Sun Valley Area Drainage Master Plan

Step 3
Recommended Alternative Report

Volume 1
Executive Summary & Overview

Flood Control District of Maricopa County

December 2006

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: May 8, 2007

TO: Bing Zhao, PE, PhD/FCDMC

FROM: Jon Fuller, PE

RE: Sun Valley ADMP – Corridor Wall Concept Sketch

CC: Valerie Swick/FCDMC

The concept sketch shown in the Sun Valley ADMP final reports inaccurately depicts toe-down measured from the base of the flood wall. In fact, toe-down was measured from the channel invert as shown in the sketch below. A corrected sketch is provided below.

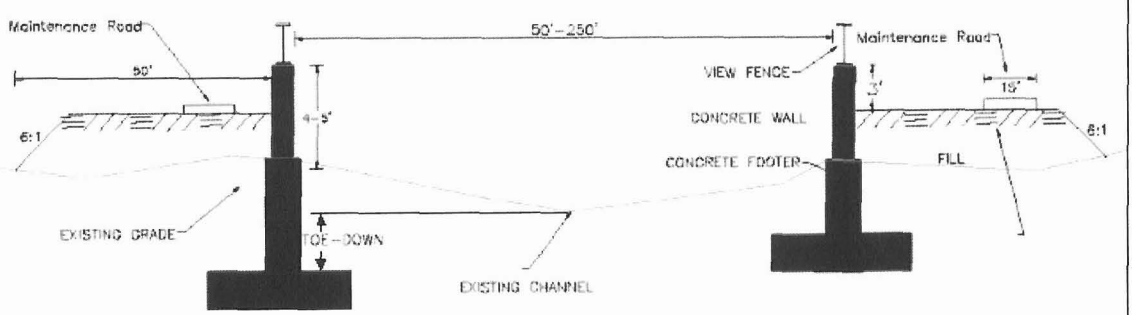

Figure 28 Example Of Typical Floodwall And Corridor

SUN VALLEY AREA DRAINAGE MASTER PLAN

STEP 3
RECOMMENDED ALTERNATIVE REPORT
VOLUME 1

EXECUTIVE SUMMARY
AND
OVERVIEW

Flood Control District of Maricopa County

Registered Professional Engineer (Civil)
CERTIFICATE NO.
35895
TED W.
LEHMAN
Date Signed 12-29-06
ARIZONA U.S.A.

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

LOGAN SIMPSON
DESIGN INC.

EDAW

CL Williams
Consulting Engineers

amec

Richard H. French, Ph.D., P.E.

December 2006

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Appendix B Preliminary Maintenance Plan, prepared by C.L. Williams Consulting Engineers, December 2006

Appendix C - Hazardous Materials, Database Search Results, prepared by Logan Simpson Design, September 2005.

Appendix D - Title VI Environmental Justice, prepared by Logan Simpson Design, October 2006

ENCLOSED DATA CD INCLUDES:

- **Digital Copy of Report in PDF Format**
- **GIS Shapefiles of Project Elements**

1 ABSTRACT / EXECUTIVE SUMMARY

ADMP & Alluvial Fans

The Sun Valley Area Drainage Master Plan (SVADMP) is a regional flood control master plan developed for a 180 square mile area in western Maricopa County. The area lies between the White Tank Mountains and the Hassayampa River mostly within the Town of Buckeye. The mountains drain on to a large sloping alluvial area of coalescing alluvial fans, or bajada (Figure 1). Alluvial fans are sloping, fan-shaped landforms created over long periods of time by the deposition of sediment. Alluvial fan landforms are commonly located at the base of mountain ranges in the arid and semi-arid American Southwest.

Figure 1 Oblique View Of White Tank Mountain Bajada In Wagner Sub-Area

The highly dynamic nature of alluvial fan flooding presents significant challenges for the design of engineered flood control measures. The designed drainage infrastructure must effectively and efficiently convey 100-year discharges without creating unwanted sediment deposition or erosion.

Further complexity is added as flood hazards change in type and severity with geographic position on the fan.

Known problems associated with alluvial fan flooding include spatial uncertainty of the flow distribution, lack of containment within the relatively flat topographic relief laterally across the fan, rapid, large scale changes of flow path locations, flooding along undefined flow paths, sheet flooding, distributary flow, scour, and landform deposition. In addition, steep channel slopes result in high flow velocities with the energy to move significant volumes of sediment and debris during large floods. Figure 2 shows an example of widespread channel changes on Fan 36 in the FRS No. 1 sub-area. A large flood in August 1951 created all the bright colored new channels seen in the aerial photo from 1954. Compare that to the relative absence of large channels visible today.

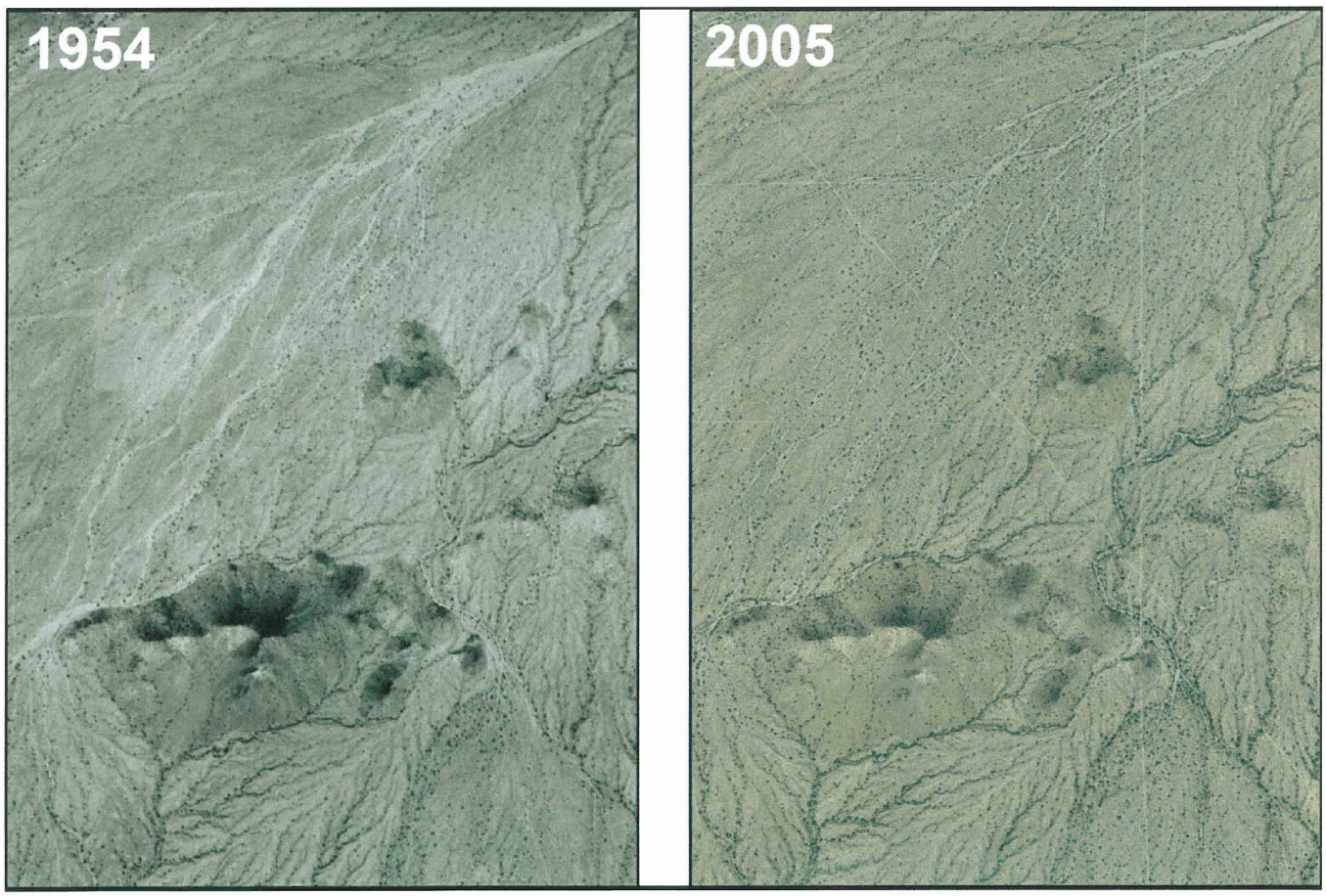

Figure 2 Comparison Of Active Fan Area For Fan 36 - 1954 Vs. 2005

Three Step Process

Structural and non-structural alternatives were refined and cost estimates prepared as part of the Step 3 Recommended Alternative development for the SVADMP. This is the final step of a three-step process to develop a drainage master plan for the Sun Valley area. Four flood control alternative strategies were identified in Step 1 of the ADMP process. Those four strategies were further refined and evaluated in Step 2. The refined alternatives included both non-structural and environmentally friendly, aesthetically compatible structural flood control measures. Step 3 is a further refinement of the engineering elements and cost estimates of the recommended alternative resulting from the Step 2 evaluation process. Concept implementation and maintenance plans are also provided with the Step 3 Recommended Alternative.

Special attention has been given to maximizing non-structural, floodplain management approaches along the preferred corridor alignments. Stakeholders and the public have been consulted as to their feedback in an attempt to incorporate existing and imminent developer plans into the drainage master plan for the Sun Valley area. Numerous group and individual meetings were held with potentially impacted parties in the study area. The project team received input and maintained two-way communication with stakeholders to ensure clear understanding of the nature of the recommended alternative and study progress. Ultimately, the close interaction of the project team and stakeholders had a significant impact on the nature of the recommended alternative for the SVADMP including the selection of walled-levee corridors and the location of the preferred corridor alignments.

In order to achieve the refinement of the recommended alternative, the study area which had been divided into seven geographic sub-areas in Step 2, was further broken up into individual alluvial fan systems. This report presents an overview and summary of the recommended alternative for the entire ADMP area. The six piedmont sub-areas within the ADMP study area are presented in separate reports (Volumes 2 – 7). Step 3 of the ADMP concentrated on refinement of the design and cost estimates of the on-line detention basins at the apices as well as the use of walled-levee corridors for the downfan conveyance structures. Fan Systems 36, 37, and 38 also include segments of excavated channels. Non-structural approaches were incorporated wherever possible. In particular, significant reaches of existing riverine floodplain delineations along Wagner Wash and White Tank Wash are included as part of the non-structural recommendations for the Sun Valley ADMP.

Significant Area of Impact

Figure 3 shows an overview of the primary structural elements of the recommended alternative and the existing floodplain areas for the Sun Valley ADMP area. Within the 150 square mile area south of the CAP Canal, there are over 41 square miles of floodplain area; most are directly associated with the alluvial fans. Figure 3 also shows the primary land ownership including the master planned communities within the area. Table 1 shows a summary of right of way requirements and cost estimates for the recommended alternative for each sub-area. The recommended alternative for the entire ADMP area includes seventeen on-line detention basins near alluvial fan apices, three off-line detention basins, 65 miles of walled-levee corridors, and four miles of excavated, earthen channels. The total right of way area needed for the structural elements of the ADMP is about 2,540 acres. The estimated total cost of the recommended alternative is about $610 million including construction, right of way, landscaping, and 50 years' maintenance. Right of way costs make up about 42% of the total cost, construction about 38%, landscaping about 5%, and maintenance about 16%.

Landscape Aesthetics & Multiple-Use Opportunities

The recommended alternative includes elements and geometries to address the District's aesthetic treatment requirements. The important characteristics of aesthetic treatment elements include: 1) a 35 foot setback buffer on all structural elements in addition to a 15 foot wide area for maintenance access and multiple-use/recreation, 2) a maximum height restriction on the external side of each floodwall corridor of 3 feet, 3) average side slopes for all earthen slopes of 6 to 1, and 4) detention basin storage depths limited to a maximum of 12 feet. Other aesthetic treatments are described in the design guidelines set forth for each structure type. The walled-levee structure type for the flood conveyance corridors was selected for predominant use in the study area because, among other reasons, it will preserve most of the natural desert wash corridor as a scenic open space resource. In addition, a semi-soft construction method that incorporates landscape contour grading design was selected for the construction of the detention basins, excavated channels, and targeted patch dikes as a major step toward achieving context sensitivity with the surrounding landscape. Landscaping is provided for all disturbed surface areas for the recommended landscape themes per the design guidelines for all structure types. Figure 4 shows an example of an on-line detention basin with the aesthetic treatment features including the perimeter buffer area, side slope configurations and terraced inlet structure. Figure 5 shows an example of a walled-levee corridor section with natural containment on one side and floodwall containment on the other incorporating the above aesthetic features.

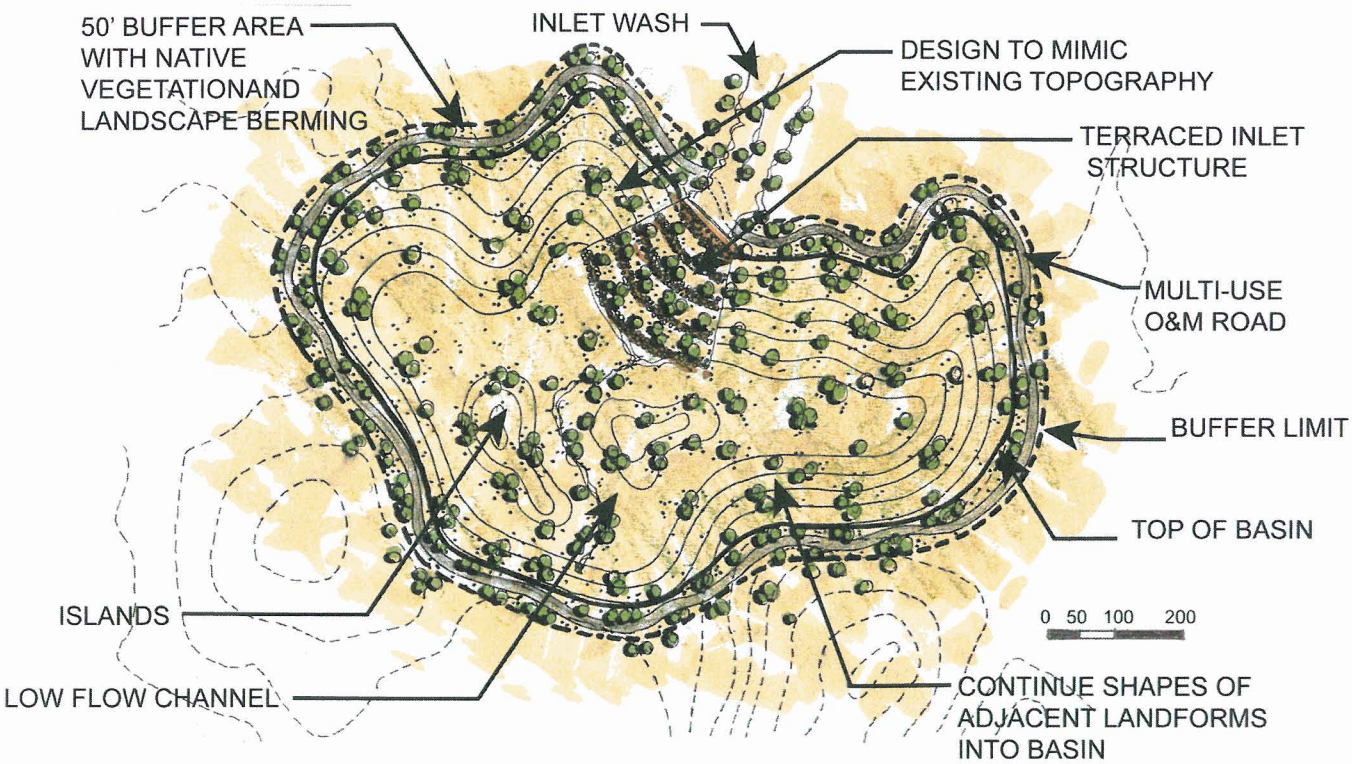

Figure 4 Example Of On-Line Detention Basin With Aesthetic Treatment

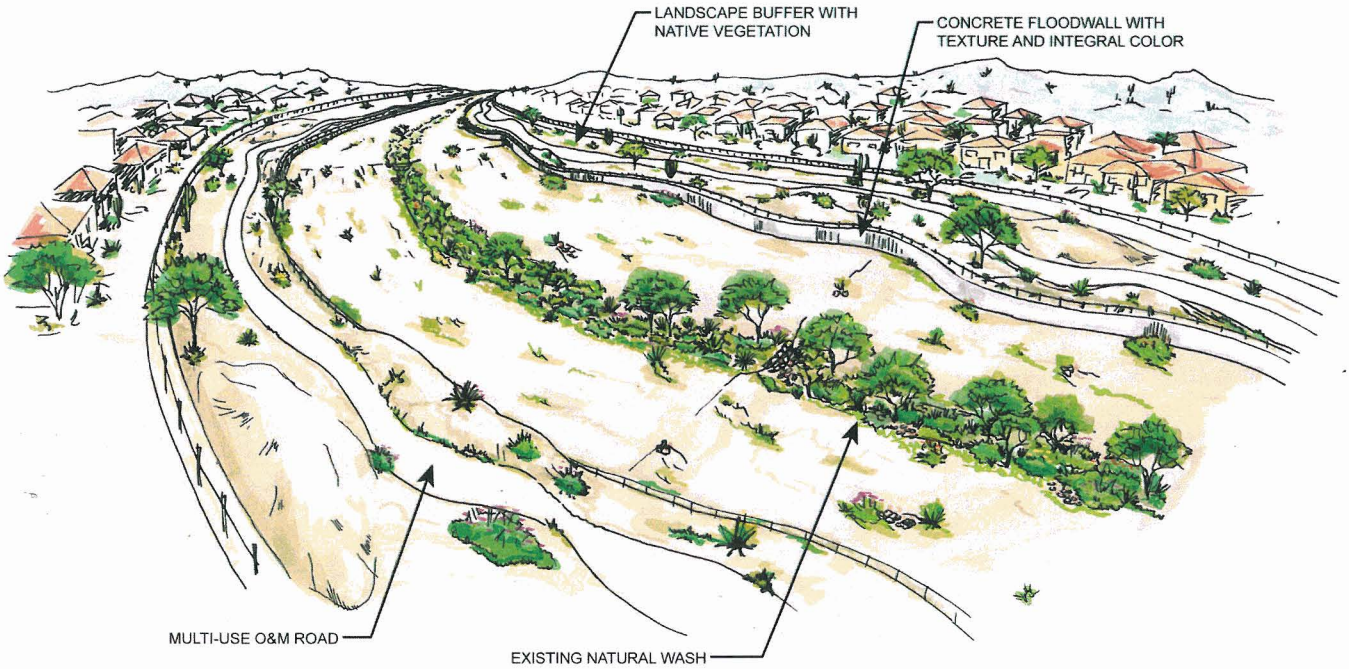

Figure 5 Example Of Walled-Levee Corridor With Aesthetic Treatment

Project Implementation

Implementation is suggested such that the apex detention basins are constructed first for any given fan system. The selection of the large, on-line basin option will provide a significant level of protection to the downstream areas in advance of the completion of the downstream corridors. Funding will likely come through a combination of cost-sharing from public and private sources including possible impact fees associated with new master planned communities in the area. Maintenance should be provided by a publicly backed entity.

Successful implementation of the Sun Valley ADMP will require continued close coordination between the District, the Town of Buckeye, and stakeholders. Refinement of the concept designs and project prioritization should continue in parallel with the negotiations regarding funding.

Multiple Benefits

Project benefits include creation of regional flood control trunk systems throughout the piedmont area, removal of alluvial fan uncertainties, and elimination or drastic reduction of large areas of alluvial fan floodplains. Finally, the recommended alternatives for each fan system work together to provide protection to the entire Sun Valley piedmont. Moreover, the design of each fan system is contingent on the other. That is, the design discharges for each fan system corridor assume the construction of adjacent systems. Therefore, neighboring fan systems should be given consideration during the planning, design, and phasing of the recommended alternative going forward. As a collection, the components of the recommended alternative provide a regional flood control solution that advances public safety, promotes cooperation, and provides a long-term regional amenity to the Town of Buckeye and Maricopa County.

Table 1 Summary Of Recommended Alternative Costs By Sub-Area

		Costs (in millions of $)								
Subarea	ROW Area (acres)	Land Cost	Construction Cost	Landscaping Cost	50-Year Maintenance Cost	Total Cost	Land Cost %	Construction Cost %	Landscaping Cost %	50-Yr Maintenance Cost %
CAP	266.5	$ 26.650	$ 20.741	$ 2.760	$ 8.982	$ 59.132	45%	35%	5%	15%
Wagner	369.5	$ 36.950	$ 37.910	$ 4.540	$ 17.526	$ 96.926	38%	39%	5%	18%
Hassayampa	331.6	$ 33.160	$ 33.139	$ 3.827	$ 13.722	$ 83.848	40%	40%	5%	16%
White Tank Wash	590.7	$ 59.070	$ 45.846	$ 5.980	$ 18.631	$ 129.527	46%	35%	5%	14%
FRS 1	852.9	$ 85.290	$ 79.389	$ 8.860	$ 31.248	$ 204.787	42%	39%	4%	15%
FRS 2 & 3	125.8	$ 12.580	$ 15.462	$ 2.066	$ 5.426	$ 35.534	35%	44%	6%	15%
ALL SUBAREAS	**2,537.0**	**$ 253.7**	**$ 232.5**	**$ 28.0**	**$ 95.5**	**$ 609.8**	**42%**	**38%**	**5%**	**16%**

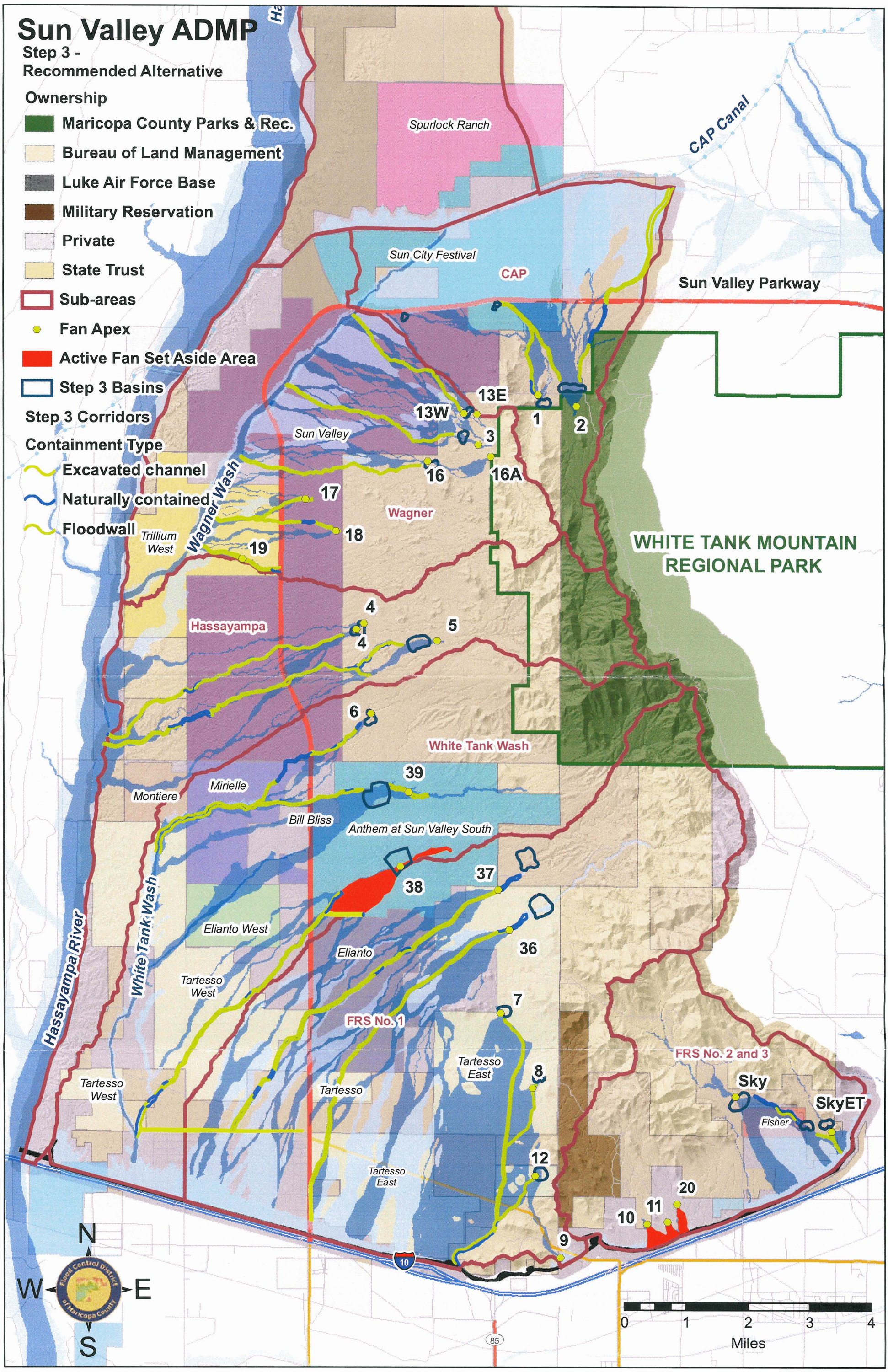

Figure 3 SVADMP Recommended Alternative For The Piedmont Sub-Areas

2 INTRODUCTION

2.1 Report Organization

The Step 3 Recommended Alternative Report is presented in seven (7) volumes similar to the Step 2 report. Volume 1 provides an overview of the ADMP, explains the ADMP process, and summarizes the recommended alternative for each sub-area and the entire study area. Volume 1 also provides a discussion of general area-wide flood control issues and potential solutions as well as specific issues and potential solutions for the area north of the Central Arizona Project Canal. The so-called North of CAP sub-area is included in Volume 1 for two reasons: first, the sub-area is not dominated by large alluvial fans like the piedmont sub-areas in the remainder of the study area; second, the recommendations for the North of CAP sub-area are predominantly non-structural in nature.

Volumes 2 through 7 present the recommended alternatives for the piedmont sub-areas as follows:

2) CAP (Volume 2),

3) Wagner Wash (Volume 3),

4) Hassayampa River (Volume 4),

5) White Tank Wash (Volume 5),

6) Buckeye FRS #1 (Volume 6), and

7) Buckeye FRS #2 & #3 (Volume 7).

Volumes 2 through 7 also include site specific data, hydraulic analyses, and cost estimates. It is intended that each Volume of the Step 3 report be able to stand alone so that a reader, such as an interested stakeholder, unfamiliar with the ADMP, or uninterested in other sub-areas, can understand the overall study as well as the details of an individual sub-area of particular interest to them. Excessive detail associated with the design calculations are left out of Volume 1 in order to provide a more digestible document for the reader interested in the Recommended Alternatives Analysis as a whole.

The advantages of this type of report organization are:

- The reduction of reproducible materials required for interested users or stakeholders.
- It provides a condensed overview of the ADMP process and the Recommended Alternative.
- It narrows the focus to a specific sub-area while still providing an overall comprehensive summary of the Step 3 process and recommended alternative descriptions.

2.2 Project Background

The Sun Valley area (Figure 6), located in western Maricopa County, Arizona, is presently experiencing the first stages of accelerated urbanization. Future development is anticipated to occur on the largely undisturbed alluvial fans and piedmont surfaces comprising the western slope of the White Tank Mountains (Figure 7). The upland areas and adjacent watershed drain to the Hassayampa River to the west and the Buckeye Flood Retarding Structure (FRS) Numbers 1, 2, & 3 along Interstate 10 to the south.

The purpose of the Sun Valley Area Drainage Master Plan (SVADMP) is to develop a conceptual drainage plan to serve as a roadmap that jurisdictional authorities and developers can use in planning flood control measures to mitigate flood hazards up to the 100-year event in the area. The SVADMP incorporates development plans for the area and jurisdictional drainage policies to develop a preferred regional flood control solution.

The major objectives of the project include the following:

- Plan regional flood hazard mitigation;
- Preparation of approximate alluvial fan floodplain delineations, meeting Federal Emergency Management Agency (FEMA) and Flood Control District of Maricopa County (District) standards, for those alluvial fans in the study area not previously delineated (presented in six separate Technical Data Notebooks);
- Coordination between the ADMP regional flood control measures and the design of drainage features within the master planned community developments within the study area;
- Preparation of preliminary design of flood control facilities in areas not within master planned communities; and,
- Design flood control solutions to complement the character and preserve the beauty of the natural desert landscapes of the study area and achieve consistency with the Flood Control District's *Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects* (FCDMC, 1993).

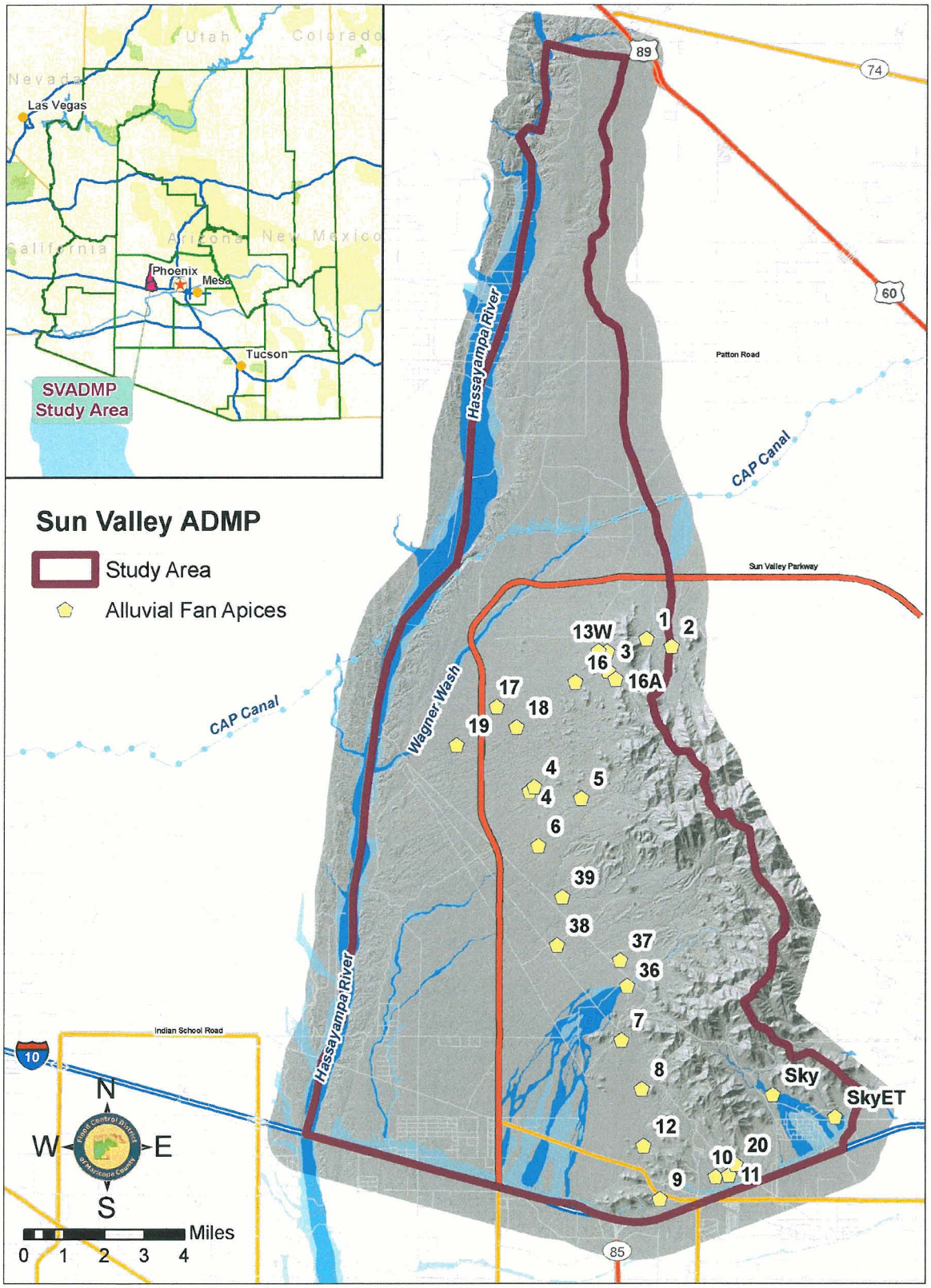

Figure 6 Location Of Study Area

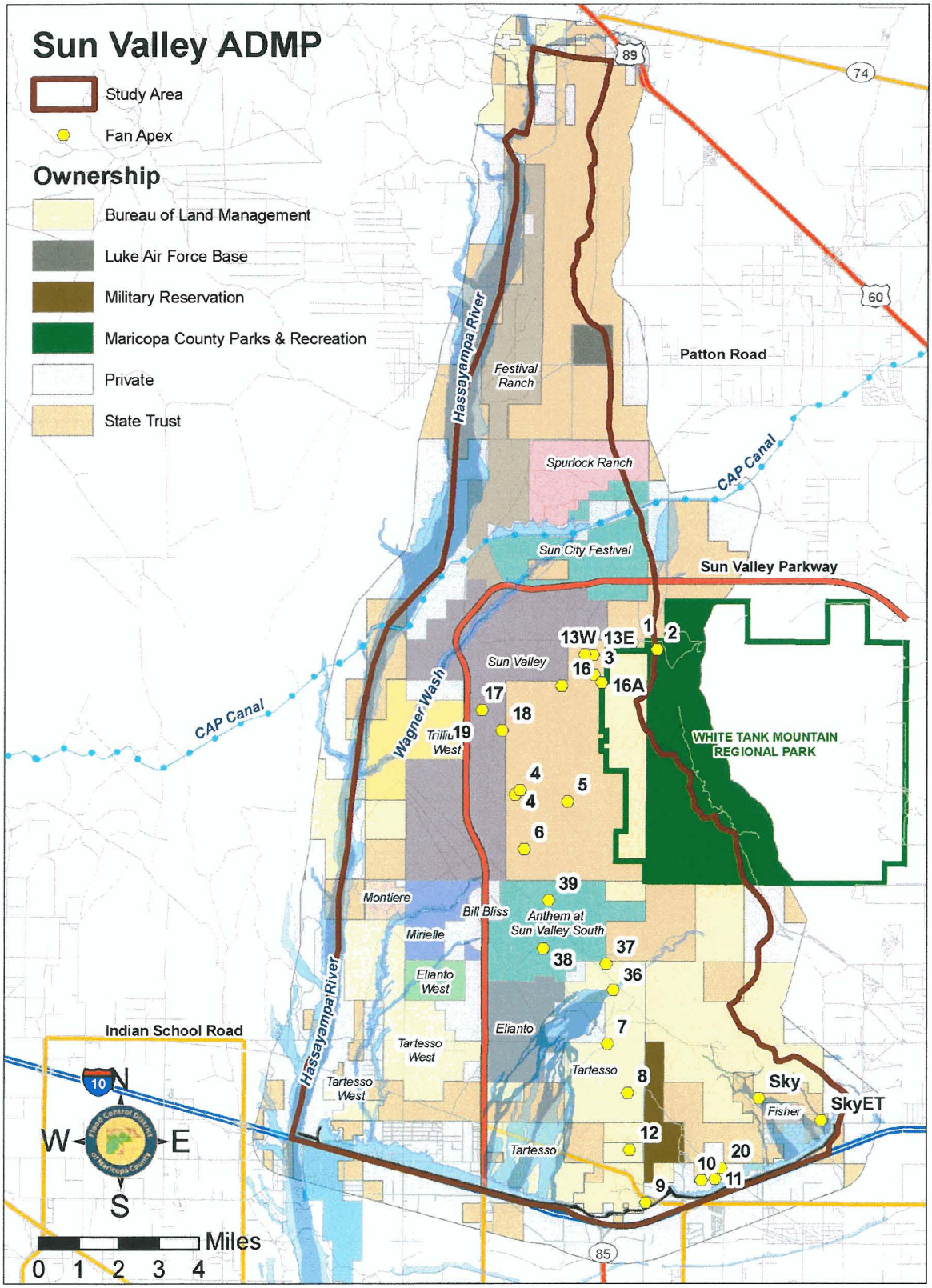

Figure 7 Future Developments In The ADMP Study Area

Previously, the Phase I Buckeye/Sun Valley Area Drainage Master Study (ADMS), conducted by PBS&J, documented and analyzed existing conditions and identified drainage and flooding problems in the study area for the purpose of initial formulation of flood protection alternatives. The Phase II Sun Valley Area Drainage Master Plan builds on the Phase I findings by employing a 3-step process with the goal of developing a Recommended Alternative, consisting of both environmentally friendly structural and non-structural measures, to address flood hazards in the study area. Figure 8 shows a flowchart illustrating the SVADMP alternatives development process.

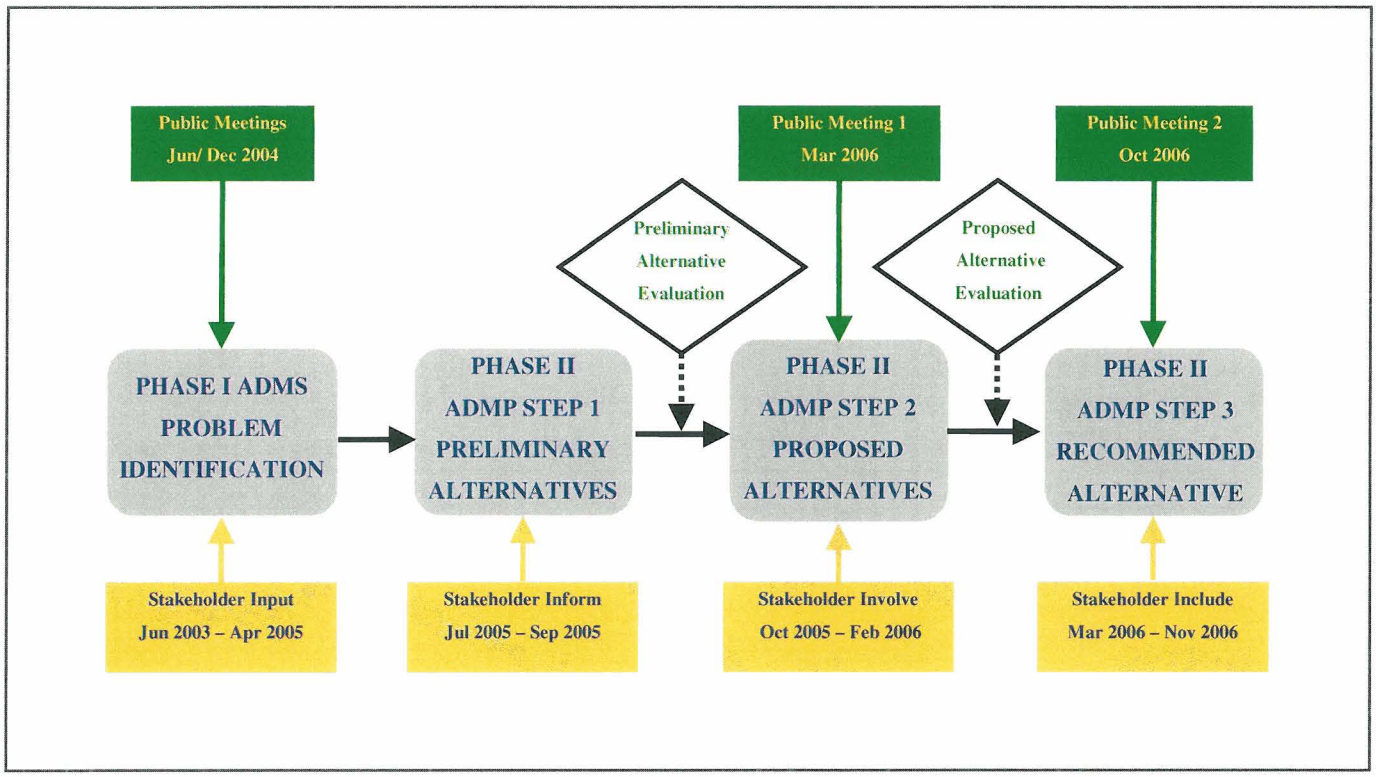

Figure 8 Alternatives Development Process

This report is part of the Phase II ADMP Step 3 Recommended Alternative process which focuses on further refinement of the recommendations of the Step 2 Proposed Alternatives Analysis (JEF, 2006b). The purpose of this report is to present the Step 3 Recommended Alternative for the SVADMP.

Based on the recommendations resulting from the Step 2 process, the conceptual designs of regional, whole-fan solutions were developed. The recommended alternatives were generally based on the B1 or B4-3 Alternative from Step 2. That is, the recommended alternative for each sub-area is comprised of large, on-line detention basins near the alluvial fan apices and walled-levee corridors downstream to the fan system outfall. Cost estimates are also provided. The costs include engineering design, major construction items, right-of-way acquisition, major utility relocations, aesthetic treatment requirements, and maintenance costs for a 50-year design life.

2.3 Authority for Study

The current study was performed for the Flood Control District of Maricopa County (District) under contract FCD 2004C049 as part of the scope of services for the SVADMP. The Town of Buckeye, Arizona was an important project participant. The ADMP was performed by JE Fuller/ Hydrology & Geomorphology, Inc., with subconsultants C.L. Williams Consulting, Inc., Logan Simpson Design, Inc., AMEC Earth & Environmental, EDAW Inc., and Richard H. French, Ph.D., P.E.

2.4 Location of Study Area

Figure 6 shows the location of the study area. The study area has a total watershed area of about 180 square miles. Most of the study area is located within the Town of Buckeye. The study area is bounded by the White Tank Mountains and the Trilby Wash watershed on the east, the Hassayampa River on the west, the Buckeye Flood Retarding Structures on the south, and Gates Road to the north. The watercourses within the study area are all tributaries to the Hassayampa River or the Buckeye Flood Retarding Structures, except Fan 2 in the CAP sub-area, which is a tributary to Trilby Wash.

3 ADMP PROCESS

3.1 Process Overview

The highly dynamic nature of alluvial fan flooding presents significant challenges for the design of engineered flood control measures. The designed drainage infrastructure must effectively and efficiently convey 100-year discharges without creating unwanted sediment aggradation or degradation. Further complexity is added as flood hazards change in type and severity with geographic position on the fan whether the area of interest is located at the apex, mid-fan, or near the outfall; and if the flood event is less than the 100-year event.

Known problems associated with alluvial fan flooding include spatial uncertainty of the flow distribution, lack of containment within the relatively flat topographic relief laterally across the fan, abrupt, large scale changes in channel location, flooding along undefined flow paths, sheet flooding, distributary flow, scour, and landform deposition. In addition, steep channel slopes result in high flow velocities with the energy to move significant volumes of sediment and debris during large floods.

The Step 1 Preliminary Alternatives Evaluation (JEF, 2006a) presented the outline for the alternatives to be analyzed as part of the Step 2 Proposed Alternatives Evaluation (JEF, 2006b) and refined during the Step 3 Recommended Alternatives process. The Step 1 Preliminary Alternatives Evaluation process identified five areas within each fan starting from upstream to downstream: 1) Apex, 2) Up Fan, 3) Parkway, 4) Down Fan, and 5)

Outfall (see Figure 9). Flooding and drainage characteristics vary for each of these component areas of the alluvial fan landform. This classification permits the design process to identify potential flood control measures specific to each of these areas which, in combination, comprise a whole-fan solution. Whole-fan solutions were preferred because they provide a regional flood control system which acts as a major trunk system for the adjacent watersheds. The trunk system is designed to convey runoff and sediment inflows from the apex plus that generated from the fan surface itself. Note that most, but not all, of the alluvial fans considered in this study have all the five component areas. However, the overall design considerations are similar for all the fans.

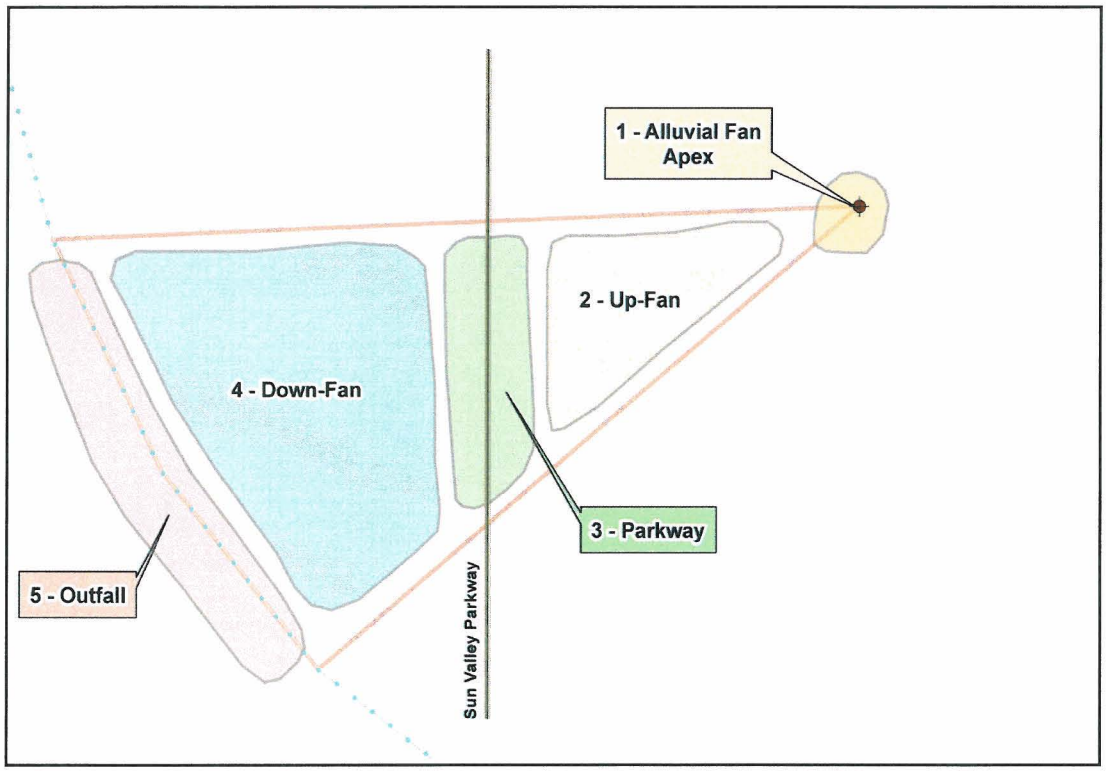

Figure 9 Fan Area Classification

The Step 1 process identified the following design strategies: 1) Conveyance, 2) Storage, 3) Management, and 4) No Measure. These strategies apply to each of the five areas starting from the apex to the outfall and formed the basis of the Preliminary Alternatives. Four major alternatives were identified based on these strategies: Alternative A, Alternative B, Alternative C, and Alternative D. These four alternatives consist of different selections of strategies for each of the different areas from apex to outfall. Each alternative can be described as a particular set of strategies applicable to different areas of the fan. Those four alternatives were considered as part of the Step 2 Proposed Alternatives Evaluation process.

The Alternatives A, B, C, and D formulated in the Step 2 process consisted of particular combinations of detention basins, conveyance corridors, developer-planned drainage improvements, and 'no measure' options applied to different areas of the alluvial fan starting upstream at the apex to the downstream outfall. During the Step 2 process, Alternative B was further subdivided into five similar, but unique alternatives named B1, B2, B3, B4, and B5. This was done to evaluate: 1) the influence of size and type of the apex basin on the design of the downfan system; 2) different channel cross-section types; and 3) various channel alignments.

The result of the Step 2 Proposed Alternatives Evaluation was a preference for large, on-line detention basins (Alternative B1) with leveed downstream corridors. In addition, where multiple alignments were possible, a greater number of paths was preferred to fewer for connectivity and environmental reasons (Alternative B4-3).

In addition to the selection of large, on-line basins with multiple corridors, the Step 2 alternatives evaluation also identified a number of items for consideration in the refinement of the recommended alterative for Step 3. The recommendations were based on input received during the development of the proposed alternatives, the team evaluation process, and input from stakeholders and the public.

- There is a need to balance earthwork by project. For Step 3, a project will be considered the apex-to-outfall system for an individual alluvial fan (or fan complex if hydraulically connected, called 'fan system' in this report).
- Existing channel conveyance should be quantified and incorporated into the recommended alternative designs. This could result in the elimination of some levee/wall reaches where the existing conveyance is adequate or natural lateral containment exists on one or more sides of the corridor. This will also maximize the use of non-structural or nearly non-structural reach management elements.
- The required aesthetic treatments should be included explicitly in the hydrologic and hydraulic design.
- Incorporate the specific sediment data collected in Step 2 into the design calculations.
- Identify the area benefited using the Stage 3 floodplain delineations.
- Refine the design concepts including riprap sizing calculations and the evaluation of basin inlet structures (e.g., energy dissipaters, collection dikes/ ditches, off-line basin outlet structures, etc.)
- Refine the hydrologic models to include more HEC-1 subreaches, ideally one subreach per design reach.
- Discretize the quantities and costs by individual fan system (by "project").

All of these items have been incorporated into the Step 3 recommended alternative. The details of those refinements and designs for the piedmont sub-areas are presented in separate reports (Volumes 2 – 7).

In addition to the recommendations for Step 3 above, a Value Engineering (VE) process was undertaken by the District external to the ADMP project team at the end of Step 2. The VE process identified the following items for the refinement of the recommended alternative in the Hassayampa sub-area which are also addressed in this report:

- Consider the use of floodwalls rather than earthen levees wherever possible
- Design to the higher end of the range of hydraulic constraints for the leveed corridors
- Optimize the toe-down to grade control relationship

The use of floodwalls was recommended based on the significant cost savings identified in the Step 2 reports. As will be discussed further in the design discussion (see Section 5), the Step 2 hydraulic design targeted a hydraulic depth of one foot and a velocity range of 4 to 6 feet per second. The VE suggestion was to design to the higher end of the velocity range. To accomplish this, the Step 3 design will allow hydraulic depths up to two feet. The toe-down to grade control relationship is further refined in Step 3 through the use of a sediment transport capacity continuity approach to the equilibrium slope assessment for the selection of grade control spacing.

