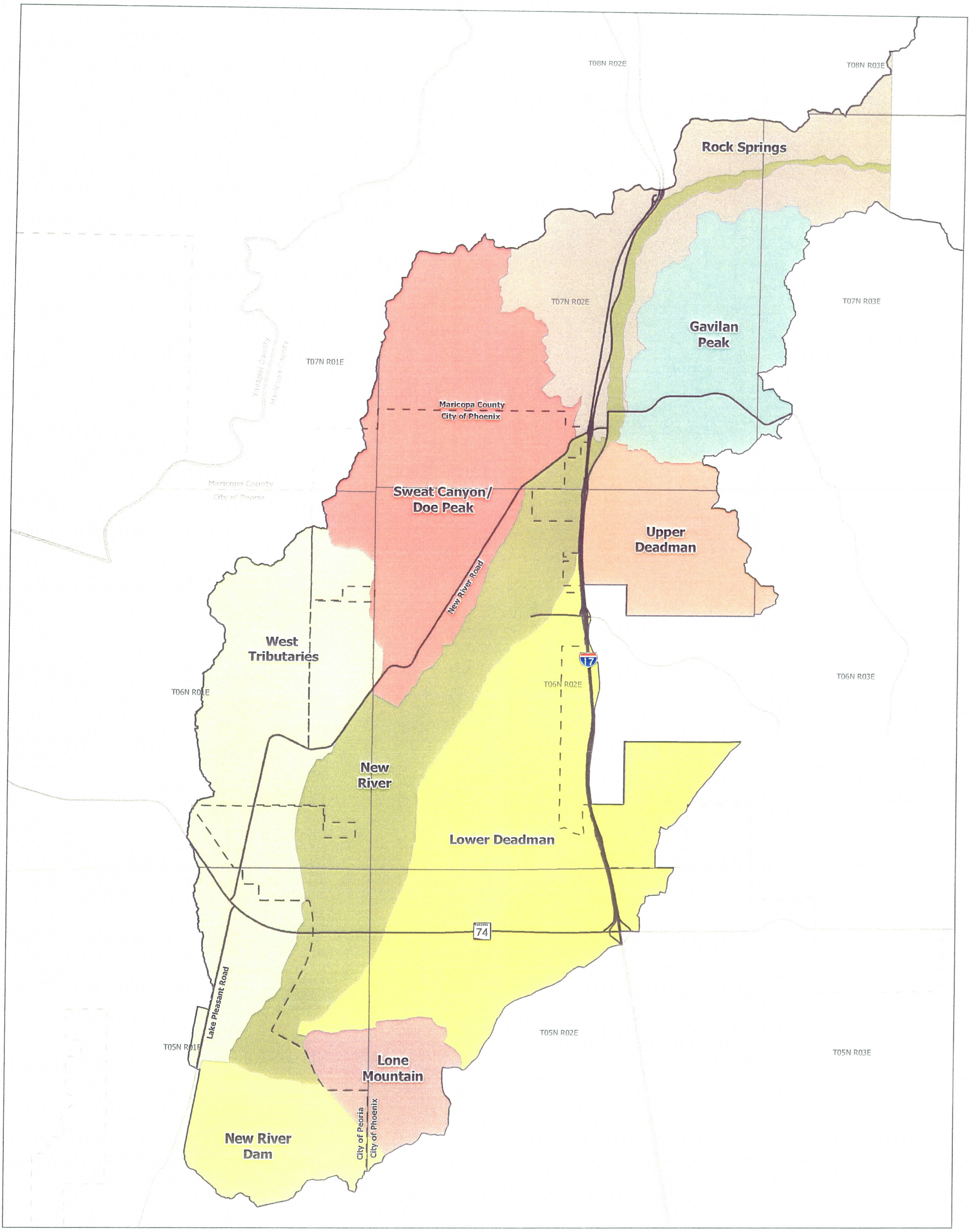

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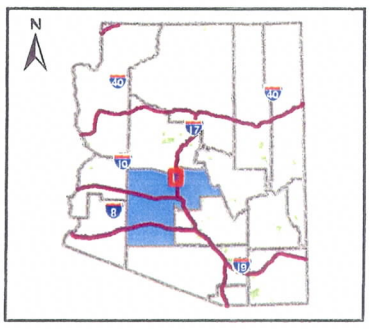

Notes:

N

N.T.S.

Legend:

- Roadway
- Project Boundary
- Corporate Limit
- County Boundary

Flood Control District of Maricopa County

Flood Control District
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Upper New River ADMP
FCD 2005CO20
Figure 4: Upper New River Planning Areas

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Prepared By:
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April 2008

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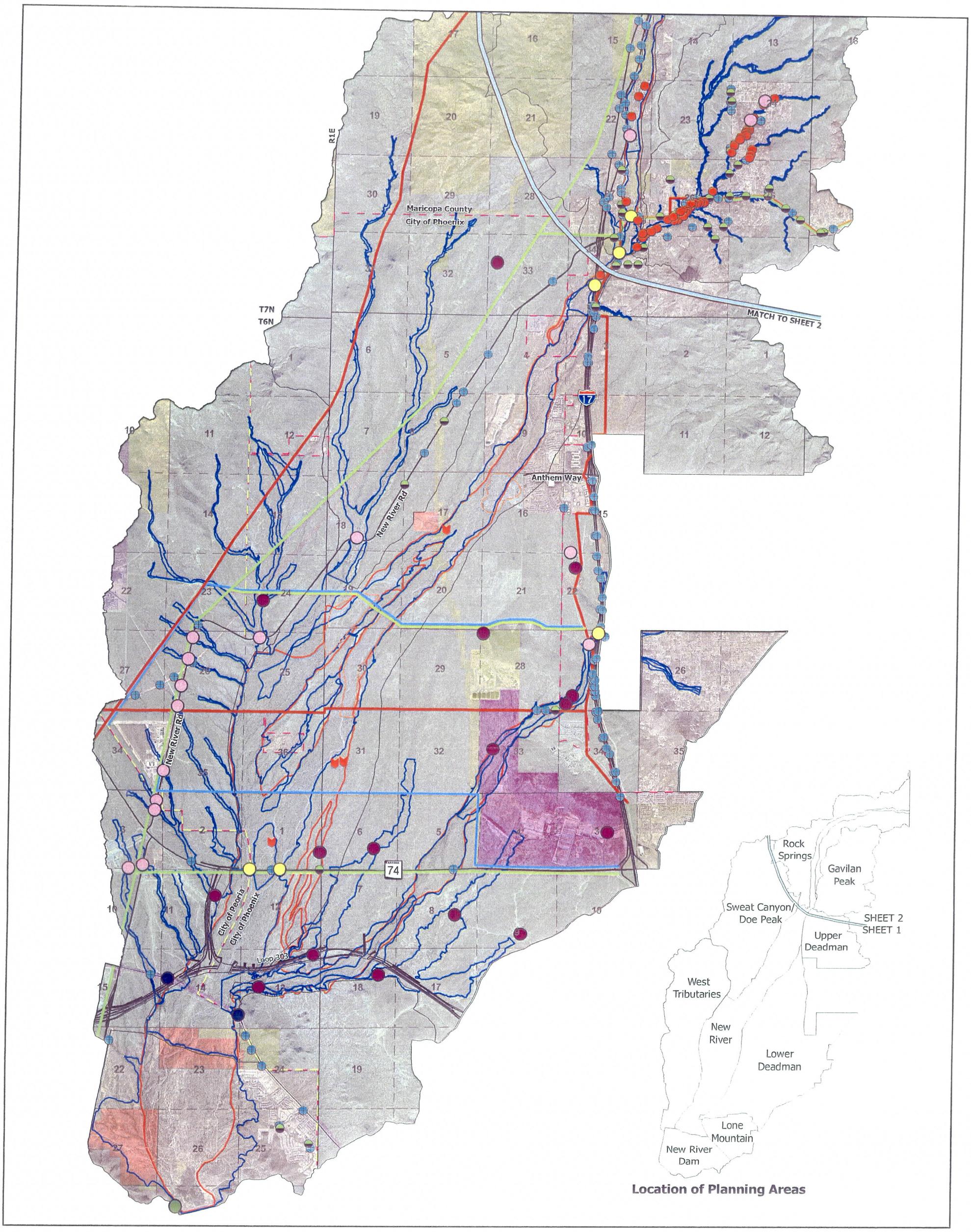
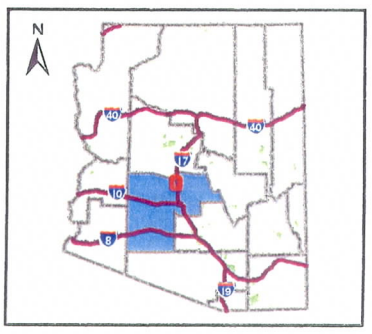


Location of Planning Areas

Location Map:



Notes:

Legend:

N

N.T.S.

- Potential Breakout Area
- Dip Section
- Structure within the Floodplain
- Bridges
- Culvert with Sedimentation
- Culvert
- Siphon
- Spillway
- Stock Tank
- Gasline
- Powerline
- Waterline
- Sand & Gravel Operation
- Roadway
- Floodplain
- Erosion Hazard
- Peoria Corporate Boundary
- Phoenix Corporate Boundary
- Township & Range
- Section
- Bureau of Reclamation
- County Land
- Game and Fish
- BLM
- Forest
- Private
- State Trust

Flood Control District of Maricopa County

Flood Control District
of Maricopa County
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Upper New River ADMP
FCD 2005C020
Figure 5 Sheet 1 of 2:
Land Ownership/
Utilities/Drainage Structures

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Prepared By:
AMG
April 2008

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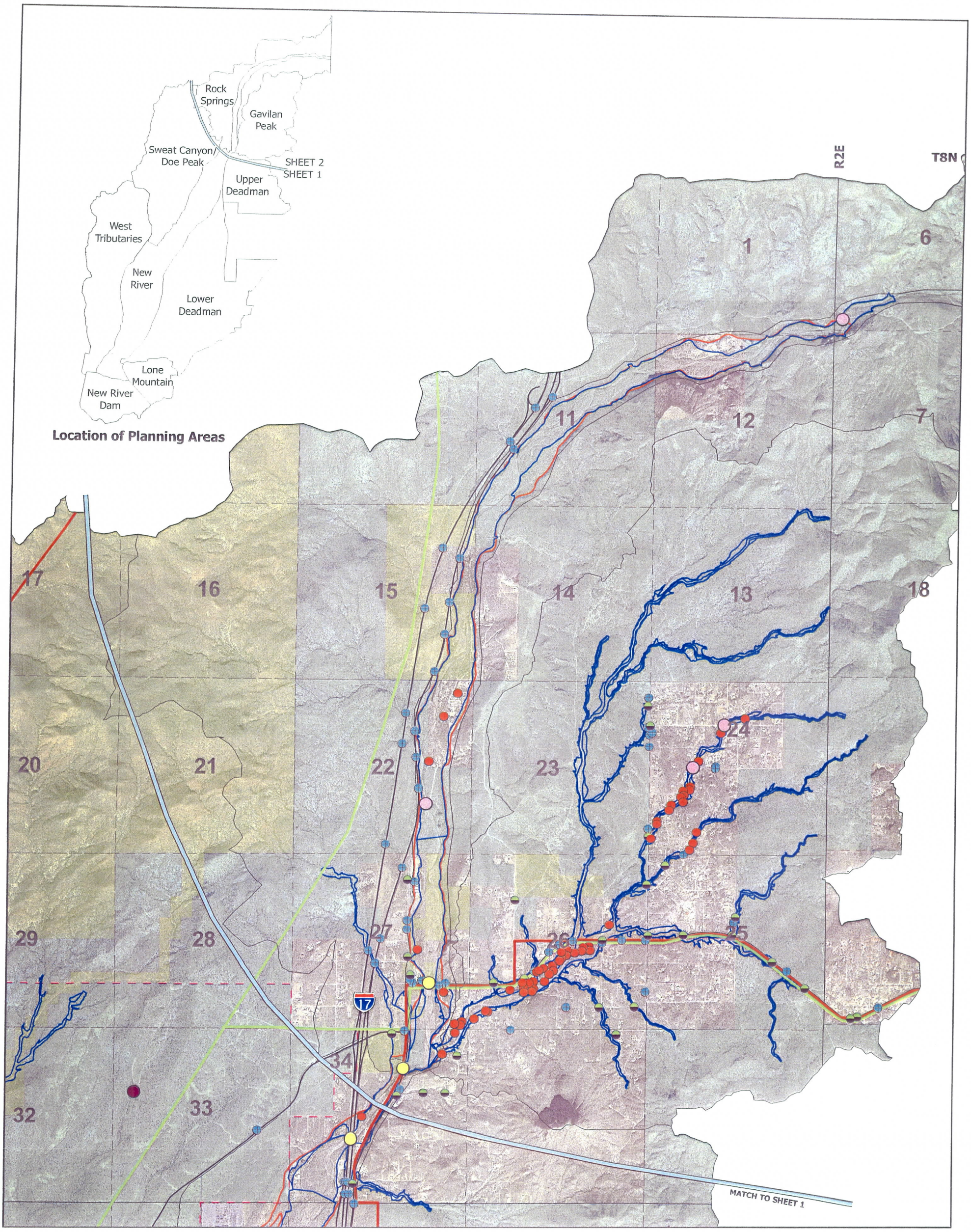

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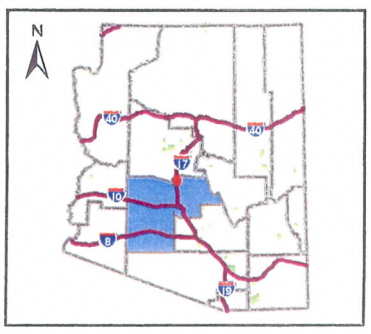

Notes:

Legend:

N.T.S.

- Potential Breakout Area
- Dip Section
- Structure within the Floodplain
- Bridges
- Culvert with Sedimentation
- Culvert
- Siphon
- Spillway
- Stock Tank
- Gasline
- Powerline
- Waterline
- Sand & Gravel Operation
- Roadway
- Floodplain
- Erosion Hazard
- Peoria Corporate Boundary
- Phoenix Corporate Boundary
- Township & Range
- Section
- Bureau of Reclamation
- County Land
- Game and Fish
- BLM
- Forest
- Private
- State Trust

Flood Control District of Maricopa County
2801 W. Durango St.
Phoenix, AZ 85009

Upper New River ADMP
FCD 2005CO20
Figure 5 Sheet 2 of 2:
Land Ownership/ Utilities/Drainage Structures

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Phoenix, AZ U.S.A. 85044

Project No. 182000418

Prepared By: AMG April 2008

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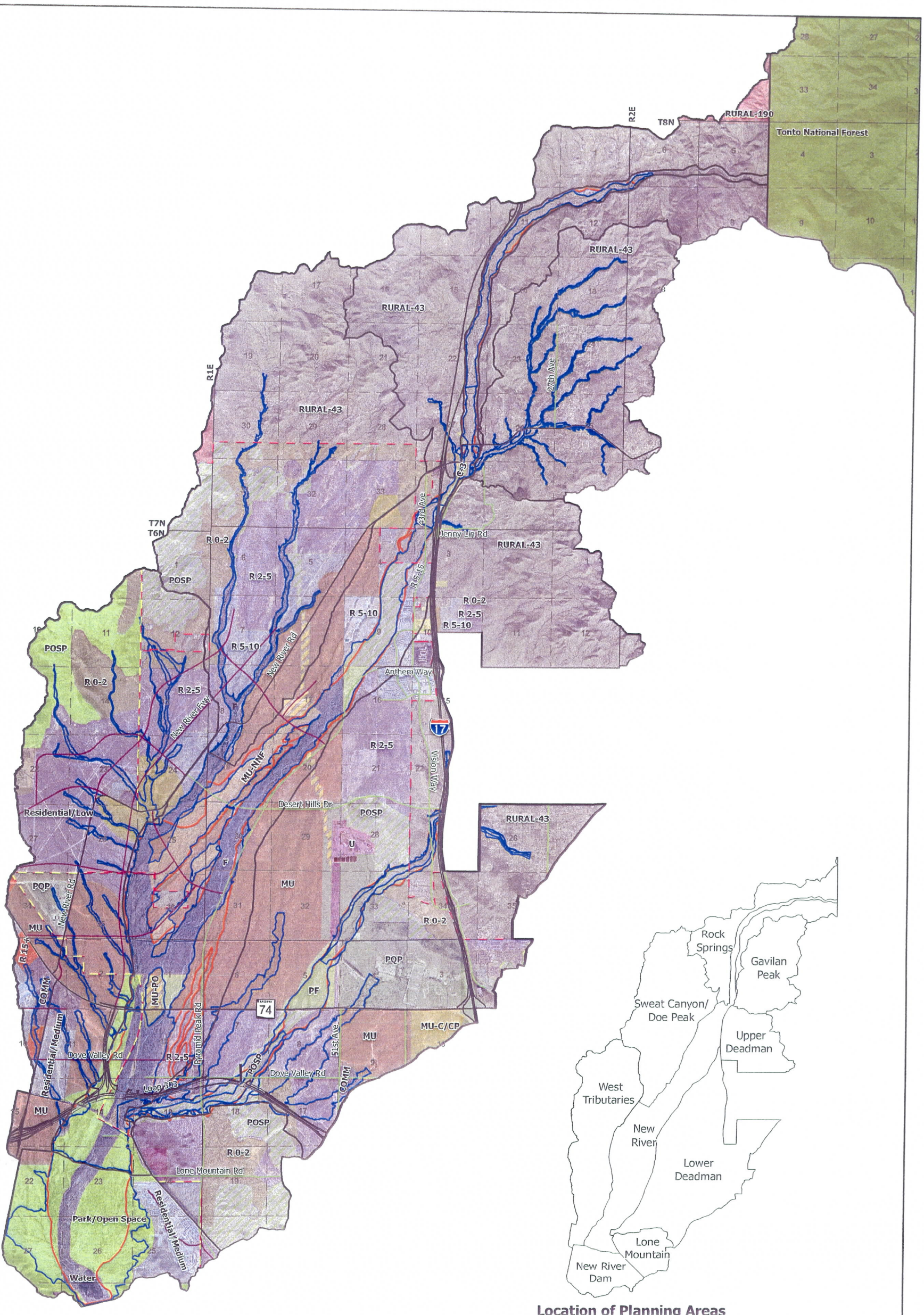
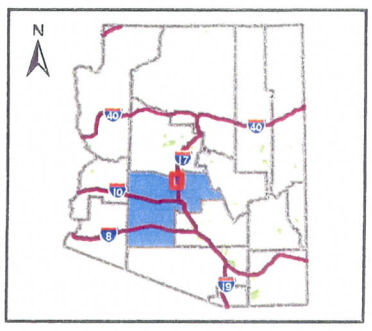


Location of Planning Areas

Location Map:



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April 2008

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Notes:

N

N.T.S.

