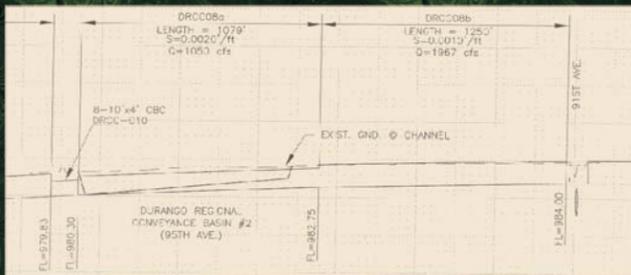
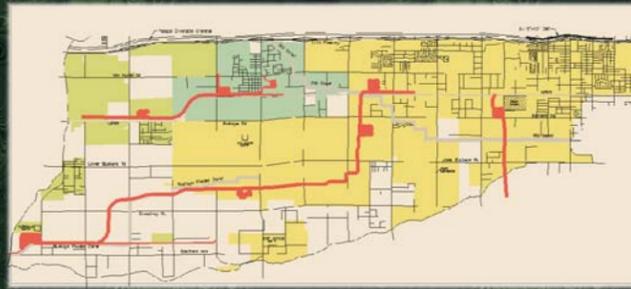
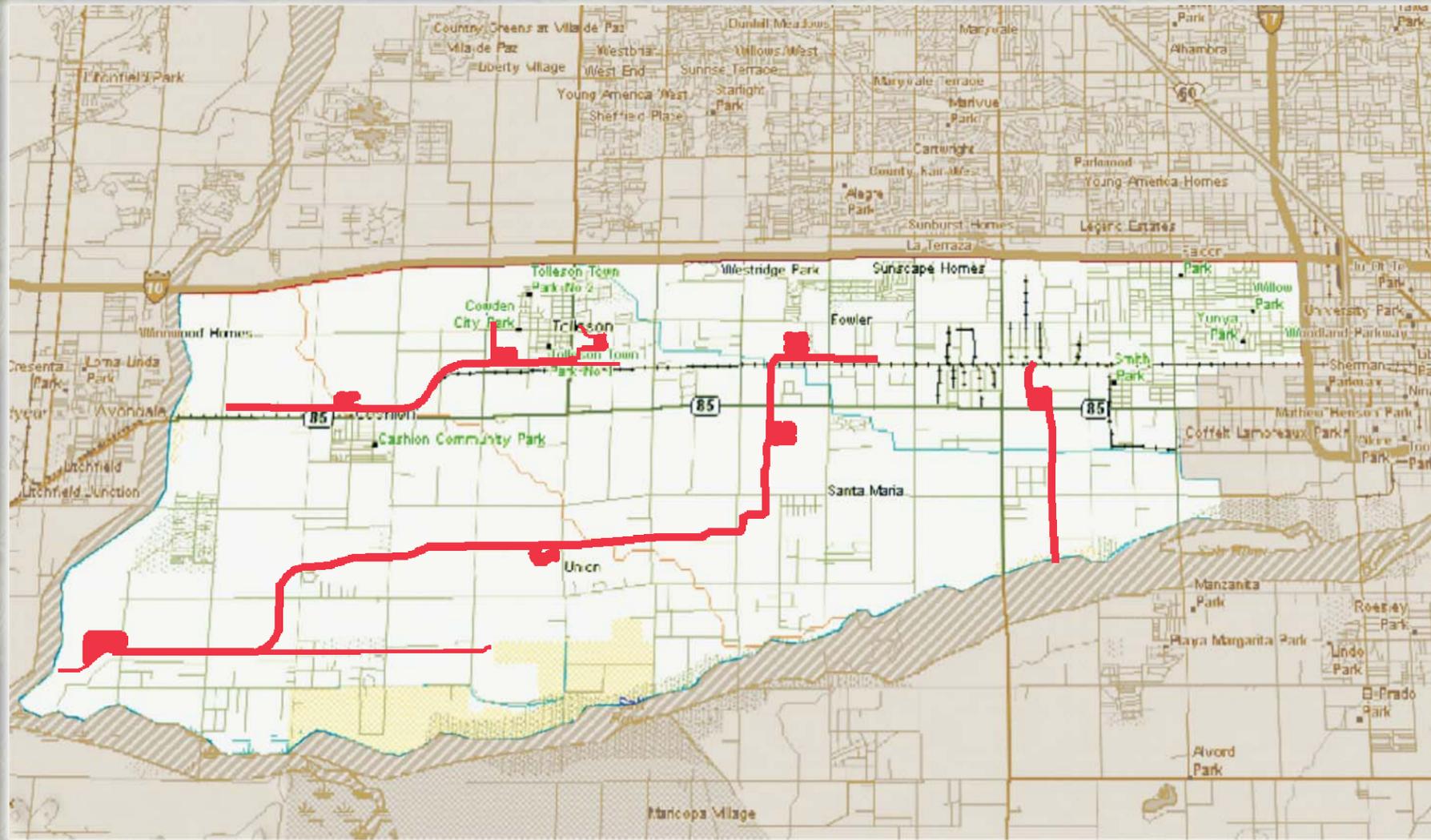


Durango Area Drainage Master Plan Recommended Design Report FCD #99-41

Prepared for:

Flood Control District of Maricopa County



Prepared by:



In Cooperation With:



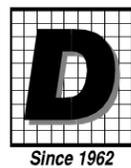
October, 2002

Durango Area Drainage Master Plan Recommended Design Report FCD #99-41

Prepared for:



Prepared by:



DIBBLE & ASSOCIATES
CONSULTING ENGINEERS



In Cooperation With:

McCloskey ♦ Peltz, Inc.
LANDSCAPE ARCHITECTS

and

SWA Environmental
Inc. Consultants

October 2002



**DURANGO AREA DRAINAGE MASTER PLAN
RECOMMENDED DESIGN REPORT**

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ABBREVIATIONS

- ADA - Americans with Disabilities Act
- ADMP - Area Drainage Master Plan
- APS - Arizona Public Service
- BFC - Buckeye Feeder Canal
- BID - Buckeye Irrigation District
- cfs - cubic feet per second
- CIP - Capital Improvement Program
- DDMSW - Drainage Design Management System for Windows
- DOE - Department of Energy
- FCDMC - Flood Control District of Maricopa County
- FEMA - Federal Emergency Management Agency
- FIRM - Flood Insurance Rate Map
- IGA - Inter-Governmental Agreement
- MAG - Maricopa Association of Governments
- MCDOT - Maricopa County Department of Transportation
- NAMU - Natural Appearing Multi-Use
- NPDES - National Pollutant Discharge Elimination System
- RID - Roosevelt Irrigation District
- RRS - Roads of Regional Significance
- SRP - Salt River Project
- UPRR - Union Pacific Railroad



I. INTRODUCTION

A. Objective

This Recommended Design Report has been prepared for the Flood Control District of Maricopa County (FCDMC) as part of the Durango Area Drainage Master Plan (ADMP). The study area location is shown on **Figure I-1**. The purpose of the project is to quantify the extent of flooding problems and develop alternative solutions to identified flooding problems. The ADMP process evaluates the drainage area, identifies structural and non-structural alternatives, and develops a preferred solution. The ADMP identifies preliminary costs, alignments, typical sections, right-of-way requirements, utility conflicts, environmental issues, landscape design concepts, and potential project participants for the preferred alternative. The recommended plan of the ADMP addresses mitigation of flooding along the Buckeye Feeder Canal (BFC), the Roosevelt Irrigation District (RID) Canal, and the Union Pacific Railroad (UPRR). This project includes the delineation of the 100-year floodplain for the BFC associated tributaries, from the Agua Fria River eastward to approximately 105th Avenue and an extension of the Tolleson floodplain delineation along the UPRR extending from 69th Avenue to 35th Avenue. The new floodplain delineations are documented in the *Durango ADMP Floodplain Delineation, Final Report and Technical Data Notebook*.

B. Study Area Location

The study area is within Maricopa County and includes portions of the City of Phoenix, the City of Tolleson, the City of Avondale, and unincorporated Maricopa County. The jurisdictional boundaries are depicted on **Figure I-2**. The study area encompasses approximately 53 square miles bounded by the Interstate 10 freeway on the north, the Salt and Gila Rivers on the south, the Agua Fria River on the west, and the Interstate 17 freeway on the east. The study area has been divided into three geographic areas.

The **Northern Study Area** extends the full width of the study area from the Agua Fria River eastward to I-17 and from I-10 southward to the UPRR at approximately Buckeye Road. The **Southwest Study Area** extends from the Agua Fria River eastward to approximately 83rd Avenue and from the UPRR southward to the Gila River. The **Southeast Study Area** extends from approximately 83rd Avenue eastward to I-17 and from the UPRR southward to the Salt River.

C. Existing Reports

The Durango area has been previously studied in other master plans and studies. These plans and studies are discussed in the *Durango ADMP Alternatives Analysis Report*, dated March 2001. Improvements identified in this report are based on preliminary information contained in the *Alternatives Analysis Report*, and the *Durango ADMP Data Collection Report*, dated March 2000. The reader is referred to the *Alternatives Analysis Report* for additional background information on the alternatives considered and the selection process.

D. Project Coordination

A Review Committee was established by the FCDMC to provide coordination and input throughout the project. The Review Committee consisted of representatives of the agencies that will be impacted by the project and have an interest in its outcome. The Review Committee met for the following meetings:

1. Project kick-off meeting.
2. Brainstorming meeting to identify drainage problems and alternative solutions.
3. Potential Alternatives meeting to confirm the drainage alternatives identified by the consultant to be developed in detail for the alternatives evaluation.
4. Preferred alternative meeting to evaluate the alternatives and select a preferred alternative for further design development.
5. Project Prioritization Meeting to determine the appropriate priority of each project throughout the study area.

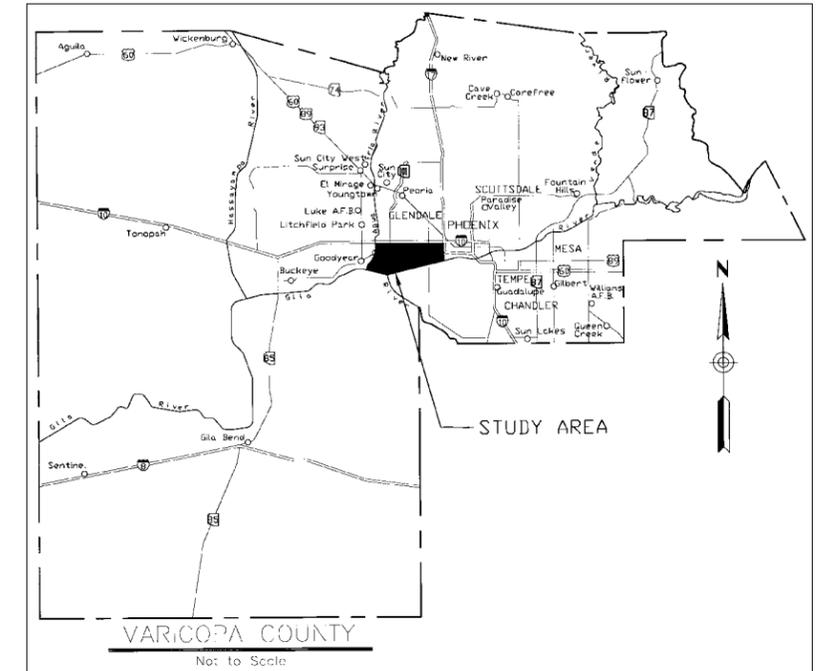


Figure I-1. - Study Area Location

The Review Committee consisted of the following members:

REVIEW COMMITTEE

<u>Agency</u>	<u>Representative</u>
City of Avondale	Mr. Jim Mitchell
Flood Control District of Maricopa County	Multiple Members
Maricopa County Dept of Parks & Recreation	Mr. Dave Konopka
Maricopa County Dept of Planning & Dev.	Mr. Neil Urban / Mr. Matthew Holmes
Maricopa County Dept of Transportation	Mr. Mike Smith
City of Phoenix	Mr. Hasan Mushtaq / Mr. Raimundo Dovalina / Ms. Chris Hood
Roosevelt Irrigation District	Mr. Stan Ashby
Salt River Project	Mr. Steven Tanis / Mr. Bill Phillips
City of Tolleson	Mr. Woody Scoutten / Mr. Manuel Dominguez
U.S. Army Corps of Engineers	Mr. Mike Ternak / Mr. John Drake
Buckeye Irrigation District	Mr. Jackie Meck

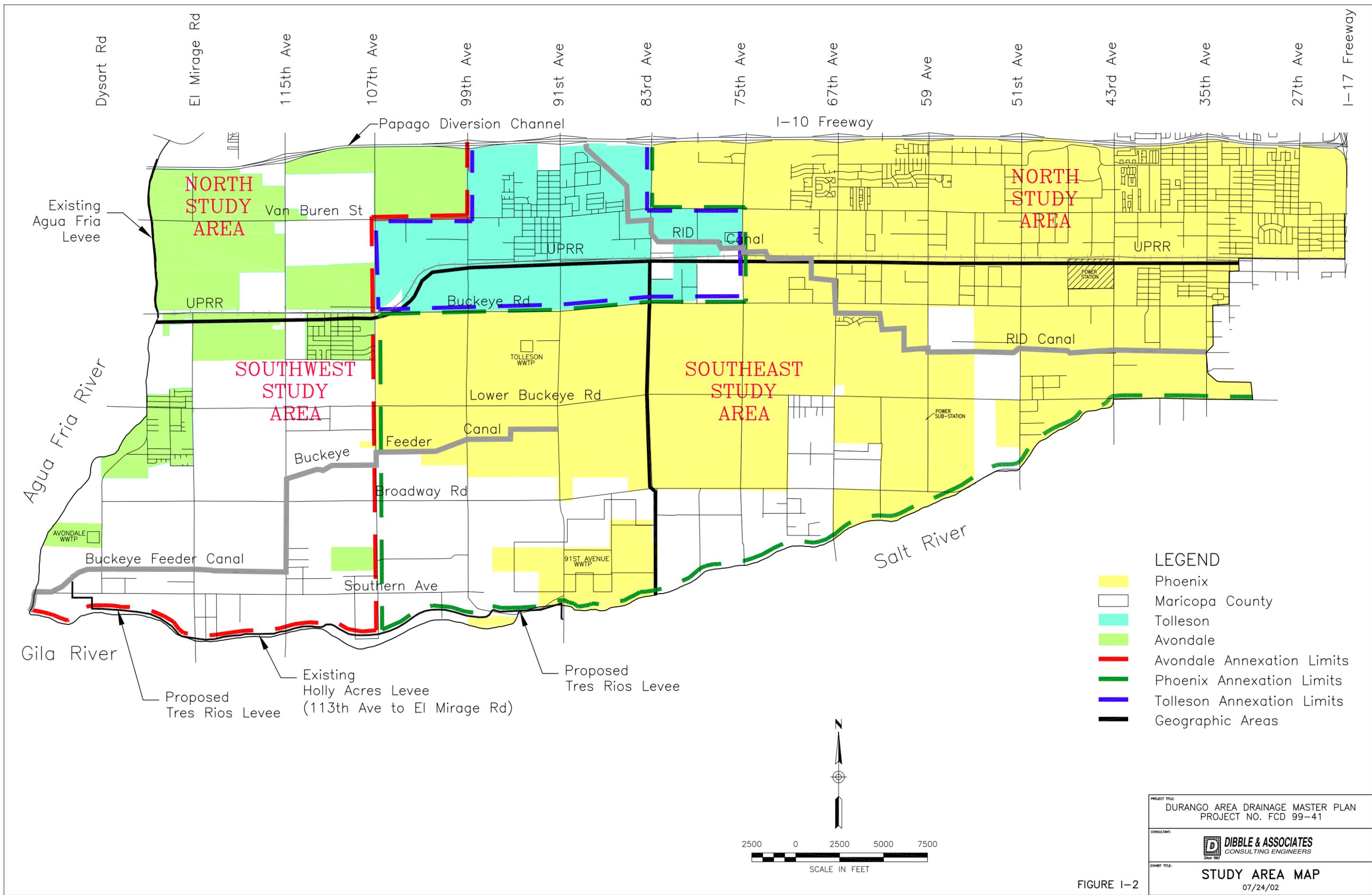


FIGURE I-2

PROJECT TITLE:	DURANGO AREA DRAINAGE MASTER PLAN PROJECT NO. FCD 99-41
CONSULTANT:	 DIBBLE & ASSOCIATES CONSULTING ENGINEERS
EXHIBIT TITLE:	STUDY AREA MAP 07/24/02

E. Public Involvement

1. Public Meetings

In addition to the Review Committee, public input was solicited at five sets of public open house meetings held in the project study area. Each set of public open house meetings was held at two locations within the study area, one in Phoenix for residents in the eastern portion of the study area, and the other in Avondale for residents in the western portion of the study area. The first set of public open house meetings was held early in the project to allow public input to be incorporated into the entire planning process and to present the proposed alternatives of the ADMP. The second set of public open house meetings was held just after the selection of the preferred alternative to allow opportunity for comment on the selected alternative. A third set of public open house meetings was held to show the preliminary results of the floodplain delineations from the study. A fourth set of public open house meetings was held after a draft of this Recommended Design Report was completed to give the public the opportunity to see the preliminary results of the study. A fifth public open house meeting was held at the completion of the project to present the overall recommended plan to the public.

The public was notified of the open house meetings via newspaper advertisements, flyers in the City of Tolleson water bills, direct notification to developers and the City of Phoenix Estrella Planning Committee, and direct mailings to property owners along the alignments of the preferred alternative and within floodplain areas. Copies of the public meeting invitation brochures and community questionnaires can be found in **Appendix F**.

2. Estrella Village Planning Committee

Input from the City of Phoenix Estrella Village Planning Committee was instrumental in developing the Recommended Plan. Representatives from the Committee were invited to participate in all of the project meetings and actively express ideas for the project based on the City of Phoenix General Plan. As a result, many of the project facilities are located on sites that can become amenities to the

community. Additionally, two presentations were made to the Estrella Village Planning Committee on May 2nd and September 5th of 2000 to provide an overview of the project and to inform the committee of the progress of the plan.

F. Deliverables

The project consisted of five phases resulting in an implementation plan with estimated costs for a recommended plan to address the drainage issues within the study area. The five project phases are summarized as follows:

<u>Phase</u>	<u>Products</u>
1. Data Collection	Data Collection Report Survey & Mapping
2. Level I Analysis	Potential Alternatives Submittal
3. Level II Analysis	Alternatives Analysis Report
4. Level III Analysis	Preliminary Recommended Design Report Preliminary Design Plans
5. Implementation	Final Submittal Recommended Design Report w/ Maintenance Plan



Public Meeting, September 20, 2001

This Recommended Design Report is the final deliverable for the Level III analysis documenting the preliminary design and engineering of the recommended plan as well as development of landscape themes and multiple use opportunities to be incorporated into the plan.

G. Acknowledgments

The completion of this report was made possible by many individuals whose assistance and cooperation are gratefully acknowledged. We especially wish to thank the staff of the FCDMC, all of the members of the Review Committee, and the participation of concerned citizens of this area.

H. Consultant Project Team

Dibble and Associates is the prime consultant on the project. The following individuals from Dibble and Associates are responsible for completion of this project: Mr. Richard Perry, P.E., Principal in Charge, Mr. Brian Fry, P.E., Project Manager, Mr. Jason Mikkelsen, P.E., Mr. Dan Frank, P.E., Mr. Joshua Papworth, P.E., and Mr. Ezra Page, EIT, Project Engineers.

Dibble and Associates was assisted by McCloskey-Peltz, Inc. (MPI) for landscape analysis and by SWCA, Inc. Environmental Consultants for environmental analysis. Individuals from MPI who have contributed to the project include: Ms. Diane McCloskey, RLA, Principal. Individuals from SWCA who have contributed to the project include: Mr. Ken Houser, Project Manager, Ms. Melissa Keane, and Mr. Mike List.

II. HYDROLOGY

A. Introduction

The hydrology for this study was developed based on existing conditions hydrology from the *Floodplain Delineation of the Tolleson Area* (Project FCD 95-26). The hydrology was updated as part of this project to reflect changes in land-use and routing which have occurred since the original study. The reader is encouraged to review the full *Durango Area Drainage Master Plan Hydrology Report*, dated June 2001, for additional details not presented here.

The updated existing conditions hydrology was then revised to model the improvements of the recommended plan reflecting routing changes due to the proposed channels, storm drains, and detention basins.

B. Methodology

The U.S. Army Corps of Engineers, *HEC-1 Flood Hydrograph Package* (HEC-1) computer program was used for the development of this model. Guidance is given in the *Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology* (Hydrology Manual) for application of the HEC-1 program within Maricopa County. Additionally, the computer program *Drainage Design Management System for Windows* (DDMSW), developed by the District, was used to modify drainage sub-basin and routing parameters which changed due to the proposed improvements. The revised drainage sub-basin boundaries and routing are shown on **Figure II-1**.

C. Hydrologic Criteria

The preliminary design hydrology is based on providing 100-year flood protection under existing watershed conditions. Both the 6-hr and the 24-hr storms were evaluated for the 100-year event. The higher of the 6-hr and 24-hr peak discharges was used as the design discharge in each reach. Retention and detention basins for the recommended plan were sized based on the 24-hr storm event. A table summarizing the 6-hr and 24-hr peak discharge comparison is contained in **Appendix A**.

D. Drainage Area Characteristics

Three features that play a significant role in defining the drainage patterns in the watershed are the RID Main Canal, the UPRR and the BFC. The RID Canal and the UPRR are elevated through the watershed. Roadways that cross these features typically rise to meet the elevated grades and proceed over the top. This causes water to form ponding “cells” behind these features. Runoff will continue to pond until it either overtops the railroad/canal, or until it overtops the sag portion of the crossing roadways. Overtopping flows are then directed westerly along the railroad or canal, or are directed southerly over the railroad or canal, or a combination of the two. Flooding of this type occurred along the RID Canal and UPRR in a documented 1966 flood in the City of Tolleson, around 91st Avenue and Van Buren Street. Photos of this event are presented in the *Durango ADMP Alternatives Analysis Report*, dated March 2001.

The BFC is the dominant drainage feature in the southwest portion of the watershed. The BFC is an SRP owned and operated irrigation tailwater ditch. The BFC was not designed to convey storm water. However, the BFC is located at the low point in the terrain and receives runoff during storm events. During storm events that exceed the channel capacity, runoff spreads beyond the limits of the canal and flows in an overland flow fashion causing shallow flooding of the adjacent agricultural fields. Flooding of homes and businesses has been reported along the BFC in the vicinity of 115th Avenue.

Other features that define the flow pattern are roads and local irrigation ditches. Low flows accumulate along roadways and ditches, converging at road intersections at the northeast corner of each road intersection. Higher flows accumulating along roadways and ditches may overtop the roadway or ditch and proceed in the direction of the predominant land slope.

E. Build-Out Conditions Hydrology

Hydrology for the area was updated for fully developed watershed conditions at build-out using a combination of aerial photography and Maricopa Association of Governments (MAG) land use projections. The MAG projections are used exclusively except where aerial photographs show that existing development has already occurred that is contradictory to the MAG projections. The build-out conditions land use is shown on **Figure II-2**. The build-out conditions modifications were limited to changes in land use on a sub-basin basis. Hydrograph routing changes were only made for ADMP proposed elements. The impact of a developer constructing a channel through their site to convey off-site runoff through the development is not modeled. Overland routing in areas with no ADMP channel is unchanged from the existing conditions.

The build-out conditions hydrology is further refined to account for future on-site retention. This is accomplished by applying the FCDMC’s retention requirement according to how the sub-basin is projected to develop with respect to the amount of developable land. The effective retention volume is considered to be 80% of the required volume to account for inefficiencies in the system. The results of these calculations along with a table summarizing the 6-hr and 24-hr build-out peak discharges are found in **Appendix B**. Retention is modeled in HEC-1 as a divert that is limited to the effective retention volume and is not returned.

In general, there was no distinct conclusion about how the build-out conditions affected the peak flows. The Peak flows both increased and decreased in different areas of high future development. The overall cost difference is negligible for the whole plan, however individual projects may derive cost savings from designing for build-out conditions.

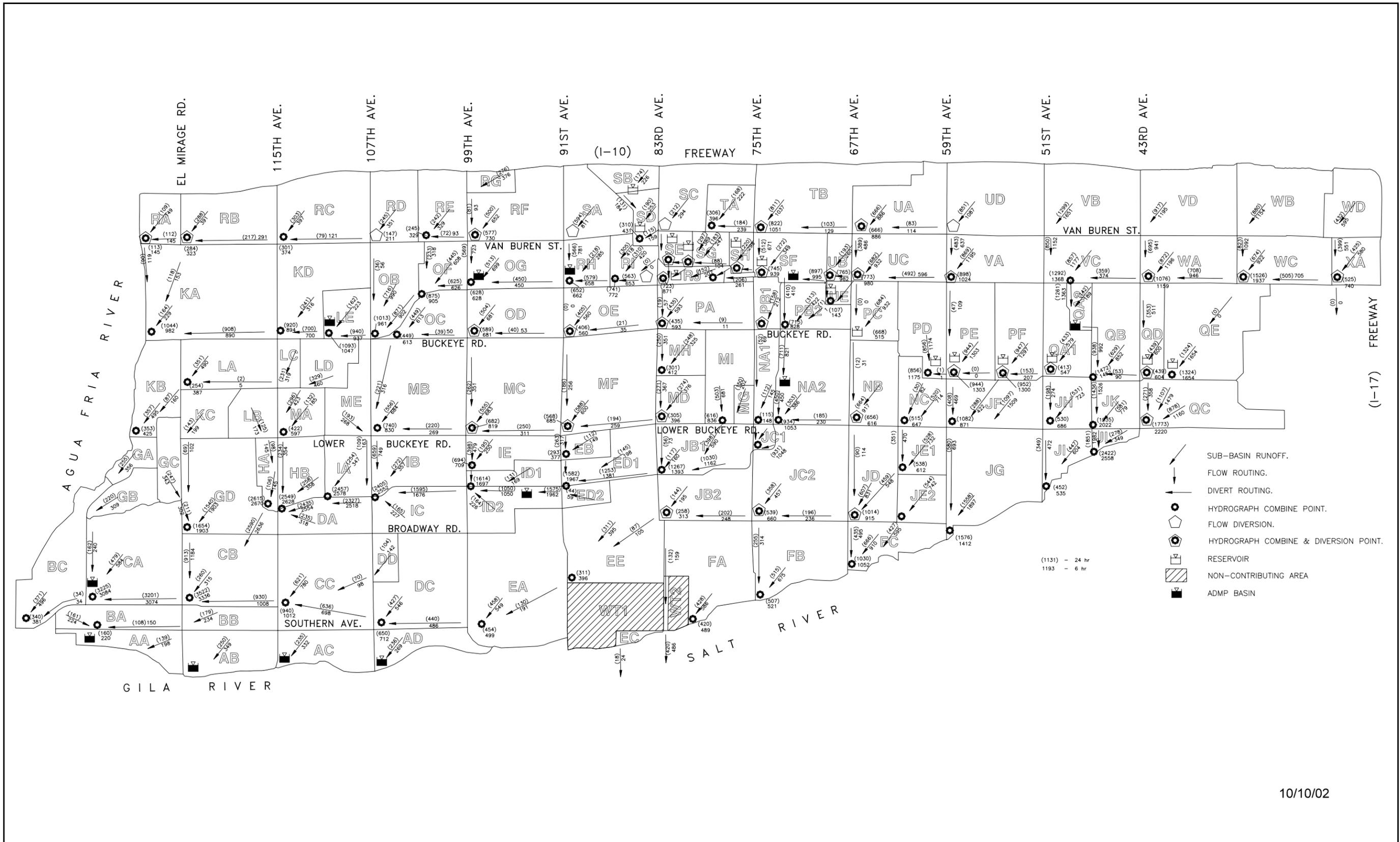


Figure II-1. - Improved Conditions Drainage Sub-Area Boundaries

10/10/02

Subbasins and Future Land Use in the Durango Area Drainage Master Plan Area

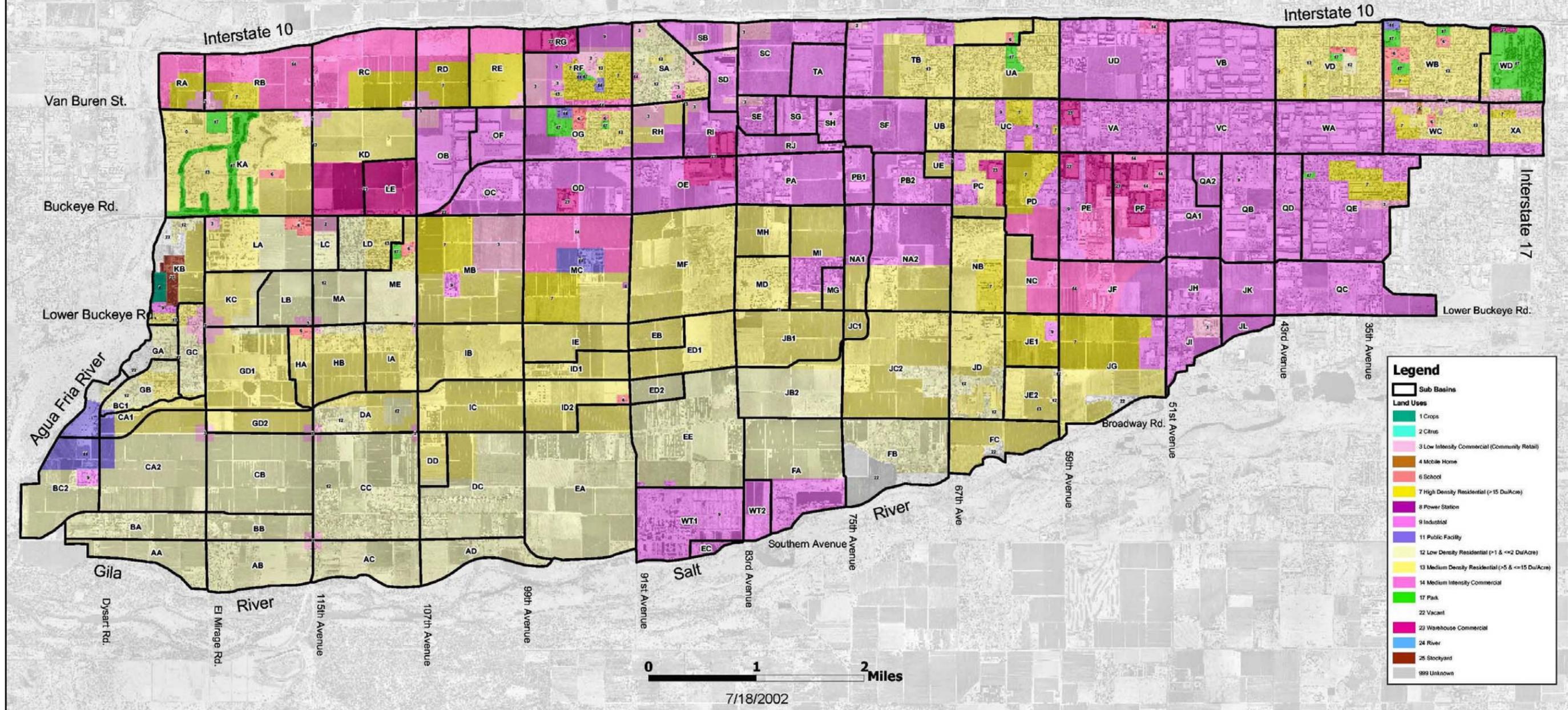


Figure II-2. - Build-Out Conditions Land Use

III. DESIGN CRITERIA & OBJECTIVES

A. Introduction

This section describes the criteria for open channel, box culvert, and detention basin design and the computational procedures used for preliminary design and recommended for final design.

