AGUA FRIA

WATERCOURSE MASTER PLAN ADDENDUM

CHANNELIZATION ALTERNATIVE - VOLUME I

SUMMARY REPORT

FINAL REPORT

01-05-05

Prepared by:

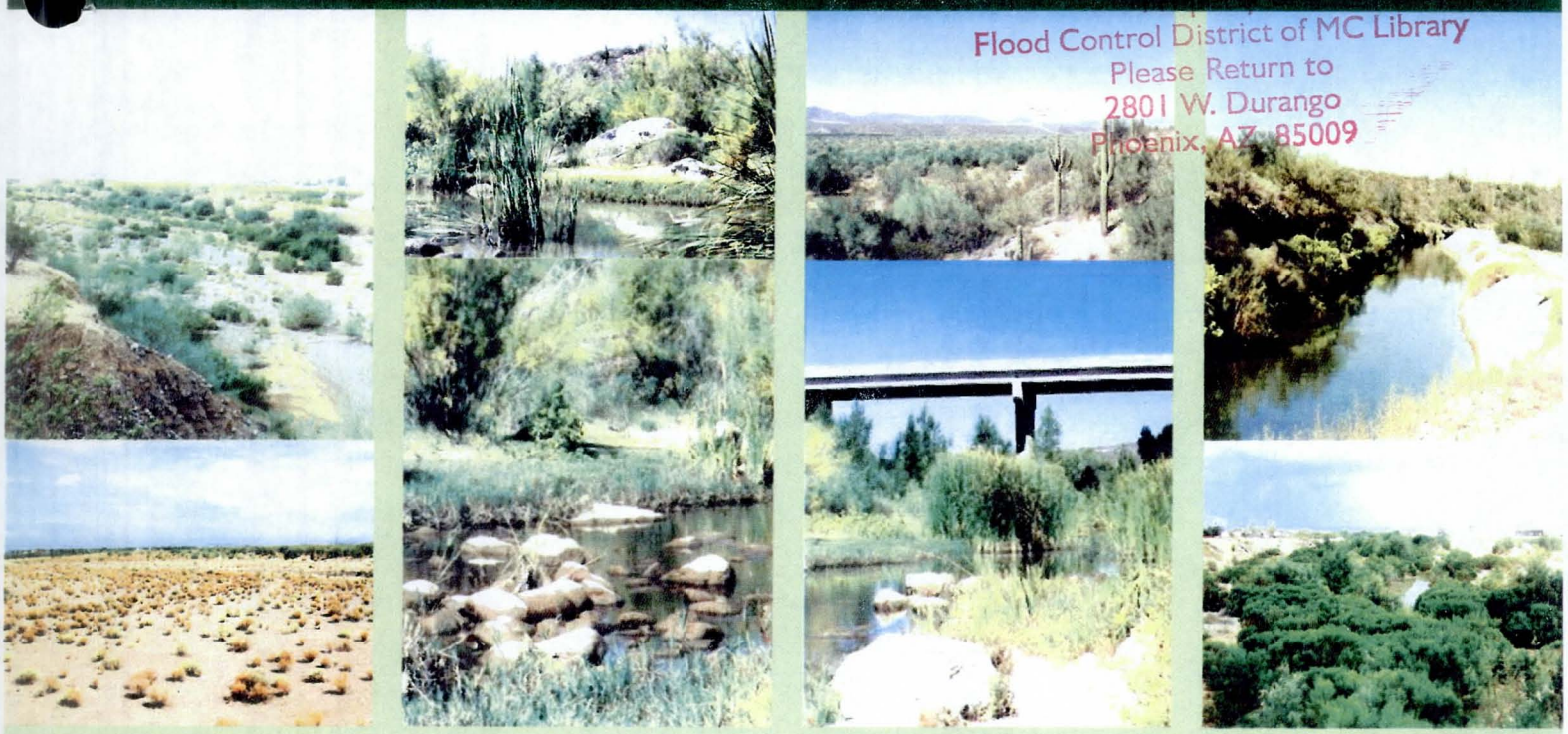
EDAW
455 N 3rd Street, Suite 272
Phoenix, Arizona 85004

DAVID EVANS and ASSOCIATES, INC.

JE FULLER HYDROLOGY & GEOMORPHOLOGY, INC.

Flood Control District of Maricopa County

EDAW



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1) Autocad file of Erosion Hazard Zones
2) Pdf file of technical memo. Figures 22 (Erosion Hazards Zones) were added to the end of the report.

THE AGUA FRIA WATERCOURSE MASTER PLAN ADDENDUM

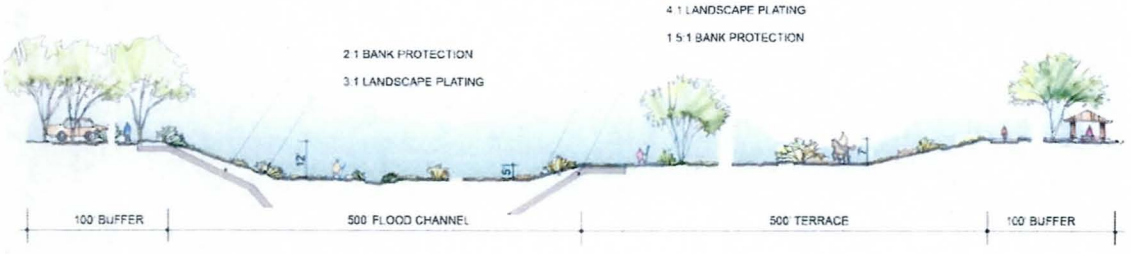
CHANNELIZATION ALTERNATIVE

Executive Summary

The Agua Fria River is characterized by large flood flows, high sediment transport, and a floodplain that can migrate radically from side-to-side during large events. The historic flow regime has been altered by Lake Pleasant, which greatly reduces flood peaks and sediment inflow from the upper watershed, and disturbances to the river due to development, including large scale extraction of high-quality aggregate. Development pressures along the Agua Fria corridor increase potential threats from both the floodplain and the hazard of lateral migration of the river.

In response to the changing river character and the increasing potential for flood damages to existing and new development, the Flood Control District of Maricopa County initiated the Agua Fria Watercourse Master Plan, resulting in a Final Recommended Plan, issued in November 2001. The Final Recommended Plan proposed a non-structural approach to flood hazard management through delineation of the 100-year floodplain and identification of erosion hazard zones. Some structural components were included to protect critical areas, such as bridges and other infrastructure, from erosion. While channelization was considered in the development of the plan, it was not part of the Final Recommended Plan due to high cost and the lack of apparent cost-share partners at that time. Prior to adoption of the Final Recommended Plan, landowners and other stakeholders asked the District to revisit the channelization alternative.

The Agua Fria Watercourse Master Plan Channelization Alternative serves as an addendum to the Agua Fria Watercourse Master Plan (AFR-WCMP). This is an amendment to the AFR-WCMP that addresses a master plan alternative – an approach that channelizes the river to a 1,200-foot wide river corridor to ensure flood control protection while accommodating a continuous recreational corridor and seamless public interaction with the river. Sand and gravel mining activity is a key component in establishing the channel, providing much of the channel excavation and rough grading. Once the channel is constructed mining activities will be primarily limited to lands outside of the corridor. The channelization will also eliminate flooding potential on lands outside of the channel, greatly reducing risks to public infrastructure and creating additional development opportunities on land previously designated as floodplain area.



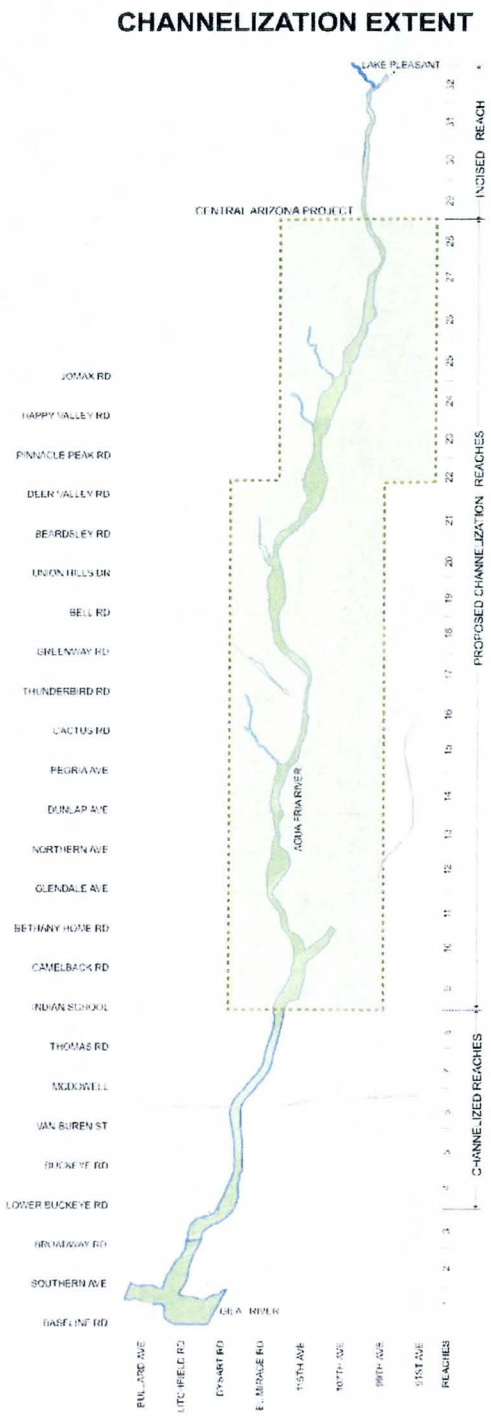
Typical Channel Section

The multi-stage channel alternative proposes to channelize the river to a 1,000-foot channel with 100-foot landscaped buffers on both banks. Rather than a conventional trapezoidal channel, the channel design for this alternative will be 'multi-staged', comprised of a 500-foot wide flood channel and a 500-foot wide vegetated midlevel terrace. The entire channelized section accommodates the Standard

Project Flood (SPF) passing through the new Waddell Dam as well as the 100-year flood level. The mid-level terrace will be safeguarded against floods lower than the ten-year level and will provide for predominantly open space and recreational purposes.

Project Extent & Ownership

The project extends twenty miles from Indian School Road in the south to the Central Arizona Project (CAP) siphon crossing in the north. The separate jurisdictions that fall within the project area include the Cities of Peoria, Surprise, Glendale, El Mirage, Phoenix, Avondale, Youngtown, and Maricopa County. The unincorporated communities of Sun City and Sun City West are also adjacent to the river. The majority of the land within the study area is held under private ownership.



Corridor Alignment

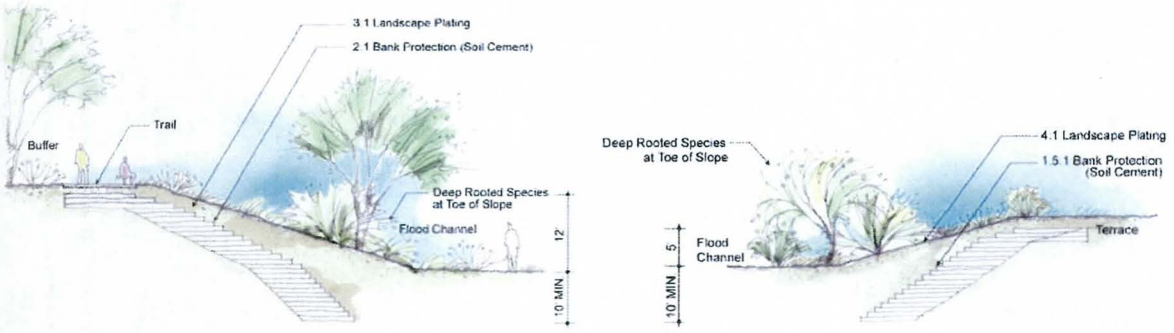
The corridor is aligned with existing bridge crossings at Indian School Road, Camelback Road, Glendale Avenue, Olive Avenue, Grand Avenue, Bell Road and Agua Fria Boulevard/Happy Valley Road. The corridor avoids known structures, development and landfills.

Flow characteristics during flood events

For the 100-year flood event, the average velocity in the flood channel is 8.5 feet per second with maximum flow depths at an average of 7.9 feet. Estimated maximum 100-year velocities on the midlevel terrace are less than 4 feet per second with an average of less than three 3 feet per second. The average depth of flow over the midlevel terrace is 2.9 feet for the 100-year event.

Bank Protection

Bank protection is proposed on the slopes of the flood channel throughout the entire 22 miles of the project. For planning purposes, channel bank protection is assumed to be soil cement for both banks of the flood channel and bioengineering techniques for the bank of the floodplain terrace. A purely bioengineered bank protection in the flood channel is not used due to a higher probability of failure during extreme flooding, susceptibility to failure by undercutting, reduced effectiveness due to drought, poor maintenance or irrigation problems and damage by fire or vandalism. Soil cement bank protection will be placed in the flood channel with side slopes of 1.5:1 to 2:1, and will be plated with a mantle of soil cover that has side slopes that range from 3:1 to 4:1. The soil mantle over the soil cement will then be vegetated to improve the natural character of the corridor and to provide a safe slope for recreation opportunities.



Typical Bank Protection

Grade Control Structures

There will be 24 grade control structures located along the entire 22-mile corridor. Grade control structures will be located about every mile to protect the stability of the river profile and primarily at bridges and utility crossings. Grade control structures are located where differences in long-term stable channel bottom elevations create a deep channel. In order to be as unobtrusive as possible in the landscape, the drop and grade control structures have been designed at a 6:1 slope with soil cement. Typically the height of the drop associated with the structures range from 4-6 feet high.

Recovered Lands

Recovered lands are those lands lying outside of the constructed Agua Fria River channelization corridor that are currently in either the FEMA regulatory floodplain and floodway, or the erosion hazard zone. The channelization alternative will impact over 4,000 parcels as identified in the County Assessor's Records. However, the degree to which each parcel is effected will vary from parcel to parcel. Although the proposed channelization will remove significant acreage (+/- 5400 acres) from identified floodways, floodplains, and lateral migration erosion hazard zones; the channelization improvements for the alignment will occupy an estimated +/- 3,000 acres of land for construction and maintenance. The majority of these lands within the proposed corridor would remain in the FEMA regulatory floodway/floodplain.

Recreation Opportunities

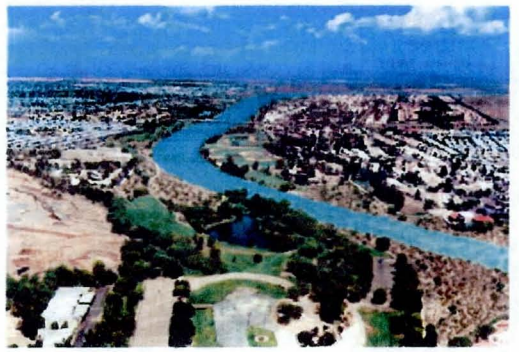
Recreational linkages at the regional, community and neighborhood level were identified at the onset of the project. The Maricopa Regional Trail system is the primary vehicle linking open space projects and trail systems throughout the County, and the Agua Fria River is an important component of that system. The locations of the terraces preserve these linkages to ensure a recreational network that is interconnected along the length of the project area. Increased interaction with the river will be promoted by shifting mining activity to the outside of the floodway corridor. The adoption of the channelization alternative also creates opportunities for the installation of park improvements on terrace areas that would be safeguarded against damaging storm flows. The careful integration of recharge projects and drainage inflow into the corridor design will serve to develop safe but enhanced habitat areas.

A major consideration for municipalities within the floodplain will be amending the zoning of "recovered lands" to conform to the Watercourse Master Plan and to take advantage of the recreational benefits offered by the terraces. Key to this would be the integration of future and existing city parks with the recreational corridor and the eventual development of "recovered lands" adjacent to the channel to foster activity along the corridor edge.

Existing river bed

Channel implementation

Development of recovered lands



Flood condition

River Channelization Simulation

Implementation

This project is expected to take twenty to thirty years for completion at a currently estimated cost of $115,000,000 - $148,000,000. It is anticipated that the majority of the costs to construct the flood control channel option would not be borne entirely by the public. The construction would occur through a partnership of landowners, municipalities, the District, and the mining industry. For example, sand & gravel mining operators would construct a discrete segment of the channel between grade control structure location (typically bridges) as part of their reclamation plan. Besides providing protection for mine areas removed from the floodplain, it opens opportunities for future high-value development adjacent to the channelized corridor. The channel corridor, where implemented, would be turned over to the respective municipalities, the County or special district for operation and maintenance. Funding, construction, and long-term operation and maintenance of segments of the corridor could also occur within a future Recreational Corridor Channelization District established under authority of legislation enacted in June 2004.

Important components for implementation will be effective coordination with the U.S. Army Corps of Engineers to develop a Regional 404 Permit strategy, and the Federal Emergency Management Agency (FEMA) for a similar strategy for removing recovered lands from the regulatory floodplain through the Conditional Letter of Map Amendment (CLOMR) – Final Letter of Map Amendment (LOMR) process.

This study and design is not intended to be the final design of the Agua Fria Channelization Alternative, but is intended to lay out sufficient direction and design concepts so that uniform detailed design and analysis can be completed for specific construction projects.

1 PROJECT OVERVIEW

The Agua Fria Watercourse Master Plan Channelization Alternative serves as an addendum to the Agua Fria Watercourse Master Plan (AFR-WCMP) that was developed in November of 2001. This is an amendment to the AFR-WCMP that addresses a master plan alternative – an approach that channelizes the river to a 1,200-foot wide river corridor to ensure flood control protection while accomodating a continuous recreational corridor and seamless public interaction with the river. Sand and gravel mining activity is a key component in establishing the channel and will ultimately be accommodated outside of the channel, greatly reducing risks to public infrastructure and creating additional development opportunities on land previously designated as floodplain area. The channelization will also eliminate flooding potential onlands.

The multi-stage channel alternative proposes to channelize the river to a 1,000-foot channel with 100-foot landscaped buffers on both banks. Rather than a conventional trapezoidal channel, the channel design for this alternative will be 'multi-staged', comprised of a 500-foot wide flood channel and a 500-foot wide vegetated mid-level terrace. The entire channelized section accommodates the Standard Project Flood (SPF) passing the new Waddell Dam as well as the 100-year flood level. The mid-level terrace will be safeguarded against floods lower than the ten-year level and will provide for predominantly open space and recreational purposes.

Figure 1.1 Conceptual Sketch – Agua Fria Channelized Corridor

1.1 Background Information

The Agua Fria Watercourse Master Plan (AFR-WCMP) funded by the Flood Control District of Maricopa County (District) was initiated in 1999 to examine flood control solutions for the Agua Fria River. While focusing on protecting the public from the hazards of flooding, the master plan also provides an opportunity to integrate open space and recreation uses with floodplain management. A watercourse master plan is a comprehensive flood control plan

that includes hydraulic engineering analysis, future land use development and environmental considerations.

The AFR-WCMP was developed as a means to achieve floodplain management concurrent with the vision for the West Valley Recreation Corridor. The West Valley Recreation Corridor utilizes the major rivers in the West Valley as a backdrop for community-based recreation and as a means to link neighborhoods, communities and commerce. The river, if managed with recreation as a planning component, presents a myriad of opportunities along its length including north-south linkages to regional trails, community benefits through open space enhancements, and the potential for habitat enhancement. Flooding hazards along the river were also investigated as part of the master plan, following concerns about land development encroaching into the floodplain.

The three stated goals (or purposes) of the AFR-WCMP are:

- Protect public interests by regulating land use in the floodplain and reducing development in areas prone to the hazards of flooding and erosion.
- Increase the potential area available for recreation.
- Increase opportunities for habitat enhancement and open space.

Structural solutions were considered by the AFR-WCMP for channelization and levee protection of property, including conceptual bank protection and levee locations. This alternative was not in the final recommended plan due to the overall cost and lack of apparent cost-share partners. The recommended alternative plan called for the identification of a Lateral Migration Erosion Hazard Zone (LMEHZ) and use of non-structural flood control methods.

1.2 Need for the Channelization Addendum

Sand and gravel mining is the predominant land use occurring along the Agua Fria River corridor, especially in areas of high growth and expanding populations. However, increased growth in the West Valley and new developments along the river floodplain have resulted in conflicts with sand and gravel operations. Moreover, continued mining and the lateral erosion of the river during flood events pose a serious threat to ongoing development and public infrastructure. Mining operations are long term, extending over a period of twenty years or more. The existence of mining operations is vital to the economy of the West Valley and, hence, it is critical that they be integrated into the Watercourse Master Plan.

Prior to adoption of the AFR-WCMP by the Flood Control District Board of Directors, the District was approached by property owners and other interests for reconsideration of a channelization option upstream of Indian School Road. In March, 2002, a memorandum titled 'Agua Fria River Conceptual Channelization Plan' was prepared by JE Fuller/Hydrology & Geomorphology, Inc. (JEF) under contract to the District. The purpose of the study was to prepare a concept channelization plan that is compatible with the overall goals of the AFR-WCMP and accommodates open space, sand and gravel mining, and flood control. The study returned a favorable conclusion and recommendations for further investigation toward preliminary design of a corridor that would meet the goals of the AFR-WCMP (JEF, 2002).

1.3 Purpose of the Channelization Addendum

The purpose of the Channelization Addendum is to prepare a more detailed conceptual design of the Agua Fria channelized corridor through engineering design and technical analysis. The conceptual design of the corridor determines a preferred alignment and profile for the channel, taking into consideration key criteria that affect its configuration. This study was developed as a combined effort from the teams of David Evans & Associates (DEA), JE Fuller Hydrology & Geomorphology, Inc. (JEF), EDAW and the Flood Control District of Maricopa County staff.

The engineering design for the project was conducted by DEA and includes the development of a controlled alignment, detailed quantities of construction material, lands required for the project, lands recovered from the floodway, and floodplain or erosion impact areas. For detailed information on the alignment and land recovery refer to the DEA Engineering Design Report (Volume II).

Technical analysis for the project was conducted by JEF, including the analysis of channel parameters, bank protection, sedimentation engineering and erosion hazard zone delineation. For detailed information on the analysis conducted with regard to the proposed channel alignment refer to the JEF Technical Analysis Report (Volume III).

Land use compatibility, recreational opportunities, trail linkages and channel configuration were investigated by EDAW, and are presented as a section within this Summary Report (Volume I).

This study and design is not intended to be the final design of the Agua Fria Channelization Alternative, but is intended to lay out sufficient direction and design concepts so that uniform detailed design and analysis can be completed for specific construction projects. This study also outlines other areas of investigation (e.g., groundwater migration, 404 permits) that should be provided at the time of specific construction project identification.

1.4 Public Involvement

As part of the contract to update and refine the AFR-WCMP, DEA and EDAW along with BJ Communications (BJC) organized a wide variety of stakeholder meetings and interviews to present a conceptual channelization plan and discuss opportunities to implement the overall master plan. As part of this effort, a PowerPoint presentation was developed along with an informational brochure. A copy of the presentation is included in Appendix A of Volume I.

1.4.1 Community Outreach

Starting in July 2003, the team began contacting West Valley community groups, municipalities, state and regional organizations, and private development interests. A draft of the invitation and summary of the meetings is included in the Engineering Design Report (Volume II) appendix.

A partial list of the public meetings and contacts included the following:

- Arizona House of Representatives and State Senate: Distinguished Members from Districts 4,6,9,12 & 16
- Maricopa County: Supervisors; Planning Staff; Parks and Recreation staff
- Flood Control;
- City of Avondale
- City of El Mirage
- City of Glendale
- City of Goodyear
- City of Peoria
- City of Phoenix
- City of Surprise
- Town of Youngtown
- Southwest Valley Chamber of Commerce
- WESTMARC
- Estrella Mountain Community College
- Arizona Rock Products Association
- State Land Department
- Central Arizona Project
- Staff briefing
- Board presentation
- Sun City Homeowner's Association Water Subcommittee
- Sun City Grand Cam Jam
- Sun City West PORA Executive Committee of the Board

Developers and Related Interests

- Sunbelt Holdings
- Diamond Ventures
- DMB and Associates
- Pivotal
- Pulte Homes
- John F. Long Properties
- Shea Homes
- Central AZ Homebuilders Association
- Gammage & Burnham
- Stardust Development

During these meetings, a wide range of concerns and opportunities were discussed. Concerns expressed often related to funding, the timing of such an ambitious plan, as well as how the multiple jurisdictions could coordinate efforts. Technical issues involved discussions about existing industrial activities, environmental challenges such as the El Mirage landfill, as well as incorporation of existing levees and other flood control structures into the project.

The discussions also yielded some very creative ideas for new development opportunities, revitalization projects, new trails and recreational facilities, and potential economic development possibilities. A summary of some of the primary meetings is included in Volume II. A visioning session that facilitated a more interactive discussion was also conducted on October 10, 2003 at Estrella Mountain Community College. Representatives from most every jurisdiction along the Agua Fria River attended, and the team again received very positive feedback about the overall plan.

1.5 Project Extents

The project extends twenty miles from Indian School Road in the south to the Central Arizona Project (CAP) siphon crossing in the north (Figure 1.2). The east west boundaries generally include the extents of lateral migration hazard zone and the property within it. The channelization alternative does not extend to the Gila River as most of the river south of Camelback Road is already channelized. Soil cemented levees, constructed by the Corps of Engineers, extend roughly from lower Buckeye Road to Camelback Road. Generally most of the land beyond the levees are out of the floodplain. The levees provide a high level of flood protection for the southern portion of the river. North of the CAP Siphon to Lake Pleasant the river is incised into hard rock and channelization would not be a viable alternative in this stretch.

1.6 Project Reaches

For the purpose of the channelization alignment within the Project Area, the corridor is sub-divided into 28 reaches that generally follow the mile-by-mile roadway designations from Indian School Road to the CAP siphon south of the Dove Valley Road alignment. Table 1 shows each of the reach designations. Reaches 1-8 are not included as part of the channelization project limits due to prior channelization projects in the river.

Table 1.1 Reach Designations

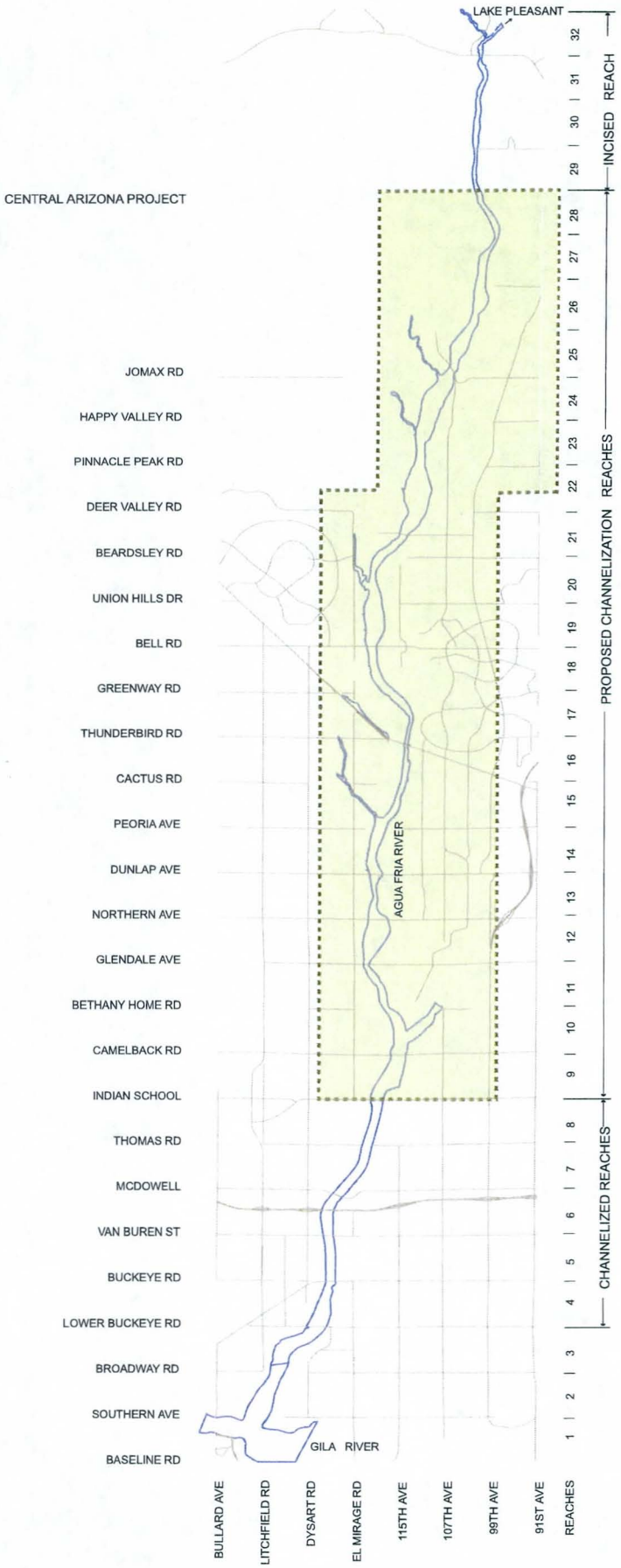
Reach	Downstream End of Reach	Upstream End of Reach
Reaches 1-8	Gila River	Indian School Rd.
Reach 9	Indian School Rd.	Camelback Rd.
Reach 10	Camelback Rd.	Bethany Home Rd.
Reach 11	Bethany Home Rd.	Glendale Ave.
Reach 12	Glendale Ave.	Northern Ave.
Reach 13	Northern Ave.	Olive Ave.

Reach 14	Olive Ave.	Peoria Ave.
Reach 15	Peoria Ave.	Cactus Rd.
Reach 16	Cactus Rd.	Thunderbird Rd. Alignment
Reach 17	Thunderbird Rd. Alignment	Greenway Rd.
Reach 18	Greenway Rd.	Bell Rd.
Reach 19	Bell Rd.	Union Hills Dr.
Reach 20	Union Hills Dr.	Beardsley Rd.
Reach 21	Beardsley Rd.	Deer Valley Rd.
Reach 22	Deer Valley Rd.	Pinnacle Peak Rd.
Reach 23	Pinnacle Peak Rd.	Happy Valley Rd. Alignment
Reach 24	Happy Valley Rd. Alignment	Jomax Rd. Alignment
Reach 25	Jomax Rd. Alignment	Dynamite Blvd. Alignment
Reach 26	Dynamite Blvd. Alignment	Dixileta Dr. Alignment
Reach 27	Dixileta Dr. Alignment	Lone Mountain Rd. Alignment
Reach 28	Lone Mountain Rd. Alignment	Dove Valley Rd. Alignment
Reach 29-34	Dove Valley	Lake Pleasant

AGUA FRIA WATERCOURSE MASTER PLAN ADDENDUM

CHANNELIZATION EXTENT

Figure 1.2



2 STAKEHOLDERS AND AFFECTED ENTITIES

Multiple entities including public and private ownerships and municipality jurisdictions, are affected by the channelization alternative. The public outreach conducted as part of the project served to create awareness of the project and to gather valuable feedback on issues concerning the channel alignment. The various entities affected by the channelization project are briefly discussed in the following sections.

2.1 Land Ownership

The majority of the land within the study area is held under private ownership (Figure 2.1). The Arizona State Land Department is the second largest landowner followed by the Federal Government (Bureau of Land Management and Bureau of Reclamation) and Maricopa County (Table 2.1). A detailed list and map of property ownership within the study area are provided in Volume II (DEA Engineering Design Report, 2004). The land impacted by the channelization alternative is approximately 8378 acres and currently lies within the lateral erosion hazard zone, which includes approximately 3660 acres of floodway and 3050 acres of designated floodplain (DEA, 2004).

Table 2.1 Land Ownership within the Floodplain

ENTITY	ACRES	PERCENT OF TOTAL ACRES
Bureau of Reclamation	50	.8%
Bureau of Land Management	492	7.9%
Maricopa County Parks and Recreation	194	3.1%
Private	4,470	71.7%
State Land Trust	1,026	16.5%
TOTAL	6,232	100%

Source: Maricopa Association of Governments, Arizona Land Resource Information System, Flood Control District of Maricopa County

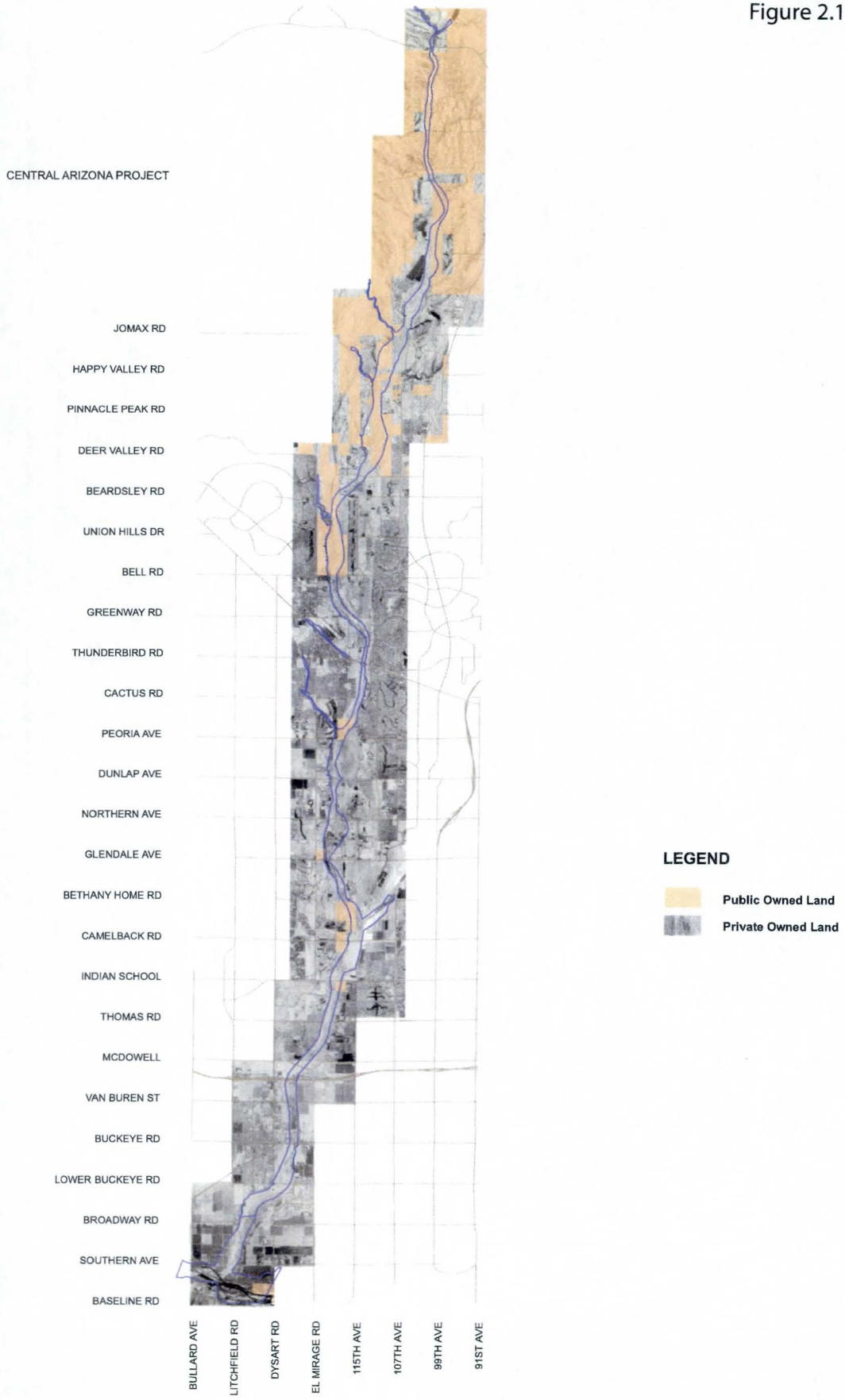
2.2 Jurisdictions

The separate jurisdictions that fall within the project area include the Cities of Peoria, Surprise, Glendale, El Mirage, Phoenix, Avondale, Youngtown, and Maricopa County. (Figure 2.2). The unincorporated communities of Sun City and Sun City West are also adjacent to the river. The Flood Control District of Maricopa County is the primary entity that influences floodplain management and flood control along the river. Many of the City municipalities adjacent to the river consider the floodplain as a primary recreational component that contributes substantially to their respective trails, open space and parks. Several jurisdictions have or are considering developing regional recreational facilities along the watercourse that also include multi-modal transportation, recharge facilities and habitat areas. Almost all cities have expressed support for partnering with the District towards achieving the goals of the Watercourse Master Plan (AFMP Recreation Report, 2001).

