Sun Valley Area Drainage Master Plan

Step 1

Alternatives Formulation and Preliminary Analysis

Flood Control District of Maricopa County

August 2006

SUN VALLEY AREA DRAINAGE MASTER PLAN

STEP 1 ALTERNATIVES FORMULATION AND PRELIMINARY ANALYSIS

Flood Control District of Maricopa County

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ENCLOSED DATA CD INCLUDES:

- **Digital Copy of Report in PDF Format**
- **Database of Data Collected**

SECTION 1: INTRODUCTION

Project Background

The Sun Valley area, located in western Maricopa County, Arizona, is presently experiencing the first stages of accelerated urbanization (Figure 1). 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 2). The upland areas and adjacent watershed drain to the Hassayampa River to the west and the Buckeye Flood Retarding Structures (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. 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:

- 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;
- Plan regional flood hazard mitigation.
- 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;
- Design of landscape aesthetics and visual character in accordance with the District's *Landscape Aesthetics and Multi-Use Consultant Handbook (April 2003)*; and

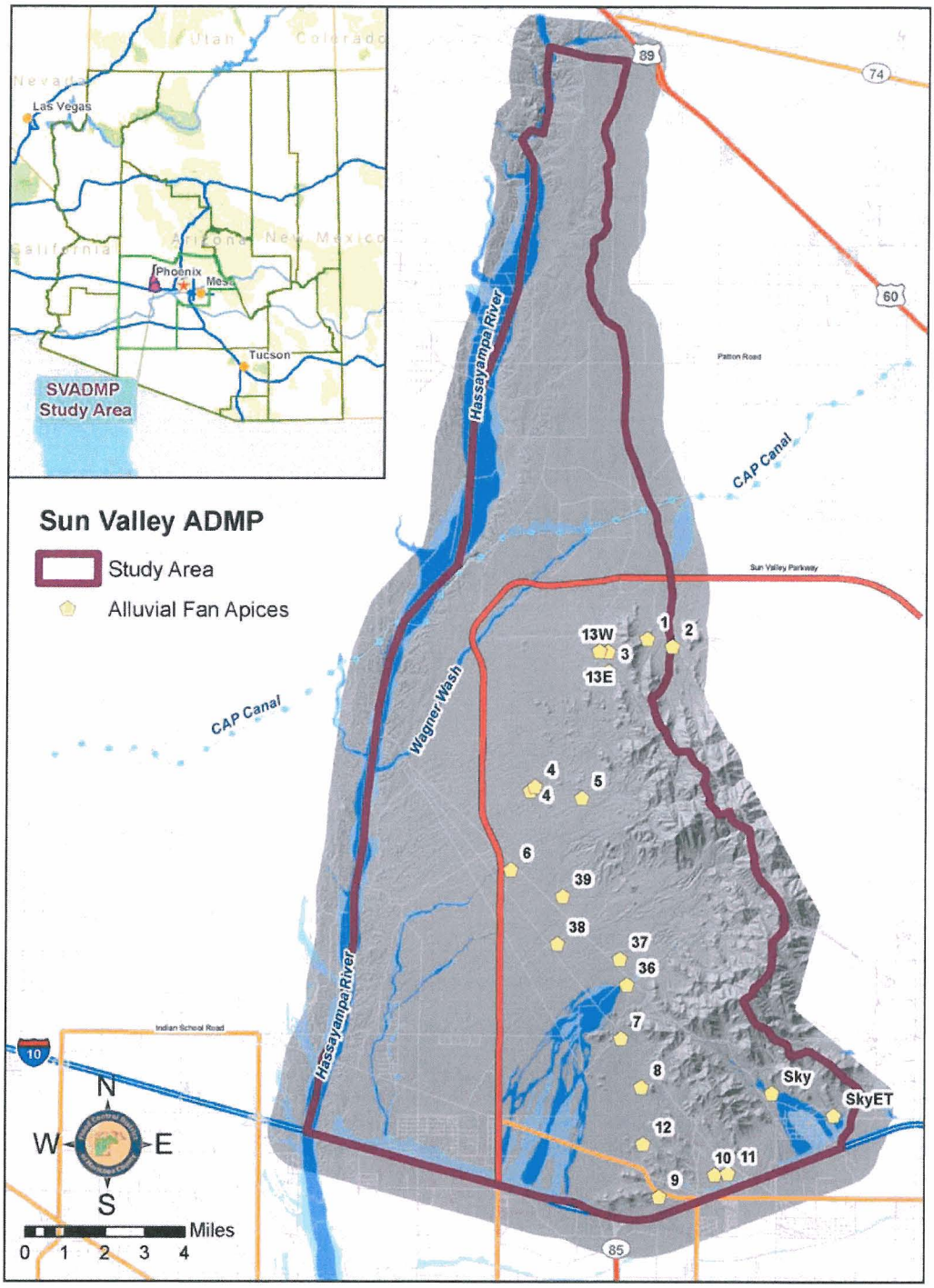

Figure 1: Location of Study Area

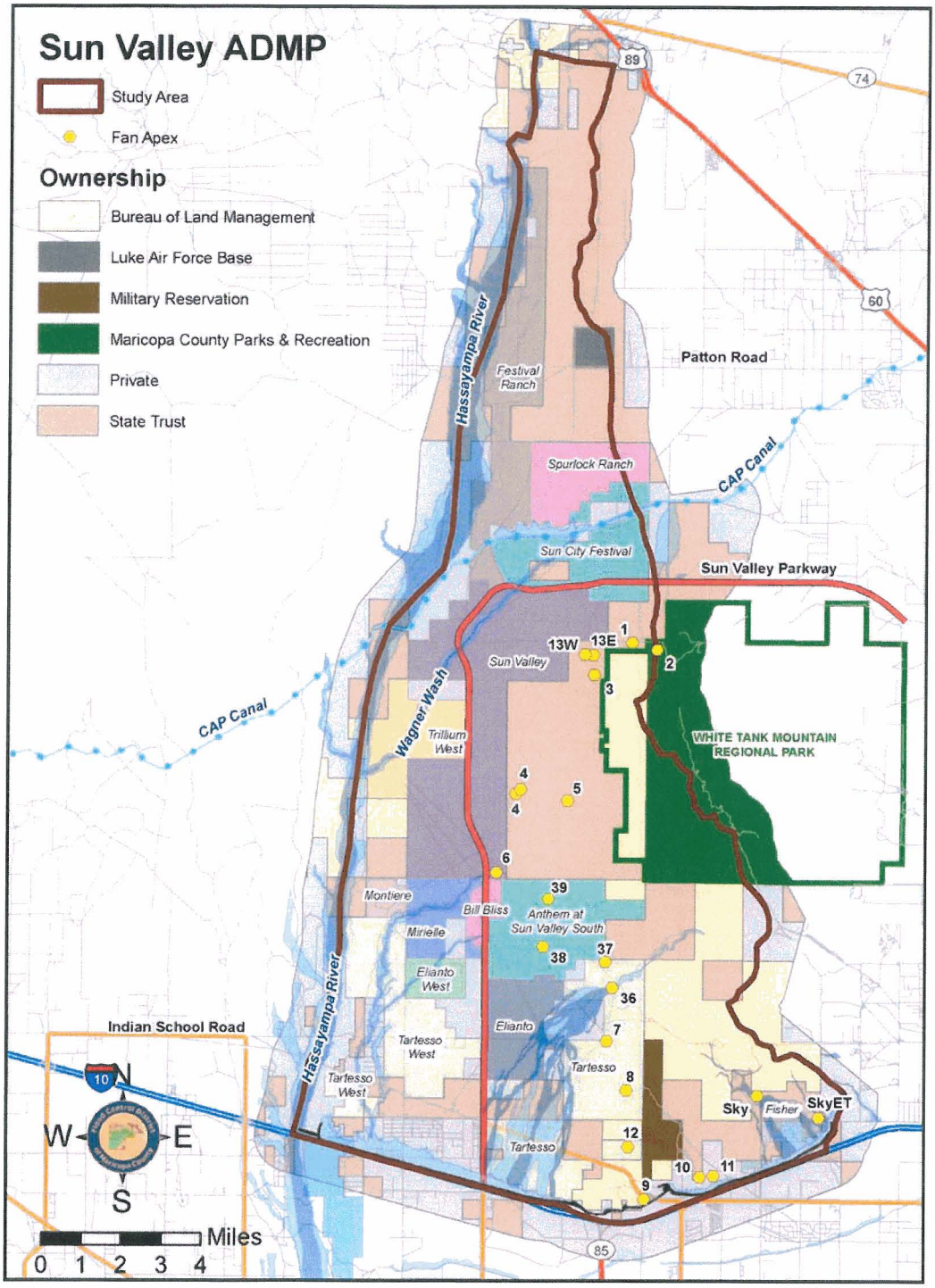

Figure 2: Future Developments in the SVADMP Study Area

The SVADMP is aimed at developing a conceptual drainage plan to aid in the planning of flood control measures. This conceptual drainage plan will provide a roadmap that the developers and jurisdictional authorities can use in mitigating flood hazards up to the 100-year event.

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. Phase II of the SVADMP builds on the Phase I findings by employing a 3-step process with the goal of developing a Recommended Alternative, consisting of both structural and non-structural measures, to address flood hazards in the study area. Figure 3 shows a flowchart illustrating the SVADMP alternatives development process.

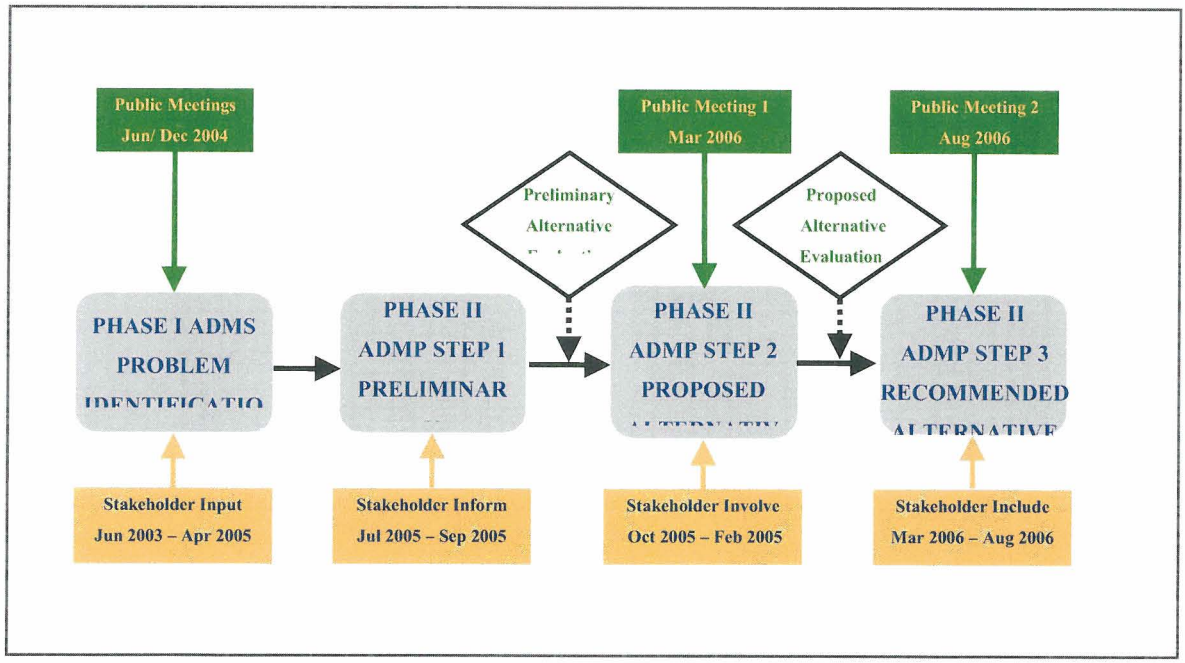

Figure 3: Alternative Development Process

This report summarizes the first of three steps identified within Phase II. This Step 1 Proposed Alternatives Report outlines the Preliminary Alternatives that will be considered for Step 2 Proposed Alternatives. Based upon the recommendations from Step 1, further evaluation of the Preliminary Alternatives will be performed at Step 2 to determine engineering feasibility and approximate costs.

Authority for Study

The current study was authorized by the Flood Control District of Maricopa County (District) under contract FCD 2004C049 as part of the scope of services for the Sun Valley ADMP. The ADMP was performed by JE Fuller/Hydrology & Geomorphology, Inc. (JEF), with subconsultants C.L. Williams Consulting, Inc. (CLW), Logan Simpson Design, Inc. (LSD), EDAW Inc., AMEC Earth & Environmental, and Richard H. French PhD, P.E. on behalf of the Flood Control District of Maricopa County (District).

Location of Study Area

The study area is located in western Maricopa County, Arizona and includes a total watershed area of 183 square miles. Figure 1 shows the location of the study area. Most of the study area is located within the Town of Buckeye. The study area is bounded by the White Tank Mountains (Figure 4) and 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 with the exception of Fan 2 which is a tributary to Trilby Wash. Fan 2 was added to this study because it intermingles with Fan 1. This intermingling means that it needs to be addressed at the same time as Fan 1.

Figure 4: View Northeast Towards White Tank Mountains

SECTION 2: STEP 1 ALTERNATIVES FORMULATION AND PRELIMINARY ANALYSIS

2.1 Brainstorm Meeting

Numerous items were introduced as part of the Brainstorming Meeting and then further developed throughout the Step 1 analysis. This section describes the issues raised as part of the Brainstorming Meeting and shows the outcomes that were developed as a result of these discussions. Included in this section is discussion about the following:

- Alluvial Fan Components (Section 2.2)
- Strategies to address the Alluvial Fan Components (Section 2.3)
- Alternative Formulation and Existing Constraints (Section 2.4)
- Categorizing the Alluvial Fans by Sub-Areas (Section 2.5)

2.2 Alluvial Fan Components

The highly dynamic nature of the alluvial fan flooding presents real challenges in the design of engineered flood control measures to contain and convey discharge and sediment from apex to outfall. The complex physical system presents unique technical challenges in the design of drainage infrastructure that effectively and efficiently conveys 100-year discharges without creating unwanted sediment aggradation or degradation impacts. Further complexity is added as flood hazards change in type and severity with geographic position on the fan depending on whether the area of interest is located at the apex, mid-fan, or near the outfall; and with the occurrence of flood events of frequencies other 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, avulsive movement of defined flow paths, flooding along undefined flow paths, sheet flooding, distributary flow, scour, and landform aggradation. In addition, the steep channel slopes between the fan apices and the fan toes result in high flow velocities with enough energy to move significant volumes of sediment and debris episodically during rare floods.

The Step 1 Preliminary Alternatives Brainstorming Meeting identified five areas along each fan starting from upstream to downstream: 1) Apex 2) Up-Fan 3) Parkway 4) Down-Fan and 5) Outfall (See Figure 5). This classification permits the design process to identify potential design solutions for each of these areas to arrive at a whole-fan solution. The whole fan solution will also provide a regional flood control system which will act as a major trunk system for the adjacent watersheds. Note that most of fans considered in this study have all the five areas, while some of the fans may not have all the five areas. The overall design considerations are similar for all the fans.

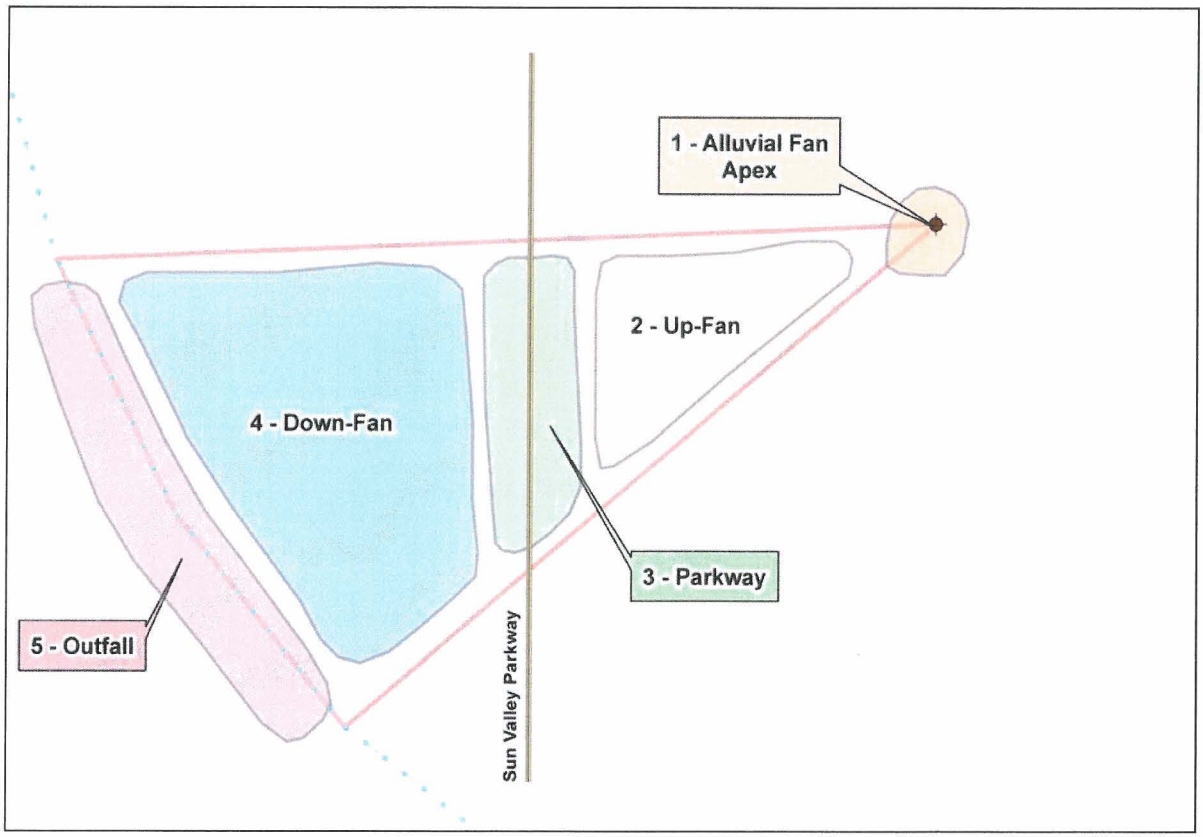

Figure 5: Alluvial Fan Components

Below is a list of each alluvial fan apex and the flood safety issues associated with each one. Figure 6 conceptually depicts each alluvial fan component location.