During the Step 3 process, it was recognized that with the migration to a concrete floodwall containment strategy for the levee corridors, the balancing of earthwork objective identified in Step 2 was not feasible. That is, for many fan systems, the excavation requirements far outweigh the fill needs. Therefore, material disposal from the detention basin excavation will be necessary for most of the fan systems.

3.2 Scenery Resource Assessment

The scope of work for the ADMP specifically states that the recommended alternative be "environmentally friendly and blend with the natural landscape of the study area following the District's *Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects*". An assessment of the scenic resources, including landscape character, scenic quality, and viewshed sensitivity was undertaken as part of this study (LSD, 2006) utilizing information and guidelines provided by the Flood Control District. The data from this assessment was used to identify a range of flood protection methods that would be compatible with the visual character of the settings of the study area. This data was also used to identify a variety of landscape design themes that could be applied to flood control projects proposed within the study area. The recommended alternative incorporates aesthetic features to ensure that the proposed alternative meet these objectives. In addition, the cost estimates also include the costs associated with the aesthetic and landscaping treatment requirements of the recommended alternative including structure enhancements, additional right of way requirements, grading design requirements, and landscape plantings.

3.3 Cultural Resource Assessment

A separate cultural resource assessment overview was provided in *An Archeological Resource Overview of the Sun Valley ADMP Area Of West - Central Maricopa County, Arizona* (SAS, 2005). Archival research was the principal tool of that investigation, but it has also included some fieldwork. Together they revealed no fewer than 80 cultural resource investigations have previously been completed across the project area. They began in 1882 and are of six different types. Significantly, 53 of them are prior intensive field surveys that thoroughly examined roughly 8,842 acres, or 11.7 percent, of the area.

The project inventory of resources consisted of 77 individual sites, all but 23 of which have been disturbed or totally destroyed. They include 17 prehistoric sites, 1 prehistoric-historic site, 58 historic sites, and 1 modern site, which dates 1981-present. The prehistoric sites date A.D. 400-1450 and represent only one unidentifiable and two identifiable cultural themes: residential life and natural resource exploitation, that are attributable to both the Hohokam and the Patayan Indians. The historic sites date exclusively to the Arizona Territorial (1863-1912) and Statehood (1912-1952) phases, and represent nine cultural themes: canal irrigation, community growth and development, farming, homesteading, mining, railway transportation, ranching, roadway transportation, and trash deposition.

Pertinent recommendations were advanced for careful use and consideration during implementation of the ADMP. Among others, it was suggested that all State and Federal archeological compliance guidelines be followed during the design and construction of recommended features that will result in land disturbances. Compliance would require intensive field survey of all new construction areas, an evaluation of possible subsurface features occurring at any archival site known to exist there, and the recording and National Register significance evaluation of all newly found sites.

3.4 Stakeholder and Public Involvement

The District and ADMP project team conducted an extensive stakeholder and public involvement process as part of the ADMP. Public meetings were held in Buckeye for Step 2 on March 8th, 2006 and for Step 3 on October 18th, 2006. Stakeholders included in the process are listed in Table 2. The stakeholder process included Stakeholder Workgroup meetings as well as numerous individual meetings with stakeholders and the project team. The project team received input and maintained two-way communication with stakeholders to ensure clear understanding of the nature of the recommended alternative and study's progress. Ultimately, the close interaction of the project team and stakeholders had a significant impact on the nature of the recommended alternative for the SVADMP including the selection of walled-levee corridors and the location of the preferred corridor alignments.

Table 2 SVADMP Stakeholders

Agencies / Public Entities	Development/ Developers/ Engineers
FCDMC	Capitol Pacific Homes/ CVL
Town of Buckeye	Sun Valley South (West)/ Communities Southwest/ WRG
ADEQ	Festival Ranch/ Lyle Anderson/ WRG
ADOT	Skyline Wash/ Fisher-Williams / PDC
AZ Game & Fish	Elianto/ Lennar/ CVL
ASLD	Anthem/ Pulte/ CMX
ADWR	Tartesso/ Stardust/ DEA
Bureau of Land Management	Tartesso West/ Stardust/ DEA
Bureau of Reclamation	Spurlock Ranch/ Glen Spurlock
CAP	Sun City Festival/ Pulte/ CVL
Luke Air Force Base	SunCor Arizona
MCDOT	Trillium West/ Gateway/ DEA
MC Parks	Sun Valley/ Vistoso/ Erie & Assoc
NRCS	
Palo Verde Power Plant (APS & SRP)	
US Fish & Wildlife	
Western Power Authority	
White Tanks Concerned Citizens	

3.5 Environmental Issues and Permitting

3.5.1 Biological Resources

An environmental overview was prepared for the Sun Valley ADMP project and it identified several sensitive or protected species for which habitat exists within the study area. None of the species was observed during the fieldwork for the study. The federally protected species include the Cactus Ferruginous Pygmy-Owl (*Glaucidium brasilianum cactorum*), the Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*), and California leaf-nosed bat *(Macrotus californicus*). The Sun Valley ADMP area is outside the historic range and required survey area of the Pygmy owl. The overview also recommends a more complete survey of the mines, caves and rock outcroppings in the study area to determine the existence of the bat species. If indications are present of the Cactus Ferruginous Pygmy-owl or either of the bats within the disturbance area of the recommended plan, the District would act in accordance with Section 10 Habitat Conservation Plan of the Endangered Species Act (ESA). If there is a federal nexus in the proposed construction, then ESA Section 7 consultation would be required with the United States (U.S.) Fish and Wildlife Service.

The Sun Valley ADMP area also has suitable habitat for several Arizona Game and Fish Department species of Wildlife of Special Concern including the Sonoran Desert Tortoise (*Gopherus agassizzii*), American Peregrine Falcon (*Falco peregrinus anatum*), Ferruginous Hawk (Buteo regalis), Common Black Hawk (Buteogallus anthracinus), and Cave myotis (myotis velifer). In addition, habitat for several additional Special Concern species could occur in proximity to the existing stock tanks. The overview recommends performing detailed surveys of mines, caves, rock outcroppings and potential disturbance areas to determine the existence of the species.

3.5.2 404 Permit Requirements

Implementation of the recommended alternative will cut off and/or obliterate small washes, impact native vegetation, and potentially impact waters of the U.S., especially in the basin locations. Impacts to waters of the U.S. may require permit(s) from the U.S. Army Corps Engineers and mitigation as part of the requirements of Sections 404 and 401 of the Clean Water Act. The actual amount of disturbance to water of the U.S. is not known at this stage of design. Mitigation for disturbed areas will depend on the final design at each basin location and will be determined on a site-specific basis.

A biological evaluation and cultural resource investigation specific to each construction location would be required as parts of any Section 404 permit application. This evaluation would serve the purpose of performing the surveys recommended in the Environmental Overview.

3.5.3 Air Quality

According to current Arizona Department of Environmental Quality, the Sun Valley ADMP area is in an area where the National Ambient Air Quality Standards (NAAQS) are not being met for carbon monoxide, ozone, and particulate matter less than 10 microns (PM_{10}). Some deterioration of air quality may be expected during construction due to the operation of construction equipment combined with the slower traffic speeds associated with a construction zone. This localized condition will be discontinued when the project is completed. Dust generated from construction activities will be controlled and minimized, and Maricopa County Rule 310, Open Fugitive Dust Services would be enforced by the Maricopa County Environmental Services Department. In addition, the contractor would have to observe and comply with all air pollution ordinances, regulations, orders, etc., from those agencies having expertise and/or jurisdiction.

3.5.4 Hazardous materials

A review of various federal and state government records was completed to identify evidence of hazardous materials within and immediately adjacent to the Sun Valley ADMP area. These databases included, but was not limited to the Comprehensive Environmental Response, Compensation, and Liability Information (CERCLA) system; the Resource Conservation and Recovery Act (RCRA Info); the Superfund Program List; the Directory of Solid Waste Landfills; the Underground Storage Tank (UST) listing; the Leaking Underground Storage Tank (LUST) list; the State's Water Quality Assurance Revolving Fund (WQARF) Registry; the Drywell list; and the Hazardous Materials Incident Logbook (HMIL). The search identified twelve hazardous materials concerns within or adjacent to the project limits with most located along I-10, and not in proximity to the flood control features of the recommended alternative. Three potential hazardous materials locations were observed during field reconnaissance for the visual resource and landscape character components of the Sun Valley study. The results of the record search for hazardous material concerns and a map are provided in Appendix C - Hazardous Materials, Database Search Results, prepared by Logan Simpson Design, September 2005.

3.6 Title VI Environmental Justice

The population statistics of the citizens within the Sun Valley study area were mapped and analyzed based on the 2000 census. The study area is comprised of four block groups from three different census tracts. Because of the pace of development in the Sun Valley area, the current population and demographics may be different from those shown in this study. The map of the census tracts and demographics breakdown are in Appendix D - Title VI Environmental Justice, prepared by Logan Simpson Design, October 2006.

4 DESCRIPTION OF THE RECOMMENDED ALTERNATIVE

Flood control alternatives for the SVADMP area included both structural and non-structural solutions. Given the scenic resource assessment, non-structural solutions are generally preferred whenever possible. However, for the areas impacted by active alluvial fans, the degree, extent, and uncertainties associated with the flood hazards are considered too extreme to make fully non-structural alternatives feasible. Therefore, for the areas impacted by large active alluvial fan flooding, structural measures are central to the recommended flood control alternative.

The study area was divided geographically into sub-areas to focus attention on appropriate structural or non-structural recommended flood control solution for each part of the study area. This sub-area division was also used in Step 2.

1) North of CAP (in this volume)
2) CAP (Volume 2),
3) Wagner Wash (Volume 3),
4) Hassayampa River (Volume 4),
5) White Tank Wash (Volume 5),
6) Buckeye FRS #1 (Volume 6), and
7) Buckeye FRS #2 & #3 (Volume 7).

The sub-areas are based on the outfall locations and the fans discharging to a particular outfall location. For example, fans that drain to Buckeye FRS No. 1 are included in the FRS No. 1 sub-area. The sub-areas also represent the hydrologic watershed for the particular outfall location. The sub-area boundaries are shown in Figure 10.

The area north of the Central Arizona Project (CAP) Canal is not impacted by large, widespread alluvial fan flooding and was therefore addressed separately (within this volume of the ADMP). Most of the remainder of the study area south of the CAP is impacted by large active alluvial fans along the White Tank Mountains piedmont. This area, south of the CAP, was the focus of most of the ADMP recommended alternative development. In addition to the sub-area specific flood control solutions, be they structural or non-structural, other general flood hazard related issues exist across the study area. These issues are addressed through a category called "areawide" issues.

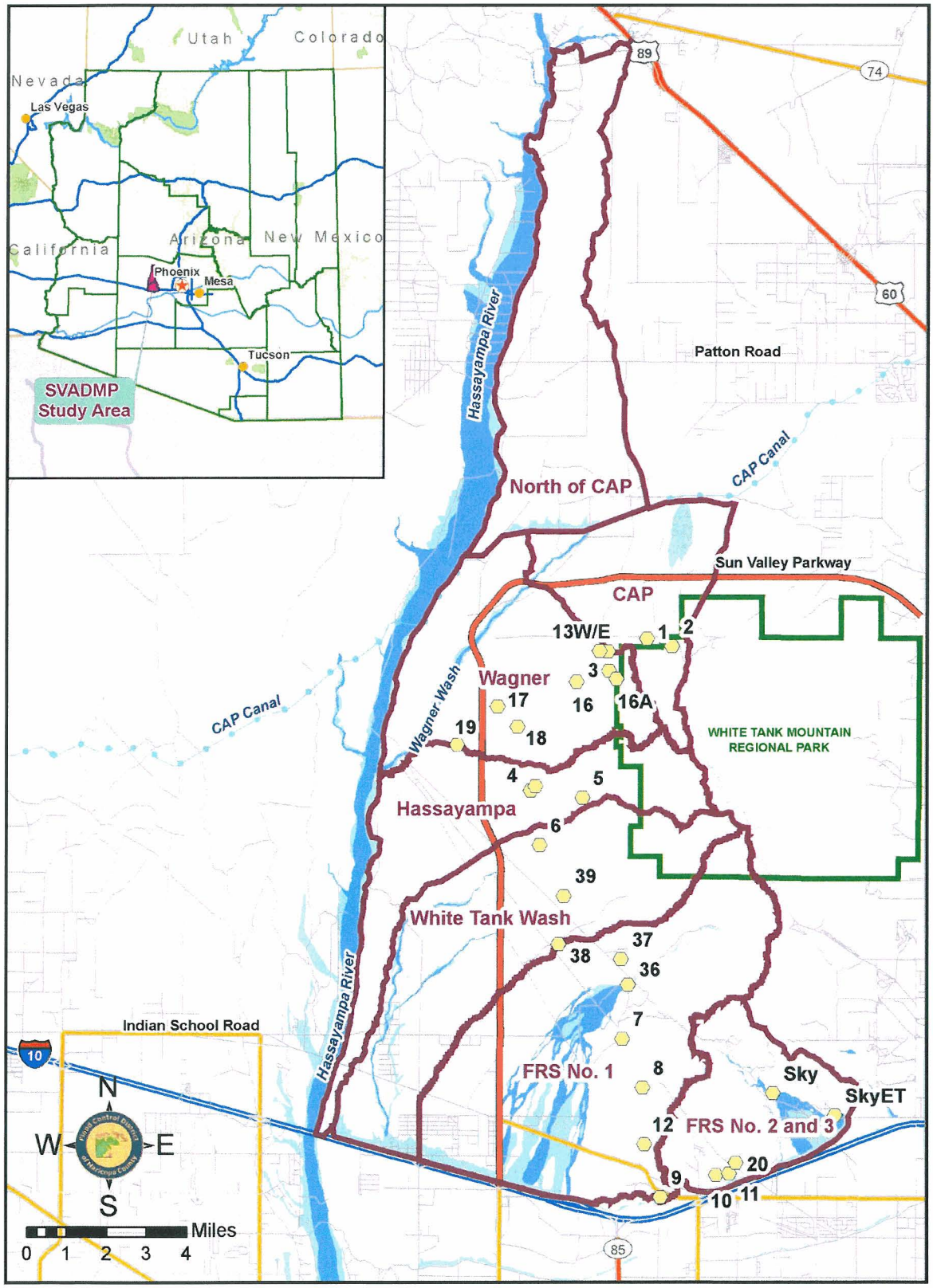

Figure 10 Sun Valley ADMP Sub-Areas

This report provides an overview of the Step 3 Recommended Alternative for the entire study area. Additional details for the six alluvial fan sub-areas south of the CAP Canal are presented in separate companion volumes (Step 3, Volumes 2 – 7). This organization is analogous to that used in the Step 2 presentation.

The following sections describe the recommended alternative for the SVADMP study area. The North of CAP sub-area is addressed specifically in this volume. Additional details on the piedmont sub-areas south of the CAP are provided in Volumes 2 – 7 of the Step 3 Recommended Alternative Report.

4.1 Areawide

A number of general, or areawide, flood hazard-related issues were identified and addressed in the Step 2 portion of the ADMP. Again, non-structural flood control alternatives are preferred. Therefore, many of the areawide issues are addressed with non-structural approaches. In other cases, areawide issues are related to existing or potential future structural flood control measures. The following areawide items were noted:

Piecemeal solutions – Engineers generally do not recommend piecemeal construction of flood control projects (except for construction phasing) due to potential for conflicts in design and construction practice, inability to tie in to previously constructed sections, and the potential for permanent gaps. Other concerns with piecemeal flood control solutions include reflective scour, flanking of partial systems, first-come, first-serve inequities, landscape aesthetics, timing issues or other unplanned phasing complications, and potential changes in the regulatory environment whether it be FEMA, Section 404 Clean Water Act, or local ordinance changes. Piecemeal flood control solutions apply to any system including floodway fringe encroachments and channelization. Therefore, whenever structural solutions are proposed to address localized flood or erosion problems in the area, special attention should be paid to address the incompatibility concerns arising from piecemeal solutions.

Stock tanks - Stock tanks present several potential challenges and issues for future development in the area. Though stock tanks are structural flood control facilities of a sort, they are rarely engineered and pose a potential hazard in the event of an embankment failure. The failure of a stock tank can create a larger magnitude flood wave than had the tank not been present. Twenty stock tanks were identified in the study area. Thirteen of those are located north of the CAP Canal (see Section 4.2.4). As part of the SVADMP, it is therefore recommended that stock tanks be removed whenever possible as an area develops.

Other floodprone areas (i.e. non-alluvial fan floodplains) – It should be remembered that while much of the area is dominated by alluvial fans and their associated flood and sedimentation hazards, other locations within the study area are subject to riverine or sheetflooding conditions. It is recommended that floodplain management

be the preferred approach to address future development in areas not specifically impacted by the large active alluvial fans in the area.

ADMS Development Guidelines – The Development Guidelines from the Buckeye / Sun Valley ADMS were reviewed in Step 2 of the ADMP. The review revealed that the suggested guidelines were focused on single lot development and were not especially applicable to master planned community development as the guidelines generally promote application of non-structural flood control measures. The SVADMP study area will be almost exclusively developed as a series of large master planned communities, many of these communities impacted by large active alluvial fans. Therefore, the majority of the development guidelines from the ADMS are not recommended for application to the ADMP. However, the Development Guidelines from the Buckeye / Sun Valley ADMS do specifically identify a goal for flood control features for the area that provide a regional solution, controlling the apices of the active alluvial fans and conveyance of flow through the entire fan. The structural solutions in the recommended alternative for the piedmont sub-areas achieve this objective.

Flood warning – Another areawide flood hazard mitigation measure could be the development of a flood warning system for the area. Instead of, or in addition to, other structural or non-structural flood control measures, flood detection technologies could be deployed in the study area to warn existing and future residents of the forecast or occurrence of severe weather. Recommendations for the placement of flood detection equipment and/or the development of a flood response plan are part of the Step 3 Recommended Alternative for the ADMP. However, a detailed flood response plan is not part of this project. It is recommended that ideally each structural element constructed be instrumented at its inflow and outflow locations. For example, the inflow wash to each detention basin should be instrumented. Similarly, the detention basin pool should also be instrumented. The downstream corridors should also contain instrumentation at their outlet locations. Additional intermediate instrumentation would also be helpful. Instrumentation would include rainfall and water level sensors. Additional weather sensors could be added at one or more of these stations if they help complement the existing District ALERT weather station network. Finally, water level monitoring of Wagner Wash and White Tank Wash near their outlet points could provide a integrated picture of watershed development impacts as well as data for inflows to the Hassayampa River and Buckeye FRS No. 1 respectively.

4.2 North of CAP Sub-Area

A discussion of the flood related issues and recommended solutions for the North of CAP sub-area was included in Volume 1 of the Step 2 Proposed Alternatives Report. Because most of the recommendations were non-structural in nature, no further refinement was required in Step 3. Pertinent elements of the recommendations for the North of CAP sub-area are repeated in the following sections. Refer also to Volume 1 of the Step 2 report for additional information.

4.2.1 Description of Area

The North of CAP sub-area is a long narrow area located north of the CAP Canal parallel to the Hassayampa River. The area is bounded on the north by Gates Road, on the west by the Hassayampa River floodplain, on the south by the CAP Canal, and on the east by the drainage divide to the Trilby Wash watershed. The sub-area is about 28 square miles in area. The majority of the area drains directly to the Hassayampa River. The remaining area drains to a detention area along the CAP Canal. About 25 percent of the area is composed of potentially floodprone areas. The identification of those areas and the issues for the ADMP associated with those areas are discussed below.

4.2.2 Floodprone Areas

Potentially floodprone areas in the North of CAP sub-area were delineated based on examination of the 2005 color digital orthophotography and the countywide 10-foot topographic contour data (Figure 11). The specific frequency of flooding was not evaluated and probably varies from place to place for the delineated areas.

Three types of flooding were recognized in the sub-area:

- Riverine flooding
- Small alluvial fans along Hassayampa River
- CAP pool area

Most of the floodprone areas in the sub-area are subject to riverine-type flooding. That is, flood water is collected and concentrated within tributary watersheds into individual channels. Riverine floodprone areas are identifiable based on vegetation patterns and surficial geologic indicators such as surface texture, color, and composition. Figure 12 shows an example of an area subject to riverine flooding. Note the larger, darker vegetation and the browner sediment colors surrounding that vegetation. Close examination also reveals small channels within and immediately adjacent to the areas of browner sediments.

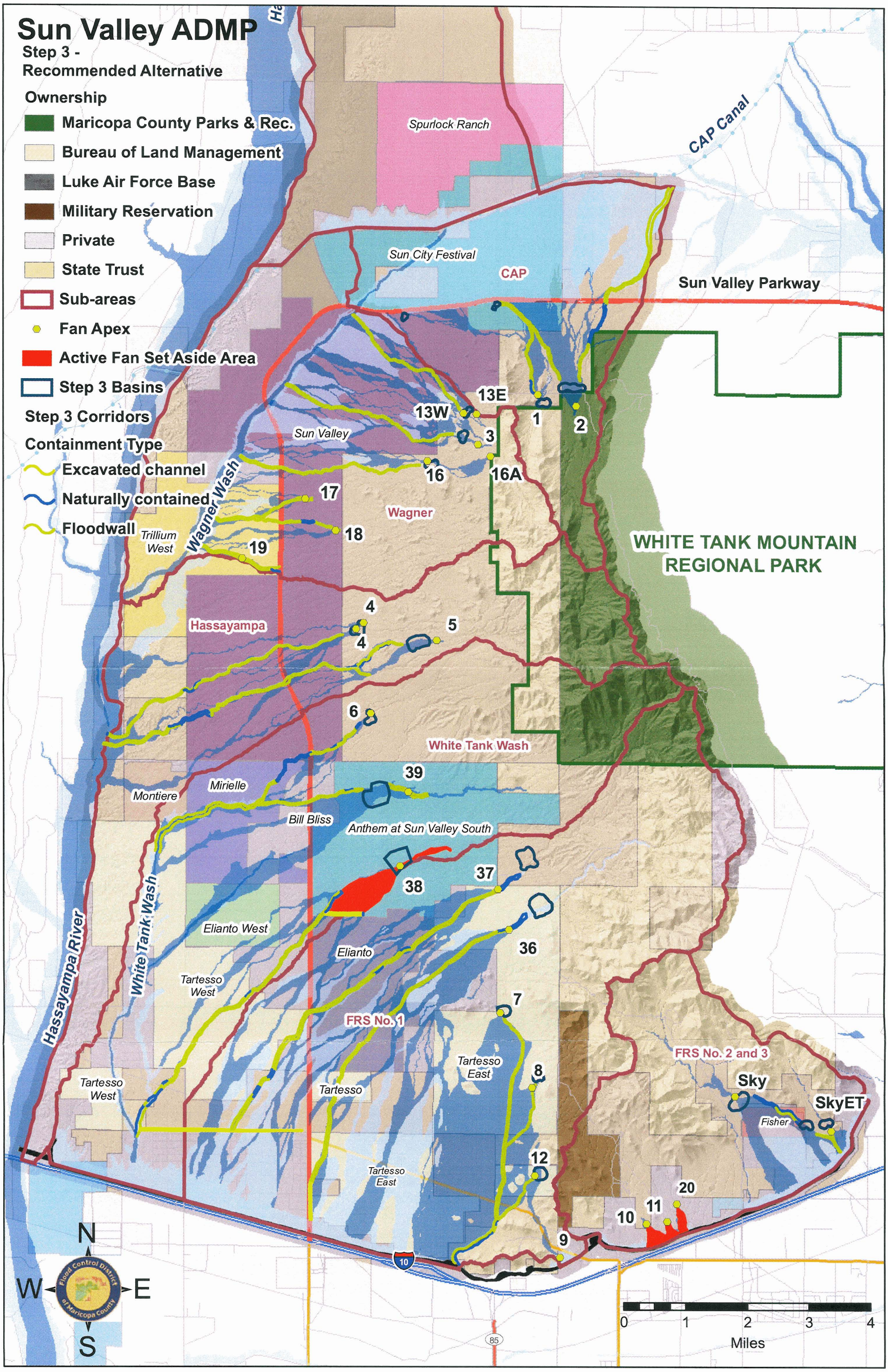

Figure 3 SVADMP Recommended Alternative For The Piedmont Sub-Areas

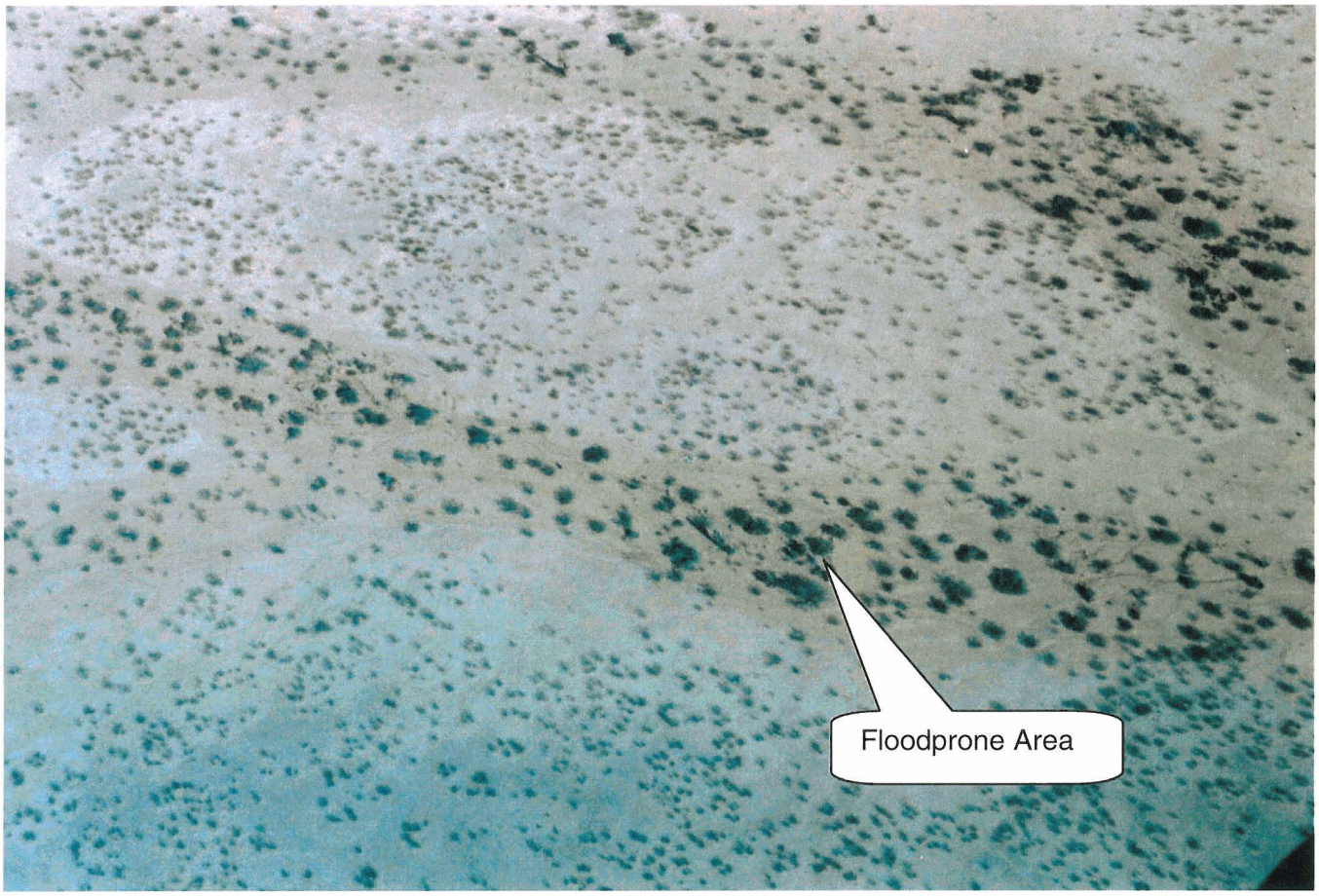

Figure 12 Example Of Riverine Floodprone Area North Of CAP

A number of the tributary drainages exit onto the Hassayampa River floodplain within the sub-area (Figure 13). The abrupt change in slope from the tributary watershed to the Hassayampa floodplain creates a sudden loss of sediment transport capacity. The result is the development of an alluvial fan. Several small alluvial fans are found along the southwest portion of the sub-area. Compared to the alluvial fans in the rest of the study area, these fans are small, steep, and very active. Slopes on these fans are on the order of 5 percent.

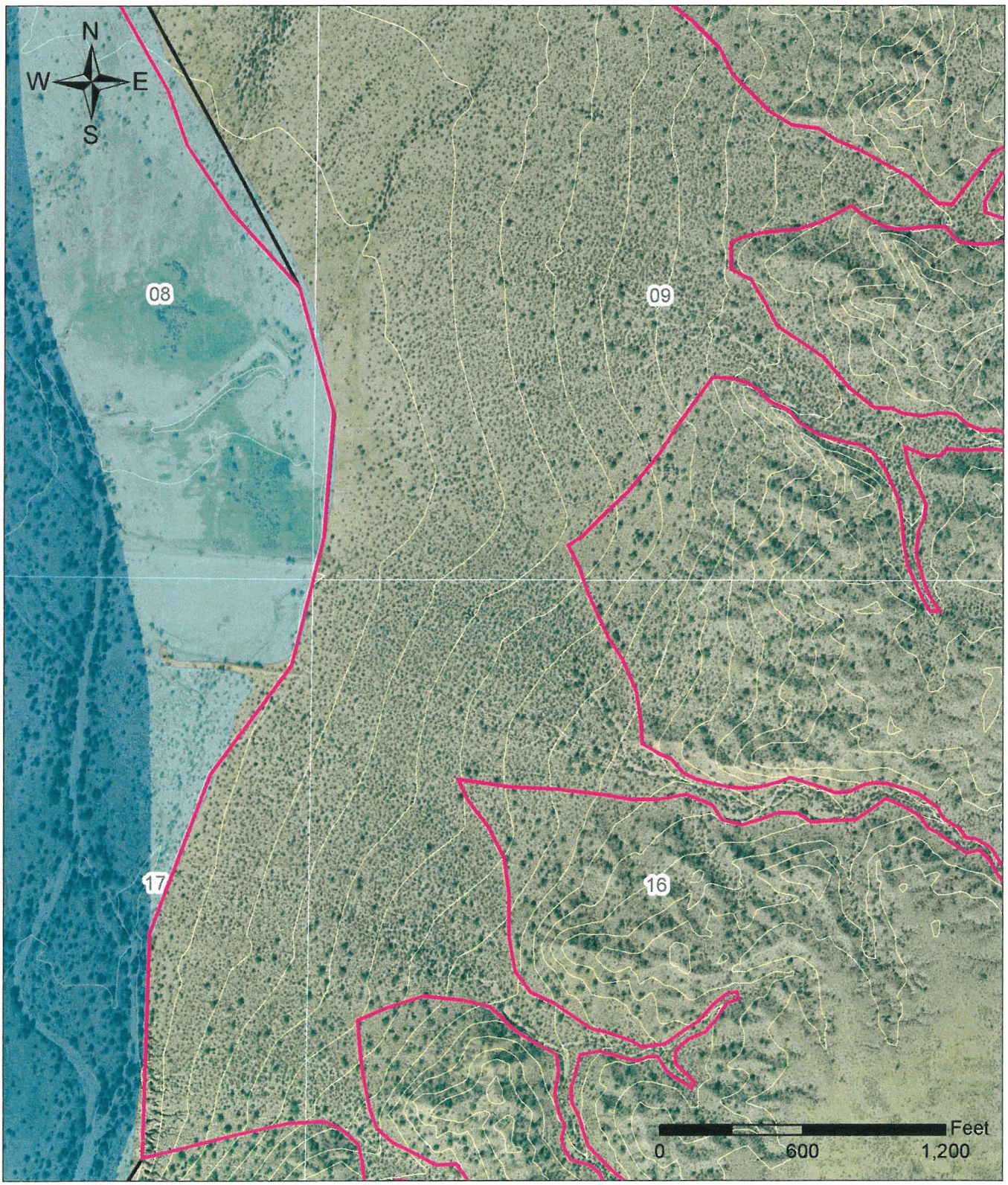

Figure 13 View Of Area Of Small Alluvial Fans Along The Hassayampa River In North Of CAP Sub-Area

Another floodprone area is the detention pool north of the CAP Canal. The detention area significantly reduces the flow that crosses the canal. Outflow occurs through one of two 18-foot wide concrete overchute structures in CAP Reach 8 – one located at Sta. 181+00 and the other at Sta. 248+00 (Figure 14). The peak discharge is reduced from about 7,800 cfs to 150 cfs in the 100-year 24-hour event (JEF, 2006c). This area needs to be reserved, preserving detention capacity, to prevent failure of the overchutes or overtopping of the CAP Canal.

Figure 14 View Downstream Of CAP Overchute At Sta. 248+00.

4.2.3 Luke Auxiliary Air Field No. 4

An abandoned auxiliary air field, Luke Auxiliary Field No. 4, is located just north of Patton Road. The air field is protected by a dike and channel system that diverts flow around the abandoned runways (Figure 15). The future disposition of the airfield and its neglected drainage facilities will need to be addressed as the area develops.

Figure 15 Close-Up View Of Luke Auxiliary Air Field No. 4

4.2.4 Stock Tanks

Thirteen of the 20 stock tanks in the study area are located within the North of CAP sub-area (Figure 11). Stock tanks present several potential challenges and issues for future development in the area. Stock tanks provide some level of protection from flooding to downstream reaches. Property owners downstream of existing stock tanks may perceive some flood control benefit from the tanks. However, these structures are rarely engineered and pose a potential hazard in the event of an embankment failure (Figure 16). Stock tank failure is not uncommon in Maricopa County. The failure of a stock tank can create a larger magnitude flood wave than had the tank not been present.

Figure 16 View Upstream Into Stock Tank Breach On Skunk Tank Wash (October 2000)

Stock tanks also disrupt sediment transport along the washes in which they are placed. The ponds trap sediment inflowing from the upstream wash and prevent sediment delivery to the downstream reach. In some cases, the sediment trapping effect can result in dramatic channel incision downstream.

Stock tanks also create a locally lush riparian habitat of mesquite, palo verde, and other large trees. This creates a challenge to the selected mitigation of the hazards posed by these tanks. In most cases, removal of a tank is the preferred solution to eliminate the potential hazards associated with a catastrophic tank failure. However, potential habitat mitigation and perceived increased flooding by downstream property owners may

create impediments to their removal. Nevertheless, as part of the ADMP it is recommended that stock tanks be removed as development begins to occur with the area north of the CAP Canal.

4.2.5 Summary

Much of the North of CAP sub-area is subject to some level of flood or sedimentation hazard. It is recommended that future development acknowledge and address these hazards according to existing federal, state, and local regulations. Special issues for the area include legacy issues such as stock tanks and an old abandoned airfield. The drainage impacts of these facilities are best addressed by removing all of them and returning the drainages to their original conditions. Finally, an area of small, but steep and very active, alluvial fans is found adjacent to the Hassayampa River floodplain. Development of these areas should be avoided unless engineered facilities are provided to mitigate the hazards. As detailed for the piedmont sub-areas south of the CAP Canal, the recommended structural solution for an active alluvial fan is an on-line detention basin at the apex with downstream conveyance to drain the basin and collect local drainage. However, these areas may be small enough that a non-structural avoidance strategy may prove acceptable and cost-effective.

4.3 Piedmont Sub-Areas

Six piedmont sub-areas were designated for organizational purposes in the ADMP (Figure 10). The piedmont area is about 150 square miles in area. Within those six sub-areas, fifteen "fan systems" were differentiated. The following sections provide a summary of each sub-area, its fan systems, and their recommended alternative features. The recommended alternatives for each sub-area are generally comprised of large, on-line detention basins near the alluvial fan apices with walled-levee corridors downstream to the sub-area outfall. The walled-levee corridors provide a path not only for the detention basin outflows, but also serve as a trunk system to which the downstream tributary watersheds may also deliver storm water. Given the hydraulic design criteria for the walled-levees, the height of the walls along most of the reaches would range from about four to five feet as the depth of flow varies along the corridors. Two sub-areas (White Tank Wash & FRS No. 1) have supplemental excavated channel reaches. Two sub-areas (CAP & White Tank Wash) have off-line basins as part of its recommended flood control solution.

The sub-areas and fan systems are presented from north to south in a counter-clockwise direction.

4.3.1 CAP Sub-area

The CAP sub-area is located on the northwestern slope of the White Tank Mountains piedmont. The sub-area is about 15.5 square miles in area. Two major alluvial fans, designated Fan 1 and Fan 2, drain from the White Tank Mountain Regional Park onto the piedmont in this sub-area. These two fans coalesce somewhat in

the downslope direction. Fan 1 drains predominantly to the west to Wagner Wash, while Fan 2 drains predominantly to a tributary of Trilby Wash to the east. The piedmont is bisected by the Sun Valley Parkway. Existing runoff from most of Fan 1 flows to Wagner Wash via an existing channel along the south side of Sun Valley Parkway. Runoff reaching the Parkway east of the Parkway channel crosses the road via existing culverts of various sizes beneath the roadway at various locations.

The recommended alternative for the CAP sub-area was refined from Alternative B1 in Step 2. It is comprised of two large, on-line detention basins near the alluvial fan apices, two off-line detention basin near Sun Valley Parkway, and walled-levee corridors downstream (Figure 17). The recommended alternative for Fan System 1/2 also includes the use of the existing Sun Valley Parkway channel downstream of the Fan 1 walled-levee corridor. Non-structural measures include approximate floodplain delineations of the contained wash reaches upstream from the detention basins to the White Tank Mountain Regional Park boundary.

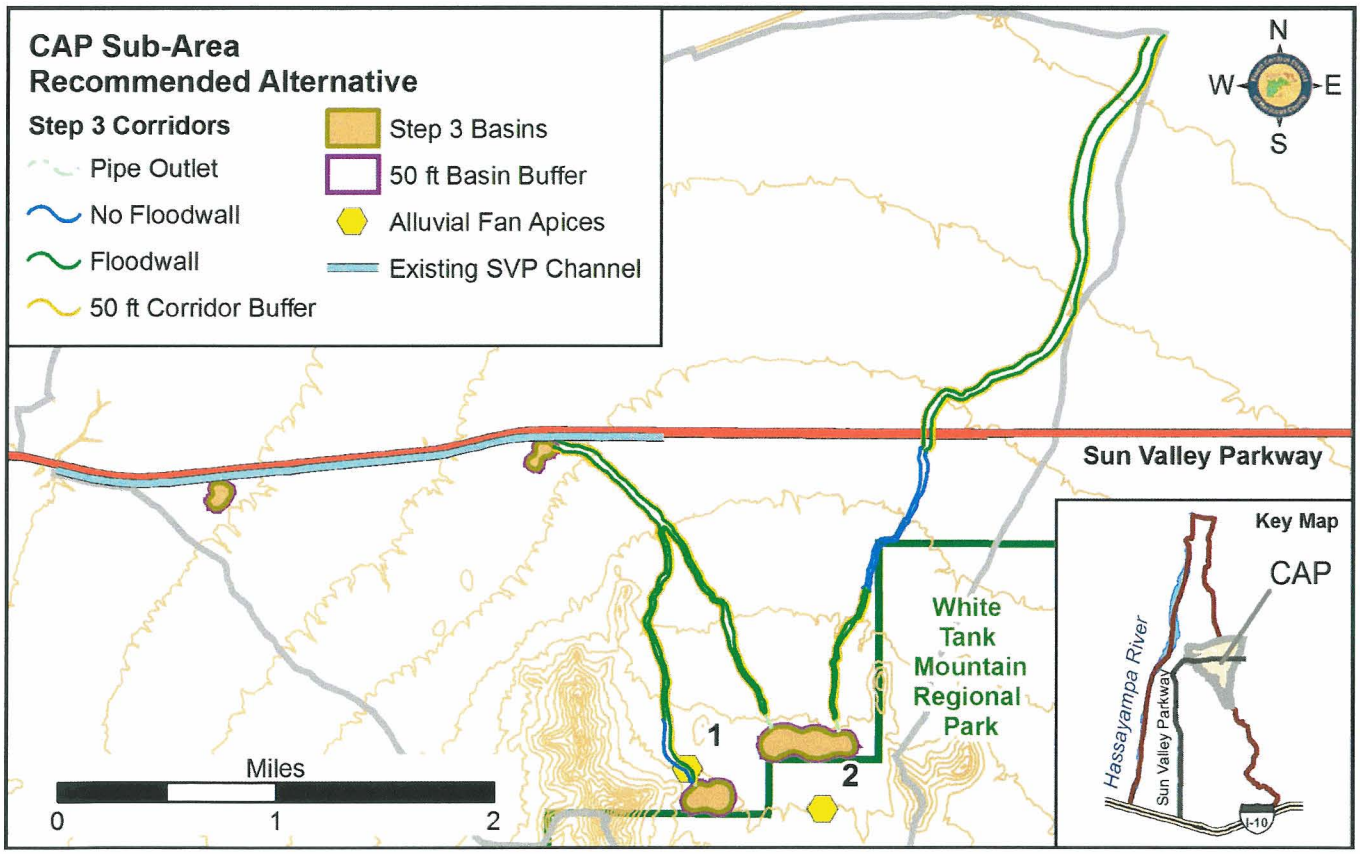

Figure 17 Recommended Alternative Features For CAP Sub-Area

The design concepts for the CAP sub-area incorporate the existing roadway drainage facilities without modification. Therefore, two off-line basins were required to limit flow to the existing Sun Valley Parkway

channel capacity. One of these basins is located at the end of the Fan 1 walled-levee corridor. The second is located at a primary tributary entrance to the channel about ¾ mile upstream of Wagner Wash.

Additional details associated with each fan system within the CAP sub-area are provided in the following sections. The conceptual planimetric layout of the recommended alternative is shown in Figure 17. Larger scale, more detailed layout sheets are found in the appendices of Volume 2.

4.3.1.1 Fan System 1 & 2

Fan System 1/2 has two apex detention basins, one for Fan 1 and another for Fan 2. The basin at the apex of Fan 1 will be approximately 16 acres at the top of the basin and will have a storage depth of 7.5 feet deep to retain the required 36 acre feet of storage from its upstream drainage area. The slope of the existing grade will create a height of approximately 34 feet on the uphill side of the basin. One riprap inlet spillway structures will be needed to collect inflows from washes entering the basin.

The basin at the apex of Fan 2 will be approximately 30 acres at the top of the basin and will have a storage depth of 7.5 feet to retain the required 115 acre feet of storage from its upstream drainage area. The slope of the existing grade will create a height of approximately 24 feet on the uphill side of the basin. Because the basin is located outside the Regional Park downstream of the fan apex, nearly the entire upstream slope of the basin will require riprap protection to protect the slope and act as an inlet spillway structure to collect inflows from washes entering the basin.

The outflow from the Fan 1 basin would require a corridor width of approximately 110 feet, which increases to about 230 feet at its end where it approaches the Sun Valley Parkway channel with a flow rate of about 1400 cfs. The outflow from the Fan 2 basin would require a corridor width of approximately 40 feet, which increases to about 300 feet where it ends at a tributary of Trilby Wash with a flow rate of about 3300 cfs. The total length of walled-levee corridor for the entire Fan System is about 6.8 miles – 3.8 miles from the Fan 2 basin to the Trilby Wash tributary, 1.1 miles from the Fan 2 basin to the Fan 1 corridor, and 1.9 miles from the Fan 1 basin to the Sun Valley Parkway channel.

A total of about 45 drop structures would be required to control grade in the corridor. Some of these are expected to be achieved in conjunction with future transportation or utility crossings. About ¾ of a mile of the eastern Fan 2 corridor are naturally contained by the existing natural wash.

Backfill will be needed along much of the floodwall to meet the landscape aesthetic treatment objectives. The backfill needed is about 64 ac-ft, which is significantly less than the 712 ac-ft of total excavation required for the detention basins. Therefore, there will be a large amount of material that will require disposal. Some of this material might be used in the vicinity of the basins or elsewhere along the corridors to provide additional visual screening.

4.3.2 Wagner Sub-area

The Wagner Wash sub-area is located on the northwestern slope of the White Tank Mountains piedmont. The sub-area is about 24.6 square miles in area. Three major alluvial fans, designated Fan 13 (E and W), Fan 3, and Fan 16, drain from the White Tank Mountain Regional Park onto the piedmont in this sub-area. Three additional areas of large channel divides (distributary channels) are also located in the southern portion of the sub-area and were designated Fans 17, 18, and 19. The entire sub-area drains into Wagner Wash. The piedmont below portions of Fans 16, 17, and 18 is bisected by the Sun Valley Parkway. Existing runoff from Fans 13 and 3 enters Wagner Wash between its two existing Sun Valley Parkway crossings. Runoff from the remainder of the sub-area, including Fans 16 - 19, flows to Wagner Wash via existing drainage facilities across the Sun Valley Parkway. Those facilities consist of culverts of various sizes beneath the roadway at various locations. The design concepts for the Wagner sub-area incorporate the existing culverts without modification except for Fan System 16. Culvert capacities were computed assuming a headwater depth equal to one foot greater than the internal culvert height as indicated on the design plan sheets for the Parkway. The culvert for Fan System 16 required an upgrade to pass the design discharge. This approach was a variation from Step 2. The reason for the variation in approach was that the culvert upgrade was found to be substantially less expensive than the cost of an off-line basin to limit the flow rate at Sun Valley Parkway.

Within the Wagner sub-area, five "fan systems" were further differentiated. The five fan systems within the Wagner Wash sub-area are:

- Fan System 13 which controls Fans 13E and 13W
- Fan System 3 which controls Fan 3
- Fan System 16 which controls Fan 16 and 16A
- Fan System 17/18 which addresses Fans 17 and 18
- Fan System 19 which addresses Fan 19

The recommended alternative for the Wagner Wash sub-area was refined from Alternative B4-3 in Step 2. It is comprised of three large, on-line detention basins near the alluvial fan apices, one culvert crossing upgrade at Sun Valley Parkway for Fan System 16, and walled-levee corridors downstream to Wagner Wash for the five fan systems (Figure 18). Fan Systems 13, 3, and 16 are comprised of one on-line detention basin with a downstream walled-levee corridor for each fan system. Fan Systems 17/18 and 19 are comprised of walled-levee corridors only. The recommended alternative for Fan Systems 3 and 13 also include small containment dikes to prevent flow breakouts between the fan system watersheds. Non-structural measures include approximate floodplain delineations of the contained wash reaches upstream from the detention basins to the White Tank Mountain Regional Park boundary and along the outfall, Wagner Wash.

Additional details associated with each fan system within the Wagner sub-area are provided in the following sections. The conceptual planimetric layout of the recommended alternative is shown in Figure 18. Larger scale, more detailed layout sheets are found in the appendices of Volume 3.

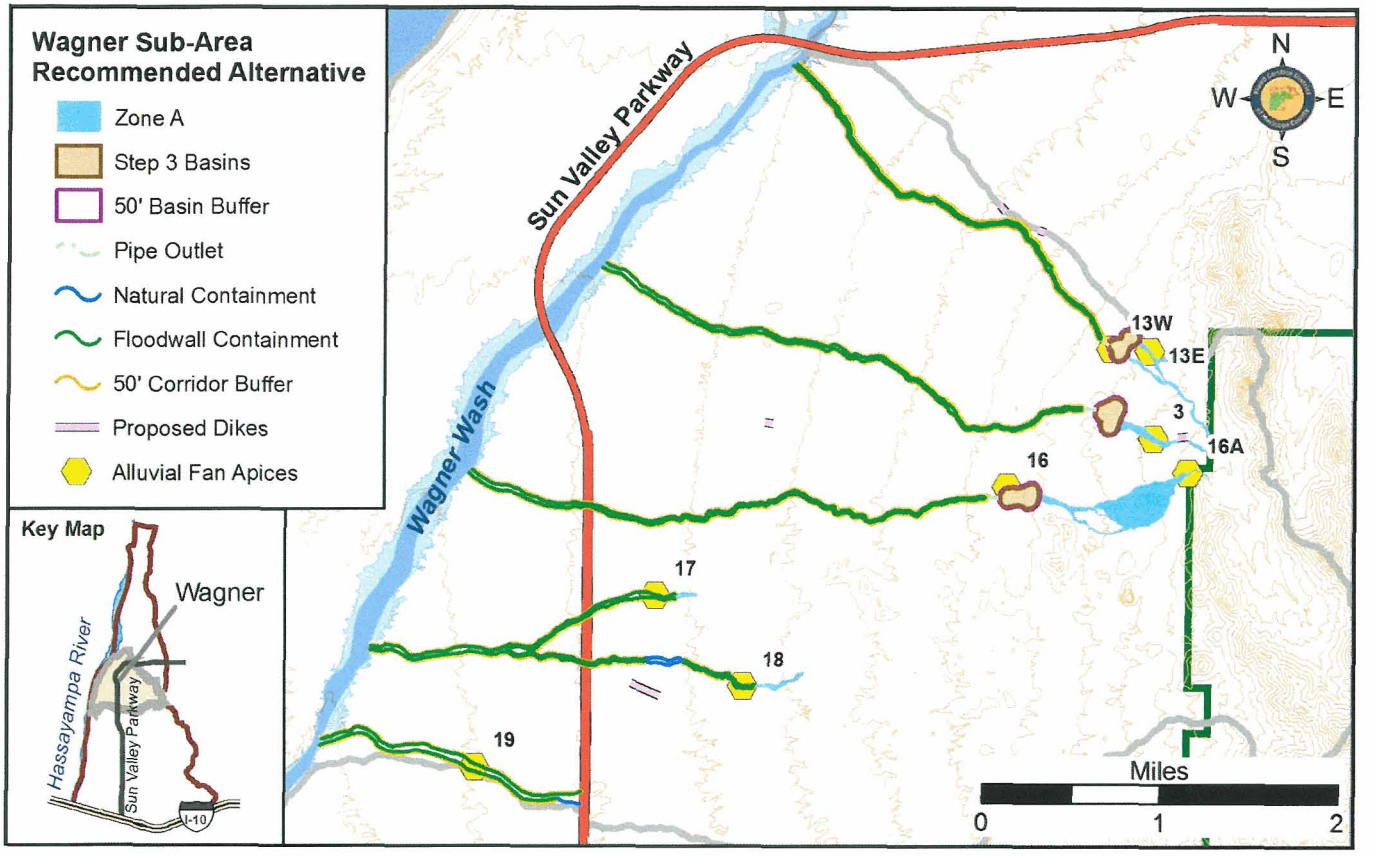

Figure 18 Recommended Alternative Features For Wagner Wash Sub-Area

4.3.2.1 Fan System 13

The basin at the apex of Fan System 13 will be approximately 10.5 acres at the top of the basin and will have a storage depth of 7.5 feet to retain the required 31.2 acre feet of storage from the drainage area to this fan. The slope of the existing grade will create a height of approximately 26 feet on the uphill side of the basin. Two separate riprap inlet spillway structures will be needed to collect inflows from washes entering the basin.