AGUA FRIA WATERCOURSE MASTER PLAN ADDENDUM

LAND OWNERSHIP MAP

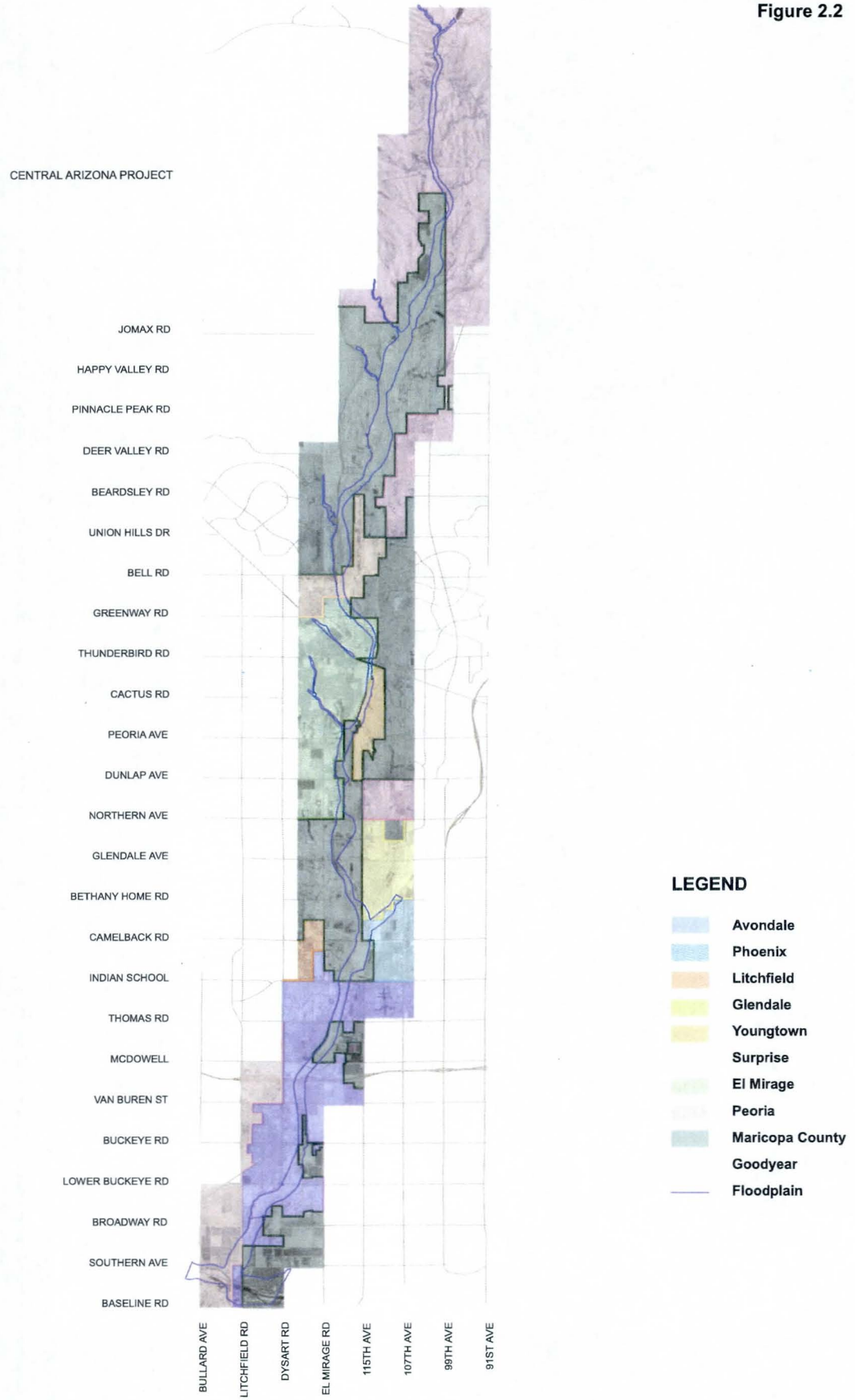
Figure 2.1



AGUA FRIA WATERCOURSE MASTER PLAN ADDENDUM

JURISDICTION MAP

Figure 2.2



2.3 Mining Operations

Sand and gravel mining operations occupy a large part of the river floodplain and floodway for extraction and processing (Figure 2.3). These operations, many located close to the urbanized sections along the river, are a key component for development of the channelization alternative. The Arizona Rock Products Association, representing several property owners/operators along the river, has become a key partner in the development of this alternative. The mining industry has tools readily available to create the channel and terraces. Mine operators will have commercial access to the resource generated during the creation of the channel. Once the channel is in place, mining will not be permitted within the channel. This coordinated effort in creating the channel will ultimately stabilize the river by reducing the potential for head cutting (erosion progressing upstream), downstream erosion and lateral migration while preserving the structural integrity of utility and transportation infrastructure spanning the river. Interaction with the river for recreational purposes will also be greatly enhanced by creating a continuous open space connection between Lake Pleasant and the Gila River.

2.4 Recharge Operations

There are several existing and proposed recharge operations associated with the Agua Fria River (Figure 2.4). These operations make use of the high infiltration rates of the riverbed to recharge excess water for long-term storage credits, and subsequent recovery. With the discharge of water into the predominantly ephemeral channel, the establishment of vegetation and the creation of habitat are facilitated. Recharge projects are viewed as opportunities that greatly enhance the visual character of the river, and which can be considerably manipulated in their design to take advantage of the recreational opportunities they create. Some of the existing or proposed recharge projects along the Agua Fria River include:

2.4.1 CAP Agua Fria Recharge Project (Built and Operating)

The CAP Agua Fria Recharge Project combines streambed recharge and infiltration basins at a single facility that extends from the CAP canal to just north of Happy Valley Road. Colorado River water released from the CAP system flows about four miles down the Agua Fria River bed where it is then diverted into 100 acres of spreading basins. The water percolates into the ground, both in the streambed and the spreading basins, and replenishes the aquifer. This recharge project is designed to store 100,000 acre-feet of water annually (one acre-feet of water is the volume of water that would cover one acre to a depth of one foot). This is considered an industrial offline recharge facility that does not permit public interaction. However, projects like this have the potential to develop into integrated recreational/habitat facilities.

2.4.2 SROG Agua Fria Linear Recharge Project (Study in Progress)

The SROG Agua Fria Linear Recharge Project is a coordinated effort by the Southern Regional Operations Group (SROG) to recharge water into the Agua Fria River. The total water discharged into the streambed is eligible for long-term storage credits. SROG, comprised of the Cities of Glendale, Mesa, Phoenix, Scottsdale and Tempe, is the local sponsor while BLM is the federal sponsor of the recharge project. An estimated 40,000 to 60,000 acre-feet per year of reclaimed water from the 91st Avenue Wastewater Treatment Plant (WWTP) will

be available for recharge. The general mode for recharge would be to route a pipeline from the WWTP to Bell Road, with several discharge points into the Agua Fria River.

Several alternatives for the pipeline route are currently being investigated. Alternatives include routing the pipeline: a) along a major north-south arterial, b) along the Agua Fria River corridor and c) along a combination of an existing power line alignment and north-south road alignments. Impact analyses are currently underway to determine the preferred alternative. It is the goal of the SROG to work in tandem with the District to develop an alternative that conforms to the Watercourse Master Plan, while fulfilling the goals of the recharge project. The alignment along the corridor proposes to run the pipeline parallel to the bank within the landscape buffer, with discharge into the terrace and flood channel. This alternative maximizes the recreational potential of the project and will be most beneficial to the Watercourse Master Plan. An Environmental Impact Statement is currently in the process of being developed for the project. A consensus plan that details the initial feasibility and stakeholder coordination studies has been developed. Further information for the Project is available at http://phoenix.gov/AGUAFRIA/phase1report.html

2.4.3 NAUSP Recharge Project (Design and Construction)

The New River – Agua Fria River Underground Storage Project is a 'water banking' facility developed through a partnership between SRP and the cities of Avondale, Chandler, Glendale and Peoria. The implementation of the project will ensure a reliable and adequate supply of water for the West Valley. The project, sited west of Loop 101 and north of Bethany Home Road on the east bank of the New River, will allow for various water supplies to be stored in natural underground aquifers for future use. The Project will be operated by SRP and will eventually store up to 80,000 acre-feet of water per year. The current project design includes six off-channel basins and one in-channel basin. The off-channel basins will have an approximate surface area of 120 acres and will be located on the eastern bank of the New River. The in-channel basin will have an approximate surface area of 80 acres and will be located in the eastern half of the bed of the New River near its confluence with the Agua Fria River. The recharge basins are expected to begin operations by spring of 2005. Because of the proximity of the project area with the Glendale airport, the development of habitat areas that can attract birds are discouraged. This reduces the potential for possible bird strike hazards.

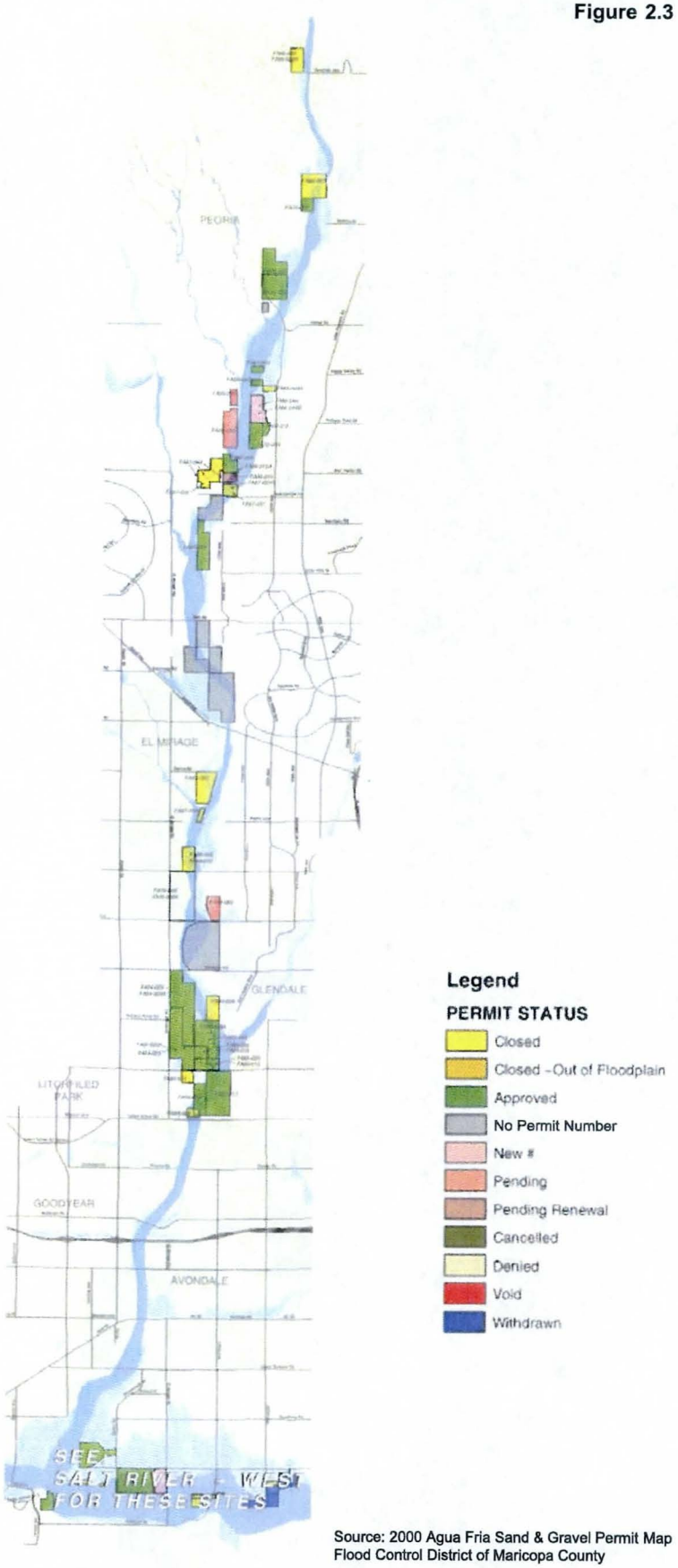
2.4.4 City of Peoria – Water Reuse Master Plan (Planning)

The City of Peoria reuse project incorporates reclaimed water as a key element in their water supply, and is currently developing a Water Reuse Master Plan to guide the development of its direct and indirect use activities. Water reuse includes the collection and treatment of wastewater from homes and businesses to be utilized where potable water is not required. The study will be evaluating direct reuse for irrigation as well as recharge opportunities that could include the Agua Fria River.

AGUA FRIA WATERCOURSE MASTER PLAN ADDENDUM

MINING OPERATION MAP

Figure 2.3

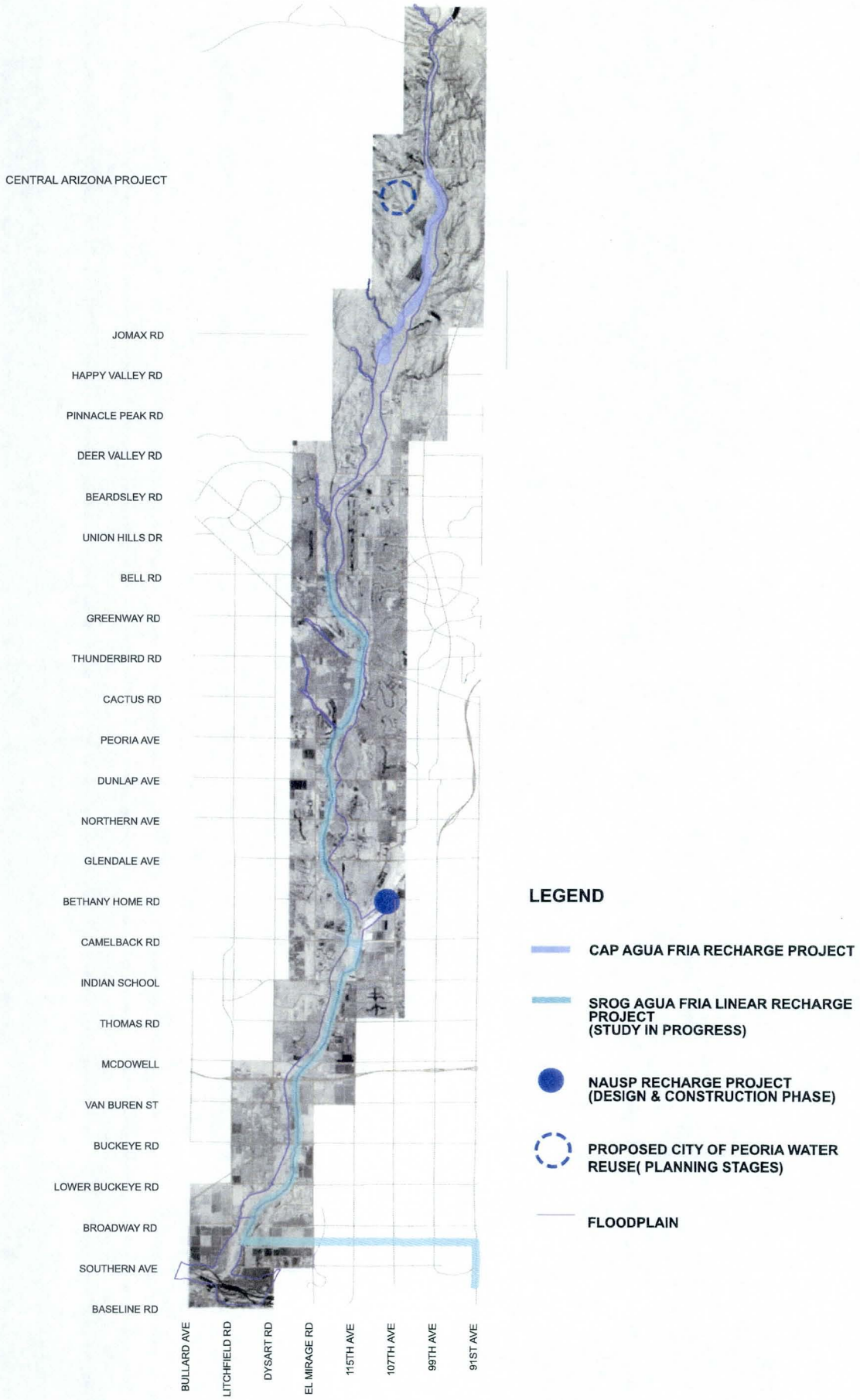


Source: 2000 Agua Fria Sand & Gravel Permit Map
Flood Control District of Maricopa County

AGUA FRIA WATERCOURSE MASTER PLAN ADDENDUM

EXISTING & PROPOSED RECHARGE OPERATIONS MAP

FIGURE 2.4



3 EXISTING CONDITIONS

Due to the storage capacity of the New Waddell Dam, the Agua Fria River, below Lake Pleasant is essentially an ephemeral river, responding only to precipitation flows or localized point flows. It is a primary channel for conveying water during flood events, carrying flows from a series of washes and outflow channels and the New River down to its confluence with the Gila River. Dry rivers exhibit frequent adjustments in their sandy channels during flow conditions, and this is evident along the Agua Fria in its tendency to migrate laterally and erode its banks. The floodplain of the river is wide and expansive, extending to over 1.5 miles at its widest point. Poorly defined banks and homogenous creosote vegetative communities characterize the landscape of the river for the most part (Figure 3.1). However, rich biodiversity and habitat conditions exist immediately south of the Waddell Dam (Figure 3.2), at the Gila River confluence, and where there is access to intermittent supplies of water downstream of storm sewer outflows as a result of surface runoff from urbanized areas and irrigation tail-waters from agricultural areas.

Figure 3.1 Agua Fria River bed

Figure 3.2 Agua Fria south of Waddell Dam

3.1 Land Use

3.1.1 Residential Use

Residential uses consist of single family homes, subdivisions, master planned communities, and manufactured/mobile home areas adjoining the floodplain. Neighborhood parks and golf courses are often associated with residential areas, creating opportunities for a linkage with the river corridor. Residential uses also provide the population base that will benefit from the creation of parks, trails and other recreational elements within the corridor.

3.1.2 Sand and Gravel Mining

The sand and gravel mining operations envelope extensive areas within the floodplain and in numerous cases extend into the floodway. These areas are located on private lands or on leased public lands. These areas are restricted to the general public because of the risk associated with large pits and heavy machinery. Sand and gravel mining operations, as currently operated, present a challenge to the creation of a continuous recreation corridor. Areas adjoining the river within the County jurisdiction are dominated by sand and gravel mines. This is most prominent between Indian School Road and Olive Avenue. The

configuration of sand and gravel pits present opportunities for the creation of future habitat areas and active recreation areas once mining is completed and the pits are reclaimed. The sand and gravel mining industry is an important partner in the effort toward successful implementation of a stable channel and a continuous recreational corridor.

3.1.3 Recreation

Existing recreational facilities within the project area include several golf courses associated with the residential areas. Apart from two courses immediately north of Indian School Road, the majority of golf courses are located north of Northern Avenue. Other recreational amenities within a mile from the river include neighborhood parks, sports fields and active play areas associated with schools, and equestrian facilities adjoining the river in Glendale and Phoenix. A network of dirt paths has risen out of informal use along the river corridor. Currently, some of the newer residential areas provide open spaces and trails adjacent to the river with opportunities to link to the corridor. Existing multi-use paths are limited to park boundaries. Existing recreational facilities along the channelization corridor provide an understanding of the recreational needs and type of user base currently present along the river.

3.1.4 Industrial Use

Industrial uses include Glendale Municipal Airport and several city wastewater treatment plants (WWTP) with discharge into the river, including the Glendale Area WWTP, El Mirage WWTP, and Luke Air Force Base WWTP. Adjacent landfills include the Glendale Landfill and the El Mirage landfill. Also present are storage areas, industrial gravel processing plants associated with the sand and gravel industry, railway loading and unloading, as well as other small scale industrial units. Industrial areas are characterized by indistinct areas with minimal aesthetic value, combined with large truck transportation networks and heavy traffic. The creation of a distinct recreational corridor disconnected from adjacent industrial infrastructure poses a significant challenge.

3.1.5 Agricultural and Vacant Land

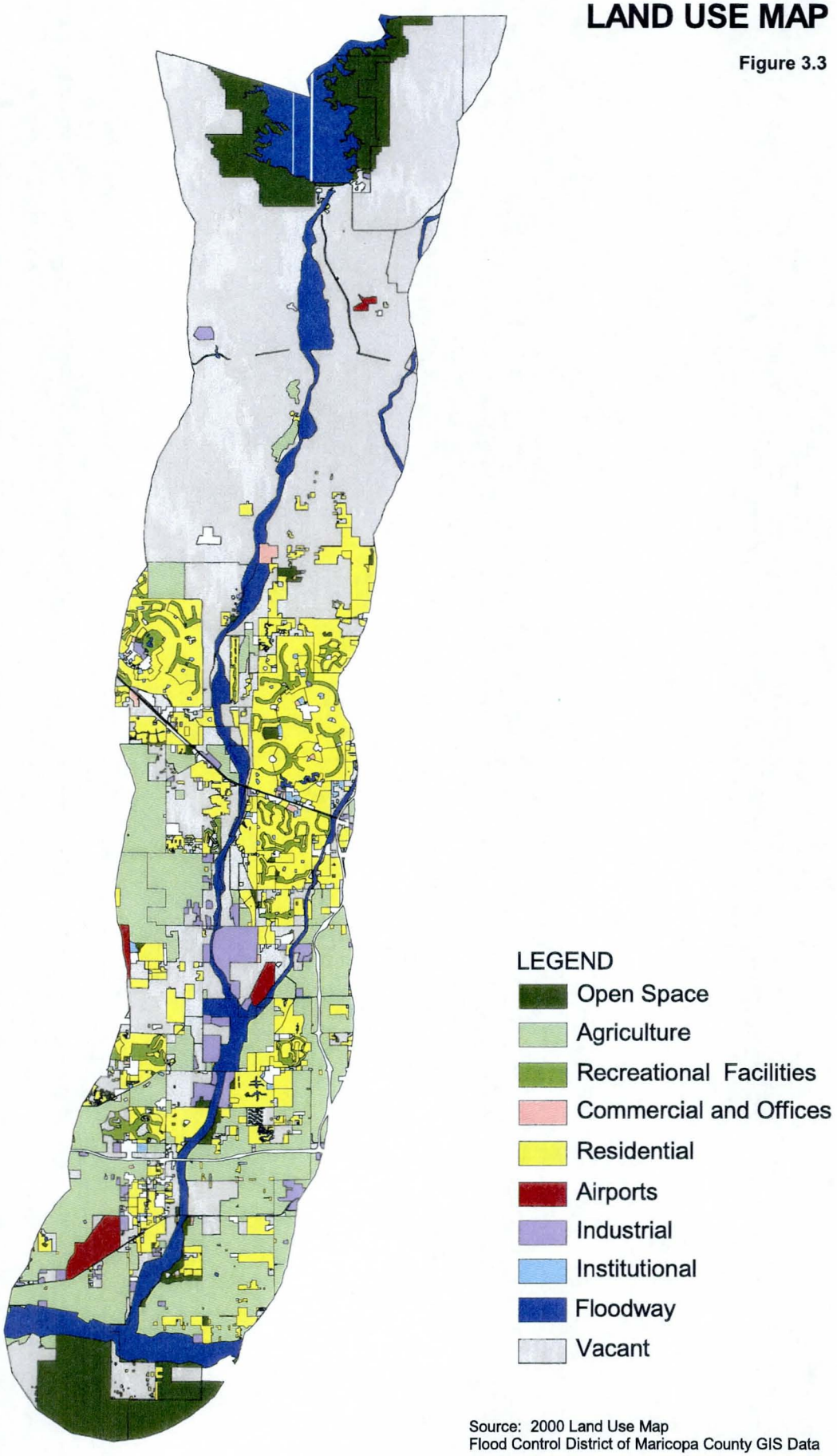
Agricultural and vacant land is limited along the channelization project area. Agricultural uses occur south of the project area where there is irrigation water. Vacant land adjacent to the river is limited and in most cases slated for sand and gravel mining operations. However, with the implementation of the channelization concept and the removal of large tracts of land out of the floodplain, the accommodation of greater value added development becomes a much more viable option.

Refer to Figure 3.3 for the land use map.

AGUA FRIA WATERCOURSE MASTER PLAN ADDENDUM

LAND USE MAP

Figure 3.3



Source: 2000 Land Use Map
Flood Control District of Maricopa County GIS Data

3.2 Utilities

Building on previous studies, work was conducted by DEA to identify existing utilities and canals within the corridor, and the record maps of known utilities existing within the proposed recreation corridor were reviewed. Utility company maps and other infrastructure improvement records obtained and reviewed include:

- El Paso Natural Gas
- Southwest Gas Corporation (SWG)
- USWest (Qwest) Communications
- Arizona Public Service
- Sanitary Sewer
- Central Arizona Project
- Beardsley Canal Flume

Please refer to the DEA Engineering Design Report (Volume II) for a detailed review and location of these utilities.

3.3 Bridges

Bridge structures along the Agua Fria River occur along the main arterials and are key determinants in the channel alignment process. Bridge characteristics, including span lengths, low-chord of the bridge (bottom of girders/bridge deck), location of pier/column tip, bottom of pile casing, top of foundation, and top of pier protection, were compiled from previous studies and analyses along with field surveys to determine the impact of the channelization project on existing bridges. Analysis reports were reviewed to determine approximate impacts of the project and to recommend any future steps in the detailed design of the proposed corridor. The Agua Fria River Conceptual Channelization Plan (JEF, 2002) and the Agua Fria River Watercourse Master Plan (KHA, 2001), were the main sources of this information. Table 3.1 lists the bridges impacted by the proposed channelization concept.

Table 3.1 Bridges Impacted by the Agua Fria Channelization Conceptual Plan.

Bridge	Bridge Span (ft)	Scour Assessment [1]
Indian School Road	1623	Critical
Camelback Road	1725	Stable
Glendale Avenue	598.25	Critical
Olive Avenue	1503.5	Stable
Grand Avenue (US60)	504	Stable
BNSF RR	480' + 150	-
Bell Road	1110	Stable
Agua Fria Boulevard	1250	-
Proposed Loop 303	-	-

[1]Scour Assessment from Final Bridge Scour Reports for 16 MCDOT Bridges, Cannon and Associates, 1996 as seen in KHA, 2001 and JEF, 2002.

In addition to existing bridges, all future bridge designs that cross the Agua Fria River should anticipate the channel alternative. Please refer to the DEA Engineering Design Report (Volume II) for a detailed review and analysis of the bridge structures.

3.4 Tributary Outfalls

Specific tributary outfalls into the Agua Fria River were investigated by JEF. Several tributary outfalls that contribute to the Agua Fria River in the project reach were identified for consideration of conceptual design alternatives (Refer to Volume III for conceptual tributary inflow studies). These include:

- Six Unnamed washes identified in the North Peoria Area Drainage Master Plan
- Unnamed wash north of Hatfield Road on the east bank
- Caterpillar Tank Wash (CTW)
- Twin Buttes Wash
- McMicken Outfall
- Eastward drainage along Bell Road
- Lizard Acres Wash
- El Mirage Wash
- Dysart Drain
- Colter Channel
- New River
- Westbound drainage along Indian School Road

Tributary outfalls and lateral drainage into the channel corridor must be incorporated into the channel alignment to safely convey storm flows. The modification to the channel depth and width of channel will impact the existing flow into the corridor. Generally, effective flow lines to the channel and sufficient erosion control at outfall points will need to be addressed. Typically, drainage easements connecting to the channel provide enhanced vegetation conditions and opportunities for habitat establishment due to fairly constant "nuisance flows" typical of urban washes.

4 CHANNEL ALIGNMENT

The corridor builds on the goals of the AFR-WCMP to provide flood control protection from the Standard Project Flood (SPF), incentives for both private and public sector participation, and the creation of open space and a linear recreation corridor. The key considerations that influenced the alignment of the channel are described in the following section.

4.1 Criteria for Establishing Horizontal Channel Alignment

- Maximize use of area within the floodway
- Provide gentle transitions and "smooth out" sharp curves
- Minimize negative impacts of proximity to sand and gravel mining operations
- Accommodate significant side drainageways
- Safeguard existing bridge locations
- Accommodate known future roadway crossings
- Safeguard existing developments
- Maximize the use of existing bank armoring
- Maximize the use of natural hard and/or high banks
- Minimize small, partial, parcel right-of-way "takes"
- Preserve natural habitats
- Maximize recreational opportunities
- Avoid known structures, developments, utilities, landfills

4.2 Criteria for Establishing Vertical Alignment of Channel and Terrace

- Connect to existing vertical tie-in point at Indian School Road
- Provide for a range of equilibrium slopes to maintain continuity of sediment transport for a range of discharges
- Allow reasonable drops at grade control and drop structures
- Accommodate bridge pier depths
- Account for utility conflicts
- Accommodate impacts of local scour at constricted channel sections
- Avoid levee situations

4.3 Criteria for Establishing Terrace Locations

The terrace locations shift from the east bank to the west bank to take advantage of existing or proposed components that maximize the recreational use of the terrace. These factors include the following:

- Maximize terrace use compatibility with adjacent land uses
- Promote connectivity through linkages to existing trail systems
- Accommodate in-flow channels in the low-flow channel to promote vegetation and habitat conditions

5 PREFERRED CHANNEL CHARACTERISTICS

5.1 Typical Channel Characteristics

The standard corridor width is 1200 feet wide (Figure 5.1). This includes a total conveyance channel that is 1,000 feet wide, consisting of a 500-foot wide low-flow flood channel (flood channel) and a 500-foot wide terrace. There will be two 100-foot wide buffers on each side of the conveyance channel. A typical section with proposed slope protection measures is shown in Figure 5.2.

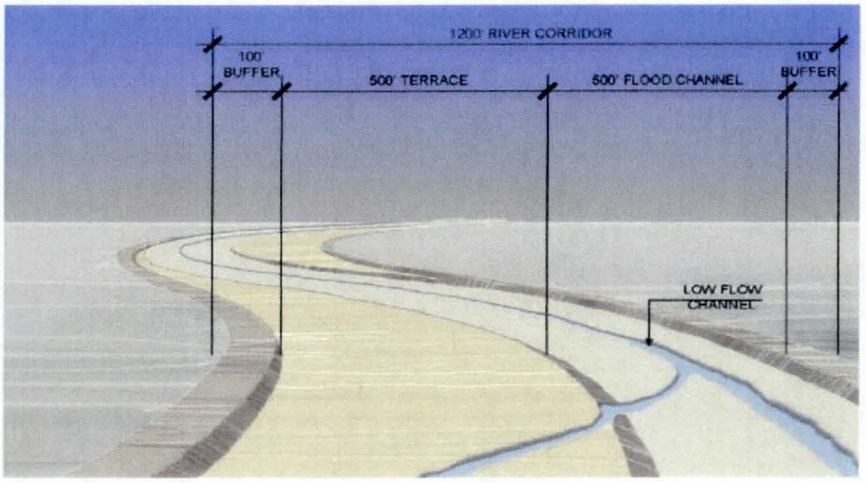


Figure 5.1 Typical channel components

The cross section of the multipurpose corridor provides for:

- Containment of the SPF from bank to bank of the full channel
- Passage of a 10-25-year design flow in the flood channel
- Positive conveyance of nuisance flows
- Passage of groundwater recharge flows

The terrace will experience infrequent flows above the 10-year return frequency discharge and will be available for certain recreation improvements. The flood channel will convey the most damaging flows of up to about 9,000 cubic feet per second (cfs), which is approximately the 10-year return frequency discharge. Overall, the 1,000-foot wide conveyance channel will safely convey 100-year discharge the SPF discharge from the New Waddell Dam. The 100-foot wide buffers will accommodate permanent trails and provide for emergency access and setback for the sand and gravel operations outside and above the active conveyance area of the channel. As shown in Figure 5.2, the maximum depth of the channel will be twelve feet and the terrace will be five feet above the 500-foot flood channel.

5.2 Horizontal Alignment

The corridor is aligned with existing bridges at Indian School Road, Camelback Road, Glendale Avenue, Olive Avenue, Grand Avenue, Bell Road and Agua Fria Boulevard/Happy Valley Road (Figure 5.4). The corridor avoids known structures, development and landfills. The El Mirage landfill, on the west side of the corridor south of Grand Avenue, constrains the alignment of the corridor along with the Grand Avenue bridge. Bank protection should be provided to protect the landfill from the potentially erosive action of the river, even in its current state. The proposed channel has no bends through the deep pits at the Sunstate Sand and Rock facility located about one mile north of Bell Road. This is to minimize the potential for scour.

There are areas where the channel section deviates from the typical section due to space limitations or other constraints. These include channel sections adjacent to the CAP recharge facility, Grand Avenue bridge and El Mirage landfill. Downstream of Bethany Home Road, the corridor widens to 1700 feet to accommodate the increased SPF discharge at the New River confluence. The width of the flood channel and terrace will vary as the channel transitions to match the existing channel cross section at Indian School Road. Please refer to Appendix B of this volume for a complete reach by reach plan of the alignment.

The CAP canal forms the northern boundary of the plan and does not affect the horizontal alignment of the corridor. The CAP Agua Fria Groundwater Recharge project, however, does constrain the alignment of the channel. The corridor stays on the east side of the recharge facility (Figure 5.3) and will not affect the function of the facility. From the CAP to the recharge facility, the terrace is on the west side of the corridor to provide for the uninterrupted flow of discharge to the recharge facility. The conveyance channel for the recharge facility that conveys flow from the CAP to the facility may be relocated to the west buffer of the corridor. Alternatively, the channelization may end downstream of the CAP recharge facility.

5.3 Vertical Alignment

The vertical alignment matches the existing channel invert elevation at Indian School Road and the existing invert at Station 1571+04, downstream of the CAP Canal. Maximum scour erosion protection was required at the El Mirage landfill, the Glendale Avenue bridge and Sunstate Sand and Rock Properties. Therefore these locations also served as fixed vertical points along the channel profile. Based on these fixed vertical elevation locations, the proposed channel profile was designed utilizing an equilibrium slope regime for the SPF (JEF, 2002). The vertical profile of the corridor is shown in Appendix B.

The vertical alignment of the channel includes drop structures or grade control structures at bridges and areas of instability or potential instability such as the El Mirage landfill, Grand Avenue bridge and Sunstate Properties. Large drop structures are not desirable from an aesthetic or safety point of view, so the height of the drops for the most part range from four to six feet. At existing or proposed bridges, drop structures are located immediately downstream of the bridge. Utility crossings such as major water, sewer and gas lines were also assessed to avoid conflict with the channel profile and other major adverse impacts on the utilities. Grade controls were set at general locations along the channel. During final design, exact locations of these grade controls and structures will be determined from detailed field surveys.

