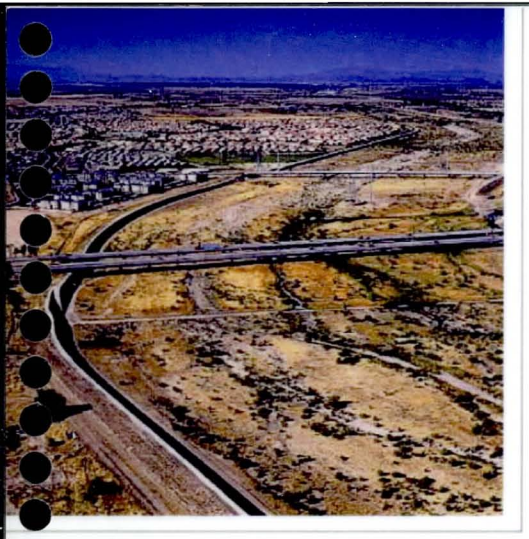

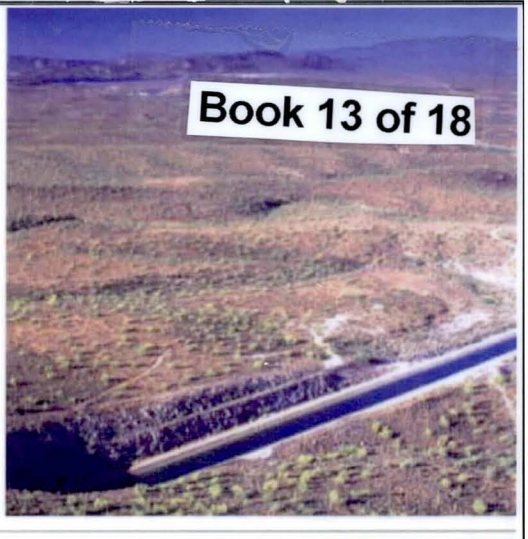

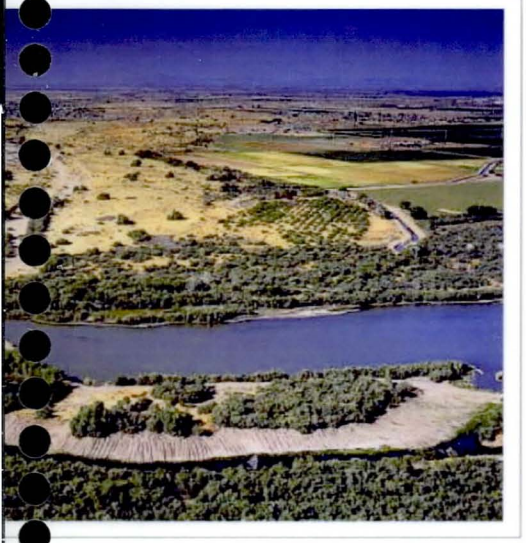

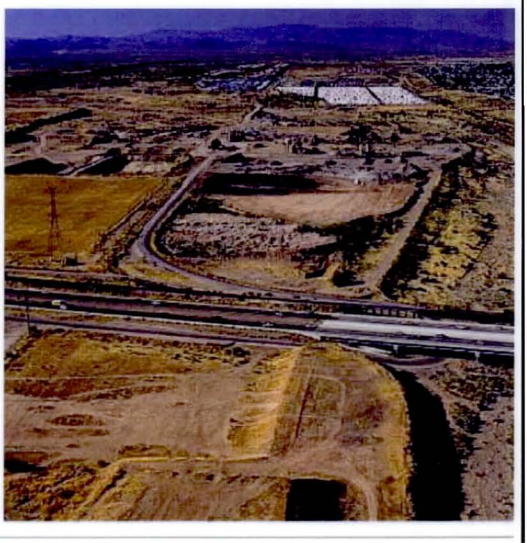

AGUA FRIA
WATERCOURSE MASTER PLAN

Environmental Assessment Documentation for the Proposed Agua Fria Watercourse Master Plan

Prepared for

December 2001

Kimley-Horn and Associates, Inc.

Acknowledgements

This watercourse master plan was prepared by a group of Maricopa County and Consulting professionals dedicated to improving the way we protect people and property from flood damages while meeting the multiple use needs of a growing population. The commitment to this ideal was demonstrated throughout this project by the Maricopa County Board of Supervisors and by leaders of the Flood Control District of Maricopa County. Finally, the plan for the West Valley Recreation Corridor captures the vision of John F. Long — a man who has spent his entire life trying to improve and promote quality of life for families in the West Valley.

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1.0 Chapter 1-Project Purpose and Need

1.1 Scope of Environmental Assessment

The Agua Fria River is located in south central Arizona (**Figure 1.1**). The project study area includes the approximately 32 mile portion of the channel from New Waddell Dam to the confluence with the Gila River (**Figure 1.2**). The Agua Fria Watercourse Master Plan Environmental Assessment (EA) was prepared to document the evaluation process for the Agua Fria Watercourse Master Plan (Master Plan) prepared by the Flood Control District of Maricopa County. The evaluation was conducted to identify potential flood control issues and to develop an overall plan to provide management strategies for flood protection and guide development in the Agua Fria River Corridor.

This document is divided into four chapters that provide a summary of the results of the evaluation process and provide an assessment of the potential human and natural environmental effects of implementing and not implementing the proposed Master Plan. Chapter 1.0 provides a brief introduction and discusses the purpose and need for the proposed project. Chapter 2.0 offers a brief history of the proposed project, explains the alternative development process, and describes the advanced and not advanced alternatives. Chapter 3.0 is a description of the existing environment of the Agua Fria River Corridor, and Chapter 4.0 evaluates the potential affects of the implementation of each of the advanced alternatives.

The document is based on and includes, by reference, a series of technical memorandums and technical reports that were prepared in support of the evaluation. Those reports include:

- Hydrology Report for the Agua Fria Watercourse Master Plan, *Kimley-Horn and Associates, Inc., 2001*
- Hydraulic Analysis for the Agua Fria Watercourse Master Plan, *LTM Engineering Inc., 2001*
- Sedimentation/Scour Report, *Kimley-Horn and Associates, Inc., 2001*
- Sand and Gravel Mining Summary, *Kimley-Horn and Associates, Inc., 2001*
- Agua Fria River Lateral Migration Report, *JE Fuller/ Hydrology & Geomorphology, Inc., 2001*
- Visual Resources Inventory & Scenic Quality Assessment, *EDAW, 2001*
- Recreation Corridor Master Plan, *Cornoyer-Hedrick, 2001*
- Evaluation of Public Safety Issues for the Agua Fria Watercourse Master Plan, *LTM Engineering Inc., 2001*
- Aqua Fria Watercourse Implementation/Maintenance Strategy, *Kimley-Horn and Associates, Inc., 2001*
- Groundwater Recharge- Alternative Analysis Report, *Fluid Solutions, 2001*
- Ecological Evaluation of the Lower Agua Fria Corridor- New Waddell Dam to Confluence with Gila River, *Kimley-Horn and Associates, Inc., 2002*
- Jurisdictional Determination for Agua Fria Watercourse- New Waddell Dam to Confluence with the Gila River, *Kimley-Horn and Associates, Inc., 2000*

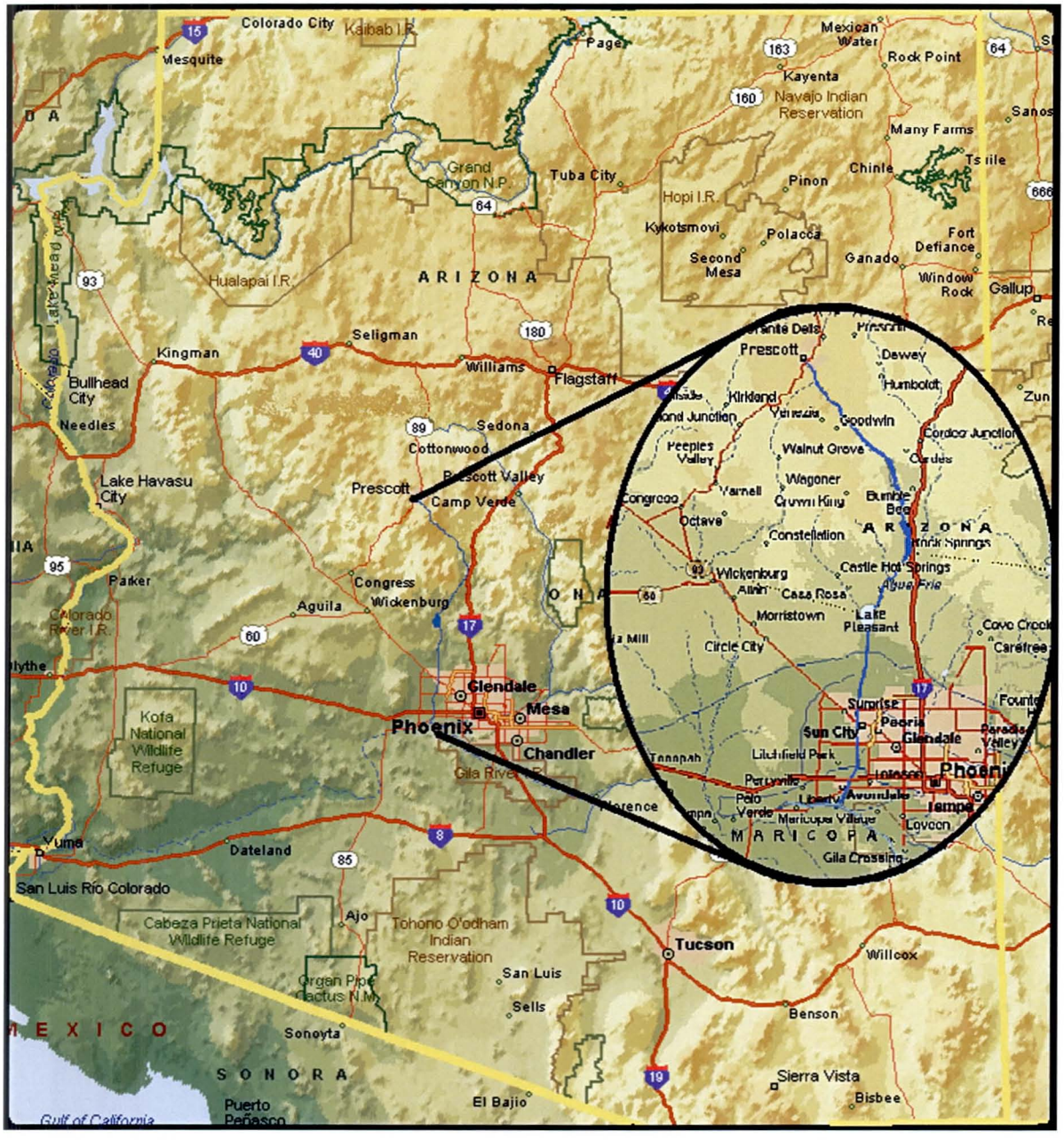


FIGURE 1.1
Agua Fria River Location

FIGURE 1.2
Agua Fria River Watershed

- Habitat Enhancement Opportunities/Techniques on the Agua Fria River- New Waddell Dam to Confluence with Gila River, *Kimley-Horn and Associates, Inc., 2002*
- El Mirage Landfill Site, Summary of Status Review, *Kimley-Horn and Associates, Inc., 2001*
- The Agua Fria: A Working River for the West Valley Themes and Historic Sites, Dallett, *September 11, 2000*
- A Selected Sample of Prehistoric and Historic Sites of the Western Salt River Valley, Arizona. *Scientific Archeological Services, 2000*
- Historic Resources of the Agua Fria River, Watercourse Master Plan Area, A Selected Sample of Prehistoric and Historic Sites of the Western Salt River Valley, Arizona, *Scientific Archeological Services, 2000*
- West Valley Common Ground: The Agua Fria as a Corridor of Natural, Historic, Cultural, and Recreational Resources, *Dallett, 2001*
- Historic Cultural Resources Along the Agua Fria River Between the Gila River and Waddell Dam, *Archaeological Consulting Services, Ltd., 2000.*

The reports are summarized and referenced in the appropriate sections of this document. The reports are available for review (with the exception of non-public information) at the Flood Control District of Maricopa County (Flood Control District or FCD) located at 2801 W. Durango Street, Phoenix, Arizona. Mr. Douglas Williams is the Flood Control District project manager.

1.2 Proposed Action

The Agua Fria Watercourse Master Plan encompasses the 32 mile reach from the New Waddell Dam to the Gila River. Between the New Waddell Dam and the Gila River, the Agua Fria River channel traverses unincorporated Maricopa County and the Cities and Towns of Peoria, Glendale, Surprise, El Mirage, Youngtown, Phoenix, and Avondale. Land uses along the river are varied and include undeveloped desert canyons, residential and commercial properties, sand and gravel mines, and farms.

The Master Plan includes a series of technical and planning documents that identify the existing conditions within the Agua Fria watershed downstream from New Waddell Dam. The evaluation included a review of recreation, aesthetics, riparian restoration, transportation, and groundwater recharge opportunities in conjunction with the flood control functions of the river. The Master Plan planning process focuses on resolving existing flood control problems while developing strategies that reduce the likelihood of creating future problems. The Master Plan evaluates and recommends one "action" alternative for the proposed project. This action alternative combines a series of different structural and non-structural management strategies to alleviate potential flood problems in the river corridor. The alternatives are discussed further in Chapter 2. The goal of the Master Plan is to improve flood protection by establishing management strategies for this reach of the Agua Fria River. Additional objectives of the plan include conserving habitat and incorporating multiple use opportunities into the plan where they do not adversely affect floodwater conveyance within the River.

1.3 Need for Action

While the Agua Fria Watercourse Master Plan portion of the channel (from New Waddell Dam to the confluence with the Gila River) is primarily an ephemeral channel, it has the potential for large volume flows. Much of the surface runoff from the West Valley is directed through the Agua Fria River channel. Morgan City Wash, Caterpillar Tank Wash, Twin Buttes Wash, New River and its tributaries, the Dysart Drain, Colter Channel, El Mirage Wash, McMicken Dam outlet and others discharge to the Agua Fria River channel below New Waddell Dam. The primary tributary, New River, joins the Agua Fria River between Camelback and Glendale Roads. Additional discharge from local storm water drains, wastewater treatment plants (WWTP), and agricultural sites contribute to runoff volumes.

Precipitation in this portion of southern Arizona is variable, but on average is between 8 and 10 inches per year. Single localized storms can result in one or more inches of precipitation over a relatively short period of time. This can result in significant volumes of surface runoff in otherwise dry channels such as the Agua Fria River. Hydrologic modeling suggests that during a 100-year regulatory storm event, the river can be expected to convey a flood wave over 1,000 feet across and approximately 8 feet deep. While these events are normally infrequent and of short duration, they cause significant property damage and erosion. Past flooding along this reach of the Agua Fria River is well documented. Flood events in the 1980's caused significant damage to infrastructure along the Agua Fria River and caused delays and interruptions in west valley travel corridors.

Development in the watershed further exacerbates the problem by interrupting natural drainage patterns, reducing infiltration and altering natural floodwater storage. Development of an upstream portion of the watershed or changes in the Agua Fria River channel can have significant effects on areas upstream and downstream. The Arizona State Legislature recognized the need for basin or watercourse wide planning and enacted *The Watercourse Master Planning Statutes of the State of Arizona*. This legislation provides the flood control districts and area communities with a statutory authority to develop a master plan that allows for the long-term management of the hydraulic and sediment system of a watercourse. Additionally, the statute authorizes the districts to consider groundwater recharge opportunities and allow for the adoption of a specific structural and/or non-structural management strategy that defines the look and feel of the watercourse for the future.

Planning at a watercourse level allows the communities to establish long-range goals and objectives for flood protection that also encompass other multiple use scenarios and minimize overall costs. This process requires that the constraints and objectives of the corridor are identified and management measures are adopted prior to the majority of the development.

1.4 Purpose of Action

The purpose of the proposed Agua Fria Watercourse Master Plan is to provide a flood protection strategy for the residents of the Agua Fria River Corridor. The flood protection should be provided in an economically practical manner, while not unnecessarily limiting development of other multiple use objectives. Thus, providing primarily for public safety from flooding, and secondly providing for the social and environmental concerns of the communities through a cost efficient plan.

To the extent practical, without adversely affecting the purpose of flood control, the Agua Fria River Watercourse Master Plan incorporates the following objectives into the flood control strategy:

- Resolve the existing flood and erosion problems
- Evaluate hydrologic/hydraulic conditions
- Evaluate channel stability
- Incorporate recreational opportunities
- Enhance/protect natural and cultural resources
- Create community and civic cohesiveness and pride

A separate technical report, *Alternative Analysis Report – Agua Fria Watercourse Master Plan* details the development of potential alternatives, the alternative evaluation process and the resulting advanced alternative - Recommended Agua Fria Watercourse Master Plan Alternative. Chapter 2 of this EA summarizes the alternative evaluation process.

2.0 Chapter 2-Alternative Analysis

2.1 *Introduction*

The purpose of the Agua Fria Watercourse Master Plan, as outlined in Chapter 1, is to establish a long-term plan for the management of flood control for development activities along the channel corridor. While the purpose of the Master Plan is to establish management strategies for flood control and public safety, the plan also addresses the protection/enhancement of natural and cultural resources, incorporation of recreational opportunities and other multiple use objectives. These additional goals were incorporated into the Master Plan only after it was determined that they would not adversely affect the primary purpose (flood control and public safety) of the proposed project.

This chapter is a summary of the evaluation process for the development of alternatives for the proposed Master Plan. A more complete analysis of the development of the proposed alternative is included in the *Alternative Analysis Report – Agua Fria Watercourse Master Plan.* Additionally, this summary is based on the results of numerous studies and resulting technical reports that are listed in Chapter 1 and referenced throughout this document.

2.2 *Alternative Formulation and Evaluation Process*

The considered alternatives range from traditional structural flood control alternatives to non-structural flood control through management and policy strategies. The alternatives are based upon the results of evaluation of river system hydrology, hydraulics, lateral migration potentials, and sediment trends of the 32 mile corridor of the Agua Fria River.

The alternatives considered include:

- Structural Alternative
- Non-Structural Alternative
- Combination Alternative (Alternative B - The Agua Fria Watercourse Master Plan)
- No Additional Action Alternative (Alternative A –No Additional Action)

The process for developing the initial alternatives, a description of the alternatives, and the evaluation process used to develop a recommended alternative is described in the remaining sections of this chapter.

2.2.1 History and Development Guidelines

The Watercourse Master Planning Statutes of the State of Arizona provides the Flood Control District and area communities with a statutory authority to develop master plans that allow for the long-term management of the hydraulic and sediment system of a watercourse. The statue also provides for the incorporation of multiple use opportunities that help define the "look and feel" of the watercourse.

In the last few years community leaders and the public have become increasingly aware of the unique opportunities to further enhance their environment by incorporating multiple use opportunities into flood control projects. Linear projects, such as the Agua Fria Watercourse Master Plan can provide many recreational and environmental opportunities without detracting from the goal of flood control. Therefore, while the proposed project is intended to provide flood

protection, the Flood Control District of Maricopa County also evaluated multiple use opportunities.

The proposed Agua Fria Watercourse Master Plan identifies existing and potential flooding and erosion problems along the Agua Fria River and proposed management strategies for reducing the threat to public safety. In addition, the proposed plan identifies opportunities for multiple uses of the river corridor, such as recreation and habitat for wildlife. Through identification of these issues along the corridor within the Watercourse Master Plan, the Flood Control District of Maricopa county (Flood Control District or FCD) was able to formulate a series of alternatives to address such problems.

2.2.2 Goals and Objectives

For purposes of the alternative evaluation and this EA, the **goals** of the Agua Fria Watercourse Master Plan were considered to be the same as the stated purpose – **provide flood protection**. Additional *objectives* of the Plan were to *consider multiple use opportunities* that might be included in the final Plan.

Each alternative advanced must meet the goal of the Plan by providing a management strategy for flood protection. The alternative should, to the extent practical and without compromising the goal of flood protection, provide for multiple use opportunities. The following criteria were necessary for a specific alternative to provide the goal of a management strategy for flood protection.

The proposed alternatives must meet the following requirements to meet the **goal**:

- Promote uses that are compatible with the Agua Fria River floodplain
- Provide management strategies primarily related to flood control, flood-proofing and emergency response activities within the Agua Fria corridor
- Establish a technically, economically, and regulatory feasible plan for the Agua Fria corridor

To the extent practical and without compromising the floodplain management purpose of the proposed project the alternatives should also meet the following objectives:

- Resolve existing flood and erosion problems
- Incorporate recreational opportunities
- Enhance/protect natural, aesthetic and cultural resources
- Create community and civic cohesiveness and pride

2.2.3 Environmental Protection Requirements

The proposed project must meet all regulatory requirements and mandated recommendations of, but not limited to, the following regulations and agencies:

- Clean Water Act
- Endangered Species Act
- Migratory Bird Treaty Act and other avian protection regulation
- Arizona Department of Game and Fish
- Arizona State Parks State Historic Preservation Office and related regulations

- Arizona Department of Agriculture Native Plant Law
- Applicable federal land management agency guidelines, and
- Arizona Department of Water Resources.

2.3 Alternative Considered But Not Advanced

This section describes the structural and non-structural alternatives formulated under the initial evaluation process, but not advanced for analysis in the EA document. Section 2.4 describes the alternatives advanced for evaluation in this EA. Since the alternatives discussed in this section were not advanced, they are not discussed further in Chapter 4 of this document.

2.3.1 Structural Alternative

The purpose of the structural alternative is to protect existing and future residents from a specified flood event and the possible damages associated with potential lateral migration of the river channel. Implementation of flood control by structural methods is used primarily to resolve flooding or erosion problems in site-specific areas. In many instances, structural controls are the only reasonable option for flood control.

The first major structural element considered for the Agua Fria River Corridor would extend along the study area from New Waddell Dam to the floodplain of the Gila River. This element would consist of new levees tying into the existing levees along both banks. The levees are assumed to be constructed along the current regulatory floodway boundary line. The primary reason for considering a full-length structural solution is to establish an upper boundary limit for potential project costs and impact. Structural implementation for subreaches with proposed full-length levees on both sides are as follows:

- Cloud Road to New Waddell Dam
- CAP Canal to Cloud Road
- Dixileta Road Alignment to the CAP Canal
- Jomax Road to Dixileta Road Alignment
- Pinnacle Peak Road to Jomax Road
- Grand Avenue to Bell Road
- Cactus Road to Grand Avenue
- Olive Avenue to Cactus Road
- Glendale Avenue to Olive Avenue
- Confluence of New River to Glendale Avenue
- Broadway Road to MC85
- Confluence of Gila River to Broadway Road

The following subreaches have an existing levee on one side of the bank and one proposed for the other side:

- Bell Road to Beardsley Road
- Indian School Road to the confluence of the New River

The following subreaches have existing levees on both sides of the bank or cannot accommodate any levees due to the presence of mines:

- Beardsley Road to Pinnacle Peak Road
- I-10 to Indian School Road
- MC85 to I-10

The projected cost of the first major structural element is approximately $134 million. The *Alternative Analysis Report – Agua Fria River Watercourse Master Plan* provides a more detailed explanation of the development of the projected cost of the Structural Alternative

The second structural element consists of channelization of the river between Jomax Road and Grand Avenue. The channel would be constructed to convey the 100-year regulatory discharge with one foot of freeboard. The purpose of the channel is to make land available for development within the existing floodplain. There are also a number of specific flood and erosion concerns at various locations within the floodplain. Isolated flood/erosion control structures would be implemented to mitigate these specific concerns and are as follows:

- Cactus Road to Grand Avenue – Bank protection is needed to protect the existing landfill
- Grand Avenue to Bell Road – Existing culverts need to be blocked rerouting flows to the river.

The projected probable cost of the Structural Alternative is approximately $136 to $196 million. The *Alternative Analysis Report – Agua Fria Watercourse Master Plan* provides a more detailed explanation of the development of the projected cost of the Structural Alternative.

The Structural Alternative was considered, but not advanced for further consideration in the EA document because extensive use of structural solutions within the floodplain can lead to adverse impacts on other properties. Further, the projected cost of a Structural Alternative may be prohibitive.

2.3.2 Non-Structural Alternative

Non-structural flood control strategies define the watercourse or land area necessary to allow for natural river dynamics. The strategy is to reduce the number of vulnerable structures within the areas affected by flooding. Implementation of this strategy is done with zoning ordinances, land use planning, property acquisition, vegetation management and drainage management. Under current policy, property owners are allowed to encroach the floodway fringe or construct bank protection. These types of activities have the potential to increase the water surface elevation up to one foot, increase peak flows, force floodwaters from one side of the floodplain to the other, increase erosion on the opposite banks or increase erosion in the main channel.

The non-structural alternative would not allow development within the 100-year floodplain unless the impacts to downstream flood flow or of pushing floodwaters onto other properties can be mitigated. As part of this concept, it is proposed to adopt a lateral migration setback based on the recommended lateral migration erosion hazard zone (LMEHZ). This LMEHZ would be considered a "no encroachment zone" with regards to development.

Specific requirements of the Non-Structural Alternative are noted below for various reaches of the river:

- Cloud Road to New Waddell Dam - Continued enforcement of the floodplain regulation and adoption of a LMEHZ regulation.

- CAP Canal to Cloud Road - Continued enforcement of the floodplain regulation and adoption of a LMEHZ regulation.
- Dixileta Road Alignment to the CAP Canal – Continued enforcement of the floodplain regulation and adoption of a LMEHZ regulation.
- Jomax Road to Dixileta Road Alignment – Land development has been proposed within the area adjacent to Calderwood Butte that would be within the LMEHZ
- Pinnacle Peak Road to Jomax Road - Continued enforcement of the floodplain regulation and adoption of a LMEHZ regulation.
- Beardsley Road to Pinnacle Peak Road - Continued enforcement of the floodplain regulation and adoption of a LMEHZ regulation.
- Bell Road to Beardsley Road - Continued enforcement of the floodplain regulation and adoption of a LMEHZ regulation.
- Grand Avenue to Bell Road - Continued enforcement of the floodplain regulation and adoption of a LMEHZ regulation. In the area south of Bell Road, a monitoring and acquisition program may be feasible.
- Cactus Road to Grand Avenue - Continued enforcement of the floodplain regulation and adoption of a LMEHZ regulation. However, the non-structural solution would not meet project objectives in this area.
- Olive Avenue to Cactus Road - Continued enforcement of the floodplain regulation and adoption of a LMEHZ regulation.
- Glendale Avenue to Olive Avenue - Continued enforcement of the floodplain regulation and adoption of a LMEHZ regulation.
- Confluence of New River to Glendale Avenue - Continued enforcement of the floodplain regulation and adoption of a LMEHZ regulation.
- Indian School Road to the confluence of the New River – Continued enforcement of the floodplain regulation and adoption of a LMEHZ regulation.
- I-10 to Indian School Road – Additional non-structural solutions are not necessary.
- MC85 to I-10 – No non-structural solutions were viewed as necessary.
- Broadway Road to MC85 – Implementation of a monitoring and acquisition program.
- Confluence of the Gila River to Broadway Road – continued enforcement of the floodplain regulation, adoption of the LMEHZ, and the adoption of a local standard that would require elevating finished floors at least 2 feet higher than the regulatory (floodway) water surface elevation.

The projected probable cost of implementing the Non-Structural Alternative is projected to be $34 million. The *Alternative Analysis Report – Agua Fria Watercourse Master Plan* provides a more detailed explanation of the development of the projected cost of the Non-Structural Alternative.

Implementation of only non-structural methods for flood control is unrealistic in certain reaches of the Agua Fria River Corridor due to extreme channel instability within these areas. In these cases, implementing a structural control would best protect existing structures and infrastructure from floodwaters. Therefore, the Non-Structural Alternative was not advanced.

2.4 Alternatives Advanced

2.4.1 Alternative A – No Additional Action Alternative

The No-Additional Action Alternative addresses the condition of the watershed without implementation of a project. This alternative would include continued implementation of the ongoing or planned activities in the corridor (mining, road crossings, limited bank armoring, etc.), which would continue to have substantial impacts both environmentally and structurally.

Numerous analyses such as HEC-6 modeling, equilibrium slope calculations, and examination of the system's geology and geomorphology were utilized to estimate the stability of the river system without implementation of the "action" alternative. The results are as follows:

- The Agua Fria River north of Jomax Road trends toward degradation during hydrologic events.
- The reach from Jomax Road to Bell Road indicates a general aggradation condition. Sediment deposition in this area is 1.4 feet.
- The reach from Bell Road to Grand Avenue appears to be aggrading due to sediment deposition in the gravel mines during the 100-year event.
- The channel is degrading at the confluence with the New River and aggrading at the beginning of the Corps' levees at river mile 8.198.
- Existing headcuts downstream of the Olive Avenue Bridge pose a potential threat to the bridge

Sand and gravel mining have contributed significantly to the instability of the Agua Fria River Corridor. Historical records indicate that prior to the 1950's the Agua Fria River was relatively stable. However, active sand and gravel mining has been taking place since then causing a significant volume of sediment to be extracted from the river. Headcutting has been noted in several locations along the river.

The No Additional Action Alternative is also considered the baseline of existing conditions of the Agua Fria River study corridor (Chapter 3).

2.4.2 Alternative B - Agua Fria Watercourse Master Plan Alternative

This alternative combines the structural and non-structural strategies to best fit the needs of the project corridor. The Agua Fria River has been divided into one to two-mile subreaches. The subreach characteristics dictate the flood control strategy best suited to each portion of the project. However, the non-structural control strategy appears to be well suited for most of the subreaches. Specific areas of existing flooding or erosion hazards have been identified in the development of the Alternative Analysis Report. In the case of the Agua Fria River Corridor, areas where structural controls already exist may be the most appropriate places to implement or continue to maintain existing structures for flood control. In other areas, limiting encroachment of the river by non-structural methods is a more desirable mechanism for protecting the public.

This alternative would not allow development within the 100-year floodplain unless the impacts to downstream flood flow or impacts from pushing floodwaters onto other properties can be mitigated. As part of this concept, it is proposed to adopt a lateral migration setback based on the recommended LMEHZ. This LMEHZ would be considered a "no encroachment zone" with regards to development.