The outflow from the basin would require a corridor width of approximately 40 feet, which would increase to about 80 feet at the end where the flow rate would be about 900 cfs. The total length of walled-levee corridor is about 2.5 miles. A total of about 14 drop structures would be required to control grade in the corridor. Some of these are expected to be achieved in conjunction with future transportation or utility crossings. Backfill will be needed along much of the floodwall to meet the landscape aesthetic treatment objectives. The backfill needed is about 47 ac-ft, which is less than half of the 125 ac-ft of total excavation required for the detention basin. Finally,

two small dikes are needed in conjunction with the recommended alternative for Fan System 13. These dikes are required about half way downstream of the on-line basin in order to prevent split flows from the neighboring watershed from entering the Fan System 13 watershed.

4.3.2.2 Fan System 3

The basin at the apex of Fan System 3 will be approximately 14 acres at the top of the basin and will have a storage depth of 9 feet to retain the required 59.3 acre feet of storage from the drainage area to this fan. The basin has been located on the uphill side of two small landforms to reduce visibility of the structure from lower elevations and from areas to the north and south of the basin. The slope of the existing grade will create a height of approximately 33 feet on the uphill side of the basin. About seven terraces would be used on the inlet structure to dissipate the energy of the incoming flow and minimize damage to the basin and inlet structure.

The outflow from the basin would require a corridor width of approximately 60 feet, which would increase to about 150 feet at the end where the flow rate would be about 1750 cfs. The total length of walled-levee corridor is about 3 miles. A total of about 21 drop structures would be required to control grade in the corridor. Backfill will be needed along much of the floodwall to meet the landscape aesthetic treatment objectives. The backfill needed is about 46 ac-ft, which is significantly less than the 216 ac-ft of total excavation required for the detention basin. Finally, one small dike is needed in conjunction with the recommended alternative for Fan System 3. The dike required is located about 2200 feet upstream of the detention basin in order to prevent an entrenched split into the Fan System 13 watershed.

4.3.2.3 Fan System 16

The basin at the apex of Fan System 16 will be approximately 14 acres at the top of the basin and will have a storage depth of 8 feet to retain the required 41 acre feet of storage from the drainage area to this fan. The slope of the existing grade will create a height of approximately 35 feet on the uphill side of the basin. One riprap inlet spillway structures will be needed to collect inflows from the wash entering the basin.

The outflow from the basin would require a corridor width of approximately 50 feet, which would increase to about 130 feet at the end where the flow rate would be about 1365 cfs. The total length of walled-levee corridor is about 3.2 miles. A total of about 15 drop structures would be required to control grade in the corridor. Backfill will be needed along much of the floodwall to meet the landscape aesthetic treatment objectives. The backfill needed is about 56 ac-ft, which is significantly less than the 219 ac-ft of total excavation required for the detention basin. Finally, one small dike is needed in conjunction with the recommended alternative for Fan System 16. The dike required is located about one mile east of Sun Valley Parkway and one half mile north of the corridor. The dike is needed to prevent inflows from the adjacent watershed into the Fan System 16 watershed.

4.3.2.4 Fan System 17 & 18

The recommended alternative for Fan System 17 & 18 does not include an apex detention basin. The channel avulsion potential associated with Fan 17 & 18 is not as severe as other fans within the study area. However, containment of several channel breakouts is needed. Therefore, a walled-levee corridor is proposed for Fan System 17 & 18.

The required corridor would have a width of approximately 75 feet, which would increase to about 130 feet at the end where the flow rate would be about 1450 cfs. The total length of walled-levee corridor is about 3.4 miles. A total of about five drop structures would be required to control grade in the corridor. Backfill will be needed along much of the floodwall to meet the landscape aesthetic treatment objectives. The backfill needed is about 52 ac-ft. Finally, one small dike is needed in conjunction with the recommended alternative for Fan System 17 & 18. The dike required is located east of Sun Valley Parkway, south of the Fan 18 corridor. The dike is required in order to prevent a secondary breakout to the Fan 19 corridor.

4.3.2.5 Fan System 19

The recommended alternative for Fan System 19 does not include an apex detention basin. The channel avulsion potential associated with Fan 19 is not as severe as other fans within the study area. However, containment of several channel breakouts is needed. Therefore, a walled-levee corridor is proposed for Fan System 19.

The required corridor would have a width of approximately 200 feet to contain the flow rate of about 1600 cfs. The total length of walled-levee corridor is about 1.6 miles. A total of about five drop structures would be required to control grade in the corridor. Backfill will be needed along much of the floodwall to meet the landscape aesthetic treatment objectives. The backfill needed is about 22 ac-ft to maintain the 3 foot maximum wall exposure on the outside of the corridor.

4.3.3 Hassayampa Sub-area

The Hassayampa sub-area is located on the western slope of the White Tank Mountains piedmont. The sub-area is about 22 square miles in area. Two major alluvial fans, designated Fan 4 and Fan 5, drain from the White Tank Mountain Regional Park onto the piedmont in this sub-area. The entire sub-area drains into the Hassayampa River. The piedmont is bisected by the Sun Valley Parkway. Runoff from the sub-area, including Fans 4 and 5 flow to the Hassayampa River via existing drainage facilities under the Sun Valley Parkway. Those facilities consist of culverts of various sizes beneath the roadway at various locations. The design concepts for the Hassayampa sub-area incorporate the existing culverts without modification. Culvert capacities were computed

assuming a headwater depth equal to one foot greater than the internal culvert height as indicated on the design plan sheets for the Parkway.

Within the Hassayampa sub-area, two "fan systems" were further differentiated. The two fan systems within the Hassayampa sub-area are:

- Fan System 4 which addresses Fan 4
- Fan System 5 which addresses Fan 5

The recommended alternative for the Hassayampa sub-area was refined from Alternative B4-2 in Step 2. It is comprised of two large, on-line detention basins near the alluvial fan apices and walled-levee corridors downstream to the Hassayampa River. The Fan System 4 recommended alternative also includes a small containment dike to prevent a flow breakout into the Fan 5 system watershed. Non-structural measures include approximate floodplain delineations of the contained wash reaches upstream from the detention basins.

Additional details associated with each fan system within the Hassayampa sub-area are provided in the following sections. The conceptual planimetric layout of the recommended alternative is shown in Figure 19. Larger scale, more detailed layout sheets are found in the appendices of Volume 4.

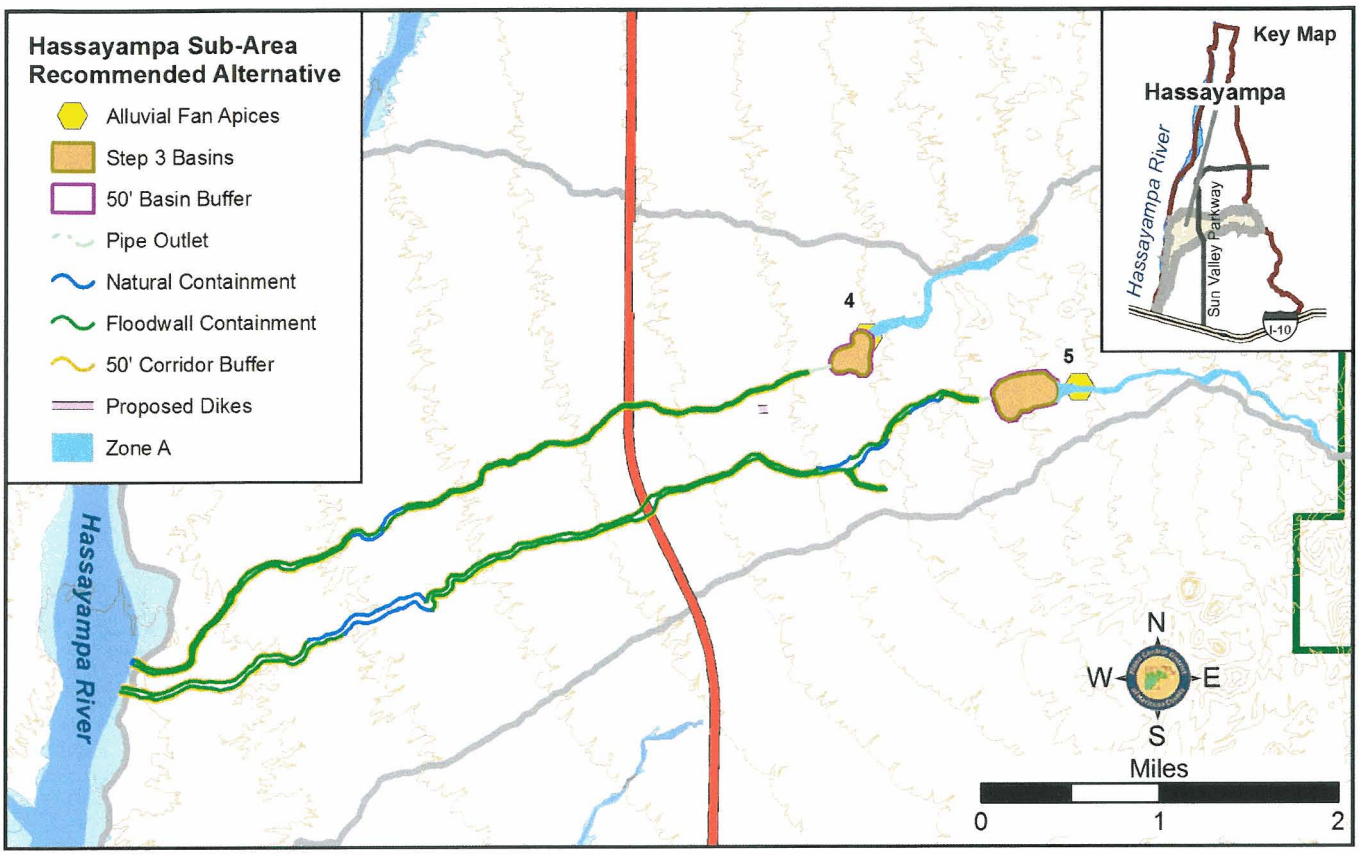

Figure 19 Recommended Alternative Features For Hassayampa Sub-Area

4.3.3.1 Fan System 4

The basin at the apex of Fan System 4 will be approximately 23 acres at the top of the basin and will have a storage depth of 9 feet to retain the required 104 acre feet of storage from the drainage area to this fan. The slope of the existing grade will create a height of approximately 30 feet on the uphill side of the basin. Two separate inlet spillway structures will be needed to collect inflows from washes entering the basin. The northern inlet spillway will be a terraced inlet structure with 5 to 6 terrace steps. The southern inlet could be either another terraced inlet or could be a riprap lined spillway given the relatively smaller inflow discharges.

The outflow from the basin would require a corridor width of approximately 40 feet, which would increase to about 110 feet at the Hassayampa River where the flow rate would be about 1000 cfs. The total length of walled-levee corridor is about 4.6 miles. A total of about 33 drop structures would be required to control grade in the corridor. Some of these are expected to be achieved in conjunction with future transportation or utility crossings. Backfill will be needed along much of the floodwall to meet the landscape aesthetic treatment objectives. The backfill needed is about 60 ac-ft, which is significantly less than the 358 ac-ft of total excavation required for the detention basin. Finally, one small dike is needed in conjunction with the recommended

alternative for Fan System 4. The dike is required about half way downstream of the on-line basin to the Sun Valley Parkway (see Figure 19) in order to prevent split flows from the crossing over to the neighboring watershed of Fan System 5.

4.3.3.2 Fan System 5

The basin at the apex of Fan System 5 will be approximately 41 acres at the top of the basin and will have a storage depth of 10 feet to retain the required 215 acre feet of storage from the drainage area to this fan. The slope of the existing grade will create a height of approximately 60 feet on the uphill side of the basin. Ten to twelve terraces would be used on the inlet structure to dissipate the energy of the incoming flow and minimize damage to the basin and inlet structure.

The outflow from the basin would require a corridor width of approximately 60 feet, which would increase to about 170 feet approaching the Hassayampa River where the flow rate would be about 1600 cfs. The total length of walled-levee corridor is about 6 miles of which about one half mile is naturally contained within the existing wash. A total of about 31 drop structures would be required to control grade in the corridor. Backfill will be needed along much of the floodwall to meet the aesthetic treatment objectives. The backfill needed is about 66 ac-ft, which is significantly less than the 925 ac-ft of total excavation required for the detention basin.

4.3.4 White Tank Wash Sub-area

The White Tank Wash sub-area is located on the southwestern slope of the White Tank Mountains. The sub-area is about 32 square miles in area. Three major alluvial fans drain the White Tank Mountains spreading out over a very large area before collecting naturally into White Tank Wash. The major alluvial fans from north to south are Fan 6, Fan 39, and Fan 38. The outflow corridors from Fan 6 and 39 join along an existing large tributary to White Tank Wash. The corridor is continued downstream to a point where the existing wash turns south and begins to flow toward Buckeye FRS No. 1.

Within the White Tank Wash sub-area, two "fan systems" were further differentiated. The two fan systems within the White Tank Wash sub-area are:

- Fan System 6 & 39 which addresses Fans 6 and 39
- Fan System 38 which addresses Fan 38

The recommended alternative for the White Tank Wash sub-area was refined from Alternative B1 in Step 2 for Fan System 6 & 39. The recommended alternative for Fan System 6 & 39 is comprised of two large, on-line detention basins and walled-levee corridors downstream to White Tank Wash near a point where it turns from an east to west alignment to a north to south alignment. The recommended alternative for the Fan System 38 is

comprised of a single large, off-line detention basin (to be designed and constructed by others), an active fan set aside area, and walled-levee corridors downstream to White Tank Wash.

Additional details associated with each fan system within the White Tank Wash sub-area are provided in the following sections. The conceptual planimetric layout for each fan system is shown in Figure 20. Larger scale, more detailed layout sheets are found in the appendices of Volume 5.

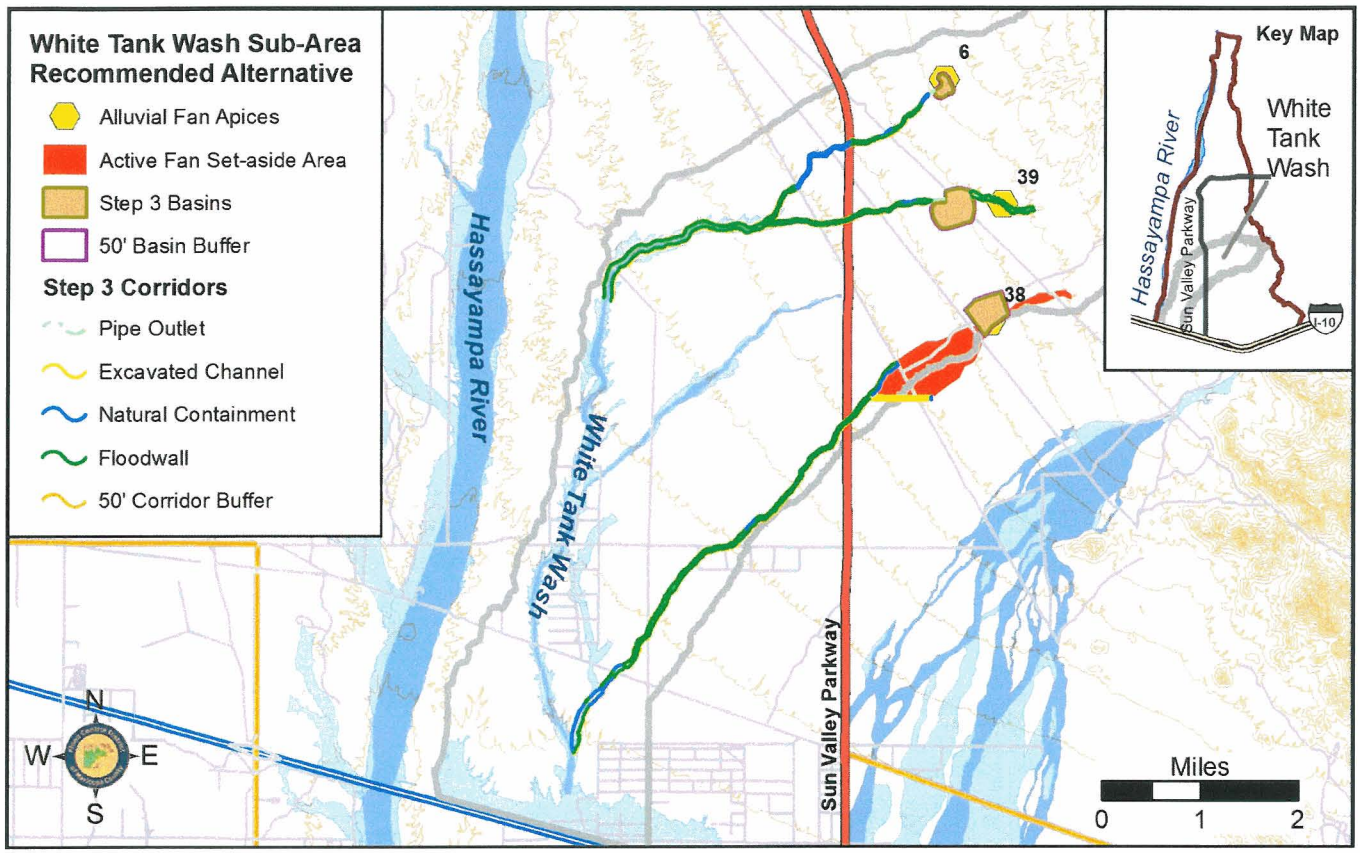

Figure 20 Recommended Alternative Features For The White Tank Wash Sub-Area

4.3.4.1 Fan System 6 & 39

Fan System 6 & 39 is composed of two on-line detention basins and 7.3 miles of downstream corridors. The basin at the apex of Fan 6 (RRE1) will be approximately 17 acres at the top of the basin and will have a storage depth of 8 feet to retain the required 70 acre feet of storage from the drainage area to this fan. The slope of the existing grade will create a height of approximately 25 feet on the uphill side of the basin. A terraced inlet spillway structure with about 5 steps will be needed to collect inflows as they enter the basin.

The outflow from the Fan 6 basin is contained within the existing downstream wash corridor intermittently for about one mile of its length before the walled-levee corridor joins with the corridor from Fan 39. About 14 drop structures would be required to control grade in this reach of the corridor.

The basin at the apex of Fan 39 (RRF2) will be approximately 83 acres at the top of the basin and will have a storage depth of 6 feet to retain the required 325 acre feet of storage from the drainage area to this fan. The slope of the existing grade will create a height of approximately 40 feet on the uphill side of the basin. A terraced inlet spillway structure with about 8 steps will be needed to collect inflows as they enter the basin. Another 0.75 mile reach of leveed corridor will be needed upstream of the Fan 39 basin to prevent a channel breakout and collect flows more efficiently into the basin

Downstream of the Fan 39 basin outflows are contained within a walled-levee corridor for about 1.9 miles where it joins with the corridor from Fan 6. About 9 drop structures would be required to control grade in this reach of the corridor.

The combined corridors continue another two miles before they outlet into a non-structural reach of White Tank Wash itself. The peak discharges at the end of the design corridor reach are about 2700 cfs compared to the 3400 cfs estimated in the existing FEMA floodplain for this reach (Alpha, 1994). Therefore, continued floodplain management of the remaining downstream reach is considered a sufficient yet integral part of the recommended alternative for the White Tank Wash sub-area.

Backfill will be needed along much of the floodwall to meet the aesthetic treatment objectives. The total backfill needed is about 46 ac-ft, which is significantly less than the 2,048 ac-ft of total excavation required for the detention basins.

4.3.4.2 Fan System 38

Fan System 38 is composed of a single off-line detention basin, 286 acres of active fan set-aside area, 6 miles of downstream corridors, 0.6 miles of which are excavated channels with the other 5.4 miles being walled-levee corridors. The basin at the apex of the Fan 38 will be an off-line basin to be designed and constructed by others. The design is such that it will allow up to 1,000 cfs to flow past the basin before collecting any runoff. The design by the developer's engineer estimates a diverted volume of about 100 acre-feet.

With this design, the continuing flows will be allowed to spread out over an existing active alluvial fan set aside area before being collected and controlled. The costs associated with the detention basin and the active fan set-aside area are included in the cost estimates.

The active alluvial fan area is controlled by means of a one-sided floodwall corridor along the west side of the area and an excavated earthen channel on the south side. Downstream of the active fan set-aside area, the flows are contained within a walled-levee corridor about 5 miles in length.

Backfill will be needed along much of the floodwall to meet the aesthetic treatment objectives. The backfill needed is about 34 ac-ft, which is approximately the same as the 32 ac-ft needed to construct the excavated channel reaches along the south side of the active fan set-aside area.

4.3.5 Buckeye FRS No. 1 Sub-area

The FRS No. 1 sub-area is located on the southwestern slope of the White Tank Mountains. Three major and two minor alluvial fans drain the White Tank Mountains spreading out over a very large area before being captured by Buckeye Flood Retarding Structure No. 1. The major alluvial fans from north to south are Fan 37, Fan 36, and Fan 7. Fans 8 and 12 are relatively small and were incorporated into the Fan 7 outfall corridor. Buckeye FRS No. 1 is a long earthen dam. It is drained by a small diameter pipe outlet. Flows must also pass beneath the major roadway crossings of the FRS flood pool at Sun Valley Parkway and Johnson Road. In the event of flows in excess of its design capacity, an emergency spillway located at the west end of the FRS will serve to discharge the additional flows to the Hassayampa River.

Within the FRS No. 1 sub-area, three "fan systems" were further differentiated. The three fan systems within the FRS No. 1 sub-area are:

- Fan System 37 which addresses Fan 37
- Fan System 36 which addresses Fan 36
- Fan System 7, 8 & 12 which addresses Fans 7, 8, & 12

The recommended alternative for the FRS No. 1 sub-area was refined from Alternative B4-3 in Step 2. The recommended alternative for the Fan System 37 is comprised of a single large, on-line detention basin and walled-levee corridors downstream to the McDowell Road alignment. The walled corridor joins an excavated interceptor channel along McDowell Road which flows from east to west from about Sun Valley Parkway to White Tank Wash (and eventually then to Buckeye Flood Retarding Structure No. 1). The excavated channel along McDowell Road serves to intercept additional runoff and protect the area of existing homes south of McDowell Road. The recommended alternative for the Fan System 36 is comprised of a single large, on-line detention basin and walled-levee corridors downstream to a point about 1000 feet north of the Van Buren Street alignment. Downstream of that point the flow is conveyed in an excavated channel along Sun Valley Parkway to the FRS No. 1 flood pool. The Fan System 7, 8, & 12 recommended alternative is comprised of three large, on-line detention basins and walled-levee corridors downstream to FRS No. 1.

Additional details associated with each fan system within the FRS No. 1 sub-area are provided in the following sections. The conceptual planimetric layout for each fan system is shown in Figure 21. Larger scale, more detailed layout sheets are found in the appendices of Volume 6.

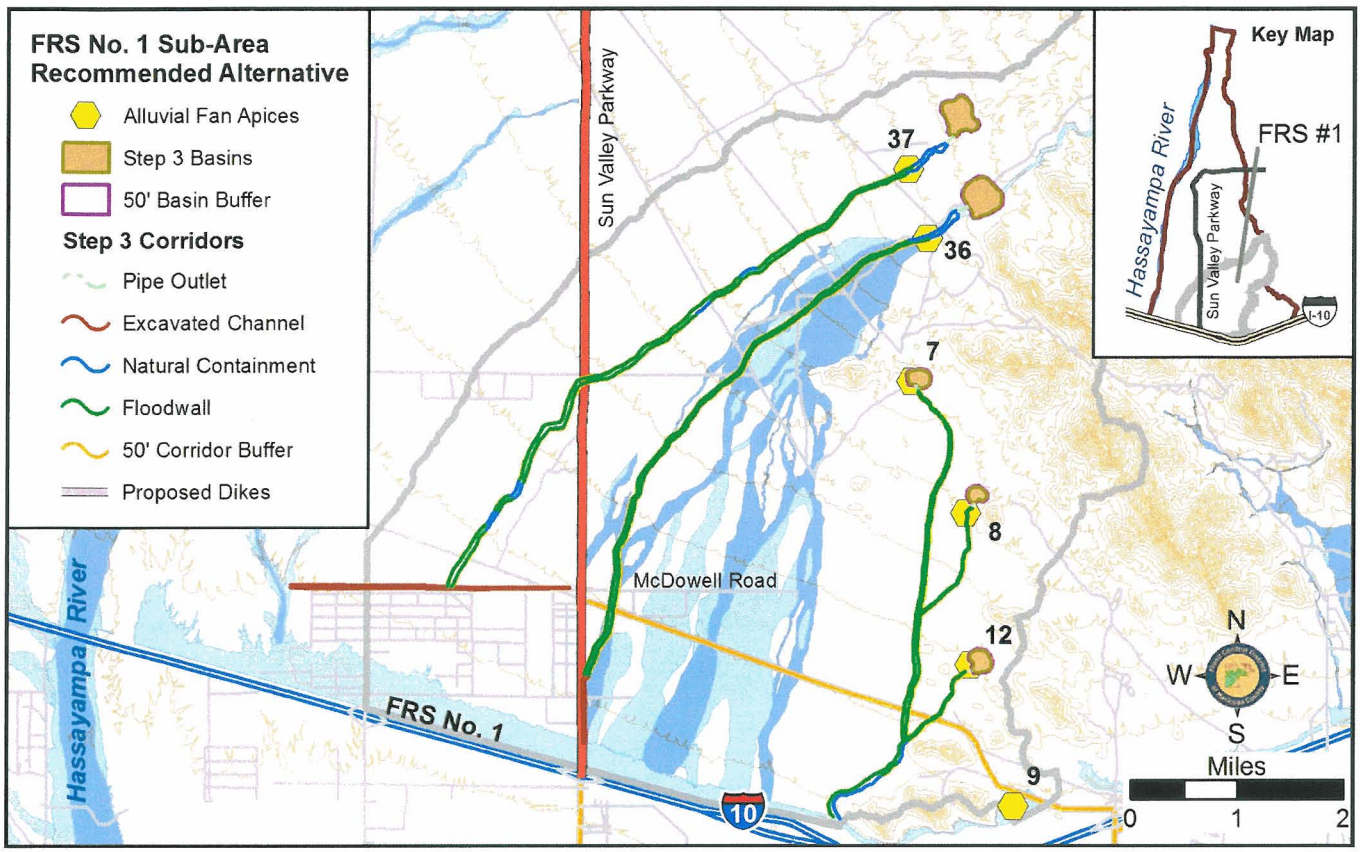

Figure 21 Recommended Alternative Features For The FRS No. 1 Sub-Area

4.3.5.1 Fan System 37

Fan System 37 is composed of a single on-line detention basin and 9.3 miles of downstream corridors, 2.6 miles of which are excavated channels with the other 6.7 miles being walled-levee corridors. The basin at the apex of Fan 37 (RRL1) will be approximately 52 acres at the top of the basin and will have a storage depth of 10 feet to retain the required 237 acre feet of storage from the drainage area to this fan. The slope of the existing grade will create a height of approximately 50 feet on the uphill side of the basin. Two terraced inlet spillway structures with 8 to 10 steps will be needed to collect inflows as they enter the basin.

The outflow from the Fan 37 basin is contained within the existing downstream wash corridor for about one half mile before the walled-levee corridor leads to an excavated channel along the McDowell Road alignment. The length of walled-levee corridor between the basin and McDowell Road is about 6.7 miles. About 40 drop structures would be required to control grade in this reach of the corridor.

Backfill will be needed along much of the floodwall to meet the aesthetic treatment objectives. The backfill needed is about 56 ac-ft, which is significantly less than the 1300 ac-ft of total excavation required for the

detention basin. Another 140 ac-ft of excavation will be needed to construct the excavated channel reaches along McDowell Road.

4.3.5.2 Fan System 36

Fan System 36 is composed of a single on-line detention basin and 6.7 miles of downstream corridors, 0.6 miles of which are excavated channels with the other 6.1 miles being walled-levee corridors. The basin at the apex of Fan 36 (RRCM1) will be approximately 62 acres at the top of the basin and will have a storage depth of 10 feet to retain the required 317 acre feet of storage from the drainage area to this fan. The slope of the existing grade will create a height of approximately 50 feet on the uphill side of the basin. Three terraced inlet spillway structures with 8 to 10 steps will be needed to collect inflows as they enter the basin.

The outflow from the Fan 36 basin is contained within the existing downstream wash corridor for about one half mile before the walled levee corridor leads to a short reach of excavated channel near the Van Buren Street alignment, parallel to Sun Valley Parkway. The length of walled-levee corridor between the basin and Van Buren Street is about six miles. About 24 drop structures would be required to control grade in the corridor.

The height of the walls along the Fan 36 corridors would range from about four feet to about five feet as the depth of flow varies along the corridor where flows are not naturally contained. Backfill will be needed along much of the floodwall to meet the aesthetic treatment objectives. The backfill needed is about 57 ac-ft, which is significantly less than the 1600 ac-ft of total excavation required for the detention basin. Another 30 ac-ft of excavation will be needed to construct the excavated channel reaches along Sun Valley Parkway.

4.3.5.3 Fan System 7, 8, & 12

Fan System 7, 8, & 12 is composed of three on-line detention basins and 6.9 miles of downstream corridors, about one mile of which is naturally contained on one side. The basin at the apex of Fan 7 (RRN1) will be approximately 18 acres at the top of the basin and will have a storage depth of 7.5 feet to retain the required 78 acre feet of storage from the drainage area to this fan. The slope of the existing grade will create a height of approximately 28 feet on the uphill side of the basin. Two riprap-lined inlet spillway structures will be needed to collect inflows as they enter the basin.

The outflow from the RRN1 basin drains to a walled levee corridor for about 2.3 miles where it joins the outflows from basin RRP1A which controls flows from Fan 8. About 12 drop structures would be required to control grade in this reach of the corridor. The basin at the apex of Fan 8 (RRP1A) will be approximately 13 acres at the top of the basin and have a storage depth of 7 feet to retain the required 36 acre feet of storage from the drainage area to this fan. The slope of the existing grade will create a height of approximately 30 feet on the

uphill side of the basin. One riprap-lined inlet spillway structure will be needed to collect inflows as they enter the basin.

The outflow from the Fan 8 basin drains to a 1.3 mile long walled-levee corridor before joining the corridor from Fan 7. The combined outflows flow about another 1.2 miles where they meet the outflow from Fan 12.

The RRQ1A basin controls the Fan 12 alluvial fan just upstream of its apex. The basin has a top area of about 22 acres and will retain about 76 acre feet at the peak of the 100-year flood. The basin storage depth will be 7 feet which with the slope of the existing grade will create a height of approximately 32 feet on the uphill side of the basin. One primary riprap-lined inlet spillway structure will be needed to collect inflows as they enter the basin. Another three smaller inlets may also be required.

The outflow from the Fan 12 basin flows through about one mile of walled-levee corridor before combining with the Fan 7-8 corridor. The total fan system combined flows continue another 1.1 miles in partially contained walled-levee corridor before they outflow into the east end of the Buckeye FRS No. 1 flood pool. A total of about 27 grade control structures will be needed to control long-term degradation along the entire fan system corridor length.

Backfill will be needed along much of the floodwall to meet the aesthetic treatment objectives. The backfill needed is about 85 ac-ft, which is significantly less than the 790 ac-ft of total excavation required for the detention basins.

4.3.6 Buckeye FRS No. 2 & 3 sub-area

The FRS No. 2 & 3 sub-area is located on the southern slope of the White Tank Mountains. The sub-area is about 43 square miles in area. One major and four minor alluvial fans drain the White Tank Mountains spreading out briefly before being captured by the Buckeye Flood Retarding Structures. The major alluvial fan, Skyline Fan, also has an inset area of significant instability located on its southeastern side. The Skyline Fan System drains into Buckeye FRS No. 3 while Fans 10, 11, and 20 drain to Buckeye FRS No. 2. Buckeye Flood Retarding Structures No. 2 and 3 are long earthen dams. They are drained by small diameter pipe outlets. FRS No. 3 drains to FRS No. 2 which drains to FRS No. 1. In the event of flows in excess of the design capacities, emergency spillways serve to discharge these additional flows. The emergency spillway for FRS No. 3 exits on its east end, while FRS No. 2 spills to the west.

Within the FRS No. 2 & 3 sub-area, two "fan systems" were further differentiated. The two fan systems within the FRS No. 2 & 3 sub-area are:

- Skyline Fan System which addresses Skyline Fan and SkyET Fan
- Fan System 10, 11 & 20 which addresses Fans 10, 11, & 20

The recommended alternative for the Skyline Fan System is comprised of three large, on-line detention basins and walled-levee corridors downstream to Buckeye Flood Retarding Structure No. 3. The Fan System 10, 11, & 20 recommended alternative is comprised of a strictly non-structural approach of floodplain management of the active alluvial fan areas.

Additional details associated with each fan system within the FRS No. 2 & 3 sub-area are provided in the following sections. The conceptual planimetric layout of the recommended alternative is shown in Figure 22. Larger scale, more detailed layout sheets are found in the appendices of Volume 7.

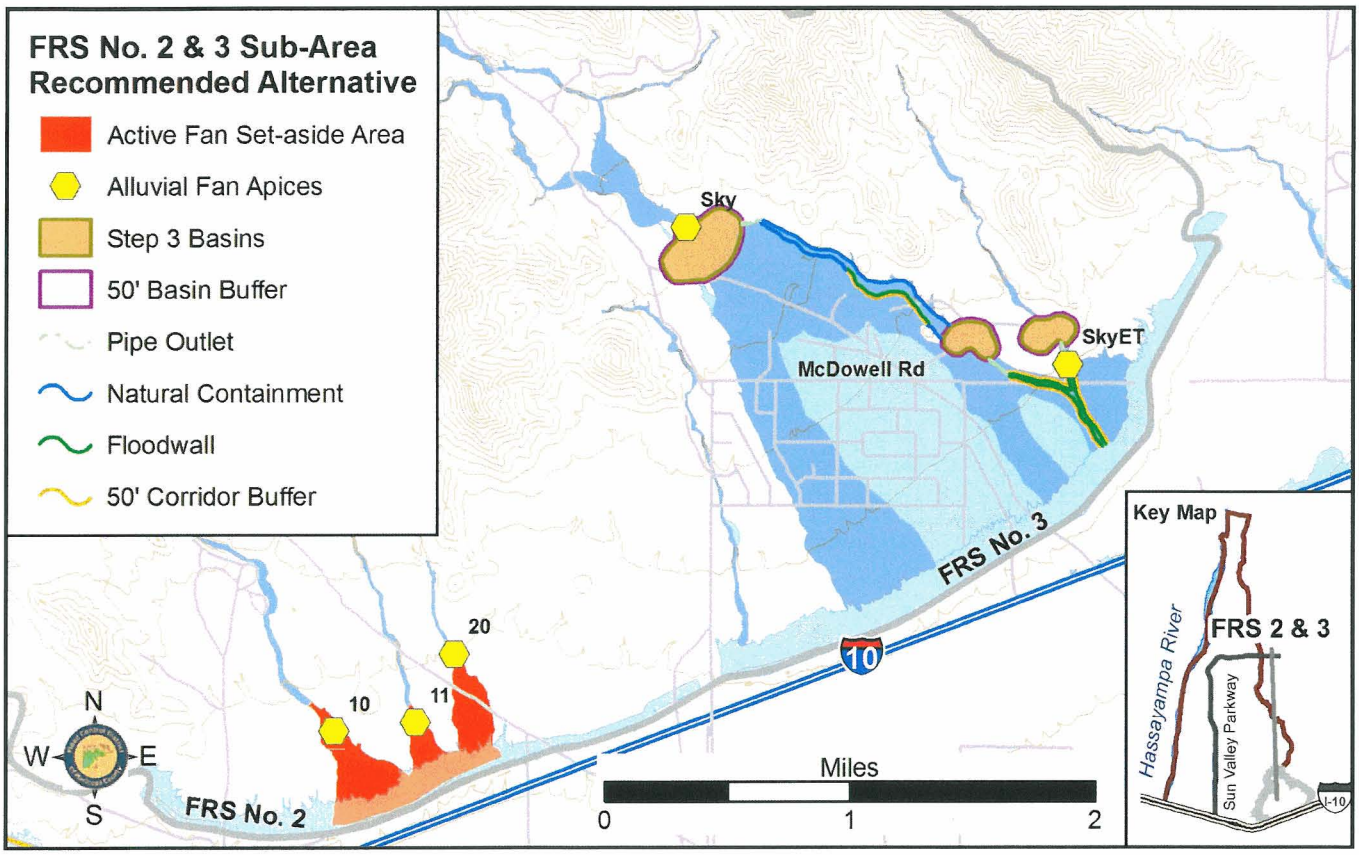

Figure 22 Recommended Alternative Features For Frs No. 2 & 3 Sub-Area

4.3.6.1 Fan System 10, 11, & 20

The recommended alternative for Fans 10, 11, and 20 is a fully non-structural flood control approach. Active alluvial fan areas have been delineated for these fans. The total active fan area is about 123 acres. Table 3 summarizes the land ownership of the active fan areas for Fans 10, 11, and 20. Seventy-two percent of this acreage is already owned by the Flood Control District. The remaining private land is relatively small in area and therefore a major structural solution for this fan system is not recommended. Because the recommended alternative for Fans 10, 11, & 20 is fully non-structural, no costs were assigned to its implementation.

Table 3 Fan System 10, 11, & 20 – Active Alluvial Fan Area And Land Ownership

FAN ID	STAGE III Zone	Acres	Owner	% of Land
10	AFUFD	7.6	FCDMC	12.8
10	AFUFD	5.2	FCDMC	8.7
10	AFHH	36.3	FCDMC	61.2
Subtotal		49.1		82.7
10	AFHH	9.0	ASLD	15.1
10	AFHH	1.3	Private - Garretson	2.2
Fan 10 Total		59.4		100.0
11	AFHH	24.1	FCDMC	85.4
11	AFHH	4.1	Private - Garretson	14.6
Fan 11 Total		28.2		100.0
20	AFUFD	4.8	FCDMC	13.6
20	AFHH	10.7	FCDMC	30.0
Subtotal		15.5		43.6
20	AFHH	7.4	State of Arizona	20.7
20	AFHH	2.1	Private - Thomas	6.0
20	AFHH	10.5	Private - Garretson	29.6
Fan 20 Total		35.5		100.0
Total FCDMC		88.6		**72.0**
Total Private		18.1		14.7
Total State		16.3		13.3
Grand Total		123.0		100.0

4.3.6.2 Skyline Fan System

The Skyline Fan System is composed of three on-line detention basins and 1.9 miles of downstream corridors a half mile of which is naturally contained. The basin at the apex of the Skyline Fan (RRW1) will be approximately 43 acres at the top of the basin and have a storage depth of 10 feet to retain the required 234 acre feet of storage from the drainage area to this fan. The slope of the existing grade will create a height of approximately 36 feet on the uphill side of the basin. A terraced inlet spillway structures with 6 to 8 steps will be needed to collect inflows from Skyline Wash as it enters the basin.

The outflow from the RRW1 basin is contained within the existing downstream wash corridor for about one half mile before the walled levee corridor leads to another on-line detention basin (RRW2B). The length of walled-levee corridor is between the two basins is about one mile. About 7 drop structures would be required to control grade in this reach of the corridor.

The second basin in the Skyline Fan System, RRW2B, will be about 15 acres in top area and have a storage depth of 9.5 feet. Its total storage volume will be 69 acre feet. The slope of the existing grade will create a height

of approximately 30 feet on the uphill side of the basin. Two riprap-lined inlet spillway structures will be needed to collect inflows as they enter the basin.

The RRW2B basin will drain via two five foot diameter pipes to a walled-leveed corridor. About 1500 feet downstream of RRW2B, the corridor is joined by the outflows from the third Skyline Fan System detention basin, RRX1A. The combined outflows flow about another quarter mile until they outlet into the flood pool of Buckeye FRS No. 3.

The RRX1A basin controls the SkyET alluvial fan just upstream of its apex. The basin has a top area of about 15 acres and will retain about 50 acre feet at the peak of the 100-year flood.

Backfill will be needed along much of the floodwall to meet the aesthetic treatment objectives. The backfill needed is about 8 ac-ft, which is significantly less than the 1300 ac-ft of total excavation required for the detention basin.

4.3.7 Summary of Piedmont Sub-area Recommended Alternative

The recommended alternative for the entire ADMP area includes seventeen on-line detention basins near alluvial fan apices, three off-line detention basins, two along Sun Valley Parkway, 65.3 miles of walled-levee corridors, and 3.9 miles of excavated, earthen channels. Non-structural approaches were also incorporated into wherever possible. In particular, significant reaches of existing riverine floodplain delineations along Wagner Wash and White Tank Wash are included as part of the non-structural recommendations for the Sun Valley ADMP. In addition, Fan System 10. 11, & 20 employs a floodplain management approach.

All of the alternatives include elements and geometries to address the District's aesthetic treatment policy. The important elements include: 1) a 35 feet setback buffer on all structural elements in addition to a 15 foot wide area for maintenance access, 2) a maximum height restriction on the external side of each floodwall corridor of 3 feet, 3) average side slopes for all earthen slopes of 6 to 1, and 4) detention basin storage depths were limited to a maximum of 12 feet. In addition, landscaping is provided for all disturbed surface areas per the recommended landscaping design guidelines (Section 5.6).

An overview of each component of the recommended alternative and their design are provided in the following sections. Additional details are provided in Volumes 2 – 7 of the Step 3 report.

5 STEP 3 CONCEPT DESIGN APPROACH

This section of the report provides an overview of the design concepts and approach for the Step 3 recommended alternatives. The recommended alternative location, typical sections, and planimetric layout are also presented. The design approach used a combination of HEC-1 modeling, normal-depth hydraulics, and GIS through an Excel spreadsheet interface. The conceptual planimetric layout sheets for all elements of the fan system components are provided in the appendices of Volumes 2 – 7 for each sub-area.

5.1 Data Sources

5.1.1 Mapping

The District provided 10-foot contour mapping and DTM data for use in the hydrologic and hydraulic calculations. That work was done under separate contract for the District in 2000/2001. The flight dates of that mapping were 12-16-00, 12-17-00, and 12-27-00. A triangulated irregular network (TIN) was developed in ArcGIS software using the 10-ft mass points and breaklines. The TIN and the contours were used to obtain all the elevation data used in this study. It was noted in the use of this topographic data that many wash bottoms were incorrectly shown as ridges rather than valleys. This phenomenon was more prevalent on the relatively low relief downfan areas. These ridges were removed manually from the cross sections used in the design process.

5.1.2 Aerial Photographs

The Flood Control District provided aerial photographs for use in the GIS applications. The photo dates are November 2004.

5.1.3 Sun Valley Parkway Drainage Facilities

The as-builts for the existing drainage facilities associated with the Sun Valley Parkway were obtained from MCDOT. The as-builts are included as pdf documents on the disc with this report.

5.1.4 Sediment Gradations

Sediment gradations used in this study are based on data collected at 38 locations throughout the SVADMP study area. Examination of these data suggested relatively little variation in sediment sizes across the study area. Therefore, an average sediment gradation of the 38 samples was used in the sediment transport analyses for the recommended alternative for all fan systems.

The following values were therefore selected for the sediment gradation parameters:

D50 = 0.7 mm D16 = 0.17 mm D65 = 1.2 mm

D84 = 2.7 mm D90 = 4 mm

5.2 Process Overview and Summary of Design Criteria

The following sections provide a brief overview of the design procedures for each structure type in the recommended alternative for the SVADMP. Table 4 shows a summary of the important design criteria used for the on-line detention basins and downstream corridors. These were refined from the Step 2 process based on the selection of a floodwall corridor containment structure and the input of the external value engineering team. All structures are designed for the maximum peak flow or volume from the 100-year 6-hour or 24-hour event.

Table 4 Summary Of Design Criteria For Step 3 Recommended Alternatives

Apex Treatment	Basin Geometry Criteria	Downstream Channel	Hydraulic Criteria	External Wall Height
On-line Basin; 10% outflow	Average Z = 6:1; D < 12 ft	Floodwall	4 - 5 ft levee height; ≤ 6 ft/s; 3 ft min.	≤ 3 feet
		Excavated channel	Depth < 8 feet; Average Z = 6:1; design slope ≈ equilibrium slope	

Additional details on the design associated with each structural element are discussed in the following sections.

5.3 General Procedure Outline

The general design procedure was similar to that used in Step 2. The following outline describes that procedure:

- Identify the fan apex/upstream area location and the preferred channel alignment from the apex to the outfall. These were derived from Step 2 and additional input received from stakeholders following the end of Step 2.
- Design an on-line basin near the apex location using the following criterion: Peak Outflow ≈ 10% Peak Inflow.

- Route flow from on-line basin to the fan system outfall by designing a walled-levee natural channel corridor or excavated channel along the preferred channel alignment as applicable.

5.4 Hydrology

The design of the walled-levee corridors, excavated channels, and the detention basins are based on the 100-year storm. HEC-1 modeling was used to determine the peak discharges as well as the flow volume passing through the designed structures. The existing conditions hydrology model was used for the estimation of peak discharges for the design. The flows computed from existing conditions model are higher than the future conditions model (JEF, 2006c). Thus, the use of existing conditions discharges represents a more conservative design approach. In addition, the specific phasing of future development is unknown. As a result, it was deemed prudent to be conservative and use the existing conditions hydrology to ensure effective continuous functioning of the recommended flood control system as the area develops.

The HEC-1 models developed for each sub-area in Step 2 were divided into separate models for each fan system. These models were modified to incorporate the basin and channel features associated with the recommended alternative for the 100-year 24-hour and 100-year 6-hour storms. For the purpose of the design, the maximum of the values obtained from the 24-hour and 6-hour results was used to ensure adequate functionality under 6-hour and 24-hour storm scenarios. This means that the design analyses sometimes use the 6-hour value and vice-versa depending on whichever is larger.

5.5 Sediment Yield

Sediment contributions from the watershed draining to the on-line detention basins were estimated using a sediment yield approach. The sediment yield was estimated assuming a 3-year maintenance period plus a single 100-year event. The MUSLE method as outlined in the Arizona Department of Water Resources' *Design Manual for Engineering Analysis of Fluvial Systems* (1985; hereafter, "ADWR Manual") and the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) *Sediment and Erosion Design Guide* (AMAFCA, 1994) was used to compute the average annual sediment yield and the 100-year single event sediment yield for the subbasin(s) contributing to each on-line detention basin. The total sediment volume estimated was added to the required design volume for each detention basin.

5.6 Aesthetic Treatment Requirements

In order to ensure that the proposed flood control structures can be compatible with the landscape character of the study area, incorporation of landscape architectural design as an integral part of the structural design is required. In 1993, the District adopted a "Policy for the Aesthetic Treatment and Landscaping of Flood Control

Projects". This policy aims at planning and designing flood control projects that are compatible with the visual character of the adjacent landscape. In addition, the policy aims to integrate recreational opportunities into the planning and design of flood control facilities.

Utilizing the information from the Scenic Resource Assessment (SRA) (LSD, 2006), incorporation of aesthetic features in the project components of the Sun Valley ADMP generally followed a four-step approach to achieve context sensitivity with the visual environment, to the extent possible. The four steps are outlined below and briefly described.

1. Selection of structure types to maximize context sensitivity
2. Selection of flood protection methods (semi-soft structural method and hard structural method with aesthetic treatment) that are most compatible with the character of the landscape
3. Application of most appropriate landscape design theme
4. Development of context sensitive landscape design guidelines

5.6.1 Selection of Structure Types

During the development of the recommended alternative, consideration was given to the selection of flood control structure types that most lend themselves to adaptation of their topographic form to the landforms of the study area. The flood storage basins contained in the plan are a structure type that can be designed to mimic the landforms of the piedmont. The walled-levee corridors that are recommended for stormwater conveyance is a hard structural solution that will have relatively low visual impact and can be adapted to the existing landforms of the sub-area, while preserving the natural character of the existing wash corridors. The recommended alternative minimizes the use of large scale excavated channels and flood retarding structures that have a lower capability to be designed to blend with the landforms of the sub-area. The recommended alternative also completely avoids the use of heavily armored (concrete lined) structures that would be completely out of context with the landscape settings of the sub-area.

5.6.2 Flood Protection Methods

The Flood Control District has identified six general flood control methods that are routinely evaluated for use on flood projects throughout the County. The selection of flood control methods is driven by the engineering requirements for reducing the risk of flooding and the Scenery Resource Assessment (SRA) prepared for the project (LSD, 2006). Detailed descriptions of all the flood control methods are provided below. The descriptions are taken from the Flood Protection Methods, Scenery and Recreation Resource Assessment for Maricopa County report (FCDMC, 2006).