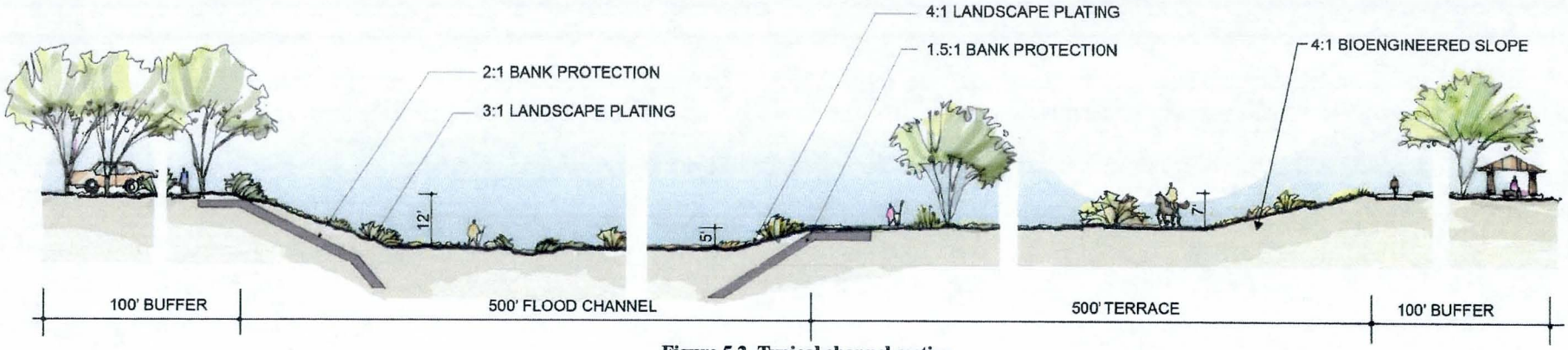


Figure 5.2 Typical channel section

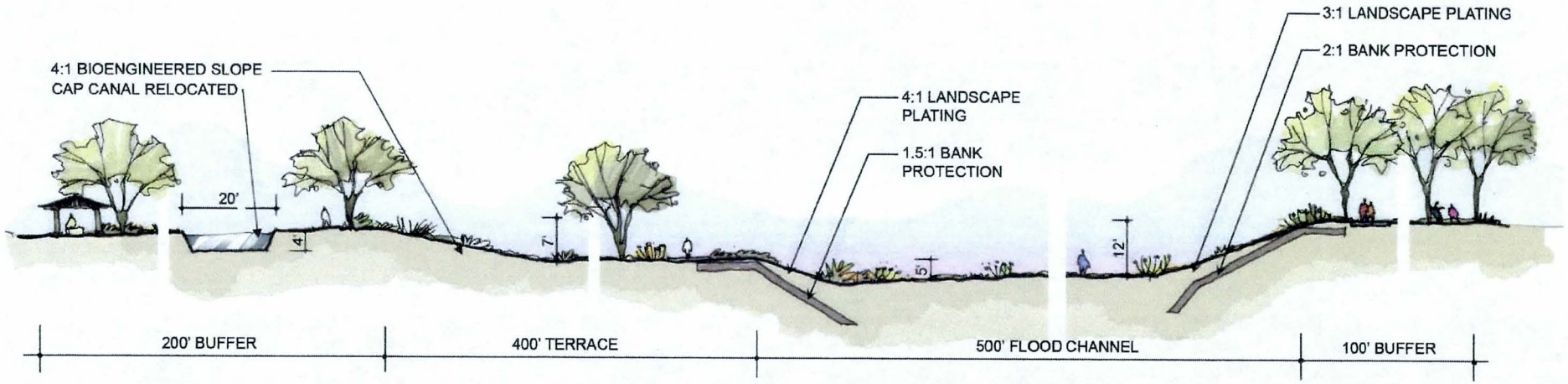


Figure 5.3 Channel section at the CAP recharge canal

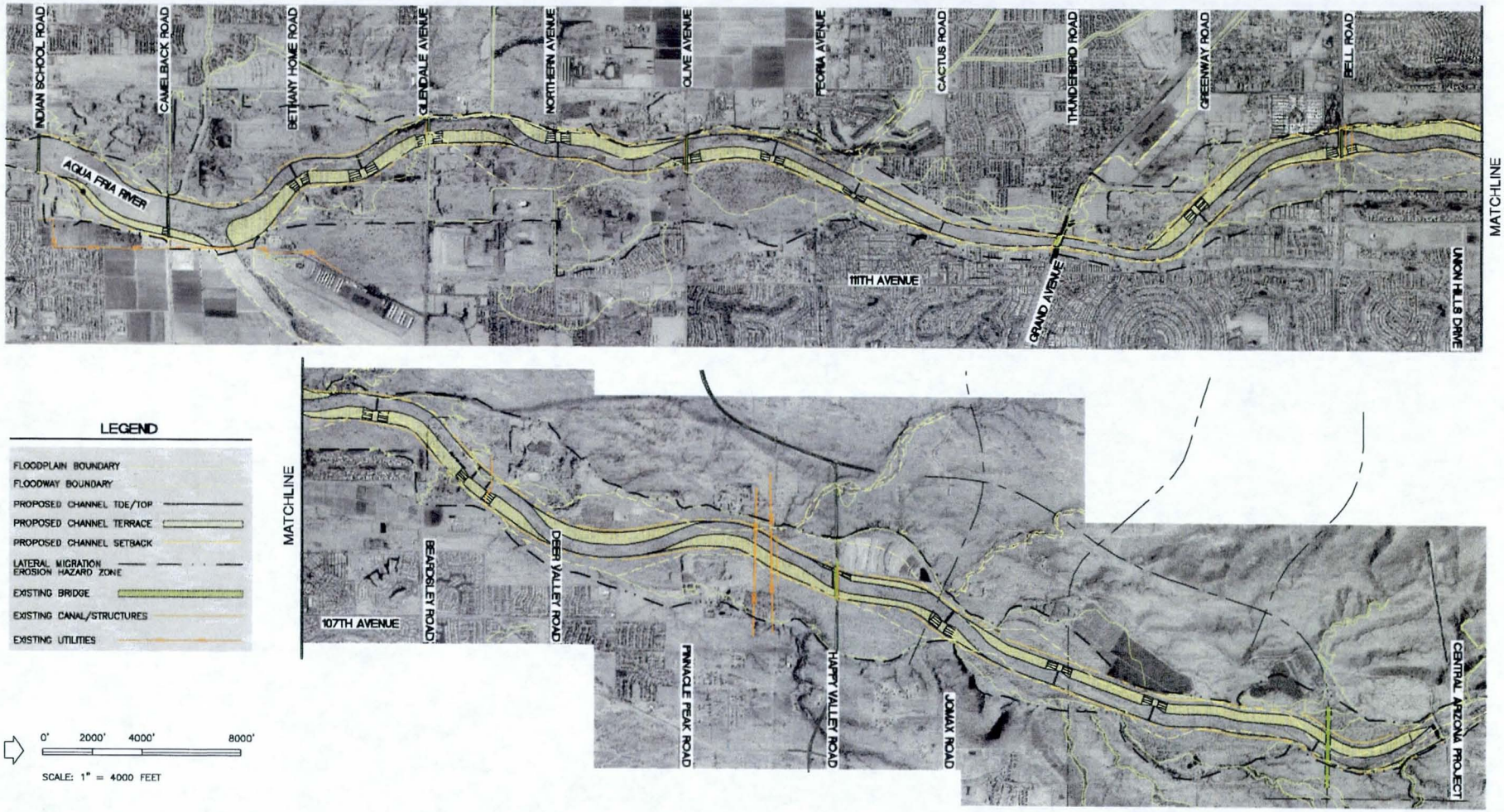


Figure 5.4 Channelization alignment

5.4 Flood Channel

The proposed corridor geometry includes a flood channel that conveys flows up to and including the 10-year event. The floodplain terrace will be inundated and convey flows during larger floods. The terrace alternates from the east to west of the corridor over the length of the channelization project in a manner similar to that of a natural meandering river. For the 100-year flood event, the average velocity in the flood channel is 8.5 feet per second with maximum flow depths at an average of 7.9 feet. Estimated maximum 100-year velocities on the floodplain terrace are less than 4 feet per second with an average of less than three 3 feet per second. The average depth of flow over the terrace is 2.9 feet for the 100-year event.

5.5 Bank Protection

Bank protection is proposed on the slopes of the flood channel throughout the entire 22 miles of the project. For planning purposes, channel bank protection (Figure 5.1) is assumed to be soil cement for both banks of the flood channel and bioengineering techniques for the bank of the floodplain terrace. A purely bioengineered bank protection in the flood channel is not used due to a higher probability of failure during extreme flooding, susceptibility to failure by undercutting, reduced effectiveness due to drought, poor maintenance or irrigation problems, and damage by fire or vandalism.

5.5.1 Flood Channel Bank Protection

Soil cement bank protection will be placed in the flood channel with side slopes of 1.5:1 to 2:1 (as shown in Figure 5.5-5.6), and will be plated with a mantle of soil cover that has side slopes that range from 3:1 to 4:1. The soil mantle over the soil cement will then be vegetated to improve the natural character of the corridor and to provide habitat and recreation opportunities. The proposed mantled and planted soil cement design achieves the primary advantage of a pure bioengineering alternative. Refer to the DEA Design Engineering report for further soil cement construction details and sections.

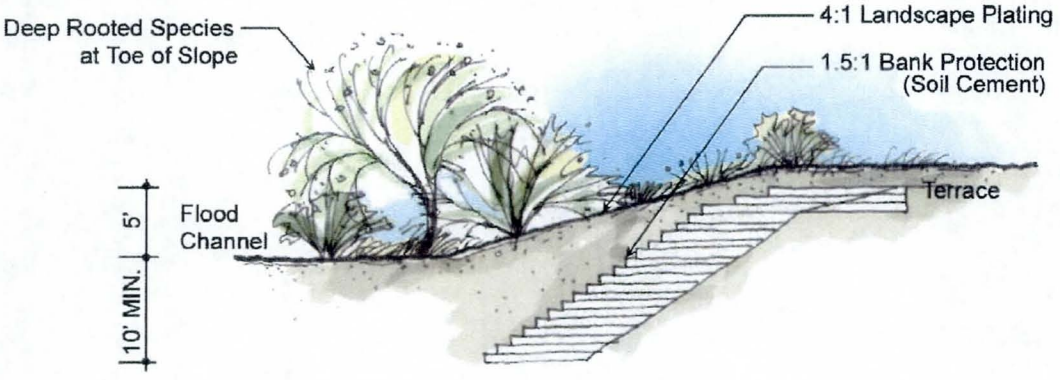


Figure 5.5 Typical bank protection between flood channel and terrace

5.5.2 *Bank Protection Toe Down*

In general, bank protection should be toed-down below the expected 100-year total scour depth in the flood channel, determined to be a minimum of 10 feet for the entire project reach. At locations where greater score is expected, such as at the entrance to the drop structures, downstream of the drop structures, and at tributary outfalls a toe-down of 20 feet is recommended (JEF, 2004).

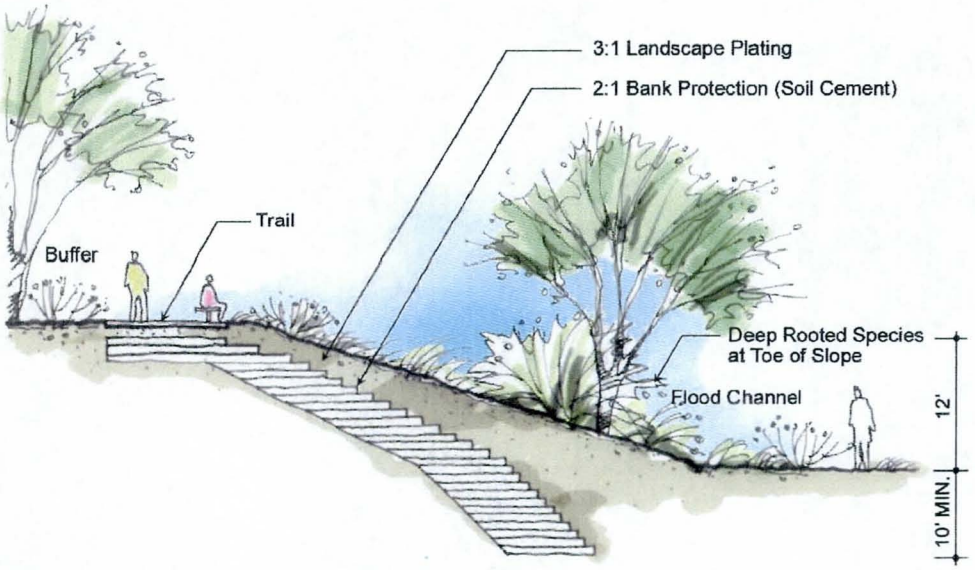


Figure 5.6 Typical bank protection between flood channel and buffer

5.5.3 *Floodplain Terrace Bank Protection*

Given the infrequency and short duration of flow on the floodplain terrace, the risk of erosion is minimal (JEF 2004). Therefore a bioengineered bank stabilization plan for the bank of the floodplain terrace was selected (Figure 5.7). Vegetation of the floodplain terrace banks will help mitigate visual impacts of the constructed channel, provide habitat and recreation opportunities, and achieve a more natural character for the channelization corridor. Bank vegetation provides soil stability by minimizing the exposure of bare, unprotected soils to flood waters, by the binding effect of roots on the soil matrix, and by lowering flow velocities through increased roughness. Vegetated banks also have better internal drainage than non-vegetated banks, and thus tend to become less saturated during flood flows, thereby maintaining greater stability.

As the project progresses, individual landowners and sand and gravel operators may propose alternative bank protection schemes, which would have to be approved by the District and meet District criteria.

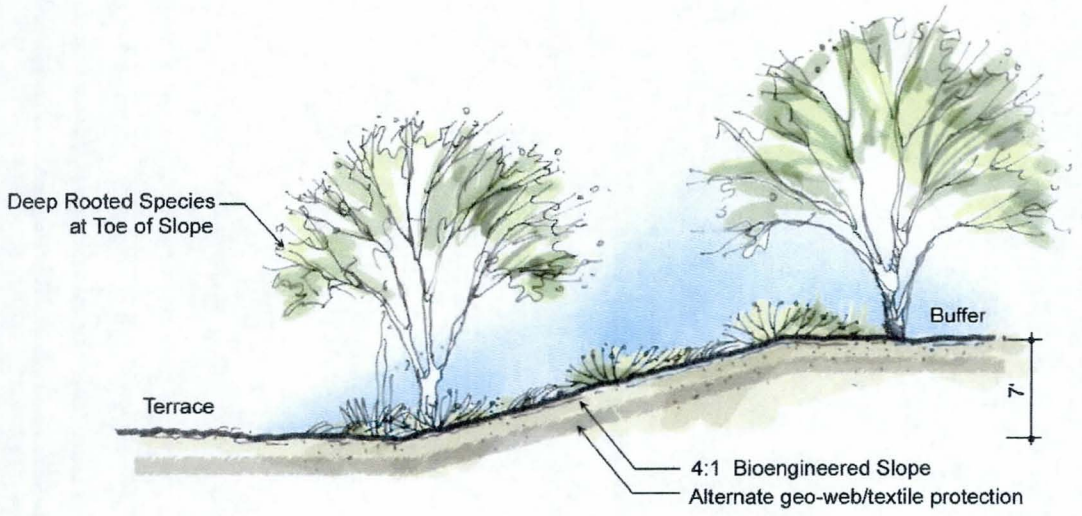


Figure 5.7 Typical bank protection between terrace and buffer

5.6 Revegetation for Bioengineered Slopes

Deep rooting, long-lived, woody species should be planted at the toe of bank slopes and up the bank slope to minimize the potential for undercutting, to provide the greatest resistance to higher velocities, and to mimic natural riparian plant density and distribution.

- Only flood tolerant plants should be planted in areas likely to be flooded.
- Drought tolerant plants are more likely to survive over the long term.
- Deep rooting plants withstand erosion better, and are more likely to find a natural, sustained water supply.
- Use of plant species with high habitat value is encouraged.
- True ground cover species are generally not found in natural, non-irrigated settings. Plants with hanging branches may provide the same effect as low growing ground cover for the purpose of slowing flow velocities and thereby enhancing erosion protection and resistance to flood flows.
- Use of plants native to central Arizona is encouraged.
- Design of a plant community with understory and overstory species is encouraged to provide vertical complexity that slows flow velocities as well as a variety of habitats for birds and animals.

5.7 Drop and Grade Control Structures

There will be 24 grade control structures located along the entire 22-mile corridor. They will be located about every mile and in other locations to protect the stability of the river profile. There will be 22 combination drop and grade control structures and two grade control structures with no drop. The grade control structures with no drop will be located at the Grand Avenue bridge, which has been identified as scour critical, and at the El Mirage landfill. The longitudinal slope of the corridor should generally follow the ultimate "stable slopes" of the flowline. (JEF, 2002). Drop/grade control structures (Figure 5.8) should be located where differences in long-term stable channel bottom elevations create a deep channel (compared to undisturbed overbanks) and begin to require excessively high drops

(i.e. >8 ft. measured design flowline to flowline), or where the bottom needs to be maintained for other reasons.

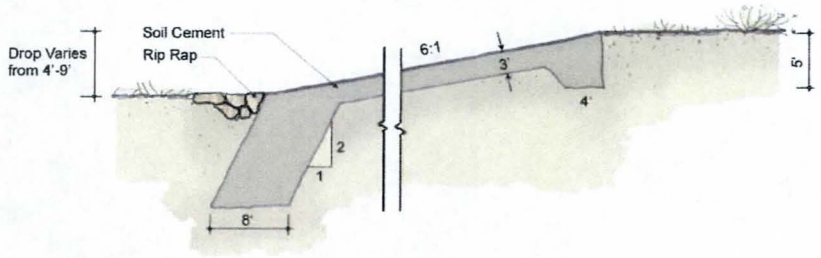


Figure 5.8 Typical grade control structure – cross section

In order to be as unobtrusive as possible in the landscape, the drop and grade control structures have been designed at a 6:1 slope with soil cement. This allows for easy access and crossing by recreationists. However, because of the erosive nature of water flows, the transitions from the riverbed to grade control structures may be impacted and may pose safety concerns for certain activities in a channel. Design and signage of the structure should consider ways to minimize safety problems. The 6:1 slope will be paved with a 3-foot layer of soil cement to protect the invert of the channel.

The height of the drop associated with the structures range from 4-6 feet high with three exceptions. One 8-foot high drop structure will be located at Agua Fria Boulevard/Happy Valley Road and one 9-foot high drop structure will be located just upstream of Jomax Parkway. There is a 17-foot drop at the upstream end of the project, which could be designed as a series of small drops as opposed to one 17-foot drop.

5.8 Channel Configuration at Drop Structures (Terrace Transition)

A second type of flood channel/terrace transition will occur near the proposed drop structures when flow rates exceed the terrace elevation. The channel configuration contracts the corridor width over the drop structures to shorten the required length of the drop structures, and thus reduce construction costs. The width of the flood channel will be widened to 600 feet at the grade control/drop structures so that the entire SPF discharge will be conveyed through the flood channel with no flow on the terrace. The terrace will gradually transition from the standard terrace elevation to the buffer elevation and then back to the standard terrace elevation downstream of each structure (Figure 5.9). There will be no soil plating on soil cement bank protection along the flood channel where grade control structures are located.

The only locations where grade control structures/drops will vary from the 600-foot width standard are at the Grand Avenue bridge, the El Mirage landfill and the Cactus Avenue alignment, where the width of the channel is about 500 feet and no terraces are proposed. A variation from the typical 600-foot width will also occur at Camelback Road where the drop structure will extend across the entire 1500-foot width of the channel downstream of the bridge.

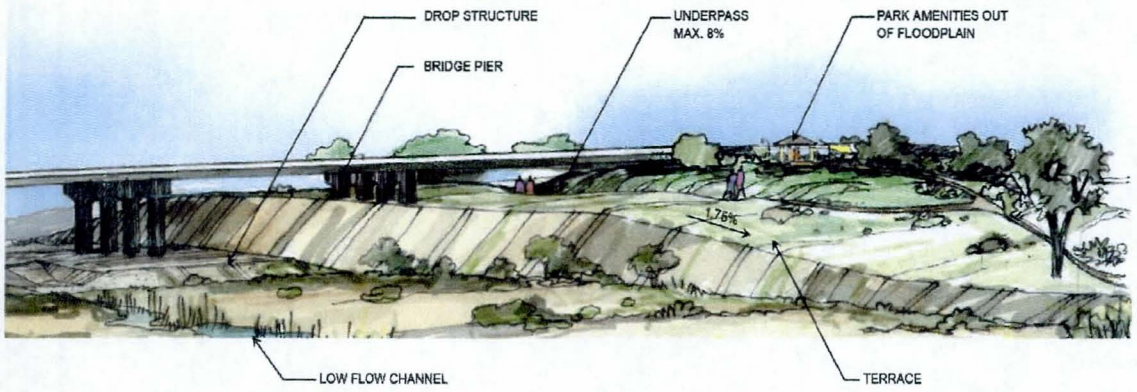


Figure 5.9 Terrace transition at drop structures

5.9 Bridge Pier Protection

Where drops are constructed at bridge locations, the slope paving will extend upstream to protect the entire area under the bridge from potential pier and contraction scour (Figure 5.10). The drop structures at the bridges will parallel the bridge and may be slightly skewed to the corridor to reduce the volume of slope paving that would otherwise be required if the drop structures were placed perpendicular to the direction of flow. The proposed channelization design includes channel bed paving through every bridge section within the project reach, except at Grand Avenue. The technical analysis conducted by JEF has, however, recommended the provision of channel bed paving through the Grand Avenue and ATSF railroad bridge sections, given the narrow channel section, age of the Grand Avenue and ATSF railroad bridges, and scour status.

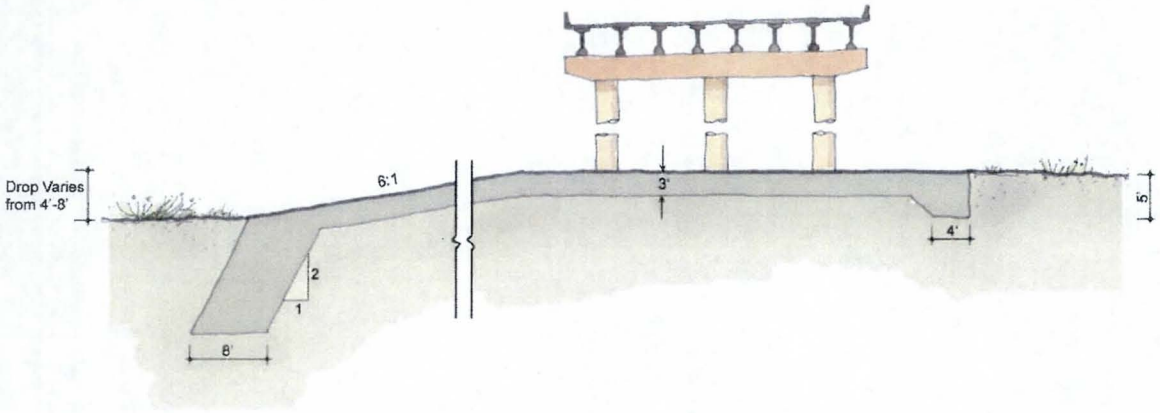


Figure 5.10 Bridge pier protection

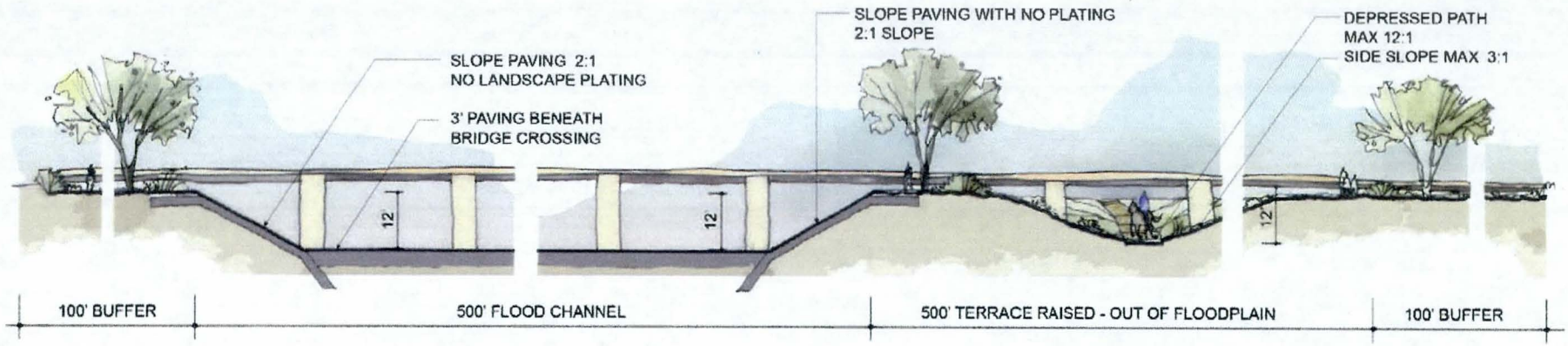


Figure 5.11 Corridor section at bridge crossing

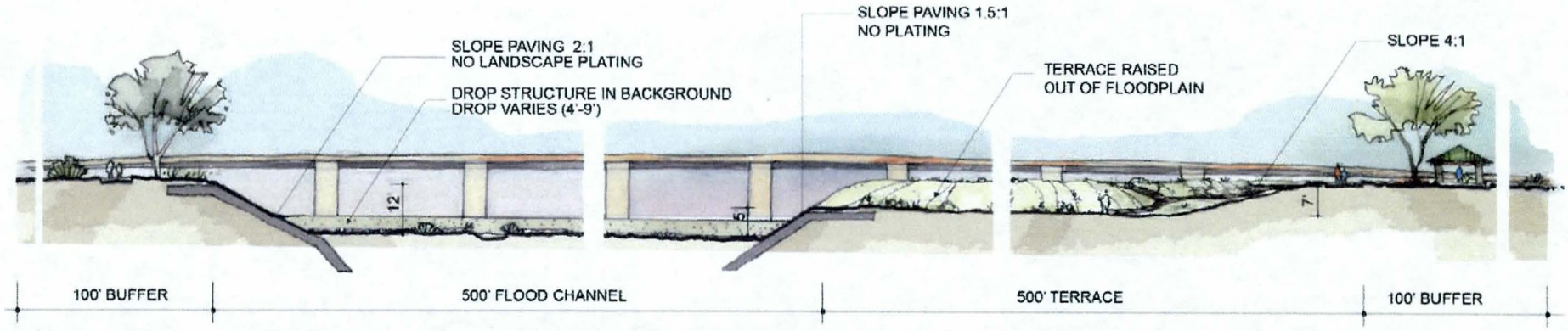


Figure 5.12 Corridor section downstream of drop structure

5.10 Other Considerations

5.10.1 Equilibrium Slope Analysis

The technical analysis (JEF, 2004) has determined that the predicted equilibrium slope for the 2-year event is slightly steeper than the proposed constructed channel. Therefore, some deposition of sediment will be expected during the most frequent events, particularly near the mouths of tributaries. However, the estimated equilibrium slopes based on the 10- and 100-year peak discharges are slightly flatter than the proposed constructed channel, and thus will tend to scour during large floods. Because of the predicted tendency for deposition during the most frequent events, regular maintenance and inspection should occur to assure that adequate conveyance capacity is maintained in the corridor. Refer to the Technical Analysis Report (Volume III) for long-term scour depths.

5.10.2 Sediment Continuity Analysis

The technical analysis conducted by JEF predicts relative sediment balance between adjacent cross sections, except for the channel sections located near the proposed drop structures. Discontinuity in sediment transport capacity is expected given the change in channel width, unit discharge, and slope breaks.

The sediment continuity results predict that most of the corridor will experience a sediment deficit during floods and thus will have tendency toward net scour and degradation, a prediction which is consistent with the equilibrium slope analysis. Sediment deficits in the 10-year event generally are not significant. Not surprisingly, the largest sediment deficits occur in the narrow channelized reach downstream of Grand Avenue, providing support for the conclusion of the original AFR WCMP that this reach may require full lining to prevent erosion of the El Mirage landfill. Net sediment surplus is predicted for the reaches between the Cactus Road alignment and Olive Road, the reach upstream of Camelback Road, and the USACE levee reach. Regular inspection for sediment deposition and loss of conveyance capacity should be conducted in these potentially aggrading reaches.

5.10.3 Tributary Outfalls

Nineteen tributary outfalls that contribute to the Agua Fria River in the project reach have been identified as part of the technical analysis; outfall design conceptual plans were prepared for each tributary and are included in the JEF Technical Analysis Report (Volume III). The proposed conceptual design for the majority of the tributary outfalls is for the tributary runoff to spill down the bank of the corridor channel, either directly into the flood channel or onto the floodplain terrace. Some tributary outfalls will require constructed channels or dikes to route tributary washes across areas removed from the natural floodplain, by the channelization to the constructed channel bank. Tributary channels should be designed to start at a point that will fully contain the discharge at the existing mouth of the tributary. Channel design should conform to the *District's Drainage Design Manual – Hydraulics* and the *Policy for Aesthetic Treatment and Landscaping of Flood Control Projects*. Conceptual performance specifications and recommendations are provided in the Technical Analysis Report.

6 LAND RECOVERY AND EARTHWORK QUANTITIES

6.1 Land Recovered

Recovered lands are those lands lying outside of the constructed Agua Fria River Recreation Corridor that are currently in either the FEMA regulatory floodplain and floodway, or the erosion hazard zone. Table 6.1 shows the area required for channel construction, the lands recovered from FEMA regulated floodplain and floodway, and the erosion hazard zone by reach. The benefit cost savings is different for each zone, assuming the greatest cost benefit would be for those lands in the floodway, followed by the floodplain and lastly, the erosion hazard zone. Refer to the DEA Engineering Design Report (Volume I) for parcel specific land recovery information.

Table 6.1 Summary of Recovered Lands.

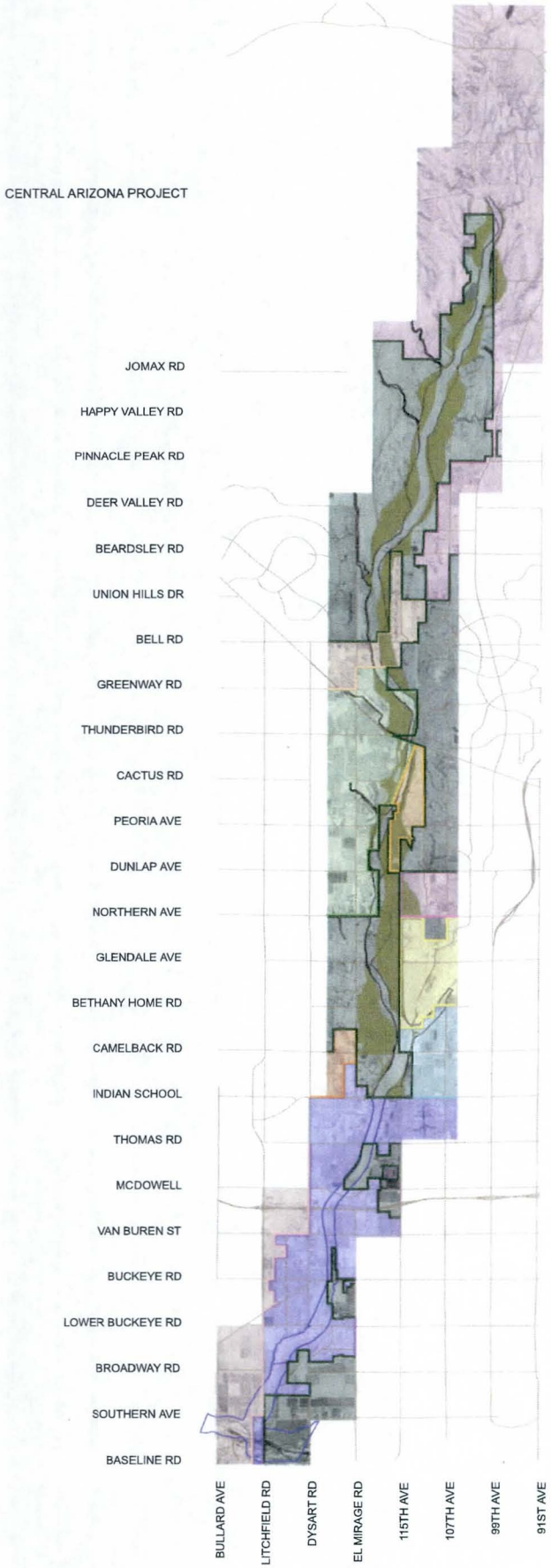
Reach	Beginning Alignment of Reach	Ending Alignment of Reach	Total Recovered for the Reach (in acres)
Reach 9	Indian School Rd.	Camelback Rd.	169.5
Reach 10	Camelback Rd.	Bethany Home Rd.	632.3
Reach 11	Bethany Home Rd.	Glendale Ave.	267.3
Reach 12	Glendale Ave.	Northern Ave.	287.5
Reach 13	Northern Ave.	Olive Ave.	396.5
Reach 14	Olive Ave.	Peoria Ave.	319.7
Reach 15	Peoria Ave.	Cactus Rd.	123.7
Reach 16	Cactus Rd.	Thunderbird Rd. Alignment	193.4
Reach 17	Thunderbird Rd. Alignment	Greenway Rd.	180.5
Reach 18	Greenway Rd.	Bell Rd.	221.1
Reach 19	Bell Rd.	Union Hills Dr.	277.8
Reach 20	Union Hills Dr.	Beardsley Rd.	144.8
Reach 21	Beardsley Rd.	Deer Valley Rd.	372.5
Reach 22	Deer Valley Rd.	Pinnacle Peak Rd.	407.7
Reach 23	Pinnacle Peak Rd.	Happy Valley Rd. Alignment	236.8
Reach 24	Happy Valley Rd. Alignment	Jomax Rd. Alignment	477.0
Reach 25	Jomax Rd. Alignment	Dynamite Blvd. Alignment	203.9
Reach 26	Dynamite Blvd. Alignment	Dixileta Dr. Alignment	206.6
Reach 27	Dixileta Dr. Alignment	Lone Mountain Rd. Alignment	202.5
Reach 28	Lone Mountain Rd. Alignment	Dove Valley Rd. Alignment	79.0
		Total Areas	**5400.1**

(Note: Recovered lands includes land recovered from the floodway, floodplain and erosion hazard zone)

AGUA FRIA WATERCOURSE MASTER PLAN ADDENDUM

RECOVERED LANDS

Figure 6.1



LEGEND

AREA RECOVERED

JURISDICTION	RECOVERED AREA (ACRE)
Avondale	9.9
Phoenix	21
Litchfield	N/A
Glendale	122.8
Youngtown	258
Surprise	159.8
El Mirage	515.1
Peoria	330
Maricopa County	3983.5
Goodyear	N/A

TOTAL RECOVERED AREA
5400.1 Acre

DISCLAIMER

Recovered land area specific to Jurisdictions are preliminary only.

