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# **CANDIDATE ASSESSMENT REPORT**

## **DURANGO REGIONAL CONVEYANCE CHANNEL**

### **Main Report and Appendices**

*Prepared for:*



**FLOOD CONTROL DISTRICT OF  
MARICOPA COUNTY  
2801 WEST DURANGO STREET  
PHOENIX, ARIZONA 85009**

**Contract FCD 2004C027**

*Prepared by:*

***Aspen***

Consulting Engineers

426 N. 44<sup>th</sup> Street, Suite 370  
Phoenix, Arizona 85008

**February 2006**

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## EXECUTIVE SUMMARY

This Candidate Assessment Report (CAR) describes baseline conditions, alternatives, and a recommended plan for the Durango Regional Conveyance Channel (DRCC) in Avondale and Phoenix, Arizona. This analysis with a recommended alternative developed to 10 percent design plans was done to further refine the DRCC project from the Durango Area Drainage Master Plan (ADMP) dated October 2002.

The proposed DRCC project is located approximately along the alignment of the Buckeye Feeder Canal (BFC), within the area encompassed by Lower Buckeye Road, Southern Avenue, 75<sup>th</sup> Avenue, and the Agua Fria River in Avondale and Phoenix. 107<sup>th</sup> Avenue is the boundary between Phoenix and Avondale in this area.

The Durango ADMP was developed by the Flood Control District of Maricopa County and is described in the report entitled "Durango Area Drainage Master Plan Recommended Design Report, FCD #99-41, Prepared for the Flood Control District of Maricopa County." This report describes a recommended flood control channel that would extend from 75<sup>th</sup> Avenue to the Agua Fria River along the basic alignment of the BFC. Also included was a tributary channel, referred to as the Sunland Channel, basically following the alignment of Sunland Avenue.

The area within the project location is historically agricultural, with some light residential development. This area is currently changing rapidly to an urban residential land use. The DRCC would 1) provide flood protection for existing flood-prone areas along the BFC and Sunland Avenue, 2) provide a regional drainage solution with opportunities for developer participation; and, 3) provide a regional corridor for recreational and aesthetic uses.

Since preparation of the original ADMP, development has occurred along the proposed DRCC alignment within the City of Phoenix between 75<sup>th</sup> Avenue and 107<sup>th</sup> Avenue. This development has used the area within the proposed DRCC alignment for retention according to normal requirements by the City of Phoenix. Other recent developments include the proposed 75<sup>th</sup> Avenue storm drain by the City of Phoenix, and development within the area proposed for a detention basin in the original ADMP. Development within the City of Phoenix has the potential for increasing discharges in Avondale. The purpose of this study is to revise and update the DRCC in light of these recent developments.

Baseline hydrologic conditions were assessed based on a reassessment of expected development conditions, installation of the 75<sup>th</sup> Avenue storm drain, and truncating the DRCC at 75<sup>th</sup> Avenue rather than continuing it upstream as in the original ADMP. The result was DRCC design discharges that were lower than those presented in the original ADMP.

Eight DRCC alternatives were evaluated:

1. 100-Year, 2-Hour Retention, Full DRCC
2. First Flush Retention, Full DRCC
3. 100-Year, 2-Hour Retention, Avondale DRCC
4. First Flush Retention, Avondale DRCC
5. Removed 95th Avenue Basin
6. 100-Year Phoenix Culverts, 100-Year 2-Hour Retention in Avondale
7. 10-Year Phoenix Culverts, 100-Year 2-Hour Retention in Avondale
8. 99th Avenue Storm Drain

All alternatives assumed future full development within the drainage area, and 100-year, 2-hour development retention except as otherwise described. In the above list of alternatives, "First Flush Retention" refers only to development adjacent to the DRCC. "Avondale DRCC" means the DRCC would be constructed in Avondale only. "Phoenix Culverts" means the existing retention basins along the DRCC alignment in Phoenix would be converted to detention basins by installing culverts at the DRCC alignment at major north-south streets.

The alternatives were evaluated in terms of hydrology, conceptual design, and cost. It was found that all alternatives would result in an increase in the 100-year discharge over existing conditions. The DRCC cost ranged from \$28,000,000 for Alternative 3 to \$73,000,000 for Alternative 2.

During the evaluation of alternatives the Cities of Avondale and Phoenix agreed that the 100-year discharge exiting Phoenix along the DRCC alignment would be limited to approximately 1,300 cfs. Alternatives 3 and 4 met this criterion but were deemed impractical because of the lack of regional drainage continuity with the City of Phoenix, and the potential for installing culverts at major arterials in Phoenix to provide flood access along the DRCC/BFC alignment. Therefore, although the Phoenix DRCC alignment is currently mostly developed, portions of the DRCC must be constructed in Phoenix.

Based on the evaluation of alternatives, the identified opportunities and constraints, and by agreement between the Cities of Avondale and Phoenix, the Recommended Plan for the DRCC consists of:

- The channel extending from 107<sup>th</sup> Avenue to the Agua Fria River in Avondale. The channel alignment generally follows the course of the BFC.
- A regional detention basin at approximately the 95<sup>th</sup> Avenue alignment and south of the DRCC/BFC/Development Drainage alignment in Phoenix.
- 10-Year culverts along the DRCC/BFC/Development Drainage alignment at major arterial streets in Phoenix.

The Recommended Plan also includes improvements to the tributary Sunland Channel between the DRCC and 91<sup>st</sup> Avenue. The DRCC/Sunland Channels would be landscaped earth with depth approximately 6 feet and 6:1 side slopes. Reinforced concrete box culverts would be installed at major arterials along the channels. The detention basin at the confluence with the Agua Fria River recommended in the original ADMP is included within the design.

Based on the 10 percent design, the DRCC cost would be \$52,886,000 not including the Sunland Channel. The Sunland Channel cost would be \$17,758,000.

The report includes an assessment of the potential effect of the I-10 Reliever Freeway and the South Mountain Freeway on the DRCC, an assessment of environmental considerations, an assessment of drainage needs and costs for new development in the absence of the DRCC, and a list of recommendations for future studies.

## 1 INTRODUCTION

This Candidate Assessment Report (CAR) describes baseline conditions, alternatives, and a recommended plan for the Durango Regional Conveyance Channel (DRCC) in Avondale and Phoenix, Arizona. This analysis with a recommended alternative developed to 10 percent design plans was done to further refine the project from the Durango ADMP dated October 2002.

### 1.1 PROJECT LOCATION

The proposed DRCC project is located approximately along the alignment of the Buckeye Feeder Canal (BFC) in Avondale and Phoenix (Figures 1.1 and 1.2, please note that all Figures are located in Appendix A). The DRCC alignment is located between Lower Buckeye Road and Southern Avenue, and between 75<sup>th</sup> Avenue in Phoenix and the Agua Fria River in Avondale. 107<sup>th</sup> Avenue is the boundary between Phoenix and Avondale at the DRCC/BFC alignment.

### 1.2 PROJECT OVERVIEW

The Durango Area Drainage Master Plan was developed by the Flood Control District of Maricopa County and is described in the report entitled "Durango Area Drainage Master Plan Recommended Design Report, FCD #99-41, Prepared for the Flood Control District of Maricopa County." This report, dated October 2002, was prepared by Dibble & Associates Consulting Engineers (Dibble, 2002). The report describes a recommended flood control channel that would extend from 75<sup>th</sup> Avenue to the Agua Fria River along the alignment shown in Figure 1.2. This alignment basically follows the alignment of the BFC. Also included was a channel along the alignment of the Sunland Channel, shown in Figure 1.2, the Sunland Channel is a tributary to the BFC. In the original Dibble (2002) report, the recommended DRCC Channel extended upstream (east) of 75<sup>th</sup> Avenue. The plan also included flood control channels north of the Southern Pacific Railroad and east of 51<sup>st</sup> Avenue. The portions upstream of 75<sup>th</sup> Avenue and north of the Southern Pacific Railroad are not included in this study.

### 1.3 PROJECT PURPOSE AND NEED

The area within the project location is historically agricultural, with some light residential development. Drainage is conveyed overland, or in irrigation canals designed for irrigation, not flood control. The primary irrigation conduits in the area are the BFC and the Sunland Channel. Flooding along these channels, which affects existing residential development, access, and agricultural land, results in a need for effective flood control in the area.

The Cities of Avondale and Phoenix are experiencing rapid urban growth in the project area. As development occurs, drainage patterns, peaks and volumes are affected. Each development is typically required to retain excess runoff, protect itself from flooding, and avoid increasing the flood damage potential for other property. Some of the developments are in the project area floodplain. Without a comprehensive drainage master plan, each development would be forced to address floodplain issues individually, with a resulting piecemeal drainage solution that may not have a consistent design strategy and may include features such as collector channels and spreader basins that would not be needed with a comprehensive drainage system that also improves flood conditions for existing development. The proposed development in the area results in a need for a comprehensive drainage plan. The purpose of the DRCC project is to provide a comprehensive drainage solution for the area drained by the BFC and Sunland Channel.

Since preparation of the DRCC master plan, development has occurred along the proposed DRCC alignment within the City of Phoenix between 75<sup>th</sup> Avenue and 107<sup>th</sup> Avenue. This development has used the area within the proposed DRCC alignment for retention according to normal requirements by

the City of Phoenix. As development occurs in the City of Phoenix, there is a concern that DRCC alignment discharges at 107<sup>th</sup> Avenue could be increased over those of existing conditions, possibly resulting in increased DRCC flow and associated costs within the City of Avondale. The City of Phoenix has designed and will be constructing a storm drain along 75<sup>th</sup> Avenue. This storm drain will collect flows from upstream of 75<sup>th</sup> Avenue that would otherwise have been delivered to the DRCC downstream of 75<sup>th</sup> Avenue, thereby altering the original DRCC plan presented by Dibble (2002). As a result of these issues, there is a need to update the DRCC master plan in terms of hydrology and design. The purpose of this study is to revise the DRCC master plan in view of these and other anticipated changes.

#### 1.4 PROJECT SCOPE

This study consists of a description of existing conditions within the DRCC drainage area, revised hydrologic modeling for existing conditions assuming the 75<sup>th</sup> Avenue storm drain is in place, assessment of probable future conditions within the drainage area, and development and evaluation of DRCC Project alternatives given the modified existing and future conditions. The study includes selection of a recommended plan based on cost, right-of-way considerations, and discussions with the two cities involved. There is an assessment of the potential effects of planned freeway construction within the drainage area, an evaluation of current versus previous ADMP hydrology (in the appendix), and an assessment of potential developer-related drainage improvements and costs in the event the DRCC is not constructed. This report includes 10 percent plans for the recommended plan, and recommendations for future studies.

The primary focus of the alternatives analysis is the DRCC exclusive of the Sunland Channel for the reason that the Sunland Channel is not affected by development activities that have occurred to date in the City of Phoenix. The Sunland Channel is included as an addition to the recommended plan using design discharges from the revised hydrologic analysis presented herein.

## 2 EXISTING CONDITIONS

### 2.1 DRAINAGE AREA DESCRIPTION

The DRCC drainage area drains approximately 17.7 square miles between the Agua Fria River and 75<sup>th</sup> Avenue, and between the Gila River and the Southern Pacific Railroad (SPRR) south of Van Buren Street (Figure 2.1). Approximately 5.8 square miles of the drainage area is in Avondale. The rest, 11.9 square miles, is in Phoenix. An additional area of 6 square miles (Figure 2.1) in the City of Phoenix partially drains into the DRCC drainage area through flow splits at street intersections. The majority of this area of 6 square miles drains either directly south into the Gila River, or directly west into the Agua Fria River, but some enters the DRCC drainage area across 75<sup>th</sup> Avenue and across the SPRR. This portion of the drainage area, since it drains only partially into the DRCC drainage area through flow splits, is referred to in this report as the DRCC extended drainage area.

The DRCC drainage area is very flat, dropping only 80 feet in the 7.9 miles between 75<sup>th</sup> Avenue and the Agua Fria River. Paved streets are situated approximately a mile apart running east-west and north-south in a checkerboard pattern. Past land use in the drainage area is agricultural, with some low-density residential development located primarily along the Southern Avenue alignment, and in the western portion of the drainage area.

Flow in the DRCC drainage area generally runs east to west in two main drainageways referred to in this report as the BFC and the Sunland Channel. The BFC, shown in Figure 2.2, is a large earthen irrigation drain ditch (See Figure 2.2 for general dimensions) owned and operated by the Salt River Project. Under current conditions the BFC begins approximately 1,300 feet upstream of 107<sup>th</sup> Avenue

between Lower Buckeye Road and Broadway Road, and runs west to 115<sup>th</sup> Avenue, where it turns south to a point approximately 1,200 feet north of Southern Avenue, then runs west to discharge into the Agua Fria River at about the Southern Avenue alignment. Although not designed for drainage, the BFC, being at the low point in the drainage area, carries stormwater runoff. The BFC capacity varies with location but is approximately 270 cfs.

The Sunland Channel is a wide, open swale with occasional earthen channels to convey flow. Earthen channels are approximately two feet deep, three feet wide at the bottom, and 12 feet wide at the top. Channel capacity is low, and most runoff travels westward overland to meet the BFC at 115<sup>th</sup> Avenue. 100-year floodplains for the BFC and Sunland Channel, from Dibble (2002), are shown in Figure 2.3.

## 2.2 DEVELOPMENT

During the past few years urban development, primarily medium-density residential, has been replacing the agricultural land use. Figure 1.2, based on an aerial photograph dated 11/29/2004, shows the level of development within the drainage area.

## 2.3 DRAINAGE FACILITIES

The BFC and Sunland Channel are the primary existing (pre-development) drainageways within the DRCC drainage area. These channels, as well as a series of smaller tributary channels, are designed to carry irrigation flow rather than stormwater flow. Figure 2.2 shows the location of existing drainage structures, and representative capacities of drainageways.

Recent development in Phoenix has constructed drainage facilities leading to the DRCC alignment, as well as retention basins within the developments and in the DRCC alignment. The retention basins in the DRCC alignment, which currently extend from 83<sup>rd</sup> Avenue to a point approximately 1,300 feet upstream of 107<sup>th</sup> Avenue, are drained by small culverts which release retained flows into one another along the alignment to be eventually discharged into the BFC. Thus, the DRCC alignment corridor within the City of Phoenix serves not only as a retention area for new development, but as a drainage conduit leading to the BFC channel just upstream of 107<sup>th</sup> Avenue. As development has occurred, the BFC has been replaced by an underground pipe that carries irrigation flow only.

## 2.4 HYDROLOGY

Hydrologic analysis for existing conditions was conducted by the Maricopa County Flood Control District in a hydrologic model developed in the year 2001 by Dibble (2001). The model is based on the HEC-1 flood hydrograph package by the U.S. Army Corps of Engineers. The HEC-1 package simulates runoff from an assumed rainfall pattern and physical drainage area characteristics. The drainage area is divided into a series of sub-basins. Simulated runoff hydrographs from the sub-basins are routed between sub-basins and added together to simulate the runoff response to a rainfall event based on the hydrologic and hydraulic parameters used as input to the model. The 100-year 6-hour and 100-year 24-hour storms are used by the FCDMC as design events. Whichever produces the greater peak runoff at any given point is considered the design storm.

The 2001 Dibble model, with the addition of the 75<sup>th</sup> Avenue Storm Drain, is considered to be the baseline model for existing drainage area conditions. The 75<sup>th</sup> Avenue storm drain is a proposed underground storm drain running beneath 75<sup>th</sup> Avenue from Van Buren Street to the Gila River. A detention basin located northeast of the intersection of 75<sup>th</sup> Avenue and the SPRR would collect and retain flows originating within the DRCC extended drainage area east of 75<sup>th</sup> Avenue and north of the SPRR. Discharge from this detention basin would go directly into the 75<sup>th</sup> Avenue storm drain. Inlets along 75<sup>th</sup> Avenue would provide additional sources of inflow to the 75<sup>th</sup> Avenue Storm Drain, as would

storm drain laterals entering from the east along the Buckeye and Lower Buckeye road alignments. Maximum capacity of this storm drain is approximately 280 cfs.

Table 2.1 shows peak discharges for the existing conditions model for selected concentration points along the BFC at major north-south streets. Discharges range from 68 cfs at 83<sup>rd</sup> Avenue to 1,610 cfs at El Mirage Road. The 75<sup>th</sup> Avenue Storm Drain has negligible effect on peak discharges downstream of 75<sup>th</sup> Avenue, but does not reduce the volume.

**Table 2.1 Existing Conditions Discharges along the Buckeye Feeder Canal Alignment within the DRCC Drainage area**

Concentration Point	Source: Dibble (2001)			Design Discharge with 75 <sup>th</sup> Avenue Storm Drain in Place, in cfs
	100-Year, 24-Hour Discharge, in cfs	100-Year, 6-Hour Discharge, in cfs	Design Discharge, in cfs	
83 <sup>rd</sup> Avenue	61	68	68	66
91 <sup>st</sup> Avenue	465	602	602	602
99 <sup>th</sup> Avenue	695	711	711	711
107 <sup>th</sup> Avenue	1,141	1,193	1,193	1,193
115 <sup>th</sup> Avenue	1,171	1,199	1,199	1,185
El Mirage Road	1,610	1,465	1,610	1,610

Discharges upstream of 107<sup>th</sup> Avenue are along the alignment for the proposed DRCC.  
\* CFS = Cubic Feet per Second.

### 3 FUTURE CONDITIONS

#### 3.1 DRAINAGE AREA DESCRIPTION

The drainage area for future conditions is the same as for existing conditions. Under future conditions the existing agricultural uses would likely be replaced by mostly residential development. The BFC would likely be placed in an underground drain for irrigation flow, and drainage would be conveyed along a similar alignment as the BFC in a conveyance channel such as the DRCC. Streets would be improved, and convey much of the drainage tributary to the DRCC.

#### 3.2 DEVELOPMENT

Figure 2.1 shows the potential level of future development based on land use designations. In addition to the existing development shown in Figure 1.2, four developments along the DRCC alignment are planned or currently under review. Three of these, referred to as Lakin, Silver Bullet, and Shadow Ridge, are in Avondale. The fourth, Lion's Gate, is in Phoenix. These developments are described in detail in Section XI of this report.

#### 3.3 DRAINAGE FACILITIES

Future drainage facilities within the DRCC drainage area would include retention basins and conveyance features constructed by and in the course of new development, storm drains constructed along arterial streets, and the DRCC. As development occurs, the existing irrigation channels are either eliminated, or if of regional importance such as the BFC placed in underground pipes.

The potential adverse effect of increased runoff peaks and volumes from new development is offset by retaining flood discharges on site in retention basins. The normal retention requirement in the cities of Phoenix and Avondale is the volume of runoff created by a 100-year, 2-hour storm. Retention basins are generally located within the development area, are approximately 3 feet deep, and landscaped with grass. It is expected that the City of Phoenix will continue to allow retention within the DRCC

alignment, and eventually all of the alignment between 107<sup>th</sup> Avenue and 75<sup>th</sup> Avenue would be occupied by a series of retention basins.

New development would also construct conveyance facilities for onsite drainage, and as needed for offsite drainage. All would lead eventually either to retention basins or to the BFC/DRCC alignment. Much of the drainage will likely be conveyed in the streets, including the existing arterial streets, which would be improved as development goes in. New storm drains could be constructed in the arterial streets. In the absence of the DRCC, storm drains would likely drain to the Gila River. The BFC is not designed to accept storm drain flow. With the DRCC in place as a flood control channel, it may be possible to discharge storm drains into the DRCC provided there is sufficient conveyance capacity.

The DRCC would be a regional drainage conveyance facility between 75<sup>th</sup> Avenue and the Agua Fria River as shown in Figure 1.2. As proposed and described in detail in Dibble (2002), the DRCC would consist of an earthen trapezoidal channel with 6:1 side slopes. Channel depth would be approximately 6 feet. Channel top width would range from 104 to 291 feet. Channel lining would be grass. The DRCC would include a detention basin between 91<sup>st</sup> Avenue and 95<sup>th</sup> Avenue, referred to in this report as the 95th Avenue Basin, and a detention basin at the end of the channel just before the confluence with the Agua Fria River, also referred to in this report as Basin #1.

The purpose of the DRCC is to provide flood protection for existing development within the local floodplain in the DRCC drainage area, provide flood protection for future development, and provide a conveyance conduit for drainage from the developing drainage area and identified flooding hazards. Design discharges for the original DRCC master plan were based on Dibble (2002) and are listed in Table 3.1.