B. Design Criteria

Drainage design for hydraulic structures in Maricopa County is governed by criteria presented in *Drainage Design Manual for Maricopa County, Arizona, Volume II, Hydraulics*, January 28, 1996 (Hydraulics Manual.) In addition to the criteria from the Hydraulics Manual, additional criteria are adopted for preliminary design. The criteria listed below are used as a guideline during design development and are intended to be followed during final design development.

1. Open Channels

Channel Section - The maximum side slope is 2:1 for concrete channels and 4:1 for earth channels. The design side slope for earth channels is 6:1 where sufficient right of way is available. A minimum bottom width of 4 feet is required. The design channel lining depth is the normal flow depth plus freeboard. Required freeboard is 0.25 times the sum of depth plus velocity head with a minimum of 1 foot for sub-critical flow and 2 feet for super-critical flow conditions.

Manning's n - The following Manning's n values are used in development of the channel design: n=0.014 for concrete, n=0.030 for earth, n=0.040 for landscaped earth, n=0.040 for grass, and n=0.040 for riprap.

Froude Number - Froude numbers for channel design are to be less than or equal to 0.86 for sub-critical flow. In most cases channels are designed for sub-critical flow. Drop structures are provided, if necessary, to flatten the grade to achieve sub-critical flow conditions. Although no super-critical reaches are anticipated, super-critical flow

may be allowed in special circumstances, such as where right-of-way is limited. Super-critical flow channels, if used, are to have Froude numbers greater than 1.13 and less than 2.0.

Longitudinal Slope - Extremely flat slopes are avoided for constructability reasons. Specific slope criteria are not provided because slopes will generally be dictated by the Froude number or velocity criteria. Slopes are set to approximate the existing ground slope within the limitations of the channel material maximum allowable velocity and the limitation on Froude number.

Drop Structures and Channel Profile - When the natural ground slope is steeper than the maximum allowable longitudinal channel slope, drop structures are provided. The size and spacing of drop structures are established based on a minimum drop height of 3 feet, and a maximum drop height of 6 feet. Additionally, the top of channels should project no more than 2 feet above adjacent existing ground (fill situations) and the top of channels should be incised no more than 3 feet below adjacent existing ground (cut situations).

Channel Alignment - Horizontal curves are designed with a minimum radius equal to 3 times the flow topwidth.

River Outfalls - The downstream water surface at channel outfalls into the Salt, Gila, and Agua Fria Rivers is assumed to be low enough to not create a backwater effect that would reduce the outfall channel capacity. It is recognized that the outfall channels may not have 100-year capacity during a coincident 100-year flow event in the rivers. However, the outfall channels should have 100-year capacity with a coincident 10-year water surface in the rivers. In cases where the 10-year water surface elevation in the river is higher than the water surface at the outfall of the channel, additional freeboard is added to the channel upstream of the outfall, to compensate for the backwater effect from the

river and allow positive drainage of the channel.

Side Drainage - Surface runoff entering the channel from the side should be directed to enter the channel at planned locations with side spillways. This will prevent rill erosion for earth channels and undermining at the concrete-soil interface for concrete channels.

Auxiliary Drainage Facilities - Where the top of channel projects above the adjacent existing ground (fill situations), a parallel channel or swale should be used to convey runoff to a planned channel inflow point. Additional right of way may be required in these areas. The parallel auxiliary drainage channel should generally be a v-shaped swale.

Maintenance Access Road - The channel cross-section allows for a 16-foot wide maintenance road on each side of the channel. Where the channel is adjacent to a public street, or an existing canal maintenance road, the street or existing road serves as one of the maintenance roads. New maintenance roads should have a 2% cross slope, away from the main channel. At specified locations, the maintenance road should be dipped to allow side drainage to enter the main channel. A stabilized decomposed granite surface is required on the maintenance road.

Some areas with existing development adjacent to an unimproved channel do not have adequate right of way to allow maintenance roads. The District should be involved in decisions to provide either dry weather access only, along the channel bottom, or to obtain additional right of way for all weather access roads.

Fence - Due to the multiple use objective in the channel design new fencing is not provided along the channel. Existing private fences along the alignment are suggested to be protected in place during construction or replaced in kind.

Concrete Lining - For planning purposes, concrete channel lining includes 6-inch thick concrete lining with reinforcing steel using #4 bars at 12 inch center spacing each way. The final concrete channel section design should be based on recommendations from a future geotechnical investigation.

2. Box Culverts

Height & Cover Requirements - A minimum height of 4 feet shall be provided for maintenance purposes. A minimum of 1 foot of cover is planned for a full roadway structural section. If one foot of cover cannot be provided, traffic should drive directly on the box culvert top slab. Approach slabs shall be included for box culverts with no cover.

Design Flow - Culverts constructed with channels shall be designed for the same 100-year design discharge as used for the channel. Inlet control is desired for the culverts.

3. Detention Basins

Side Slopes - Side slopes of 6:1 are normally used for the inside basin side slopes. Maximum inside side slopes of 4:1 can be used when required to achieve the required volume within the available site. Fill embankments are avoided for detention basins except to provide freeboard. Side slopes on fill embankments outside the basin are limited to a maximum of 3:1, with 4:1 or flatter desired if site constraints permit.

Basin Longitudinal Slope - Minimum slopes of 0.5% are used for grass or earth low-flow channels or swales within the basin. A minimum slope of 0.2% and a maximum slope of 0.5% is used for concrete low-flow channels within the basin.

Basin Cross Slope - A 1% minimum cross slope is used for sheet flow runoff surfaces. Surfaces are graded to drain toward the low-flow channel or outlet pipe.

Maintenance Road - A 16-foot wide maintenance access road is

provided around the top of the basin. To minimize rill erosion, maintenance roads should have a 2% cross slope away from the top of basin. At specified locations, the maintenance road should be dipped, or other provision made, for side drainage to enter the basin. The maintenance road will include a stabilized decomposed granite surface. Provision should be made in final design for maintenance access to the basin floor by providing one or more access ramps.

Principal Outlet Pipe - Principal outlet pipes consist of a concrete pipe or box culvert, designed to operate under inlet or pipe control. The minimum allowable outlet pipe size is 24-inches. The outlet pipe invert is typically set 12 inches below the basin floor to facilitate complete draining of the basin and to prevent soggy areas near the outlet. For planning purposes, the outlet pipes are modeled in HEC-1 as orifices with an orifice coefficient of 0.62. A more detailed analysis of the outlet is recommended for the final design.

Emergency Spillway - The basins are proposed to be constructed in excavation conditions only, thus emergency spillways are not required. However, a planned overflow location shall be designed to direct overtopping flows to a suitable outfall location.

Freeboard - No freeboard is required, due to the basins being constructed in excavation conditions only. However, additional capacity is recommended to be provided during final design to account for volume lost to sedimentation, landscaping, or some other purpose, based on the specific site conditions at the time of final design.

Safety Features - All inflow and outflow pipes will be equipped with access barrier grates. The grates shall have adequate open area to limit design flow velocities through the grate to 3 feet per second (ft/s) or less with a plugging factor of 50% applied to the clear opening area. A maximum clear opening of 4 inches is allowed between grate bars.

Off Line Storage basins - Off line detention basin concepts are utilized in this master plan. Planning level estimates are provided for the inflow

weir length based on an average depth of flow of 1 ft over the weir. More detailed analysis will be required for the final design to ensure proper functioning of side weirs.

C. Design Calculations

New open channels, box culverts, and detention basins are sized based on projected peak runoff rates under existing development conditions. The existing conditions hydrology model is updated to reflect the design channel cross sections and slopes and the detention basin stage-storage-discharge relationships and then rerun. The resulting updated flows are used to update the design calculations. Through this process the hydrologic routing effects of the proposed improvements are included in the design discharges. The design calculations for each project element are presented on the facing page of each preliminary plan sheet in the back of this report.

1. Open Channels

Open channels are sized using Manning's equation. The maximum allowable longitudinal slope is determined based on the Froude number criteria and the maximum allowable velocity for the channel material. The design slope is then fit into the profile using the preliminary plan and profile sheets. The freeboard requirement is computed from the hydraulic parameters and added to the normal flow depth to determine the channel lining depth and top width. The required right-of-way width for each channel is computed by adding the required channel top width, increased by ten percent to allow for a buffer area, plus 32 feet to allow for 16 foot maintenance roads on both sides of the channel.

Earth Channel Stability - The recommended channels are planned as grass and "decomposed granite" lined channels. The preliminary design calculations contained in this report are based on these linings being in-place. As a result, the linings should not be considered as simply landscape enhancements, but as an integral part of the channel design. The channel slopes and cross-sections presented in these plans and the resulting velocities in unlined, unlandscaped channels, may not be stable for the in-place soils present within the study area without protection.

During final design, the Manning's n values should be reviewed for the actual proposed lining and a tractive shear approach should be used to develop the final design channel cross-section and slope. For grass to be considered as a reliable channel lining, permanent irrigation must be provided. For "decomposed granite" channels, a fractured rock should be considered instead of the smaller, conglomerate granites typically used in landscape applications.

The channel design calculations are tabulated on the facing page of each channel plan and profile sheet in the *Preliminary Design Plans* section of this report. The headings in the "Channel Properties" portion of the facing page calculations are defined as follows:

Col No.	Heading	Description
1	I.D.	Reach identifier from plans.
2	HEC-1 I.D.	Identifier from HEC-1 output.
3	Design Q100	Design discharge from HEC-1 output corresponding to HEC-1 I.D.
4	Comp. Capacity	Computed channel capacity from parameters in table (should match Design Q100)
5	DS Invert El.	Invert El. at downstream end of reach.
6	US Invert El.	Invert El. at upstream end of reach.
7	Length	Length of channel reach.
8	Comp. Invert Slope	Natural ground slope.
9	Design Invert Slope	Design channel invert slope.
10	Total Vert. Drop	Vertical drop from difference in natural
11	No. Of Drops	and design invert slopes.
12	Vertical Drop	Number of drop structures in reach
13	Material Type	Height of each drop structure
14	Manning's n	Channel lining material code
15	Bottom Width	N-value for lining material
16	Depth of Flow	Channel design bottom width
17	SS Left	Design normal depth of flow
18	SS Right	Channel side-slope left
19	Area	Channel side-slope right
20	Perimeter	Flow cross-sectional area
21	Froude No.	Wetted perimeter of flow
22	Type of Flow	Froude no based on hydraulic depth Flow regime; sub-critical, transition, or super-critical.
23	Velocity	Average channel flow velocity
24	Freeboard	Required freeboard
25	Design Depth	Channel flow depth plus freeboard.
26	Channel Topwidth	Topwidth at design depth.
27	Total ROW Width	Total Right-of-Way Width Required

2. Box Culverts

New culverts are sized using standard culvert design methodology considering inlet or outlet control as presented in Federal Highway Administration, Hydraulic Design Series No. 5, *Hydraulic Design of Highway Culverts*, September 1985. The calculations check for inlet control, pipe barrel (friction), or tail water control. The condition resulting in the highest computed headwater elevation controls.

The culvert design calculations are also tabulated on the facing page of each channel plan and profile sheet in the *Preliminary Design Plans* section of this report. The headings in the "Culvert Properties" portion of the facing page calculations are defined as follows:

Col No.	Heading	Description
1	I.D.	Reach identifier from plans.
2	HEC-1 I.D.	Identifier from HEC-1 output.
3	Design Q100	Design discharge from HEC-1 output corresponding to HEC-1 I.D.
4	Comp. Capacity	Computed culvert capacity from parameters in table (should match Design Q100)
5	Length	Length of culvert
6	Inlet Invert	Invert El. at culvert inlet.
7	Outlet Invert	Invert El. at culvert outlet.
8	Slope	Culvert barrel slope.
9	Mat/Barrel type	Culvert material code (C=concrete).
10	Manning's n	N-value for culvert material.
11	No. of barrels	Number of culvert barrels.
12	Culv. Dia./Height	Diameter of pipes or height of boxes.
13	Unit	Units for "12"; in. for pipes, ft. for boxes.
14	Width	Width for box culvert barrels.
15	Barrel Material	RCBC for box, RCP for pipes
16	Entrance	Wingwall, Headwall, or Project.
17	Tailwater depth	Tailwater depth of downstream channel.
18	Comp. headwater	U.S. ponding depth at culvert inlet.
19	Comp. HW/D	Ratio of headwater depth to culvert height.
20	Control	Flow control condition; IC, Pipe, TW

3. Detention Basins

Detention basins are sized by developing a preliminary grading plan that optimizes the volume available at each site based on the design constraints presented in Section B. "Design Criteria" and the physical constraints presented at each site. Twenty percent of the site is not used for the basin to allow for buffers and other uses. The site constraints include existing topography and land slope, existing development, outfall pipe elevation limits to "daylight," and inflow capture requirements.

Opportunities for an off-line basin concept are first explored. Off-line basins allow for a more effective use of the available basin volume by passing low flows by the basin without occupying any storage volume. This preserves more available storage volume for attenuating the flow peaks when they arrive at the basin. Opportunities for off-line basin concept development exist when the inflow can be channelized. When runoff to be captured in the basin presents itself in an overland flow condition or in many small channels, an off-line concept may not be feasible. In these cases a flow-through basin concept is utilized. Storage volume can be preserved for peak flows in flow-through basins by providing a low flow channel and by depressing the outlet. A depressed outlet allows a hydraulic head to build up on the outlet before a significant area within the basin is inundated. The low flow channel conveys low flows to the depressed outlet without ponding.

Following development of the optimum grading plan for the site and determining off-line or flow-through concept, the basin inlet and outlet structures are sized to accommodate the design inflow hydrograph. In an off-line basin, a flow-by discharge is selected that allows the basin to be fully utilized with the runoff diverted into the basin. The total diverted flow is retained in the basin and drained through a small outlet pipe following the storm. In a flow-through basin, the outlet pipe size is adjusted until the available basin volume is used.

The side spillway for an off-line basin is then sized for the flow in excess of the flow-by discharge. Side spillways are sized using the

broad crested weir equation using the average flow depth over the side spillway. The grading plan is input into the surface modeling software to determine the stage-storage relationship. The stage-discharge relationship is determined by inputting the outlet pipe size and invert elevation. The HEC-1 model develops the stage-discharge relationship using the orifice equation.

IV. EXISTING UTILITIES & PLANNING CONSTRAINTS

A. Introduction

This section describes the existing utilities within the project limits and constraints that impacted the preliminary design.

B. Existing Utilities

Major existing and planned utilities within the study area are shown on **Figure IV-1**. Utility conflicts crossing each planned project are shown in profile on the *Preliminary Design Plans*. Utility providers with facilities within the study area are listed in **Table 1** with the name and phone number of the local representative contacted during the study.

1. Water, Sanitary Sewer, and Reclaimed Water

The **Cities of Phoenix, Tolleson, and Avondale** provide *water* and *sanitary sewer* service within the study area. Sewer service is provided in cooperation with the Sub-Regional Operating Group (SROG)

The *water* distribution system within the **City of Phoenix** consists of water mains constructed on section line roads. Existing primary water distribution corridors include Van Buren Street, 35th Avenue, 51st Avenue, and 67th Avenue, which contain 16 to 48 inch lines. The water distribution systems within the city limits of **Avondale** and **Tolleson** are limited and somewhat fragmented due to the relatively small sizes of the Cities. Water lines within both Cities fall below 16 inches in diameter, with primary service corridors along 99th, 91st, and 83rd Avenues, and Buckeye Road.

Within the **City of Phoenix**, existing primary *sanitary sewer* corridors include 43rd, 47th, 51st, 59th, 67th, 75th, and 83rd Avenues, and Lower Buckeye Road, with lines ranging from 18 to 87 inches in diameter. Within the **City of Avondale** a single primary sanitary sewer corridor exists at El Mirage Road, with smaller lines branching out to developing areas. This 36" inch primary transmission line ties into the Avondale wastewater treatment plant at Dysart Road, 1/4 mile south of Broadway

Road. The sanitary sewer service system within the **City of Tolleson** centers around the Tolleson Wastewater Treatment Plant, 1/4 mile south of Buckeye Road and 1/4 mile west of 91st Avenue. A primary sewer system corridor consisting of lines ranging in size from 24 inch to 60 inch extends north from this plant, crossing the UPRR, and then traveling along the north side of the railroad until reaching 99th Avenue, where it turns north and away from the study area.

The **Palo Verde Nuclear Generating Station** operates a 114 inch effluent line that passes through the study area. This line follows the mid-section line between Broadway Road and Southern Avenue, Beginning at the City of Phoenix 91st Avenue Waste Water Treatment Plant, and leaving the study area at the Agua Fria River.

2. Natural Gas

Natural gas service within the study area is provided by **El Paso Natural Gas Company** and **Southwest Gas Corporation**. A number of long distance transmission lines operated by **El Paso Natural Gas Company** exist within the study area. Corridors are Buckeye Road, 115th Avenue, and 47th Avenue.

3. Electric Power

Electric power service within the study area is provided by **Salt River Project (SRP)**, **Arizona Public Service (APS)**, and **The Department of Energy (DOE)**. A number of high voltage overhead transmission corridors exist within the study area. An east-west 230 KV DOE overhead transmission corridor exists along the mid-section line between Lower Buckeye Road and Broadway Road. This line ties into a north-south corridor at 47th Avenue, where it turns south and crosses the Salt River. Also present within the 47th Avenue corridor is a 115 KV DOE line extending to the Power Station located at 47th Avenue and the UPRR. Two 230 KV SRP lines exist along an east-west corridor at Broadway Road. This corridor begins at the western limit of the study

area and extends to a substation at 59th Avenue. A north-south 230 KV SRP overhead transmission corridor exists along El Mirage Road, ending at a substation at Broadway Road. An additional 500 KV SRP corridor exists at the mid-section line between Broadway Road and Southern Avenue, turning south and crossing the Salt River at 83rd Avenue. Finally, a 230 KV DOE line extends west from the power station at 47th Avenue and the UPRR to 83rd Avenue, where it turns north-west and away from the study area. A number of proposed high voltage overhead lines are planned within the study area as well. A 230 KV APS line is proposed for the east-west corridor at the mid-section line between Lower Buckeye Road and Broadway Road mentioned above. At it's west end, this line will turn north and extend out of the project area along the existing El Mirage road corridor mentioned above. At it's east end, this proposed line turns north at 47th Avenue, ending at the 47th Avenue power station. In addition to overhead electrical lines, underground electrical lines exist throughout the study area, with corridors following existing roadways along section lines.

4. Cable TV

Cable TV service is provided by **Cox Communications**. Cable TV lines are not shown on the *Preliminary Design Plans*. Standard Cable TV lines are not considered a critical utility conflict, however Cox Communications is in the process of upgrading to fiber optic lines, which will need to be identified at the time of final design.

5. Telephone

Telephone lines owned by **Qwest** (formerly U.S. West) are found within the study area. Additionally, long haul fiber optic lines provided by **Qwest, MCI Worldcom, Sprint, and AT&T** are known to be located within the study area. Major duct banks and fiber optic lines are considered critical utility conflicts.

The City of Phoenix has received multiple requests by several companies to install fiber optic cables over the last several years and is

continuing to receive such requests at a rapid rate. The requests and associated approvals have been generated at such a high rate that the City has not been able to keep accurate records of all the facilities for future referencing. Therefore, individuals within the permit department at the City have been provided with copies of the Recommended Plan in an effort to notify the permittees to design any new facilities around the proposed channels. For instance, in the areas of a proposed channel, the contractor will be asked to install new fiber optic cables at a minimum depth of 10 feet from the surface.

6. Irrigation

SRP Irrigation is the primary irrigation provider within the study area. The **RID** owns and operates a delivery canal that passes through the study area for ultimate irrigation delivery west of the Agua Fria River.

7. Petroleum

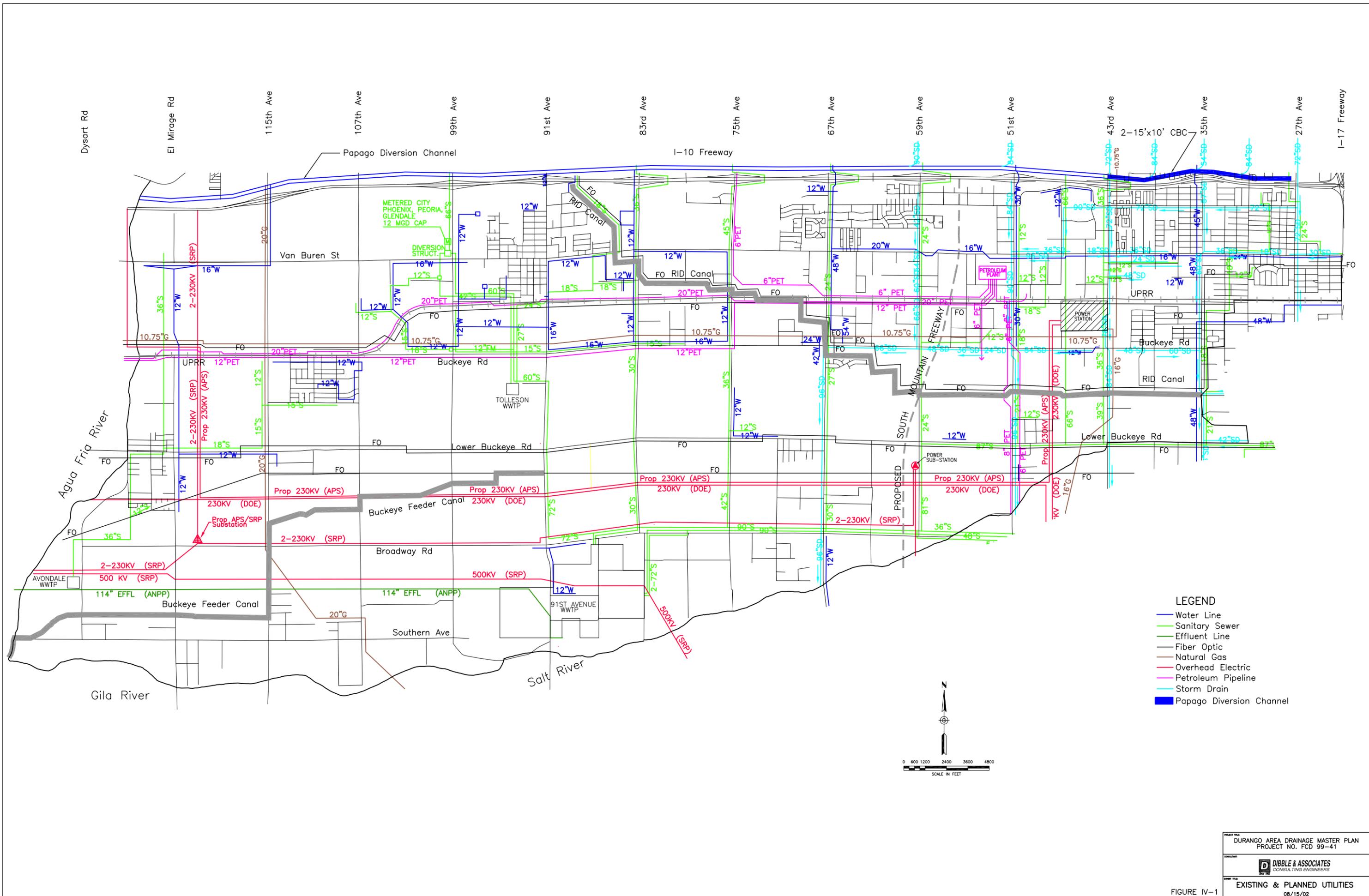
There is a **Kinder/Morgan** long-distance petroleum line that provides fuel to a number of users within Arizona, including Luke Air Force Base, Sky Harbor International Airport, and Williams Gateway Airport. A number of critical fuel lines extend out from a petroleum plant at 51st Avenue and Van Buren Street, including lines owned by **Dyn-Air** and **APS**. The most critical of these lines include a 20 inch line, extending west and adjacent to the UPRR, and a 12 inch line, also extending west and adjacent to Buckeye Road. Substantial effort has been made to design away from these high pressure fuel lines.