Legend:

- Roadway
- Future Alignment
- Future Alignment
- Erosion Hazard
- Peoria Corporate Boundary
- Phoenix Corporate Boundary
- Township & Range Line
- Section
- Floodplain
- RURAL 43 - 0 to 1 du/acre
- R 0-2 - Residential 0 to 2 du/acre
- R 2-5 - Residential 2 to 5 du/acre
- R 5-10 - Residential 5 to 10 du/acre
- R-15+ - Residential 15+ du/acre
- Residential/Low
- Residential/Medium
- MU - Mixed Use
- MU-NNF - Mixed Use North Gateway and Northwest Area/Floodplain
- COMM - Commercial
- MU-C/CP - Mixed Use Commercial/Commerce Park
- PQP - Public/Quasi-Public
- MU-PO - Preserves/Mixed Use
- PF - Preserves/Floodplain
- POSP - Parks & Open Space, Future 1 du/acre
- F - Floodplain
- Water - Portion of Floodplain
- U - Undesignated

Flood Control District of Maricopa County

Flood Control District
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Upper New River ADMP
FCD 2005C020
Figure 6: Upper New River Planning Elements Existing Floodplain

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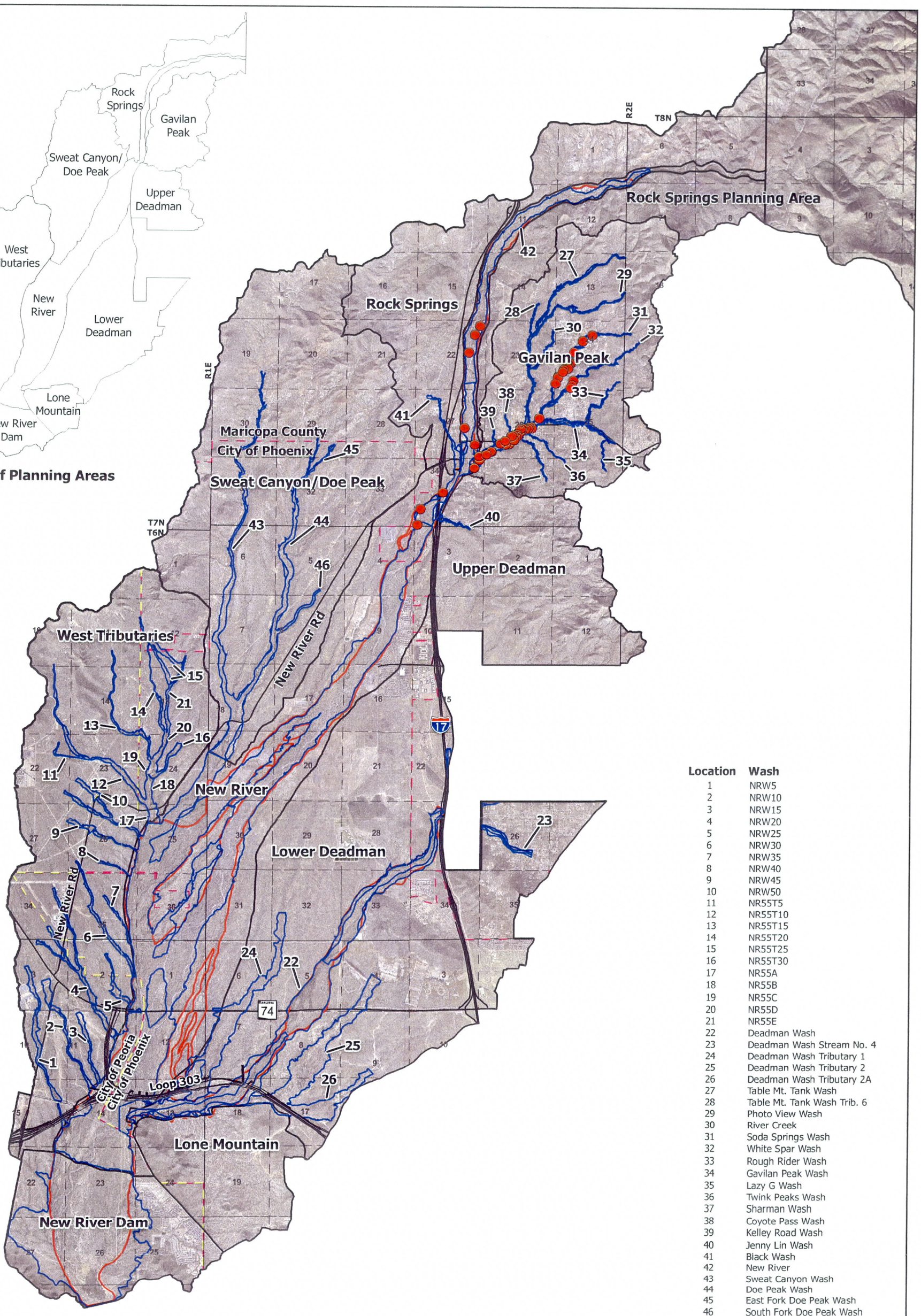
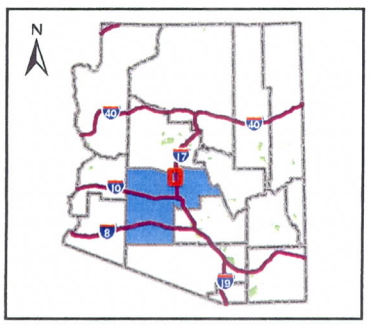
Location of Planning Areas



Location	Wash
1	NRW5
2	NRW10
3	NRW15
4	NRW20
5	NRW25
6	NRW30
7	NRW35
8	NRW40
9	NRW45
10	NRW50
11	NR55T5
12	NR55T10
13	NR55T15
14	NR55T20
15	NR55T25
16	NR55T30
17	NR55A
18	NR55B
19	NR55C
20	NR55D
21	NR55E
22	Deadman Wash
23	Deadman Wash Stream No. 4
24	Deadman Wash Tributary 1
25	Deadman Wash Tributary 2
26	Deadman Wash Tributary 2A
27	Table Mt. Tank Wash
28	Table Mt. Tank Wash Trib. 6
29	Photo View Wash
30	River Creek
31	Soda Springs Wash
32	White Spar Wash
33	Rough Rider Wash
34	Gavilan Peak Wash
35	Lazy G Wash
36	Twink Peaks Wash
37	Sharman Wash
38	Coyote Pass Wash
39	Kelley Road Wash
40	Jenny Lin Wash
41	Black Wash
42	New River
43	Sweat Canyon Wash
44	Doe Peak Wash
45	East Fork Doe Peak Wash
46	South Fork Doe Peak Wash

Location Map:



Notes:

Legend:

N

N.T.S.

- Structure within the Floodplain
- Roadway
- Floodplain
- Erosion Hazard
- Peoria Corporate Boundary
- Phoenix Corporate Boundary
- Township & Range
- Section

Flood Control District of Maricopa County
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Upper New River ADMP
FCD 2005CO20
Figure 7 Sheet 1: Flood and Erosion Hazard

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Project No.
182000418

Prepared By:
AMG
April 2008

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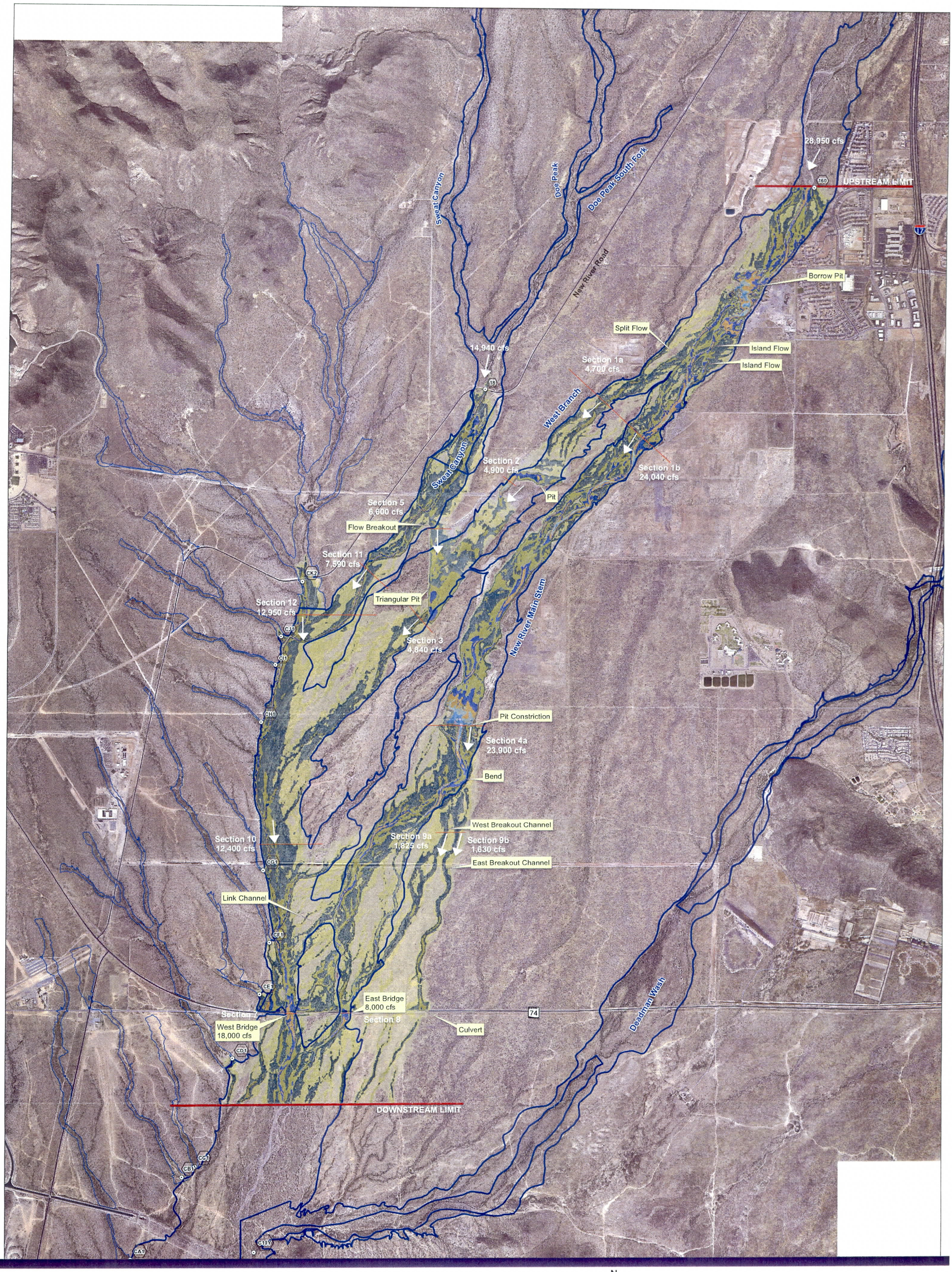
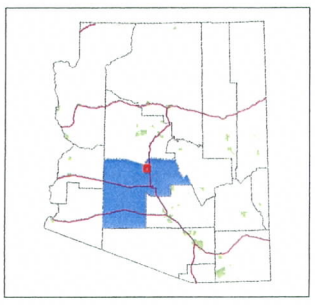


Location Map



Notes:

1. Aerial photographic base: Circa 2006, provided by the Flood Control District of Maricopa County
2. Mapping: Circa 2005, provided by the Flood Control District of Maricopa County
   Scale: 1 inch = 200 feet at 2-foot C.I.
   1 inch = 400 feet at 4-foot C.I.

Prepared By
IA
22 May 2007

Revision

By	Appd	Date

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N
N.T.S.

Legend:

- Concentration Point
- Roadway
- FEMA Floodplain
- Pending Floodplain
- CD1 Concentration Point ID
- FP_CrossSections
- FLO2D_Model Limit
- 18,000 cfs 100 year Peak Discharge

Depth (ft)

- >12
- 10 - 12
- 8 - 10
- 6 - 8
- 4 - 6
- 2 - 4
- 1 - 2
- <1

Flood Control District of Maricopa County
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Phoenix, AZ 85009

Upper New River ADMP
FCD 2005CO20
Figure 7 Sheet 2:
FLO-2D Depth Plan

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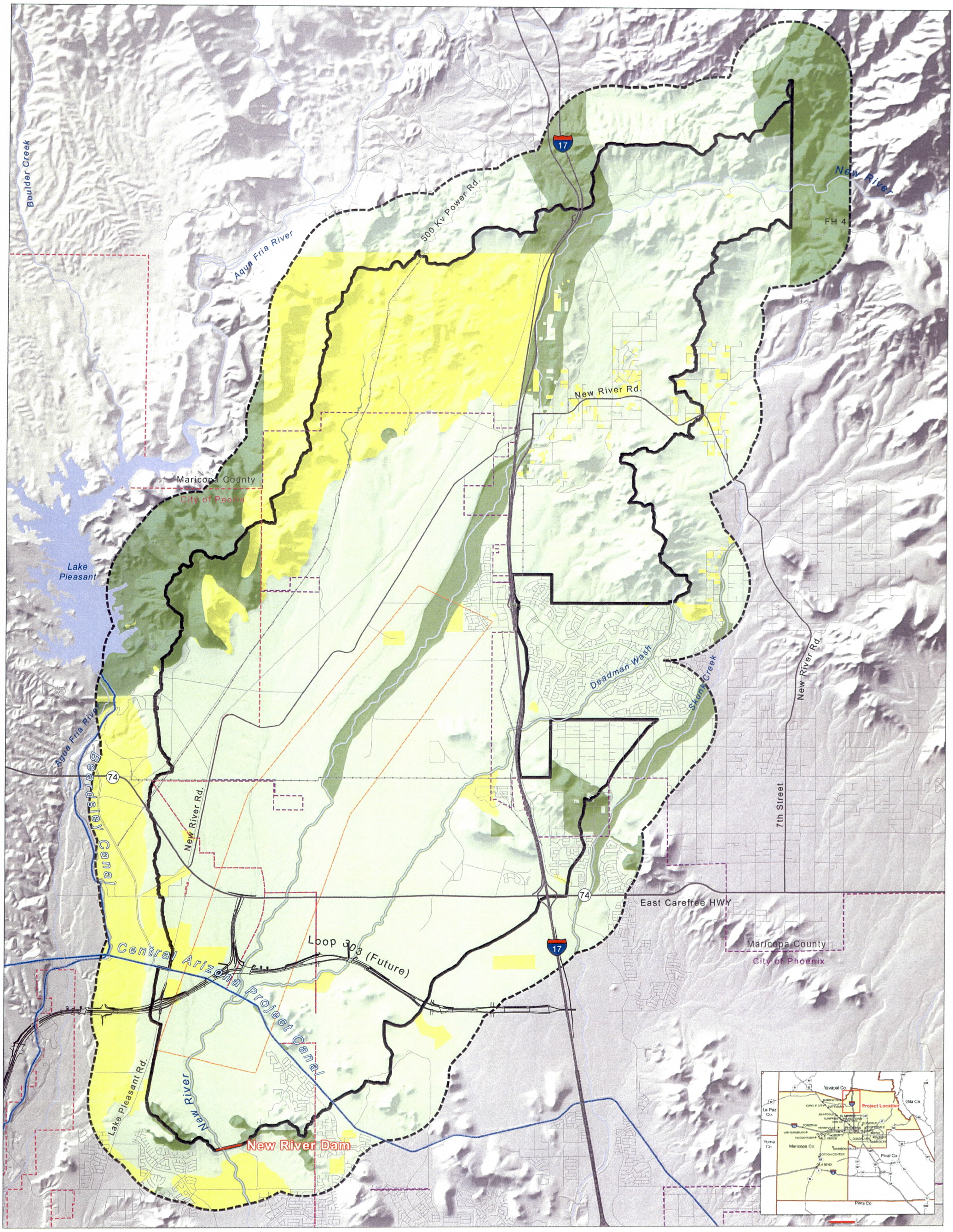
Phoenix, AZ U.S.A. 85044



LEGEND

EXISTING SCENIC RESOURCE COMPATIBILITY RATINGS

- Compatibility Class 1
- Compatibility Class 2
- Compatibility Class 3

	Compatibility Classes					
Compatibility Class 1	Non-Structural					
Compatibility Class 2	Non-Structural	Soft				
Compatibility Class 3	Non-Structural	Soft	Semi-Soft			
Compatibility Class 4	Non-Structural	Soft	Semi-Soft	Hard w/ Aesthetic Treatment		
Compatibility Class 5	Non-Structural	Soft	Semi-Soft	Hard w/ Aesthetic Treatment	Semi-Hard	
Compatibility Class 6	Non-Structural	Soft	Semi-Soft	Hard w/ Aesthetic Treatment	Semi-Hard	Hard
Incompatible						

Compatibility Levels
C= Complementary and Compatible
IC= Not Complimentary or Compatible

0 0.25 0.5 1 Miles

N

REFERENCE FEATURES:

- Project Boundary
- Project Buffer Area (1 mi.)
- Focus Area
- Interstate Highway
- Important Roads
- Other Roads
- Powerlines
- Dams
- Drainages
- Canals
- Lakes
- Peoria City Limits
- Phoenix City Limits

PREPARED BY: EDAW AECOM

DATE: September 2007

Flood Control District of Maricopa County
2801 W. Durango St.
Phoenix, AZ 85009

Upper New River Area Drainage Master Plan

FCD 2005CO20

Figure 8
Future Scenic Resource Compatibility

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NO DATA AVAILABLE

NO DATA AVAILABLE

Hells Canyon Wilderness Area

Lake Pleasant Regional Park

Maricopa County

City of Peoria

Lake Pleasant

Boulder Creek

Aqua Fria River

500 Kv Power Rd.

17

New River

FH 41

New River Rd.

Spur Cross Ranch Recreation Area

Black Canyon Hiking and Equestrian Trail

Deadman Wash

Skunk Creek

Cave Creek Regional Park

Black Mtn. Summit Preserve

7th Street

74

Ben Avery Rec. Area

East Carefree HWY

Maricopa County

City of Phoenix

Central Arizona Project Canal

Lake Pleasant Rd.

New River Dam

Thunderbird Regional Park

Adobe Dam Rec. Area

Project Location

Yavapai Co.

Gila Co.

La Paz Co.

Yuma Co.

Maricopa Co.

Pinal Co.

Pima Co.

LEGEND

- Regional Boundary (10 mi.)
- Regional Trails

Compatibility Class

- 1
- 2
- 3
- No Data

Compatibility Classes						
Compatibility Class 1	Non-Structural					
Compatibility Class 2	Non-Structural	Soft				
Compatibility Class 3	Non-Structural	Soft	Semi-Soft			
Compatibility Class 4	Non-Structural	Soft	Semi-Soft	Hard w/ Aesthetic Treatment		
Compatibility Class 5	Non-Structural	Soft	Semi-Soft	Hard w/ Aesthetic Treatment	Semi-Hard	
Compatibility Class 6	Non-Structural	Soft	Semi-Soft	Hard w/ Aesthetic Treatment	Semi-Hard	Hard
Incompatible						

Compatibility Levels
C= Complimentary and Compatible
IC= Not Complimentary or Compatible

RECREATION RESOURCES' COMPATIBILITY CLASSES MATRIX

Parks, Recreation Use Areas and Open Spaces	Flood Protection Method: Non-Structural	Soft Structural	Semi-Soft Structural	Hard Structural w/ Aesthetic Treatment	Semi-Hard Structural	Hard Structural
Federal						
National Forest	C	IC	IC	IC	IC	IC
Wilderness Areas	C	IC	IC	IC	IC	IC
National Monuments	C	IC	IC	IC	IC	IC
National Wildlife Refuges	C	IC	IC	IC	IC	IC
Resources						
State						
State Parks (Nonp	C	C	C	IC	IC	IC
Wildlife Areas	C	C	IC	IC	IC	IC
Regional						
County Regional Parks	C	C	IC	IC	IC	IC
County Recreation Areas	C	C	C	IC	IC	IC
City Regional Parks	C	C	IC	IC	IC	IC
City Mountain Preserves	C	C	IC	IC	IC	IC
County Open Spaces (e.g., MAG Desert Spaces Plan Designations)						
Secured Open Spaces	Refer to Above Designations					
Conservation Areas	C	C	IC	IC	IC	IC
Retention Areas	C	C	IC	IC	IC	IC
Local						
City Parks						
Rural	C	C	C	IC	IC	IC
Suburban	C	C	C	C	IC	IC
Urban	C	C	C	C	C	IC
Other Recreation Areas	C	C	C	C	C	IC
Golf Courses	C	C	C	IC	IC	IC

0 0.5 1 2 3 Miles

N

REFERENCE FEATURES:

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- Project Buffer Area (1 mi.)
- Focus Area
- Interstate Highway
- Important Roads
- Other Roads
- Powerlines
- Dams
- Drainages
- Canals
- Lakes
- Peoria City Limits
- Phoenix City Limits

PREPARED BY: EDAW AECOM

DATE: September 2007

Flood Control District of Maricopa County
2801 W. Durango St.
Phoenix, AZ 85009

Upper New River Area Drainage Master Plan

FCD 2005CO20

Figure 9
Regional Recreation and Open Spaces Resources Compatibility (10 mi.)