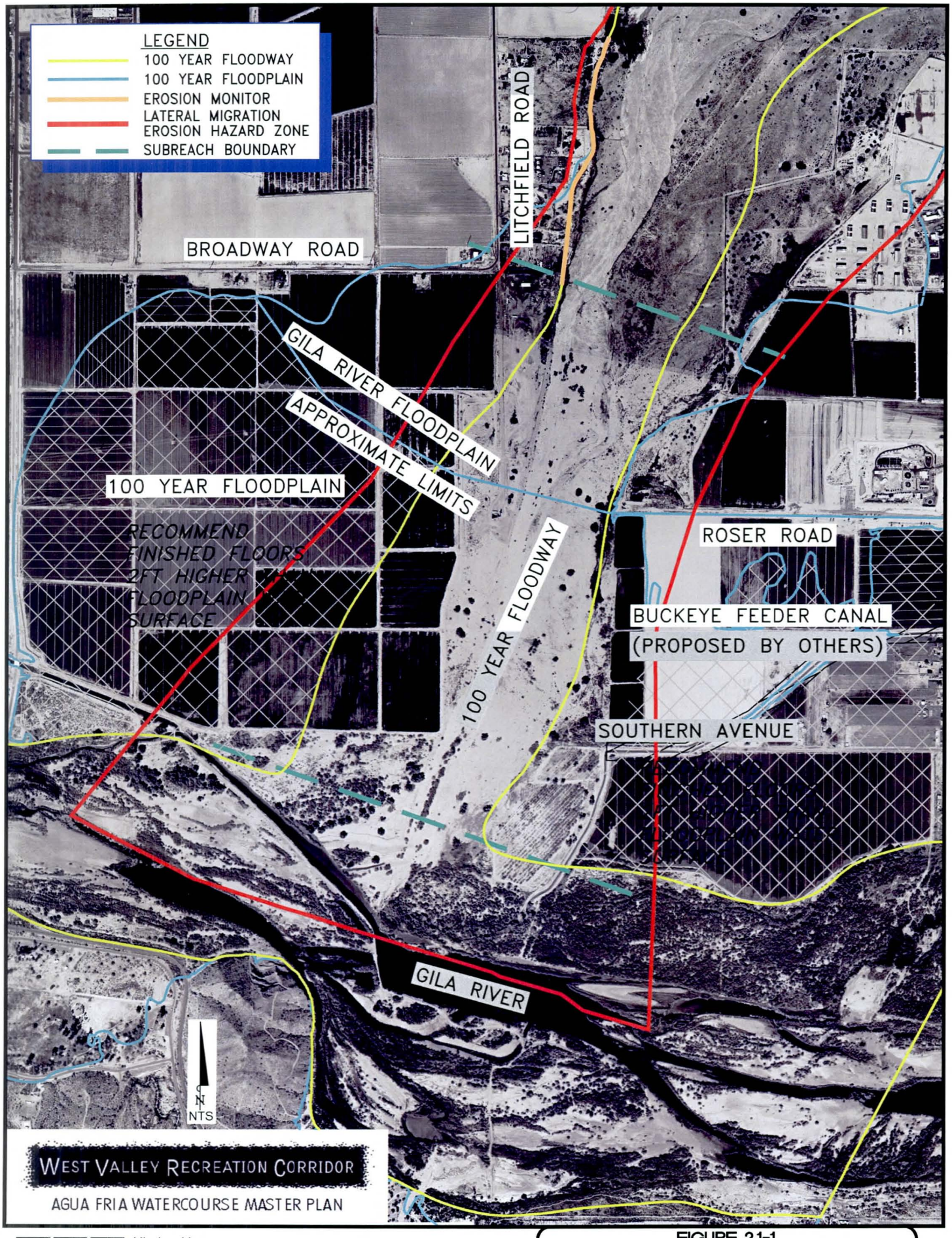
The following subreaches are recommended to have non-structural controls:

- Cloud Road to New Waddell Dam - There are no existing buildings within the regulatory boundaries.
- CAP Canal to Cloud Road – There are no existing buildings within the regulatory boundaries.
- Dixileta Road Alignment to the CAP Canal - The subreach is well suited to non-structural flood control.
- Jomax Road to Dixileta Road Alignment – There are no existing buildings within the subreach that require structural protection.
- Pinnacle Peak Road to Jomax Road - Mine and recharge ponds are located within the LMEHZ, but are acceptable land uses within the LMEHZ.
- Beardsley Road to Pinnacle Peak Road - Non-structural regulation of the floodplain is a practical method of protecting the public in this subreach.
- Bell Road to Beardsley Road - No flood control structures appear to be warranted.
- Grand Avenue to Bell Road – No existing buildings are within the floodplain. Ongoing monitoring of the channel condition near the El Mirage Landfill (Grand Avenue) is recommended. Additional structural controls are also recommended (See Below).
- Olive Avenue to Cactus Road – Monitoring erosion near existing buildings is recommended, but no structural controls are recommended at this time.
- Glendale Avenue to Olive Avenue – The east bank is protected by existing levees. No additional flood control structures appear to be warranted.
- Confluence of the New River to Glendale Avenue – Sand and gravel mines are in operation on both sides of the river. No flood control structures appear to be warranted.
- Indian School Road to Confluence of New River – The east bank is protected by existing levees. The west bank is occupied by several sand and gravel mining operations.
- I-10 to Indian School Road - The entire subreach is protected by existing levees, therefore no additional protection is recommended.
- MC 85 to I-10 – The entire subreach is protected by existing levees, so no additional protection is recommended.
- Broadway Road to MC 85- Most of the west bank and a subdivision on the east bank are protected by existing levees.

The following subreaches are recommended to have structural controls:

- Cactus Road to Grand Avenue – A structural alternative will be required if the existing riprap is inadequate.
- Grand Avenue to Bell Road – No existing buildings are within the floodplain, however some form of bank protection is proposed to protect the El Mirage Landfill on the west bank and to stabilize the east bank. Ongoing monitoring of the channel condition is recommended.
- Confluence of Gila River to Broadway Road – Elevate proposed buildings 2 feet above the estimated water surface to offer protection in this area.

Figures 2.1-1 through **2.1-17** illustrate the proposed management techniques for the Agua Fria Watercourse Master Plan.



WEST VALLEY RECREATION CORRIDOR

AGUA FRIA WATERCOURSE MASTER PLAN

Kimley-Horn and Associates, Inc.

FIGURE 2.1-1
AGUA FRIA WATERCOURSE MASTER PLAN
CONFLUENCE OF GILA TO BROADWAY ROAD

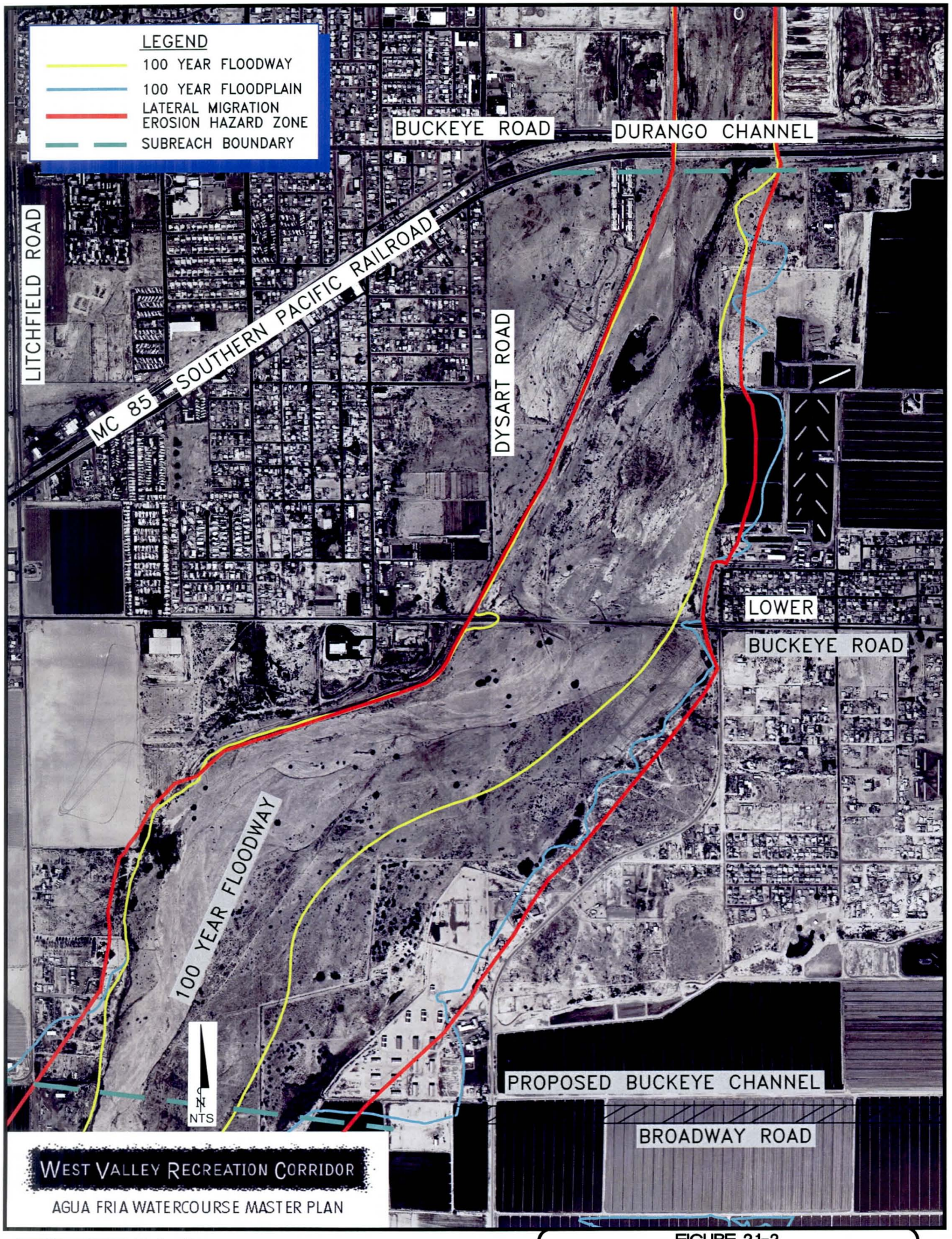


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FIGURE 2.1-2
AGUA FRIA WATERCOURSE MASTER PLAN
BROADWAY ROAD TO MC 85

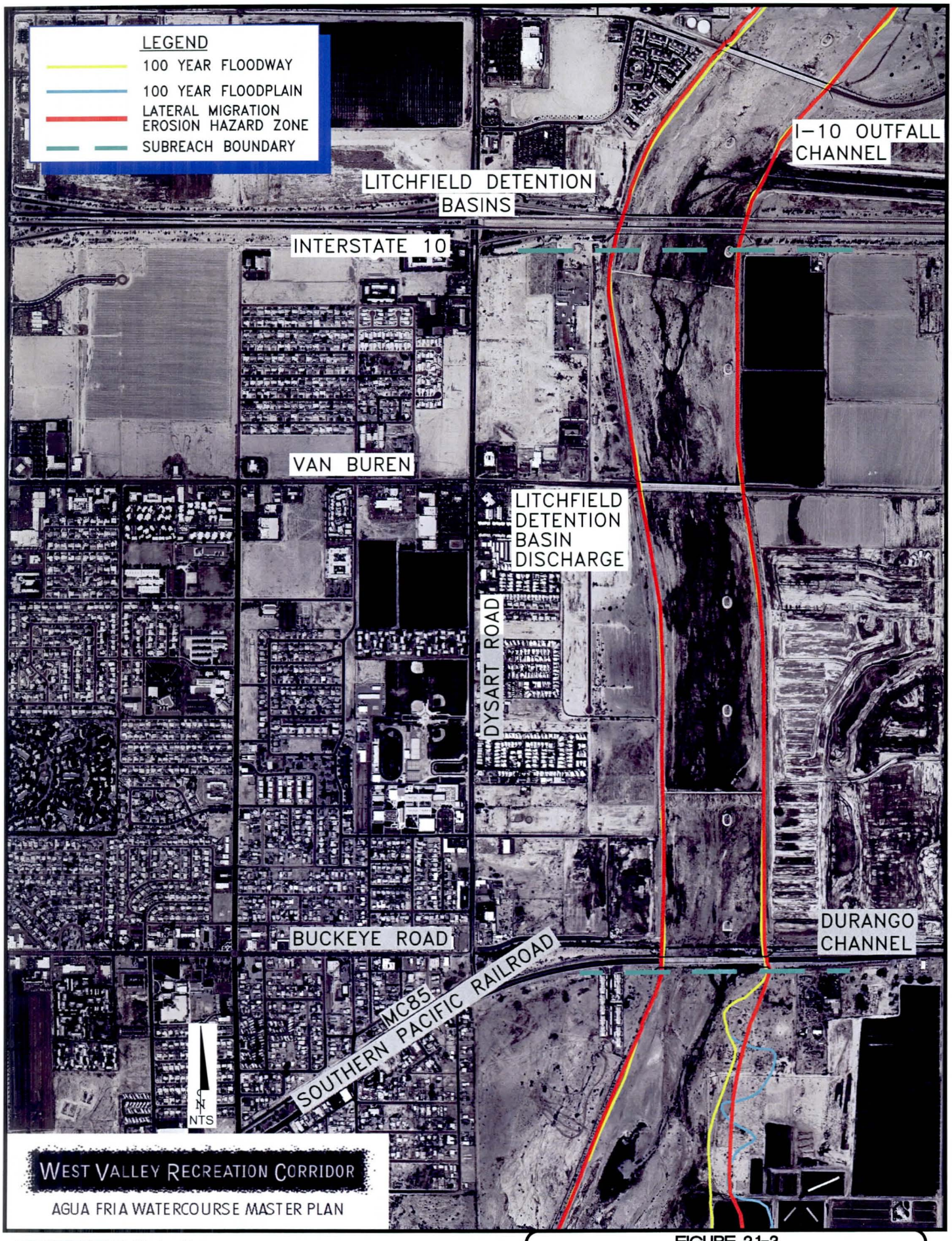

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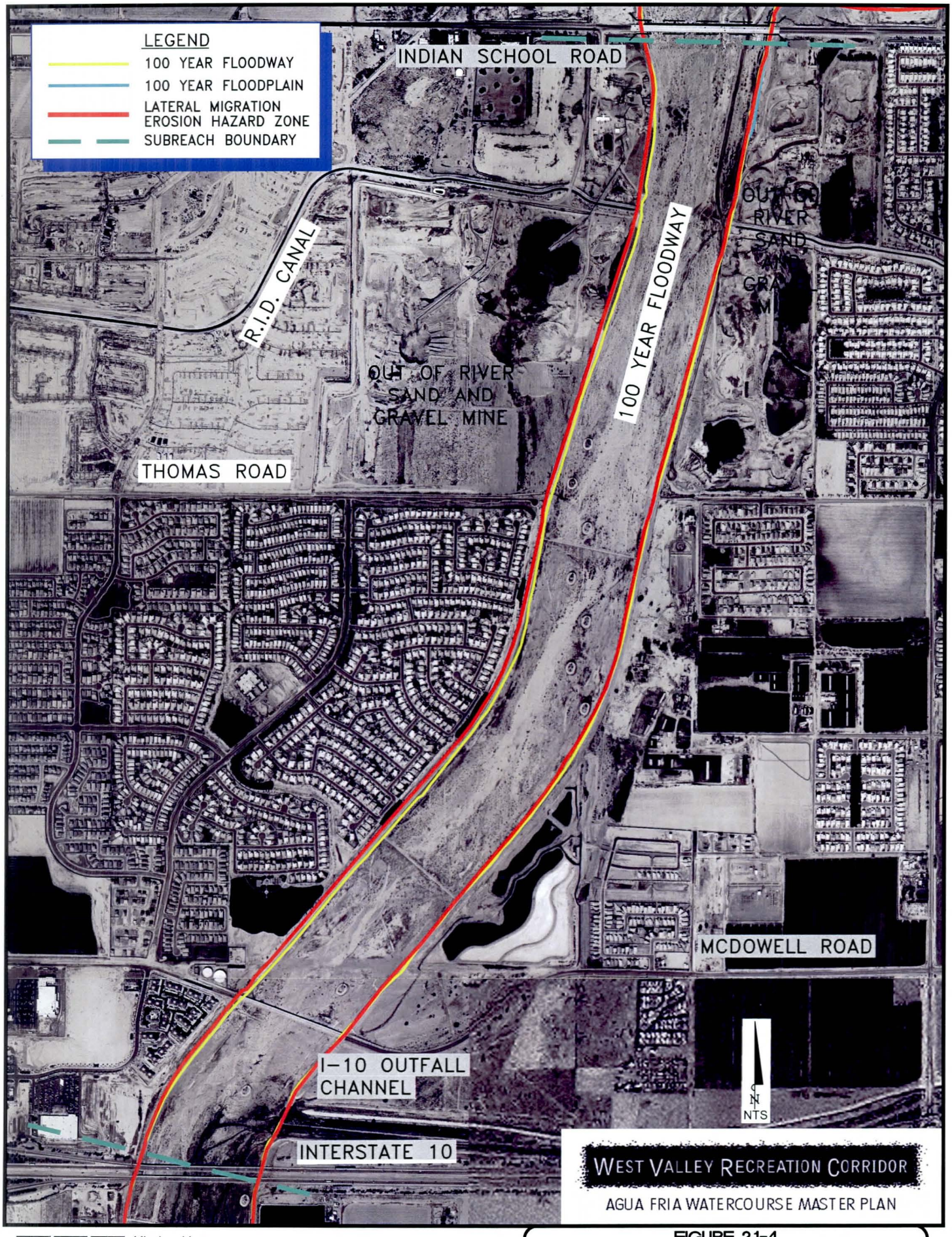
FIGURE 2.1-3
AGUA FRIA WATERCOURSE MASTER PLAN
MC 85 TO INTERSTATE 10

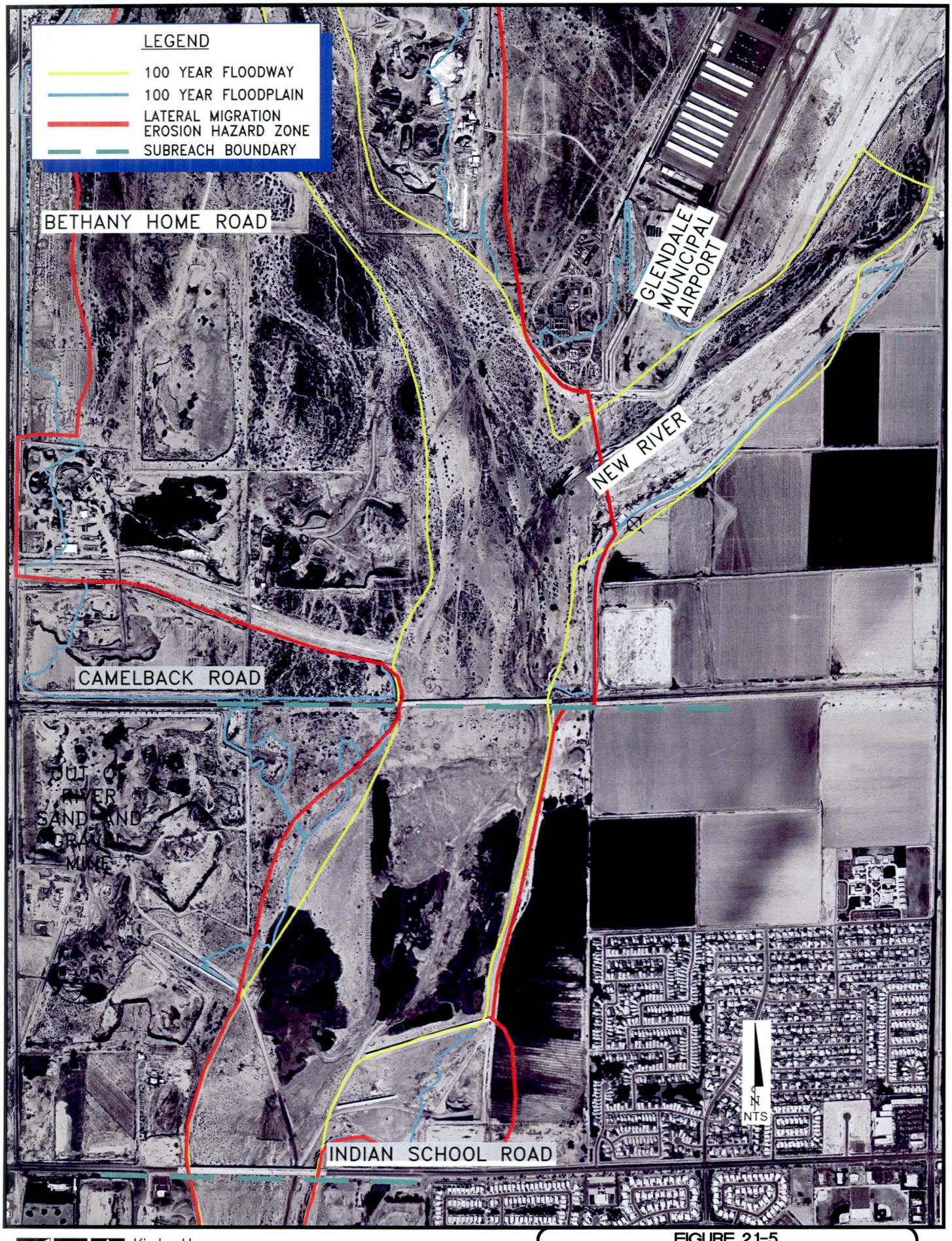


WEST VALLEY RECREATION CORRIDOR

AGUA FRIA WATERCOURSE MASTER PLAN

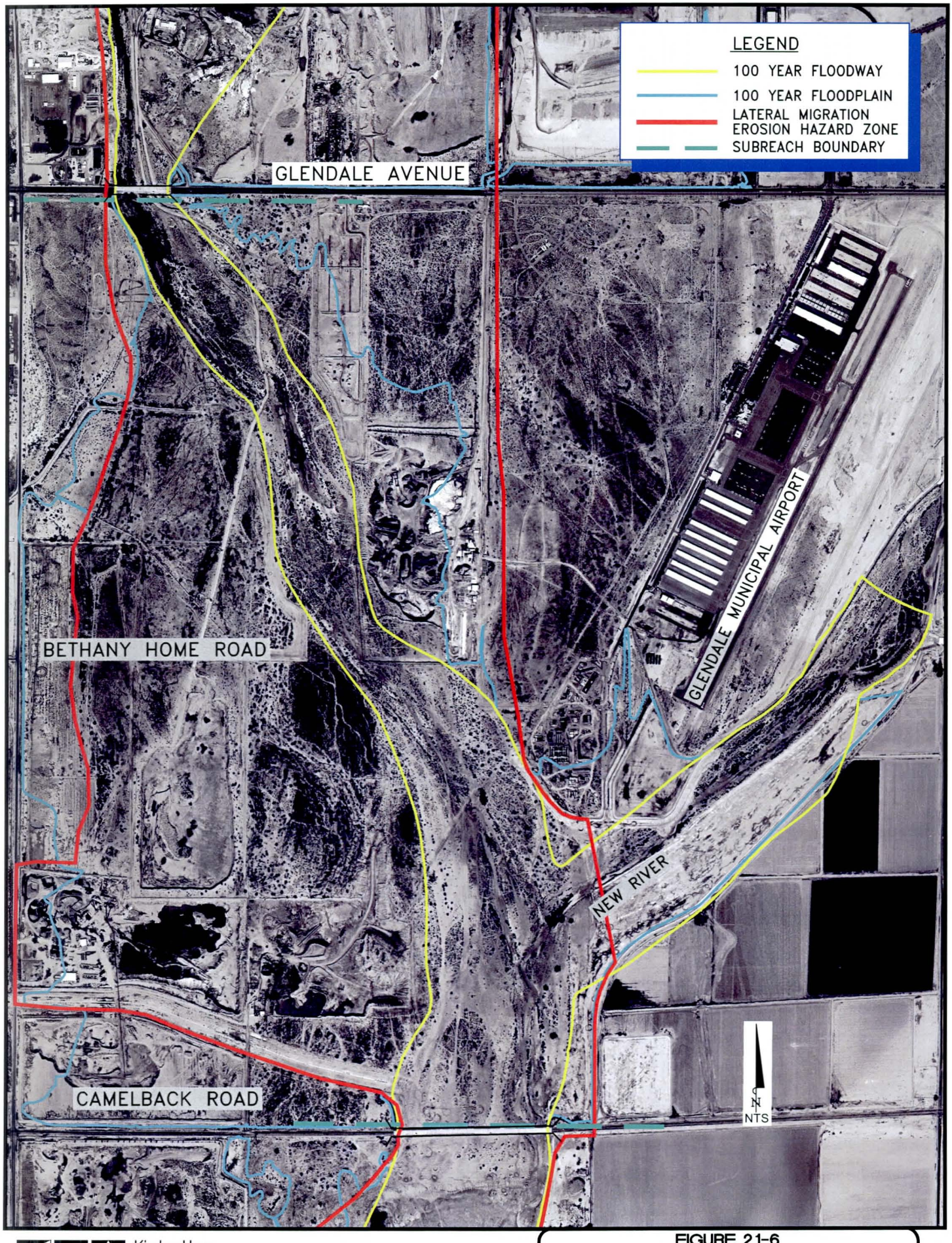
Kimley-Horn and Associates, Inc.

FIGURE 2.1-4
AGUA FRIA WATERCOURSE MASTER PLAN
INTERSTATE 10 TO INDIAN SCHOOL ROAD



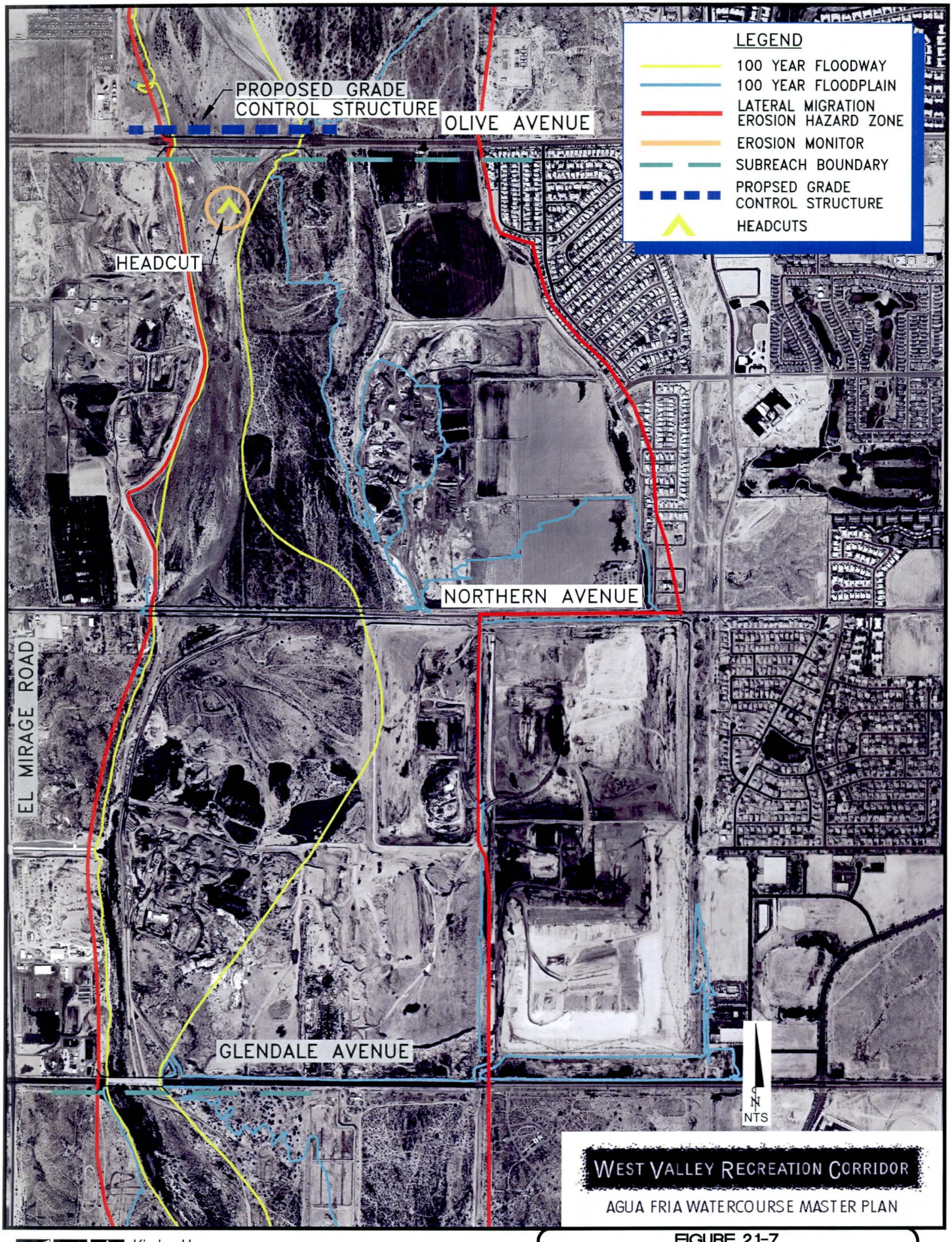
Kimley-Horn and Associates, Inc.

FIGURE 2.1-5
AGUA FRIA WATERCOURSE MASTER PLAN
INDIAN SCHOOL ROAD TO CONF OF NEW RIVER



Kimley-Horn and Associates, Inc.

FIGURE 2.1-6
AGUA FRIA WATERCOURSE MASTER PLAN
CONFLUENCE OF NEW RIVER TO GLENDALE AVE

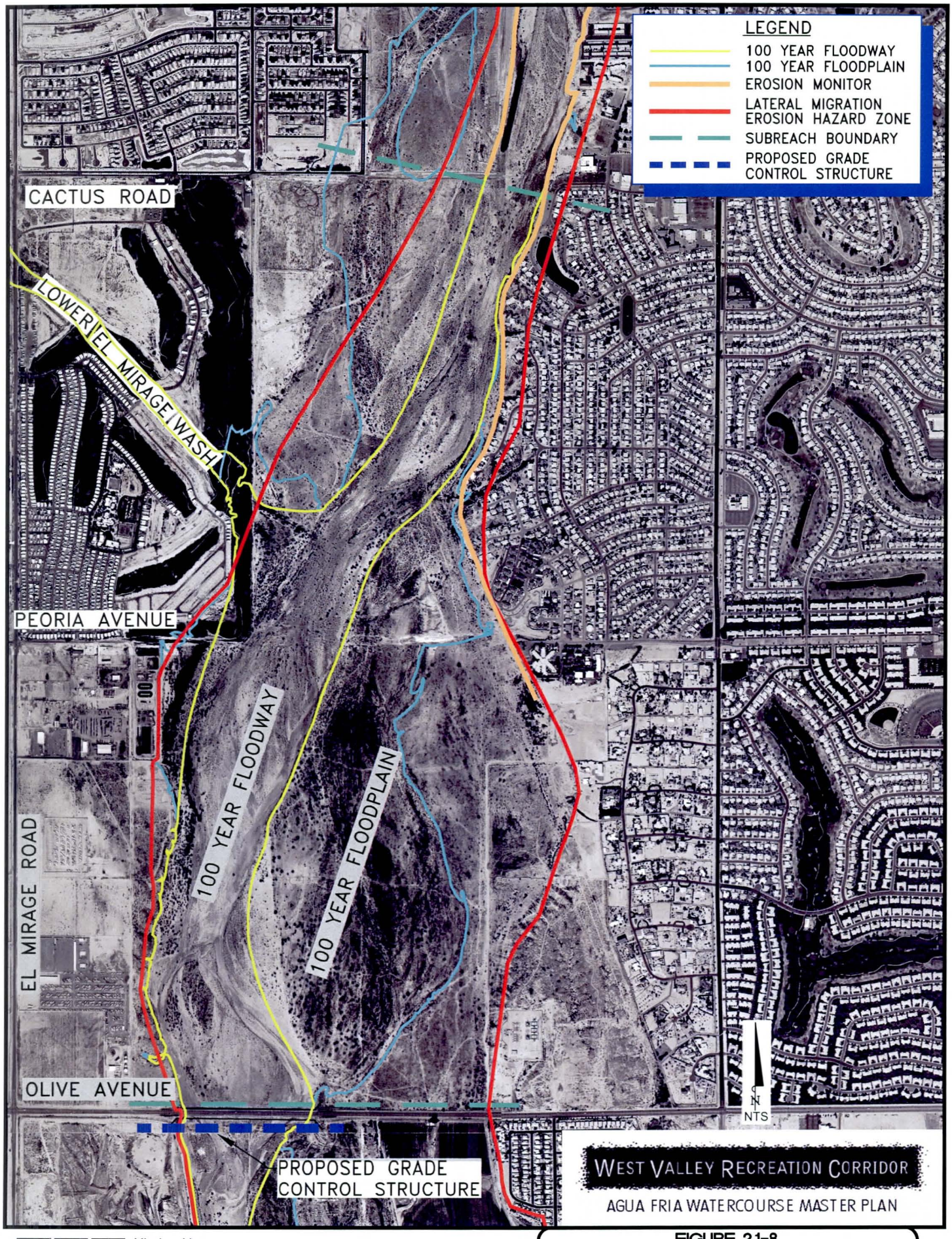


WEST VALLEY RECREATION CORRIDOR

AGUA FRIA WATERCOURSE MASTER PLAN

Kimley-Horn and Associates, Inc.