1) Apex: The problem at the APEX is that overland flow transitions from contained channel flow to uncontained overland flow in unstable and unpredictable flow paths. The widening of the flow results in a decrease in its sediment carrying capacity such that sediment is deposited at the apex and down slope from it.

2) Up Fan: The problem in the UP-FAN area is that overland flow is distributed into multiple braided and unpredictable flow paths.

3) Parkway: The problem at the PARKWAY is that overland flow is delivered to the roadway at multiple locations within the fan area. Discrete discharges at each crossing location are not computable. These locations can change and can require costly lateral and cross drainage structures.

4) Down Fan: The problem at the DOWN-FAN is that overland flow from the parkway is distributed into shallow sheet flow spreading laterally in the streamwise and transverse directions.

5) Outfall: The problem at the OUTFALL is that overland flow delivered from the Down-Fan to the outfall either deposits sediment or headcuts in the upstream direction from the outfall.

2.3 Strategies to Address Alluvial Fan Components

Preliminary Alternatives were identified for each of the five alluvial fan components. These alternatives were divided into structural, non-structural, and no action categories. The structural alternatives where further divided into storage and conveyance categories. Under the non-structural category possible new management strategies are identified. Whereas the no measure option presumes solely that the existing regulations are enforced. For each of these alternatives strengths, weaknesses, opportunities, constraints, comparative expenses, and evaluation criteria are identified. The following tables show these alternatives in order 1) Apex 2) Up Fan 3) Parkway 4) Down Fan and 5) Outfall.

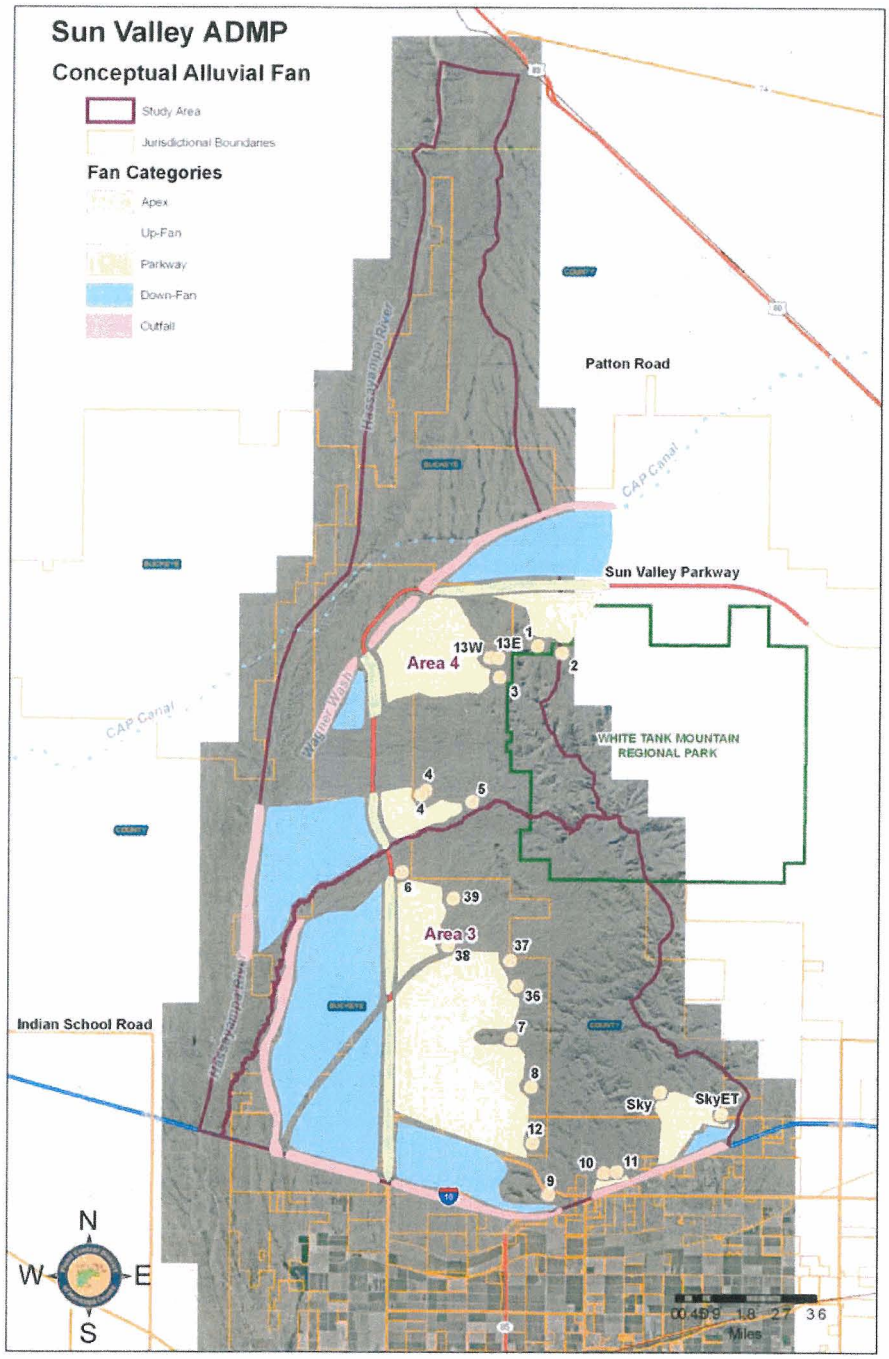

Figure 6: Location of Alluvial Fan Components

Table 1: Strategies for the Apex Conceptual Alluvial Fan Component

1 - APEX: **The problem at the APEX is that overland flow transitions from contained channel flow to uncontained overland flow in unstable and unpredictable flow paths. The widening of the flow results in a decrease in its sediment carrying capacity such that sediment is deposited at the apex and down slope from it.**

Strategy	Measure	Strengths	Weaknesses	Opportunities	Constraints	Costs	Evaluation Criteria
Structural							
STORAGE	**Detention Basin On-line**	1. Controls flow and sediment discharges at apex 2. Increases certainty of drainage design down slope on fan 3. Controls volume and timing of runoff delivered to outfall (e.g., FRS) 4. Provides flexibility to move apex	1. Aesthetic impact to surrounding landscape of hard structural measure (impact severity depends on basin size) 2. Maintenance responsibility and costs 3. Supercritical flow makes these basins ineffective. 4. 404 mitigation measures and costs greater due to larger area of vegetation/ landform disturbance 5. Relatively larger acreage needed for on-line basin footprint	1. Multi-use recreation opportunity 2. Potential aggregate materials source 3. Groundwater recharge possible with augmentation measures (e.g., wells). Recharge opportunity relatively less feasible at apex as compared to farther downstream.	1. Land ownership 2. Steep slope can result in over excavation to provide sufficient basin volume. Want to avoid high embankment within regulatory jurisdiction. 3. Permitting issues 4. Inflow/outflow velocities to basin can be high resulting in erosion 5. Flow is cut off from smaller downstream JD watercourses 6. Site Conditions	Comparatively expensive	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint)
	Detention Basin Off-line	1. Flow-by discharge from smaller events available to feed the vegetation located down slope on fan surface 2. Relatively smaller acreage needed for off-line basin footprint	1. Aesthetics impact to surrounding landscape of hard structural measure (impact severity depends on basin size) 2. Maintenance responsibility and costs 3.Supercritical flow makes these basins ineffective. 4. Difficult to make these basins work hydraulically 5. Less confidence in capturing flows	1. Multi-use recreation opportunity 2. Potential aggregate materials source 3. Groundwater recharge possible with augmentation measures (e.g., wells). Recharge opportunity relatively less feasible at apex as compared to farther downstream.	1. Land ownership 2. Steep slope can result in over excavation to provide sufficient basin volume. Want to avoid high embankment within regulatory jurisdiction 3. Permitting issues 4. Velocities 5. Site Conditions	Comparatively expensive	
	Retention Basin	1. Controls flow and sediment discharges at apex 2. Increases certainty of drainage design down slope on fan	1. Aesthetics impact to surrounding landscape of hard structural measure (impact severity depends on basin size) 2. Maintenance responsibility and costs	1. Multi-use recreation opportunity 2. Potential aggregate materials source 3. Groundwater recharge possible with augmentation measures (e.g., wells). Recharge opportunity relatively less feasible at apex as compared to farther downstream.	1. Land ownership 2. Steep slope can result in over excavation to provide sufficient basin volume. Want to avoid high embankment within regulatory jurisdiction 3. Permitting issues 4. Velocities 5. Site Conditions	Comparatively expensive	
	Erosion Control	1. Increases design life of basin	1. Maintenance responsibility and costs	1. Incorporate erosion control design into aesthetic treatment of basin		Appurtenant to basin cost	
	Sediment Control	1. Increases design life of basin	1. Maintenance responsibility and costs			Appurtenant to basin cost	
CONVEYANCE	**Channel**	1. Moves apex downstream if necessitated by constraints at apex 2. Flow containment above the apex 3. Accommodates wildlife movement	1. Aesthetics of hard structural measure 2. Maintenance responsibility and costs 3. Freeboard uncertainty/ Flow instability	1. Open space corridor 2. Multi-use recreation opportunity/ trail incorporation	1. Land ownership 2. Slope/ velocity 3. Permitting issues 4. FEMA regulations dictate design	Comparatively expensive	
	Levee	1. Moves apex downstream if necessitated by constraints at apex 2. Flow containment above the apex 3. Accommodates wildlife movement 4. Allows flexibility to prevent flow into stable fan areas	1. Aesthetics of hard structural measure 2. Maintenance responsibility and costs 3. Access into drainage corridor blocked 4. Interior drainage problems 5. Freeboard uncertainty/ Flow instability	1. Open space corridor 2. Multi-use recreation opportunity/ trail incorporation 3. May be easily integrated into existing development plans	1. Land ownership 2. Slope/ embankment height 3. Permitting issues 4. FEMA regulations dictate design	Comparatively expensive	
	Diversion	1. Moves apex downstream if necessitated by constraints at apex	1. Maintenance responsibility and costs	1. Open space corridor 2. Multi-use recreation opportunity/ trail incorporation	1. Land ownership 2. Slope/ embankment height 3. Permitting issues	Comparatively expensive	
	Erosion Control	1. Increases design life of conveyance structure	1. Maintenance responsibility and costs	1. Incorporate erosion control design into aesthetic treatment of channel, levee, and/or diversion		Appurtenant to cost of conveyance measure	
Non-Structural							
MANAGEMENT	**Development Guidelines**	1. Prevent/ mitigate impacts of future development 2. Addresses impacts of development above apex to prevent new breakouts	1. Enforcement of guidelines	1. Better manage alluvial fan hazards county-wide 2. Streamline review processes internally		Comparatively inexpensive	
	New Floodplain Delineations	1. Defines floodplain and floodway 2. Prevents encroachment into floodway at apex 3. Maintains aesthetic and habitat value at the apex	1. Does not remove flood hazard 2. Does not address uncertainty of drainage design on fan 3. May give false sense of security for stable areas			Moderately inexpensive	
	Land use and Density Regulations	1. Prevent/ mitigate impacts of future development	1. Enforcement of regulations			Comparatively inexpensive	
No Action							
NO MEASURE	**Existing Regulation Enforcement**	1. Spreads the risk	1. Does not remove flood hazard 2. Does not address uncertainty of drainage design on fan 3. Some areas are not delineated and have no regulation 4. Potential for impacts on adjacent properties			No cost	

Table 2: Strategies for the Up-Fan Conceptual Alluvial Fan Component

2 - UP-FAN:	**The problem in the UP-FAN area is that overland flow is distributed into multiple braided and unpredictable flow paths.**						
Strategy	**Measure**	**Strengths**	**Weaknesses**	**Opportunities**	**Constraints**	**Costs**	**Evaluation Criteria**
Structural							
STORAGE	**Detention Basin On-line**	1. Controls flow and sediment discharges 2. Increases certainty of drainage design down slope on fan 3. Controls volume and timing of runoff delivered to outfall (e.g., FRS) 4. Provides flexibility to move apex	1. Aesthetic impact to surrounding landscape of hard structural measure (impact severity depends on basin size) 2. Maintenance responsibility and costs 3. Supercritical flow makes these basins ineffective. 4. 404 mitigation measures and costs greater due to larger area of vegetation/ landform disturbance 5. Relatively larger acreage needed for on-line basin footprint 6. Low potential for aggregate materials source	1. Multi-use recreation opportunity 2. Groundwater recharge possible with augmentation measures (e.g., wells). Recharge opportunity not significantly better in up-fan than at apex. Recharge credits may be available for opportunistic recharge, but requires inflow/outflow measurements to quantify credits.	1. Land ownership 2. Steep slope can result in over excavation to provide sufficient basin volume. Want to avoid high embankment within regulatory jurisdiction. 3. Permitting issues 4. Inflow/outflow velocities to basin can be high resulting in erosion 5. Flow is cut off from smaller downstream JD watercourses 6. Site Conditions 7. Need to convey discharge to basin if it is not located at apex unless basin spans fan and captures all inflow.	Comparatively expensive	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint)
	Detention Basin Off-line	1. Flow-by discharge from smaller events available to feed the vegetation located down slope on fan surface 2. Relatively smaller acreage needed for off-line basin footprint	1. Aesthetics impact to surrounding landscape of hard structural measure (impact severity depends on basin size) 2. Maintenance responsibility and costs 3.Supercritical flow makes these basins ineffective. 4. Difficult to make these basins work hydraulically 5. Less confidence in capturing flows 6. Low potential for aggregate materials source 7. Off-line basin typically located on prime developable land contiguous to watercourse corridor/ open space.	1. Multi-use recreation opportunity 2. Groundwater recharge possible with augmentation measures (e.g., wells). Recharge opportunity for retention basin possibly better as compared to detention basin (increased contact time). Recharge credits may be available for opportunistic recharge, but requires inflow/outflow measurements to quantify credits.	1. Land ownership 2. Steep slope can result in over excavation to provide sufficient basin volume. Want to avoid high embankment within regulatory jurisdiction 3. Permitting issues 4. Velocities 5. Site Conditions 6. Need to convey discharge to basin if it is not located at apex unless basin spans fan and captures all inflow.	Comparatively expensive	
	Retention Basin	1. Controls flow and sediment discharges 2. Increases certainty of drainage design down slope on fan	1. Aesthetics of hard structural measure 2. Maintenance responsibility and costs 3. Low potential for aggregate materials source	1. Multi-use recreation opportunity 2. Groundwater recharge possible with augmentation measures (e.g., wells). Recharge opportunity not significantly better in up-fan than at apex. Recharge credits may be available for opportunistic recharge, but requires inflow/outflow measurements to quantify credits.	1. Land ownership 2. Slope 3. Permitting issues 4. Need to convey discharge to basin if it is not located at apex unless basin spans fan and captures all inflow.	Comparatively expensive	
	Erosion Control	1. Increases design life of basin	1. Maintenance responsibility and costs	1. Incorporate erosion control design into aesthetic treatment of basin		Appurtenant to basin cost	
	Sediment Control	1. Increases design life of basin	1. Maintenance responsibility and costs			Appurtenant to basin cost	
CONVEYANCE	**Channel**	1. Moves apex downstream if necessitated by constraints at apex 2. Flow containment 3. Accommodates wildlife movement	1. Aesthetics of hard structural measure 2. Maintenance responsibility and costs 3. Freeboard uncertainty/ Flow instability	1. Open space corridor 2. Multi-use recreation opportunity/ trail incorporation	1. Land ownership 2. Slope/ velocity 3. Permitting issues 4. FEMA regulations dictate design	Comparatively expensive	
	Levee	1. Moves apex downstream if necessitated by constraints at apex 2. Flow containment 3. Accommodates wildlife movement 4. Allows flexibility to prevent flow into stable fan areas	1. Aesthetics of hard structural measure 2. Maintenance responsibility and costs 3. Access into drainage corridor blocked 4. Interior drainage problems 5. Freeboard uncertainty/ Flow instability	1. Open space corridor 2. Multi-use recreation opportunity/ trail incorporation 3. May be easily integrated into existing development plans	1. Land ownership 2. Slope/ embankment height 3. Permitting issues 4. FEMA regulations dictate design	Comparatively expensive	
	Diversion	1. Moves apex downstream if necessitated by constraints at apex	1. Maintenance responsibility and costs	1. Open space corridor 2. Multi-use recreation opportunity/ trail incorporation	1. Land ownership 2. Slope/ embankment height 3. Permitting issues	Comparatively expensive	
	Erosion Control	1. Increases design life of conveyance structure	1. Maintenance responsibility and costs	1. Incorporate erosion control design into aesthetic treatment of channel, levee, and/or diversion		Appurtenant to cost of conveyance measure	
Non-Structural							
MANAGEMENT	**Development Guidelines**	1. Prevent/ mitigate impacts of future development 2. Addresses impacts of drainage modifications resulting from development	1. Enforcement of guidelines	1. Better manage alluvial fan hazards county-wide 2. Streamline review processes internally		Comparatively inexpensive	
	New Floodplain Delineations	1. Defines floodplain and floodway 2. Prevents encroachment into floodway 3. Maintains aesthetic and habitat value	1. Does not remove flood hazard 2. Does not address uncertainty of drainage design on fan 3. May give false sense of security for stable areas			Moderately inexpensive	
	CLOMR	1. Hazard and mitigation measures are identified.			1. CLOMR only if structural measure is implemented.	Moderately inexpensive	
No Action							
NO MEASURE	**Existing Regulation Enforcement**	1. Spreads the risk	1. Does not remove flood hazard 2. Does not address uncertainty of drainage design on fan 3. Some areas are not delineated and have no regulation 4. Potential for impacts on adjacent properties			No cost	

Table 3: Strategies for the Parkway Conceptual Alluvial Fan Component

3 - PARKWAY: **The problem at the PARKWAY is that overland flow is delivered to the roadway at multiple locations within the fan area. Discrete discharges at each crossing location are not computed. These locations can change and can require costly lateral and cross drainage structures.**