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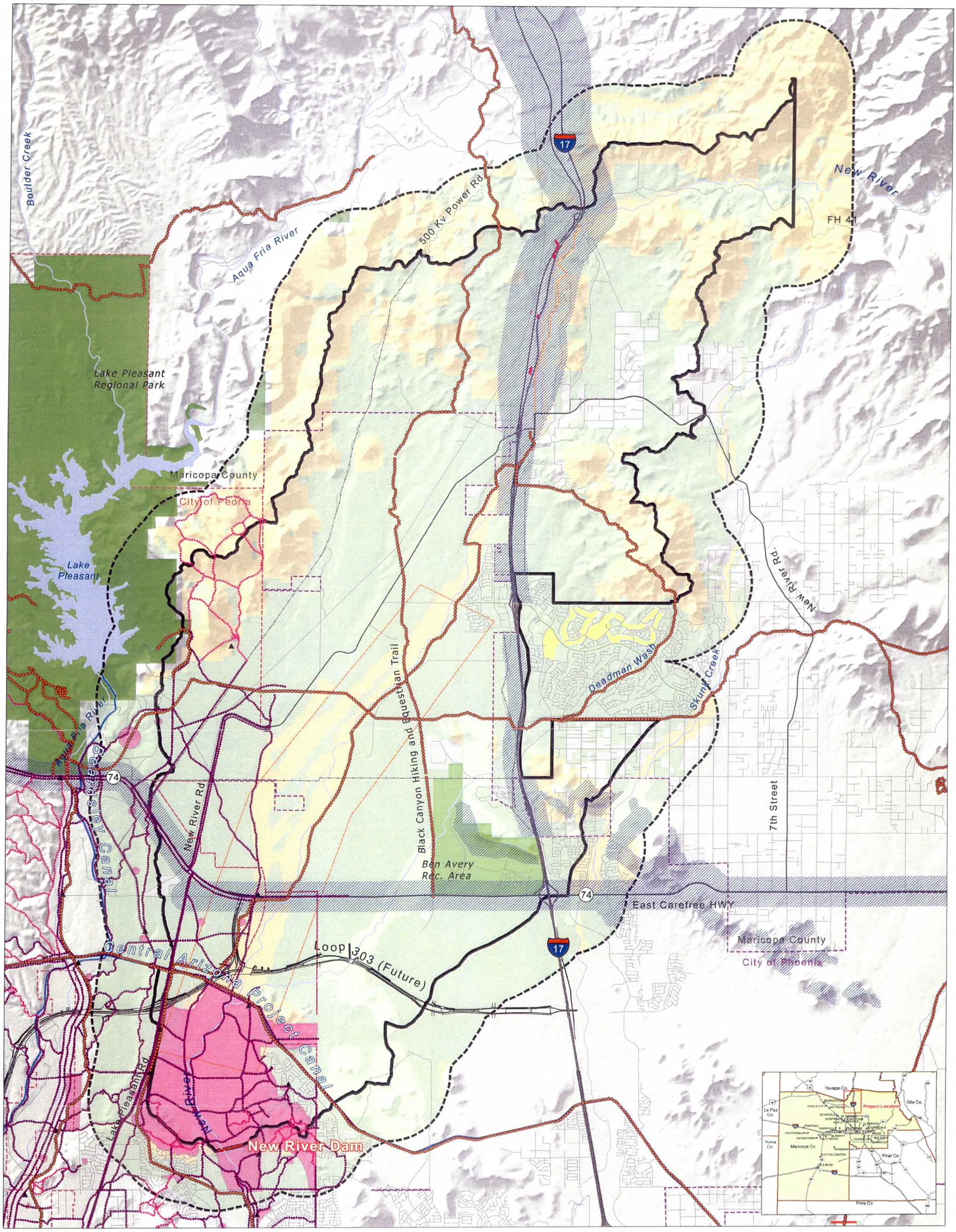

LEGEND

- Peoria Trailheads
- Peoria Trails
- Peoria Back-country Trails
- Regional Trails

Recreation (1 mile & Adjacent)

- County Regional Parks
- County Regional Recreation Areas
- City Regional Parks
- City Mountain Preserves
- County Open Spaces & Retention Areas
- County Open Spaces & Conservation Areas
- County Parks
- Local Parks & Golf Courses
- Proposed Peoria Parks

Scenic Integrity

- Scenic Routes

Other Features

- HistoricRd
- EcoCultural

0 0.25 0.5 1 Miles

N

REFERENCE FEATURES:

- Project Boundary
- Project Buffer Area (1 mi.)
- Focus Area
- Interstate Highway
- Important Roads
- Other Roads
- Powerlines
- Dams
- Drainages
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PREPARED BY: FDAW

DATE: September 2007

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Upper New River Area Drainage Master Plan

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Figure 10
Recreation and Open Space Resources (1 Mile)

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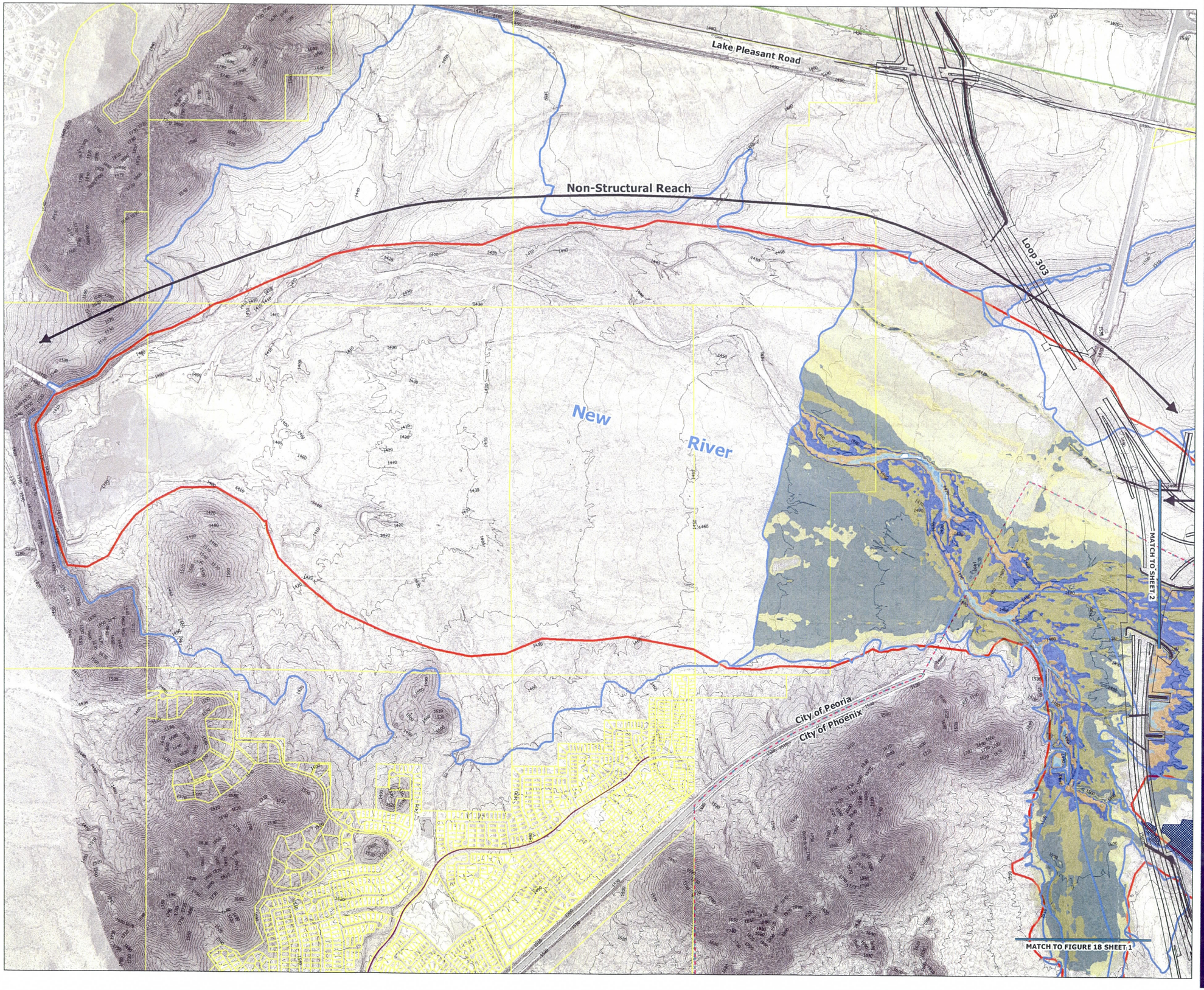

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Upper New River ADMP
FCD 2005CO20

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Phoenix, AZ U.S.A. 85044
Stantec

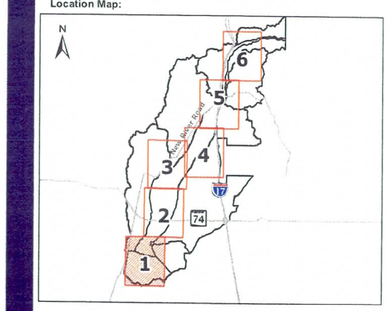
Legend:

- City Proposed Roads
- Roadway
- Gasline
- Index Contour
- 2 ft Intermediate Contour
- 100-year Floodplain Boundaries
- Reclaimed Floodplain
- Erosion Hazard
- Parcel Boundary
- Phoenix Corporate Boundary
- Peoria Corporate Boundary

Two Dimensional Hydraulic Model Flow Depth (ft)

- >12
- 10 - 12
- 8 - 10
- 6 - 8
- 4 - 6
- 2 - 4
- 1 - 2
- <1

Location Map:



N

0 600 1,200 1,800 2,400 Feet

Project No.
182000418

Prepared By:
AMG
June 2008

Title:
New River Downstream
of I-17 Recommended Alternative
Figure 17

Revision:

By Appd. Date

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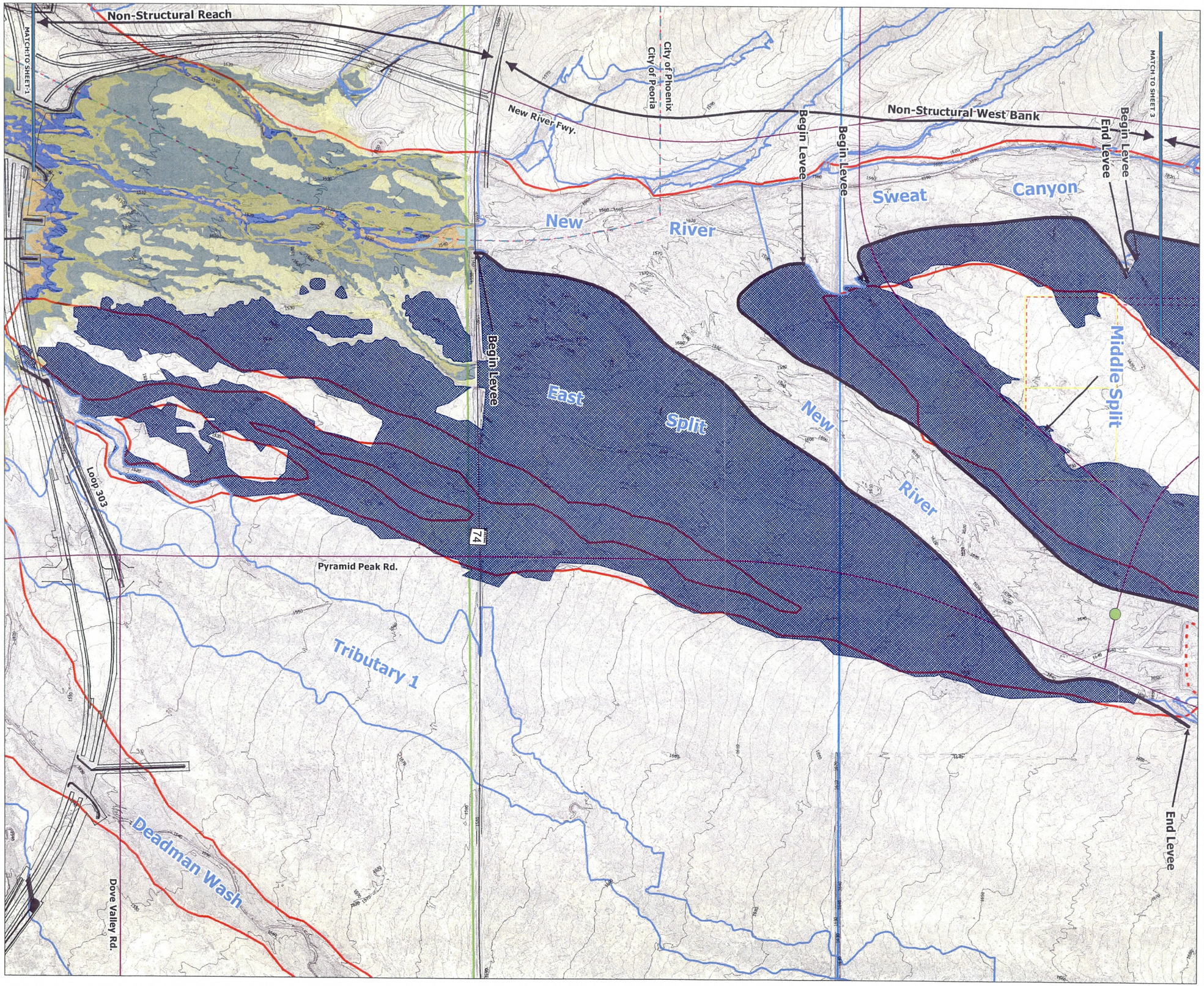

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Upper New River ADMP
FCD 2005CO20

Prepared By:

Stantec Consulting Inc.
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Phoenix, AZ U.S.A. 85044

Legend:

- Roadway/Wash Crossing
- City Proposed Roads
- Roadway
- Levee
- Waterline
- Powerline
- Gasline
- Index Contour
- 2 ft Intermediate Contour
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- 10 - 12
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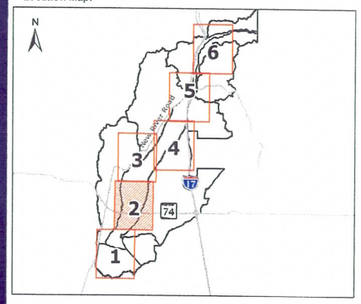
- 1 - 2
- <1

Location Map:



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0 600 1,200 1,800 2,400 Feet

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182000418

Prepared By:
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June 2008

Title:
New River Downstream of I-17 Recommended Alternative
Figure 17

Revision:

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Sheet 2 of 6

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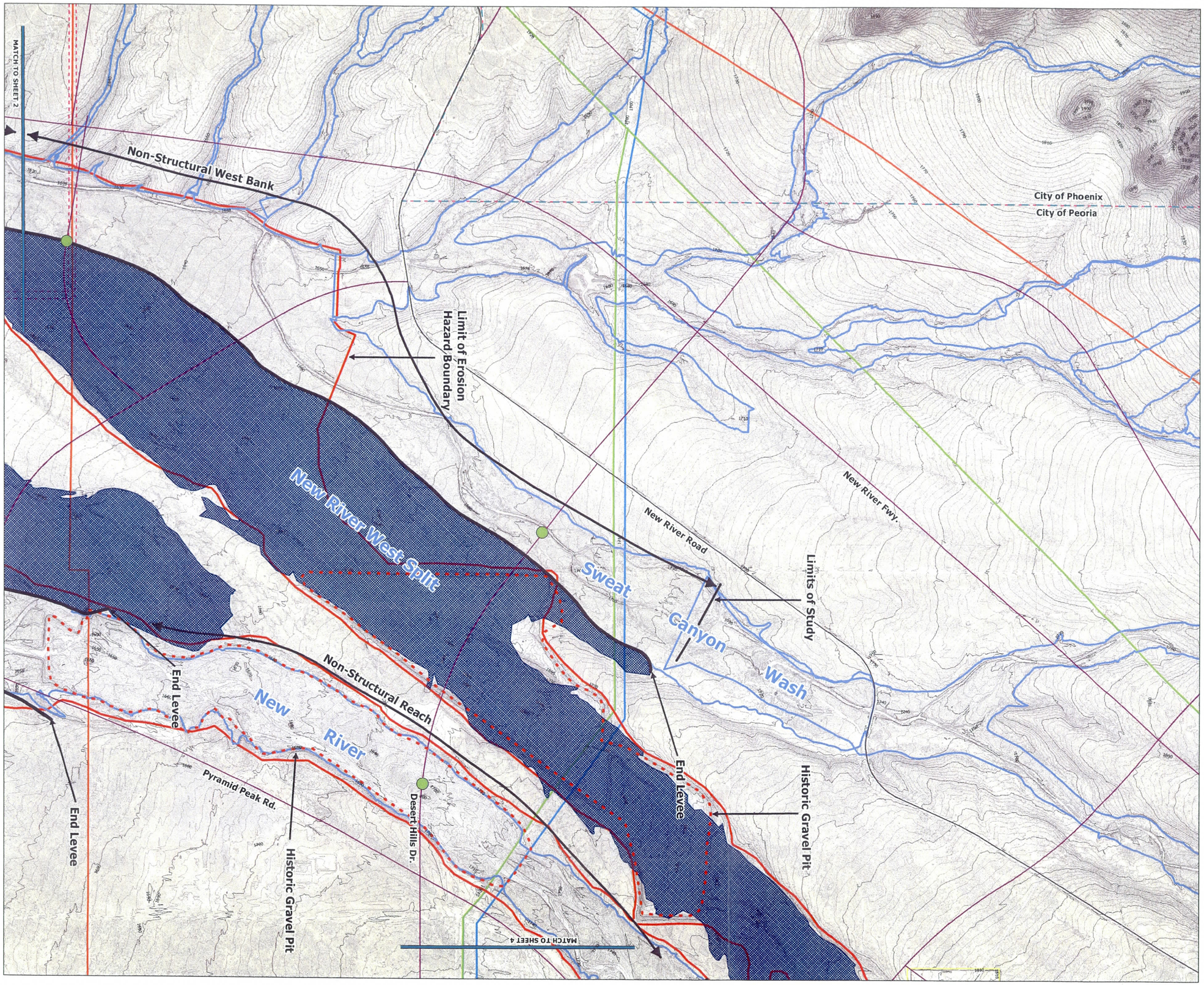

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2801 W. Durango St.
Phoenix, AZ 85009

Upper New River ADMP
FCD 2005CO20

Prepared By:
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Phoenix, AZ U.S.A. 85044

Legend:

- Roadway/Wash Crossing
- City Proposed Roads
- Roadway
- Levee
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- Powerline
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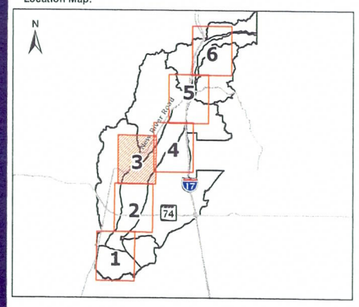
Location Map:



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Title:
New River Downstream of I-17 Recommended Alternative
Figure 17

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By Appd. Date

Sheet 3 of 6

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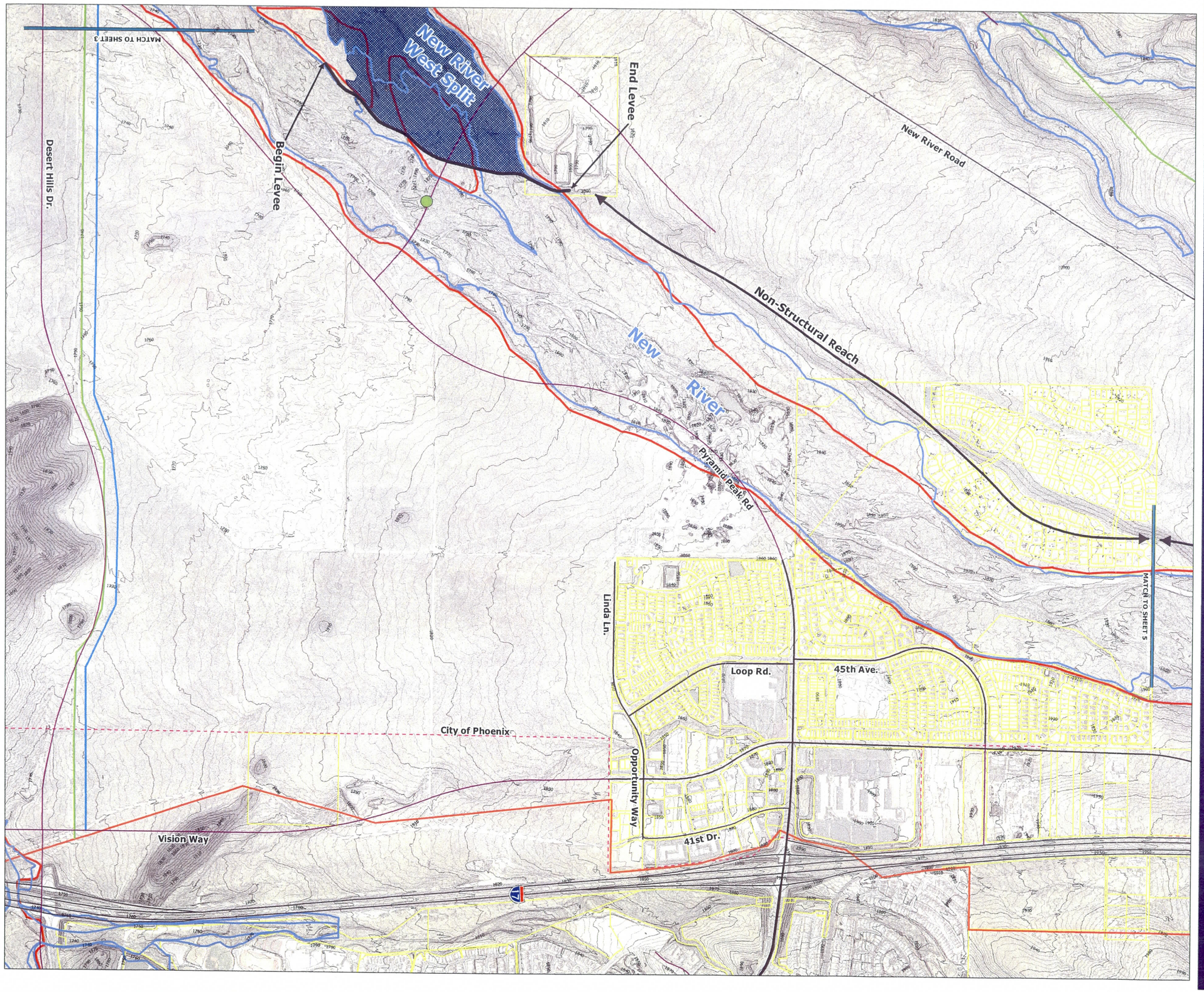