Non-Structural Method

The non-structural method of flood protection employs the use of regulatory mechanisms such as erosion control setback zones and zoning regulations as mechanisms for providing flood protection. This method is characterized by an absence of structural elements or features for flood protection. Exceptions may include provision of low standard road facilities for carrying out flood control monitoring, operations and maintenance activities. Natural drainage features such as rivers, washes, and arroyos perform the function of storm water conveyance. Interior valleys and playas perform the function of storm water storage and natural ridges sometimes perform the function of flood water retardation and containment. The existing character of the landscape is usually preserved under this method. This method will usually complement and achieve context sensitivity with the visual character of most landscape settings.

Soft Structural Method

The soft structural method includes construction of large-scale flood protection structures such as conveyance channels, storage basins and flood retarding structures. The superstructure is constructed of earthen materials and the overall form of the structure is designed to emulate the character of natural landforms found in the surrounding landscape (Character Type). Hard structural components are absent, buried, concealed or designed to blend with and minimize their visibility in the landscape. Additionally, the soft structural method incorporates landscape architectural design themes, features and materials that are designed to complement the valued character of natural, pastoral, rural and suburban landscape settings in which these structures are located and includes right of way for landscape setbacks and other features to enable the structure to visually blend with and complement adjacent land use areas. This method also offers significant potential for enhancing heavily built environments such as the suburban, urban and industrial landscape settings through the preservation or introduction of natural features within these settings.

Semi-Soft Structural Method

The semi-soft structural method includes construction of large-scale flood control facilities constructed predominantly of earthen materials. The overall form of the superstructure is designed to emulate the character of natural landforms found in the surrounding landscape (Character Type). Structural components such as grade control structures, energy dissipaters, low flow features, inlets and outlets may be visually evident but their overall form, color, texture and materials usage is designed to remain visually subordinate to and complement the valued character of the landscape settings in which they are located through careful placement, materials usage, and landscape architectural design. This method also incorporates landscape architectural design themes, features and materials that complement the valued character of the settings in which flood control structures are located and includes right of way to provide landscape setbacks and other features to enable the structure to visually blend with and complement adjacent land use areas. As a result, this method can complement and achieve context sensitivity with a wide range of landscape settings in Maricopa County, including natural, pastoral, rural, suburban and urban landscapes. The semi-soft method also has a large potential for introducing positive variety into and enhancing heavily built environments.

Hard Structural Method with Aesthetic Treatment

The hard structural method with aesthetic treatment includes construction of large scale flood control structures with superstructures that are fully or partially concrete lined. Structural components are also typically constructed of hardened (concrete) materials. This method produces structures that stand out as visually dominant feature attractions within most urban and industrial landscape settings in Maricopa County. It incorporates landscape design themes, features and materials that complement the valued character of urban and industrial landscape settings. Examples of aesthetic treatments include gracefully meandering the overall form of the superstructure, use of color, textural patterns, rustication techniques, urban art, other architectural embellishments and landscape plantings to establish visual and cultural context sensitivity primarily within urban and industrial settings. This method also includes right of way to provide an adequate landscape setback to enable these structures to visually blend with and complement adjacent land use areas. This method has a large potential for being viewed as a negative deviation that can detract from the valued character of natural, pastoral, rural and many suburban landscape settings.

Semi-Hard Structural Method

The semi-hard structural method includes construction of large scale flood control structures constructed predominantly with earthen materials. These structures typically employ standard civil engineering design practices without inclusion of landscape architectural design or aesthetic features. The superstructure typically contains a geometric form, with uniform side slopes, bottom (invert) and over-bank areas. Component structures for grade control, energy dissipation inlets and outlets are characteristically standard engineering designs that do not incorporate landscape architectural design or aesthetic features. Vegetation treatments are typically limited to those required for erosion and dust control or for meeting USACE 404 permitting requirements. Right of way for establishing a landscape setback is typically not included with this method. Except for rural and industrial landscapes, this method generally lacks the ability to complement the visual character of and achieve context sensitivity with natural, pastoral, suburban and urban landscape settings in Maricopa County.

Hard Structural Method

The hard structural method includes the construction of heavily armored large scale flood control structures and component structural features. The superstructure and component structures typically employ standard civil engineering design practices without inclusion of landscape architectural design or aesthetic treatments. The superstructure typically contains a strongly geometric form, with uniform profile, side slopes, bottom (invert), and over-bank areas. Component structures for grade control, energy dissipation, inlets and outlets are also characteristically standard engineering designs that have a strongly geometric appearance. Vegetation planting is typically limited to the over-bank and/or perimeter area around the structure and only to the extent required for dust and erosion control or USACE 404 permitting requirements. Right of way for establishing a landscape setback is typically not included with this method. The hard structural method is usually complementary to and achieves context sensitivity only with heavy industrial landscape settings within Maricopa County. Within other settings, this method has a large potential to introduce very strong negative deviations that will detract from the valued landscape character.

The primary approach will be to utilize naturalistic, free form land shapes and informal arrangements of plant materials reflective of the study area flora in the design of the proposed storage basins within the CAP sub-area. The hard structural with aesthetic treatment method, as employed within the sub-area, will preserve a large amount of the existing natural desert within the walled-levee corridors and, with the architectural treatment proposed for the hard structural elements, will achieve context sensitivity within the surrounding visual environment. As a component of both flood control approaches, landscaped buffer zones and berming will be used around and adjacent to improvements such as basins and corridors to help reduce their visual impact. The setback buffer areas also provide the opportunity to develop multi-use trails and other recreational facilities in conjunction with maintenance roads along basin perimeters and channel corridors. The overall approach will be to reduce the hard engineered appearance of the features to maintain a high level of context sensitivity with the existing and future land use and landscape character in the Sun Valley ADMP area.

In some situations hard structural components will be required to provide the proper level of flood protection and meet the long term maintenance needs of the improvements. The structures used in the recommended alternative include:

- Flood containment walls – Concrete walls at edges of corridors to contain the design flood flows within the drainage corridor.
- Drop structures – Structures that are built within the flood corridors, perpendicular to the flow direction to control the longitudinal slope and flow velocities over an extended period of time.
- Inlet structures – Structures built at the location where the flood flows enter a detention basin and must withstand and dissipate the energy from high volume and high velocity flows to protect the basin from major damage.
- Outlet structures – built at the location of the outlet pipe which drains the detention basins at controlled rates.

The hard structural components, while not a dominant visual element of the entire flood control solution, are an essential part of the long-term success of the system. Through careful design and placement of the structures, the overall flood control method will be maintained as a semi-soft or hard structural with aesthetic treatment method. The design of hard structural features will include the use of architectural or design elements on the constructed features to reduce the visual impacts. Architectural treatments will include the use of integral color concrete, form liners for texture, use of natural materials, and form modifications to enable the structures to more fully fit the natural contours and landforms of the study area. The use of integral color and form liners in the construction of concrete features would help reduce their visual impacts by incorporating the colors and textures of the natural landscape. Special attention will be paid to use of enhancements in areas of high visibility

and public use, such as near intersections, pedestrian access nodes into corridors or basins that would be multiple use areas for recreation facilities.

An overall landscape theme would be applied to the design of the structural features as well as the landscape improvements. The SRA (LSD, 2006) report identified the landscape themes most compatible with the character of the landscape setting of the Sun Valley area. A landscape theme defines the distinctive characteristics of the local landscape setting and establishes the general framework for designing landscape architectural elements that would be consistent with that setting. The theme application as incorporated into the design components would include approaches such as, the selection of colors and textures that can be found in the local landscape, minimizing strong contrasts to existing landforms and selecting plant material that has been identified for the theme.

The development of comprehensive design guidelines is the final step in achieving context sensitivity. The design guidelines describe the methods and criteria for designing the project components in multiple locations and applications so that they are sensitive to the local landscape setting. A summary of the design guidelines is provided in each section of this report and detailed design guidelines are located in the sub-area reports and are refined if needed to reflect the design themes for each sub-area.

A brief discussion of the design approach is included in the discussion of each structural component. The aesthetic treatments result in additional costs to the project. The cost differential for the aesthetic treatments is presented in Section 6.2.

5.6.3 Landscape Themes

During the scenery resource assessment, a variety of landscape design themes were identified for possible application to flood control structures based on an analysis of existing, historic, and planned future landscape character. Landscape design themes are unifying concepts that establish the overall visual design concept and serve as the basis for establishing design guidelines that govern landform grading, plant palettes, use of color and etc. for (up the side of the page) flood control structures in different settings. The themes were developed as a framework to help integrate flood control components into the existing natural setting and allow flexibility for coordination with the master planned communities developing in the Sun Valley ADMP area. Because flood control components will occur in multiple landscape character areas, the two main themes identified were further divided into sub-themes specific to the landscape character units. Figure 23 shows the recommended alternatives located on the existing landscape character units for the study area. The themes to be used are outlined below and are discussed in more detail in the Scenery Multi-use Data Collection and Analysis Report (LSD, 2006) prepared for this project. The SRA report also identifies several sub-themes appropriate for the Sun Valley ADMP area.

Incorporation of those elements will be coordinated with the planned communities for consistency with their proposed aesthetic development

5.6.3.1 Natural Sonoran Desert Theme

The natural Sonoran Desert theme is based on reinforcing the relatively undisturbed, pastoral landscape of the Sun Valley ADMP area. Landscaping and revegetation will be accomplished with Sonoran desert native species, specifically those in the Sun Valley area and in particular in each landscape character unit. It will also preserve the existing natural landscapes in the study area, help extend it into future development areas, and provide connectivity to preserved wash corridors and the landscapes of the White Tank Mountains. Figure 24 and Figure 25 show conceptual sketches of the Natural Sonoran Desert theme applied to a basin and channel respectively. Application of the specific character unit themes will be subtle variations of the main theme and are not shown because of the conceptual nature of the sketches.

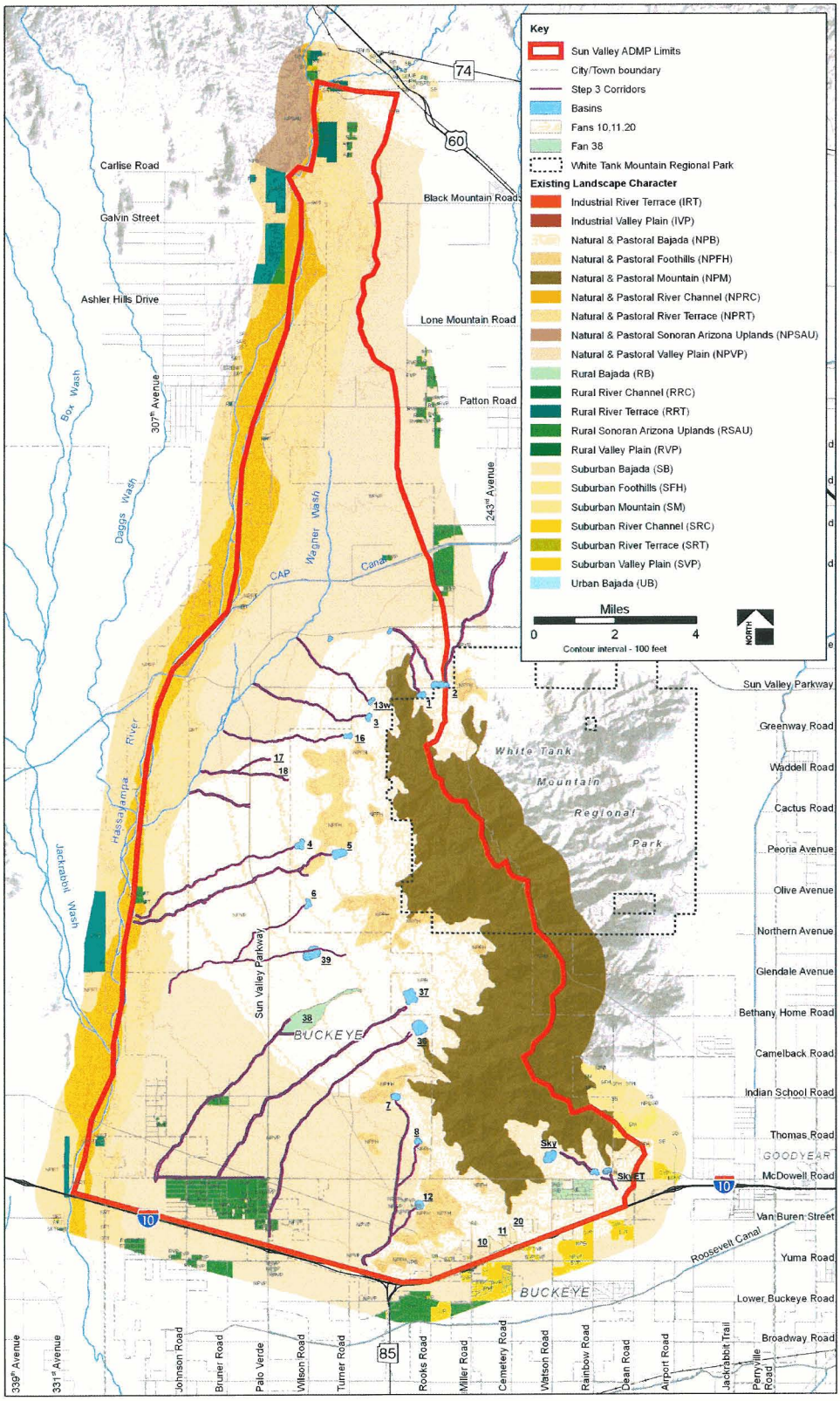

Figure 23 Recommended Alternative and Existing Landscape Character Units

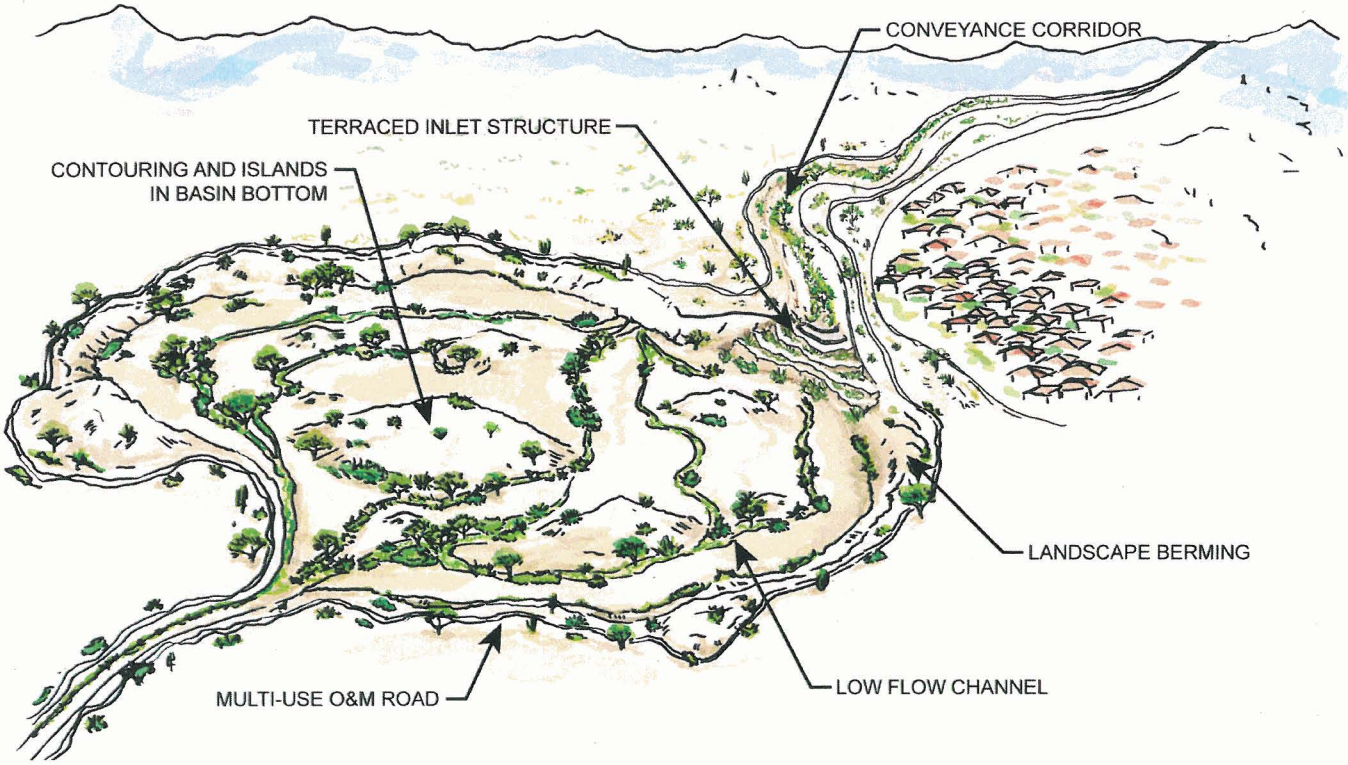

Figure 24 Example Of Natural Sonoran Desert Themed Detention Basin

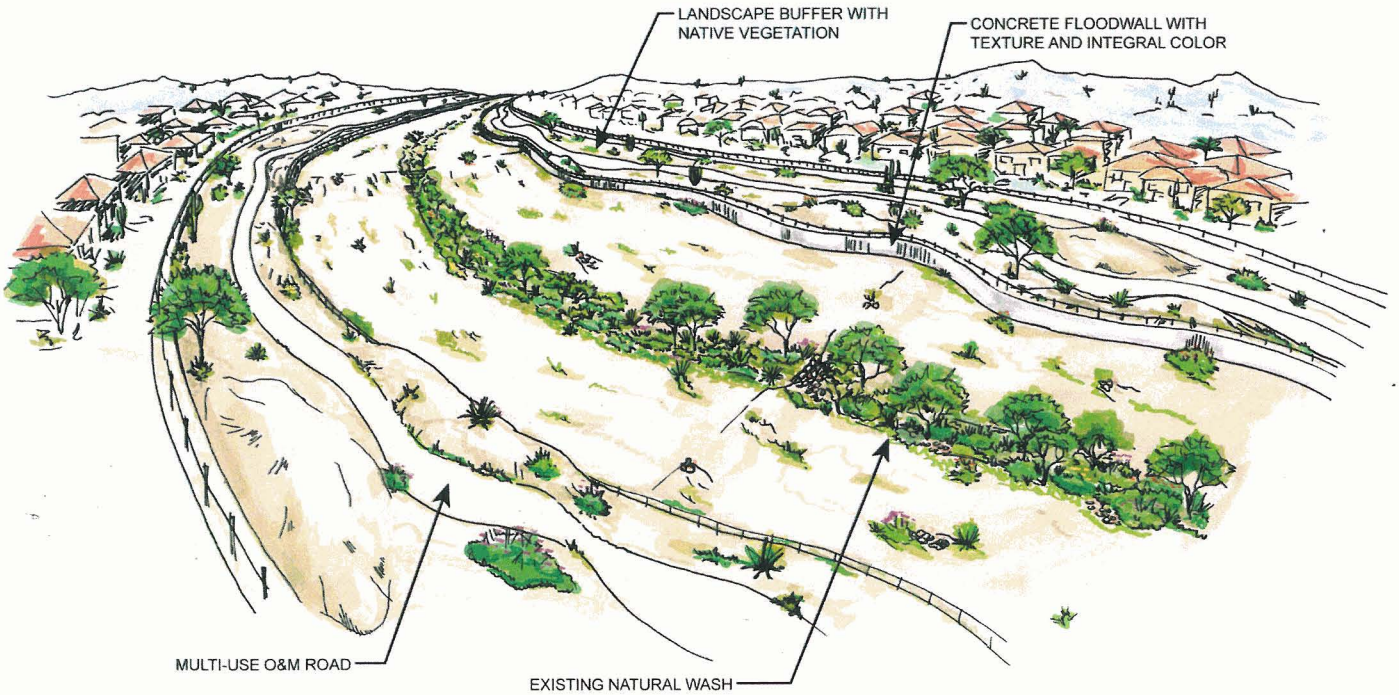

Figure 25 Example of Natural Sonoran Desert Themed Walled-Levee Corridor

5.6.3.1.1 Natural Sonoran Desert River Sub-Theme

When flood control facilities fall within the River Terrace character unit the landscape design will include several elements that will help integrate them into the character of the adjacent landscape. Grading will mimic the braided network of small channels separated by undulating low linear mounds. Use of large scale rock and boulder features will be minimal as small to medium boulders are common but large-scale rock outcrops are virtually non-existent in the river character unit. The grading of the landforms will allow incorporation of vegetation in similar locations as they are naturally found. Vegetation will include xeroriparian species such as mesquite, palo verde, cat claw acacia, and possibly an occasional cottonwood to recall some of the natural riparian vegetation that existed prior to development.

5.6.3.1.2 Natural Sonoran Desert Valley Plains Sub-Theme

In the Valley Plains character unit the landscape design will include much shallower slope and mound grading to be consistent with the adjacent, very shallow topography of the Valley Plains unit. Use of large landscape mounding will be minimal to non-existent. Vegetation near the river terrace units will be primarily creosote, to mimic adjacent creosote flats, along with some introduction of shrubs, perennials, and grasses. Flood control features found higher in elevation, near the Bajada character unit, will include palo verde and mixed cacti to integrate with the landscape of the Bajada.

5.6.3.1.3 Natural Sonoran Desert Bajada Sub-Theme

In the Bajada character unit, the Natural Sonoran Desert Theme will take on a more interesting form. Grading will include use of berms and low flow washes to mimic the adjacent undulating character of the Bajada landforms. Rock and boulder features will be used as they will be consistent with the more frequent occurrence in of rock outcroppings in the Bajada. Landscape vegetation will include increased use of mixed cacti especially the saguaro as well as higher density of trees such as palo verde and ironwood.

The natural Sonoran Desert theme incorporates forms, colors, and textures of natural desert into required structural components. Landscape designs will create topography similar to the immediate surrounding area of the character units and will utilize plants, boulders and ground cover in ways that mimic adjacent areas. Applying themes in this way will result in a drainage corridor that extends from the Hassayampa River to the White Tank Mountains that has a high level of context sensitivity with the surrounding area over its entire length.

5.6.3.2 Semi-Natural/Desert Adapted Park Theme

The semi-natural/desert adapted park theme would also reinforce the desert character of the planning area by focusing primarily on native materials but would also include desert adapted plants in areas of high activity. The theme would allow the modest use of turf for passive or active recreation. Design features would include natural looking structures in colors and materials such as desert varnish, boulder/rock outcrops in appropriate locations. Figure 26 show conceptual sketches of the Semi-Natural/Desert Adapted Park Theme applied to a basin. Application of the specific character unit themes will be subtle variations of the main theme and are not shown because of the conceptual nature of the sketches.

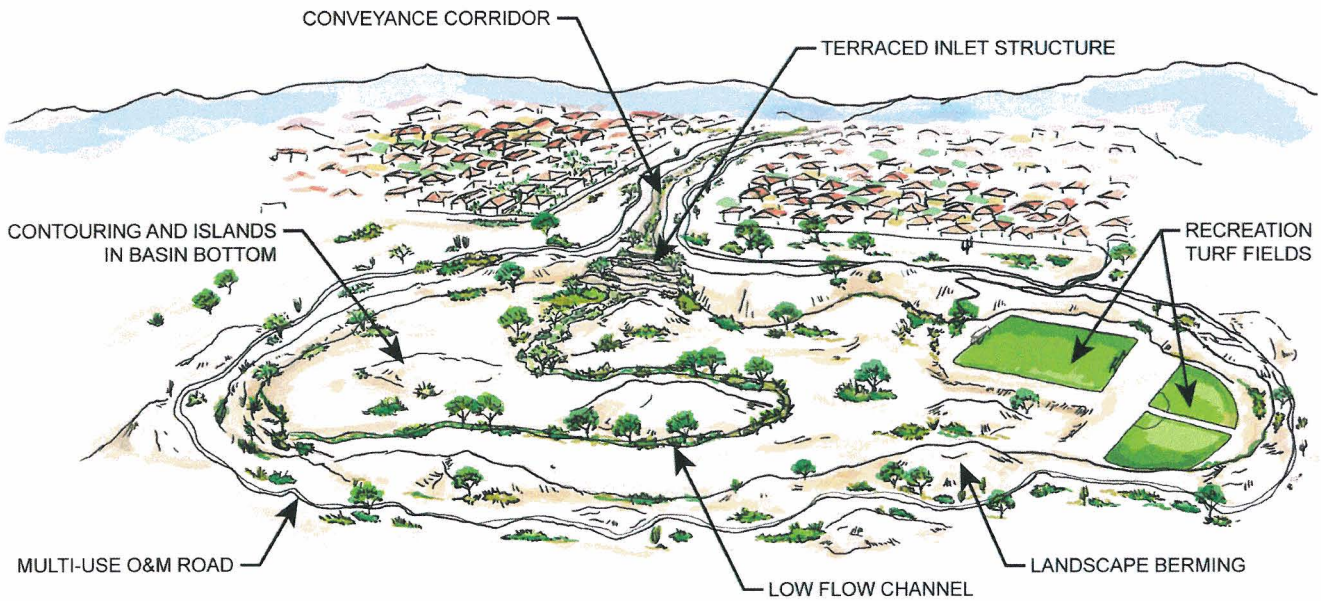

Figure 26 Example Of Semi-Natural/Desert Adapted Park Themed Detention Basin

5.6.3.2.1 Semi-Natural/Desert Adapted Park River Sub-Theme

In the river character unit, use of the Semi-Natural Desert Adapted Park theme will be very similar to the use of the Natural Desert Theme in relation to landforms and use of rocks/boulder features. Vegetation will include a higher concentration of riparian species to emphasize the increased use for recreation activities which could include turf. Development of active play fields in this theme will be less than in the Valley Plains character units because the natural undulating terrain does not easily lend itself to grading of scale flat turf areas. The river is expected to be a recreational draw for residents of the future developments in the Sun Valley area and the landscape designs will incorporate desert adapted, people friendly plants such as the many sage varieties, thornless species of mesquite and acacia and flowering ground covers such as verbena and lantana.

5.6.3.2.2 Semi- Natural/Desert Adapted Park Valley Plains Sub-Theme

The Semi-natural/Desert adapted park theme will likely see the greatest development of turf areas for active recreation in the Valley Plains character unit. The natural slope of the unit is very flat and almost not discernable to the casual observer and is well suited to larger expanses of flat turf areas for play fields. Use of turf in flood control facilities would be consistent with the landform and future development patterns of the Valley Plains Character Unit. The Valley Plains unit will also see the highest density development in the future master planned communities and flood control facilities may be tapped to provide more intensive recreation opportunities. Vegetation used in the development of the theme in these high use areas will include the use of shrubs and ground covers such as sage and lantana as well as thornless species of mesquite and acacia. Also included in the landscape plant palettes of flood control facilities in this theme will be many varieties of plants from the future adjacent development so that the facilities integrate into the overall character of the community.

5.6.3.2.3 Semi-Natural/Desert Adapted Park Bajada Sub-Theme

In the Bajada character unit, the Semi-Natural/Desert Adapted Park theme will have less extensive use of turf because the natural undulating character of the Bajada landscape is not well suited to creating vast expanses of flat areas for turf play fields. Turf in the basins that occur in this unit will be used primarily for passive recreation and open play areas for the adjacent communities. Vegetation will be more focused on native species but will include the use of sage, lantana and thornless tree varieties, though in lower quantities than in the Valley Plains unit. Landforms of the basin will mimic the surrounding Bajada landscape and boulder/rock features will be more prevalent than in the other themes.

5.6.4 Landscape Theme Plant Palettes

Preliminary plant palettes have been developed for application of each theme. The plants lists are provided in the individual sub-area reports (Volumes 2 – 7) and include plants for the Natural Sonoran Desert Theme and the Semi-Natural/Desert Adapted Park Theme. The plant palettes provide the most appropriate plants that will be used based on the character unit in which the flood control facility occurs. The final plant list developed for a design will consider the immediate context of the facility.

5.6.5 Landscape Design Guidelines

The development of comprehensive design guidelines is the final step in the achieving context sensitivity. The design guidelines are a prescription that identifies the methods and criteria to ensure achievement of the landscape design themes. The design guidelines are specified in the individual sub-area reports (Volumes 2 – 7) for each structure type.

5.7 On-line Detention Basins

5.7.1 Design Considerations

The on-line detention basin for each fan system was located near the fan apex where flows begin to spread out unpredictably into numerous smaller channels. The basin volume is created entirely through excavation and designed to be entirely below existing ground. Average side slopes of 6H:1V were used to represent the average of variations between 8H:1V to 4H:1V needed to meet the aesthetic treatment requirements. A stage-storage relationship was calculated from the 10-foot digital terrain model in GIS based on the irregular top shape and an average side slope of 6H:1V.

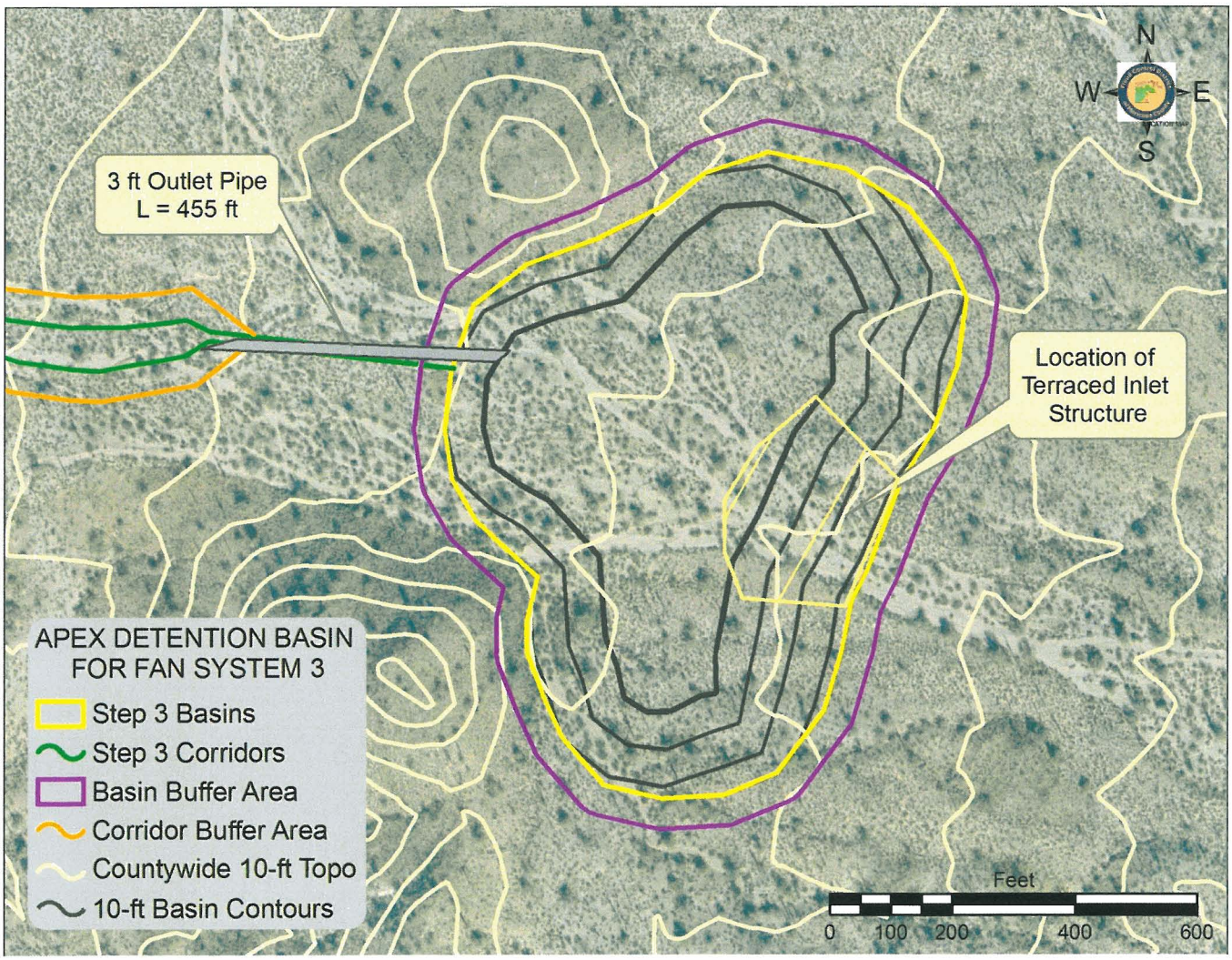

Figure 27 Concept Plan View Of On-Line Basin For Fan System 3, Wagner Sub-Area

Figure 27 shows the concept plan view of the on-line basin for Fan System 3, in the Wagner sub-area, on an aerial photo of the area with the existing topography as an example. Figure 28 and Figure 29 show a generic concept basin with the aesthetic treatments.

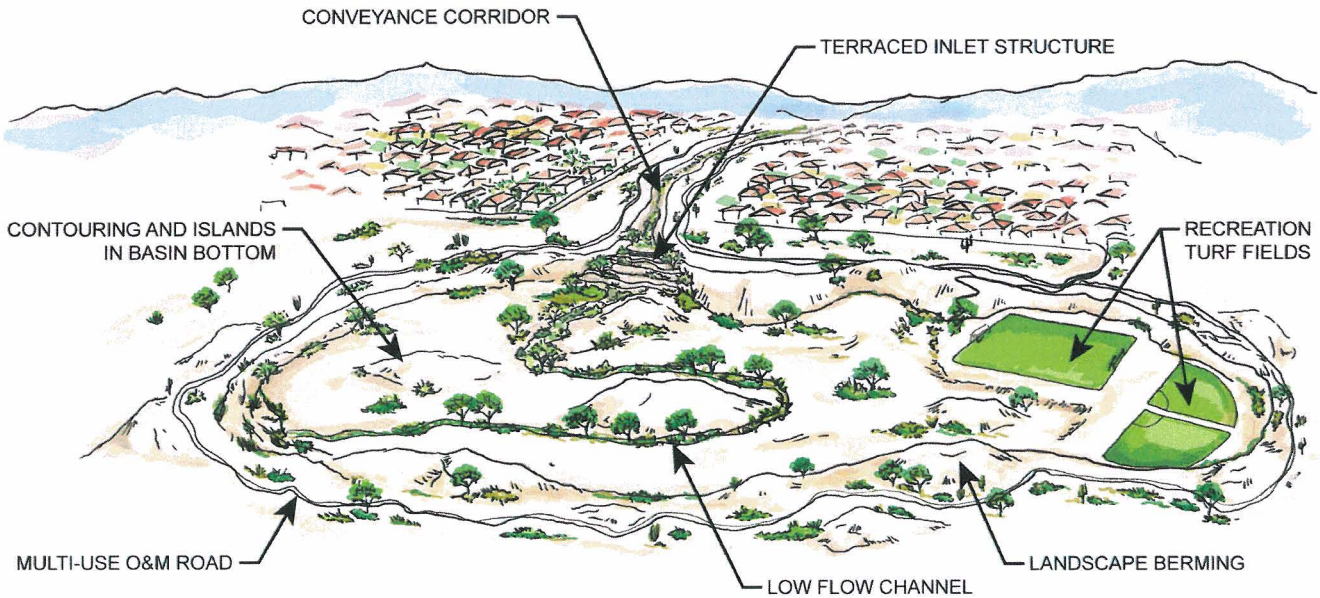

Figure 28 Concept Plan View Of An On-Line Basin

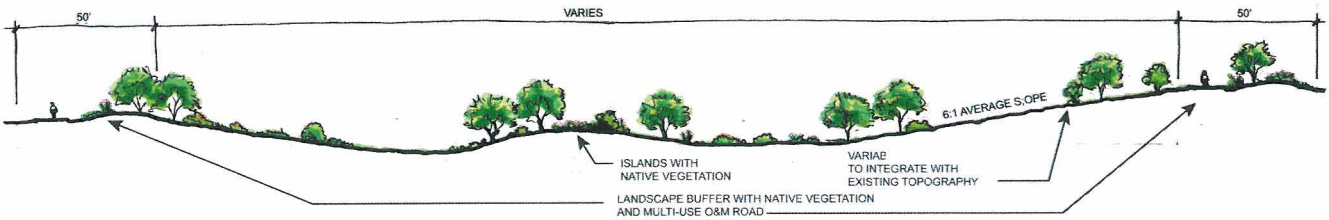

Figure 29 Concept Profile View Of On-Line Basins With Aesthetic Treatments

The basins were designed to have a peak outflow of approximately 10% of the peak inflow. Ten percent of the peak flow approximates the 2-year flow. Pipe outlets were designed to drain the basins. The Fan 3 basin, for example, requires a 3-foot diameter pipe and discharges about 75 cfs during the 100-year event. The stage–discharge relationship was computed using the HY8 computer program. Sediment yield from the upstream watershed was estimated using MUSLE according to the approach laid out in the ADWR & AMAFCA Manuals (1985; 1994). The design basin volume includes space for three average year's sediment plus one 100-year event volume. The basins were designed to be no greater than 12 ft in depth including one foot for freeboard.

5.7.2 Inlet Design Concepts

The detention basin inlet structure design objectives include: public safety, hydraulic performance, aesthetic treatment, cost, and maintenance requirements with an emphasis on blending the facility into the landscape character. Selection of the inlet design concept for each fan system varies depending on the inflow discharge, approach depth, and other site constraints. Two main inlet types were selected for the Step 3 recommended alternatives – riprap-lined spillways and multiple-step, terraced inlets.

5.7.2.1 Riprap-lined spillways

Riprap-lined spillways consist of dumped riprap on top of a gravel filter and/or geotextile fabric (see Figure 30). Typical spillway sections are trapezoidal normal to the basin side slope. A cut-off wall would be necessary upstream of the spillway to promote an even flow distribution down the spillway and to prevent degradation upstream. A relatively small riprap-lined sloped stilling basin would be required at the bottom of the spillway and would likely serve as the initial sediment trap for the basin. Riprap-lined spillways can provide sufficient energy dissipation for relatively low flow depths down the spillway. The suitability of riprap depends on the size, D_{50}, 100-year design unit discharge, q (cfs/ft), and the spillway slope. One conservative method for designing riprap-lined spillways can be established with the following relationship (Abt, 1991):

$$q = 0.052 D_{50}^{1.79} S^{-0.77}$$

Using a safety factor of 1.5, the safe maximum slope of 4H:1V, and a D_{50} of 18 inches, the maximum unit discharge that is recommended is approximately 13 cfs/ft. Using this unit discharge for a 40 foot wide channel would limit the total design discharge to approximately 500 cfs. As shown in this example, this application would be limited to fans with smaller design discharges or if measures were taken to distribute the flow into a wider spillway. The riprap depth is usually 2-3 times the D_{50}. Large diameter riprap availability is limited in Arizona; therefore, a material source should be identified prior to design. Construction of riprap spillways is fairly straight forward; however, material and construction inspection would be essential to ensure the quality of the material and stability of the structure. Rock color, texture, and arrangement could be selected so as to minimize visual impacts of the inlet spillway.

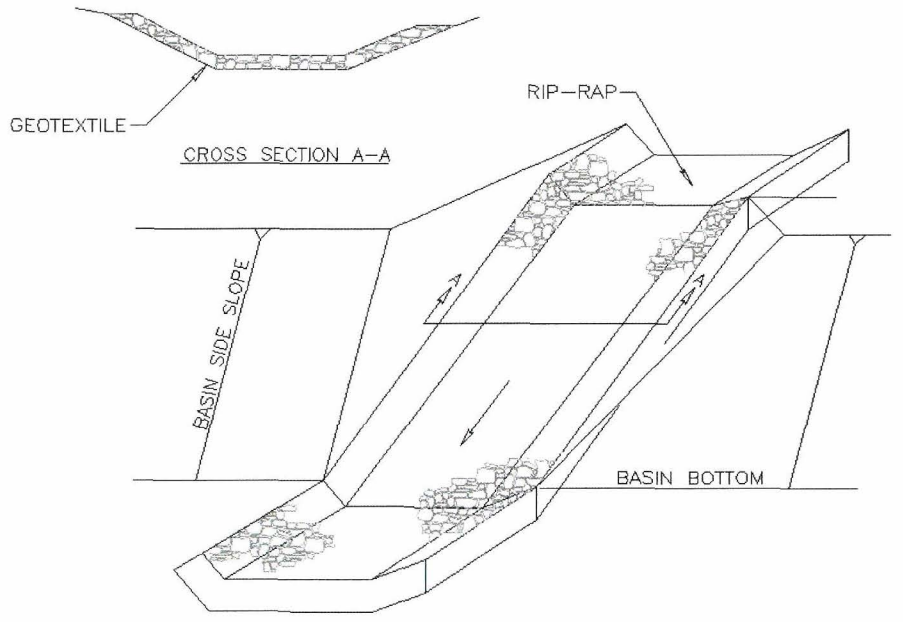

Figure 30 Example Of Riprap-Lined Spillway

5.7.2.2 Stepped drop structures

Stepped drop structures consist of hardened steps that dissipate energy as flow drops down each step. Stepped drop structures are typically constructed of concrete, RCC, soil cement, or gabions, but can also be constructed of large boulders (Figure 31). Stepped drop structures promote two energy dissipating flow conditions: Nappe flow and Skimming flow.

Nappe flow is when the step height, tread width, to critical depth relationship permits a free-falling nappe and hydraulic jump on each step. Skimming flow occurs when the steps are overcome by flow depth resulting in recirculating vortices and air entrainment. The relationship at which the flow condition is between the nappe and skimming flow regimes is shown by the following equation (Chanson, 1994):

$$\frac{y_c}{h} = 1.057 - 0.465 * \frac{h}{l}$$

where y_c is the critical depth, h is the step height, and l is the tread width.

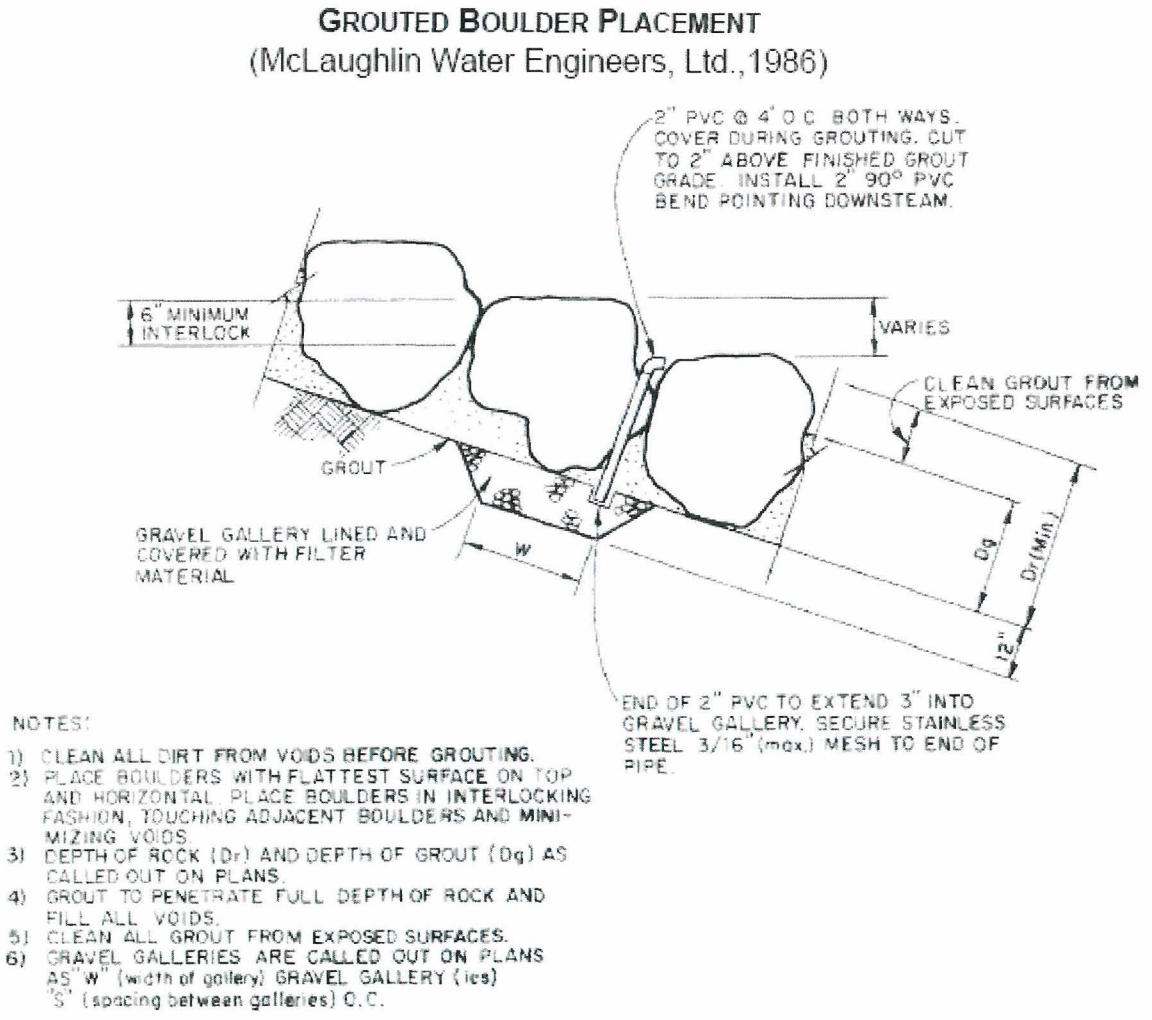

Figure 31 Example of Stepped Boulder Drop Structure

(source: Figure 7.19 from FCDMC, 2003a)

If a flow condition was in between flow regimes, an increase in y_c would initiate the skimming flow regime. Steps designed for nappe flow are generally much larger and more costly than steeper sloped steps designed for skimming flow (Frizell, 2006). Steps large enough to permit nappe flow may be a public safety concern as well. Given basin side-slopes between 4H:1V and 8H:1V, the flow regime will more than likely be limited to skimming flow. Well established hydraulic design guidelines for stepped drop structures do not exist. Therefore a stepped drop structure design would require research and a careful analysis of the structure to ensure stability, flow containment, and adequate reduction in residual energy at the bottom of the drop. The step height and tread width should be established to accommodate maintenance, accessibility, and public safety.

5.7.3 Discussion of Inlet Concepts

No non-structural inlet alternatives are recommended given the magnitude of the design discharges. The use of riprap lined spillways is limited by the design unit discharge. The remaining alternatives are therefore limited to hard material types. Given the goal of blending the basin inlet structure into the natural landscape character, various features could be added to hard structures to enhance the appearance such as adding color pigments to concrete, texturing techniques, curvilinear designs, and/or integrating boulders into the structure. The selection and placement of vegetation would also be crucial in softening the appearance of the facilities. Creative inlet geometry could be considered to accommodate additional landscape character to the basins and allow for softer structural alternatives.

For example, the inlet drop could be divided into multiple stepped drops of curved tiers or terraces to spread the flow width to accommodate a riprap spillway and/or allow for more flexibility in landscaping options. Figure 32 depicts a conceptual terraced inlet with integrated landscaping along the facility. As shown in Figure 33, the terrace lengths increase and/or vary as they go down the drop. If the width of flow down each terrace can be successfully increased, the unit discharge over each drop would be reduced allowing for the use of a riprap spillway if desired. Alternately, the terrace steps could be constructed of stepped boulder drops such as those outlined in Chapter 7 of the District's Hydraulics Design Manual (FCDMC, 2003). Stepped boulder drops are considered the preferred aesthetic treatment for drop structures in the ADMP. A notch should be created in each structure to provide a low flow path for frequent flows to focus regular maintenance in a concentrated area. The use of the terraced inlet concept could allow for plantings on the intermediate terraces which would help to screen the engineered structures associated with the drops and stilling basins. The selection of inlet structure alternatives will depend on the inlet channel width, design discharge, and basin layout.