FIGURE 2.1-7
AGUA FRIA WATERCOURSE MASTER PLAN
GLENDALE AVENUE TO OLIVE AVENUE



WEST VALLEY RECREATION CORRIDOR

AGUA FRIA WATERCOURSE MASTER PLAN

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FIGURE 2.1-8
AGUA FRIA WATERCOURSE MASTER PLAN
OLIVE AVENUE TO CACTUS ROAD

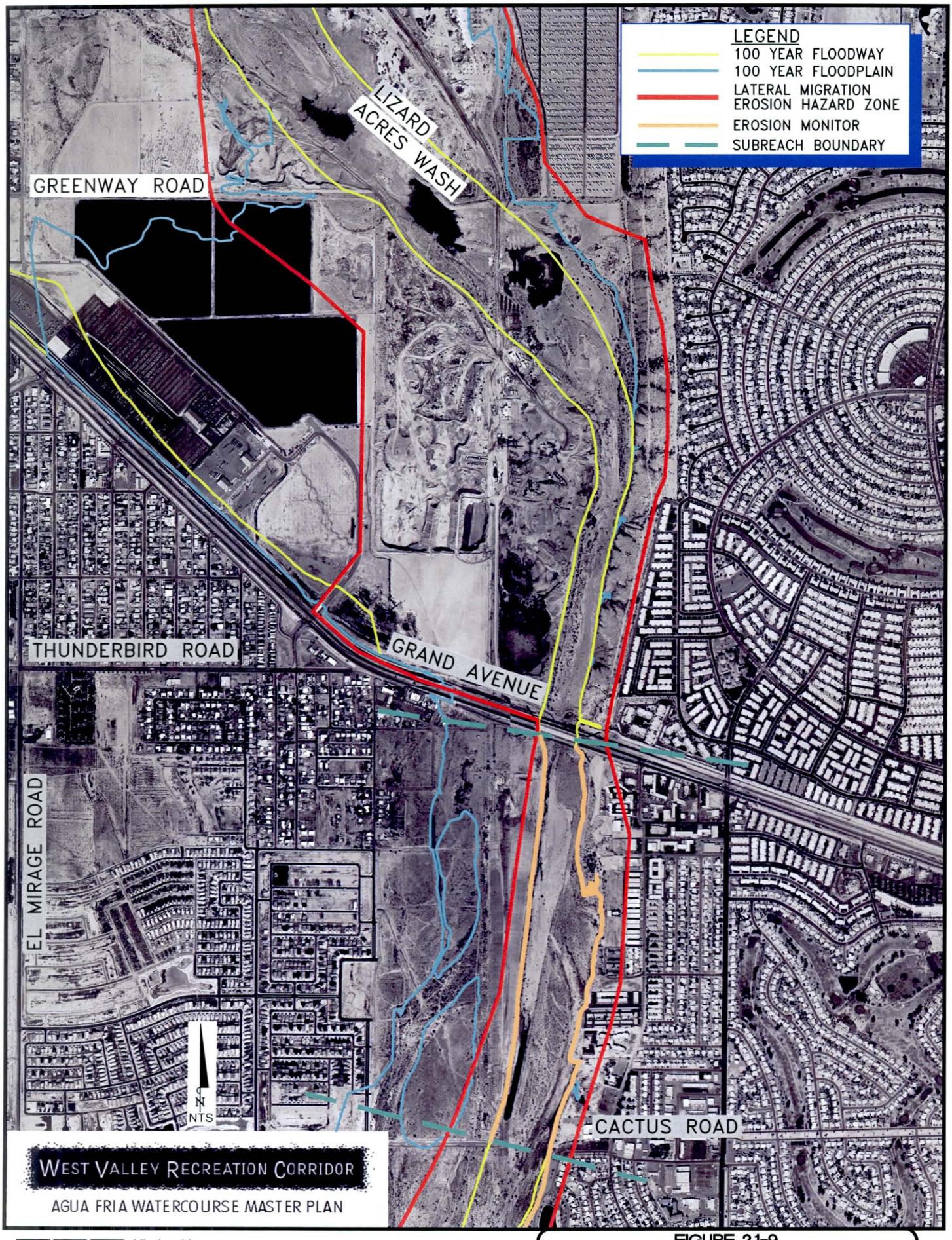

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FIGURE 2.1-9
AGUA FRIA WATERCOURSE MASTER PLAN
CACTUS ROAD TO GRAND AVENUE

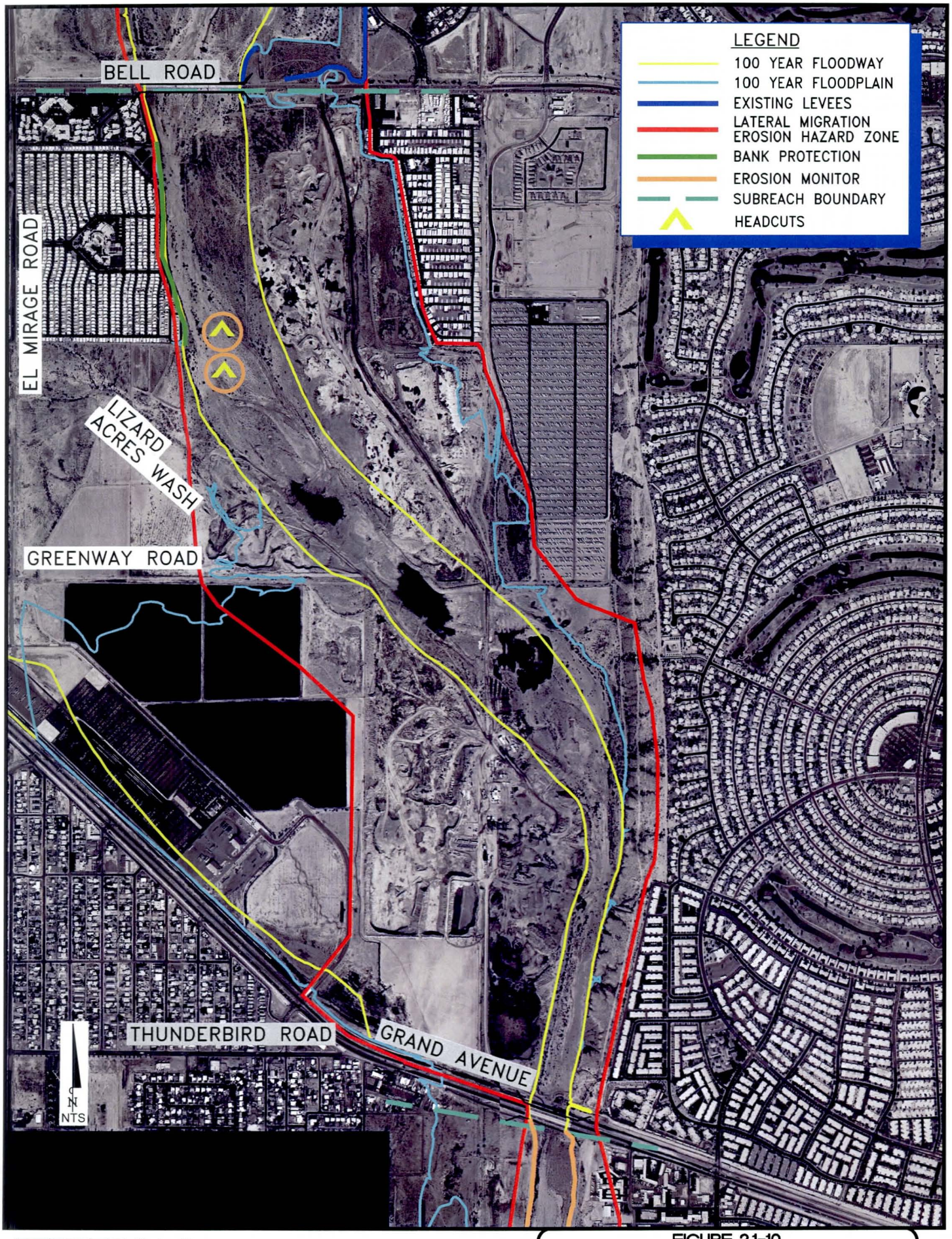

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FIGURE 2.1-10
AGUA FRIA WATERCOURSE MASTER PLAN
GRAND AVENUE TO BELL ROAD

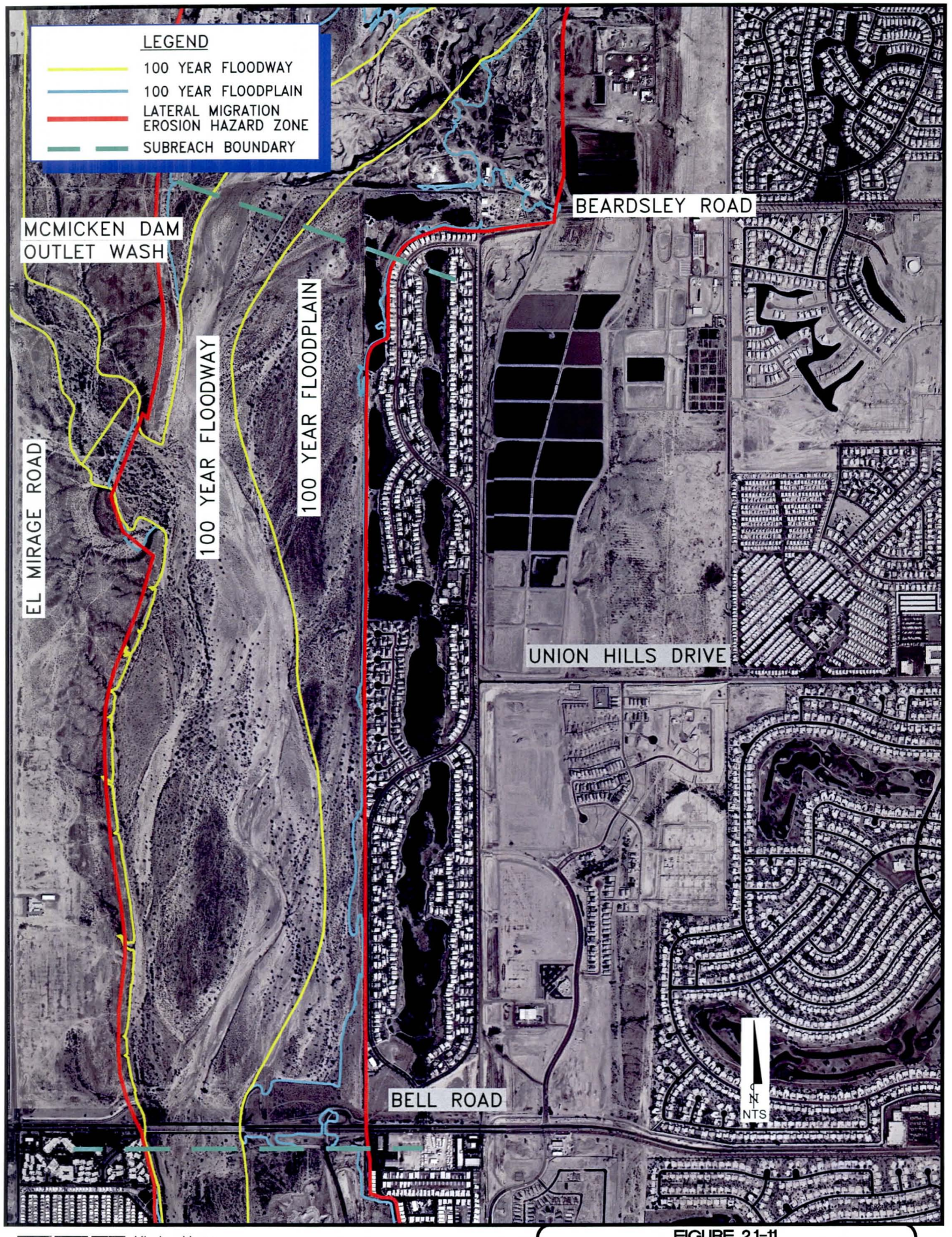

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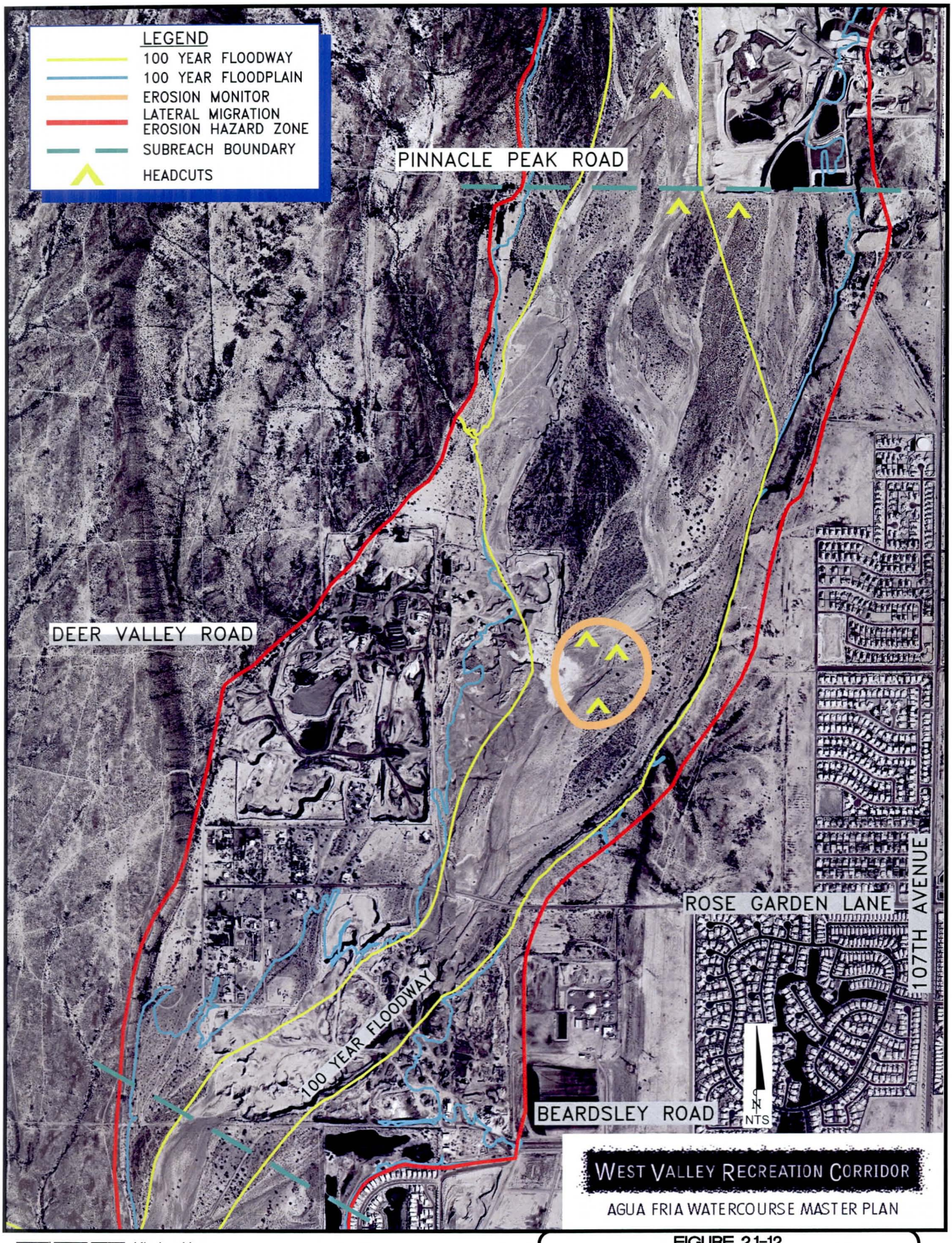
FIGURE 2.1-11
AGUA FRIA WATERCOURSE MASTER PLAN
BELL ROAD TO BEARDSLEY ROAD



WEST VALLEY RECREATION CORRIDOR

AGUA FRIA WATERCOURSE MASTER PLAN

Kimley-Horn and Associates, Inc.

FIGURE 2.1-12
AGUA FRIA WATERCOURSE MASTER PLAN
BEARDSLEY ROAD TO PINNACLE PEAK ROAD

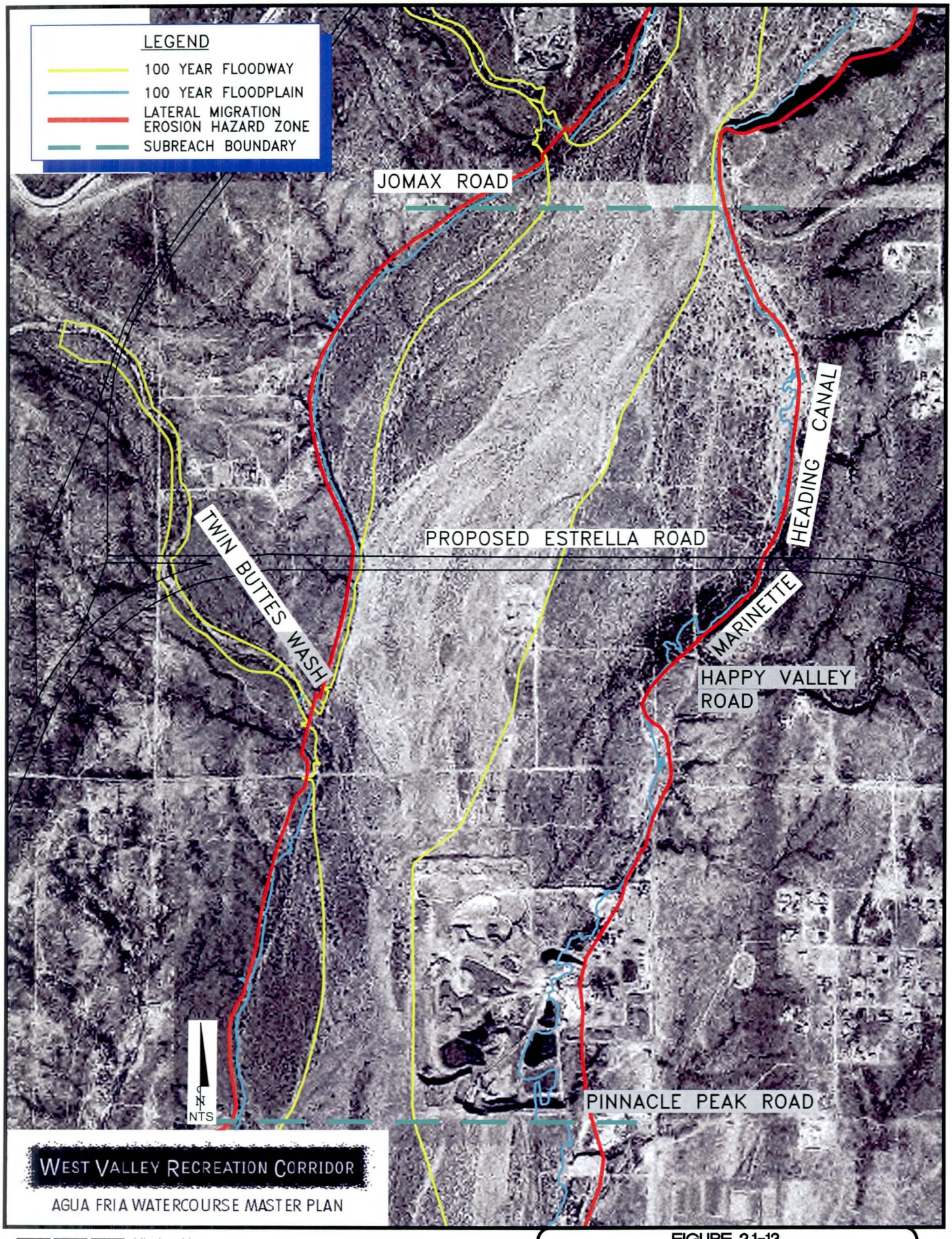


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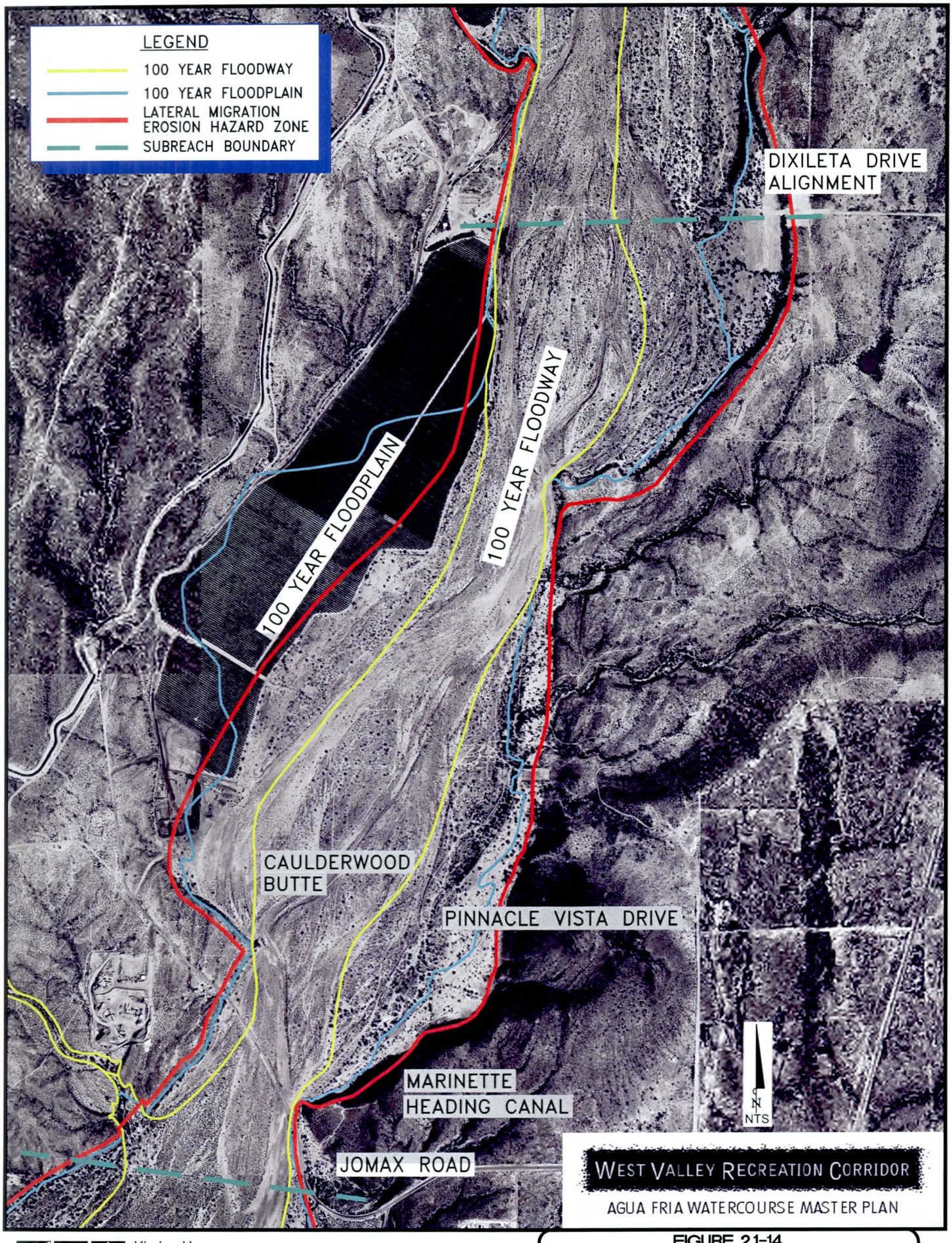
FIGURE 2.1-13
AGUA FRIA WATERCOURSE MASTER PLAN
PINNACLE PEAK ROAD TO JOMAX ROAD



WEST VALLEY RECREATION CORRIDOR

AGUA FRIA WATERCOURSE MASTER PLAN

Kimley-Horn and Associates, Inc.

FIGURE 2.1-14
AGUA FRIA WATERCOURSE MASTER PLAN
JOMAX ROAD TO DIXILETA DRIVE ALIGNMENT

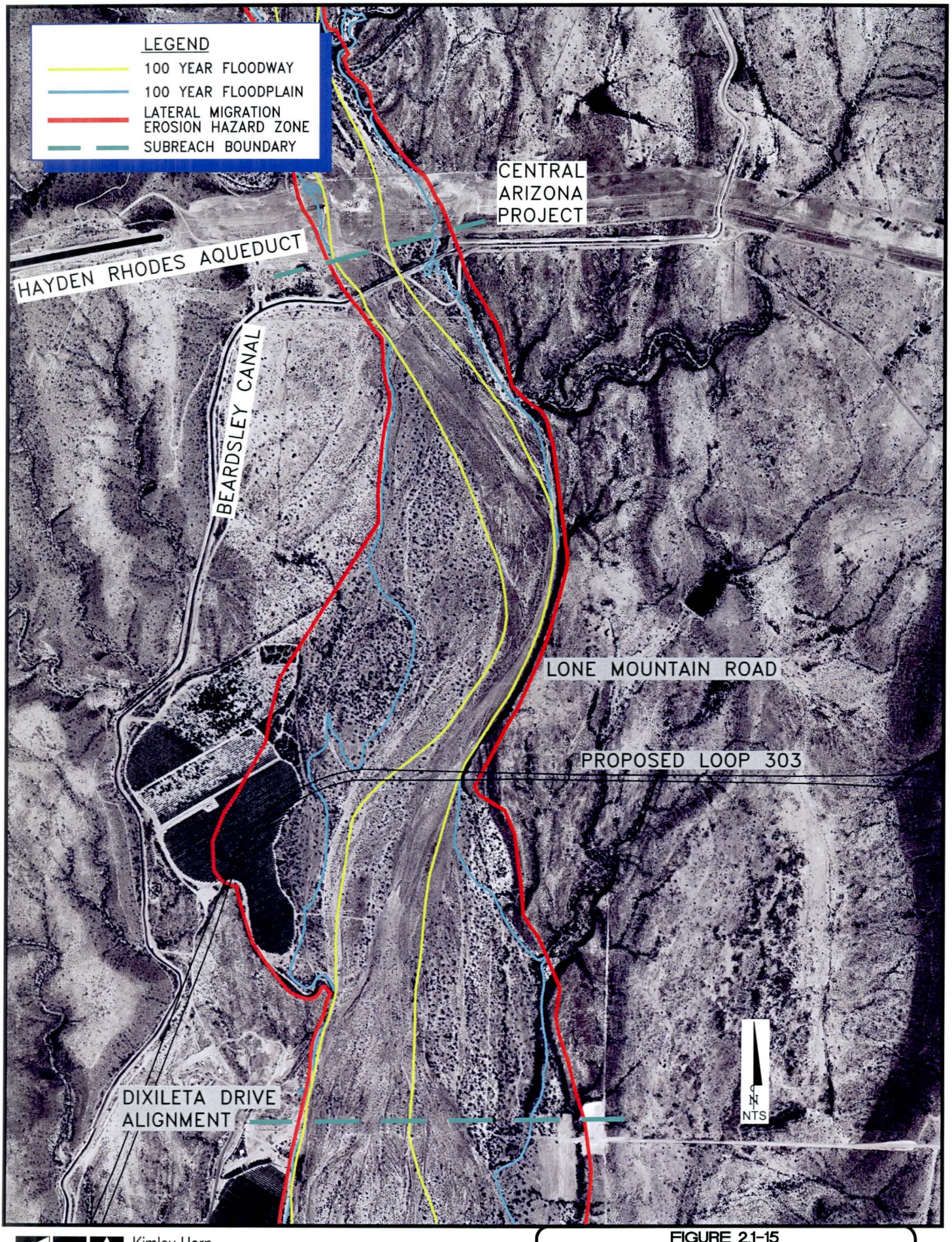


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FIGURE 2.1-15
AGUA FRIA WATERCOURSE MASTER PLAN
DIXILETA DRIVE ALIGNMENT TO CAP CANAL

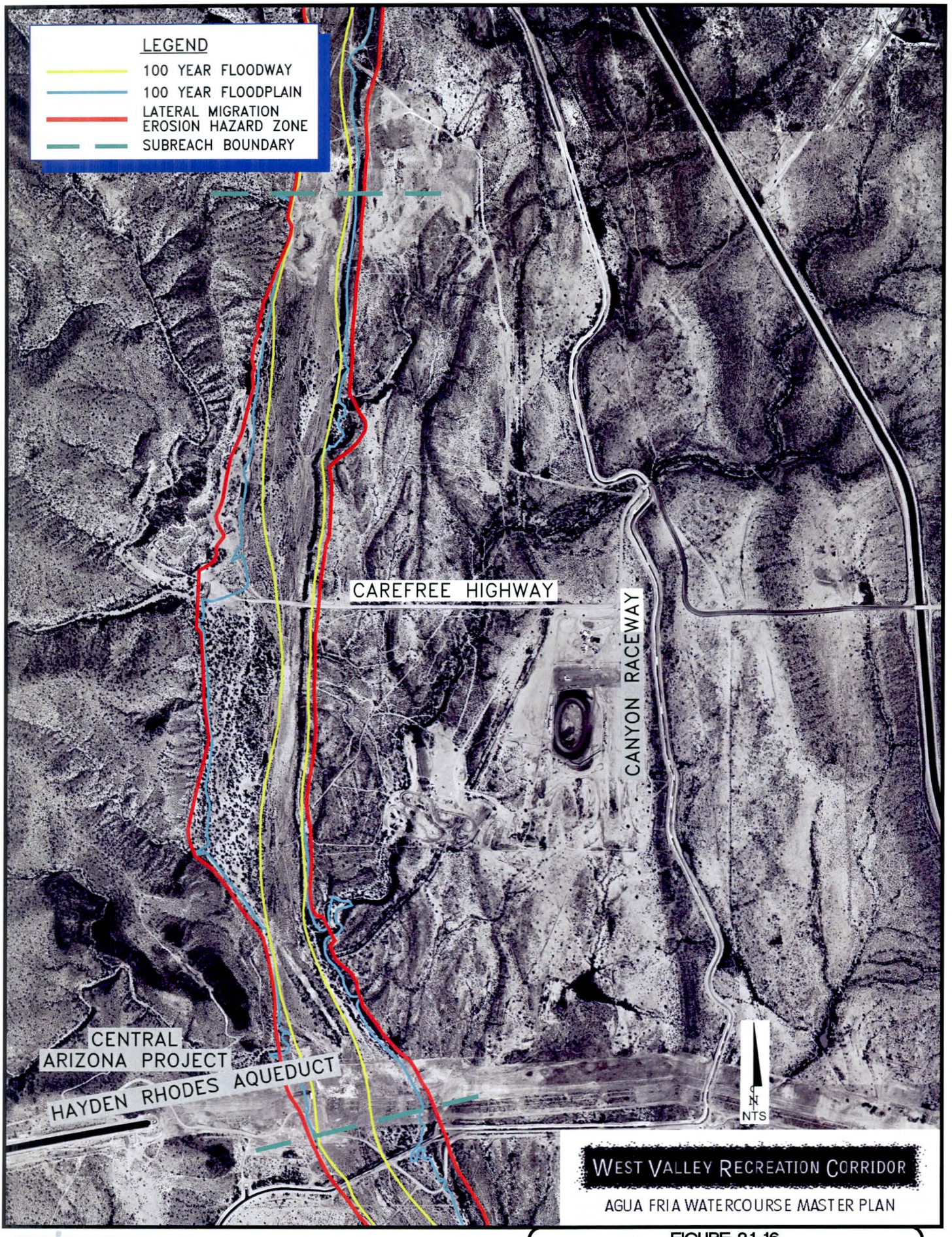

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FIGURE 2.1-16
AGUA FRIA WATERCOURSE MASTER PLAN
CAP CANAL TO CLOUD ROAD

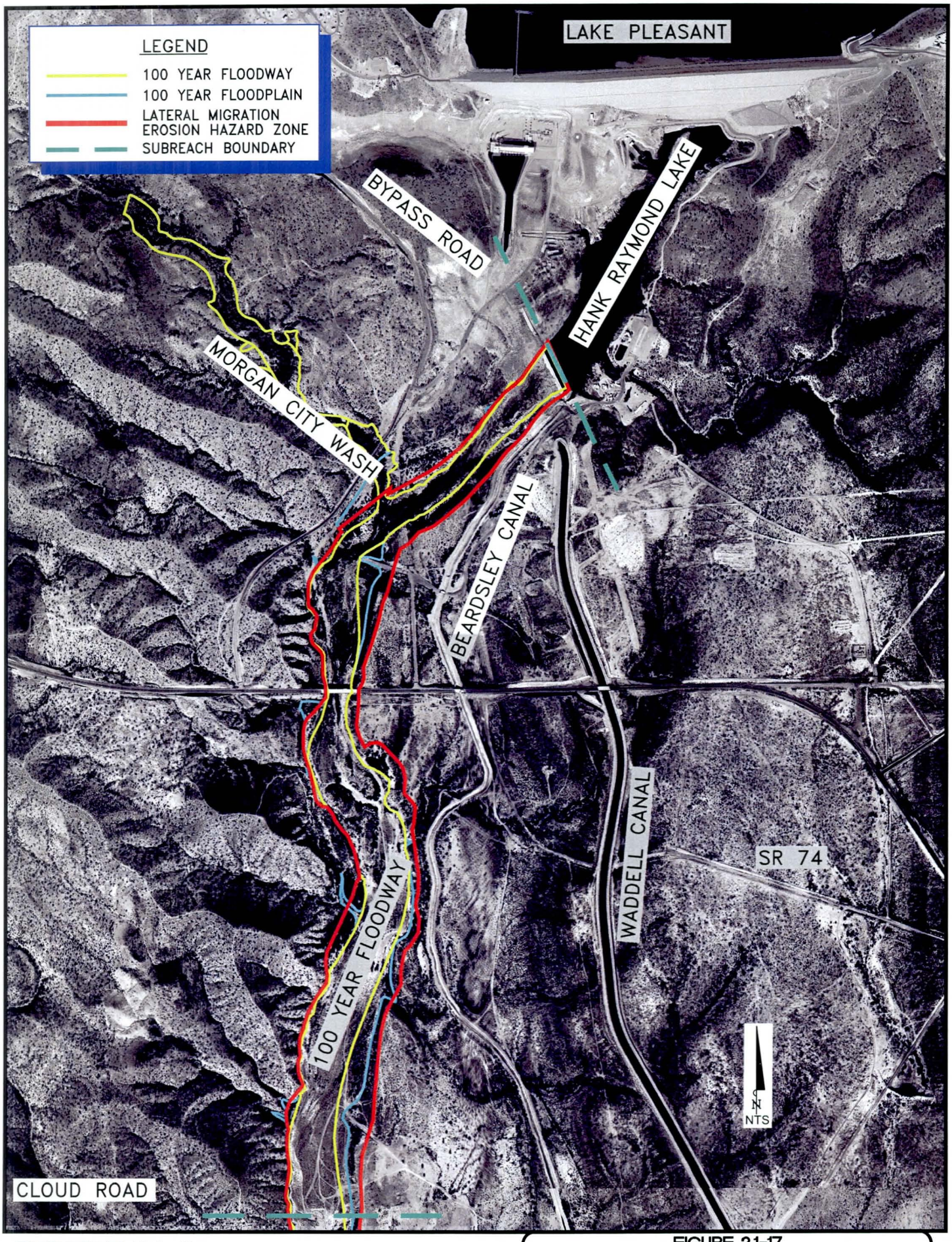

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FIGURE 2.1-17
AGUA FRIA WATERCOURSE MASTER PLAN
CLOUD ROAD TO NEW WADDELL DAM

3.0 Chapter 3-Affected Environment

Chapter 3, Affected Environment, describes resources that will affect or potentially be affected by the proposed project. The following sections present resource category baselines (existing conditions) against which the District, regulatory agencies, and the public can compare the effects of the proposed alternative.