Table 1 - Utility Company Contacts

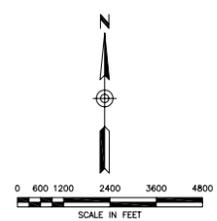
Utility	Representative	Telephone No.
City of Phoenix - Water, Sanitary Sewer, & Reclaimed Water	Ray Dovalina	602-262-4026
City of Avondale - Water, Sanitary Sewer, & Reclaimed Water	Scott Zipprich	623-932-1909
City of Tolleson - Water, Sanitary Sewer, & Reclaimed Water	Woody Scoutten	602-993-5686
Southwest Gas Corporation	Geraldo Lopez	602-484-5306
El Paso Natural Gas Co.	John McNealy	915-496-5562
Salt River Project - Power	Cindy Scott	602-236-0684
Arizona Public Service	Steve Goodman	602-371-6965
Salt River Project - Irrigation	Bonnie Garcia	602-236-6179
Sprint	Collin Sword	602-419-0970
AT&T	David Blackburn	602-228-9461
MCI Worldcom	Rick Thomas	623-734-1273
UPRR (Union Pacific RR)	John Clarke	520-343-4563
Cox Communications	Walter Coombs	623-322-7288
Qwest - Telephone	Gary Legumina	602-604-4804
Palo Verde Nuclear Station	Gary Gene	623-393-1951
Kinder / Morgan	Don R. Quinn	714-560-4940

8. Utility Locating

Several utilities were identified for pothole locating to determine the elevation where they may cross a channel alignment. Typical potholed utilities include sanitary sewer lines, natural gas lines, petroleum lines, and fiber optic lines. Most of the requested utilities were able to be located and an elevation identified. These utilities are shown and designated on the *Preliminary Design Plans* in the **Exhibits** section of this report with known elevations. Due to discrepancies in utility records and/or an inability to obtain permission from the utility and land owners, some of the requested utilities were not able to be located. These utilities are shown with assumed locations and elevations based on the best available information at the time of design. The complete data set for all of the utilities potholed as part of the project is on file with the FCDMC. A summary of the pothole results is located in **Appendix I**.



- LEGEND**
- Water Line
 - Sanitary Sewer
 - Effluent Line
 - Fiber Optic
 - Natural Gas
 - Overhead Electric
 - Petroleum Pipeline
 - Storm Drain
 - █ Papago Diversion Channel



PROJECT TITLE
DURANGO AREA DRAINAGE MASTER PLAN
PROJECT NO. FCD 99-41

CONSULTING ENGINEERS
D DIBBLE & ASSOCIATES
CONSULTING ENGINEERS

FIGURE IV-1
EXISTING & PLANNED UTILITIES
08/15/02

C. Existing Drainage Features

Few drainage facilities exist within the study area. The drainage pattern is predominantly overland in a northeast to southwest direction accumulating along the RID Canal and along the UPRR, eventually reaching the Salt and Gila Rivers on the south and the Agua Fria River on the west.

1. Papago Diversion Channel

The ADOT Papago Diversion Channel drains to the west along the north side of Interstate 10 and defines the north limit of the study area. This channel captures flow from the north and diverts it west to the Agua Fria River. Most of the storm drains from the north tie into the channel, although two pipes at 27th and 43rd Avenues pass to the south un-intercepted.

2. Irrigation Canals

Other facilities receive and convey runoff by virtue of the fact that they are within the path of the runoff even though they are not designed for drainage. Such existing features that receive runoff are the BFC, and several small SRP irrigation ditches along agricultural properties. All of the canals in the project area are designed for irrigation delivery rather than storm drainage. This results in flooding when runoff exceeds the capacity of the canals. Runoff that is intercepted by the railroad embankment makes its way westerly along the face of the embankment. Runoff flowing west along the embankment ponds behind section line roads that have raised profiles to pass over the railroad. The flow breaks out to the south when the ponding elevation exceeds the height of the embankment. None of the cross-roads have culverts of adequate size to convey major flows through the roadway embankment without ponding.

3. Agua Fria Levee

The Agua Fria East Bank Levee extends from north of Interstate 10 south to Buckeye Road near the UPRR. The levee is designed to convey the Standard Project Flood (SPF) flow in the river without overtopping the banks. Additional flowage easements extend from the end of the levee to the Gila River to complete this system.

4. Holly Acres Levee

The Holly Acres Levee is an existing bank protection project on the Salt / Gila Rivers, extending from 113th Avenue downstream to El Mirage Road. The levee was designed to accommodate 115,000 cubic feet per second (cfs), approximately a 35-year flow, with three feet of freeboard. However at approximately 100,000 cfs, approximately a 30-year flow, the river flows over the north bank at 99th Ave and around the Holly Acres Levee. The levee is not in danger of being overtopped since it is outflanked before the river level rises high enough. The outflanking is not likely to cause damage to the levee, as it is armored with stones on both sides.

D. Planned Private Development

The study area, particularly the southwest area, is developing at a rapid pace. Planned developments are identified on **Figure IV-2**. The planned developments shown were identified by the staff from the Cities of Phoenix, Tolleson, and Avondale, and from Maricopa County. The Durango ADMP development and timing of implementation is constrained by the developments shown on **Figure IV-2**.

E. Planned Public Improvements

1. Proposed Tres Rios project

The Tres Rios project is a proposed multi-purpose project in the Salt/Gila River which includes flood control and restoration of critical riparian and wetland habitats. The project extends from approximately the 91st Ave wastewater treatment plant to just west of Dysart Road. A Feasibility Report has recently been completed identifying potential benefits for flood control, including bank protection levees. The proposed Tres rios levee location is shown on **Figure I-2**.

2. South Mountain Freeway (Loop 202)

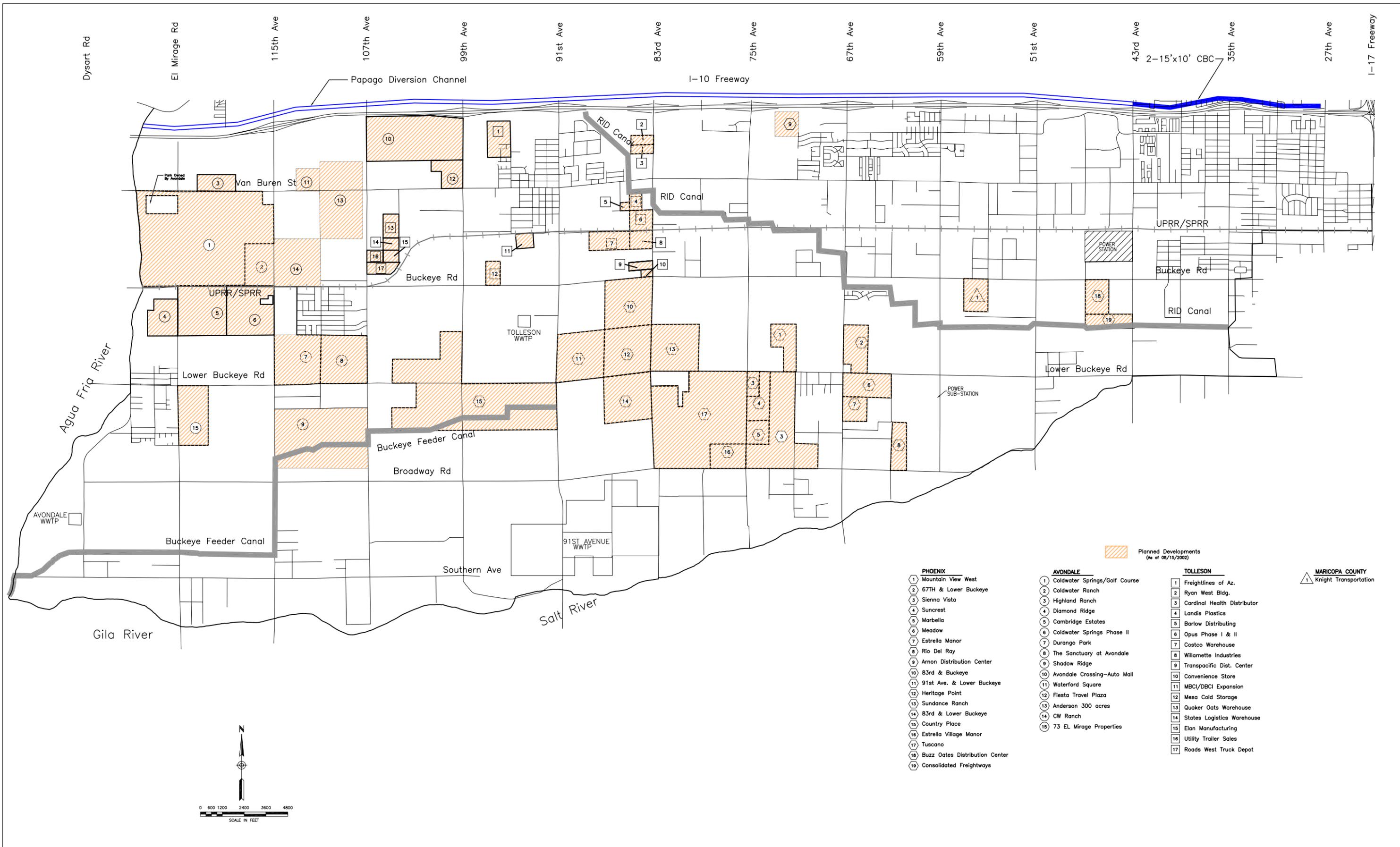
The possibility exists for a future Loop 202 Freeway extension to the south, approximately along the 59th Ave alignment, which may block westerly drainage within the study area. It is anticipated that the design for the freeway will include collector channels and basins to intercept the runoff, retain the flows, and drain south to the Salt River.

3. 115th Avenue - McDowell Road to Buckeye Road (MC85)

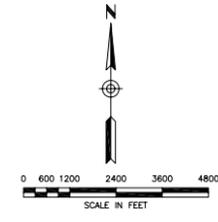
MCDOT has plans to improve 115th Avenue from McDowell Road to MC85. This project will cross the proposed Durango Regional Outfall Channel alignment at the UPRR north of Buckeye Road. The MCDOT design should incorporate the box culvert from the Recommended Plan.

4. 75th Avenue Widening

The City of Phoenix and MCDOT are planning to widen 75th Avenue from the Interstate 10 freeway to MC 85 (Buckeye Road). This project is planned to include major drainage improvements and offers an opportunity to cooperate with the District to provide drainage facilities in support of the Recommended Plan of this study.



- PHOENIX**
- 1 Mountain View West
 - 2 67TH & Lower Buckeye
 - 3 Sienna Vista
 - 4 Suncrest
 - 5 Marbella
 - 6 Meadow
 - 7 Estrella Manor
 - 8 Rio Del Ray
 - 9 Arnon Distribution Center
 - 10 83rd & Buckeye
 - 11 91st Ave. & Lower Buckeye
 - 12 Heritage Point
 - 13 Sundance Ranch
 - 14 83rd & Lower Buckeye
 - 15 Country Place
 - 16 Estrella Village Manor
 - 17 Tuscano
 - 18 Buzz Oates Distribution Center
 - 19 Consolidated Freightways
- AVONDALE**
- 1 Coldwater Springs/Golf Course
 - 2 Coldwater Ranch
 - 3 Highland Ranch
 - 4 Diamond Ridge
 - 5 Cambridge Estates
 - 6 Coldwater Springs Phase II
 - 7 Durango Park
 - 8 The Sanctuary at Avondale
 - 9 Shadow Ridge
 - 10 Avondale Crossing-Auto Mall
 - 11 Waterford Square
 - 12 Fiesta Travel Plaza
 - 13 Anderson 300 acres
 - 14 CW Ranch
 - 15 73 EL Mirage Properties
- TOLLESON**
- 1 Freightlines of Az.
 - 2 Ryan West Bldg.
 - 3 Cardinal Health Distributor
 - 4 Landis Plastics
 - 5 Barlow Distributing
 - 6 Opus Phase I & II
 - 7 Costco Warehouse
 - 8 Willamette Industries
 - 9 Transpacific Dist. Center
 - 10 Convenience Store
 - 11 MBI/DBCI Expansion
 - 12 Mesa Cold Storage
 - 13 Quaker Oats Warehouse
 - 14 States Logistics Warehouse
 - 15 Elan Manufacturing
 - 16 Utility Trailer Sales
 - 17 Roads West Truck Depot
- MARICOPA COUNTY**
- 1 Knight Transportation



V. RECOMMENDED PLAN

A. Introduction

The Recommended Plan is shown on **Figure V-1**. The plan elements are shown in plan and profile on the *Preliminary Design Plans* at the end of this report. This section is intended to be used with the *Preliminary Design Plans* to further describe the planned improvements, project costs, and special issues to be considered during final planning and design. The project elements are described as well as environmental considerations, right-of-way requirements, and utility conflicts. In addition, the area benefitting from the project is described, and the agencies with an interest in the project are identified as possible participants in project implementation.

B. Floodplain Impacts

A number of floodplains were delineated as a part of this study. These delineations identify areas of potential flooding due to stormwater runoff from within the study area. The areas identified include the UPRR from 69th Avenue to 35th Avenue, the BFC from the confluence with the Agua Fria River to approximately 105th Avenue, and the Sunland Avenue Tributary to the BFC from the confluence with the BFC to 91st Avenue. After the floodplain delineations were completed and the Preliminary Recommended Plan was developed, the residual floodplains were delineated with the intent to show the floodplain reduction benefit derived from the ADMP projects. The existing and residual floodplains are shown on **Figure V-2**.

1. Southwest Area Re-Study

After evaluation of the residual floodplains, based on the Preliminary Recommended Plan, the southwest portion of the study area was determined to receive a less than desired benefit due to the quantity of stormwater runoff generated by the local sub-basins. The southwest area was then re-analyzed to determine if there was a better solution which would have a greater impact on reducing the residual floodplains. The *Southwest Area Alternatives Analysis Report* can be found in

Appendix C. The results of the preferred alternative have been incorporated into this final Recommended Plan.

2. Northeast Area Re-Study

The northeast area was also found to have minimal reduction in the floodplain from the Preliminary Recommended Plan improvements. Additional analysis was performed to determine the feasibility and cost of a flood control solution in the northeast portion of the study area to remove existing homes and businesses from the floodplain. A solution for this area had not been identified in the previous alternatives analysis due to the high cost of constructing open channels in the high density, highly developed and populated area. Typically, industrial businesses are too close to the railroad and to each other to allow an open channel to be constructed in a continuous path.

Upon further investigation, it was determined that a large concrete box culvert storm drain system could be constructed in local east-west roadways, approximately 1/4 mile north of the railroad with laterals in the north-south streets to capture runoff from the sub-basins. Exhibits of the analyzed system are shown in **Appendix D**. In order to analyze the cost versus benefit of the box culvert storm drain system, three alternatives were formulated to convey runoff from the 10-year, 50-year and 100-year storms. The three alternatives all used the same alignment, but were sized according to the storm they were intended to convey. The residual floodplain along the railroad due to the 100-year storm was then analyzed for each of the alternatives.

The costs of the three different alternatives ranged from \$68.6 million dollars to \$99.4 million dollars. The residual floodplain benefit of the alternatives is described based on the area of impact:

69th Avenue to 57th Avenue
- No residual floodplain with 10-yr, 50-yr, or 100-yr system

57th Avenue to 51st Avenue
- Very minor benefit with any system in place

51st Avenue to 43rd Avenue
- Minor benefit with any system in place

43rd Avenue to 31st Avenue
- No residual floodplain with 100-yr system
- Very minor benefit with 10-yr or 50-yr system

The greatest benefit occurred between 69th and 57th Avenues because the greatest number of residences were removed from the residual floodplain. Most of the other areas received very little benefit with any system in place. It was found that the spurs and obstructions along the railroad cause such a large ponding effect, that conveyance of the runoff does not occur with even the smallest amount of flow. Therefore, even the local runoff within the sub-basin was causing nearly as much flooding due to ponding regardless of whether the box culvert storm drain system was in place 1/4 mile north. The only way to completely alleviate flooding along the railroad is to provide a system of conveyance immediately adjacent to the railroad, allowing runoff to flow under the spurs and other obstructions. This is infeasible due to the number of existing buildings so close to the tracks and the number of high-cost utilities that would have to be relocated within the railroad right-of-way.

In lieu of providing a complete box culvert storm drain system, a portion of the analyzed alternatives was incorporated into the recommended plan to provide a significant benefit to a majority of the residences which are located between 69th and 57th Avenues. A section of vertical concrete open channel at grade was identified along the railroad from the east edge of the previously identified retention basin (DRC Basin #4) at 69th Avenue, east to approximately the 63rd Avenue alignment. This section of channel connects to the bypass channel of

the DRCC and is part of the overall DRCC system. The result of this design can be seen on the *Preliminary Design Plans*, Sheets 23 and 24 of 38.

C. Traffic

There are two roads which bisect the study area that are classified by Maricopa County as Roads of Regional Significance (RRS). These roads are generally 7 lanes wide, 3 lanes each way with a center turn lane/raised median. The two roads which fall under this classification are Buckeye Road (MC 85) and 99th Avenue. ADMP improvements for the Buckeye Feeder Diversion Channel cross these roads at two locations. The Durango Regional Outfall Channel crosses 99th Avenue at one location and the 99th Avenue Lateral is parallel to 99th Avenue for ½-mile.

Generally, in developing the preliminary design plans, culverts are placed at ½-mile intervals unless channels are adjacent to a RRS which require access points at 1/8-mile intervals. Additionally, access to all parcels must be maintained. If a channel prevents access to an adjacent parcel, a culvert or access road is provided to restore access to that parcel. Farm access roads are also maintained or shared by the channel maintenance road.

D. Durango Regional Outfall Channel (Sheets 3-7 of 38)

1. Location: Adjacent to and north of the UPRR, beginning ½ mile west of 83rd Avenue and ending ½-mile west of 115th Avenue, discharging into the Coldwater Springs Golf Course Channel.
2. Purpose: To collect runoff accumulating along the upstream side of the UPRR and convey it to the Coldwater Springs Channel. The channel will contain and eliminate the FEMA designated floodplain.
3. Project elements: Channels within this reach will be lined with irrigated turf. New concrete box culverts will be constructed at 115th, 107th, and 99th Avenues and at intermediate channel crossings. A ½ - mile long section of box culvert will be installed from 95th Avenue to 91st Avenue.
4. Environmental Considerations:
 - a. *Environmental Resources*: Possible interaction with historic sites (Cashion Station, Cowden Station, and Jean Station) along UPRR corridor. There are no prehistoric sites. Also, a small portion of this channel (on the western end) runs adjacent to historic State Route 80. The Durango channel is located in the central and western sections of the project area, this area consists of agricultural fields that do not contain Sonoran desert habitat. Potential environmental concern site #308, listed as a Leaking Underground Storage Tank site, is located immediately adjacent to the proposed channel. Current alignment is not designed to impact any sites considered to be a potential environmental concern.
 - b. *404 Permitting*: Construction of this channel would require coordination with the UPRR in addition to obtaining all permits discussed in Section VI, Environmental Permits and Approvals such as a NPDES permit for construction. Since this channel is terminating in the Coldwater Springs Golf Course, it is anticipated that no Section 404 permit will be required.
5. Right-of-Way: The channel is intended to parallel the UPRR corridor. The requirement shown on the plans is the ROW for the channel and access road.

6. Utility Conflicts: The following utilities are in direct conflict with the proposed alignment and require relocation as of 08/15/2002.
 - 20" Natural Gas line, 42" irrigation piped lateral, and 42" irrigation piped drain at 115th Avenue.
 - Irrigation open lateral at 111th Avenue.
 - Irrigation open lateral 1/8 mile west of 107th Avenue.
 - Overhead SRP high voltage electric line, and (2) underground telephone lines at 107th Avenue.
 - 12" waterline, 12" waterline, and underground SRP electric line 1/4 mile north of Buckeye Road and the SPRR.
 - Underground electric line (SRP) and (2) 24" irrigation piped laterals 3/8 mile north of Buckeye Road and the UPRR.
 - 12" water line, irrigation open lateral, and buried telephone line at 99th Avenue.
 - 12" water line and 10" sewer line at approximately 97th Avenue.
 - 12" water line and irrigation open lateral at 95th Avenue.
 - 4" water line, 12" water line, 3" gas line (SWG), (2) underground telephone lines, 6" water line, and irrigation open lateral at 91st Avenue.
7. Benefitted Area: From the Agua Fria River to approximately 87th Avenue, immediately adjacent to and north of the UPRR. The floodplain will be contained within the banks of the channel.
8. Project Participants: FCDMC, City of Avondale, City of Tolleson, MCDOT, Developers.

E. Durango Regional Outfall Basin #1 (Sheet 31 of 38)

1. Location: Adjacent to and north of the UPRR. Adjacent to and east of 111th Avenue. Within Avondale city limits.
2. Purpose: To attenuate peak discharges in the Durango Regional Outfall Channel and to serve as a neighborhood park.
3. Project elements: This off-line basin will allow up to 700 cfs to pass by. Flows above this amount will enter the basin via a side channel spillway. At an approximate depth of 6.2', the basin will impound 44 acre-feet. The basin will be drained by a 24-inch storm drain to the downstream channel.

4. Environmental Considerations:

a. *Environmental Resources:* There are no prehistoric or historic sites found in the proposed basin area. One site considered to be a potential environmental concern, Site #311, was identified near the basin but not impacted by the proposed basin location; this site was listed as a Leaking Underground Storage Tank. This sub-project is located in the western section of the project area; this area consists of agricultural fields and does not contain adequate Sonoran desert habitat.

b. *404 Permitting:* There are no Section 404 permit requirements for this sub-project.

5. Right-of-Way: This basin and park will require 22.5 acres of additional right-of-way.

6. Utility Conflicts: No conflicts as of 08/15/2002.

7. Benefitted Area: Works in conjunction with the Durango Regional Outfall Channel, reducing channel flows in order to contain the 100-year floodplain within the banks of the channel. Also provides an opportunity for open space and possibly a city park.

8. Project Participants: FCDMC, City of Avondale.

F. Durango Regional Outfall Basin #2 & 99th Ave Lateral
(Sheets 8 & 32 of 38)

1. Location: The basin is adjacent to and east of 99th Avenue, 1/8 mile north of the UPRR. The lateral runs parallel to 99th Avenue and extends to the north side of Van Buren Street, within Tolleson city limits.

2. Purpose: The lateral will convey flows from north of Van Buren Street to the Durango Regional Outfall Channel. The basin is intended to attenuate peak discharges in the Durango Regional Outfall Channel and to serve as a neighborhood park.

3. Project elements: The channel will be lined with irrigated turf and will include a concrete box culvert at Van Buren Street and another at 1/8 mile south of Van Buren Street. The off-line basin will allow up to 500 cfs to pass through the 99th Avenue culvert. Flows above this amount will enter the basin via a side channel spillway located just upstream of the culvert. At an approximate depth of 7.1', the basin will impound approximately

75 acre-feet. The basin will be drained by a 24-inch storm drain to the downstream channel.

4. Environmental Considerations:

a. *Environmental Resources:* There are no prehistoric or historic sites found in the surrounding area. This sub-project is located near one Potential Environmental Concern site, #221, that is listed as a Leaking Underground Storage Tank. Current project location is not designed to impact any sites considered to be a potential environmental concern. This project site is also located in the central and western section of the project area consisting of agricultural fields. These fields do not consist of Sonoran desert habitat.

b. *404 Permitting:* There are no Section 404 permit requirements for this basin and lateral sub-project.

5. Right-of-Way: This basin and park will require 28.3 acres of additional right-of-way.

6. Utility Conflicts: 12" water line at Van Buren Street. This line is in direct conflict with the proposed lateral alignment and requires relocation as of 08/15/2002.

7. Benefitted Area: Works in conjunction with the Durango Regional Outfall Channel, reducing channel flows in order to contain the 100-year floodplain within the banks of the channel. Also provides an opportunity for open space and possibly a city park.

8. Project Participants: FCDMC, City of Tolleson.

G. Durango Regional Outfall Basins #3a/3b & 91st Ave Lateral
(Sheets 9 & 33 of 38)

1. Location: Basin 3a is east of 91st Avenue, 1/4 mile south of Van Buren Street. The lateral runs from the intersection of 91st Avenue and Van Buren southeasterly to the basin within Tolleson city limits. Basin 3b is west of 91st Avenue, immediately north of the UPRR.

2. Purpose: The lateral will convey runoff from north of Van Buren Street to Basin 3a which will then drain into Basin 3b which is an offline storage basin for the Durango Regional Outfall Channel. Basin 3a is intended to detain peak discharges from the lateral. Basin 3b is intended to attenuate peak discharges from the Durango Regional Outfall Channel. These basins will also serve as neighborhood parks.

3. Project elements: The channel will be lined with irrigated turf and will include a concrete box culvert at Van Buren Street. Basin 3a will detain up to 574 cfs from the 91st Avenue lateral. The off-line basin, 3b, will receive flows via a box culvert diversion located just upstream of the basin. At an approximate depth of 5.1', Basin 3a will impound approximately 61 acre-feet. The basin will be drained to Basin 3b by a 24-inch storm drain. At an approximate depth of 5.0', Basin 3b will impound approximately 18 acre-feet. The basin will be drained back into the Durango Regional Outfall Channel by a 24-inch storm drain.

4. Environmental Considerations:

a. *Environmental Resources:* There are no prehistoric sites or historic sites found in this segment. This basin and lateral are located within the central and western sections of the project area; this area consists of agricultural fields that do not contain Sonoran desert habitat. There are two sites that may have potential environmental concern (#116 (FINDS), #117 (AZ-SPIILL)). These sites are near this sub-project but would not be impacted by the channel's currently proposed alignment.

b. *404 Permitting:* There are no Section 404 permit requirements for this outfall and lateral sub-project.

5. Right-of-Way: This basin and park will require 31 acres of right-of-way.

6. Utility Conflicts: The following utilities are in direct conflict with the proposed alignment and require relocation as of 08/15/2002.

- 8" water line, 12" water line and (2) underground telephone lines at Van Buren Street.

7. Benefitted Area: Works in conjunction with the Durango Regional Outfall Channel, reducing channel flows in order to contain the 100-year floodplain within the banks of the channel. Also provides an opportunity for open space and possibly a city park.

8. Project Participants: FCDMC, City of Tolleson.

H. Durango Regional Conveyance Channel
(Sheets 10-24 of 38)

1. Location: Beginning at the UPRR, at approximately 63rd Avenue, extending west to 73rd Avenue, then south to 1/2 mile south of

Lower Buckeye Road and continuing west. Ending at the Agua Fria River, 1/4 mile south of Broadway Road.

2. Purpose: To convey flood water from the area north of the UPRR and thus reducing the FEMA Floodplain. This channel will also reduce the flooding potential along the BFC and provide an outfall for local development projects.
3. Project elements: Most of the channels within this reach will be grass lined. New concrete box culverts will be constructed at Dysart Road, El Mirage Road, Broadway Road, 115th, 107th, 99th, 91st and 83rd Avenues, Lower Buckeye Road, 75th Avenue, Buckeye Road, and at the UPRR/RID and at several intermediate locations. Concrete channels with vertical walls are required at the two most upstream reaches of the channel due to limited right-of-way.
4. Environmental Considerations:
 - a. *Environmental Resources*: A section of the route would be located near the prehistoric Fowler Ruin where the channel connects with DRC Basin #4. The route also crosses historic St. John's Canal. Five areas of potential environmental concern appear to be near the proposed channel (Sites #345, #347, #389, #390, and #392). This sub-project area is located within the western and central portions of the project area. These areas consist of agricultural fields that would not contain a significant amount of Sonoran desert habitat. The outfall pipe would be designed to enter the Agua Fria River. The river's bank are relatively undisturbed areas located within riverine floodplains that do yield sonoran desert riparian habitat.
 - b. *404 Permitting*: Construction along this channel would require agency coordination with the UPRR, RID, and SRP in addition to obtaining all permits including a NPDES permit. A NWP 404 Permit is not anticipated based on a current jurisdictional delineation of the ordinary high water mark of the Agua Fria River. Detailed discussions of these environmental permit processes are included in Section VI *Environmental Permits and Approvals*.
5. Special Considerations: Based on the 10-year WSE in the Agua Fria River, a flap gate will be required on the end of the outfall pipe in order to prevent backwater in the river from entering the system and allow for positive drainage pipe.
6. Right-of-Way: The requirement shown on the plans is the ROW for the channel and access road.

7. Utility Conflicts: The following utilities are in direct conflict with the proposed alignment and require relocation as of 08/15/2002.