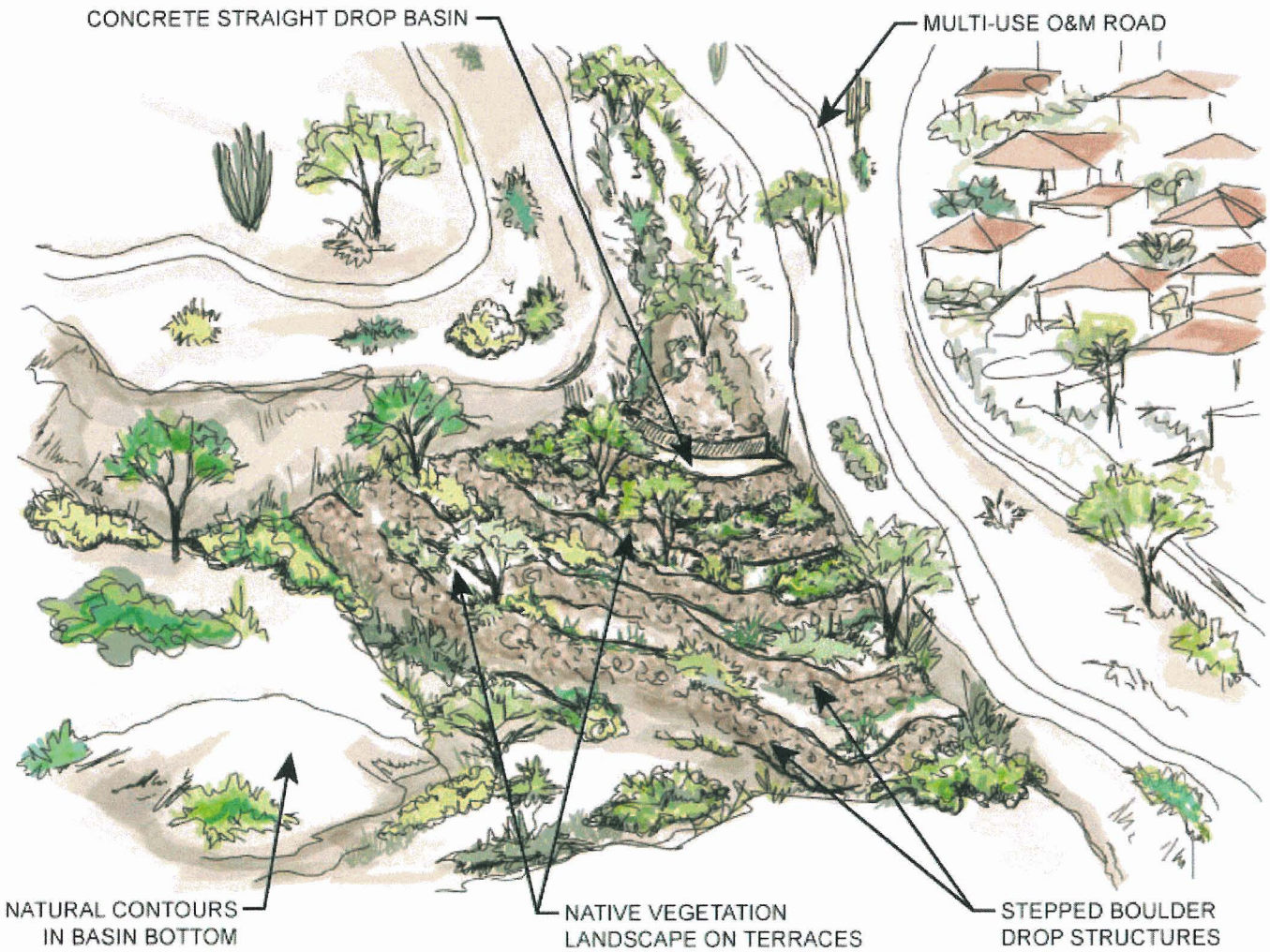

Figure 32 Conceptual Terraced Inlet Rendering

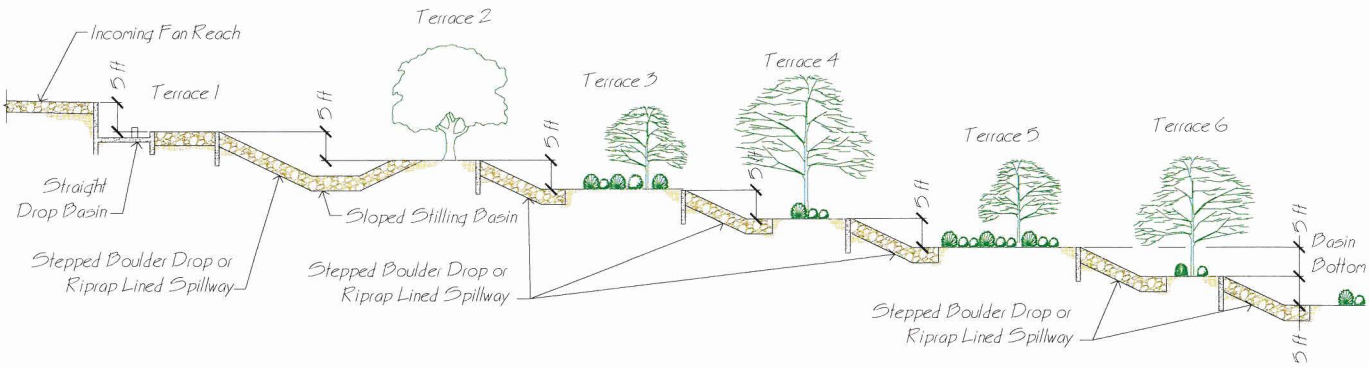

Figure 33 Example Terraced Inlet Concept Profile For Fan System 3, Wagner Sub-Area

5.7.4 Outlet Design Concepts

The design concept for the outlets the on-line detention basins are circular pipes. Reinforced concrete pipes will drain the detention basins to the downstream walled-levee corridor. Inlets will require trash racks to prevent clogging. Inlet headwalls will conform to the basin slope. Figure 34 shows an example of what a basin inlet structure might look like. The outlet pipes will be buried and exit downstream of the detention basin such that the pipe has sufficient slope to adequately discharge flows and maintain an inlet control hydraulic condition. The downstream outlet of the pipes will require scour protection. Riprap is proposed to serve this purpose.

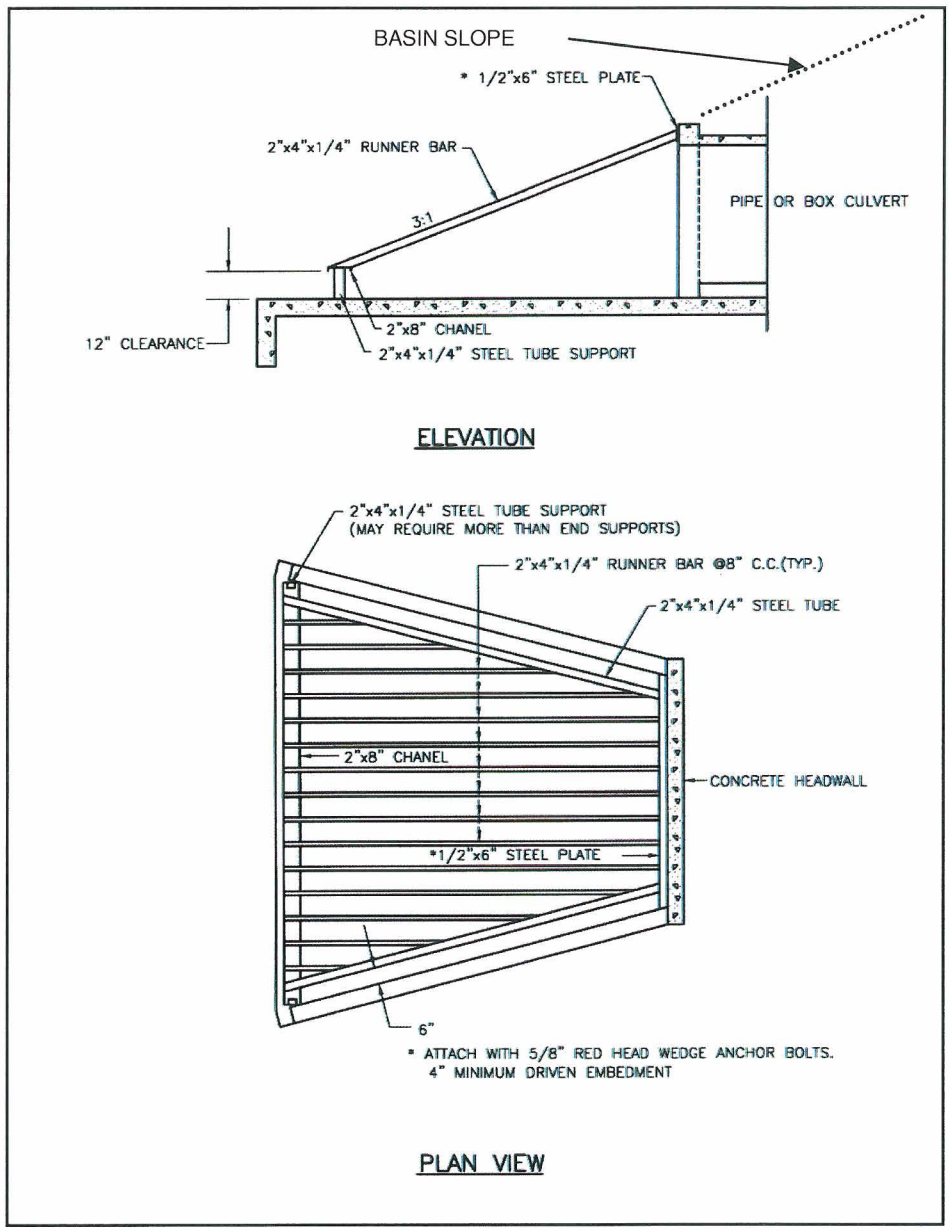

Figure 34 Typical Detail For On-Line Basin Outlet Structure

5.8 Aesthetic Treatments for Detention Basins

5.8.1 Design Guidelines

The aesthetic treatments for the detention basins include shallower side slopes, a buffer area around the basins, and architectural enhancements to inlet and outlet structures. The detention basins to control flood flows from the alluvial fans will be areas of disturbance ranging from about 7 acres to about 83 acres. Each general area where a basin was required was reviewed and the basin was located to reduce its visibility. The basin configurations were also conceptually designed to best fit with the topography of each site. The side slopes of the basins will vary from a maximum of 4:1 to a minimum of about 8:1. The slopes of the basins would be landscaped and seeded for revegetation using native Sonoran Desert plants. Figure 35 shows an example plan view of a basin with the landscape aesthetic design features.

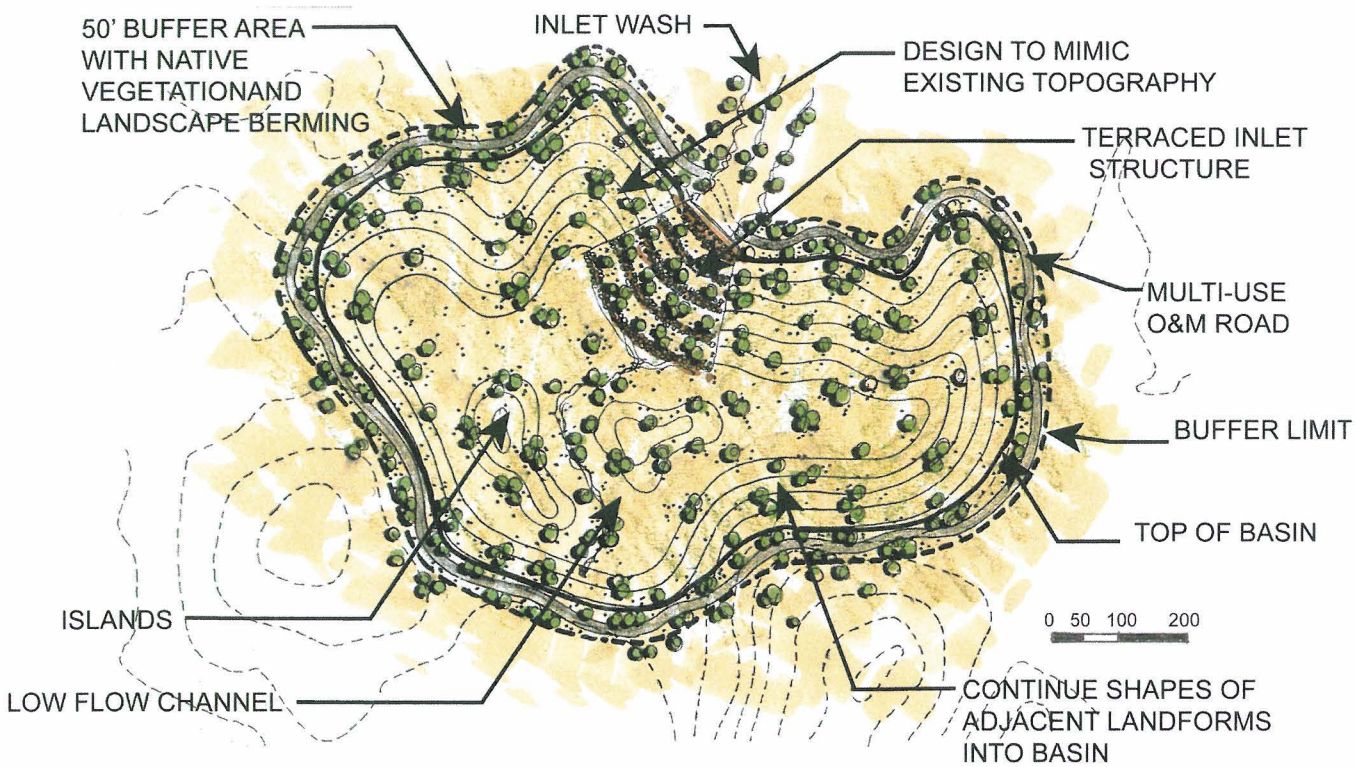

Figure 35 Planimetric View Of On-Line Detention Basin With Landscape Design Features

The bottoms of the basins will undulate to mimic the character of the surrounding landscape. The grading will create a low flow channel from the inlet structure to the outlet of the basin to direct the small flows from frequent events through a simulated natural wash.

A landscaped buffer area of 50' around the perimeter of the basins will be provided to create a visual transition with the surrounding landscape (Figure 36). The buffer area will incorporate landscape berming,

vegetative planting and a meandering multi-purpose O&M road to provide open space access and visual integration with future development (Figure 37). The buffer will also provide the necessary area required to provide grading for a transition from the basin to the existing landscape or future development.

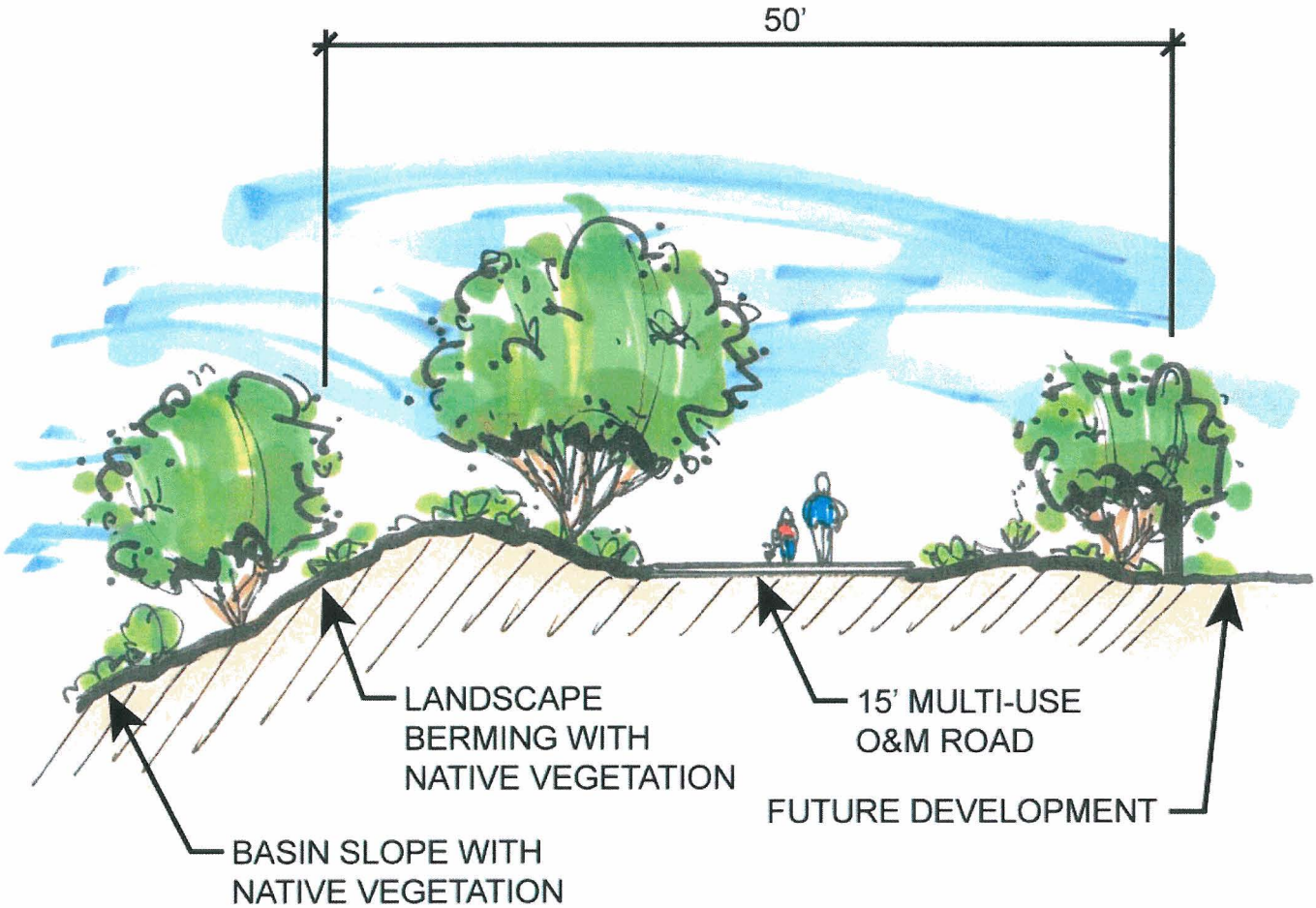

Figure 36 Concept Cross Section Of Basin Buffer Area With Landscape Design Features

The inlet structures for wash flows into the basins will present challenges to the aesthetic design of the features because of the high volume of flows in many of the washes. The natural slope of the existing landscape causes average slope heights of about 30 feet up to a maximum of about 60 feet at the inlet of the washes into the basins on the uphill side of the basin. The preferred approach to developing the structural inlet components will be to develop a series of terraces that allow the flow into the basin to occur over several smaller drops of approximately four to six feet. Terraces will also be used to visually reduce the apparent height of the back slopes of the basins by limiting the slope height of any single slope to about 15-20 feet. The inlet structure terraces will range from approximately 10 feet wide to 30 feet wide. After the first one or two drops the energy of the flow should be dissipated enough to allow landscaping and revegetation on the terraces to reduce the visual impact of

the structures. The landscape could be subject to some damage during the largest storm events, but once established, should recover similar to the surrounding native desert. In cases where a hard structural with aesthetic treatment solution approach would best meet the requirement for flood control, integral color, form liners for texture would be used to reduce visibility of the feature.

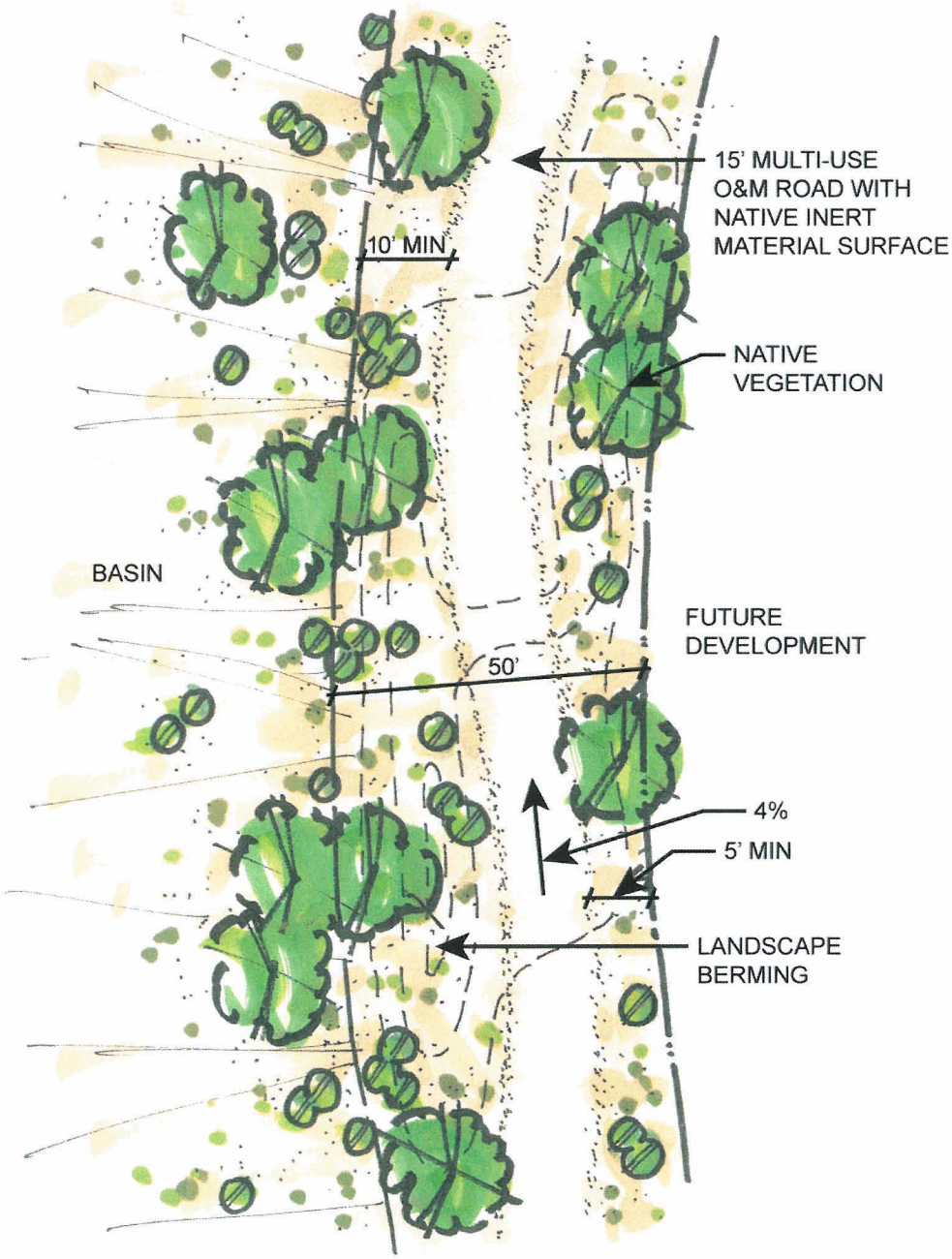

Figure 37 Plan View Of Landscape Design Features For Basin Buffer Area

In the basins with tall slopes on the uphill side, further detailing will be done during the design phase to analyze ways to reduce the visual height of the slopes. In the conceptual designs, these basins would have a reduced level of context sensitivity as compared to the basins that have slopes 35' high or less. Based on current development trends and the planned communities that are under way in the Sun Valley area, future adjacent development will include a substantial number of two-story homes that will reach heights of 25' or more. The final design of the basins should include slopes and structures that are generally in scale with the adjacent homes so that the flood control structures can be as sensitive to the local context as possible. In some situations, close coordination with adjacent development may allow the slopes above the flood detention level to be used for other purposes, such as permanent park improvements or other development associated with the planned community, including residences or other structures.

For the purpose of estimating the aesthetic treatment differential cost estimates, the average side slopes of the basins without aesthetic treatment were increased from 6H:1V to 4H:1V. Although the total storage volume was assumed unchanged, the land area requirements are less for the steeper side slopes. In addition, the setback area of 50 feet around the perimeter of the detention basins was not included. Finally, additional costs were included for architectural enhancements to the inlet and outlet structures which are assumed to be 20% of total cost for the inlet structure and 5% for the outlet structure.

5.8.2 Summary of Detention Basin Design Guidelines for Aesthetic Treatment

The detention basins in the recommended alternative are currently in undisturbed desert areas but most will eventually be adjacent to different types of residential or mixed-use developments. The development will be of various character types including low-density desert neighborhoods and moderate-density, production housing and commercial sites of the various planned area developments. Mature mesquite, palo verde, and ironwood trees and a variety of cacti including saguaros, are prevalent in the native desert areas. Vegetation varies in species composition depending on the landscape character unit. The detention basins occur in the Natural/Pastoral Bajada character unit. The detailed design guidelines for the basins are contained within the individual sub-area reports (Volumes 2 – 7). They have been developed to help reduce the visual intrusion in the landscape as the basins are developed in the existing natural desert and also to allow them to become open space amenities for future residents of the Sun Valley ADMP area.

5.9 Walled-Levee Corridors

5.9.1 Design Considerations

The walled-levee corridors were designed to act as a regional flood control trunk system and were sized to include local drainage as well as sediment from the adjacent watershed area. The minimum freeboard for the walled-levee corridors was set to meet the FEMA freeboard requirement of 3 feet for the concept designs.

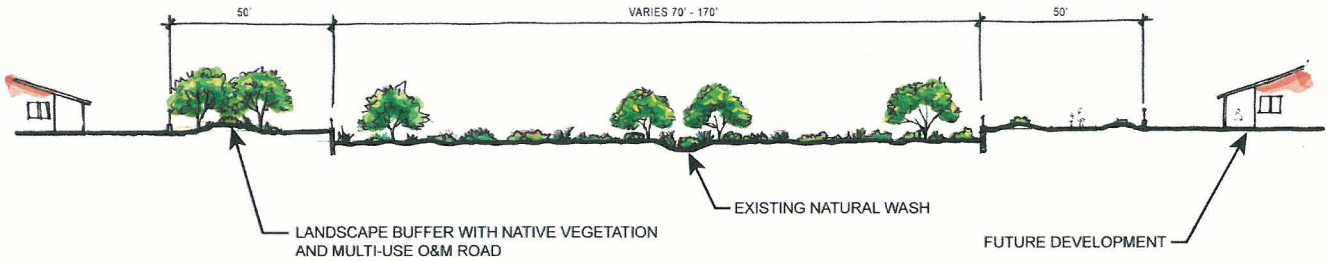

Figure 38 Concept Cross Section For Leveed Corridor With Walls & Aesthetic Treatments

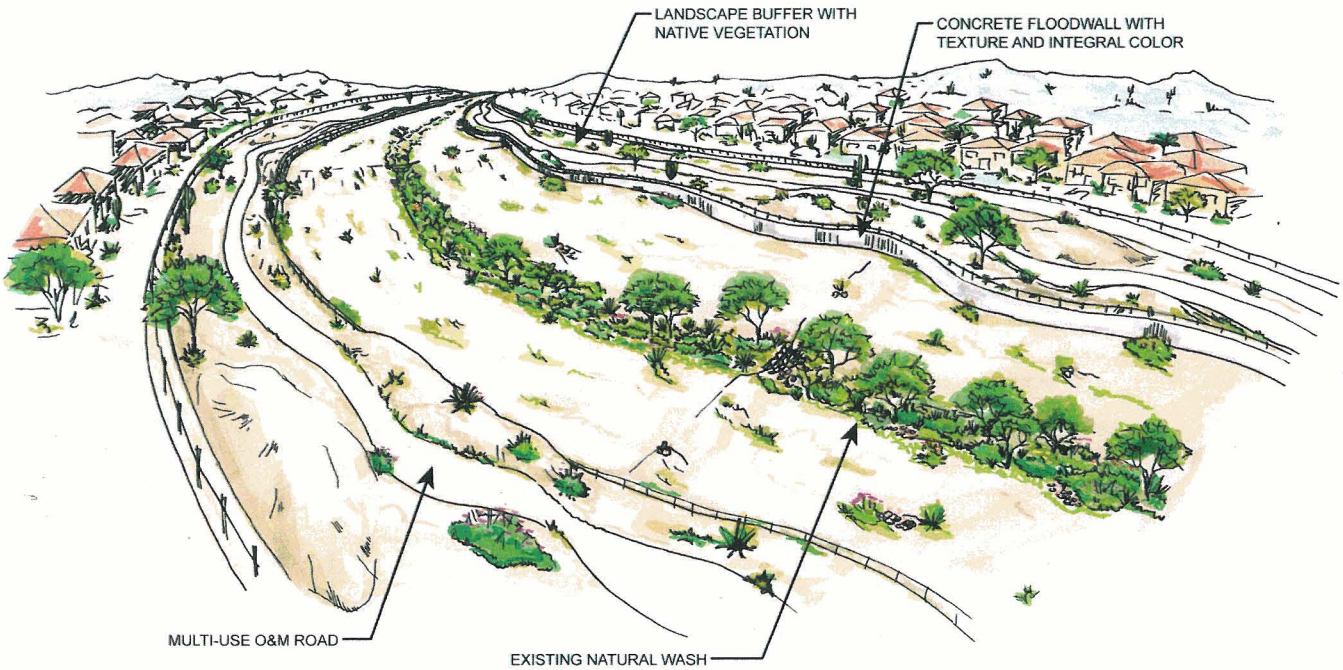

Figure 39 Oblique View Of Walled-Levee Corridor With Aesthetic Treatments

The walled-levee corridors were generally designed for subcritical flow with Froude numbers less than 0.86. Subcritical flows result in flows with lesser velocity and are favorable from public safety point of view. However, for some cross sections, the existing natural channel widths, slopes, and/or depths do not allow this criterion to be met.

Velocity within the walled-levee corridors was designed to be no greater than 6 ft/sec for the 100-year discharge and about 4 ft/sec for the 5 to 10-year discharge. Average flow depth in the corridors was restricted to 2 feet unless the velocity or Froude number requirement could not be met simultaneously.

Figure 38 shows a conceptual cross section of the walled-levee corridor. Figure 39 shows an oblique rendering of an example corridor reach.

5.9.2 Hydraulics

The hydraulics for the walled-levee corridors were performed using Manning's equation (normal-depth assumption). This was done using visual basic macros within an Excel spreadsheet environment. The numerical calculations were performed using the Newton-Raphson method for rapid convergence. In cases where the Newton-Raphson method failed to converge, the bisection method was adopted to ensure accurate results.

Channel geometry data were taken from a digital terrain model based on the 10-foot topography. A Manning's n-value of 0.045 was used for all cross sections. Analyses were performed to ensure adequate conveyance and freeboard for the estimated flow rates at each cross section. Freeboard was assumed to be a minimum of 3 feet for all cross sections.

5.9.3 Equilibrium Slope

In order to mitigate long-term vertical erosion, or degradation, of the walled-levee corridors, grade control structures are proposed. The spacing of these structures was estimated by computing the equilibrium slope for each design reach. The equilibrium slope is interpreted as the slope the channel would evolve into, provided continuous flows for a long period of time and provides an idea as to what the long-term channel slope could become.

The following methods were used in Step 3 to compute equilibrium slope:

- Meyer-Peter, Muller (MPM) for clear water reaches immediately downstream of the on-line detention basins
- ADWR approach for live bed reaches

Design reach-averaged data required for application of the equilibrium slope equations to the study area were derived from the following sources:

- Hydraulic data – normal-depth computations
- Hydrologic data - HEC-1 modeling and area weighting
- Topographic data – 10-foot contour data and DTM

5.9.3.1 Meyer-Peter, Muller Equation

Equilibrium slope for clear water reaches was estimated using the Meyer-Peter, Muller (1948) equation which is based on the incipient motion theory, or the point of initiation of sediment transport. The equation is given by:

$$S_L = K_{mpm} (Q/Q_{bf}) (n_s/D_{90}^{1/6})^{3/2} D / d$$

Where:

S_L = Stable slope (ft/ft)

K_{mpm} = 0.19

Q/Q_{bf} = Ratio of total flow to flow over the channel

Q_{bf} = Dominant discharge (cfs)

n_s = Manning's n for the stream bed

D_{90} = Bed sediment diameter for which 90 percent is smaller (mm)

D = Mean sediment diameter (mm)

d = Channel depth (ft)

The resulting slope was used to compute grade control requirements for the leveed corridors immediately downstream of the on-line detention basins.

5.9.3.2 ADWR Approach

The sediment transport capacity values were used to compute equilibrium slope for live bed reaches based on the sediment transport continuity approach outlined in the ADWR Manual. Sediment transport capacity was computed for each design reach as well as significant tributaries to the leveed corridors.

The Zeller-Fullerton equation from the ADWR Manual was used to compute sediment transport capacity for the design corridor reaches. The Zeller-Fullerton Equation is a total bed-material discharge equation, and is formulated as follows:

$$Q_s = 0.0064\, n^{1.77} V^{4.32} G^{0.45} Y_h^{-0.30} D_{50}^{-0.61}$$

Where: Q_s = sediment discharge rate (cfs)

n = Manning's roughness coefficient, channel

V = mean channel velocity (ft/s)

G = gradation coefficient

Y_h = hydraulic depth, channel (ft)

D_{50} = median bed sediment size (mm)

Hydraulic data required to apply the Zeller-Fullerton equation were obtained from the normal-depth hydraulic calculations for each design reach and corridor tributary. The gradation coefficient and D_{50} were based on the average sediment gradation curve described in Section 5.1.4.

Geometry for the corridor tributaries was estimated from the aerial photographs and 10-foot topography. Tributary slope was measured from the contours approaching the corridor confluence. Cross sections were approximated as rectangular with channel width estimated from the aerial photographs. Channel depths were estimated based on the computed normal-depth velocity. Velocities were targeted to approximately 4 feet per second which were considered appropriate for bankfull depths for these tributary reaches (Moody et al., 2003).

5.9.4 Scour and Toe Protection

The toe-down for the floodwalls was estimated using scour calculation procedures outlined in the ADWR Manual. The following equation for depth of scour in a stream is given in the ADWR Manual:

$$Z_t = 1.3\ (Z_{deg} + Z_{ls} + Z_{gs} + Z_{bs} + Z_i + \tfrac{1}{2}\ h_a) \quad \text{(ADWR Eq. 5.28)}$$

where:

Z_t = Design scour depth (ft)

Z_{deg} = Long-term degradation (ft)

Z_{ls} = Local scour depth (ft)

Z_{gs} = General scour depth (ft)

Z_{bs} = Bend scour depth (ft)

Z_i = Low-flow incisement depth (ft)

h_a = Anti-dune height (ft)

1.3 = Safety factor to account for non-uniform flow distribution

Scour depth below drop structures was estimated using the following equation from Pemberton & Lara (1984):

$$D_s = 4.7\ h^{0.2}\, q^{0.57} / d_{90}^{\ 0.32} - d_m$$

where:

D_s = Scour depth below downstream water surface (m)

h = Drop height (m)

q = Unit discharge ($m^3/s/m$)

d_{90} = Bed material size for which 90% of the sample is finer (mm)

d_m = downstream mean water depth

5.9.5 *Floodwalls*

Where the existing topographic relief and/or the natural channel does not contain the design flow rate, conveyance is provided by floodwalls. The preliminary floodwall design for this project had to account for the following constraints:

- The floodwall had to be extended below the total scour depth anticipated within the channel.
- The floodwall had to have a minimum of 3 feet of freeboard above the maximum computed water surface.
- On the protected side, the maximum of three (3) feet above the final grade could be left exposed. Backfill will be placed to achieve this requirement.
- The height of the wall was taken to be the sum of the scour depth plus the flow depth plus the freeboard amount. The result was rounded to the nearest larger full foot.

The conceptual floodwalls were generated using the assumptions presented in the U.S. Army Corps of Engineers Publication EM 1110-2-2502 *Engineering and Design of Retaining and Flood Walls* supplemented with the *Design Manual for Retrofitting Flood-prone Residential Structures* (FEMA, 1986).

The typical cross-section along with the basic design criteria for each of the above scenarios is presented on Figure 40.

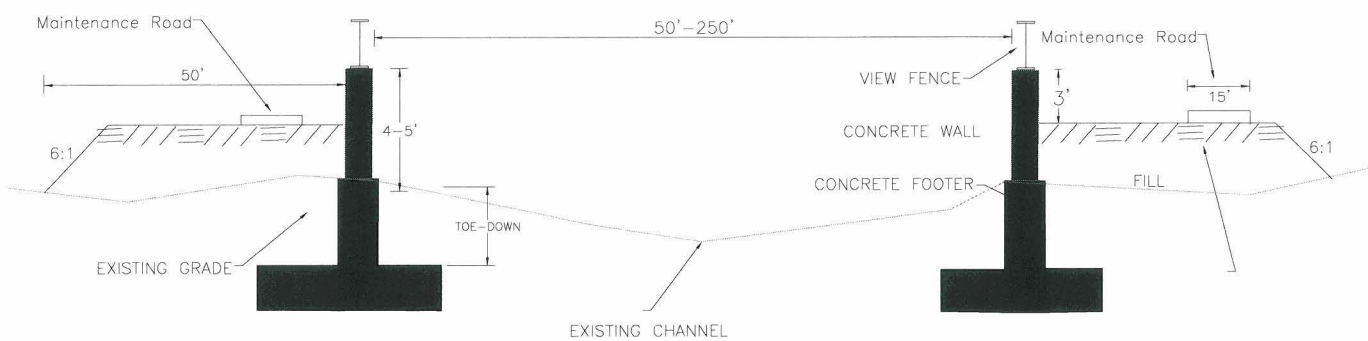

Figure 40 Example Of Typical Floodwall And Corridor

Upon completion of the design, the cost per linear foot was determined. This analysis will serve to provide a means to estimate the preliminary costs for the materials for the construction of the floodwalls. The unit costs are based on past projects bids and could vary considerably from future values. As the reinforcing rebar could not be designed at this phase, a standard price ratio of 15% of the wall cost was used as a base value. Table 5 below provides a summary of the unit cost estimates for the floodwalls. Additional discussion of the cost estimates for the recommended alternative is found in Section 7.

Table 5 Flood Wall Typical Section Properties

(from "Computer Program Users Manual for the Nonstructural Evaluation Program", USCOE, Nov. 1992)												
Wall	Base			Batter			Area		Total	LF	Steel	Total
Height	Toe	Heel	Thickness	Base	Top	length	Base	Wall	Area	Cost	Cost	Unit Cost
A	*C*	*D*	*F*	*E*	*G*	*A-F*	*sf*	*sf*	*cy / lf*	*$155 / cy*	*15%*	*$ / LF wall*
9.0	1.5	2.94	1.08	1.08	1.00	7.92	4.8	8.2	0.48	$75	$11	$86
10.0	1.6	3.22	1.17	1.17	1.00	8.83	5.6	9.6	0.56	$87	$13	$100
11.0	1.89	3.78	1.33	1.33	1.10	9.67	7.5	11.7	0.71	$111	$17	$127
12.0	2.00	4.00	1.50	1.50	1.25	10.50	9.0	14.4	0.87	$135	$20	$155
13.0	2.15	4.30	1.55	1.55	1.28	11.45	10.0	16.2	0.97	$150	$23	$173
14.0	2.28	4.56	1.67	1.67	1.38	12.33	11.4	18.8	1.12	$174	$26	$200

*Note: All wall variables are in feet

In addition to the above costs, a cost of $7 per square foot of wall was added to allow for the use of form liners for aesthetic treatment of the wall surfaces.

5.9.6 Drop Structures

Drop structures are included to limit long-term degradation where necessary. The on-line detention basins collect both sediment and flow volume. As a result, the on-line detention basins also function as sedimentation traps near the fan apices. The result is relatively clear water discharges immediately downstream of the detention basins. Drop structures will be required to limit degradation of the channel in these reaches. Downstream tributaries deliver sediment to the corridors. The inflowing sediment provides supply to offset the reduction in supply due to the on-line detention basin. Clear water conditions were assumed to prevail for the first one or two design sections (generally 1000 to 2000 feet) or until the first tributary enters the corridor.

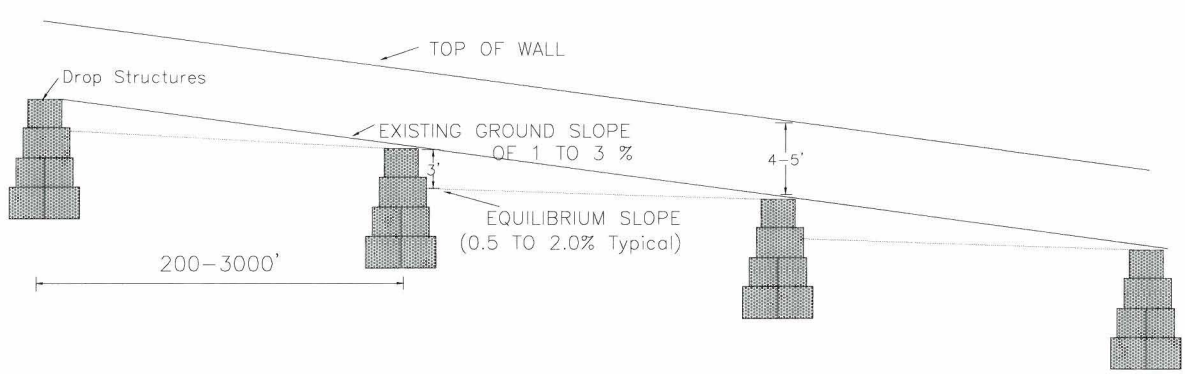

Figure 41 Concept Profile View Of Walled-Levee Corridor Using Gabion Drop Structures

The drop structures were designed to be three feet high and spaced accordingly. This size provides a reasonable height from multiple-use and visual scale points of view. Grade control structures were assumed to be made of buried gabions for the purposes of the cost estimates. The number and spacing of drop structures was determined by using the difference between the existing slope and the anticipated long-term slope for the leveed

corridors. Costs were estimated using the fractional number of structures computed for each design reach. Figure 41 shows the concept profile view of the leveed channel corridor with the buried gabion grade control structures and the anticipated long-term, or equilibrium, slope. Stepped boulder structures could be used in lieu of gabions if sufficiently large rock were available. Boulder structures are the preferred aesthetic treatment for drop structures.

It is suggested that a grade control structure be placed at the downstream end of each corridor at its outlet to prevent headcutting into the corridor. Similarly, vertical downcutting of tributaries to the corridor should be prevented by placing grade control structures for the corridor just downstream of significant tributary confluences. Elsewhere, it is anticipated that transportation and utility crossings will provide most of the required grade control needs. Scour below the drop structures should be estimated using the scour equation from Pemberton and Lara (1984) shown in Section 5.9.4. The total height of the drop structures should include this estimated scour depth.

5.10 Aesthetic Treatments of Walled-Levee Corridors

5.10.1 Floodwalls

The design approach for flood control corridors will retain much of the natural character of the existing wash. The use of walls to contain the design flood flows will minimize the disturbance of the area adjacent to the wash corridor but will require architectural enhancement to reduce the visual intrusion into the landscape and be more compatible with the landscape character of future development. These enhancements would include but not be limited to:

- the use of form liners to add texture to the wall surface;
- the use of integral color in the concrete to blend with the surrounding landscape;
- horizontal undulation to reduce the rigid look of the walls and to avoid major vegetation when possible;
- limit interior wall height to 5 feet whenever possible through meandering with the existing topography;
- installation of trees in a random pattern along the interior base of the walls to reduce their visibility;
- and vertical undulation with the existing terrain to reduce the rigid engineering aspect of the walls.

While the walls alone would be considered a hard structural with aesthetic treatment method of flood control, the minimal disturbance to the natural wash and the width of the corridors would result in a good level of compatibility with the landscape character and is generally sensitive to the context of the existing and future landscape setting.

An additional setback area of 35 ft was applied to each side of the conveyance corridor to provide visual screening as well as recreational and/or environmental benefits. This is in addition to 15 feet added for a maintenance road on each side. If flow and freeboard containment can be achieved by natural ground, the maintenance road and setback area are provided within the freeboard area above the 100-year water surface elevation.

It should also be noted that the selection of a walled natural corridor with relatively low floodwalls is integral to the recommended alternative. While the internal wall height was limited to about five feet on average, the external wall height was limited to three feet through the use of backfill behind the floodwall outside the flood channel.

The costs associated with the color, form liners, backfill, and setback area right of way were considered the differential costs required to meet the aesthetic treatment policy requirements. Landscaping of the setback area was also assumed to be required. These costs were computed for comparison with the District's cost guidelines for aesthetic treatment of flood control facilities.

5.10.2 Drop Structures

The planned flows in the drainage corridors will require drop structures to control long-term degradation of the channel. Large boulders will be used as part of the structural design to reduce the visual impact of the structures. If suitable materials for stepped boulder drops are not readily available, concrete with architectural design treatments may be an acceptable alternative. Seeding and revegetation upstream and downstream of the structures will help reestablish native vegetation after construction and further reduce the visual affect to the landscape. A 10% increase in the length of the drop structures was applied for the purpose of assessing the differential cost for the required aesthetic treatments.

5.10.3 Summary of Walled-Levee Corridor Design Guidelines for Landscape Aesthetics

The walled-levee corridors are located in areas where the natural desert vegetation is mostly undisturbed. The corridors will serve as the unifying element that would create an organic pattern of elements connecting the adjacent developments to other major trail corridors. The aesthetic design guidelines and criteria for the corridors include developing the corridors in meandering forms, incorporating a multi-use O&M road, using native vegetation along the corridor that is specific to the adjacent character unit, and using stepped boulder drop structures for channel grade control. Figure 42 shows a cross section of a flood wall and adjacent buffer area with the landscape aesthetic treatments. The detailed landscape aesthetic design guidelines are located in the sub-area reports. They have been developed to help reduce the visual effects of the corridors as they are developed in the

existing natural desert and also to allow them to become open space amenities for future residents of the Sun Valley ADMP area.

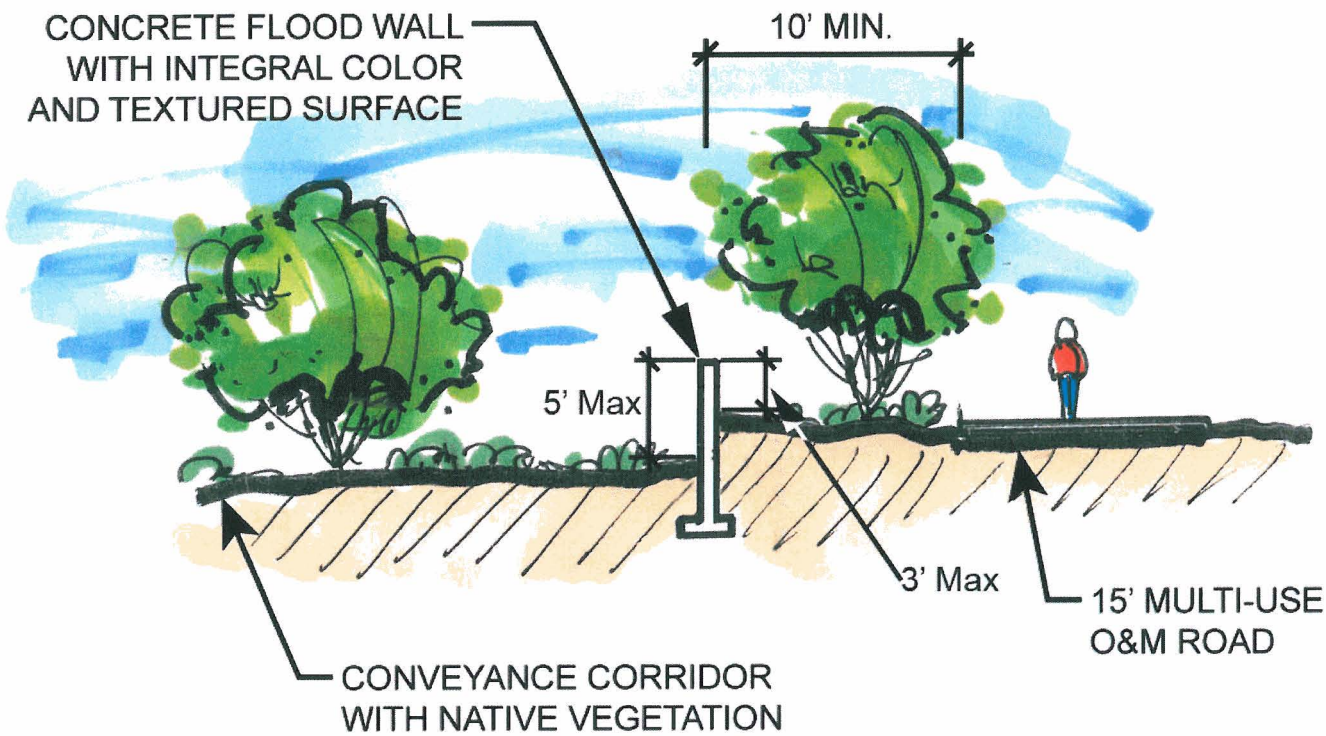

Figure 42 Buffer Area Detail With Landscape Design Features

5.11 Excavated Channels

The excavated channels were designed using the same spreadsheet tools used for the walled-levee corridors. The excavated channel reaches were derived from Alternative B3 from Step 2. Hydraulics for the channels were computed using normal-depth (see Section 5.9.2). The primary design objective was to create a channel cross section that was capable of transporting the sediment delivered to it such that the long-term, equilibrium slope (see Section 5.9.3) was approximately equal to the prevailing existing slope. Channel side slopes of 6:1 were maintained whenever possible to meet the landscape aesthetic objectives. Channel banks were assumed to require protection from lateral erosion.

Figure 43 shows a conceptual cross section of an excavated earthen channel. Figure 44 shows an oblique rendering of an excavated channel reach.

Costs were estimated for land, construction, landscaping, and 50 years of maintenance. Fan Systems 36, 37, and 38 contain excavated channel reaches.

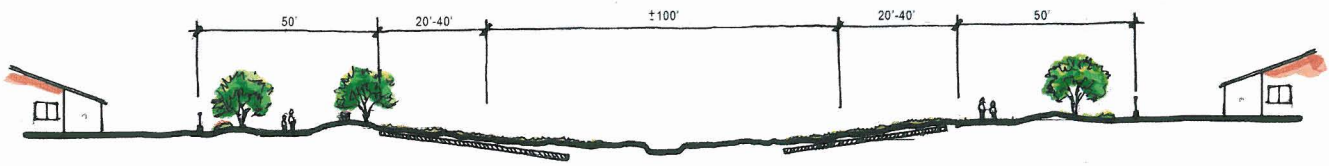

Figure 43 Concept Cross Section For Earthen Excavated Channel With Landscape Aesthetic Treatment

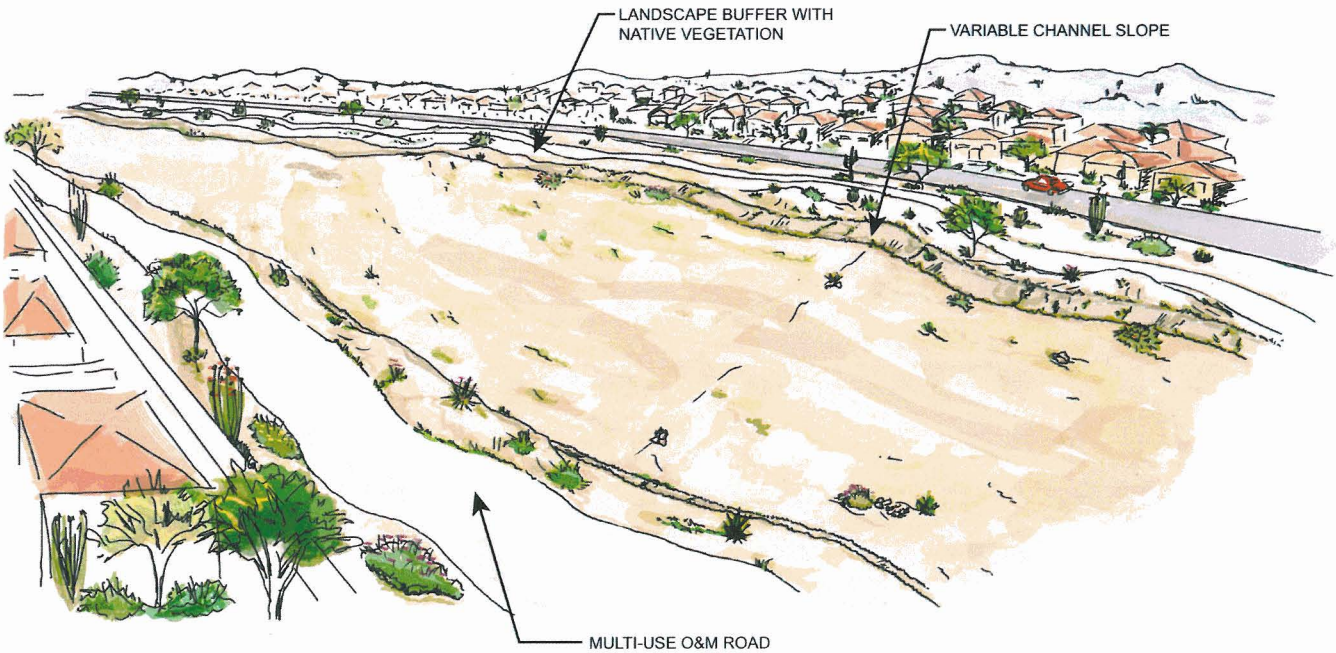

Figure 44 Oblique View Of Earthen Excavated Channel With Aesthetic Treatment

5.12 Aesthetic Treatments of Excavated Channels

The aesthetic treatments for the excavated channel involve a decrease in the side slope of the channel and an additional 50 ft buffer area parallel to all channels (including the O&M road). The side slope for enhanced design will vary between 4:1 to 8:1. For purpose of the Step 3 design and cost estimates for the aesthetic treatment components, the average side slope was decreased from 4:1 to 6:1. The decrease in the side slope increases the total land area needed which, in turn, increases the landscape and maintenance costs.