Flood Control District of Maricopa County
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Phoenix, AZ 85009

Upper New River ADMP
FCD 2005CO20

Prepared By:
Stantec Consulting Inc.
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Phoenix, AZ U.S.A. 85044

Legend:

- Roadway/Wash Crossing
- City Proposed Roads
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- Levee
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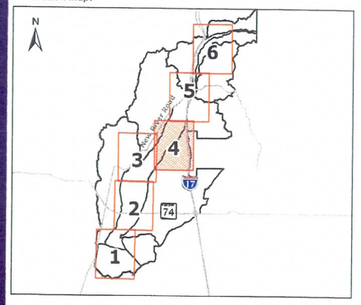
Location Map:



N

0 600 1,200 1,800 2,400 Feet

Project No.
182000418

Prepared By:
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June 2008

Title:
New River Downstream of I-17 Recommended Alternative
Figure 17

Revision:

By Appd. Date

Sheet 4 of 6

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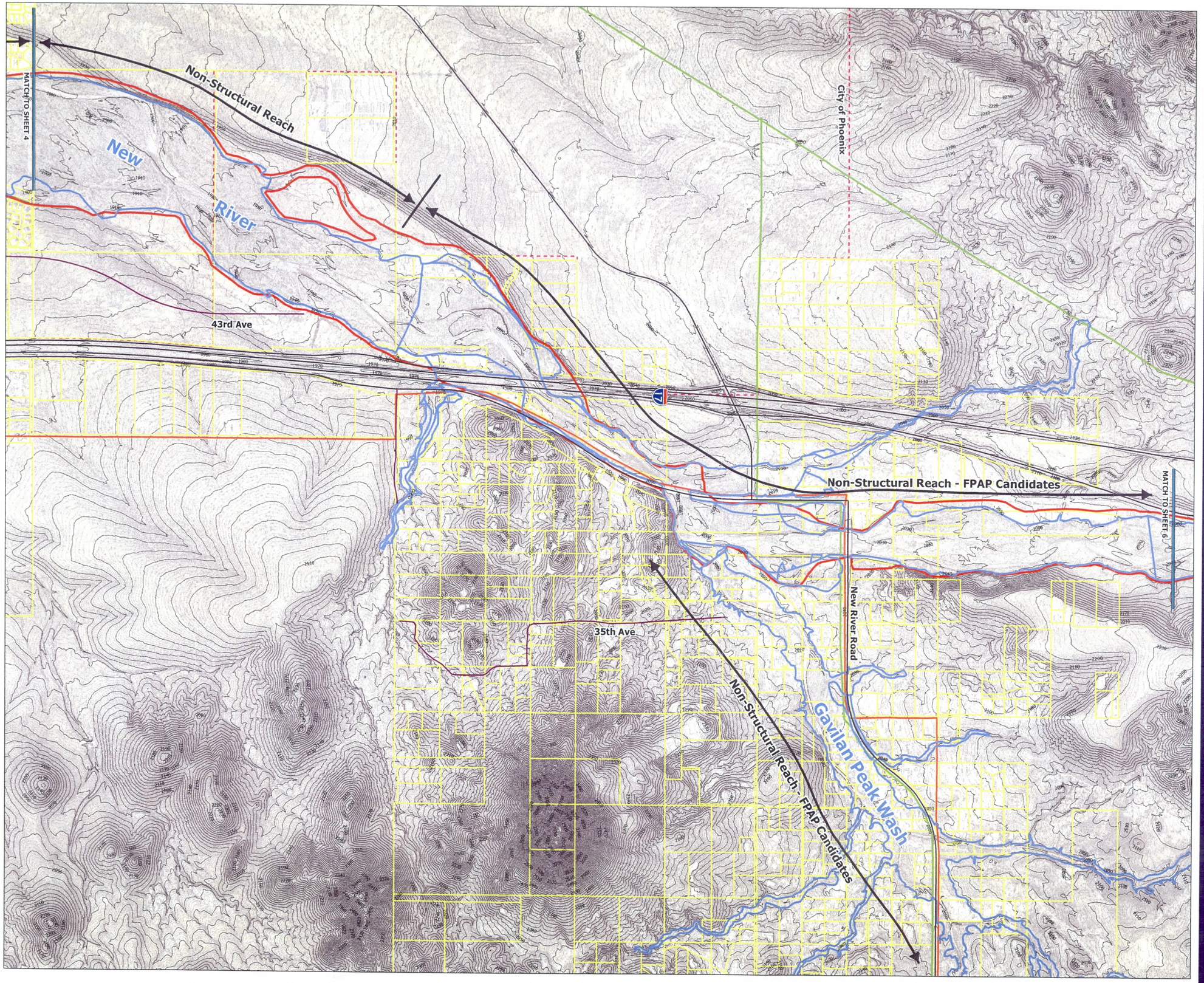

Flood Control District
of Maricopa County
2801 W. Durango St.
Phoenix, AZ 85009

Upper New River ADMP
FCD 2005CO20

Prepared By:
Stantec Consulting Inc.
8211 S. 48th Street
Phoenix, AZ U.S.A. 85044

Legend:

- Roadway/Wash Crossing
- City Proposed Roads
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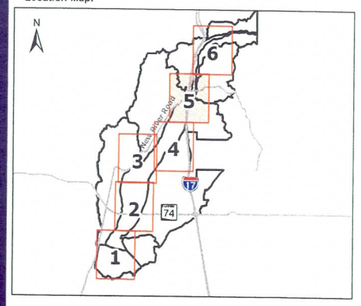

N

0 600 1,200 1,800 2,400 Feet

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182000418

Prepared By:
AMG
June 2008

Title:
New River Downstream
of I-17 Recommended Alternative
Figure 17

Revision:

By Appd. Date

Sheet 5 of 6

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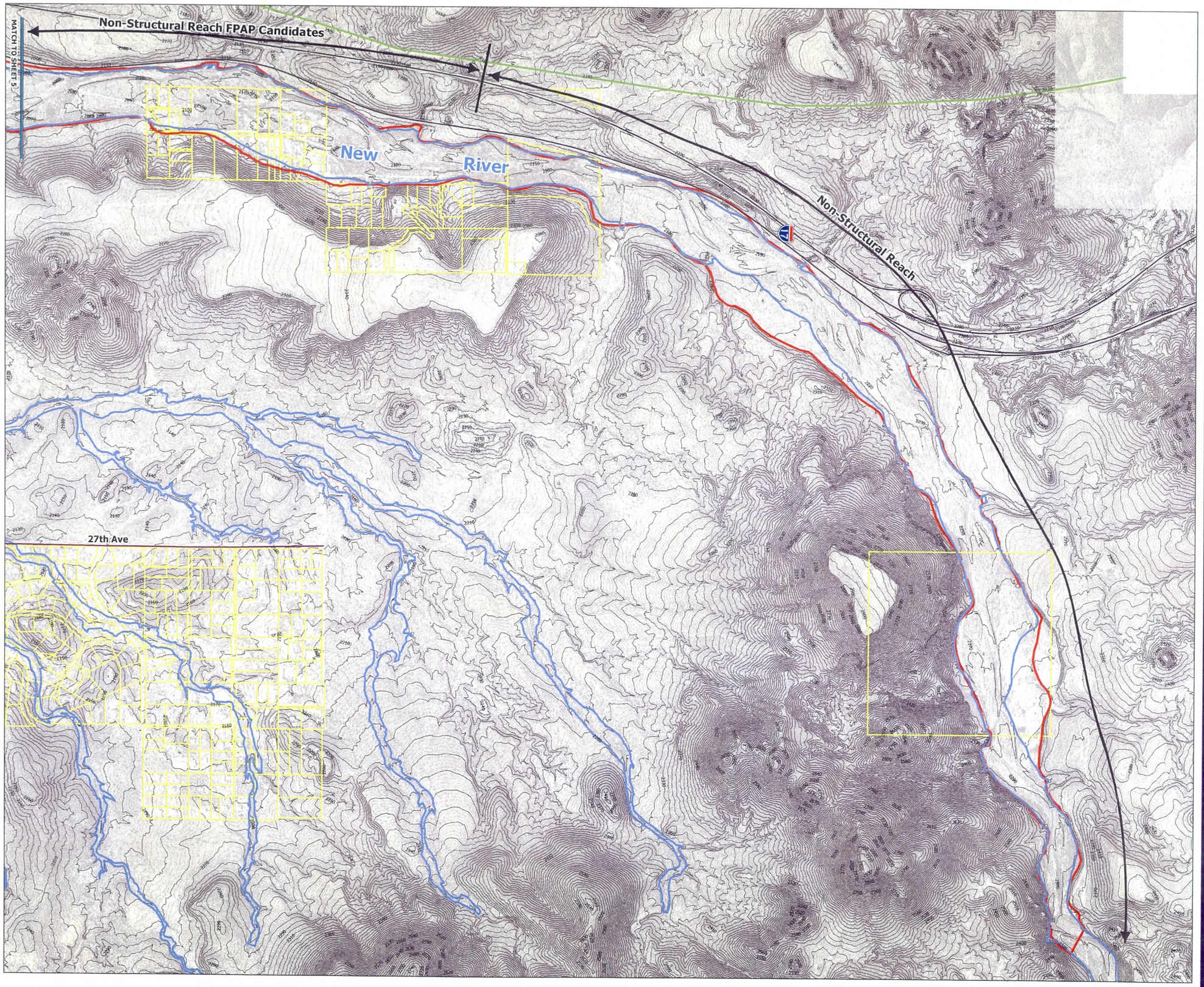

Flood Control District
of Maricopa County
2801 W. Durango St.
Phoenix, AZ 85009

Upper New River ADMP
FCD 2005CO20

Prepared By:

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Phoenix, AZ U.S.A. 85044

Legend:

- City Proposed Roads
- Roadway
- Gasline
- Index Contour
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- Erosion Hazard
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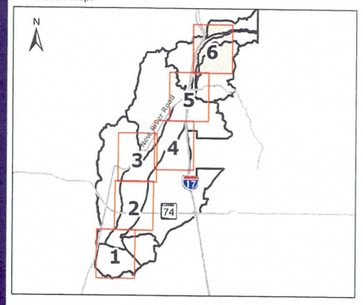
Location Map:



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0 600 1,200 1,800 2,400 Feet

Project No.
182000418

Prepared By:
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June 2008

Title:
New River Downstream
of I-17 Recommended Alternative
Figure 17

Revision:

By Appd. Date

Sheet 6 of 6

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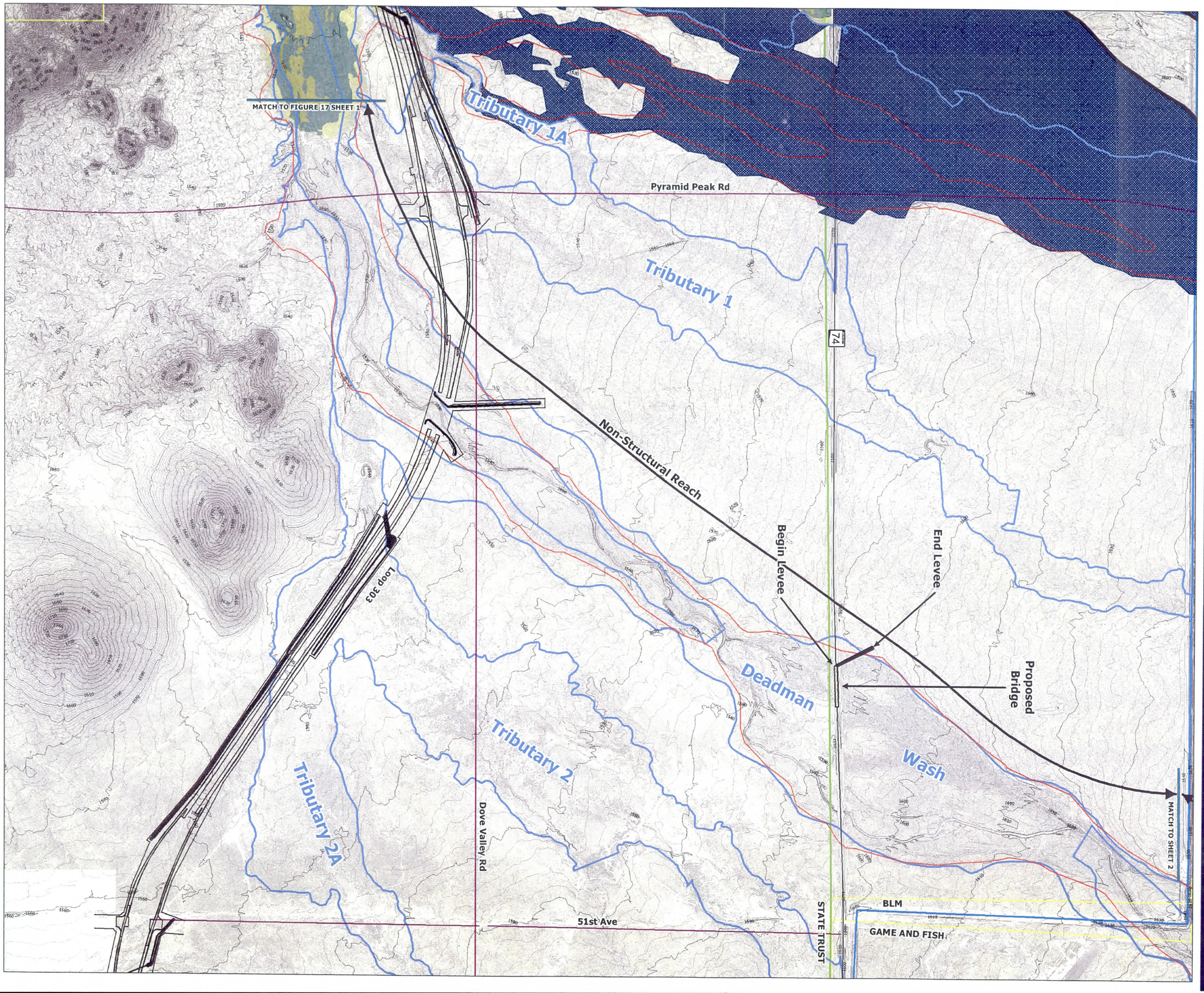

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Upper New River ADMP
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Legend:
- Proposed Bridge
- City Proposed Roads
- Roadway
- Levee
- Waterline
- Gasline
- Index Contour
- 2 ft Intermediate Contour
- 100-year Floodplain Boundaries
- Reclaimed Floodplain
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Two Dimensional Hydraulic Model Flow Depth (ft)
- >12
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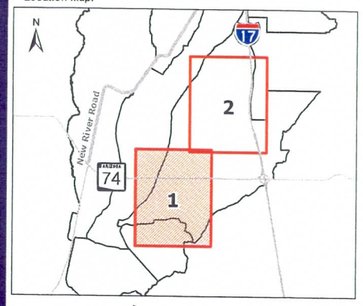
- <1

Location Map:



N

0 600 1,200 1,800 2,400 Feet

Project No.
182000418

Prepared By:
AMG
June 2008

Revision:

By Appd. Date

Title:
Deadman Wash Downstream of I-17 Recommended Alternative
Figure 18

Sheet 1 of 2

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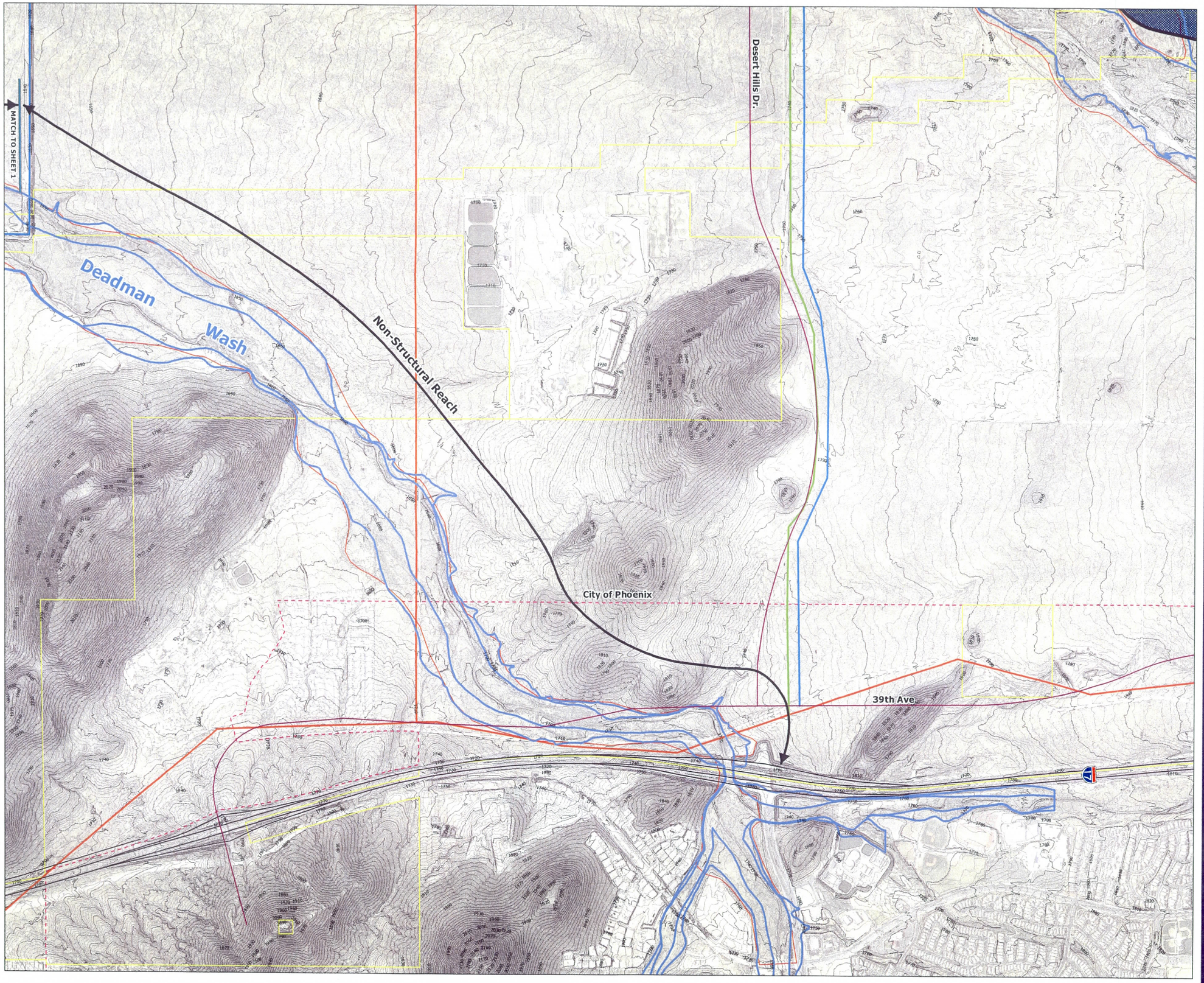

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Phoenix, AZ U.S.A. 85044

Legend:

- City Proposed Roads
- Roadway
- Powerline
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- Index Contour
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- 100-year Floodplain Boundaries
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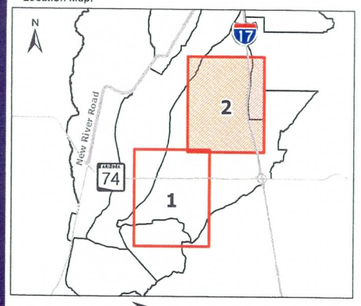
Location Map:



N

0 600 1,200 1,800 2,400 Feet

Project No.
182000418

Prepared By:
AMG
June 2008

Title:
Deadman Wash Downstream of I-17 Recommended Alternative
Figure 18

Revision:

By Appd. Date

Sheet 2 of 2

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Appendix A

Landscape Design Theme and Aesthetic Design Guidelines

ORIENTATION MAP

Upper New River Area Drainage Master Plan

SCENIC RESOURCE ASSESSMENT (SRA):
The primary goal for the aesthetic treatment of District flood protection facilities is to incorporate features and measures that will; enhance the visual appearance of flood protection facilities, preserve the visual character of natural Sonoran Desert landscapes, protect and enhance local community character and create aesthetic value. The SRA of the Upper New River Area Drainage Master Plan identified the surrounding natural and local community visual characteristics. The SRA predominantly analyzes the visual impact of flood control structures. This analysis was then utilized to better complement the existing landscape settings. The characteristics within the study area are primarily a pristine natural landscape with rolling topography associated with the mountain lands and a variety of vegetation densities including the saguaro as a signature feature. The washes and arroyos also provide dense vegetation and variety in landform. Flood control structures within this area should adopt a natural appearance that can blend with the surrounding landscape. There were some minor areas within the recommended alternative which included industrial landscapes. The industrial areas are located near New River within the bajada and need a natural landscape theme that is heavily vegetated with rolling landforms creating positive visual variety.