7 MULTI-USE OPPORTUNITIES

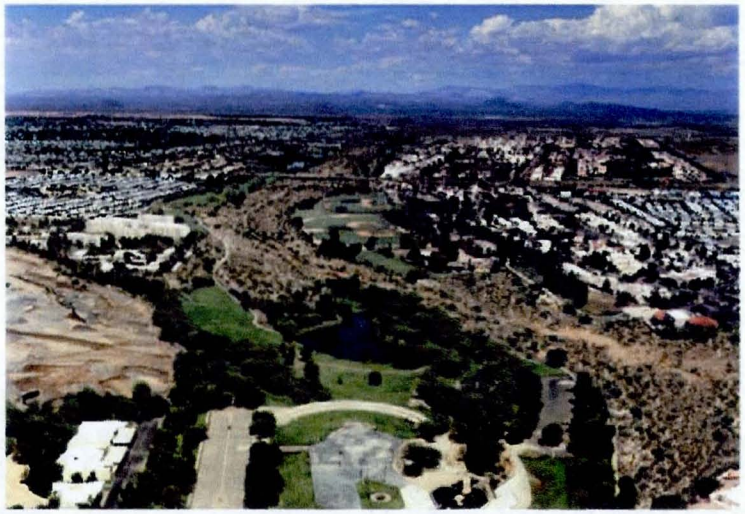
7.1 Recreation Opportunities

The Agua Fria River channelized corridor with its flood channel, terrace and continuous buffers provide for continuous and sustained interaction with the river. The opportunities created by the amended configuration of the corridor not only promote the safe conveyance of storm flows, but also allow the integration of multiple recreational elements and value added development adjacent to the river (Figure 7.1). The multi-use opportunities created by the establishment of the channelized corridor include, but are not limited to the following:

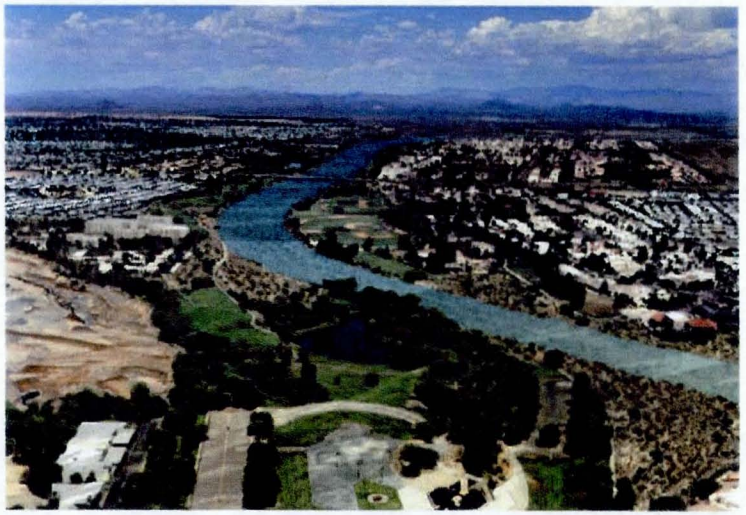
- Increased interaction with the river will be promoted by limiting mining activity to the outside of the corridor.
- Opportunities for park improvements on terrace areas that would be safeguarded against damaging storm flows.
- Opportunities for park amenities and structures within the corridor completely out of the floodplain.
- Opportunities for enhanced connectivity along the continuous river corridor linking Gila River in the south to Lake Pleasant in the north.
- Opportunities to create an interconnected network that link with on-street biking facilities and public transportation systems, promoting connectivity to the East and West Valley as well.
- Opportunities to capitalize on tributary and drainage inflow points to create safe, but enhanced habitat areas.
- Opportunities to integrate recharge projects into the corridor design to maximize on the recreational opportunity created.
- Opportunities to integrate future and existing city parks with the recreational corridor to expand the area of influence into surrounding neighborhoods.
- Opportunities for the eventual development of 'recovered lands' adjacent to the channel to foster activity along the corridor edge.
- Building on previous recreation studies conducted along the Agua Fria, and taking into consideration planned recharge projects and planned recreation elements along the river, a comprehensive map was developed - The Agua Fria Watercourse Master Plan Addendum Graphic (AFWMP Addendum Graphic). The establishment of the channel components, comprised of the buffer, the terrace and the flood channel will further serve to link recreational elements along the river. Furthermore, opportunities created by the implementation of the channel have also been identified in the AFWMP Addendum Graphic (Fig 7.10). The opportunities and linkages specific to each jurisdiction are further presented in Appendix C.

Existing river bed

Channel implementation



Development of recovered lands



Flood condition

Figure 7.1 River channelization simulation

7.2 Existing Recreational Analysis

The Agua Fria Watercourse Master Plan Recreation Corridor Report (2001) comprehensively inventoried planned and existing recreation features, as well as any relevant plans or factors that could influence recreation. Existing and proposed parks were identified within a mile of the river. A need-based analysis was also conducted to identify gaps in the recreational facilities serving adjacent communities. While most of the areas are currently well served appropriate to current demographic patterns, some gaps were identified on the east side of the river between Olive Avenue and Thunderbird Road, as well as north of Bell Road on the east side of the river. Apart from existing and planned parks, opportunities for additional parks that would serve future growth were also identified along the corridor. Refer to the Amended Master Plan Graphic at the end of this chapter for detailed locations of planned and existing recreational elements (7.10). Recreational opportunities created by the development of the channelization corridor have also been included in the graphic. Major and minor trailheads and staging areas have been located based on existing regional and community linkages.

Since the Agua Fria River is an important component of the Maricopa Trail system, recreational linkages at a regional, community and neighborhood level were identified at the onset of the project. The locations of the terraces preserve these linkages to ensure a recreational network that is interconnected along the length of the project area. Also, because of the compact nature of the proposed channel, facilities to cross the channel will involve much less investment.

A major consideration for municipalities within the floodplain will be amending the zoning 'recovered lands' to conform with the Watercourse Master Plan and to take advantage of the recreational benefits offered by the terraces. Future developments proposed along previously floodplain designated lands should allow for the integration of parks and open space with the continuous recreation corridor in the channel.

7.3 Buffer Opportunities

The 100-foot buffer on both sides of the corridor will be out of the floodplain and continuous along the entire corridor. Recreational components within the buffer include:

- Twelve-foot wide primary concrete trails will also function as the maintenance road for the District.
- Depending on its location, improvements to the buffer may include park like landscaping in the more urban reaches or a more naturalized theme in undeveloped areas.
- The buffer and terrace transitions can be integrated to create large open spaces out of the floodplain (Figure 7.2).
- Continuous trail crossings at arterials will be made possible below existing bridges where terrace areas transition to the buffer elevation (Figure 7.3).
- All weather trail crossings across bridges will also be provided when weather conditions do not permit crossing beneath bridges.
- Improved public access to the buffer is easily provided at the arterial bridge crossings, or may be locally accessed from adjacent developments or local street systems.

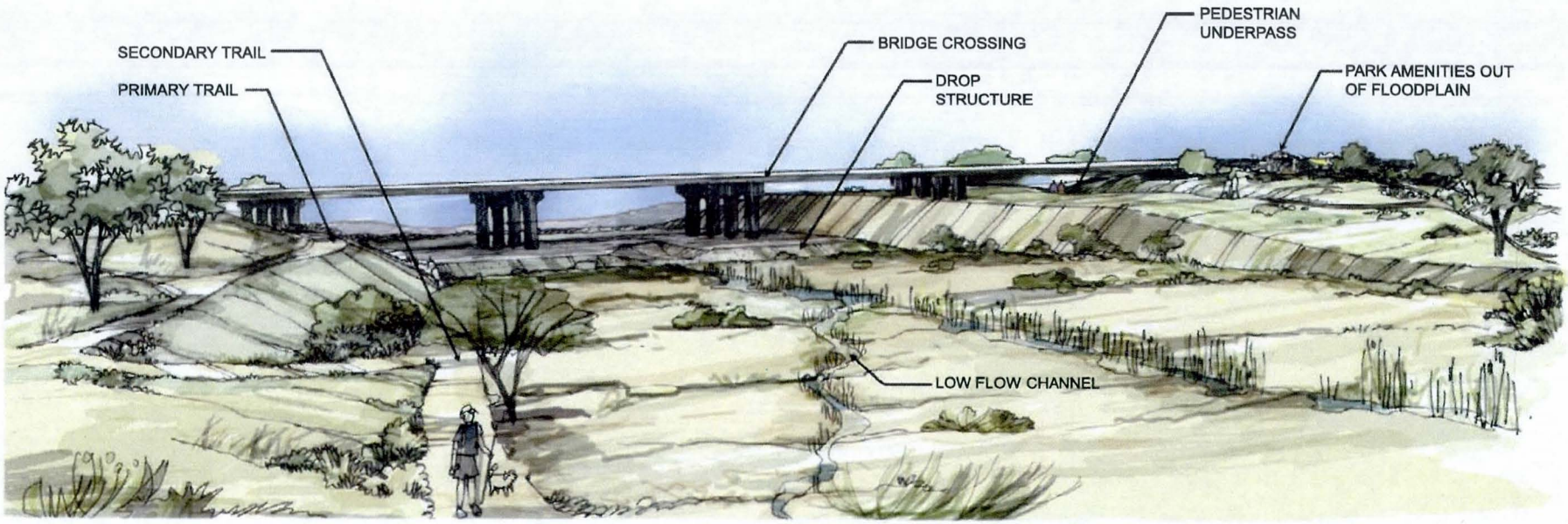


Figure 7.2 Terrace transition at arterials

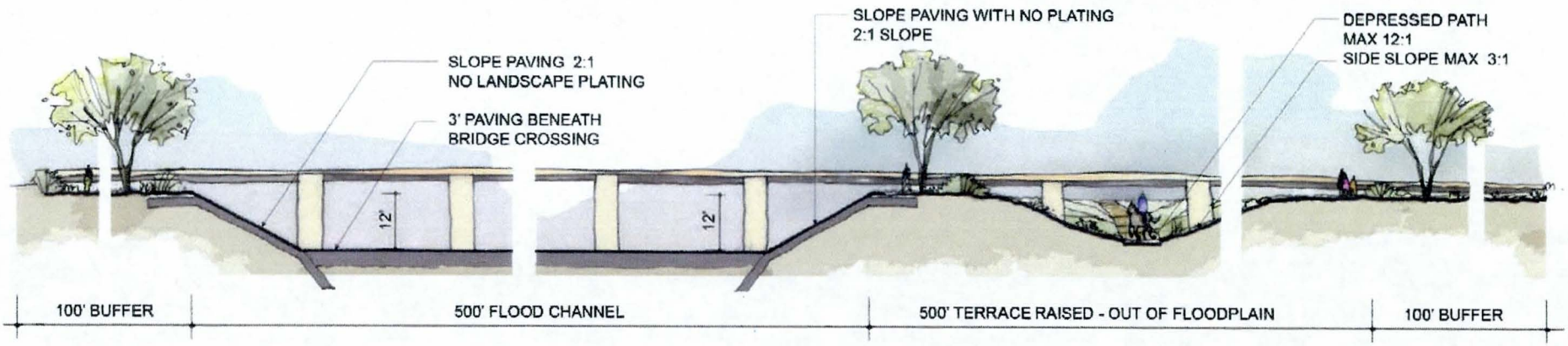


Figure 7.3 Underpass trail crossing at arterials

7.4 Terrace Opportunities

Terrace locations alternate between banks to allow for a meandering channel, and to take advantage of natural inflow points and adjacent land uses that are compatible with recreational use of the corridor. For example, residential areas provide a good population base for their use while industrial uses adjacent to the channel are generally avoided. The terrace transition refers to the gradual rise of the terrace elevation to that of the buffer elevation, in order to divert all flows across a 600-foot wide drop structure and provides for added opportunities for open space development that will be completely out of the floodplain.(Refer to Section 5.8). Recreational opportunities in the terrace areas include:

- Trail System

  A secondary trail system 6-8 feet wide that may or may not be improved depending on the project setting. Generally, improved terrace areas will possess developed trails, while naturalized open space terraces may be limited to compacted dirt trails.

- Active Sports Facilities

  Apart from passive park facilities, the 500-foot wide terraces are wide enough to accommodate baseball fields, soccer fields and other active sports facilities (Figure 7.4). The 100-foot buffer provides a continuous landscaped easement that links the terraced areas. The narrowing of the channel at drop structures allows for the establishment of park structures outside of the floodplain at the high points within the corridor. Park structures, including restroom facilities, parking and ramadas may be provided in the terrace areas outside of the floodplain.

Figure 7.4 Active sports fields on terrace areas

- Water recharge projects.

  Recharge projects supply a significant amount of water to the streambed for infiltration and hold immense potential to utilize portions of the water recharged for recreational purposes. The coordination with City entities may ensure the integration of parks or educational habitat sites (Figure 7.5) with specific recharge sites to capitalize on the opportunities created by the introduction of water in an otherwise dry landscape. Cities may also provide partnerships with recharge entities to maintain and allocate water during dry months, when there is a limited supply of water.

Figure 7.5 Conceptual recharge interpretive site

- Equestrian Areas.

  The Agua Fria River is a favorite corridor among equestrians in the west valley as it provides great opportunities for horseback riding in an otherwise urbanized landscape. The channelization concept allows for continuous riding along looped trails without being restricted by the presence of sand and gravel mining operations. Several established stables exist adjacent to the river, including Camelback Ranch Park, north of Camelback Road on the east side of the river, and the Luke Air Force Base stables along Glendale Road.

  Areas earmarked for equestrian use along the corridor include the terraced areas that extend from Glendale Road to Indian School Road. This area is in the proximity of established stables and encompasses the wider section of the channel where the New River joins the Agua Fria River. Other equestrian reaches include the more naturalized areas in the north. Generally, equestrian uses are encouraged in the floodway channel to avoid conflict with other trail users. Equestrian trails in the corridor must link to the equestrian corridor proposed in the West Valley Multi-modal Transportation Corridor Master Plan. A major trailhead with equestrian staging areas is proposed at Camelback Road, and a minor trailhead at Glendale Avenue. Refer to the Agua Fria Master Plan Addendum Graphic, Figure 7.10 and 7.11 at the end of this chapter for locations.

- Golf Courses

  Golf courses (Figure 7.6) are ideal uses for terrace areas. They not only provide low risk areas for recreational improvement, but minimal damage to improvements can be expected in the event of a flood situation that inundates the terrace. Terrace areas adjacent to residential areas and densely populated areas allow for value added development in recovered lands outside the floodplain. Golf facilities in low risk terrace areas complement the increased density and provide for shared recreational facilities such as trails. Access to the surrounding community is also made possible by community linkage along the continuous landscaped buffers.

Figure 7.6 Golf course on terrace area

- Off-line Water Storage Facilities

  Off line recharge storage sites, such as lakes or active water sports areas. Following the Tempe Town Lake model, opportunities to use existing deep mine sites as off line storage or active lake parks may be investigated.

Figure 7.7 Conceptual lake/off line storage on terrace

7.5 Flood Channel Opportunities

Recreational opportunities within the flood channel include more passive activities like hiking and equestrian uses (Figure 7.8). Incoming tributary and drainage flows provide moisture conditions that encourage vegetation growth in the flood channel. Several water in-flow points exist along the river where discharge from drainage canals, wastewater treatment plants, incidental flows from storm water run off, and discharge from tributaries or washes join the river. In-flow points are accommodated in the floodway channel to ensure uninterrupted discharge of water into the river. Since water runoff will be confined within the low-flow portion of the channel, as opposed to the original expanse of the floodplain, opportunities for improved riparian vegetation and habitat will be created.

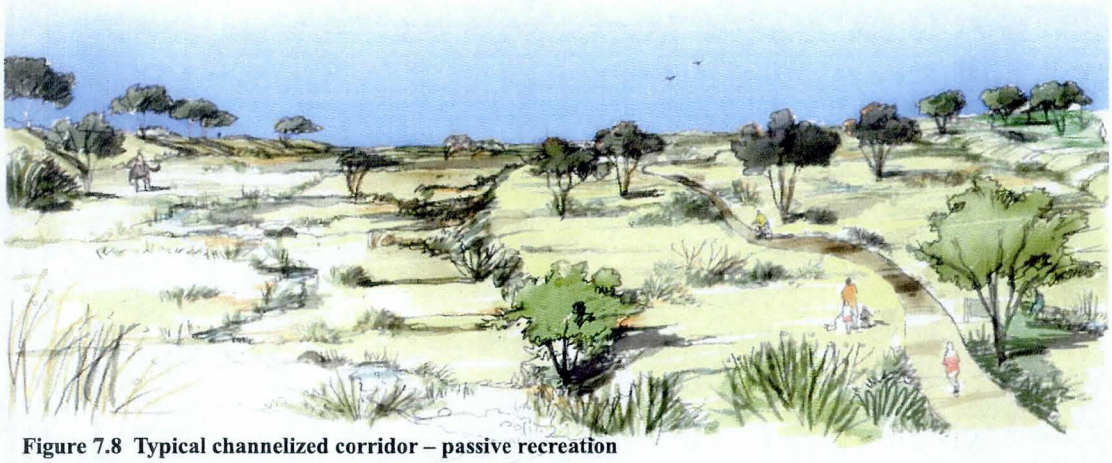


Figure 7.8 Typical channelized corridor – passive recreation

Incidental runoff from storm drains in urbanized areas along major arterials crossing the river have resulted in sporadic stands of vegetation below bridge crossings. In addition, the routine placement of drop structures downstream of bridge crossings creates ideal conditions for vegetation establishment and habitat development. This concept holds substantial value in recreational terms, as it implies that access to the channel can be achieved at bridge crossings within hospitable shady conditions (bridge shadow) and can remove the negative connotation associated with such infrastructure. In-flow channels and tributaries flowing into the river also provide an easement for trail opportunities and linkages from the channel corridor.

7.6 Trail Linkages

The opportunity to establish community linkages along the 100-foot wide buffers is tremendous. Extending from the City of Goodyear to Peoria, opportunities for inter-city multi-modal connections will be created, including alternative routes of access to places of study, work and play. Closely associated with the trail system will be on-street biking facilities and public transportation systems. The eventual development of 'recovered lands' adjacent to the channel also provides immense opportunity to create activity along the corridor edge. Community centers, cultural and sports centers, commercial and office

developments, parks and playgrounds attract users to the river edge. Community linkages promote increased interaction with the river and have the potential to develop public support and pride for the corridor, ensuring its continued upkeep and its perpetuation for future generations.

Connections to the river from neighborhood parks, schools and local trail systems must eventually connect to a community linkage system. The creation of neighborhood linkages to the river from new developments, schools and public facilities increases the amenity value of their respective properties and is key to ensuring continued use of the river corridor.

7.7 Trail Categories and Users

Primary Trails: Primary trails will usually run along both banks of the corridor in the 100-foot buffer, and will serve both regional and community linkages along the corridor. A variety of users, including bicyclists, pedestrians, joggers, strollers and in-line skaters are expected to use these trails. Primary trails on either bank are also expected to serve as a maintenance road for the Flood Control District. Generally, primary trails must link to on-street biking trails and be accessible to public transit nodes.

Secondary Trails: Secondary trails run within the corridor along the terraced areas, and connect to opposite banks along drop structures in the channel or along arterial bridges out of the channel. Secondary trails reflect the character of the terrace and provide a basis for prioritizing its construction. Generally, improved terrace areas will possess developed trails, while naturalized open space terraces may be limited to compacted dirt trails. Where terraces are improved in association with adjoining residential areas or parks, secondary trails need to link to the park trail network and can be used by in-line skaters, pedestrians, strollers, joggers and bicyclists. Secondary trails in such high activity areas must also be ADA compliant. Equestrian uses in high activity zones are not encouraged.

Tertiary Trails: Tertiary trails are localized trails in the corridor that address immediate needs and requirements based on their location. Tertiary trails link to secondary and primary trails and are almost always looped, and they change in character to reflect their use. Equestrian trails in specific equestrian reaches, interpretive trails next to cultural sites, and habitat sensitive trails in wetland areas are all tertiary trails that are designed for specific uses. ADA accessible trail loops, park path networks or even existing dirt tracks are also tertiary trails that link into the corridor trail network. It is not possible to specify a material or width for tertiary trails as this is dependent on their intended or existing use.

7.8 Trail Access and Crossings

Apart from local neighborhood access points, access to the river corridor trail system will occur at major arterial bridge crossings or where drop structures occur. The configuration of the channel and its components create advantageous opportunities for accessing the trail corridor on gentle slopes. Trail crossings at arterial streets will be made continuous below bridge crossings (Figure 7.9). Channel crossings can be achieved over bridges or at drop structures.

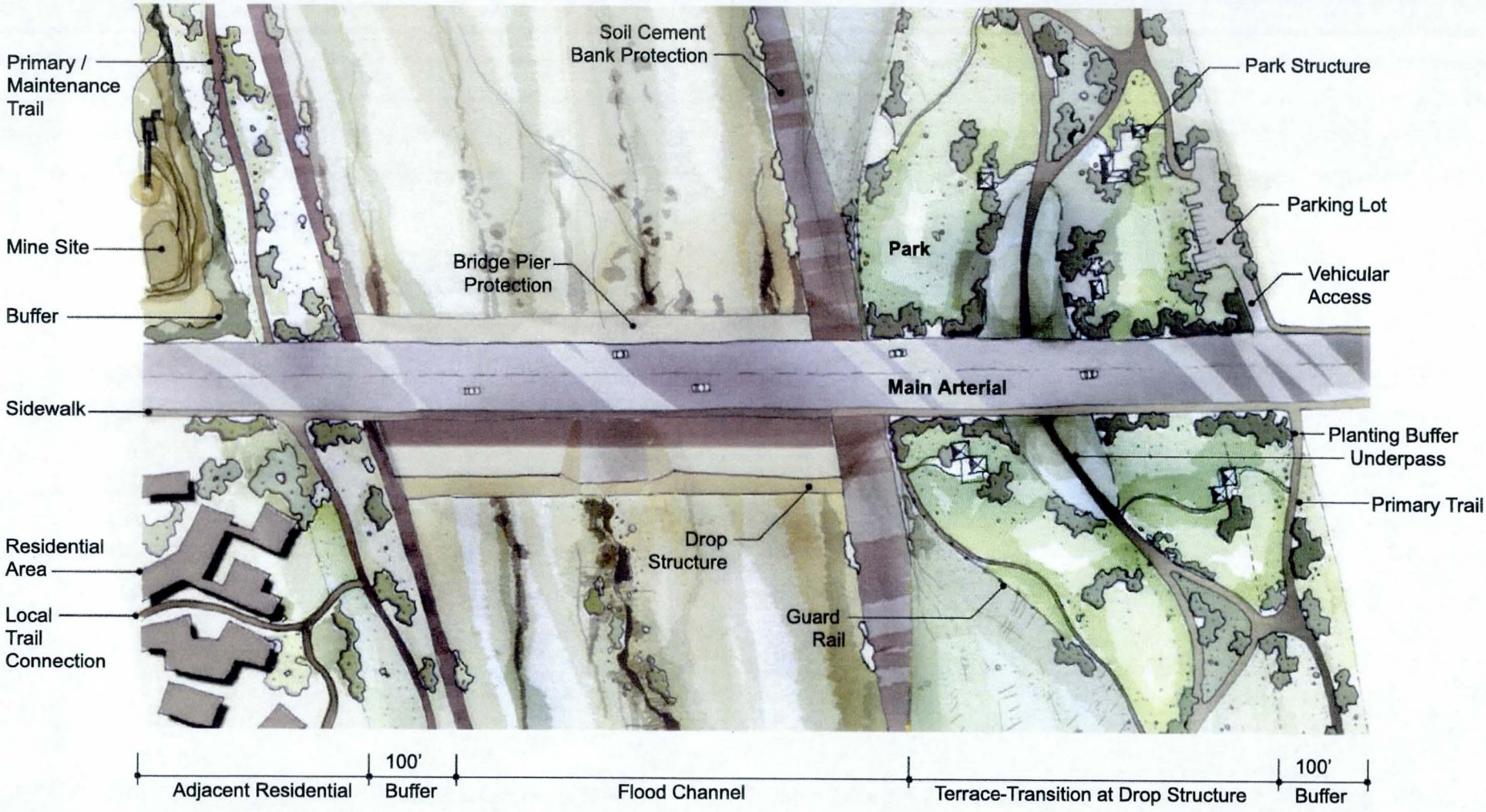
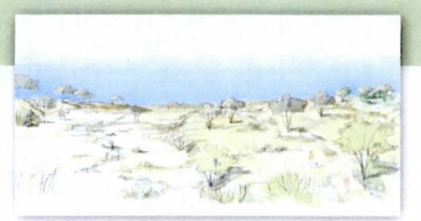


Figure 7.9 Channel access at drop structure

AGUA FRIA WATERCOURSE MASTER PLAN - ADDENDUM

CHANNELIZATION ALTERNATIVE: INDIAN SCHOOL TO CAP CANAL

CONCEPTUAL RECHARGE AREA



TYPICAL CHANNEL - PASSIVE USE

TERRACE CONFIGURATION AT DROP STRUCTURE

EDAW

JE FULLER

CORRIDOR SECTION DOWNSTREAM OF DROP STRUCTURE

TYPICAL CORRIDOR SECTION

BANK PROTECTION - FLOOD CHANNEL / TERRACE

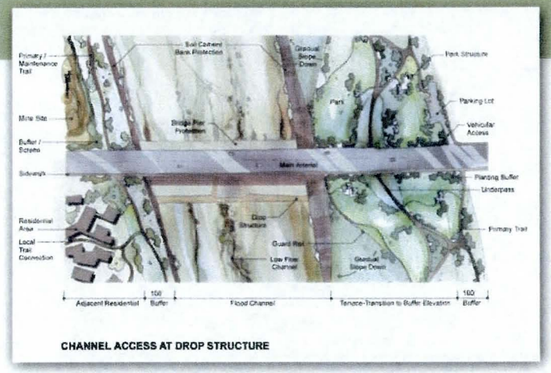
BANK PROTECTION - FLOOD CHANNEL / BUFFER

BANK PROTECTION - TERRACE / BUFFER

BRIDGE PIER PROTECTION

Figure 7.10

TERRACE CONFIGURATION AT DROP STRUCTURE

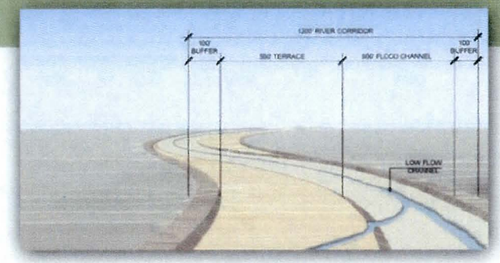


CHANNEL ACCESS AT DROP STRUCTURE

LEGEND

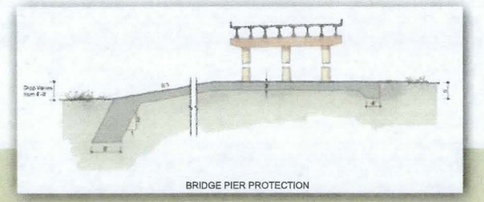
- Avondale
- Phoenix
- Litchfield
- Glendale
- Youngtown
- Surprise
- El Mirage
- Peoria
- Maricopa County
- Goodyear
- Floodway
- Floodplain
- Erosion Control Limit
- Primary Trail
- Secondary Trail
- Tertiary Trail
- Proposed / Existing Bike Trail
- Regional Connection
- Primary Trail Head
- Secondary Trail Head
- Proposed and Existing Parks
- Equestrian Facility
- Interpretive Area
- Water Inflow Points

TYPICAL CHANNEL - ACTIVE USE

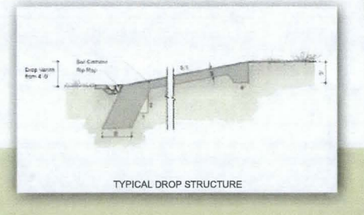


CHANNEL ELEMENTS

PROPOSED CORRIDOR PARK
EL MIRAGE WWTP DISCHARGE
LOWER EL MIRAGE WASH DISCHARGE
MARICOPA COUNTY REGIONAL PARK
ADAPTIVE REUSE PARK OPPORTUNITY AT LIZARD ACRES WASH INFLOW
PROPOSED McMICKEN DAM OUTFLOW PARK
WHITE TANKS PARK CONNECTION
CAWCD CONSTRUCTED RECHARGE FACILITY
PROPOSED PRE-HISTORIC RUINS INTERPRETIVE SITE
PROPOSED CAP CANAL & BEARDSLEY BRIDGE INTERPRETIVE SITE
CAP CANAL TRAIL LINKAGE
LINK TO LAKE PLEASANT RECREATIONAL AREA
PROPOSED GEORGE'S POND RIPARIAN PRESERVE
CONNECTION TO TRILBY WASH
LINK TO 404 MITIGATION SITE
CAWCD WATER INFLOW POINT
CONNECTION TO CAVE CREEK RECREATIONAL AREA
YOUNG TOWN RIVERWALK PARK OPPORTUNITY
EL MIRAGE RIVERWALK PARK OPPORTUNITY
PROPOSED SROG LINEAR RECHARGE UPPER LIMIT
GLENDALE WEST RECHARGE FACILITY

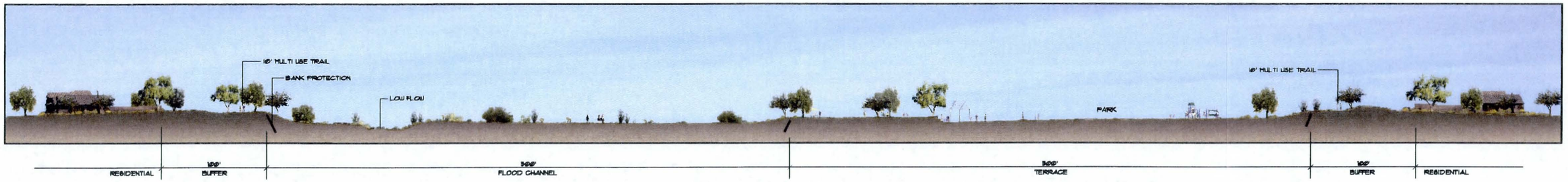


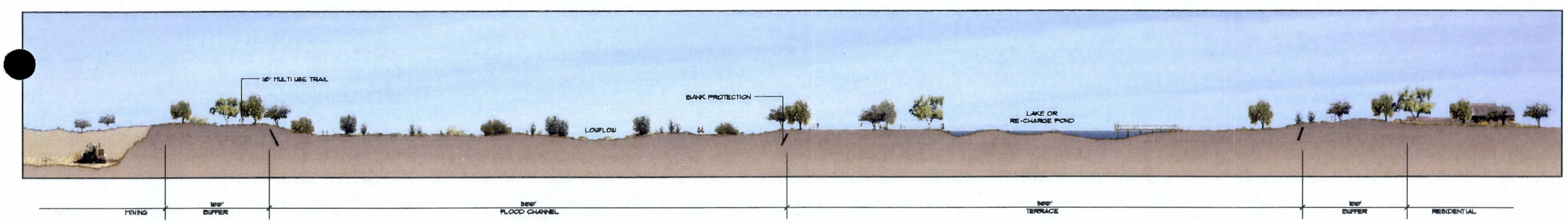
BRIDGE PIER PROTECTION



TYPICAL DROP STRUCTURE

Figure 7.11





FLOOD CONTROL CHANNELIZATION SECTIONS
RECREATIONAL OPPORTUNITY

Figure 7.12

8 REGULATIONS

8.1 404 Permit Requirements for Next Phase of Work

It is recommended that efforts begin immediately to coordinate with the USACE to obtain a Regional 404 Permit for the Agua Fria. The goals of the regional permit would be to:

- Define parameters of "permittable" uses within the river.
- Define local jurisdictional authority of the regional permit.
- Reserve riparian habitat above the CAP siphon crossing of the river and below State Highway 74 (a 3-mile area of undeveloped and incised channel with high habitat value).
- Determine other opportunities for the Gila and Agua Fria rivers, including areas of habitat "banking" potential.
- Include the opportunities created by proposed and existing groundwater recharge projects.

It is recommended that the District take the lead in these discussions. The other municipal jurisdictions need to be brought into the discussion and concur with the plan for the Regional 404 Permit and the process of administration after its creation. A means to develop this communication and ongoing support should be created during the next steps of the Public Outreach program.

8.2 LOMR/CLOMR

It is recommended that the channelization plans and supporting report be submitted to FEMA for consideration and issuance of a Conditional Letter of Map Revision (CLOMR) for the entire study limits (i.e. Indian School Road to CAP siphon). This will provide a higher level of certainty of revised mapping of the 100-year floodplain if the channelization option is implemented. Conditions will be included in the CLOMR that, dependent of specific comments, can either be addressed with a revised submittal of the entire report or addressed in the future with individual submittals of smaller sections of specific implementation plans.

It is anticipated that the project will likely be implemented in phases. Minimum reach lengths will be dependent on the ability to have a project that functions in the short run (i.e., without full up and downstream project implementation) and in the long run (i.e., with full implementation). It is hard to determine minimum reach lengths in advance of a specific proposal, but in general, they would run from one grade control/drop structure to the next. Shorter lengths would require a plan to address interim conditions or propose an alternative to the concept plans herein. At a minimum, the plans would need to:

- Provide ultimate channel capacity, although interim floodplain functionality of the ultimate channel may be to the 100-year level prior to full project implementation.
- Address upstream and downstream channel impacts vertically and horizontally.
- Analyze far enough upstream and downstream to determine where conditions return to existing profile.

Subsequent CLOMR applications should be made for specific subreach projects prior to construction. Upon completion of the entire subreach channelization project, including all

bank protection and, if applicable, interim improvements, a Letter of Map Revision (LOMR) can be applied for requesting the floodplain revisions be implemented.

9 QUANTITY AND COST SUMMARY

9.1 Conceptual Level Quantity and Cost Summary

Channel excavation quantities were developed using the proposed profile and typical section as compared with the existing terrain developed from the 10-foot contour interval mapping. Beyond the 100-foot buffers, 2:1 fill and 1.5:1 cut slopes to daylight were used. Shrink/swell adjustments in earthwork were not applied. The total channel excavation includes an adjustment for the difference found in DEA field surveyed cross sections and the FCD DTM cross sections. On average, the difference in depth between the DEA and the FCD cross sections was two feet.

All quantities were developed utilizing the typical sections proposed for this conceptual plan. Detailed designs will address other construction items and quantities necessary for project completion. This includes side-channel inlet treatments, CAP recharge canal and access ramps. Table 9.1 shows the total quantities (estimated and summarized) for the conceptual channelization plan.

The flood channel bank protection (12-foot height) typical section will require approximately 6.5 cubic yards of soil cement/cement stabilized alluvium per linear foot. The flood channel/terrace bank protection (5-foot height) typical section will require approximately 4.4 cubic yards of soil cement/cement stabilized alluvium per linear foot. The flood channel/terrace bank protection typical section in the transition zone at the drops will require 5.5 cubic yards of soil cement/CSA per linear foot.

Each typical drop structure will require 4,100 cubic yards of soil cement/cement stabilized alluvium for the drop and about 2,200 yards of slope paving, for a total of 6,300 cubic yards for each drop structure where there is no bridge. An additional 5,000 cubic yards of slope paving will be required at the bridge locations, bringing the total soil cement required for the drop and slope paving at the bridge locations to 11,100 cubic yards.

For a more detailed review of the quantity estimation, refer to Volume II, (DEA Engineering Design Report.

Table 9.1 Estimated Quantity and Cost Summary.

Item	Unit	Quantity
Soil Cement Bank Protection	yd^3	1,464,000
Soil Cement for Drop Structures and Slope Paving	yd^3	204,000
Channel Excavation	yd^3	43,200,000
Sunstate Rock (Walker) Pit Fill	yd^3	1,075,000
Landscape Plating	yd^3	715,000
Terrace Area	Acres	1017
Cost	$115,000,000 - $148,000,000	

10 IMPLEMENTATION PLAN

10.1 Construction/Final Design

Individual property owners, sand and gravel operators, and other parties will begin to develop the corridor at different times, implying that the corridor will be constructed in phases. Instead of developing standards and details for phased implementation, the final design and construction should be required to meet a minimum performance standard. The standard should include the following criteria at a minimum:

- The ultimate corridor build-out must have the capacity to convey the SPF safely. In the interim, the corridor must function to safely convey the 100-year return frequency discharge.
- The final design and construction cannot adversely impact adjacent properties upstream, downstream or across the river of the subject property.
- No ponding of stormwater discharge will be allowed.
- All interim projects or sections of the corridor must provide positive grading-to-drainage to the surrounding properties that are unimproved.
- Minimum allowable reaches for pilot projects should include the entire corridor between proposed grade control structures.
- Side-slopes, setbacks, mining depths, and other FCD sand and gravel mining regulations outside of the corridor as long as they remain within the floodplain.
- Lateral migration erosion hazard zones are advisory only unless contained within the floodplain limit of unincorporated Maricopa County.

During corridor excavation and initial construction phasing, the flood channel, or portions thereof, could also be used as a temporary haul road for sand and gravel materials to allow easier access to production and processing facilities. A hardened surface, wide enough to accommodate truck traffic, could be placed in the flood channel, but the haul road must conform to all current and relevant city, county, state and federal statutes. The design and construction of a haul road must not adversely impact the corridor, or any existing infrastructure. The constructor of the haul road must ensure that the durability of the soil cement is not compromised.

Process and studies required to update and finalize design of a reach should include:

- A revised HEC-RAS model, which should be incorporated into the conceptual design model being created with this channelization model. It should be tied in at both the upstream and downstream ends. This will be used in a CLOMR application.
- Sediment transport analysis or modeling to show the impacts of the proposed design. This will be very important to subreach implementation as suggested.
- Final design plans of a channel, bank protection and drop/grade control structures.
- Schedule for construction.
- Right-of-way analysis and plans.
- Cost estimate and quantity estimate.

- Financial plan, including assurances that the County or other jurisdiction can rely on construction being completed once begun.
- Operation and maintenance plan.
- Recreation Corridor District Reports if this path is being suggested.
- Structural analysis at existing bridge structure discussing impact of scour.
- Ultimate ownership or control of channelized segments for liability and maintenance purposes.