5.12.1 Summary of Excavated Channel Design Guidelines for Landscape Aesthetics

The excavated channels are located primarily along existing or future significant transportation corridors including the Sun Valley Parkway and McDowell Road. However, in order to retain the unifying elements that connect the adjacent developments and other major trail corridors, the aesthetic design guidelines and criteria would include development of the low flow channel to mimic a desert wash, use of integral color and formliners

for structural components and development the O&M road as a multi-use facility. Landscape design will also be encouraged to incorporate plant material from existing and future development to provide a transition to the flood control facilities. Detailed design guidelines for the excavated channels are contained within the sub-area reports with excavated channel reaches (White Tank Wash & FRS No. 1 Sub-areas).

5.13 Recreation and Multiple-Use

Information from the Town of Buckeye, Maricopa County and other planning organizations were utilized to identify multiple-use and recreation opportunities. Within the study area, numerous multi-use opportunities could be developed in conjunction with existing and planned recreation facilities. While most all the proposed corridors could be developed with multi-use trails, the ones identified here should be developed as major corridors for regional planning purposes as they are consistent with the proposed corridors of Buckeye and/or Maricopa County. The coordination of flood control facilities with local recreation plans will contribute to the integration of regional and local open space systems and also provides the potential partnership opportunities between the District and the Town. The proposed recreation and multi-use components that should be incorporated into the recommended alternative for flood control in the Sun Valley ADMP area are shown in Figure 45 for locations of basins and corridors in relation to proposed recreation facilities. All flood control components in the study area should be developed according to the landscape themes presented in the individual sub-area reports (Volumes 2 – 7) which include additional details on the recreational opportunities associated with the recommended alternative for each sub-area.

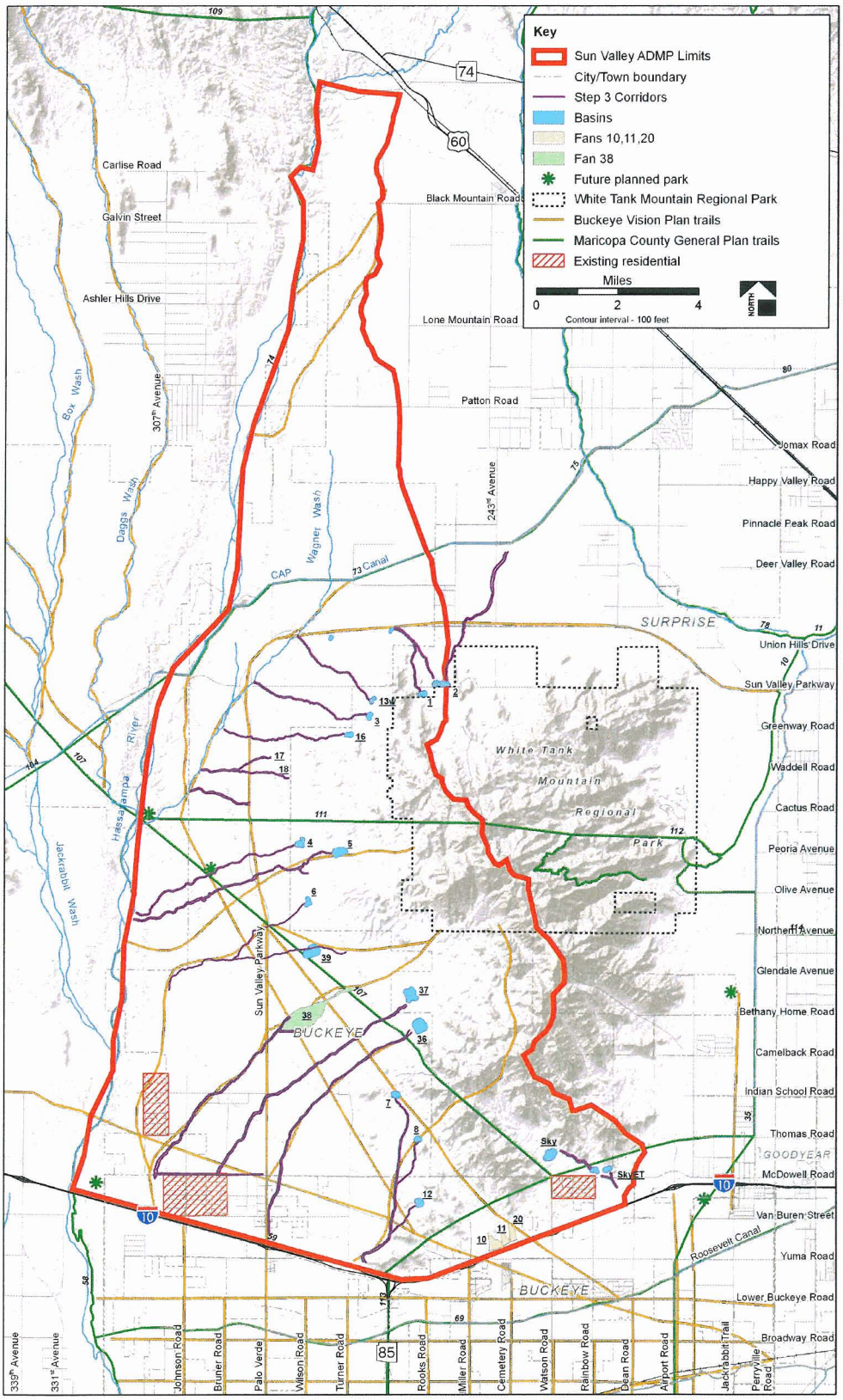

Figure 45 Recommended Alternative And Multiple-Use Opportunities

6 STEP 3 COST ESTIMATES

6.1 Design Cost Estimates

The costs of the recommended alternative were estimated by establishing unit costs for the various design components. The total cost for each component was obtained by multiplying the quantities associated with each design element with the unit costs. The cost components considered in the design are: 1) Land Cost, 2) Construction Cost, 3) Landscaping Cost, and 4) Maintenance Cost.

A summation of all cost components provides the total cost for a particular channel reach or detention basin. The costs for all design elements (channels, basins, and dikes) are totaled to provide the total cost for the recommended alternative for each fan system.

The procedures adopted in estimating the cost for each component are presented below. The details of the calculations performed are presented in the appendices in Volumes 2 – 7. The summary of the unit costs for all the components is presented in Table 6.

6.1.1 Land Cost

The land cost is the largest cost component followed by construction cost. The land cost was estimated using a unit cost of $100,000 per acre. The land areas considered in the estimates are: 1) the on-line basin footprint and setback area, 2) the channel area between the floodwalls for the walled-levee corridors or the top of bank for excavated channel reaches, plus the adjacent maintenance road and setback area. No additional area was included for naturally contained corridor reaches.

6.1.2 Construction Cost

The construction costs were estimated mainly based on unit costs for materials and excavation costs. The unit material cost includes all costs associated with material fully constructed in place. For example, a unit cost of $85 per cubic yard for gabions for drop structures includes the cost of material as well the cost of constructing the drop structure. A contingency cost of 25% was applied to the estimated construction cost. Similarly, the cost for the engineering design is set at 5% of the construction cost. The sum of the construction cost, contingency cost and the design cost provides the total construction cost.

Table 6 Summary Of Unit Costs

	Construction Units	Construction Cost	Landscape Units	Landscape Cost	Maintenance Units	3 Year Maintenance Cost
Levee						
Fill	cu. Yd	$ 7.00	sq. Yd	$ 4.50	sq. Yd	$ 0.70
9 ft Floodwall	LF	$ 144	sq. Yd	$ -	sq. Yd	$ 4.50
10 ft Floodwall	LF	$ 168	sq. Yd	$ -	sq. Yd	$ 4.50
11 ft Floodwall	LF	$ 210	sq. Yd	$ -	sq. Yd	$ 4.50
12 ft Floodwall	LF	$ 256	sq. Yd	$ -	sq. Yd	$ 4.50
13 ft Floodwall	LF	$ 286	sq. Yd	$ -	sq. Yd	$ 4.50
14 ft Floodwall	LF	$ 331	sq. Yd	$ -	sq. Yd	$ 4.50
Toe Protection						
Riprap	cu. Yd	$ 75.00	sq. Yd	$ -	sq. Yd	$ 1.50
Gabions	cu. Yd	$ 85.00	sq. Yd	$ -	sq. Yd	$ 1.70
Soil Cement	cu. Yd	$ 50.00	sq. Yd	$ -	sq. Yd	$ 1.50
Concrete	cu. Yd	$ 155.00	sq. Yd	$ -	sq. Yd	$ 2.35
Levee Lining						
Riprap	cu. Yd	$ 75.00	sq. Yd	$ -	sq. Yd	$ 1.25
Drop Structure						
Riprap	cu. Yd	$ 75.00	sq. Yd	$ -	sq. Yd	$ 2.00
Gabions	cu. Yd	$ 85.00	sq. Yd	$ -	sq. Yd	$ 2.25
Soil Cement	cu. Yd	$ 75.00	sq. Yd	$ -	sq. Yd	$ 3.00
Concrete	cu. Yd	$ 155.00	sq. Yd	$ -	sq. Yd	$ 2.50
Basin Inlet						
Riprap	cu. Yd	$ 75.00	sq. Yd	$ -	sq. Yd	$ 2.00
Concrete	cu. Yd	$ 155.00	sq. Yd	$ -	sq. Yd	$ 2.50
Outlet Pipes						
24" RGRCP	LF	$ 55.00	sq. Yd	$ -		$ 0.55
30" & 36" RGRCP	LF	$ 82.00	sq. Yd	$ -		$ 1.20
42" & 48" RGRCP	LF	$ 160.00	sq. Yd	$ -		$ 2.40
54" & 60" RGRCP	LF	$ 183.00	sq. Yd	$ -		$ 2.75
Channel						
Excavated Channel	$ 10.00	cu. Yd	sq. Yd	$ 4.50	sq. Yd	$ 0.50
Basin						
Excavated Basin	$ 4.00	cu. Yd	sq. Yd	$ 4.50	sq. Yd	$ 0.50

Note: Includes aesthetic treatment costs where applicable.

6.1.3 Landscaping Cost

The landscaping costs were also applied as unit costs for the cost categories where landscaping is needed. The landscaping costs were based on "per area" unit cost with the areas estimated using the design parameters. A landscaping cost of $0.50 per square foot was assumed. Landscaping costs were applied only to the disturbed elements of the design components. For example, the surface area of the backfill behind the floodwalls was assumed to require landscaping. Similarly, the interior slopes of the detention basins were assumed to require landscaping.

6.1.4 Maintenance Cost

The maintenance costs are based on a 3-year maintenance cycle. The costs are estimated for a design life of 50 years. The costs include maintenance costs for a period of 50 years assuming that maintenance will be performed every 3 years.

6.2 Aesthetic Treatment Costs

In order to ensure that the proposed structural flood control measures are compatible with the future landscape character of the area, some modifications to the engineering design were required. The additional costs will be incurred to ensure that the proposed structural flood control measures conform with the future landscape character of the Sun Valley area and meet the aesthetic treatment requirements. The additional costs were estimated based on increased land area, construction, landscaping, and maintenance requirements for the enhanced structures. Details of the computation of the aesthetic treatment costs are provided in the appendices of the individual sub-area reports (Volumes 2 – 7).

Overall, the landscaping and other aesthetic treatment costs averaged about 26 percent of the recommended alternative costs. This percentage includes about 5 percent for landscaping. The remaining 21 percent is for other aesthetic treatments including additional right of way, integral color, form liners, and additional excavation. The landscaping costs are about half of the District's maximum cost guidelines at about $20,000 per acre. Of the remaining aesthetic treatment costs, about $56.7 million are for additional right of way requirements. The total ROW cost is estimated at about $254 million. The District's additional right of way cost ceiling for aesthetic treatment is 30 percent. Therefore, the additional ROW for the recommended alternative lies below the cost ceiling ($56.7 / ($254 - $56.7) = 29 %). The total construction costs for the recommended alternative are estimated at about $233 million. The portion of the costs attributable to the aesthetic treatment components was estimated at about $55 million. This is well in excess of the 4 to 10 percent cost ceiling provided in Table 2 of the District's Policy for Aesthetic Treatment and Landscaping of Flood Control Projects.

6.3 Summary of Recommended Alternative Costs

Table 7 presents a summary of the cost estimates for the recommended alternative for the Sun Valley area. The engineering and aesthetic treatment costs were estimated for all of the proposed structural components of the recommended alternative for each sub-area. The recommended alternative was arrived at by a collaborative effort of the project team, stakeholders, and the public. The results for the entire ADMP area are seventeen on-line and three off-line detention basins with a total cost of $213 million and 69 miles of walled-levee and excavated channel corridors with a total cost of $396 million. The total cost of the recommended alternative for the Sun Valley ADMP area was estimated at $610 million including right of way, construction, aesthetic treatments, and 50 years' maintenance. Right of way costs were estimated as about 42% of the total costs. Construction was estimated at about 38% of the total cost, landscaping at about 5% of the total cost, and maintenance about 16% of the total cost.

Table 8 provides a breakdown of costs and other geometric elements of the recommended alternative for each fan system, summarizes by sub-area, and for the entire ADMP area as well.

The following sections provide a brief discussion of the cost results for the recommended alternative for each sub-area.

6.3.1 North of CAP Sub-area

The recommended alternative elements for the North of CAP sub-area are all non-structural in nature. Management approaches for the floodprone areas including the small alluvial fans along the Hassayampa River are the primary concern. Future development should provided detailed demonstration of the magnitude and extent of flood hazards affecting their proposed improvements and the adequacy of their mitigation strategies whether structural or non-structural in nature. The legacy facilities of the Luke Auxiliary Field and the numerous stock tanks in the area should be addressed by their planned removal. No costs were assigned to the implementation of these recommendations.

6.3.2 CAP Sub-area

Fan System 1 & 2 is the only fan system in the CAP sub-area. The estimated total cost of the recommended alternative for Fan System 1/2 is $59.1 million including right of way, construction, aesthetic treatments, and 50 years' maintenance. The apex basins cost was estimated at $17.7 million. The off-line basins cost was estimated at $3.5 million. The walled-levee corridors were estimated at $37.9 million. The additional costs associated with the landscaping and other aesthetic treatment requirements are about 27 percent of the total cost.

6.3.3 Wagner Sub-area

The Wagner sub-area has five fan systems: Fan System 13, Fan System 3, Fan System 16, Fan System 17 & 18, and Fan System 19. The estimated total cost of the recommended alternative for Fan System 13 is $18.4 million including right of way, construction, aesthetic treatments, and 50 years' maintenance. The apex basin cost was estimated at $4.2 million. The walled-levee corridors were estimated at $13.9 million. The additional costs associated with the landscaping and other aesthetic treatment requirements are about 39 percent of the total cost.

The estimated total cost of the recommended alternative for Fan System 3 is $23.3 million including right of way, construction, aesthetic treatments, and 50 years' maintenance. The apex basin cost was estimated at $5.2 million. The walled-levee corridors were estimated at $18 million. The additional costs associated with the landscaping and other aesthetic treatment requirements are about 36 percent of the total cost.

The estimated total cost of the recommended alternative for Fan System 16 is $24.7 million including right of way, construction, aesthetic treatments, and 50 years' maintenance. The apex basin cost was estimated at $5.5 million. The walled-levee corridors were estimated at $19.1 million. The additional costs associated with the landscaping and other aesthetic treatment requirements are about 37 percent of the total cost.

The estimated total cost of the recommended alternative for Fan System 17 & 18 is $20 million including right of way, construction, aesthetic treatments, and 50 years' maintenance. There is no apex basin in Fan System 17 & 18. The walled-levee corridors were estimated at $19.5 million. The additional costs associated with the landscaping and other aesthetic treatment requirements are about 39 percent of the total cost.

The estimated total cost of the recommended alternative for Fan System 19 is $10.5 million including right of way, construction, aesthetic treatments, and 50 years' maintenance. The walled-levee corridors comprise the total cost as there are no other structural elements in Fan System 19. The additional costs associated with the landscaping and other aesthetic treatment requirements are about 34 percent of the total cost.

6.3.4 Hassayampa Sub-area

The Hassayampa sub-area has two fan systems: Fan System 4 and Fan System 5. The estimated total cost of the recommended alternative for Fan System 4 is $33.2 million including right of way, construction, aesthetic treatments, and 50 years' maintenance. The apex basin cost was estimated at $8.8 million. The walled-levee corridors were estimated at $24.3 million. The additional costs associated with the landscaping and other aesthetic treatment requirements are about 35 percent of the total cost.

The estimated total cost of the recommended alternative for Fan System 5 is $50.6. The apex basin cost was estimated at $18.4 million. The walled-levee corridors were estimated at $32.2 million. The additional costs associated with the landscaping and other aesthetic treatment requirements are about 27 percent of the total cost.

6.3.5 White Tank Wash Sub-area

The White Tank Wash sub-area has two fan systems: Fan System 6 & 39 and Fan System 38. The estimated total cost of the recommended alternative for Fan System 6 & 39 is $77.7 million including right of way, construction, aesthetic treatments, and 50 years' maintenance. The basin costs were estimated at $38..2 million. The walled-levee corridors were estimated at $39.5 million. The additional costs associated with the landscaping and other aesthetic treatment requirements are estimated at about 22 percent of the total cost.

The total cost estimated for the recommended alternative for Fan System 38 is $51.9 million including right of way, construction, aesthetic treatments, and 50 years' maintenance. The off-line detention basin costs to be designed and built by others were estimated at about $16.5 million. The walled-levee corridors were estimated at $28.8 million. The excavated channel costs were estimated at $6.6 million. The additional costs associated with the landscaping and other aesthetic treatment requirements are about 18 percent of the total cost.

6.3.6 FRS No. 1 Sub-area

The FRS No. 1 sub-area has three fan systems: Fan System 37, Fan System 36, and Fan System 7, 8, & 12. The estimated total cost of the recommended alternative for Fan System 37 is $79.9 million including right of way, construction, aesthetic treatments, and 50 years' maintenance. The basin costs were estimated at $21.6 million. The walled-levee corridors were estimated at $40.5 million. The excavated channel costs were estimated at $17.8 million. The additional costs associated with the landscaping and other aesthetic treatment requirements were estimated at about 20 percent of the total cost.

The estimated total cost of the recommended alternative for Fan System 36 is $65.7. The detention basin costs were estimated at $26.2 million. The walled-levee corridors were estimated at $35.6 million. The excavated channel costs were estimated at $3.9 million. The additional costs associated with the landscaping and other aesthetic treatment requirements are about 23 percent of the total cost.

The estimated total cost of the recommended alternative for Fan System 7, 8, & 12 is $59.2 million. The cost of the three basins was estimated at $19 million. The walled-levee corridors were estimated at $40.2 million. The additional costs associated with the landscaping and other aesthetic treatment requirements are about 33 percent of the total cost.

6.3.7 FRS No. 2 & 3 Sub-area

The FRS No. 2 & 3 sub-area has two fan systems: Fan System 10, 11, & 20 and the Skyline Fan System. The recommended alternative for Fan System 10, 11, & 20 is fully non-structural. Therefore, no costs were assigned to its implementation.

The estimated total cost of the recommended alternative for the Skyline Fan System is $35.5 million including right of way, construction, aesthetic treatments, and 50 years' maintenance. The three basins costs were estimated at $28.3 million. The walled-levee corridors were estimated at $7.2 million. The additional costs associated with the landscaping and other aesthetic treatment requirements were estimated at about 19 percent of the total cost.

Table 7 Summary Of Recommended Alternative Costs By Fan System & Sub-Area

			Costs (in millions of $)					Cost Percentages			
Subarea	Fan System	ROW Area (acres)	Land Cost	Construction Cost	Landscaping Cost	50-Year Maintenance Cost	Total Cost	Land Cost %	Construction Cost %	Landscaping Cost %	50-Yr Maintenance Cost %
CAP	FANS1_2	266.5	$ 26.650	$ 20.741	$ 2.760	$ 8.982	$ 59.132	45%	35%	5%	15%
	TOTAL	266.5	$ 26.650	$ 20.741	$ 2.760	$ 8.982	$ 59.132	45%	35%	5%	15%
Wagner	FAN3	88.8	$ 8.880	$ 8.979	$ 1.163	$ 4.241	$ 23.262	38%	39%	5%	18%
	FAN13	62.8	$ 6.280	$ 7.611	$ 0.965	$ 3.525	$ 18.380	34%	41%	5%	19%
	FAN16	88.1	$ 8.810	$ 10.043	$ 1.227	$ 4.666	$ 24.746	36%	41%	5%	19%
	FAN19	51.0	$ 5.100	$ 3.438	$ 0.377	$ 1.585	$ 10.501	49%	33%	4%	15%
	FANS1718	78.8	$ 7.880	$ 7.840	$ 0.807	$ 3.509	$ 20.036	39%	39%	4%	18%
	TOTAL	369.5	$ 36.950	$ 37.910	$ 4.540	$ 17.526	$ 96.926	38%	39%	5%	18%
Hassayampa	FAN4	128.5	$ 12.850	$ 13.135	$ 1.612	$ 5.637	$ 33.233	39%	40%	5%	17%
	FAN5	203.1	$ 20.310	$ 20.003	$ 2.215	$ 8.086	$ 50.615	40%	40%	4%	16%
	TOTAL	331.6	$ 33.160	$ 33.139	$ 3.827	$ 13.722	$ 83.848	40%	40%	5%	16%
White Tank Wash	FAN38	250.0	$ 25.000	$ 15.065	$ 2.637	$ 9.153	$ 51.855	48%	29%	5%	18%
	FANS6_39	340.7	$ 34.070	$ 30.782	$ 3.343	$ 9.478	$ 77.672	44%	40%	4%	12%
	TOTAL	590.7	$ 59.070	$ 45.846	$ 5.980	$ 18.631	$ 129.527	46%	35%	5%	14%
FRS 1	FANS7812	254.1	$ 25.410	$ 21.950	$ 2.773	$ 9.024	$ 59.157	43%	37%	5%	15%
	FAN36	264.6	$ 26.460	$ 26.645	$ 2.909	$ 9.709	$ 65.722	40%	41%	4%	15%
	FAN37	334.2	$ 33.420	$ 30.794	$ 3.179	$ 12.515	$ 79.908	42%	39%	4%	16%
	TOTAL	852.9	$ 85.290	$ 79.389	$ 8.860	$ 31.248	$ 204.787	42%	39%	4%	15%
FRS 2 & 3	SKYLINES	125.8	$ 12.580	$ 15.462	$ 2.066	$ 5.426	$ 35.534	35%	44%	6%	15%
	TOTAL	125.8	$ 12.580	$ 15.462	$ 2.066	$ 5.426	$ 35.534	35%	44%	6%	15%
TOTAL - ALL SUBAREAS		2,537.0	$ 253.7	$ 232.5	$ 28.0	$ 95.5	**$ 609.8**	42%	38%	5%	16%

Table 8 Summary Of Design Parameters And Costs For The Sun Valley ADMP Recommended Alternative

Sub-Area	Fan System	CHANNEL											BASINS						DIKES	TOTAL			
		Length	*Width*			*Area*			*Volume*		*Cost (in millions $)*		*Area*			*Volume*	*Cost (in millions $)*		*Cost*	*(Channel & Basins)*			
		Total Length (miles)	Average Channel Width (ft)	Average Other ROW Width (ft)	Average Total ROW Width (ft)	Channel Corridor Area (acres)	Other ROW Area (acres)	Total ROW Area (acres)	Fill Volume (million cu. Yd)	Exc. Volume (million cu. Yd)	Cost per mile	Total Channel Cost	Basin Area (acres)	Other Area (acres)	Total ROW Area (acres)	Basin Exc. Volume (million cu. Yd)	Cost per ac. ft	Total Basin Cost	Total Dike Cost (in millions)	ROW Area (acres)	Fill Volume (million cu. Yd)	Exc. Volume (million cu. Yd)	Total Cost (in millions $)
CAP	FANS1_2	6.85	148.6	86.6	235.2	123.3	71.9	195.2	0.11	0.00	$ 5.5	$ 37.9	56.7	14.6	71.3	1.149	$ 0.041	$ 21.2		266.5	0.1	1.1	$ 59.1
	AVERAGE		148.6	86.6	235.2	123.3	71.9	195.2			$ 5.5						$ 0.041						
	TOTAL	6.85						195.2	0.11	0.00		$ 37.9	56.7	14.6	71.3	1.149		$ 21.2	$ -	266.5	0.1	1.1	$ 59.1
Wagner	FAN3	3.04	93.9	99.9	193.8	34.6	36.8	71.4	0.07	0.00	$ 5.9	$ 18.0	13.9	3.4	17.3	0.349	$ 0.024	$ 5.2	$ 0.08	88.8	0.1	0.3	$ 23.3
	FAN13	2.47	62.1	100.2	162.3	18.6	30.0	48.6	0.07	0.00	$ 5.6	$ 13.9	10.5	3.3	13.8	0.202	$ 0.034	$ 4.2	$ 0.24	62.8	0.1	0.2	$ 18.4
	FAN16	3.18	82.7	100.1	182.8	31.9	38.6	70.5	0.09	0.00	$ 6.0	$ 19.1	13.8	3.6	17.4	0.353	$ 0.025	$ 5.5	$ 0.14	88.1	0.1	0.4	$ 24.7
	FAN19	1.58	170.9	95.7	266.6	32.7	18.3	51.0	0.04	0.00	$ 6.7	$ 10.5								51.0	0.0	0.0	$ 10.5
	FANS1718	3.38	95.5	94.8	190.3	39.1	38.8	77.9	0.08	0.00	$ 5.8	$ 19.5							$ 0.55	78.8	0.1	0.0	$ 20.0
	AVERAGE		94.8	98.3	193.1	32.0	34.3	66.3			$ 5.9						$ 0.017						
	TOTAL	13.65						319.4	0.35	0.00		$ 80.9	38.2	10.3	48.5	0.904		$ 15.0	$ 1.00	369.5	0.4	0.9	$ 96.9
Hassayampa	FAN4	4.48	88.3	96.2	184.6	48.0	52.3	100.3	0.09	0.00	$ 5.4	$ 24.3	23.2	4.8	28.0	0.603	$ 0.024	$ 8.8	$ 0.11	128.5	0.1	0.6	$ 33.2
	FAN5	5.87	135.3	82.6	217.9	96.3	58.8	155.1	0.11	0.00	$ 5.5	$ 32.2	41.9	6.1	48.0	1.588	$ 0.019	$ 18.4		203.1	0.1	1.6	$ 50.6
	AVERAGE		115.0	88.5	203.5	75.4	56.0	131.4			$ 5.5						$ 0.021						
	TOTAL	10.36						255.4	0.20	0.00		$ 56.6	65.1	10.9	76.0	2.191		$ 27.2	$ 0.11	331.6	0.2	2.2	$ 83.8
White Tank Wash	FAN38	5.97	160.9	81.0	241.9	116.5	58.6	175.1	0.05	0.05	$ 5.9	$ 35.4	67.0	7.9	74.9	0.807	$ 0.033	$ 16.5		250.0	0.1	0.9	$ 51.9
	FANS6_39	7.17	163.6	98.9	262.5	142.2	86.0	228.2	0.07	0.00	$ 5.5	$ 39.5	99.7	12.8	112.5	3.303	$ 0.023	$ 38.2		340.7	0.1	3.3	$ 77.7
	AVERAGE		162.4	90.8	253.1	130.5	73.6	204.1			$ 5.7						$ 0.028						
	TOTAL	13.14						403.3	0.13	0.05		$ 74.9	166.7	20.7	187.4	4.109		$ 54.6	$ -	590.7	0.1	4.2	$ 129.5
FRS 1	FANS7812	6.76	112.7	119.8	232.4	92.3	98.1	190.4	0.14	0.00	$ 5.9	$ 40.2	52.4	11.3	63.7	1.279	$ 0.024	$ 19.0		254.1	0.1	1.3	$ 59.2
	FAN36	6.74	156.4	83.6	240.0	127.8	68.3	196.1	0.09	0.06	$ 5.9	$ 39.5	61.5	7.0	68.5	2.626	$ 0.016	$ 26.2		264.6	0.1	2.7	$ 65.7
	FAN37	9.31	172.3	71.7	244.0	194.5	81.0	275.5	0.09	0.23	$ 6.3	$ 58.4	51.6	7.1	58.7	2.087	$ 0.017	$ 21.6		334.2	0.1	2.3	$ 79.9
	AVERAGE		149.9	89.5	239.4	144.5	82.3	226.8			$ 6.1						$ 0.019						
	TOTAL	22.81						662.0	0.32	0.29		$ 138.1	165.5	25.4	190.9	5.992		$ 66.7	$ -	852.9	0.3	6.3	$ 204.8
FRS 2 & 3	SKYLINES	1.88	120.1	57.0	177.0	27.4	13.0	40.4	0.01	0.00	$ 3.8	$ 7.2	72.0	13.4	85.4	2.106	$ 0.022	$ 28.3		125.8	0.0	2.1	$ 35.5
	AVERAGE		120.1	57.0	177.0	27.4	13.0	40.4			$ 3.8						$ 0.022						
	TOTAL	1.88						40.4	0.01	0.00		$ 7.2	72.0	13.4	85.4	2.106		$ 28.3	$ -	125.8	0.0	2.1	$ 35.5
TOTAL - ALL SUBAREAS		68.69						1,875.7	1.12	0.34		$ 395.6	564.2	95.3	659.5	16.451		$ 213.0	$ 1.12	2,537.0	1.1	16.8	$ 609.8

7 MAINTENANCE PLAN

The primary maintenance concerns for the recommended alternative for the recommended alternative are the maintenance cycle, funding, and operation responsibilities. As discussed in the cost estimates, a maintenance period of 3 years and a design life of 50 years were assumed. Maintenance also includes regular, periodic and post-storm monitoring of all the flood control facilities. Monitoring includes periodic physical inspections as well as instrumentation of hydraulic performance (e.g. stream/rain gauges). If monitoring indicates the occurrence of a large storm or flood, the entire system should be inspected to verify the post-storm condition of the facilities. There is one item of special note with respect to sediment maintenance of the on-line detention basins. Given the long-term clear water discharge condition downstream of the basin, it is suggested that sediment removed from the basin be moved to the downstream channel to help offset the long-term sediment deficit in this reach. Finally, in order to ensure long-term safe performance of the proposed facilities, funding and execution of the monitoring and maintenance needs to be provided by a public entity. A more detailed discussion of maintenance can be found in Appendix B of this report in the Preliminary Maintenance Plan.

8 IMPLEMENTATION PLAN

The implementation plan for the recommended alternative involves funding, phasing, and responsibility. While the funds may come from a creative blend of public and private sources, the specifics of such funding plan are beyond the scope of the ADMP. Given the large dollar amounts associated with these projects, funding will likely come from multiple sources including possible impact fees, various improvement districts, and multiple public agencies.

It is suggested in general that the on-line apex detention basins be constructed first. This will provide for significant protection of the downstream area as the walled-levee corridors are constructed with future development of the area. The large on-line basins provide storage of about 80 percent of the 100-year event for most fan systems. Another component that should be considered for early construction is the McDowell Road alignment interceptor channel west of Sun Valley Parkway (part of Fan System 37).

Any projects constructed to control alluvial fan flooding most likely will require publicly-backed maintenance schemes. For a more detailed discussion of implementation see Appendix A of this report; Implementation and Stakeholder Involvement Summary. Therein lay more details regarding stakeholder involvement during the ADMP as well as information regarding possible temporal phasing needs and cost sharing opportunities.

9 SUMMARY

The recommended alternative for the Sun Valley area was developed and refined in Step 3 of the ADMP process. The alternative includes both non-structural and environmentally friendly and aesthetically compatible structural flood control measures. Engineering and aesthetic treatment costs were also estimated for all of the proposed structural components of the recommended alternative. The recommended alternative was arrived at by a collaborative effort of the project team, stakeholders, and the public.

The recommended alternative is comprised of about 69 miles of corridors. Of the 69 miles of corridor, about 4 miles are comprised of earthen excavated channels. The total right of way requirements for the whole ADMP area are about 2,540 acres including about 660 acres for twenty detention basins. Total costs for the structural elements of the recommended alternative are estimated at about $610 million. These costs include right of way, construction, landscaping, and maintenance for a 50-year period.

Figures 46 - 51 show the recommended alternative for each of the piedmont sub-areas. In addition, these figures also show the existing and proposed alluvial fan floodplains delineations. It can be seen from examination of these figures that a number of benefits would be derived as a result of the implementation of the ADMP recommended alternative. Specifically, the presence of the on-line detention basins eliminates the alluvial fan uncertainty from the flood hazards downstream of the detention basins. The elimination of alluvial fan uncertainty would allow future infrastructure in the area to be designed using conventional engineering analytic approaches and reduce the need for potentially redundant systems downstream. In particular, transportation crossings and underground utilities could be sized for just the downstream contributing drainage area without need to anticipate potential channel instability from the alluvial fan upstream.

Another benefit would be the reduction of the downstream floodplains. Although detailed redelineation of the post-ADMP floodplain is beyond the scope of the current contract, it is anticipated that much of the floodplain will be significantly reduced.

In addition to the elimination of alluvial fan uncertainty, the ADMP recommended alternative provides a trunk system to which the downstream development could deliver tributary drainage. A trunk system provides a regional flood control facility that provides controlled connectivity from the alluvial fan apices to their piedmont outfalls.

Finally, these maps also show how the recommended alternatives for each fan system work together to provide protection to the entire Sun Valley piedmont. Moreover, the design of each fan system is contingent on the other. That is, the design discharges for each fan system corridor assume the construction of adjacent systems. For example, Fan 38 would otherwise discharge at least partially into Fan 37 increasing the magnitude of potential peak flows to the Fan 37 corridor.

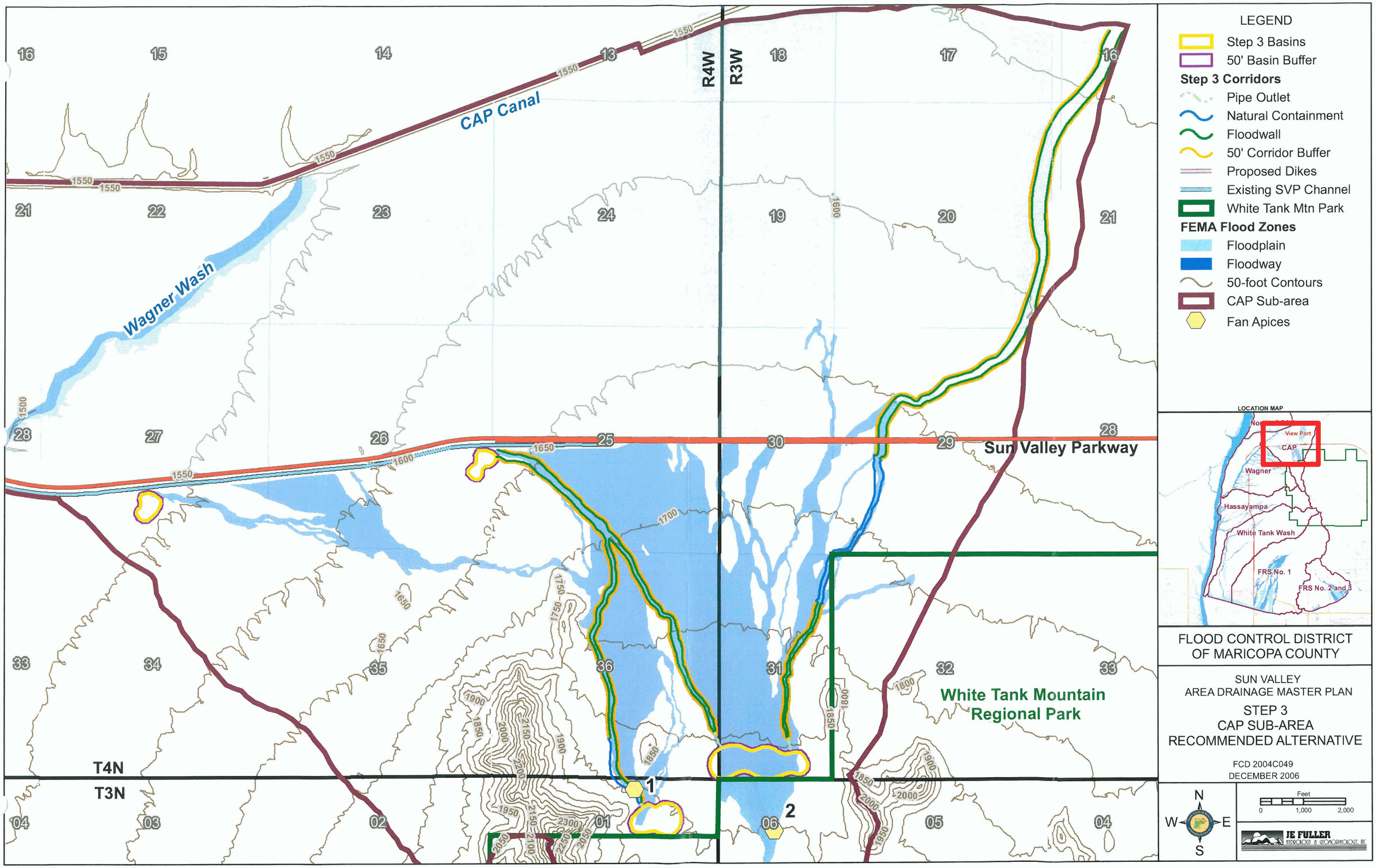

Figure 46 CAP Sub-Area - FEMA Floodplains, Recommended Alternative, And Benefited Area

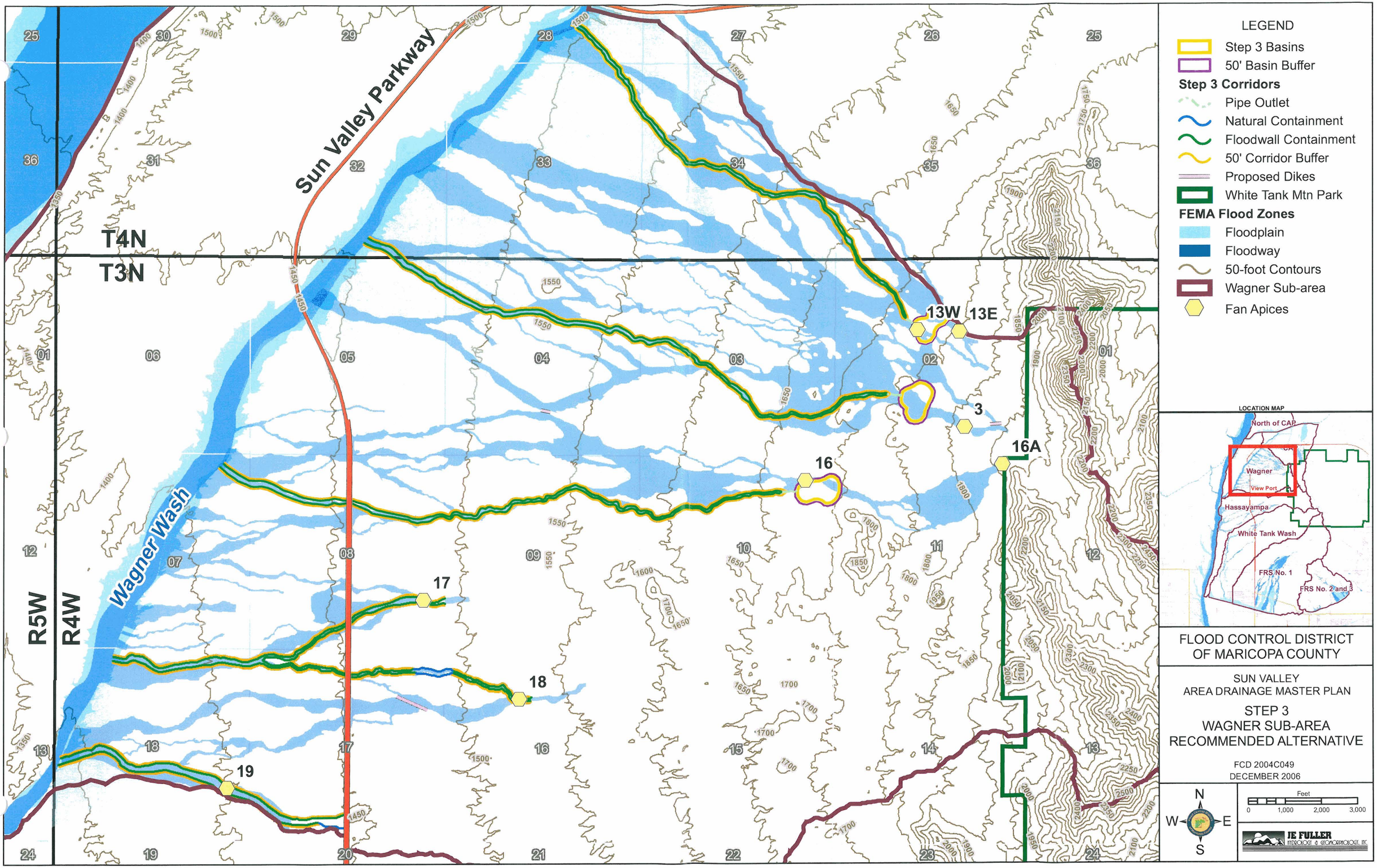

Figure 47 Wagner Sub-Area - FEMA Floodplains, Recommended Alternative, And Benefited Area

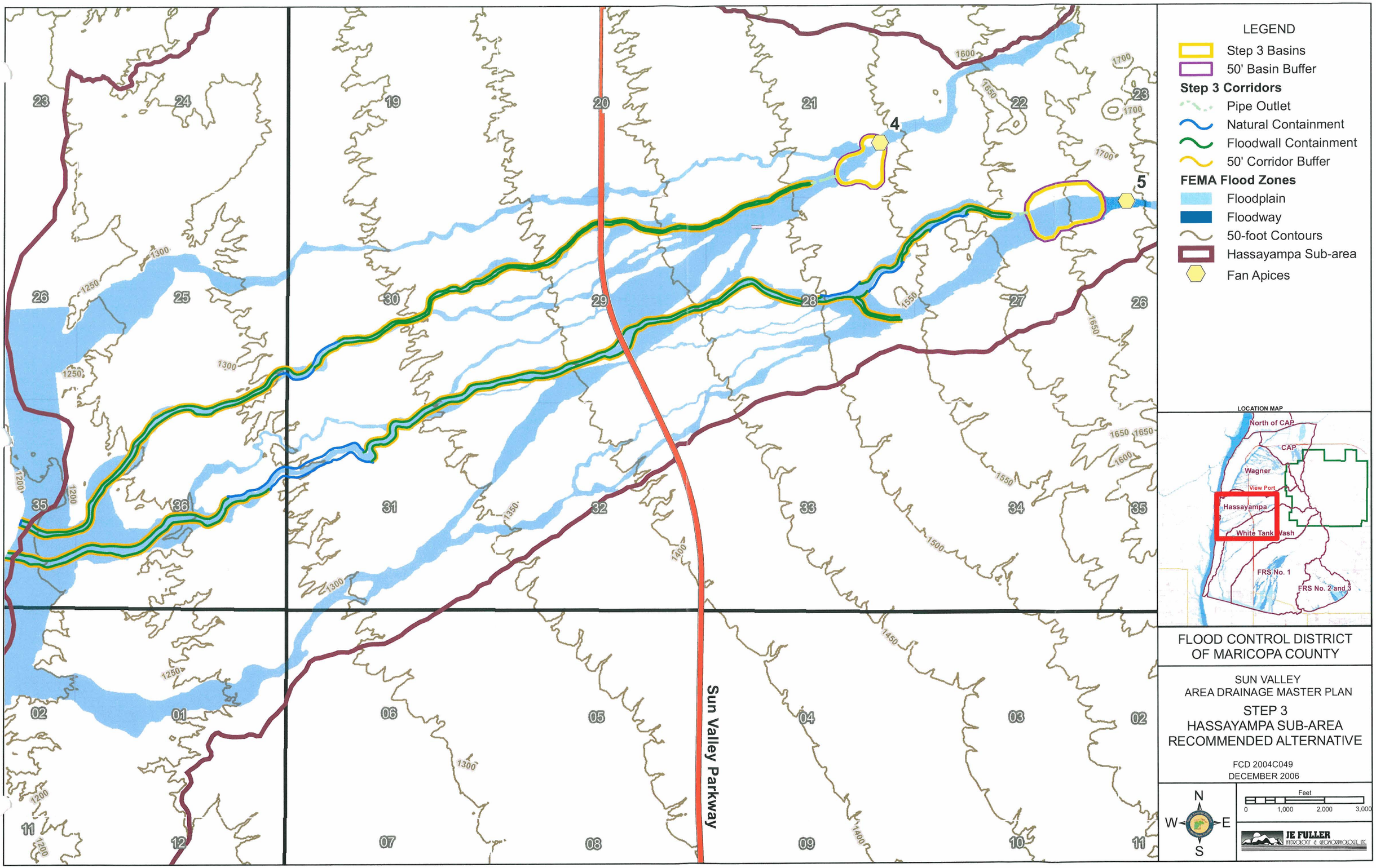

Figure 48 Hassayampa Sub-Area - FEMA Floodplains, Recommended Alternative, And Benefited Area

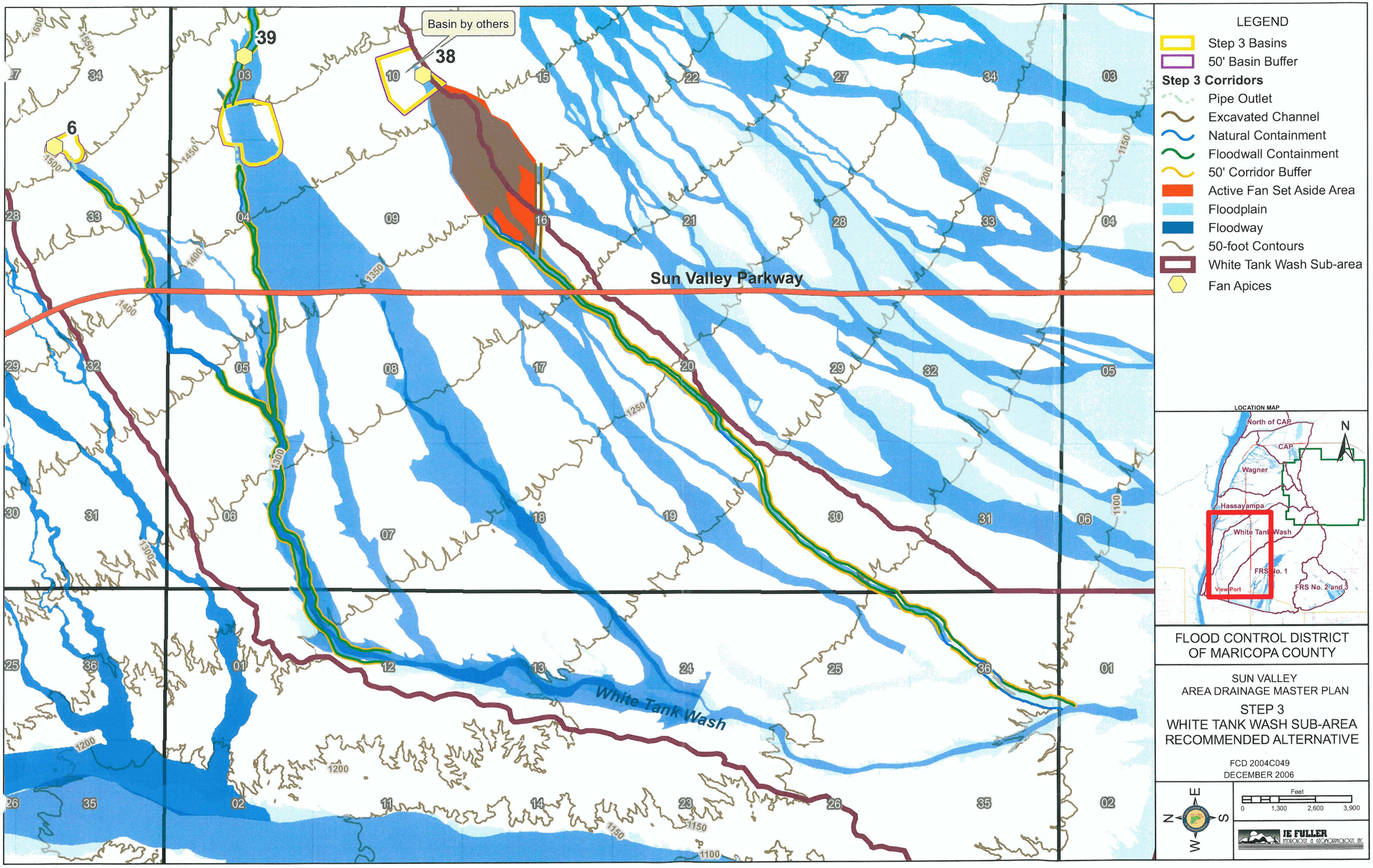

Figure 49 White Tank Wash Sub-Area - FEMA Floodplains, Recommended Alternative, And Benefited Area