- 20" gas line (El Paso Natural Gas) and (2) underground telephone line at 115th Avenue.
 - Underground telephone line at El Mirage Road.
 - Underground telephone line at 99th Avenue.
 - Underground telephone line at 91st Avenue.
 - Irrigation open lateral at 87th Avenue.
 - Irrigation open drain at 85th Avenue.
 - 36" sewer line and irrigation open lateral at 83rd Avenue.
 - MCI fiber optic line at Elwood Road, just east of 83rd Avenue.
 - Irrigation open lateral at 79th Avenue.
 - Sprint fiber optic at Lower Buckeye Road, just west of 75th Avenue.
 - 36" sewer line, 12" water line, and (3) underground telephone lines at 75th Avenue, approx. 1/4 mile north of Lower Buckeye Road.
 - Irrigation open lateral, underground electric line (SRP), (2) 12" water lines, 10" gas line (EPNG), and underground telephone line at Buckeye Road.
 - Tile approximately 9000 LF of existing BFC
7. Benefitted Area: North of the UPRR, between approximately 63rd Avenue and 73rd Avenue, the floodplain will be contained within the banks of the channel, removing over 100 homes from the potential floodplain. Benefits developers along the channel with a discharge point for flows. Helps to alleviate some of the flooding along the BFC.
 8. Project Participants: City of Phoenix, City of Avondale, FCDMC, SRP Irrigation, Developers.
 - I. **Durango Regional Conveyance Basin #1**
(Sheet 34 of 38)
 1. Location: Existing Sand and Gravel Pit between Dysart Road and the Agua Fria River, north of the BFC.
 2. Purpose: To retain peak discharges from the Durango Regional Conveyance Channel.
 3. Project elements: This off-line basin will allow up to 34 cfs to pass by in a 48-inch pipe. Flows above this amount will enter the basin via a side channel spillway. At a depth of up to 25', the basin will impound approximately 1584 acre-feet. The basin

may be up to 44' deep in some locations from excavation operations, however groundwater is estimated to be approximately 25' below the surface, limiting the effective storage depth. The basin will be drained by a pump to the downstream channel or by natural infiltration.

4. Environmental Considerations:
 - a. *Environmental Resources*: There are no prehistoric or historic sites found in the basin's surrounding area. Construction based on current basin design would not impact any sites considered to be a potential environmental concern. This sub-project is located within the western section of the project area; this area consists of agricultural fields that do not contain a significant amount of Sonoran desert habitat.
 - b. *404 Permitting*: There are no Section 404 permit requirements for this sub-projects.
 5. Right-of-Way: This basin will require approximately 150 acres of right-of-way.
 6. Utility Conflicts: No conflicts as of 08/15/2002.
 7. Benefitted Area: Works in conjunction with the Durango Regional Conveyance Channel, reducing channel flows in order to allow for a gated outfall into the Agua Fria River, thus eliminating the need for channel berming due to backwater from the river. Also provides a possible opportunity for open space and a park in the future after sand and gravel operations are complete.
 8. Project Participants: FCDMC, City of Avondale.
- J. Durango Regional Conveyance Basin #2**
(Sheet 35 of 38)
1. Location: Adjacent to and east of the 95th Avenue alignment, 1/2-mile north of Broadway Road, within Phoenix city limits.
 2. Purpose: To attenuate peak discharges in the Buckeye Feeder Diversion Channel and to serve as a neighborhood park.
 3. Project elements: This off-line basin will allow up to 1050 cfs to pass by. Flows above this amount will enter the basin via a side channel spillway. At an approximate depth of 4.6', the basin will impound approximately 61 acre-feet. The basin will be drained by a 24-inch outlet pipe into the channel.

4. Environmental Considerations:
- a. *Environmental Resources*: There are no prehistoric or historic sites found in the basin's surrounding area. Construction based on current basin design would not impact any sites considered to be a potential environmental concern. This sub-project is located within the western section of the project area; this area consists of agricultural fields that do not contain a significant amount of Sonoran desert habitat.
 - b. *404 Permitting*: There are no Section 404 permit requirements for this sub-project.

5. Right-of-Way: This basin and park will require 48 acres of additional right-of-way.

6. Utility Conflicts: No conflicts as of 08/15/2002.

7. Benefitted Area: Works in conjunction with the Durango Regional Conveyance Channel, reducing channel flows in order to allow for downstream capacity and to alleviate flooding along the BFC. Also provides an opportunity for open space and a possible city park.

8. Project Participants: FCDMC, City of Phoenix.

K. Durango Regional Conveyance Basin #3
(Sheet 36 of 38)

1. Location: Adjacent to and east of the 73rd Avenue alignment, 1/4 mile south of Buckeye Road. Within Phoenix city limits.

2. Purpose: To attenuate peak discharges in the Durango Regional Conveyance Channel and to serve as a community park.

3. Project elements: This off-line basin will allow up to 450 cfs to pass by. Flows above this amount will enter the basin via a side channel spillway. At an approximate depth of 4.5', the basin will impound approximately 16 acre-feet. The basin will be drained by a 24-inch outlet pipe into the channel.

4. Environmental Considerations:
- a. *Environmental Resources*: There are no prehistoric or historic sites found in the basin's surrounding area. Construction based on current basin design would not impact any sites considered to be a potential environmental concern. This sub-project is located within the central section of the

project area; this area consists of agricultural fields that do not contain a significant amount of Sonoran desert habitat.

b. *404 Permitting*: There are no Section 404 permit requirements for this sub-project.

5. Right-of-Way: This basin and park will require 16.5 acres of additional right-of-way.

6. Utility Conflicts: No conflicts as of 08/15/2002.

7. Benefitted Area: Works in conjunction with the Durango Regional Conveyance Channel, reducing channel flows in order to allow for downstream capacity. Also provides an opportunity for open space and a possible city park.

8. Project Participants: FCDMC, City of Phoenix.

L. Durango Regional Conveyance Basin #4
(Sheet 37 of 38)

1. Location: Adjacent to and north of the UPRR, 1/4 mile west of 67th Avenue.

2. Purpose: To attenuate peak discharges in the Durango Regional Conveyance Channel and to serve as a neighborhood park.

3. Project elements: This off-line basin will allow up to 410 cfs to pass by. Flows above this amount will enter the basin via a side channel spillway. At an approximate depth of 8.0', the basin will impound approximately 58 acre-feet. The basin will be drained by a 24-inch storm drain to the downstream channel.

4. Environmental Considerations:
- a. *Environmental Resources*: The basin would be constructed near, and may impact a portion of the Fowler Ruin prehistoric site and two historic sites of the railroad (Fowler Station and Fowler Depot). Construction based on current basin design would not impact any sites considered to be a potential environmental concern. This sub-project is located within the central section of the project area; this area consists of agricultural fields that do not contain a significant amount of Sonoran desert habitat.
 - b. *404 Permitting*: There are no Section 404 permit requirements for this sub-projects.

5. Right-of-Way: This basin and park will require 29.3 acres of additional right-of-way.

6. Utility Conflicts: No conflicts as of 08/15/2002.

7. Benefitted Area: Works in conjunction with the Durango Regional Conveyance Channel, reducing channel flows in order to allow for downstream capacity. Also provides an opportunity for open space and a possible city park.

8. Project Participants: FCDMC, City of Phoenix.

M. Sunland Avenue Channel
(Sheets 25-27 of 38)

1. Location: Between 99th Avenue and 119th Avenue, approximately 1/4 mile north of Southern Avenue.

2. Purpose: To convey storm water to the Durango Regional Conveyance Channel and contain the local flooding potential.

3. Project elements: Water will be conveyed from the area along 99th Avenue, approximately 2.5 miles west to a junction with the Durango Regional Conveyance Channel. The majority of the project is designed as a grass channel, although a small portion from 113th Avenue to 115th Avenue is required to be a concrete box culvert in order to fit the channel under a local road in a small developed residential area.

4. Environmental Considerations:
- a. *Environmental Resources*: There are no prehistoric or historic sites found in the basin's surrounding area. Construction based on current basin design would not impact any sites considered to be a potential environmental concern. This sub-project is located within the western section of the project area; this area consists of a small residential development along with agricultural fields that do not contain a significant amount of Sonoran desert habitat.
 - b. *404 Permitting*: A Section 404 permit will not be required for this sub-project.

5. Right-of-Way: The requirement shown on the plans is the ROW for the channel and access road.

6. Utility Conflicts: No conflicts as of 08/15/2002.

7. Benefitted Area: Areas along the Sunland Avenue alignment which are subject to storm water runoff flows and have been identified as within a potential floodplain. Designed to contain flooding within the channel.

8. Project Participants: FCDMC, City of Phoenix, City of Avondale.

N. 47th Avenue Detention Basin and Channel
(Sheets 30 & 38 of 38)

1. Location: The northwest corner of the intersection of 47th Avenue and Buckeye Road alignment. Within Phoenix city limits.

2. Purpose: To attenuate peak discharges in the 47th Avenue Channel and to serve as a neighborhood park.

3. Project elements: Water will be conveyed from the area north of the UPRR by a box culvert and a landscaped earth channel to the detention basin. The detention basin is intended to be approximately 8' deep and impound approximately 75 acre-feet of water. The basin will drain via a box culvert to the downstream channel.

4. Environmental Considerations:

a. Environmental Resources: There are no prehistoric or historic sites identified in the basin and inlet area. Four areas have been identified in the vicinity of the detention basin area as potential environmental concerns (Site #214, #240, #250, #252).

b. 404 Permitting: A Section 404 permit will not be required for this sub-project.

5. Right-of-Way: This basin and park will require 44 acres of additional right-of-way.

6. Utility Conflicts: No conflicts as of 08/15/2002.

7. Benefitted Area: North of the UPRR near the 49th Avenue alignment and along Buckeye Road near 47th Avenue. Provides an opportunity for open space and possibly a city park.

8. Project Participants: FCDMC, City of Phoenix.

O. 47th Avenue Channel
(Sheets 28 & 29 of 38)

1. Location: Adjacent to and east of 47th Avenue, beginning at the 47th Ave Detention Basin and ending at the intersection with the Salt River. Within Phoenix city limits.

2. Purpose: To convey storm water to the Salt River and reduce the local flooding potential.

3. Project elements: Channels within this reach will be constructed with landscaped earth. New box culverts will be required at Lower Buckeye Road and the RID Canal and at intermediate channel crossings.

4. Environmental Considerations:

a. Environmental Resources: Outfall structure to the Salt River required. There are no prehistoric archaeological sites but the channel does cross historic Highway 80 and Farmers Canal. The route also crosses the RID canal. There were no areas of potential environmental concern identified within the channel's route. Construction of this channel would require coordination with the RID in addition to obtaining all permits discussed in Section VI, Environmental Permits and Approvals.

b. 404 Permitting: A Section 404 permit as well as a construction NPDES will likely be required for construction of this outfall structure. According to the current design drawings, a minimal area within jurisdictional waters will be disturbed during the construction of this sub-project.

5. Special Considerations: There may be a need for a flap-gate or pinch-valve to prevent Salt River flows from entering the channel system.

6. Right-of-Way: The requirement shown on the plans is the ROW for the channel and access road.

7. Utility Conflicts: The following utilities are in direct conflict with the proposed alignment and require relocation as of 08/15/2002.

- 30" irrigation piped lateral at the Salt River.

- Underground electric line (SRP) and MCI fiber optic line ½ mile south of Lower Buckeye Road.

- Sprint fiber optic cable and 36" irrigation drain at Lower Buckeye Road.

- Underground electric line (SRP) 1/4 mile south of the RID canal.

- (4) fiber optic cable lines and (2) 10" petroleum pipelines at the UPRR.

8. Benefitted Area: Eastern portion of the study area. Allows regional runoff to be conveyed to the river. Alleviates some local flooding along 51st Avenue, Buckeye Road, and Lower Buckeye Road. Decreases the potential total runoff reaching the alignment of the proposed South Mountain Freeway.

9. Project Participants: FCDMC, City of Phoenix, Developers.

P. Tres Rios Retention Basins

Throughout the ADMP process, the need for a solution to accommodate the interior drainage in the southwest portion of the study area due to the proposed Tres Rios levee was discussed. The purpose of the discussions was ultimately to make the U.S. Army Corps of Engineers aware of the impacts created by constructing the levee. An analysis to determine the benefit of 1 large retention basin versus several smaller retention basins was developed in September, 2000 and can be found in **Appendix E**. Based on the interior drainage analysis, the Draft Recommended Plan indicated a series of retention basins constructed behind the levee and were shown as part of the Recommended Plan.

In this final Recommended Plan, the Tres Rios Retention Basins are omitted, as it was determined that their benefit is solely to relieve interior drainage south of Southern Avenue, and would have no impact to the remaining ADMP elements. Thus the responsibility of accommodating interior drainage due to the proposed Tres Rios levee is that of the Corps of Engineers and is not included in this ADMP.

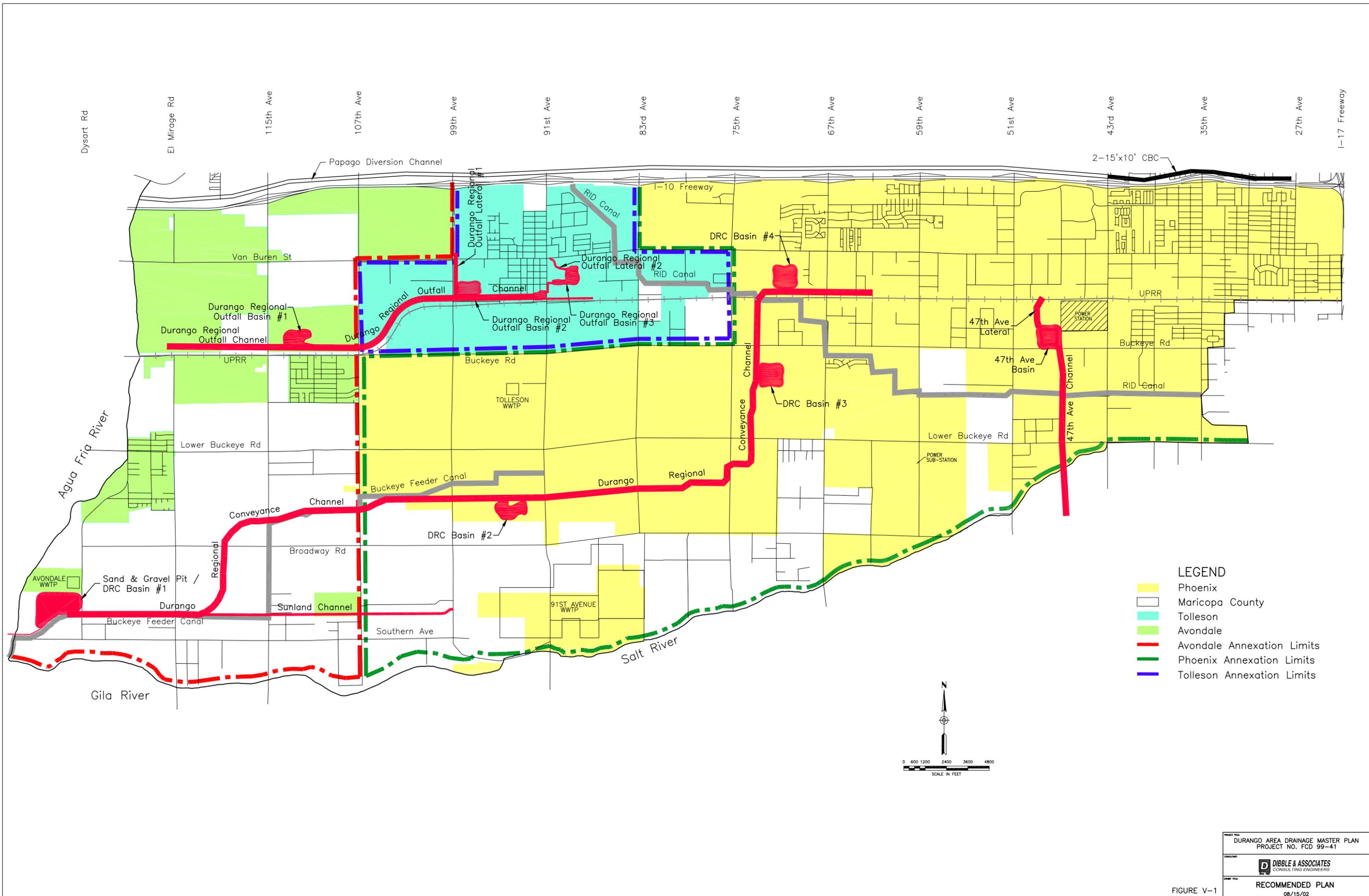
The ultimate solution for the accommodation of interior drainage is not required to be a series of retention basins as previously recommended in the Draft of this report, but rather could be a single basin, a linear basin behind the length of the levee, or some other solution as determined by the Corps of Engineers.

Q. Watershed Build-Out Conditions

Due to the Federal Emergency Management Agency (FEMA) regulatory floodplains within the study area, the Durango ADMP recommended plan elements were developed and sized based on existing watershed conditions hydrology. This was done so that when the master plan elements are constructed, the regulatory floodplains can be removed from the FEMA Flood Insurance Rate Maps (FIRM). FEMA regulates floodplains based on existing watershed conditions only. The watershed hydrology was updated for fully developed watershed conditions at build-out assuming on-site retention is in place. The master plan elements were then re-sized for build-out conditions flows to determine if any cost savings could be realized due to possible reductions in channel sizes.

Upon detailed analysis, it was determined that there is relatively little overall cost savings by designing for build-out conditions in the Durango ADMP Watershed. While certain channel segments and culverts could be reduced due to a reduction in peak flows, other channel segments were found to increase due to higher peak flows. There were no channels or basins that could be eliminated. The overall cost savings for the project was less than ½% of the original cost of the Recommended Plan. Cost savings of approximately \$2.3 million and \$0.9 million could be realized on the Durango Regional Conveyance Channel (DRCC) System and the 47th Avenue System respectively, while the cost of the Durango Regional Outfall Project (DROP) System and the Sunland Avenue System would increase by approximately \$1.2 million and \$1.5 million respectively.

A full summary of the build-out conditions analysis can be found in **Appendix B**.



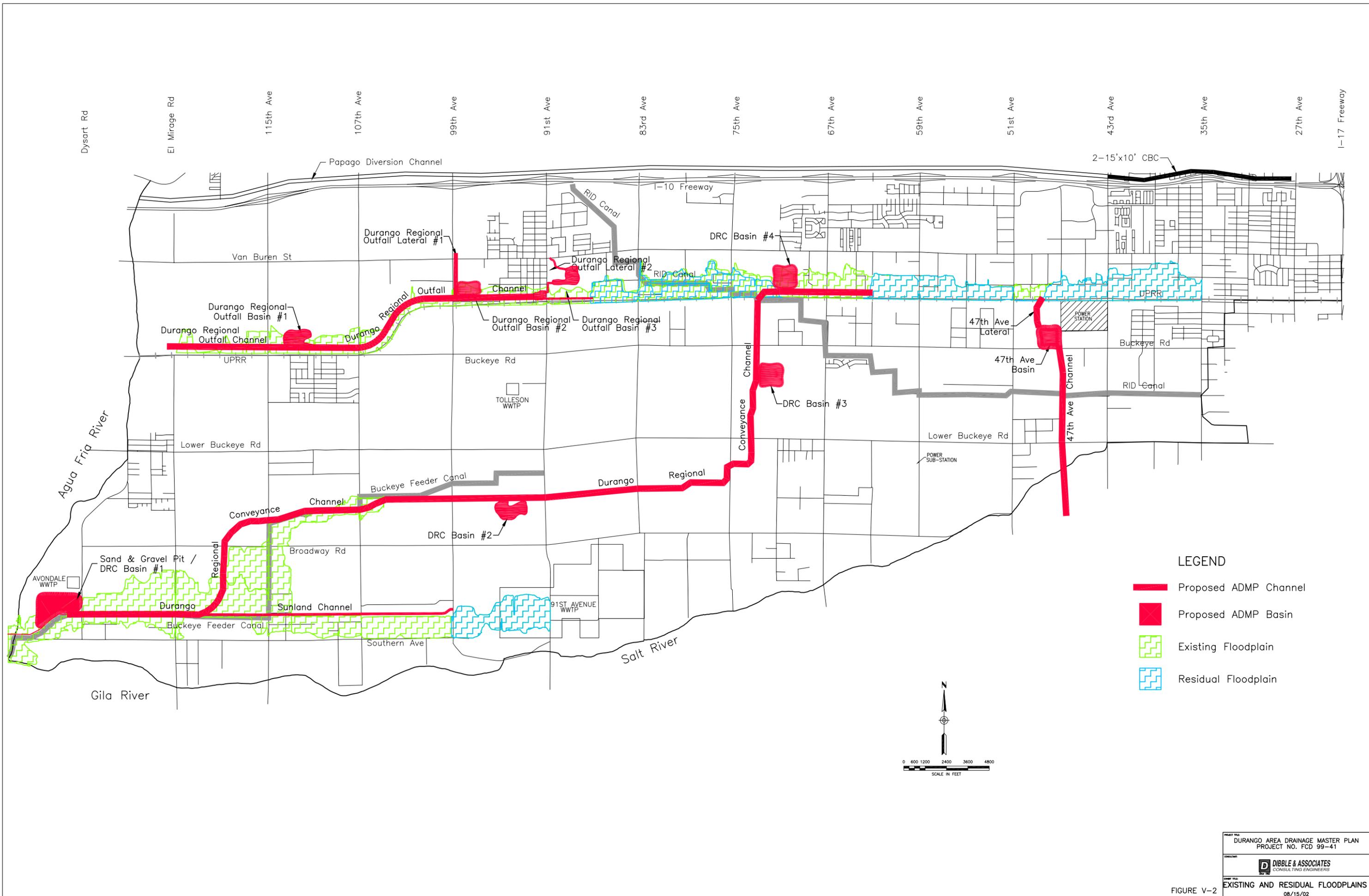
- LEGEND**
- Phoenix
 - Maricopa County
 - Tolleson
 - Avondale
 - Avondale Annexation Limits
 - Phoenix Annexation Limits
 - Tolleson Annexation Limits

PROJECT NO. DURANGO AREA DRAINAGE MASTER PLAN
PROJECT NO. FCD 99-41

CONSULTING ENGINEERS **DIBBLE & ASSOCIATES**
CONSULTING ENGINEERS

DATE: RECOMMENDED PLAN
08/15/02

FIGURE V-1



- LEGEND**
- Proposed ADMP Channel
 - Proposed ADMP Basin
 - ▨ Existing Floodplain
 - ▨ Residual Floodplain

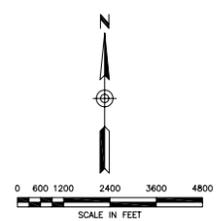


FIGURE V-2

VI. LANDSCAPE, AESTHETICS & MULTI-USE

A. Introduction

As part of the Durango ADMP process, a major objective has been to maximize opportunities to incorporate landscape aesthetics and multi-use into an effective flood control solution for this study area (“NAMU”- natural appearing multi-use). This effort has been driven by the belief that flood control solutions which successfully blend engineering, aesthetics, and multiple uses will provide the greatest benefit to the community. The study has included an extensive landscape aesthetic and multi-use analysis which documents the factors which have contributed to the development of recommended landscape themes deemed appropriate for the Durango area. Factors include existing and future desired landscape character, visual quality, visual resources, historic, prehistoric, and cultural influences and multi-use opportunities. Data was collected and concepts developed based upon field visits, project team meetings, stakeholder and agency meetings, municipal planning documents, and public open house meetings. This section describes the existing visual conditions, and the proposed landscape, aesthetics, and multi-use opportunities which are recommended to be incorporated into the design of the recommended plan for the Durango study area.

B. Recommended Plan

The recommended plan is divided into several different “projects” as depicted on the key map on **Figure VI-1**. The projects include the Durango Regional Outfall Channel, Basins and Laterals; the Durango Regional Conveyance Channel and Basins; the Sunland Channel; and the 47th Avenue Channel, Basin and Inlet. Each project will be described separately. The narrative for each project includes a description of the Visual Analysis, the Desired Landscape Character Theme, Multiple Use Opportunities, and the Recommended Landscape Design Guidelines.

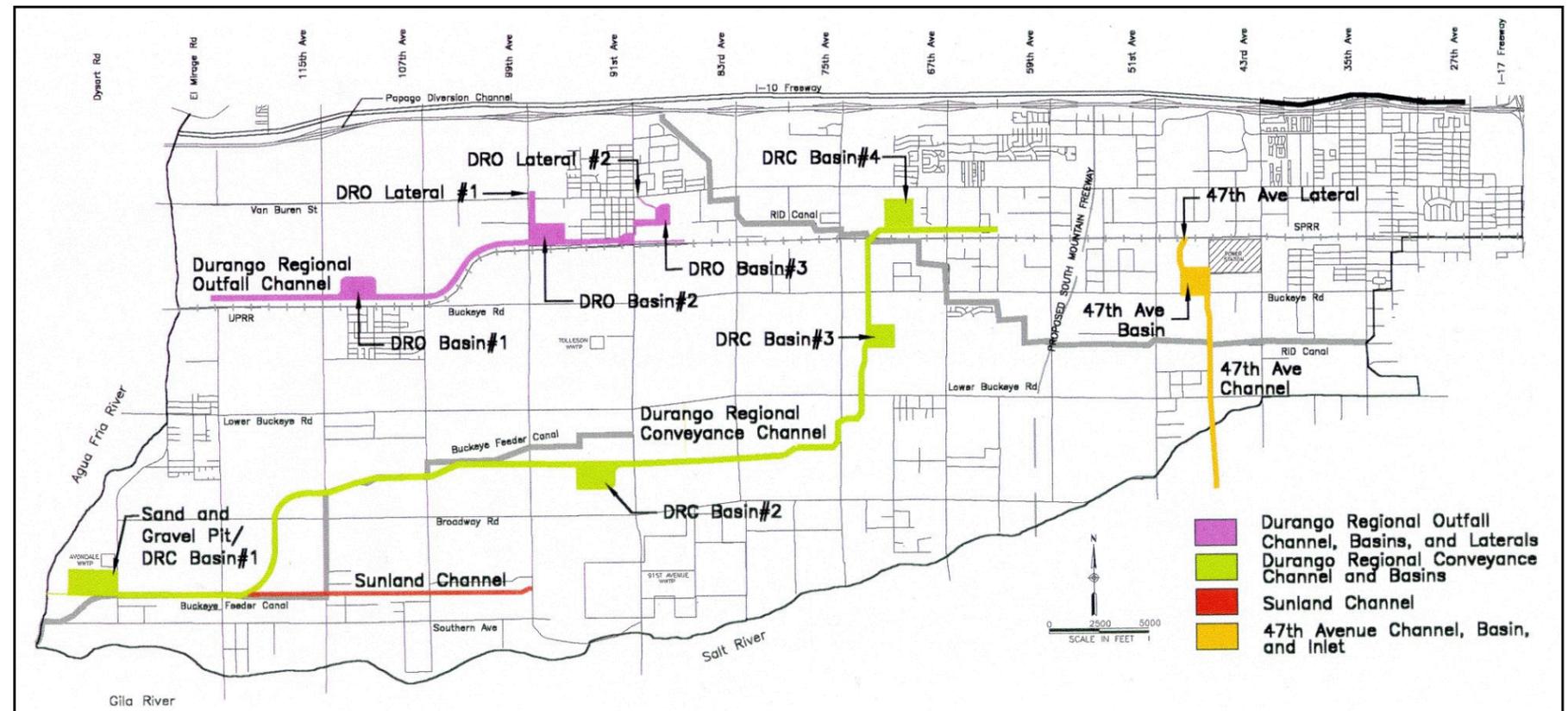


Figure VI-1. - Recommended Plan Key Map

1. Visual Analysis

The corridor visual analysis is intended to document existing visual conditions specific to the areas proposed as part of the recommended flood control plan alignment(s). Representative photographs are utilized to depict existing visual conditions. Refer to the **Figure VI-2, Visual Analysis Photo Key Map** for photograph locations.

2. Desired Landscape Character Themes

Because of the diversity within the Durango study area and the non existence of a single dominant appropriate theme applicable throughout, it is recommended that a mixed theme approach be taken to the landscape design of the recommended plan. The recommended

landscape theme for each area or component should bear a relationship to either the proposed use, existing landscape character, future desired landscape character, and / or characteristics relating to the culture, history, or prehistory of the area. The desired landscape character themes are based on the information presented in the data collection phase of the project, supplemental corridor analysis, and the alternative evaluation process. See **Figures VI-3, VI-4, and VI-5**.