The Agua Fria Watercourse Master Plan encompasses the 32 mile reach from the New Waddell Dam to the Gila River. Between the New Waddell Dam and the Gila River, the Agua Fria River flows through Maricopa County and the Cities and Towns of Peoria, Glendale, Surprise, El Mirage, Youngtown, Phoenix, and Avondale.

For document purposes, the river is divided into three general reaches (**Figure 3.1**). Unless otherwise specified, the reaches discussed in the existing conditions information presented in the following sections are defined as:

- Upper Reach – New Waddell Dam to Bell Road
- Middle Reach – Bell Road to the confluence of the New River
- Lower Reach – The confluence of the New River to the confluence of the Gila River

Subreaches are also defined in many of the technical memorandums. The subreaches vary between the disciplines and resource categories. If a technical report subreach designation is applicable or if it differs from the general reach categories above, it is noted.

Chapter 3 divides study area resources into those potentially affected by the proposed project (Section 3.1) and resources not affected by the proposed project (Section 3.2). A summary of the resources contained in each section is included within.

3.1 Resources Potentially Affected

The resources described below will be affected by the advanced alternatives. Impacts to these resources are detailed in Chapter 4.0, Environmental Consequences.

- Section 3.1.1 - Watershed
- Section 3.1.2 - Geomorphology
- Section 3.1.3 - Land Use and Relevant Planning
- Section 3.1.4 - Biological Resources
- Section 3.1.5 - Protected Species
- Section 3.1.6 - Visual Environment
- Section 3.1.7 - Infrastructure
- Section 3.1.8 - Cultural Resources
- Section 3.1.9 - Recreation
- Section 3.1.10 - Water Quality
- Section 3.1.11 - Regulatory Requirements of the Clean Water Act
- Section 3.1.12 - Contamination
- Section 3.1.13 - Social and Economic Resources

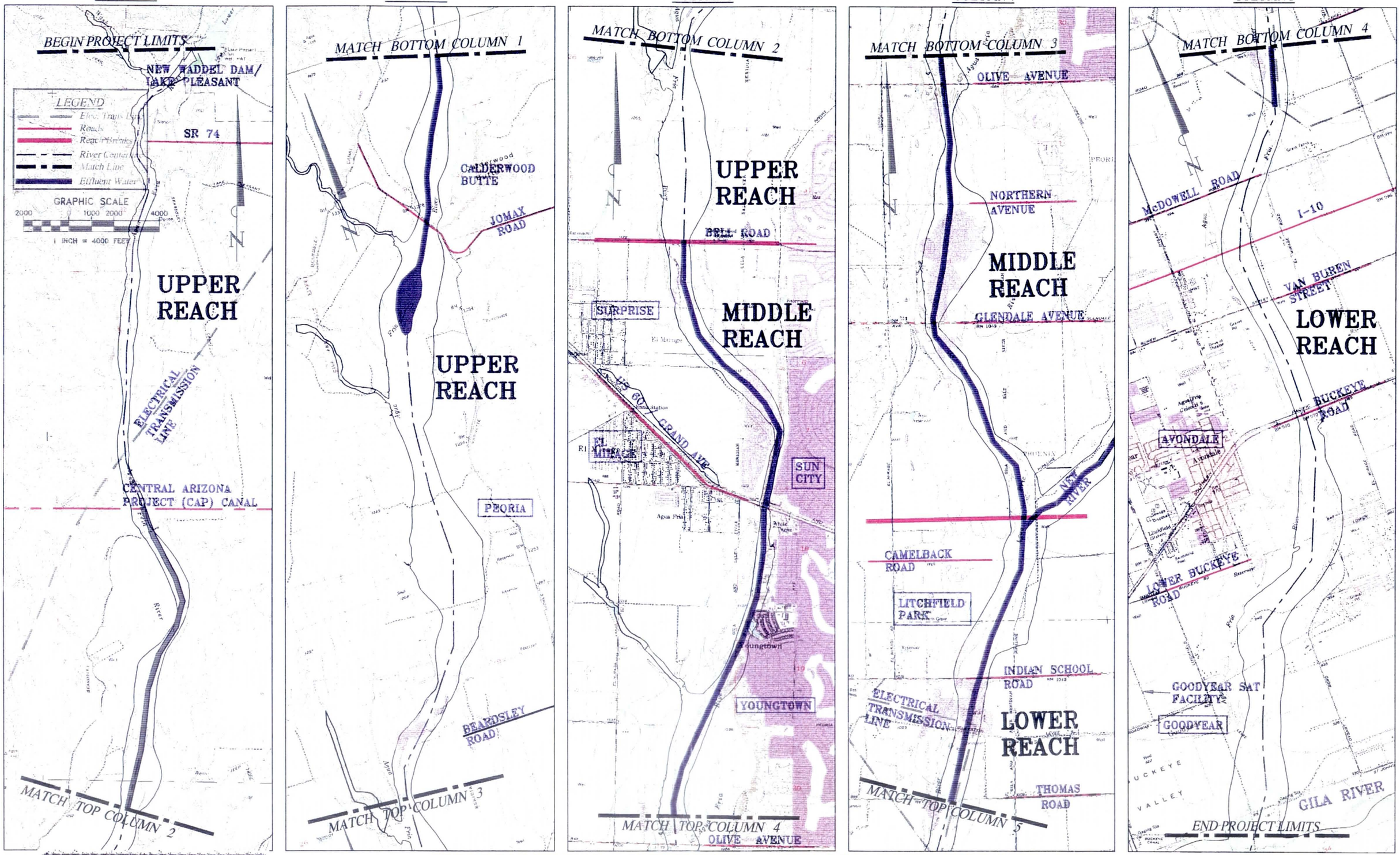
COLUMN 1

COLUMN 2

COLUMN 3

COLUMN 4

COLUMN 5



WEST VALLEY RECREATION CORRIDOR

AGUA FRIA WATERCOURSE MASTER PLAN

ENVIRONMENTAL ASSESSMENT - AGUA FRIA RIVER STUDY REACHES

FIGURE 3.1

3.1.1 Study Area Watershed

The entire Agua Fria River Watershed is approximately 100 miles long, extending from the central highlands near Prescott, Arizona to its confluence with the Gila River, south of Phoenix, Arizona. This evaluation is limited to the approximately 32 mile reach from New Waddell Dam to the confluence (Figure 3.1).

The Agua Fria River downstream from the dam is ephemeral, with significant flows being related to the runoff from localized storms and area discharges (treatment plants, recharge, agricultural, and urban runoff).

The lower reach is generally agricultural land use with scattered residential and commercial areas. The middle reach is much more heavily developed with commercial and residential use dominating. This reach also contains the majority of the sand and gravel activity. The southern portion of the upper reach is developed with commercial and residential uses. The northern portion of the upper reach (CAP crossing north) is relatively undeveloped. The ecological evaluation, hydrology, and visual characterization reports contain more detail on the watershed.

3.1.1.1 Groundwater and Recharge

A summary of the groundwater recharge report prepared by Fluid Solutions is included below. The complete technical report, *Alternative Analysis Report – Agua Fria Water Course Master Plan*, is included in the Agua Fria Watercourse Master Plan Technical Memorandums.

Groundwater recharge is water that infiltrates into the zone of saturation, also referred to as the water table. Groundwater recharge occurs naturally from precipitation or from surface water impoundments that seep through the soil into aquifers. Recharge may also occur from anthropogenic activities including injection wells, seepage ponds, and irrigation seepage.

Historic pumping for agricultural and municipal use has depleted the groundwater system throughout much of the West Salt River Valley, including those areas around the Agua Fria River below New Waddell Dam. Groundwater levels in these areas have declined significantly, resulting in increasingly limited water supplies, deterioration of water quality, land subsidence, and development of earth fissures.

Little natural groundwater recharge occurs in southern Arizona due to the hot, dry climate where evaporation and transpiration greatly exceed atmospheric precipitation. Many municipalities and water management agencies/companies have begun to augment groundwater recharge with structured procedures to replace withdrawn water resources. Several of these groundwater recharge facilities are located in the greater Phoenix metro area, including along the Agua Fria corridor.

There are three primary water sources available for recharge in the Agua Fria River:

- Surface water from the Agua Fria, Salt, and Verde watersheds
- Colorado River water imported through the CAP aqueduct, and
- Treated wastewater effluent generated by the municipalities and private utilities in the Phoenix metropolitan area

In addition, less significant sources, including local runoff and agricultural tail water, may also be capable of contributing water to the Agua Fria channel. Within each class of water recharge, significant differences exist in the quantity, quality, and reliability of these water supplies throughout the study area.

There are a number of existing facilities that are permitted to conduct recharge and underground storage in the vicinity of the Agua Fria River. These facilities are listed in **Table 3-1**, Permitted Recharge Facilities along the Agua Fria River. **Figure 3.2** notes the permitted and proposed groundwater recharge facilities along the study area.

Table 3-1

Permitted Recharge Facilities along the Agua Fria River

Facility name	River Reach[1]	Distance from River (miles)	Facility Type	Type of Construction	Scale	Water Source	Permitted Volume (ac-ft/yr)
Aqua Fria CAWCD[2]	upper	0	managed		full	CAP	100,000
Aqua Fria CAWCD[2]	upper	0	constructed	basins	full	CAP	100,000
Sun City West	upper	< 0.5 (east)	constructed	basins	full	effluent	3042
Peoria Beardsley	upper	< 0.5 (east)	constructed	basins	full	effluent	2470
Surprise South Plant	middle	2 (east)	constructed	basins	full	effluent	3584
Glendale West	middle	< 0.5 (east)	constructed	basins, trenches, vadose wells, injection wells	pilot	effluent	5000
Avondale	lower	< 0.5 (west)	constructed	basins	full	CAP, SRP	10,000
Goodyear SAT	lower	3.5 (west)	constructed	basins	full	effluent	3360

(1) The Upper Reach is from New Waddell Dam to Bell Road. The Middle Reach is from Bell Road to New River confluence. The Lower Reach is from New River Confluence to Gila Confluence.
(2) Facility not yet operational.

3.1.1.2 Surface Hydrology

Tributary Flows

Local runoff drains to the upper reach of the Agua Fria River in numerous locations such as Morgan City Wash, Caterpillar Tank Wash, and Twin Buttes Wash. Morgan City Wash, reportedly, is spring fed and supplies near perennial flows. These washes are uncontrolled and drain generally undeveloped desert areas. Below the uncontrolled drainage area is the McMicken Dam Outfall channel, a major tributary.

The New River, which joins the Agua Fria River channel between Glendale Avenue and Camelback Road (Figure 3.2), accepts runoff from the Arizona Canal Diversion Channel (ACDC). The ACDC was constructed to divert floodwaters from north central Phoenix to the New River. Flood control dams located on the New River, Skunk Creek, Cave Creek, and Dreamy Draw play an integral role in the functioning of this system.

Existing Drainage Modifications

The hydrology of the study reach has been significantly modified over the past century due to human activity. Modifications include the construction of dams such as New Waddell Dam (Waddell Dam existed prior to construction of New Waddell Dam), New River Dam (New River), Adobe Dam (Skunk Creek), Cave Creek and Cave Buttes Dams (Cave Creek), McMicken Dam (Trilby Wash), and White Tanks Flood Retarding Structure (FRS) #3. These flood control dams reduce the low flows, peak flood discharges, and sediment supply delivered to the study reach. Only 17 percent of the 2,700 square mile Agua Fria watershed is not controlled by dams.

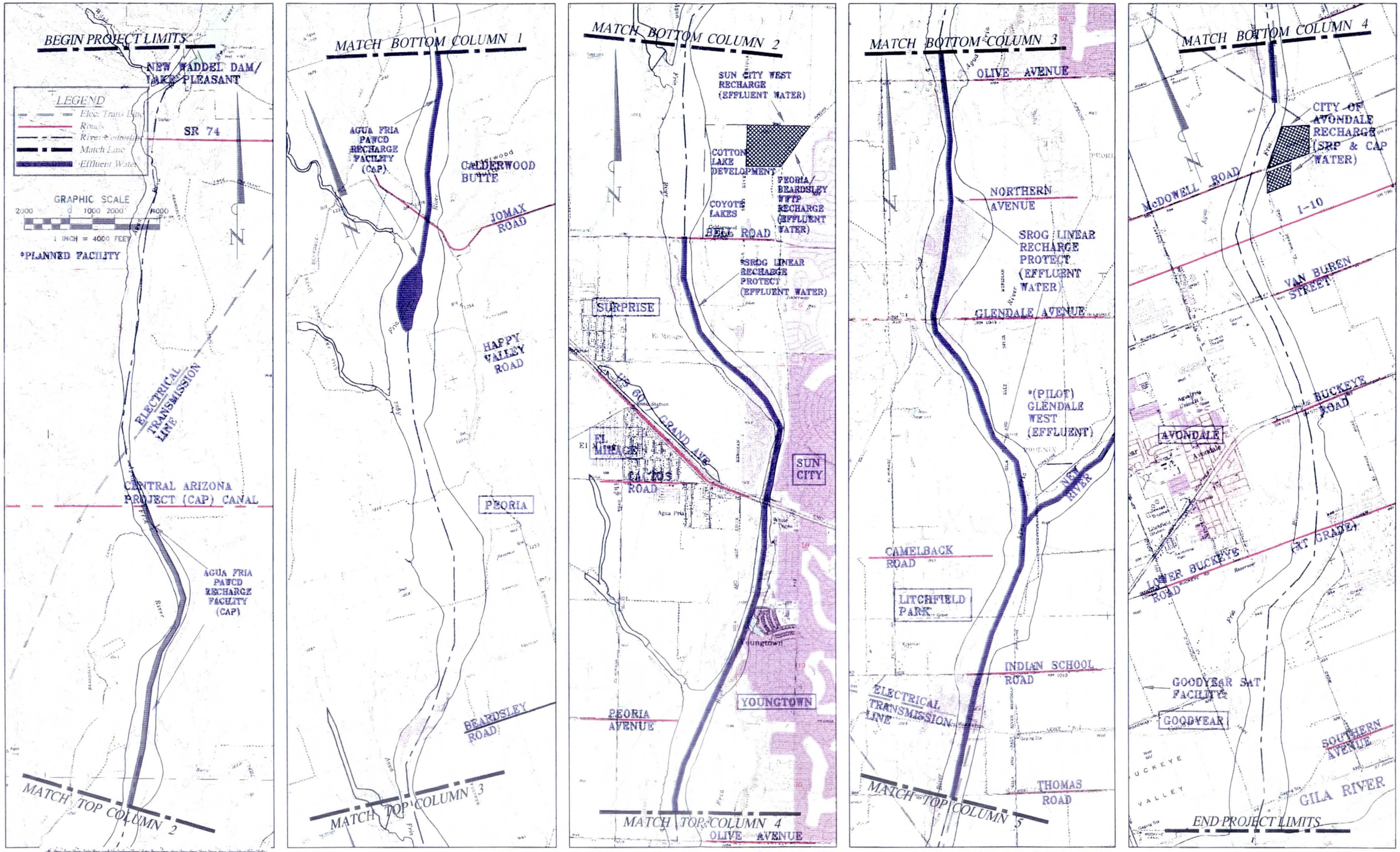
COLUMN 1

COLUMN 2

COLUMN 3

COLUMN 4

COLUMN 5



WEST VALLEY RECREATION CORRIDOR

AGUA FRIA WATERCOURSE MASTER PLAN

ENVIRONMENTAL ASSESSMENT - GROUND WATER RECHARGE FACILITIES

FIGURE 3.2

Diversions including the ACDC, McMicken Dam, and the Interstate 10 channel expand the watershed area that ultimately drains to the study reach, potentially increasing the volume of water delivered to the study reach during large floods.

Urbanization of the west valley downstream of the New Waddell Dam has changed the natural hydrology in the study reach in conflicting ways. In contrast to non-urbanized watersheds, urbanization typically results in more frequent runoff, higher peaks, higher flow volumes, reduced sediment supply, and "flashier" floods due to less infiltration and smoother surfaces. However, enforcement of storm water retention requirements in areas that were developed in the past 15 years may have reduced flood volumes and peak discharges in some watersheds. Of the 460 square miles of watershed not controlled by dams, more than half is highly urbanized or is expected to be within ten years.

Irrigation return flows, discharge from water and wastewater treatment plans, and other point sources of manmade runoff augment the natural drainage.

Floodplain Storage

Floodplain storage occurs naturally in floodplains. The impact of storage on floodwave attenuation tends to be most pronounced in wide floodplains and less pronounced in narrow floodplains. The Agua Fria River upstream of the New River confluence has a varied floodplain. The northernmost portion is relatively constricted within steep rock banks while southern areas are very broad and flat. Sand and gravel pits are scattered throughout the river both inside and outside the floodway. Some of these pits can provide significant storage volume.

Hydrologic models depicting existing conditions show a significant amount of flow attenuation through the river. In general, the more narrow incised upper sub-reaches have less attenuation than the wider southern subreaches. However, flood attenuation was most dramatically impacted in the following subreaches with significant sand and gravel mining activity. Three areas that stand out are:

- South of Jomax Road to Beardsley Road
- North of Grand Avenue to Bell Road
- Near Northern Avenue

The hydrologic models confirm that encroachments on the flood fringe (100-year floodplain) will increase peak flows downstream and decrease the time it takes for the river to peak. While it is not possible to precisely evaluate the percentage of attenuation that can be attributed to sand and gravel mining versus floodplain storage, it is apparent that attenuation is significantly impacted in areas with large pits in the flood fringe.

Retention

Maricopa County and many of the municipalities in the Phoenix metropolitan area established storm water retention policies in the mid to late 1980's. Requiring retention of storm water ensures that future development does not cause large increases in peak flows, adversely impacting downstream areas of the watershed. The majority of municipalities require on-site retention of runoff from the 100-year, 2-hour design storm. Although not all municipalities have the same retention criteria, they all have a retention requirement of no less than the 100-year, 1-hour rainfall.

A hydrologic model was created to evaluate the effect of current retention policies on a fully developed watershed. The results of the model indicate that the current retention policy will effectively control inflows to the Agua Fria River, and no additional increase in retention storage is necessary to account for watershed development.

3.1.1.3 Hydraulics

The hydraulic conditions in the Agua Fria River are affected by constantly changing geometric features. These features include channel contractions and expansions, levees, bridges, and grade control structures. Contractions and expansions in the river affect the routing hydrology by increasing or decreasing the volume of water in a subreach and the average velocity at which flows pass through a given subreach.

Within the middle reach of the Agua Fria River, the subreach between Bell Road and Grand Avenue is the most problematic from a hydraulic perspective. The parallel bridges at Grand Avenue and the railroad provide a relatively narrow opening. Flow is constricted through the opening, causing velocity to increase. This leads to increased potential for erosion of the channel bed and the riverbanks downstream from the bridges. The west bank is formed by a closed landfill (El Mirage Landfill). The landfill embankment rises approximately 30 feet above the channel at a steep slope.

3.1.1.4 Floodplains and Flood Control

The Agua Fria River and the New River are the two primary channels that drain runoff from the West Valley to the Gila River. The peak flow from the 100-year regulatory storm is approximately 54,400 cubic feet per second (cfs) between the Agua Fria River/New River confluence and the Gila River. The normally dry floodplain is expected to convey a flood wave over 1,000 feet across and approximately 8 feet deep. Given the appearance of the existing channel and the fact that it is normally dry, the public tends to disregard the potential destructive force of the river. Development continues to encroach on the Agua Fria floodplain.

The New Waddell Dam, completed in 1992, replaces the Waddell Dam, which was constructed in 1927. Although the dam was not constructed for the purposes of flood control, the U.S. Army Corps of Engineers determined that for a 100-year flood, the dam provides a greater degree of downstream flood protection than provided by the previous dam.

The lower watershed also contains numerous other dams that regulate discharge on various tributaries. The largest tributary watershed, the New River, has three large dams on each of its primary drainages: New River Dam on New River, Adobe Dam on Skunk Creek, and Cave Buttes Dam on Cave Creek. Two additional earthen dams are on the western side of the drainage basin: McMicken Dam on Trilby Wash, and White Tanks FRS #3 flanking the central portion of the White Tanks Mountains.

There are numerous flood and erosion control structures within the study reach of the Agua Fria River. **Table 3-2**, Existing Levees, summarizes the locations of existing levees. **Figure 3.3** notes the approximate location of the control structures.

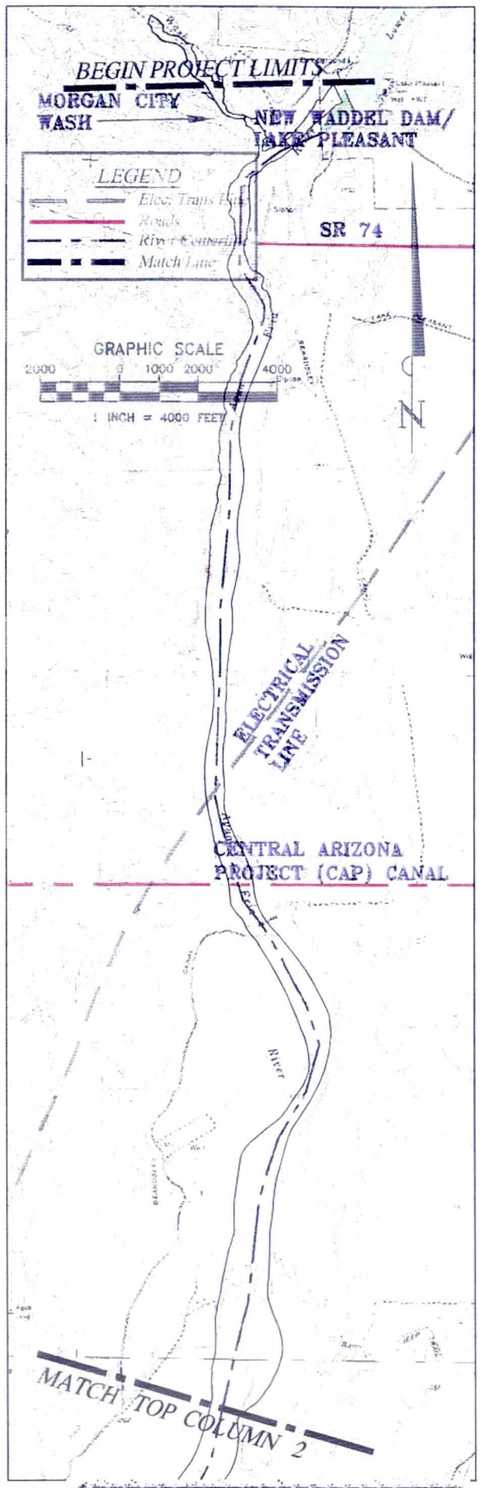
COLUMN 1

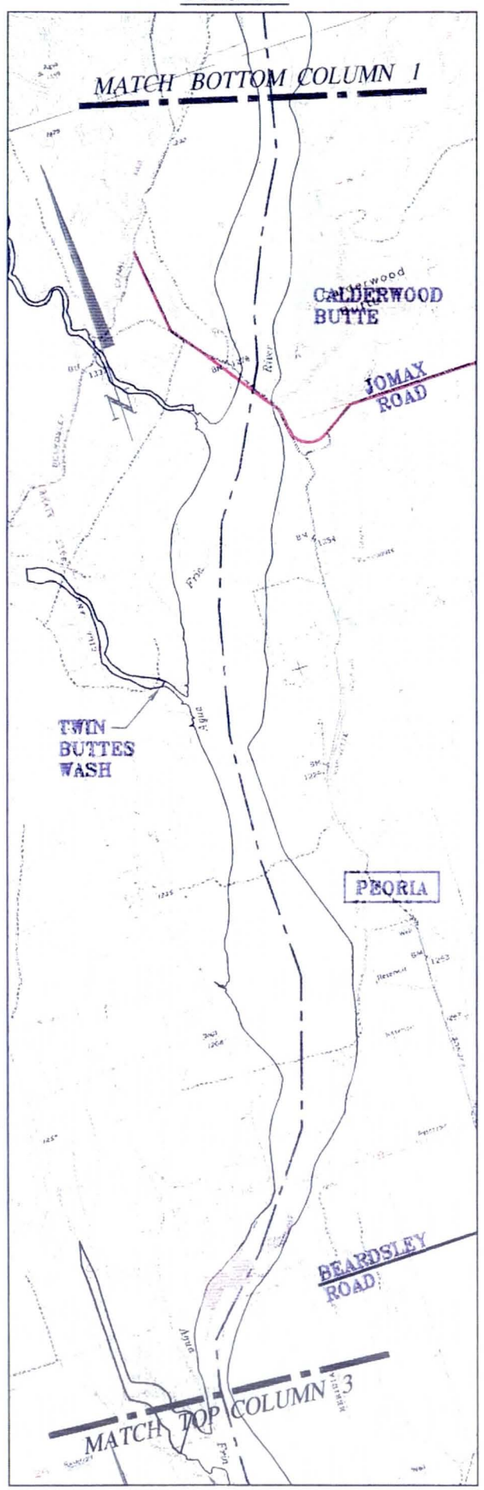
COLUMN 2

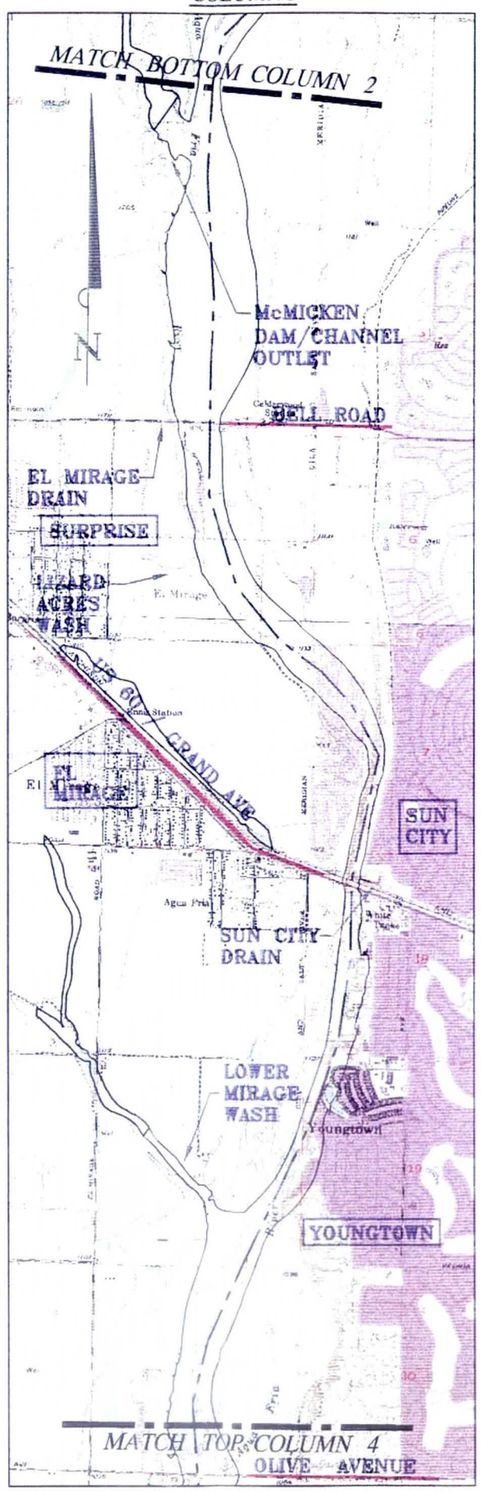
COLUMN 3

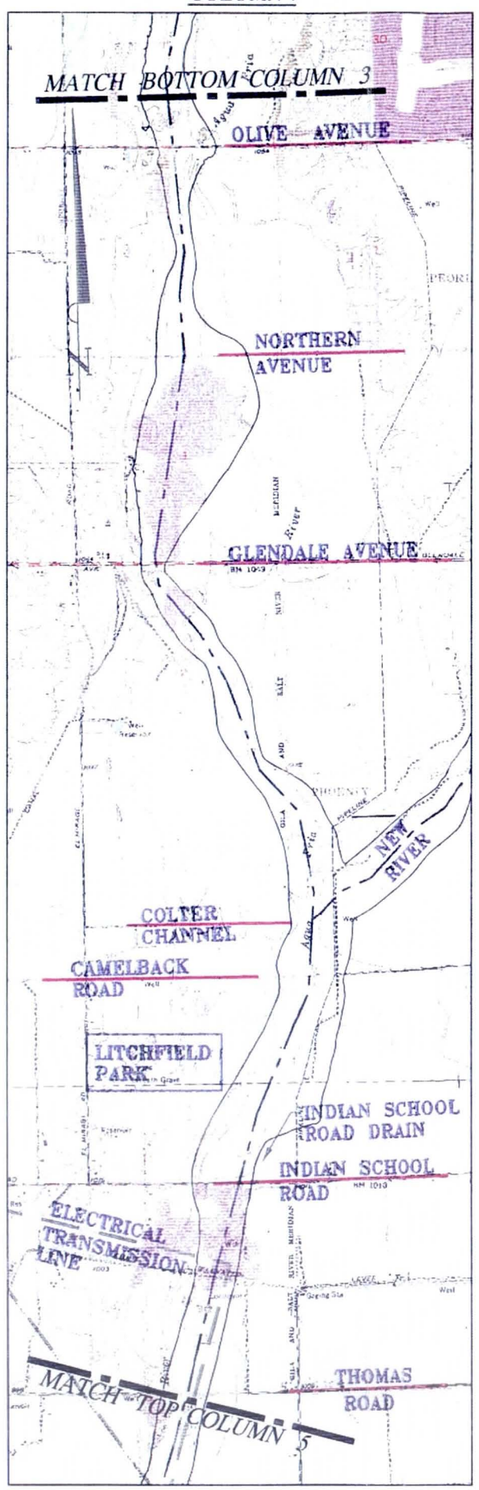
COLUMN 4

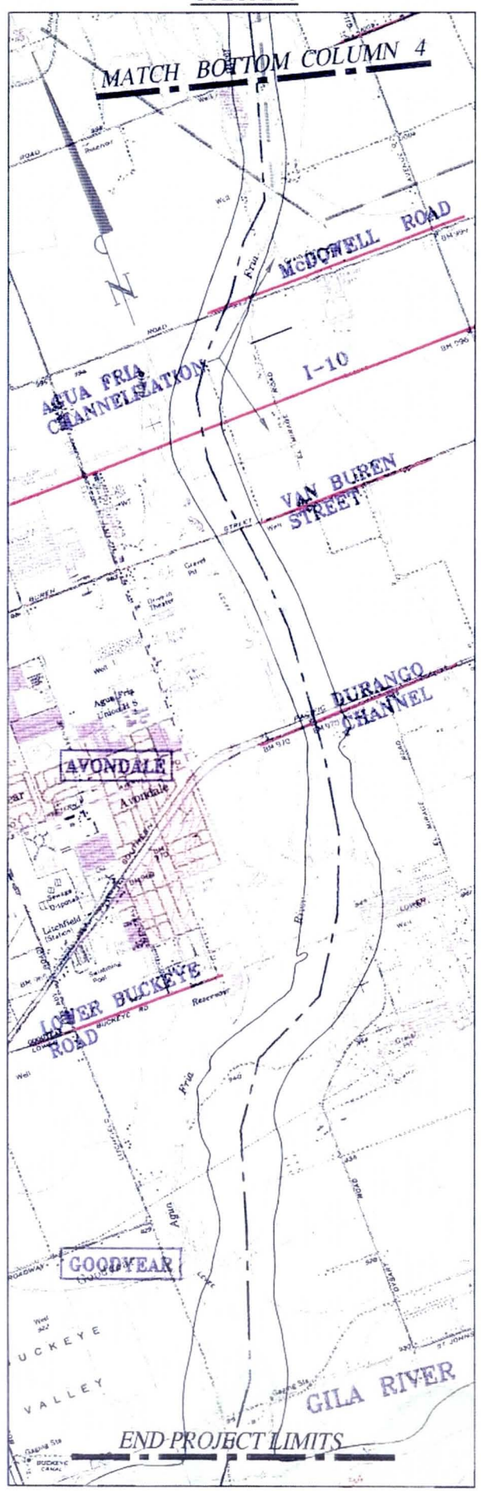
COLUMN 5











WEST VALLEY RECREATION CORRIDOR

AGUA FRIA WATERCOURSE MASTER PLAN

SURFACE HYDROLOGY - FLOOD CONTROL STRUCTURES DISTRICT

FIGURE 3.3

Table 3-2

Existing Levees

Reach	Bank	Protecting
Broadway Road to MC 85	West	Avondale
MC 85 to I-10	East/West	Avondale
I-10 to Indian School Road	East/West	Avondale
Indian School Road to Confluence of New River	East	Camelback Ranch
Confluence of New River to Glendale Avenue	East	Glendale WWTP
Glendale Avenue to Olive Avenue	East	Glendale landfill and Glendale recycling facility
Bell Road to Beardsley Road	East	Coyote Lakes

Over two-thirds of the Agua Fria Watercourse is currently regulated by non-structural flood control methods. With the exception of the levees and bank protection described above, the public is protected from flooding by enforcement of FEMA regulations. Sand and gravel mines and agriculture are the only encroachments into the floodway of the Agua Fria River between New Waddell Dam and the confluence of the Gila River. Existing floodplain encroachments not related to agriculture or mining operations are limited to the fringe areas.