RECREATION RESOURCE ASSESSMENT (RRA):
The goal for the recreation treatment is to enhance the public value of the District's flood protection facilities by designing these facilities to provide opportunities for incorporating year round recreation open space multiple-uses, by others, as an integral part of structural design. The RRA findings within the Upper New River Area Drainage Master Plan report identified the regional and local recreational features within the study area. The findings are used to enhance the public value of the District's flood protection facilities by identifying potential opportunities for year round recreation and open space linkages as an integral part of flood control facility design. The regional linkages near the recommended alternative include the Black Canyon Hiking & Equestrian Trail, State Route 74 Scenic Corridor, and the Maricopa County Regional Trail System. The Maricopa County Trails include a trail along New River which has a significant connection north/south with tangent trails to the east and west connecting to Lake Pleasant Regional Park, Ben Avery Recreation Area, Cave Creek Regional Park and Spur Cross Ranch Recreation Area. Locally the City of Phoenix and Peoria have plans to create more open space and trails along New River. The recommendations for recreation shall be to protect and maintain the natural visual character while also working with the City of Phoenix and Peoria identifying their needs and future recreation opportunities within the study area.

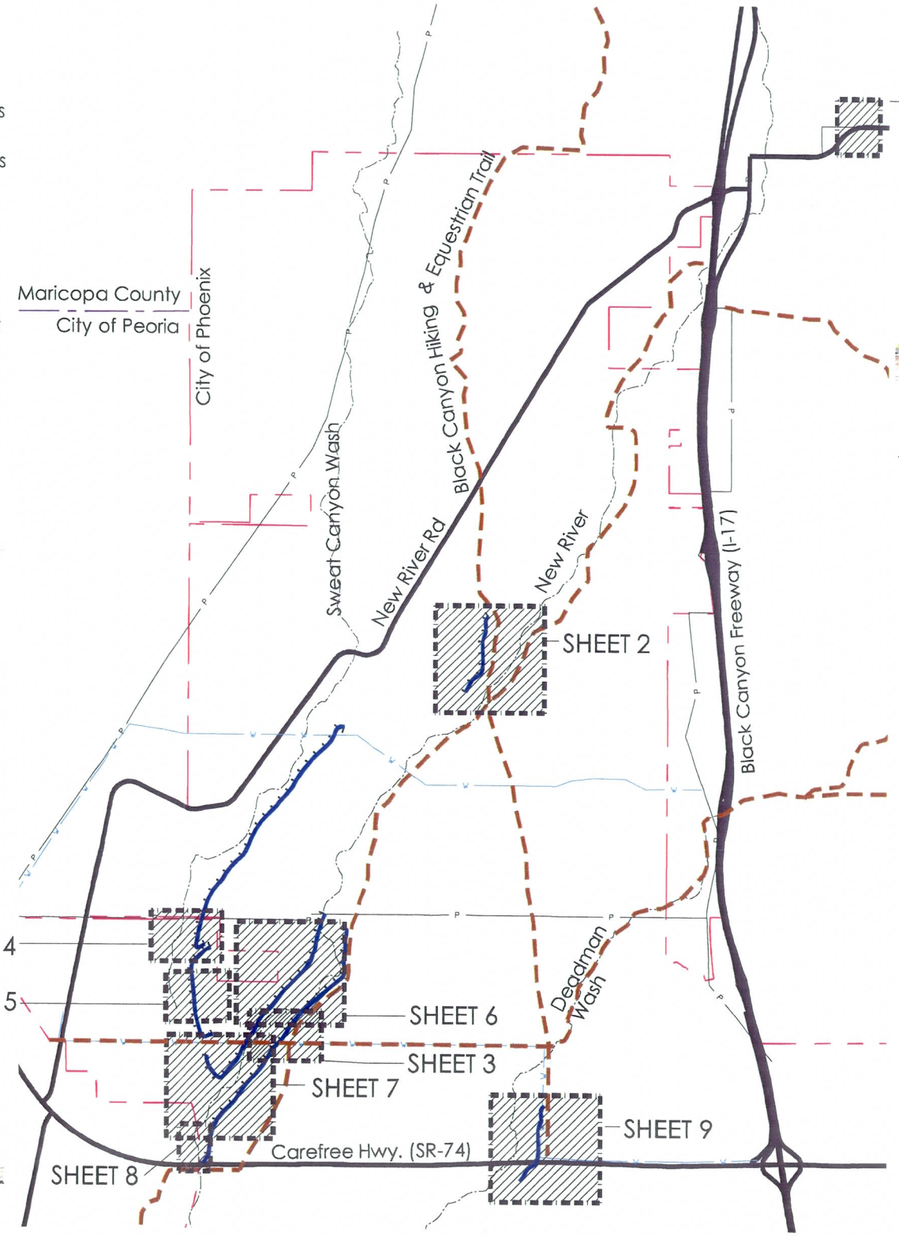
LANDSCAPE DESIGN THEME:
The recommended Natural Landscape Theme represents a design character of organic natural forms, rough edges, boulders and natural aggregate which restores and preserves natural beauty and provides a visual resource. Landform edges blend to native, slopes compliment existing desert and there is the presence of braided streams and natural low flow channels with cobble stone bottoms. The vegetation shall be 100% native species and used to soften, screen and blend engineered slopes. For the levee structures all native materials shall be constructed of earthen materials, boulders and aggregate that blend and conform to the natural desert conditions, color form and texture.

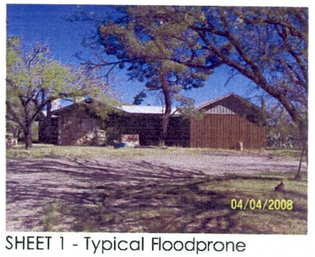
SHEET 3 - Regional Trail Crossing/ O & M Access Road

SHEET 4 - In-Flow (Tributary) Break In Levee

SHEET 5 - Sweat Canyon

SHEET 8 - Typical Bridge & Levee Interaction





SHEET 1 - Typical Floodprone Assistance Program

SHEET 2 - New River West Split

SHEET 6 - New River Levee Reach

SHEET 7 - Confluence of Sweat Canyon Wash & New River

SHEET 9 - Spur Dike at Deadman Wash

NORTH

2801 West Durango Street, Phoenix, Arizona 85009 (602)506-1501

www.fcd.maricopa.gov

A TYPICAL FPAP (FLOODPRONE ASSISTANCE PROGRAM) PURCHASE

Upper New River Area Drainage Master Plan

Typical FPAP Purchase:

Landscape Design Theme:
The recommended Natural Sonoran Desert Uplands Riparian Theme represents a design character of natural arroyo landscape settings found within the Sonoran Desert. The vegetation shall be 100% riparian native species and used to soften, screen and blend flat residential lands. The enlarged area is located within the Rural Sonoran Arizona Uplands vegetation in this region tend to have an increase in density and diversity due to greater precipitation. Common vegetation consist of Mesquite, Palo Verde, Acacia, Bursage and Saltbush with small Cacti and Saguaros located outside the floodplan. This type of natural plant material provides a sustainable environment for wildlife movement corridors, connecting habitats and natural open spaces.

FPAP Re-vegetation Criteria:

1. Vegetation & Surface Treatment:
   - The re-vegetation for the reclaimed area shall mimic adjacent vegetation pattern found along the river and washes in size, density and form.
   - Hydroseed shrubs and groundcover with stain over desert pavement. See hydroseed specifications.
   - Salvage and re-establish indigenous vegetation where possible.
   - Protect existing native vegetation where possible.

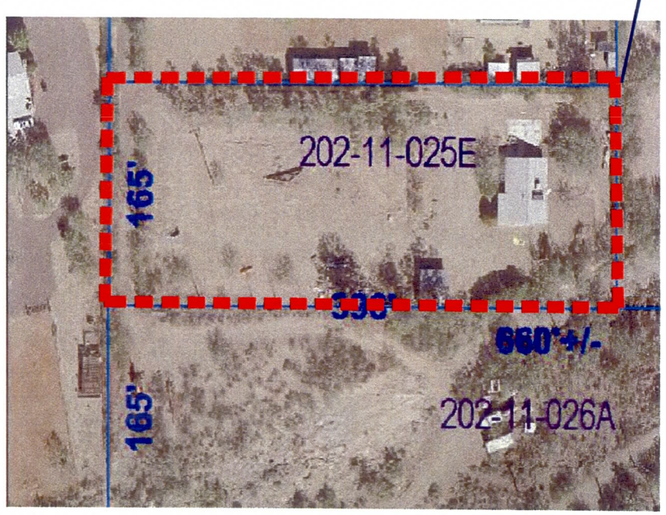
- SEEDMIX - RIPARIAN:

COMMON NAME	BOTANICAL NAME	PLS RATE (POUNDS/ACRE)
ACACIA CONTICTA	WHITETHORN	2
ACACIA GREGGII	CATCLAW ACACIA	4
AMBROSIA DELTOIDEA	TRIANGLE-LEAF BURSAGE	1
ATRIPLEX CANESCENS	FOUR-WING SALTBUSH	1
ATRIPLEX POLYCARGA	QUAILBUSH	1
BAILEYA MULTIRADIATA	DESERT MARIGOLD	0.5
CERCIDIUM MICROPHYLLUM	FOOTHILLS PALO VERDE	2
CHILOPSIS LINEARIS	DESERT WILLOW	1
DIGITARIA CALIFONRICA	ARIZONA COTTONTOP	0.5
ESCHSCHOLZIA MEXICANA	MEXICAN GOLD POPPY	1
LEAQUERELLA GORDONII	GORDON BLADDER POD	0.5
LYCIUM ANDERSONI	WOLFBERRY	1
OLNEYA TESOTA	IRONWOOD	3
ORTHOCARPUS PURPUROSCENS	OWL CLOVER	0.5
PHACELIA CRENULATA	DESERT PHACELIA	1
SPORABOLUS AIROIDES	ALKALI SACATON	1
SPORABOLUS CRYPTANDRUS	SAND DROPSEED	1

2. MATERIALS:
   - The inert material for the ground plain shall blend with the surrounding native surface materials to minimize visual contrast.

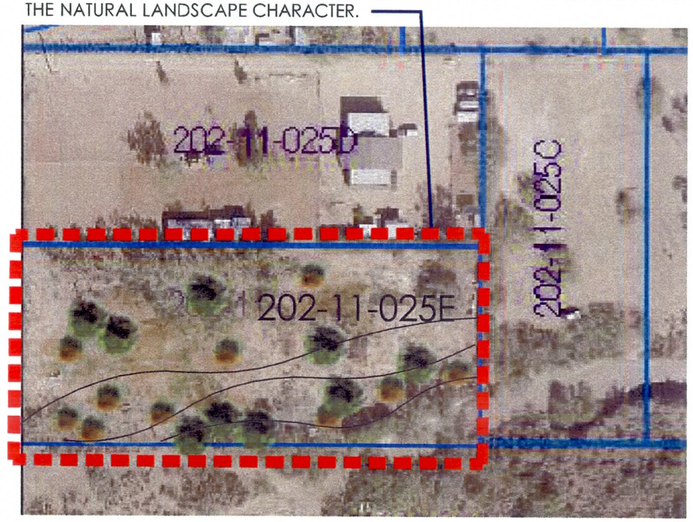
Site Images

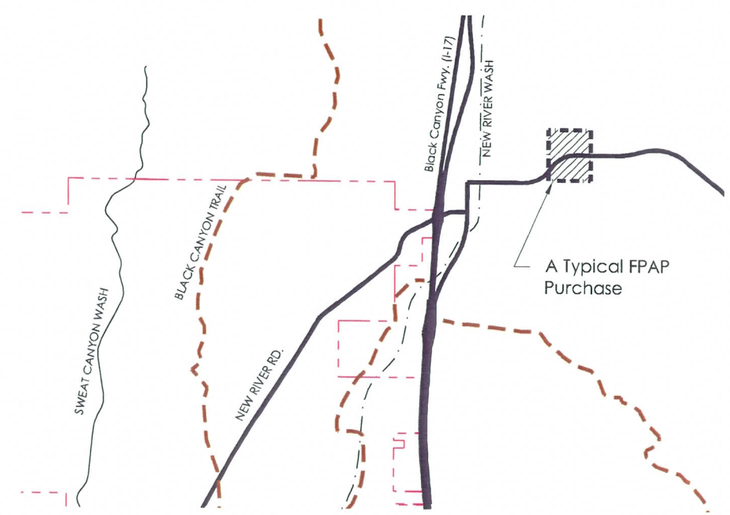
BEFORE



AFTER

RE-VEGETATION OF RECLAIMED AREA - MATCH EXISTING TREE & SHRUB TYPE DENSITY OF SURROUNDING AREA. GRADING SHALL ALSO BE REVISED TO MATCH THE NATURAL LANDSCAPE CHARACTER.





Reference Features

- ROADWAYS
- REGIONAL TRAILS
- PEORIA CITY LIMITS
- PHOENIX CITY LIMITS
- LEVEE ALTERNATIVES

Location Map

NORTH

SHEET 1

2801 West Durango Street, Phoenix, Arizona 85009 (602)506-1501

www.fcd.maricopa.gov

NEW RIVER WEST SPLIT
Upper New River Area Drainage Master Plan

New River West Split - Levee:

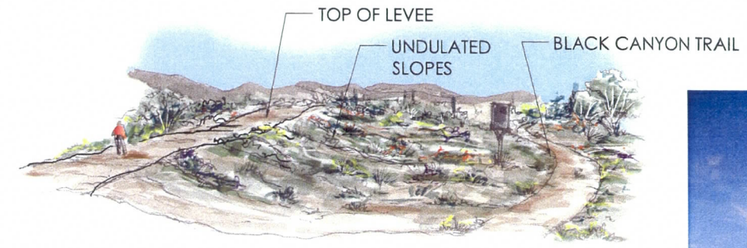
Landscape Design Theme:
The recommended Natural Sonoran Desert Uplands Theme represents a design character of organic natural forms, rough edges, boulders and natural aggregate which restores and preserves natural beauty and provides a visual resource. Landform edges blend to native, slopes complimenting existing desert and there is the presence of braided streams and natural low flow channels with cobble stone bottoms. The vegetation shall be 100% native species and used to soften, screen and blend engineered slopes. For the levee structures all native materials shall be constructed of earthen materials, boulders and aggregate that blend and conform to the natural desert conditions, color form and texture. The enlarged area is located within the Natural Bajada Landscape Character Unit and consists of Mesquite, Palo Verde, Creosote, Brittlebush and Cacti species. This type of natural plant material provides a sustainable environment for wildlife movement corridors, connecting habitats and natural open spaces.

Levee Design Guidelines:

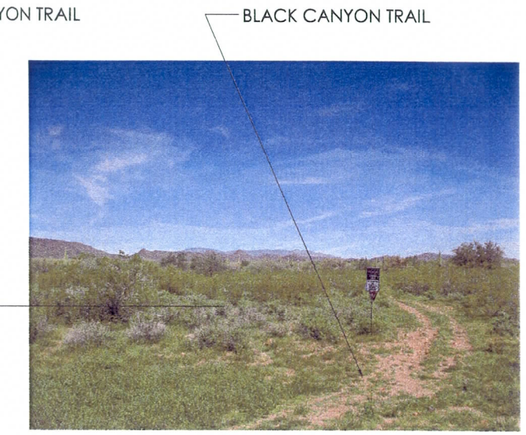
1. Configuration
   - The levee shall have warping side slopes creating a more natural character and match the existing character of the bajada lands.
   - The O & M Road shall meander slightly aligning with the side contours.
   - When possible add berming along the side slopes of the levee for additional undulation.
   - Levee shall appear more organic and less geometric.
   - Side slopes shall be a maximum of 6:1.
   - The levee alignments shall follow topographic high points to lessen levee height.

2. Vegetation & Surface Treatment
   - Plant material shall match existing species and shall respond to the context of the levee.
   - Hydroseed shrubs and groundcover with stain over desert pavement.
   - Salvage and re-establish indigenous vegetation where possible.
   - Place rocks and boulders in an irregular pattern along the side slopes.
   - Salvage surface soil (6"-8") from the levee area and replace in the landscape. Maximum stockpile height for surface soil should be to 8 feet.
   - Trees shall be located along the side slopes and maintain a 15 ft. distance from edge of canopy to the toe of the levee.
   - Avoid disturbance to Saguaros, Ironwoods and to the existing xeroriparian vegetation as much as possible.
   - The surface for the O & M Road shall be gravel mulch matching existing surroundings.
   - The gravel mulch for the O & M Road shall have a stabilizer mix to reduce dust and erosion.

3. Structural Component
   - Use materials, shapes, and colors that blend in with the surroundings for the levee as required during final design. Use of boulders native to the vicinity is preferred as a structural component.
   - Exposed concrete components shall be colored concrete and textured to match the natural landscape.