3. Multiple Use Opportunities

The recommended flood control plan for the Durango area features numerous opportunities to incorporate multiple uses including a variety of potential detention basin/park sites to serve existing and future development as well as multi-use trail/channel corridors providing local links to the regional trail systems along the Salt, Gila, and Agua Fria Rivers (See Figure VI-3). The multi-use opportunities developed as part of this study and incorporated into the recommended plan are derived from recreational/park sites and trail alignments identified in various planning documents for the Cities of Phoenix, Tolleson, and Avondale. Grading and landscaping concepts for basins and channel corridors should consider park and recreational uses, buffers, safety, visual interest, maintenance, space requirements, and Americans with Disabilities Act (ADA) accessibility. Maintenance roads should be designed in an aesthetically pleasing manner as meandering multi-use trails with a stabilized decomposed granite surface to allow for pedestrian, bicycle, and equestrian uses. Each corridor and basin should be examined individually to determine appropriate maintenance access needs. In order to maximize opportunities for landscape enhancement, buffering, and aesthetic grading it is recommended that the maintenance road be designed on only one side of channel corridors where possible.

4. Recommended Design Guidelines

Proposed landscape treatments should be consistent with adjacent developments and reinforce the landscape standards and guidelines proposed as part of the City of Phoenix's Estrella Village Plan, or landscape guidelines and objectives for the Cities of Tolleson and Avondale as applicable. The design guidelines included herein include a description of the recommended landscape palette, arrangement, scale of spaces, buffers, treatment of grading, low flow channels, and structures, and other amenities as applicable.

C. Durango Regional Outfall Channel, Basins and Laterals

The flood control solution proposed for the northwest portion of the Durango study area in the Cities of Tolleson and Avondale includes the

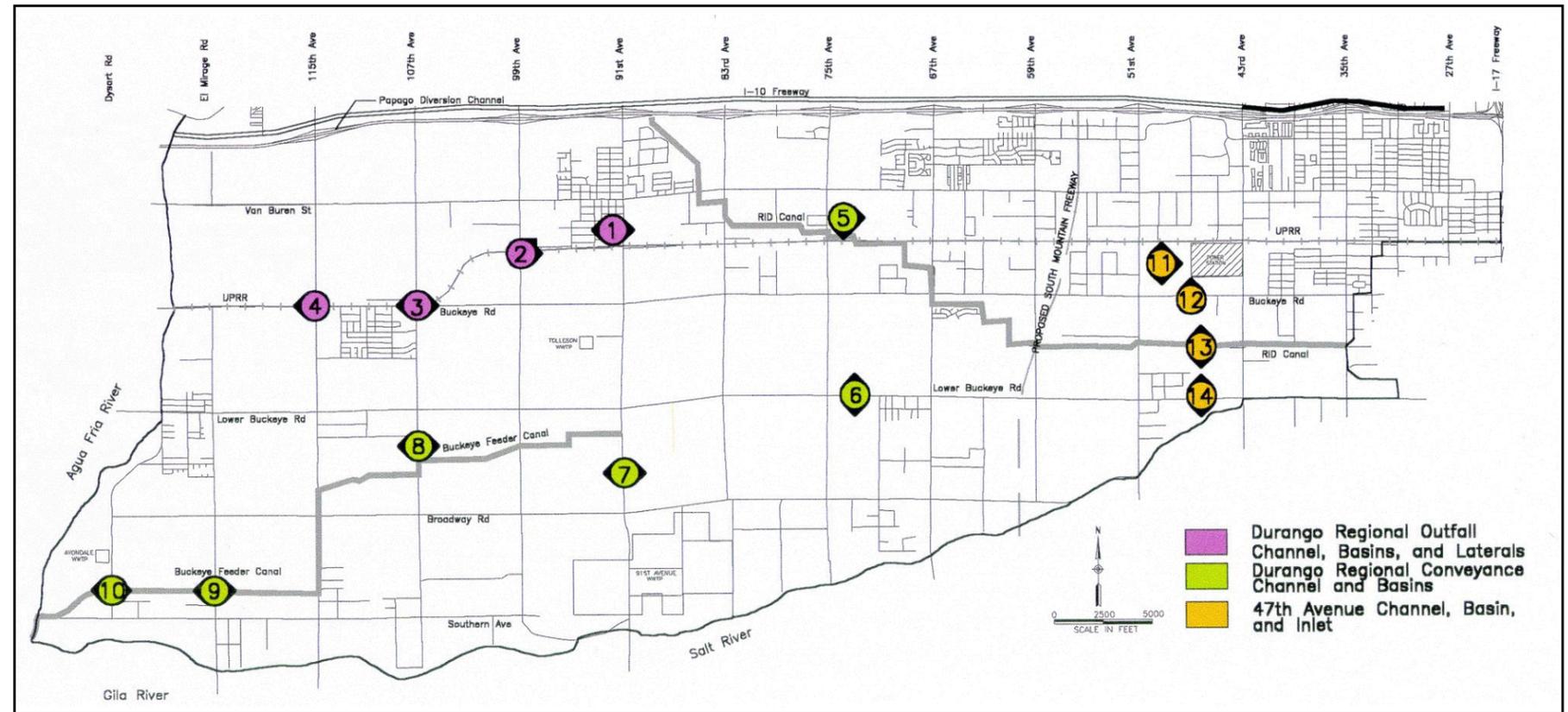


Figure VI-2. - Visual Analysis Photo Key Map

Durango Regional Outfall (DRO) Channel (Via FÁrrea Channel), Durango Regional Outfall Basins 1 (Cashion Station Basin), 2 (Cowden Station Basin), and 3 (Jean Station Basin), and the Durango Regional Outfall Laterals 1 and 2. These facilities are intended to relieve the flooding which occurs along the north side of the UPRR and in the downtown Tolleson area. See Figure VI-3.

1. Corridor Visual Analysis

The alignment generally follows the north side of the railroad from approximately 85th Avenue west through the Coldwater Springs development to the outfall at the Agua Fria River, with some minor “jogs” to avoid existing development. The DRO Channel from 85th Avenue to 107th Avenue, Basins 2 and 3, and Laterals 1 and 2 are located within the City of Tolleson, and the DRO Channel west of 107th Avenue and Basin 1 are within the City of Avondale.

The area in the vicinity of 91st and 99th Avenues in Tolleson has a unique character with the existence of formal wind rows of pecan trees. Shaded irrigation canals, rows of large scale canopy trees, and turf characterize many areas in the vicinity of 91st Avenue within the City of Tolleson.

The majority of the railroad frontages consist of industrial type uses with relatively low visual quality. With the potential for the railroad corridor to become a future light rail corridor, opportunities to improve and enhance the visual quality of this corridor should be maximized. The western portion of the alignment has been incorporated into the Coldwater Springs development and golf course.

DRO Basin #3 Site - Northeast Corner of UPRR and 91st Avenue
(Photo key location 1)



(Looking Northeast) (05/2000)

UPRR at 91st Avenue(Photo key location 1)



(Looking West-existing pecan tree row along south side of UPRR)
(05/2000)

UPRR at 99th Avenue (Photo key location 2)



(Looking East) (05/2000)



(Looking East) (05/2001)



(Looking East) (05/2000)



(Looking Northeast) (05/2000)

UPRR at 107th Avenue (Photo key location 3)



(Looking East) (05/2000)

UPRR at 115th Avenue (Photo key location 4)



(Looking East) (05/2000)

2. Desired Landscape Character Theme

The “Railroad Theme” combined with a “Park-Like Theme” and / or modified “Formal Promenade Theme” would be applicable for the corridor and three associated basins which follow along the north side of the UPRR from 85th Avenue to the Coldwater Springs golf course. See Figures VI-3 and VI-5. The combination of themes allows for the design of an active recreation corridor and park sites which incorporates both turf and decomposed granite planting areas as well as shade trees in both formal and informal arrangements. Amenities and hardscape elements would reflect a railroad theme. This approach will result in a relatively lush appearing railroad corridor which provides opportunities for greater visual interest and variety, and which also relates to the existing landscape character (formal pecan tree rows) in the area and the landscape design approach for both the Cities of Tolleson and Avondale.

3. Multiple Use Opportunities

The three basins provide the opportunity to preserve community recreational open space in Tolleson and Avondale. A variety of active recreation uses can be accommodated in the three detention basins. These park facilities should be master planned in conjunction with the Cities of Tolleson and Avondale’s Parks and Recreation Department once recreational needs for the area are identified and specific park uses programmed. Together with the basins, the channel corridor along the north side of the railroad will enhance this potential future light rail corridor, provide viewing opportunities for the railroad as well as a multi-use trail link to the regional trail system along the Agua Fria River. To further enhance the local trail system, a multi use trail connection is recommended north of DRO Basin #3 from the DRO Lateral #2 to the RID canal. With this connection, the RID Canal could become a potential trail corridor which would link a number of trail alignments thus greatly increasing the length of continuous trail in this area. The maintenance road both along the channel corridor and around the basins perimeter should be designed as a multi-use trail with a stabilized decomposed granite surface.



(Looking West) (05/2000)



(Looking West) (05/2000)

4. Recommended Design Guidelines

Currently a streetscape/drainage improvement project is under design for Van Buren Street in the City of Tolleson from approximately 91st Avenue to 96th Avenue. This project includes a streetscape landscape design with street trees, landscape plantings, traffic calmers and specialty paving for pedestrian nodal areas, site furniture, and amenities. As the main road through the City, a primary objective for this streetscape is to establish an identity for Tolleson. The landscape design will create an “oasis” with the site amenities featuring an “old town” theme. The street tree concept features canopy street trees with color accent trees at nodal areas. The street tree theme will be complimented by a variety of color shrubs, ground covers, and accent plants. Amenities which may be incorporated include a clock tower, bus shelters, trellis’, and ornamental iron site furniture such as drinking fountains, lighting, benches, and trash receptacles. As another potential major corridor for Tolleson, the railroad corridor should also be designed to reinforce Tolleson’s identity.

Landscape Treatment. The landscape palette would include extensive turf with canopy shade trees and color/accent trees as well as some side slope areas in both the basins and channels which would receive decomposed granite and mass shrub plantings. Primary canopy trees will consist of varieties such as Mesquite, Oak, Evergreen Elm, and Sissoo, with palms or color accent trees such as Acacia or Chinese Pistache also used in areas for special emphasis or significance. Strategic planting placement will serve to add visual interest, provide climate mitigation, and provide mitigation or visual buffering as appropriate for the adjacent railroad and other adjacent industrial uses. Shrub varieties may include: Cassia sp., Leucophyllum sp., Ruellia sp., Caesalpinia sp., Sophora, Simmondsia chinensis, Calliandra californica, Baccharis centennial, Hymenoxys acaulis, Lantana sp., Dalea sp, Hesperaloe, Convolvulus cneorum, Damianita, and Acacia redolens ‘Desert Carpet’. Placement of materials in both formal and informal arrangements should be designed to maximize visual interest and should also consider the potential recreational uses of these areas.

Grading. Slopes and grading for both the channels and basins should vary and undulate (4:1 to 8:1 or more) to create a natural appearing landform. Both the top of slope (and trail) and toe of slope should meander slightly in a natural manner to create visual interest and variety. Grading should be natural, organic and freeform and should not follow site property lines. The basins should be designed with multiple levels including a low flow channel to maximize usability for various recreational activities. Low flow channels should be turf or natural rock depending on location. The basin grading should also include upper level flat areas for a potential parking lot and ramada locations. The trails and any access to the bottom of the basin should be graded to be ADA accessible.

Arrangement / Scale. The arrangement of materials along this alignment should vary and include both formal and informal groupings depending on location. Massings, scale of spaces, and degree of enclosure should vary along the corridor with some areas featuring a high degree of massing and sense of enclosure and other areas larger scale and open to allow views of the railroad and park areas.

Amenities / Structures. Amenities and structures should be designed to reinforce the railroad theme and or City of Tolleson identity.

Nodes. The primary nodes associated with the DRO Channel include the three detention basin sites, intersections with all major roadways including 91st Avenue, 99th Avenue, 107th Avenue, 115th Avenue and the connection to the regional trail system along the Agua Fria River. A grade separated crossing is desirable at all major roadways, however has not been accounted for in the preliminary channel designs or cost estimates. Nodes should receive accent / color plants. Site furniture, ramadas and other amenities may be incorporated within basins and at the intersection of the regional trail system at the Agua Fria River along with signage or an informational kiosk specific to that particular location. Public education opportunities, buildings, hardscape elements, design details, public art, and structures can be developed to establish relevant themes for special emphasis areas.

D. Durango Regional Conveyance Channel and Basins (DRC)

The proposed flood control facilities for the central portion of the study area consist of the Durango Regional Conveyance Channel, (DRCC, Estrella Channel) and Basins #1 (Sand and Gravel Pit), 2 (Pueblo Poniento Basin), 3 (Santa Maria Basin), and 4 (Fowler Station Basin). The north and eastern portion of this corridor to 107th Avenue and Basins 2, 3, and 4 are within the City of Phoenix. The corridor west of 107th Avenue is within the City of Avondale annexation limits. See **Figure VI-3**.

1. Corridor Visual Analysis

The Durango Regional Conveyance Basin #4 is located at 71st Avenue north of the UPRR. The Durango Regional Conveyance Channel is a conveyance facility which originates at the DRC Basin #4, proceeds to the south past Lower Buckeye Road, then jogs to the west, south, and west again following the property lines of proposed developments in the area of 75th Avenue. West of 83rd Avenue the alignment angles to the southwest to follow a power line corridor to 107th Avenue. West of 107th Avenue the corridor angles to the southwest generally following the BFC alignment. At the intersection of 115th Avenue and the BFC the corridor proceeds due west then arcs to the south to follow an alignment approximately one half mile west of 115th Avenue. The corridor then arcs to the west again to follow the BFC / Sunland alignment to Dysart Road. Just west of Dysart Road, the channel terminates at DRC Basin #1 / Sand and Gravel Pit. A pipeline corridor then extends from DRC Basin #1 due west to the outfall at the Agua Fria River. The Durango Regional Conveyance Channel alignment incorporates the Sunland Channel which originates at 99th Avenue and follows the Sunland Avenue alignment to the DRCC. The DRCC also includes the two additional park/detention basin locations - one between Buckeye Road and Lower Buckeye Road east of 75th Avenue (DRC Basin #3) and one between 91st and 99th Avenue south of the BFC (DRC Basin #2).

The existing areas surrounding the Basin #4 site and northeastern portion of the channel corridor are a mixture of industrial and agricultural uses. Areas south of Buckeye Road are primarily existing

agricultural lands which are quickly being developed into residential uses. Other than the existing Swift Transportation facility which is located northwest of the corner of 75th Avenue and Lower Buckeye Road, the entire area is planned to become residential with associated support facilities such as schools, parks, and neighborhood commercial. There are currently two schools in close proximity to this alignment - the Santa Maria Middle School on Lower Buckeye Road east of 75th Avenue, and the Union Elementary School on 91st Avenue between Lower Buckeye Road and Broadway Road. The alignment utilizes the existing open agricultural and currently undeveloped land and follows a portion of an existing transmission line corridor. The agricultural lands in this area have a wide open character, with little vegetation other than the crop lands, and allow a panoramic vista of South Mountain and the Estrella Mountains to the south. Opportunities to provide parks, trails, and other recreational uses for the planned residential development in this area as well as linkages to the school sites should be maximized.

The Basin #1 site is an existing Sand and Gravel mining operation. This use is expected to continue for a number of years.

Durango Regional Conveyance Channel and Basin 4
(Photo key location 5)



(DRC Basin 4 Site) (05/2000)

Durango Regional Conveyance Channel
(Photo key location 6)



(Looking North - Channel and Basin #3 Site) (05/2001)



(Looking South) (05/2001)



(Looking South) (05/2001)

Besides one mile roadways, the major existing corridors in this area consist of large transmission line corridors, the BFC and other numerous smaller irrigation canals. The Durango Regional Conveyance Channel utilizes the existing transmission line corridor south of Lower Buckeye Road from east of 83rd Avenue to 107th Avenue. This transmission line corridor contains of a double row of metal monopoles.

Design of the sections of the corridor following the transmission corridor should create pedestrian scale visual interest and include mitigation measures to buffer views of the power poles and power line and maintain the desirable views of the mountains to the south.

The recommended plan alignment also uses a small portion of the BFC alignment between 99th Avenue and 115th Avenue and then again from one half mile west of 115th Avenue to just west of Dysart Road. The existing BFC is an elevated, unimproved dirt lined ditch. It's route is adjacent to or within existing open agricultural lands and some rural residences. There are currently planned residential developments along the BFC from 91st Avenue to 115th Avenue. West of Dysart, the route is also adjacent to the existing Sand and Gravel Pit to the north.

Durango Regional Conveyance Channel (Photo key location 7)
Transmission Line Corridor



(Looking East) (05/2001)

Durango Regional Conveyance Channel (Photo key location 8)
Transmission corridor along the existing BFC.



(Looking East) (05/2001)



(Looking West - Channel and Basin #2 Site) (05/2001)



(Looking West) (05/2001)

Durango Regional Conveyance Channel (Photo key location 9)



(Looking East) (06/2002)

Durango Regional Conveyance Channel (Photo key location 10)



(Looking East) (06/2002)



(Looking Northwest towards Sand and Gravel Pit) (06/2002)



(Looking West) (06/2002)



(Looking West) (06/2002)

2. Desired Landscape Character Theme

The desired landscape theme for the DRC Channel and Basins represents a combination of themes based on the surrounding land uses and surrounding landscape character. See Figures VI-3 and VI-4. The Durango Regional Conveyance Basin #4 and Channel corridor north of I Buckeye Road are in an area of existing agricultural land uses and industrial facilities in the vicinity of the railroad. South of Buckeye Road, the Durango Regional Conveyance Channel and Basins 2 & 3, traverses an area which is primarily open agricultural land uses currently being developed and planned for residential uses. The flood control facility theme in this area should reflect the opportunity to preserve open space and provide active recreation areas for a growing residential community. Special emphasis areas can reflect the agricultural heritage of the area or railroad theme depending on location. Public education opportunities, buildings, hardscape elements, design details, public art, and structures can be developed to establish relevant themes for special emphasis areas.

The “Modified Sonoran Theme” is recommended in the industrial areas north of Buckeye Road with the “Railroad Theme” incorporated for special emphasis areas and amenities along the railroad corridor. The “Modified Sonoran Desert Theme” can be described as a modified natural overall theme characterized by decomposed granite slopes and an informal arrangement of a modified Sonoran Desert plant palette including Mesquite, Palo Verde, and Acacia trees, with complimentary shrubs, ground covers, and accent plants. Turf would be incorporated in areas suitable for potential active recreation uses.

In the vicinity of Buckeye Road and extending to Dysart Road with surrounding agricultural and residential uses, the theme should transition to a “Park-Like theme” with the “Agricultural Heritage Theme” incorporated for special emphasis areas. The overall “Park-Like Theme” can be described as a turf greenbelt with similar characteristics as Scottsdale’s Indian Bend Wash through this area. The emphasis is on active recreation, park facilities and amenities. The treatment is characterized by primarily open turf areas with an informal arrangement of medium to large canopy trees for climate mitigation, power line corridor mitigation, and framing of views to the mountains.

West of Dysart Road the treatment of the corridor should transition to a more natural treatment consistent with the landscape theme proposed along the Agua Fria River corridor. Durango Regional Conveyance Basin #1 is an existing Sand and Gravel Pit in this area. The sand and gravel mining operations are expected to continue for a number of years however as phases are completed, mitigation of this area should include landscape improvements and aesthetic grading

3. Multiple Use Opportunities

The overall flood control facility alignment in this area consisting of four total detention basins and connecting channel corridor provides an opportunity to create and preserve valuable community recreational open space for a growing residential population. All basins should ultimately be designed to accommodate some form of active recreation and the channel designed as a trail corridor with an ultimate connection to the proposed regional trail system along the Agua Fria River. Durango Regional Conveyance Basin #1 is an existing Sand and Gravel Pit. Mitigation of this area at the conclusion of each phase of sand and gravel mining operations should include landscape improvements and aesthetic grading to accommodate appropriate recreational activities as programmed by the City of Avondale’s Parks Department. The pipeline corridor west of Basin 1 can be used as a trail corridor connection to the Regional Trail system along the Agua Fria. Basin 2 (between 91st and 99th Avenues) is located in an area designated for a community park facility per the City of Phoenix’s Estrella Village Plan. Basin 3 (at 71st Avenue south of Buckeye Road) is located in an area designated for a neighborhood park facility per the Estrella Village Plan. These park facilities should be master planned in conjunction with the City of Phoenix Parks, Recreation, and Library Department once recreational needs for this area are identified and specific park uses programmed. Durango Regional Conveyance Basin #4 (at 71st Avenue on the north side of the UPRR) is located in an area along the railroad corridor designated to develop as industrial. The channel corridor connecting the basins utilizes open agricultural lands in the north/south direction and follows a portion of a transmission corridor, the BFC, and open agricultural lands east/west. The channel alignment provides a multi use trail corridor linking to the proposed regional trail along the Agua Fria River. Where possible the trail should be located on the south side of the transmission corridor to provide opportunities for mitigation of the power line and allow unobstructed mountain views to the south. Maintenance access to the transmission line must be maintained.

4. Recommended Design Guidelines

Landscape Treatment. Proposed landscape treatments should be consistent with adjacent developments and reinforce the park and landscape standards and guidelines proposed for these areas by the Cities of Phoenix and Avondale.

All basins and channel corridors should be designed for active recreation with a heavy emphasis on turf and shade trees. The plant palette will be consistent with the Estrella Village Plan in the City of Phoenix, and with the TresRios Greenway Specific Plan in Avondale. North of Buckeye Road the primary tree palette will consist of Mesquite, Palo Verde or Palo Brea and Acacia with flowering trees or palms as accents. South of Buckeye Road the primary canopy trees will consist of Mesquite, Oak, Chinese Pistache, Evergreen Elm, Sissoo, and Acacia with palms or color accent trees such as Acacia, Palo Brea, or Chinese Pistache also used in areas for special emphasis or significance. Strategic tree placement will serve to add visual interest, provide climate mitigation, mitigation for the adjacent transmission corridors, and also allows for creation of view corridors of the mountains to the south. Placement and arrangement of materials should also consider the potential recreational uses of these areas.

In buffer areas, or areas where screening or special emphasis is required, decomposed granite planting areas may be incorporated. The shrub palette may include: Cassia sp., Leucophyllum sp., Ruellia sp., Caesalpinia sp., Sophora, Simmondsia chinensis, Calliandra californica, Baccharis centennial, Hymenoxys acaulis, Lantana sp., Dalea sp, Hesperaloe, Convolvulus cneorum, Damianita, and Acacia redolens ‘Desert Carpet’. Placement and massings of materials should reflect an informal arrangement and should be designed to maximize visual interest, provide screening in areas as appropriate and should also consider the potential recreational uses of these areas.

In the areas in close proximity to the river, a more native palette should be utilized consisting primarily of Mesquite and Palo Verde trees in conjunction with a variety of native shrubs, groundcovers, and accents.

Grading. Slopes and grading for both the channels and basins should vary and undulate (4:1 to 8:1 or more) to create a natural appearing landform. Both the top of slope (and trail) and toe of slope should meander in a natural manner to create visual interest and variety. Grading should be natural, organic and freeform and should not follow site property lines. The basins should be designed with multiple levels including a low flow channel to maximize usability for various recreational activities. Low flow channels should be turf or natural rock depending on location. The park sites (especially the community park and neighborhood park sites (DRC Basins #2 and 3)) should also include upper level flat areas for a potential parking lot and ramada locations. The trails and any access to the bottom of the basins should be graded to be ADA accessible.

Channel sections adjacent to transmission line corridors should include a landscape buffer between the trail and power poles. The landscape buffer should include berming and tree and shrub massings to mitigate the views of the power line and create pedestrian scale visual interest.

Arrangement / Scale. The general scheme for the DRC Channel and Basins should reflect an informal arrangement which provides visual interest, shade for potential users, direct views of mountains, and adds screening where needed

Amenities / Structures. Minimize hard structures. Features should be designed to blend using natural materials or materials which are colored / stained / and or textured to be compatible. Amenities can be designed to reinforce the agricultural heritage of the area, railroad, or river areas as appropriate for each location.

Nodes. The primary nodes associated with the DRC Channel include the four detention basin sites, intersections with the UPRR, local trail intersections, intersection with the RID canal, and all major roadway intersections including 75th Avenue, 83rd Avenue, 91st Avenue, 99th Avenue, 107th Avenue, 115th Avenue, El Mirage Road, Broadway Road, and Dysart Road as well as the connection to the regional trail system

along the Agua Fria River. A grade separated crossing should be provided at all major roadways, however has not been accounted for in the preliminary channel designs or cost estimates. Nodes should receive accent / color plantings. Site furniture, ramadas and other park amenities such as benches, lighting, drinking fountains, barbeque units, picnic tables, and play equipment may be incorporated within basins and at trail intersections along with signage or an informational kiosk specific to that particular location. Public education opportunities, buildings, hardscape elements, design details, public art, and structures can be developed to establish relevant themes such as the agricultural heritage of the area, railroad theme or river areas as applicable.

E. 47th Avenue Channel, Basin, and Inlet

The eastern portion of the study area within the City of Phoenix is served by a flood control facility which generally follows an alignment adjacent to 47th Avenue and an existing power line corridor.

1. Corridor Visual Analysis

This alignment originates at the 47th Avenue Detention Basin Inlet which conveys water from the UPRR to the 47th Avenue Detention Basin (Pueblo Del Rio Park) located at the northwest corner of 47th Avenue and Buckeye Road. From the 47th Avenue Detention Basin, the 47th Avenue Channel conveys water to the south along the power line corridor to the Salt River. **See Figure VI-3.**

The selected alignment utilizes open undeveloped or agricultural corridors within an area which contains primarily industrial development. The majority of the alignment south of Buckeye Road follows an existing canal and power line corridor. The 47th Avenue power line corridor contains three rows of tall metal monopoles north of Buckeye Road and two rows south of Buckeye Road. An existing irrigation ditch follows along the east side adjacent to the power line corridor for much of the distance south of Buckeye Road.

Panoramic views of South Mountain to the south are partially obstructed by buildings and power poles. Visual quality varies from one property

to the next, however, many areas are characterized by industrial developments with outdoor operations or storage yards which are not sufficiently screened and have generally low visual quality. A flood control solution in this area provides a great opportunity to screen objectionable views, preserve desirable view corridors to the south, provide an open space recreational amenity and preserve a landscaped open space corridor and regional trail system link for industrial facility employees in an area relatively devoid of amenities.

47th Avenue Detention Basin Inlet Area (Photo key location12)
Southeast corner of 51st Avenue and the UPRR



(Looking North - adjacent industrial development)
(05/2000)

47th Avenue Detention Basin Inlet Area (Photo key location 12)



(Looking East - adjacent industrial development) (05/2000)

47th Avenue Power Line Corridor and Buckeye Road
(Photo key location 13)



(Looking North-
47th Avenue Detention Basin
Site) (05/2000)

47th Avenue Power Line Corridor and Lower Buckeye
(Photo key location 15)



(Looking North) (05/2000)



(Southwest of alignment - views of adjacent historic mills and
background mountains) (05/2000)

47th Avenue Power Line Corridor and RID Canal
(Photo key location 14)



(Looking North) (05/2000)



(Looking South) (05/2000)



(Looking South) (05/2000)

2. Desired Landscape Character Theme

The Proposed Landscape Theme for this area is a “Modified Sonoran Theme”. See Figures VI-3 and VI-4 . The “Modified Sonoran Desert Theme” can be described as a modified natural overall theme characterized by decomposed granite slopes and an informal arrangement of a modified Sonoran Desert plant palette including trees, shrubs, ground covers, and accent plantings. Turf would be incorporated in areas suitable for potential active recreation uses.

3. Multiple Use Opportunities

47th Avenue Basin, Inlet, and Channel landscape features a detention basin and multi use trail / channel which follows the alignment of a transmission line corridor . It is recommended that the basin and channel corridor feature a combination of active and passive recreational areas.

Turf should be limited to active recreation areas with planted and decomposed granite side slopes along the channel corridor and in more passive use areas of the basin. The detention basin should be designed with sufficient turf area, slope plantings, shade trees and park amenities (i.e. ramadas, benches, picnic tables, barbeques, lighting, and recreational/exercise/par course equipment) to facilitate site security and maintenance as well as provide a pleasant and functional environment for lunchtime and recreational uses for employees of adjacent industrial facilities.