**Table 3.1 DRCC Design Discharges from Dibble (2002)**

DRCC Channel At:	DRCC Design Discharge, in cfs (Downstream of Indicated Street)
83 <sup>rd</sup> Avenue	1,681
91 <sup>st</sup> Avenue	1,967
99 <sup>th</sup> Avenue	1,849
107 <sup>th</sup> Avenue	2,578
115 <sup>th</sup> Avenue	3,278
El Mirage Road	3,224

See Figure 1.2 for DRCC alignment. See Dibble (2002) for detailed description of design and analysis.

### 3.4 HYDROLOGY

Future hydrologic conditions within the DRCC drainage area will depend on a variety of factors. Primary among these is the demonstrated tendency of the drainage area to be converted from agricultural use to urban residential use. Other considerations include the capacity and extent of the DRCC, the amount of retention required of new development, and other factors such as new storm drains, or other drainage area modifications, that could affect peak discharge rates.

For purposes of this study, basic future hydrologic conditions consist of: (1) full development as depicted in Figure 2.1; (2) 100-year, 2-hour retention for all new development; and, (3) the DRCC as described in Dibble (2002) in place between 75<sup>th</sup> Avenue and the Agua Fria River. Culverts would be installed at major access roads to achieve 100-year access on these roads. The existing conditions HEC-1 model was modified to reflect these conditions. This model is compared to the previous (Dibble) model in the appendix to this report.

Installation of the DRCC in Phoenix would require the elimination of retention basins that are now in the DRCC alignment in Phoenix. It is assumed, for purposes of establishing a baseline future conditions

model by which DRCC alternatives (Section 4 of this report) can be compared, that these retention basins would be reconstructed alongside the DRCC. This assumption may not be practical.

The results of the HEC-1 modeling (Figure 3.1 and Table 3.2) show that, in comparison to existing conditions discharges, future development with 100-year, 2-hour retention and the DRCC in place would generally increase discharges along the DRCC/BFC alignment. At 107<sup>th</sup> Avenue, which is the boundary between Phoenix and Avondale, the increase is about one third (from 1,193 cfs to 1,578 cfs).

**Table 3.2 Key Discharges for Basic (Baseline) Future Conditions**

Concentration Point	Future Developed Drainage Area Conditions			Existing Conditions Peak Discharge in cfs (From Table 2.1)
	100-Year, 2-Hour Retention Full DRCC in Place			
	100-Year, 24-Hour Discharge in cfs	100-Year, 6-Hour Discharge in cfs	Design Discharge in cfs	
83 <sup>rd</sup> Avenue	406	534	534	66
91 <sup>st</sup> Avenue	482	1,169	1,169	602
99 <sup>th</sup> Avenue	717	973	973	711
107 <sup>th</sup> Avenue	1,097	1,578	1,578	1,193
115 <sup>th</sup> Avenue	945	1,277	1,277	1,185
El Mirage Road	866	1,258	1,258	1,610

107<sup>th</sup> Avenue is the boundary between Phoenix and Avondale.

#### 4 PLAN FORMULATION/EVALUATION OF ALTERNATIVES

This section describes basic opportunities and constraints for development of a DRCC design, describes alternatives that were developed based on the opportunities and constraints, and describes each of the alternatives in terms of description, hydrology, conceptual design, and cost.

##### 4.1 OPPORTUNITIES AND CONSTRAINTS

DRCC opportunities include:

1. The DRCC provides an opportunity for a regional drainage solution rather than relying on piecemeal drainage improvements to be installed by developers or cities.
2. The DRCC would provide flood hazard reduction for existing flood-prone areas along the BFC alignment.
3. The DRCC would provide a corridor that could be used for recreational and aesthetic purposes as well as flood control.
4. Although development is occurring along the BFC alignment, there undeveloped land along the corridor that can be utilized for flood protection structures.
5. First flush retention rather than 100-year, 2-hour retention for developers adjacent to the DRCC results in lower construction costs for developers and allows an opportunity for developer participation in the DRCC project. Retention of the runoff produced from a 100-year, 2-hour storm is required for flood control purposes of all new development in Avondale and Phoenix. The purpose of the retention is to prevent the development from increasing flood peaks downstream. First flush retention is required for water quality purposes only. The flood control retention requirement could be eliminated for developments adjacent to the DRCC if the DRCC were designed to accept the with-development flood peaks, thus facilitating potential developer partnering in the project.

DRCC constraints include:

1. There has been development along the DRCC alignment in the City of Phoenix. This development has used the DRCC alignment to install 100-year, 2-hour retention basins.

2. The proposed site of the 95th Avenue Basin is currently under development. This site is no longer practical for use as a flood control basin.
3. By agreement between Avondale and Phoenix, the 100-year discharge at 107th Avenue is limited to approximately 1,300 cfs.
4. The City of Phoenix has limited funding for participation in a regional flood control project at this location.

#### 4.2 DRCC ALTERNATIVES

Eight DRCC design alternatives were developed. Each alternative included one or more of the opportunities and constraints as a design feature. For hydrologic analysis purposes, all of the alternatives assume the following:

- Full development according to the land use map shown in Figure 2.1, with the exception that existing, older residential areas would remain as is.
- 100-year, 2-hour retention for all new development except as otherwise described.
- The DRCC will be constructed as designed by Dibble (2002), except as otherwise indicated.
- The Sunland Channel was modeled as in its existing condition (no future improvements). This was done for the DRCC alternatives analysis only. The Sunland Channel is addressed separately in Section 5.2.5 of this report.

Hydrologic analysis for the alternatives was performed by modifying the future conditions HEC-1 model described in Section 3.4 to conform to the conditions specific to each alternative. HEC-1 input and output are provided in the supplementary report. Additionally, normal depth hydraulic computations were used to determine the appropriate channel bottom width. A typical cross section is presented in each alternative figure.

Table 4.1 and Figure 4.1 provide a summary of basic design features for all alternatives.

**Table 4.1 Basic DRCC Design Features**

DESIGN FEATURE	DESCRIPTION
Channel Bottom Width	Varies with discharge
Channel Flow Depth	4.6 to 4.8 feet. Varies with discharge
Channel Freeboard	1.2 to 1.3 feet. Varies with discharge.
Channel Slope	Varies by reach. Ranges from 0.0005 to 0.0032
Channel Roughness (Mannings)	0.04
Channel Side Slope	6 horizontal to 1 vertical.
Channel Flow Velocity	Varies. All less than 4.5 feet per second.
Channel Froude Number	Varies. All less than 0.50 (subcritical).
Channel Top Width	Varies. Generally about 72 feet plus channel bottom width.
Maintenance Access	Two, 16-foot ABC roads.
Total Right of Way	Varies. Generally about 122 feet plus channel bottom width. Landscaped except for access roads. Additional right of way may be required for aesthetic or recreational purposes.
Culverts	At major roadway crossings. Typically reinforced concrete box culverts 4 feet high with 6-foot total head. Culvert width and number vary with discharge.
Detention Basins	See Figure 4.1 and otherwise as described in the Alternative descriptions.

#### 4.2.1 Alternative 1: Future 100-Year, 2-Hour retention Full DRCC (Baseline Future Conditions) (see Figure 4.1)

##### 4.2.1.1 Description

Alternative 1 is the same as the basic future conditions described in Section 3 and is based on the following:

- With the exception of older light residential areas, the entire DRCC drainage area will develop to the maximum extent possible as shown in Figure 1.2;
- All new development, including recent development within the City of Phoenix, would be required to retain the runoff generated from a 100-year, 2-hour rainfall; and,
- The DRCC would be constructed between 75<sup>th</sup> Avenue and the Agua Fria River as shown in the Dibble (2002) plan.

Alternative 1 provides a baseline against which the other alternatives can be compared for purposes of evaluating effect on DRCC discharges, design and cost.

##### 4.2.1.2 Hydrology

Discharges for Alternative 1 are the same as those for basic future conditions per Section 3 of this report.

##### 4.2.1.3 Conceptual Design

Table 4.2 provides a summary of key channel design and hydraulic parameters for Alternative 1 between El Mirage Road and 99<sup>th</sup> Avenue. Channel top width for the indicated reaches ranges from 104 to 199 feet. Total right of way width ranges from 154 feet to 249 feet. Reach design discharges for this and other alternatives is higher of the estimated discharge for the reach where the higher discharge is at the upstream end, or the average if the higher discharge is at the downstream end.

**Table 4.2 Selected Design Parameters for Alternative 1, Future 100-Year, 2-Hour retention, Full DRCC**

Channel reach	Design Discharge in cfs	Channel Bottom width in Feet	Channel Top width in Feet	Right of Way width in Feet	Flow depth in Feet	Flow velocity in Feet per Second	Channel depth in Feet
El Mirage Road to 115th Avenue	1,276	49	120	170	4.7	3.5	5.9
115 <sup>th</sup> Avenue to 107 <sup>th</sup> Avenue	1,578	127	199	249	4.8	2.1	6.0
107 <sup>th</sup> Avenue to 99 <sup>th</sup> Avenue	1,276	34	104	154	4.6	4.5	5.8

##### 4.2.1.4 Cost

Tables 4.3 and 4.4 summarize the cost estimate for Alternative 1. The estimated cost, with contingency, is approximately \$64,000,000. With Alternative 1, as well as with other alternatives, right of way is the most significant single cost item, followed by landscaping. Approximately 48 percent of the total cost is in Avondale, the rest is in Phoenix.

**Table 4.3 Alternative 1 Cost Estimate by Cost Item**

COST ITEM	QUANTITY	UNIT	UNIT COST	COST
Excavation	975,399	Cubic Yards	\$ 6	\$ 5,852,394
Landscaping	203.1	Acres	\$ 78,408	\$15,924,665
Right of Way	209.1	Acres	\$ 100,000	\$20,910,000
Basin #1 Right of Way	137	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	5092.0	Cubic Yards	\$ 669	\$ 3,406,548
Maintenance Road	30	Acres	\$ 28,314	\$ 849,420
Miscellaneous Items (Basin spillway, manholes, headwall, drain pipe)				\$ 1,305,460
Subtotal				\$ 49,070,487
Contingency 30%				\$ 14,721,146
Total Cost				\$ 63,791,635

**Table 4.4 Alternative 1 Cost by Reach**

REACH	COST
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 430,205
Dysart to El Mirage	\$ 4,511,712
El Mirage to 115th Avenue	\$ 7,787,615
115th to 107 <sup>th</sup>	\$ 6,755,082
Avondale Subtotal	\$ 23,493,866
Avondale Contingency 30%	\$ 7,048,160
Avondale Total	\$ 30,542,026
107th to 99 <sup>th</sup>	\$ 3,993,463
99th to 91 <sup>st</sup>	\$ 3,972,466
91st to 83 <sup>rd</sup>	\$ 4,254,904
83rd to 75 <sup>th</sup>	\$ 3,574,805
Phoenix Channel Subtotal	\$ 15,795,638
95th Avenue Basin	\$ 9,780,984
Phoenix Subtotal	\$ 25,576,622
Phoenix Contingency 30%	\$ 7,672,987
Phoenix Total	\$ 33,249,609
TOTAL	\$ 63,791,635

## 4.2.2 Alternative 2: Future First Flush Retention Full DRCC

### 4.2.2.1 Description

Alternative 2 is the same as Alternative 1, with first flush retention rather than 100-year, 2-hour retention adjacent to the DRCC. Development adjacent to and draining directly into the DRCC would be allowed to drain all runoff except first flush into the DRCC. All other development would be subject to the normal 100-year, 2-hour retention requirement. The potential advantage would be a reduced retention cost for adjacent developers. The disadvantage would be a potentially higher DRCC cost.

### 4.2.2.2 Hydrology

The modeling results for key concentration points along the DRCC are presented in Table 4.5 and Figure 4.2. The results show an increase over baseline future conditions discharges (Alternative 1) at

every location. Increases range from 15 percent at 83<sup>rd</sup> Avenue to 100 percent at the Agua Fria River. At 107<sup>th</sup> Avenue, the First Flush discharge of 2,176 cfs is 38 percent higher than the corresponding Baseline Future Conditions discharge, and 82 percent higher than the existing conditions discharge of 1,193 cfs.

**Table 4.5 Key Discharges for Alternative 2, Future First Flush Retention Full DRCC.**

Concentration Point	Future Developed Drainage area Conditions First Flush Retention Adjacent to the DRCC Full DRCC In Place			Baseline Future (Alternative 1) Conditions Discharge in cfs (From Table 3.2)
	100-Year, 24-Hour Discharge in cfs	100-Year, 6-Hour Discharge in cfs	Design Discharge in cfs	
83 <sup>rd</sup> Avenue	492	613	613	534
91 <sup>st</sup> Avenue	682	1,548	1,548	1,169
99 <sup>th</sup> Avenue	1,137	1,250	1,250	973
107 <sup>th</sup> Avenue	1,780	2,176	2,176	1,578
115 <sup>th</sup> Avenue	1,651	1,944	1,944	1,277
El Mirage Road	2,087	1,860	2,087	1,258
Agua Fria River	681	526	681	339

<sup>a</sup>107<sup>th</sup> Avenue is the boundary between Phoenix and Avondale.

#### 4.2.2.3 Conceptual Design

Table 4.6 provides a summary of key channel design and hydraulic parameters for Alternative 2. Because of higher discharges the channel is wider than Alternative 1, requiring more right-of-way.

**Table 4.6 Selected Design Parameters for Alternative 2, Future First Flush Retention, Full DRCC.**

Channel reach	Design Discharge in cfs	Channel Bottom width in Feet	Channel Top width in Feet	Right of Way width in Feet	Flow depth in Feet	Flow velocity in Feet per Second	Channel depth in Feet
El Mirage Road to 115 <sup>th</sup> Avenue	1,944	84	155	205	4.7	3.7	5.9
115 <sup>th</sup> Avenue to 107 <sup>th</sup> Avenue	2,176	181	253	303	4.8	2.2	6.0
107 <sup>th</sup> Avenue to 99 <sup>th</sup> Avenue	1,713	51	121	171	4.6	4.7	5.8

#### 4.2.2.4 Cost

The Alternative 2 cost is approximately \$74,000,000 (Tables 4.7 and 4.8).

**Table 4.7 Alternative 2 Cost Estimate by Cost Item**

COST ITEM	QUANTITY	UNIT	UNIT COST	COST
Excavation	1,232,514	Cubic Yards	\$ 6	\$ 7,395,084
Landscaping	230.2	Acres	\$ 78,408	\$18,049,522
Right of Way	236.2	Acres	\$ 100,000	\$23,620,000
Basin #1 Right of Way	137	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	6977	Cubic Yards	\$ 669	\$ 4,667,613
Maintenance Road	30	Acres	\$ 28,314	\$ 849,420
Miscellaneous Items (Basin spillway, manholes, headwall, drain pipe)				\$ 1,305,460
Subtotal				\$56,709,100
Contingency 30%				\$17,012,730
Total Cost				\$73,721,830

Table 4.8 Alternative 2 Cost by Reach

REACH	COST
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 751,635
Dysart to El Mirage	\$ 6,219,180
El Mirage to 115th Avenue	\$ 9,888,575
115th to 107 <sup>th</sup>	\$ 8,455,781
Avondale Subtotal	\$ 29,324,423
Avondale Contingency 30%	\$ 8,797,327
Avondale Total	\$ 38,121,750
107 <sup>th</sup> to 99 <sup>th</sup>	\$ 4,610,409
99 <sup>th</sup> to 91 <sup>st</sup>	\$ 4,421,476
91 <sup>st</sup> to 83 <sup>rd</sup>	\$ 4,807,062
83 <sup>rd</sup> to 75 <sup>th</sup>	\$ 3,764,746
Phoenix Channel Subtotal	\$ 17,603,693
95th Avenue Basin	\$ 9,780,984
Phoenix Subtotal	\$ 27,384,677
Phoenix Contingency 30%	\$ 8,215,403
Phoenix Total	\$ 35,600,080
TOTAL	\$ 73,721,830

#### 4.2.3 Alternative 3: Future 100-Year, 2-Hour retention Avondale DRCC

##### 4.2.3.1 Description

In Alternative 3, the DRCC would be constructed in Avondale only, between 107<sup>th</sup> Avenue and the Agua Fria River. Existing retention within the DRCC alignment within the City of Phoenix would remain as is, and the DRCC corridor of retention basins in Phoenix be used as a pathway for drainage exceeding the retention capacity. All new development would retain the 100-year, 2-hour runoff. The purpose of this alternative is to explore the possibility that the City of Phoenix not participate in the DRCC, and that the Avondale retention requirement would be the 100-year, 2-hour standard.

##### 4.2.3.2 Hydrology

Table 4.9 and Figure 4.3 summarize the hydrology for this alternative. Alternative 3 would produce lower discharges than the Baseline Future Conditions discharges at almost every point. The discharge of 1,312 cfs at 107<sup>th</sup> Avenue is approximately 83 percent of the baseline future discharge, but is 10 percent higher than the existing conditions discharge of 1,193 cfs.

Table 4.9 Key Discharges for Alternative 3, Future 100-Year, 2-Hour retention Avondale DRCC

Concentration Point	Future Developed Drainage area Conditions 100-Year, 2-Hour Retention DRCC in Avondale Only			Baseline Future (Alternative 1) Conditions Discharge, in cfs (From Table 3.2)
	100-Year, 24-Hour Discharge, in cfs <sup>a</sup>	100-Year, 6-Hour Discharge, in cfs	Design Discharge, in cfs	
83 <sup>rd</sup> Avenue	406	534	534	534
91 <sup>st</sup> Avenue	459	1,124	1,124	1,169
99 <sup>th</sup> Avenue	716	887	887	973
107 <sup>th</sup> Avenue	904	1,312	1,312	1,578
115 <sup>th</sup> Avenue	831	1,073	1,073	1,277
El Mirage Road	762	1,078	1,078	1,258

Concentration Point	Future Developed Drainage Area Conditions 100-Year, 2-Hour Retention DRCC in Avondale Only			Baseline Future (Alternative 1) Conditions
	100-Year, 24-Hour Discharge, in cfs	100-Year, 6-Hour Discharge, in cfs	Design Discharge, in cfs	Discharge, in cfs (From Table 3.2)
Agua Fria River	339	170	339	339
107 <sup>th</sup> Avenue is the boundary between Phoenix and Avondale.				

#### 4.2.3.3 Conceptual Design

Table 4.10 provides a summary of key channel design and hydraulic parameters for Alternative 3. The channel in Avondale is narrower than the Alternative 1 channel for the reason that the retention along the DRCC alignment in Phoenix keeps the 100-year discharge at 107<sup>th</sup> Avenue close to the existing level.

**Table 4.10 Selected Design Parameters for Alternative 3, Future 100-Year, 2-Hour Retention, Avondale DRCC**

Channel reach	Design Discharge, in cfs	Channel Bottom width, in Feet	Channel Top width, in Feet	Right of Way width, in Feet	Flow depth, in Feet	Flow velocity, in Feet per Second	Channel depth, in Feet
El Mirage Road to 115 <sup>th</sup> Avenue	1,073	39	110	160	4.7	3.4	5.9
115 <sup>th</sup> Avenue to 107 <sup>th</sup> Avenue	1,312	103	175	225	4.8	2.1	6.0

#### 4.2.3.4 Cost

The Alternative 3 cost (Tables 4.11 and 4.12) of \$28,000,000 is all in Avondale. This Avondale cost is lower than the Avondale cost for Alternatives 1 and 2, both of which have the DRCC in Phoenix.

**Table 4.11 Alternative 3 Cost Estimate by Cost Item**

COST ITEM	QUANTITY	UNIT	UNIT COST	COST
Excavation	403,731	Cubic Yards	\$ 6	\$ 2,422,386
Landscaping	90.6	Acres	\$ 78,408	\$ 7,103,765
Right of Way	81.2	Acres	\$ 100,000	\$ 8,120,000
Basin #1 Right of Way	137.0	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	2389.0	Cubic Yards	\$ 669	\$ 1,598,241
Maintenance Road	14.6	Acres	\$ 28,314	\$ 413,384
Miscellaneous Items (Basin spillway, manholes, headwall, drain pipe)				\$ 1,305,460
Subtotal				\$21,785,237
Contingency 30%				\$ 6,535,571
Total Cost				\$28,320,808

**Table 4.12 Alternative 3 Cost by Reach**

REACH	COST
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 428,237
Dysart to El Mirage	\$ 4,184,003
El Mirage to 115 <sup>th</sup> Avenue	\$ 7,194,189
115 <sup>th</sup> to 107 <sup>th</sup>	\$ 5,969,556
Avondale Subtotal	\$ 21,785,237
Avondale Contingency 30%	\$ 6,535,571
Avondale Total	\$ 28,320,808

#### 4.2.4 Alternative 4: Future First Flush Retention Avondale DRCC.

##### 4.2.4.1 Description

Alternative 4 is the same as Alternative 3, but with first flush retention for new development adjacent to the DRCC in Avondale. All other development would retain the 100-year, 2-hour runoff. The purpose of this alternative is to explore the possibility that the City of Phoenix not participate in the DRCC, and that the Avondale retention requirement be relaxed to first flush for development adjacent to the DRCC.