There has been little residential land development within the historic floodplain fringe. However, the west valley is developing rapidly, and there is increasing pressure to build homes along the river. Two housing developments are under construction along the west bank between Olive Avenue and Grand Avenue. Both developments have phases that will be constructed in the floodplain fringe. The homes will be protected by elevating them on fill or with levees.

Several open-walled agricultural sheds are within the lateral migration erosion hazard zone (LMEHZ) on the east bank (lower reach). The sheds within the LMEHZ are also within the FEMA regulatory floodplain. The sheds are awning-type covers, without walls, for storing alfalfa hay. Floodwaters are expected to encroach the shed during a 100-year storm. The sheds are unoccupied and located at least 1,000 feet from the floodway line.

3.1.2 Geomorphology

3.1.2.1 Geology

Section 2.1.2, Geologic Setting, of JE Fuller's *Lateral Migration Report – Agua Fria Watercourse Master Plan*, presents the geologic history of the study area. The complete document is included in the Agua Fria Watercourse Master Plan Technical Memorandums.

Downstream of Lake Pleasant and the New Waddell Dam, the Agua Fria River crosses through the Sonoran Desert of the Phoenix Basin, which lies within the Basin and Range province. This physiographic province is characterized by 2,000 to 4,000 feet high rugged bedrock ranges surrounded by gently sloping aprons of eroded material, called piedmonts. These desert piedmonts consist of series of coalescing alluvial fans typically ranging from 1,000 to 2,000 feet in elevation. The mountain ranges are comprised of metamorphic rocks, granitic intrusions, and

volcanic flows. The alluvial surfaces generally slope away from the mountain "roots" and are comprised of coarse alluvium shed from the adjacent bedrock ranges. The gentle topography of the western Phoenix Basin is typical of the large alluvial basins of southwestern Arizona.

The geologic record indicates that the Agua Fria River channel has experienced net degradation at about 0.02 to 0.06 mm/year over the past two million years. Given that shorter cycles of aggradation undoubtedly occurred within this time period, much higher rates of degradation are implied over shorter time periods. Net degradation of the Agua Fria River created a series of older, stable terraces that effectively define the limits of long-term lateral channel movement. Other existing geologic impacts on the study reach include base level adjustments to the Gila River and land subsidence due to ground water withdrawal. Geomorphic stream classification data indicate that the Agua Fria River is subject to rapid bank erosion rates, except where the banks are stabilized by carbonate-cemented soils, bedrock, or engineered stabilization measures (JE Fuller 2001).

3.1.2.2 Soils

Soil determinations presented below are based on data gathered from the 1977 Soil Conservation Service's (now the National Resource Conservation Service) *Soil Survey of Maricopa County, Arizona, Central Part*, and *Soil Survey of Aguila-Carefree Area, Parts of Maricopa and Pinal Counties*, Arizona Maps.

Upper Reach

The upper reach of the Agua Fria River is composed of three main soils. These soils are: the Carrizo-Brios, which is the main composition of the Agua Fria throughout, the Rillito-Gunsign-Perryville association, on the northern tip, runs on either side, and finally, the Tremant-Rillito Complex, on the southern portion of the upper reach, is set on the eastern side.

The Rillito-Gunsign-Perryville association is nearly level to moderately steep. It is composed of gravelly loams and loams on old alluvial fans and valley plains. The depth of this soil exceeds 60 inches, with a permeability of 0.6 to 2 inches per hour. This soil is good for rangeland and wildlife habitat, and in some areas, when irrigated, is prime farmland.

The Carrizo-Brios association, which composes the entire length of the river, has nearly level to gently sloping gravelly sand loams and sandy loams in stream channels on low stream terraces. This soil reaches depths of over 60 inches and has a high permeability. This soil is used for rangeland, recreation, and wildlife, and in some areas, when irrigated, is prime farmland.

The Tremant-Rillito Complex is gently sloping and is mostly on ridges of old alluvial fans. This complex is a gravelly clay loam, with some sandy loam. This depth is also greater than 60 inches, and if irrigated, is prime farmland.

Middle Reach

The middle reach has the Tremant-Rillito Complex on the western side of the river, with the Rillito-Gunsign-Perryville association on either side on the southern part of the reach. The Carrizo-Brios association is still the main soil that composes the Agua Fria, but in addition, the river is surrounded throughout with a Vint Loamy Fine Sand.

The Vint Loamy Fine Sand is a level or nearly level soil on floodplains and terraces along major streams. Included in this sand is the Brios Sandy loam. Most of Phoenix is on this soil and it is considered prime farmland if irrigated.

Lower Reach

The lower reach of the Agua Fria contains areas of the previously noted soils and two additional soil complexes. West of the river is the Laveen-Coolidge soils, and along the Gila River–Agua Fria River confluence is the Carrizo soil.

The Laveen-Coolidge soil is composed of nearly level sandy loams, loams, and clay loams on old alluvial fans and valley plains. This soil is deep and when irrigated, makes prime farmland.

The Carrizo soil is nearly level and gently sloping, occasionally flooded, and very gravelly or sandy. This soil is evident on flood plains. The Carrizo has a depth of over 60 inches, and has a high permeability. This soil is used mostly for rangeland, but when irrigated, can be prime farmland.

3.1.2.3 Sediment Transport

A sediment trend analysis was conducted to establish existing conditions of the Agua Fria River channel. The details of the models used and their results are included in the *Sediment Trend Analysis Technical* Memorandums. The conclusions drawn from those models are summarized below. The complete memorandums are included in the Agua Fria Watercourse Master Plan Technical Memorandums.

The Agua Fria River has been significantly influenced by human activity, including the construction of New Waddell Dam, sand and gravel mining, construction of bridged roadway crossings, and channelization.

The sediment trend analysis indicates that the Agua Fria River is currently responding to external influences. The river is generally moving sediment from the upstream reach of the river to the downstream reach. The gradation of the materials in the riverbed are more coarse (larger) in the upstream reach and more fine (smaller) in the downstream reach indicating the movement of sands and small gravel from upstream to downstream during flood flows. The sediment transportation process is subject to localized channel conditions that result in inclusions of aggrading and degrading sub-reaches throughout the channel.

3.1.2.4 Lateral Migration/Erosion

Archaeological records imply that channel erosion has affected the Agua Fria River for at least 2,000 years. This indicates that lateral erosion is not caused solely by human impacts on the channel and watershed. Natural cycles of stream degradation, local aggradation, lateral migration, and climate change must be accounted for in development of the erosion hazard zones and the watercourse management plan. Climatic changes have been significant factors in long-term lateral erosion and channel development.

An inventory of changes to the Agua Fria River based on historical maps and aerial photographs indicates that human impacts have been substantial in the past 100 years. These impacts include construction of:

- Eleven major bridges
- Three dedicated at-grade road crossings
- Beardsley Canal flume
- CAP and Roosevelt Irrigation District (RID) siphons
- Aggregate mines
- Numerous levees and grade control structures

- Utility crossings (buried and aerial)
- Landfill
- Recreational facilities
- Groundwater recharge facilities
- Water treatment dams
- Airport flood control dams

Additionally, there has been encroachment by residential development, filling within the floodplain and illegal dumping.

The existing river bears little resemblance to its prehistoric ancestor. Except for the decrease in low flows and reduction of flood peaks due to construction of New Waddell and other dams, human impacts tend to destabilize stream channels and lead to increased rates of lateral erosion due to reduced sediment supply, increased flood flow peaks, and direct excavation of the channel for mining.

Although historical changes in watershed hydrology imply that use of pre-New Waddell Dam channel changes may lead to conservative estimates of future channel movement due to decreased peak flows, historical data does provide the most reliable physical basis for such predictions. While the future lateral movement of the Agua Fria River may be somewhat muted in comparison to past lateral movement, the historical data changes at minimum represent the upper boundary of predictions of future changes. Furthermore, given the uncertainty in flood storage conditions in Lake Pleasant, the potential for large, sustained, erosive outflows from New Waddell Dam still exists. The scale of lateral erosion during such a large flood would be analogous to the scale of erosion during historical pre-New Waddell Dam floods. Therefore, measurements of long-term and single event lateral and vertical erosion were made for the Agua Fria River from historical maps and aerial photographs to establish a baseline of potential channel movement.

Historical channel width and channel position have changed significantly during the past 100 years. Overall, the average channel width decreased from 1,696 feet in 1953 to about 968 feet in 1999, except in the levee reach where the channel was artificially widened during levee construction. Despite this historical narrowing trend, significant lateral movement has occurred. The maximum recorded channel movement was more than 2,200 feet. During the 1980 flood, the channel near Indian School Road widened by more than 1,100 feet. Avulsions were the primary mechanism for the largest long-term channel movements in the study reach. Bed elevations fluctuated throughout the study reach, with an overall decrease (degradation) during the period of record. The maximum measured degradation between 1903 and 1995 was 13 feet, with most of the degradation occurring after 1957. No reaches experienced net aggradation during the period of record, including the reach nearest the Gila River confluence. The rate of lateral movement has been fastest on the youngest, less indurated surfaces and slowest along the margins of the older, more indurated surfaces. Therefore, the older terrace margins serve as a practical limit for predicted future rapid channel change, although the older terraces are also subject to lateral erosion where abutted by the main channel.

Analysis indicates that the Agua Fria River is over-widened and under-deepened and will continue to narrow in the future. Concentration of floods within a narrower, deeper channel will result in higher flow velocities, erosion of the main channel banks, and continued long-term degradation, but decreased potential for avulsions, except during the largest floods. Flood velocities in the main channel generally exceed allowable velocity limits for non-cohesive sediments, even for the 2-year flood. However, where the channel abuts more cohesive older surfaces, the channel velocities are generally less than the allowable velocity thresholds.

Overbank velocities are generally considered erosive, especially for overbank areas dominated by finer-grained sediments and areas of local flow concentrations.

Analysis indicates that the Agua Fria River will continue to degrade during large floods. During smaller floods, the middle reach is expected to remain stable or aggrade slightly. These predictions do not account for the effects of in-stream sand and gravel mining, which tends to accelerate long-term degradation and induce headcutting. In general, the bed material of the Agua Fria River is not large enough to form an armor layer that would prevent long-term degradation. Predicted single-event scour depths are moderate, ranging from about one foot for the 2-year event, to about five feet for the 100-year event. Analysis indicates that lateral erosion and degradation will occur during large floods, but minimal erosion will occur during small floods, except where the channel has been disturbed by human activity.

Three erosion hazard zones are defined for the study reach. These zones are listed and described below:

- Severe Erosion Hazard Zone
- Lateral Migration Erosion Hazard Zone
- Long-Term Erosion Hazard Zone

Severe Erosion Hazard Zone

The severe erosion hazard zone is comprised of the active stream channels and the channel margin areas likely to be eroded during a single 100-year flood or the area likely to be removed if the bank angle was to be reduced to the natural angle of repose. Areas within the limits of existing sand and gravel mining operations were considered to be in the severe erosion hazard zone, as no engineered erosion protection was observed near the mines during field visits.

Lateral Migration Erosion Hazard Zone

The lateral migration erosion hazard zone consists of the channel margin area likely to be eroded by a "typical" series of floods over a 60-year period, plus the erosion that would be caused by a 100-year flood. The lateral migration erosion hazard zone also includes the natural channel movement due to geomorphic processes such as meander migration or channel avulsion. The lateral migration erosion hazard zone includes portions of the floodplain that have been occupied by the main channel during the period of the historical record, unless clear and convincing evidence of future stability was available. In general, the lateral migration erosion hazard zone included areas outside the regulatory floodway of the Agua Fria River.

Long-Term Erosion Hazard Zone

The long-term erosion hazard zone consists of the channel margin area defined by geologic evidence of channel movement over the past 100 to 1,000 years and represents expected or potential channel movement over the next 60 to 1,000 years in the future. The boundary of the expected long-term erosion hazard zone envelopes the results of all the predictive methods used to assess channel stability, in addition to application of engineering judgment and interpretation of the site geomorphology. Portions of the areas mapped as older geomorphic surfaces, but adjacent to active channels and floodplains, were generally included in the long-term erosion hazard zone. Areas protected by engineered levees or other bank protection were considered the outside limit for the long-term erosion hazard zone.

In general, high rates of single event and long-term erosion should be expected, except where structural flood control measures are provided (JE Fuller, 2001).

3.1.3 Land Use and Relevant Planning

3.1.3.1 Commercial and Residential Development

The Upper Reach of the Agua Fria River is generally undeveloped from New Waddell Dam to Jomax Road. Infrastructure within this reach includes the State Route 74 Bridge, the Central Arizona Project (CAP) canal below grade crossing, the Beardsely Canal above grade crossing, electrical transmission lines and several at-grade road crossings. Residential development has occurred in the lower portion of this reach, primarily on the east overbank area. Some of the residential development has encroached the historic floodplain. Several other residential developments on both sides of the river are in the planning stages. The existing and planned sand and gravel facilities are noted in Section 3.1.3.2.

The Middle Reach of the river has significant development. Numerous roads cross the channel (both at-grade and bridged) and several utility lines are also located within the reach. Residential development is common up to the boundary of the floodplain. New residential subdivisions are planned or are under construction within the floodplain fringe. This reach is constricted and well incised.

Within the Lower Reach of the Agua Fria River from the New River confluence to Maricopa County Route (MC) 85, the river has been extensively channelized. The river is contained in nearly continuous levees within this reach. This reach contains several grade control structures. With the exception of some utility crossings, bridges, and power pole bases, there is no development within the River. The levees, designed and constructed by the Corps to the standard project flood (SPF), terminate near MC 85. Numerous agricultural fields are located within the floodplain downstream from MC 85.

3.1.3.2 Sand and Gravel Mining

Sand and gravel mining has been taking place within the river channel and its floodplain since at least 1949 (based on examination of aerial photographs) resulting in the removal of a significant amount of sediment from the Agua Fria River. This is further compounded by the New Wadell Dam, which traps upper watershed sediment and eliminates periodic downstream flows. These two factors result in an increased potential for significant degradation, or lowering, of the bed of the Agua Fria River (JE Fuller, 2001).

Upper Reach

There are numerous active, inactive, or planned aggregate operations within the Upper Reach of the Agua Fria channel (**Figure 3.4).** A pit is located immediately south of Beardsley Road on the east side of the river. This pit is outside of the 100-year floodplain and is owned by the operation between Beardsley Road and Rose Garden Lane. This active operation, which spans both sides of the river, is within the regulatory floodway and floodway fringe. An active operation on the west side of the river extends from Rose Garden Lane to north of Deer Valley Road. This operation is outside the 100-year floodway. To the west of this operation, there is an active mining operation across the Deer Valley Road alignment on the west side of the river. This operation is within the regulatory floodway and floodway fringe. There is one active operation north of Pinnacle Peak Road on the east side of the river. This operation is within the floodway fringe. There are two sand and gravel operations near the Pinnacle Vista Drive alignment on the west side of the river. The operation to the south is outside of the 100-year floodplain. The active operation to the north

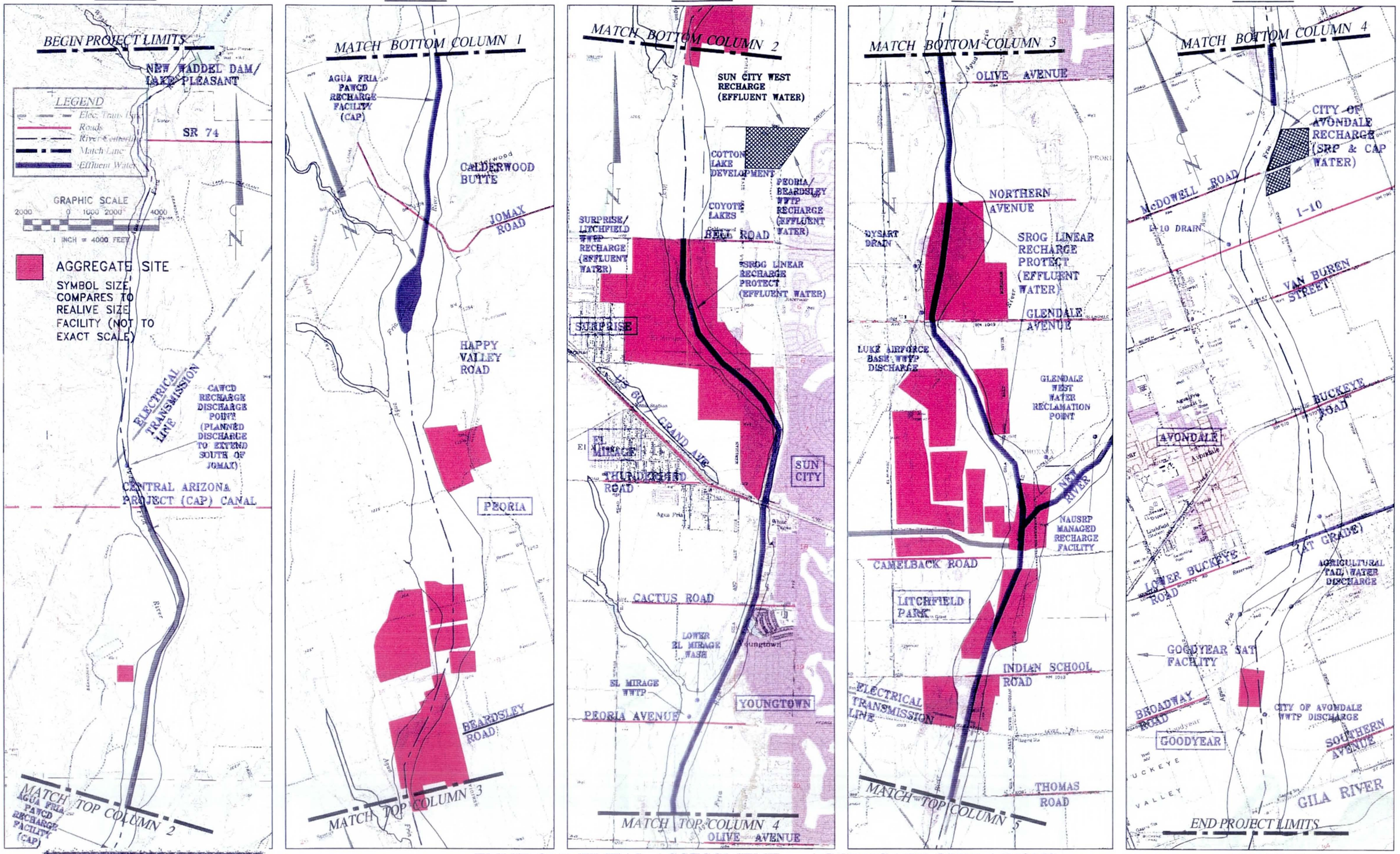
COLUMN 1

COLUMN 2

COLUMN 3

COLUMN 4

COLUMN 5



WEST VALLEY RECREATION CORRIDOR

AGUA FRIA WATERCOURSE MASTER PLAN

ENVIRONMENTAL ASSESSMENT - AGGREGATE OPERATIONS

FIGURE 3.4

is encroaching upon the floodway fringe. There is also an active operation at the Dixileta Drive alignment on the west side of the river, which is outside the 100-year floodplain.

Middle Reach

The Middle Reach of the Agua Fria River is heavily mined. One sand and gravel operation exists just north of Bethany Home Road on the east side of the river. This is an active operation that is within the floodway fringe. There is a large active operation extending from Glendale Avenue to Northern Avenue that is within the regulatory floodway and floodway fringe. Two active operations exist midway between Northern Avenue and Olive Avenue, one on each side of the river. The operation on the west side of the river is outside of the 100-year floodplain. The operation on the east side of the river is within the floodway fringe. A very large sand and gravel operation extends from Grand Avenue to Bell Road. This active operation, which spans both sides of the river, is within the regulatory floodway and floodway fringe.

Lower Reach

The Lower Reach of the Agua Fria River is also heavily mined. The active sand and gravel operation that extends from Indian School Road to Camelback Road on the west side of the river is outside of the 100-year floodplain. There are, however, mining pits extending from Indian School Road to Camelback Road that are within the regulatory floodway. These pits appear to be inactive, but may now be part of the operation to the west. Additionally, there is a mining pit on the east side of the river just north of Indian School Road, which is outside of the 100-year floodplain. There are three active sand and gravel operations at the confluence of the Agua Fria River and New River. These operations extend from Camelback Road to Bethany Home Road on the west side of the river and are within the floodway fringe (Kimley-Horn and Associates, 2001).

Currently, mining operations within the "ordinary high water mark " of the channel are considered to be within jurisdictional waters of the United States under Section 404 of the Clean Water Act. As such, the U.S. Army Corps of Engineers (Corps) regulates these areas. Corps guidelines for activities in jurisdictional waters include recommendations for aggregate operations near Corps funded, regulated etc. facilities. These guidelines were published by the Los Angeles District of the Corps (District of Jurisdiction for the Agua Fria River area), which has a Field Office in Phoenix, Arizona.

These recommendations include:

- Incorporation of set back from bridges and utilities of 500 feet, and maximum pit depths no deeper than that allowed by a 1% slope (a pit initiated 500 feet downstream from the structure would be no deeper than 10 feet deep at a point 1,000 feet downstream from the bridge or utility).
- Pit depths would not be lower than the existing thalweg elevation.
- Pits would be set back from channel banks 500 feet, and pit depths would be limited to being no deeper than a 10:1 slope as measured from the setback.
- Mining operations should be continuous and not be set up to promote skipping over land areas.

The recommendations may or may not be applicable to the various operations within the Agua Fria River Corridor because there are no Corps facilities/structures in the near vicinity of the mining operations. Additionally, some of the operations have been "grandfathered" under previous Corps regulations. They are currently operating under previous agreements with the regulatory agencies. Corps regulation and policy is subject to change.

3.1.3.3 Agricultural

Prior to the beginning of the 20th century, much of the lower Agua Fria watershed was cultivated by European settlers. Water for irrigation was supplied both by the Agua Fria River from the Salt and Verde Rivers via an elaborate system of canals. Farm fields encroached into the river's floodplain to take advantage of the fertile floodplain soils deposited by the river.

Historically, the area near the Agua Fria River was used for fruit production in operations such as Sahuaro Ranch, which is further described in the Cultural Resources Section of this document.

Currently, agriculture land use is predominant in the area from the confluence of the Gila River to Broadway Road. Scattered agricultural activity is noted along portions of the entire corridor, although many agricultural areas have been consumed by residential and commercial development. Citrus orchards are present in the west overbank of the Agua Fria River near the Lone Mountain Road alignment.

3.1.4 Biological Resources

3.1.4.1 Vegetation Communities

A more detailed description of the ecological resources along the study corridor is contained within the Technical Report *Ecological Evaluation of Agua Fria River Corridor New Waddell Dam to Gila River.* **Figure 3.5** notes the general location of the various vegetation communities within the corridor.

Field reconnaissance revealed five vegetation communities throughout the Agua Fria River Corridor:

- Early Level Successional
- Sonoran Upland
- Agricultural
- Mesic/Hydric Riparian
- Commercial/Residential/Disturbed

Early-Level Successional Community

The Early-Level Successional community is located within the low terrace banks of the Agua Fria River channel from south of the State Route 74 Bridge crossing to near the confluence with the Gila River. This community is relatively heterogeneous throughout the corridor with the exception of areas where the sand and gravel mining operations exist. It is also interspersed with small inclusions of the mesic/hydric riparian community in several areas. This community is composed of ruderal, invasive or early level successional species with isolated inclusions of mid-level successional species and dominated by annual/perennial herbaceous and low-growth shrub species. In areas of recent or repeated disturbance the vegetation community is dominated by annuals or is barren. The transition zone between this community and the adjacent communities is relatively abrupt and is driven by the moisture regime and by the development of hard-pack desert soils along the terrace banks.

Sonoran Upland Community

The Sonoran Upland Community includes both the Arizona Upland Subdivision and Lower Colorado River Valley vegetation communities since the transition between these two