10.2 Municipalities' Role

Upon formal acceptance and approval of the AFR-WCMP and Addendum by the County Board of Supervisors, City jurisdictions, within which the corridor lies, may consider amending their respective General Plans to reflect the amended AFWCMP. In addition to the support this will give the plan, it will further form the basis for each jurisdiction to formally consider amendments to the land uses/zoning designations for recovered lands as well as other contiguous land.

In the event the channelization option is adopted within and through a municipality, the decision on whether to own, operate and maintain the flood control components within the corridor along with the follow-on non-flood control components of the project would have to be made by the municipality (or special district if created for that purpose).

10.3 Land Needs/Requirements

The channelization alternative described herein will impact over 4,000 parcels as identified in the County Assessor's Records. The degree of which the proposed channelization will impact each of the parcels will vary however. Although the proposed channelization will remove significant acreage (+/- 5400 acres) from identified floodways, floodplains, and lateral migration erosion hazard zones; the channelization improvements will occupy an estimated +/- 3,000 acres of land for construction and maintenance. The vast majority of these lands within the proposed corridor would remain in the floodway/floodplain.

It is the intent that all lands (+/- 3,000 acres) within the corridor be under the control of either a county, municipal, or special district agency for the purposes of construction and maintenance of the flood control improvements. This control of the drainageway properties may be in the form of construction easements, drainageway easements, dedicated rights-of-way, or a combination of these.

10.4 Zoning/Land Use

The acceptance of the AFR-WCMP by each municipality is desirable. The cities and County should subsequently look at considering revisions to the targeted land uses adjacent to the corridor. For large areas, General Plan Amendments may be warranted.

10.5 Funding

It is anticipated that the bulk of the costs to construct the flood control channel option would not be borne by the public. Reaches, where developed, would be turned over to the city, County or special district for operation and maintenance. Subreaches would need to be long enough to function properly and not create problems with erosion and flooding beyond

current levels. Risk to portions of the existing public improvements within the corridor would be greatly reduced through implementation of the channelization option, including grade control/drop structures. The respective agencies for each bridge crossing should consider construction of grade control/drop structures for that reason.

Currently, the USACE has not been approached for participation of the specific improvements suggested in this study.

The Sub Regional Operating Group (SROG), made up of the cities of Phoenix, Glendale, Scottsdale, Tempe and Mesa, is considering construction of a reclaimed waterline in the vicinity of the corridor. This line would convey flow from the 91st Avenue Wastewater Treatment Plant upstream for release into the Agua Fria River channel for groundwater recharge. Implementation of the channelization option would likely reduce the cost of this structure compared with construction within existing arterial road rights-of-way. Consideration of a river corridor alignment for this reclaimed waterline should be promoted.

10.6 Recreation Corridor District

In June 2004, the first part of the Recreation Corridor District (RCD) legislation was signed into law. There is additional work that needs to be completed on certain aspects of the District legislation to complete what is currently statute. Most significant is the discussion of financing options, which may specifically include some taxing authority. Even without those specific options defined, most of what is required to facilitate development of the West Valley Recreation Corridor, including the flood control components, is in the statute.

This District could act as a liaison in conveying multi-jurisdictional issues and facilitating the varied means through which construction will occur and contribution of lands and other capital will flow. The law requires that a waiting period occur. No RCD can be created until July 1, 2005. It is recommended that after approval of the WCMP by the Board of Directors, efforts continue to set up creation of an RCD along section(s) of the Agua Fria River where interest and support are highest.

10.7 Permits

The Floodplain Use Permit will be the key to ensuring that the channel is built according to FCD approved plan and specification. It is anticipated that FEMA will not issue a LOMR until the entire channel or significant contiguous reaches of the corridor are complete. The piecemeal treatment of reclaimed lands subject to CLOMR may not be legal. Floodplain use permits and flood insurance will be required until a LOMR is established. A phased LOMR will need to be worked out with FEMA and other regulatory entities.

The local sand and gravel operators and community will reap significant benefits when the corridor is constructed because lands outside of the corridor will not be under FCD floodway/floodplain regulation when a LOMR is obtained by FCD. However, if the issuance of a LOMR is many years into the future, the operators may lose motivation to participate in the project if the status quo floodplain regulation is continued after the corridor is constructed, but before the LOMR is issued. To prevent any loss of motivation by the operators, the floodplain and floodway areas located outside of the completed corridor could be effectively taken out of the floodway/floodplain at a given time under prescribed conditions, but before the LOMR is issued.

10.8 Public Relations/Stakeholder Outreach - Suggested Next Steps

It will be very important to make an outreach to elected officials and their staff in each jurisdiction to get buy-in of this plan. This should occur prior to scheduling the WCMP for Board approval. From the feedback that has been received during this current phase of work, there are a number of follow-up activities that should be undertaken. These include:

- A meeting with the planning staff from each of the jurisdictions adjacent to the Agua Fria River to discuss their general plans, as well as potential changes that might be necessary to accommodate any possible economic opportunities generated from land removed from floodplain status.
- Additional meetings with selected civic and business leaders to help refine ideas for one or two possible pilot projects along the corridor.
- Possibly a joint meeting with parks and recreation directors and representatives from the State Parks Department to discuss grant opportunities through the Heritage Fund and federal trails programs.

10.9 Utilities

Utility providers who will be designing and installing facilities along this corridor should use this Volume II and Volume III as a guide when setting horizontal and vertical alignments for their projects. This report outlines how the project should be implemented, following it will ensure that costly and unnecessary relocations do not occur in the future.

10.10 Side Flows/Trapped Flows

Major sideflows from drainage outside of the corridor were identified by location (JEF 2004). This project was not intended to be an exhaustive investigation of all side drainage into the channel. However, during final design of any subreach, a complete identification and appropriate measures to accommodate sideflows must be carried out. This may involve conveyance to the channel, as well as identification of alternative means to accommodate these (e.g., retention basins, etc.).

APPENDIX A

STAKEHOLDER PRESENTATION

The Agua Fria River Watercourse Master Plan:

A Vision for Change & Promise

Overview

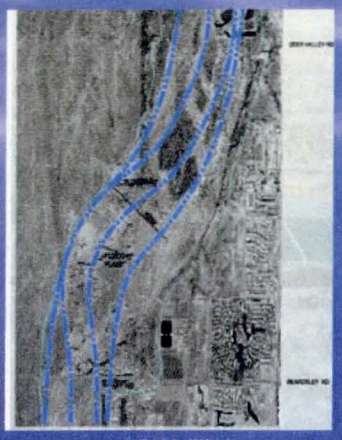
Initiated by the Flood Control District

Extends 32 miles from the Gila River to the New Waddell Dam at Lake Pleasant

Watercourse Master Plan includes unincorporated Maricopa County and the cities of Avondale, El Mirage, Glendale, Peoria, Phoenix, Surprise, and Youngtown

INDIAN BEND WASH
1,300' WIDE

Bike Trails, Lakes,
Ball Fields, Playgrounds,
Picnic Areas

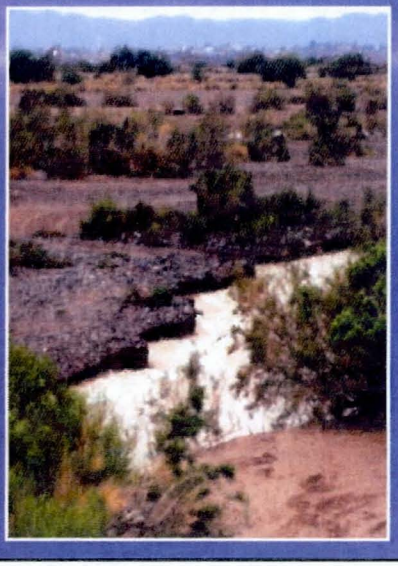


AGUA FRIA
1,200' WIDE

Bike Trails, Paths,
Lakes, Ball Fields,
Playgrounds, Natural
Areas, Wetlands

Why Is Change Needed?

Flood events are uncontrolled, causing damage and rendering large areas unusable



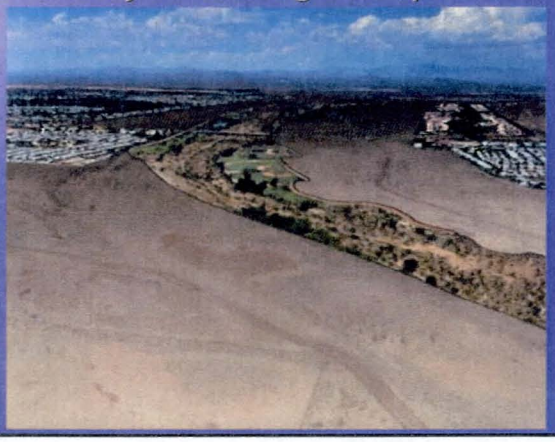
The Master Plan Will…

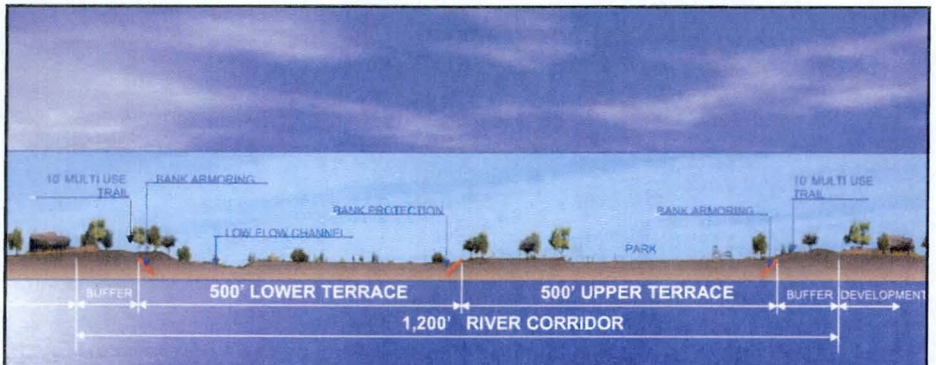
- Address flood control & public safety concerns by creating a channelized streambed
- Add recreational opportunities & open space
- Accommodate existing economic activities
- Allow for groundwater recharge
- Transform more than 5,800 acres of existing floodplain into prime developable land

The Aqua Fria River Master Plan

Channelized Streambed

A deeper 10-15 foot channel that could control potential flows from large-scale storm events excavated by sand and gravel operators



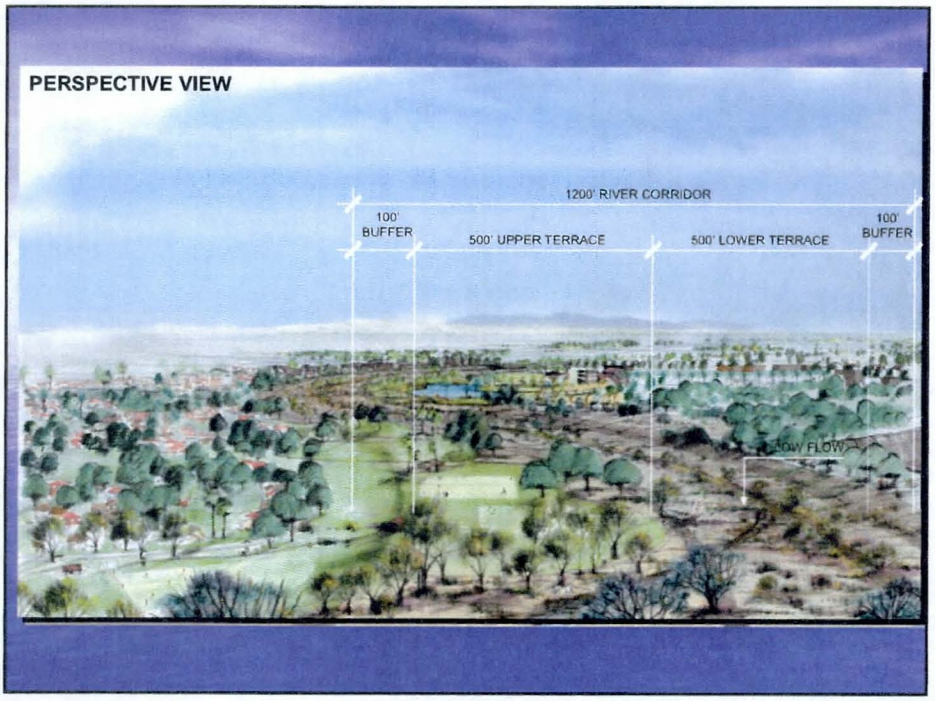


1200 Feet Wide River Corridor with Buried Bank Protection

River Corridor Carries 100-Year Flood

Lower Terrace Carries 20-Year Flood

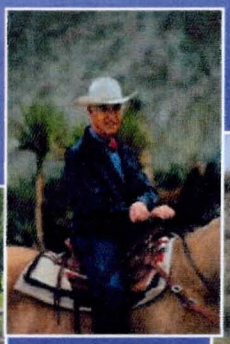
Upper Terrace is Protected from Recurrent Damage during Smaller Floods



The Aqua Fria River Master Plan

Recreation and Open Space

A shallow tier of land on each side of the river bank that can now be used for parks, ball fields, equestrian and hiking trails



The Aqua Fria River Master Plan

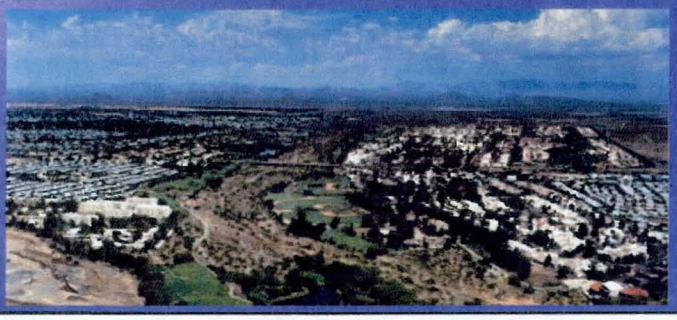
Recharge and Riparian Opportunities

- Opportunities for groundwater recharge throughout the watercourse
- Water features within the shallow tier to encourage wildlife, vegetation and a rich river habitat

The Aqua Fria River Master Plan

Economic Development

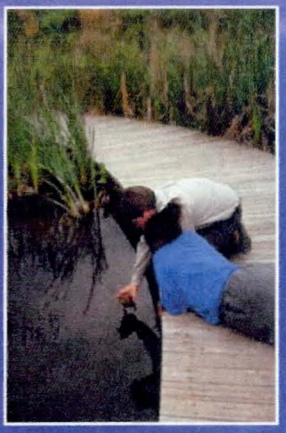
- Protects and reduces future public infrastructure costs
- Brings excess floodplain and floodway land into productive use
- Enhances property values



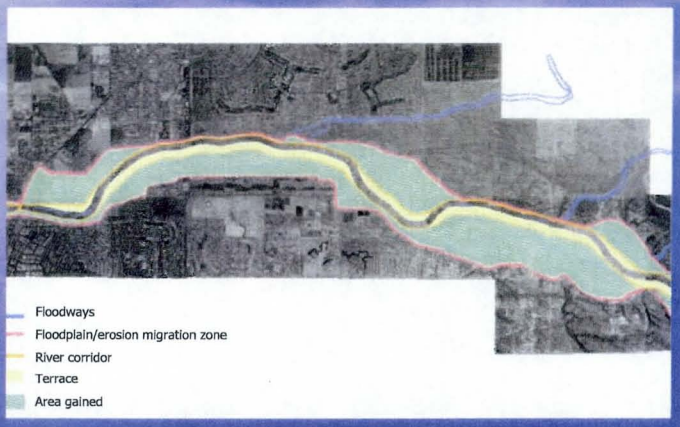
West Valley Recreation Corridor

"The West Valley Recreation Corridor represents a unique opportunity to facilitate regional connectivity, open space and economic vitality."

Diane Brossart
President, Valley Forward Association
Vice Chair, Friends of the West Valley Recreation Corridor

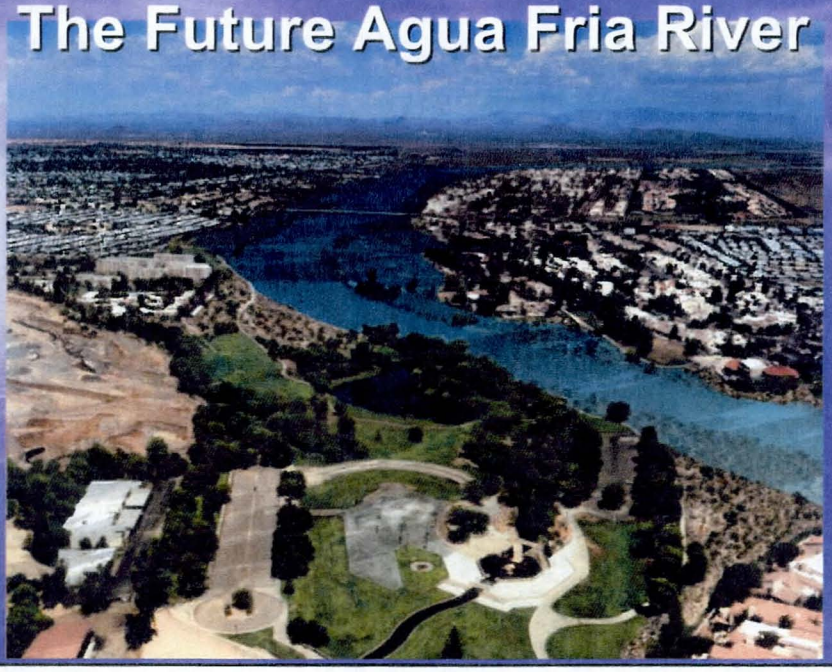


Land Removed From The Floodplain



Total Land Gained
5,824 Acres

The Future Agua Fria River



What is Needed to Make this Work?

- Intensive planning and coordination among several public and private interests throughout the West Valley
- A variety of funding mechanisms and improvement district concepts
- 10 - 20 years to complete
- Development in segments
- Participation of sand and gravel industry

Sand and Gravel Mining's Role

Vital part of West Valley's economy

Ability to excavate and restore river to natural function

Excellent public, private partnership

Reduced public expense

Creates a "Win – Win" for Sand and Gravel Industry and the Community

Estimated Cost For The River Channel Construction

	Public Cost Without Mining Participation	Public Cost With Mining Participation
Upper Reach:	$125	$ 25
Middle Reach:	$ 90	$ 30
Lower Reach:	$ 30	$ 4
Totals (millions)**	$245	$ 59

** Does not include Land Costs or Recreational Facilities
** Cost for Construction from Existing Funds

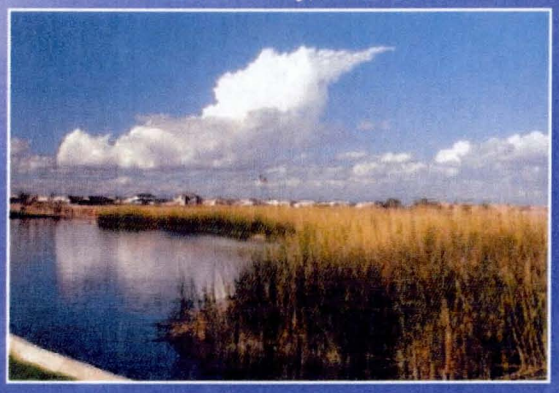
Challenges To Implementation

- Flood Control has planning and jurisdictional constraints
- Multiple jurisdictions make linear planning and development difficult

The Aqua Fria River Master Plan

"West Valley leaders understand the potential of the Agua Fria River and its significance to the area's economic vitality and quality of life."

Diane McCarthy, Westmarc

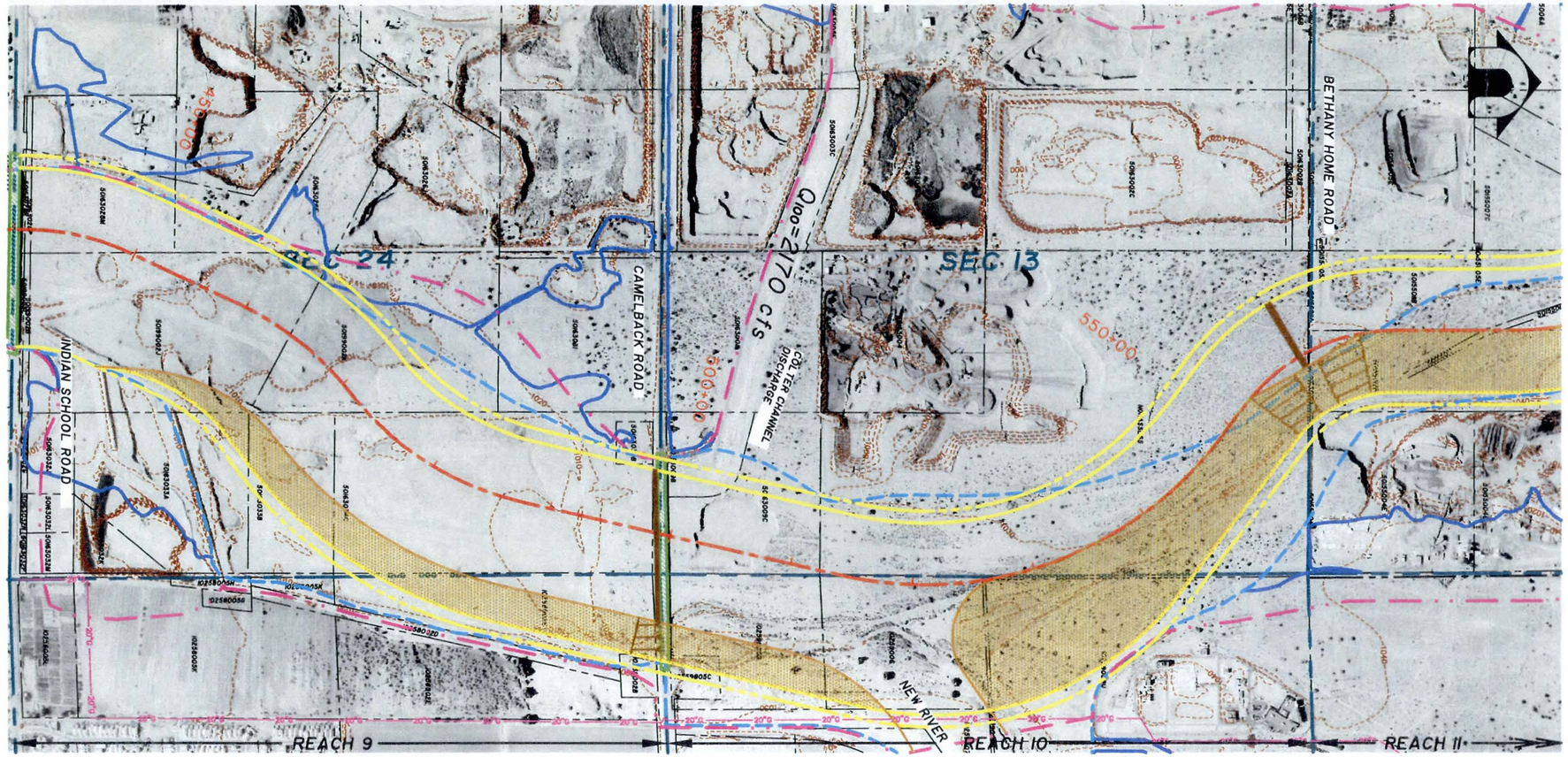


Next Steps

Explore creative opportunities to coordinate development of this project

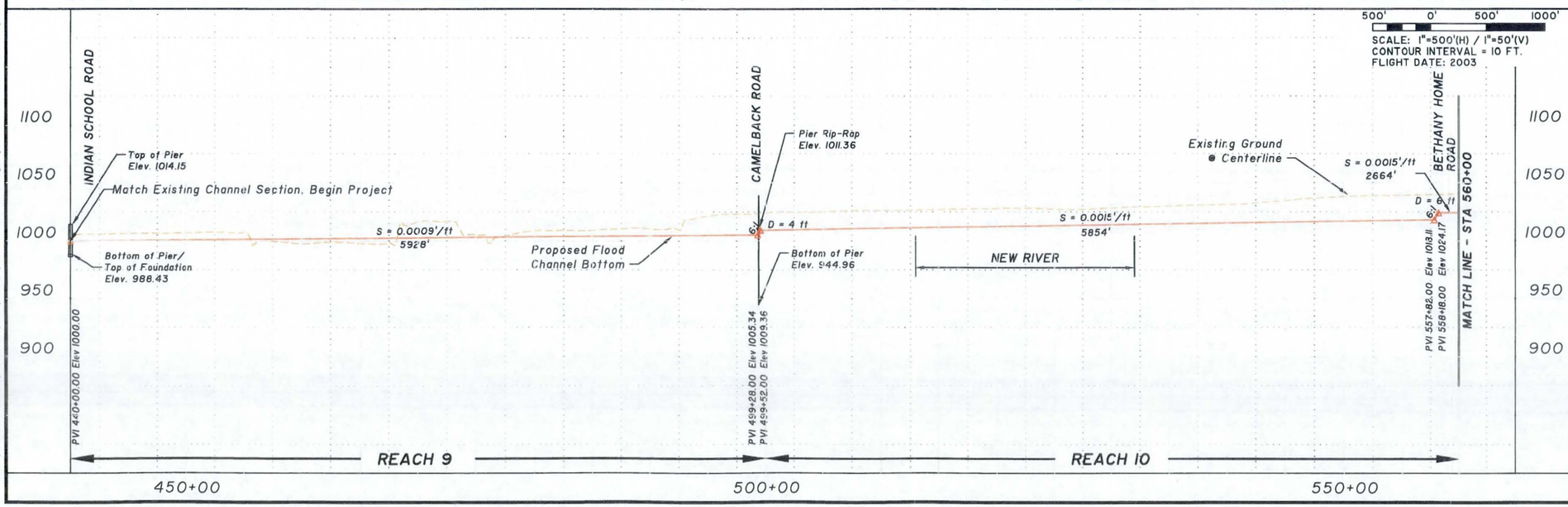
APPENDIX B

DETAILED PLAN AND PROFILE OF THE CHANNELIZATION
ALTERNATIVE BY REACH



LEGEND

- FLOODWAY BOUNDARY
- 100-YR FLOODPLAIN BOUNDARY
- LATERAL MIGRATION EROSION HAZARD ZONE*
- PROPOSED CHANNEL SETBACK
- PROPOSED CHANNEL TOP
- CONCEPTUAL CHANNEL/ ROADWAY CENTERLINE
- BRIDGE CROSSING
- TERRACE
- PROPERTY LINE
- SECTION LINE
- EXISTING UTILITIES — TYPE
- EXISTING GROUND CONTOURS — 1000



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DESIGNED IN CONJUNCTION WITH

EDAW

JE FULLER HYDROLOGY & GEOMORPHOLOGY, INC.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

AGUA FRIA
WATERCOURSE MASTER PLAN ADDENDUM
CHANNELIZATION ALTERNATIVE

ENGINEERING DESIGN
DRAFT REPORT
EXHIBIT 1

DAVID EVANS AND ASSOCIATES INC.
2141 East Highland Avenue, Suite 200
Phoenix, Arizona 85016
Phone: 602.678.5151

JANUARY 2005

SHEET 1 OF 11

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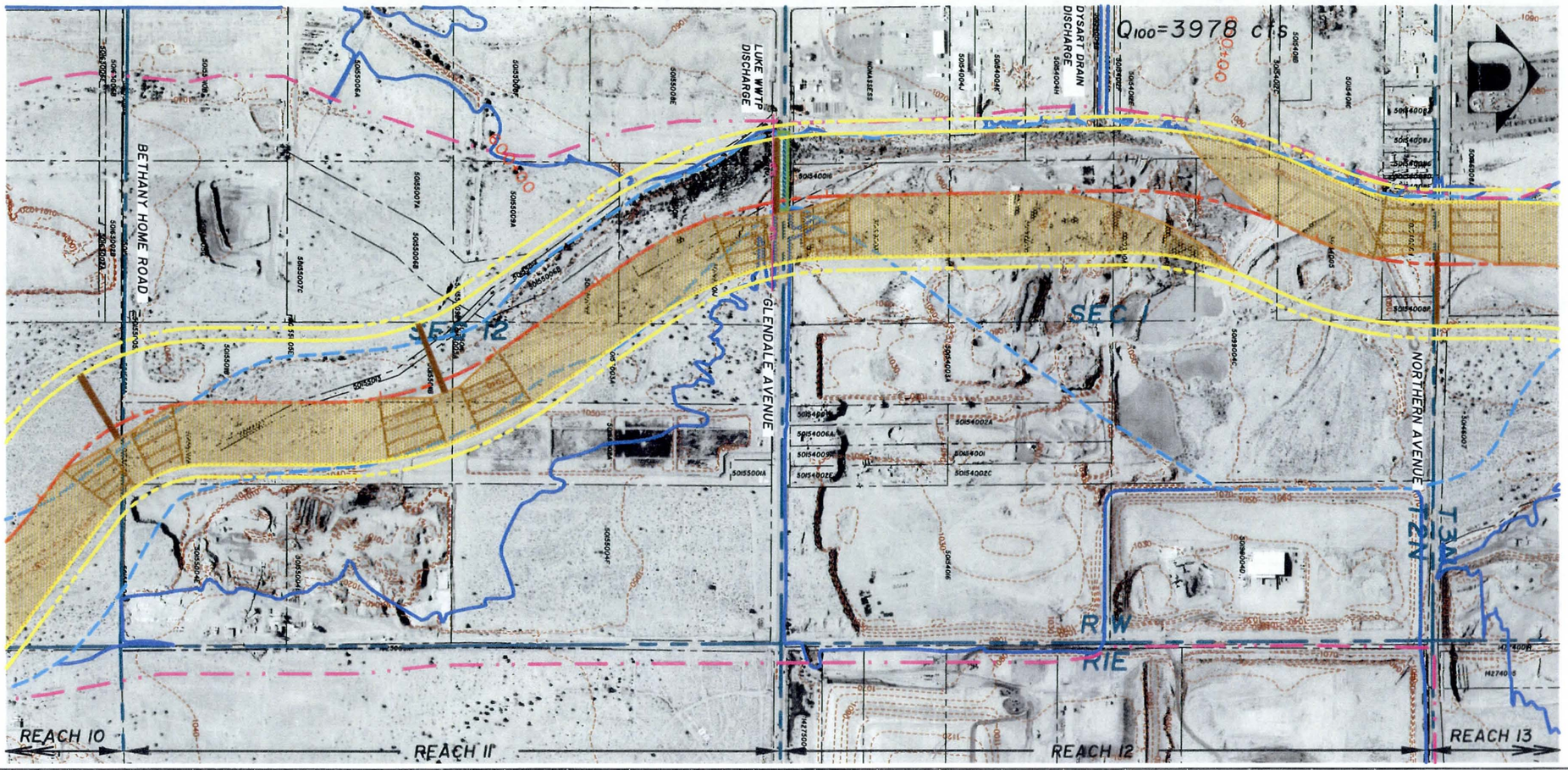

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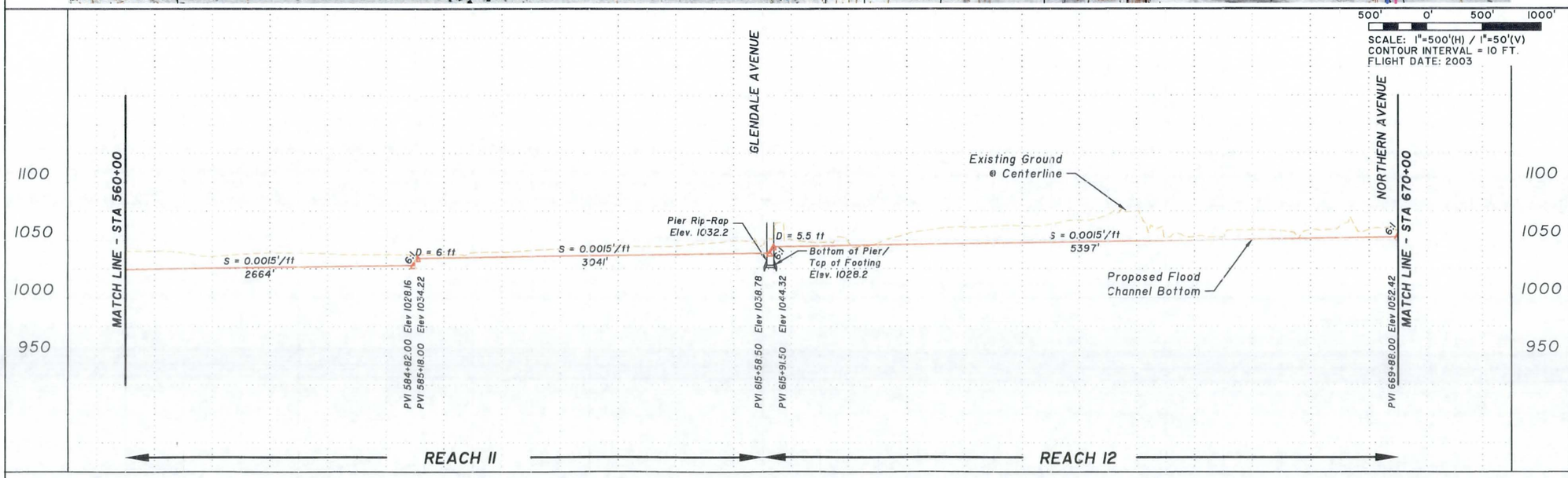

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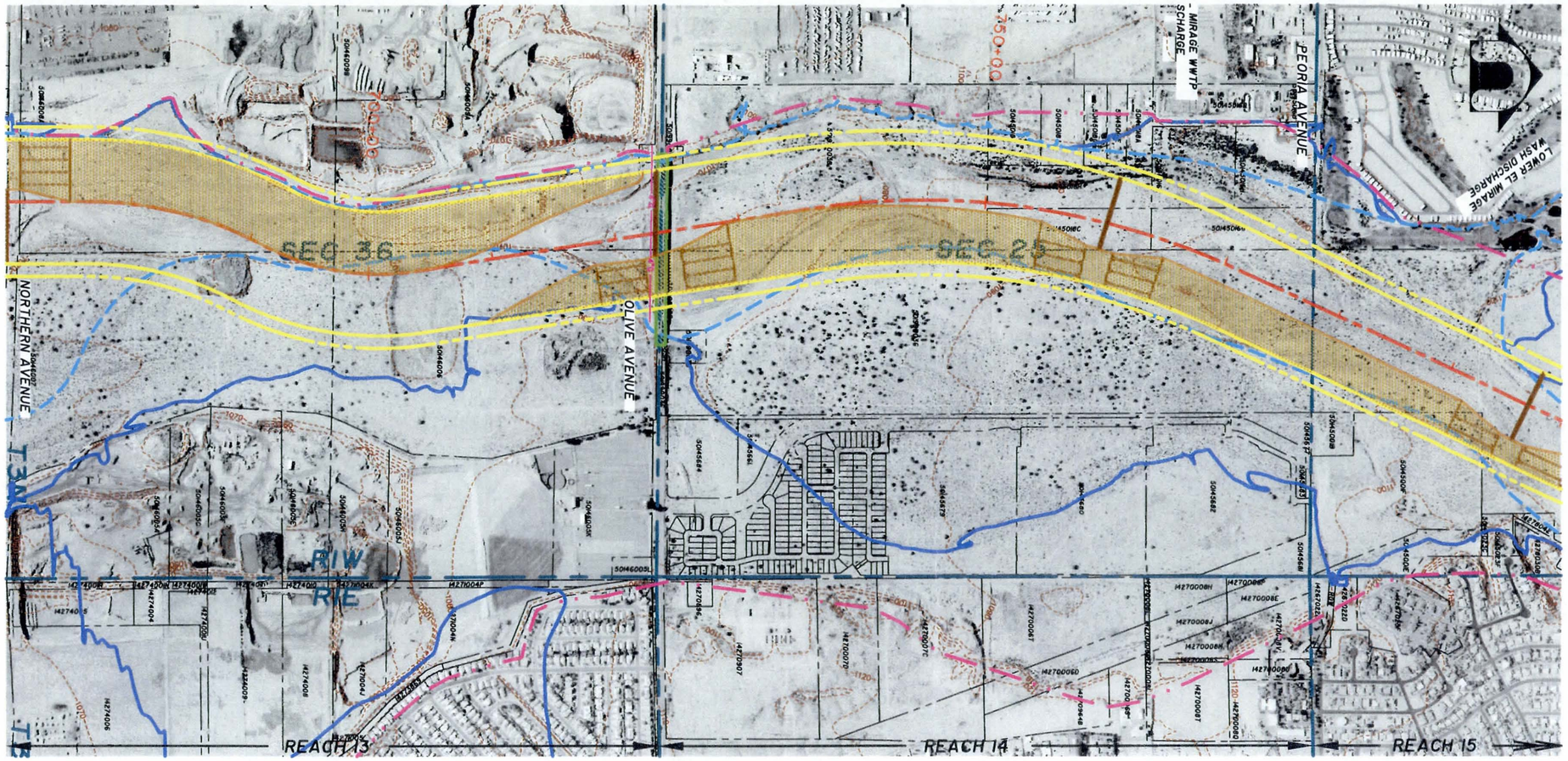