The channel corridor alignment, adjacent to a north/south transmission line provides an off-road multi-use trail link to proposed regional trails along the banks of the Salt and Gila Rivers. In areas where alignments follow transmission line corridors, the combination multi-use trail and maintenance road must provide maintenance access to both the channel corridor as well as transmission line poles. The trail alignment should vary to maximize visual interest and variety while maintaining desirable views.

4. Recommended Design Guidelines

Landscape Treatment. Proposed landscape treatment for the 47th Avenue Channel and Basin should be consistent with desirable adjacent developments and reinforce the landscape standards and guidelines proposed as part of the City of Phoenix’s Estrella Village Plan. The basin and channel corridor feature a combination of active and passive recreational areas. Turf should be limited to active recreation areas with planted and decomposed granite side slopes along the channel corridor and in more passive use areas of the basin. The plant palette will be consistent with the Estrella Village Plan Plant List, recommended street trees and adjacent existing industrial development. Primary canopy trees will consist of Mesquite, Palo Verde, and Acacia varieties, with palms and or color accent trees used in areas for special emphasis. Trees will also be complimented with mass plantings of compatible low water use arid region shrubs, ground covers, and accent plantings designed to maximize visual interest, variety, color, and texture. The shrub palette may include: Cassia sp., Leucophyllum sp., Ruellia sp., Caesalpinia sp., Sophora, Simmondsia chinensis, Calliandra californica, Baccharis centennial, Hymenoxys acaulis, Lantana sp., Dalea sp, Hesperaloe, Convolvulus cneorum, Damianita, and Acacia redolens ‘Desert Carpet’. Strategic plant placement will serve to add visual interest, provide climate mitigation, mitigation for the adjacent transmission corridor, and also allows for creation of view corridors of the mountains to the south. Placement and arrangement of materials should also consider the potential recreational uses of these areas.

Grading. Slopes and grading for both the channels and basins should vary and undulate (4:1 to 8:1 or more) to create a natural appearing landform. Both the top of slope, trail, and toe of slope should meander in a natural manner to create visual interest and variety. Grading should be natural, organic and freeform and should not follow site property lines. The basin should be designed with multiple levels including a low flow channel to maximize usability for various recreational activities. Low flow channels should be turf or natural rock depending on location. The basin grading should incorporate a meandering perimeter trail with possible par course stations and also include upper level flat areas for

potential ramada locations. The trails and any access to the bottom of the basin should be graded to be ADA accessible.

For channel sections adjacent to the transmission line corridor or adjacent to industrial facilities with poor visual quality, the design should include a landscape buffer between the trail and adjacent uses. The landscape buffer should include berming and tree and shrub massings to mitigate the views of the power line or other objectionable views and create pedestrian scale visual interest.

Arrangement / Scale. The general scheme for the 47th Avenue Channel and Basin should reflect an informal arrangement which provides visual interest, shade for potential users, directs views of mountains, and adds screening where needed. Plant massings shall vary creating a variety of scale of spaces, varying degrees of enclosure. The layout of plantings shall maintain and enhance desirable views of both adjacent historic mills and of the mountains to the south.

Amenities / Structures. Minimize hard structures. Features should be designed to blend using natural materials or materials which are colored / stained / and or textured to be compatible. Incorporate park amenities including ramadas, benches, lighting, signage, play equipment, etc. Design theme may reflect details evident in the design of the historic mills adjacent to the basin site.

Nodes. The primary nodes associated with the 47th Avenue Channel include the detention basin site, the intersection with the UPRR, the intersection with the RID canal, and all major roadway intersections including Buckeye Road, and Lower Buckeye Road as well as the connection to the regional trail system along the Salt River. A grade separated crossing should be provided at all major roadways, however has not been accounted for in the preliminary channel designs or cost estimates. Nodes should receive accent / color plantings. Site furniture, ramadas and other park amenities such as benches, lighting, drinking fountains, barbeque units, picnic tables, and play equipment may be incorporated within basins and at trail intersections along with signage

or an informational kiosk specific to that particular location. Public education opportunities, buildings, hardscape elements, design details, public art, and structures can be developed to establish relevant themes.

F. Future Related Projects

A flood control solution will be developed for the Tres Rios area south of Southern Avenue and west of 99th Avenue to solve interior drainage problems in this area. The exact configuration and extent of the flood control facilities has not yet been determined. This project is not part of the Durango ADMP.

The Tres Rios area consists of existing agricultural lands adjacent to the Holly Acres Levee along the north side of the Salt/Gila River. With the availability of water in this area, the river areas adjacent to the levee represent dense areas of vegetation consisting of a mixture of Cottonwood, Willow, and a large amount of Tamarisk (Salt Cedar).

Where vegetation opens, there are opportunities for relatively close up mountain views. These areas represent an opportunity to restore the natural character associated with the rivers, maintain and enhance mountain views, as well as restore and enhance bird and wildlife habitat. The river areas also have recreational significance as part of the regional trail system planned along those corridors.

The recommended theme for the flood control solution developed for this area would be a natural theme which incorporates native plant materials, enhanced bird and wildlife habitat, natural materials, possible water features, grading consistent with natural landforms, passive recreation uses, and a multi-use trail link to the regional trail system or nodes along the river corridors.

G. Public Sensing

As part of the Master Plan process, after the alternative evaluation process was completed and the preferred alternative selected, two public meetings were held on August 15 and August 17 in Tolleson and Phoenix respectively. The recommended plan was displayed and the community invited to review and comment. A questionnaire was

distributed to all attendees. Sixteen people attended the August 15 public meeting at Littleton Elementary School in Tolleson and thirty four people attended the August 17 meeting at the City of Phoenix Fire Station #34. The results of Community Questionnaire 2 are summarized in **Appendix F**.

Conclusion: Generally, the reaction to the flood control facilities which incorporates the proposed multi use features and landscape amenities was well received by the public however many of the long time residents do not support any improvements which would encourage development of the area. There is a strong desire to retain the open spaces, natural features, and rural, agricultural heritage as much and as long as possible. Many suggested modifications to the alignment to be more compatible with existing land uses and proposed development plans.

Typical View to Gila River in Tres Rios Area



(05/2001)

H. Special Considerations

1. Landscape Costs

It should be noted that the themes, landscape treatments, and multi-use opportunities described herein represent a level of landscape treatment beyond the standard FCDMC funded landscape treatment as defined in the *Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects*. Implementation of the themes and multi-use features described herein will require a cost sharing arrangement with other partners or supplemental funding sources.

Per the current FCDMC Policy, the landscaping cost ceiling per acre for a suburban channel or basin is \$40,000 per acre (\$0.92 per s.f.). This represents the maximum total costs considered appropriate for landscaping including plantings, irrigation, seeding, general system costs, and labor. The FCDMC policy also includes a provision for some non landscaping aesthetic treatment such as for enhancing the structural components of District Projects. The maximum cost guideline for project aesthetic feature costs for a suburban facility is 8% for project costs of \$1,000,000 and less, 6% for project costs of \$1,000,000 to \$2,500,000, 5% for project costs of \$2,500,000 to 10,000,000, and 4% for projects over 10,000,000. Cost share percentage rates are determined between the District and project partners on a case by case basis and included in project Inter-governmental Agreements (IGA) for overall project costs.

For the purposes of this study, an estimated average per square foot landscape cost to completely implement the themes described herein is \$1.80 per s.f., which is approximately double the landscape treatment cost of \$0.92 per s.f. that the current FCDMC policy allows. Costs will vary depending on the exact types and sizes of materials, and the extent hardscape features, site furniture, buildings, structures, and other equipment is incorporated into the design. Addition of other elements such as lighting will also impact costs. These types of amenities could easily be phased in the future as funding becomes available.

2. Retention Basin Aesthetics & Multi-Use Evaluation

As a separate part of the project, an additional evaluation was performed to determine the additional land area required to enhance an “engineered” basin by incorporating aesthetic and multi-use features to create a “kinder and gentler” basin design that, with additional enhancements, can be utilized as a public park. The results of this evaluation determined that the additional area required is highly dependent on the individual site, but could range from approximately a 10 percent increase to approximately a 50 percent increase. The full evaluation of this analysis can be found in **Appendix G**.

PLAN KEY

-  NODAL AREA
-  PLANNED REGIONAL TRAIL ALIGNMENT
-  PLANNED LOCAL TRAIL ALIGNMENT

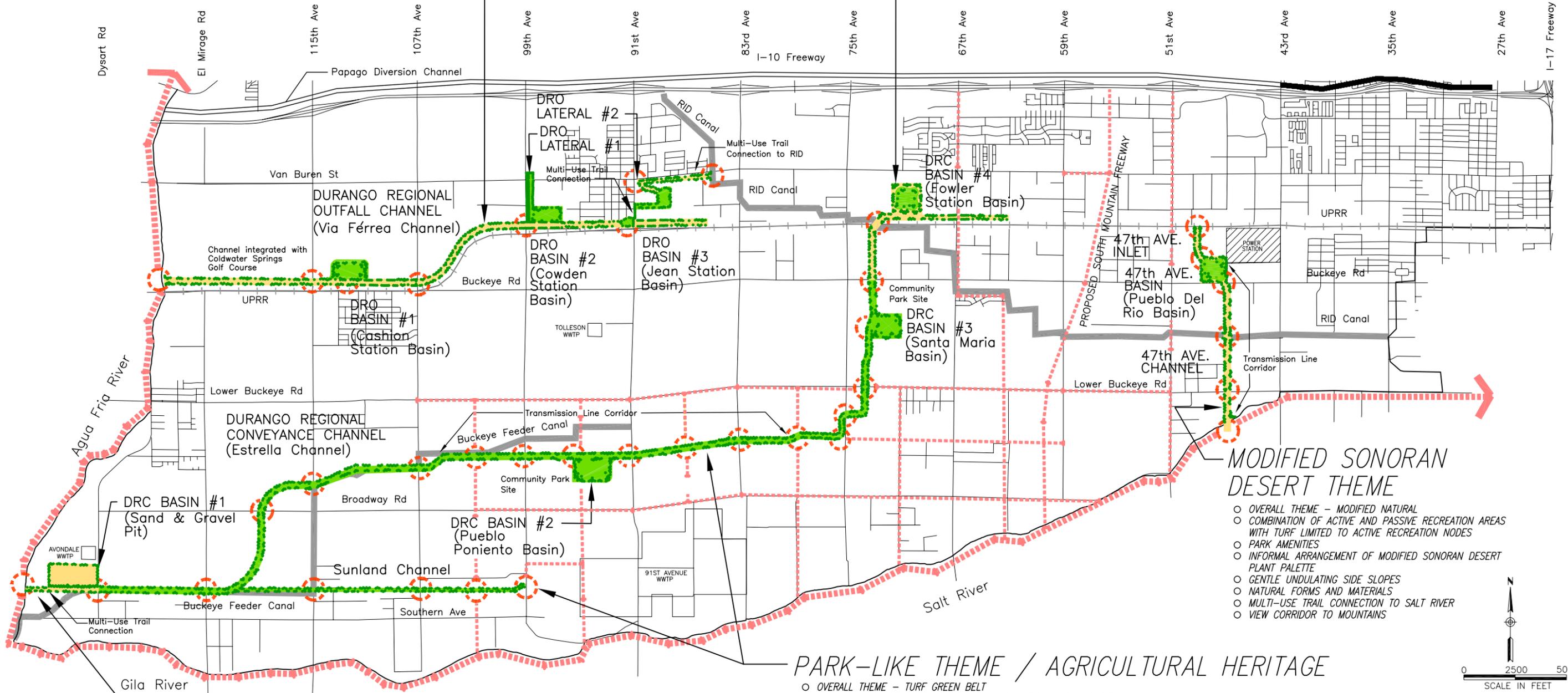
*NOTE: NAMES IN PARENTHESIS (Name) REPRESENT SUGGESTED POSSIBLE NAMES FOR THE PLANNED BASINS/PARKS AND CHANNELS

RAILROAD THEME COMBINED WITH PARK-LIKE THEME AND FORMAL PROMENADE

- COMBINATION OF FORMAL THEME AND PARK-LIKE THEME ADJACENT TO UPRR
- DESIGN CONSISTANT WITH TOLLESON AND AVONDALE LANDSCAPE OBJECTIVES
- FORMAL ROWS AND INFORMAL GROUPINGS OF LARGE SCALE CANOPY TREES
- UNDERSTORY TREATMENT IS A COMBINATION OF TURF, DECOMPOSED GRANITE AND SHRUB PLANTINGS
- FORMAL PLANTING AND HARDSCAPE ARRANGEMENT WITH BUILDINGS, HARDSCAPE ELEMENTS, DESIGN DETAILS, BRIDGES, PUBLIC ART, AND STRUCTURES FEATURING A RAILROAD THEME
- POSSIBLE FUTURE LIGHT RAIL CORRIDOR
- PUBLIC EDUCATION OPPORTUNITY - RAILROAD
- POTENTIAL BASIN/PARK SITES AND MULTI-USE TRAIL CORRIDOR LINK TO THE AGUA FRIA

MODIFIED SONORAN DESERT COMBINED WITH RAILROAD THEME

- CHANNEL AND BASIN NORTH OF BUCKEYE ROAD IN INDUSTRIAL AREA



MODIFIED SONORAN DESERT THEME

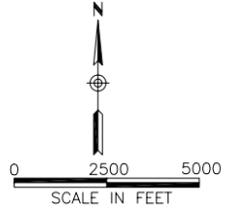
- OVERALL THEME - MODIFIED NATURAL
- COMBINATION OF ACTIVE AND PASSIVE RECREATION AREAS WITH TURF LIMITED TO ACTIVE RECREATION NODES
- PARK AMENITIES
- INFORMAL ARRANGEMENT OF MODIFIED SONORAN DESERT PLANT PALETTE
- GENTLE UNDULATING SIDE SLOPES
- NATURAL FORMS AND MATERIALS
- MULTI-USE TRAIL CONNECTION TO SALT RIVER
- VIEW CORRIDOR TO MOUNTAINS

PARK-LIKE THEME / AGRICULTURAL HERITAGE

- OVERALL THEME - TURF GREEN BELT
- EMPHASIS ON ACTIVE RECREATION, PARK FACILITIES, AND AMENITIES
- INCORPORATE "AGRARIAN THEME" AMENITIES
- LANDSCAPE TREATMENT CONSISTS PRIMARILY OF TURF WITH INFORMAL ARRANGEMENT OF MEDIUM TO LARGE CANOPY TREES FOR CLIMATE MITIGATION, POWER LINE CORRIDOR MITIGATION, AND FRAMING OF VIEWS TO THE MOUNTAINS
- GENTLE UNDULATING SIDE SLOPES
- MAINTAIN OPEN FEEL OF EXISTING AG LANDS
- MULTI-USE TRAIL CONNECTION TO AGUA FRIA AND GILA RIVERS

NATURAL THEME / NATIVE AMERICAN

- OVERALL NATURAL APPEARING THEME / TRANSITION TO RIVER AREA
- NATURAL FORMS, LAYOUT, AND MATERIALS
- LANDSCAPE TREATMENT CONSISTS PRIMARILY OF NATIVE PLANT PALETTE
- POSSIBLE WATER FEATURES
- BIRD AND WILDLIFE HABITAT IMPROVEMENT
- PASSIVE RECREATION / MULTI-USE TRAIL CONNECTION
- PUBLIC EDUCATION OPPORTUNITIES
- NATIVE AMERICAN THEME ELEMENTS CAN BE INCORPORATED



07/17/02

PROJECT TITLE:
DURANGO AREA DRAINAGE MASTER PLAN
PROJECT NO. FCD 99-41

CONSULTANT:
McCloskey • Peltz, Inc.
LANDSCAPE ARCHITECTS

EXHIBIT TITLE:
**RECOMMENDED PLAN
PROPOSED LANDSCAPE THEMES**

FIGURE VI-3

PARK-LIKE THEME
TURF GREENBELT
ACTIVE RECREATION EMPHASIS

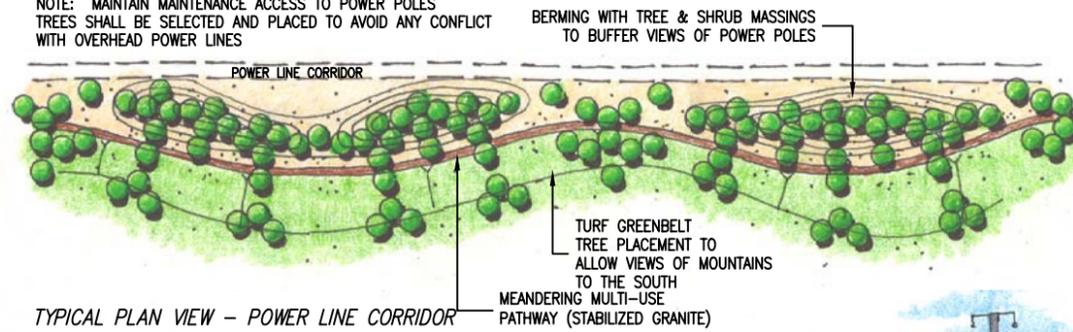
NOTE:
COORDINATE RECREATIONAL FACILITY NEEDS
WITH MUNICIPAL PARK DEPARTMENT



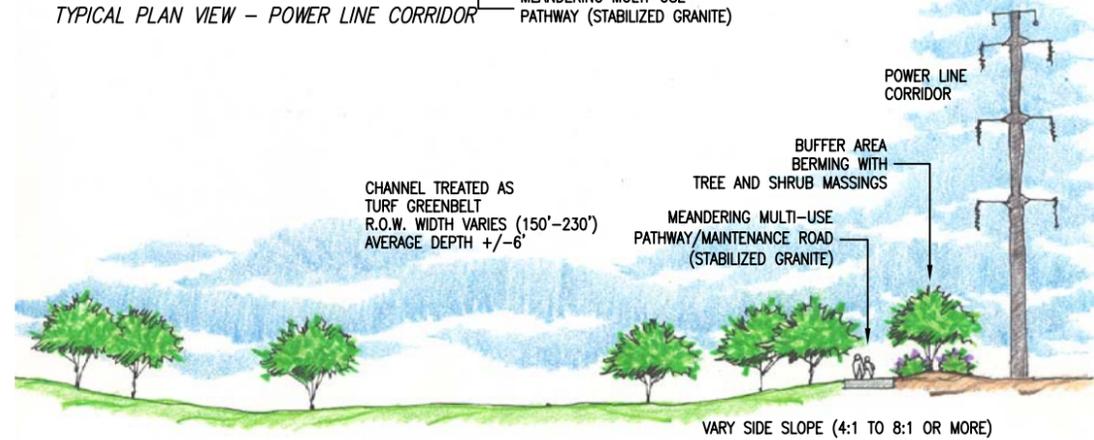
TYPICAL BASIN PARK
DURANGO REGIONAL
CONVEYANCE CHANNEL

NOTE:
SLOPES AND GRADING FOR CHANNELS AND BASINS
SHOULD BE ROUNDED AND SHOULD VARY AND
UNDULATE TO CREATE A NATURAL APPEARING
LANDFORM.
BASINS SHOULD BE DESIGNED WITH MULTIPLE LEVELS
INCLUDING A LOW FLOW CHANNEL TO MAXIMIZE
USABILITY FOR VARIOUS RECREATION ACTIVITIES.

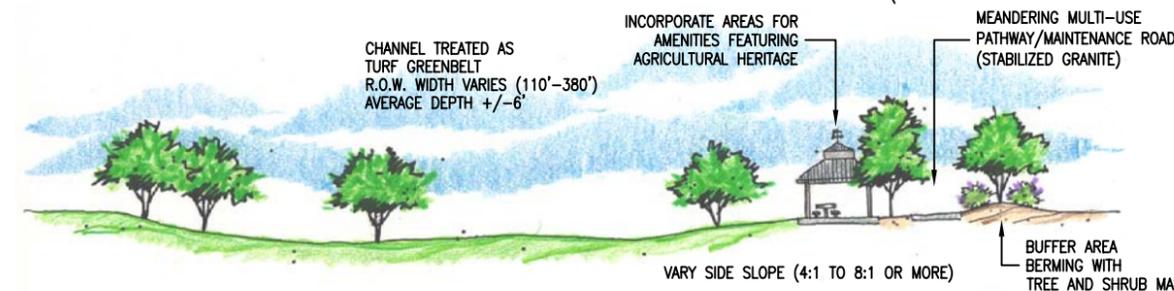
NOTE: MAINTAIN MAINTENANCE ACCESS TO POWER POLES
TREES SHALL BE SELECTED AND PLACED TO AVOID ANY CONFLICT
WITH OVERHEAD POWER LINES



TYPICAL PLAN VIEW - POWER LINE CORRIDOR



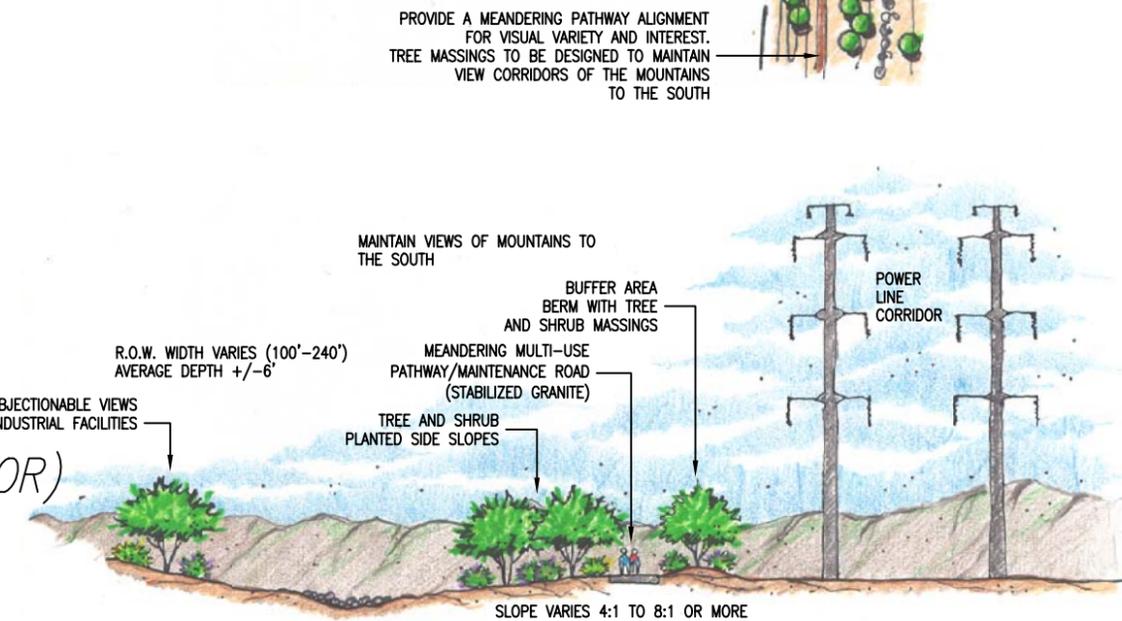
DURANGO REGIONAL CONVEYANCE CHANNEL (POWER LINE CORRIDOR)



DURANGO REGIONAL CONVEYANCE CHANNEL (NON POWER LINE CORRIDOR)



47TH AVENUE BASIN AND CHANNEL



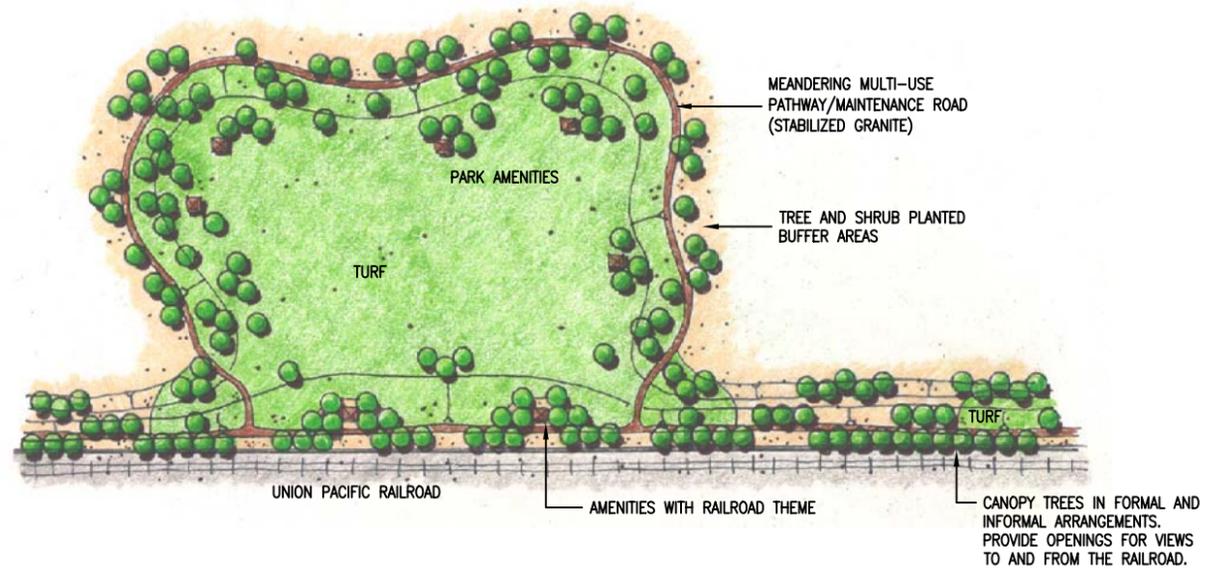
47TH AVENUE CHANNEL (POWER LINE CORRIDOR)

PROJECT TITLE:	DURANGO AREA DRAINAGE MASTER PLAN PROJECT NO. FCD 99-41
CONSULTANT:	McCloskey • Peltz, Inc. LANDSCAPE ARCHITECTS
EXHIBIT TITLE:	RECOMMENDED PLAN LANDSCAPE CHARACTER

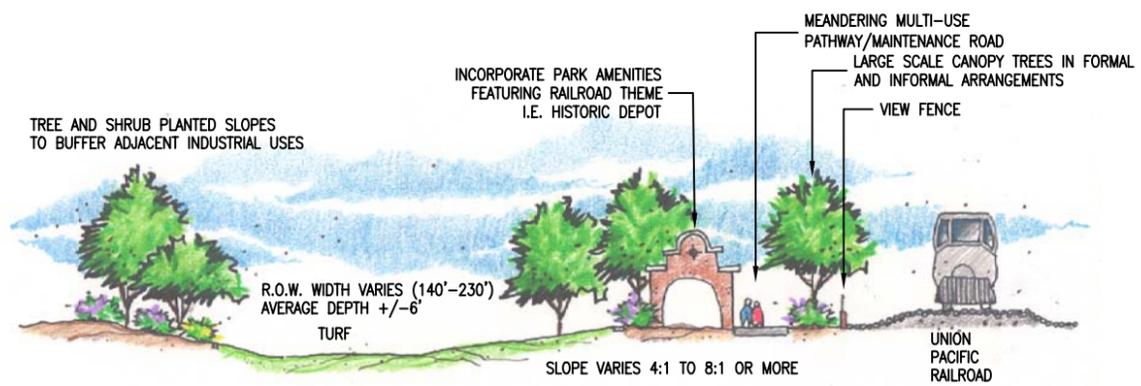
FIGURE VI-4

07/01/02

NOTE:
AMENITIES AND MATERIALS PALETTE FOR BASINS AND CHANNEL CORRIDOR IN TOLLESON
TO BE COORDINATED WITH THE CITY OF TOLLESON VAN BUREN ROAD STREETSCAPE
IMPROVEMENT PROJECT.