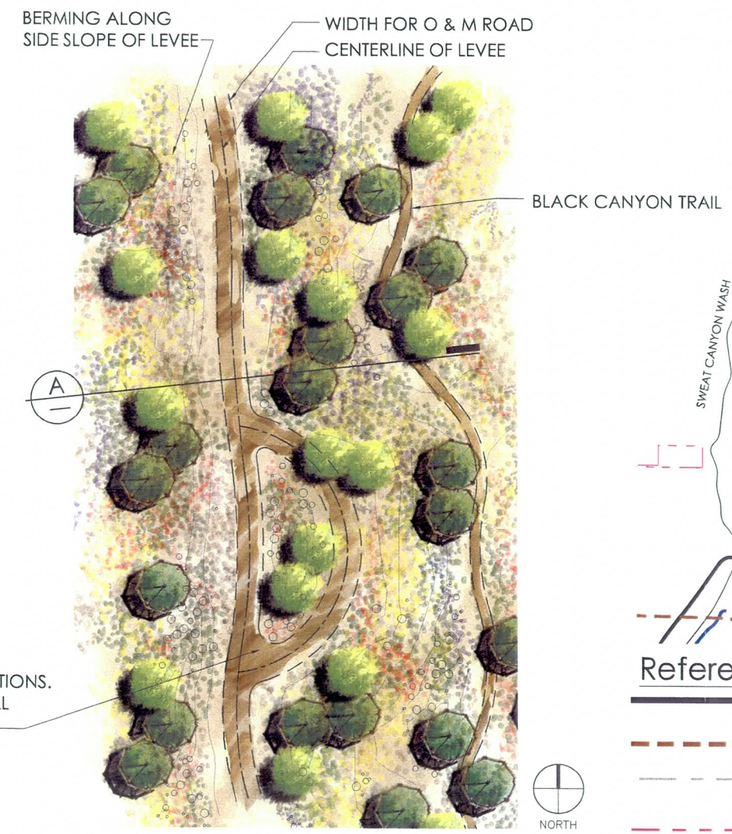


Perspective Sketch

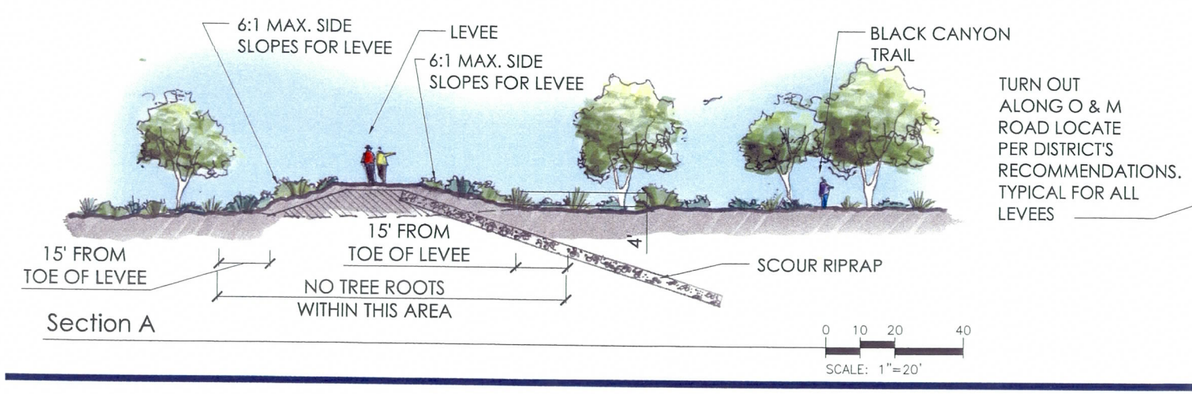


Site Image & Perspective

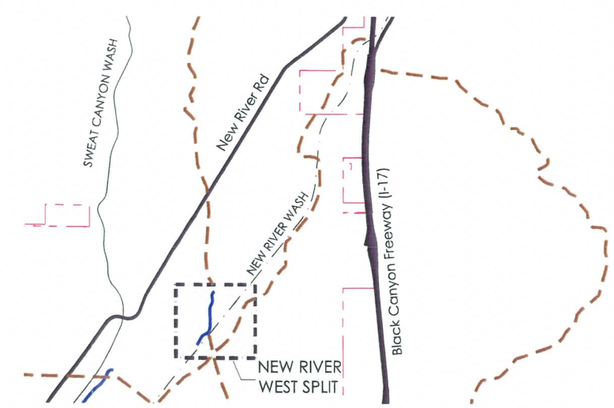
BLACK CANYON TRAIL NEAR STOCK POND



Plan View



Section A



Reference Features

ROADWAYS
REGIONAL TRAILS
PEORIA CITY LIMITS
PHOENIX CITY LIMITS
LEVEE ALTERNATIVES

Location Map

NORTH

Sheet 2

REGIONAL TRAIL / O & M ACCESS ROAD

Upper New River Area Drainage Master Plan

Regional Trail / O & M Access Road - Levee Interaction:

Landscape Design Theme:
The recommended Natural Sonoran Desert Uplands Riparian Theme represents a design character of natural arroyo landscape settings found within the Sonoran Desert. The vegetation shall be 100% riparian native species and used to soften, screen and blend engineered slopes. For the levee structures all native materials shall be constructed of earthen materials, boulders and aggregate that blend and conform to the natural desert conditions, color form and texture. The enlarged area is located within the Natural and Pastoral Valley River and Washes consisting of Ironwood, Mesquite, Palo Verde, Willow Trees, Bursage and Saltbush. This type of natural plant material provides a sustainable environment for wildlife movement corridors, connecting habitats and natural open spaces.

Regional trail/Levee Interaction Design Guidelines:

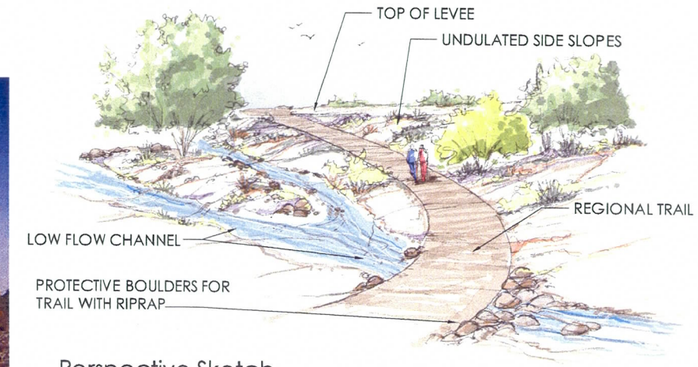
1. Configuration
   - The levee shall have warping side slopes creating a more natural character and match the existing character of the bajada lands.
   - The O& M Road shall meander slightly aligning with the side contours.
   - When possible add berming along the side slopes of the levee for additional undulation.
   - Levee shall appear more organic and less geometric.
   - Side slopes shall be a maximum of 6:1.
   - The Regional trail shall be protected along the low flow area with boulders and riprap.
   - The trail shall have a maximum slope of 12:1.
   - The low flow channel shall have a sandy bottom with some boulders.
   - Create islands in the low flow channel to add vegetation within the wash areas.
   - Access road for levee shall be every 1 mile

2. Vegetation & Surface Treatment
   - Plant material shall match existing species and shall respond to the context of the levee.
   - Hydroseed shrubs and groundcover with stain over desert pavement.
   - Salvage and re-establish indigenous vegetation where possible.
   - Place rocks and boulders in an irregular pattern along the side slopes.
   - Salvage surface soil (6"-8") from the levee area and replace in the landscape. Maximum stockpile height for surface soil should be to 8 feet.
   - Trees shall be located along the side slopes and maintain a 15 ft. distance from edge of canopy to the toe of the levee.
   - Avoid disturbance to Saguaros, Ironwoods and to the existing xeroriparian vegetation as much as possible.
   - The surface for the O & M Road shall be gravel mulch matching existing surroundings.
   - The gravel mulch for the O & M Road shall have a stabilizer mix to reduce dust and erosion.

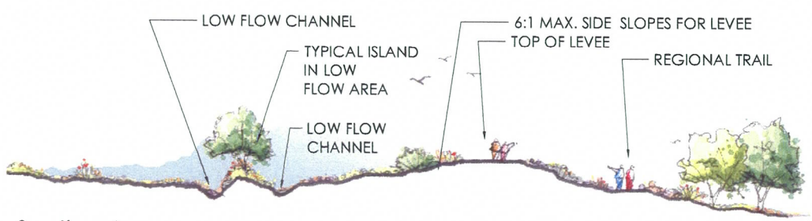
3. Structural Component
   - Use materials, shapes, and colors that blend in with the surroundings for the levee and boulders within the low flow trail crossing as required during final design. Use of boulders native to the vicinity is preferred as a structural component.
   - Exposed concrete components shall be colored concrete & textured to blend with the natural landscape.

NEW RIVER

Site Image & Perspective



Perspective Sketch



Section A

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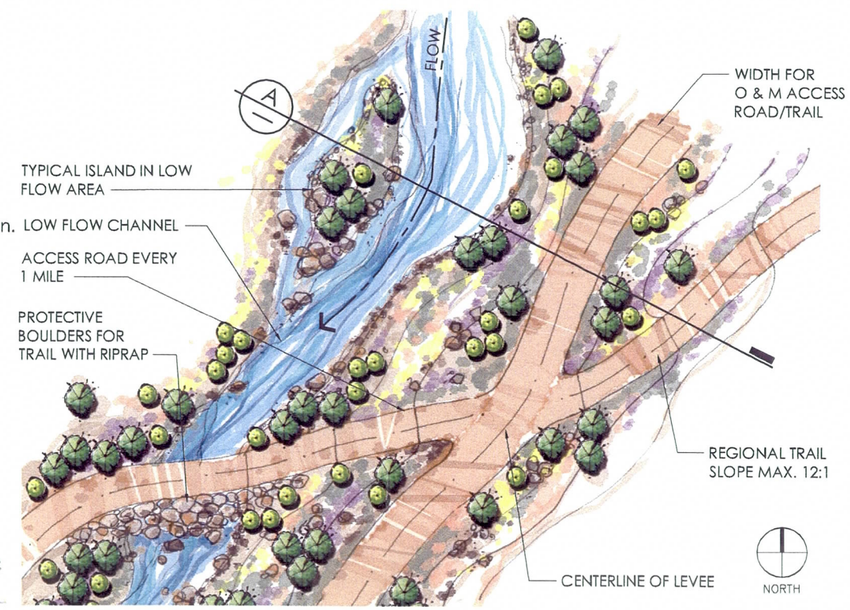
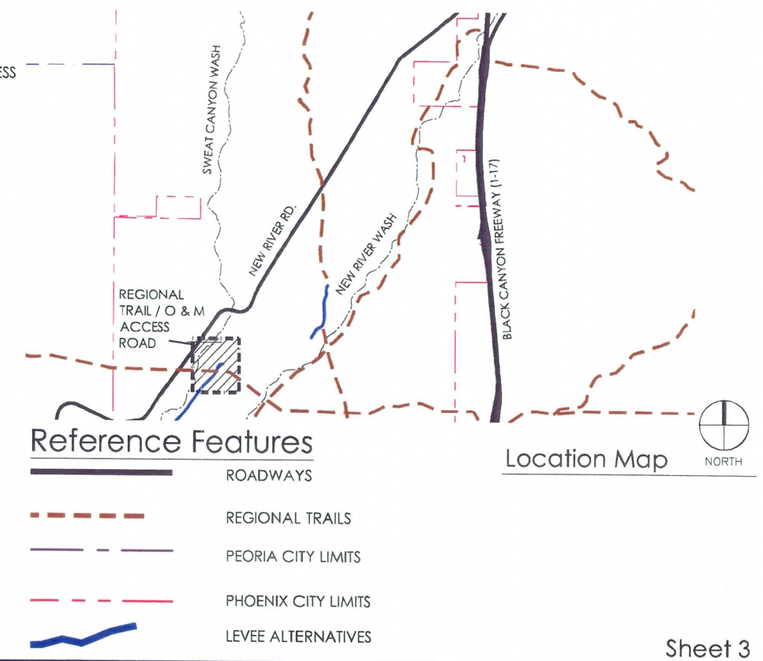


Plan View

0 15 30 60



Location Map

Sheet 3

IN-FLOW (TRIBUTARY) BREAK IN LEVEE

Upper New River Area Drainage Master Plan

In-Flow (Tributary) Break In Levee:

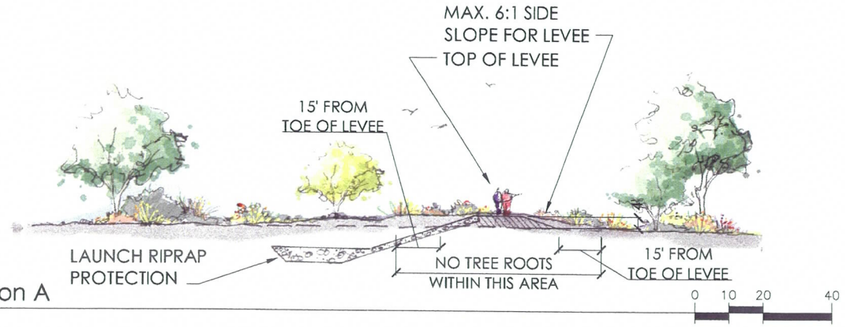
Landscape Design Theme:
The recommended Natural Sonoran Desert Uplands Riparian Theme represents a design character of natural arroyo landscape settings found within the Sonoran Desert. The vegetation shall be 100% riparian native species and used to soften, screen and blend engineered slopes. For the levee structures and training dikes all native materials shall be constructed of earthen materials, boulders and aggregate that blend and conform to the natural desert conditions, color form and texture. The enlarged area is located within the Natural and Pastoral Valley River and Washes consisting of Ironwood, Mesquite, Palo Verde, Willow Trees, Bursage and Saltbush. This type of natural plant material provides a sustainable environment for wildlife movement corridors, connecting habitats and natural open spaces.

Bridge & Levee Interaction Design Guidelines:

1. Configuration
   - The levee shall have warping side slopes creating a more natural character and match the existing character of the bajada lands.
   - The O & M Road shall meander slightly aligning with the side contours.
   - When possible add berming along the side slopes of the levee for additional undulation.
   - Levee shall appear more organic and less geometric.
   - Side slopes shall be a maximum of 6:1.
   - Underpass shall have enough spacing for horse trail crossing.
   - Parking shall be provided along the levee.
   - The levee alignment shall follow topographic high point to lessen levee height.

2. Vegetation & Surface Treatment
   - Plant material shall match existing species and shall respond to the context of the levee.
   - Hydroseed shrubs and groundcover with stain over desert pavement.
   - Salvage and re-establish indigenous vegetation where possible.
   - Place rocks and boulders in an irregular pattern along the side slopes.
   - Salvage surface soil (6"-8") from the levee area and replace in the landscape. Maximum stockpile height for surface soil should be to 8 feet.
   - Trees shall be located along the side slopes and maintain a 15 ft. distance from edge of canopy to the toe of the levee.
   - Avoid disturbance to Saguaros, Ironwoods and to the existing xeroriparian vegetation as much as possible.
   - The surface for the O & M Road shall be gravel mulch matching existing surroundings.
   - The gravel mulch for the O & M Road shall have a stabilizer mix to reduce dust and erosion.

3. Structural Component
   - Use materials, shapes, and colors that blend in with the surroundings for the levee as required during final design. Use of boulders native to the vicinity is preferred as a structural component.
   - Exposed concrete shall be colored concrete and textured to match the natural landscape.



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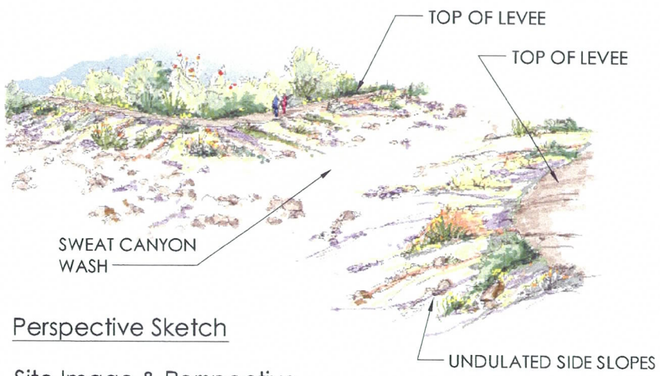
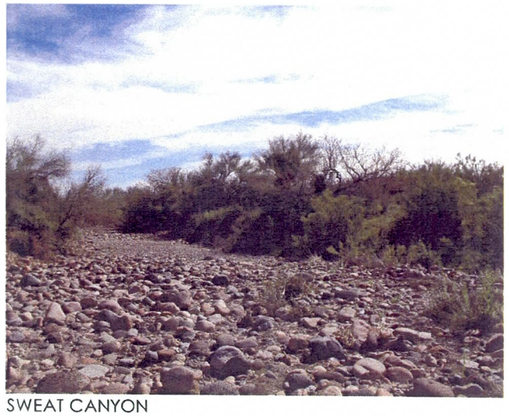
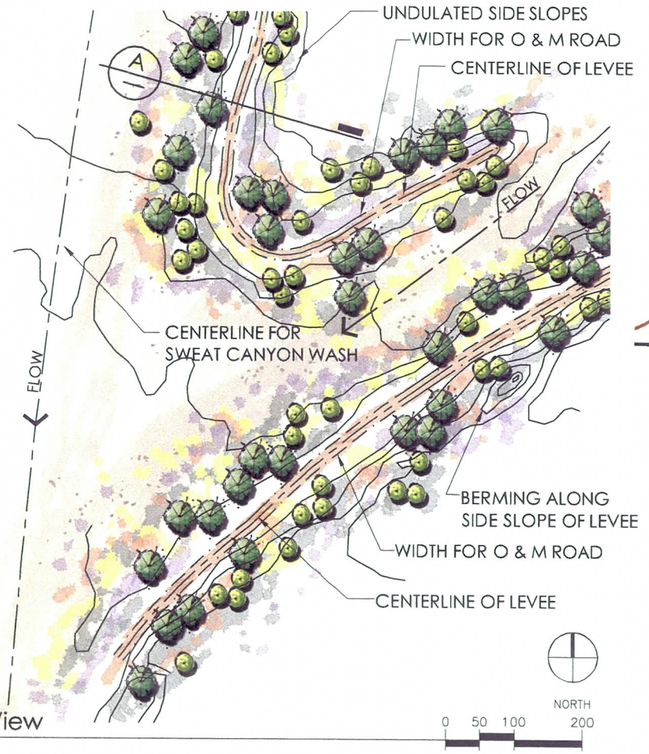


Perspective Sketch

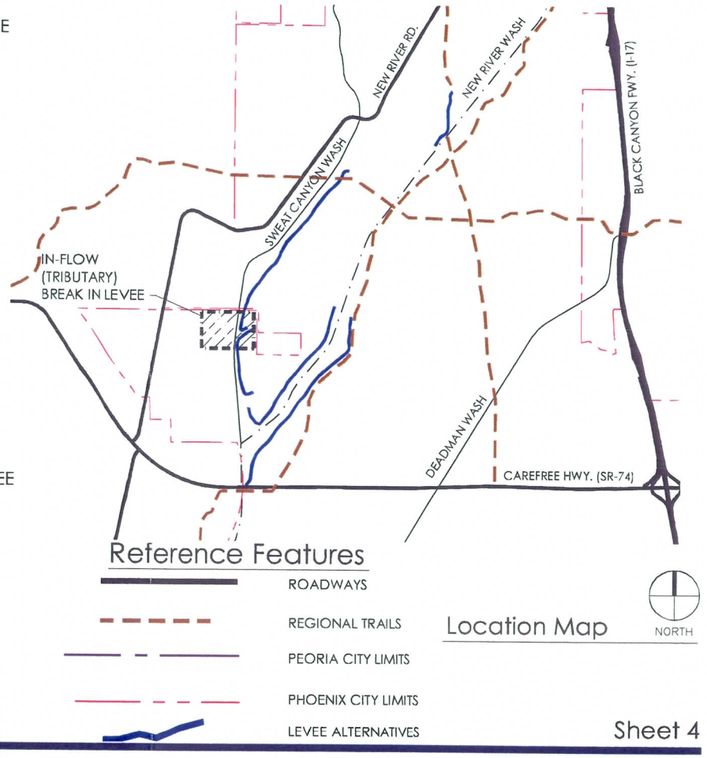


SWEAT CANYON

Site Image & Perspective



Plan View



Location Map

Sheet 4

2801 West Durango Street, Phoenix, Arizona 85009 (602)506-1501

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SWEAT CANYON WASH
Upper New River Area Drainage Master Plan

Sweat Canyon Wash - Levee

Landscape Design Theme:
The recommended Natural Sonoran Desert Uplands Theme represents a design character of organic natural forms, rough edges, boulders and natural aggregate which restores and preserves natural beauty and provides a visual resource. Landform edges blend to native, slopes complimenting existing desert and there is the presence of braided streams and natural low flow channels with cobble stone bottoms. The vegetation shall be 100% native species and used to soften, screen and blend engineered slopes. For the levee structures all native materials shall be constructed of earthen materials, boulders and aggregate that blend and conform to the natural desert conditions, color form and texture. The enlarged area is located within the Natural and Pastoral Bajada and consists of Mesquite, Palo Verde, Creosote, Brittlebush and Cacti species. this type of natural plant material provides a sustainable environment for wildlife movement corridors, connecting habitats and natural open spaces.

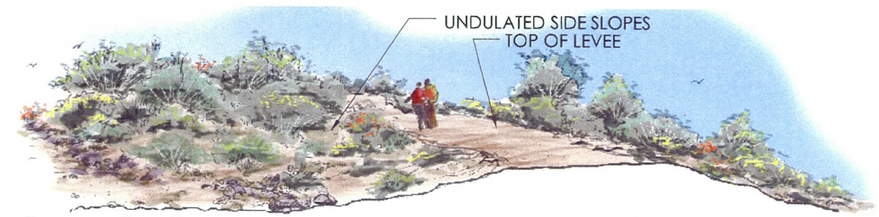
Levee Design Guidelines:

1. Configuration
   - The levee shall have warping side slopes creating a more natural character and match the existing character of the bajada lands.
   - The O & M Road shall meander slightly aligning with the side contours.
   - When possible add berming along the side slopes of the levee for additional undulation.
   - Levee shall appear more organic and less geometric.
   - Side slopes shall be a maximum of 6:1.
   - The levee alignments shall follow topographic high point to lessen levee height.