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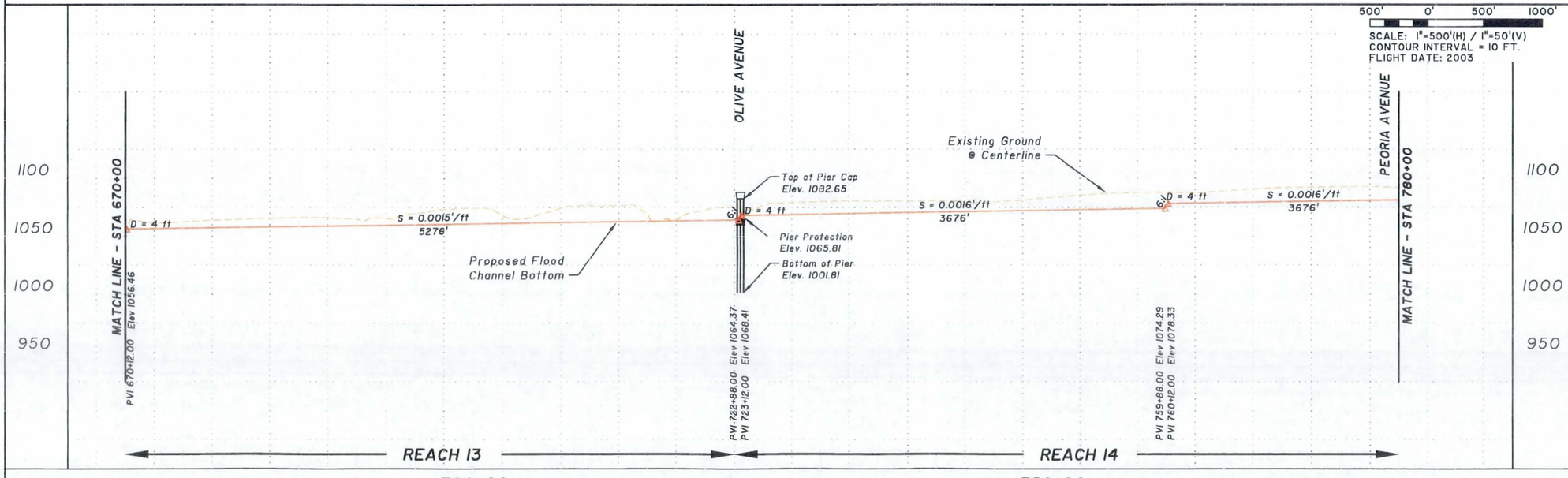

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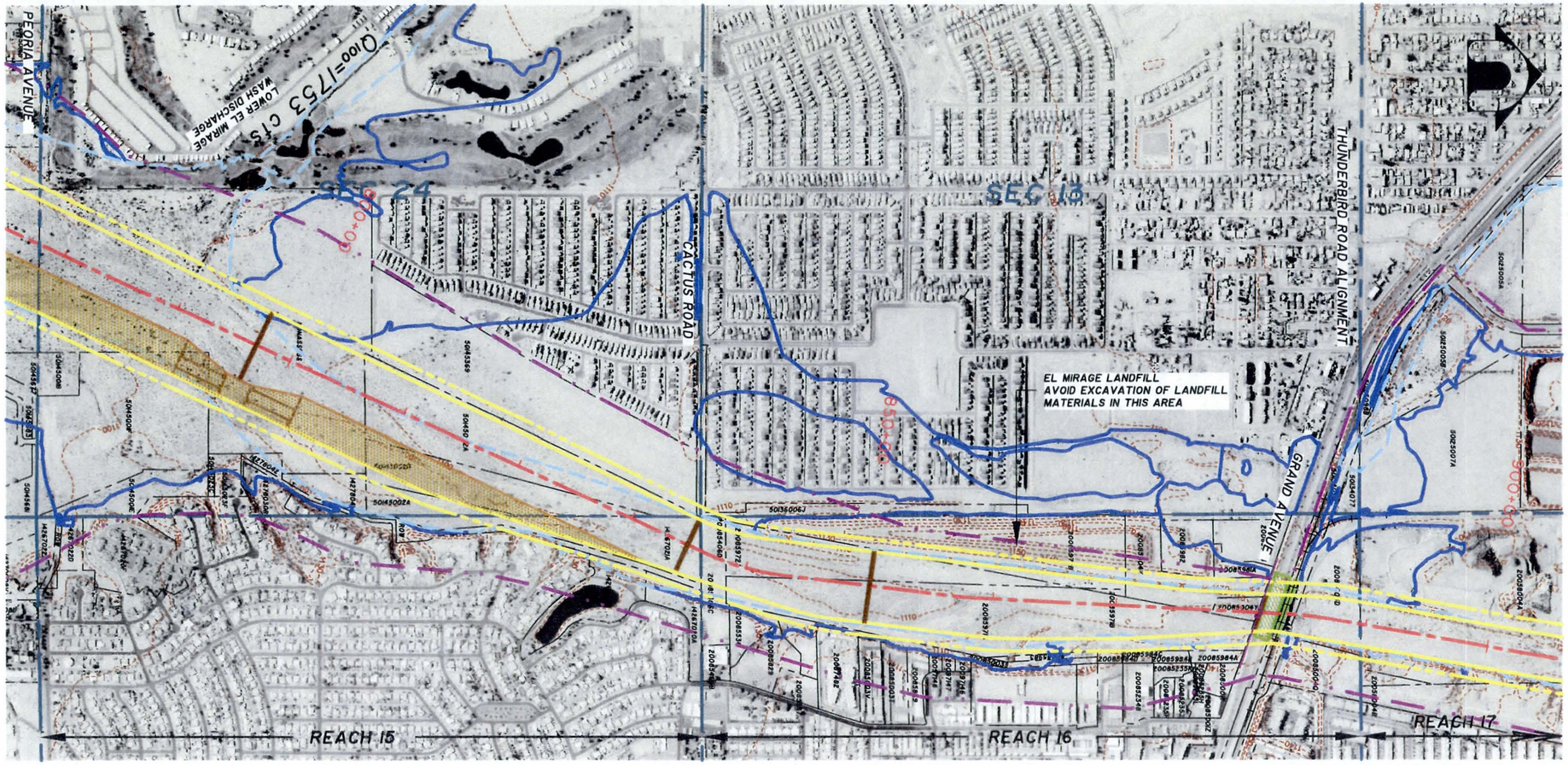

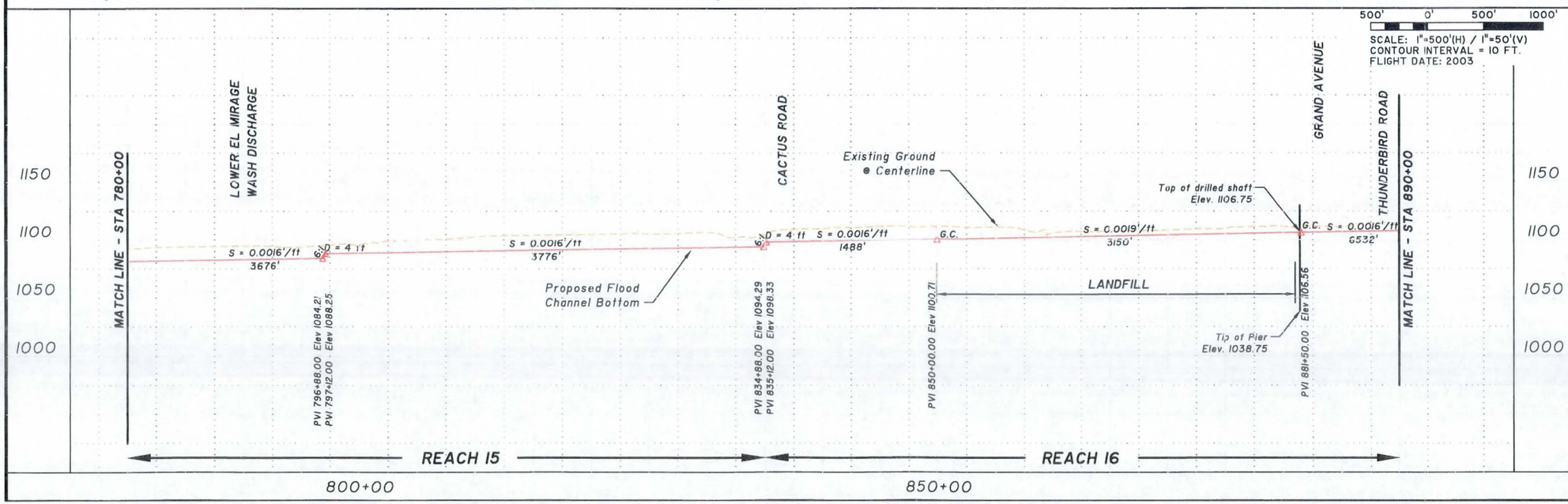

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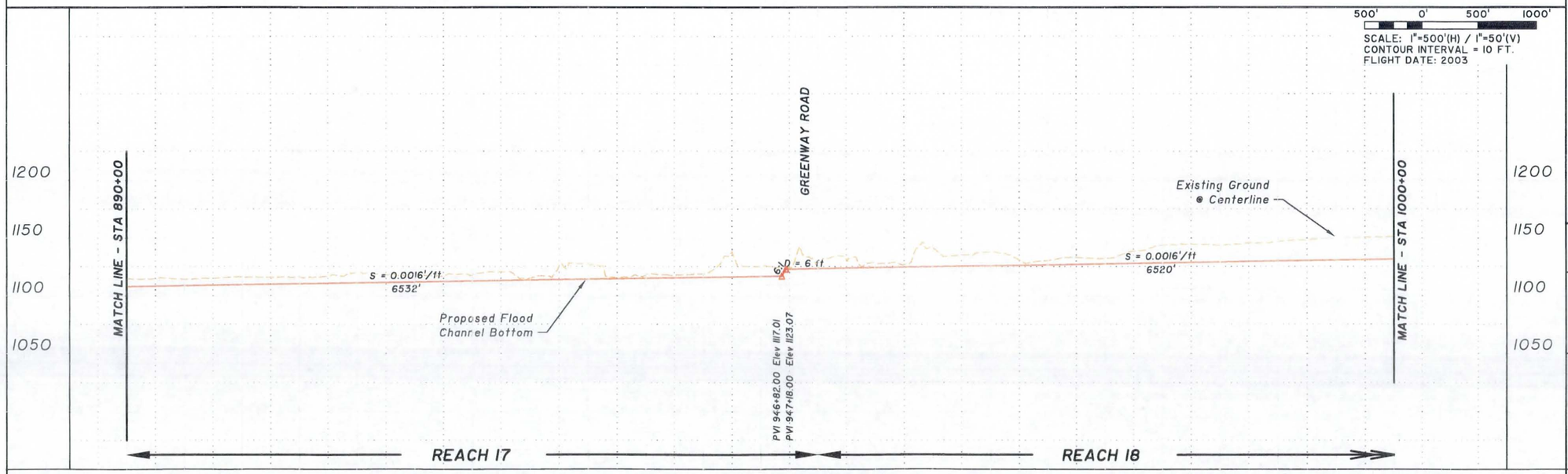
- EXISTING GROUND CONTOURS — 1000 —

500' 0' 500' 1000'

SCALE: 1"=500'(H) / 1"=50'(V)
CONTOUR INTERVAL = 10 FT.
FLIGHT DATE: 2003



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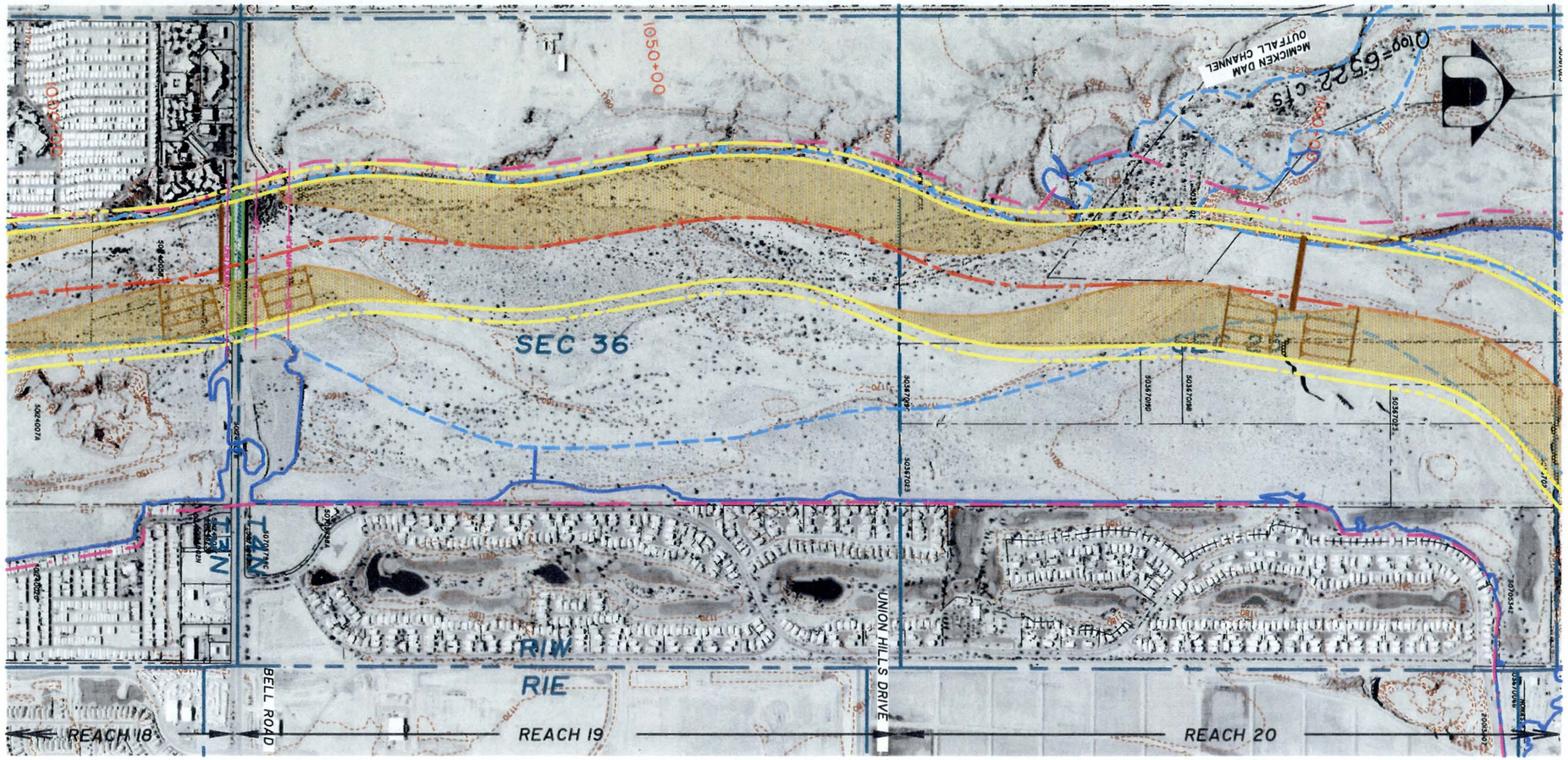
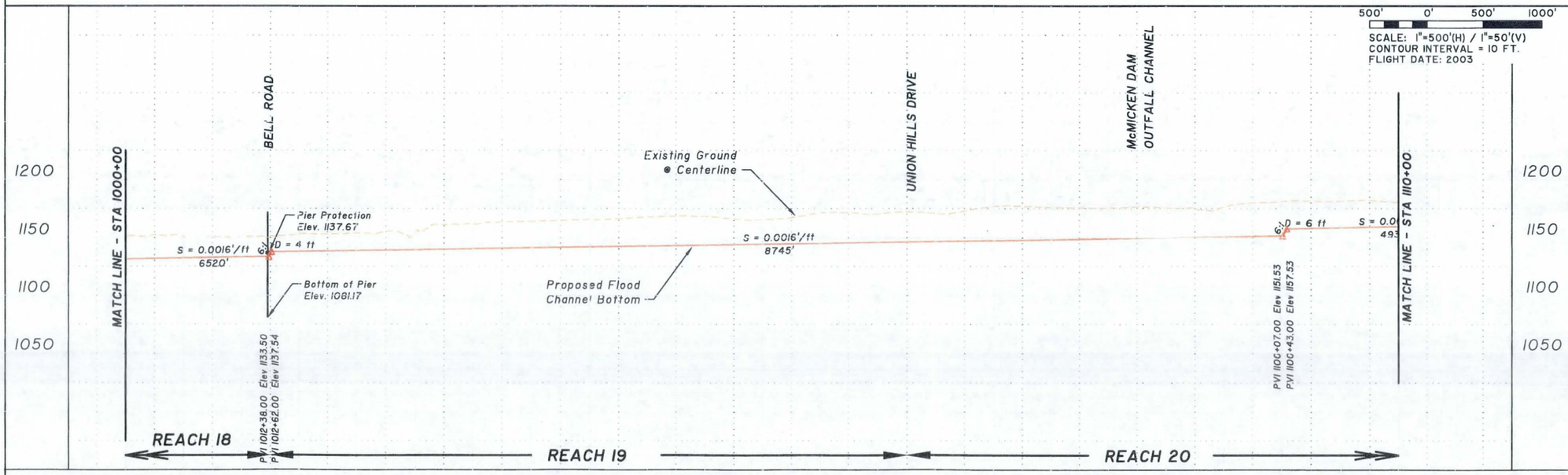




LEGEND

- FLOODWAY BOUNDARY
- 100-YR FLOODPLAIN BOUNDARY
- LATERAL MIGRATION EROSION HAZARD ZONE*
- PROPOSED CHANNEL SETBACK
- PROPOSED CHANNEL TOP
- CONCEPTUAL CHANNEL/ ROADWAY CENTERLINE
- BRIDGE CROSSING
- TERRACE
- PROPERTY LINE
- SECTION LINE
- EXISTING UTILITIES — TYPE —
- EXISTING GROUND CONTOURS ---1000---

*"ADVISORY NOTE : LATERAL MIGRATION EROSION HAZARD ZONE IS ADVISORY ONLY UNLESS CONTAINED WITHIN THE FLOODPLAIN LIMIT OF UNINCORPORATED MARICOPA COUNTY."

DESIGNED IN CONJUNCTION WITH

EDAW

JE FULLER HYDROLOGY & GEOMORPHOLOGY, INC.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

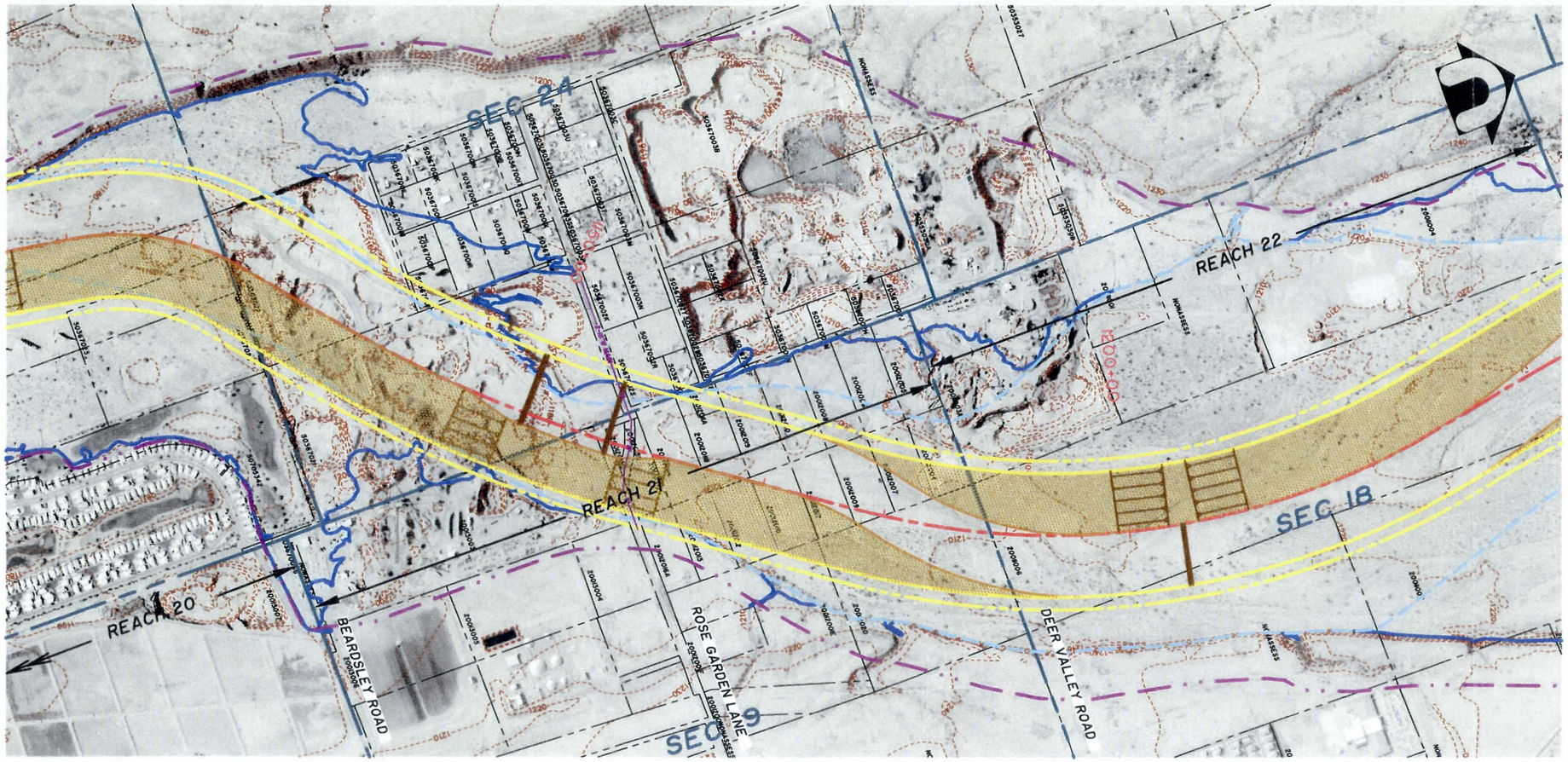
AGUA FRIA
WATERCOURSE MASTER PLAN ADDENDUM
CHANNELIZATION ALTERNATIVE

ENGINEERING DESIGN DRAFT REPORT

EXHIBIT 1

DAVID EVANS AND ASSOCIATES INC.
2141 East Highland Avenue, Suite 200
Phoenix, Arizona 85016
Phone: 602.678.5151

JANUARY 2005



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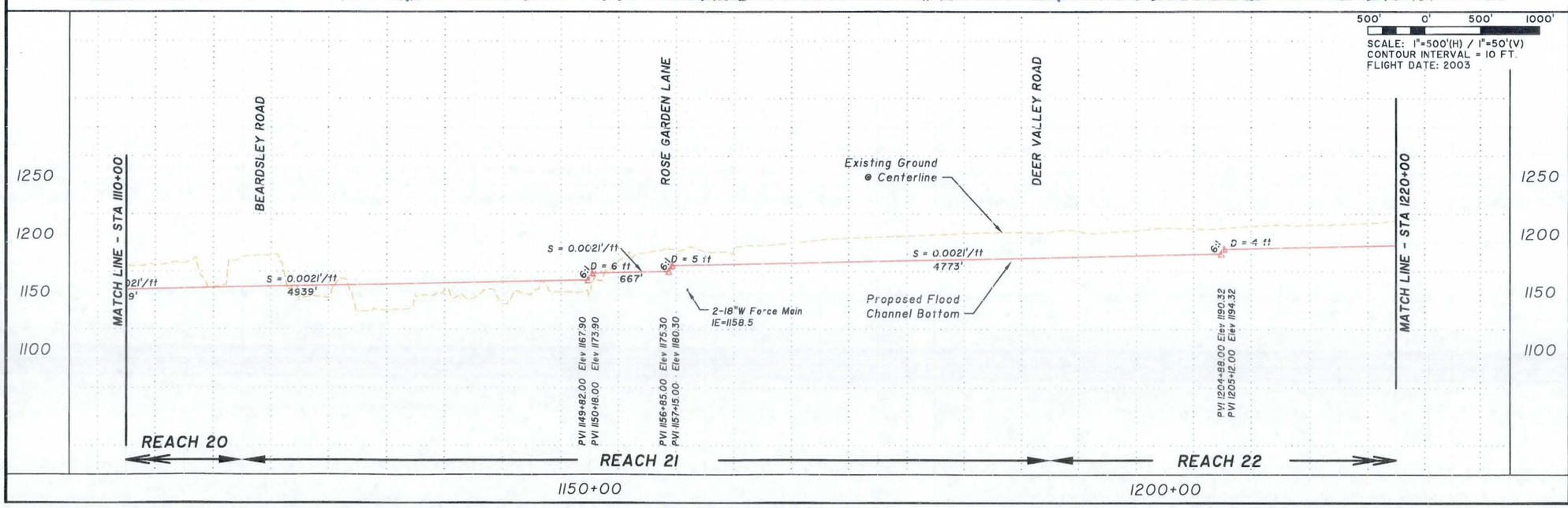

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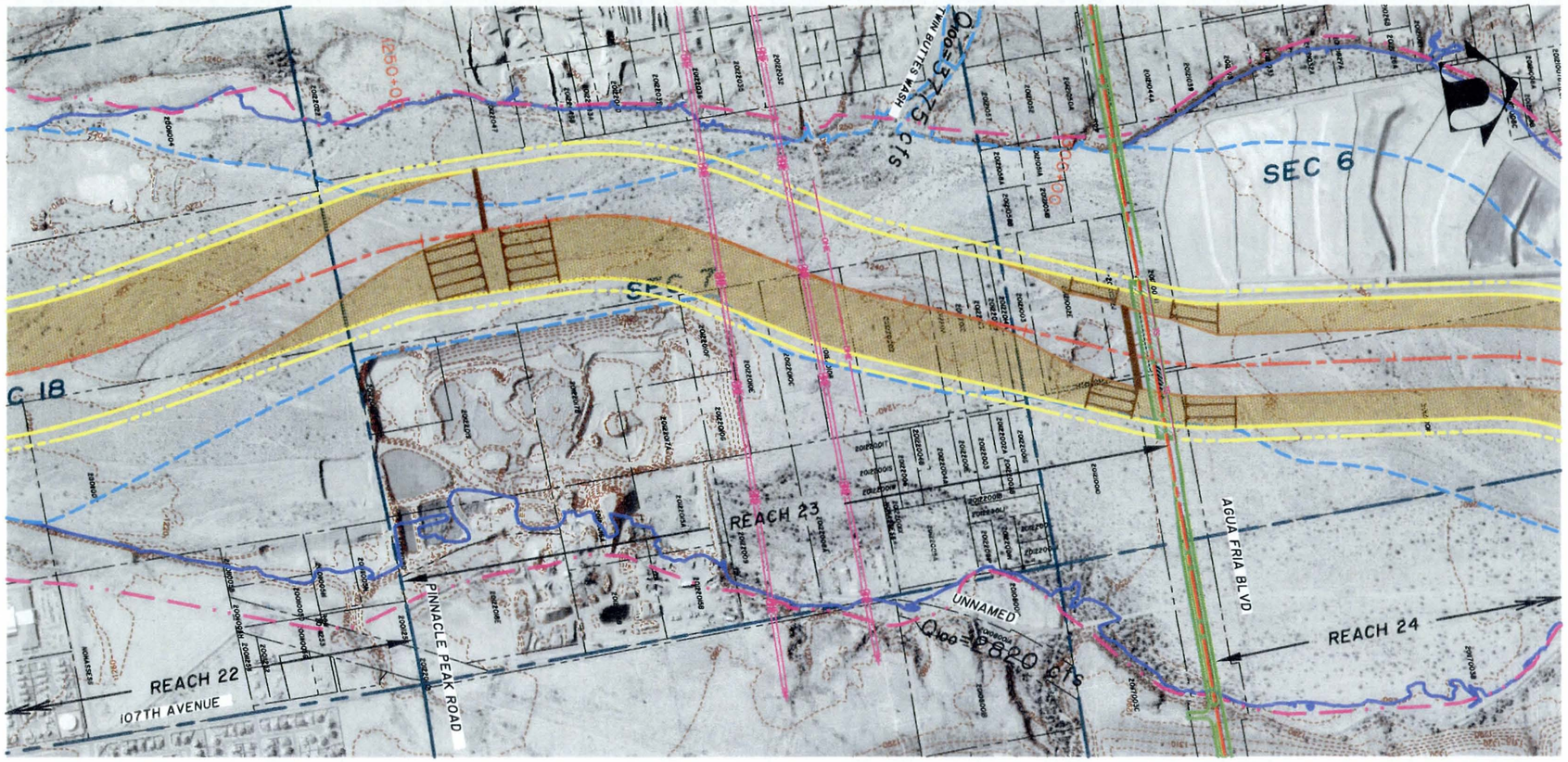

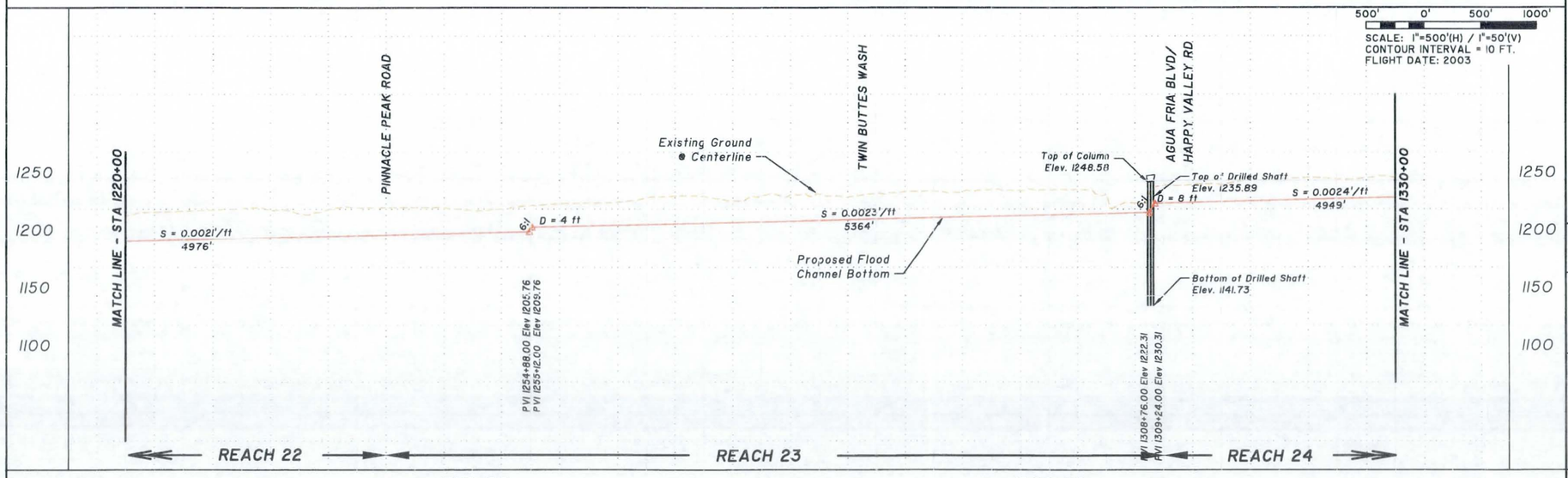

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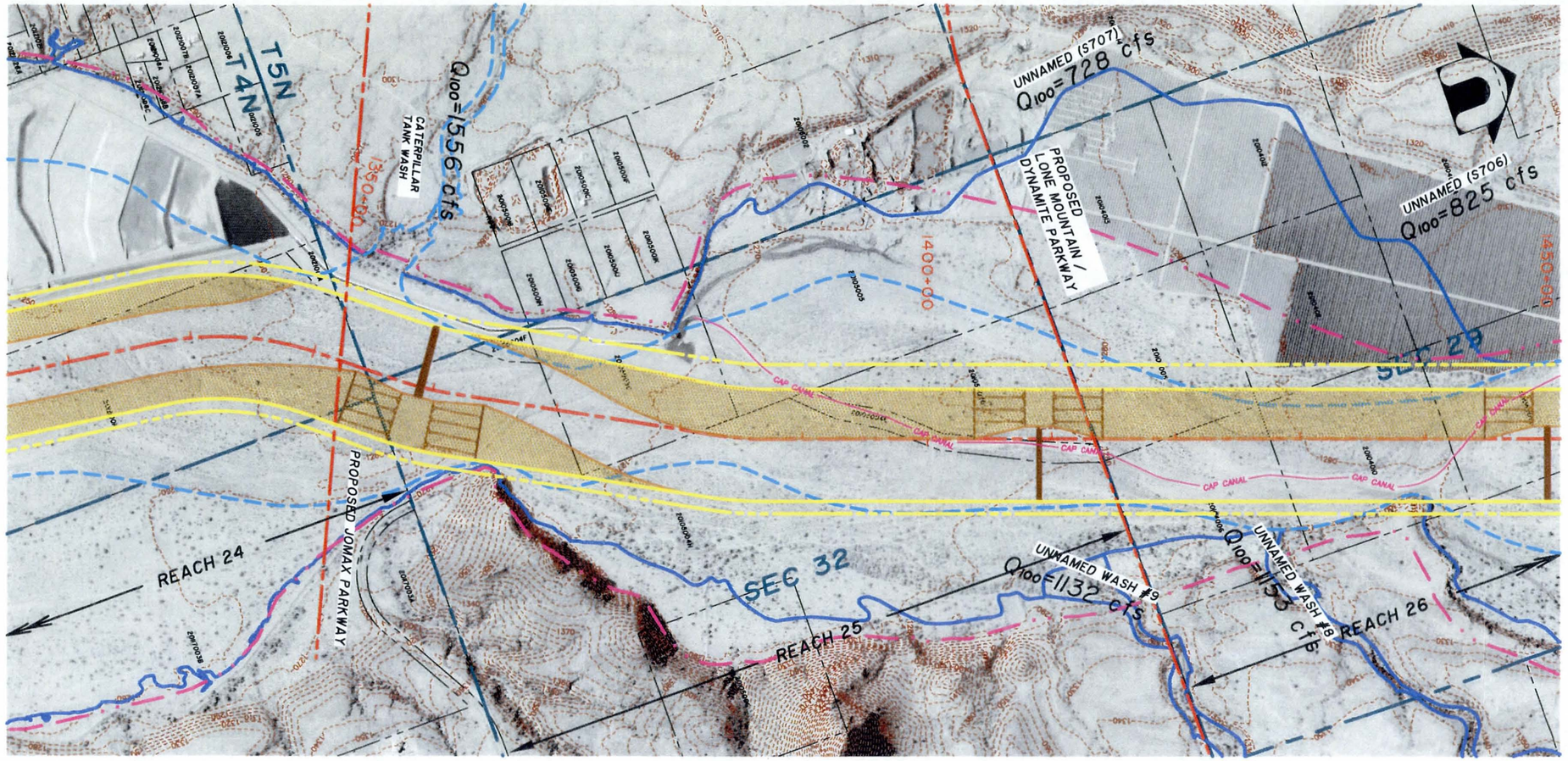