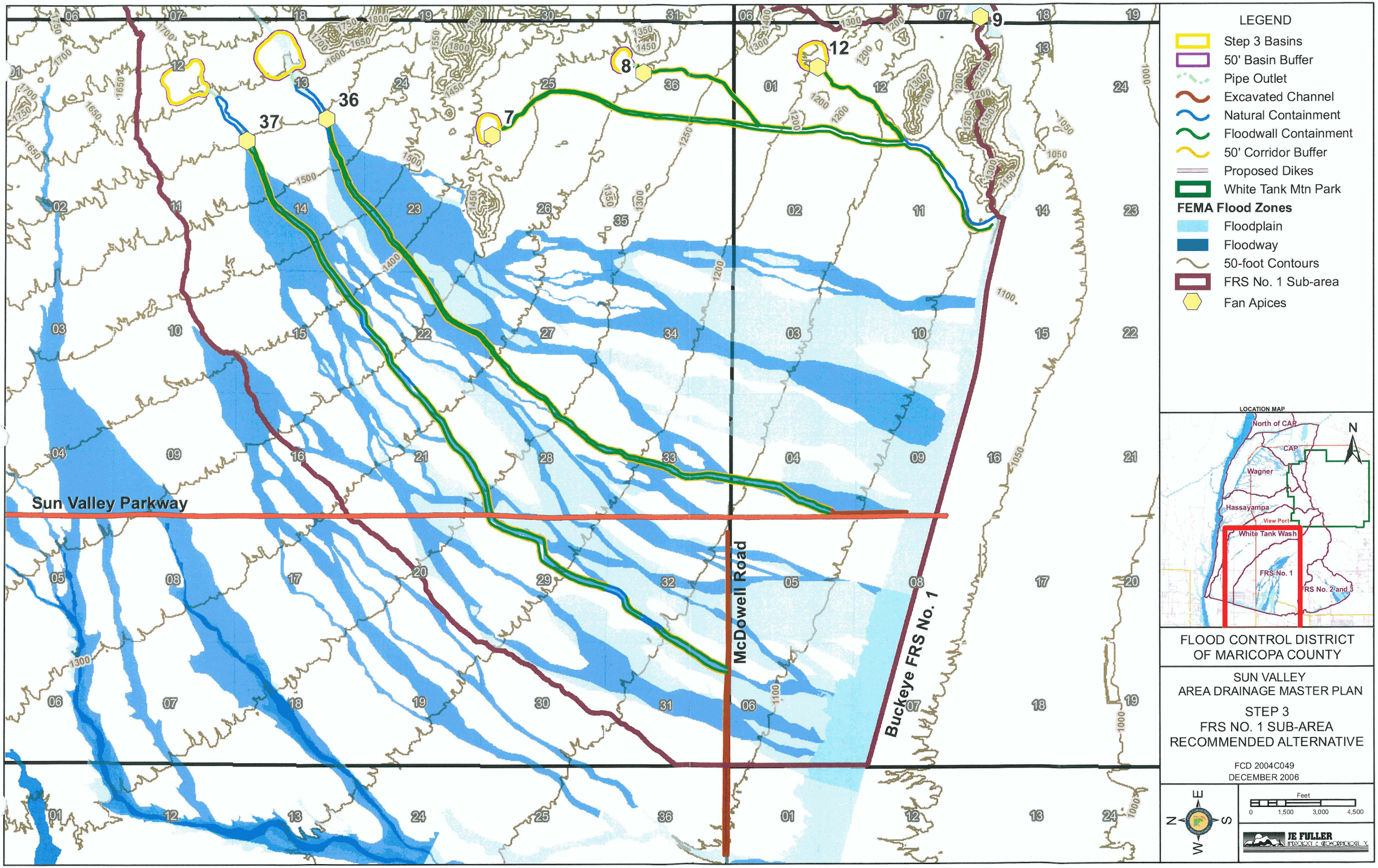

Figure 50 Buckeye FRS No. 1 Sub-Area - FEMA Floodplains, Recommended Alternative, And Benefited Area

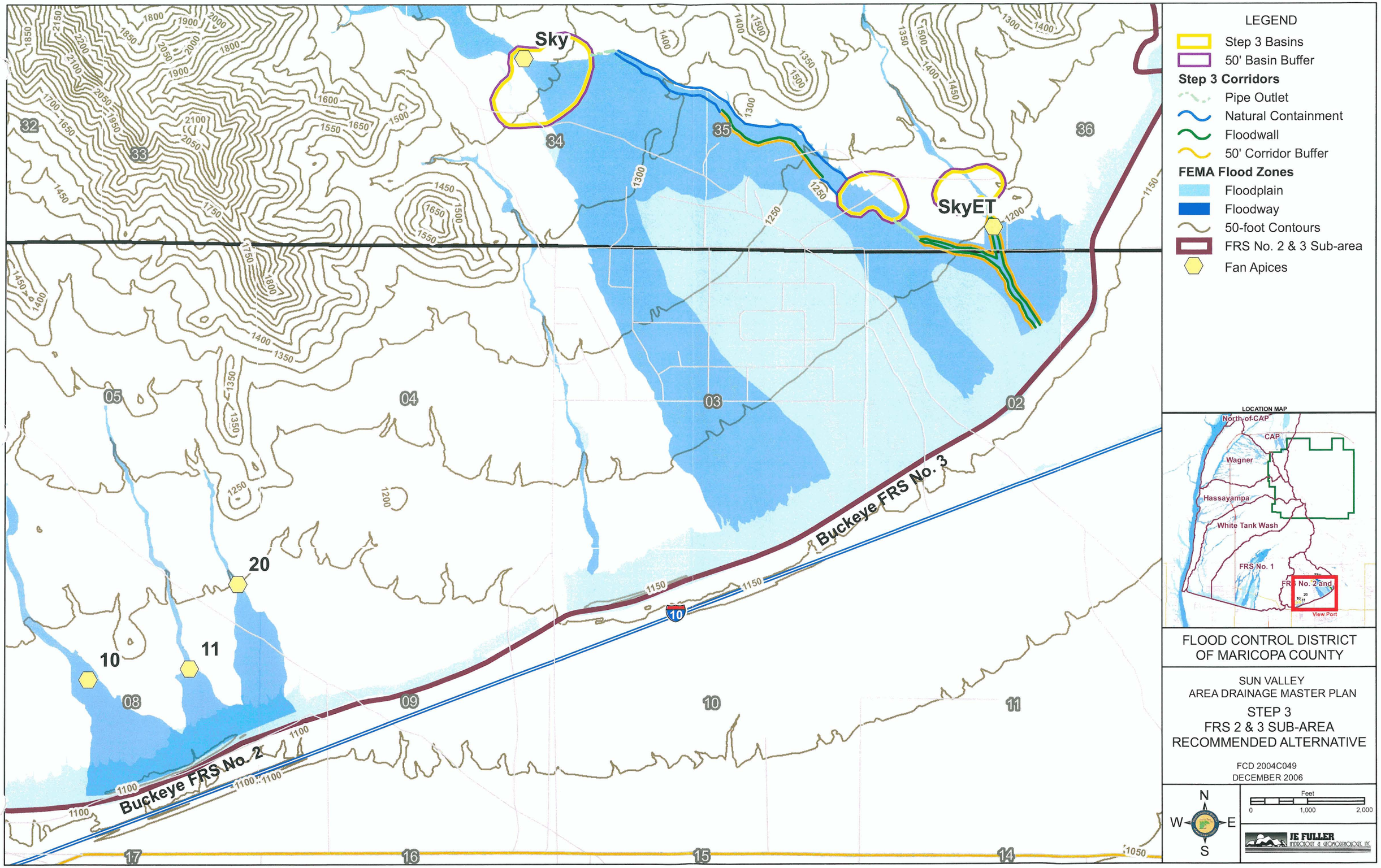

Figure 51 Buckeye FRS No. 2 & 3 Sub-Area - FEMA Floodplains, Recommended Alternative, And Benefited Area

10 RECOMMENDATIONS FOR FUTURE REFINEMENT OF THE CONCEPT DESIGNS

While working on the ADMP, the project team put together a list of things that need to be considered for future refinement of the concept design. The following is a bullet list of these recommendations:

- More detailed topographic information
- More cross sections that are site specific for hydraulically complex locations and that are spaced closer together
- Reevaluate existing channel capacity with new topography and cross section spacing
- Environmental permitting
- Cut/fill balance (including project phasing to make balance make sense)
- Use of roadway crossings and construction disturbance areas for grade control locations
- Site specific geotechnical analysis for construction.
- Incorporation of 50' buffer area into development plans
- Resolution of potential excavation issues such as depth to bedrock
- Consideration of access issues for basin and channel maintenance
- Construction phasing issues relative to urbanization schedule and flood control needs
- Refinement of structure design based on material available such as large rock for stepped boulder drops
- Right-of-way acquisition for facilities needs to occur immediately so that development does not interfere
- Site specific design of floodwalls should be pursued
- Operation and maintenance issues need to be addressed. A publicly-backed entity will be required to assume these responsibilities.

It should be emphasized that the critical elements of the Sun Valley ADMP are the preferred flood control methods, (i.e. on-line detention basins near the alluvial fan apices with downstream flood containment corridors), the alignments selected for the walled-levee flood containment corridors (selected with specific input and coordination with the area stakeholders) and the continued floodplain management of Wagner and White Tank Washes. Site specific details of the detention basins and the corridors can and should be reevaluated prior to going forward with preliminary and final design. Given more detailed answers to some of the above items, the specifics of the engineering design of individual fan systems or fan system components, and their costs, are likely to change. For example, walled-levees may give way to no floodwalls given more specific topographic depiction of existing channel capacity. The specific sizing of individual detention basins could be optimized to reflect the more accurate depiction of the existing downstream capacity. The concept plans presented in this ADMP report should be considered just that – concepts.

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Appendix A

Implementation Plan and Stakeholder Involvement Summary, prepared by C.L. Williams Consulting Engineers, December 2006

Sun Valley Area Drainage Master Plan

Implementation Plan and Stakeholder Involvement Summary

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Stakeholder Database.....

To: Valerie Swick 12/28/06

From: Chuck Williams
Jon Fuller

Re: Sun Valley Area Drainage Master Plan (ADMP) Implementation Strategy Memo

STAKEHOLDER INVOLVEMENT PROGRAM APPROACH

The Stakeholder Involvement program for this project was designed and completed with the goal of maximizing implementation opportunities for the Recommended Alternative of the ADMP. To achieve this end, the "3 I's" method which has been used successfully in other similar projects was utilized. Simply put, the 3 I's method of Stakeholder Involvement is to utilize a 3-Phase approach as identified in the accompanying Stakeholder Flowchart & Implementation Plan:

1) **Phase 1:**

   Inform the stakeholders of the project at the early stages to obtain any useful knowledge they may have from a data collection standpoint as well as to receive any initial input they may have regarding scope of work or process. This was accomplished through facilitated workgroups of stakeholders with similar mandates, jurisdictions, and interests (i.e. public sector agencies, private sector land developers, etc.). Several individual meetings were also held with various stakeholders. Stakeholders and their jurisdictional or property ownership in the project area were identified and compiled into a spreadsheet which was used as the baseline database for the rest of the stakeholder involvement program. The Stakeholder database is included as an attachment to the Implementation Plan component of the ADMP Report, and is included herein for completeness.

2) **Phase 2:**

Involve the stakeholders through out the course of the ADMP so that they stay informed and interested in the project. This also allowed for them to see the reasons why, or why not, their input would be included in the development of alternatives. This was accomplished through the use of workgroups as well as individual meetings. An added benefit of maintaining contact through the course of the project is that new staff members from the agencies were educated prior to being shown the end product.

3) **Phase 3:**

Include the stakeholders in the process of selection of the Recommended Alternative. This effort included information exchange and discussion of:

a) costs of capital improvements
b) costs of maintenance
c) conceptual funding/cost sharing for capital improvements
d) conceptual requirements of maintenance responsibilities
e) generalized construction timelines coordinated with other agencies' projects and budgets.

This was accomplished using a combination of workgroup and individual meetings because of the iterative nature of these discussions/negotiations. Stakeholders' input was documented in the conceptual design plans and cost estimates contained in the ADMP Report.

IMPLEMENTATION SUMMARY

The results of the Stakeholder Involvement and Implementation Strategy are summarized in the accompanying Implementation Summary. The Summary details the Recommended Alternative by location, capital improvement costs, potential cost sharing partner, participation interest, mechanism for participation and preliminary timeline. The Implementation Summary was developed iteratively and in a consensus manner with the

affected stakeholders. It does not represent a binding legal agreement on any partners, but does provide a summary of implementation strategies to date and a roadmap for the Flood Control District of Maricopa County implementation efforts once the ADMP is adopted by the Board of Directors.

Many of the Recommended Alternatives are connected with private land development activities and there are also linkages to public agency programs. The result is that often their schedule or funding will drive the construction timeline. Recognition of this fact by the District and planning for this in future follow through efforts will allow for timely, cost effective and efficient construction completion. If the coordination is not continued after ADMP completion, it is possible that other private developers and public agencies will move ahead with their projects and not include Recommended Alternatives drainage improvements.

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:

1) Solely funded by the District.
2) Funded solely or in partnership among private and/or public agencies including the District.
3) Funded solely or in partnership among private and/or public agencies **not** 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 Alternative. Included within the ADMP Report is documentation of the public and stakeholder activities and responses. The stakeholder effort was designed and carried out so as to maximize

development of a Recommended Alternative that could be implemented as efficiently and cost-effectively as possible. The purpose of this memo is to summarize the key opportunities and constraints for implementation of the Recommended Alternatives.

RECOMMENDED ALTERNATIVE OPPORTUNITIES AND CONSTRAINTS

The Recommended Alternatives is organized into the 7 Subareas of the project with specific alluvial fan solutions in 6 of the 7 subareas. The details of their components and costs are described and summarized in the main body of the Volume 1 report. Additional details are provided in the Volumes 2 – 7.

More details are found in the accompanying Implementation Funding Matrix and Implementation Funding Strategy memo.

IMPLEMENTATION AND FUNDING STRATEGY MEMO FOR THE SUN VALLEY AREA DRAINAGE MASTER PLAN

PROJECT ACTIVITIES FOR THE AREA DRAINAGE MASTER PLAN RECOMMENDED ALTERNATIVE

As described in the Sun Valley Area Drainage Master Plan (ADMP) summary report, flood control alternatives were evaluated including structural non-structural and no action. Multiple criteria were used to evaluate each alternative as outlined in the ADMP Summary Report. The recommended alternative for the 7 sub-areas of the ADMP is a combination of the structural and non-structural alternatives.

The ADMP presents a comprehensive approach that includes engineering, environmental, landscape, social and economic considerations. Proposed improvements will result in flood protection for greater public safety along the west side of the White Tank Mountains, increased recreation opportunity and improvements in environmental resources. While these differing elements are seemingly distinct in purpose, they are proposed to be implemented in a coordinated fashion to best achieve specified overall goals.

PROPOSED IMPLEMENTATION AND FUNDING STRATEGIES

The proposed 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 are proposed in the recommended alternative. Public safety improvements in the form of levees, grade control, detention basins, 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 realignment projects are proposed. Habitat preservation will focus on maintaining wildlife corridors along drainage corridors.

Although no specific schedules are proposed 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
- Program and policies
- Regulatory compliance
- Funding opportunities

Each of these four elements will be treated in detail, but the following describes aspects of each.

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. The implementation strategy for outreach emphasizes education, input, participation, and funding support for the various proposed programs in the ADMP.

Programs and policies in the implementation strategy include adoption of the Plan by local governments as guidance for future public and private development activity. Public activities proposed include locating facilities such as drainage/recreational corridors, multi-purpose detention basins, and transportation improvements in conformity with the Plan. Site development considerations such as location of commercial and residential facilities related to private development are recommended in accordance with Plan requirements.

Compliance with various laws and ordinances are specified as part of a successful implementation strategy for the Plan. 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). Strategies to respond to state regulations such as the Arizona Pollutant Discharge Elimination System program (AZPDES) and local floodplain and zoning ordinances are also proposed. Proposed public and private activities must comply with these regulations, and while they impose constraints on certain activities, they also present opportunities for implementation.

Funding for all activities proposed in the Area Drainage Master Plan is a critical aspect of the implementation strategy and will occur over the next few decades. They will require differing programs and selective funding from multiple sources. Implementation strategies and procedures are proposed to improve funding and completion of projects in a timely manner .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 Town of Buckeye funds to construct the Fan 37 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.

The following sections provide greater detail on these implementation and funding strategies to support the recommended alternative. The proposals acknowledge the needs and wishes of land owners, regulatory agencies, political jurisdictions and the public.

IMPLEMENTATION STRATEGY FOR COMMUNITY OUTREACH

Community outreach is a critical part of any major development project. It is especially important in the Sun Valley ADMP because of the broad base of resources, communities, agencies, interest groups and other parties affected by the program.

The developed outreach effort has been structured from the start to support the overall planning, implementation and funding strategies for the program. That is, a continued focus has been maintained and should continue in outreach efforts to engage and inform the public and gain support for specific actions over the full term of the program.

Three general periods of outreach strategies are envisioned for the Sun Valley ADMP as follows.

Year 1-2	General community involvement and education during the ADMP development to form the foundation for funding/cost sharing support through the stakeholder involvement program of the ADMP.
Year 3-4	Continued outreach to secure funding/cost sharing for the Recommended Alternative and sustaining implementation and funding groups including both public and private sector partners.
Year 6-10	Long term outreach to sustain development and education programs including both capital improvements as well as maintenance oversight.

Outreach for General Public Involvement and Education; Years 1 and 2

Gaining continued community involvement and support for the ADMP was initiated at the start of the planning process and is detailed in the Public Involvement Plan prepared by the District. Community involvement has included aspects of the general planning process and specific project needs and concerns.

The general public involvement process has focused on the local communities, but has also involved a broader cross section of interested parties, including agency specialists, elected officials, and special interest groups. The objective of the process has been one of continued education focused on updates in the planning process at prescribed time intervals, or at project benchmarks. Meetings have been held in Phoenix and Buckeye to update the general public and specific stakeholder groups on progress.

Special interest meetings have been held to discuss specific aspects of proposed activities such as alternatives, implementation, maintenance and funding. These have been noticed as special meetings of the ADMP.

General public involvement for year one and two has satisfied the strategy to inform the local community as to the purpose and proposed outcomes for the ADMP. Three meetings have been held and education materials have been developed and distributed. Also, this first phase of the outreach program has developed an effective segue to the second phase of the outreach strategy.

An Outreach Strategy to Engage the Public and Specific Supporters in Funding and Implementation Groups: Years 3-4

Major flood control watershed development projects often move through the planning phase with significant outreach in public involvement, only to disengage from the public when planning is accomplished. In recent years, federal and state agencies leading special projects have taken direction from County Supervisors, and engaged the public continuously through planning, development and implementation of projects. This is critical for special projects such as the Sun Valley ADMP, because both support for funding and gaining acceptance for actual project development is increased by maintaining public interest and involvement through outreach programs. One of the possible implementation mechanisms for the Sun Valley ADMP is establishment of a Special District. A useful function of such a district would be to maintain robust community outreach over the decades needed to fully implement the ADMP.

The implementation strategy for the second phase of outreach was to maintain general public interest and gain monetary and collaborative support from specific sectors of the public and development community stakeholders. These efforts can also be helpful in creating longer term development groups for implementation of the total ADMP.

Outreach for Implementation of Long Term ADMP Activities: Years 4-10

The broad based flood control, recreational, social, environmental, and community associated activities proposed in the recommended alternative of the ADMP are expected to require decades for implementation. An outreach program should fully engage local entities, and also maintain involvement of regional and state entities.

This project must create enhancements to the ADMP segment and benefit the total system. Many parties that have critical involvement with the larger watershed based flood control system are being engaged, informed and, as needed, counseled. Accomplishing this step successfully over the longer term is critical.

Effective implementation of this type of project over a 2-10 year time period requires support from partners who are not funding entities, as well as those who are approached for funding. Important in these are state, county and town leaders, federal and state resource

management agencies, regulatory agencies (EPA, USFWS, ADEQ,USCOE), and members of the local and regional environmental and business communities. Many of these parties have been engaged early on in the planning and will be critical to successful long term implementation of the ADMP.

An outreach program for this size of project must involve federal/state/local/private partnerships, both because of broad objectives sought, and also because of the diverse entities and their existing authorities and responsibilities within the watershed. An outreach approach for implementing and maintaining the project should embrace these diverse groups.

The Flood Control District of Maricopa County (FCDMC), already in a leadership position, could be the lead agency due to its flood control responsibilities and authorities, and expanded environmental authorities. Alternatively the Town of Buckeye could be the lead agency due to its political jurisdiction over much of the watershed as well as its potential role as a major funding agency via development impact fees. It will be critical that whoever is the lead agency that they continue to engage private and public sector agencies including the development community, local citizen groups, MCDOT, Maricopa County Parks Dept. and the Arizona State Land Dept.

A regional funding subgroup should be formed to guide implementation of the overall funding plan. It would support and help coordinate the diverse funding sources that will be needed as well as help guide the phasing and timing of improvements since such a large project will be built over time and not all improvements need to be in place immediately.

A public project funding consultant specialist could be hired by the District or Town to assist in design and implementing a specific funding plan. This specialist would not be a full time employee necessarily but would assist the lead agency staff as needed in order to meet the demands of implementing and funding such a large project.

POLICIES AND PROGRAMS TO ENHANCE THE IMPLEMENTATION STRATEGY

The implementation strategy is enhanced greatly by local communities and regional groups collaborating on activities, policies, programs, etc. that streamline adoption of various program elements.

Establishment of policies, agreements, zoning regulations, etc. by local and regional government leadership can greatly improve ADMP implementation, especially in the near term. These can relate to zoning, permitting, joint approval of activities crossing multiple jurisdictions, joint approval of collaborative agreements on funding, support of pilot projects etc.

Increased flexibility in local and regional government policies greatly improves implementation. For example, overlapping federal and state government requirements exist regarding assessment procedures on any development project for every activity performed, from disposal of waste to surveys for Threatened & Endangered Species. And, as time passes local governments are entering the process with potential additional requirements. To satisfy these requirements collaborative actions on legal requirements, policies, agreements will greatly enhance implementation.

Collaborative activities and partnerships on policies, programs and other necessary agreements are proposed as part of the implementation strategy in several areas. Most critical are areas of law, policy, programs and funding.

Much of the legal requirements will pertain to permitting proposed activities, especially as relates to actual site disturbance activities. Permitting needs, the primary concern here, are presented in a following section.

Policy issues relate strongly to specification on how various project activities will be implemented. Policies often vary from agency to agency, especially from federal to state and local agencies. Often projects managers, such as ADMP managers, find themselves ensnarled in multi-agency policies that appear at cross purpose. Examples are policies relating to survey requirements prior to development regarding biological resource issues or cultural resource issues. The proposed implementation strategy for addressing multi-agency policy issues is to resolve them in the ongoing stakeholder workgroups. A purpose of the

workgroups will be to assist with guidance documents, to afford greater coordination among agencies and also provide mediation in areas where needed.

AN IMPLEMENTATION STRATEGY FOR ADDRESSING LEGAL REQUIREMENTS

Compliance with federal, state and local laws and ordinances is critical to effective implementation of the ADMP recommended alternative. Capabilities for compliance fully exist with the extensive federal, state and local partners involved in planning the ADMP. However, explicit interest exists in having compliance and project activities move forward in both an efficient and effective manner. This will become a challenge due to the extent of law and regulation that will impact the project. This includes federal laws such as the Endangered Species Act (ESA), the Clean Water Act (Section 404 permitting) and the National Environmental Policy Act (NEPA). Actions to respond to state regulations such as the Arizona Pollutant Discharge Elimination System program (AZPDES) and local flood plain and zoning ordinances will also be critical in the implementation strategy.

Proposed public and private development activities in the ADMP must comply with these regulations, and while they impose constraints on certain activities, they also present opportunities for implementation. Examples of these opportunities in accordance with the adopted Plan could include establishment of wildlife corridors as part of required mitigation for Section 404 permitting of flood control or other construction activities. These areas would enhance wildlife habitat values and provide passive recreational opportunities to the public. Examples of these opportunities at the local government level may include satisfying requirements for erosion hazard setbacks through open space and recreational amenities for future private developments at locations identified in the Plan.

Completion of the Plan permits identification of many areas of compliance that will be necessary. However, some areas will not be obvious until actual project designs for specific areas are formulated.

Several types of proposed activities will require permitting such as:

- Levee development
- Grade Control Structures

- Apex Detention Basins
- Culvert Upgrades

These improvements will create the greatest requirements for permitting and conformance to legal constraints. However, as noted above, effective planning and collaboration by involved agencies and local groups can create mitigation strategies that can support overall project implementation.

One of the greatest difficulties in obtaining and maintaining compliance to laws, statutes, ordinances, regulations, etc., for the above improvements relates to understanding and adhering to procedure.

All federal, state and local agencies have developed guidelines and procedures for appropriate compliance to federal, state and local law, ordinances and regulations. These procedures are fully appropriate for implementation of all aspects of the ADMP.

A proposed strategy to improve project implementation related to compliance is to utilize the ADMP Stakeholder Workgroup for development of more streamlined multi-agency procedures to assure improved compliance. The Stakeholder Workgroup could provide two levels of support as follows.

1. Develop general procedures for overall coordination and completion of compliance procedures requiring multi-agency approvals.
2. Providing team assistance on specific problem areas or projects, including potential mitigation of conflict.

A FUNDING STRATEGY FOR THE RECOMMENDED ALTERNATIVE AND PILOT PROJECTS OF THEADMP

The proposed recommended alternative presents multiple activities for responding to the vision articulated for the ADMP. Significant funding capability will be necessary over a 2-10 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
- 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. The ADMP on the western slope of the White Tank Mountains is but part of the Lower Hassayampa River System and funding the recommended alternative should not only create enhancements to the ADMP but must not degrade the overall River system. Many of the same parties that have involvement with the larger system are being engaged, informed and approached for funding support of the ADMP as mentioned in the Outreach Strategy section of this report.

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. Important in these are local county and city leaders; regulatory agencies; members of the environmental community and members of business and neighborhood communities. 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.

1. Define activities included in the recommended alternative requiring funding support. Specify funding requirements across a 2-10 year timeline as identified in the Implementation Funding Matrix.

2. Identify potential funding entities/sources that traditionally fund projects or project components in the recommended alternative. These are identified as potential support in the Implementation Funding Matrix.

Developing a Formal Implementation Team and Funding Group

Planning for funding the ADMP has been part of the ongoing project. As noted earlier in the outreach, policy, and compliance sections the plan for implementation and funding development should incorporate a group with an explicitly defined role.

- ADMP Stakeholder Workgroup: Further develop implementation and funding plan, policy direction, general guidance and support for funding, compliance and program coordination

As noted earlier, the ADMP Stakeholder Workgroup is necessary to effectively coordinate all activities to fully implement the ADMP over the next 2-10 years. One of its key roles is to oversee the development of funding and potentially hire a fund development specialist to design and coordinate specific implementation funding activities over time.

The ADMP Stakeholder Workgroup would work closely with the funding specialist to implement the funding strategy through designed funding plans for projects or groups of projects. This most likely would be on the Alluvial Fan or Subarea Watershed level though it might be on a development or project level if that made the most sense.

Guidelines for an Implementation and Funding Schedule

The ADMP Stakeholder Workgroup would be responsible for updating and coordinating a specific implementation and funding plan and establishing, implementing and revising the schedule for completing all project activities of the ADMP. This would require significant effort over the life of the program.

As noted earlier, planning, implementation and funding was initiated in year one by the Flood Control District of Maricopa County (FCDMC) in developing the ADMP. In the second year the ADMP was finished. In the third year the Town of Buckeye is considering adoption of Development Impact Fees with a drainage system component which could be

available funding in years four and five. And, the entire ADMP is to be implemented and funded in years four to ten dependent on private sector development rates and contributions.

The specific schedules for most of the ADMP individual activity implementation is to be developed by the Stakeholder Workgroup as led by either the District or Town. The Workgroup will need to structure guidelines for its implementation schedule. This schedule will directly impact and be impacted by the funding schedule. The committee should consider several factors in structuring the implementation schedule as follows.

- Issues of personal safety. Projects directed at flood mitigation or control should receive primary consideration in the program schedule.
- Interdependent projects. Where completion of one project is dependant upon prior completion of another project, the initial project should be scheduled early enough to insure overall program completion in the necessary time frame.
- Issues of project or program size. The large complex projects comprised of multiple ownerships should be scheduled early in the program to assure time for planning and completion.
- Issues of permitting. All the projects will require multiple permitting so should be planned early in the program.

Identifying Constraints to the Funding Plan

Current local ordinances, and plans; state and federal law, and regulation; agency policy; future land use planning, etc. all present potential constraints on implementation of project components, and their viability for funding. Consideration of all of these potential obstacles/constraints as the Implementation and Funding Plan is further developed is critical. The following strategies are proposed to assure consideration of all potential constraints in drafting the proposed Plan by the Stakeholder Workgroup.

- Update project constraints periodically by engineers on proposed project components in the recommended alternative, including existing laws and ordinances, agency policy, design and operation guidelines, etc. This assessment includes potential constraints identified in the ongoing public involvement process.

- Maintain an updated matrix of potential costs for activities in the recommended alternative. This includes engineering estimates of development cost constraints that can change over time.

Merging Public and Private Interests

Although some constraints exist, the ADMP has significant funding options. The most positive aspects of the program for funding is that it has merged public and private interests in its alternatives, responded to safety and protection issues using the approaches that enhance many public and private values and engaged all of these interests for continuous input during project development. These efforts promote partnerships that actually open up funding options.

IDENTIFYING FUNDING OPPORTUNITIES

Funding opportunities for the ADMP exist at the Town, 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 ten year development period. The areas and expected annual costs are as follows:

- Coordination and management of ADMP implementation
- Outreach
- Support for a funding program, i.e., economic development specialist, funding group
- Funding to support ADMP project activities
- Funds to support project maintenance

Managing ADMP Implementation

No costs are proposed to support Stakeholder Workgroup members, but $5,000 to $10,000 annually is needed to support quarterly meetings.

Future Outreach Programs

Outreach programs need not be extensive, but annual funds of approximately $15,000 are necessary to support at least two activities

- Brochures to update communities annually on program progress ($5,000)
- One meeting annually to address public concerns and update the public on progress, changes, etc. ($10,000)

Financial Support for Developing Necessary Program Funds

One-third of a person/year annually is required in the form of an economic development officer to coordinate necessary funds for the ADMP and manage the ADMP Stakeholder Workgroup ($30,000). The cost is expected for years 3-10.

Annual Costs to Support Project Activities

The overall costs for 2-10 years to implement the ADMP recommended alternative is estimated at $535 million, or approximately $67 million per year. Most of these costs (75%) will occur in the final five years of the program.

Annual Maintenance costs

Maintenance costs in have been estimated at this time at $95 million or$8-11 million/year. These costs will be refined in later stages of program implementation. As possible these costs and entities who support them should be specified in project funding plans.

POTENTIAL FUNDING ENTITIES OF THE PUBLIC AND PRIVATE SECTOR

Due to the size of the project 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 mult-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 will 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.

- Town of Buckeye Development Impact Fees. The Town is currently contracting with a professional services firm to redo its development impact fees. The consultant is expected to evaluate a drainage system component in 2007. The results of the ADMP will be made available to the consultant as a guideline for anticipated implementation costs. At a stakeholder workgroup meeting in November 2006 attended by members of the development community and limited Town staff consensus was reached that a uniform application of a drainage system component of the new impact fees would be the most equitable and efficient way to implement funding of the ADMP. 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 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 or 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 an Infrastructure Assessment Study of many of the lands in the ADMP that have, for the most part, included the ADMP recommended alternative. There exists a possibility that if improvements, such as Fan Apex Basins, are needed prior to disposition of ASLD lands that will benefit off ASLD as well as ASLD lands that 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 are several component pieces of the ADMP that the District has the ability to fund as part of its Capital Improvement Program (CIP) such as the McDowell Road alignment interceptor Drainage Corridor that would provide protection for existing downstream residents. Another project is the likely improvements to FRS #1. 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 are many large private sector Master Planned Communities that are being 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 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 came online.

- A Special District is also a possibility due to the physical size of the area and the significant costs involved. The Special District would provide overall guidance, support and coordination to the various projects in the ADMP proposed for implementation as well providing capital and/or maintenance funding. A detailed analysis of existing special district statutes was not undertaken but it is possible that a Community Facilities district or something similar to it could be utilized as a Special District for the ADMP.

SUMMARY

The capital and maintenance costs identified to implement the comprehensive flood control system identified in the Sun Valley ADMP are significant. The costs are considerable due to the sheer size of the area being planned (approximately 183 square miles) and the type and size of facilities needed to address the 27 alluvial fans within the project area. The preferred most dependable method of addressing alluvial fans from a hydraulic engineering flood control perspective is by constructing large detention basins at the apex of the fans. The preferred method to convey flow from the basins is through drainage corridors that minimize excavation and use walled levees to contain flows. Both the basins and leveed drainage corridors require a significant amount of land. It is estimated that 40% of the $631 million dollar cost for construction and maintenance of the recommended alternative is for land acquisition. The recommendation to utilize private sector cash contributions, Town of Buckeye impact fees and Flood Control District of Maricopa County CIP when applicable is the most likely funding scenario. However, the continued use of a stakeholder workgroup to coordinate and expedite project priorities and to further explore a Special District is recommended to assist the lead agency whether it is the Town or the Flood Control District.

The issue of maintenance is addressed in the ADMP Maintenance Plan however funding is under discussion still and will be addressed as part of the ongoing negotiations between the District and Stakeholders.

SVADMP Implementation and Funding Matrix

Subarea	Fan System	Total Cost in millions $	Cost Percentages: Land Cost %	Construction Cost	Landscape Cost	50-Yr Maintenance	Timing	Potential Funding Partners	Potential Funding Mechanisms
CAP	FANS1,2	$ 59.132	45%	35%	5%	15%	1-3 yrs	Sun City Festival	Easement Dedication/Dollars
							> 5yrs	Az State Land Dept.	Easement Dedication
							> 5yrs	MCDOT	Easement Dedication/Dollars
							1-10 yrs	Town of Buckeye	Impact Fee Dollars
							> 5yrs	FCDMC	Planning & Design
Wagner	FANS3,13,16, 19,17,18	$ 96.926	38%	39%	5%	18%	2-4 yrs	Vistoso for Sun Valley	Easement Dedication/Dollars
							2-4 yrs	Trillium West	Easement Dedication/Dollars
							> 5yrs	Az State Land Dept.	Easement Dedication
							2-4 yrs	MCDOT	Easement Dedication/Dollars
							1-10 yrs	Town of Buckeye	Impact Fee Dollars
								FCDMC	Planning & Design
Hassayampa	FANS4,5	$ 83.848	40%	40%	5%	16%	> 5yrs	Vistoso for Sun Valley	Easement Dedication/Dollars
							> 5yrs	Az State Land Dept.	Easement Dedication
							> 5yrs	MCDOT	Easement Dedication/Dollars
							1-10 yrs	Town of Buckeye	Impact Fee Dollars
							> 5yrs	FCDMC	Planning & Design
White Tank Wash	FANS6,38,39	$ 129.527	46%	35%	5%	14%	1-5yrs	Anthem at Sun Valley South	Easement Dedication/Dollars
							1-5yrs	Tartesso West	Easement Dedication/Dollars
							> 5yrs	Montiere	Easement Dedication/Dollars
							3-5 yrs	Mirrielle	Easement Dedication/Dollars
							1-5yrs	Az State Land Dept.	Easement Dedication
							1-5yrs	MCDOT	Easement Dedication/Dollars
							1-10 yrs	Town of Buckeye	Impact Fee Dollars
							2-5yrs	FCDMC	Planning & Design & CIP
FRS 1	FANS7,8,12,36,37	$ 204.787	42%	39%	4%	15%	> 5yrs	Tartesso East	Easement Dedication/Dollars
							1-5yrs	Elianto	Easement Dedication/Dollars
							1-5yrs	Tartesso	Easement Dedication/Dollars
							1-5yrs	Tartesso West	Easement Dedication/Dollars
							1-5yrs	Az State Land Dept.	Easement Dedication
							1-5yrs	MCDOT	Easement Dedication/Dollars
							1-10 yrs	Town of Buckeye	Impact Fee Dollars
								FCDMC	Planning & Design & CIP
FRS 2 & 3	SKYLINES	$ 35.534	35%	44%	6%	15%	1-5yrs	Fisher Properties	Easement Dedication/Dollars
							1-5yrs	Az State Land Dept.	Easement Dedication
							1-5yrs	Town of Buckeye	Impact Fee Dollars
							1-5yrs	FCDMC	Planning & Design & CIP
TOTAL - ALL SUBAREAS		**$ 609.8**	**42%**	**38%**	**5%**	**16%**			

Sir Title	First Name	Last Name	Company/Agency	Title	Business Address	City	State	Postal Code	Business Fax	Business Phone	E-mail Address
Mr.	Max	Wilson	Maricopa County Board of Supervisors, District 5	Supervisor	301 West Jefferson Street, 10th Floor	Phoenix	AZ	85003	602-506-6362	602-506-7562	mwilson@mail.maricopa.gov
Mr.	Scott	Isham	Maricopa County Board of Supervisors, District 5	Assistant to Supervisor Max Wilson	301 West Jefferson Street, 10th Floor	Phoenix	AZ	85003	602-506-6362	602-506-7562	sisham@mail.maricopa.gov
Mr.	Michael	Sabatini	Maricopa County Department of Transportation	Planning Division Manager	2901 West Durango Street	Phoenix	AZ	85009-6357	602-506-4882	602-506-8628	MikeSabatini@mail.maricopa.gov
Ms.	Renee	Probst	Maricopa County Dept. of Transportation	Senior Planner	2901 W. Durango St.	Phoenix	AZ	85009	602-506-8622	602-506-8622	reneeprobst@mail.maricopa.gov
Mr.	Tom	Sonnemann	Maricopa County Dept. of Transportation	Bridge Engineer	2901 W. Durango St.	Phoenix	AZ	85009	602-506-5969	602-506-4880	tomsonnemann@mail.maricopa.gov
Mr.	Matthew	Holm	Maricopa County Planning & Development Department	Principal Planner	411 North Central, 3rd Floor	Phoenix	AZ	85004-2191	602-506-8369	602-506-7162	matthewholm@mail.maricopa.gov
Mr.	Jimmie	Munoz	Maricopa County Planning & Zoning Commission Dist. 5	Commissioner	66455 S Central	Phoenix	AZ	85040		602-268-0774	jimmiemunoz@mcjc.maricopa.gov
Mr.	Chris	Coover	Maricopa County	Trails Manager	411 N. Central , Suite 470	Phoenix	AZ	85004	602-506-4692	602-506-8719	ccoover@mail.maricopa.gov
Mr.	Randy	Randolph	Central Arizona Project	Project Management	23636 North 7th Street	Phoenix	AZ	85024	623-869-2598	623-869-2260	rrandolph@cap-az.com
Mr.	David	Gunn	Central Arizona Project	Engineering Manager	23636 North 7th Street	Phoenix	AZ	85024	623-869-2249	623-869-2233	dgunn@cap-az.com
Mr.	Darrin	Francom	Central Arizona Project	Engineering Resources Supervisor	23636 North 7th Street	Phoenix	AZ	85024	623-869-2249	623-869-2276	dfrancom@cap-az.com
Mr.	Gordon	Taylor	Arizona State Land Department	Planning Section	1616 West Adams	Phoenix	AZ	85007	602-364-0272	602-542-2683	gtaylor@land.az.gov
Mr.	V. Ottozawa	Chatupron	Arizona State Land Department	Engineering Section	1616 West Adams	Phoenix	AZ	85007	602-364-0272	602-542-2683	ochatupr@land.az.gov

Sir Title	First Name	Last Name	Company/Agency	Title	Business Address	City	State	Postal Code	Business Fax	Business Phone	E-mail Address
Mr.	Rafael	Velazquez	Arizona State Land Department		1616 W. Adams	Phoenix	AZ	85003		602-364-2224	rvelazquez@land.az.gov
Mr.	Jeff	Beimer	Arizona Department of Transportation Drainage Section	Acting Chief Drainage Engineer	205 S. 17th Avenue, Maildrop 630 E	Phoenix	AZ	85007	602-712-8992	602-712-8485	jbeimer@azdot.gov
Mr.	Alan	Como	Town of Buckeye - Planning & Engineering	Planner	110 E. Irwin Avenue	Buckeye	AZ	85326	623-386-8314	623-349-6206	acomo@buckeyeaz.gov
Ms.	Janine	Guy	Town of Buckeye	Manager	100 N. Apache Road, Suite A	Buckeye	AZ	85326		623-386-4691	jguy@buckeyeaz.gov
Mr.	Jackie	Meck	Buckeye	Councilman	100 N Apache Road, Suite A	Buckeye	AZ	85326		623-386-2196	jmeck@bwcdd.com
Mr.	Will	Doyle	Bureau of Reclamation	Planner	PO Box 81169	Phoenix	AZ	85069-1169	602-216-4007		wadoyle@lc.usbr.gov
Mr.	Michael	Martinez	U.S. Fish and Wildlife Service	Biologist	2321 W. Royal Palm Rd., Suite 103	Phoenix	AZ	85021		602-242-0210 x224	Mike_Martinez@fws.gov
Ms.	Rebecca	Davidson	Arizona Game & Fish - Habitat Branch		2221 W. Greenway Road	Phoenix	AZ	85023	602-789-3928	602-789-3602	rdavidson@azgfd.gov
Ms.	Stephanie	Helgeson	NRCS	Soil Conservationist	12409 W. Indian School Rd, Suite B201	Avondale	AZ	85323		623-535-5055 x120	stephanie.helgeson@az.usda.gov
Mr.	John	Holt	Western Area Power Authority	Environmental Manager	12155 W. Alameda Parkway	Lakewood	CO	80228-8213			holt@wapa.gov
Mr.	Randy	Butler	Palo Verde Power Plant (APS & SRP)		P.O. Box 52034	Phoenix	AZ	85072		623-393-3003	rbutler@apsc.com
Mr.	Jim	Anderson	Bureau of Land Management	Lead Realty Specialist	21605 N. 7th Avenue	Phoenix	AZ	85027		623-580-5570	jim_andersen@blm.gov
Mr.	Bill	Jenkins	Arizona Dept. of Water Resources	Engineer	500 N. Third Street	Phoenix	AZ	85004		602-771-8500	wcjenkins@adwr.state.az.us

Sir Title	First Name	Last Name	Company/Agency	Title	Business Address	City	State	Postal Code	Business Fax	Business Phone	E-mail Address
Mr.	Brian	Cosson	Arizona Dept. of Water Resources	NFID Coordinator	500 N. Third Street	Phoenix	AZ	85004	602-417-2423	602-771-8500	btcosson@adwr.state.az.us
Ms.	Don	Harris	MC Parks & Rec.	Manager	14805 W. Vineyard Ave	Goodyear	AZ	85338	623-932-7718	623-935-2505	donharris@mail.maricopa.gov
Ms.	Karyn	Moldenhauer	Arizona Department of Environmental Quality		1110 W. Washington Street	Phoenix	AZ	85007		602-771-4449	kdm@azdeq.gov
Ms.	Julie	Legg	Luke Air Force Base	Water Program	Luke AFB, 56 CES/CEV, Bldg. 302, 13970 W. Lightning Street	Luke AFB	AZ	85309		623-856-4024	julie.legg@luke.af.mil
Mr.	Doug	LaMont	Parsons Brinckerhoff Puade & Douglas, Inc.	Senior Supervising Engineer	1501 W Fountainhead Parkway, Suite 400	Tempe	AZ	85282	480-966-9234	480-966-8295	lamont@pbworld.com
Mr.	Greg	Gamble	The Nature Conservancy	Rapidly Urbanizing Areas Project Director					602-712-0059	602-322-6987	ggamble@tnc.org
Mr.	Woody	Scoutten	W.C. Scoutten, Inc.	Engineer	1646 North Litchfield Road, Suite 235	Goodyear	AZ	85338-1211	623-547-4662	623-547-4661 x-222	woody@scoutten.com
Mr.	James	Truman	White Tanks Concerned Citizens	Director	PO Box 87	Waddell	AZ	85355	623-546-1715	623-975-2182	jstruman@qwest.net
Mr.	Abe	Sahli	CAP	Civil Engineer/Project Manager	23636 North 7th Street	Phoenix	AZ	85024	623-869-2249	623-869-2126	asahli@cap-az.com

Sir Title	First Name	Last Name	Company/Agency	Title	Development	Subarea	Subarea	Subarea	Subarea	Business Address	City	State	Postal Code	Business Fax	Business Phone	E-mail Address
Mr.	Brian	Rosenbaum	Lennar Communities	Regional Vice President	Elianto	FRS # 1	White Tank Wash			1150 West Grove Parkway, Suite 109	Tempe	AZ	85283	480-897-5588	480-345-0077	brian.rosenbaum@lennar.com
Mr.	Doug	Both	CVL	Associate Director	Elianto	FRS # 1	White Tank Wash			4550 N.12th Street	Phoenix	AZ	85014-4291	602-264-0928	602-264-6831	dboth@cvlci.com
Mr.	Ricardo	Aguirre	CVL, Inc.	Assistant Project Manager	Elianto	FRS # 1	White Tank Wash			4550 N. 12th Street	Phoenix	AZ	85014-4291	602-264-0928	602-264-6831	raguirre@cvlci.com
Mr.	Charlie	Enochs	Pulte Homes		Sun Valley South (East)	FRS # 1	White Tank Wash			3401 West Anthem Way	Anthem	AZ	85086		623-742-6006	
Ms.	Terri	George	David Evans & Associates	P.E.,C.F.M.	Tartesso	FRS # 1	White Tank Wash	Hassayampa		2141 East Highland Ave., Suite 200	Phoenix	AZ	85016	602-678-5155	602-678-5151	tgeorge@deainc.com
Mr.	Howard	Cornell	David Evans & Associates	Vice President - Director of Development	Valle Del Sol Trillium -Johnson Property		White Tank Wash			2141 East Highland Ave., Suite 200	Phoenix	AZ	85016	602-678-5155	602-678-5151	hcc@deainc.com
Mr.	Michael	Weinberg	David Evans & Associates	PE	Valle Del Sol Trillium-Johnson Property			Hassayampa		2141 East Highland Ave., Suite 200	Phoenix	AZ	85016	602-678-5155	602-678-5151	miw@deainc.com
Mr.	Josh	Hartmann	Pulte West Valley Div.	Manager of Planning and Entitlement	Sun Valley South (East)	FRS # 1				15111 N Pima Rd, Suite 100	Scottsdale	AZ	85260	480-391-6109	480-862-7853	josh.hartmann@pulte.com
Mr.	Mike	Johnson	Suncor Development Comp		Trillium			Hassayampa		80 E Rio Salado Pkwy, Suite 100	Tempe	AZ	85281		602-390-6812 480-317-6812	mike.johnson@suncoraz.com
Mr.	R.D.	Fisher	Landowner		Skyline Wash				FRS #2 & #3	11201 N. 23rd Ave., Suite 106	Phoenix	AZ	85029			
Mr.	Darrell	Williams	Landowner		Skyline Wash				FRS #2 & #3	13541 W. Cypress St	Goodyear	AZ	85338		623-910-9136	wwilliams55@cox.net
Mr.	Greg	Schuelke	Project Design Consultants		Skyline Wash				FRS #2 & #3	3200 E Camelback Rd., Suite 275	Phoenix	AZ	85018		602-508-0700	gschuelke@projectdesign.com
Mr.	Jackie	Meck	Buckeye	Councilman						100 N Apache Road, Suite A	Buckeye	AZ	85326		623-386-2196	jmeck@bwcdd.com
Mr.	Woody	Scoutten	W.C. Scoutten, Inc.	Engineer						1646 N. Litchfield Rd, #235	Goodyear	AZ	85338-1211	623-4662	623-547-4661 x-222	woody@scoutten.com
Ms.	Michelle	Yerger	Communities Southwest	Market Analyst	Miriclle (West)		White Tank Wash	Hassayampa		7720 North 16th Street, Suite 310	Phoenix	AZ	85020	602-265-7740	602-328-5218	myerger@commsw.com
Mr.	Jack	Moody	WRG Design	Director of Water Resources	Miriclle (West)		White Tank Wash	Hassayampa		9977 N. 90th St., Siute 350	Scottsdale	AZ	85258	602-977-8099	602-997-8000	jack.moody@wrgdesign.com
Mr.	Roger	Smith	SDI, Inc	Vice President	Sun Valley, South			Hassayampa		15770 N. Greenway/Hayden Loop, Suite 104	Scottsdale	AZ	85260		480-348-7450	rsmith@sdiinc.net
Mr.	Gil	Gillenwater	SDI, Inc		Sun Valley, South			Hassayampa		15770 N. Greenway/Hayden Loop, Suite 104	Scottsdale	AZ	85260		480-348-7450	gil@gillenwater.us