##### 4.2.4.2 Hydrology

Allowing first flush retention rather than 100-year 2-hour retention adjacent to the DRCC in Avondale increases the DRCC discharge substantially at El Mirage Road and at the Agua Fria River (94 percent increase in both cases), but has little or no effect elsewhere (Table 4.13 and Figure 4.4).

**Table 4.13 Key Discharges for Alternative 4, Future First Flush Retention Avondale DRCC**

Concentration Point	Future Developed Drainage area Conditions First Flush Retention Adjacent to the DRCC in Avondale DRCC in Avondale Only			Avondale DRCC Discharge, Assuming 100-Year, 2-Hour Retention, in cfs
	100-Year, 24-Hour Discharge, in cfs	100-Year, 6-Hour Discharge, in cfs	Design Discharge, in cfs	
83 <sup>rd</sup> Avenue	406	534	534	534
91 <sup>st</sup> Avenue	459	1,124	1,124	1,124
99 <sup>th</sup> Avenue	716	887	887	887
107 <sup>th</sup> Avenue	904	1,312	1,312	1,312
115 <sup>th</sup> Avenue	831	1,073	1,073	1,073
El Mirage Road	2,087	1,860	2,087	1,078
Agua Fria River	658	503	658	339

107<sup>th</sup> Avenue is the boundary between Phoenix and Avondale.

##### 4.2.4.3 Conceptual Design

Table 4.14 provides a summary of key channel design and hydraulic parameters for Alternative 4. Retention along the DRCC alignment in Phoenix keeps the 100-year discharge at 107<sup>th</sup> Avenue close to the existing level, allowing a narrower channel than for Alternative 1. However, the channel is wider than for Alternative 3 because of higher Avondale discharges with first flush retention.

**Table 4.14 Selected Design Parameters for Alternative 4, Future First Flush Retention Avondale DRCC**

Channel reach	Design Discharge, in cfs	Channel Bottom width, in Feet	Channel Top width, in Feet	Right of Way width, in Feet	Flow depth, in Feet	Flow velocity, in Feet per Second	Channel depth, in Feet
El Mirage Road to 115 <sup>th</sup> Avenue	1,580	65	136	186	4.7	3.6	5.9
115 <sup>th</sup> Avenue to 107 <sup>th</sup> Avenue	1,312	103	175	225	4.8	2.1	6.0

##### 4.2.4.3 Cost

The Alternative 4 cost is presented in Tables 4.15 and 4.16. As with Alternative 3, the cost is entirely in Avondale. The Alternative 4 cost of \$33,000,000 is higher than for Alternative 3 for the reason that the channel is designed for first flush retention adjacent to the channel rather than 100-year 2-hour retention.

**Table 4.15 Alternative 4 Cost Estimate by Cost Item**

COST ITEM	QUANTITY	UNIT	UNIT COST	COST
Excavation	527,258	Cubic Yards	\$ 6	\$ 3,163,548
Landscaping	103.5	Acres	\$ 78,408	\$ 8,115,228
Right of Way	94.1	Acres	\$ 100,000	\$ 9,410,000
Basin #1 Right of Way	137.0	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	3495.0	Cubic Yards	\$ 669	\$ 2,338,155
Maintenance Road	14.6	Acres	\$ 28,314	\$ 413,384
Miscellaneous Items (Basin spillway, manholes, headwall, drain pipe)				\$ 1,305,460
Subtotal				\$ 25,567,776
Contingency 30%				\$ 7,670,333
Total Cost				\$ 33,238,109

**Table 4.16 Alternative 4 Cost by Reach**

REACH	COST
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 751,835
Dysart to El Mirage	\$ 6,095,245
El Mirage to 115th Avenue	\$ 8,742,088
115th to 107 <sup>th</sup>	\$ 5,969,556
Avondale Subtotal	\$ 25,567,776
Avondale Contingency 30%	\$ 7,670,333
Avondale Total	\$ 33,238,109

## 4.2.5 Alternative 5: Removed 95th Avenue Basin

### 4.2.5.1 Description

The purpose of Alternative 5 is to evaluate the effect on DRCC design discharges and cost of removing the 95<sup>th</sup> Avenue Detention Basin from the design. This 61-acre off-line detention basin would be located on the south side of the DRCC alignment near 95<sup>th</sup> Avenue (Figure 1.2). As currently designed, this basin would begin to accept water when the DRCC discharge exceeds 1,050 cfs. In the current future hydrologic condition the 100-year discharge at the location of the basin never reaches 1,050 cfs. Therefore, the basin as currently designed would have no effect. Discharges for first flush retention conditions (See Alternative 2) do exceed 1,050 cfs at that point, so the effect of removing the 95th Avenue Basin was tested based on first flush retention adjacent to the channel. Alternative 5 is basically the same as Alternative 2, but with the 95th Avenue Basin removed.

### 4.2.5.2 Hydrology

Removing the 95th Avenue Basin from the Future First Flush Retention Full DRCC (Alternative 2) scenario would increase discharges downstream of 95<sup>th</sup> Avenue as shown in Table 4.17 and Figure 4.5. The increase was greatest (192 cfs, or 9 percent) at 107<sup>th</sup> Avenue, and diminished in the downstream direction.

**Table 4.17 Key Discharges for Alternative 5, Removed 95th Avenue Basin**

Concentration Point	Future Developed Drainage area Conditions First Flush Retention Adjacent to the DRCC Full DRCC in Place Without the 95th Avenue Detention Basin			Full DRCC First Flush Retention (Alternative 2) Discharge, With 95th Avenue Basin in Place, in cfs
	100-Year, 24-Hour Discharge, in cfs <sup>1</sup>	100-Year, 6-Hour Discharge, in cfs	Design Discharge, in cfs	
83 <sup>rd</sup> Avenue	492	613	613	613
91 <sup>st</sup> Avenue	682	1,548	1,548	1,548
99 <sup>th</sup> Avenue	1,345	1,560	1,560	1,250
107 <sup>th</sup> Avenue	1,993	2,368	2,368	2,176
115 <sup>th</sup> Avenue	1,872	2,145	2,145	1,944
El Mirage Road	2,087	1,986	2,087	2,087
Agua Fria River	658	503	658	681

107<sup>th</sup> Avenue is the boundary between Phoenix and Avondale.

#### 4.2.5.3 Conceptual Design

The Alternative 5 channel (Table 4.18) ranges from 132 to 269 feet in width, and requires a right of way ranging from 182 to 319 feet for the indicated reaches. Removing the basin causes an increase of about 5 percent in channel width over the same condition with the basin in place (Alternative 2).

**Table 4.18 Selected Design Parameters for Alternative 5, Removed 95th Avenue Basin**

Channel reach	Design Discharge, in cfs	Channel Bottom width, in Feet	Channel Top width, in Feet	Right of Way width, in Feet	Flow depth, in Feet	Flow velocity, in Feet per Second	Channel depth, in Feet
El Mirage Road to 115 <sup>th</sup> Avenue	2,145	94	165	215	4.7	3.7	5.9
115 <sup>th</sup> Avenue to 107 <sup>th</sup> Avenue	2,368	197	269	319	4.8	2.2	6.0
107 <sup>th</sup> Avenue to 99 <sup>th</sup> Avenue	1,964	61	132	182	4.6	4.8	5.9

#### 4.2.5.4 Cost

The Alternative 5 cost of \$63,000,000 (Tables 4.19 and 4.20) is nearly two-thirds in Avondale. By comparison with Alternative 2, Alternative 5 has a significantly reduced cost in Phoenix, and a slightly higher cost in Avondale.

**Table 4.19 Alternative 5 Cost Estimate by Cost Item**

COST ITEM	QUANTITY	UNIT	UNIT COST	COST
Excavation	1,090,346	Cubic Yards	\$ 6	\$ 6,542,076
Landscaping	188.3	Acres	\$ 78,408	\$14,764,226
Right of Way	194.4	Acres	\$ 100,000	\$19,440,000
Basin #1-Right of Way	137	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	7042.0	Cubic Yards	\$ 669	\$ 4,711,098
Maintenance Road	30.1	Acres	\$ 28,314	\$ 852,251
Miscellaneous Items (Basin spillway, manholes, headwall, drain pipe)				\$ 1,305,460
Subtotal				\$48,437,113
Contingency 30%				\$14,531,134
Total Cost				\$62,968,247

Table 4.20 Alternative 5 Cost by Reach

REACH	COST
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 751,635
Dysart to El Mirage	\$ 6,219,180
El Mirage to 115th Avenue	\$ 10,114,051
115th to 107 <sup>th</sup>	\$ 8,969,950
Avondale Subtotal	\$ 30,064,068
Avondale Contingency 30%	\$ 9,019,220
Avondale Total	\$ 39,083,288
107th to 99 <sup>th</sup>	\$ 5,016,805
99th to 91 <sup>st</sup>	\$ 4,784,432
91st to 83 <sup>rd</sup>	\$ 4,807,062
83rd to 75 <sup>th</sup>	\$ 3,764,746
Phoenix Subtotal	\$ 18,373,045
Phoenix Contingency 30%	\$ 5,511,914
Phoenix Total	\$ 23,884,959
TOTAL	\$ 62,968,247

#### 4.2.6 Alternative 6: 100-Year Phoenix Culverts, 100-Year 2-Hour Retention in Avondale.

##### 4.2.6.1 Description

Alternative 6 evaluates the effect of 100-year culverts at 83<sup>rd</sup>, 91<sup>st</sup>, 99<sup>th</sup>, and 107<sup>th</sup> Avenues. The culverts would connect the existing retention systems within Phoenix and provide 100-year access along the arterial streets. With the exception of Phoenix developments that are adjacent to the DRCC, 100-year, 2-hour retention is assumed for all new development within the DRCC drainage area.

##### 4.2.6.2 Hydrology

The HEC-1 modeling results show a substantial increase in discharge (836 cfs = 64 percent) over Alternative 3, and 570 cfs over Alternative 1 at 107<sup>th</sup> Avenue. Discharges downstream of 107<sup>th</sup> Avenue show a similar increase (Table 4.21 and Figure 4.6).

Table 4.21 Key Discharges for Alternative 6, 100-Year Phoenix Culverts

Concentration Point	Future Developed Drainage area Conditions 100-Year 2-Hour Retention DRCC in Avondale Only			Avondale DRCC Discharge Assuming 100-Year 2-Hour Retention (Alternative 3) in cfs (no culverts)
	100-Year Culverts Connecting Phoenix DRCC Alignment Retention Basins			
	100-Year 24-Hour Discharge in cfs	100-Year 6-Hour Discharge in cfs	Design Discharge in cfs	
83 <sup>rd</sup> Avenue	492	613	613	534
91 <sup>st</sup> Avenue	686	1,254	1,254	1,124
99 <sup>th</sup> Avenue	967	1,145	1,145	887
107 <sup>th</sup> Avenue	1,795	2,148	2,148	1,312
115 <sup>th</sup> Avenue	1,736	1,985	1,985	1,073
El Mirage Road	1,699	1,858	1,858	1,078
Agua Fria River	430	254	430	339

107<sup>th</sup> Avenue is the boundary between Phoenix and Avondale.

#### 4.2.6.3 Conceptual Design

Building the DRCC in Avondale only and installing 100-year culverts at major arterials in Phoenix results in DRCC channel widths from 157 to 257 feet (Table 4.22). Right of way width ranges from 207 to 307 feet. This is a substantial (approximately 33 percent) increase in right of way requirement in Avondale over the without-culverts condition (Alternative 3).

**Table 4.22 Selected Design Parameters for Alternative 6, 100-Year Phoenix Culverts**

Channel reach	Design Discharge in cfs	Channel Bottom width, in Feet	Channel Top width, in Feet	Right of Way width, in Feet	Flow depth in Feet	Flow velocity, in Feet per Second	Channel depth, in Feet
115th Avenue to El Mirage Road	1,985	86	157	207	4.7	3.7	5.9
107th Avenue to 115 <sup>th</sup> Avenue	2,148	185	257	307	4.8	2.1	6.0

#### 4.2.6.4 Cost

The Alternative 6 cost is summarized in Tables 4.23 and 4.24. Nearly all (98 percent) of the \$38,000,000 cost is in Avondale. The Phoenix portion consists of four culverts only. By comparison to Alternative 3, installing 100-year culverts in Phoenix increases the Avondale cost by approximately \$9,000,000.

**Table 4.23 Alternative 6 Cost Estimate by Cost Item**

COST ITEM	QUANTITY	UNIT	UNIT COST	COST
Excavation	652,965	Cubic Yards	\$ 6	\$ 3,871,662
Landscaping	116.5	Acres	\$ 78,408	\$ 9,071,806
Right of Way	107.1	Acres	\$ 100,000	\$10,630,000
Basin #1 Right of Way	137.0	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	=5008	Cubic Yards	\$ 669	\$ 3,355,704
Maintenance Road	14.6	Acres	\$ 28,314	\$ 413,384
Miscellaneous Items (Basin spillway, manholes, headwall, drain pipe)				\$ 1,305,460
Subtotal				\$29,470,016
Contingency 30%				\$ 8,841,005
Total Cost				\$38,311,021

**Table 4.24 Alternative 6 Cost by Reach**

REACH	COST
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 622,501
Dysart to El Mirage	\$ 5,677,072
El Mirage to 115th Avenue	\$ 9,984,022
115th to 107 <sup>th</sup>	\$ 8,572,393
Avondale Subtotal	\$ 28,865,240
Avondale Contingency 30%	\$ 8,659,572
Avondale Total	\$ 37,524,812
Phoenix Culverts	\$ 604,776
Phoenix Contingency 30%	\$ 181,433
Phoenix Total	\$ 786,209
Total Cost	\$ 38,311,021

#### 4.2.7 Alternative 7: 10-Year Phoenix Culverts, 100-Year 2-Hour Retention in Avondale.

##### 4.2.7.1 Description

Alternative 7 is the same as Alternative 6 but with 10-year culverts rather than 100-year culverts in Phoenix.

##### 4.2.7.2 Hydrology

Installing 10-year culverts in the City of Phoenix increases the DRCC discharge at 107<sup>th</sup> Avenue by 313 cfs (24 percent) over Alternative 3, (Table 4.25 and Figure 4.7) and 47 cfs over Alternative 1. Discharge increases are greater in the downstream direction, reaching 352 cfs (increase) at El Mirage Road.

**Table 4.25 Key Discharges for Alternative 7, 10-Year Phoenix Culverts**

Concentration Point	Future Developed Drainage Area Conditions 100-Year 2-Hour Retention DRCC in Avondale Only 10-Year Culverts Connecting Phoenix DRCC Alignment Retention Basins			Avondale DRCC Discharge Assuming 100-Year 2-Hour Retention in cfs (no culverts)
	100-Year 24-Hour Discharge in cfs	100-Year 6-Hour Discharge in cfs	Design Discharge in cfs	
	83 <sup>rd</sup> Avenue	492	613	
91 <sup>st</sup> Avenue	576	1,113	1,113	1,124
99 <sup>th</sup> Avenue	716	831	831	887
107 <sup>th</sup> Avenue	1,369	1,625	1,625	1,312
115 <sup>th</sup> Avenue	1,354	1,520	1,520	1,073
El Mirage Road	1,355	1,430	1,430	1,078
Agua Fria River	430	253	430	339

107<sup>th</sup> Avenue is the boundary between Phoenix and Avondale.

##### 4.2.7.3 Conceptual Design

The DRCC right of way required in Avondale for Alternative 7 ranges from 183 to 253 feet (Table 4.26). This is less than required for Alternative 6 (100-year culverts), but about 13 percent more than would be required for the no-culverts condition (Alternative 3).

**Table 4.26 Selected Design Parameters for Alternative 7, 10-Year Phoenix Culverts**

Channel reach	Design Discharge in cfs	Channel Bottom width in Feet	Channel Top width in Feet	Right of Way width in Feet	Flow depth in feet	Flow velocity in feet per Second	Channel depth in Feet
El Mirage Road to 115 <sup>th</sup> Avenue	1,520	62	133	183	4.7	3.6	5.9
115 <sup>th</sup> Avenue to 107 <sup>th</sup> Avenue	1,625	131	203	253	4.8	2.1	6.0

##### 4.2.7.4 Cost

By comparison to Alternative 3, installing 10-year culverts in Phoenix increases the Avondale cost by approximately \$4,000,000. Total cost (Tables 4.27 and 4.28) is approximately \$33,000,000.

**Table 4.27 Alternative 7 Cost Estimate by Cost Item**

COST ITEM	QUANTITY	UNIT	UNIT COST	COST
Excavation	507,005	Cubic Yards	\$ 6	\$ 3,042,030
Landscaping	101.4	Acres	\$ 78,408	\$ 7,950,571
Right of Way	92.0	Acres	\$ 100,000	\$ 9,200,000
Basin #1 Right of Way	137.0	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	3878.0	Cubic Yards	\$ 669	\$ 2,594,382
Maintenance Road	14.6	Acres	\$ 28,314	\$ 413,384
Miscellaneous Items (Basin spillway, manholes, headwall, drain pipe)				\$ 1,305,460
Subtotal				\$25,327,828
Contingency 30%				\$ 7,598,349
Total Cost				\$32,926,177

**Table 4.28 Alternative 7 Cost by Reach**

REACH	COST
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 537,569
Dysart to El Mirage	\$ 4,851,909
El Mirage to 115 <sup>th</sup> Avenue	\$ 8,639,726
115 <sup>th</sup> to 107 <sup>th</sup>	\$ 6,853,853
Avondale Subtotal	\$ 24,892,309
Avondale Contingency 30%	\$ 7,467,693
Avondale Total	\$ 32,360,002
Phoenix Culverts	\$ 435,519
Phoenix Contingency 30%	\$ 130,656
Phoenix Total	\$ 566,175
Total Cost	\$ 32,926,177

#### 4.2.8 Alternative 8: 99<sup>th</sup> Avenue Storm Drain.

##### 4.2.8.1 Description

Alternative 8 was developed to evaluate the possibility that a 2-year storm drain will be constructed in 99<sup>th</sup> Avenue from the Southern Pacific Railroad to the Gila River. Aside from the addition of the storm drain, this alternative is identical to Alternative 1.

##### 4.2.8.2 Hydrology

Storm drain discharges, listed in Table 4.29, were estimated by ratio as 25 percent of the 100-year discharges reaching 99<sup>th</sup> Avenue from the adjacent sub-basins. The storm drain was modeled using flow diversions in the HEC-1 model. Otherwise, the 99<sup>th</sup> Avenue Storm Drain Model is the same as the Baseline Future Conditions Model.

The modeling results (Table 4.30 and Figure 4.8) show a substantial decrease in DRCC discharge in Avondale in comparison to the Baseline Future Condition. With the storm drain in place, the discharge at 107<sup>th</sup> Avenue would be approximately the same as the existing conditions discharge at that point.

**Table 4.29. Assumed 99th Avenue Storm Drain Discharges**

STORM DRAIN REACH	STORM DRAIN DISCHARGE (cfs)
Southern Pacific Railroad to Buckeye Road	82
Buckeye Road to Lower Buckeye Road	474
Lower Buckeye Road to DRCC	607
DRCC to Broadway Road	607
Broadway Road to Southern	745
Southern to Gila River	745

**Table 4.30 Alternative 8, 99th Avenue Storm Drain, Discharges**

Concentration Point	Future Developed Drainage Area Conditions 100-Year, 2-Hour Retention Full DRCC Storm Drain in 99th Avenue			Baseline Future (Alternative 1) Conditions Discharge in cfs
	100-Year, 24-Hour Discharge in cfs	100-Year, 6-Hour Discharge in cfs	Design Discharge in cfs	
	83rd Avenue	406	534	
91st Avenue	482	1,169	1,169	1,169
99th Avenue	479	842	842	973
107th Avenue	697	1,144	1,144	1,578
115th Avenue	610	872	872	1,277
El Mirage Road	762	1,085	1,085	1,258
Agua Fria River	339	170	339	339

107th Avenue is the boundary between Phoenix and Avondale.