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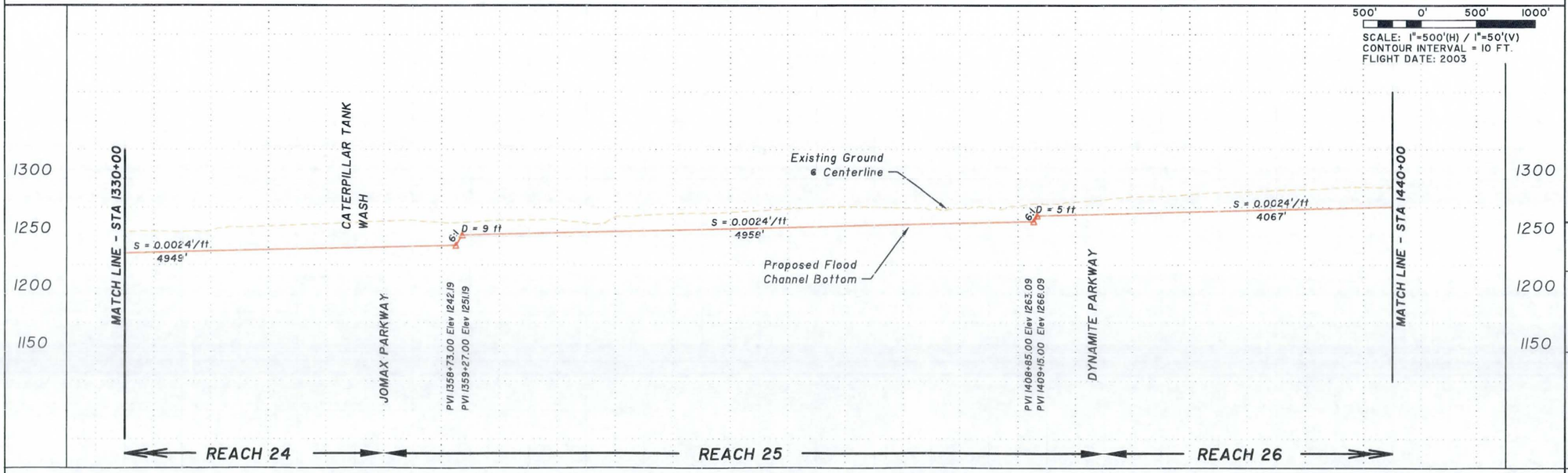
500' 0' 500' 1000'

SCALE: 1"=500'(H) / 1"=50'(V)
CONTOUR INTERVAL = 10 FT.
FLIGHT DATE: 2003



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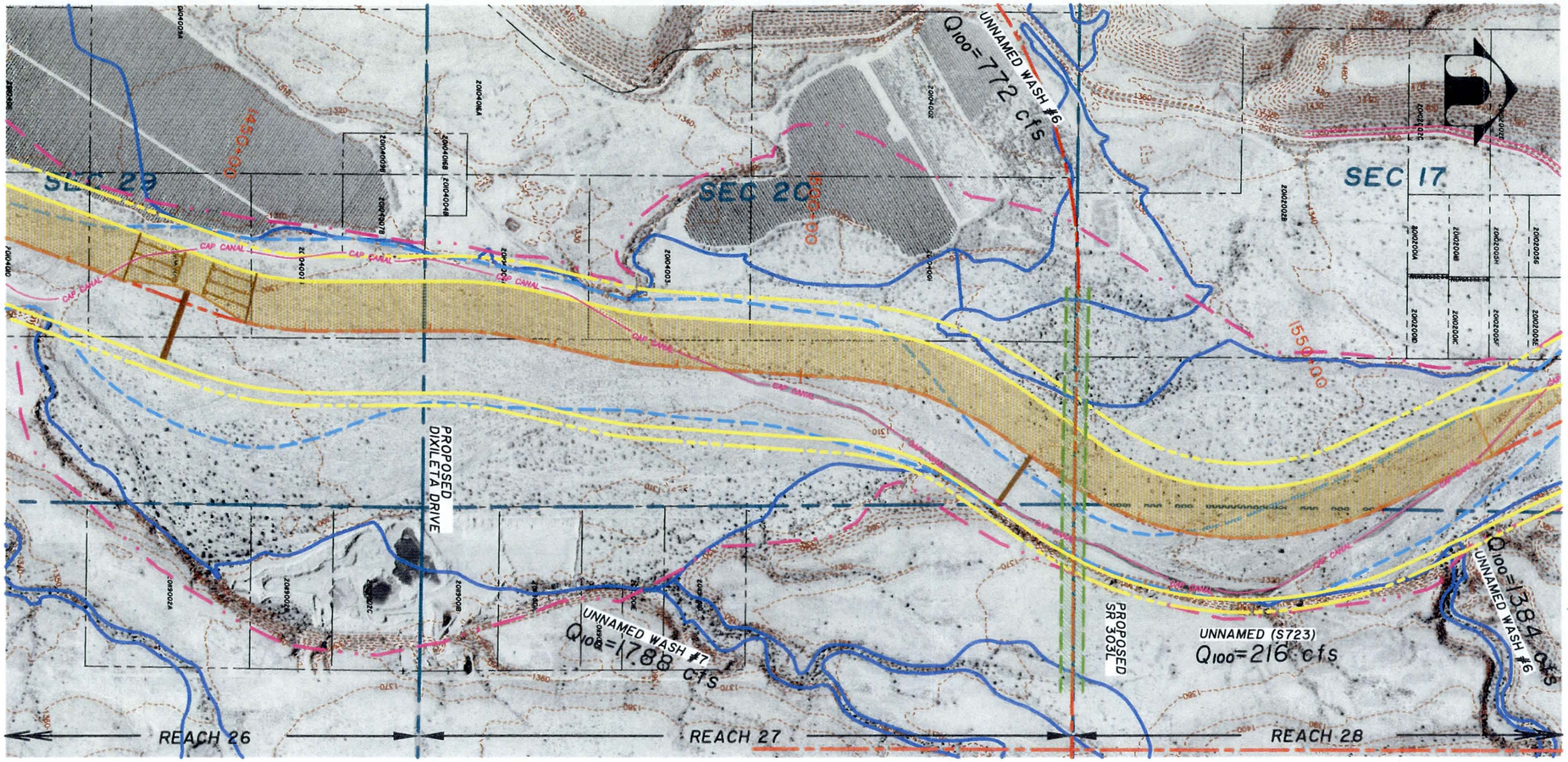

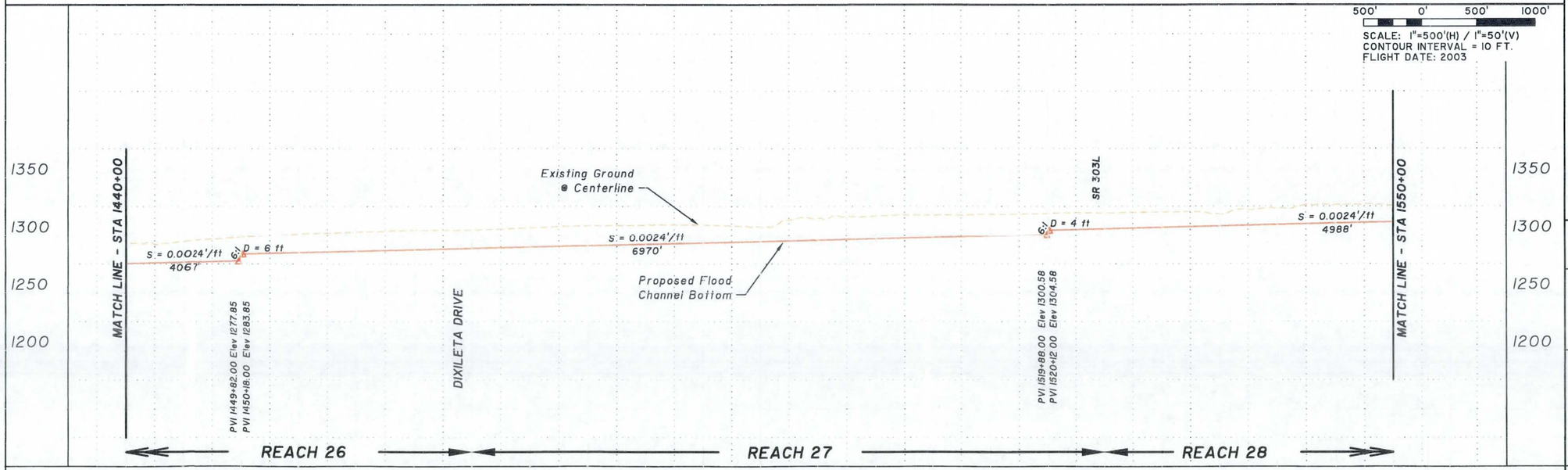

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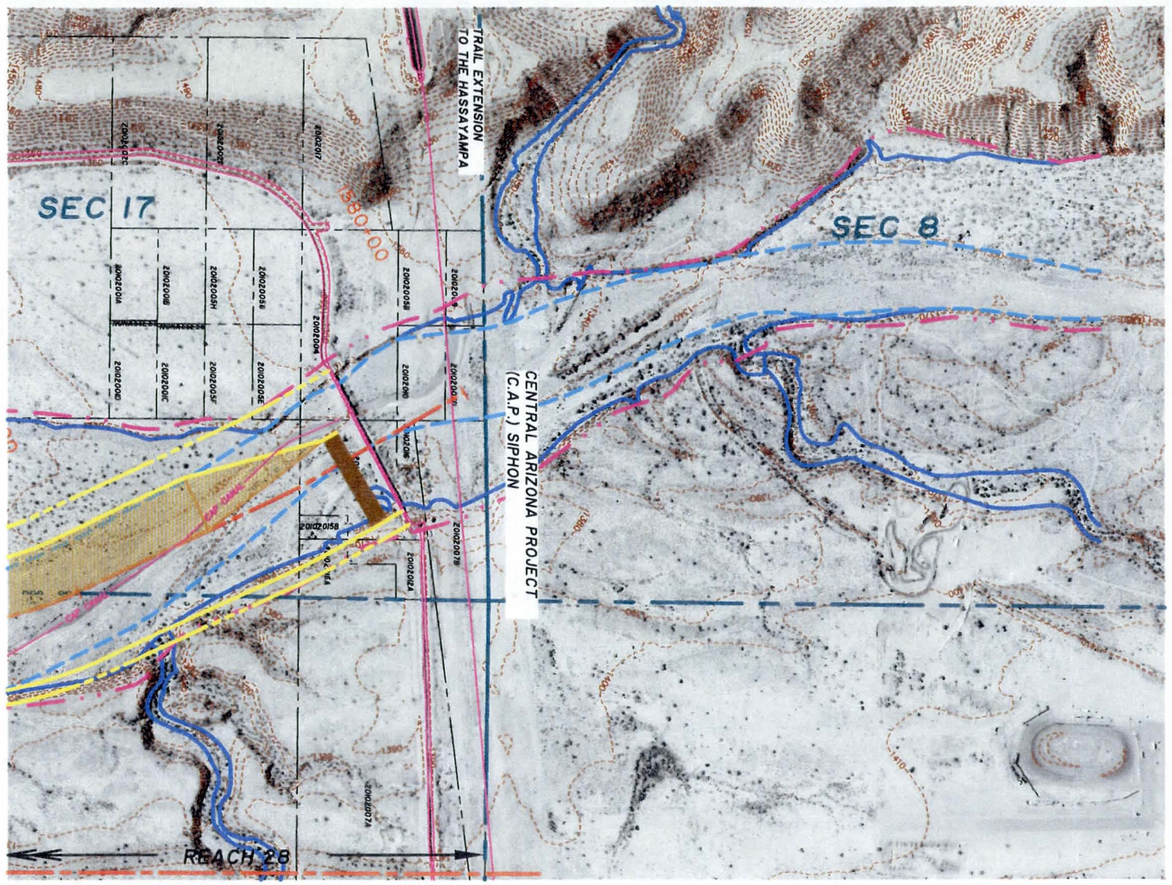

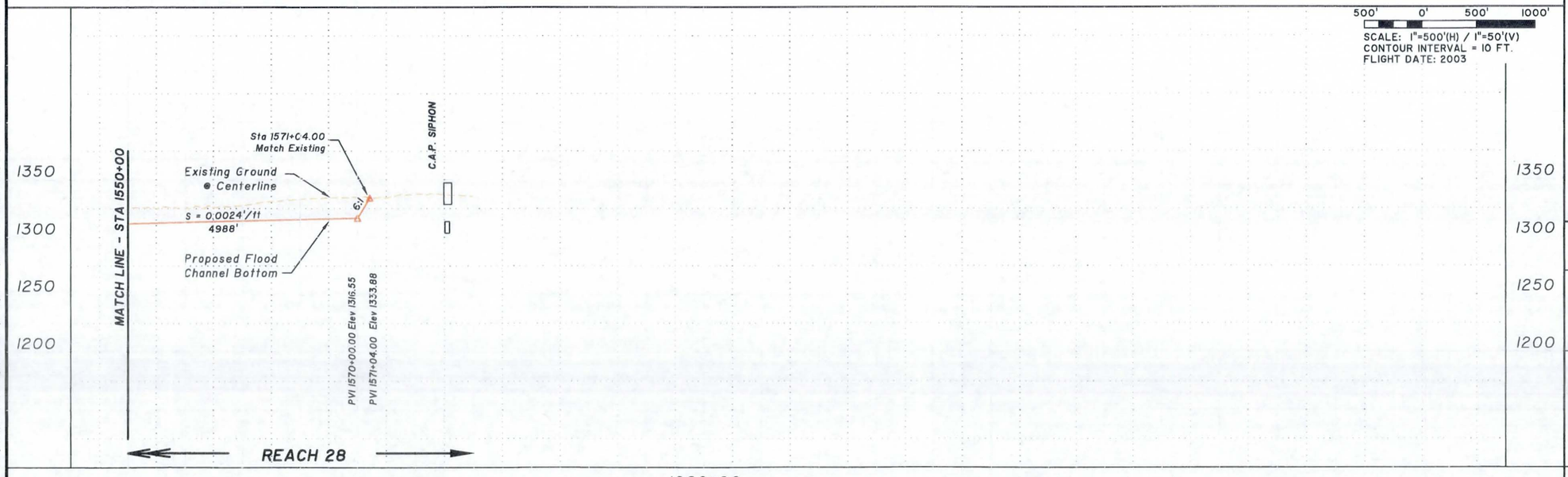

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500' 0' 500' 1000'

SCALE: 1"=500'(H) / 1"=50'(V)
CONTOUR INTERVAL = 10 FT.
FLIGHT DATE: 2003

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SHEET II OF II

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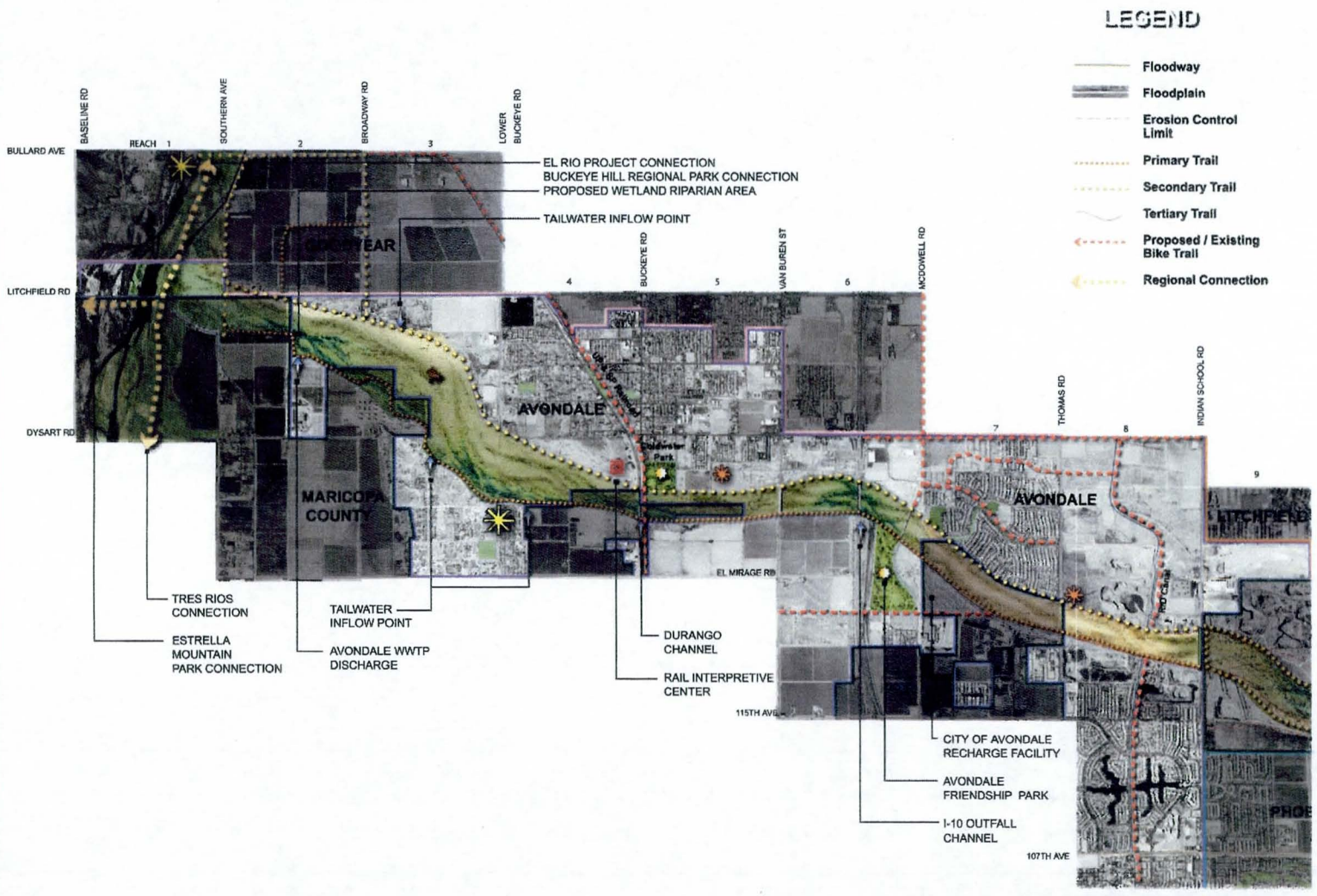
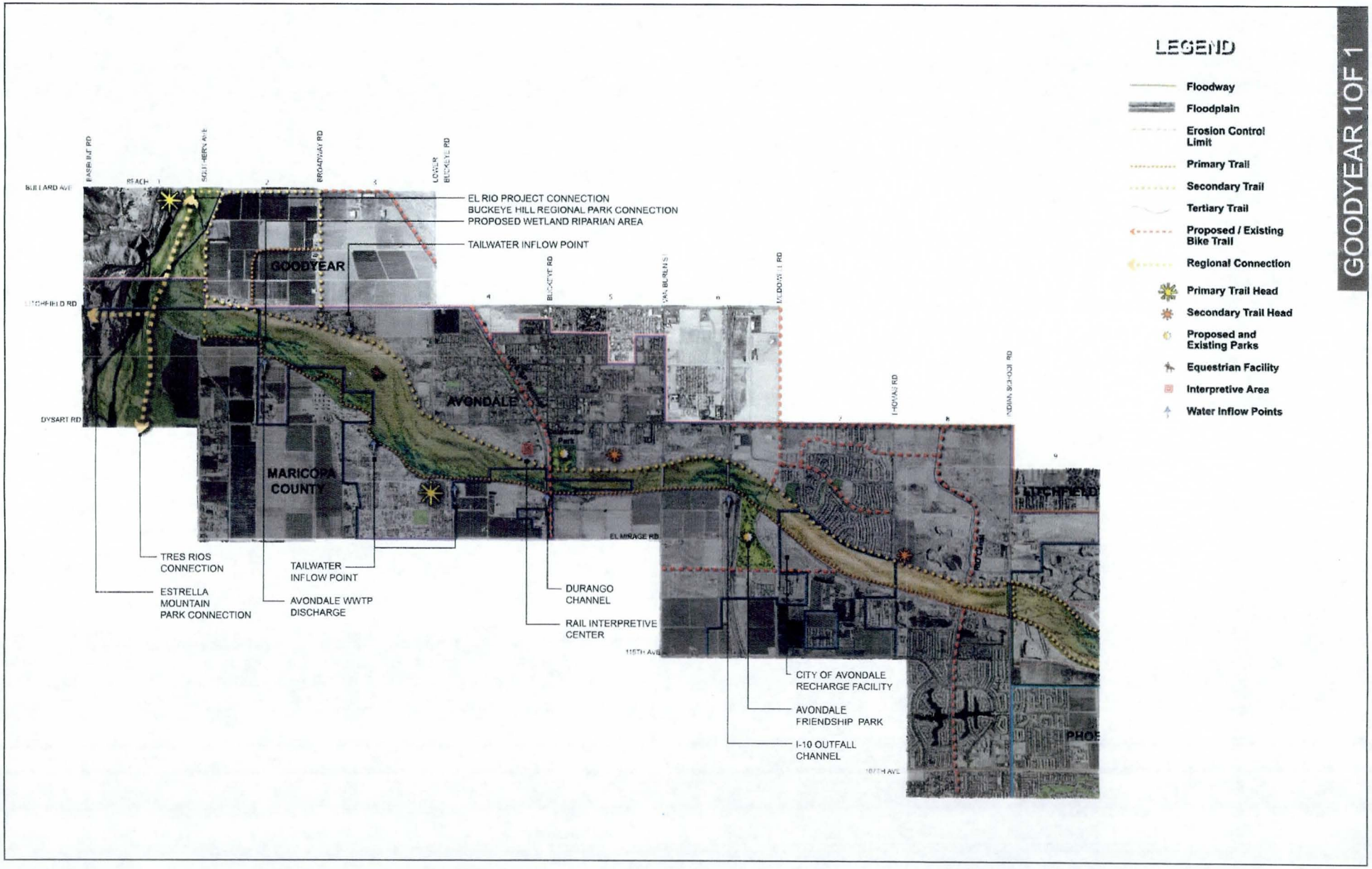
APPENDIX C

MULTIUSE OPPORTUNITIES IDENTIFIED BY JURISDICTION



CITY OF AVONDALE

- Trail linkages to Coldwater Park and Friendship park along the levee
- Regional trail linkage to the Tres Rios Demonstration site, the Estrella Mountain Regional Park, and the El Rio project along Gila River west of the Agua Fria River.
- Wetland habitat interpretation study site at the Avondale constructed wetland facility.
- Rail interpretive center at the UP & SP Railroad crossing parallel to Buckeye Road.
- Possible USACE riparian restoration project within the lower Agua Fria River in two locations; I-10 crossing and the area around the outfall from the Avondale WWTP.
- Bike trail linkages from the primary trail system along the river corridor to trails along the RID canal and neighboring local bike trails.


GOODYEAR 1OF 1
LEGEND
Floodway
Floodplain
Erosion Control Limit
Primary Trail
Secondary Trail
Tertiary Trail
Proposed / Existing Bike Trail
Regional Connection
Primary Trail Head
Secondary Trail Head
Proposed and Existing Parks
Equestrian Facility
Interpretive Area
Water Inflow Points
BASELINE RD
SOUTHERN AVE
BROADWAY RD
LOWER BUCKEYE RD
BUCKEYE RD
VAN BUREN ST
MCDOWELL RD
I-10/WEST RD
ROOSEVELT RD
BULLARD AVE
LITCHFIELD RD
DYSART RD
EL MIRAGE RD
115TH AVE
107TH AVE
REACH 1
2
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4
5
6
7
8
9
GOODYEAR
AVONDALE
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LITCHFIELD
PHOE
EL RIO PROJECT CONNECTION
BUCKEYE HILL REGIONAL PARK CONNECTION
PROPOSED WETLAND RIPARIAN AREA
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TRES RIOS CONNECTION
ESTRELLA MOUNTAIN PARK CONNECTION
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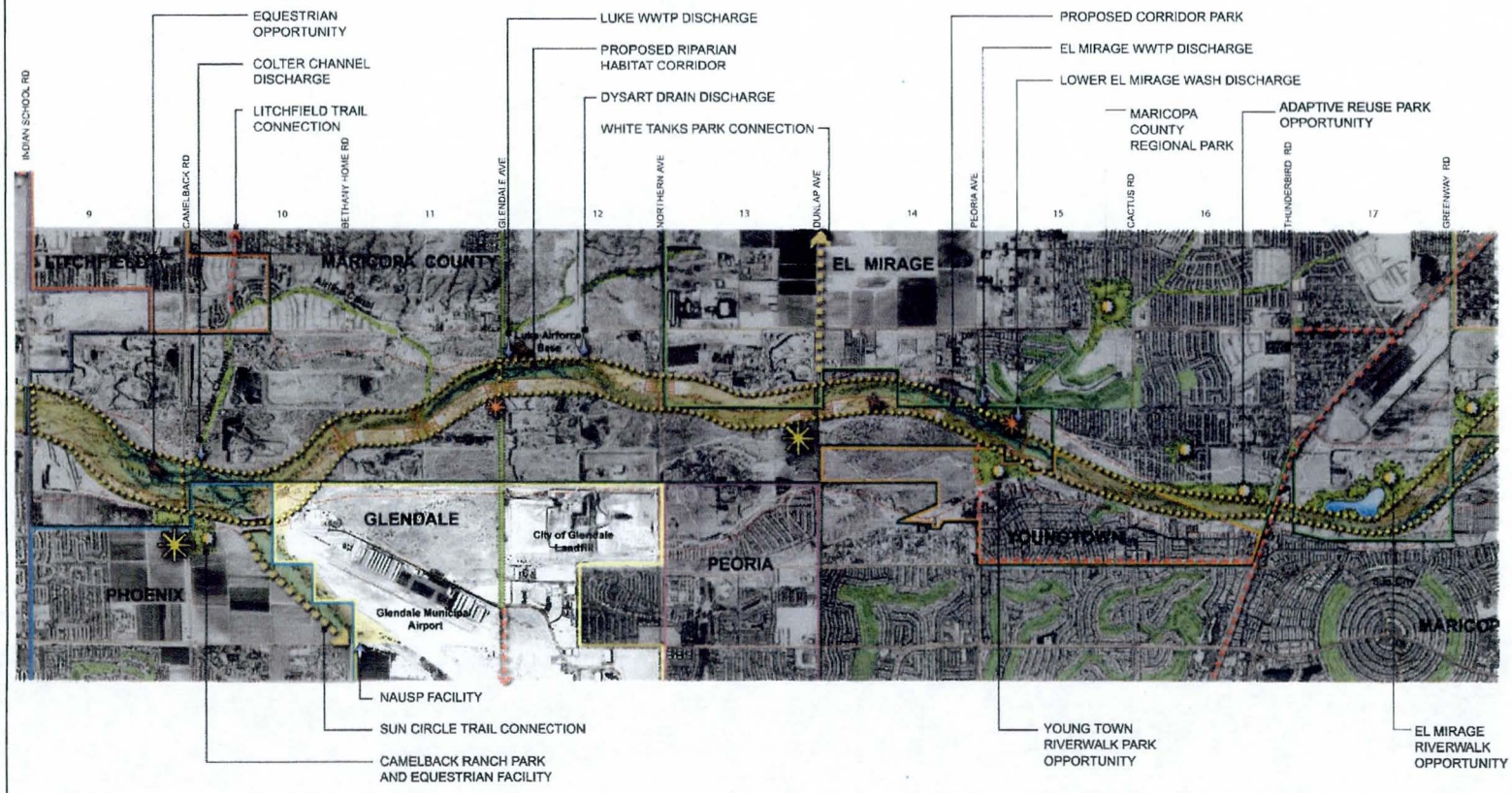
DURANGO CHANNEL
RAIL INTERPRETIVE CENTER
CITY OF AVONDALE RECHARGE FACILITY
AVONDALE FRIENDSHIP PARK
I-10 OUTFALL CHANNEL



LEGEND

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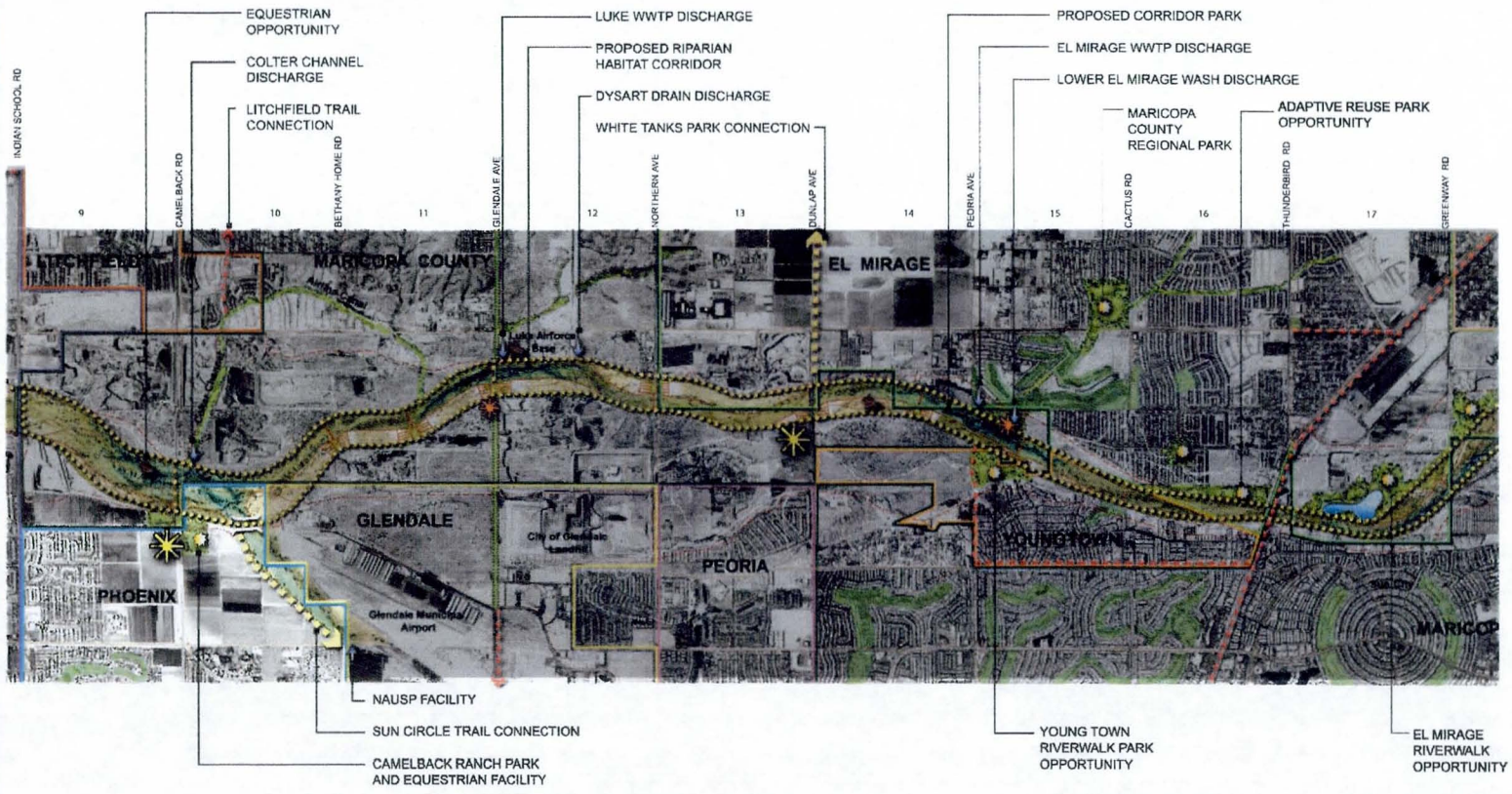
CITY OF GLENDALE

- Community linkage to the Grand Canal Linear Park (GCLP) equestrian staging area along Bethany Home road.
- Equestrian opportunity along terrace area and flood channel that links to the the Luke Air force Base horse corrals north of Glendale Road
- Existing habitat area south of Glendale road created by discharge from the Luke WWTP and the Dysart Drain discharge.
- Secondary trail head opportunity along Glendale road at terrace transition.



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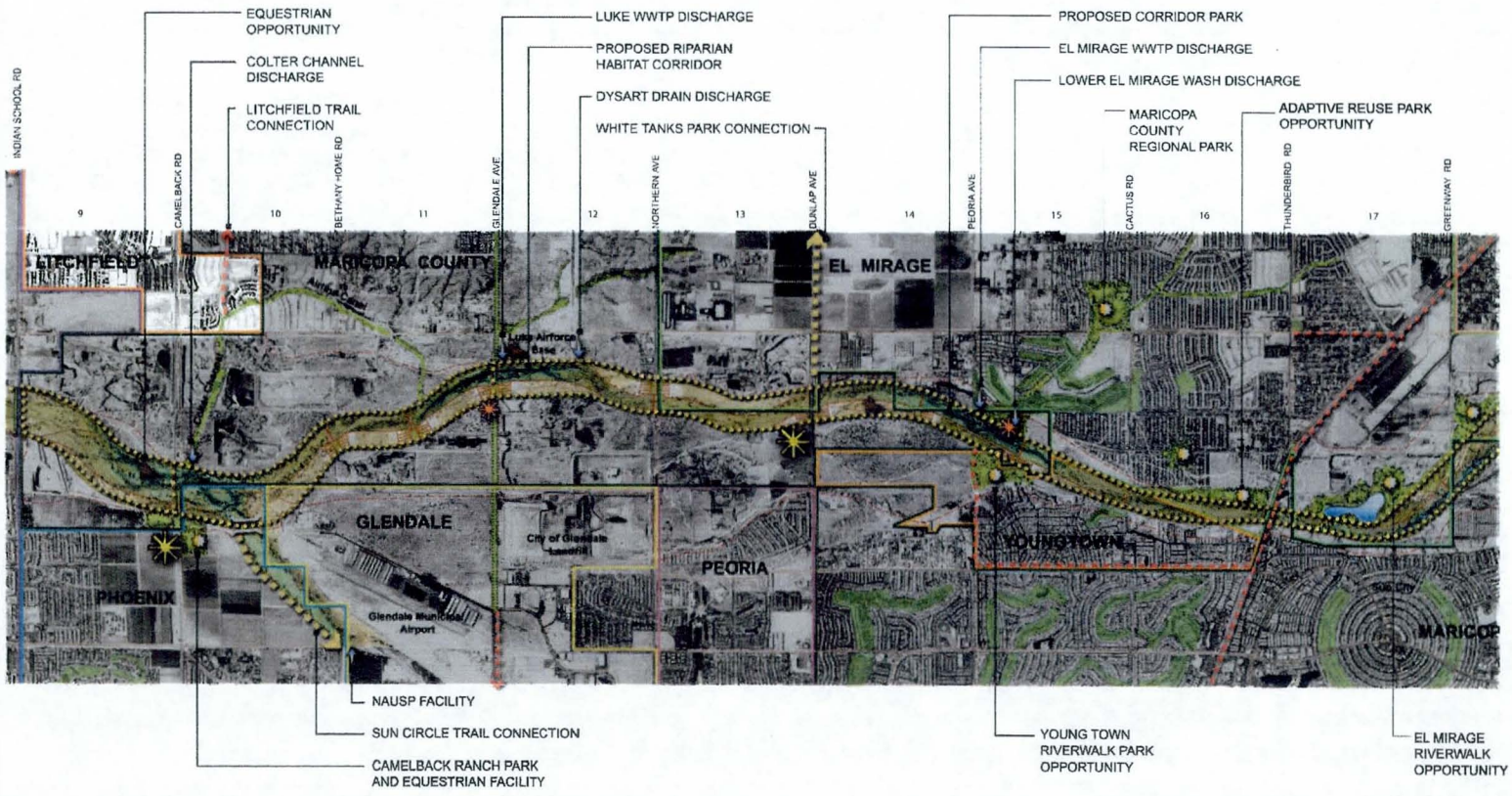
CITY OF PHOENIX

- Shared use trail connection and staging area for equestrians and hikers from Camelback Ranch park.
- Regional linkage to the Sun Circle Trail.
- Equestrian opportunity in the river corridor.
- Possible trail linkage to the between the Tres Rios Project and the Agua Fria recreational corridor.