Strategy	Measure	Strengths	Weaknesses	Opportunities	Constraints	Costs	Evaluation Criteria
Structural							
STORAGE	**Detention Basin On-line**	1. Controls flow and sediment discharges 2. Increases certainty of drainage design down slope on fan 3. Controls volume and timing of runoff delivered to outfall (e.g., FRS)	1. Aesthetic impact to surrounding landscape of hard structural measure (impact severity depends on basin size) 2. Maintenance responsibility and costs 3. Supercritical flow makes these basins ineffective. 4. 404 mitigation measures and costs greater due to larger area of vegetation/ landform disturbance 5. Relatively larger acreage needed for on-line basin footprint 6. Low potential for aggregate materials source	1. Multi-use recreation opportunity 2. Groundwater recharge possible with augmentation measures (e.g., wells). Recharge credits may be available for opportunistic recharge, but requires inflow/outflow measurements to quantify credits.	1. Land ownership 2. Steep slope can result in over excavation to provide sufficient basin volume. Want to avoid high embankment within regulatory jurisdiction. 3. Permitting issues 4. Inflow/outflow velocities to basin can be high resulting in erosion 5. Flow is cut off from smaller downstream JD watercourses 6. Site Conditions 7. Need to convey discharge to basin if it is not located at apex unless basin spans fan and captures all inflow.	Comparatively expensive	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint)
	Detention Basin Off-line	1. Flow-by discharge from smaller events available to feed the vegetation located down slope on fan surface 2. Relatively smaller acreage needed for off-line basin footprint	1. Aesthetics impact to surrounding landscape of hard structural measure (impact severity depends on basin size) 2. Maintenance responsibility and costs 3.Supercritical flow makes these basins ineffective. 4. Difficult to make these basins work hydraulically 5. Less confidence in capturing flows 6. Low potential for aggregate materials source 7. Off-line basin typically located on prime developable land contiguous to watercourse corridor/ open space.	1. Multi-use recreation opportunity 2. Groundwater recharge possible with augmentation measures (e.g., wells). Recharge opportunity for retention basin possibly better as compared to detention basin (increased contact time). Recharge credits may be available for opportunistic recharge, but requires inflow/outflow measurements to quantify credits.	1. Land ownership 2. Steep slope can result in over excavation to provide sufficient basin volume. Want to avoid high embankment within regulatory jurisdiction 3. Permitting issues 4. Velocities 5. Site Conditions 6. Need to convey discharge to basin if it is not located at apex unless basin spans fan and captures all inflow.	Comparatively expensive	
	Retention Basin	1. Controls flow and sediment discharges 2. Increases certainty of drainage design down slope on fan	1. Aesthetics of hard structural measure 2. Maintenance responsibility and costs 3. Low potential for aggregate materials source	1. Multi-use recreation opportunity 2. Groundwater recharge possible with augmentation measures (e.g., wells). Recharge credits may be available for opportunistic recharge, but requires inflow/outflow measurements to quantify credits.	1. Land ownership 2. Slope 3. Permitting issues 4. Need to convey discharge to basin if it is not located at apex unless basin spans fan and captures all inflow.	Comparatively expensive	
	Erosion Control	1. Increases design life of basin	1. Maintenance responsibility and costs	1. Incorporate erosion control design into aesthetic treatment of basin		Appurtenant to basin cost	
	Sediment Control	1. Increases design life of basin	1. Maintenance responsibility and costs			Appurtenant to basin cost	
CONVEYANCE	**Channel**	1. Conveys flows parallel to and across the parkway in a controlled manner 2. Increase hydraulic efficiency and predictability of flows	1. Aesthetics of hard structural measure 2. Maintenance responsibility and costs 3. Lateral drainage channels could limit development in prime commercial corridor along the parkway	1. Open space corridor 2. Multi-use recreation opportunity/ trail incorporation 3. Regional opportunity for a linear park along the parkway for connectivity between master planned communities	1. Land ownership 2. Slope/ velocity 3. Permitting issues	Comparatively expensive	
	Levee	1. Conveys flows parallel to and across the parkway in a controlled manner	1. Aesthetics of hard structural measure 2. Maintenance responsibility and costs		1. Land ownership 2. Slope/ embankment height 3. Permitting issues	Comparatively expensive	
	Diversion	1. Conveys flows parallel to and across the parkway in a controlled manner	1. Maintenance responsibility and costs		1. Land ownership 2. Slope 3. Permitting issues	Comparatively expensive	
	Bridges	1. Enhancement of wildlife/equestrian/trail systems crossing the parkway 2. Flexibility in handling sediment	1. Less sediment maintenance	1. Open space corridor 2. Multi-use recreation opportunity/ trail incorporation	1. Development downstream of the parkway has been designed using the culvert capacity as the design discharge.	Comparatively expensive	
	Culverts	1. Culverts are already existing in-place	1. Maintenance responsibility and costs 2. High level of sediment maintenance required		1. Development downstream of the parkway has been designed using the culvert capacity as the design discharge.	Moderately expensive	
	Erosion Control	1. Increases design life of conveyance structure	1. Maintenance responsibility and costs	1. Incorporate erosion control design into aesthetic treatment of channel, levee, and/or diversion		Appurtenant to cost of conveyance measure	
Non-Structural							
MANAGEMENT	**Development Guidelines**	1. Prevent/ mitigate impacts of future development 2. Addresses impacts of drainage modifications resulting from development	1. Enforcement of guidelines	1. Better manage alluvial fan hazards county-wide 2. Streamline review processes internally		Comparatively inexpensive	
	New Floodplain Delineations	1. Defines floodplain and floodway 2. Prevents encroachment into floodway 3. Maintains aesthetic and habitat value	1. Does not remove flood hazard 2. Does not address uncertainty of drainage design on fan 3. May give false sense of security for stable areas			Moderately inexpensive	
	CLOMR	1. Hazard and mitigation measures are identified.			1. CLOMR only if structural measure is implemented.	Moderately inexpensive	
No Action							
NO MEASURE	**Existing Regulation Enforcement**	1. Regulatory acceptance 2. Less disturbance	1. Does not remove flood hazard 2. Does not address uncertainty of drainage design on fan			No cost	

Table 4: Strategies for the Down-Fan Conceptual Alluvial Fan Component

4 - DOWN-FAN:	The problem at the DOWN-FAN is that overland flow from the parkway is distributed into shallow sheetflow spreading laterally in the streamwise and transverse directions.						
Strategy	**Measure**	**Strengths**	**Weaknesses**	**Opportunities**	**Constraints**	**Costs**	**Evaluation Criteria**
Structural							
STORAGE	**Detention Basin On-line**	1. Controls flow discharges 2. Increases certainty of drainage design down slope on fan 3. Controls volume and timing of runoff delivered to outfall (e.g., FRS)	1. Aesthetic impact to surrounding landscape of hard structural measure (impact severity depends on basin size) 2. Maintenance responsibility and costs 3. Supercritical flow makes these basins ineffective. 4. 404 mitigation measures and costs greater due to larger area of vegetation/ landform disturbance 5. Relatively larger acreage needed for on-line basin footprint 6. No potential aggregate materials source	1. Multi-use recreation opportunity 2. Groundwater recharge possible with augmentation measures (e.g., wells). Recharge opportunity not significantly better in down-fan than at apex. Recharge credits may be available for opportunistic recharge, but requires inflow/outflow measurements to quantify credits.	1. Land ownership - Fractured private ownership and county island are constraints 2. Steep slope can result in over excavation to provide sufficient basin volume. Want to avoid high embankment within regulatory jurisdiction. 3. Permitting issues 4. Inflow/outflow velocities to basin can be high resulting in erosion 5. Flow is cut off from smaller downstream JD watercourses 6. Site Conditions 7. Need to convey discharge to basin if it is not located at apex unless basin spans fan and captures all inflow.	Comparatively expensive	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint)
	Detention Basin Off-line	1. Flow-by discharge from smaller events available to feed the vegetation located down slope on fan surface 2. Relatively smaller acreage needed for off-line basin footprint	1. Aesthetics impact to surrounding landscape of hard structural measure (impact severity depends on basin size) 2. Maintenance responsibility and costs 3.Supercritical flow makes these basins ineffective. 4. Difficult to make these basins work hydraulically 5. Less confidence in capturing flows 6. No potential aggregate materials source 7. Off-line basin typically located on prime developable land contiguous to watercourse corridor/ open space.	1. Multi-use recreation opportunity 2. Groundwater recharge possible with augmentation measures (e.g., wells). Recharge opportunity for retention basin possibly better as compared to detention basin (increased contact time). Recharge credits may be available for opportunistic recharge, but requires inflow/outflow measurements to quantify credits.	1. Land ownership - Fractured private ownership and county island are constraints 2. Steep slope can result in over excavation to provide sufficient basin volume. Want to avoid high embankment within regulatory jurisdiction 3. Permitting issues 4. Velocities 5. Site Conditions 6. Need to convey discharge to basin if it is not located at apex unless basin spans fan and captures all inflow.	Comparatively expensive	
	Retention Basin	1. Controls flow and sediment discharges 2. Increases certainty of drainage design down slope on fan	1. Aesthetics of hard structural measure 2. Maintenance responsibility and costs 3. No potential aggregate materials source	1. Multi-use recreation opportunity 2. Groundwater recharge possible with augmentation measures (e.g., wells). Recharge opportunity not significantly better in down-fan than at apex. Recharge credits may be available for opportunistic recharge, but requires inflow/outflow measurements to quantify credits.	1. Land ownership - Fractured private ownership and county island are constraints 2. Slope 3. Permitting issues 4. Need to convey discharge to basin if it is not located at apex unless basin spans fan and captures all inflow.	Comparatively expensive	
	Erosion Control	1. Increases design life of basin	1. Maintenance responsibility and costs	1. Incorporate erosion control design into aesthetic treatment of basin		Appurtenant to basin cost	
	Sediment Control	1. Increases design life of basin	1. Maintenance responsibility and costs			Appurtenant to basin cost	
CONVEYANCE	**Channel**	1. Flow containment 2. Accommodates wildlife movement 3. Channel connection to parkway culverts	1. Aesthetics of hard structural measure 2. Maintenance responsibility and costs 3. Freeboard uncertainty/ Flow instability	1. Open space corridor 2. Multi-use recreation opportunity/ trail incorporation	1. Land ownership - Fractured private ownership and county island are constraints 2. Slope/ velocity 3. Permitting issues 4. FEMA regulations dictate design	Comparatively expensive	
	Levee	1. Moves apex downstream if necessitated by constraints at apex 2. Flow containment 3. Accommodates wildlife movement 4. Allows flexibility to prevent flow into stable fan areas	1. Aesthetics of hard structural measure 2. Maintenance responsibility and costs 3. Access into drainage corridor blocked 4. Interior drainage problems 5. Freeboard uncertainty/ Flow instability	1. Open space corridor 2. Multi-use recreation opportunity/ trail incorporation 3. May be easily integrated into existing development plans	1. Land ownership - Fractured private ownership and county island are constraints 2. Slope/ embankment height 3. Permitting issues 4. FEMA regulations dictate design	Comparatively expensive	
	Diversion	1. Moves apex downstream if necessitated by constraints at apex	1. Maintenance responsibility and costs	1. Open space corridor 2. Multi-use recreation opportunity/ trail incorporation	1. Land ownership - Fractured private ownership and county island are constraints 2. Slope/ embankment height 3. Permitting issues	Comparatively expensive	
	Erosion Control	1. Increases design life of conveyance structure	1. Maintenance responsibility and costs	1. Incorporate erosion control design into aesthetic treatment of channel, levee, and/or diversion		Appurtenant to cost of conveyance measure	

Continued on next page.

Non-Structural							
MANAGEMENT	**Development Guidelines**	1. Prevent/ mitigate impacts of future development 2. Addresses impacts of drainage modifications resulting from development	1. Enforcement of guidelines	1. Better manage alluvial fan hazards county-wide 2. Streamline review processes internally	1. Land ownership - Fractured private ownership and county island are constraints	Comparatively inexpensive	
	Flood Prone Property Acquisition Program	1. Removes existing residents from flood hazard areas	1. Does not remove flood hazard 2. Does not address uncertainty of drainage design on fan		1. Land ownership - Fractured private ownership and county island are constraints	Moderately expensive	
	New Floodplain Delineations	1. Defines floodplain and floodway 2. Prevents encroachment into floodway 3. Maintains aesthetic and habitat value	1. Does not remove flood hazard 2. Does not address uncertainty of drainage design on fan 3. May give false sense of security for stable areas			Moderately inexpensive	
	CLOMR	1. Hazard and mitigation measures are identified.			1. CLOMR only if structural measure is implemented.	Moderately inexpensive	
	Erosion Hazard Delineation	1. Defines limits of erosion hazard	1. Does not remove erosion hazard 2. Does not address uncertainty of drainage design on fan 3. Limited by data needs. More defined along relatively stable flow paths. More subjective along unstable, weakly defined flow paths. Need discharge Q to determine.			Moderately inexpensive	
	Floodproofing	1. Mitigates flood hazard to residences	1. Does not remove flood hazard 2. Does not address uncertainty of drainage design on fan 3. Flood proofing measures may have unintended negative impacts on adjacent properties		1. Land ownership - Fractured private ownership and county island are constraints	Comparatively inexpensive	
No Action							
NO MEASURE	**Existing Regulation Enforcement**	1. Regulatory acceptance 2. Less disturbance	1. Does not remove flood hazard 2. Does not address uncertainty of drainage design on fan			No cost	

Table 5: Strategies for the Outfall Conceptual Alluvial Fan Component

5 - OUTFALL:	The problem at the OUTFALL is that overland flow delivered from the Down-Fan to the outfall either deposits sediment or headcuts in the upstream direction from the outfall.						
Strategy	**Measure**	**Strengths**	**Weaknesses**	**Opportunities**	**Constraints**	**Costs**	**Evaluation Criteria**
			Structural				
STORAGE	**FRS Storage Adjustments**	1. Addresses potential need for increased storage to account for runoff volume differences resulting from upslope implementation of alternatives	1. Maintenance responsibilities and costs 2. Does not address fan flooding hazard	1. Multi-use recreation opportunities	1. Permitting issues	Comparatively expensive	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint)
CONVEYANCE	**Replace Dam with a Channel**			1. Possible linkage to Buckeye FRS #1 Rehabilitation Project alternatives	1. Permitting issues		
			Non-Structural				
MANAGEMENT	**Supplemental O & M of the FRS**	1. Addresses potential need for increased sediment removal due to increased sediment inflow resulting from upslope implementation of alternatives					
			No Action				
NO MEASURE	**Existing Regulation Enforcement**	1. Regulatory acceptance 2. Less disturbance	1. Does not remove flood hazard 2. Does not address uncertainty of drainage design on fan			No cost	
	Existing O & M of the FRS					No cost	

2.4 Alternative Formulation and Existing Constraints

The Step 1 Preliminary Alternatives Evaluation Task identifies many of the existing infrastructure and management guidelines. Data and information describing existing constraints was obtained from numerous sources including the Sun Valley ADMS which preceded this ADMP. Figure 8 shows many of the existing constraints identified from this data collection effort. There are FEMA approved floodplains and floodways for the Hassayampa River, Wagner Wash, and White Tank Mountain Wash, Fan 36, Fan 2 and the two fans located at Skyline Wash (Sky and SkyET). Sun Valley Parkway cross drainage culverts were installed according to the designs of Collar, Williams & White Engineering (1987). In 2005 the conditions of these culverts was rated from 'A' to 'D' in Entellus's Sun Valley Parkway Culvert Evaluation report. Entellus assigned a rating of 'A' for culverts which had little to no evidence of sedimentation and/or scour at either the upstream or downstream end of the Sun Valley Parkway, while a 'D' was designated for culverts with extensive sedimentation and/or scour. The CAP canal is another existing constraint with two overchutes which accommodate large flows only - one located at Sta. 181+00 and the other at Sta. 248+00 (Figure 7). Land ownership including future master planned communities were identified and data was collected. The data collection sources have been tracked and logged in a database and is included on the CD attached to the end of this report. The existing constraints are explored in further detail on a sub-area basis (see Section 2.5).

Figure 7: View Downstream of CAP Overchute at Station 248+00

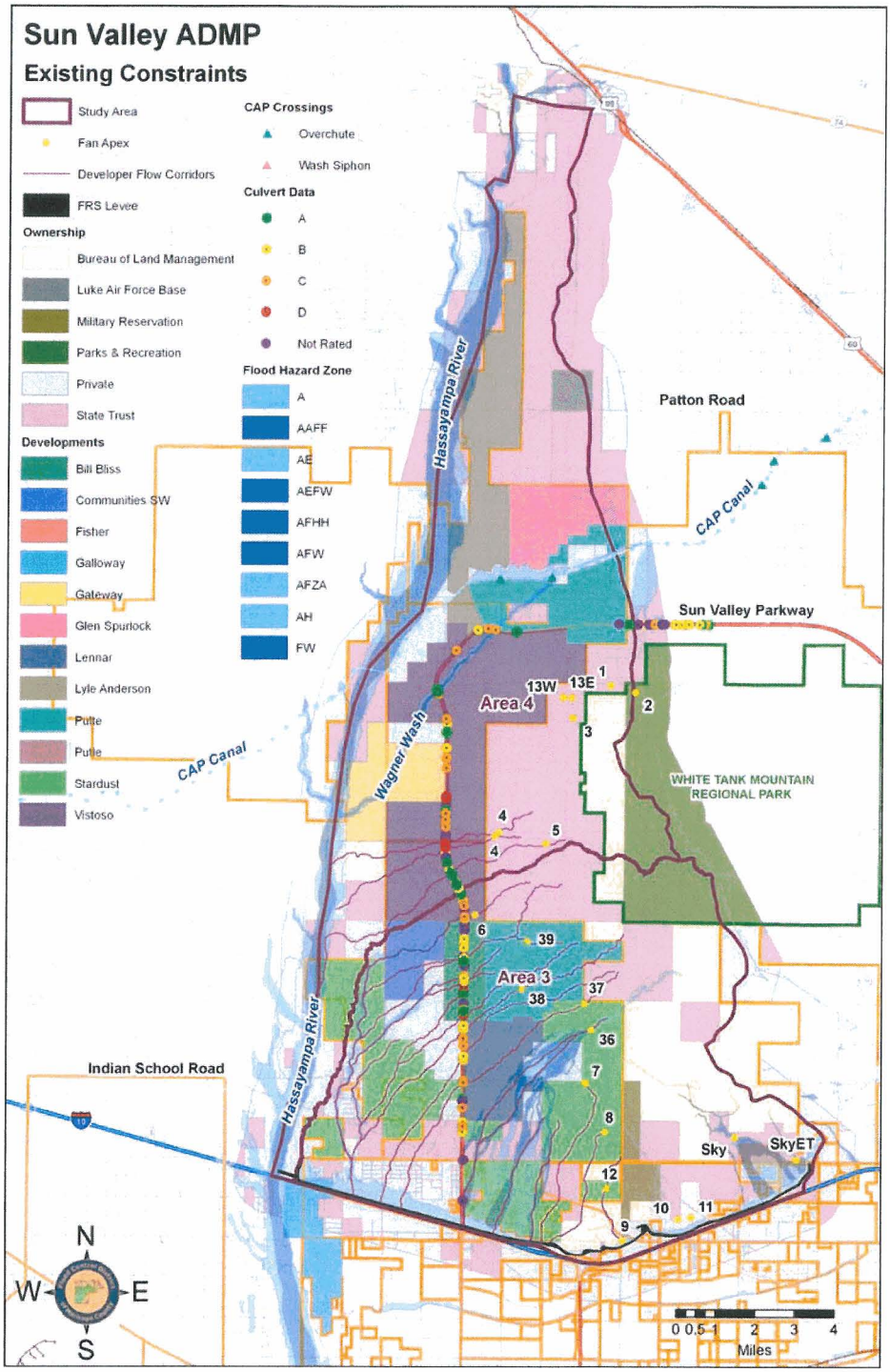

Figure 8: Existing Constraints Map

The Step 1 Preliminary Alternatives Evaluation Task determined that the many aspects available for flood control at each alluvial fan component (Section 2.3) are ultimately driven by what is implemented at the alluvial fan apex. Thus the analysis of each alluvial fan component individually transitioned into the development of whole-fan strategies. The whole fan strategy is driven by the selected flood control measure at the apex, and each alluvial fan component that follows is dependent upon that measure. Four Preliminary Alternatives resulted, namely Alternative A, Alternative B, Alternative C, and Alternative D. Alternatives A, B, and C are based upon the flood control option applied at the alluvial fan apex. For example, Alternative B uses a basin to control flows at the alluvial fan apex and therefore is expected to minimize the size of conveyance corridors and number of basins in the down-fan direction. Alternative D explores the possibilities of using "No Measure" (existing regulation enforcement) at all five alluvial fan components. The following discussion provides an overview of each alternative.