#### 4.2.8.3 Conceptual Design

The storm drain would be a reinforced concrete pipe. The design was based on normal depth computations. Conceptual design details are presented in Table 4.31. Installing a 2-year storm drain in 99th Avenue (Alternative 8) has the effect of reducing the DRCC right of way requirement downstream of 99th Avenue by about 20 percent when compared to the same situation with no storm drain (Alternative 1). For Alternative 8, DRCC right-of-way would range from 143 to 210 feet (Table 4.32).

**Table 4.31 Conceptual Design for 99th Avenue Storm Drain**

Storm Drain Reach	Design Discharge (cfs)	Slope (Feet per Foot)	Mannings Roughness	Storm Drain Diameter (Feet)	Reach Length (ft)
SPRR to Buckeye Road	82	0.0025	0.013	4.5	2,414
Buckeye Road to Lower Buckeye Road	474	0.0025	0.013	8.5	5,327
Lower Buckeye Road to DRCC	607	0.0025	0.013	9	2,618
DRCC to Broadway Road	607	0.0025	0.013	9	2,558
Broadway Road to Southern Avenue	745	0.0025	0.013	9.5	5,360
Southern Avenue to Gila river	745	0.0025	0.013	9.5	1,990

**Table 4.32 Selected Design Parameters for Alternative 8, 99th Avenue Storm Drain**

Channel reach	Design Discharge, in cfs	Channel Bottom width, in Feet	Channel Top width, in Feet	Right of Way Width, in Feet	Flow depth, in Feet	Flow velocity, in Feet per Second	Channel depth, in Feet
<b>Future 100-Year, 2-Hour retention Full DRCC</b>							
El Mirage Road to 115th Avenue	1,277	49	120	170	4.7	3.5	5.9
115th Avenue to 107th Avenue	1,578	127	199	249	4.8	2.1	6.0
107th Avenue to 99th Avenue	1,276	34	104	154	4.6	4.5	5.8
<b>99th Avenue Storm Drain</b>							
El Mirage Road to 115th Avenue	979	34	105	155	4.7	3.3	5.9
115th Avenue to 107th Avenue	1,144	88	160	210	4.8	2.0	6.0
107th Avenue to 99th Avenue	993	22	93	143	4.6	4.4	5.9

**4.2.8.4 Cost**

Alternative 8 costs are summarized in Tables 4.33 and 4.34. Although Alternative 8 assumes 100-year, 2-hour retention, which should reduce discharges and therefore cost, the overall cost of Alternative 8 is \$71,000,000. This is nearly as high as the Alternative 2 cost, which assumes first flush retention adjacent to the DRCC. A significant part of the Alternative 8 cost is the storm drain (approximately \$11,000,000 with contingency), which makes the Phoenix portion 61 percent of the total cost. The Avondale cost of \$27,000,000 is similar to the Alternative 2 Avondale cost, which is the goal of Alternative 8.

**Table 4.33 Alternative 8 Cost Estimate by Cost Item**

COST ITEM	QUANTITY	UNIT	UNIT COST	COST
Excavation	879,611	Cubic Yards	\$ 6	\$ 5,277,666
Landscaping	193.2	Acres	\$ 78,408	\$ 15,148,426
Right of Way	199.2	Acres	\$ 100,000	\$ 19,920,000
Basin #1 Right of Way	137	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	4,545	Cubic Yards	\$ 669	\$ 3,040,605
Maintenance Road	30.0	Acres	\$ 28,314	\$ 849,420
Miscellaneous Items (Basin spillway, manholes, headwall, drain pipe)				\$ 1,305,460
99th Avenue Storm Drain (20,267 feet at \$417.07/lf)				\$ 8,452,820
Subtotal				\$ 54,816,397
Contingency 30%				\$ 16,444,919
Total Cost				\$ 71,261,316

**Table 4.34 Alternative 8 Cost by Reach**

REACH	COST
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 428,237
Dysart to El Mirage	\$ 4,208,438
El Mirage to 115th Avenue	\$ 6,955,565
115th to 107 <sup>th</sup>	\$ 5,530,701
Avondale Subtotal	\$ 21,132,193
Avondale Contingency 30%	\$ 6,339,658
Avondale Total	\$ 27,471,851
107th to 99 <sup>th</sup>	\$ 3,626,803
99th to 91 <sup>st</sup>	\$ 3,993,888
91st to 83 <sup>rd</sup>	\$ 4,254,904
83rd to 75 <sup>th</sup>	\$ 3,574,805
Phoenix Channel Subtotal	\$ 15,450,400
Basin #2	\$ 9,780,984
99TH Avenue Storm Drain	\$ 8,452,820
Phoenix Subtotal	\$ 33,684,204
Phoenix Contingency 30%	\$ 10,105,261
Phoenix Total	\$ 43,789,465
TOTAL	\$ 71,261,316

**4.2.9 Alternative Summary Tables**

Tables 4.35, 4.36 and 4.37 provide summaries of discharges, design parameters and costs for the eight alternatives.

**Table 4.35 Summary of Peak Discharges for DRCC Alternatives**

ALTERNATIVE	DRCC PEAK DISCHARGE IN CFS AT INDICATED CONCENTRATION POINT					
	EL MIRAGE ROAD	115 <sup>TH</sup> AVENUE	107 <sup>TH</sup> AVENUE	99 <sup>TH</sup> AVENUE	91 <sup>ST</sup> AVENUE	83 <sup>RD</sup> AVENUE
1. Future 100-Year, 2-Hour retention Full DRCC	1,258	1,277	1,578	973	1,169	534
2. Future First Flush Retention Full DRCC	2,087	1,944	2,176	1,250	1,548	613
3. Future 100-Year, 2-Hour retention Avondale DRCC	1,078	1,073	1,312	887	1,124	534
4. Future First Flush Retention Avondale DRCC	2,087	1,073	1,312	887	1,124	534
5. Removed 95th Avenue Basin	2,087	2,145	2,368	1,560	1,548	613
6. 100-Year Phoenix Culverts, 100-Year 2-Hour Retention in Avondale	1,858	1,985	2,148	1,145	1,254	613
7. 10-Year Phoenix Culverts, 100-Year 2-Hour Retention in Avondale	1,430	1,520	1,625	831	1,113	613
8. 99th Avenue Storm Drain	1,085	872	1,144	842	1,169	534
Existing Conditions	1,610	1,185	1,193	711	602	66

Table 4.36 Selected Design Parameters for DRCC Alternatives

Channel reach	Design Discharge, in cfs	Channel Bottom width, in Feet	Channel Top width, in Feet	Right of Way width, in Feet	Flow depth, in Feet	Flow velocity, in Feet per Second	Channel depth, in Feet
<b>Alternative 1. Future 100-Year, 2-Hour retention Full DRCC</b>							
El Mirage Road to 115th Avenue	1,277	49	120	170	4.7	3.5	5.9
115th Avenue to 107th Avenue	1,578	127	199	249	4.8	2.1	6.0
107th Avenue to 99th Avenue	1,276	34	104	154	4.6	4.5	5.8
<b>Alternative 2. Future First Flush Retention Full DRCC</b>							
El Mirage Road to 115th Avenue	1,944	84	155	205	4.7	3.7	5.9
115th Avenue to 107th Avenue	2,176	181	253	303	4.8	2.2	6.0
107th Avenue to 99th Avenue	1,713	51	121	171	4.6	4.7	5.8
<b>Alternative 3. Future 100-Year, 2-Hour retention Avondale DRCC</b>							
El Mirage Road to 115th Avenue	1,073	39	110	160	4.7	3.4	5.9
115th Avenue to 107th Avenue	1,312	103	175	225	4.8	2.1	6.0
<b>Alternative 4. Future First Flush Retention Avondale DRCC</b>							
El Mirage Road to 115th Avenue	1,580	65	136	186	4.7	3.6	5.9
115th Avenue to 107th Avenue	1,312	103	175	225	4.8	2.1	6.0
<b>Alternative 5. Removed 95th Avenue Basin</b>							
El Mirage Road to 115th Avenue	2,145	94	165	215	4.7	3.7	5.9
115th Avenue to 107th Avenue	2,368	197	269	319	4.8	2.2	6.0
107th Avenue to 99th Avenue	1,964	61	132	182	4.6	4.8	5.9
<b>Alternative 6. 100-Year Phoenix Culverts</b>							
El Mirage Road to 115th Avenue	1,985	86	157	207	4.7	3.7	5.9
115th Avenue to 107th Avenue	2,148	185	257	307	4.8	2.1	6.0
<b>Alternative 7. 10-Year Phoenix Culverts</b>							
El Mirage Road to 115th Avenue	1,520	62	133	183	4.7	3.6	5.9
115th Avenue to 107th Avenue	1,625	131	203	253	4.8	2.1	6.0
<b>Alternative 8. 99th Avenue Storm Drain</b>							
El Mirage Road to 115th Avenue	979	34	105	155	4.7	3.3	5.9
115th Avenue to 107th Avenue	1,144	88	160	210	4.8	2.0	6.0
107th Avenue to 99th Avenue	993	22	93	143	4.6	4.4	5.9

Table 4.37 DRCC Alternative Cost Summary

ALTERNATIVE	DRCC COST IN AVONDALE	DRCC COST IN PHOENIX	DRCC TOTAL COST
1. Future 100-Year, 2-Hour retention, Full DRCC	\$ 30,542,026	\$ 33,249,609	\$ 63,791,635
2. Future First Flush Retention Full DRCC	\$ 38,121,750	\$ 35,600,080	\$ 73,721,830
3. Future 100-Year, 2-Hour retention Avondale DRCC	\$ 28,320,808	\$ -	\$ 28,320,808
4. Future First Flush Retention Avondale DRCC	\$ 33,238,109	\$ -	\$ 33,238,109
5. Removed 95th Avenue Basin, First Flush Retention	\$ 39,083,288	\$ 23,884,959	\$ 62,968,247
6. 100-Year Phoenix Culverts, 100-Year 2-Hour Retention in Avondale	\$ 38,311,021	\$ -	\$ 38,311,021
7. 10-Year Phoenix Culverts, 100-Year 2-Hour Retention in Avondale	\$ 32,360,002	\$ -	\$ 32,360,002
8. 99th Avenue Storm Drain	\$ 27,471,851	\$ 43,789,517	\$ 71,261,316

## 5 PLAN EVALUATION/RECOMMENDATION

### 5.1 EVALUATION

The following observations can be made from the comparison of alternatives:

- With the exception of Alternative 8 (the 99<sup>th</sup> Avenue Storm Drain Alternative), all of the alternatives increase discharges in Avondale above existing conditions, potentially resulting in a higher cost for the Avondale portion of the DRCC. The 99<sup>th</sup> Avenue Storm Drain Alternative keeps the discharge at existing levels at 107<sup>th</sup> Avenue, but at an additional cost of approximately \$11,000,000 in the City of Phoenix. The storm drain would have local flooding benefits as well as benefits to the DRCC. However, since the conceptual storm drain described in this report is designed to reduce discharges in the DRCC in Avondale, the majority of the \$11,000,000 cost would be related to the DRCC.
- Alternatives with the DRCC in Phoenix are approximately \$35,000,000 to \$41,000,000 more costly than those with the DRCC only in Avondale. With the exception of the Full DRCC, First Flush scenario, alternatives with the DRCC in Phoenix may not be practical as a result of past and ongoing retention in the DRCC right of way in the City of Phoenix.
- Whereas Future First Flush Retention Full DRCC (Alternative 2) may be practical in Phoenix, it is also the most costly of all the alternatives, and it may provide little flood control benefit for Phoenix. Removing the 95th Avenue Basin from this option could save approximately \$11,000,000 in overall costs.
- DRCC costs are lowest overall with 100-year, 2-hour retention adjacent to the channel. 100-year, 2-hour retention removes most of the runoff from each subbasin, including the peak, so DRCC discharges, and costs, are low. First flush retention allows peak flow rates to be much higher, resulting in higher DRCC costs. By comparison, first flush scenario DRCC costs are approximately 5 to 7.5 million dollars higher than 100-year, 2-hour retention scenarios in Avondale, and slightly more than 2 million dollars higher in Phoenix.
- Should culverts be installed at major roadways in the City of Phoenix, the retention which is now in the DRCC alignment would be removed, resulting in higher design peaks and additional DRCC costs of approximately 2 to 7.7 million dollars in the City of Avondale.
- Removing the 95th Avenue Basin as currently designed would have no effect on the DRCC cost for the 100-year, 2-hour retention scenario. For the full DRCC, first flush scenario, removing the 95th Avenue Basin produces a DRCC cost saving of approximately 12 million dollars for the City of Phoenix, but a 1 million-dollar increase for the City of Avondale.

Table 5.1 provides a summary of these cost differences for comparison purposes.

**Table 5.1 Summary of DRCC Design Scenario Modifications on DRCC Cost**

BASIC DRCC ALTERNATIVE DESIGN SCENARIO	APPROXIMATE COST EFFECT IN AVONDALE	APPROXIMATE COST EFFECT IN PHOENIX	APPROXIMATE TOTAL COST EFFECT
First Flush Retention	\$5,000,000 to \$7,500,000 Increase	\$2,000,000 Increase	\$7,000,000 to \$9,500,000 Increase
No DRCC in Phoenix	\$2,000,000 to \$5,000,000 Decrease	\$33,000,000 Decrease. Entire DRCC cost in Phoenix is avoided.	\$35,000,000 to \$41,000,000 Decrease.
100-Year or 10-Year Access Culverts in Phoenix	\$2,000,000 to \$7,700,000 Increase	\$33,000,000 Decrease. Entire DRCC cost in Phoenix is avoided. Culvert cost not included as not part of the DRCC.	\$25,500,000 to \$31,000,000 Decrease.
99 <sup>th</sup> Avenue Storm Drain	\$3,000,000 Decrease	\$11,000,000 Increase	\$8,000,000 Increase
Remove 95th Avenue Basin	\$1,000,000 Increase (First flush scenario only)	\$12,000,000 Decrease	\$11,000,000 Decrease
All comparisons are to the Full DRCC, 100-year, 2-hour retention scenario (Alternative 1, Baseline Future Conditions).			

Based on presentation of these results and discussions with the stakeholders during the course of this study, it was determined that:

- Participation by the City of Phoenix in the DRCC project will be limited due to budget constraints and development timing considerations.
- It is anticipated that the City of Phoenix will install culverts along the DRCC alignment in order to attain 100-year flood access at the major arterial streets. However, to do so would exacerbate the flood risk in Avondale. Thus, a detention basin should be constructed at or in the vicinity of 95<sup>th</sup> Avenue to prevent increased discharges resulting from the installation of the culverts.
- The Cities and the District agreed to limit the discharge at 107<sup>th</sup> Avenue to 1,312 cfs per the Future 100-Year, 2-Hour (Phoenix) Retention, Avondale DRCC condition represented by Alternatives 3 and 4 for any selected projects.

Based on the above analysis and determinations by the City of Avondale and City of Phoenix, the recommended DRCC consists of:

- Constructing the DRCC channel in Avondale only.
- Requiring only first flush retention by future development in Avondale and Phoenix adjacent to the DRCC alignment (there is little or no difference in total flood control cost in Avondale between the first flush and 100-year, 2-hour retention scenarios).
- Requiring 100-year, 2-hour retention in Phoenix which should be located adjacent to/in the original DRCC proposed alignment
- Limit the 100-year discharge at 107<sup>th</sup> Avenue to approximately 1,300 cfs with a basin located at approximately 95<sup>th</sup> Avenue on the south side of the retention/drainage (former DRCC alignment) corridor in Phoenix.

## 5.2 RECOMMENDATION

### 5.2.1 Description

Figure 5.1 provides a plan view and typical cross sections for the recommended plan. The alignment of the DRCC is the same as in the original Dibble (2002) design with the exception of some minor modification just downstream of 107<sup>th</sup> Avenue due to changes requested by stakeholders. Channel depths and slopes are the same as in the original design. The detention basin at approximately the 95<sup>th</sup> Avenue alignment, referred to as the 95<sup>th</sup> Avenue Basin, is converted to an in-line (flow-through) basin. The purpose of this basin is to ensure that the 100-year discharge at 107<sup>th</sup> Avenue not exceed approximately 1,300 cfs.

### 5.2.2 Hydrology

Design discharges for the recommended plan DRCC in Avondale are based on the assumptions of 100-year, 2-hour retention for new development throughout the DRCC drainage area except for new development adjacent to the DRCC channel in Avondale. These adjacent developments in Avondale would retain first flush runoff only.

Table 5.2 provides the results of the recommended plan hydrologic modeling. The design discharge at 107<sup>th</sup> Avenue is 1,318 cfs, which is slightly above the target discharge, but considered acceptable. This discharge can be refined during final design if necessary. Discharges downstream of 107<sup>th</sup> Avenue are approximately the same as those for Alternative 4: Future First Flush Retention, Avondale DRCC.

**Table 5.2 Recommended Plan Hydrology**

Concentration Point	100-Year, 6-Hour Discharge, in cfs <sup>a</sup>	100-Year, 24-Hour Discharge, in cfs	Design Discharge, in cfs
83 <sup>rd</sup> Avenue	345	272	345
91 <sup>st</sup> Avenue	876	370	876
99 <sup>th</sup> Avenue	1,038	661	1,038
107 <sup>th</sup> Avenue	1,318	1,119	1,318
115 <sup>th</sup> Avenue	1,205	1,062	1,205
El Mirage Road	2,043	2,654	2,654
Dysart Road	2,426	3,069	3,069

### 5.2.3 Conceptual Design

Table 5.3 provides general design discharges and dimensions. Channel top width ranges from 117 to 227 feet. Total right of way, not including any additions that may be required for aesthetic purposes, ranges from 167 to 277 feet. Total channel depth is approximately 6 feet. Design flow velocities range from a low of 2.1 feet per second between 115<sup>th</sup> Avenue and 107<sup>th</sup> Avenue, and a high of 3.8 feet per second between El Mirage Road and 115<sup>th</sup> Avenue.

**Table 5.3 Recommended Plan (DRCC) Design Parameters**

MAIN CHANNEL IN AVONDALE							
Channel Reach	Design Discharge, in cfs	Channel Bottom Width, in Feet	Channel Top Width, in Feet	Right of Way Width, in Feet	Channel Slope, in Feet per Foot	Flow Depth, in Feet	Channel Depth, in Feet
Downstream of Dysart Road	3,069	156	227	277	0.0014	4.7	5.9
Dysart Road to El Mirage Road	3,069	156	227	277	0.0014	4.7	5.9
El Mirage Road to Sunland Channel	1,645	69	140	190	0.0017	4.7	5.9
Sunland Channel to 115 <sup>th</sup> Avenue	1,205	46	117	167	0.0017	4.7	5.9
115 <sup>th</sup> Avenue to 107 <sup>th</sup> Avenue	1,318	49	121	171	0.0017	4.8	6.0
BASIN #1 (DOWNSTREAM OF DYSART)							
137-acre direct-inflow basin consisting of an excavated sand and gravel mine. Basin depth is up to 45 feet. Basin is drained by infiltration and by a 24-inch reinforced concrete pipe to the Agua Fria River. The basin includes a concrete inflow spillway 159 feet wide and 28 feet long. Portions of the basin above the groundwater level will be landscaped.							
BASIN #2 (DOWNSTREAM OF 95 <sup>TH</sup> AVENUE)							
Basin 6-feet deep with a 15.1-acre bottom area and 18.3-acre top area not including maintenance access. Side Slopes 6:1. Active storage depth 5 feet. Maintenance access 25 feet wide including a 16-foot ABC roadway. Entire basin and adjacent Right of Way not occupied by maintenance access road is landscaped. Basin is in-line. Inflow is directly from the DRCC. Total Right of Way is 29.2 acres.							
PHONEIX CULVERTS							
Culvert Location	Design Discharge, in cfs	Assumed Headwater, in feet	Culvert Height, in feet	Culvert Width, in feet	Number of Barrels		
83 <sup>rd</sup> Avenue	345	7	4	8	1		
91 <sup>st</sup> Avenue	862	7	4	10	2		
Detention Basin	388	7	4	9	1		
107 <sup>th</sup> Avenue	775	7	4	9	2		
Culvert design assumes inlet control. Culvert design discharge approximates the 10-year discharge and is intended to work in tandem with the detention basin to keep the 100-year discharge at 107 <sup>th</sup> Avenue to approximately 1,300 cfs. The 99 <sup>th</sup> Avenue culvert is already in place and has approximately a 10-year capacity.							