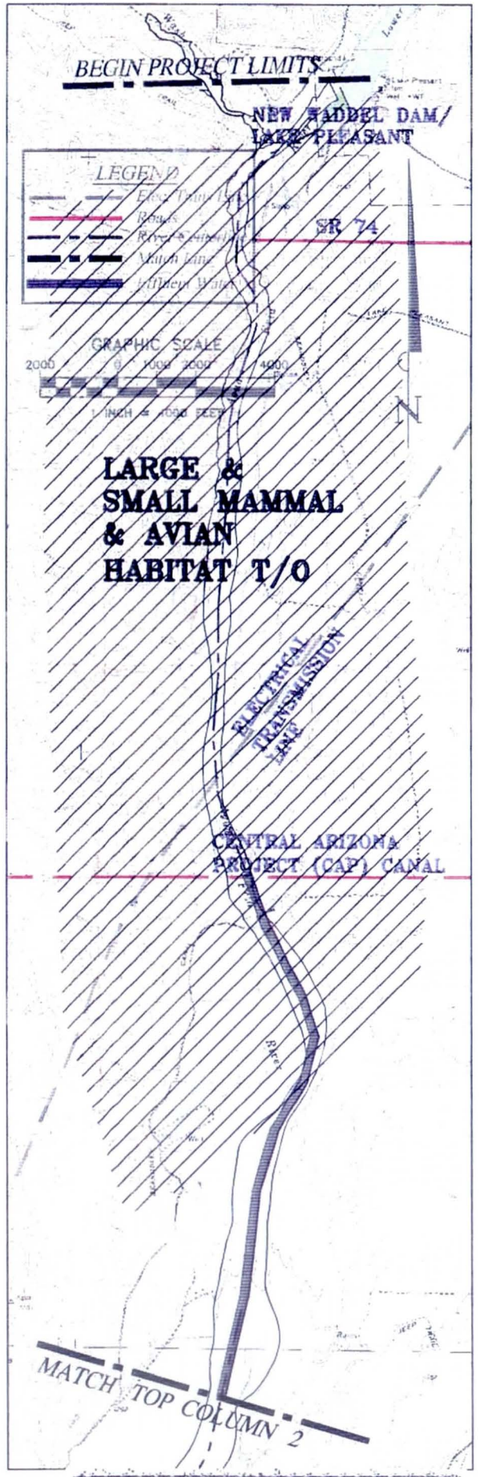
COLUMN 1

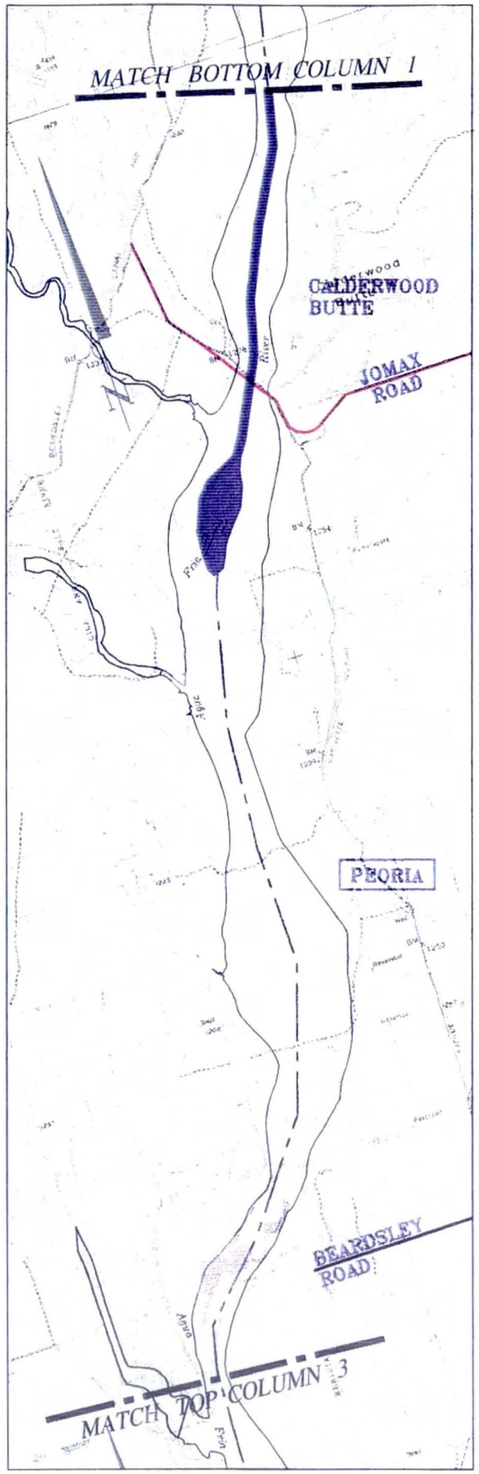
COLUMN 2

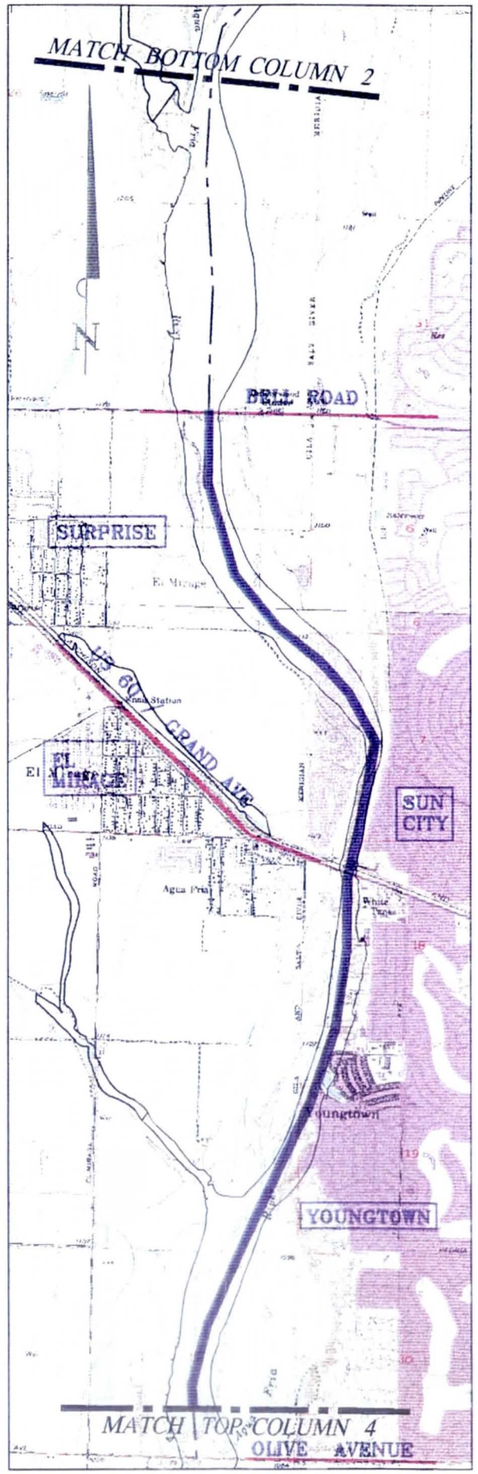
COLUMN 3

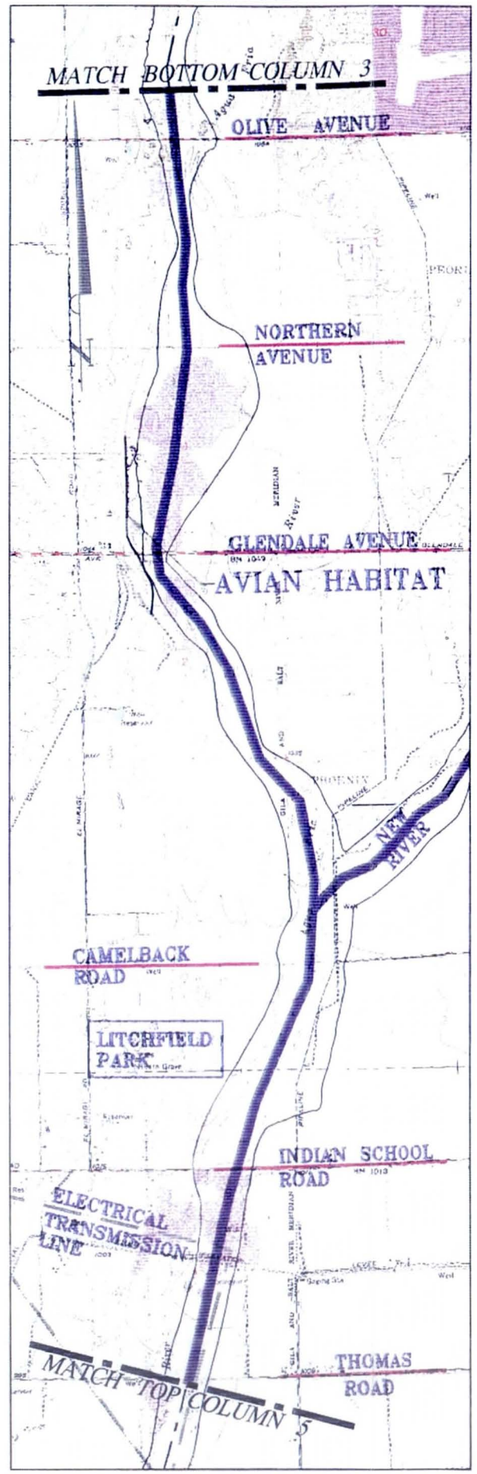
COLUMN 4

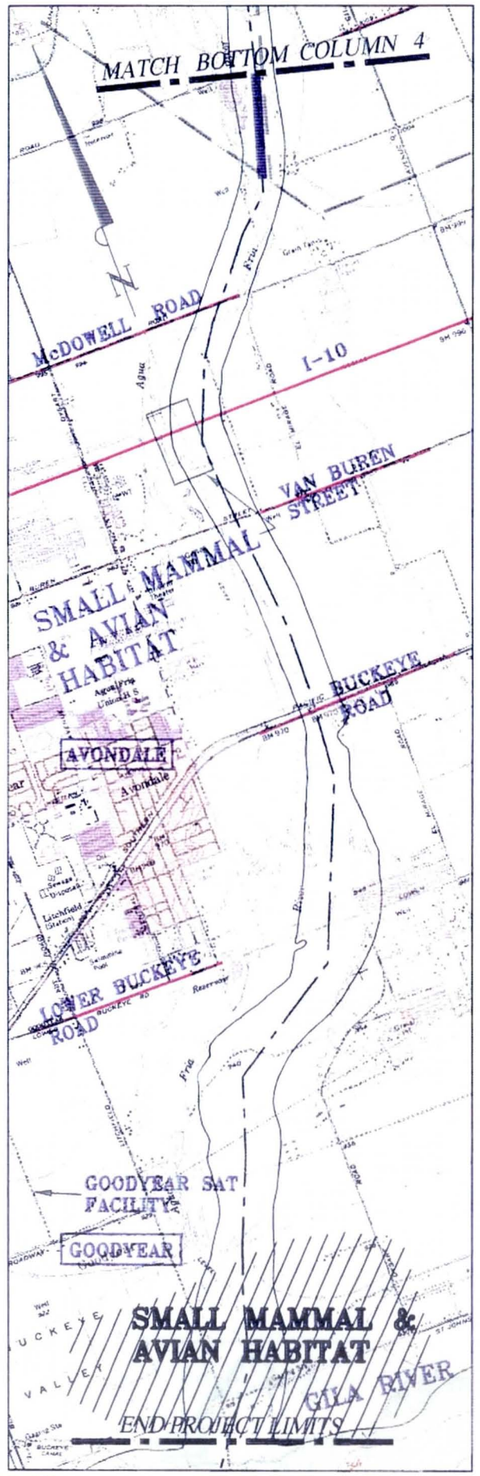
COLUMN 5











WEST VALLEY RECREATION CORRIDOR

AGUA FRIA WATERCOURSE MASTER PLAN

ENVIRONMENTAL ASSESSMENT - WILDLIFE HABITAT VEGETATION COMMUNITIES

FIGURE 3.5

communities are not well defined within the project corridor. Vegetation densities within the Sonoran Upland community vary as a function of the surrounding landform. The northern portion of the Agua Fria corridor has numerous incised, ephemeral washes that exhibit some of the highest vegetation cover densities along the corridor. These communities consist of woody desert scrub vegetation that is concentrated along the margins of the washes. The surrounding upland areas also contain some of the same woody species but are primarily dominated by succulents.

Agricultural Community

The Agricultural Community includes areas that are currently or historically under crop production or structured pasture areas. The majority of these active areas are in the southern portion of the corridor, south of the I-10 Bridge. Orchards were identified in the upper reach of the corridor north of Calderwood Butte and south of the CAP crossing. The agricultural species consist of cotton, alfalfa, and citrus. Most of the agricultural areas have been cleared of native vegetation and have been graded to promote irrigation.

Mesic/Hydric Riparian Community

The Mesic/Hydric Riparian Community consists of vegetation along the intermittent or perennially wet portions of the Agua Fria River Corridor. It is found in the northernmost portion of the corridor from the New Waddell Dam to below the SR 74 crossing. It is also noted in several areas where near permanent surface discharge outfalls to the Agua Fria channel such as I-10, wastewater treatment facilities, and sand and gravel mining operations. It includes woody vegetation as well as the herbaceous vegetation associated with the ponded areas. This community differs from the xeric-riparian community because of the increase in moisture dependent species.

Commercial/Residential/Disturbed Community

The commercial/residential vegetation communities include golf courses, landscape medians, buildings, paved areas etc. Most of the landscaped areas are irrigated and maintained.

3.1.4.2 Wildlife Populations and Habitat

Field reconnaissance revealed wildlife usage through sightings, animal signs and habitat potential. Several animal and avian species were identified throughout the Agua Fria River Corridor. The most valuable wildlife habitat was noted in the northern portion of the upper reach, the Gila River Confluence area, (southern lower reach), and in the scattered areas of increased moisture along the corridor. This coincides with the areas marked as mesic/hydric riparian on Figure 3.5. The remainder of the corridor provides moderate habitat value for avian small mammals and herptofauna. The area development and in-channel activity has significantly degraded the channel's forage, cover, and travel functional values.

3.1.5 Protected Species

3.1.5.1 Endangered Species Act Listed Species

The United States Fish and Wildlife Service (USFWS) lists three plant species as endangered species that may occur in Maricopa County and lists eleven threatened and endangered animal species. These species are listed below in **Table 3-3**.

Table 3-3

Federally Listed Species that may occur in Maricopa County

COMMON NAME	SCIENTIFIC NAME	STATUS
Plant		
Arizona Agave	*Agave arizonica*	ENDANGERED
Arizona Cliffrose	*Purshia subintegra*	ENDANGERED
Arizona Hedgehog Cactus	*Echinocereus triglochidiatus arizonicus*	ENDANGERED
Animals		
Mexican Spotted Owl	*Strix occidentalis lucida*	THREATENED
Desert Pupfish	*Cyprinodon macularius*	ENDANGERED
Bald Eagle	*Haliaeetus leucocephalus*	THREATENED
Yuma Clapper Rail	*Rallus longirostris yumanensis*	ENDANGERED
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	ENDANGERED
Sonoran Pronghorn	*Antilocapra americana sonoriensis*	ENDANGERED
Razorback Sucker	*Xyrauchen texanus*	ENDANGERED
Brown Pelican	*Pelecanus occidentalis*	ENDANGERED
Cactus Ferruginous Pygmy-Owl	*Glaucidium brasilianum cactorum*	ENDANGERED
Lesser Long-Nosed Bat	*Leptonycteris curasoae yerbabuenae*	ENDANGERED
Gila Topminnow	*Poeciliopsis occidentalis occidentalis*	ENDANGERED

http://arizonaes.fws.gov/

The technical report *Ecological Evaluation of Agua Fria River Corridor New Waddell Dam to the Confluence with Gila River* provides a more detailed discussion of the protected species evaluation for the corridor. No species listed under the endangered species act were sighted during the numerous field visits to the site. However, potentially suitable habitat was noted for the following listed species.

Bald eagle

The corridor contains suitable nesting sites throughout, although they are concentrated in the northern and extreme southern portions of the corridor. These areas are in proximity to open water areas and other suitable forage habitat. While the bald eagle is currently in the delisting process, it is still protected under the Endangered Species Act (ESA) and will be protected under other federal regulations after ESA delisting. Areas of suitable habitat should be field surveyed for the presence of eagles prior to initiating potentially disturbing activity.

Yuma clapper rail

The Gila River confluence has potentially suitable habitat for the Yuma clapper rail. The George's Pond area (extreme northern portion of the Upper Reach) has marginally potential

habitat for the species. These areas should be surveyed for the presence of the Yuma clapper rail prior to initiation of disturbance activities.

Southwestern willow flycatcher

The dense shrub growth and wet substrate considered suitable habitat for the southwestern willow flycatcher is present along the Gila River confluence. These areas will require protocol specific surveys prior to disturbance activity in the area.

Cactus ferruginous pygmy owl

The Upper Reach contains the multi-story cactus/shrub habitat favored by the owl. However, the Agua Fria River Corridor is north of the currently accepted range of the species. It is unlikely that the species inhabits the area, and protocol specific surveys should not be necessary for private actions. However, for projects with a federal nexus, surveys could be required in areas with suitable habitat.

Lesser long nosed bat

Suitable habitat for the lesser long nosed bat includes the Sonoran Upland (Cacti/Paloverde) vegetation community located in the Upper Reach of the corridor. It is likely that the lesser long nosed bat is utilizing portions of the Agua Fria River Corridor.

Gila Topminnow

The range of this species originally included the Gila River. It has been reintroduced into seven regions of southern Arizona.

3.1.5.2 Other Protected Species

The technical report *Ecological Evaluation of the Agua Fria River Corridor New Waddell Dam to Confluence with Gila River* details the species listed by other federal or state agencies. These species have been identified by other agencies as requiring additional management strategies to ensure continued stable populations. Most of these species do not have regulatory protection unless the proposed activity is planned on agency managed lands. The agency recommendations can also be implemented through agency comment on other federal actions (such as Section 404 permits). Portions of the Agua Fria River Corridor are managed by several federal and state agencies.

3.1.6 Visual Environment

The technical report, *Visual Resources and Scenic Quality Assessment – Agua Fria Watercourse Master Plan*, describes and evaluates the visual environment of the study area. The complete document is included in the Agua Fria Watercourse Master Plan Technical Memorandums.

3.1.6.1 Landscape Character Types

The Agua Fria River Corridor contains a variety of qualities that contribute to the visitor's experience. The Agua Fria Corridor has areas of scenic beauty, especially along its northern reach between the New Waddell Dam and Jomax Road. Dramatic stands of Saguaro and Cholla dot the uplands through which the river carves its way. Panoramic mountain views are visible from almost the entire length of the river. The river corridor contains expanses of open land in an otherwise developed landscape.

The character and condition of a landscape can be defined with a series of factors, including topography, climate, soils, vegetative cover and landscape. Landscape character gives a

geographic area, a visual and cultural image, and consists of the combination of physical, biological and cultural attributes that make each landscape identifiable and unique. The existing landscape character along the project area ranges from predominantly natural landscapes to those that are heavily culturally influenced. Landscape character studies in the Agua Fria River Corridor identified seven distinct landscape character types defined as zones in the study. The following table summarizes the landscape channel character types and compares them to the vegetation communities identified in Section 3.4.

Table 3-4

Landscape Character Types

Landscape Character Type Zones	Description	Location	Corresponding to Natural Resource Category
Hydric Riparian Zone	▪ Open water perennial flow ▪ wetlands	▪ Upper reach ▪ New Waddell Dam to CAP	Mesic/hydric riparian
Mesic/Xeric Riparian Zone	▪ Intermittent flows ▪ High groundwater levels	▪ I-10 and Buckeye road crossings ▪ Several aggregate mine sites ▪ Other areas	Mesic/hydric riparian
Upland Scrub Zone	▪ Open ranges desert similar to Sonoran Upland	▪ Upper reach	Sonoran Upland
Ephemeral Channel Zone	▪ Low grounding ▪ Sparse vegetation ▪ Ruderal/invasive	▪ Middle and portions of upper lower reach	Early Level Successional
Urban Development Channel Zone	▪ Influenced by landscape/invasion or disturbed	▪ T/O primary southern upper, northern lower, and complete middle reach	Commercial/Residential/ Disturbed
Rural Zone	▪ Undeveloped or agricultural scattered residential	▪ Upper and southern lower reach	Agricultural
Sand/Gravel Zone	▪ Aggregate operations	▪ Scattered T/O primary middle	Commercial/Residential/ Disturbed

3.1.6.2 Visual Resource Inventory

The following points of interest were identified along the Agua Fria River Corridor that have exceptional qualities that define the character of the corridor and contribute to the visitor's experience:

- **Lake Pleasant** is located north of the Waddell Dam, in the Arizona Upland Region and was formed by the damming of the Agua Fria waters.

- **George's Pond and associated areas** are located immediately south of the Waddell dam; the river channel is deeply incised into the rocky surface characteristic of the upland regions. This is one of the few truly hydric riparian habitats that was seen in the corridor.
- **Beardsley Canal Bridge** is the bridge flume that carries water from the Beardsley Canal across the Agua Fria River. It is a historic canal that serves as an innovative example of water transportation across difficult terrain.
- **Citrus Grove** is located on wide alluvial floodplains within the corridor. Agricultural practices are being replaced with sand and gravel mining.
- **Casa De Piedras** is an archaeological site on the corridor that includes a medium pithouse village of Hohokam Indians.
- **Calderwood Butte** is located just north of Jomax Road east of the river corridor. These are conspicuous hills, with no other ranges occurring in immediate view. They include stark rocky slopes.
- **Park Sites** include those identified along the corridor: Coldwater Park, Maricopa Lake Park, and Regional Park II in Phoenix. They are open space recreational areas.
- **Avondale Waste Water Recharge Pond** is series of constructed wetlands fed by water discharged from the Avondale Treatment Plant. These manmade wetlands have now become a haven for aquatic wildlife, birds and small mammals.
- **Chicken Ranch** is located immediately north of the confluence of the Agua Fria River and the Gila River. It was created as a mitigation site and has become a popular habitat area for birds and small mammals.
- **Gila River Confluence**, where agricultural fields and rural residences occupy the confluence of Agua Fria River and the Gila River. Thick mesquite bosques inhabit the river edge. Within the river channels certain sections are being used for water retention creating rich riparian habitats with lush vegetation and abundant wildlife.

3.1.7 Infrastructure

There are presently 15 bridges that cross the Agua Fria River (13 road bridges and two railroad bridges). Six of the roadway bridges and one railroad bridge completely span the soil cement channelized reach of the river. The Beardsley Canal Flume also completely spans the river. The remaining six bridges constrict the river's historic width to one extent or another. At least two more major crossings are planned for the future: the Loop 303 crossing near the Lone Mountain Road alignment and the new Estrella Roadway crossing near the Happy Valley Road alignment (JE Fuller, 2001). Numerous above and below ground utilities span or run within the channel or floodplain of the river. A more complete description of infrastructure along the corridor is contained in the *Agua Fria River Lateral Migration Report* and the *Hydraulic Analysis for the Agua Fria Watercourse Master Plan.*

3.1.8 Cultural Resources

The technical reports, *Historic Cultural Resources Along the Agua Fria River Between the Gila River and Waddell Dam* and *A Selected Sample of Prehistoric and Historic Sites of the Western Salt River Valley, Arizona* were prepared to document the existing cultural resources within the corridor. Additional research was conducted and is presented in the technical reports, *West Valley Common Ground: The Agua Fria River, Watercourse Master Plan Area A Selected Sample of Prehistoric And Historic Sites of the Western Salt River Valley, Arizona* and *The Agua Fria: A Working River for the West Valley Themes and Historic Sites.*

The following is a general summary of the results of those investigations.

3.1.8.1 Archaeology

The prehistoric sites identified along the Agua Fria River Corridor were evaluated by Scientific Archeological Services in a report called *A Selected Sample of Prehistoric and Historic Sites of the Western Salt River Valley, Arizona* dated November 22, 2000. The significance of the sites was based upon site age, location, and interpreted function. The four major interpreted functions or themes were as follows: canal water control, natural resource exploitation, rock art production, and residential. Most, if not all, of the prehistoric activity, in the project area was undertaken by the Hohokam Indians.

Since survival in the desert is dependent upon water availability, the design of canals in the Salt and Gila River valleys allowed the Hohokam Indians to create the largest prehistoric irrigation system in all of North America. Within the West Valley region prehistoric canals occur mainly along the New River and the Agua Fria River. The canals consist of short masonry dikes, or diversion walls, for diverting natural flow into canals, diversion canals for initially conveying water immediately away from the intakes and main canals for transporting water over long distances. It also includes smaller distribution canals that transfer water from the main canals to smaller lateral canals, to empty into reservoirs or onto fields.

The residential life of the Hohokam Indians was represented by the many architectural structures, intrasite features and artifactual assemblages. There are six different types of Hohokam settlements in the West Valley, three of which appear prior to about 1100 A.D. These three settlements included villages, hamlets, and farmsteads. The normal domestic structures at all three of these sites types were pithouses, which had shallow earth floors and sidewalls and roofs that were constructed of poles, brush and dirt. The remaining three types of settlements that occur after 1100 A.D. had masonry construction. The three types of residential dwellings at these sites are known as compound villages, smaller roomblocks and smaller field houses.

Natural resource exploitation was important to sustain the Hohokam Indian way of life. The most common types included indigenous plants and animals, materials for pottery, flaked stone and ground stone tools. A Hohokam site that is noted primarily for the manufacturing of natural resources occurs within the study area.

The Hohokam Indians were also known for the production of rock art. All of the rock art in the West Valley is limited to petroglyphs, or individual designs that were usually created by pecking through the darkly painted, or naturally varnished, surface of chiefly igneous rock. The two most noted sites in the West Valley are Calderwood Butte and Hedgpeth Hills. The latter site is one of the most significant archeological sites of central Arizona. It occurs just north of Beardsley Road at the southeastern tip of Hedgpeth Hills. No fewer than 1,571 petroglyphs occur at this site and one of the largest and most interesting of the rock art panels is located on 579 boulders of andesite. They represent human, animal, plant or abstract geometric designs. The art is believed to be attributed to the Hohokam Indians, the Patayan Indians, and even hunters and gatherers of the earlier Archaic period.

3.1.8.2 Historic Resources

Native Americans

Due to its location between the plentiful resources found along the Salt and Gila Rivers and those in the uplands of the Bradshaw Mountains, the more arid project area was not utilized for habitation by historic Native Americans. The only known historic settlement in the area was an

Akimel O'odham (Pima) Rancheria located on the north bank of the Gila River near its confluence with the Salt River. The exact location of this settlement is unknown.

The Pima and Maricopa resource areas encompassed the Hassayampa, Salt, and Gila Rivers and the land in between, including the lower and middle reaches of the Agua Fria River. The Kewevkapaya, or Southeastern Yavapai, utilized the middle and upper reaches of the Agua Fria River. Their traditional homeland extended from the Bradshaw Mountains to the Tonto Basin to the Superstition and Pinal Mountains. There was minimal territorial overlap between the groups, who traditionally were enemies. All three groups utilized the Agua Fria region for the numerous wild resources found there, including saguaro fruit, mesquite beans, and various tubers. Hunters found some deer, but concentrated mainly on small birds and rabbits.

Anglo Americans

Historic Anglo American use of the Agua Fria River may date back to the early 1800s when Sylvester and James Patty explored and trapped along the middle Gila River. It is unknown if their travels took them north along the Agua Fria River, but they are likely to have explored the confluence of the two rivers.

During the mid to late 1800's, the Agua Fria River valley was an area that people passed through on their way to settle elsewhere. The discovery of precious metals in the Wickenburg, Arizona area created additional traffic through the region. The road leading to Wickenburg started at the confluence of the Salt and Gila Rivers and crossed the Agua Fria River. As settlement increased east of the Agua Fria River, additional wagon roads crossed the river in various locations. The stagecoach routes and wagon roads that developed linked the mines in the Bradshaw Mountains with the agricultural areas along the Salt River. The first developments along the Agua Fria River were stage and wagon stops. Many of the stage and wagon stops were abandoned after the 1895 construction of the Santa Fe, Prescott and Phoenix Railway.

The first irrigation system in the Agua Fria River area was organized in 1885, when a dam site and canal heading were located at the confluence of the Agua Fria and Gila Rivers. The canal created, the Buckeye Canal, has delivered water to the Buckeye Valley since its construction. This lead to increased Euro-American settlement of the area.

In 1916, the Goodyear Tire and Rubber Company organized the Southwest Cotton Company, which purchased 16,000 acres of desert land along the Agua Fria River. The expansion and development of the Goodyear farms led to the organization of a company town of Litchfield. Ultimately, the Southwest Cotton Company expanded into experimental farming, crop rotation research, farm machinery development, and pneumatic rubber tire development.

Other communities that developed around the same time as Litchfield include Avondale, and Peoria. Goodyear became an independent community in the 1940's after the success of the Goodyear Aircraft Corporation's airplane manufacturing plant. Cattle ranches were also prevalent in the area around the Agua Fria River.

Agriculture continued to be the economic base for all communities along the Agua Fria River, until the expanding Salt River valley population began to make it more profitable to use the land for housing. Since the 1950's, the population has continued to grow, and many areas have been sold to developers for residential and commercial centers. Retirement communities, such as Youngtown and Sun City were also developed.

Communities

Today, 11 communities include the Agua Fria River within their borders. Those communities are Peoria, Sun City, Sun City West, Surprise, Youngtown, El Mirage, Glendale, Phoenix, Litchfield

Park, Avondale, and Goodyear. Historically, there were four others: Frog Tanks, Camp Dyer, Camp Pleasant, and Marinette.

3.1.8.3 Historical Themes

The technical memorandum, *The Agua Fria River: A Working River for the West Valley Themes and Historic Sites*, is included in the Agua Fria Watercourse Master Plan Technical Reports. The following is a brief summary of the Historic Themes Report

Historians identified six themes that provide an overview of the cognitive map for the Agua Fria River and the West Valley history.

- Land Surveying
- Transportation
- Water control
- Homesteading and corporate farming
- Resource exploitation
- Residential life

Each theme has a corresponding representative site (or sites) that signifies and exemplifies the theme. The sites work collectively to enable us to understand geography, history, settlement patterns, economic forces, and personalities that shaped and continue to shape West Valley landscapes. These themes and representative sites are described below.

Surveying

Development began in the Agua Fria area after the national standard for surveying was established. The grid system that established township, range, and section shaped the West Valley and provided a framework for its development. The representative site for this theme is Initial Point.

Initial Point serves as the starting point for all public surveys in Arizona. Initial Point is on top of a hill near the confluence of the Salt and Gila Rivers. It defines the north/south Gila and Salt Meridian and the east/west Baseline. The site marked the international boundary between Mexico and the United States from 1851-1853. The grid system established at Initial Point created the legal framework for ownership and development patterns. The framework is visible today in the spatial arrangements we impose of the desert, and the grid system shapes our patterns of land use, fields, roads, and housing. Currently, Initial Point is marked with a concrete monument that overlooks the Phoenix International Raceway.

Transportation

Transportation systems initially supported communication and travel through the area and eventually supported communication and travel within the area. In incremental steps, national transportation and communication lines linked the Salt River valley with the rest of the country. Calderwood Stage is the representative site for this theme.

Martin Heald Calderwood established the Agua Fria Station on the Black Canyon stage road, north of the Coldwater stage stop. He operated a series of stations along the Agua Fria River. The stage stops, located on the east side of the Agua Fria River, provided travelers water, rest, feed for horses, and accommodations. The stops were along the two major stage lines from Phoenix to Prescott; one of which went over to Wickenburg and then up Yarnell Hill and the other up the Black Canyon. The 1860's and 1870's were a time of road creation, during which the trip between Prescott and Phoenix decreased from 200 to 100 miles. There are no historic

remains of the Agua Fria or Calderwood Stations. When the Santa Fe, Prescott and Phoenix Railway linked Prescott and Phoenix, the stage lines were abandoned.

Water Control

Water is the key to development in the desert southwest. Storing, diverting, channeling, and delivering water to where it is needed is the major story of West Valley growth. The Buckeye Canal Company, the Agua Fria Land and Water Company, and the Roosevelt Irrigation District all opened up parts of the West Valley. The historic Waddell Dam unified the storage and delivery system of the Agua Fria River water and, along with the Central Arizona Project (CAP), the New Waddell Dam assures supplies for the future. Sites that represent this theme include Waddell Dam, the Beardsley Canal, and the CAP siphons.

Upon its completion in the 1920's, Waddell Dam was the largest concrete, multiple arch dam in the world. It functioned for the West Valley for 50 years. When the New Waddell Dam was constructed, the old dam was submerged. New Waddell Dam, with a clay core and layers of sand, gravel, and rock, also added hydroelectric power generation and enlarged the recreational aspects of Lake Pleasant. In the 1990's, water from the Colorado River reached the West Valley via the CAP aqueduct, and the earth and rock filled New Waddell Dam now holds back a lake five times larger than the original lake.

The Beardsley Canal is a principle conduit of water from the Agua Fria River for West Valley irrigation. The 33 mile canal and hundreds of miles of laterals from the canal have served the West Valley for 65 years. Only four miles of canal were constructed by 1892. The remaining 29 miles of canal were constructed in 1926 and 1927. The canal required a variety of engineering solutions to carry the water through different terrains, best exemplified by the bridged flume used to carry water across the Agua Fria River. Repairs and maintenance have been conducted since 1935, so only the location remains historic.

The CAP is a concrete aqueduct that brings Colorado River water to central Arizona. Colorado River water crosses under the Agua Fria and New Rivers by siphons. Construction of the CAP began in 1973 in Lake Havasu City in northwestern Arizona and ended in 1993 when the water reached the San Xavier Indian community in southeastern Arizona. Today, the CAP delivers water to cities and water utilities, agricultural users, and Native American communities in Maricopa, Pinal, and Pima Counties.

Homesteading and Corporate Farming

As a consequence of the Homestead Act of 1862 and the Desert Land Act of 1877, 640-acre homesteads were common in West Valley early 20th century agriculture. Taking advantage of rich alluvial soils, level land, and available irrigation water, West Valley agricultural productivity rivaled that of California. The area's unique conditions for cotton production enticed large corporate farmers during World War I when usual supply sources were cut off. Large-scale corporate farming gave rise to the need for farm laborers, and farm labor communities appeared throughout the West Valley. Sahuaro Ranch and El Mirage are representative sites for this theme.

Sahuaro Ranch is a show place of West Valley agricultural heritage. The evolution of Sahuaro Ranch reflects the major forces that shaped Salt River valley agriculture: the availability of irrigation, the unique conditions, technologies, the life span of the agricultural economy, and personalities that experimented with desert agriculture.

The completion of the Arizona Canal in 1885 coincided with the initial homesteading of Sahuaro Ranch. The Arizona Canal diverted Salt River water into a 44 mile canal and opened up

thousands of acres to cultivation. Sahuaro Ranch was at the western end of the delivery system of the Arizona Canal. W.H. Bartlett, from Peoria, Illinois, was one of many attracted to cultivating the West Valley. He acquired 640 acres at $1.25 per acre under the Desert Land Act. Currently, the City of Glendale's Historic Sahuaro Ranch operates on 17 acres of the original 640-acre Sahuaro Ranch homestead.

The agricultural economy of the West Valley required a vast amount of labor. The community of El Mirage was home to an important part of that labor base. El Mirage, located on the west bank of the Agua Fria River, began as a Mexican migrant labor camp. Recent attempts to attract new employers to the area have yielded distribution, wholesale, and manufacturing businesses. In 1995 the population was 5,335. Three-quarters of that 1995 population was Hispanic. The Hispanic heritage is reflected in the town's celebrations such as Founder's Day in March and Cinco de Mayo in May.

Resource Exploitation

Communities that build with aggregate drawn from nearby river beds avoid transportation costs, which often exceed the costs of raw materials. Granitic and basalt rocks from the Bradshaw Mountains are in the Agua Fria riverbed. These excellent construction materials lower building costs in the West Valley communities. Decades of withdrawing materials from the Agua Fria River, however, affected river channel flows, aesthetics of the riverbed, and public access. Sand and gravel operations are representative of this theme.

World War II facilities, like Luke Air Force Base, as well as post World War II facility expansions, relied on Agua Fria materials. Housing developments of the 1960's, such as Sun City, were supplied materials by the increasingly sophisticated commercial operators who withdrew materials from the Agua Fria River. Over the last 50 years, Agua Fria materials have built the West Valley's roads, highways, pools, schools, offices, shopping centers, and homes. Numerous sand and gravel operations continue to be active in the Agua Fria River as described in Section 3.1.3.2, Sand and Gravel Mining.

Residential Life

The West Valley has pioneered two forms of new urbanism: large-scale master planned communities, and age-segregated communities. Both forms benefited from federal funding mechanisms. Sites representative of this theme include Maryvale and Sun City.

In 1953 John F. Long started Maryvale. The homes in the community were built primarily to house World War II veterans and their families on a master-planned scale. Long's subdivision planning, construction methods and tools, and mass production techniques have been adopted by builders and engineers throughout the world.

Sun City, built on the retirement community model created by Youngtown, Arizona, became the first fully master-planned age-segregated community. When Del Webb opened Sun City in 1960, it was a gamble in experimentation with the concept of financing retirement and age-segregation. Now, more than 40 years after opening, the concept of age-segregated living is studied by people from around the world (Dallett, 2001).

3.1.9 Recreation

A summary of the recreation corridor plan is included below. The complete technical memorandum, *Agua Fria Watercourse Master Plan Recreation Corridor Plan* is included in the Agua Fria Watercourse Master Plan Technical Memorandums.

The diverse landscape and land use of the Agua Fria River Corridor provides opportunities for recreational activities such as hiking, horseback riding, jogging, mountain biking, and bird watching. There are several existing parks along the corridor including:

- Coldwater Park

  The City of Avondale has developed this park along the west bank of the Agua Fria River north of Buckeye Road.