2.4.1 Alternative A

The region downstream of the apex represents an area of significant alluvial fan instability. The alluvial fan instability, in turn, results in the uncertainty of flow paths. The region of significant alluvial fan instability can be identified to a reasonable extent. The Step 1 process defines Alternative A as "No Measure" at the apex. The main design objective of this alternative is to allow the natural geomorphic processes to occur within a designated active area downstream of the apex. Downstream of this region of active fan processes, flows will be captured via diversion levees/dikes, collector channels, and/or basins. Once collected, the flows are routed downstream using open channels, culverts, and detention/retention basins (as needed) until the flows reach the outfall. The advantage of Alternative A is that it minimizes environmental impacts near the apex by preserving existing natural conditions. The disadvantage is that no mitigation management can effectively be enforced unless the land is purchased by the managing entity.

2.4.2 Alternative B

Alternative B is based on a storage strategy at the apex. The purpose of Alternative B is to capture all of the upstream flow at the apex using on-line detention basins. The presence of the detention basins eliminates the downstream alluvial fan uncertainties by controlling flow all the way from the apices to the outfall. Once collected into the detention basins, flows are routed downstream using open channels, culverts, and detention/retention basins (as needed) until the flows reach the outfall.

This approach increases channel stability by eliminating flow path uncertainty beginning at the apex. This alternative also offers better management of sedimentation issues. In addition, the alternative provides a continuous, comprehensive flood control trunk system. The trunk system is designed to convey apex flow and sediment, plus local runoff and sediment generated on the fan surface, thus minimizing the impacts of phasing for developments in the Sun Valley Area.

The use of retention basins only at the apex is also a viable option under Alternative B. Using retention basins at the apex would allow flows to be metered to existing washes downstream of the apex eliminating the need engineered channels in the downstream direction. The primary disadvantage to Alternative B is the land costs associated with the basins at the apex

2.4.3 Alternative C

Alternative C is based on the concept of an excavated concrete-lined channel from the apex to the outfall. No basin is provided at the apex. This alternative requires that channels be designed for higher velocities or that sedimentation basins be provided throughout the system. The advantages of Alternative C include reduced land cost due to lack of a basin near the apex and smaller channel land areas. The concrete channels are easier to maintain as well. The disadvantages are that the concrete channels are not as aesthetically appealing, present significant regulatory permitting challenges, and are less amenable for multi-use opportunities, the high cost of construction due to excavation and concrete lining, and sedimentation issues.

2.4.4 Alternative D

Alternative D follows the "No Measure" strategy of using only existing management and planning practices. This alternative relies on existing drainage facilities or new master-planned communities developing their own drainage infrastructure. Current drainage ordinances and floodplain regulations are enforced to ensure adequate flood hazard mitigation measures. Enforcement options can be enhanced by developing new alluvial fan floodplain delineations.

The major advantage of this alternative is that no immediate and expensive action is needed from the District. The main disadvantage compared to the other alternatives is that there will be no regional whole-fan flood control system leading to unnecessary redundancies and/or potential planning problems. This measure is also likely to leave portions of unstable, active alluvial fan areas open and undeveloped.

As part of the Step 1 analysis, stakeholder meetings were held in part to determine the plans and stages of developers. The stage as of the August 16, 2005 Stakeholder Working Group meeting of each known development is given in Table 6. During this meeting it became evident that most developers were most concerned about CWA Section 404 permitting as it related to development plans and drainage issues. Figure 9 shows the preliminary land use plans for many of the developers within the SVADMP boundary.

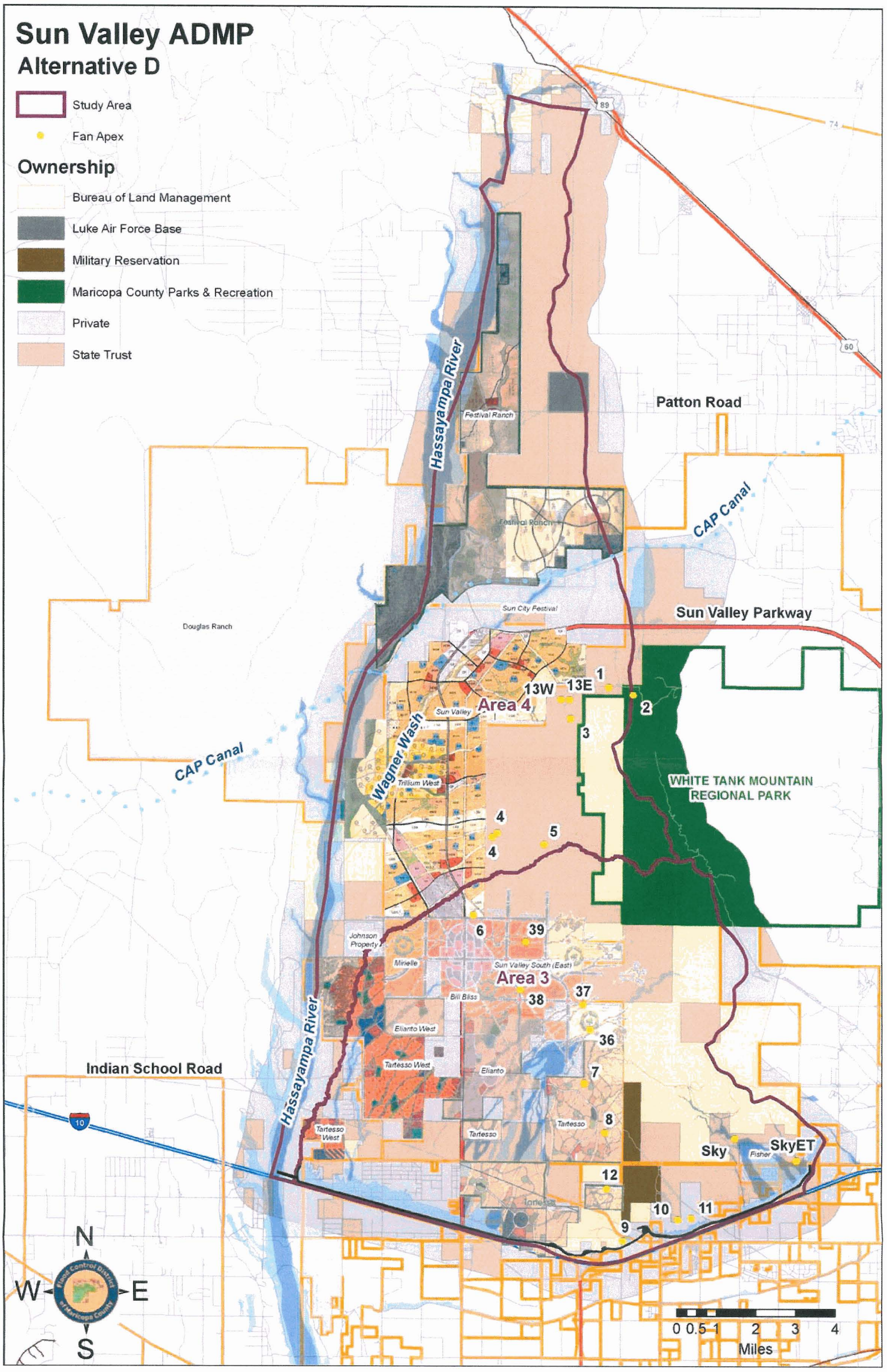

Figure 9: Development Land Use Plans

Table 6: Development Information

Table 6: Development Names, Developer Names, Engineering Firms and Status			
Development	**Developer**	**Engineering Firm**	**Status of Development as of Aug. 16, 2005 Meeting**
Commercial-Bill Bliss	Bill Bliss	None	
Elianto	Lennar	CVL	Preliminary plat has been approved. Application in for 404 permit.
Festival Ranch	Lyle Anderson	WRG Design	Preliminary Stages
Fisher Properties	Fisher	None	No engineering underway at this time.
Johnson Property	Westpac	DEA	Just completed 404.
Mixed Use-Sun Valley Prkwy	None	None	
Spurlock Ranch	Glen Spurlock	CMX	Reportedly has an approved drainage plan.
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.
Sun Valley South (East)	Pulte	CMX	Preparing Land. 404 permit is being submitted
Sun Valley South (West)	Communities SW	WRG Design	Preliminary planning stages. No 404 applications at this time.
Sundance #7	Buckeye Land, L.L.C.	RBF Consulting	
Tartesso	Stardust	DEA	Drainage Report for Tartesso Units 1 and 2a completed
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

2.5 Sub-Areas

To aid in the Step 1 process, the following seven sub-areas for the Sun Valley ADMP were identified: 1) CAP 2) Wagner Wash 3) Hassayampa River, 4) White Tanks Wash, 5) FRS #1, 6) FRS #2 & #3 and 7) Area 4 North of CAP . The sub-areas are based on the outfall locations and all the fans discharging to the particular outfall location within that sub-area. For example, all fans outfalling into

Wagner Wash are included in the Wagner Wash sub-area. The sub-areas also represent the hydrologic watershed for the particular outfall location. The sub-area boundaries are shown in Figure 10. A more detailed discussion of each of the sub-areas follows.

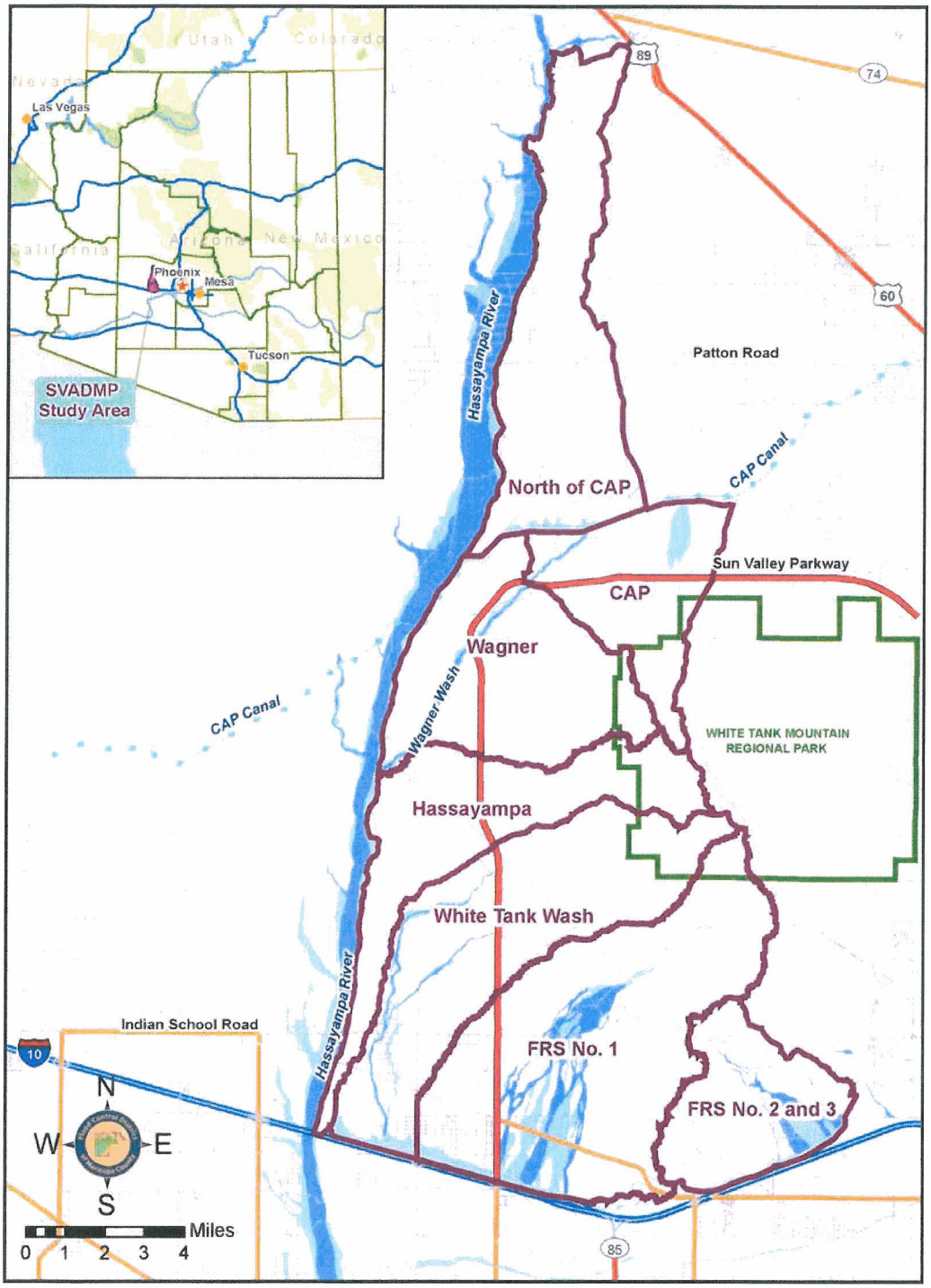

Figure 10: Sub-Areas for SVADMP

2.5.1 CAP Sub-Area:

The CAP sub-area is located on the northern end of the White Tank Mountains. Two primary alluvial fans, designated Fan 1 and Fan 2, drain from the White Tank Mountain Regional Park onto the piedmont in this sub-area. The sub-area is bisected by the Sun Valley Parkway which runs east to west across the CAP sub-area. Existing drainage facilities along the Sun Valley Parkway consist of culverts beneath the roadway in the Fan 2 portion of the piedmont and an earthen channel that transitions into a concrete channel with numerous drop structures (Figure 11) along the south side of the parkway in the Fan 1 portion of the sub-area. For Fan 2 there has been a FEMA approved floodplain as depicted in Figure 12. The following tables describe each of the four alternatives (A-D) with some of the specific considerations pertinent to the CAP sub-area in terms of selected strategy, justification, costs, and impacts (i.e. flood safety, physical/natural environment, cultural/visual resources, and socioeconomics). The evaluation criteria are also listed.