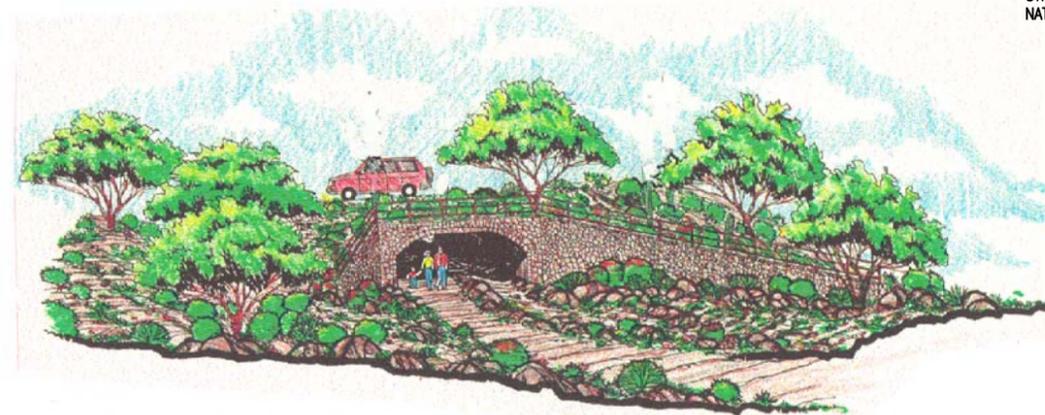
TYPICAL DURANGO REGIONAL OUTFALL BASIN AND CHANNEL



TYPICAL DURANGO REGIONAL OUTFALL CHANNEL

NOTE:
SLOPES AND GRADING FOR CHANNELS AND BASINS
SHOULD BE ROUNDED AND SHOULD VARY AND
UNDULATE TO CREATE A NATURAL APPEARING
LANDFORM.
BASINS SHOULD BE DESIGNED WITH MULTIPLE LEVELS
INCLUDING A LOW FLOW CHANNEL TO MAXIMIZE
USABILITY FOR VARIOUS RECREATION ACTIVITIES.

STRUCTURES FACED WITH
NATURAL MATERIALS

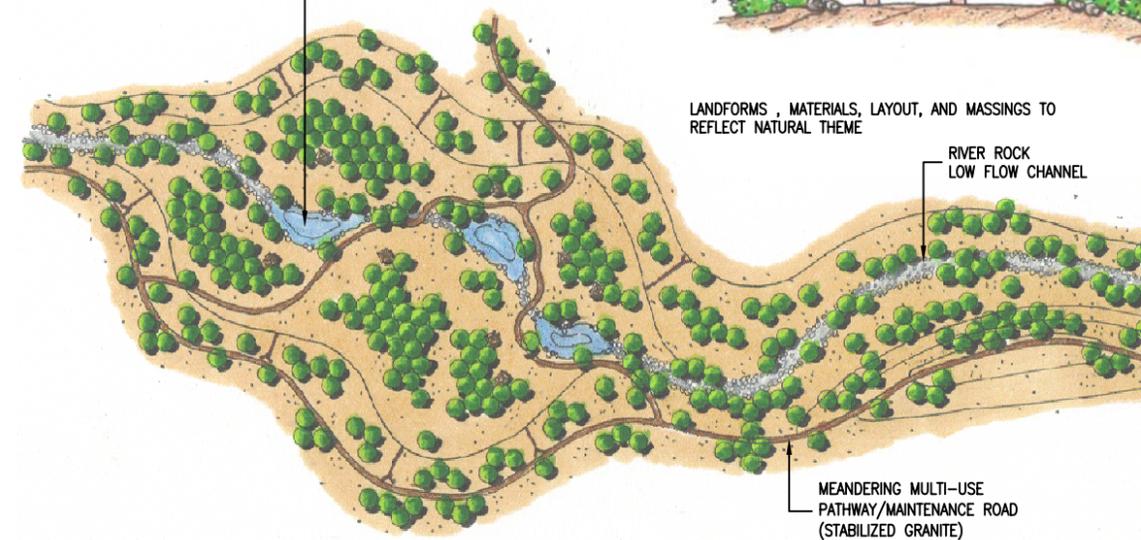


NATURAL THEME

INCORPORATE NATIVE AMERICAN THEME
AMENITIES



PERMANENT WATER FEATURES
MAY BE INCORPORATED



TRANSITIONS TO RIVER AREAS

07/01/02

PROJECT TITLE:	DURANGO AREA DRAINAGE MASTER PLAN PROJECT NO. FCD 99-41
CONSULTANT:	McCloskey • Peltz, Inc. LANDSCAPE ARCHITECTS
EXHIBIT TITLE:	RECOMMENDED PLAN LANDSCAPE CHARACTER

FIGURE VI-5

VII. ENVIRONMENTAL & PERMIT ISSUES

A. Introduction

This section describes the environmental issues that may impact project implementation and identifies permits and approvals that may be required.

B. Ecological Assessment

At least 95% of the Durango project area has been disturbed by human activities and have allowed non-native plant and animal species to dominate the area. Little biological resource value is recognized in this area. The area, historically, has been used for agriculture. Currently, it is mostly comprised of urban, industrial and agricultural uses with very few areas still consisting of Sonoran Desert habitat. Undisturbed areas that still exist are chiefly in and adjacent to floodplains. The native vegetation in the Durango area is limited, but small areas of riparian zones still exist along the Gila, Salt, and Agua Fria Rivers. Portions of Agua Fria, Gila, and Salt River riparian forests as well as permanent and intermittent aquatic communities exist near these rivers. Vegetation communities typically consist of goodding willow, cottonwood, vine-mesquite grass, saltbush, red brome, bermuda grass, salt cedar, catclaw acacia, and ironwood. These areas provide potential habitat for several special interest species as well as several non-native terrestrial and aquatic species. Also, a constructed wetland associated with the City of Phoenix wastewater treatment plant exists along the Gila River beginning at 91st Avenue supported solely by the plant's discharge of treated effluent.

Four federally-listed species (lesser long-nosed bat, cactus ferruginous pygmy-owl, Yuma clapper rail, southwestern willow flycatcher) and five state-listed species (desert tortoise, western least bittern, western yellow-billed cuckoo, snowy egret, and great egret) may or are known to occur in the project area. All of these species are most likely to occur in aquatic communities or the adjacent riparian zones within the project area.

If possible, construction methods used during the Durango ADMP implementation (e.g. construction of diversion discharge points) within the banks of either of these river systems should strive to minimize impacts to the dense, mature riparian vegetation in these areas. Where impacts are unavoidable, plans should be in place to replace or mitigate for the removal of this type of vegetation. If construction activities would impact areas that contain suitable habitat for any of the four federally listed species, surveys should be conducted, using the proper protocol, to determine if federally listed species are present within the project areas. If federally listed species are found to be present, the District, or project sponsor, must consult with the U.S. Fish and Wildlife Service.

As currently planned, the only potential impacts to sensitive riparian habitats would occur with the construction of three of the four planned outfall structures. One of these three structures, the Buckeye Feeder Diversion channel, is planned to intersect the Agua Fria River. Two other outfall structures, the 47th Avenue and 91st Avenue channels, are designed to intersect the Salt/Gila River. In each case, a U.S. Army Corp of Engineers Section 404 Clean Water Act permit would likely be necessary if any dredging or filling is planned. The Corps' permit for these types of impacts would require mitigation for impacts to any mature riparian vegetation. Based on the current preliminary design plans there would be a small area of jurisdictional waters disturbed at each of the three proposed outfall sites, as noted in the project descriptions in Section V *Recommended Plan*, of this report. Therefore, replacement or compensatory mitigation for these impacts would be required, likely at a ratio of 1:1.

C. Cultural Resources

Prehistoric Hohokam culture has been documented in the Durango project area from 500-1,450 A.D. Development in the area has disturbed much of any surface evidence of the presence of prehistoric

people but subsurface features in the area may still exist. The Hohokam people farmed the area and constructed an elaborate canal system through the Salt River Valley including the Durango project area. After the Hohokam presence, Spanish, Mexican, and Anglo factions began to occupy the area in the 18th century.

Within the project area, 30 prehistoric sites, including villages and artifact scatters, were identified during a literature search conducted for this project. Approximately five other sites were identified as historic, including two canal segments, a farmhouse, and two well sites. Specific site locations are identified in Section V of the *Data Collection Report* under separate cover for this study. During the alternative analysis process, the location of each of these cultural resource sites was considered when planning the drainage alignments. Where possible, alignments were chosen that would avoid these known cultural resource sites.

Because of the number and type of prehistoric sites present in the project area, it may not be possible to avoid impacting a small number of previously recorded prehistoric sites. Because of the nature of the data available, and the fact that the boundaries of many of the prehistoric sites have not been accurately defined, it is unclear if any of the proposed alignments will impact any prehistoric sites. According to the available data, it appears that the Buckeye Feeder Diversion Basin #3 proposed location is in the vicinity of what has been recorded as the Fowler Ruin, a pre-historic Hohokam village site originally documented in the 1920's. All prehistoric site locations, including the Fowler Ruin, are described and depicted in Section V of the *Data Collection Report*. An archeological inventory was conducted of the proposed basin location in April, 2001 by Scientific Archaeological Services. Results of that survey indicate that there is no surface expression of any archeological sites within that project's area and that no further work is recommended.

It is recommended that construction monitoring be implemented during any excavation activities to avoid impacts to any unknown buried prehistoric features.

Impacts to any of the historic train station, highway, or canal sites that may be within or adjacent to the proposed alignments should be avoided where possible. The currently proposed alignments and basin locations would not impact any of these known historic sites. If alignments shift, impacts would have to be re-evaluated based on information in the *Data Collection Report*. An extensive archaeological survey of the finalized project routes is recommended to accurately identify any historic sites that may be present.

D. Environmental Permits & Approvals

The recommended plan will require a Clean Water Act 404 Nationwide Permit (NWP), issued by the Army Corps of Engineers (CORPS), where projects impact jurisdictional waters of the U.S. Approval must be obtained in order to fill or impact jurisdictional waters. The recommended plan includes three outfall structures within riparian zones associated with jurisdictional waters. It is likely that the Corps will allow the construction of the proposed outfall structures under a Nationwide Permit for “Stormwater Management Facilities” (NWP #43) as long as impacts at each structure equal less than 0.5 acres. Mitigation for these impacts may also be required, probably at a ratio of 1:1. The Arizona Department of Environmental Quality (ADEQ) state water quality certification of jurisdictional waters is pre-certified for nationwide permit applications under Section 401 of the Clean Water Act. A National Pollutant Discharge Elimination System (NPDES) construction permit will also be required in order to construct this flood control facility. This project plans to discharge storm water to the Gila, Salt, and Agua Fria Rivers therefore a municipal NPDES permit will be required to utilize the outfalls. In this case, the FCDMC may be able to apply for a municipal application or if it already has one, may be able to include this in a system-wide or jurisdiction-wide municipal permit.

This project would impact rights-of-way and canals maintained by SRP and RID. As currently designed, the project plans to cross and modify SRP’s BFC and cross an RID canal. SRP will require that the project coordinate with the existing systems of pipes, canals, and access roads to assure that no negative impacts occur to SRP or RID operations. The project would also require each organization’s permission in order to impact canal or irrigation structures. The project would also be required to follow UPRR Drainage Modifications Procedures in order to obtain permission for drainage and waterway encroachment on railroad property/right-of-way.

Other interagency cooperation necessary for project completion will include: the City of Phoenix, City of Tolleson, City of Avondale, Maricopa County Department of Transportation (MCDOT), Maricopa County Recreation Services Department (MCRSD), Maricopa County Planning and Development Department, and the Arizona Department of Water Resources. Cooperation with each of these agencies/stakeholders will be required to obtain specific information/requirements regarding construction techniques, flooding issues, surface water rights, and existing and planned projects.

E. Potential Environmental Contamination

Environmental regulatory databases from federal, state, and local agencies were reviewed to document the type and location of any regulated sites within the project area. The database review documented 405 listed regulatory sites within the project area. Listing of a site on the environmental regulatory records, however, does not mean the site is adversely affecting human health or the environment. The regulatory sites that are near the proposed flood control projects in this report are listed in the following table. Database site types are explained in detail in the *Data Collection Report* and are indicated in the table, and in the design drawings, by site code.

Site Code	Site Type (refer to Data Collection Report for more details)	Hazardous Waste Sites (according to Site #) identified by a number and a hexagon on design drawings
CERCLIS-NFRAP	Comprehensive Environmental Response, Compensation, and Liability Information System - No Further Remedial Action Planned	#225, #226, #240
ERNS	Emergency Response Notification System	#397
RCRIS-SQG	Resource Conservation and Recovery Information System	#306, #225, #347, #240, #250, #397
HWS	ZipAcids	#226, #250
FINDS	Facility Index System/Facility Identification Initiative Program Summary Report	#306, #305, #225, #116, #347, #389, #240, #250, #397
LUST	Leaking Tank Listing	#308, #310, #304, #311, #221, #217, #392, #397
AZ_SPILL	Hazardous Material Logbook	#117, #345, #250, #404
RCRIS-LQG	Resource Conservation and Recovery Information System	#305
UST	Underground Storage Tank Listing	#308, #310, #304, #307, #311, #221, #217, #390, #392, #405, #397
WWFAC	Waste Water Treatment Facilities	#397
DRY WELL	Drywell Registration	#214, #250

Prior to construction, these sites should be located and assessed regarding their proximity to proposed construction activities. The currently proposed alignments would not impact any potential environmental contamination sites. However, if alignment shifts occur

prior to construction and there are any contaminated sites that conflict with the proposed route such as contaminated soils sites due to leaking storage tanks, for example, these sites should be documented and avoided if possible.

F. Social and Economic Issues

Social and economic issues were considered in this project. As evidenced by the data presented in the *Data Collection Report*, there are no specific groups unfairly targeted by the project's location. The specific type of groups researched for this study include: income range, age, and ethnic background.

VIII. IMPLEMENTATION PLAN

A. Introduction

This Section contains recommendations for funding, cost sharing, budgetary and construction phasing for the recommended projects identified in Section V.

B. Construction Phasing

For budgeting purposes, capital improvements must be prioritized and constructed in phases as funding permits. To identify phasing of capital improvements, three priority categories are used. Priority 1 projects are current needs that should be constructed as soon as possible to correct existing system deficiencies. Priority 2 projects are projects that should be budgeted now for construction over the next five years and are needed to accommodate the anticipated development over the next five years. Priority 3 projects are improvements that are not needed within the next five years but will be needed as development occurs. Construction scheduling of priority 3 projects will be dictated by development timing and patterns.

Priorities were assigned for each project by the Review Committee at the Review Committee Meeting held on January 23, 2001. The assigned priorities will act as a guide to the relative urgency of the storm drainage improvements and will form the basis for developing project funding and Capital Improvement Program (CIP) budgets. It is recognized that the priorities will be subject to revision for various reasons during project implementation. For instance, in the next few years changes in development patterns may occur within the study area. The current financial obligations of government agencies or that of land developers may also vary. Further, as scheduling of roadway construction in the area becomes clearer, significant savings may be achieved by coordinating box culvert and channel construction with that of the roads or highways.

Figure VIII-1 illustrates Priority No. 1, 2, and 3 projects. **Table 2** summarizes each of the master plan projects and their construction costs.

1. Durango Regional Conveyance System

The Durango Regional Conveyance Channel and Basins were identified by the Review Committee as Priority 1 projects. Advanced land acquisition for all basins is also identified as Priority 1. If basin sites are not acquired quickly, the opportunity to implement the plan may be lost, or modifications to the plan may need to be made.

Due to the length of the Durango Regional Conveyance Channel and the need to construct the channel segments from downstream to upstream, it is important to quickly obtain cooperation between the multiple land owners, developers, and jurisdictions. Additionally construction phasing will be required based on available funding and other projects which are proceeding immediately. The first phase of the project is expected to be Reach 1, the portion between the outfall at the Agua Fria River and 107th Avenue, which is within the City of Avondale. The second phase of the project is expected to be Reach 2, the portion between 107th Avenue and 75th Avenue, which is within the City of Phoenix. The third and last phase of the system is expected to be Reach 3, the portion between 75th Avenue, and 63rd Avenue, which is within the City of Phoenix. A potential modification to this phasing is described below with the *75th Avenue Preliminary Storm Drain Study*.

A portion of Reach 1 may be constructed in conjunction with new developments within the Lakin Cattle Company property currently being master planned for residential and commercial development. A portion of Reach 2 may be constructed in conjunction with the Tuscano development at 75th Avenue and Lower Buckeye Road as well as improvements to the Country Place development at 99th Avenue and Lower Buckeye Road. A portion of Reach 3 may be constructed in

conjunction with a City of Phoenix Storm Drain project along 75th Avenue as described below.

75th Avenue Preliminary Storm Drain Study

The concept of incorporating the 75th Avenue City of Phoenix Storm Drain project into a portion of the ADMP was developed to determine the feasibility of an interim drainage concept that beneficially utilizes the proposed City of Phoenix storm drain to allow implementation of certain features of the Durango ADMP prior to completion of the ultimate system outfall at the Agua Fria River. This analysis concludes that DRC basin #4 could be up sized and the flow-by channel along the basin could be redirected to a lateral storm drain that connects to the proposed City of Phoenix storm drain system, thus assisting in implementing a portion of the ADMP and still alleviating local flooding problems. A copy of the 75th Avenue Preliminary Storm Drain Study can be found in **Appendix H**.

2. Durango Regional Outfall System

The Durango Regional Outfall Channel, Basins and Laterals were identified by the Review Committee as Priority 1 projects. Advanced land acquisition for all basins is also identified as Priority 1. If basin sites are not acquired quickly, the opportunity to implement the plan may be lost, or modifications to the plan may need to be made.

3. Sunland Avenue System

The Sunland Avenue Channel was identified as a replacement to the previously identified "91st Avenue Channel" because it better accomplished the task of alleviating the floodplain. The 91st Avenue Channel was previously identified as a Priority 2 project by the Review Committee and as such the Sunland Avenue System is designated a Priority 2 project.

4. 47th Avenue System

The 47th Avenue Channel and Basin were identified by the Review Committee as Priority 3 projects. These projects are noted to be of low importance by the City of Phoenix due to the industrial nature of the area and the lack of prior flooding reported in this area.

5. Tres Rios System

The Tres Rios Basins were identified by the Review Committee as Priority 2 projects. The Tres Rios Basins should be constructed concurrently with the proposed Tres Rios levee. The Tres Rios Basins would not be needed without the proposed Tres Rios levee in place.

C. Project Funding

The projects identified in this master plan are recommended within the context of the existing development and environmental conditions of the study area as of this writing. The Durango ADMP area is developing at a rapid pace. Basin sites and channel alignments have been proposed based on perceived availability of those sites based on recent aerial photographs, field reconnaissance, and development planning information provided by the Cities and County staff. For this plan to become a reality, steps must be taken by each of the project participants to begin acquisition of needed right-of-way and to develop implementation plans. This section presents funding options to assist with the timely implementation of the adopted plan.

1. Estimated Costs

The total estimated cost of each of the projects identified in Section V is summarized in **Table 2**. The estimated costs are broken down according to the following:

- Land acquisition cost
- Landscape cost
- Construction cost
- Construction contingency at 15 percent of construction cost.
- Design and construction management cost at 15 percent of construction cost
- Total estimated cost, and
- Estimated annual maintenance cost.

Major cost items included in the channel cost estimates are excavation, concrete, utility relocations, maintenance roads, land acquisition, and landscape. The current FCDMC policy allows landscape cost of up to \$0.92 per square foot for which they will share the expense up to 50%. This allowed cost is approximately half of the \$1.80 per square foot cost estimated in this study, resulting in the FCDMC paying 1/4 of the total landscape cost as estimated. Utility relocation costs are computed separately and included in the table as a lump sum per project. Land acquisition costs are included only for new facilities and are based on required right-of-way widths.

Culvert costs are based on the length, number of barrels and size for each crossing and includes inlet and outlet headwalls.

Detention basin costs include basin excavation, outlet headwall and drain pipe with manholes, inflow spillway, land acquisition, and landscape.

A detailed breakdown of the estimated cost for each project is contained at the end of the report on the page facing the exhibits showing the project elements and I.D. descriptors.

2. Funding Sources

a. FCDMC CIP Process

The FCDMC participates in the planning, design, and construction of flood control projects throughout Maricopa County. The FCDMC follows an annual process of project prioritization to identify projects for their CIP program. The process of getting a project or projects funded by the FCDMC begins with a sponsoring agency, such as a City, submitting a project request to the FCDMC. The FCDMC includes projects requested by their constituent Cities in the prioritization process. Factors that are considered favorably in the prioritization are whether the project has been recommended in an adopted FCDMC Drainage Master Study, the level of cost participation offered by the City, and who will provide ongoing maintenance of the facility. Projects

are seldom selected for the CIP budget with no cost sharing. The FCDMC typically seeks a 50 percent level of cost participation.

b. Project Participants

The development of this master plan has been a cooperative effort between many agencies and local interests within the study area. The agencies have been involved throughout the project with an eye towards developing a plan that will be consistent with the ongoing development plans within the area and will be accepted by the local interests. The following agencies have an interest in the area and will benefit from implementation of the plan:

- City of Phoenix
- Maricopa County Department of Transportation (MCDOT)
- City of Tolleson
- City of Avondale
- Salt River Project (SRP)
- U.S. Army Corps of Engineers (Tres Rios)
- Flood Control District of Maricopa County (FCDMC)
- Multiple Private Developers

Projects where shared benefits may accrue to the above agencies are identified in Section V, *Recommended Plan*. It is anticipated that as a result of the information contained in this *Recommended Design Report*, a concept for shared project participation can be agreed upon between the agencies.

City of Phoenix

The City of Phoenix is expected to share a significant portion of the cost of the Durango Regional Conveyance System. The City has planned improvements for a storm drain system in 75th Avenue which could be integrated into this overall ADMP. Additionally, the City would be responsible for partial construction costs based on an agreement to be developed with the FCDMC.

Maricopa County Department of Transportation (MCDOT)

MCDOT is currently planning improvements to 115th Avenue between Interstate 10 and Buckeye Road. A box culvert is expected to be constructed across 115th Avenue for the Durango Regional Outfall Channel and will be cost-shared with the FCDMC.

City of Tolleson

The City of Tolleson is expected to share a portion of the cost of the Durango Regional Outfall Project. The City has submitted the project to the FCDMC CIP budget. The City would be responsible for partial construction costs based on an agreement developed with the FCDMC.

City of Avondale

The City of Avondale is expected to share a portion of the cost of the Durango Regional Outfall Project and the Durango Regional Conveyance System. The City has submitted the projects to the FCDMC CIP budget. The City would be responsible for partial construction costs based on an agreement developed with the FCDMC.

Salt River Project (SRP)

SRP is expected to share a portion of the cost of the Durango Regional Conveyance System by donating existing right-of-way from the BFC.

Flood Control District of Maricopa County (FCDMC)

The FCDMC is expected to share 50% of the cost of each of the projects identified in the Recommended Plan, including land acquisition, design, construction, and landscaping. The District will only proceed with the recommended projects based on requests from the associated local municipalities. The District will pursue Letters of Intent (LOI), Memorandums of Understanding (MOU), and Inter-Governmental Agreements (IGA) with the local municipalities to form an agreement regarding construction of any of the projects.

c. Developer Participation

Land Developers that would be impacted by components of the ADMP would benefit by participating in partial cost-sharing of the recommended projects. By participating in the regional plan, developers will have a drainage solution which will help solve many of the local drainage problems for development in the area. One method of cost-sharing is by donating right-of-way in exchange for easing of the retention requirements that would normally be part of any development. For example, a developer would normally be required to retain the 100 yr, 2 hour storm runoff in retention. By donating right-of-way for the ADMP project, the developer may only be required to retain the “first flush” of runoff, and thereby discharge all other runoff directly into a regional channel or basin. As a result, more area is available to be developed. A developer may also receive impact fee credits if the value of donated land exceeds the amount that they would normally have to use for standard retention requirements. Developers should not receive credit for donated land that would already need to be utilized to meet on-site retention requirements.

Another method of developer participation is through partial construction of the regional drainage projects. For example, a developer could use the area that is proposed for a regional channel as a retention area until the channel is constructed. When the regional project is constructed, the retention areas would be graded into a continuous channel. Since a large portion of the excavation required for the channel will have been previously completed when the retention areas were constructed, a substantial cost savings could be realized.

d. Supplemental Funding Sources

A variety of supplemental funding sources may be available to implement portions of the environmental, landscape, aesthetic, and multi-use components of this project. The possible funding sources identified below have not been included in the preliminary allocation of funding.

Development Fees - Opportunity to develop parks recreational open space as development occurs.

Community Facility Districts - Opportunity for municipalities to plan, construct, operate and maintain infrastructure including recreational open spaces

Improvement Districts - Opportunity for the county or municipality to develop park and recreational areas.

General Obligation Bonds - Opportunity for the county or municipalities to develop their multi-use trails and associated amenities.

Conservation and Reinvestment Act (CARA) - Opportunity to develop multi-use and multi-modal trails and environmental education and multi-use facilities

Contacts: Maricopa Association of Governments (MAG)- trails
Arizona Game and Fish -Teaming with Wildlife Program

Arizona Heritage Fund / Trail Heritage Funds - Opportunity for the FCD and municipalities for wildlife habitat enhancement, public education and awareness, and for non motorized trails acquisition.

Contacts: Arizona State Parks - trails
Arizona Game and Fish - wildlife habitat enhancement

The Design Arts Program - Opportunity to receive funding for projects that promote excellence in design, planning, architecture, and landscape.
Contact: National Endowment for the Arts

American Greenways Eastman Kodak Grant Program - Opportunity for a small grant to promote the development of multi-use trails and associated amenities.

Contact: The Conservation Fund, Arlington VA.

Federal Highway Administration, Department of Transportation - Opportunity for the county and municipalities to receive federal funding for developing their multi-use trails.

Contact: DOT Office of Environment and Planning, Wash. D.C.

Marshall Fund of Arizona - Opportunity for municipalities and non-profit organizations to partner for creative approaches to improving the quality of life through the development of multi-use trails, open spaces, and riparian preservation and enhancement.

Contact: Marshall Fund of Arizona

National Fish and Wildlife Challenge Grants - Opportunity for municipalities for wildlife preservation and habitat enhancement and public education opportunities.

Contact: National Fish and Wildlife Foundation, Wash, D.C.

National Park Service, Department of the Interior - Opportunity for the county and municipalities to develop multi-use trails.

Contact: Recreation and Conservation, National Park Service

National Trails Endowment - Opportunity for municipalities to work with organizations for which foot trails are a primary focus to develop low impact trails.

Contact: American Hiking Society, Silver Spring MD.

PowerBar Direct Impact on Rivers and Trails (DIRT) - Opportunity for municipalities to partner to develop multi-use trails.

Contact: Dirt Program, Berkeley CA.

Recreation Improvement Fund (RIF)Grants and Recreation Trails Program Grants - Opportunity for municipalities for the development of multi-use trails and related facilities.

Contact: Forest Management Division, RIF

Transportation Equity Act TEA-21 Transportation Enhancement Funding - Opportunity for the county and municipalities to develop multi-use and multi-modal transportation systems.

Contact: Maricopa Association of Governments (MAG)

3. Projected Expenditures

A preliminary phased cost sharing program is presented in Tables 3, 4, and 5. **Table 3** shows projected project expenditures over the next 9 years broken down by project and type of cost. **Table 4** shows a cost sharing plan between the project participants for participants with shared interests in each project. **Table 5** shows the resulting projected cost per year for each agency through project completion. **Table 5** also shows projected revenues by year for each agency that have been identified to date. The fund balance shows the cumulative overage/shortfall on an annual basis throughout project implementation. **Table 5** shows that additional funding needs to be identified by every project participant to complete the project. Based on the cost sharing arrangement and the phased implementation costs, the participating

agencies can incorporate project costs into their capital improvement programs.