2. Vegetation & Surface Treatment
   - Plant material shall match existing species and shall respond to the context of the levee.
   - Hydroseed shrubs and groundcover with stain over desert pavement.
   - Salvage and re-establish indigenous vegetation where possible.
   - Place rocks and boulders in an irregular pattern along the side slopes.
   - Salvage surface soil (6"-8") from the levee area and replace in the landscape. Maximum stockpile height for surface soil should be to 8 feet.
   - Trees shall be located along the side slopes and maintain a 15 ft. distance from edge of canopy to the toe of the levee.
   - Avoid disturbance to Saguaros, Ironwoods and to the existing xeroriparian vegetation as much as possible.
   - The surface for the O & M Road shall be gravel mulch matching existing surroundings.
   - The gravel mulch for the O & M Road shall have a stabilizer mix to reduce dust and erosion.

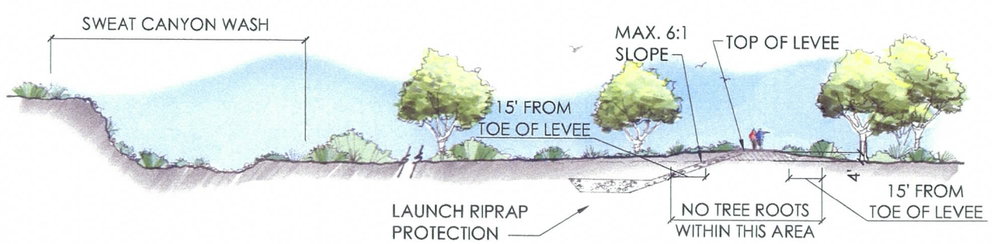
3. Structural Component
   - Use materials, shapes, and colors that blend in with the surroundings for the levee as required during final design. Use of boulders native to the vicinity is preferred as a structural component.
   - Exposed concrete components shall be colored concrete and textured to match the natural landscape.

SWEAT CANYON WASH



Perspective Sketch

Site Image & Perspective



Section A

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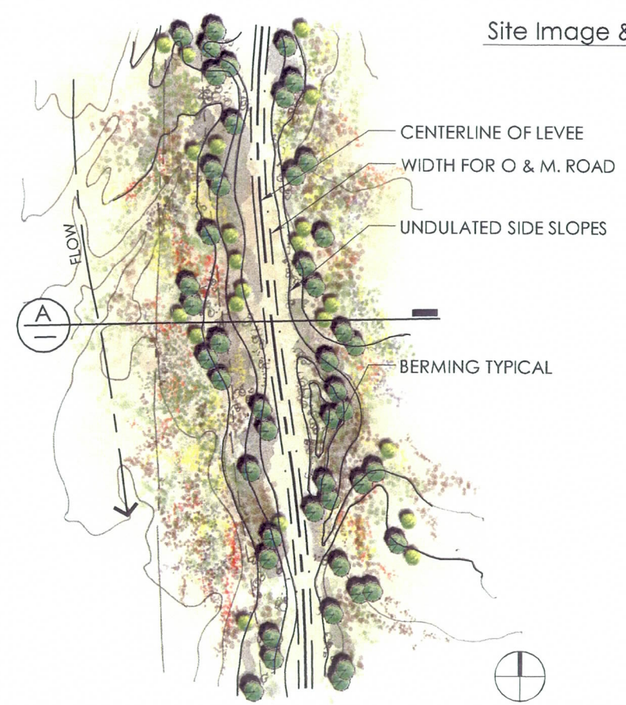

Plan View

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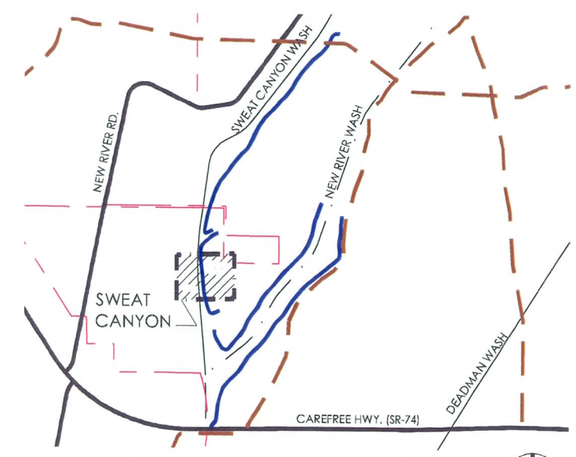


Location Map

NORTH

Reference Features
- ROADWAYS
- REGIONAL TRAILS
- PEORIA CITY LIMITS
- PHOENIX CITY LIMITS
- LEVEE ALTERNATIVES

Sheet 5

NEW RIVER LEVEE REACH

Upper New River Area Drainage Master Plan

New River Levee Reach - Levee:

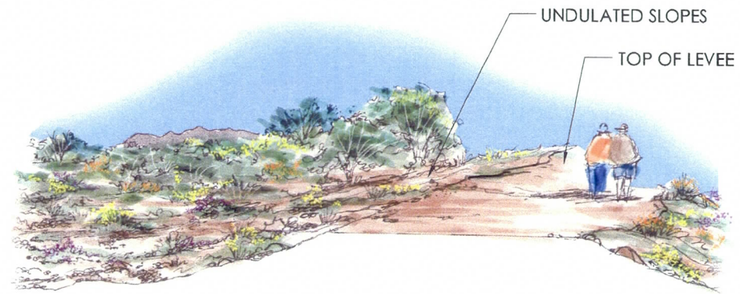
Landscape Design Theme:
The recommended Natural Sonoran Desert Uplands Riparian Theme represents a design character of natural arroyo landscape settings found within the Sonoran Desert. The vegetation shall be 100% riparian native species and used to soften, screen and blend engineered slopes. For the levee structures all native materials shall be constructed of earthen materials, boulders and aggregate that blend and conform to the natural desert conditions, color form and texture. The enlarged area is located within the natural and pastoral valley river and washes consisting of Ironwood, Mesquite, Palo Verde, Willow Trees, Bursage and Saltbush. This type of natural plant material provides a sustainable environment for wildlife movement corridors, connecting habitats and natural open spaces.

Levee Design Guidelines:

1. Configuration
   - The levee shall have warping side slopes creating a more natural character and match the existing character of the bajada lands.
   - The O & M Road shall meander slightly aligning with the side contours.
   - When possible add berming along the side slopes of the levee for additional undulation.
   - Levee shall appear more organic and less geometric.
   - Side slopes shall be a maximum of 6:1.
   - The levee alignment shall follow topographic high points to lessen levee height.

2. Vegetation & Surface Treatment
   - Plant material shall match existing species and shall respond to the context of the levee.
   - Hydroseed shrubs and groundcover with stain over desert pavement.
   - Salvage and re-establish indigenous vegetation where possible.
   - Place rocks and boulders in an irregular pattern along the side slopes.
   - Salvage surface soil (6"-8") from the levee area and replace in the landscape. Maximum stockpile height for surface soil should be to 8 feet.
   - Trees shall be located along the side slopes and maintain a 15 ft. distance from edge of canopy to the toe of the levee.
   - Avoid disturbance to Saguaros, Ironwoods and to the existing xeroriparian vegetation.
   - The surface for the O & M Road shall be gravel mulch matching existing surroundings.
   - The gravel mulch for the O & M Road shall have a stabilizer mix to reduce dust and erosion.

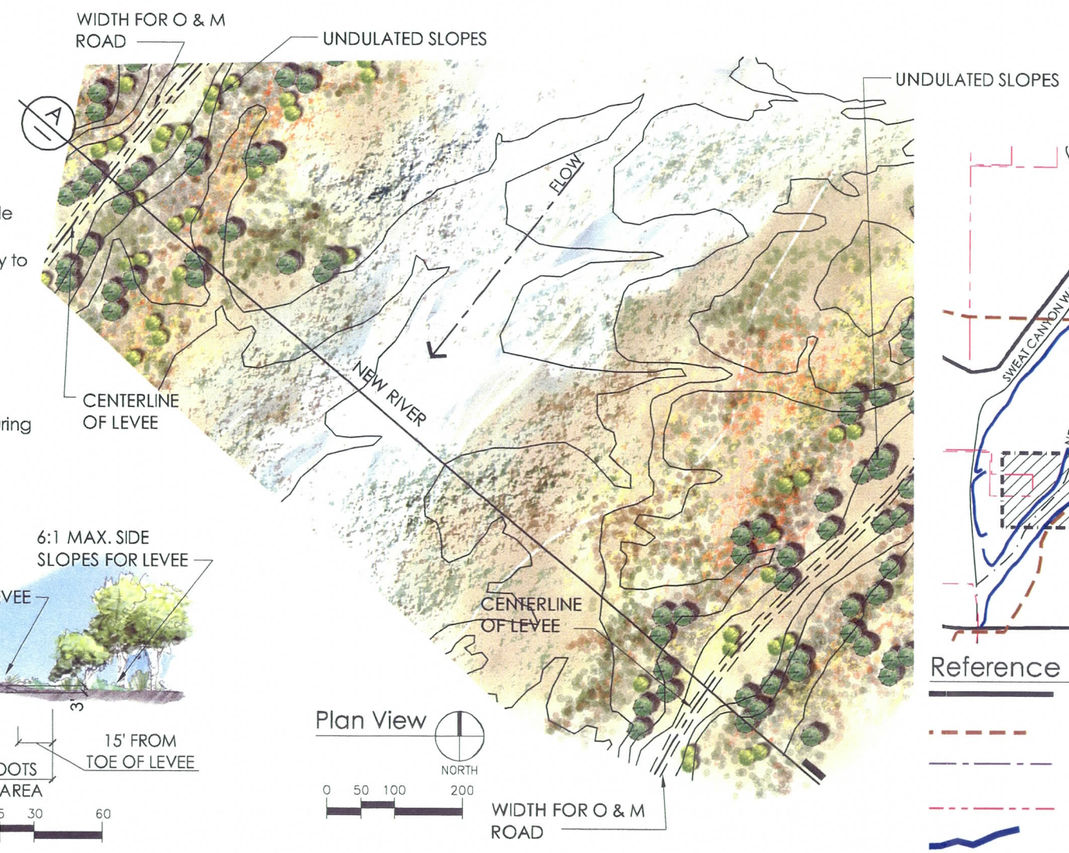
3. Structural Component
   - Use materials, shapes, and colors that blend in with the surroundings for the levee as required during final design. Use of boulders native to the vicinity is preferred as a structural component.
   - Exposed concrete components shall be colored concrete and textured to match the natural landscape.



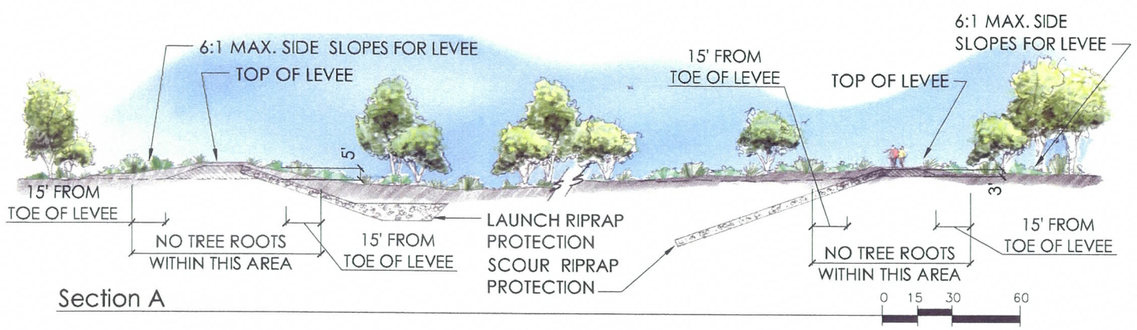
Perspective Sketch

NEW RIVER CHANNEL

Site Image & Perspective



Plan View



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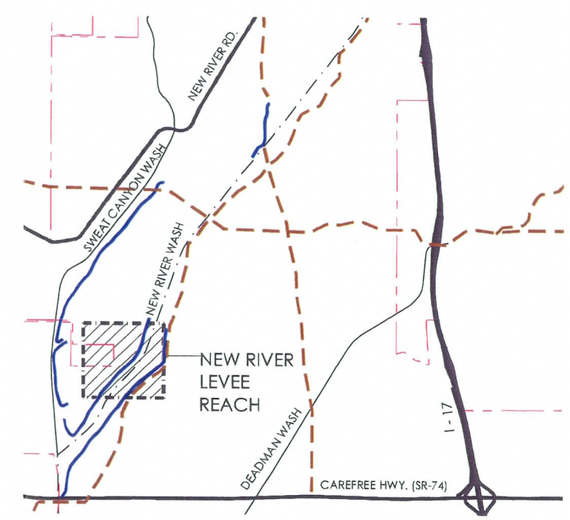


Reference Features

- ROADWAYS
- REGIONAL TRAILS
- PEORIA CITY LIMITS
- PHOENIX CITY LIMITS
- LEVEE ALTERNATIVES

Location Map

NORTH

Sheet 6

CONFLUENCE OF SWEAT CANYON WASH & NEW RIVER

Upper New River Area Drainage Master Plan

Confluence of Sweat Canyon Wash & New River - Levee:

Landscape Design Theme:
The recommended Natural Sonoran Desert Uplands Riparian Theme represents a design character of natural arroyo landscape settings found within the Sonoran Desert. The vegetation shall be 100% riparian native species and used to soften, screen and blend engineered slopes. For the levee structures and training dikes all native materials shall be constructed of earthen materials, boulders and aggregate that blend and conform to the natural desert conditions, color form and texture. The enlarged area is located within the natural and pastoral valley river and washes consisting of Ironwood, Mesquite, Palo Verde, Willow Trees, Bursage and Saltbush. This type of natural plant material provides a sustainable environment for wildlife movement corridors, connecting habitats and natural open spaces.

Bridge & Levee Interaction Design Guidelines:

1. Configuration
   - The levee shall have warping side slopes creating a more natural character and match the existing character of the bajada lands.
   - The O & M Road shall meander slightly aligning with the side contours.
   - There shall be an entrance onto the levee from Carefree Highway.
   - When possible add berming along the side slopes of the levee for additional undulation.
   - Levee shall appear more organic and less geometric.
   - Side slopes shall be a maximum of 6:1.
   - The levee alignment shall follow topographic high points to lessen levee height.

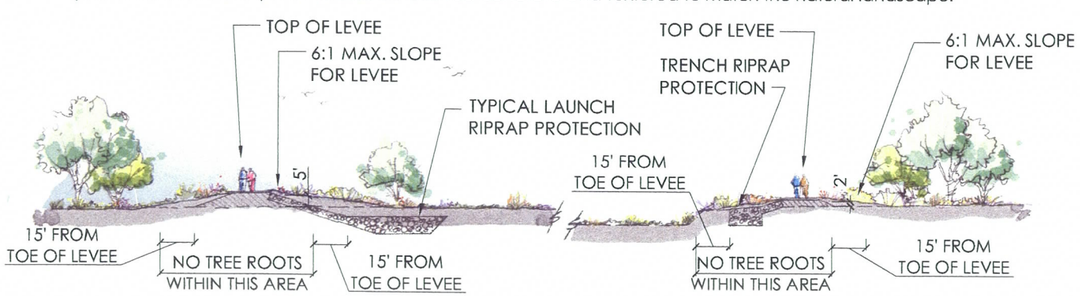
2. Vegetation & Surface Treatment
   - Plant material shall match existing species and shall respond to the context of the levee.
   - Hydroseed shrubs and groundcover with stain over desert pavement.
   - Salvage and re-establish indigenous vegetation where possible.
   - Place rocks and boulders in an irregular pattern along the side slopes.
   - Salvage surface soil (6"-8") from the levee area and replace in the landscape. Maximum stockpile height for surface soil should be to 8 feet.
   - Trees shall be located along the side slopes and maintain a 15 ft. distance from edge of canopy to the toe of the levee.
   - Avoid disturbance to Saguaros, Ironwoods and to the existing xeroriparian vegetation.
   - The surface for the O & M Road shall be mulch gravel matching existing surroundings.
   - The mulch gravel for the O & M Road shall have a stabilizer mix to reduce dust and erosion.
   - Match cobble stone surface at the base of the river and washes.

3. Structural Component
   - Use materials, shapes, and colors that blend in with the surroundings for the levee as required during final design. Use of boulders native to the vicinity is preferred as a structural component.
   - Exposed concrete components shall be colored concrete and textured to match the natural landscape.

Perspective Sketch

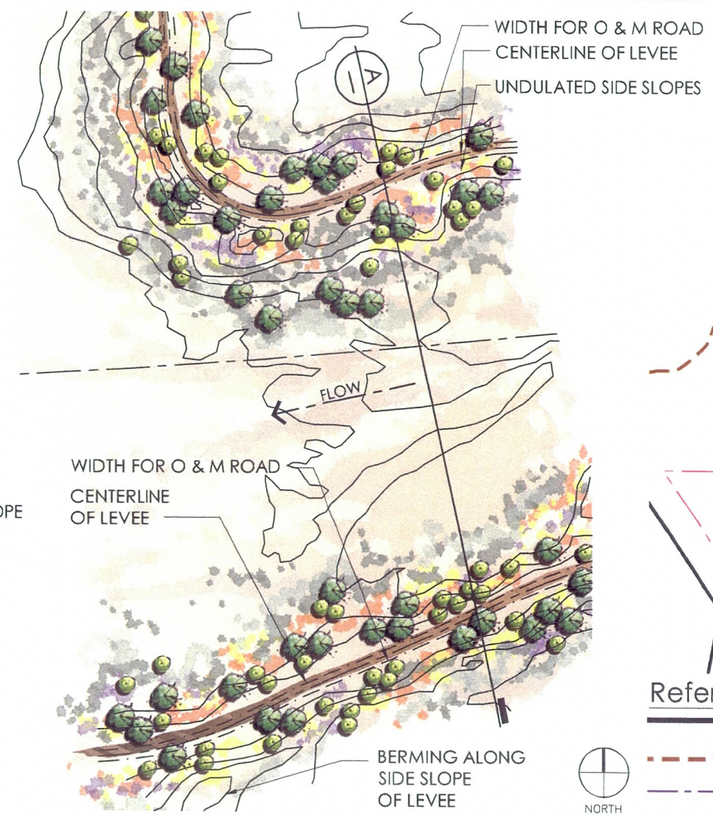
CONFLUENCE

Site Image & Perspective



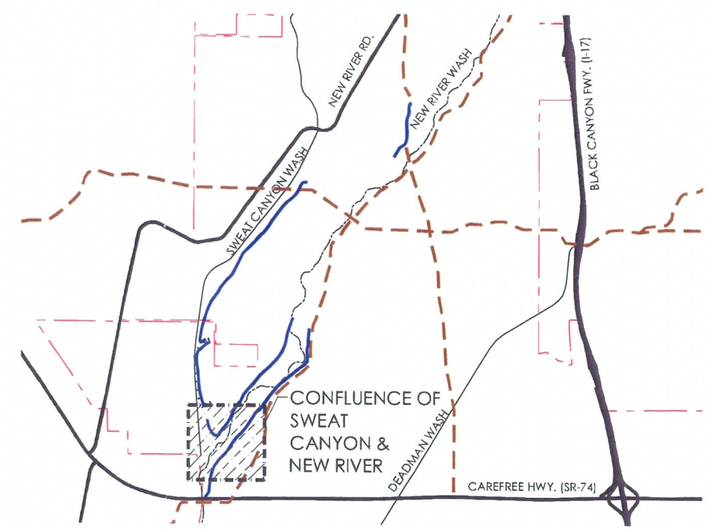
Section A

0 10 20 40



Plan View

0 50 100 200



Location Map

NORTH

Reference Features

- ROADWAYS
- REGIONAL TRAILS
- PEORIA CITY LIMITS
- PHOENIX CITY LIMITS
- LEVEE ALTERNATIVES

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TYPICAL BRIDGE & LEVEE INTERACTION

Upper New River Area Drainage Master Plan

Typical Bridge & Levee Interaction:

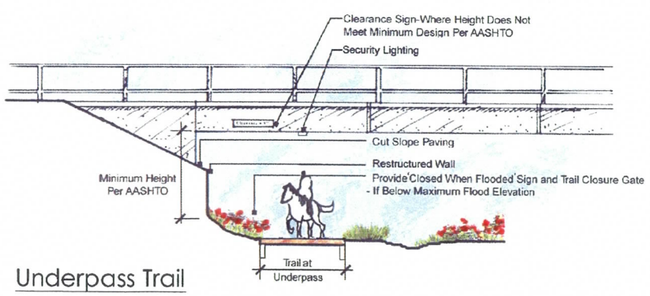
Landscape Design Theme:
The recommended Natural Sonoran Desert Uplands Riparian Theme represents a design character of natural arroyo landscape settings found within the Sonoran Desert. The vegetation shall be 100% riparian native species and used to soften, screen and blend engineered slopes. For the levee structures and training dikes all native materials shall be constructed of earthen materials, boulders and aggregate that blend and conform to the natural desert conditions, color form and texture. The enlarged area is located within the natural and pastoral valley river and washes consisting of Ironwood, Mesquite, Palo Verde, Willow Trees, Bursage and Saltbush. This type of natural plant material provides a sustainable environment for wildlife movement corridors, connecting habitats and natural open spaces.