There are two detention basins. Basin #1 is located at the outfall per Dibble (2002). Basin #2, the 95th Avenue Basin, is located on the south side of the DRCC alignment in Phoenix at about the 95th Avenue alignment. Total depth of the 95th Avenue Basin is 6 feet. A 29.2-acre parcel is allotted for this basin.

Culverts in Phoenix are reinforced concrete boxes 4 feet in depth, and ranging from 8 to 9 feet in width. Depending on discharge, from one to two of these boxes would be needed at each roadway crossing.

#### 5.2.4 Cost

Table 5.4 provides a preliminary cost estimate. During the course of the study the land cost escalated by an average of 50 percent, so Recommended Plan estimated cost were adjusted to reflect this additional costs. The current estimated cost is \$40,930,226 for the Avondale portion, plus \$11,956,270 for the Phoenix portion (including culverts at arterials), for a total cost of \$52,886,496.

#### 5.2.5 Sunland Channel

##### 5.2.5.1 Description

Although not specifically included as part of the alternatives analysis, the recommended plan includes the Sunland Channel, which would run from 99th Avenue to the DRCC along the alignment shown in Figure 5.2. The Sunland Channel would be an earthen trapezoidal channel similar to the DRCC, but approximately 1,300 feet of the channel upstream of 115th Avenue would consist of a reinforced concrete box culvert below Sunland Avenue in order to avoid the need to purchase existing homes for channel right of way.

##### 5.2.5.2 Hydrology

Table 5.5 provides Sunland Channel 100-year hydrology. Areas adjacent to and draining directly into the channel that can potentially be developed in the future are assumed in the model to retain first flush runoff only. Other areas draining to the Sunland Channel are modeled either as existing development that will remain as-is, or future development with 100-year, 2-hour retention. The future land uses shown in Figure 2:1 were used as an indicator of future development density. 100-year discharges range from 303 cfs at 99th Avenue to 1,207 cfs at the confluence with the DRCC.

##### 5.2.5.3 Conceptual Design

Sunland Channel general design discharges and dimensions are presented in Table 5.6 and Figure 5.2. Channel top width ranges from 101 to 134 feet. Total right of way, not including any additions that may be required for aesthetic purposes, ranges from 151 to 160 feet. Total channel depth ranges from 5.9 to 6.9 feet. Channel design flow velocities range from approximately 2.6 feet per second downstream of 115th Avenue to 3.8 feet per second between 115th Avenue and 107th Avenue. Maximum flow velocity (not full flow) in the Sunland Avenue culvert is 8.9 feet per second. All flow is subcritical, with maximum Froude number of 0.70 in the culvert.

The Sunland channel downstream of 115th Avenue is 6.9 feet deep. This is one foot deeper than typically used elsewhere in the DRCC design in order to provide depth for the Sunland Avenue culvert, which is made 6-foot deep to fit within the 40-foot (narrowest) right of way in Sunland Avenue. Upstream of 107th Avenue, the channel bottom width is kept at a 20-foot minimum. With the relatively low discharge there, this results in a slightly lower channel flow depth than used elsewhere in the DRCC/Sunland Channel design.

**Table 5.4 Recommended Plan (DRCC) Preliminary Cost Estimate**

ITEM	QUANTITY	UNIT	UNIT COST	COST
<b>MAIN CHANNEL IN AVONDALE</b>				
Channel Excavation	509,946	CY	\$ 6	\$ 3,059,676
Channel Landscaping	78.1	AC	\$ 78,408	\$ 6,123,665
Channel Area	93.0	AC	\$ 150,000	\$ 13,950,000
Culvert Concrete	2,881	CY	\$ 669	\$ 1,927,389
Maintenance Road	14.9	AC	\$ 28,314	\$ 421,879
BFC Replacement	5506	LF	\$ 148	\$ 814,888
Total Channel Cost				\$ 26,297,497
<b>BASIN #1 DOWNSTREAM OF DYSART ROAD IN AVONDALE</b>				
Basin Landscaping	24	AC	\$78,408	\$1,881,792
Right of Way	137	AC	\$10,000	\$1,370,000
Drain Pipe	4230	LF	\$148	\$ 626,040
Manholes	9	EA	\$ 4500	\$ 40,500
Headwall	1	EA	\$ 1,100	\$ 1,100
Inflow Spillway	253,572	SF	\$ 5	\$1,267,860
Total Basin Cost				\$5,187,292
<b>BASIN #2 AT 95<sup>TH</sup> AVENUE IN PHOENIX</b>				
Excavation	161,446	CY	\$ 6.00	\$ 968,676
Basin Landscaping	27.7	AC	\$ 78,408	\$ 2,171,902
Right of Way	29.2	AC	\$150,000	\$ 4,380,000
Maintenance Road	1.5	AC	\$ 28,314	\$ 42,471
Total Basin Cost				\$ 7,563,049
<b>CULVERTS AT 83RD, 91ST, 95TH, AND 107<sup>TH</sup> AVENUES IN PHOENIX</b>				
Culvert Concrete	653	CY	\$ 669	\$ 436,857
<b>CHANNEL EXCAVATION UPSTREAM OF 107<sup>TH</sup> AVENUE AND 91<sup>ST</sup> AVENUE IN PHOENIX*</b>				
Excavation	20,886	CY	\$ 6	\$ 125,316
Basin Landscaping	3.6	AC	\$ 78,408	\$ 282,269
Right of Way	5.0	AC	\$ 150,000	\$ 750,000
Maintenance Road	1.4	AC	\$ 28,314	\$ 39,640
Total Channel Cost				\$ 1,197,225
<b>COST SUMMARY</b>				
Avondale Subtotal				\$ 31,484,789
Avondale Contingency 30%				\$ 9,445,437
Avondale Total				\$ 40,930,226
Phoenix Subtotal				\$ 9,197,131
Phoenix Contingency 30%				\$ 2,759,139
Phoenix Total				\$ 11,956,270
<b>DRCC Total</b>				<b>\$ 52,886,496</b>

\* Costs approximate. These channels direct flow to the culverts and may not be needed depending on final design.

**Table 5.5 Sunland Channel Discharges at Key Concentration Points**

Concentration Point	100-Year, 6-Hour Discharge in cfs	100-Year, 24-Hour Discharge in cfs	Design Discharge in cfs
99 <sup>th</sup> Avenue	303	145	303
107 <sup>th</sup> Avenue	776	919	919
115 <sup>th</sup> Avenue	1,122	1,207	1,207

The Sunland Avenue Culvert is designed as a three-barrel, 6-foot by 9-foot reinforced concrete box below Sunland Avenue. The design is based on normal flow calculations using a roughness coefficient of 0.014, and assuming the culvert is flowing full. Culvert slope is as presented in Table 5.6. This culvert would have a length of approximately 1,388 feet.

**Table 5.6 Sunland Channel Design Parameters**

Channel reach	Design Discharge, in cfs	Channel Bottom Width, in Feet	Channel Top Width, in Feet	Right of Way Width, in Feet	Channel Slope, in Feet per Foot	Flow Depth, in Feet	Channel Depth, in Feet
DRCC to 115 <sup>th</sup> Avenue	1,207	51	134	159	0.0008	5.5	6.9
115 <sup>th</sup> Avenue to 107 <sup>th</sup> Avenue*	1,207	39	110	160	0.0022	4.7	5.9
107 <sup>th</sup> Avenue to 99 <sup>th</sup> Avenue	919	30	101	151	0.0018	4.7	5.9
SUNLAND AVENUE CULVERT							
Design Discharge, in cfs	Culvert Barrel Height, in Feet	Culvert Barrel Width, in Feet	Number of Barrels	Culvert Length, in feet	Right of Way Width, in Feet		
1,207	6	9	3	1,388	40		

\* Not including culvert in Sunland Avenue.

#### 5.2.5.4 Cost

Tables 5.7 and 5.8 provide a preliminary cost estimate. The estimated cost is \$ 17,757,741; of which right of way is the most costly single item, followed by the Sunland Avenue culvert and landscaping.

**Table 5.7 Sunland Channel Cost Estimate by Cost Item**

COST ITEM	QUANTITY	UNIT	UNIT COST	COST
Excavation	202,073	CY	\$ 6	\$ 1,212,438
Landscaping	34.5	AC	\$ 78,408	\$ 2,705,076
Right of Way	42.0	AC	\$ 150,000	\$ 6,300,000
Culvert Concrete	4,828	CY	\$ 669	\$ 3,229,932
Maintenance Road	7.5	AC	\$28,314	\$ 212,355
Subtotal				\$ 13,659,801
Contingency 30%				\$ 4,097,940
Total Cost				\$ 17,757,741

**Table 5.8 Sunland Channel Cost by Reach**

REACH	COST
DRCC to 115 <sup>th</sup> Avenue	\$ 2,728,993
115 <sup>th</sup> Avenue to 107 <sup>th</sup> Avenue*	\$ 6,388,214
107 <sup>th</sup> Avenue to 99 <sup>th</sup> Avenue	\$ 4,542,594
Subtotal	\$ 13,659,801
Contingency 30%	\$ 4,097,940
Total	\$ 17,757,741

## 6 EFFECT OF PROPOSED I-10 RELIEVER AND SOUTH MOUNTAIN FREEWAYS

Long-term transportation plans for the region call for the possible construction of two new freeways in the DRCC area. These are the I-10 Reliever and the South Mountain Freeways. Since these freeways may be constructed within the DRCC drainage area, they could possibly have an effect on the DRCC.

The I-10 Reliever Freeway would be an east-west freeway probably between Interstate 10 and the Gila River. There are alternative alignments to I-10 Reliever Freeway in the DRCC area (URS, 2005). One alternative runs along the BFC from (across) Basin #1 straight east/west to approximately 111<sup>th</sup> Avenue, where it deflects northward at about a 10-degree angle and continues in a northeasterly direction. A second alternative runs nearly parallel to the first, but dips below Southern Avenue between Dysart

Road and El Mirage Road. This alternative converges with the alignment of the first alternative near 99<sup>th</sup> Avenue. Both of these alternatives could affect the DRCC by (1) crossing Basin #1 and thereby affecting the Basin #1 capacity, and (2) cutting off a small part of the drainage area from the southern boundary thereby decreasing flood peaks in the Sunland Channel and the DRCC downstream of the Sunland Channel. Both of these effects, should they occur, would likely have minor effect on the DRCC. Basin #1 and its outlet could be reconfigured to avoid adverse effect from the freeway, and the drainage area potentially cut off by the freeway would be small compared to the DRCC watershed.

A third, less likely, I-10 Reliever alternative would cross the north-south alignment of the DRCC between 115<sup>th</sup> Avenue and El Mirage Road. This alignment would basically bisect the DRCC drainage area between the DRCC channel and the Sunland Avenue channel. However, little effect on DRCC discharges is expected because the basic drainage area would not likely be altered except possibly in the extreme western portion of the watershed where some sub-basins draining south to the west end of the DRCC could be cut off.

As of August 2005, there are six alternative alignments for the South Mountain Freeway in the vicinity of the DRCC (ADOT, 2005). Four alternatives extend south through the DRCC drainage area from the State Route 101 and I-10 interchange. Two have a north/south alignment along 99<sup>th</sup> Avenue to Lower Buckeye where they bend and continue in a southeasterly direction toward the western extent of South Mountain. The other two alignments continue from the interchange in a southeasterly direction to the western extent of South Mountain. The final two alternatives are east of 75<sup>th</sup> Avenue.

The two South Mountain Freeway alternatives east of 75<sup>th</sup> Avenue would have negligible effect on the DRCC because they are in an area that contributes only minimal drainage to the DRCC. All of the remaining South Mountain alternatives are in Phoenix where the recommended DRCC consists of culverts and a detention basin only. The culverts are unlikely to be affected, and if they were, would be rebuilt. None of the alignments as currently proposed would cross the proposed site of the 95<sup>th</sup> Avenue Detention Basin. However, it is possible that this basin could be affected depending on the residential land use pattern at the time the freeway is designed. If so, there would be a possibility of reducing retention and increasing DRCC discharges above the design level in Avondale. Although the four South Mountain alternatives originating at the State Route 101 and I-10 interchange cross the DRCC drainage area, it is unlikely these would substantially affect the DRCC drainage area.

## 7. ENVIRONMENTAL CONSIDERATIONS

Environmental considerations are generally as described in Dibble (2002). Main considerations include water quality, biology, environmental contamination, and cultural resources. Although not an environmental consideration, the project will affect irrigation canals.

### Water Quality

Section 404 of the United States Clean Water Act authorizes the U.S. Army Corps of Engineers to regulate fill into the waters of the U.S. The Agua Fria River, which would be the outfall of the DRCC, as well as the BFC, are likely jurisdictional, and construction of the DRCC would require a 404 Permit. The basic purpose of a 404 Permit is to ensure that losses or impacts to waters of the U.S. and adjacent wetlands through fill are avoided where possible, and minimized and mitigated where avoidance is not possible. Obtaining a 404 Permit would basically involve (1) delineating the waters of the U.S. and adjacent wetlands within the project limits; (2) identifying and quantifying fill to be placed into the waters of the U.S., in terms of fill nature, quantity and location; (3) identifying biological conditions at the site, including any endangered species that may be present; (4) conducting a cultural resources survey to identify cultural resources that could be affected; (5) developing and evaluating

project alternatives that may avoid or minimize impacts; and, (6) developing a mitigation plan acceptable to the Corps of Engineers. Some nationwide permits are available under 404 regulations. Nationwide permits are existing permits for certain activities. Compliance with nationwide permits usually requires a lesser level of effort on the part of the applicant. The most likely nationwide permit one for this project is Nationwide Permit #43, "Stormwater Management Facilities." This permit is limited to projects that affect less than 0.5 acre of waters of the U.S., and less than 300 linear feet of stream. It is likely the DRCC project would not qualify for the nationwide permit.

Activities requiring a 404 Permit also require Clean Water Act 401 Water Quality Certification administered by the Arizona Department of Environmental Quality. The 404 permit cannot be issued without 401 certification, which may include conditions to ensure that the draft 404 permit is in compliance with State water quality standards.

Construction activities affecting more than 5 acres, as would the DRCC, require compliance with the ADEQ Construction General Permit. The purpose of this permit is to avoid stormwater pollution from construction activities. Compliance requires notifying the ADEQ of the activity, and developing and adhering to a Stormwater Pollution Prevention Plan for the construction.

### **Biology**

Four federally-listed threatened or endangered 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 (Dibble, 2002). The cactus ferruginous pygmy owl is currently in the process of being de-listed.

Habitat for the pygmy owl, southwestern willow flycatcher, desert tortoise, and western yellow-billed cuckoo is marginal or non-existent on the DRCC site, which is dominated by agriculture and a man-made irrigation canal. Compliance with 404 regulations will require a survey for endangered and threatened species. Should any of these be found on the site, consultation with the U.S. Fish and Wildlife Service will determine appropriate mitigation.

Although the species is not listed as threatened or endangered, the site is home to burrowing owls. These generally have burrows along the BFC. These animals should be relocated, if possible, where construction will adversely affect them.

### **Environmental Contamination**

Dibble (2002) gives a list of sites within the DRCC area that could be contaminated with hazardous wastes. Prior to construction, a survey should be conducted to determine what contaminated sites may be in the path of the DRCC, and what measures may be appropriate to mitigate any adverse effects that may occur from disturbing these sites.

### **Cultural Resources**

As described in Dibble (2002), the site was occupied by the Hohokam culture, resulting in a possibility that subsurface excavations could uncover prehistoric sites of significance. Other historic sites could be encountered as well. However, there are no known archaeological sites within the project area (Dibble, 2002). Monitoring of construction activities by a qualified archaeologist should be conducted to ensure that any sites encountered are not adversely impacted.

## Irrigation Canals

The BFC and other irrigation canals in the project area are operated by the Salt River Project (SRP). The DRCC will cross the BFC, as well as tributary canals. Coordination with the SRP will be required to ensure that the DRCC construction not adversely affect irrigation flow.

## 8. NEW DEVELOPMENT WITHOUT THE DRCC

The DRCC is being currently proposed to be constructed with sufficient capacity, so that planned developments within the City limits for Avondale and adjacent to the facility DRCC could drain directly into the DRCC. This would allow these developments to avoid the 100-year, 2-hour retention requirement. However, the first flush retention requirement would still be required. Should the DRCC not be constructed, these developments would be required to retain the 100-year, 2-hour runoff, as well as make accommodations for offsite runoff and associated floodplains along the BFC alignment. Each development would have to be protected from flooding, as well as ensure that the development not block or divert offsite flow, or otherwise result in an adverse affect, flooding or erosion, on the upstream or down stream properties.

Probable development requirements without the DRCC in place were assessed for four developments currently proposed along the DRCC alignment from approximately 107<sup>th</sup> Avenue to the Agua Fria River. These are the Lakin, Silver Bullet, and Shadow Ridge developments in Avondale, and the Lion's Gate development in Phoenix (Figure 2.3). Internal drainage, street drainage, or other offside drainage requirements not related to the BFC and Sunland Channel drainage are not considered. Existing conditions BFC discharges are assumed. These discharges are not the same as those used for the recommended plan. A final hydrologic analysis appropriate for each development could result in different design discharges which could be higher than those used in this analysis. Figure 2.3 shows the most likely anticipated drainage improvements. The following is a narrative describing these required drainage improvements.

### 8.1 LAKIN

The Lakin development is approximately 1,160 acres located north of the BFC between Dysart Road and 115<sup>th</sup> Avenue. As shown in Figure 2.3, this development is subject to flooding from drainage along the BFC, and along the Sunland Avenue Channel. The property is also subject to flooding from the Gila River, although Gila River flooding is not an issue for this report.

Development of the Lakin property would require either avoidance of the floodplain areas, or collecting floodplain flows and conveying them through the property to be discharged downstream. For purposes of this analysis it is assumed that the floodplain would be collected and conveyed rather than avoided. Since the floodplain enters across the entire east property line, a collector channel would have to run along the entire east property line. A conveyance channel would run along the entire south property line, parallel to the BFC. In the absence of a downstream receiver channel the flows would need to be returned to the original floodplain width downstream of the property in order to avoid causing erosion damage to downstream property. A spreader channel would accomplish this. In addition to collecting and conveying flows through the property, the development would be required to retain the 100-year, 2-hour runoff. Drainage features are shown in Figure 2.3 and described briefly in Table 8.1.

**Table 8.1 Conceptual Lakin Drainage Improvements in Absence of DRCC**

DRAINAGE FEATURE	DESCRIPTION
Collector Channel	Bottom width 40 feet (may vary). Side Slopes 1:1. Lining 6-inch shotcrete to provide protection from incoming side flows. Channel depth 5.9 feet (may vary). Mannings roughness 0.023. Slope 0.0017. Design discharge 1,385 cfs (varies). Maximum flow depth 4.7 feet (may vary). Maximum flow velocity 6.6 fps. Total right of way width 55 feet.
Conveyance Channel	Bottom width 74 feet (may vary). Side Slopes 6:1. Lining grass. Channel depth 5.9 feet. Mannings roughness 0.040. Slope 0.0014. Design discharge 1,582 cfs (varies). Maximum flow depth 4.7 feet. Maximum flow velocity 3.3 fps. Total right of way width 145 feet. Basic design for this channel is based on the DRCC design.
Roadway Culverts	1 concrete box culvert, 4-barrel, 8 feet by 4 feet for the collector channel. 1 concrete box culvert, 4-barrel, 9 feet by 4 feet for the conveyance channel.
Spreader Channel	Bottom width average 65 feet (varies). Side Slopes 6:1. Lining grass. Channel depth average 3 feet (varies). Total right of way width with maintenance access averages 68 feet. Channel is designed for spreading flows, not for flood control conveyance.
Retention	137.3 acre feet. Based on 185.6 acre-feet 100-year, 2-hour runoff from 1,160 acres medium density residential development minus 48.3 acre feet first flush retention from the same area. Assumed retention depth 3 feet with 1 foot freeboard. Excavation required (including freeboard) 296,586 cubic yards. Land area required 47.7 acres. First flush retention is required in all cases for water quality purposes. 100-year 2-hour retention is for flood control purposes.
Drainage features are conceptual and for comparison purposes in this report only. No other use is implied or intended.	

The conceptual cost estimate for the drainage improvements described in Table 8.1 is provided in Table 8.2. The estimated cost for required offsite drainage if the BFC and Sunland Channel project are not built on the Lakin parcel is approximately \$15,165,621.