D. Key Success Factors

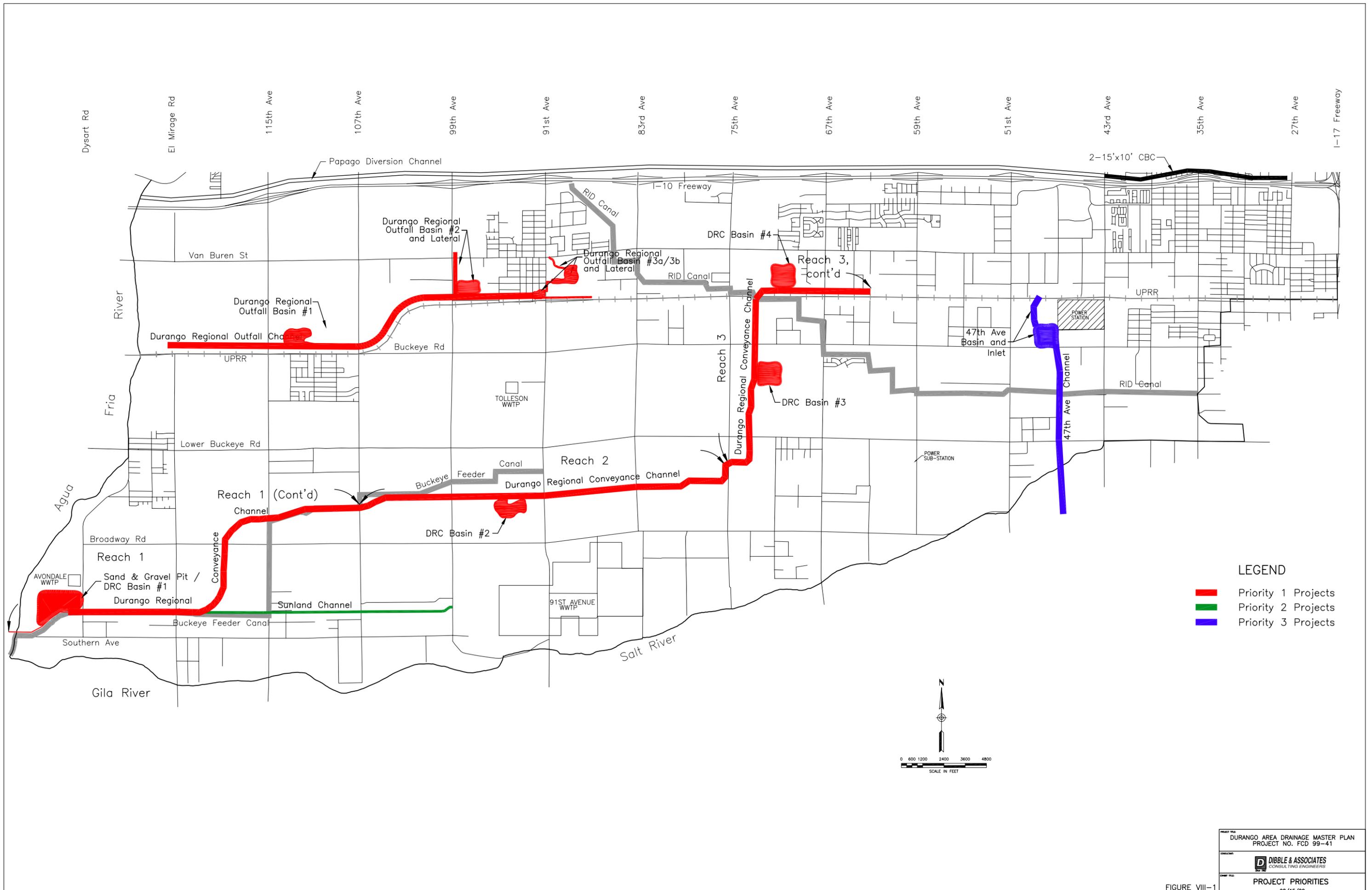
The following issues were identified at Review Committee Meeting #4 as being key to the success of the project implementation:

- Pass a resolution for cities and county to adopt the plan (and add to general plan)
- Coordination with developers
- Advanced land acquisition
- Agreements with cities
- Identify funding sources

It is recommended that action plans be developed between the participating agencies to address the key success factors immediately upon completion of this report.

Table 2 - Recommended Plan Estimated Costs

Project	Land Acquisition	Landscaping (FCD Policy)	Construction	Construction Contingency (15%)	Design & CM (15%)	Base Total	Landscaping Enhancements	Total w/ Landscaping Enhancements
Durango Regional Conveyance Channel	\$12,238,407	\$11,125,824	\$21,594,878	\$3,239,232	\$3,239,232	\$51,437,572	\$11,125,824	\$62,563,396
Durango Regional Conveyance Basin #1	\$6,468,660	\$5,880,600	\$1,305,459	\$195,819	\$195,819	\$14,046,357	\$5,880,600	\$19,926,957
Durango Regional Conveyance Basin #2	\$2,069,971	\$1,881,792	\$851,392	\$127,709	\$127,709	\$5,058,572	\$1,881,792	\$6,940,364
Durango Regional Conveyance Basin #3	\$712,846	\$648,042	\$356,826	\$53,524	\$53,524	\$1,824,762	\$648,042	\$2,472,804
Durango Regional Conveyance Basin #4	\$1,261,389	\$1,146,717	\$850,448	\$127,567	\$127,567	\$3,513,688	\$1,146,717	\$4,660,405
DRCC System Total						\$75,880,951		\$96,563,926
Durango Regional Outfall Channel	\$3,428,229	\$3,059,030	\$4,543,878	\$681,582	\$681,582	\$12,394,301	\$3,059,030	\$15,453,331
Durango Regional Outfall Basin #1	\$1,595,603	\$1,450,548	\$1,151,020	\$172,653	\$172,653	\$4,542,476	\$1,450,548	\$5,993,024
Durango Regional Outfall Basin #2 and Lateral	\$1,740,386	\$1,582,169	\$1,477,252	\$221,588	\$221,588	\$5,242,983	\$1,582,169	\$6,825,152
Durango Regional Outfall Basins #3a/3b and Lateral	\$1,522,929	\$1,384,481	\$1,542,010	\$231,301	\$231,301	\$4,912,022	\$1,384,481	\$6,296,503
DROP System Total						\$27,091,782		\$34,568,010
Sunland Avenue Channel	\$1,859,630	\$1,690,573	\$2,236,539	\$335,481	\$335,481	\$6,457,703	\$1,690,573	\$8,148,276
Sunland Avenue System Total						\$6,457,703		\$8,148,276
47th Ave Channel	\$1,689,932	\$1,536,302	\$3,393,831	\$509,075	\$509,075	\$7,638,214	\$1,536,302	\$9,174,515
47th Ave Basin and Inlet	\$2,089,886	\$1,899,896	\$3,088,042	\$463,206	\$463,206	\$8,004,237	\$1,899,896	\$9,904,133
47th Avenue System Total						\$15,642,450		\$19,078,648
Base ADMP Total						\$125,072,887		
Total Landscape Enhancements							\$33,285,974	
ADMP Total w/ Landscape Enhancements								\$158,358,861



LEGEND

- █ Priority 1 Projects
- █ Priority 2 Projects
- █ Priority 3 Projects

FIGURE VIII-1

PROJECT TITLE	DURANGO AREA DRAINAGE MASTER PLAN PROJECT NO. FCD 99-41
CONSULTANT	D DIBBLE & ASSOCIATES CONSULTING ENGINEERS
DATE	PROJECT PRIORITIES 08/15/02

Capital Expenditures	Cost	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13
DRCC - Reach 1											
Land Acquisition	\$6,119,315		\$6,119,315								
Design	\$852,677		\$852,677								
Construction/Conting./C.M.	\$13,927,065			\$13,927,065							
FCD Policy Landscape	\$5,563,013				\$5,563,013						
Landscape Enhancements	\$5,563,013				\$5,563,013						
DRCC - Reach 2											
Land Acquisition	\$4,074,396		\$4,074,396								
Design	\$487,036				\$487,036						
Construction/Conting./C.M.	\$7,954,924				\$7,954,924						
FCD Policy Landscape	\$3,703,997						\$3,703,997				
Landscape Enhancements	\$3,703,997						\$3,703,997				
DRCC - Reach 3											
Land Acquisition	\$2,044,696		\$2,044,696								
Design	\$279,902			\$279,902							
Construction/Conting./C.M.	\$4,571,736				\$4,571,736						
FCD Policy Landscape	\$1,858,814				\$1,858,814						
Landscape Enhancements	\$1,858,814				\$1,858,814						
DRC Basin 1											
Land Acquisition	\$6,468,660		\$6,468,660								
Design	\$97,909		\$97,909								
Construction/Conting./C.M.	\$1,599,188		\$1,599,188								
FCD Policy Landscape	\$5,880,600				\$5,880,600						
Landscape Enhancements	\$5,880,600				\$5,880,600						
DRC Basin 2											
Land Acquisition	\$2,069,971		\$2,069,971								
Design	\$63,854				\$63,854						
Construction/Conting./C.M.	\$1,042,955				\$1,042,955						
FCD Policy Landscape	\$1,881,792						\$1,881,792				
Landscape Enhancements	\$1,881,792						\$1,881,792				
DRC Basin 3											
Land Acquisition	\$712,846		\$712,846								
Design	\$26,762		\$26,762								
Construction/Conting./C.M.	\$437,112			\$437,112							
FCD Policy Landscape	\$648,042				\$648,042						
Landscape Enhancements	\$648,042				\$648,042						
DRC Basin 4											
Land Acquisition	\$1,261,389		\$1,261,389								
Design	\$63,784		\$63,784								
Construction/Conting./C.M.	\$1,041,798		\$1,041,798								
FCD Policy Landscape	\$1,146,717				\$1,146,717						
Landscape Enhancements	\$1,146,717				\$1,146,717						
DRC System Base Total	\$75,880,951	\$14,685,172	\$10,706,421	\$15,685,877	\$12,416,545	\$15,758,192	\$4,746,952	\$1,881,792	\$0	\$0	\$0
Landscape Enhancements	\$20,682,975	\$0	\$0	\$0	\$7,357,773	\$7,739,414	\$3,703,997	\$1,881,792	\$0	\$0	\$0
DRC System Total w/ LS Enhancements	\$96,563,926	\$14,685,172	\$10,706,421	\$15,685,877	\$19,774,317	\$23,497,606	\$8,450,948	\$3,763,584	\$0	\$0	\$0
DRO Channel - Reach 1											
Land Acquisition	\$1,419,040		\$1,419,040								
Design	\$122,182		\$122,182								
Construction/Conting./C.M.	\$1,995,633			\$1,995,633							
FCD Policy Landscape	\$1,290,037				\$1,290,037						
Landscape Enhancements	\$1,290,037				\$1,290,037						
DRO Channel - Reach 2											
Land Acquisition	\$2,009,189		\$2,009,189								
Design	\$218,609		\$218,609								
Construction/Conting./C.M.	\$3,570,618				\$1,785,309						
FCD Policy Landscape	\$1,768,993				\$884,497						
Landscape Enhancements	\$1,768,993				\$884,497						
DRO Basin 1											
Land Acquisition	\$1,595,603		\$1,595,603								
Design	\$86,326		\$86,326								
Construction/Conting./C.M.	\$1,409,999			\$1,409,999							
FCD Policy Landscape	\$1,450,548				\$1,450,548						
Landscape Enhancements	\$1,450,548				\$1,450,548						
DRO Basin 2 & Lateral											
Land Acquisition	\$1,740,386		\$1,740,386								
Design	\$110,794		\$110,794								
Construction/Conting./C.M.	\$1,809,633			\$1,809,633							
FCD Policy Landscape	\$1,582,169				\$1,582,169						
Landscape Enhancements	\$1,582,169				\$1,582,169						
DRO Basin 3 & Lateral											
Land Acquisition	\$1,522,929		\$1,522,929								
Design	\$115,651		\$115,651								
Construction/Conting./C.M.	\$1,888,962				\$1,888,962						
FCD Policy Landscape	\$1,384,481				\$1,384,481						
Landscape Enhancements	\$1,384,481				\$1,384,481						
DRO System Base Total	\$27,091,782	\$6,931,520	\$5,860,775	\$7,471,743	\$5,943,248	\$884,497	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$7,476,228	\$0	\$1,450,548	\$2,872,206	\$2,268,977	\$884,497	\$0	\$0	\$0	\$0	\$0
DRO System Total w/ LS Enhancements	\$34,568,010	\$6,931,520	\$7,311,323	\$10,343,949	\$8,212,226	\$1,768,993	\$0	\$0	\$0	\$0	\$0
Sunland Avenue Channel											
Land Acquisition	\$1,859,630		\$1,859,630								
Design	\$167,740		\$167,740								
Construction/Conting./C.M.	\$2,739,760						\$2,739,760				
FCD Policy Landscape	\$1,690,573						\$1,690,573				
Landscape Enhancements	\$1,690,573						\$1,690,573				
Sunland Avenue System Base Total	\$6,457,703	\$0	\$0	\$0	\$0	\$0	\$2,027,370	\$4,430,333	\$0	\$0	\$0
Landscape Enhancements	\$1,690,573	\$0	\$0	\$0	\$0	\$0	\$0	\$1,690,573	\$0	\$0	\$0
Sunland System Total w/ LS Enhancements	\$8,148,276	\$0	\$0	\$0	\$0	\$0	\$2,027,370	\$6,120,905	\$0	\$0	\$0
47th Ave Basin & Lateral											
Land Acquisition	\$2,089,886		\$2,089,886								
Design	\$231,603							\$231,603			
Construction/Conting./C.M.	\$3,782,851								\$3,782,851		
FCD Policy Landscape	\$1,899,896									\$1,899,896	
Landscape Enhancements	\$1,899,896									\$1,899,896	
47th Ave Channel											
Land Acquisition	\$1,689,932							\$1,689,932			
Design	\$254,537								\$254,537		
Construction/Conting./C.M.	\$4,157,442										
FCD Policy Landscape	\$1,536,302										
Landscape Enhancements	\$1,536,302										
47th Avenue System Base Total	\$15,642,450	\$0	\$2,089,886	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$3,436,198	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
47th Ave System Total w/ LS Enhancements	\$19,078,648	\$0	\$2,089,886	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
TOTAL BASE EXPENDITURES	\$125,072,887	\$21,616,692	\$18,657,082	\$23,157,620	\$18,359,793	\$16,642,689	\$6,774,322	\$8,233,660	\$4,037,388	\$6,057,339	\$1,536,302
TOTAL LANDSCAPE ENHANCEMENTS	\$33,285,974	\$0	\$1,450,548	\$2,872,206	\$9,626,750	\$8,623,911	\$3,703,997	\$3,572,365	\$0	\$1,899,896	\$1,536,302
TOTAL ADMP w/ LANDSCAPE ENHANCEMENTS	\$158,358,861	\$21,616,692	\$20,107,630	\$26,029,826	\$27,986,543	\$25,266,599	\$10,478,319	\$11,806,024	\$4,037,388	\$7,957,235	\$3,072,604

Capital Expenditures	Cost	City of Phoenix - Impact Fees		City of Phoenix - CIP Budget		City of Avondale		City of Tolleson		FCDMC		MCDOT		Tres Rios		SRP		Developers	
		\$	%	\$	%	\$	%	\$	%	\$	%	\$	%	\$	%	\$	%	\$	%
DRC - Reach 1																			
Land Acquisition	\$6,119,315		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Design	\$852,677		\$0	\$0	\$0	50%	\$426,339	\$0	\$0	50%	\$426,339	\$0	\$0	\$0	33%	\$2,019,374	67%	\$4,099,941	\$0
Construction/Conting./C.M.	\$13,927,065		\$0	\$0	\$0	50%	\$6,963,533	\$0	\$0	50%	\$6,963,533	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FCD Policy Landscape	\$5,563,013		\$0	\$0	\$0	50%	\$2,781,507	\$0	\$0	50%	\$2,781,507	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$5,563,013		\$0	\$0	\$0	100%	\$5,563,013	\$0	\$0	0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DRC - Reach 2																			
Land Acquisition	\$4,074,396	50%	\$2,037,198	\$0	\$0	\$0	\$0	\$0	\$0	50%	\$2,037,198	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Design	\$487,036	50%	\$243,518	\$0	\$0	\$0	\$0	\$0	\$0	50%	\$243,518	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Construction/Conting./C.M.	\$7,954,924	50%	\$3,977,462	\$0	\$0	\$0	\$0	\$0	\$0	50%	\$3,977,462	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FCD Policy Landscape	\$3,703,997	50%	\$1,851,998	\$0	\$0	\$0	\$0	\$0	\$0	50%	\$1,851,998	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$3,703,997	100%	\$3,703,997	\$0	\$0	\$0	\$0	\$0	\$0	0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DRC - Reach 3																			
Land Acquisition	\$2,044,696		\$0	\$0	\$0	50%	\$1,022,348	\$0	\$0	50%	\$1,022,348	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Design	\$279,902		\$0	\$0	\$0	50%	\$139,951	\$0	\$0	50%	\$139,951	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Construction/Conting./C.M.	\$4,571,736		\$0	\$0	\$0	50%	\$2,285,868	\$0	\$0	50%	\$2,285,868	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FCD Policy Landscape	\$1,858,814		\$0	\$0	\$0	50%	\$929,407	\$0	\$0	50%	\$929,407	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$1,858,814		\$0	\$0	\$0	100%	\$1,858,814	\$0	\$0	0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DRC Basin 1																			
Land Acquisition	\$6,468,660		\$0	\$0	\$0	50%	\$3,234,330	\$0	\$0	50%	\$3,234,330	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Design	\$97,909		\$0	\$0	\$0	50%	\$48,955	\$0	\$0	50%	\$48,955	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Construction/Conting./C.M.	\$1,599,188		\$0	\$0	\$0	50%	\$799,594	\$0	\$0	50%	\$799,594	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FCD Policy Landscape	\$5,880,600		\$0	\$0	\$0	50%	\$2,940,300	\$0	\$0	50%	\$2,940,300	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$5,880,600		\$0	\$0	\$0	100%	\$5,880,600	\$0	\$0	0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DRC Basin 2																			
Land Acquisition	\$2,069,971	50%	\$1,034,986	\$0	\$0	\$0	\$0	\$0	\$0	50%	\$1,034,986	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Design	\$63,954	50%	\$31,927	\$0	\$0	\$0	\$0	\$0	\$0	50%	\$31,927	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Construction/Conting./C.M.	\$1,042,955	50%	\$521,477	\$0	\$0	\$0	\$0	\$0	\$0	50%	\$521,477	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FCD Policy Landscape	\$1,881,792	50%	\$940,896	\$0	\$0	\$0	\$0	\$0	\$0	50%	\$940,896	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$1,881,792	100%	\$1,881,792	\$0	\$0	\$0	\$0	\$0	\$0	0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DRC Basin 3																			
Land Acquisition	\$712,846		\$0	\$0	\$0	50%	\$356,423	\$0	\$0	50%	\$356,423	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Design	\$26,762		\$0	\$0	\$0	50%	\$13,381	\$0	\$0	50%	\$13,381	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Construction/Conting./C.M.	\$437,112		\$0	\$0	\$0	50%	\$218,556	\$0	\$0	50%	\$218,556	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FCD Policy Landscape	\$648,042		\$0	\$0	\$0	50%	\$324,021	\$0	\$0	50%	\$324,021	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$648,042		\$0	\$0	\$0	100%	\$648,042	\$0	\$0	0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DRC Basin 4																			
Land Acquisition	\$1,261,389		\$0	\$0	\$0	50%	\$630,694	\$0	\$0	50%	\$630,694	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Design	\$63,784		\$0	\$0	\$0	50%	\$31,892	\$0	\$0	50%	\$31,892	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Construction/Conting./C.M.	\$1,041,798		\$0	\$0	\$0	50%	\$520,899	\$0	\$0	50%	\$520,899	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FCD Policy Landscape	\$1,146,717		\$0	\$0	\$0	50%	\$573,359	\$0	\$0	50%	\$573,359	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$1,146,717		\$0	\$0	\$0	100%	\$1,146,717	\$0	\$0	0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DRC System Base Total	\$75,880,951		\$16,225,251	\$10,700,372	\$28,638,170	\$0	\$0	\$0	\$0	\$34,880,818	\$0	\$0	\$211,781	\$0	\$0	\$2,019,374	\$0	\$4,099,941	\$0
Landscape Enhancements	\$20,682,975																		
DRC System Total w/ LS Enhancements	\$96,563,926																		
DRO Channel - Reach 1																			
Land Acquisition	\$1,419,040		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Design	\$122,182		\$0	\$0	\$0	12%	\$14,662	\$0	\$0	40%	\$56,716	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Construction/Conting./C.M.	\$1,995,633		\$0	\$0	\$0	12%	\$239,476	\$0	\$0	50%	\$997,817	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FCD Policy Landscape	\$1,290,037		\$0	\$0	\$0	14%	\$180,605	\$0	\$0	50%	\$90,303	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$1,290,037		\$0	\$0	\$0	64%	\$825,623	\$0	\$0	0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DRO Channel - Reach 2																			
Land Acquisition	\$2,009,189		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Design	\$218,609		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Construction/Conting./C.M.	\$3,570,618		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FCD Policy Landscape	\$1,768,993		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$1,768,993		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DRO Basin 1																			
Land Acquisition	\$1,595,603		\$0	\$0	\$0	50%	\$797,801	\$0	\$0	50%	\$797,801	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Design	\$86,326		\$0	\$0	\$0	50%	\$43,163	\$0	\$0	50%	\$43,163	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Construction/Conting./C.M.	\$1,409,999		\$0	\$0	\$0	50%	\$705,000	\$0	\$0	50%	\$705,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FCD Policy Landscape	\$1,450,548		\$0	\$0	\$0	50%	\$725,274	\$0	\$0	50%	\$725,274	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$1,450,548		\$0	\$0	\$0	100%	\$1,450,548	\$0	\$0	0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DRO Basin 2 & Lateral																			
Land Acquisition	\$1,740,386		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Design	\$110,794		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Construction/Conting./C.M.	\$1,809,633		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FCD Policy Landscape	\$1,582,169		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$1,582,169		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DRO Basin 3 & Lateral																			
Land Acquisition	\$1,522,929		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Design	\$115,651		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Construction/Conting./C.M.	\$1,888,962		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FCD Policy Landscape	\$1,384,481		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Landscape Enhancements	\$1,384,481		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
DRO System Base Total	\$27,091,782		\$0	\$0	\$4,982,152	\$12,592													

TABLE 5 - PROJECTED COST VS. REVENUE

COST VS. REVENUES		03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	Total
City of Phoenix - Impact Fees	Project Cost	\$3,072,184	\$522,472	\$0	\$243,518	\$4,009,389	\$6,077,473	\$2,880,589	\$1,009,347	\$2,464,283	\$1,152,226	\$21,431,480
	Projected Revenues	\$620,000	\$682,000	\$750,200	\$825,220	\$907,742	\$998,516	\$1,098,368	\$1,208,205	\$1,329,025	\$1,461,928	\$9,881,203
	Fund Balance	(\$2,452,184)	(\$2,292,655)	(\$1,542,455)	(\$960,753)	(\$4,062,400)	(\$9,141,357)	(\$10,923,578)	(\$10,724,720)	(\$11,859,978)	(\$11,550,277)	(\$11,550,277)
City of Phoenix - CIP Budget	Project Cost	\$987,118	\$1,590,092	\$879,406	\$4,978,007	\$2,788,221	\$83,870	\$3,963,640	\$1,009,347	\$2,464,283	\$1,152,226	\$19,896,210
	Projected Revenues		\$700,000	\$11,000,000								\$11,700,000
	Fund Balance	(\$987,118)	(\$1,877,210)	\$8,243,384	\$3,265,378	\$477,157	\$393,286	(\$3,570,353)	(\$4,579,701)	(\$7,043,983)	(\$8,196,210)	(\$8,196,210)
City of Avondale	Project Cost	\$4,138,911	\$4,346,230	\$7,969,761	\$8,344,520	\$8,820,900	\$0	\$0	\$0	\$0	\$0	\$33,620,323
	Projected Revenues											\$0
	Fund Balance	(\$4,138,911)	(\$8,485,141)	(\$16,454,902)	(\$24,799,423)	(\$33,620,323)	(\$33,620,323)	(\$33,620,323)	(\$33,620,323)	(\$33,620,323)	(\$33,620,323)	(\$33,620,323)
City of Tolleson	Project Cost	\$1,854,185	\$0	\$4,170,725	\$5,240,602	\$1,326,745	\$0	\$0	\$0	\$0	\$0	\$12,592,256
	Projected Revenues											\$0
	Fund Balance	(\$1,854,185)	(\$1,854,185)	(\$6,024,910)	(\$11,265,511)	(\$12,592,256)	(\$12,592,256)	(\$12,592,256)	(\$12,592,256)	(\$12,592,256)	(\$12,592,256)	(\$12,592,256)
FCDMC	Project Cost	\$10,666,442	\$6,168,424	\$11,478,350	\$9,179,897	\$8,321,344	\$3,201,198	\$3,947,837	\$2,018,694	\$3,028,669	\$768,151	\$58,779,007
	Projected Revenues	\$1,075,000	\$2,350,000	\$4,100,000	\$3,450,000	\$2,000,000						\$12,975,000
	Fund Balance	(\$9,591,442)	(\$13,409,866)	(\$20,788,217)	(\$26,518,113)	(\$32,839,458)	(\$36,040,656)	(\$39,988,492)	(\$42,007,186)	(\$45,035,856)	(\$45,804,007)	(\$45,804,007)
MCDOT	Project Cost	\$12,218	\$199,563	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$211,781
	Projected Revenues											\$0
	Fund Balance	(\$12,218)	(\$211,781)	(\$211,781)	(\$211,781)	(\$211,781)	(\$211,781)	(\$211,781)	(\$211,781)	(\$211,781)	(\$211,781)	(\$211,781)
Tres Rios	Project Cost	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
	Projected Revenues											\$0
	Fund Balance	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
SRP	Project Cost	\$0	\$2,019,374	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$2,019,374
	Projected Revenues											\$0
	Fund Balance	\$0	(\$2,019,374)	(\$2,019,374)	(\$2,019,374)	(\$2,019,374)	(\$2,019,374)	(\$2,019,374)	(\$2,019,374)	(\$2,019,374)	(\$2,019,374)	(\$2,019,374)
Developers	Project Cost	\$885,635	\$5,261,475	\$1,531,583	\$0	\$0	\$1,115,778	\$1,013,959	\$0	\$0	\$0	\$9,808,430
	Projected Revenues											\$0
	Fund Balance	(\$885,635)	(\$6,147,110)	(\$7,678,693)	(\$7,678,693)	(\$7,678,693)	(\$8,794,471)	(\$9,808,430)	(\$9,808,430)	(\$9,808,430)	(\$9,808,430)	(\$9,808,430)
TOTAL PROJECT COST		\$21,616,692	\$20,107,630	\$26,029,826	\$27,986,543	\$25,266,599	\$10,478,319	\$11,806,024	\$4,037,388	\$7,957,235	\$3,072,604	\$158,358,861
TOTAL PROJECTED REVENUES		\$1,695,000	\$3,732,000	\$15,850,200	\$4,275,220	\$2,907,742	\$998,516	\$1,098,368	\$1,208,205	\$1,329,025	\$1,461,928	\$34,556,203
NET FUND BALANCE		(\$19,921,692)	(\$36,297,322)	(\$46,476,948)	(\$70,188,271)	(\$92,547,128)	(\$102,026,931)	(\$112,734,588)	(\$115,563,771)	(\$122,191,982)	(\$123,802,658)	(\$123,802,658)

IX. MAINTENANCE PLAN

A. Introduction

This section contains requirements anticipated for ongoing operation and maintenance for the Recommended Plan features.

B. Operation & Maintenance Guidelines

Through partnerships with the agencies involved, it is recommended that local jurisdictions be responsible for maintenance of the proposed channels and detention basins. Maintenance should be such that grass, earth, and other channel and basin linings reflect the “n” value as shown on the preliminary design plans.

Specific maintenance tasks should include but not be limited to:

- Yearly inspection of structures
- Routine landscaping maintenance, and
- Inspection/cleaning of facilities after major storm events.

C. Maintenance Costs

Based on information provided by the FCDMC, an average maintenance cost was interpolated to be \$0.025 per square foot of right-of-way per year. This cost was derived by comparing actual maintenance costs of existing channels and basins which are similar to the proposed ADMP channels in shape, size and landscaping. The annual maintenance costs for the recommended projects are shown in **Table 6**.

Table 6 - Recommended Plan Estimated Maintenance Costs

Project	Annual Maintenance
Durango Regional Conveyance Channel	\$275,868
Durango Regional Conveyance Basin #1	\$149,193
Durango Regional Conveyance Basin #2	\$32,670
Durango Regional Conveyance Basin #3	\$9,910
Durango Regional Conveyance Basin #4	\$17,424
DRCC System Annual Maintenance Total	\$485,065
Durango Regional Outfall Channel	\$75,208
Durango Regional Outfall Basin #1	\$19,602
Durango Regional Outfall Basin #2 and Lateral	\$36,385
Durango Regional Outfall Basins #3a/3b and Lateral	\$34,672
DROP System Annual Maintenance Total	\$165,867
Sunland Avenue Channel	\$41,568
Sunland Ave System Annual Maintenance Total	\$41,568
47th Ave Channel	\$37,860
47th Ave Basin and Inlet	\$24,086
47th Avenue System Annual Maintenance Total	\$61,947
ADMP Annual Maintenance Total	\$754,446

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