Bridge & Levee Interaction Design Guidelines:

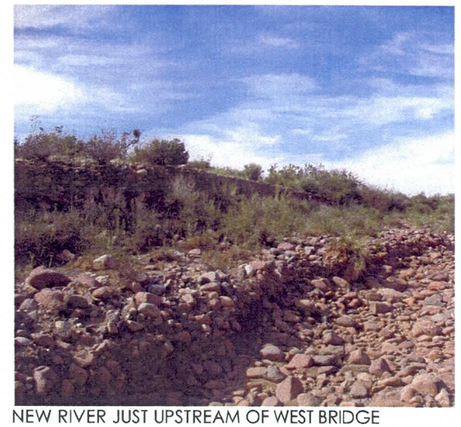
1. Configuration
   - The levee shall have warping side slopes creating a more natural character and match the existing character of the bajada lands.
   - The O & M Road shall meander slightly aligning with the side contours.
   - When possible add berming along the side slopes of the levee for additional undulation.
   - Levee shall appear more organic and less geometric.
   - Side slopes shall be a maximum of 6:1.
   - Underpass shall have enough spacing for equestrian trail crossing.
   - Parking shall be provided along the levee.

2. Vegetation & Surface Treatment
   - Plant material shall match existing species and shall respond to the context of the levee.
   - Hydroseed shrubs and groundcover with stain over desert pavement.
   - Salvage and re-establish indigenous vegetation where possible.
   - Place rocks and boulders in an irregular pattern along the side slopes.
   - Salvage surface soil (6"-8") from the levee area and replace in the landscape. Maximum stockpile height for surface soil should be to 8 feet.
   - Tees shall be located along the side slopes and maintain a 15 ft. distance from edge of canopy to the toe of the levee.
   - Avoid disturbance to Saguaros, Ironwoods and to the existing xeroriparian vegetation as much as possible.
   - There shall be an entrance onto the levee from Carefree Highway.
   - The surface for the O & M Road shall be gravel mulch matching existing surroundings.
   - The gravel mulch for the O & M Road shall have a stabilizer mix to reduce dust and erosion.

3. Structural Component
   - Use materials, shapes, and colors that blend in with the surroundings for the levee as required during final design. Use of boulders native to the vicinity is preferred as a structural component.
   - Exposed concrete components shall be colored concrete and textured to match the natural landscape.

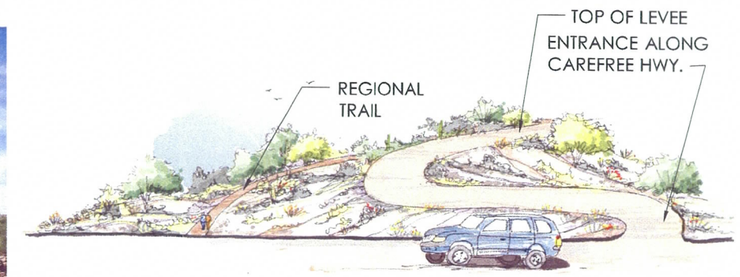


Underpass Trail

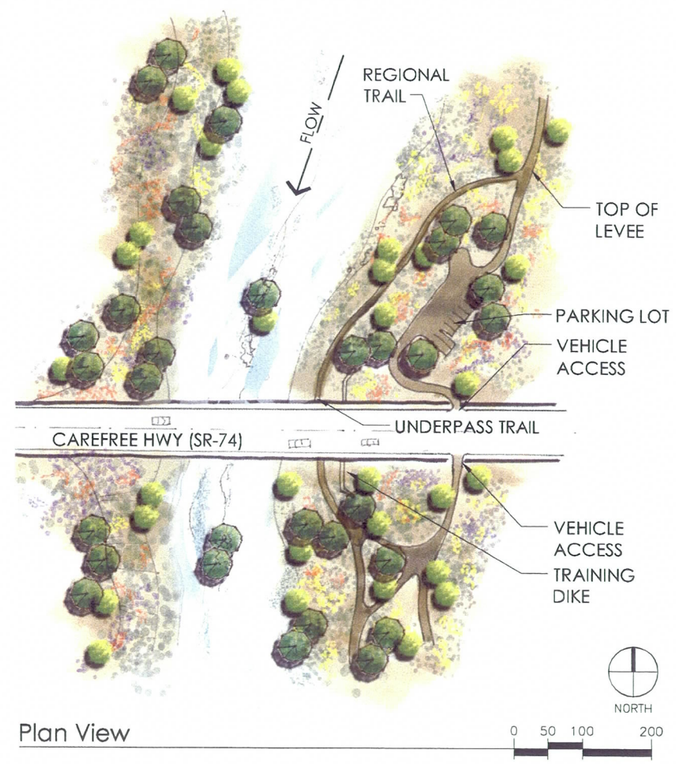


NEW RIVER JUST UPSTREAM OF WEST BRIDGE

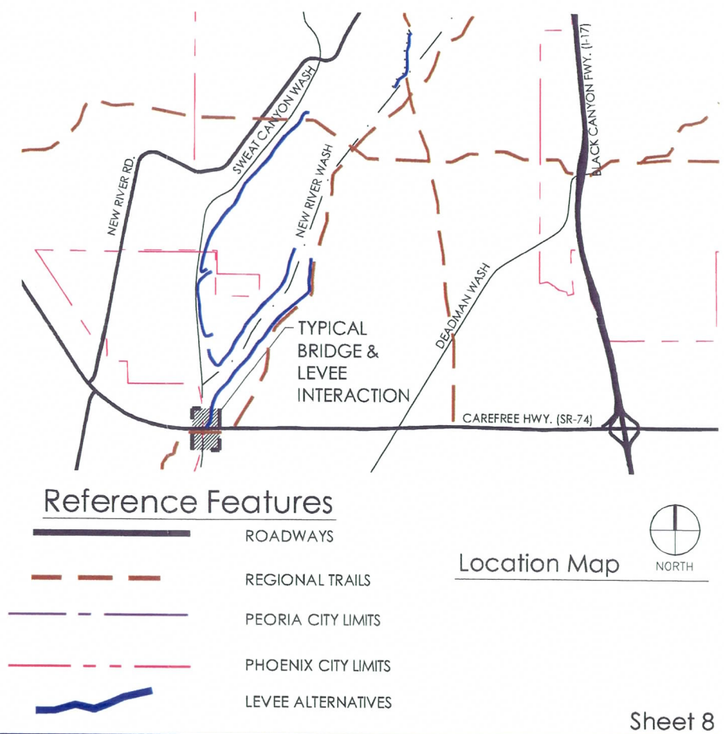
Site Image & Perspective



Perspective Sketch



Plan View



Reference Features

Location Map

Sheet 8

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DEADMAN WASH

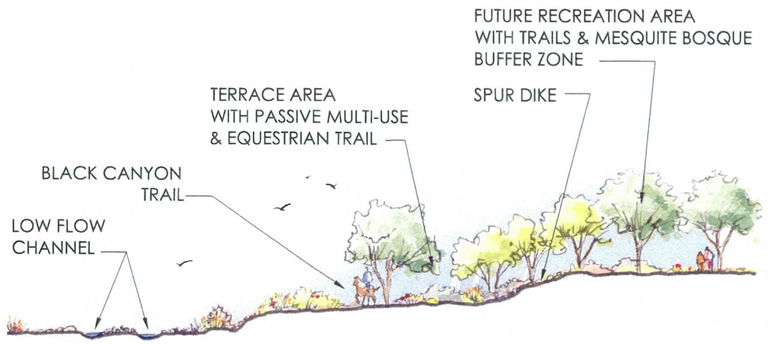
Upper New River Area Drainage Master Plan

Deadman Wash Spur Dike:

Landscape Design Theme:
The recommended Natural Sonoran Desert Uplands Riparian Theme represents a design character of natural arroyo landscape settings found within the Sonoran Desert. The vegetation shall be 100% riparian native species and used to soften, screen and blend engineered slopes. For the structures. All native materials shall be constructed of earthen materials, boulders and aggregate that blend and conform to the natural desert conditions, color form and texture. the enlarged area is located within the natural and pastoral valley river and washes consisting of Ironwood, Mesquite, Palo Verde, Willow Trees, Bursage and Saltbush. this type of natural plant material provides a sustainable environment for wildlife movement corridors, connecting habitats and natural open spaces.

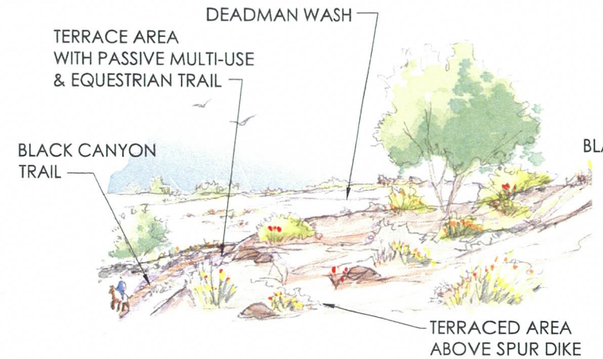
Deadman Wash Design Guidelines:

1. Configuration
   - The O & M Road shall meander slightly aligning with the side contours.
   - There shall be an entrance onto the spur dike from Carefree Highway.
   - When possible add berming along the side slopes of the spur dike shall have undulated side slopes.
   - The spur dike shall appear more organic and less geometric.
   - Side slopes shall be a maximum of 6:1.
   - Underpass shall have enough spacing for equestrian trail crossing.
   - Future parking shall be provided near Deadman Wash regional trail.
2. Vegetation & Surface Treatment
   - Plant material shall match existing species and shall respond to the context of the levee.
   - Hydroseed shrubs and groundcover with stain over desert pavement.
   - Salvage and re-establish indigenous vegetation where possible.
   - Place rocks and boulders in an irregular pattern along the side slopes.
   - Salvage surface soil (6"-8") and replace in the landscape. Maximum stockpile height for surface soil should be to 8 feet.
   - Avoid disturbance to Saguaros, Ironwoods and to the existing xeroriparian vegetation.
   - The surface for the O & M Road shall be gravel mulch matching existing surroundings.
   - The gravel mulch for the O & M Road shall have a stabilizer mix to reduce dust and erosion.
3. Structural Component
   - Use materials, shapes, and colors that blend in with the surroundings for the spur dike as required during final design. Use of boulders native to the vicinity is preferred as a structural component.
   - Exposed concrete components shall be colored concrete and textured to match the natural landscape.

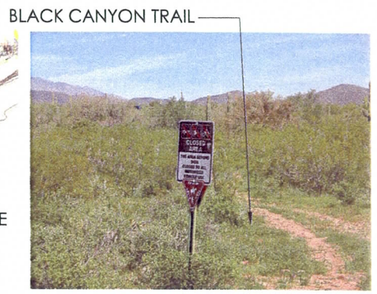


Section A - Looking Downstream

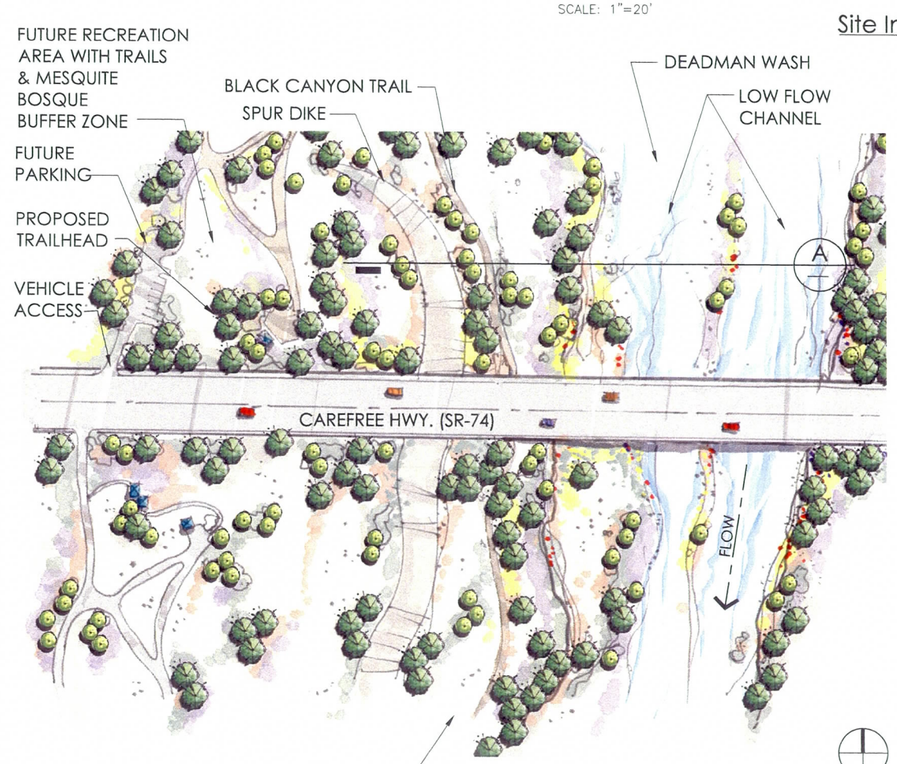
0 10 20 40
SCALE: 1"=20'



Perspective Sketch Looking Downstream

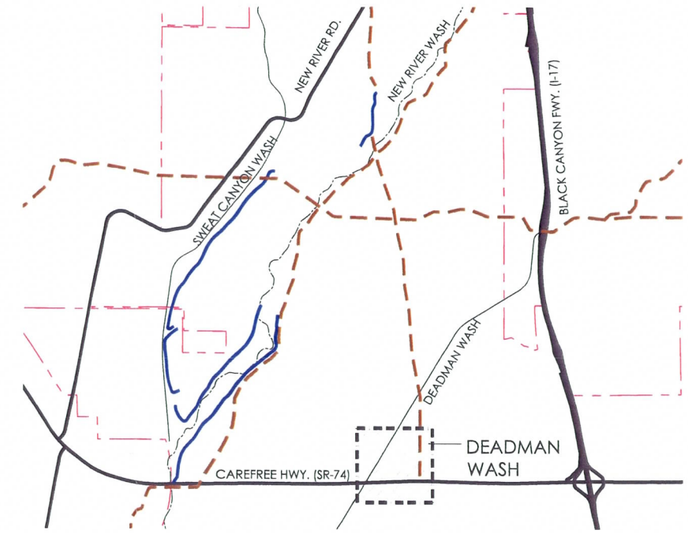


Site Image & Perspective



Plan View

0 50 100 200
SCALE: 1"=100'



Reference Features

- ROADWAYS
- REGIONAL TRAILS
- PEORIA CITY LIMITS
- PHOENIX CITY LIMITS
- LEVEE ALTERNATIVES

Location Map

NORTH

Sheet 9

HYDROSEED / DESERT PAVEMENT

Upper New River Area Drainage Master Plan

HYDROSEED METHOD:

The work under this section shall consist of furnishing all material, preparing the soil and applying the hydroseed mixture to all graded and disturbed areas within the District's boundary.

Requirements:
- Limit of work: The contractor shall stay within all defined limits of grading/disturbance.

Seedmix
- The seed source shall be compatible with the District's standards and match existing vegetation along the wash. The seed shall be delivered to the project site in standard, sealed undamaged containers.
- All seed shall be clearly tagged or labeled showing the type of seed, purity, germination, test date and weed content. Tetrazolium staining shall be acceptable to test for germination and hard seed.
- A certificate of analysis from an accredited seed testing lab shall accompany each container of seed. Seed shall be delivered to the site in individual seed containers by species.

Irrigation
- No irrigation required.

Trees
- Tree quantity and spacing shall match the natural desert adjacent to the site.

Revegetation seed mix
- Reference the FPAP sheet for seedmix type.

Recommended application methods:
- Re-grade the site to match the natural landscape.
- Tackifier shall be applied at the rate shown in the following chart with 200 pounds per acre of wood fiber mulch for slopes up to 3:1, 600 pounds per acre for slopes exceeding 3:1 and 1000 pounds per acre for extremely erosive slopes along with fertilizer at 150 pounds per acre in the slurry with the seed.
- Seed shall not be in the slurry more than 30 minutes. seed planted by this method will not require covering with soil.
- The contractor shall submit a batch (tank) mix of the Engineers' approval prior to mixing any seed/mulch slurry. Batch mixing and coverage will be monitored throughout the seeding operations. The contractor shall coordinate the mixing operations with the District in advance of all mixing.
- Place tackifier in hydromulch slurry with seed, fertilizer, wood fiber mulch and water at the following rates:

Slope	Tackifier amount of pure mucilage per acre
Flat to 4:1	40 pounds
4:1 to 3:1	60 pounds
3:1 to 2:1	80 pounds
2:1 +	100 pounds

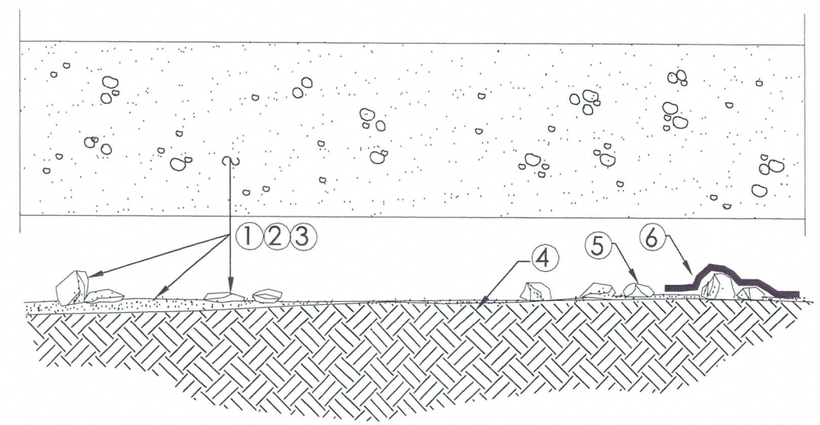
Tillage:
- All slopes flatter than 3:1 shall be tilled a minimum of 6 inches in depth. Tillage shall be accomplished with a ripper bar, chisel plow or harrow tool or with other equipment which will provide thorough soil cultivation. Slopes to steep for equipment to operate shall be tilled by hand raking.
- Tillage shall be performed along the contour. No work shall be done when the moisture content of the soil is unfavorable or the ground is otherwise in a condition inimical to tillage.
- All competitive vegetation shall be uprooted during the tillage operation and the soil shall be left in a roughened condition free of clods or large stones over 6 inches in any dimension and other foreign material that would interfere with the seeding operation. Existing native trees, shrubs, and cacti shall be worked around and not damaged. Do not till closer to the center of existing vegetation than the drip line of the plant.

Seeding:
- Hydroseeding shall be the preferred method for seed distribution. Seedmix shall be distrubutated over the desert pavement and then the integral color hardening powder (shall match existing desert soil)shall be placed on top of the desert pavement.
- Test panels of 20'x50' are required prior to installation for approval by the District.

DESERT PAVEMENT SURFACE METHOD:

GENERAL NOTES:

1. All materials for desert paving shall be obtained from on-site stockpile areas as directed by owner's representative
2. Desert paving aggregates shall be scattered over all disturbed soil surfaces in an uneven layer no greater than 1/2" depth. Approximately 80 % of the disturbed area shall receive desert pavement stone.
3. Size of desert pavement stone material shall include a mix of soil and aggregate granular stones, up to 6" diameter.
4. Subgrade
5. Cobbles 4" and greater shall be half buried. Aggregate to be blended by means of a straw broom, and then water settle to create a naturalistic desert floor.
6. Hydroseed to be placed on top of desert pavement with color hardening powder matching the existing natural desert soil /pavement adjacent to site.



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