This, as well as all subsequent development cost estimates do not include the cost of land or landscaping for the 100-year, 2-hour retention. These costs were not included for the reason that the City of Avondale has an open-space requirement that is generally larger than the amount of land that would be required for retention. Since retention basins, properly located and landscaped, could double as open space, the retention cost was considered to be the cost of excavation only.

## 8.2 SILVER BULLET

The Silver Bullet development is approximately 250 acres located west of Avondale Boulevard (115<sup>th</sup> Avenue) between the Lakin development and Lower Buckeye Road (Figure 2.3). This development is not within the BFC floodplain, and would have no associated drainage improvements other than retention, onsite drainage, and offsite drainage not related to the BFC. The retention related to flood control (100-year, 2-hour retention minus first flush retention) is approximately 29.6 acre feet, requiring a retention excavation volume of approximately 64,267 cubic yards. At \$2/cubic yard for excavation, the cost of this retention is \$128,534. With 30 percent contingency: \$167,000.

**Table 8.2 Estimated Drainage Feature Cost for Lakin Development Assuming no DRCC**

ITEM	QUANTITY	UNIT COST	COST
<b>COLLECTOR CHANNEL</b> (Length 4,800 Feet)			
Excavation Volume, Cubic Yards	48,144	\$ 2	\$ 96,288
Shotcrete Volume, Cubic Yards	5,600	\$ 310	\$ 1,736,000
Total Right of Way, Acres	6.1	\$ 150,000	\$ 915,000
Culvert Concrete, Cubic Yards	403	\$ 669	\$ 269,607
Total Collector Channel Cost			\$ 3,016,895
<b>MAIN CHANNEL</b> (Length 9,000 Feet)			
Excavation Volume, Cubic Yards	215,153	\$ 2	\$ 430,306
Channel Landscape Area, Acres	30.0	\$ 78,408	\$ 2,352,240
Total Right of Way, Acres	30.0	\$ 150,000	\$ 4,500,000
Culvert Concrete, Cubic Yards	436	\$ 669	\$ 291,684
Total Main Channel Cost			\$ 7,574,230
<b>SPREADER CHANNEL</b> (Length 1,000 Feet)			
Excavation Volume, Cubic Yards	5,556	\$ 2	\$ 11,112
Channel Landscape Area, Acres	1.6	\$ 78,408	\$ 125,453
Total Right of Way, Acres	2.3	\$ 150,000	\$ 345,000
Total Spreader Channel Cost			\$ 481,565
<b>RETENTION</b> (100-Year, 2-Hour Minus First Flush)			
Excavation Volume, Cubic Yards	296,586	\$ 2.00	\$ 593,172
Total Retention Cost*			\$ 593,172
<b>TOTAL COST, ALL FEATURES</b>			<b>\$ 11,665,862</b>
Contingency 30%			\$ 3,499,759
<b>TOTAL COST WITH CONTINGENCY</b>			<b>\$ 15,165,621</b>
* Retention land cost and landscaping cost assumed zero. Entire 47.7-acre retention area can be used as required open space.			

### 8.3 SHADOW RIDGE

The Shadow Ridge development is approximately 240 acres north of the BFC between Avondale Boulevard and 107<sup>th</sup> Avenue (Figure 2.3). A portion of this property is subject to BFC flooding.

Development of the Shadow Ridge property in the absence of the DRCC would most likely require avoidance of the floodplain areas. Subdivision drainage would likely be into the BFC. In compliance with Salt River Project policy that development may not discharge point drainage into the BFC, this would likely require a spreader channel along most or all of the southern portion of the development adjacent to the BFC to allow discharges to enter the BFC in the same manner as under pre-development conditions. Basic drainage features for Shadow Ridge are shown in Figure 2.3 and described briefly in Table 8.3.

Table 8.4 provides a conceptual cost estimate for these drainage improvements. Estimated Shadow Ridge cost for required drainage is approximately \$1,602,128 excluding internal drainage, street drainage or other offside drainage not related to the BFC.

**Table 8.3 Conceptual Shadow Ridge Drainage Improvements in Absence of DRCC**

DRAINAGE FEATURE	DESCRIPTION
Spreader Channel	Bottom width average 10 feet. Side Slopes 6:1. Lining grass. Channel depth 4 feet. Channel length 1,400 feet. Total right of way width 58 feet. Channel is designed for spreading flows, not for flood control conveyance. Dimensions are conceptual and subject to change.
Retention	28.4 acre feet. Based on 38.4 acre feet 100-year, 2-hour runoff from 240 acres medium density residential development minus 10 acre feet first flush runoff from the same area. Assumed retention depth 3 feet with 1 foot freeboard. Excavation required (including freeboard) 61,814 cubic yards. Land area required 13.9 acres. First flush retention is required in all cases for water quality purposes. 100-year 2-hour retention is for flood control purposes.
Drainage features are conceptual and for comparison purposes in this report only. No other use is implied or intended.	

**Table 8.4 Estimated Drainage Feature Cost for Shadow Ridge Development Assuming no DRCC**

ITEM	QUANTITY	UNIT COST	COST
<b>SPREADER CHANNEL</b> (Length 3,500 Feet)			
Excavation Volume, Cubic Yards	17,630	\$ 2	\$ 35,260
Channel Landscape Area, Acres	4.7	\$ 78,408	\$ 368,518
Total Right of Way, Acres	4.7	\$ 150,000	\$ 705,000
Total Spreader Channel Cost			\$ 1,108,778
<b>RETENTION</b> (100-Year, 2-Hour Minus First Flush)			
Excavation Volume, Cubic Yards	61,814	\$ 2	\$ 123,628
Total Retention Cost*			\$ 123,628
<b>TOTAL COST, ALL FEATURES</b>			<b>\$ 1,232,406</b>
Contingency 30%			\$ 369,722
<b>TOTAL COST WITH CONTINGENCY</b>			<b>\$ 1,602,128</b>
* Retention land cost assumed zero. Entire 13.9-acre retention area can be used as required open space.			

#### 8.4 LION'S GATE

The Lion's Gate development is approximately 40 acres located at the southeast corner of the intersection of the BFC and 107<sup>th</sup> Avenue. Approximately half of this property is subject to flooding from the BFC (Figure 2.3). Development of Lion's Gate in the absence of the DRCC would require collecting floodplain flows and conveying them through the property to be discharged downstream. As with the Lakin development, this would require a collector channel, a conveyance channel, and a spreader channel. 100-year, 2-hour retention would also be required. Conceptual drainage features are shown in Figure 2.3 and described briefly in Table 8.5. Additionally, since this development is located within the City of Phoenix the development will have to provide these features regardless. The following is an example of the cost contributions that could have been considered for the project with the City of Phoenix. At this time, the project will be designed to maintain the existing flows from the City of Phoenix.

**Table 8.5 Conceptual Lion's Gate Drainage Improvements in Absence of DRCC**

DRAINAGE FEATURE	DESCRIPTION
Collector Channel	Bottom width 40 feet (may vary). Side Slopes 1:1. Lining 6-inch shotcrete to provide protection from incoming side flows. Channel depth 5.9 feet (may vary). Mannings roughness 0.023. Slope 0.0032. Maximum discharge 1,193 cfs. Maximum flow depth 4.6 feet (may vary). Maximum flow velocity 8.6 fps. Total right of way width 41 feet.
Conveyance Channel	Bottom width 31 feet (may vary). Side Slopes 6:1. Lining grass. Channel depth 5.9 feet. Mannings roughness 0.040. Slope 0.0014. Maximum discharge 1,193 cfs. Maximum flow depth 4.6 feet. Maximum flow velocity 4.5 fps. Total right of way width 102 feet. Basic design for this channel is based on the DRCC design.
Spreader Channel	Bottom width average 15 feet (varies). Side Slopes 6:1. Lining grass. Channel depth average 3 feet (varies). Total right of way width averages 51 feet. Channel is designed for spreading flows, not for flood control conveyance.
Retention	4.7 acre feet. Based on 6.3 acre feet 100-year, 2-hour runoff from 40 acres medium density residential development minus 1.6 acre feet first-flush runoff from the same area. Assumed retention depth 3 feet with 1 foot freeboard. Excavation required (including freeboard) 10,353 cubic yards. Land area required 2.5 acres. First flush retention is required in all cases for water quality purposes. 100-year 2-hour retention is for flood control purposes.
Drainage features are conceptual and for comparison purposes in this report only. No other use is implied or intended.	

Table 8.6 provides a conceptual cost estimate for the Lion's Gate drainage improvements. Estimated cost is approximately \$1,654,649. These costs exclude internal drainage, street drainage or other offside drainage not related to the BFC.

**Table 8.6 Estimated Drainage Feature Cost for Lion's Gate Development Assuming no DRCC**

ITEM	QUANTITY	UNIT COST	COST
<b>COLLECTOR CHANNEL (Length 480 Feet)</b>			
Excavation Volume, Cubic Yards	3,346	\$ 2	\$ 6,692
Shotcrete Volume, Cubic Yards	436.0	\$ 310	\$ 135,160
Total Right of Way, Acres	0.5	\$ 150,000	\$ 75,000
Total Collector Channel Cost			\$ 216,852
<b>MAIN CHANNEL (Length 1,320 Feet)</b>			
Excavation Volume, Cubic Yards	19,153	\$ 2.00	\$ 38,306
Channel Landscape Area, Acres	3.1	\$ 78,408.00	\$ 243,065
Total Right of Way, Acres	3.1	\$ 150,000.00	\$ 465,000
Total Main Channel Cost			\$ 746,371
<b>SPREADER CHANNEL (Length 1,000 Feet)</b>			
Excavation Volume, Cubic Yards	3,573	2	\$ 7,146
Channel Landscape Area, Acres	1.2	78408	\$ 94,090
Total Right of Way, Acres	1.2	150000	\$ 180,000
Total Spreader Channel Cost			\$ 281,236
<b>RETENTION (100-Year, 2-Hour Minus First Flush)</b>			
Excavation Volume, Cubic Yards	10,353	\$ 2.00	\$ 28,348
Total Retention Cost*			\$ 28,348
<b>TOTAL COST, ALL FEATURES</b>			<b>\$ 1,272,807</b>
Contingency 30%			\$ 381,842
<b>TOTAL COST WITH CONTINGENCY</b>			<b>\$ 1,654,649</b>
* Retention land cost and landscaping cost assumed zero. Entire 2.5-acre retention area can be used as required open space.			

## 8.5 DEVELOPMENT SUMMARY

Table 8.7 provides a summary of expected conceptual development costs related to offsite drainage in the absence of the DRCC. Total cost is approximately \$18,589,000. Most of this cost is channel improvements. The rest is flood-related retention.

**Table 8.7 Expected Conceptual Development Costs Related to BFC and Sunland Avenue Flooding in the Absence of the DRCC**

DEVELOPMENT	CHANNEL COST	RETENTION COST	TOTAL COST
LAKIN	\$ 14,394,000	\$ 771,000	\$ 15,165,000
SILVER BULLET	\$ -	\$ 167,000	\$ 167,000
SHADOW RIDGE	\$ 1,441,000	\$ 161,000	\$ 1,602,000
LIONS GATE	\$ 1,618,000	\$ 37,000	\$ 1,655,000
TOTAL	\$ 17,453,000	\$ 1,136,000	\$ 18,589,000

Costs include 30% contingencies and are rounded to the nearest \$1,000.  
\*Shadow Ridge channel cost is floodplain set aside.

## 9 RECOMMENDATIONS AND FUTURE STUDIES

- The HEC-1 models used in this report were from the original ADMP study and modified as described in this report. Aside from the modifications described, the original model was generally accepted as accurate. The final design analysis should include a thorough checking and updating of the HEC-1 model for watershed and routing conditions as well as final design configuration.
- The original ADMP report was the main reference for topography and utilities in the development of the 10 percent design plans. The final design analysis should include a revised utility analysis.
- The hydraulic analysis presented herein is based on normal depth calculations, and inlet control calculations for most culverts. The final design analysis should be based on a more detailed hydraulic analysis, for instance using a backwater analysis such as HEC-RAS, and outlet control verification for the culvert design.
- The topography used in this analysis was the same as used in the original DRCC report. More detailed, updated topography should be obtained for the final design.
- No survey was performed for this analysis or for preparation of the 10 percent plans. Property lines are as presented in the original ADMP (Dibble, 2002). A property line survey will be required for the final design, and the design adjusted accordingly.
- The channel as presented in this report is basically the same as the original DRCC channel, with modifications mainly to the channel bottom width, although there are other minor changes. In some areas the channel as designed, with depth of 6 feet, 6:1 side slopes, and 50-foot maintenance right of way, may not be practicable given the existing topography at the site. Examples include the Sunland Channel upstream of 107<sup>th</sup> Avenue, and the DRCC downstream of 107<sup>th</sup> Avenue, where the top of channel as designed is several feet below the existing ground surface. This will require final design modifications such as flattening the channel slope, using steeper side slopes (which may have to be hardened) using a channel bed width that changes with linear distance, shifting the channel laterally, or increasing the right of way width.
- Right of way requirements may need to be adjusted upward for local conditions and for recreation access and aesthetic reasons. This includes the 95th Avenue Basin, which could serve a dual purpose as a park. A multiple-use basin might have a different configuration than shown in this report.
- Basin #1, downstream of Dysart Road, was not evaluated in this study. The design as presented herein is as presented in the original ADMP study. The cost estimate was changed to reflect a change in landscape area due to standing water in the gravel pit, and a modified land cost due to reduced use potential of an abandoned gravel pit. The design analysis for this basin should be revisited at the time of final design.

- Negotiations between the Flood Control District and the SRP regarding the disposition of irrigation flow crossing the DRCC at 107<sup>th</sup> Avenue are currently under way. The current (original) design of the DRCC downstream of 107<sup>th</sup> Avenue assumes the channel will be dropped to an elevation approximately ten feet below the invert of an SRP irrigation ditch alongside 107<sup>th</sup> Avenue. It will be possible to raise the channel invert approximately three feet, and possibly more depending upon negotiations with SRP. Raising the invert will allow a steeper channel slope between 107<sup>th</sup> Avenue and 115<sup>th</sup> Avenue, a narrower channel, and lower excavation and land cost.
- The Phoenix culverts are described as 10-year culverts, meaning that there will be overflow of the roadways during a 100-year flood. Although described as 10-year culverts, this return-period description is approximate. Culvert capacities were set to be approximately equivalent to a 10-year discharge, then adjusted as necessary to achieve, in conjunction with the 95th Avenue Basin, a maximum 100-year discharge of approximately 1,300 cfs at 107<sup>th</sup> Avenue. The existing culvert at 99<sup>th</sup> Avenue is assumed to remain in place (this culvert is approximately a 10-year culvert). Some grading and channel construction may be necessary to convey flow to culverts at 107<sup>th</sup> and 91<sup>st</sup> Avenues. A preliminary estimate of this has been made for the cost estimate.
- The modeling and design assumptions for flow upstream of 107<sup>th</sup> Avenue represent a best estimate at this time, are preliminary, and are subject to change dependent upon development which is currently in progress. The final design analysis should revisit this issue in detail, including hydrology and development retention, and make appropriate adjustments to the design as necessary.
- If the DRCC and Sunland Channel are constructed, a Letter of Map Revision should be sought from FEMA to remove those areas from the designated floodplain. Within the context of the submittal to FEMA, it should be realized that the discharges presented herein for design purposes are not necessarily the discharges used to delineate the floodplain. The Conditional Letter of Map Revision analysis will need to use the FEMA discharges, or demonstrate to FEMA that other discharges are appropriate.
- This study includes no sediment transport analysis. A sediment analysis should be performed as part of the final design analysis.

## 10 REFERENCES

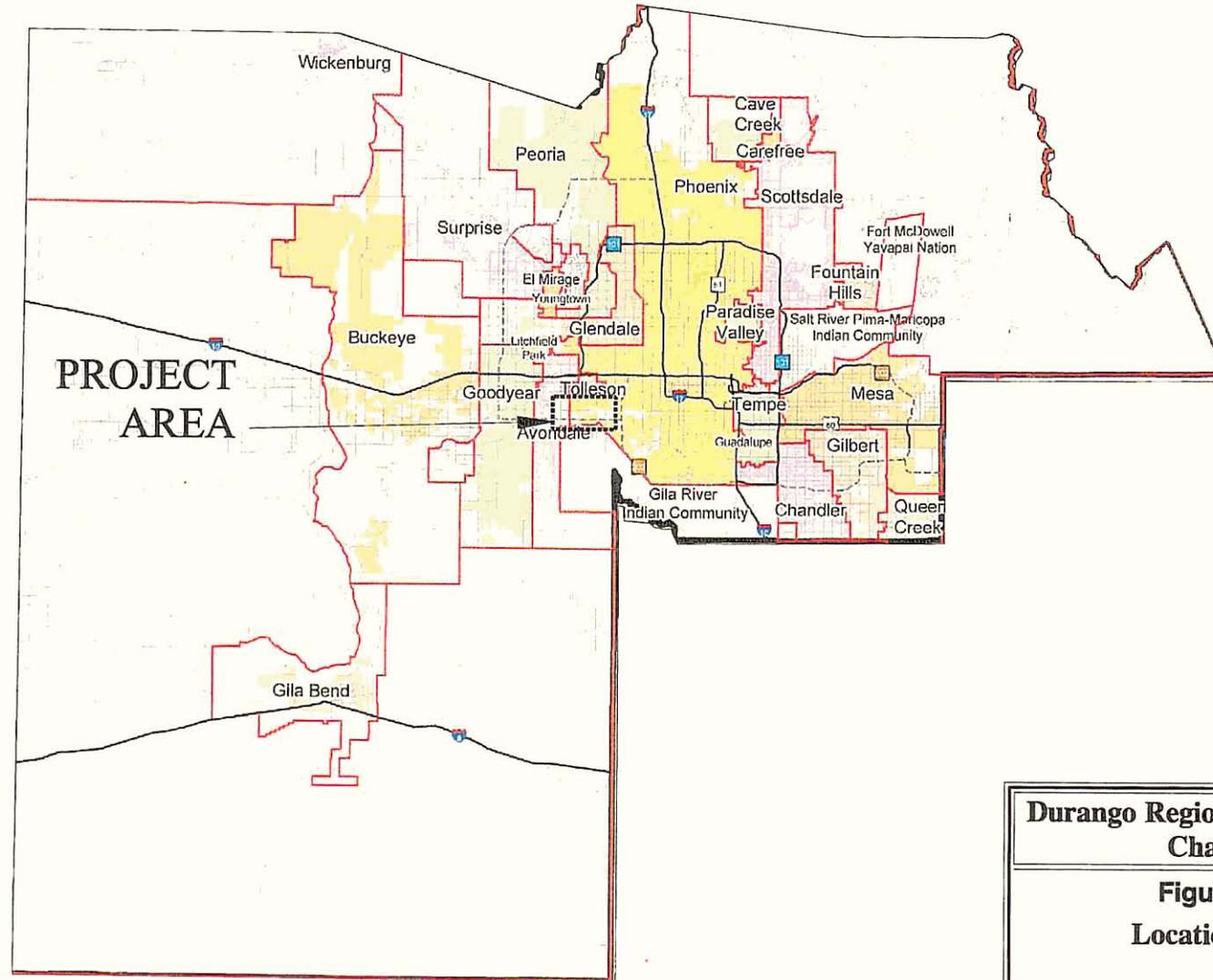
Dibble & Associates Consulting Engineers, *Durango Area Drainage Master Plan Recommended Design Report FCD #99-41*, October, 2002

Dibble & Associates Consulting Engineers, *Durango Area Drainage Master Plan FCD #99-41, Hydrology Report*, September, 2002