- Maricopa Lake Park

  The park is located within Youngstown, Arizona on the east bank of the river south of the Cactus Road alignment.

- Rancho Santa Fe Park

  A private facility located on the west bank of the river north of McDowell Road.

Avondale's Regional Park II (located on the north side of McDowell Road) and the City of Phoenix Camelback Ranch Park (near Camelback Road) are currently being developed. Regional Park II will include sports fields, a soccer facility, picnic areas, gardens, restrooms, and ramada-like shelters. Camelback Ranch Park will include an equestrian trail and trailhead, sports fields, restrooms picnic areas, and a ramada-like shelter. A third park is currently planned at Deer Valley Road on the east side of the river.

Several golf courses are located along the corridor including:

- Coyote Lakes Golf Course in the Town of Surprise
- Pueblo El Mirage Gold Course in El Mirage
- Sun City Community Golf Courses
- Sun City West Community Golf Courses
- Coldwater Springs Golf Course

Several existing and planned multi-use trails intersect with or terminate at the Agua Fria River. While the City of Avondale has no adopted trails plan, several trails, constructed through part of private development, cross or are adjacent to the river. Maricopa County is currently working to designate a countywide shared-use trail that would include the Agua Fria River Corridor. While east-west routes provide a variety of connections from the river to other destinations, the Sun Circle Trail is the only designated north-south connection identified along the river.

The City of Phoenix designates all arterial streets for bicycle lanes. Bicycle lanes are planned for Camelback and Indian School Roads. Similarly, Glendale designates arterial routes for bicycle lanes. Additionally, the New River is a planned shared use corridor. In addition to the recreation encouraged by the above-mentioned facilities, informal and unauthorized recreation occurs throughout the Agua Fria River ranging from equestrian use to off-road vehicle use.

Substantial designated open space exists along the Agua Fria River Corridor. In the southern areas of the river, the City of Avondale has designated the Gila River confluence as an opportunity to promote ecotourism. In the upper reach of the river, the City of Peoria has identified both banks of the Agua Fria River as an open space buffer. Additionally, slopes over 14 percent and most major washes in Peoria have been designated open space. The Agua Fria River has not traditionally been viewed as a recreation resource, many older residential developments near the middle reach were not designed to encourage access to the river. However, newer

residential developments frequently include open spaces and trails adjacent to the river (Cornoyer-Hedrick, 2001).

3.1.10 Water Quality

The Agua Fria River channel is normally dry, with the exception of isolated discharge sites along the corridor. Surface water quality issues are related primarily to the discharges. **(Figure 3.6)** There are also isolated areas of potential groundwater contamination in scattered areas along the corridor. Several Wastewater Treatment Plants (WWTPs) are located in the vicinity of the Agua Fria River and are listed below:

- Surprise/Litchfield WWTP approximately five miles west of the corridor
- City of El Mirage WWTP discharges at Peoria Avenue (West Bank)
- Luke Air Force Base WWTP discharges at Glendale Avenue (West Bank)
- Glendale Water Treatment Facility
- City of Avondale WWTP approximately ½ mile south of Broadway Road (East Bank)

Additional discharges include stormwater point source and non-point source discharges at several locations along the corridor and irrigation tailwater discharge points

3.1.10.1 Regulatory Requirements of the Clean Water Act

A field reconnaissance of the Agua Fria River Corridor was conducted to identify areas that are likely to be considered jurisdictional "waters of the U.S." under Section 404 of the Clean Water Act. The complete jurisdictional determination is in *Jurisdictional Determination for Agua Fria Watercourse – New Waddell Dam to Confluence with the Gila River (KHA, 2001)* and is summarized in the Technical *Report Ecological Evaluation of the Lower Agua Fria River Corridor New Wadell Dam to the Confluence with the Gila River.* These documents are included in the Agua Fria Watercourse Master Plan Technical Memorandums.

The U.S. Army Corps of Engineers (Corps) administers Section 404 of the Clean Water Act (CWA). The jurisdictional determination prepared by KHA was submitted to the Corps for review and approval. At the time of this report, Corps approval has not yet been received. Prior to conducting activity considered jurisdictional under Section 404, the Flood Control District of Maricopa County will apply to the Corps for authorization.

In the State of Arizona, Arizona Department of Environmental Quality (ADEQ) administers Section 401 of the CWA. The Flood Control District of Maricopa County will apply to ADEQ for 401 Certification prior to conducting activities regulated under Section 401 of the CWA.

The U.S. Environmental Protection Agency (EPA), with input from ADEQ, administers Section 402 of the CWA in Arizona. If activities regulated under Section 402 of the CWA are planned, the Flood Control District of Maricopa County will notify and receive approval from EPA and ADEQ prior to the start of these activities.

3.1.10.2 Contamination

Potential sources of contamination along the Agua Fria River Corridor consist of two active and six inactive landfills, one hazardous wastewater treatment plant, storage and disposal facility, two superfund sites, two Leaking Underground Storage Tank (LUST) facilities, a waste tire facility and an agricultural storage facility. The landfill facilities include the closed El Mirage Landfill

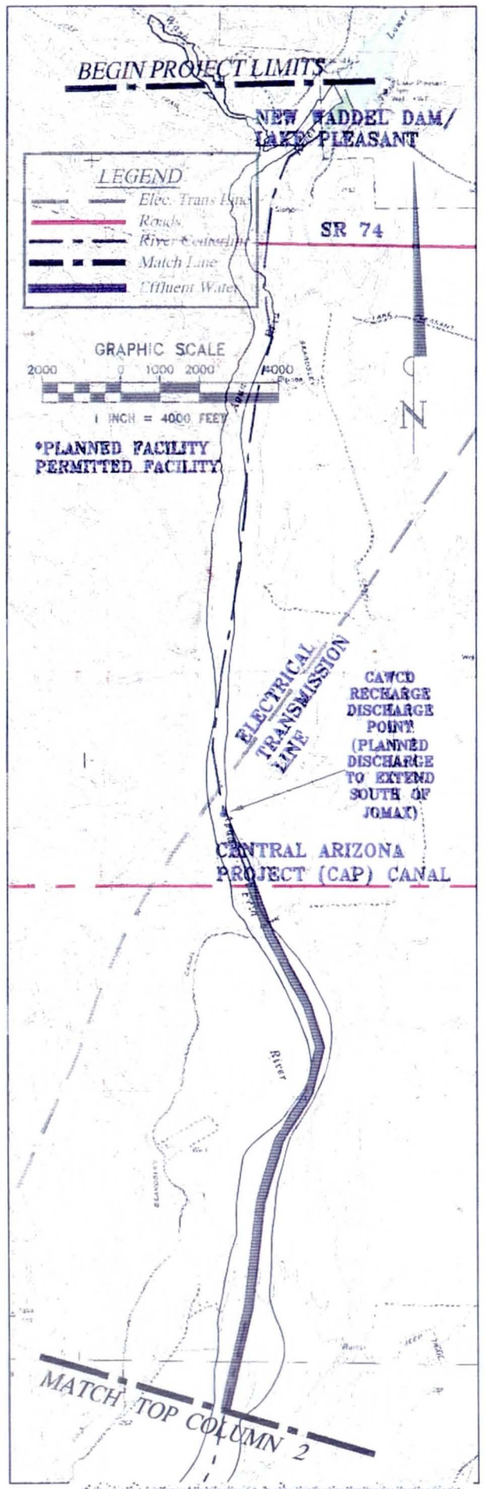
COLUMN 1

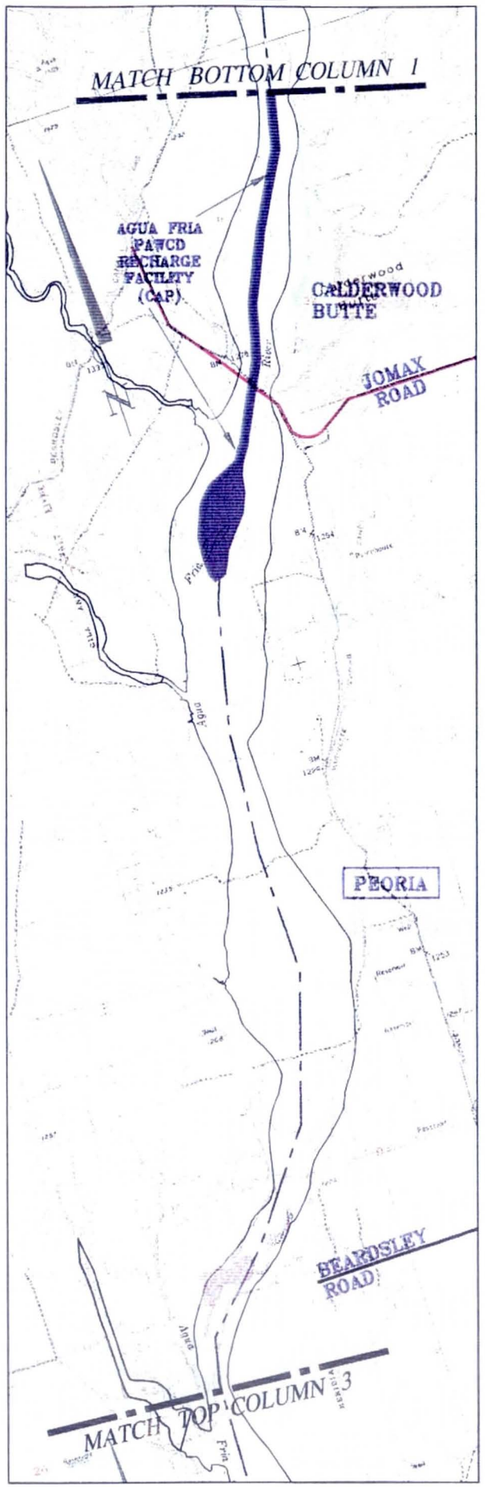
COLUMN 2

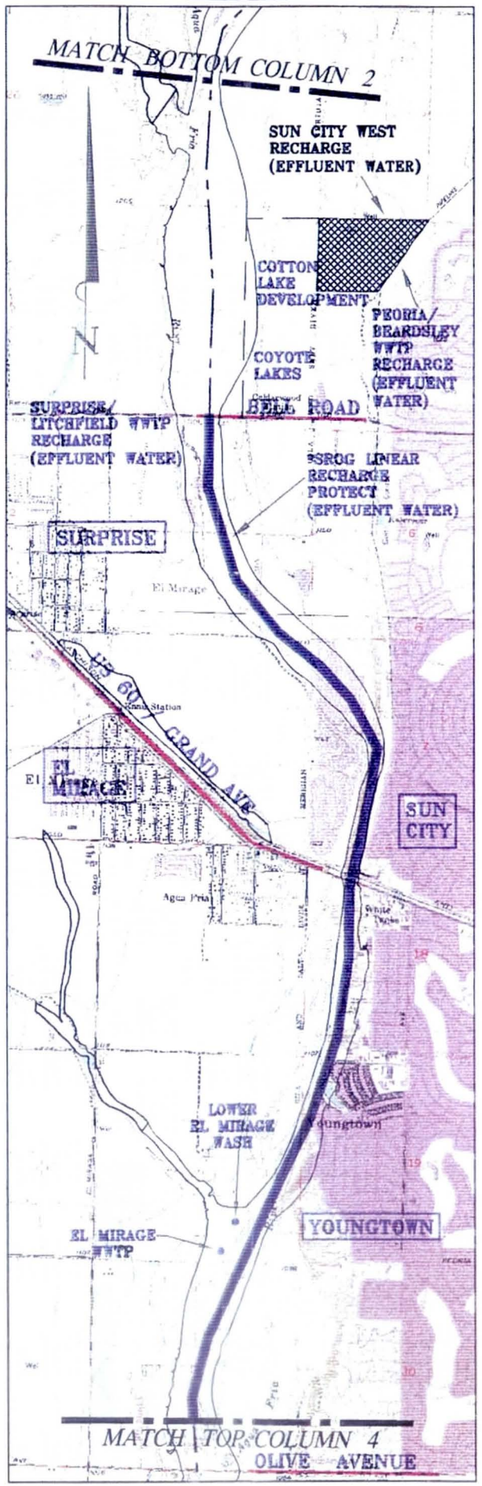
COLUMN 3

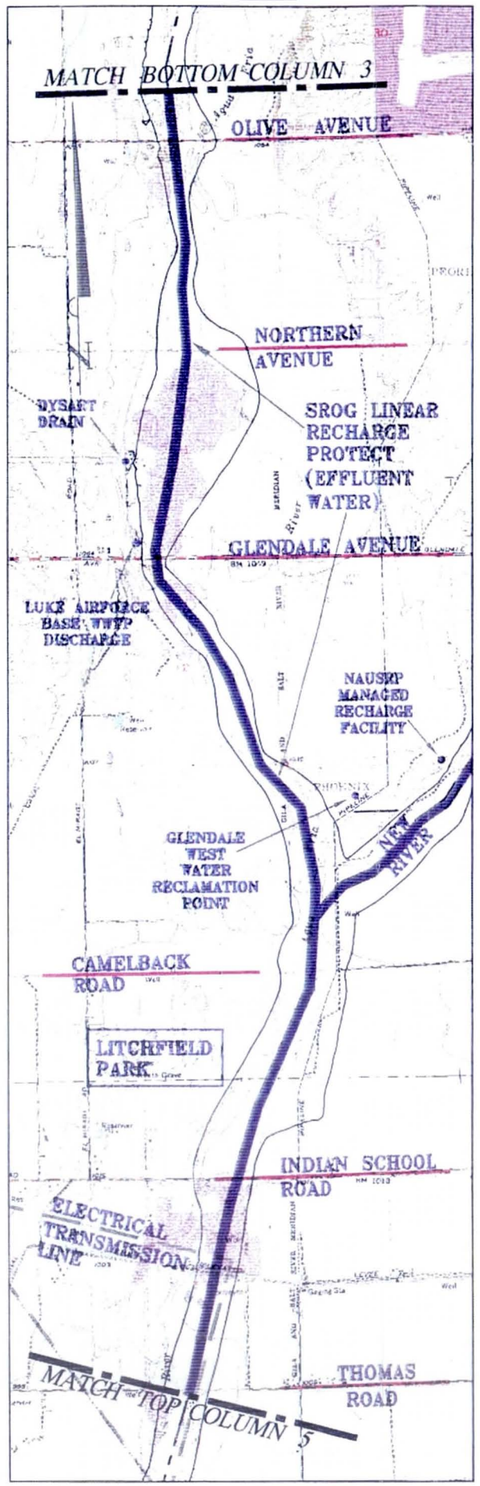
COLUMN 4

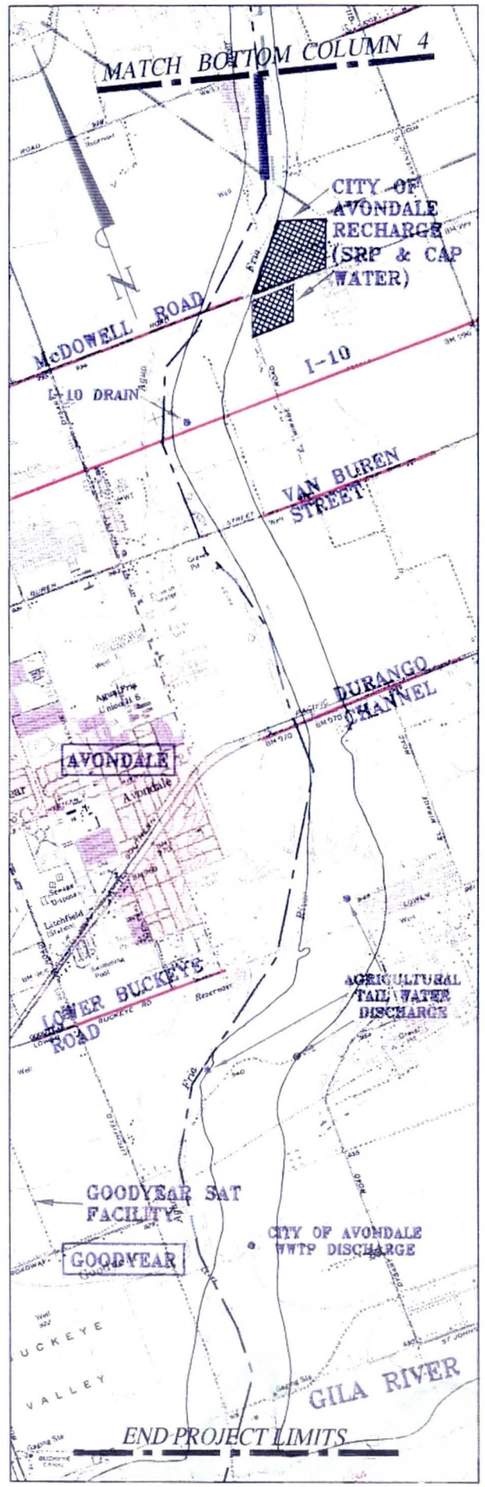
COLUMN 5











WEST VALLEY RECREATION CORRIDOR

AGUA FRIA WATERCOURSE MASTER PLAN

WATER QUALITY - POTENTIAL SURFACE DISCHARGE SOURCES

FIGURE 3.6

located along the west bank of the river at the Grand Avenue crossing. ADEQ records indicate that volatile organic compounds have been found in the groundwater in the general area of the El Mirage Landfill. Further investigation is needed to determine if the El Mirage Landfill is the source of the contamination. A technical memorandum, *El Mirage Landfill Site – Summary of Status Review* is included with the Technical Reports prepared for this study.

Of the potential hazardous material sites listed above, the known sources include the Phoenix-Goodyear Airport North and South site, Luke Air Force Base, and two CALMAT Industrial Asphalt Plants. The Phoenix-Goodyear Airport North and South site is a superfund site and contaminants associated with this facility are chlorinated solvents and chromium. Luke Air Force Base is also a superfund site with contaminants such as organic solvents, paint stripper, waste oil, petroleum, metal-plating wastes, hydraulic fluids, and radiological wastes. The CALMAT Industrial Asphalt Plants are listed as LUST facilities.

3.1.10.3 Social and Economic Resources

The watershed downstream of the New Waddell Dam has experienced significant urbanization within the areas historically irrigated for agriculture, as well as within large desert areas never farmed. The earliest urbanization included small service centers for agriculture, such as Avondale and El Mirage. Following World War II and accelerating since, large areas of residential and commercial development spread across the watershed as the cities of Phoenix, Glendale, Peoria, Sun City, and Avondale grew rapidly. Today, most of the watershed downstream of Beardsley Road is urbanized. Much of the remaining non-urbanized areas have plans for future urbanization. Eventually, the entire lower watershed is expected to be almost completely urbanized (JE Fuller, 2001).

The population within one mile of the Agua Fria River is projected to increase 104 percent between 2000 and 2020. The largest increases are expected in north Peoria and west Glendale. Other substantial population increases are expected for Phoenix and Avondale. Litchfield Park, which is not adjacent to the Agua Fria River but within one mile of it, is also expected to experience substantial population growth. **Table 3-5**, Projected Population Growth within One Mile of the Agua Fria River, summarizes projected population growth by jurisdiction.

Table 3-5

Projected Population Growth within One Mile of the Agua Fria River

	Population				
Jurisdiction	2000	2005	2010	2015	2020
Surprise	7,724	10,300	11,264	11,291	13,215
Maricopa County	19,333	19,538	20,985	22,885	27,187
El Mirage	5,837	5,905	5,918	6,069	7,210
Youngtown	2,739	2,799	2,875	2,957	3,032
Litchfield Park	0	605	1,284	2,529	2,913
Avondale	20,140	22,201	24,258	32,355	45,269
Peoria	4,594	8,097	10,015	12,972	17,101
Glendale	1,513	1,809	2,354	4,233	5,333
Phoenix	7,063	16,467	19,017	19,109	19,110
Total	**68,953**	**87,721**	**97,970**	**114,400**	**140,369**

In addition to increases in population, increases in retail, service, and industrial employment are projected to increase within one mile of the Agua Fria River. These projections are summarized in **Table 3-6**, Employment within One Mile of the Agua Fria River.

Table 3-6

Employment within One Mile of the Agua Fria River

	Employment				
Jurisdiction	2000	2005	2010	2015	2020
Surprise	1,968	2,648	3,058	3,118	3,202
Maricopa County	4,549	5,436	6,677	7,018	7,368
El Mirage	1,828	2,988	4,162	5,126	6,450
Youngtown	1,336	1,336	1,336	1,337	1,341
Litchfield Park	236	371	524	702	716
Avondale	4,830	6,068	9,101	12,186	13,668
Peoria	309	794	2,045	2,466	3,764
Glendale	1,203	1,437	1,913	2,548	3,180
Phoenix	335	568	642	723	1,029
Total	**16,594**	**21,647**	**29,457**	**35,224**	**40,719**

3.2 Description of Relevant Non-Affected Resources

3.2.1 Environmental Justice

Executive Order 12898 on Environmental Justice directs that programs, policies, and activities not have a disproportionately high adverse environmental effect on minority and low-income populations. While minority and low-income populations are known to exist within the Agua Fria River Corridor, no issues relating to the Agua Fria River Watercourse Master Plan will disproportionately affect these populations.

3.2.2 Air Quality

Parts of Maricopa County, including the City of Phoenix and adjacent areas, are considered to be non-attainment areas for ozone, carbon monoxide, and particulate matter. The main anthropogenic sources of air pollution along the Agua Fria River Corridor are freeway traffic, off-road vehicle activity, and industries within the area.

Dust generated from commercial and recreational use of the Agua Fria River channel contributes particulate matter to the atmosphere. Commercial activity, dependent on the channel for their raw material, contributes emissions from gasoline and diesel-powered equipment, as well as from facility/plant stack emissions.

The proposed Agua Fria Watercourse Master Plan will encourage additional vegetation of the Agua Fria River channel, and may restrict development activities in some areas and limit off-road vehicle activity. This may result in an indirect improvement to the area's air quality by reduction of particulate matter.

3.2.3 Acoustics

Similar to air pollution sources, noise along the Agua Fria River Corridor can be attributed to off-road vehicle activity, industries within the area, and vehicle traffic on roads running adjacent to the project area. Additional sources of noise include Luke Air Force Base and Glendale Municipal Airport, occurring near the middle reach of the Agua Fria River. Generally, noise levels are expected to be highest in the most densely populated areas of the Agua Fria River Corridor.

3.2.4 Climate

For ephemeral streams like the Agua Fria River and its tributaries, runoff is directly related to precipitation. Precipitation records can be used to identify wet/dry cycles, climatic variation, and other trends that may affect stream stability or explain historical channel change. Long-term precipitation data were obtained from the Western Regional Climate Center web site. The precipitation data are presented in **Table 3-7**, Regional Long-term Precipitation Stations.

Table 3-7

Regional Long-term Precipitation Stations

Station Name	Period of Record	Average Annual Precipitation
Alhambra	1948-1976	7.77
Buckeye	1893-1999	7.74
Carefree	1962-1999	13.37
Castle Hot Springs	1959-2000	15.42
Cordes	1948-2000	15.18
Deer Valley	1950-1985	8.64
Groom Creek	1948-1976	23.44
Litchfield Park	1917-1999	8.13
Marinette	1913-1964	7.90
Mesa	1896-1999	8.33
Phoenix City	1948-1998	7.89
Prescott	1898-2000	19.33
Youngtown	1964-1999	9.17
Wittman	1923-1966	9.42

Temperature in combination with precipitation will determine the amount of evaporation that occurs. Due to the high temperatures and low precipitation rates in the Phoenix area, evaporation rates are high. The average temperatures between January and July range from 50 to 93 °F, with an average yearly temperature of 84 ° (Western Regional Climate Center).

4.0 Chapter 4 - Environmental Consequences

4.1 Introduction

Chapter 4- Environmental Consequences and Chapter 3- Affected Environment, form the scientific and analytic basis for the summary comparison of effects of the advanced alternatives presented in Chapter 2- Alternatives. Chapter 4 presents the predicted effects of the advanced alternatives, presenting the predicted attainment or non-attainment of the project goals and objectives and the predicted effects on the quality of the environment. This chapter outlines the direct, indirect and cumulative effects of the Agua Fria River Watercourse Master Plan.

The two alternatives advanced are:

Alternative A - No Additional Action Alternative. This alternative would not implement the management strategies for flood control and multiple use outlined in the Agua Fria River Watercourse Master Plan. Other planned activities would continue. This alternative also represents the status quo or existing conditions of the corridor and was used as the baseline for comparison of potential impacts form the proposed project.

Alternative B - Agua Fria River Watercourse Master Plan. As described in Chapter 2, the Agua Fria Watercourse Master Plan has components of both the non-advanced Structural Alternative and the Non-Structural Alternative. It provides for multiple use opportunities where they will not adversely affect the flood control goal of the project.

Chapter 2 provides more detail as to the development of the various alternatives and the specific management recommendations of each alternative. This chapter is broken into two major sections:

- Section 4.2. - Predicted Attainment of the Project Goals and Objectives of Advanced Alternatives, and
- Section 4.3 - Predicted Effects on Relevant Affected Resources of Advanced Alternatives.

4.2 Predicted Attainment of the Project Goals and Objectives of Advanced Alternatives

4.2.1 Predicted Attainment of Project Goal: Flood Control

As noted in Chapter 1, the goal of the Agua Fria Watercourse Master Plan is to provide management techniques for flood protection along the river corridor and, where practical and without adverse effects to the flood control goal, provide for multiple use opportunities. To attain the project goal of flood control, the alternatives must meet the following requirements:

- Provide management strategies primarily related to flood control, flood-proofing and emergency response activities within the Agua Fria River Corridor
- Establish a technically, economically, and regulatory feasible plan for the Agua Fria River Corridor

4.2.1.1 Alternative A: No Additional Action

The Flood Control District of Maricopa County currently implements numerous measures to provide flood protection; however, these measures alone are not adequate to provide the level of

protection intended through this objective. The areas in which the District is unable to provide the desired level of flood protection with the "no additional action" alternative are described below.

- Jomax Road, an at-grade crossing in the Upper Reach, would be inundated during a major storm.
- Twin Buttes Wash drains to the Agua Fria River on the west side, just south of Happy Valley Road. Immediately south of the Twin Buttes Wash confluence, Hatfield Road crosses the river at grade. This road crossing could be impacted by flooding of the Agua Fria River or Twin Buttes Wash.
- Rose Garden Lane crosses the Agua Fria River channel at-grade. This road is flooded during heavy storms and isolates residents on the west side of the river.
- Undeveloped land along the east bank of the Agua Fria River between Beardsley and Bell Roads is contained between the Coyote Lakes subdivision levee and the river's floodway. Under current regulations, it is permissible to construct in this area by raising a building on an embankment or by building a levee to protect the building. However, development in this area would be in immediate danger if a storm event exceeds the level of protection provided by a levee or embankment. Floodwaters would be contained between the Coyote Lakes levee and the west bank of the river. Damage to buildings created through future development could be significant due to depth of flow and velocity of flow.
- Existing homes abut the floodplain on the west bank of the Agua Fria River, south of Bell Road at the top of an approximately 25 foot bluff. Many of the homes are located near the edge of the bluff that forms the boundary of the floodway, floodplain, and LMEHZ. Although the homes are outside of the regulatory boundaries, sudden failure of a small portion of the bank would cause homes to fall into the river.
- The El Mirage Landfill, located on the west bank of the Agua Fria River near Grand Avenue, has experienced past flooding problems, including losing a portion of the landfill.
- In the vicinity of the Agua Fria River from Olive Avenue to Grand Avenue the east bank of the river is a high, nearly vertical bluff. The bluff is subject to the effects of hillside erosion from the top and to the effects of stream erosion from the bottom. Numerous buildings are located within the LMEHZ in this area.
- Flows from both the Agua Fria River and Gila River have the potential to inundate the Agua Fria in the Broadway Road area. Along the west bank of the Agua Fria at Broadway Road, existing buildings are within the LMEHZ. Bank loss due to erosion is possible in this area.

Based on this analysis, Alternative A: No Additional Action **does not meet** the goal of providing management strategies for flood control.

4.2.1.2 Alternative B: Agua Fria Watercourse Master Plan

The Agua Fria Watercourse Master Plan was formulated to address many of the flood control concerns that are expected to exist with the "no additional action" alternative. The Agua Fria Watercourse Master Plan (Master Plan) is expected to meet the flood control goal of the District through implementation of the management measures listed below.

- Numerous sand and gravel mining operations currently occupy the portion of the Agua Fria River between Grand Avenue and Bell Road. To comply with the "no adverse impact" mining policy, it is anticipated that nearly continuous levees will be

required on both sides of the river to isolate the mines from the floodway. These levees would be constructed by the owners of the mine.

- South of Bell Road, where existing homes abut the floodplain of the west bank, the Master Plan proposes bank protection.
- The Master Plan recognizes the concerns related to the El Mirage Landfill, and proposes further evaluation of the situation to determine the extent of structural protection required at the site.
- Between Olive Avenue and Cactus Road, the Master Plan proposes to monitor the rate of slope erosion of the east bank of the Agua Fria River. If the monitoring determines that erosion threatens existing buildings, further action may be required.
- Along the west bank of the Agua Fria River at Broadway Road, where buildings are within the LMEHZ, the Master Plan proposes to monitor the location of the existing riverbank. The monitoring will be conducted to determine if future action will be required in case of bank loss due to erosion.
- In areas south of Broadway Road affected by both the Gila and Agua Fria Rivers, the Master Plan proposes that future buildings be protected by elevating the finished floor grade two feet above the regulatory (100-year) water surface elevation.
- Additionally, in many areas throughout the corridor not specifically noted above, the Master Plan proposes to implement non-structural management policies.

4.2.2 Predicted Attainment of Project Objective: Multiple Use Opportunities

To the extent practical and without compromising the goal of flood protection, the alternatives should meet the following requirements to achieve the objective of multiple use opportunities:

- Incorporate recreational opportunities
- Enhance/protect natural, aesthetic, and cultural resources
- Create community and civic cohesiveness and pride

4.2.2.1 Alternative A: No Additional Action

The No Additional Action alternative includes plans currently being implemented and planned for future implementation by municipalities that are along the Agua Fria River Corridor. Numerous parks currently exist or are planned. Additionally, the City of Avondale is working in cooperation with the U.S. Army Corps of Engineers to enhance the vegetation and wildlife habitat in the area of the I-10 Bridge. However, under the No Additional Action alternative, multiple use opportunities are not currently planned to be connected, physically or through a consistent theme, between municipalities. This lack of coordination between municipalities will not result in the desired level of community and civic cohesiveness. Alternative A- No Additional Action will not meet the mandate of the *Watercourse Master Planning Statutes of the State of Arizona*, because it does not provide a strategy that defines the "look and feel of the watercourse for the future."

4.2.2.2 Alternative B: Agua Fria Watercourse Master Plan

Under the Agua Fria Watercourse Master Plan, the existing and planned recreational and enhancement opportunities presented by the municipalities will continue as planned, but will be connected between municipalities through trail linkages and consistent themes. This linkage provided by the Agua Fria Watercourse Master Plan will meet all of the criteria associated with the objective of creation of multiple use opportunities, including an improved sense of

community and civic cohesiveness and pride. Alternative B: Agua Fria Watercourse Master Plan will meet the mandate of the *Watercourse Master Planning Statutes of the State of Arizona.*

4.3 Predicted Effects on Relevant Affected Resources of Advanced Alternatives

4.3.1 Predicted Effects on Watershed

For this analysis, the predicted effects on watershed are divided into four subcategories. These subcategories include ground water and recharge, surface hydrology, hydraulics, and floodplains and flood control.

4.3.1.1 Effects of Alternative A: No Additional Action on Watershed

Groundwater and Recharge- The No Additional Action Alternative would not change the groundwater recharge facilities that are currently permitted or planned. Implementation of the District's currently established policy and permitting process for groundwater recharge, replenishment, or underground storage on land leased from the District would continue. The No Additional Action alternative would not include watershed level planning. This would result in lost opportunities for appropriate multiple use opportunities or identification of potential constraints.

Surface Hydrology- Continued development will alter the Agua Fria watershed. However, storm water retention policies, which may have reduced flood volumes and peak discharges, will continue to be implemented by the individual municipalities. Sand and gravel pits within the floodway or floodplain will continue to have an effect because of the amount of storage volume that they potentially provide. This alternative will not coordinate riverwide multiple use opportunities for surface water drainages and may not provide the mechanism for management of cumulative affects from multiple single project impacts.

Hydraulics- The No Additional Action Alternative would allow adverse impacts to the hydraulics of the Agua Fria River to continue. This includes development within the LMEHZ and potential attenuation caused by the sand and gravel mining pits.