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Mr.	Gary	Freeman	River Research and Design, Inc.	President	Elianto	FRS # 1	White Tank Wash			1345 E Spur Ave	Gilbert	AZ	85296	480-497-6390	480-275-5077	freeman@r2d.eng.com
Mr.	Kevin	Kammerzell	CMX		Sun Valley, South (Pulte)	FRS # 1	White Tank Wash			7740 N. 16th Street	Phoenix	AZ	85048	602-567-1901	602-567-1900	kkammerzell@cmxinc.com
Mr.	Bob	Speirs	Stardust		Tartesso	FRS # 1	White Tank Wash	Hassayampa		6730 N. Scottsdale Rd	Scottsdale	AZ	85253		480-607-5800	bspeirs@stardustco.com
Mr.	Len	Erie	Erie& Associates				White Tank Wash								602-954-6399	erie@waterwiz.net
Mr.	Charlie	Potter	Capital Pacific Homes	Land Development Project Manager	Eliato West		White Tank Wash			1855 W Baseline Road, Suite 101	Mesa	AZ	85202	480-777-2407	480-777-2400	charlie.potter@cph-inc.com
Mr.	Les	Fletcher	Coldwell Banker	Vice President	Fisher					2525 E Camelback, Suite 150	Phoenix	AZ	85016	602-955-7650	602-850-2012	

Sir Title	First Name	Last Name	Company/Agency	Title	Development	Subarea	Subarea	Subarea	Subarea	Subarea	Business Address	City	State	Postal Code	Business Fax	Business Phone	E-mail Address
Ms	Cindy	Paddock	JF Properties, Inc	Platting and Entitlements Manager	Trillium		Hassayampa	Wagner Wash????			6720 N. Scottsdale Rd., Suite 250	Scottsdale	AZ	85253	480-422-6924	480-422-6900/ Direct 480-422-6914	cpaddock@jfcompanies.com
Mr.	Josh	Hartmann	West Valley Div.	Manager of Planning & Entitlement	Sun Valley South(East)	White Tank Wash				Area 4 North of CAP	15111 N Pima Rd, Suite 100	Scottsdale	AZ	85260	480-391-6109	480-862-7853	josh.hartmann@pulte.com
Mr.	Glenn	Spurlock	Spurlock Land, L.L.C.		Spurlock Ranch					Area 4 North of CAP	11039 S. 163rd St.	Gilbert	AZ	85296			spurlock@direcway.com; spurlockland@cox.net
Mr.	Doug	Both	CVL	Associate Director	Sun City Festival				CAP	Area 4 North of CAP	4550 N.12th Street	Phoenix	AZ	85014-4291	602-264-0928	602-264-6831	dboth@cvlci.com
Mr.	Jackie	Meck	Buckeye	Councilman							100 N Apache Road, Suite A	Buckeye	AZ	85326		623-386-2196	jmeck@bwcdd.com
Mr.	Woody	Scoutten	W.C. Scoutten, Inc.	Engineer							1646 N. Litchfield Rd, #235	Goodyear	AZ	85338-1211	623-547-4662	623-547-4661 v-222	woody@scoutten.com
Mr.	Toby	Block	The Lyle Anderson Company, Inc.	Vice President of Development - Festival	Festival Ranch					Area 4 North of CAP	8777 N. Gainey Center Dr., Suite 205	Scottsdale	AZ	85258	480-524-4197	480-443-2630	tblock@andersonco.com
Mr.	Richard	Maes	WVSV Holdings., L.L.C.		Vistoso for Sun Valley	White Tank Wash	Hassayampa	Wagner Wash	CAP	Area 4 North of CAP	1121 W. Warner Rd., Suite 109	Tempe	AZ	85284		480-831-2000	richardm@vistoso.net
			Lyle Anderson		Festival Ranch					Area 4 North of CAP	8777 N. Gainey Center Dr., Suite 205	Scottsdale	AZ	85258	480-524-4197	480-443-2630	pjoseph@anderson.co.com
Mr	Don	Willie	Kimley Horne		Festival Ranch					Area 4 North of CAP	7878 N 16th Street, Suite 300	Phoenix	AZ	85020	602-944-7423	602-944-5500	don.willie@kimley-horn.com
			Vistoso		Sun Valley	White Tank Wash	Hassayampa			Area 4 North of CAP							
Mr.	Sherrick	Campbell	WRG Design, Inc	Project Manager	Festival Ranch					Area 4 North of CAP	9977 N. 90th Street, Suite 350	Scottsdale	AZ	85258	602-977-2099	602-977-8000	sherrick.campbell@wrgdesign.com
Mr.	Phil	Miller	WestPac Development		Montiere							Scottsdale	AZ			480-889-8910	
Mr.	Michael	Weinberg	David Evans & Associates	PE	Valle Del Sol Trillium - Johnson Property		Hassayampa	Wagner Wash			2141 East Highland Ave., Suite 200	Phoenix	AZ	85016	602-678-5155	602-678-5151	miw@deainc.com
Mr	Josh	Lessard	Erie& Associates				Hassayampa	Wagner Wash	CAP	Area 4 North of CAP					602-607-5800	602-954-6399	josh@waterwiz.net
Mr.	Duane	Hunn	Carter Burgess	Land Development Unit Manager							101 North First Avenue, Suite 3100	Phoenix	AZ	85003	602-253-1202	602-650-4010	duane.hunn@c-b.com
Mr.	Ricardo	Aguirre	CVL, Inc.	Assistant Project Manager	Elianto	FRS # 1	White Tank Wash				4550 N.12th Street	Phoenix	AZ	85014-4291	602-264-6831	602-264-6831	raguirre@cvlci.com
Ms	Elisabeth	Kahn	CVL, Inc.	Assistant Project Manager							4550 N.12th Street	Phoenix	AZ	85014-4291	602-264-0928	602-285-4890	ekahn@cvlci.com
Mr.	Troy	Morteusen	Sunbelt Holdings	Project Manager	Sun Valley South Commercial Core						6720 N. Scottsdale Rd.,	Scottsdale	AZ	85253		602-574-5605	tmortensen@sunbeltholdings.com
Mr.	Nasir	Raza	URS	Project Manager	ASLD							Phoenix	AZ			602-648-2352	nasir_raza@urscorp.com

Sir Title	First Name	Last Name	Company/Agency	Title	Development	Subarea	Business Address	City	State	Postal Code	Business Fax	Business Phone	E-mail Address
Mr.	Doug	Both	CVL	Associate Director	Sun City Festival	CAP	4550 N.12th Street	Phoenix	AZ	85014-4291	602-264-0928	602-264-6831	dboth@cvlci.com
Mr.	Charlie	Enochs	Pulte Homes		Sun City Festival	CAP	3401 West Anthem Way	Anthem	AZ	85086		623-742-6006	
Mr.	Richard	Maes	WVSV Holdings., L.L.C.		Vistoso for Sun Valley	CAP	1121 W. Warner Rd., Suite 109	Tempe	AZ	85284		480-831-2000	richardm@vistoso.net
Mr.	Josh	Lessard	Erie& Associates			CAP	3120 N. 24th St	Phoenix	AZ	85016		602-954-6399	erie@waterwiz.net

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Ms	Cindy	Paddock	JF Properties, Inc	Platting and Entitlements Manager	Trillium	Wagner Wash????	6720 N. Scottsdale Rd., Suite 250	Scottsdale	AZ	85253	480-422-6924	480-422-6900/ Direct 480-422-6914	cpaddock@jfcompanies.com
Mr.	Richard	Maes	WVSV Holdings., L.L.C.		Vistoso for Sun Valley	Wagner Wash	1121 W. Warner Rd., Suite 109	Tempe	AZ	85284		480-831-2000	richardm@vistoso.net
Mr.	Michael	Weinberg	David Evans & Associates	PE	Valle Del Sol Trillium - Johnson Property	Wagner Wash	2141 East Highland Ave., Suite 200	Phoenix	AZ	85016	602-678-5155	602-678-5151	miw@deainc.com
Mr.	Josh	Lessard	Erie& Associates			Wagner Wash	3120 N. 24th St.	Phoenix	AZ	85016		602-954-6399	erie@waterwiz.net

Sir Title	First Name	Last Name	Company/Agency	Title	Development	Subarea	Business Address	City	State	Postal Code	Business Fax	Business Phone	E-mail Address
Ms.	Terri	George	David Evans & Associates	P.E.,C.F.M.	Tartesso West	Hassayampa	2141 East Highland Ave., Suite 200	Phoenix	AZ	85016	602-678-5155	602-678-4691	tgeorge@deainc.com
Mr.	Michael	Weinberg	David Evans & Associates	PE	Valle Del Sol Trillium - Johnson Property	Hassayampa	2141 East Highland Ave., Suite 200	Phoenix	AZ	85016	602-678-5155	602-678-5151	miw@deainc.com
Mr.	Mike	Johnson	Suncor Development Comp		Trillium	Hassayampa	80 E Rio Salado Pkwy, Suite 100	Tempe	AZ	85281		602-390-6812 480-317-6812	mike.johnson@suncoraz.com
Ms.	Jami	Schulman	Communities Southwest	Vice President	Sun Valley South (West)	Hassayampa	7720 North 16th Street, Suite 310	Phoenix	AZ	85020	602-265-7740	602-265-1952	jschulman@comsw.com
Ms.	Michelle	Yerger	Communities Southwest	Market Analyst	Miriclle (West)	Hassayampa	7720 North 16th Street, Suite 310	Phoenix	AZ	85020	602-265-7740	602-328-5218	myerger@commsw.com
Mr.	Jack	Moody	WRG Design	Director of Water Resources	Miriclle (West)	Hassayampa	9977 N. 90th St., Siute 350	Scottsdale	AZ	85258	602-977-2099	602-997-8000	jackmoody@wrgdesign.com
Ms.	Dianne	Thornburg	WestPac Development	Assistant Project Manager	Johnson/ Montiere	Hassayampa	8501 N. Scottsdale Rd., Suite 260	Scottsdale	AZ	85253	480-889-1984	480-889-1999	dthornburg@westpacdev.com
Mr.	Bob	Speirs	Stardust		Tartesso West	Hassayampa	6730 N. Scottsdale Rd	Scottsdale	AZ	85253		480-607-5800	bspeirs@stardustco.com
Ms	Cindy	Paddock	JF Properties, Inc	Platting and Entitlements Manager	Trillium	Hassayampa	6720 N. Scottsdale Rd., Suite 250	Scottsdale	AZ	85253	480-422-6924	480-422-6900/ Direct 480-422-6914	cpaddock@jfcompanies.com
Mr.	Richard	Maes	WVSV Holdings., L.L.C. (Vistoso)		Sun Valley Community	Hassayampa	1121 W. Warner Rd., Suite 109	Tempe	AZ	85284		480-831-2000	richardm@vistoso.net
Mr.	Len	Erie	Erie& Associates		Sun Valley Community	Hassayampa	3120 N. 24th St.	Phoenix	AZ	85016	602-954-6601	602-954-6399	erie@waterwiz.net
Mr.	Duane	Hunn	Carter-Burgess		Sun Valley Community	Hassayampa	101 N. First Avenue Suite 3100	Phoenix	AZ	85003	602-253-1202	602-650-4010	duane.hunn@c-b.com

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Mr.	Brian	Rosenbaum	Lennar Communities	Regional Vice President	Elianto	White Tank Wash	1150 West Grove Parkway, Suite 109	Tempe	AZ	85283	480-897-5588	480-345-0077	brian.rosenbaum@lennar.com
Mr.	Doug	Both	CVL	Associate Director	Elianto	White Tank Wash	4550 N.12th Street	Phoenix	AZ	85014	602-264-0928	602-264-6831	dboth@cvlci.com
Mr.	Ricardo	Aguirre	CVL, Inc.	Assistant Project Manager	Elianto	White Tank Wash	4550 N. 12th Street	Phoenix	AZ	85014-4291	602-264-0928	602-264-6831	raguirre@cvlci.com
Ms.	Terri	George	David Evans & Associates	P.E.,C.F.M.	Tartesso	White Tank Wash	2141 East Highland Ave., Suite 200	Phoenix	AZ	85016	602-678-5155	602-678-4691	tgeorge@deainc.com
Ms.	Michelle	Yerger	Communities Southwest	Market Analyst	Miriclle (West)	White Tank Wash	7720 North 16th Street, Suite 310	Phoenix	AZ	85020	602-265-7740	602-265-1952	myerger@commsw.com
Mr.	Jack	Moody	WRG Design	Director of Water Resources	Miriclle (West)	White Tank Wash	9977 N. 90th St., Siute 350	Scottsdale	AZ	85258	602-977-8099	602-997-8000	jack.moody@wrgdesign.com
Mr.	Gary	Freeman	River Research and Design, Inc.	President	Elianto	White Tank Wash	1345 E Spur Ave	Gilbert	AZ	85296	480-497-6390	480-275-5077	freeman@r2d.eng.com
Mr.	Kevin	Kammerzell	CMX		Sun Valley, South (Pulte)	White Tank Wash	7740 N. 16th Street	Phoenix	AZ	85048	602-567-1901	602-567-1900	kkammerzell@cmxinc.com
Mr.	Bob	Speirs	Stardust		Tartesso	White Tank Wash	6730 N. Scottsdale Rd	Scottsdale	AZ	85253		480-607-5800	bspeirs@stardustco.com
Mr.	Len	Erie	Erie& Associates		Sun Valley Community	White Tank Wash	3120 N. 24th St.	Phoenix	AZ	85016	602-954-6601	602-954-6399	erie@waterwiz.net
Mr.	Josh	Hartmann	West Valley Div.	Vice President	Sun Valley South(East)	White Tank Wash	15111 N Pima Rd, Suite 100	Scottsdale	AZ	85260	480-391-6109	480-862-7853	josh.hartmann@pulte.com

Sir Title	First Name	Last Name	Company/Agency	Title	Development	Subarea	Business Address	City	State	Postal Code	Business Fax	Business Phone	E-mail Address
Mr.	Richard	Maes	WVSV Holdings., L.L.C. (Vistoso)		Sun Valley Community	White Tank Wash	1121 W. Warner Rd., Suite 109	Tempe	AZ	85284		480-831-2000	richardm@vistoso.net
Mr.	Duane	Hunn	Carter-Burgess	Land Development Unit Manager	Sun Valley Community	White Tank Wash	101 N. First Avenue Suite 3100	Phoenix	AZ	85003	602-253-1202	602-650-4010	duane.hunn@c-b.com
Mr.	Howard	Cornell	David Evans & Associates	Vice President - Director of Development	Valle Del Sol - Johnson Property	White Tank Wash	2141 East Highland Ave., Suite 200	Phoenix	AZ	85016	602-678-5155	602-678-5151	hcc@deainc.com

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Mr.	Brian	Rosenbaum	Lennar Communities	Regional Vice President	Elianto	FRS # 1	1150 West Grove Parkway, Suite 109	Tempe	AZ	85283	480-897-5588	480-345-0077	brian.rosenbaum@lennar.com
Mr.	Doug	Both	CVL		Elianto	FRS # 1	4550 N.12th Street	Phoenix	AZ	85014		602-264-6831	dboth@cvlci.com
Mr.	Ricardo	Aguirre	CVL, Inc.	Assistant Project Manager	Elianto	FRS # 1	4550 N. 12th Street	Phoenix	AZ	85014-4291	602-264-0928	602-264-6831	raguirre@cvlci.com
Ms.	Terri	George	David Evans & Associates	P.E.,C.F.M.	Tartesso	FRS # 1	2141 East Highland Ave., Suite 200	Phoenix	AZ	85016	602-678-5155	602-678-4691	tgeorge@deainc.com
Mr.	Josh	Hartmann	Pulte West Valley Div.		Sun Valley South (East)	FRS # 1	15111 N Pima Rd, Suite 100	Scottsdale	AZ	85260		480-862-7853	josh.hartmann@pulte.com
Mr.	Tony	Mortensen	Sunbelt Holdings	Project Manager	Sun Valley, South	FRS # 1	6710 N. Scottsdale Rd., Suite 160	Scottsdale	AZ	85253	480-905-1419	602-574-5605	tmortensen@sunbeltholdings.com
Mr.	Sean	Walters	Sunbelt Holdings		Sun Valley, South	FRS # 1	6720 N. Scottsdale, Suite 160	Scottsdale	AZ	85253	480-905-1419	602-574-5602	swalters@sunbeltholdings.com
Mr.	Gary	Freeman	River Research and Design, Inc.	President	Elianto	FRS # 1	1345 Spur Ave	Gilbert	AZ	85296	480-497-6390	480-275-5077	freeman@r2d.eng.com
Mr.	Kevin	Kammerzell	CMX		Sun Valley, South (Pulte)	FRS # 1	7740 N. 16th Street	Phoenix	AZ	85048	602-567-1901	602-567-1900	kkammerzell@cmxinc.com
Mr.	Bob	Speirs	Stardust		Tartesso	FRS # 1	6730 N. Scottsdale Rd	Scottsdale	AZ	85253		480-607-5800	bspeirs@stardustco.com
Mr.	Gil	Gillenwater	SDI, Inc.		Sun Valley South	FRS # 1	15770 N Greenway/Hayden Loop, Suite 104	Scottsdale	AZ	85260		480-348-7450	gil@gillenwater.us

Sir Title	First Name	Last Name	Company/Agency	Title	Development	Subarea	Business Address	City	State	Postal Code	Business Fax	Business Phone	E-mail Address
Mr.	R.D.	Fisher	Landowner		Skyline Wash	FRS #2 & #3	11201 N. 23rd Ave., Suite 106	Phoenix	AZ	85029		602-861-5614 (wrong #)	
Mr.	Darrell	Williams	Landowner		Skyline Wash	FRS #2 & #3	13541 W. Cypress St	Goodyear	AZ	85338		623-910-9136	wwilliams55@cox.net
Mr.	Greg	Schuelke	Project Design Consultants		Skyline Wash	FRS #2 & #3	3200 E Camelback Rd., Suite 275	Phoenix	AZ	85018		602-508-0700	gschuelke@cvlci.com

Sir Title	First Name	Last Name	Company/Agency	Title	Development	Subarea	Business Address	City	State	Postal Code	Business Fax	Business Phone	E-mail Address
Mr.	Glenn	Spurlock	Spurlock Land, L.L.C.		Spurlock Ranch	Area 4 North of CAP	11039 S. 163rd St.	Gilbert	AZ	85296			spurlock@direcway.com; spurlockland@cox.net
Mr.	Michael	Tiffany	Spurlock Land, L.L.C.	Attorney	Spurlock Ranch	Area 4 North of CAP							met@tblaw.com
Mr.	David	Burrows	CMX, L.L.C	PE	Spurlock Ranch	Area 4 North of CAP	1515 E. Missouri, Suite 115	Phoenix	AZ	85014		602-279-8436	spurlock@direcway.com; spurlockland@cox.net
Mr.	Doug	Both	CVL	Associate Director	Sun City Festival	Area 4 North of CAP	4550 N.12th Street	Phoenix	AZ	85014	602-264-0928	602-264-6831	dboth@cvlci.com
Mr.	Charlie	Enochs	Pulte Homes		Sun City Festival	Area 4 North of CAP	3401 West Anthem Way	Anthem	AZ	85086		623-742-6006	
Mr.	Toby	Block	The Lyle Anderson Company, Inc.	Vice President of Development - Festival	Festival Ranch	Area 4 North of CAP	8777 N. Gainey Center Dr., Suite 205	Scottsdale	AZ	85258	480-624-4197	480-443-2630	tblock@andersonco.com
Mr.	Sherrick	Campbell	WRG Design, Inc	Project Manager	Festival Ranch	Area 4 North of CAP	9977 N. 90th Street, Suite 350	Scottsdale	AZ	85258	602-977-2099	602-977-8000	sherrick.campbell@wrgdesign.com
Mr.	Josh	Hartmann	West Valley Div.	Manager of Planning and Entitlement	Sun Valley South(East)	Area 4 North of CAP	15111 N Pima Rd, Suite 100	Scottsdale	AZ	85260	480-391-6109	480-862-7853	josh.hartmann@pulte.com
Mr.	Richard	Maes	WVSV Holdings., L.L.C.		Vistoso for Sun Valley	Area 4 North of CAP	1121 W. Warner Rd., Suite 109	Tempe	AZ	85284			richardm@vistoso.net
Mr.	Josh	Lessard	Erie& Associates			Area 4 North of CAP	3120 N. 24th St.	Phoenix	AZ	85016		602-954-6399	erie@waterwiz.net

Development Names, Developer Names, and Engineering Firms by Subarea

SUBAREA	Development	Developer	Engineering Firm	Status of Development as of Aug. 16, 2005 Meeting
FRS #2 & #3	Skyline Wash	Fisher	Unknown	No engineering underway at this time.
	Sundance #7	?	Unknown	
FRS #1	Tartesso	Stardust	DEA	Drainage Report for Tartesso Units 1 and 2a completed
	Tartesso West	Stardust	DEA	
	Elianto	Lennar	CVL	Preliminary plat has been approved. Application in for 404 permit.
	Sun Valley South (East)	Pulte	CMX	Preparing Land. 404 permit is being submitted
	Tartesso Town Center (Commercial)		DEA	
	?		Hoskins/ Ryan	Valerie to check with Paul Hoskins
White Tank Wash	Sun Valley South (West)	Communities SW	WRG Design	Preliminary planning stages. No 404 applications at this time.
	Sun Valley South (East)	Pulte	CMX	Preparing Land. 404 permit is being submitted
	Elianto	Lennar	CVL	Preliminary plat has been approved. Application in for 404 permit.
	Tartesso West	Stardust	DEA	
	Commercial-Bill Bliss	Bill Bliss	Unknown	
	Sun Valley	Vistoso	Erie & Assoc.	Preliminary Drainage Plan completed at Northern end of development. Reportedly has an approved Area Plan also.
	Mixed Use- Sun Valley Prkv	Unknown	Unknown	
Hassayampa	Johnson Property	Westpac	DEA	Just completed 404.
	Sun Valley	Vistoso	Erie & Assoc.	Preliminary Drainage Plan completed at Northern end of development. Reportedly has an approved Area Plan also.
	Sun Valley South (West)	Communities SW	WRG Design	Preliminary planning stages. No 404 applications at this time.
	Tartesso West	Stardust	DEA	
	Trillium West	Gateway	DEA	Phase I preliminary report under review. Phase II preliminary plat is being prepared. 401 is completed and the 404 is being reviewed

Development Names, Developer Names, and Engineering Firms by Subarea

SUBAREA	Development	Developer	Engineering Firm	Status of Development as of Aug. 16, 2005 Meeting
Wagner Wash	Sun Valley	Vistoso	Erie & Assoc.	Preliminary Drainage Plan completed at Northern end of development. Reportedly has an approved Area Plan also.
	Trillium West	Gateway	DEA	Phase I preliminary report under review. Phase II preliminary plat is being prepared. 401 is completed and the 404 is being reviewed
CAP	Sun City Festival	Pulte	CVL	
	Sun Valley	Vistoso	Erie & Assoc.	Preliminary Drainage Plan completed at Northern end of development. Reportedly has an approved Area Plan also.
Area 4 Sun Valley Parkway	Festival Ranch	Lyle Anderson	WRG Design	Preliminary Stages
	Sun City Festival	Pulte	CVL	
	Sun Valley	Vistoso	Erie & Assoc.	Preliminary Drainage Plan completed at Northern
	Spurlock Ranch	Glen Spurlock	Unknown	Reportedly has an approved drainage plan.
	Festival Ranch	Lyle Anderson	WRG Design	Preliminary Stages
	Sun City Festival	Pulte	CVL	

Appendix B

Preliminary Maintenance Plan, prepared by C.L. Williams Consulting Engineers, December 2006

PRELIMINARY MAINTENANCE PLAN
FOR THE
SUN VALLEY AREA DRAINAGE MASTER PLAN

PURPOSE

This Preliminary Maintenance Plan (PMP) is developed for the purpose of providing recommendations for a systematic approach for monitoring and maintenance procedures for the detention basins, walled levee drainage corridors, grade control structures and other flood control features found in the Recommended Alternative (RA) for the Sun Valley Area Drainage Master Plan (ADMP). This document is intended as a guideline only commensurate with the level of development of the improvements outlined in the RA. As improvements are designed and constructed detailed maintenance plans should be developed for the specific facilities.

LOCATION

This PMP is applicable to the RA of the ADMP which is located within portions of the Town of Buckeye and the surrounding unincorporated areas found in western Maricopa County, Arizona.

APPROACH

This PMP considers the following activities as important elements to be addressed programmatically:

- Routine (monthly) maintenance/clean up; items such as trash removal, fence repair, landscaping etc.
- Periodic (annual) inspections/repairs to evaluate feature structural integrity and physical system status such as aggradation/degradation, vandalism, minor repairs, vegetative invasion, etc.
- Post storm or flooding inspection/repairs to address significant aggradation/degradation episodes, damage to structural concrete or earthen features and to re-establish flood control feature functionality if needed.

RESPONSIBLE PARTIES

The flood control improvements of the RA are not yet constructed at the time this PMP was prepared. The responsibility for capital funding of the RA has not been determined at this time and is discussed in detail in the ADMP Implementation Plan & Funding Strategy Memo. It is probable that multiple agencies will be responsible for funding the various monitoring and maintenance activities proposed herein. These agencies will most likely include the:

- Town of Buckeye
- Flood Control District of Maricopa County
- Maricopa County Department of Transportation
- Homeowner Associations

There have been discussions regarding the possibility of implementing an ADMP wide Drainage Maintenance District. There may be merit to this concept of a dedicated agency having the responsibility and authority to maintain the RA due to the size and complexity of the flood control features developed for the alluvial fan systems found on the western slopes of the White Tank Mountains.

At this time no agreements have been reached on responsibility for monitoring and maintenance using either the Maintenance District or other more traditional methods. One maintenance responsibility scenario that has merit using traditional methods is for:

1) the applicable Homeowners Association to perform Routine Maintenance,
2) The Town of Buckeye public works forces would perform Periodic Maintenance and
3) The Flood Control District to perform Post-Storm Maintenance.

The advantage of this scenario is that each responsible party would be providing services at the maintenance level it is most qualified for based upon location, budget and expertise.

OPERATIONAL PROCEDURES

Operational procedures are needed for continuity of effort when staff changes and for appropriate budgeting. Inspection is a function that takes place prior to and during physical maintenance activities. The following sections should be used to guide routine, periodic and post-storm procedures.

Routine Maintenance

Maintenance activities that occur under this maintenance element will be based upon minimum interval monthly inspection of the detention basins, and landscaping amenities. The detention basin floors will be cleaned of all trash and debris which could potentially clog the outlet pipe structures during a flooding event. The outlet pipes will also be inspected and cleaned of any debris. The landscaping vegetative amenities will be kept trimmed to design levels and any brush generated will be disposed of at an approved facility not placed in the channels or detention basins. Any landscaping features such as gravel or decomposed granite will be maintained at design levels including sweeping and replacement after minor rainfall events.

Any damage to the facilities beyond the scope of routine maintenance will be immediately reported to the the Town of Buckeye and Flood Control District Engineering Sections.

Periodic Maintenance

Inspection and maintenance activities that occur under this maintenance element will be based upon annual inspections of the detention basins, walled levee drainage corridors and grade control structures. If no damage has occurred from minor storms or vandalism then major maintenance will only occur at 3-year intervals.

1) Measurements of basin floor elevations will be taken if the inspection reveals signs of sediment aggradation or degradation. The elevations will then be compared to the design and as-built condition. If elevations are found to be more than one foot average difference per basin then the Town of Buckeye and Flood Control District Engineering Sections will be notified immediately for a determination as to what course of action, if any, is needed.

2) Detention basin side slopes will be inspected for signs of rill erosion, embankment cracking or sloughing due to slope instability. If the erosion, cracking or sloughing is minor then the appropriate grading will be performed to re-establish the design grades. If major grading is necessary that significantly disturbs any established vegetation then the Town of Buckeye and Flood Control District Engineering Sections will be notified immediately for a determination as to what course of action, if any, is needed.

3) Measurement of any scour holes elevations either up or downstream of any grade control

structure will be made if the vertical degradation appears to be one foot or greater. If elevations are found to be more than one foot difference then the Town of Buckeye and Flood Control District Engineering Sections will be notified immediately for a determination as to what course of action, if any, is needed.

4) Measurement of any scour holes elevations on the channel side of any walled levee will be made if the vertical degradation appears to be one foot or greater. If elevations are found to be more than one foot difference then the Town of Buckeye and Flood Control District Engineering Sections will be notified immediately for a determination as to what course of action, if any, is needed.

5) A visual inspection of all surface concrete or metal wall, headwalls or pipes will be completed. They will be evaluated for signs of distress, sulfate attack, cracking, differential settlement, tilting, surface water ponding near the foundations, or unauthorized modifications. Minor repairs will be made as needed but before any major repair are conducted the Town of Buckeye and Flood Control District Engineering Sections will be notified immediately for a determination as to what course of action, if any, is needed.

The results of all Periodic (annual) Maintenance inspections, measurements, correspondence and photographs will be recorded and filed with both the Town of Buckeye and the Flood Control Districts Engineering Sections. All maintenance activities performed as a result of the annual inspection will be photographed post-activity and a description of any action taken and costs will be recorded and filed with both the Town of Buckeye and the Flood Control Districts Engineering Sections.

Post Storm Maintenance

Post-storm inspections should be performed as soon as possible after significant storm and/or flood conditions have subsided. Although the flood control system is designed for 100-year flow conditions, it is still susceptible to damage during other flow conditions. A post-storm maintenance inspection shall be completed after a 1.5 inch per 2 –hour rainfall or similar has occurred regardless of any reported flooding. During prolonged storm events daily monitoring of the flood control structures particularly the detention basins should be conducted. The results of all Post-Storm Maintenance inspections, measurements, correspondence and photographs will be recorded and filed with both the Town of Buckeye and the Flood Control Districts Engineering Sections.

If major damage has occurred due to the storm or flooding event then the Town of Buckeye and Flood Control District Engineering Sections will be notified immediately for a determination as to what course of action, if any, is needed.

MAINTENANCE COSTS

The following maintenance costs are based on a 3-year maintenance cycle. The costs are estimated for a design life of 50 years. The costs include maintenance costs for a period of 50 years assuming that regular major maintenance will be performed every 3 years. The following table shows the projected maintenance cost for each sub-area as defined in the ADMP.

Subarea	Fan System	ROW Area (acres)	50-Year Maintenance Cost (in millions $)
CAP	FANS1_2	266.5	$ 8.982
	TOTAL	266.5	$ 8.982
Wagner	FAN3	88.8	$ 4.241
	FAN13	62.8	$ 3.525
	FAN16	88.1	$ 4.666
	FAN19	51.0	$ 1.585
	FANS1718	78.8	$ 3.509
	TOTAL	369.5	$ 17.526
Hassayampa	FAN4	128.5	$ 5.637
	FAN5	203.1	$ 8.086
	TOTAL	331.6	$ 13.722
White Tank Wash	FAN38	250.0	$ 9.153
	FANS6_39	340.7	$ 9.478
	TOTAL	590.7	$ 18.631
FRS 1	FANS7812	254.1	$ 9.024
	FAN36	264.6	$ 9.709
	FAN37	334.2	$ 12.515
	TOTAL	852.9	$ 31.248
FRS 2 & 3	SKYLINES	125.8	$ 5.426
	TOTAL	125.8	$ 5.426
TOTAL - ALL SUBAREAS		2,538.4	$ 95.5

Appendix C

Hazardous Materials, Database Search Results, prepared by Logan Simpson Design, September 2005

Hazardous Materials

Database Search Results

By: Patricia McCabe
Date: November 2006
Project Name: Sun Valley Area Drainage Master Plan
LSD Project No.: 045367

Project Location and Description

The continuing population growth in Maricopa County has placed increasing development pressures on the Sun Valley area. The purpose of the Sun Valley Area Drainage Master Plan (ADMP) is to create a regional drainage plan to accommodate future development in the Sun Valley area. The study area is located west of the White Tank Mountains and north of Interstate 10 (I-10) in Maricopa County, Arizona. The study area includes portions of the Town of Buckeye, the City of Surprise, the City of Wittman, and unincorporated portions of Maricopa County.

This hazardous materials report seeks to identify the presence of hazardous materials concerns located within the study limits of the Sun Valley ADMP project. In order to determine the presence of hazardous materials, applicable Arizona Department of Environmental Quality (ADEQ) and US Environmental Protection Agency (EPA) databases were queried in September 2005, and updated in November 2006. The results of the database searches are outlined below.

Results of Database Review

A review of various ADEQ databases for hazardous materials was conducted in September 2005 and updated in November 2006:

- The Arizona Directory of Active/Inactive Landfills and Closed Solid Waste Landfills reported no sites within or adjacent to the study area.
- The State of Arizona's Water Quality Assurance Revolving Fund (WQARF) Registry (including Superfund sites) reported no sites within or adjacent to the study area.
- The ADEQ Drywell Registration List reported ten drywells at two separate sites within or adjacent to the study area (Table 1).

Table 1. Drywell sites

Registration number	Facility name	Address	Number of drywells
32946	Festival Ranch (Sun City)	Sun Valley Parkway & 271st Avenue	2
32123	Sundance Cove	229th Lane & North Sundance Parkway	8

Source: ADEQ, http://www.azdeq.gov/databases/drywellsearch.html.

- The ADEQ Brownfields Tracking System reported no incidents of brownfields occurring within or adjacent to the study area.
- The Arizona Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDFs) List reported no sites within or adjacent to the study area.
- The ADEQ List of Licensed Septic Haulers reported one hauler at an unknown location in the study area (Table 2).

Table 2. Septic haulers

License number	Facility name	Address	Vehicle VIN
ADEQ# 1034	Sep-Tec	PO Box 625, Buckeye, AZ 85326 (mailing address only)	1GDL7D1BXHV09023

Source: ADEQ, http://www.azdeq.gov/environ/water/permits/download/haulers-num.pdf.

- The ADEQ Underground Storage Tank (UST) List reported two sites containing USTs within or adjacent to the study area (Table 3).

Table 3. USTs

Facility ID	Name	Address	Owner name	Number of tanks	Tank status
0-009187	FAA Airway Beacon Site #007	NW of I-10 on Miller Road	Federal Aviation Administration	2	Removed on 7/10/2001
0-009100	Love's Country Store #280	1610 S. Miller Road Buckeye, AZ 85326	Love's Country Stores, Inc.	5	In use

Source: ADEQ, http://www.azdeq.gov/databases/ustsearch.html.

- The ADEQ Leaking Underground Storage Tank (LUST) list indicated there are no sites containing LUSTs located within or adjacent to the study area.

- The ADEQ Hazardous Material Incident Logbook (HMIL), last updated November 15, 2001, reported seven incidents within or adjacent to the study area (Table 4).

Table 4. Hazardous material incidents

Incident No.	Date	Name	Address	Location	Chemical/ Material	Quantity
98-139-E	6/20/1998	Pro Petroleum	I-10, milepost 111	Buckeye	Diesel	7,500 gallons
96-030-B	4/12/1996	PT-73 Productions, Inc.	Sun Valley Boulevard So, at milepost 188	Maricopa County	Fireworks/ Class 1.1 Explosives	1,000 lbs
98-086-E	12/08/1997	APS	Hassayampa Pump Station	Maricopa County	Effluent Wastewater	4.5 million gallons
98-027-B	9/10/1997	Unknown	Sun Valley Parkway, milepost 116	Buckeye	Drug Lab Chemicals	None
96-099-B	11/27/1996	Unknown	Miller Road Flood Control Dike	Buckeye	Unknown	> 200 gallons
00-066-B	1/13/2000	Unknown / Maricopa County	Miller Road, north of I-10	Buckeye	NA	Empty drum
00-060-B	1/09/2000	Unknown/BLM	I-10 & Miller Road	Buckeye	Unknwown liquid	Unknown

Source: ADEQ, http://www.azdeq.gov/databases/hwssearch.html.

A review of various EPA databases for hazardous materials was conducted in September 2005 and updated in November 2006:

- The Air Releases (AIRS/AFS) list reported no air release sites within or adjacent to the study area.

- A review of the Biennial Reporting System (BRS) of wastes generated on-site and from off-site facilities was unavailable. A conversation with EPA in June 2006 revealed that the database would be unavailable maintenance purposes until further notice.

- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Superfund) Envirofacts reported no sites within or adjacent to the study area.

- The Facility Registry System (FRS) reported one facility located within or adjacent to the study area (Table 5).

Table 5. FRS facilities

Facility name	Registry ID	Address	City	ZIP code
Hassayampa Pumping Plant – Central Arizona Project	110024443431	0.7 miles west of Akin Road along the south bank of the Hassayampa River	Buckeye	85326

Source: USEPA, http://www.epa.gov/enviro/html/fii/fii_query_java.html.

- The Resource Conservation and Recovery Act (RCRA Info) Envirofacts reported no facilities within or adjacent to the study area (Table 6).

Table 6. RCRA facilities

Facility name	Handler ID	Address	City	ZIP code	NAICS code
Hassayampa Pumping Plant – Central Arizona Project	AZR000502286	0.7 miles west of Akin Road along the south bank of the Hassayampa River	Buckeye	85326	22131

Source: USEPA, http://www.epa.gov/enviro/index.html.

- The Toxics Release Inventory (TRI) database in Envirofacts reported no sites within or adjacent to the study area.

Environmental Concerns / Conclusion

The database search revealed the presence of several hazardous materials concerns within or adjacent to the study area. These hazardous materials concerns include 10 drywells at two separate sites, one licensed septic hauler vehicle, seven USTs at two separate sites, and seven hazardous materials incidents at seven separate sites (Figure 1). The majority of these sites are located in the vicinity of the I-10 and Miller Road traffic interchange near the Town of Buckeye. According to the database search, there are no landfills, WQARF/Superfund, TSDFs, LUSTs, or brownfields located within or adjacent to the study area. The database search also revealed several facilities/incidents at unknown locations throughout Maricopa County. Because the location of these facilities cannot be verified, these facilities/incidents have been omitted from this report.

A review of the relevant EPA databases reported one FRS facility and one RCRA facility within the study area. No AIRS/AFS, CERCLA, RCRA, or TRI sites were reported within or adjacent to the study area.

A reconnaissance visit to the study area in August 2005 indicated the presence of three sites of possible illegal dumping (Figure 1):

A Dump site with soil stain that appears to be caused by petroleum products.
B. Dump site of automobile fuel tanks and propane fuel tanks.
C. Abandoned mine area where substantial shotgun and rifle/pistol shooting takes place.

Recommendations

During future development within the Sun Valley area, it is recommended that a thorough hazardous materials investigation be conducted to determine the magnitude of contamination at the sites mentioned in this report.

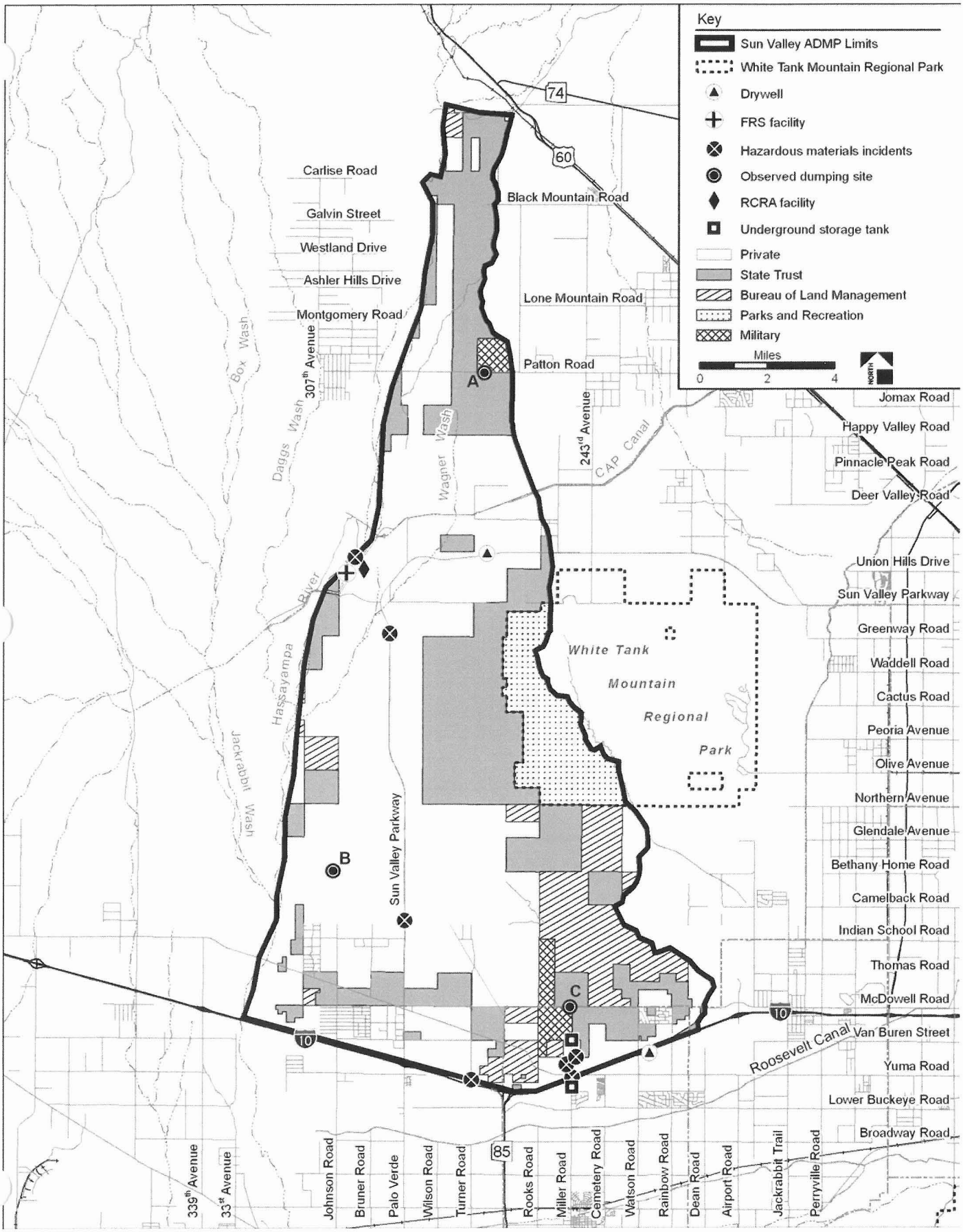

Figure 1. Hazardous materials concerns

Appendix D

Title VI Environmental Justice, prepared by Logan Simpson Design, October 2006

Table 1. 2000 Racial and Ethnic Demographics

Area	Total Population	White		African American		Native American		Asian		Pacific Islander		Two or More Races		Other Race		Hispanic[A]	
		#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
405.09-3	3,035	2,765	91.1	3	0.1	84	2.8	0	0.0	3	0.1	155	5.1	25	0.8	293	9.7
506.01-2	1,938	1,575	81.3	40	2.1	11	0.6	0	0.0	0	0.0	248	12.8	82	4.2	415	27.7
506.01-4	1,982	1,793	90.5	29	1.5	0	0.0	0	0.0	0	0.0	123	6.2	26	1.3	294	18.2
506.02-2	2,721	2,325	85.4	29	1.1	36	1.3	27	1.0	0	0.0	239	8.8	65	2.4	466	21.9
Total Tracts	9,676	8,458	87.4	101	1.0	131	1.4	27	0.3	3	0.0	765	7.9	198	2.0	1,468	18.7
Buckeye town	6,417	4,699	73.2	239	3.7	59	0.9	40	0.6	0	0.0	1,190	18.5	190	3.0	2,288	61.2
Surprise city	30,886	26,667	86.3	874	2.8	91	0.3	249	0.8	17	0.1	2,525	8.2	463	1.5	7,189	32.3
Total Towns	37,303	31,366	84.1	1,113	3.0	150	0.4	289	0.0	17	0.0	3,715	10.0	653	1.8	9,477	36.5
Maricopa County	3,072,149	2,375,391	77.3	111,584	3.6	55,177	1.8	66,294	2.2	3,811	0.1	365,320	11.9	94,572	3.1	763,333	24.8

Source: U.S. Department of Commerce, Bureau of the Census. *Census 2000, Summary File 3.*

Note: See table notes for Table 4, below.

[a] "Hispanic" refers to ethnicity and is derived from the total population, not as a separate race; i.e., it is calculated differently from the other columns in this table.

Table 2. 2000 Total Minority, Age 60 Years and Over, Below Poverty Level, Disabled, and Female Head of Household Populations

Area	Total Population	Total Minority[A]		Elderly		Total Population for Whom Disabled Is Determined	Disabled		Total Population for Whom Poverty Is Determined	Below Poverty Level		House-holds	Female Head of Household	
		#	%	#	%		#	%		#	%		#	%
405.09-3	3,035	408	13.4	901	29.7	2,411	813	33.7	2,350	299	12.7	1,261	231	18.3
506.01-2	1,938	442	22.8	225	11.6	1,493	408	27.3	1,415	73	5.2	612	90	14.7
506.01-4	1,982	367	18.5	179	9.0	1,379	250	18.1	1,311	137	10.5	663	125	18.9
506.02-2	2,721	592	21.8	263	9.7	1,953	474	24.3	1,853	82	4.4	861	89	10.3
Total Tracts	9,676	1,809	18.7	1,568	16.2	7,236	1,945	26.9	6,929	591	8.5	3,397	535	15.7
Buckeye town	6,417	2,676	41.7	1,190	18.5	4,406	1,159	26.3	4,222	601	14.2	2,140	569	26.6
Surprise city	30,886	8,659	28.0	10,549	34.2	25,191	5,498	21.8	24,771	1,657	6.7	12,474	2,178	17.5
Total Towns	37,303	11,335	30.4	11,739	31.5	29,597	6,657	22.5	28,993	2,258	7.8	14,614	2,747	18.8
Maricopa County	3,072,149	1,038,729	33.8	455,849	14.8	2,317,675	478,892	20.7	2,236,838	226,957	10.1	1,133,048	303,905	26.8

Source: U.S. Department of Commerce, Bureau of the Census. *Census 2000, Summary File 3.*

Notes: CT = Census Tract, BG = Block Group, CDP = Census Designated Place, # = Number, % = Percentage.
Shaded areas denote percentages notably higher than comparison areas' percentages.

[a] "Total Minority" is composed of all people who consider themselves Non-White racially plus who consider themselves White Hispanic

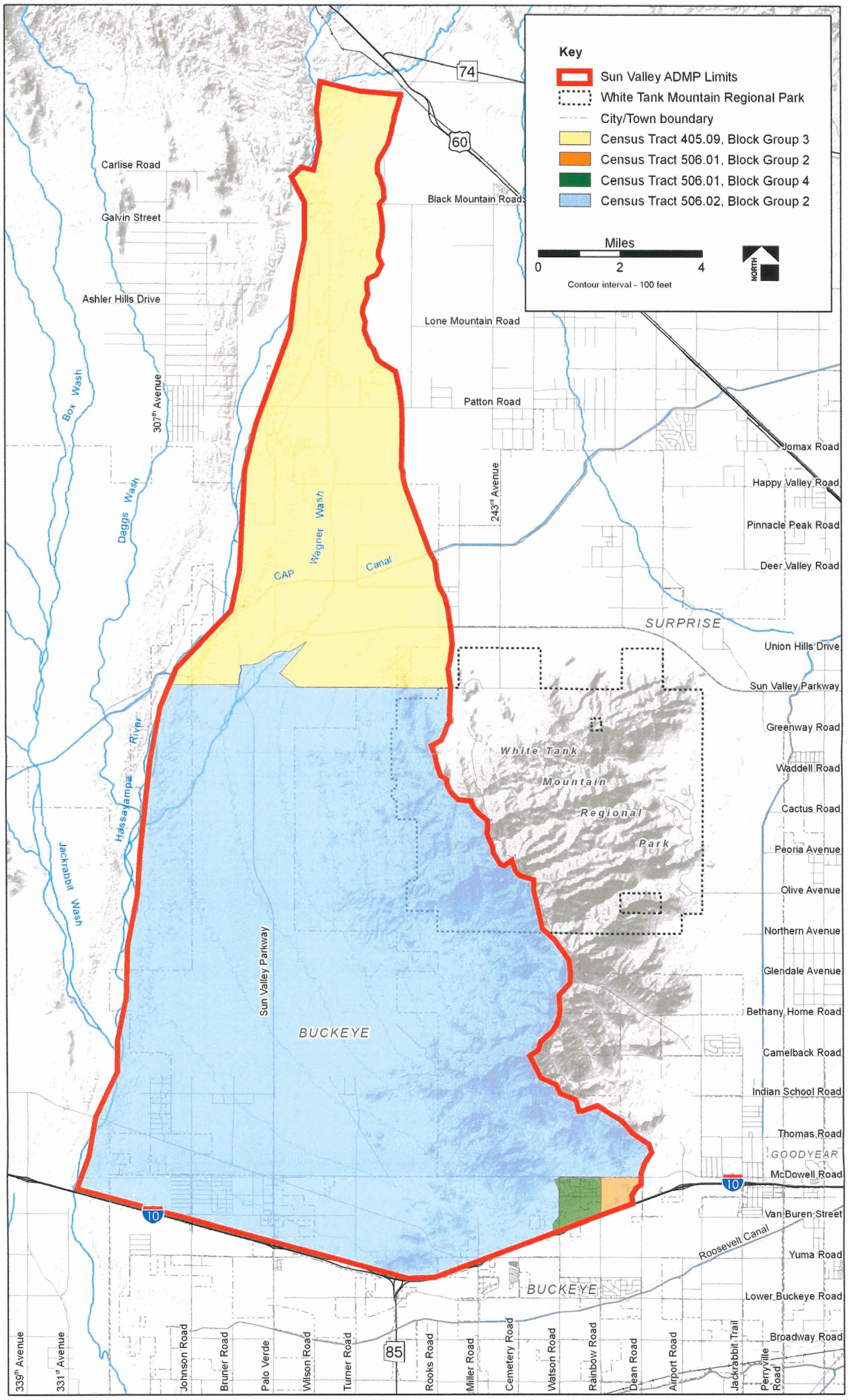

Figure D-1 Census Tracks for Sun Valley ADMP Area