**CANDIDATE ASSESSMENT REPORT  
DURANGO REGIONAL CONVEYANCE  
CHANNEL**

**APPENDIX A: Report Figures.**

**February 2006**

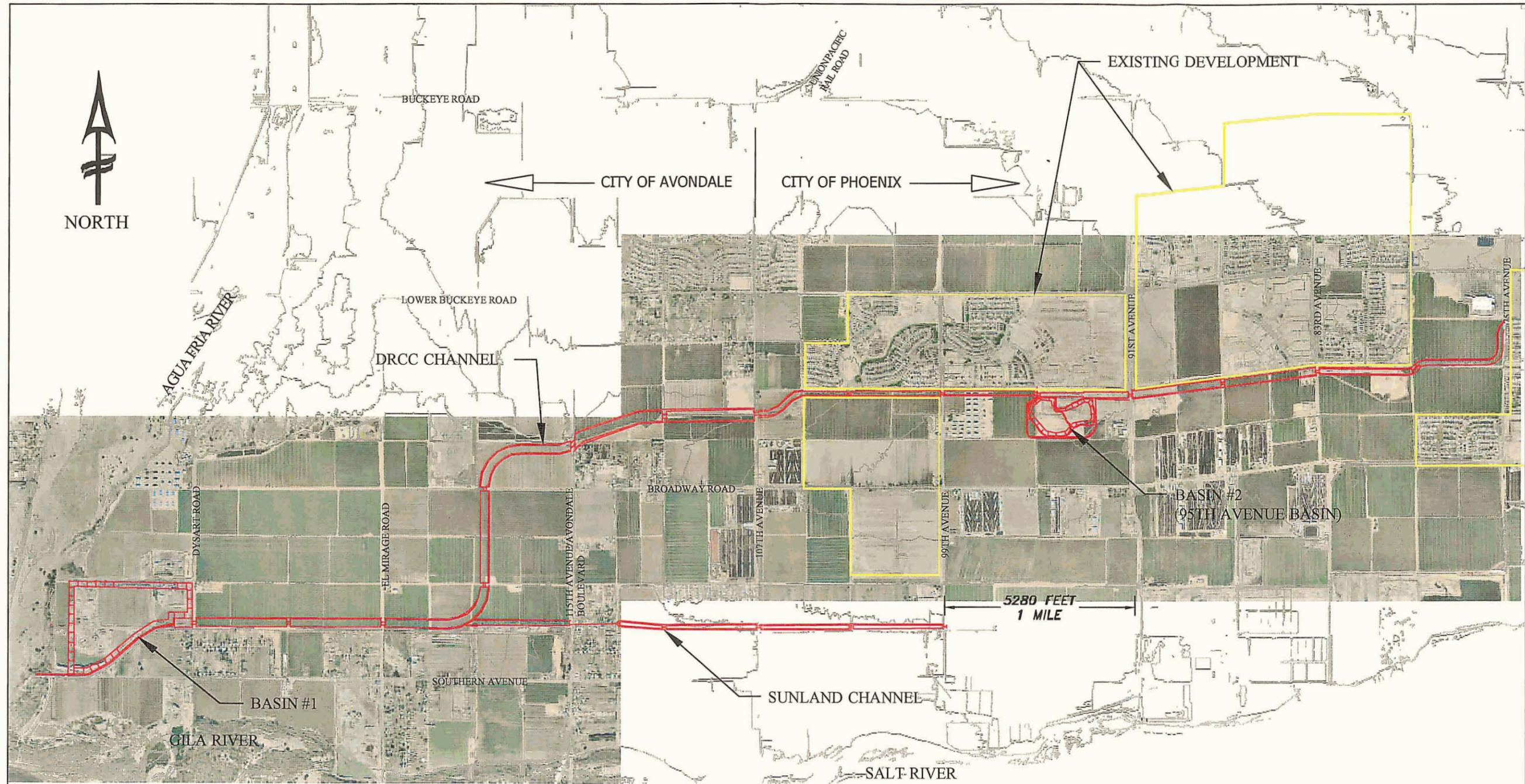


**Durango Regional Conveyance Channel**

**Figure 1.1**

**Location Map**

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NOTES:  
 CURRENT DEVELOPMENT SHOWN AS BLUE ROADWAY ALIGNMENTS.  
 ROADWAY ALIGNMENTS SOURCE: FCDMC GIS (2005).  
 AERIAL PHOTO SOURCE: FCDMC  
 AERIAL PHOTO DATE: 11/29/2004  
 DRCC ALIGNMENT LOCATION SOURCE: DIBBLE (2002).

**DRCC Alignment**

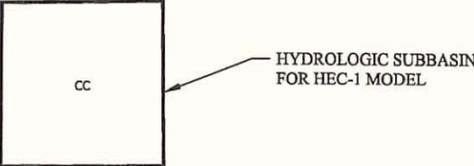
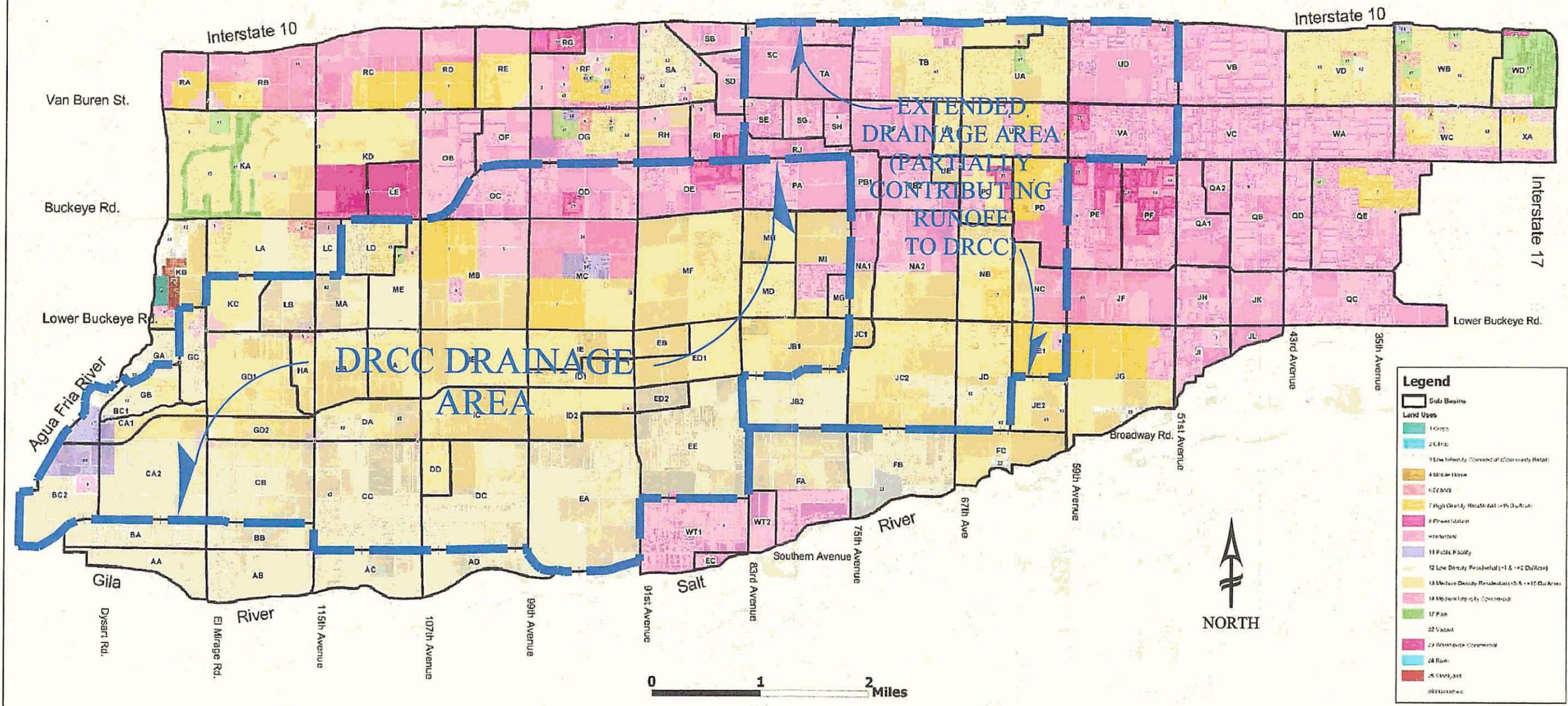
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FIGURE 1.2

PROJECT NO. P1005

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



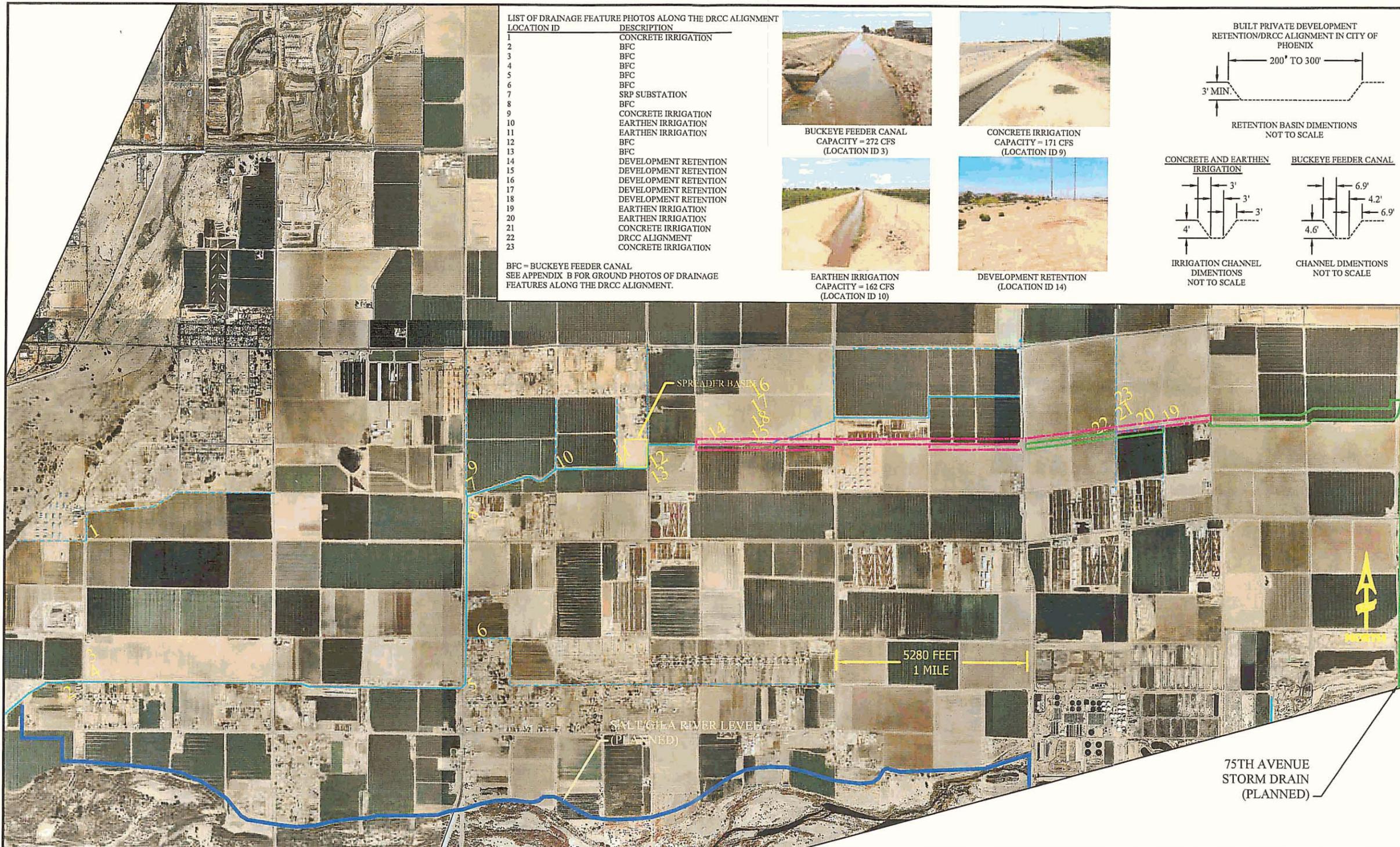
BASE MAP SOURCE DIBBLE & ASSOCIATES (2002).

DRCC DRAINAGE AREA AND FUTURE LANDUSE MAP

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FIGURE 2.1 PROJECT NO. P1005



LIST OF DRAINAGE FEATURE PHOTOS ALONG THE DRCC ALIGNMENT

LOCATION ID	DESCRIPTION
1	CONCRETE IRRIGATION
2	BFC
3	BFC
4	BFC
5	BFC
6	BFC
7	SRP SUBSTATION
8	BFC
9	CONCRETE IRRIGATION
10	EARTHEN IRRIGATION
11	EARTHEN IRRIGATION
12	BFC
13	BFC
14	DEVELOPMENT RETENTION
15	DEVELOPMENT RETENTION
16	DEVELOPMENT RETENTION
17	DEVELOPMENT RETENTION
18	DEVELOPMENT RETENTION
19	EARTHEN IRRIGATION
20	EARTHEN IRRIGATION
21	CONCRETE IRRIGATION
22	DRCC ALIGNMENT
23	CONCRETE IRRIGATION

BFC = BUCKEYE FEEDER CANAL  
 SEE APPENDIX B FOR GROUND PHOTOS OF DRAINAGE FEATURES ALONG THE DRCC ALIGNMENT.



BUCKEYE FEEDER CANAL  
 CAPACITY = 272 CFS  
 (LOCATION ID 3)



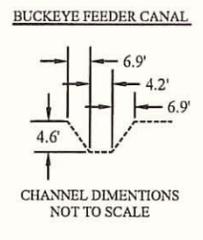
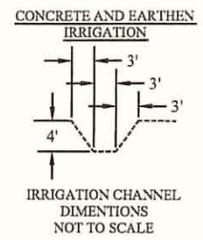
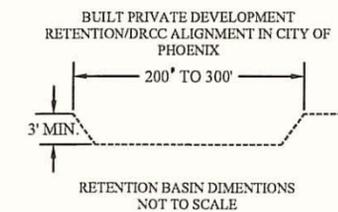
CONCRETE IRRIGATION  
 CAPACITY = 171 CFS  
 (LOCATION ID 9)



EARTHEN IRRIGATION  
 CAPACITY = 162 CFS  
 (LOCATION ID 10)



DEVELOPMENT RETENTION  
 (LOCATION ID 14)



LEGEND

PLANNED PRIVATE DEVELOPMENT RETENTION/DRCC ALIGNMENT	
BUILT PRIVATE DEVELOPMENT RETENTION/DRCC ALIGNMENT	
BUCKEYE FEEDER CANAL ALIGNMENT	
IRRIGATION CANAL ALIGNMENT	
GROUND PHOTO LOCATION ID	

NOTES:  
 1. ALL BUILT PRIVATE DEVELOPMENT RETENTION FACILITIES WERE CONSTRUCTED AFTER 1999.  
 2. DRCC/SUNLAND CHANNEL NOT INCLUDED. SEE FIGURE 1.2.

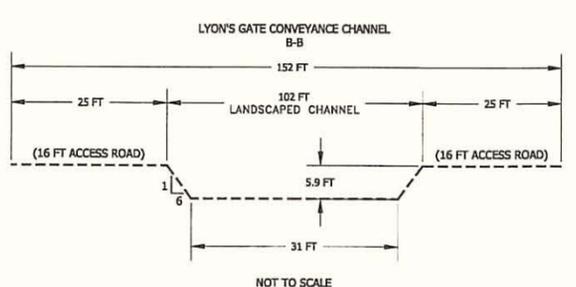
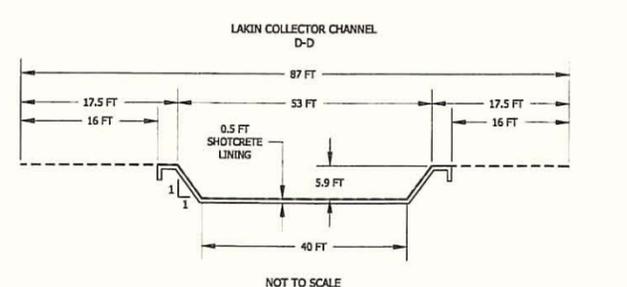
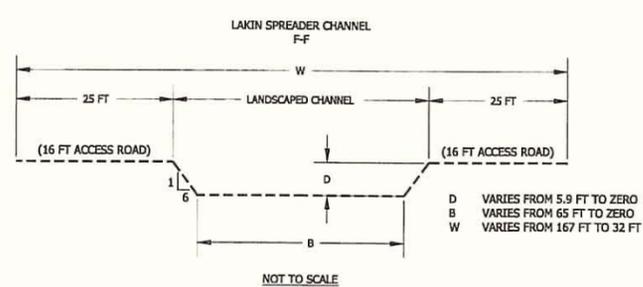
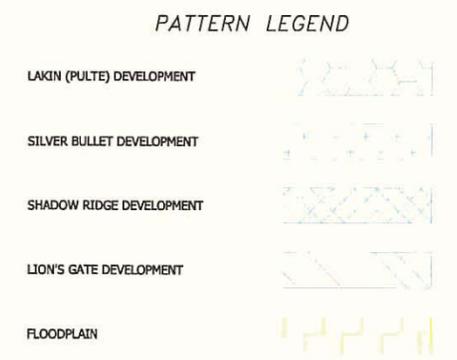
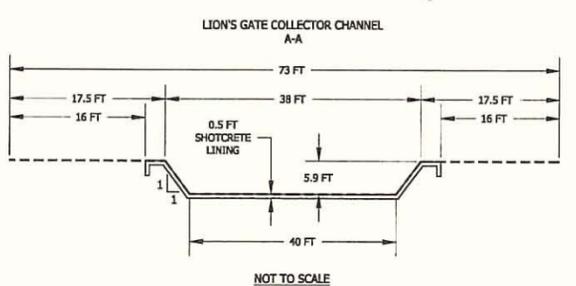
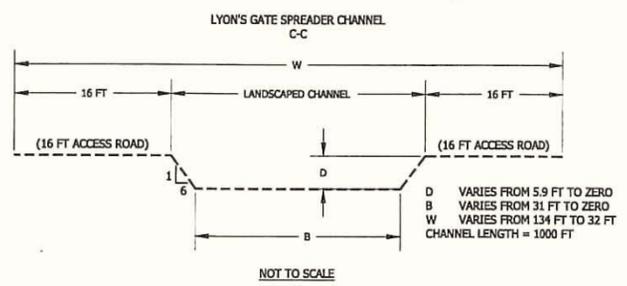
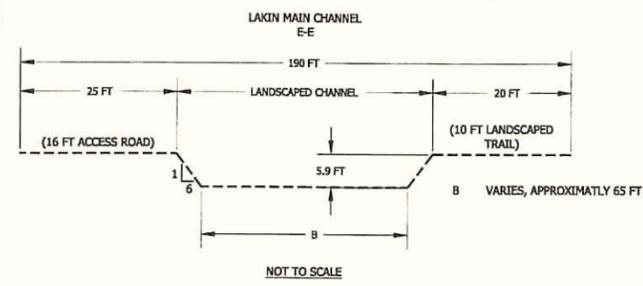
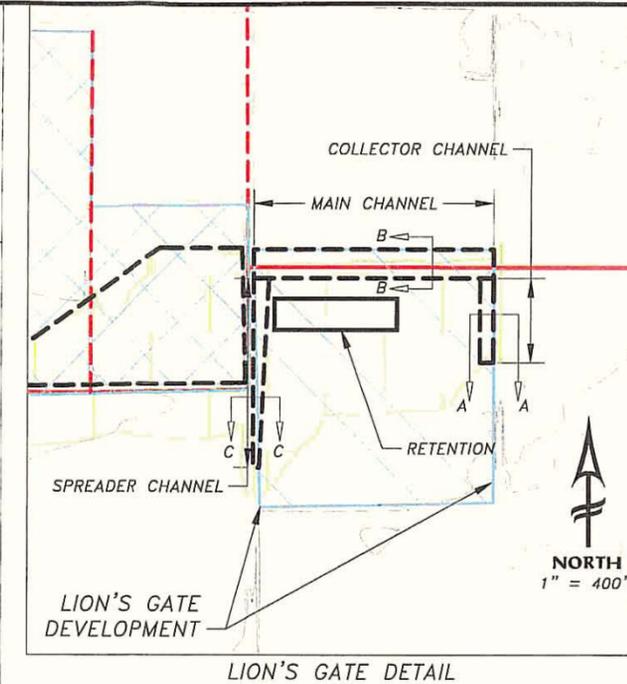
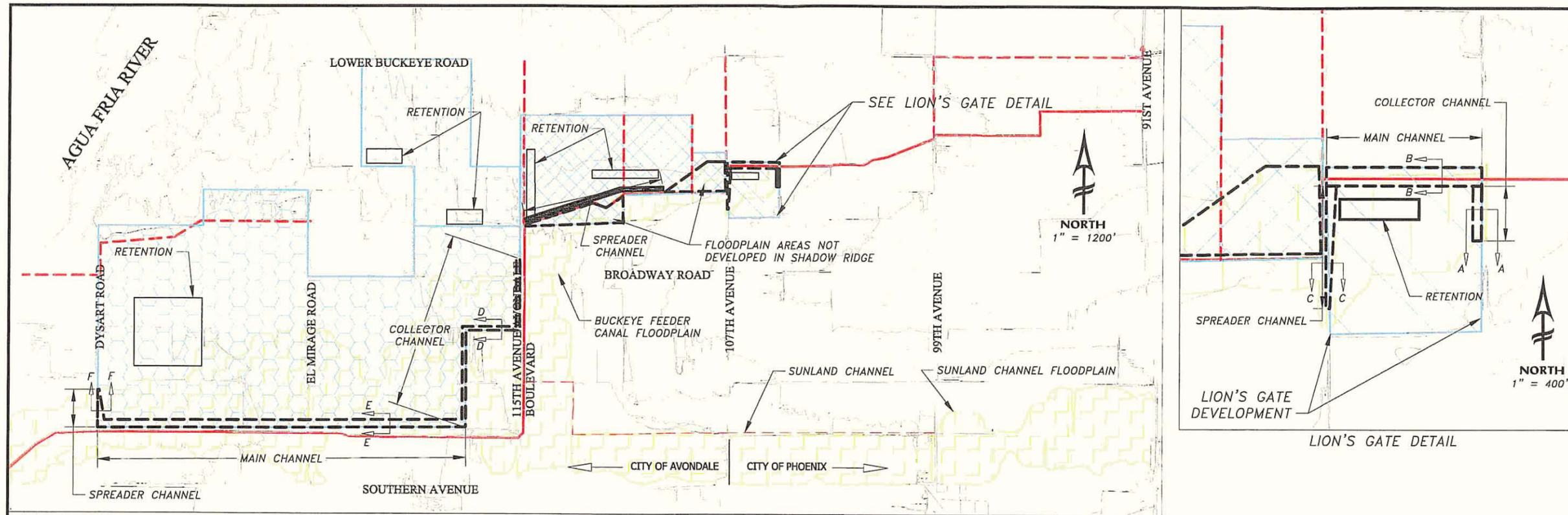
EXISTING AND PLANNED FACILITIES EXHIBIT

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 FIGURE 2.2

COLOR AERIAL PHOTOS ARE FROM THE DURANGO ADMP FCD 99-41 AND WERE SUPPLIED BY THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY. MAPPING SUPPLIED TO THE FCDMC BY KENNY AERIAL MAPPING, 1:400 SCALE, FLIGHT DATE JANUARY 2, 1999.