Figure 11: Existing Channel along Sun Valley Parkway (CAP Sub-Area)

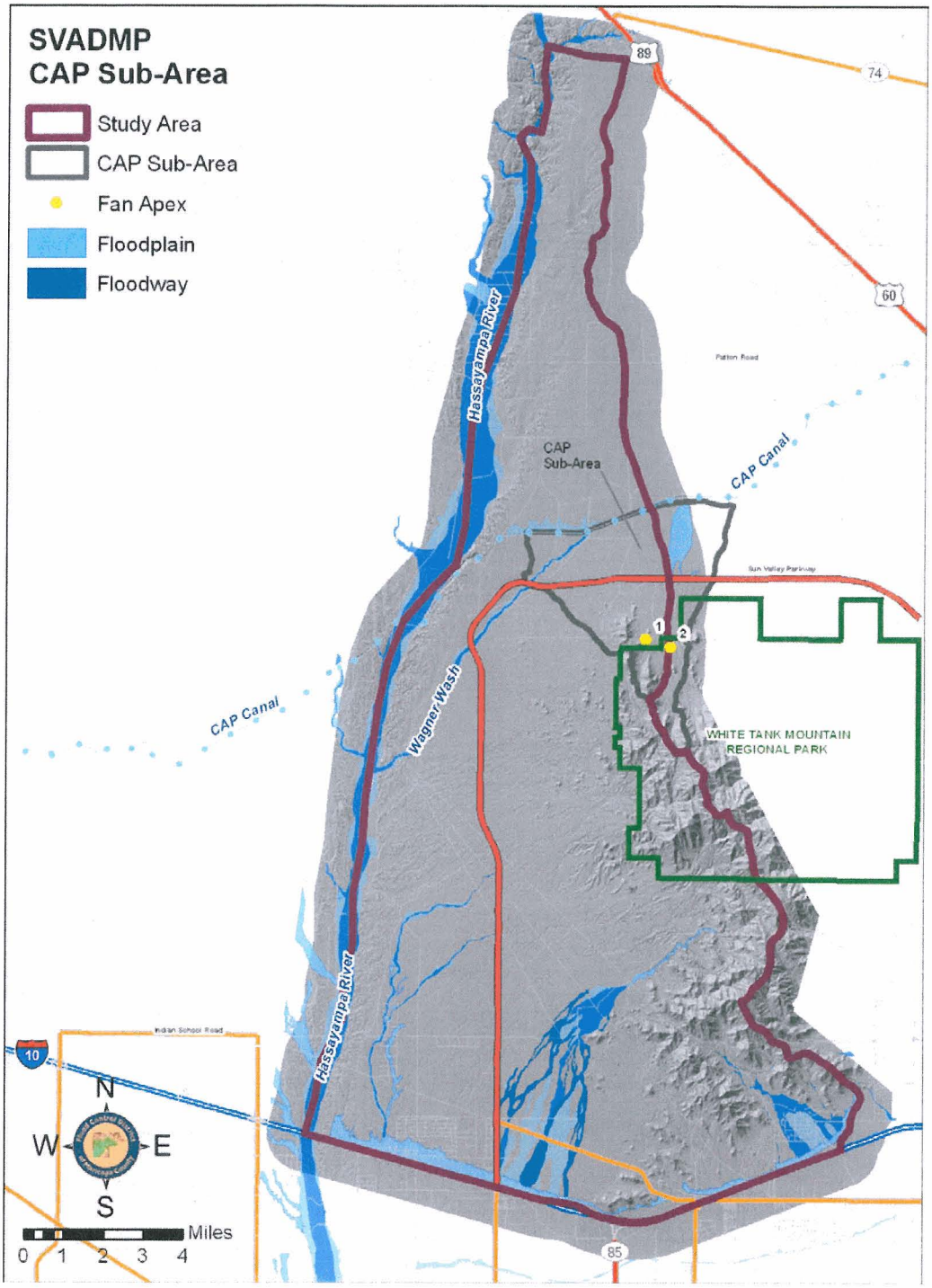

Figure 12: CAP Sub-Area

Table 7: Preliminary Alternative A Analysis for CAP Sub-Area

SUN VALLEY ADMP - CAP SUB-AREA PRELIMINARY ALTERNATIVE A								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	No Measure	Apex located within the park boundaries limiting the existence of a basin for storage.	Comparably Expensive (Land Costs)	Does not insure any proper safety	Minimizes the impact to the environment	No known cultural resources are impacted.	Less land downstream of the apex will be developable.	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	Storage / Conveyance	If No Measure is taken at the apex, flows will need to be captured via diversion levees/dikes, collector channels, and/or basins.	Comparably Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result to the surrounding areas.	More land downstream of the basin will be developable providing for economic opportunities.	
PARKWAY - Parallel Channel	Conveyance	This channel would parallel the Parkway to the west and convey the concentrated flows to Wagner Wash. Upgrade existing channel. Possibly move channel along Sun Valley Parkway up fan to allow commercial property along the Parkway.	Moderately Expensive, to Extremely Expensive if channel is moved	Contains the flows and protects the Parkway.	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result to the surrounding areas.	By routing the water within the right-of-way of the Parkway, more developable area in the down-fan region will be available.	
DOWN-FAN -	Management Development Guidelines	Since the heavy flows are contained at the Apex and Up-Fan areas, flows downstream will be manageable locally.	Considerably Inexpensive	Dependent upon development guidelines.	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	
OUTFALL -	Management Development Guidelines	Since the heavy flows are contained at the Apex and Up-Fan areas, flows downstream will be manageable locally.	Considerably Inexpensive	Dependent upon development guidelines.	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	

Table 8: Preliminary Alternative B Analysis for CAP Sub-Area

SUN VALLEY ADMP - CAP SUB-AREA PRELIMINARY ALTERNATIVE B								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	Storage	A basin at the proposed location would reduce the peak flow rate and limit sedimentation in the down fan direction. Therefore a basin at the apex would greatly decrease flood uncertainty.	Expensive: Especially if placed in bedrock.	Contains the flows decreasing flow uncertainty common with alluvial fan systems.	Strongly impacts the environment depending on size of basin that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Even though the basin takes up a lot of area, the basin provides for more developable area within the fan area.	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	Conveyance	Conveys the flows combined in the upstream basin in a controlled manner to the Parkway	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result to the surrounding areas.	More land downstream of the basin will be developable providing for economic opportunities.	
PARKWAY -	Conveyance	This channel would parallel the Parkway to the west and convey the concentrated flows to Wagner Wash. Upgrade existing channel. Possibly move channel along Sun Valley Parkway up fan to allow commercial property along the Parkway.	Moderately Expensive, to Extremely Expensive if channel is moved	Contains the flows and protects the Parkway.	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result to the surrounding areas.	By routing the water within the right-of-way of the Parkway, more developable area in the down-fan region will be available.	
DOWN-FAN -	Management Development Guidelines	Since the heavy flows are contained at the Apex and Up-Fan areas, flows downstream should be manageable locally.	Considerably Inexpensive	Dependent upon development guidelines.	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	
OUTFALL -	Management Development Guidelines	Since the heavy flows are contained at the Apex and Up-Fan areas, flows downstream should be manageable locally.	Considerably Inexpensive	Dependent upon development guidelines.	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	

Table 9: Preliminary Alternative C Analysis for CAP Sub-Area

SUN VALLEY ADMP - CAP SUB-AREA
PRELIMINARY ALTERNATIVE C

PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	Conveyance	Land ownership and topography at apex 1 present conveyance as a viable solution to flood control.	Expensive	Breakouts are more likely than if basins are used	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Maximizes the developable land at the apex	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	Storage & Conveyance	Basins down stream of the apex would be necessary to control peak flows and sediment issues. Conveyance corridors would be needed as a transport path to the parkway.	Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY -	Storage & Conveyance	This channel would parallel the Parkway to the west and convey the concentrated flows to Wagner Wash. Upgrade existing channel. Possibly move channel along Sun Valley Parkway up fan to allow commercial property along the Parkway.	Moderately Expensive, to Extremely Expensive if channel is moved	Contains the flows and protects the Parkway.	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result to the surrounding areas.	By routing the water within the right-of-way of the Parkway, more developable area in the down-fan region will be available.	
DOWN-FAN -	Management Development Guidelines	Since the heavy flows are contained at the Apex and Up-Fan areas, flows downstream should be manageable locally.	Considerably Inexpensive	Dependent upon development guidelines.	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	
OUTFALL -	Management Development Guidelines	Since the heavy flows are contained at the Apex and Up-Fan areas, flows downstream should be manageable locally with additional consideration at Wagner Wash.	Considerably Inexpensive	Dependent upon development guidelines.	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	

Table 10: Preliminary Alternative D Analysis for CAP Sub-Area

SUN VALLEY ADMP - CAP SUB-AREA PRELIMINARY ALTERNATIVE D								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
PARKWAY -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
DOWN-FAN -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
OUTFALL -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	

2.5.2 Wagner Sub-Area:

The Wagner sub-area is located on the northwestern slope of the White Tank Mountains piedmont. Three major alluvial fans, designated Fans 13 (E and W) and Fan 3 drain from the White Tank Mountain Regional Park onto the piedmont in this sub-area. Two secondary areas of large channel divides (distributary channels) are also located in the southern portion of the sub-area. The entire sub-area drains into Wagner Wash, which cross Sun Valley Parkway at two locations (Figure 13). The piedmont below portions of Fan 13 is bisected by the Sun Valley Parkway. Existing runoff from Fans 13 and 3 enters Wagner Wash between the two Sun Valley Parkway crossings. Runoff from the remainder of the sub-area flow to Wagner Wash via existing drainage facilities along the Sun Valley Parkway. Those facilities consist of culverts of various sizes beneath the roadway at various locations. Wagner Wash has FEMA approved floodplain and floodways regulations as depicted in Figure 14. The following tables describe each of the four alternatives (A-D) with some of the specific considerations pertinent to the Wagner sub-area in terms of selected strategy, justification, costs, and impacts (i.e. flood safety, physical/natural environment, cultural/visual resources, and socioeconomics). The evaluation criteria are also listed.

Figure 13: Upstream Crossing of Wagner Wash Under Sun Valley Parkway

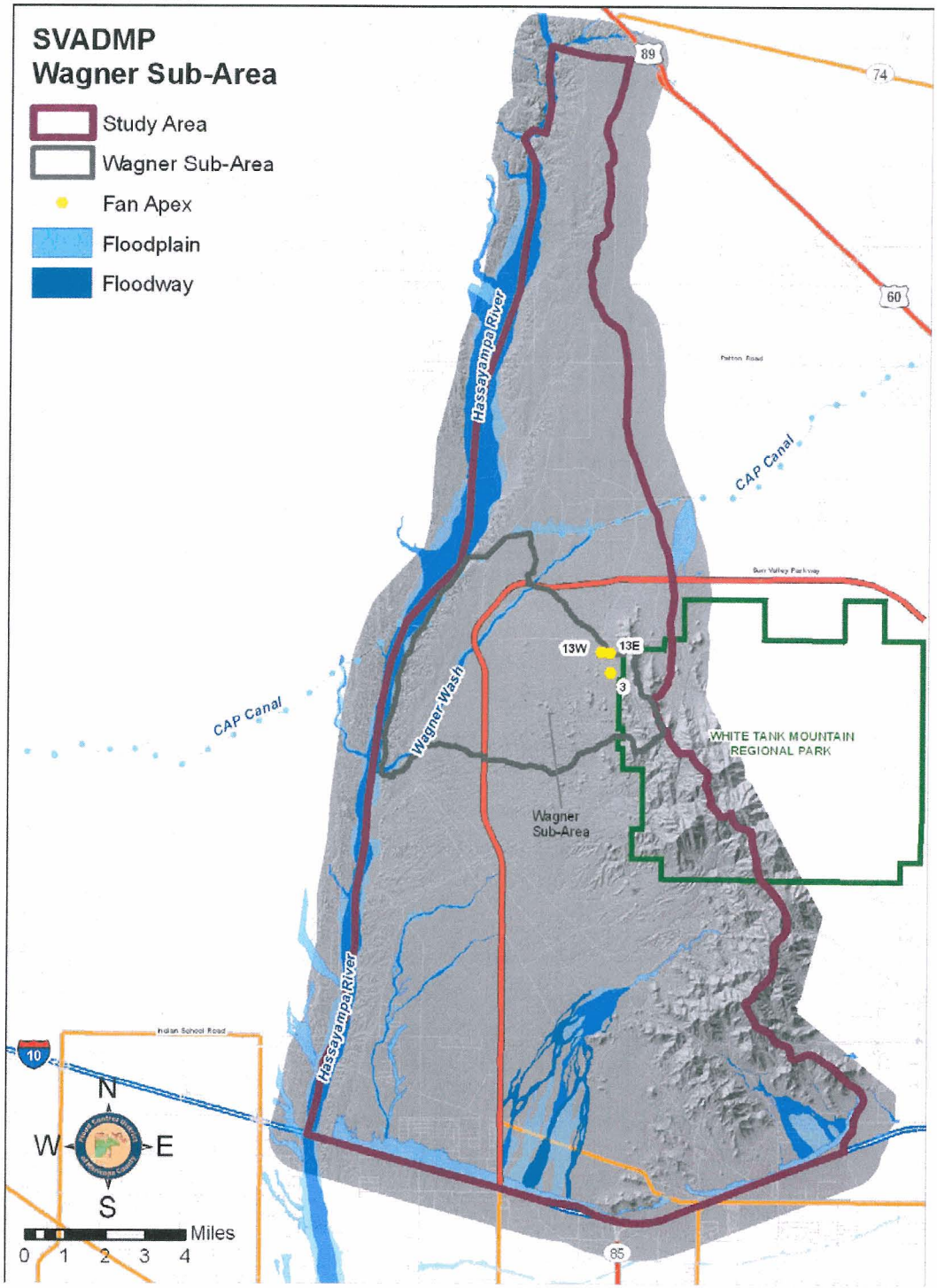

Figure 14: Wagner Sub-Area

Table 11: Preliminary Alternative A Analysis for Wagner Sub-Area

SUN VALLEY ADMP - WAGNER SUB-AREA PRELIMINARY ALTERNATIVE A								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	No Measure	Allows the natural geomorphic processes to occur within a designated active area downstream of the apex.	Comparably Expensive (Land Costs)	Does not insure any proper safety	Minimizes the impact to the environment	No known cultural resources are impacted.	Less land downstream of the apex will be developable.	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	Storage & Conveyance	If No Measure is taken at the apex, flows will need to be captured via diversion levees/dikes, collector channels, and/or basins.	Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY -	Storage & Conveyance	Use the existing culverts along Sun Valley Parkway whenever possible. Place basins when capacity of culverts is not adequate	Comparatively Inexpensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	Management Development Guidelines	Once flows reach Wagner Wash. Flows should be managed locally and per FEMA regulations.	Considerably Inexpensive	Dependent upon development guidelines.	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	
OUTFALL -	Conveyance	Erosion Control may be necessary at Wagner Wash. Soft engineering may be best suited per 404 permit restrictions.	Moderately Expensive	Contains the flows and minimizes erosion	Minimizes the impact to the environment by preventing erosion	No known cultural resources are impacted, but visual impacts will result.	None Identified	

Table 12: Preliminary Alternative B Analysis for Wagner Sub-Area

SUN VALLEY ADMP - WAGNER SUB-AREA PRELIMINARY ALTERNATIVE B								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	Storage	A basin at the proposed location would reduce the peak flow rate and limit sedimentation in the down fan direction. Therefore a basin at the apex would greatly decrease flood uncertainty.	Expensive: Especially if placed in bedrock.	Contains the flows decreasing flow uncertainty common with alluvial fan systems.	Strongly impacts the environment.	No known cultural resources are impacted, but visual impacts will result.	Even though the basin takes up a lot of area, the basin provides for more developable area within the fan area.	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	Conveyance	Conveys the flows combined in the upstream basin in a controlled manner to the Parkway	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result to the surrounding areas.	More land downstream of the basin will be developable providing for economic opportunities.	
PARKWAY -	Storage & Conveyance	Use the existing culverts along Sun Valley Parkway whenever possible. Place basins when capacity of culverts is not adequate	Comparatively Inexpensive	Contains the flows and protects the Parkway.	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result to the surrounding areas.	More land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	Management Development Guidelines	Once flows reach Wagner Wash. Flows should be managed locally and per FEMA regulations.	Comparatively Inexpensive	Dependent upon development guidelines.	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	
OUTFALL -	Conveyance	Erosion Control may be necessary at Wagner Wash. Soft engineering may be best suited per 404 permit restrictions.	Moderately Expensive	Contains the flows and minimizes erosion	Minimizes the impact to the environment by preventing erosion	No known cultural resources are impacted, but visual impacts will result.	None Identified	

Table 13: Preliminary Alternative C Analysis for Wagner Sub-Area

SUN VALLEY ADMP - WAGNER SUB-AREA PRELIMINARY ALTERNATIVE C								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	Conveyance	Reduced land cost due to lack of a detention basin near the apex and the concrete channels are easier to maintain.	Moderately Expensive	Breakouts are more likely than if basins are used	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Maximizes the developable land at the apex	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	Storage & Conveyance	Basins down stream of the apex would be necessary to control peak flows and sediment issues. Conveyance corridors would be needed as a transport path to the parkway.	Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY -	Storage & Conveyance	Use the existing culverts along Sun Valley Parkway whenever possible. Place basins when capacity of culverts is not adequate	Comparatively Inexpensive	Contains the flows and protects the Parkway.	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result to the surrounding areas.	More land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	Management Development Guidelines	Once flows reach Wagner Wash. Flows should be managed locally or per FEMA regulations.	Considerably Inexpensive	Dependent upon development guidelines.	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	
OUTFALL -	Conveyance	Erosion Control may be necessary at Wagner Wash. Soft engineering may be best suited per 404 permit restrictions.	Considerably Inexpensive	Contains the flows and minimizes erosion	Minimizes the impact to the environment by preventing erosion	No known cultural resources are impacted, but visual impacts will result.	None Identified	

Table 14: Preliminary Alternative D Analysis for Wagner Sub-Area

SUN VALLEY ADMP - WAGNER SUB-AREA PRELIMINARY ALTERNATIVE D								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
PARKWAY -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
DOWN-FAN -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
OUTFALL -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	

2.5.3 Hassayampa Sub-Area:

The Hassayampa sub-area is located on the western slope of the White Tank Mountains piedmont. Two primary alluvial fans, designated Fan 4 and Fan 5, drain from the White Tank Mountain Regional Park onto the piedmont in this sub-area. The sub-area is bisected by the Sun Valley Parkway which runs north to south across the Hassayampa sub-area. Existing drainage facilities along the Sun Valley Parkway consist of culverts of various sizes beneath the roadway at various locations. Hassayampa River has regulatory FEMA approved floodplains and floodways as depicted in Figure 16. The following tables describe each of the four alternatives (A-D) with some of the specific considerations pertinent to the Hassayampa sub-area in terms of selected strategy, justification, costs, and impacts (i.e. flood safety, physical/natural environment, cultural/visual resources, and socioeconomics). The evaluation criteria are also listed. Figure 15 shows the Hassayampa sub-area as viewed from the White Tank Mountains.