Floodplains and Flood Control- The No Additional Action Alternative would allow current practices that affect floodplains and flood control to continue. This includes continued development within the LMEHZ and encroachment within the flood fringe.

4.3.1.2 Effects of Alternative B: Agua Fria Watercourse Master Plan on Watershed

Groundwater and Recharge- The Agua Fria Watercourse Master Plan would encourage currently permitted and planned groundwater recharge facilities. Through this alternative, development of currently unplanned recharge facilities in areas identified in the Watercourse Master Plan as suitable for groundwater recharge would be encouraged. Development of recharge facilities in areas identified in the Watercourse Master Plan as unfavorable for recharge would be discouraged. Additionally, this alternative would encourage, where practical, vegetation and habitat enhancement and interpretive sites in conjunction with planned and future groundwater recharge facilities. While this type of vegetation enhancement does improve wildlife habitat and the visual character of an area, it decreases the efficiency of groundwater recharge due to evapotranspiration. Before this type of enhancement is implemented, the District would work closely with ADWR, ADEQ, and other agencies to ensure that the multiple use benefits of this

enhancement outweigh the impact of water loss associated with the creation of these enhancement areas.

As with the No Additional Action Alternative, implementation of the District's currently established policy and permitting process for groundwater recharge, replenishment, or underground storage on land leased from the District would continue.

The Agua Fria Watercourse Master Plan would discourage recreational usage in groundwater recharge areas where such activity may affect the class of water and quantity of water being recharged.

Surface Hydrology- The effects of implementation of the Agua Fria Watercourse Master Plan on surface hydrology would provide a watershed-wide multiple use analysis of proposed projects that might effect the watershed's surface water hydrology.

Hydraulics- No adverse impacts would be associated with the implementation of the Agua Fria Watercourse Master Plan, however minimal hydraulic affects are associated with this alternative. The Plan was developed after thorough research of hydraulic issues to minimize effects. Hydraulic effects associated with this alternative would include those associated with vegetation enhancement, construction of recreational facilities, additional bank protection in limited areas, and the proposed construction of levees in sand and gravel mining areas to achieve the "no adverse impact" approach for existing and future sand and gravel operations. The vegetation enhancement and recreational improvements recommended in this alternative were planned and located in a manner to minimize hydraulic effects. Additionally, this alternative would minimize future adverse effects to the hydraulics of the Agua Fria River through regulations preventing development within the LMEHZ.

Floodplains and Flood Control- Flood control is the primary goal of the Agua Fria Watercourse Master Plan. The implementation of the Agua Fria Watercourse Master Plan would positively affect floodplains and flood control in the Agua Fria River study area.

4.3.2 Predicted Effects on Geomorphology

For this analysis, the predicted effects on geomorphology are divided into four sub-categories. These categories include geology, soils, sediment transport, and lateral migration/erosion.

4.3.2.1 Effects of Alternative A: No Additional Action on Geomorphology

Geology-The No Additional Action Alternative would allow the existing geologic impacts to continue. These impacts include continued net degradation of approximately 0.02 to 0.06 mm/year, base level adjustments to the Gila River, and land subsidence due to ground water withdrawal. Additionally, rapid bank erosion would continue in areas where the banks are not stabilized by carbonate-cemented soils, bedrock, or engineered stabilization measures.

Soils- The No Additional Action Alternative may result in the continued loss of soil reserves to erosion or damage to soil horizons by uncontrolled sedimentation. Some of the soils susceptible to damage are classified as prime farmland soils.

Sediment Transport- The river will continue moving sediment from the upstream reach of the river to the downstream reach with the No Additional Action Alternative. This could affect area infrastructure and mining operations.

Lateral Migration/Erosion- Analysis indicates that the with the No Additional Action Alternative the Agua Fria River will continue to degrade during large floods. During smaller floods, the middle reach is expected to remain stable or aggrade slightly.

4.3.2.2 Effect of Alternative B: Agua Fria Watercourse Master Plan on Geomorphology

Geology-The implementation of the Agua Fria Watercourse Master Plan would include erosion monitoring in selected areas and structural bank protection in other selected areas detailed in the *Agua Fria Watercourse Master Plan (KHA, 2001)*. Additionally, this alternative will encourage groundwater recharge in favorable areas in addition to that already planned, which has the potential to lessen land subsidence related to dropping groundwater levels.

Soils- The implementation of the Agua Fria Watercourse Master Plan may stabilize banks and reduce channel lateral migration, thus reducing soil erosion losses. While some of the soils that occur in the study area are classified as prime farmland if irrigated, no conversion of prime farmland would result from the implementation of this alternative.

Sediment Transport- The Agua Fria Watercourse Master Plan would affect sediment transport by stabilizing portions of the channel. The Master Plan proposes construction of grade control structures to arrest bed degradation and stabilize the river system at Olive Avenue and the addition of grade control structures in the heavily mined area from Beardsley Road to Pinnacle Peak Road. Bank stabilization will also affect sediment transportation.

Lateral Migration/Erosion- The erosion control measures included in Agua Fria Watercourse Master Plan are directed primarily at protecting the public from inundation or avulsion (sudden stream channel relocation) due to flood flows. The implementation of the Agua Fria Watercourse Master Plan would include monitoring the few areas where encroachments into the regulatory floodplain or the LMEHZ for imminent erosion threats.

4.3.3 Predicted Effects on Land Use and Relevant Planning

For this analysis, land use and relevant planning is divided into three subcategories. These sub-categories are sand and gravel mining, residential/commercial development and agriculture.

4.3.3.1 Effect of Alternative A: No Additional Action on Land Use and Relevant Planning

Residential/Commercial Development-Alternative A does not provide for additional management strategies for planned development along the corridor. This alternative would not provide additional strategies for flood control protection for existing or planned residential and commercial development.

Sand and Gravel Mining- The No Additional Action Alternative proposes to allow sand and gravel operators to extract sand and gravel based on the design assumptions currently employed. However, erosion and lateral migration analyses completed in conjunction with the Master Plan indicate it is not likely that mine operators will be able to limit the cumulative impact of their activities to their property under current operating conditions. Significant degradation of the riverbed is anticipated. Due to the sporadic spacing and random depth of pits, it is not practical to assume that grade control structures can be implemented in any meaningful fashion since it is not feasible to control mining activities between pits. This plan assumes that the existing bridges north of Camelback Road and south of the CAP Canal ultimately will be replaced, and that bank stabilization for the entire reach of the floodplain would need to be constructed. These actions are anticipated more on a demand basis rather than on a programmed basis.

Current regulations require sand and gravel operations to obtain a floodplain use permit for excavation within the regulatory floodplain. Applicants submit permit requests to the floodplain administer for the community in which the proposed operation is located. In some communities, the District administers this program. Applicants are required to renew permits every two to five years. The District currently requires the incorporation of a reclamation plan as part of the permit

application. The district is currently working with operators to develop reclamation strategies that may promote a more orderly introduction of phased reclamation, as well as mitigating the long-term impact to the visual landscape. This coordination would continue with the No Additional Action Alternative.

Agriculture- The No Additional Action Alternative might result in increased flooding and damage from erosion and sedimentation, as upstream development exacerbates local flooding. No other impacts to agricultural activities are anticipated.

4.3.3.2 Effect of Alternative B: Agua Fria Watercourse Master Plan on Land Use and Relevant Planning

Residential/Commercial Development- The proposed Master Plan would prohibit development within the boundaries of the LMEHZ. Thus, some areas currently available for development (but with some current restrictions – such as minimal elevations for finished floors or levee protection requirements) would no longer be available. The Master Plan would provide management strategies for providing flood control for both existing and planned residential development along the Agua Fria River Corridor.

Sand and Gravel Mining- The Agua Fria Watercourse Master Plan recommends implementation of the No Adverse Impact Policy for sand and gravel mining. This policy is premised on limiting the impact of mining operations to within the boundaries of the property being mined. The policy would be implemented when mine owners renew their Floodplain Use Permits. In order to renew the permit, a mine owner would have to show that the engineering design of the operation limits the potential impact of the 100-year storm to the mining property boundary.

This policy should result in:

- Relocation of mining activities outside of the floodway
- Mitigation of reflective erosion
- Construction of protection separating excavation pits from the floodway
- Replacement of channel storage (drown out features for excavation pits)

These actions would reduce the potential adverse affects of the mining operation on the overall watershed.

Mining within the floodway is expected to be extremely limited. The Corps LA District published the Sand and Gravel Mining Guidelines in 1987, to provide recommendations related to in-stream mining near Corps facilities/structures. These recommendations included setback limits it depth restrictions and location requirements. The Master Plan should adopt similar guidelines based on the established floodway or ordinary high water mark boundary.

Mine owners would be expected to provide the infrastructure necessary to limit mining impacts to their property line. Current channel conditions indicate that grade stabilization will be required to arrest further degradation of the riverbed. The Master Plan recommends a grade control structure downstream from the Olive Road Bridge to minimize the potential for impacts to the existing bridge and utility crossings. These structures could be programmed into the District's construction budget based on project priority.

Implementation of policies in the proposed Master Plan will probably result in mine operators isolating excavation pits from the floodway, most likely with an engineered levee. This requirement would increase the capital improvements required to operate a mine. In order to offset this cost increase, it is proposed that the District pursue a river-wide 404 Permit from the Corps. The permit would encompass the entire reach from New Waddell Dam to the confluence

of the Gila River. The District would then assist individual miners to obtain site-specific 404 Permits for their mines.

Agriculture- The Agua Fria Watercourse Master Plan would not adversely affect agriculture. No areas currently under agricultural production or prime farmland soils will be affected. Implementation of the Master Plan may provide reductions in potential flooding and sedimentation for existing agricultural areas.

4.3.4 Predicted Effects on Biological Resources

For this analysis, biological resources are divided into two sub-categories. These sub-categories include vegetation communities and wildlife population/habitat.

4.3.4.1 Effect of Alternative A: No Additional Action on Biological Resources

Vegetation-The No Additional Action Alternative would not impact vegetation beyond those impacts from already planned projects. Vegetation clearing for maintenance and proposed development would continue. Vegetation enhancement currently planned by the individual municipalities would also continue.

The ongoing degradation of the existing vegetation communities from invasive species and other activities would continue. This alternative would not include the enhancement strategies proposed with the Agua Fria Watercourse Master Plan.

Wildlife and Habitat- Fragmentation and destruction of wildlife habitat would continue without an overall mitigation plan to minimize the impacts. Development, particularly in the northern portion of the corridor, will continue to encroach on buffer areas further reducing habitat values in the corridor.

Some planned habitat enhancements, such as the I-10 Bridge area are likely to continue, but will not have the benefit of the Master Plan guidance for watershed level habitat enhancement. This may result in lack of connectivity, inappropriate locations or habitat types and a lack of continuity in management plans. This alternative will not provide for the potential restrictions on land use or on proposed requirements for habitat enhancements The amount of habitat enhancement will not be as extensive as that proposed in the Master Plan.

4.3.4.2 Effect of Alternative B: Agua Fria Watercourse Master Plan on Biological Resources

Vegetation-The implementation of the Agua Fria Watercourse Master Plan may require the clearing of vegetation in several areas including:

- Structural flood control devices (bank armoring, levees, grade control structures)
- Habitat Enhancement areas requiring vegetation manipulation
- Recreational facilities
- Groundwater recharge facilities

In general, the areas identified for the above controls are vegetated with the early level successional vegetation that dominates the majority of ephemeral channel. This vegetation community is not a high value community and is not a unique resource in the area. Limited vegetation clearing should not have a significant adverse affect on vegetation communities.

Implementation of the Agua Fria Watercourse Master Plan would enhance vegetation in the Agua Fria River Corridor. This includes plans to rehabilitate, enhance or replace vegetation in many

areas of the corridor including those disturbed by the proposed structural controls noted above. Proposed vegetation enhancement techniques within riparian areas may include:

- Development of an invasive species management strategy
- Establishment of vegetation buffer zones in select areas
- Development of a vegetation management strategy for select areas
- Changes in land use management, including land use restrictions
- Coordination with water user groups
- Establishment of volunteer groups to manage and maintain enhancement areas

The Master Plan recommends that proposed and existing groundwater recharge facilities evaluate vegetation enhancement as part of the recharge project. The vegetation species would be primarily low transpiration species, and the proposed vegetation could create shading in recharge areas. Implementation of this strategy would require coordination with Arizona Department of Water Resources (ADWR) and other agencies to establish guidelines for permitting of these facilities.

In the areas of the I-10 Bridge the Master Plan proposes planting of herbaceous species, and in the area of Buckeye Road the Plan proposes enhancement through the planting of additional woody species.

In the area of the Avondale WWTP, the Master Plan proposes supplementing existing wetland vegetation with additional hydropytic species. Implementation of the Plan would also include coordination with the City of Avondale to determine the potential for expanding the wetland area.

The Master Plan proposes that a created vegetation community called the "Mediterranean Mix" be used in many of the proposed park areas throughout the corridor. This planting mix is detailed in the *Habitat Enhancement Opportunities/Techniques Lower Agua Fria River Corridor New Waddell Dam to Confluence with Gila River (KHA, 2001)*. This mix of vegetation, which is a combination of native and non-native landscape species, would provide enhanced avian habitat. It would pose little risk of being invasive because of the artificial moisture regime that would be required to sustain the vegetation community.

The implementation of the vegetation enhancement strategies in the proposed Master Plan should provide significant enhancement to the vegetation communities in the Agua Fria River Corridor.

Wildlife and Habitat- Through the vegetation enhancements detailed above, implementation of the Agua Fria Watercourse Master Plan would improve habitat along the Agua Fria River Corridor, which would likely encourage wildlife activity in the area. The Master Plan would incorporate habitat enhancement activities currently proposed by the municipalities along the corridor.

4.3.5 Predicted Effects on Protected Species

4.3.5.1 Effect of Alternative A: No Additional Action on Protected Species.

Protected Species- Under this alternative previously planned actions will continue. It is possible that these planned actions will impact some of the areas identified in Section 3.1.5, where potential suitable habitat has been identified for several species. It will be the responsibility of those undertaking the activity to maintain compliance with the ESA and related species protection regulations. The applicant should coordinate with the agencies noted in Section 3.1.5, prior to activity in those areas containing potential suitable habitat

This alternative does not provide for corridor-wide master planning and therefore no habitat enhancement, which might mitigate or enhance protected species habitat is planned.

4.3.5.2 Effect of Alternative B: Agua Fria Watercourse Master Plan on Protected Species

Protected Species- Some of the Master Plan's recommended management strategies will include activity in areas that contain potential suitable protected species habitat. Some of the recommended habitat enhancement areas and recommended techniques could also impact potentially suitable protected species habitat. Section 3.1.5 and the Technical Report *Ecological Evaluation of the Lower Agua Fria River Corridor New Waddell Dam to Confluence with the Gila River (KHA, 2002)* provides more information regarding the location of the habitat areas.

The Master Plan includes habitat enhancement strategies that will improve the overall habitat conditions of the corridor. These strategies will also provide enhancements for those areas included as potential habitat for protected species. The areas of potential protected species habitat are in the areas recommended for invasive species control, land use restrictions and limited vegetation planting. These strategies should improve the overall habitat condition.

The Flood Control District should assure that proper coordination with the following agencies, as applicable, has been conducted prior to implementation of the management techniques recommended in the Agua Fria River Watercourse Master Plan. During the preparation of this report, the municipalities with jurisdiction along the corridor were contacted to gather information about local native plant ordinances. At the time this contact, December 2001, none of the municipalities with jurisdiction along corridor had a local native plant ordinance.

- U.S. Fish and Wildlife Service (USFWS)
- Arizona Game and Fish Department (AGFD) – Wildlife of Special Concern
- AGFD Natural Heritage Program
- State of Arizona Department of Agriculture – Arizona Native Plant Law
- Bureau of Land management (BLM)
- U.S. Forest Service (USFS)

4.3.6 Predicted Effects on Visual Environment

For this analysis, predicted effects on the visual environment are divided into two sub-categories. These sub-categories are landscape character types and visual resource inventory.

4.3.6.1 Effect of Alternative A: No Additional Action on Visual Environment

Landscape Character Types- The No Additional Action Alternative would not affect the landscape character types along the corridor beyond changes to landscape character that result from recreational areas created by the municipalities and changes related to future development in the area. This alternative would not provide a river wide plan that would establish and preserve the "look and feel of the watercourse."

Visual Resource Inventory- The No Additional Action Alternative would not significantly affect the visual resources inventory. Locations identified in the visual resources inventory would continue to undergo natural deterioration and pressure from surrounding development unless otherwise controlled by municipalities or private entities.

4.3.6.2 Effect of Alternative B: Agua Fria Watercourse Master Plan on Visual Environment

Landscape Character Types-The Master Plan includes recommended guidelines for recreational and other development that establishes guidelines to preserve and enhance the landscape character.

Visual Resource Inventory- Implementation of the Agua Fria River Watercourse Master Plan would include the creation of interpretive sites at many of the locations identified in the visual resources inventory. The Master Plan would also encourage preservation of these sites to maintain their value to visitors to the Agua Fria River.

4.3.7 Predicted Effects on Infrastructure

4.3.7.1 Effects of Alternative A: No Additional Action on Infrastructure

Infrastructure-The technical reports for the hydrologic, sedimentation transport and geomorphic evaluations prepared for the Master Plan identify existing infrastructure that may be at risk of damage in a flood event or as a result of channel morphology. These areas will continue to be at risk, unless site specific mitigation measures are undertaken. This alternative does not provide for a watershed wide plan for management of flood risk and potential damage to existing or planned infrastructure.

4.3.7.2 Effects of Alternative B: Agua Fria Watercourse Master Plan on Infrastructure

Infrastructure-The implementation of the Agua Fria Watercourse Master plan will not adversely affect existing infrastructure. The implementation of the plan may reduce the potential for damage to some existing infrastructure. Some areas will continue to be at risk after the implementation of the Master Plan. Each specific activity implemented under the proposed Master Plan will require an individual analysis to determine its potential to effect existing or planned infrastructure.

The management strategies recommended in the Agua Fria Watercourse Master Plan were formulated to reduce the likelihood of flood damage. Future construction would adhere to the guidelines established to further reduce the potential for damage.

4.3.8 Predicted Effects on Cultural Resources

4.3.8.1 Effects of Alternative A: No Additional Action on Cultural Resources

Cultural Resources- The No Additional Action Alternative would not affect cultural resources. Individual projects that require federal actions would be required to mitigate for impacts to cultural resources. Projects without a federal nexus might not be required to avoid or mitigate cultural resource sites. Natural deterioration of these resources would continue.

4.3.8.2 Effects of Alternative B: Agua Fria Watercourse Master Plan on Cultural Resources

Cultural Resources-The proposed Agua Fria Watercourse Master Plan includes a recommendation for a river-wide Section 404 permit. As part of the application for the permit, the proposed management techniques included in the Master Plan would require adherence to federal and state regulations for cultural resources. The Master Plan also proposes to create interpretive sites in areas of archaeological and historical significance. These sites would educate and entertain visitors to the Agua Fria River.

4.3.9 Predicted Effects on Recreation

4.3.9.1 Effects of Alternative A: No Additional Action on Recreation

Recreation-The No Additional Action Alternative would not significantly affect recreation opportunities along the Agua Fria River Corridor. Recreational enhancements currently planned by individual municipalities would continue to be implemented. This alternative would not provide the corridor wide trail connections and interpretive enhancements proposed in the Master Plan.

4.3.9.2 Effects of Alternative B: Agua Fria Watercourse Master Plan on Recreation

Recreation- As in the No Additional Action Alternative, only the existing and future recreational enhancements created by the individual municipalities would exist within the corridor. However, unlike the No Action Alternative, implementation of the Master Plan would link the recreational facilities not only through a physical trail system but also through consistent themes throughout the corridor. This effort would create community cohesiveness throughout the West Valley. Additionally, the Master Plan would encourage the future development of recreational facilities throughout the corridor in areas where these facilities do not conflict with the primary goal of the master Plan, which is flood control. The plan may also limit future development of certain areas within or adjacent to the Agua Fria River channel, thus maintaining open space areas.

4.3.10 Predicted Effects on Water Quality

4.3.10.1 Effects of Alternative A: No Additional Action on Water Quality

Water Quality- This alternative will continue with the current point source discharge site identified in Section 3.1.1. Some of these discharges are from unregulated agricultural areas and large drainage basins. Such runoff normally contains high levels of nutrients and oils and grease. There is also the potential for heavy metals or other contaminants. These discharges will continue or increase as additional development occurs along the channel.

This alternative does not provide watershed-wide guidelines for the development of water quality enhancements and management strategies. It does not provide for additional guidelines for the design and location of groundwater recharge areas.

4.3.10.2 Effects of Alternative B: Agua Fria Watercourse Master Plan on Water Quality

Water Quality- The Agua Fria Watercourse Master Plan includes recommended management guidelines for incorporating water quality enhancement into the implementation of many phases of the project. It also includes guidelines for the location and design of multiple use facilities that would be compatible with water quality enhancement. It also restricts activities that might have an adverse affect on water quality The Technical Report, *Habitat Enhancement Opportunities/TechniquesLower Agua Fria River Corridor New Waddell Dam to Confluence with Gila River (KHA, 2002)* provides more details regarding the techniques proposed for water quality enhancement.

4.3.11 Predicted Effects on Regulatory Requirements of the Clean Water Act

4.3.11.1 Effects of Alternative A: No Additional Action on Clean Water Act

Clean Water Act-This alternative would not provide a river-wide approach to permitting or mitigating potential effects to waters of the U.S. Individual projects, that include activity within the jurisdictional channel will require coordination with the Corps and may require mitigation.

4.3.11.2 Effects of Alternative B: Agua Fria Watercourse Master Plan on Clean Water Act

Clean Water Act- The Agua Fria Watercourse Master Plan includes provisions for coordinating with the Corps to authorize a river-wide Section 404 authorization. This would allow the implementation of management strategies proposed in the Master Plan as special provisions or conditions of the Section 404 permit. Each project undertaken within the Agua Fria jurisdictional channel would be reviewed and authorized by the Corps based on its adherence to the requirements of the Master Plan. This would provide a coordinated approach to mitigation and habitat enhancement. If the Master Plan does includes a Section 404 authorization it may provide an incentive for activities within the channel.

4.3.12 Predicted Effects on Contamination

4.3.12.1 Effects of Alternative A: No Additional Action on Contamination

Contamination- This alternative would not have a direct effect on contamination. However, individual projects, implemented without the watershed level management strategies may have indirect effects on contamination sources. These types of projects include, groundwater recharge facilities, grade control structures and additional point source discharges.

This alternative would not include provisions for management strategies related to the El Mirage Landfill.

A future flood event could result in damage to the El Mirage Landfill.

4.3.12.2 Effects of Alternative B: Agua Fria Watercourse Master Plan on Contamination

Contamination- The Agua Fria Watercourse Master Plan includes recommendations for the monitoring and potential channel stabilization of the channel in the area of the El Mirage Landfill. Further evaluation of the El Mirage Landfill will be required prior to implementing these management strategies.

4.3.13 Predicted Effects on Social and Economic Resources

4.3.13.1 Effects of Alternative A: No Additional Action on Social and Economic Resources

Social and Economic Resources- The No Additional Action Alternative would not affect socioeconomic resources in the area of the Agua Fria River. Federal, state and local government funded projects would continue to be proposed and implemented. The potential for flood damage and the associated costs of repairing or replacing damaged buildings and infrastructure would remain.

4.3.13.2 Effects of Alternative B: Agua Fria Watercourse Master Plan on Social and Economic Resources

Social and Economic Resources-The Agua Fria Watercourse Master Plan is expected to only minimally affect socioeconomic resources in the area. The management strategies proposed may

result in additional design and construction costs for projects planned or proposed, but may reduce overall costs with strategic planning of resource development. Implementation of the Master Plan would decrease the potential for property loss related to flooding due to improved flood control, which is expected to result from implementation of the Plan. A potential long-term or cumulative effect of the Master Plan would be increased revenue to businesses in the West Valley as visitors utilize the proposed recreational enhancements along the corridor.

4.4 Summary of Predicted Effects

This Environmental Assessment details the results of the evaluation of the potential effects to the natural and human environment from the implementation of the proposed Agua Fria Watercourse Master Plan (Alternative B). It also evaluates the effects of No Additional Action (Alternative A). The evaluation is based on numerous Technical Reports and other studies that are listed in Chapter 1.

Based on this evaluation it appears that the proposed Agua Fria Watercourse Master Plan will meet the identified goals and objectives. It also appears that the Agua Fria Watercourse Master Plan will not have a significant negative effect on the human and natural environment and offers significant opportunities for enhancement of land use, natural resources and cultural resources.

Table 4-1 summarizes the results of the evaluation by resource category.

Table 4-1

Environmental Assessment Summary

Section Number / **Resource**	**Alternative A No Additional Action**			**Alternative B Agua Fria Watercourse Master Plan**		
	Enhancement	**Not Significant**	**Adverse**	**Enhancement**	**Not Significant**	**Adverse**
3.1.1 Watershed						
3.1.1.1 Groundwater/Recharge		X		Potential		
3.1.1.2 Surface Hydrology			Potential	X		
3.1.1.3 Hydraulics			Potential	X		
3.1.1.4 Floodplain/Control			X	X		
3.1.2 Geomorphology						
3.1.2.1 Geology		X			X	
3.1.2.2 Soils		X			X	
3.1.2.3 Sediment Transport			Potential	X		
3.1.2.4 Lateral Migration/Erosion			Potential	X		
3.1.3 Land Use/Planning						
3.1.3.1 Commercial/Residential			X	X		
3.1.3.2 Sand and Gravel		X				Potential
3.1.3.3 Agricultural		X			X	
3.1.4 Biological Resources						
3.1.4.1 Vegetation Communities		X		X		
3.1.4.2 Wildlife		X		X		
3.1.5 Protected Species						

3.1.5.1 ESA Listed			Potential	Potential		
3.1.5.2 Other Protected			Potential	Potential		
3.1.6 Visual Environment						
3.1.6.1 Landscape Character			Potential	X		
3.1.6.2 Visual Resource Inv.			Potential	X		
3.1.7 Infrastructure			Potential	Potential		
3.1.8 Cultural Resources						
Section Number Resource	**Alternative A** **No Additional Action**			**Alternative B** **Agua Fria Watercourse Master Plan**		
	Enhancement	**Not Significant**	**Adverse**	**Enhancement**	**Not Significant**	**Adverse**
3.1.8.1 Archaeology Resources		X			X	
3.1.8.2 Historical Resources		X			X	
3.1.8.3 Historical Themes		X		X		
3.1.9 Recreation		X		X		
3.1.10 Water Quality		X		Potential		
3.1.11 Clean Water Act		X			X	
3.1.12 Contamination			Potential		X	
3.1.13 Social/Economic		X			X	
3.2 Non-Affected Resources		X			X	
3.2.1 Env. Justice		X			X	
3.2.2 Air Quality		X			X	
3.2.3 Acoustics		X			X	
3.2.4 Climate		X			X	

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Terms, Acronyms, and Abbreviations

Terms

10-year flood event is a flood that has a 10% chance of occurring in any given year.

100-year flood event is a flood that has a 1% chance of occurring in any given year.

100-year floodplain is an area that is flooded by a 100-year flood event.

Aggradation is the process by which a stream's gradient steepens due to increased deposition of sediment.

Anthropogenic: relating to or resulting from the influence of human beings on nature

Avulsion is the sudden relocation of a stream away from its original flow path, usually due to catastrophic sediment deposition in the original flow path (JE Fuller, 2001).

Aquifer refers to a water bearing stratum of permeable rock, sand, or gravel (Merriam-Webster).

Artificial recharge is the act of deliberately augmenting the water supply of an aquifer. It has become an increasingly important water management tool in Arizona. Artificial recharge in Arizona has been characterized in two ways: 1) the storage of water, or direct physical addition of water to an aquifer; 2) the saving of water, which is the act of indirectly saving groundwater by irrigating agriculture with renewable water sources and not pumping groundwater.

Bankfull discharge is defined as the flow rate that fills the active channel just prior to inundating the floodplain (JE Fuller, 2001).

Ephemeral watercourse is defined as a watercourse in which runoff occurs only in direct response to precipitation.

Erosion is the movement of soil by water.

Erosion hazard zone is an area of land that is prone to erosion.

Fissures are narrow openings or cracks of considerable length and depth usually occurring from some breaking or parting

Floodwave attenuation is the reduction of flow due to channel storage. As water flows downstream, it spreads out to fill a channel. If the channel configuration is such that it holds significant amounts of water, a noticeable decrease in flow occurs downstream.

Floodway fringe is the portion of the floodplain lying on either side of the floodway.

Gabion is defined as a basket or cage filled with earth or rocks (Merriam-Webster).

Geomorphology is the study of the shape and form of the Earth's Surface (JE Fuller, 2001).

Headcutting is channel degradation associated with abrupt changes in the bed elevation that migrate in an upstream direction (JE Fuller, 2001).

Incidental recharge occurs as a consequence of human activities. This type of recharge occurs by excess application of irrigation in agricultural fields and turfed areas, or as a result of leaks and/or losses within municipal distribution systems.

Indurate means to grow hard or to become established (Merriam-Webster).

Injection wells deliver water directly to an aquifer, below the water table (Fluid Solutions, 2001).

Lateral Migration is the movement of channel banks caused by erosion.

Natural recharge is the movement of water from the surface through the soil zone to form or add to an aquifer. Natural recharge is the result of atmospheric precipitation that has escaped evaporation and uptake by plants (transpiration) and has infiltrated the soil. Ultimately, impermeable geologic materials impede the further downward movement of water and groundwater aquifer forms. In the arid southwest this type of recharge is generally limited to areas along the mountain fronts that define the basin peripheries and along flowing watercourses.

Open Water Obligates are species that require open water for survival.

Piedmont is a general term for the sloping land area adjacent to a mountain front (JE Fuller, 2001).

Point sources enter waterways at well-defined locations (Nadakavukaren, 1995).

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses (USDA SCS NRI).

Ramada is an open or semi-open shelter roofed with brush or branches, designed to provide shade

Recharge is the process of adding water to an aquifer system either through the infiltration of water from land surface or injection into the subsurface via wells

Recurrence interval storm or flood is defined as a storm or flood that has a specific probability of occurring within any given year. For example, a 100-year recurrence interval storm has a 1% chance of occurring within any given year.

Regulatory floodway is the area defined by FEMA that is reserved for the conveyance of floodwaters. Buildings and other obstructions are not allowed within the regulatory floodway.

Riprap is rock material placed on stream banks to protect a structure or embankment from erosion (JE Fuller, 2001).

Runoff is the part of precipitation that appears in surface-water bodies. It is the same as streamflow unaffected by artificial diversions, storage, or other human works in or on the stream channels (JE Fuller, 2001).

Scour is the lowering of the channel bed elevation due to flowing water.

Storm water means storm water runoff, snowmelt runoff, and surface runoff and drainage (Vanderver et. al, 1994).

Subsidence is the sinking of the surface of the earth (Fowler, 1990).

Thalweg is a line joining the lowest points along the entire length of a streambed or valley, whether or not the bed or valley lies underwater.

Vadose zone wells deliver water to the unsaturated interval between the land surface and the water table (Fluid Solutions, 2001).

Watershed is an area confined by drainage divides, usually having only one streamflow outlet (JE Fuller, 2001).

Acronyms and Abbreviations

ACDC: Arizona Canal Diversion Channel

ADEQ: Arizona Department of Environmental Quality

ADWR: Arizona Department of Water Resources

CAP: Central Arizona Project

CAWCD: Central Arizona Water Conservation District

cfs: cubic feet per second

District: Flood Control District of Maricopa County

EPA: United States Environmental Protection Agency

FEMA: Federal Emergency Management Agency

FRS: Flood Retarding Structure

LMEHZ: Lateral Migration Erosion Hazard Zone

LUST: Leaking Underground Storage Tank

MC 85: Maricopa County Route 85

mm: millimeters

MWD: Maricopa Water District

NPL: National Priorities List

NRCS: Natural Resources Conservation Service

NRI: National Resources Inventory

RID: Roosevelt Irrigation District

SCS: Soil Conservation Service

SPF: Standard Project Flood

TCE: Trichloroethene

USDA: United States Department of Agriculture

USFWS: United States Fish and Wildlife Service

USGS: United States Geological Survey

WWTP: Wastewater Treatment Plant

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