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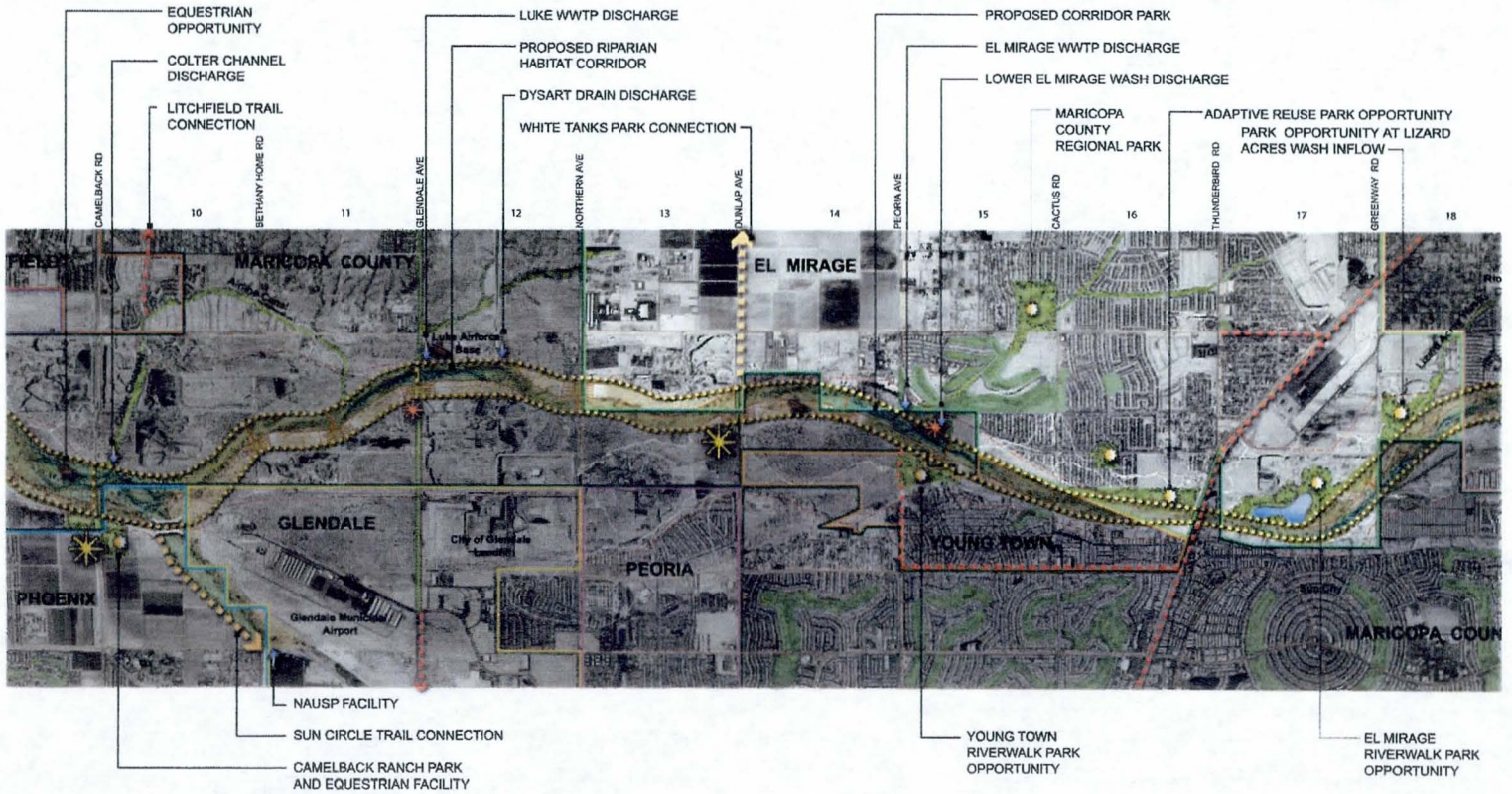
LITCHFIELD PARK

- Litchfield trail connection along Colter Channel and Airline Canal to the continuous recreation corridor.



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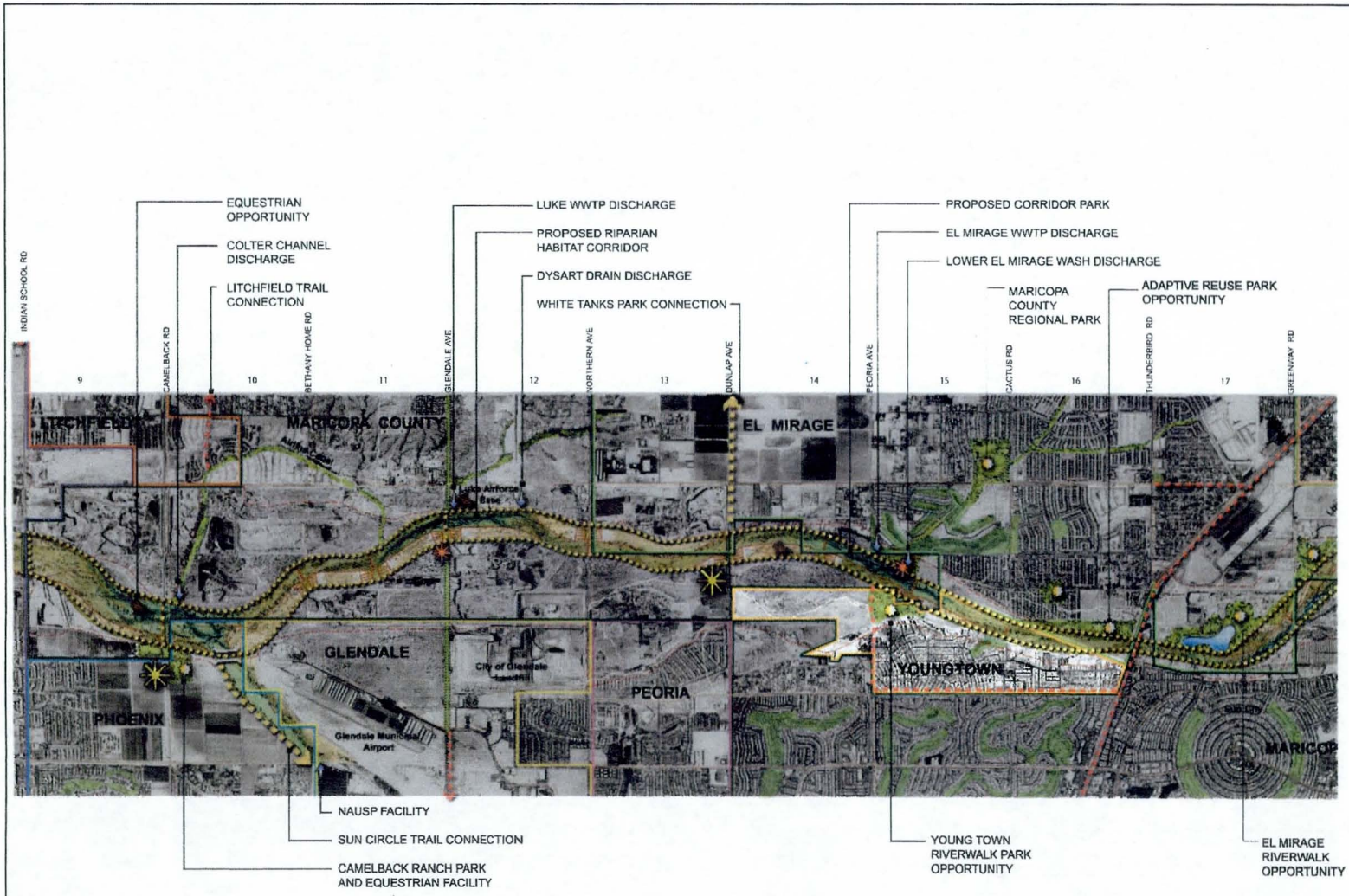
CITY OF EL MIRAGE

- White Tank trail connection along Dunlap avenue with primary trail head opportunity at the terrace transition along Dunlap Road.
- Extensive trail and park system greenways within the City of El Mirage that links to the primary trail along the landscape buffer.
- Future opportunity for the adaptive reuse of the landfill site to park use and potential linkage to trail system beneath Glendale Avenue and the Rail Road (name).
- Potential opportunity for the reclamation of the mine site north of Grand Avenue into a river walk park
- Opportunity for park development at the Lizard Acres Wash inflow point and its integration with the outflow from the SROG linear discharge at Bell road for enhanced habitat and wetland opportunities.



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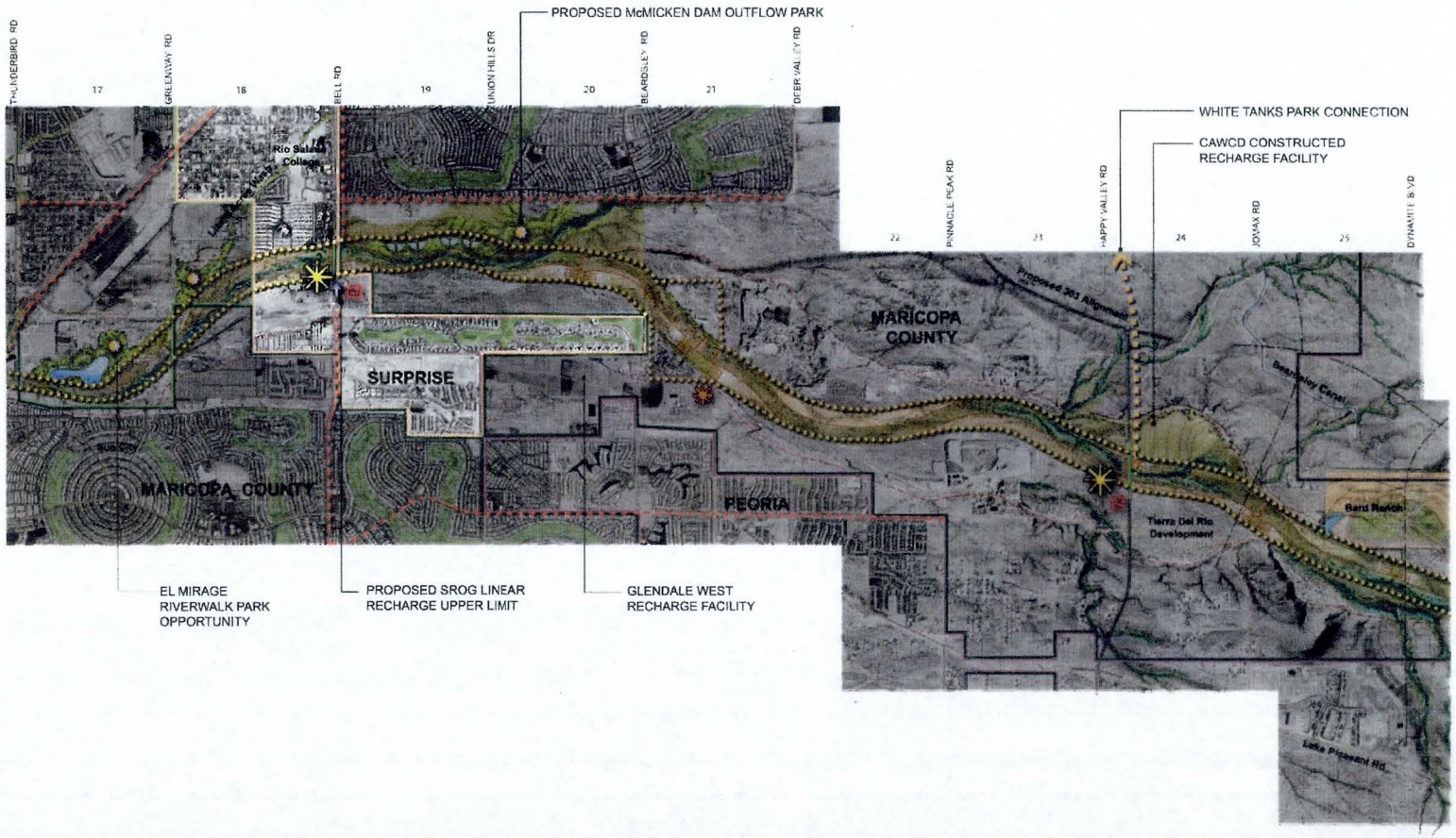
CITY OF YOUNGTOWN

- Possible park opportunity on vacant land north of Peoria Avenue on the east side of the river



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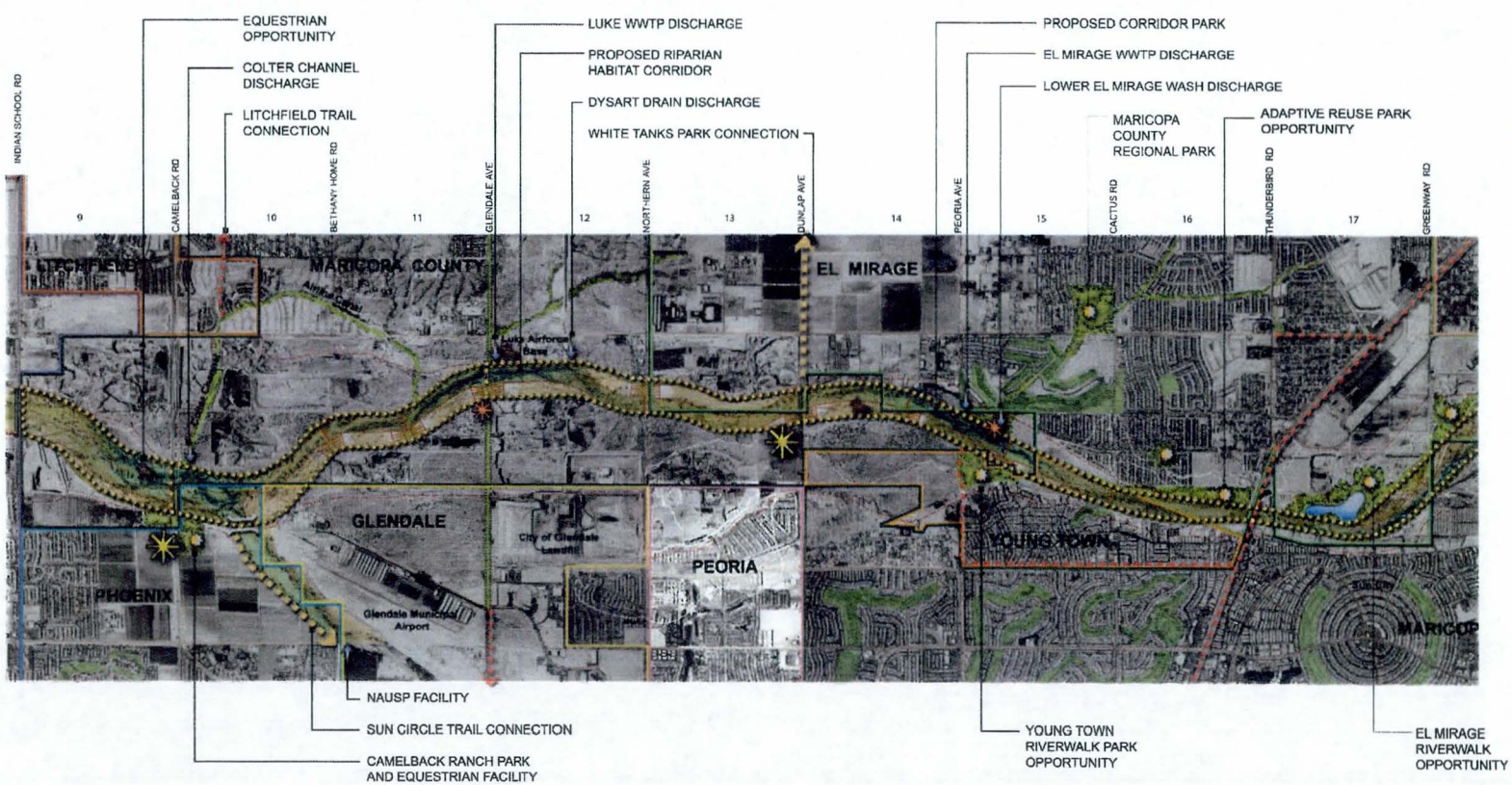
CITY OF SURPRISE

- Major trailhead opportunity at Bell road for linkage to the White Tanks Recreational Area
- River restoration interpretive opportunity along terrace where the SROG linear recharge originates along Bell road



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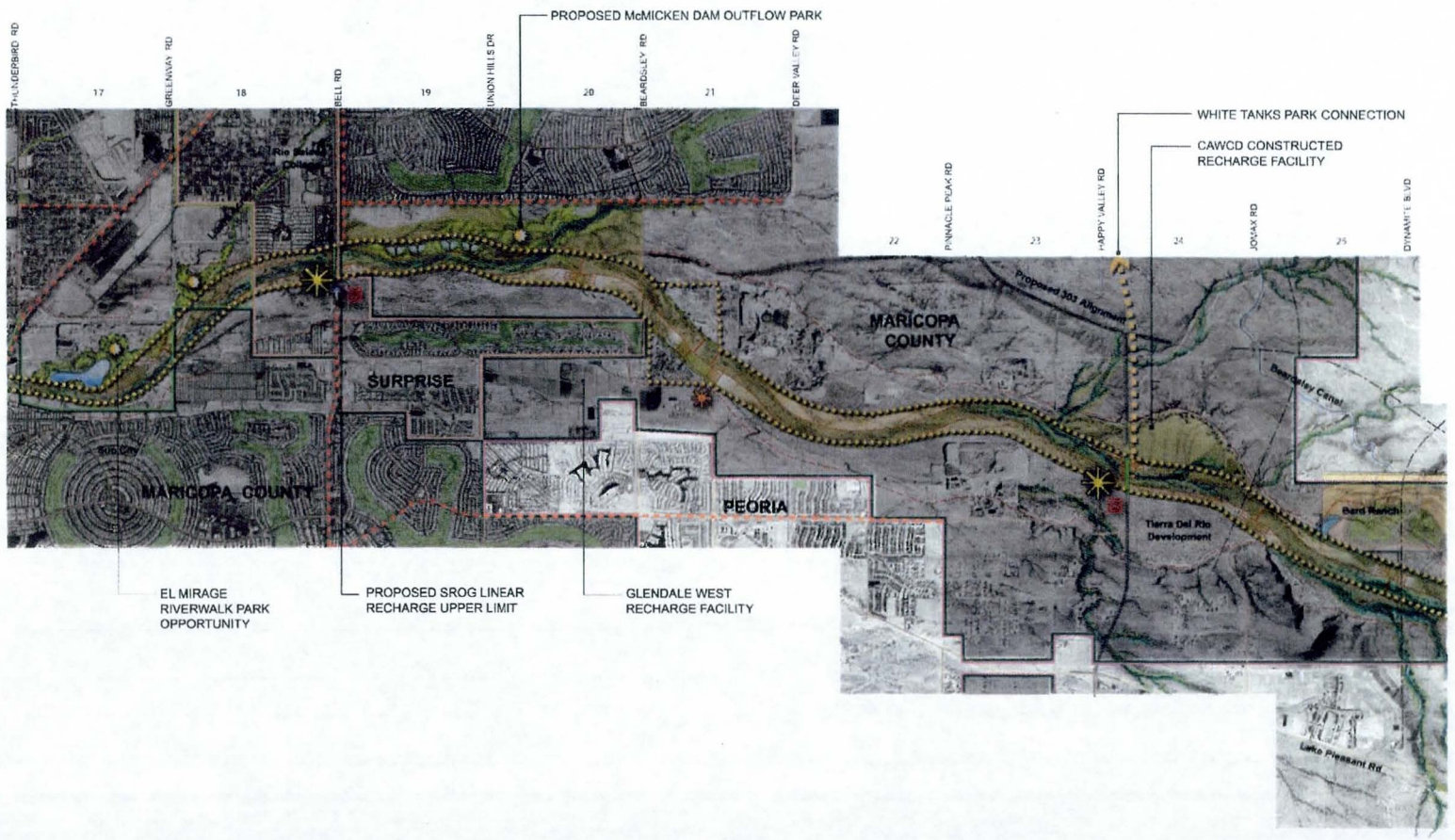

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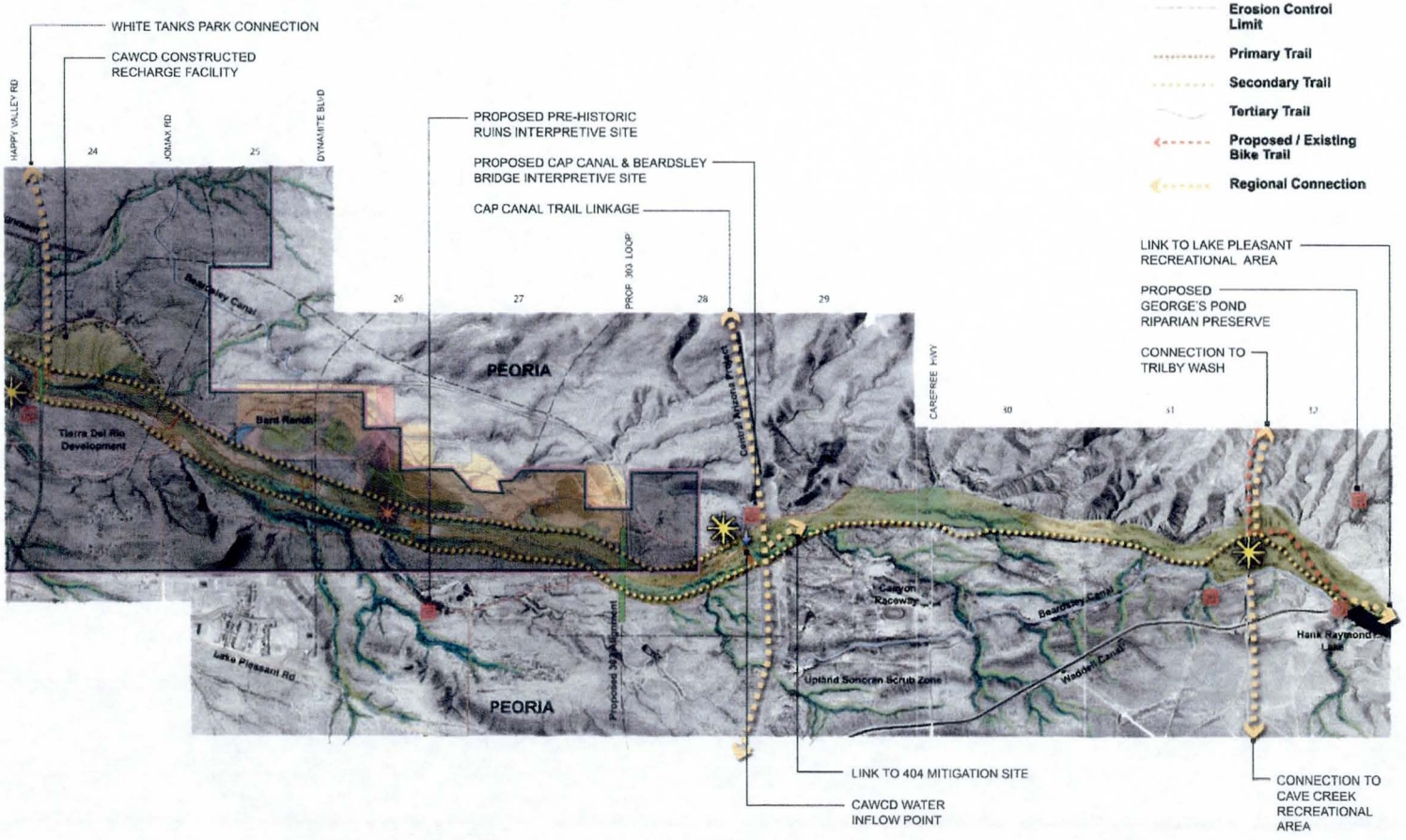
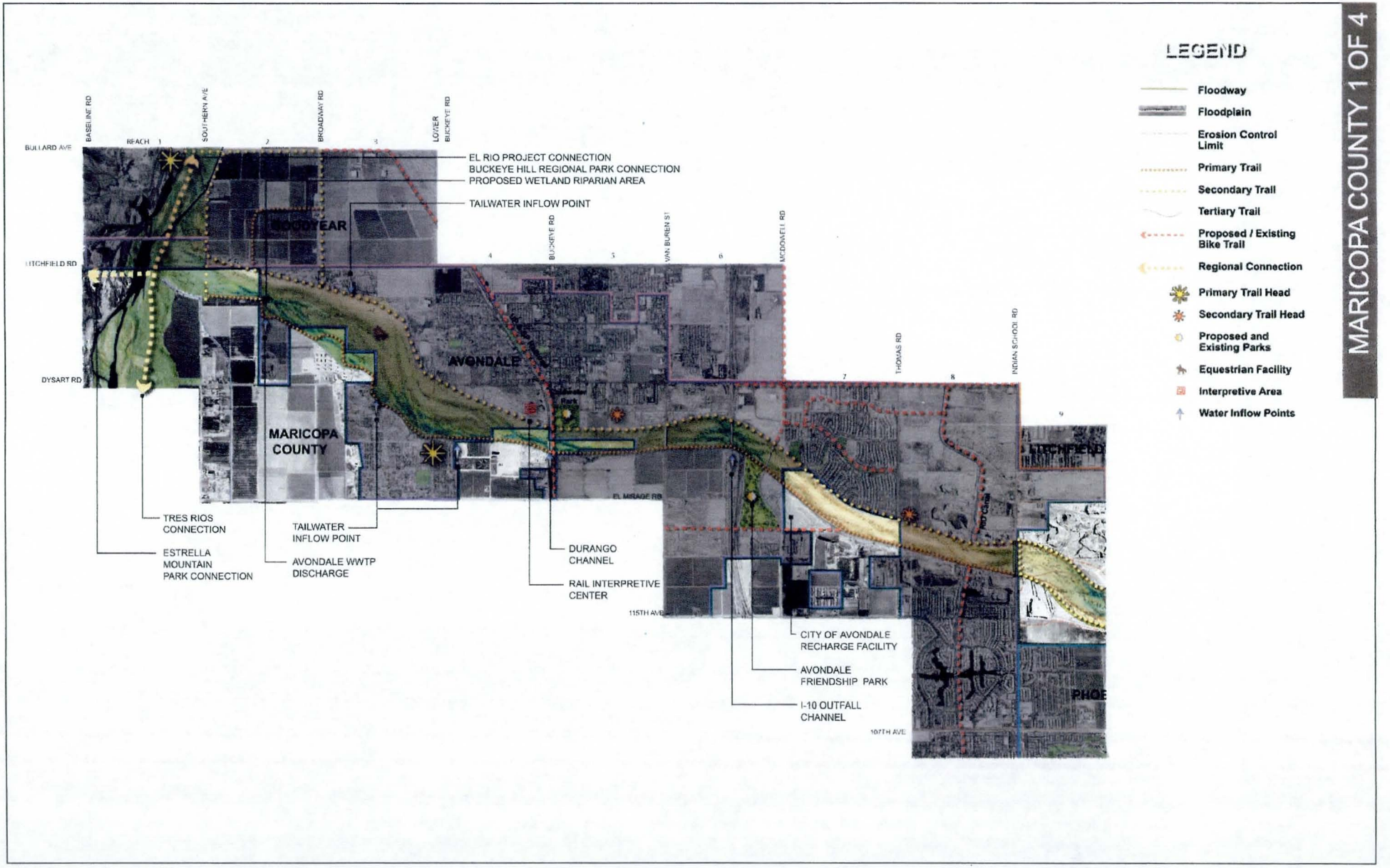
PEORIA 2 OF 3



CITY OF PEORIA

- Major trail head and recreational linkages from the Agua Fria River along the CAP canal to the east and west
- Possible 404 mitigation site and riparian preserve north of the CAP canal within the river corridor.
- Habitat and wetland interpretive opportunity. The naturalized incised channel, with a limited depth to bed rock allows for hydric riparian conditions in the river bed flanked by dramatic upland scrub vegetation along the edges
- Several historic canals including the Beardsley Canal, the Waddell Canal, the Marionette Canal and the CAP Canal provide ample opportunity for an interpretive center that deals with the role of Canals in the growth of the Valley
- Possible Prehistoric ruins interpretive site east of the River
- Lake Pleasant Recreational Area, northern destination for the continuous linear corridor


MARICOPA COUNTY 1 OF 4
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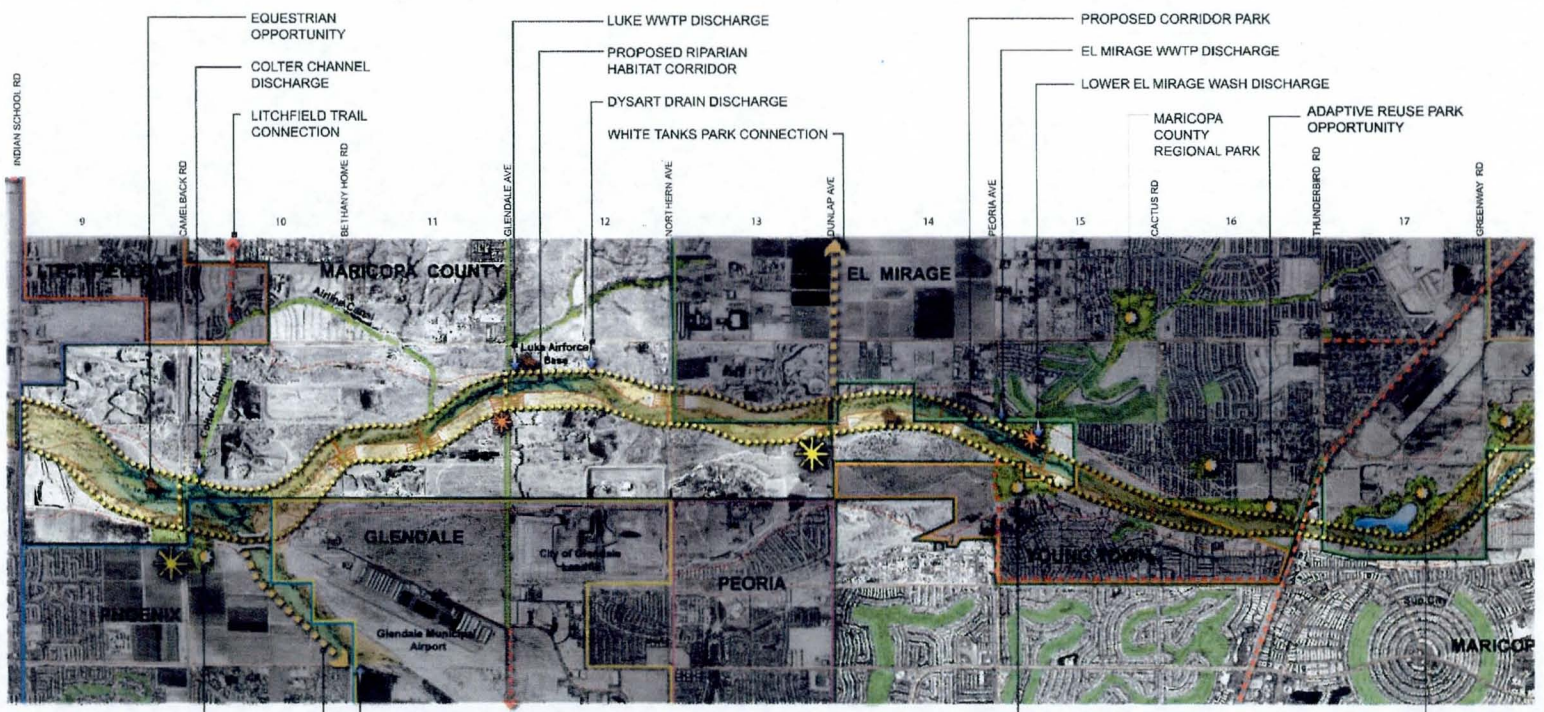

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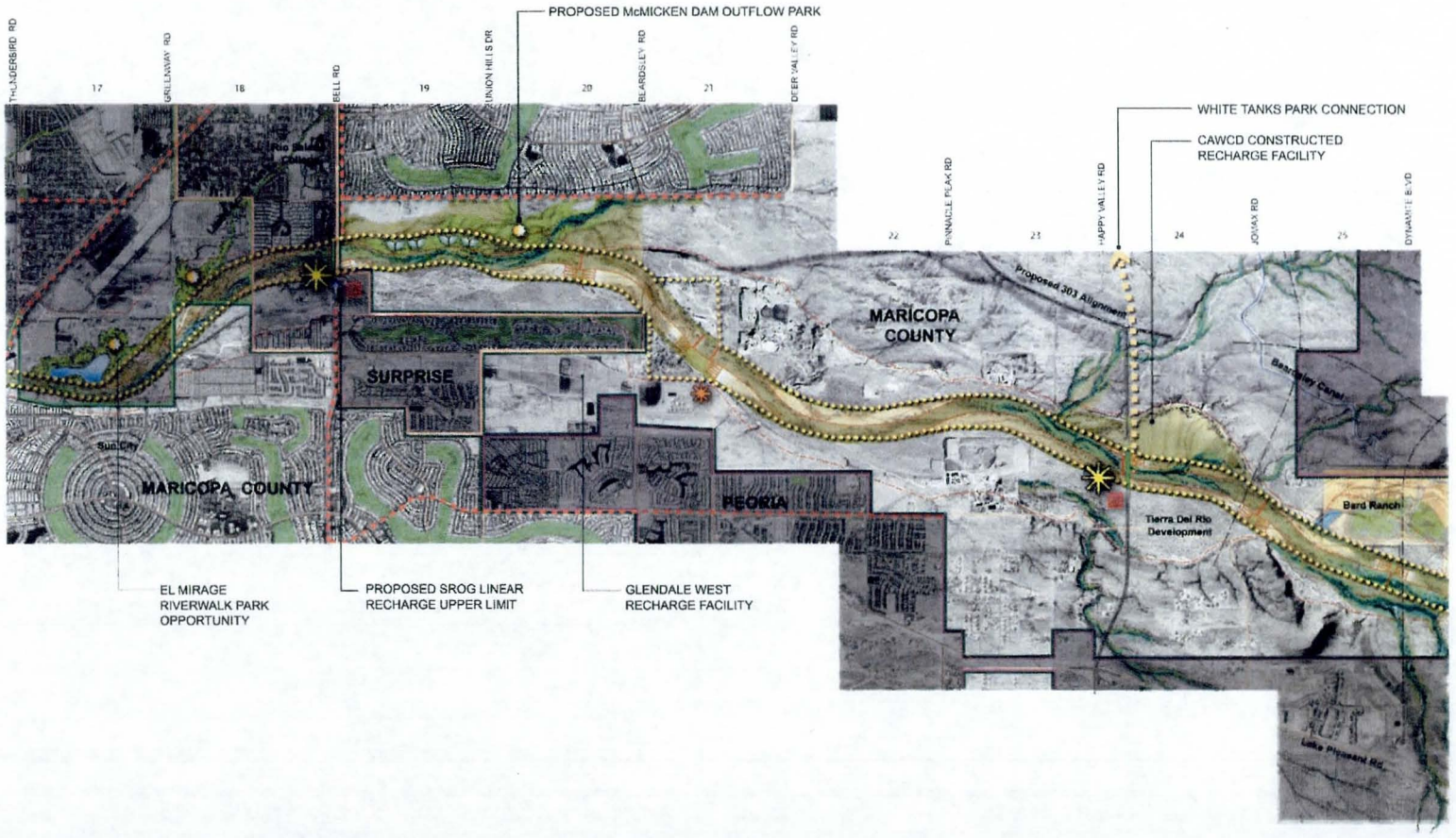
MARICOPA COUNTY

- Possible riparian habitat corridor north of Bethany Home road in response to discharge from the Dysart drain, Luke WWTP and the Airline Canal.



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- Tertiary Trail
- Proposed / Existing Bike Trail
- Regional Connection
- Primary Trail Head
- Secondary Trail Head
- Proposed and Existing Parks
- Equestrian Facility
- Interpretive Area
- Water Inflow Points

MARICOPA COUNTY

- Park opportunity at the McMicken Dam outfall area that can be integrated with the terrace area
- Great recreational opportunity along the CAP recharge canal which, conceptually will lie along a 200 landscaped buffer that extends from the CAP siphon south to the constructed recharge facility north of Happy Valley Road
- Possible trail linkage to the White Tanks Recreational Area around Happy Valley Road