Figure 15: View from White Tank Mountains Across Hassayampa Sub-Area

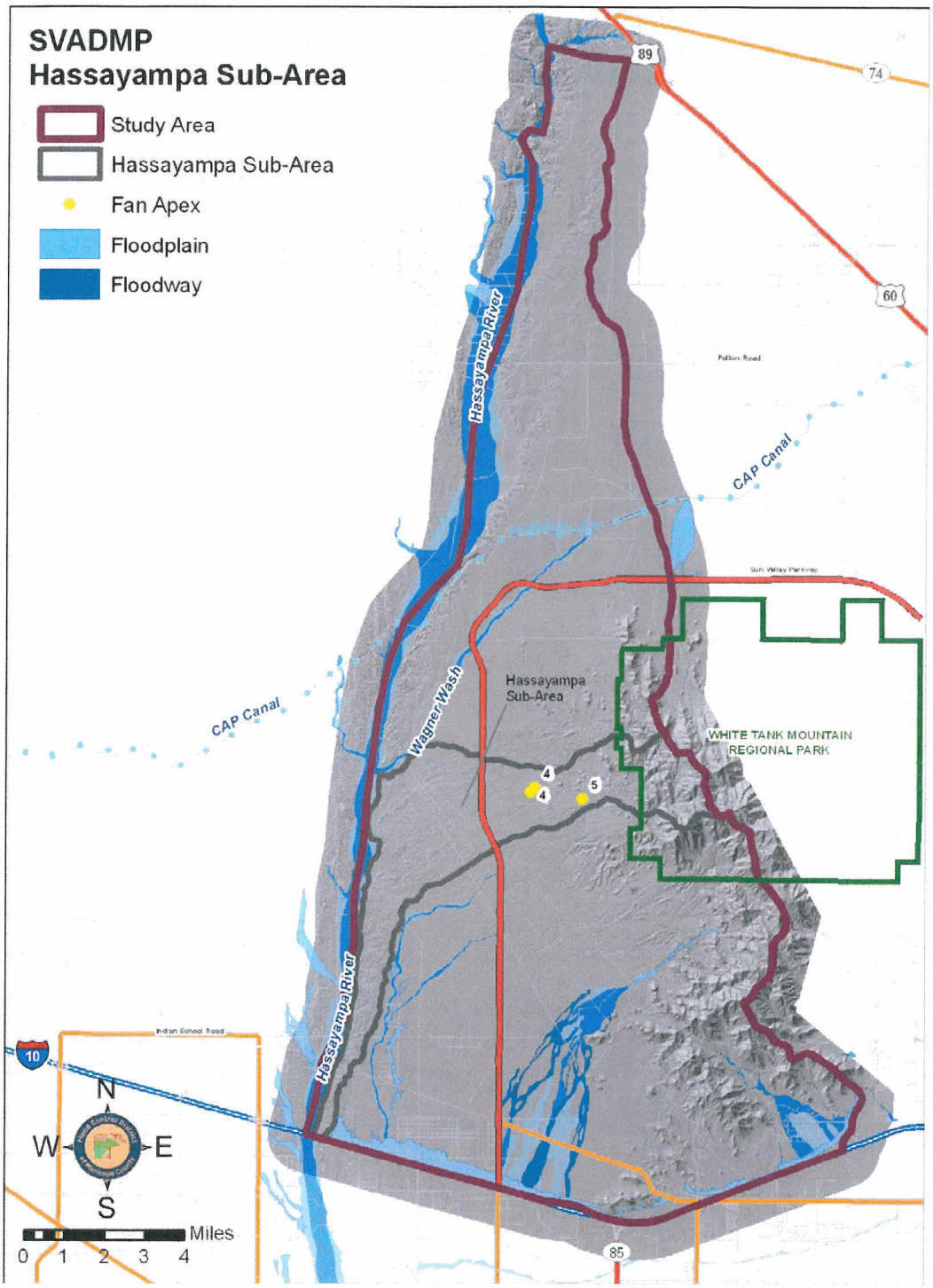

Figure 16: Hassayampa Sub-Area

Table 15: Preliminary Alternative A Analysis for Hassayampa Sub-Area

SUN VALLEY ADMP – HASSAYAMPA SUB-AREA
PRELIMINARY ALTERNATIVE A

PROPOSED ACTION				IMPACTS				
Alternative Measure	**Alternative Strategy**	**Justification**	**Cost**	**Flood Safety**	**Physical/ Natural Environmental**	**Cultural/ Visual Resources**	**Socioeconomic**	**Evaluation Criteria**
APEX -	**No Measure**	Allows the natural geomorphic processes to occur within a designated active area downstream of the apex.	Comparably Expensive (Land Costs)	Does not insure any proper safety	Minimizes the impact to the environment	No known cultural resources are impacted.	Less land downstream of the apex will be developable.	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	**Storage & Conveyance**	If No Measure is taken at the apex, flows will need to be captured via diversion levees/dikes, collector channels, and/or basins.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY -	**Storage & Conveyance**	Use the existing culverts along Sun Valley Parkway whenever possible. Place basins when capacity of culverts is not adequate	Comparatively Inexpensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	**Storage & Conveyance**	The large reach from the Sun Valley Parkway to the Hassayampa River should continue with conveyance corridors and sediment basins if necessary.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Increases the land available to be developable providing for economic opportunities.	
OUTFALL -	**Conveyance**	Erosion Control may be necessary at Hassayampa River. Soft engineering may be best suited per 404 permit restrictions, although flow rates may require a hard structure.	Moderately Expensive	Contains the flows and minimizes erosion	Minimizes the impact to the environment	No known cultural resources are impacted, but visual impacts will result.	None Identified	

Table 16: Preliminary Alternative B Analysis for Hassayampa Sub-Area

SUN VALLEY ADMP - HASSAYAMPA SUB-AREA PRELIMINARY ALTERNATIVE B								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	Storage	A basin at the proposed location would reduce the peak flow rate and limit sedimentation in the down fan direction. Therefore a basin at the apex would greatly decrease flood uncertainty.	Expensive:	Contains the flows decreasing flow uncertainty common with alluvial fan systems.	Strongly impacts the environment.	No known cultural resources are impacted, but visual impacts will result.	Even though the basin takes up a lot of area, the basin provides for more developable area within the fan area.	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	Conveyance	Conveys the flows combined in the upstream basin in a controlled manner to the Parkway	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result to the surrounding areas.	More land downstream of the basin will be developable providing for economic opportunities.	
PARKWAY -	Storage & Conveyance	Use the existing culverts along Sun Valley Parkway whenever possible. Place basins when capacity of culverts is not adequate	Comparatively Inexpensive	Contains the flows and protects the Parkway.	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result to the surrounding areas.	More land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	Storage & Conveyance	The large reach from the Sun Valley Parkway to the Hassayampa River should continue with conveyance corridors and sediment basins if necessary.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Increases the land available to be developable providing for economic opportunities.	
OUTFALL -	Conveyance	Erosion Control may be necessary at Hassayampa River. Soft engineering may be best suited per 404 permit restrictions, although flow rates may require a hard structure.	Moderately Expensive	Contains the flows and minimizes erosion	Minimizes the impact to the environment	No known cultural resources are impacted, but visual impacts will result.	None Identified	

Table 17: Preliminary Alternative C Analysis for Hassayampa Sub-Area

SUN VALLEY ADMP – HASSAYAMPA SUB-AREA PRELIMINARY ALTERNATIVE C								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	Conveyance	Reduced land cost due to lack of a detention basin near the apex and the concrete channels are easier to maintain.	Moderately Expensive	Breakouts are more likely than if basins are used	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Maximizes the developable land at the apex	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	Storage & Conveyance	Basins down stream of the apex would be necessary to control peak flows and sediment issues. Conveyance corridors would be needed as a transport path to the parkway.	Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY -	Storage & Conveyance	Use the existing culverts along Sun Valley Parkway whenever possible. Place basins when capacity of culverts is not adequate	Comparatively Inexpensive	Contains the flows and protects the Parkway.	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result to the surrounding areas.	More land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	Storage & Conveyance	The large reach from the Sun Valley Parkway to the Hassayampa River should continue with conveyance corridors and sediment basins if necessary.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Increases the land available to be developable providing for economic opportunities.	
OUTFALL -	Conveyance	Erosion Control may be necessary at Hassayampa River. Soft engineering may be best suited per 404 permit restrictions, although flow rates may require a hard structure.	Moderately Expensive	Contains the flows and minimizes erosion	Minimizes the impact to the environment	No known cultural resources are impacted, but visual impacts will result.	None Identified	

Table 18: Preliminary Alternative D Analysis for Hassayampa Sub-Area

SUN VALLEY ADMP - HASSAYAMPA SUB-AREA
PRELIMINARY ALTERNATIVE D

PROPOSED ACTION				IMPACTS				
Alternative Measure	**Alternative Strategy**	**Justification**	**Cost**	**Flood Safety**	**Physical/ Natural Environmental**	**Cultural/ Visual Resources**	**Socioeconomic**	**Evaluation Criteria**
APEX -	**No Measure**	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	**No Measure**	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
PARKWAY -	**No Measure**	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
DOWN-FAN -	**No Measure**	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
OUTFALL -	**No Measure**	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	

2.5.4 White Tank Wash Sub-Area:

The White Tank Wash sub-area is located on the western slope of the White Tank Mountains piedmont (see Figure 17). The primary alluvial fans are Fans 6, 38, and 39. These fans drain the west slope of the White Tank Mountains and eventually collect into White Tank Wash which flows from north to south parallel to the Hassayampa River. White Tank Wash outfalls into the western end of Buckeye Flood Retarding Structure No. 1. The sub-area is bisected by the Sun Valley Parkway which runs north to south through the sub-area. Existing drainage facilities along the Sun Valley Parkway consist of culverts beneath the roadway. Existing FEMA regulatory floodplains are depicted in Figure 18. The following tables describe each of the four alternatives (A-D) with some of the specific considerations to the White Tank Wash sub-area in terms of selected strategy, justification, costs, and impacts (i.e. flood safety, physical/natural environment, cultural/visual resources, and socioeconomics). The evaluation criteria are also listed.

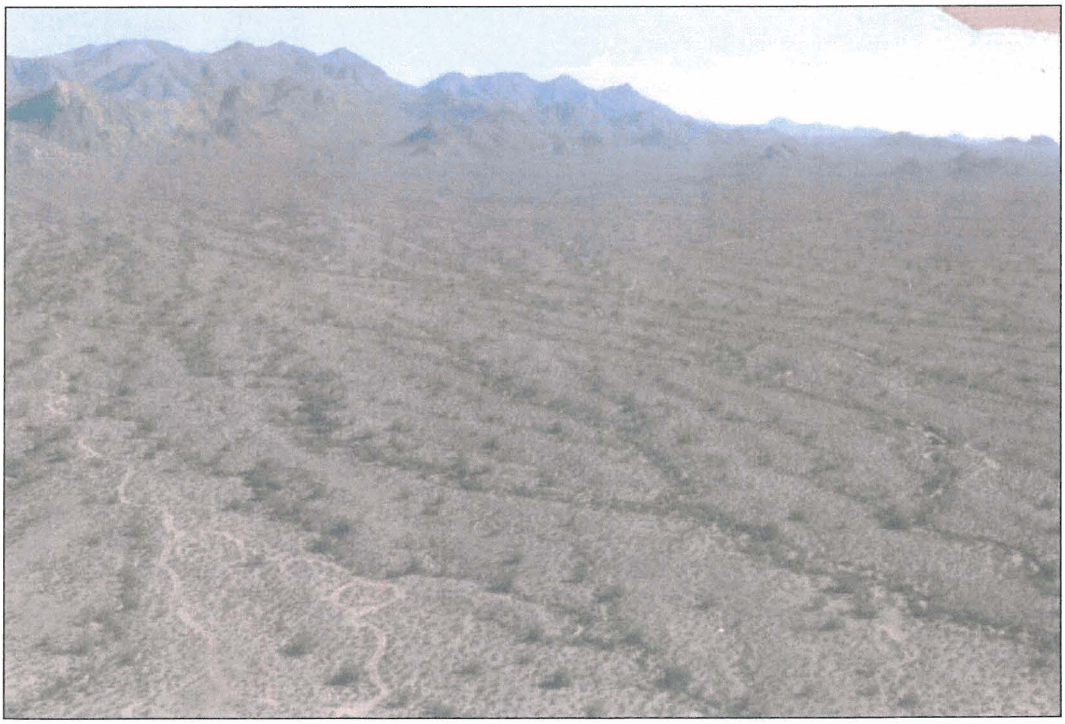

Figure 17: Aerial of White Tank Mountains

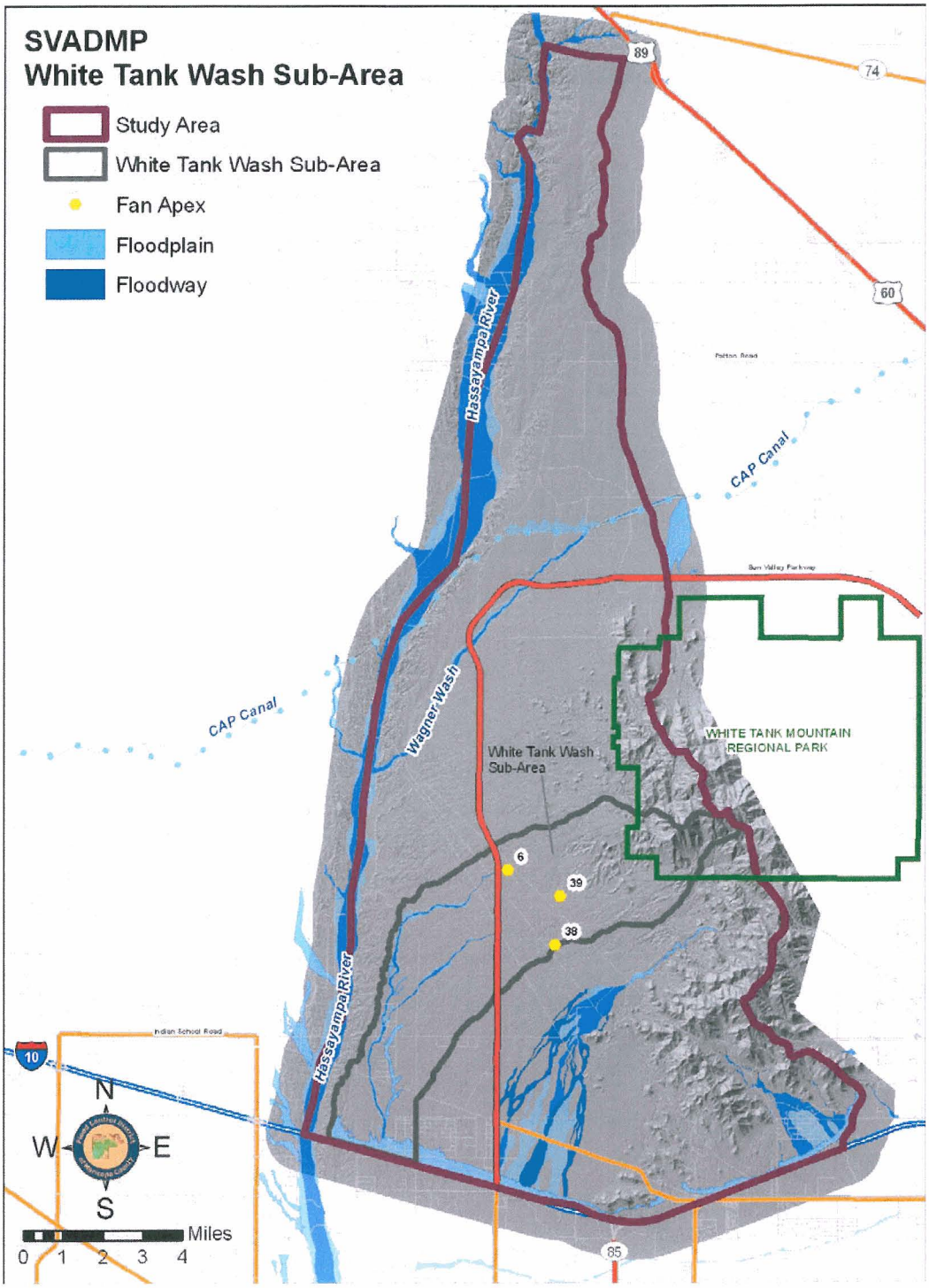

Figure 18: White Tank Wash Sub-Area

Table 19: Preliminary Alternative A Analysis for White Tank Wash Sub-Area

SUN VALLEY ADMP – WHITE TANK WASH SUB-AREA
PRELIMINARY ALTERNATIVE A

PROPOSED ACTION				IMPACTS				
Alternative Measure	**Alternative Strategy**	**Justification**	**Cost**	**Flood Safety**	**Physical/ Natural Environmental**	**Cultural/ Visual Resources**	**Socioeconomic**	**Evaluation Criteria**
APEX -	**No Measure**	Not a preferable alternative for this sub-area, due to the relative location of apex #6 to Sun Valley Parkway. The remaining apices within this sub-area do allow for exploration of this alternative.	Comparably Expensive (Land Costs)	Does not insure any proper safety	Minimizes the impact to the environment	No known cultural resources are impacted.	Less land downstream of the apex will be developable.	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	**Storage & Conveyance**	If No Measure is taken at the apex, flows will need to be captured via diversion levees/dikes, collector channels, and/or basins.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY -	**Storage & Conveyance**	Use the existing culverts along Sun Valley Parkway whenever possible. Place basins when capacity of culverts is not adequate	Comparatively Inexpensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	**Storage & Conveyance**	The reach from the Sun Valley Parkway to White Tank Wash should continue with conveyance corridors and sediment basins if necessary.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Increases the land available to be developable providing for economic opportunities.	
OUTFALL -	**Conveyance**	Erosion Control may be necessary at White Tank Wash. Soft engineering may be best suited per 404 permit restrictions, although flow rates may require a hard structure.	Moderately Expensive	Contains the flows and minimizes erosion	Minimizes the impact to the environment	No known cultural resources are impacted, but visual impacts will result.	None Identified	

Table 20: Preliminary Alternative B Analysis for White Tank Wash Sub-Area

SUN VALLEY ADMP – WHITE TANK WASH SUB-AREA PRELIMINARY ALTERNATIVE B								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	Storage	A basin at the proposed location would reduce the peak flow rate and limit sedimentation in the down fan direction. Therefore a basin at the apex would greatly decrease flood uncertainty.	Expensive:	Contains the flows decreasing flow uncertainty common with alluvial fan systems.	Strongly impacts the environment.	No known cultural resources are impacted, but visual impacts will result.	Even though the basin takes up a lot of area, the basin provides for more developable area within the fan area.	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	Conveyance	Conveys the flows combined in the upstream basin in a controlled manner to the Parkway	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY -	Storage & Conveyance	Use the existing culverts along Sun Valley Parkway whenever possible. Place basins when capacity of culverts is not adequate Lateral conveyance corridors to Sun Valley Parkway could be used to create a buffer between commercial and residential property.	Comparatively Inexpensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	Storage & Conveyance	The reach from the Sun Valley Parkway to the White Tank Wash should continue with conveyance corridors and sediment basins if necessary.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Increases the land available to be developable providing for economic opportunities.	
OUTFALL -	Conveyance / Storage	Grade Control and a detention basin to decrease peak flows to prevent erosion at White Tank Wash.	Moderately Expensive	Contains the flows and minimizes erosion	Minimizes the impact to the environment	No known cultural resources are impacted, but visual impacts will result.	None Identified	

Table 21: Preliminary Alternative C Analysis for White Tank Wash Sub-Area

SUN VALLEY ADMP – WHITE TANK WASH SUB-AREA PRELIMINARY ALTERNATIVE C								
PROPOSED ACTION				IMPACTS				
Alternative Measure	**Alternative Strategy**	**Justification**	**Cost**	**Flood Safety**	**Physical/ Natural Environmental**	**Cultural/ Visual Resources**	**Socioeconomic**	**Evaluation Criteria**
APEX -	**Conveyance**	Reduced land cost due to lack of a detention basin near the apex and the concrete channels are easier to maintain.	Moderately Expensive	Breakouts are more likely than if basins are used	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Maximizes the developable land at the apex	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	**Storage & Conveyance**	Basins down stream of the apex would be necessary to control peak flows and sediment issues. Conveyance corridors would be needed as a transport path to the parkway.	Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY -	**Storage & Conveyance**	Use the existing culverts along Sun Valley Parkway whenever possible. Place basins when capacity of culverts is not adequate	Comparatively Inexpensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	**Storage & Conveyance**	The reach from the Sun Valley Parkway to the White Tank Wash should continue with conveyance corridors and sediment basins if necessary.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Increases the land available to be developable providing for economic opportunities.	
OUTFALL -	**Conveyance / Storage**	Grade Control and a detention basin to decrease peak flows to prevent erosion at White Tank Wash.	Moderately Expensive	Contains the flows and minimizes erosion	Minimizes the impact to the environment	No known cultural resources are impacted, but visual impacts will result.	None Identified	

Table 22: Preliminary Alternative D Analysis for White Tank Wash Sub-Area

SUN VALLEY ADMP – WHITE TANK WASH SUB-AREA PRELIMINARY ALTERNATIVE D								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
PARKWAY -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
DOWN-FAN -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
OUTFALL -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	

2.5.5 FRS 1 Sub-Area:

The FRS No. 1 sub-area is located on the southwestern slope of the White Tank Mountains piedmont. Three major alluvial fans, designated Fan 7, Fan 36, and Fan 37, drain from the White Tank Mountain Regional Park onto the piedmont in this sub-area. The Fan 7 portion of the piedmont receives inflows of water and sediment from two additional small alluvial fans, designated Fan 8 and Fan 9. The piedmont below Fan 37 is bisected by the Sun Valley Parkway which runs north to south across the piedmont in this area. The downstream portions of Fan 36 and Fan 7 are bisected by the old Tonopah-Salome Highway. Existing drainage facilities along the Sun Valley Parkway consist of culverts of various sizes beneath the roadway at various locations. There are no existing drainage facilities crossing the Tonopah-Salome Highway. Existing Regulatory FEMA floodplains exist for Fan 36. The following tables describe each of the four alternatives (A-D) with some of the specific considerations pertinent to the FRS 1 sub-area in terms of selected strategy, justification, costs, and impacts (i.e. flood safety, physical/natural environment, cultural/visual resources, and socioeconomics). The evaluation criteria are also listed.

Figure 19: View Westerly Along FRS 1

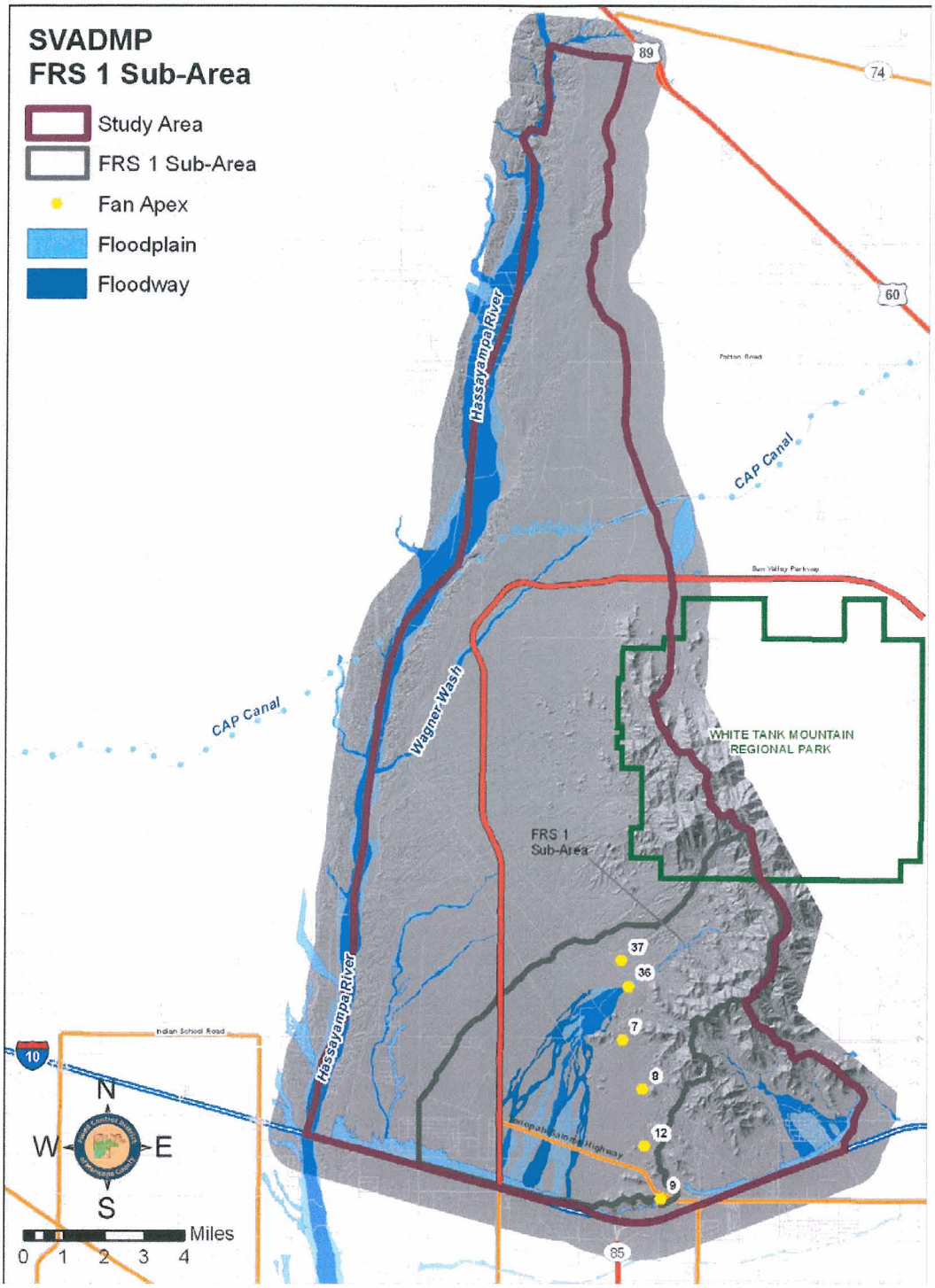

Figure 20: FRS 1 Sub-Area

Table 23: Preliminary Alternative A Analysis for FRS 1 Sub-Area

SUN VALLEY ADMP – FRS 1 SUB-AREA PRELIMINARY ALTERNATIVE A								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	No Measure	Allows the natural geomorphic processes to occur within a designated active area downstream of the apex.	Comparably Expensive (Land Costs)	Does not insure any proper safety	Minimizes the impact to the environment	No known cultural resources are impacted.	Less land downstream of the apex will be developable.	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	Storage & Conveyance	If No Measure is taken at the apex, flows will need to be captured via diversion levees/dikes, collector channels, and/or basins.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY: Sun Valley Pky. & McDowell Rd.	Storage & Conveyance	Use the existing culverts along Sun Valley Parkway whenever possible. Place basins when capacity of culverts is not adequate. The McDowell Road alignment is still in the planning stages, new culverts and lateral drainages can be implemented accordingly.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	Conveyance	Flood containment should continue down to the flood retarding structure.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Increases the land available to be developable providing for economic opportunities.	
OUTFALL -	Management Development Guidelines	Need cooperation with B1RP for possible erosion control and controlling delta formation in the low flow areas	Moderately Expensive	Dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	

Table 24: Preliminary Alternative B Analysis for FRS 1 Sub-Area

SUN VALLEY ADMP – FRS 1 SUB-AREA PRELIMINARY ALTERNATIVE B								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	Storage	A basin at the proposed location would reduce the peak flow rate and limit sedimentation in the down fan direction. Therefore a basin at the apex would greatly decrease flood uncertainty. A basin may not control all sediment issues.	Expensive:	Contains the flows decreasing flow uncertainty common with alluvial fan systems.	Strongly impacts the environment.	No known cultural resources are impacted, but visual impacts will result.	Even though the basin takes up a lot of area, the basin provides for more developable area within the fan area.	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	Storage & Conveyance	Conveys the flows combined in the upstream basin in a controlled manner to the Parkway	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY: Sun Valley Pky. & McDowell Rd.	Storage & Conveyance	Use the existing culverts along Sun Valley Parkway whenever possible. Place basins when capacity of culverts is not adequate. The McDowell Road alignment is still in the planning stages, new culverts and lateral drainages can be implemented accordingly.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	Conveyance	Flood containment should continue down to the flood retarding structure.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Increases the land available to be developable providing for economic opportunities.	
OUTFALL -	Management Development Guidelines	Need cooperation with B1RP for possible erosion control and controlling delta formation in the low flow areas	Moderately Expensive	Dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	

Table 25: Preliminary Alternative C Analysis for FRS 1 Sub-Area

SUN VALLEY ADMP – FRS 1 SUB-AREA
PRELIMINARY ALTERNATIVE C

PROPOSED ACTION				IMPACTS				
Alternative Measure	**Alternative Strategy**	**Justification**	**Cost**	**Flood Safety**	**Physical/ Natural Environmental**	**Cultural/ Visual Resources**	**Socioeconomic**	**Evaluation Criteria**
APEX -	**Conveyance**	Reduced land cost due to lack of a detention basin near the apex and the concrete channels are easier to maintain.	Moderately Expensive	Breakouts are more likely than if basins are used	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Maximizes the developable land at the apex	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	**Storage & Conveyance**	Basins down stream of the apex would be necessary to control peak flows and sediment issues. Conveyance corridors would be needed as a transport path to the parkway.	Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY: Sun Valley Pky. & McDowell Rd.	**Storage & Conveyance**	Use the existing culverts along Sun Valley Parkway whenever possible. Place basins when capacity of culverts is not adequate. The McDowell Road alignment is still in the planning stages, new culverts and lateral drainages can be implemented accordingly.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	**Conveyance**	Flood containment should continue down to the flood retarding structure.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Increases the land available to be developable providing for economic opportunities.	
OUTFALL -	**Management Development Guidelines**	Need cooperation with B1RP for possible erosion control and controlling delta formation in the low flow areas	Moderately Expensive	Dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	

Table 26: Preliminary Alternative D Analysis for FRS 1 Sub-Area

SUN VALLEY ADMP – FRS 1 SUB-AREA
PRELIMINARY ALTERNATIVE D

PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
PARKWAY -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
DOWN-FAN -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
OUTFALL -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	

2.5.6 FRS 2 & 3 Sub-Area:

The Buckeye Flood Retarding Structure (FRS) Number 2 & 3 sub-area is located on the southern slope of the White Tank Mountains piedmont (Figure 21). An aerial of this sub-area is shown in Figure There are four alluvial fan apices located within the sub-area. All of the alluvial fans drain to either the FRS No. 2 or FRS No. 3. Two small fan apices, Fan 11 and Fan 12, drain to FRS No. 2. The Skyline Wash Fan and an eastern tributary fan, designated Fan SkyET, drain to FRS No. 3. Existing FEMA regulatory floodplains exist for Skyline Wash (Figure 22). The following tables describe each of the four alternatives (A-D) with some of the specific considerations pertinent to the FRS 2 & 3 sub-area in terms of selected strategy, justification, costs, and impacts (i.e. flood safety, physical/natural environment, cultural/visual resources, and socioeconomics). The evaluation criteria are also listed.

Figure 21: View North at FRS 2 and White Tank Mountains

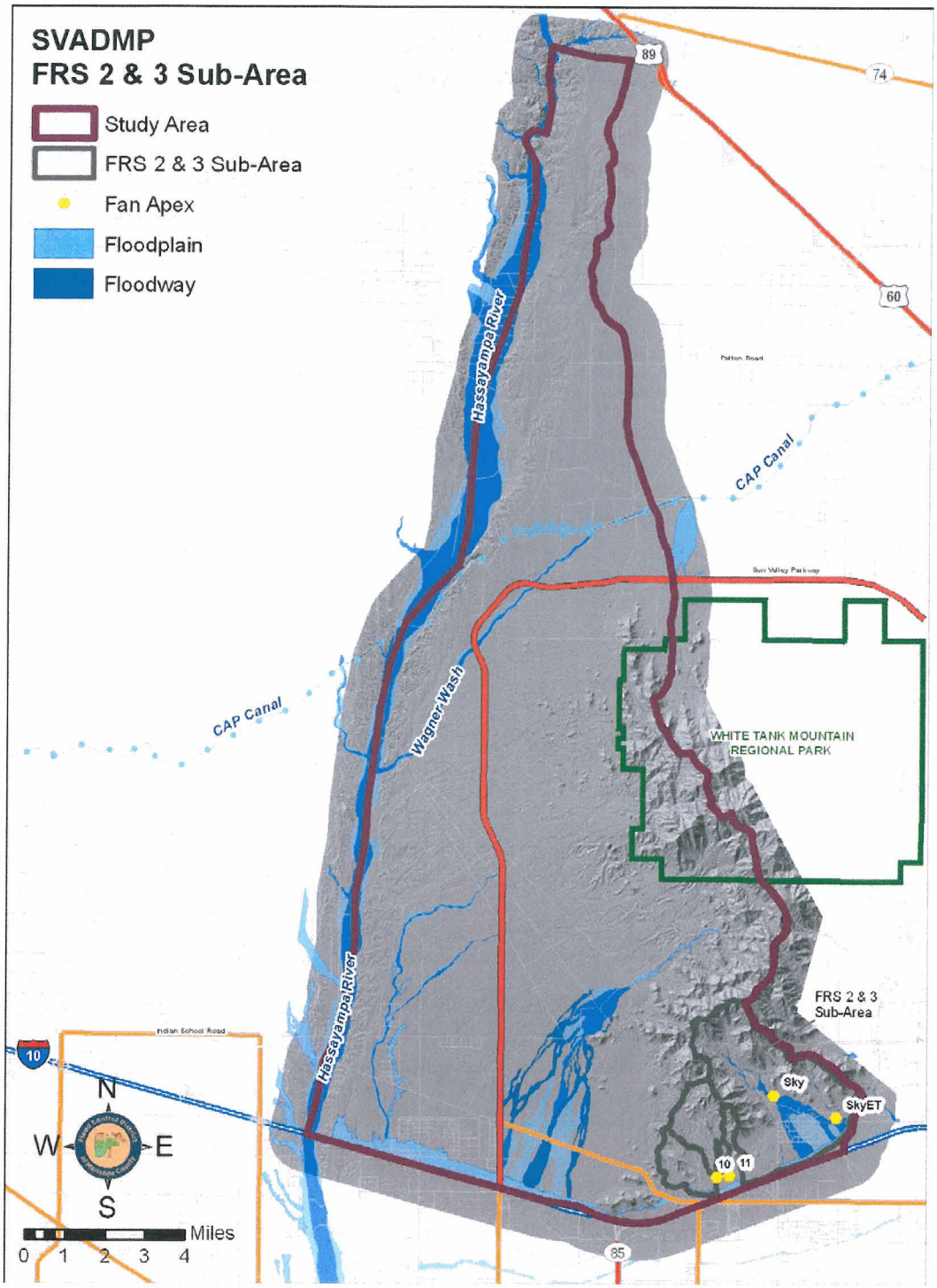

Figure 22: FRS 2 & 3 Sub-Area

Table 27: Preliminary Alternative A Analysis for FRS 2 & 3 Sub-Area

SUN VALLEY ADMP – FRS 2 & 3 SUB-AREA PRELIMINARY ALTERNATIVE A								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	No Measure	Allows the natural geomorphic processes to occur within a designated active area downstream of the apex.	Comparably Expensive (Land Costs)	Does not insure any proper safety	Minimizes the impact to the environment	No known cultural resources are impacted.	Less land downstream of the apex will be developable.	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	Storage & Conveyance	If No Measure is taken at the apex, flows will need to be captured via diversion levees/dikes, collector channels, and/or basins.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY: McDowell Rd.	Storage & Conveyance	The McDowell Road alignment is still in the planning stages, new culverts and lateral drainages can be implemented accordingly.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	Conveyance	Flood containment should continue down to the flood retarding structure.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Increases the land available to be developable providing for economic opportunities.	
OUTFALL -	Management Development Guidelines	Need cooperation with B1RP for possible erosion control and controlling delta formation in the low flow areas	Moderately Expensive	Dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	

Table 28: Preliminary Alternative B Analysis for FRS 2 & 3 Sub-Area

SUN VALLEY ADMP – FRS 2 & 3 SUB-AREA
PRELIMINARY ALTERNATIVE B

PROPOSED ACTION				IMPACTS				
Alternative Measure	**Alternative Strategy**	**Justification**	**Cost**	**Flood Safety**	**Physical/ Natural Environmental**	**Cultural/ Visual Resources**	**Socioeconomic**	**Evaluation Criteria**
APEX -	**Storage**	A basin at the proposed location would reduce the peak flow rate and limit sedimentation in the down fan direction. Therefore a basin at the apex would greatly decrease flood uncertainty. A basin may not control all sediment issues.	Expensive:	Contains the flows decreasing flow uncertainty common with alluvial fan systems.	Strongly impacts the environment.	No known cultural resources are impacted, but visual impacts will result.	Even though the basin takes up a lot of area, the basin provides for more developable area within the fan area.	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	**Storage & Conveyance**	Conveys the flows combined in the upstream basin in a controlled manner to the Parkway	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY: McDowell Rd.	**Storage & Conveyance**	The McDowell Road alignment is still in the planning stages, new culverts and lateral drainages can be implemented accordingly.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	**Conveyance**	Flood containment should continue down to the flood retarding structure.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Increases the land available to be developable providing for economic opportunities.	
OUTFALL -	**Management Development Guidelines**	Need cooperation with B1RP for possible erosion control and controlling delta formation in the low flow areas	Moderately Expensive	Dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	

Table 29: Preliminary Alternative C Analysis for FRS 2 & 3 Sub-Area

SUN VALLEY ADMP – FRS 2 & 3 SUB-AREA PRELIMINARY ALTERNATIVE C								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	Conveyance	Reduced land cost due to lack of a detention basin near the apex and the concrete channels are easier to maintain.	Moderately Expensive	Breakouts are more likely than if basins are used	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Maximizes the developable land at the apex	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	Storage & Conveyance	Basins down stream of the apex would be necessary to control peak flows and sediment issues. Conveyance corridors would be needed as a transport path to the parkway.	Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the apex will be developable providing for economic opportunities.	
PARKWAY: McDowell Rd.	Storage & Conveyance	The McDowell Road alignment is still in the planning stages, new culverts and lateral drainages can be implemented accordingly.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Land downstream of the parkway will be developable providing for economic opportunities.	
DOWN-FAN -	Conveyance	Flood containment should continue down to the flood retarding structure.	Moderately Expensive	Contains the flows	Strongly impacts the environment depending on the type of channel that is constructed.	No known cultural resources are impacted, but visual impacts will result.	Increases the land available to be developable providing for economic opportunities.	
OUTFALL -	Management Development Guidelines	Need cooperation with B1RP for possible erosion control and controlling delta formation in the low flow areas	Moderately Expensive	Dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	Impacts dependent upon development guidelines	

Table 30: Preliminary Alternative D Analysis for FRS 2 & 3 Sub-Area

SUN VALLEY ADMP – FRS 2 & 3 SUB-AREA PRELIMINARY ALTERNATIVE D								
PROPOSED ACTION				IMPACTS				
Alternative Measure	Alternative Strategy	Justification	Cost	Flood Safety	Physical/ Natural Environmental	Cultural/ Visual Resources	Socioeconomic	Evaluation Criteria
APEX -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Function Cost Safety Land ownership at apex Upstream watershed size Sediment yield of upstream watershed Basin size (available footprint) Physical/ Natural environmental Impacts Cultural/ Visual Resource Impacts Socioeconomic Impacts.
UP-FAN -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
PARKWAY -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
DOWN-FAN -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	
OUTFALL -	No Measure	Minimizes the initial infrastructure costs for regulatory agencies. No measure places all the decisions of flood control to the discretion of the developers or existing managing jurisdiction.	Inexpensive	Varies	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	Impacts vary according to the individual decisions made by developers	

2.5.7 Area 4 North of CAP Sub-Area:

The North of CAP Sub-Area is a long narrow area located north of the CAP Canal parallel to the Hassayampa River (Figure 24). 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. Area 4 North of the CAP is the only sub-area that does not fit into the parameters outlined throughout this entire report. This is because Area 4 North of CAP sub-area is primarily a tributary flow system and not an alluvial fan system. For this reason preliminary analysis was performed to determine specific considerations applicable to this sub-area only. The Preliminary Alternatives identifies three flood prone areas:

- Riverine Flooding (Figure 23)
- Small Alluvial Fans Along Hassayampa River
- CAP Pool Area with FEMA approved floodplain (Figure 24)

Additional consideration should also be given to stock tanks and the abandoned auxiliary air field, Luke Auxiliary Field No. 4 (Figure 25).

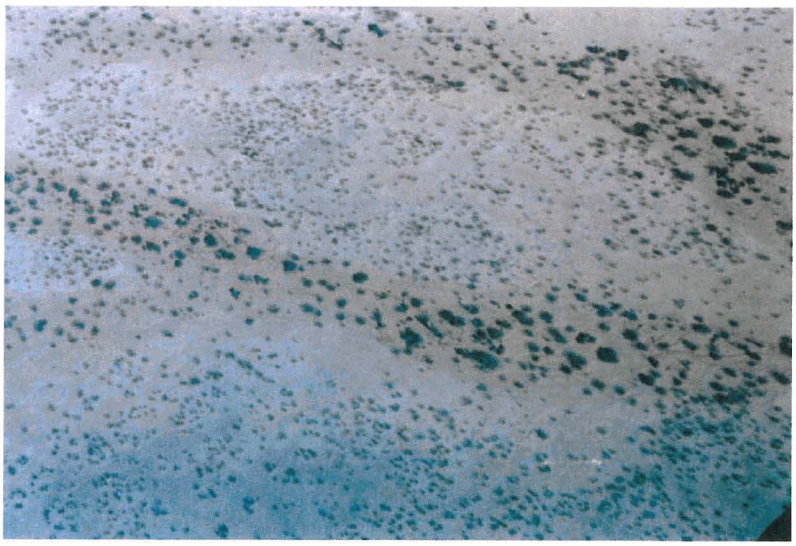

Figure 23: Aerial of Riverine Flooding Areas

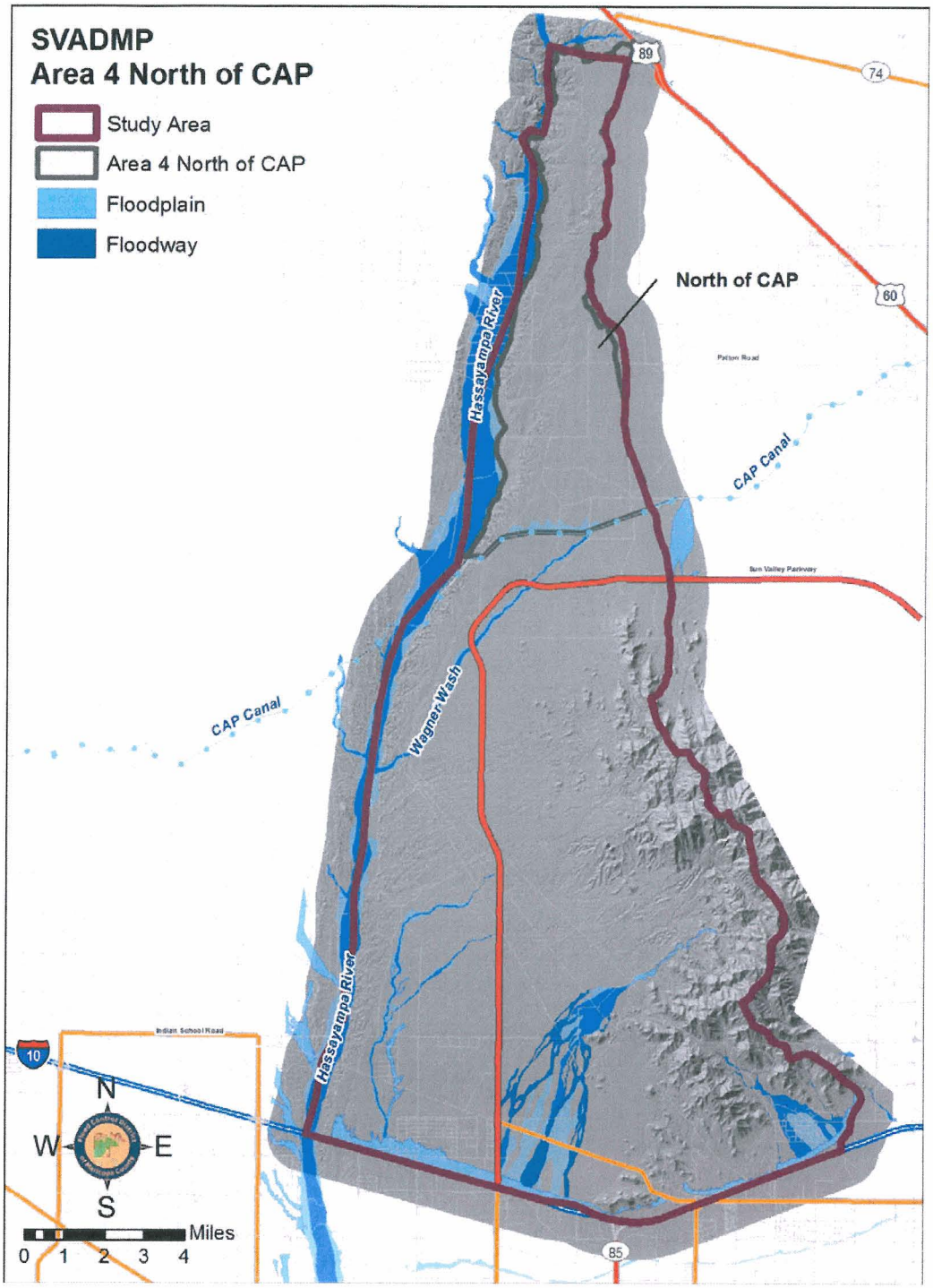

Figure 24: Area 4 North of CAP Sub-Area

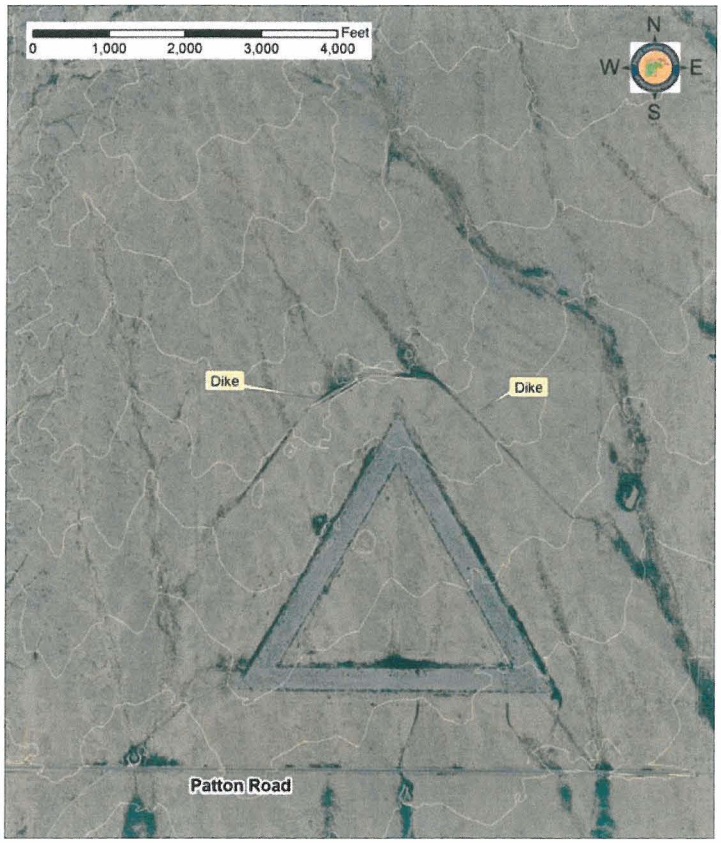

Figure 25: Aerial of Auxiliary Air Field

2.5.8 Alternative Comparison:

Table 31 summarizes the strategy decided upon by the team members during the course of numerous meetings. Each of the four alternatives is driven primarily by what is implemented at the apex. The differences between sub-areas for the same alternative are a result of different parameters such as the location of apices, property ownership, landscape features, existing infrastructure, and existing regulatory mandates. Within the individual sub-area categories there is no variation in strategy for the last three fan components. For example, the CAP has conveyance, management, and management for the parkway, down-fan, and outfall respectively. This is true for all alternatives with the exception of Alternative D. The reason for this is that all flows need to be contained and controlled by the time the flows reach the parkway so as to prevent the overtopping of existing infrastructure. Alternatives A-C explored three separate strategies for this purpose. Once the flows are contained the management and conveyance strategies become the primary recommendations in the down-fan and outfall fan components.

Table 31: Preliminary Alternative Comparison

ALTERNATIVES COMPARISON						
	Alternative A					
Alternative Measure	CAP	Wagner Wash	Hassayampa	White Tank Wash	FRS #1	FRS #2 & #3
APEX	No Measure	No Measure	No Measure	No Measure	No Measure	No Measure
UP-FAN	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance
PARKWAY	Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance
DOWN-FAN	Management	Management	Storage & Conveyance	Storage & Conveyance	Conveyance	Conveyance
OUTFALL	Management	Conveyance	Conveyance	Conveyance	Management	Management
	Alternative B					
Alternative Measure	CAP	Wagner Wash	Hassayampa	White Tank Wash	FRS #1	FRS #2 & #3
APEX	Storage	Storage	Storage	Storage	Storage	Storage
UP-FAN	Conveyance	Conveyance	Conveyance	Conveyance	Conveyance	Conveyance
PARKWAY	Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance
DOWN-FAN	Management	Management	Storage & Conveyance	Storage & Conveyance	Conveyance	Conveyance
OUTFALL	Management	Conveyance	Conveyance	Conveyance / Storage	Management	Management
	Alternative C					
Alternative Measure	CAP	Wagner Wash	Hassayampa	White Tank Wash	FRS #1	FRS #2 & #3
APEX	Conveyance	Conveyance	Conveyance	Conveyance	Conveyance	Conveyance
UP-FAN	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance
PARKWAY	Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance	Storage & Conveyance
DOWN-FAN	Management	Management	Storage & Conveyance	Storage & Conveyance	Conveyance	Conveyance
OUTFALL	Management	Conveyance	Conveyance	Conveyance / Storage	Management	Management
	Alternative D					
Alternative Measure	CAP	Wagner Wash	Hassayampa	White Tank Wash	FRS #1	FRS #2 & #3
APEX	No Measure	No Measure	No Measure	No Measure	No Measure	No Measure
UP-FAN	No Measure	No Measure	No Measure	No Measure	No Measure	No Measure
PARKWAY	No Measure	No Measure	No Measure	No Measure	No Measure	No Measure
DOWN-FAN	No Measure	No Measure	No Measure	No Measure	No Measure	No Measure
OUTFALL	No Measure	No Measure	No Measure	No Measure	No Measure	No Measure

SECTION 3: STEP 1 ALTERNATIVES SUMMARY

3.1 Summary by Alternative

Alternative A:

Alternative A ("No Measure" at the apex) does not address design certainty by capturing the flows at the apex nor does it mitigate for the hazards associated to the apex and the unstable, active alluvial fan down fan from it. For Alternative A to be a viable solution, the land which is identified as unstable, active alluvial fan would need to be purchased as open, undevelopable land, and new mitigation would need to be implemented. The main disadvantage is the cost of land set aside to allow for the natural alluvial fan processes. The advantage of Alternative A is that it minimizes environmental impacts near the apex by preserving existing natural conditions.

Alternative B:

Alternative B is based on a storage strategy at the apex. The purpose of Alternative B is to capture all of the upstream flow at the apex using on-line detention or retention basins. The presence of the detention basins eliminates the downstream alluvial fan uncertainties by controlling flow all the way from the apices to the outfall. Once collected into the detention basins, flows are routed downstream using open channels, culverts, and detention/retention basins (as needed) until the flows reach the outfalls. If a retention basin is used at the apex, flows could be metered eliminating the need for engineered channels down-fan of the apex.

This approach increases channel stability by eliminating flow path uncertainty beginning at the apex. This alternative also offers better management of sedimentation issues. In addition, the alternative provides a continuous, comprehensive flood control trunk system which minimizes the impacts of phasing of the developments in the Sun Valley Area.

By analyzing the probable outcome of placing a basin at the apex many benefits were recognized as part of the Step 1 process. These benefits include increased channel stability, decreased flooding extent, minimization of flow path changes, decreased uncertainty, maximized flood control, and it would allow development to take place in phases. Given the benefits determined for this alternative it is

recommended for Step 2 analysis. The main disadvantage is the cost of land associated to purchasing area for the basins.

Alternative C:

Alternative C is based on the concept of an excavated concrete-lined channel from the apex to the outfall. No basin is provided at the apex. This alternative requires that channels be designed for higher velocities or that sedimentation basins are provided throughout the system. The advantages of Alternative C include reduced land cost due to lack of a basin near the apex and smaller channel land areas. The concrete channels are easier to maintain as well. The disadvantages are that the concrete channels are not as aesthetically appealing and are less amenable for multi-use. Another disadvantage is the high cost of construction due to excavation and concrete lining.

Alternative C is not a recommended alternative without the use of sediment basins. To successfully transport sediment from the apex to the outfall steeper slopes, deeper channels, and large velocities within the channels are necessary. These are not a preferred options for all three categories (public safety, economic, and Aesthetic) outlined in the criteria table above. If it is decided that Alternative C should proceed from the Step 1 to the Step 2 analysis the use of sediment basins throughout the conveyance corridors is recommended.

Alternative D:

Alternative D follows the "No Measure" strategy of using only existing mitigation and planning practices. This alternative relies on existing drainage facilities or new master-planned communities developing their own drainage infrastructure. Current drainage ordinances and floodplain regulations are enforced to ensure adequate flood hazard mitigation measures. Enforcement options can and should be enhanced by developing new alluvial fan floodplain delineations.

Alternative D was also determined to be a viable option. Developers would presumably incorporate an appropriate criteria list; however this alternative gives the District less control over what is built. The main disadvantage compared to the other alternatives is that there will be no regional whole-

fan flood control system leading to unnecessary redundancies and/or potential planning problems. This lack of whole fan planning has the potential for expensive fixes that may be needed in the future. The main advantage is that it would minimize the initial costs for the managing jurisdiction.

3.2 Outcome Statement

The Step 1 analysis was performed to determine which alternatives should be considered for the Step 2 analysis. This was done by gathering information from various sources; holding stakeholder meetings with agencies and developers; and holding meetings between the project team members. At the end of the Step 1 analysis the project team members decided that all four alternatives (A-D) should proceed to Step 2 for further analysis. Further it was decided that Alternative B be broken into five similar, but unique alternatives named B1, B2, B3, B4, and B5. This was done primarily to evaluate the following:

- Influence of size of the apex basin on the design of the downfan system;
- Different channel cross-section types; and
- Various channel alignments that explored the use of large, medium, and small basins at the apex.

The primary objective of the SVADMP is to provide adequate flood control to the residents of Buckeye while addressing the aesthetic treatment of the facilities developed for flood control. It is the District's ambition to make the Proposed Alternatives more compatible with the surrounding landscape and reduce their visual impact for future residents and recreation users. The goals for providing landscaping compatibility to be applied for each Proposed Alternative are outlined below:

- Plan and design the Flood Control District's projects to preserve and compliment the visual character of the landscape settings.
- To protect the beauty of the natural, rural, suburban, and urban landscapes of Maricopa County.
- Identify landscape themes and aesthetic treatment design guidelines for implementing the themes for each project component in the plan.
- To develop aesthetic treatments that are consistent with District cost ceiling guidelines in its aesthetic treatment policy.

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