DEVELOPMENT DRAINAGE COST INCLUDING LAND ACQUISITION			
	DEVELOPMENT CHANNEL COST	RETENTION COST	TOTAL COST
LAKIN	\$15,633,000	\$2,313,000	\$17,946,000
SILVER BULLET	\$0	\$501,000	\$501,000
SHADOW RIDGE	\$6,095,000	\$482,000	\$6,577,000
LIONS GATE	\$1,831,000	\$111,000	\$1,942,000
<b>TOTAL</b>	<b>\$23,559,000</b>	<b>\$3,407,000</b>	<b>\$26,966,000</b>

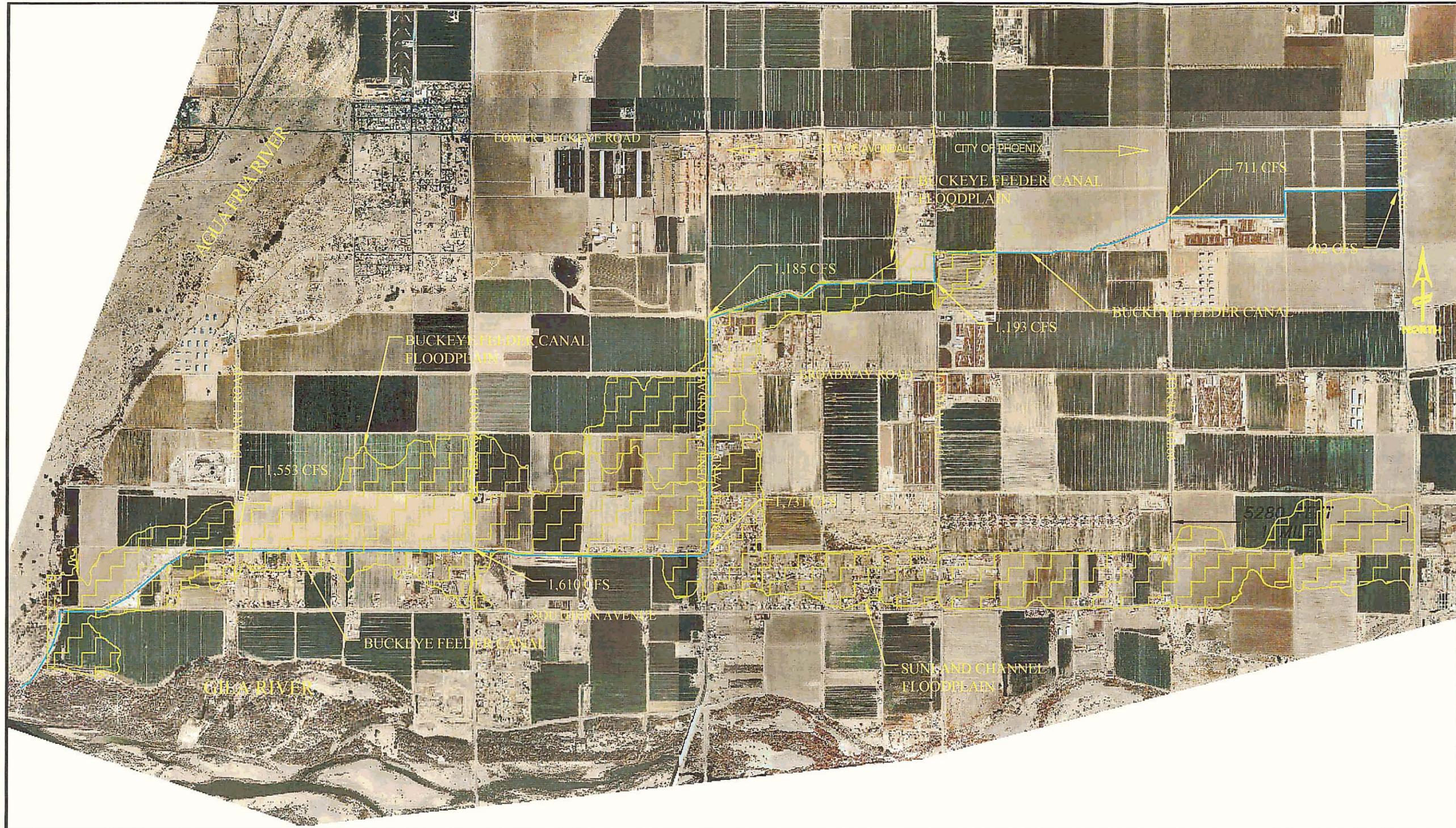
Notes: Costs include 30% contingency and are rounded to the nearest \$1,000. Silver Bullet channel cost consist of land cost for floodplain set aside. Retention land cost and landscaping cost assumed zero. Retention area can be used as required open space.

CONCEPTUAL PRIVATE DRAINAGE PLAN EXHIBIT

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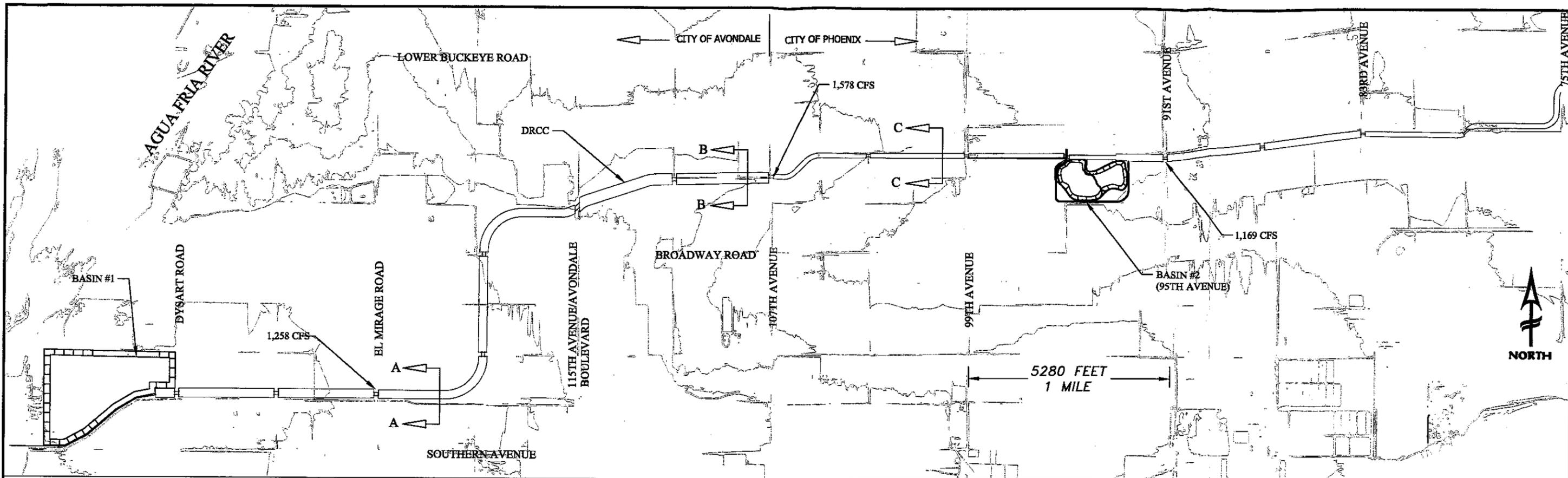
NOTES:  
FLOODPLAIN SOURCE DIBBLE 2002

Existing Conditions With 75th Avenue Storm Drain, 100-Year Discharge Along Buckeye Feeder Canal

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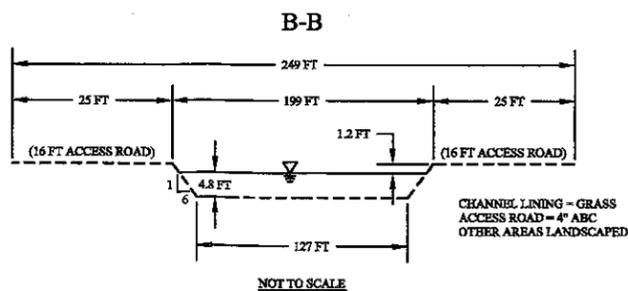
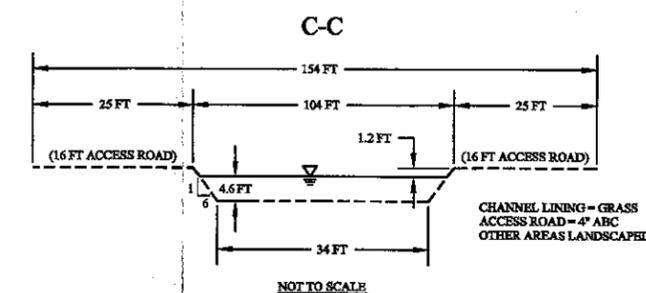
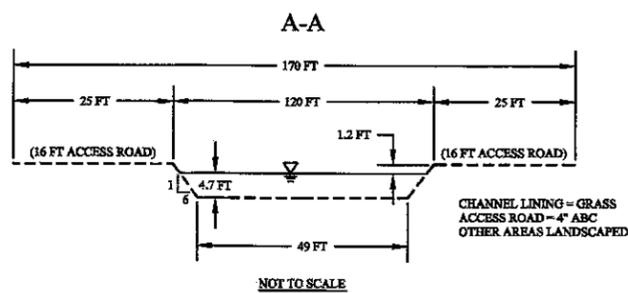
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FIGURE 3.1



**DRCC COST ESTIMATE USING GIVEN DISCHARGES**

LOCAL	COST
AVONDALE	\$ 30,542,026
PHOENIX	\$ 33,249,609
<b>TOTAL</b>	<b>\$ 63,791,635</b>



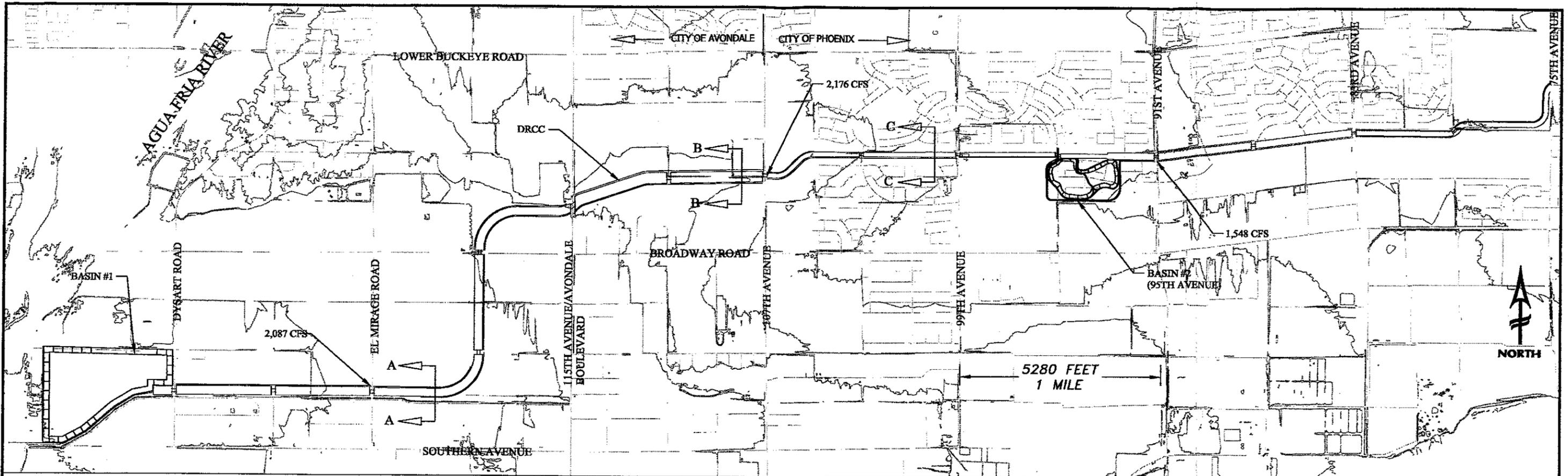
NOTES:  
ALL COSTS INCLUDE 30% CONTINGENCY.

Alternative 1: Future 100-Year, 2-Hour retention Full DRCC

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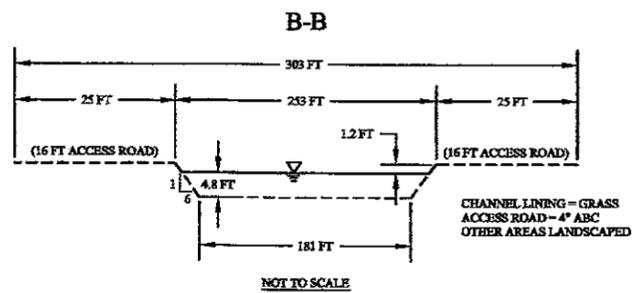
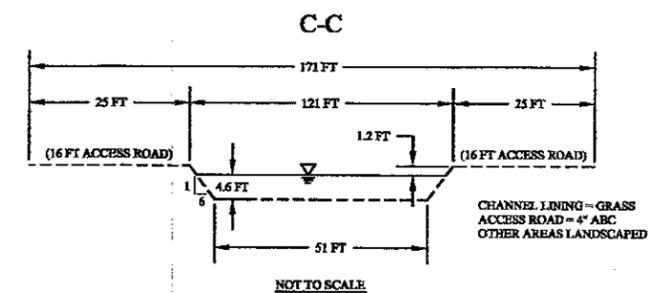
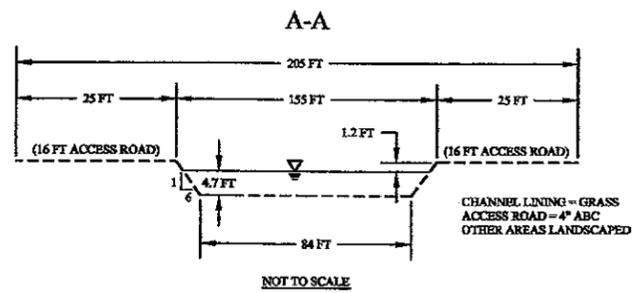
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FIGURE 4.1



**DRCC COST ESTIMATE USING GIVEN DISCHARGES**

ITEM/LOCAL	COST
AVONDALE	\$ 38,121,750
PHOENIX	\$ 35,600,080
<b>TOTAL</b>	<b>\$ 73,721,830</b>



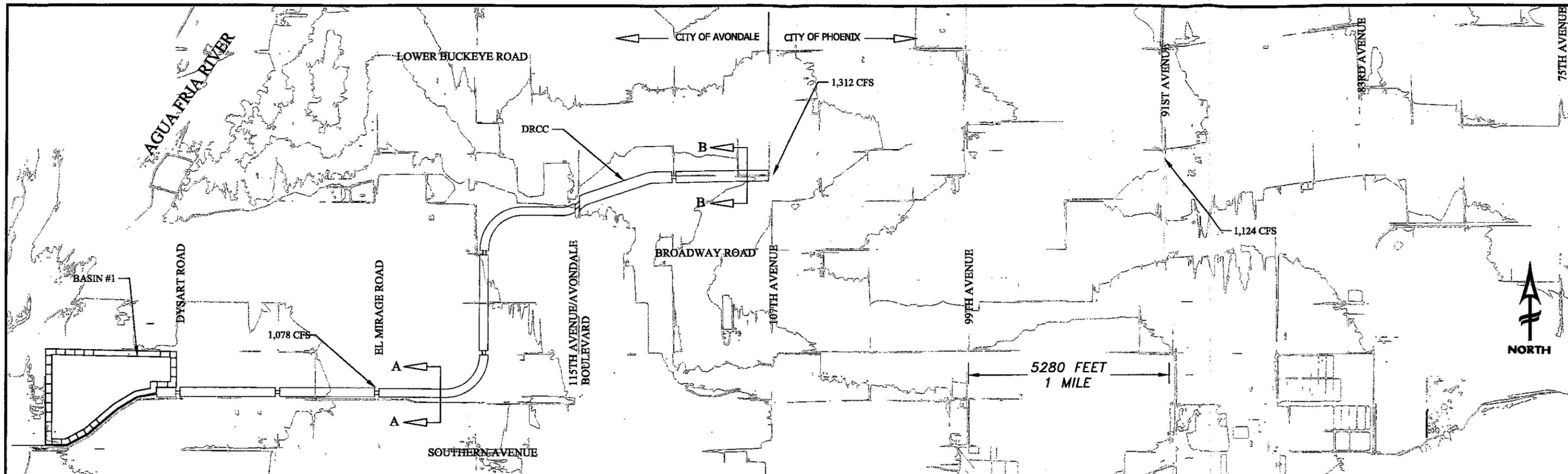
NOTES:  
ALL COSTS INCLUDE 30% CONTINGENCY.

**Alternative 2: Future First Flush Retention Full DRCC**

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DISTRICT OF MARICOPA COUNTY

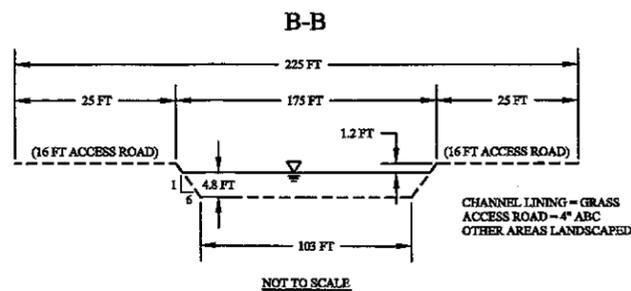
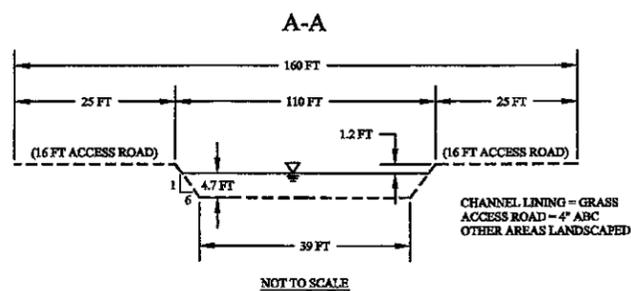
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FIGURE 4.2



**DRCC COST ESTIMATE USING GIVEN DISCHARGES**

ITEM/LOCAL	COST
AVONDALE	\$ 28,320,808
PHOENIX	\$ 0
<b>TOTAL</b>	<b>\$ 28,320,808</b>



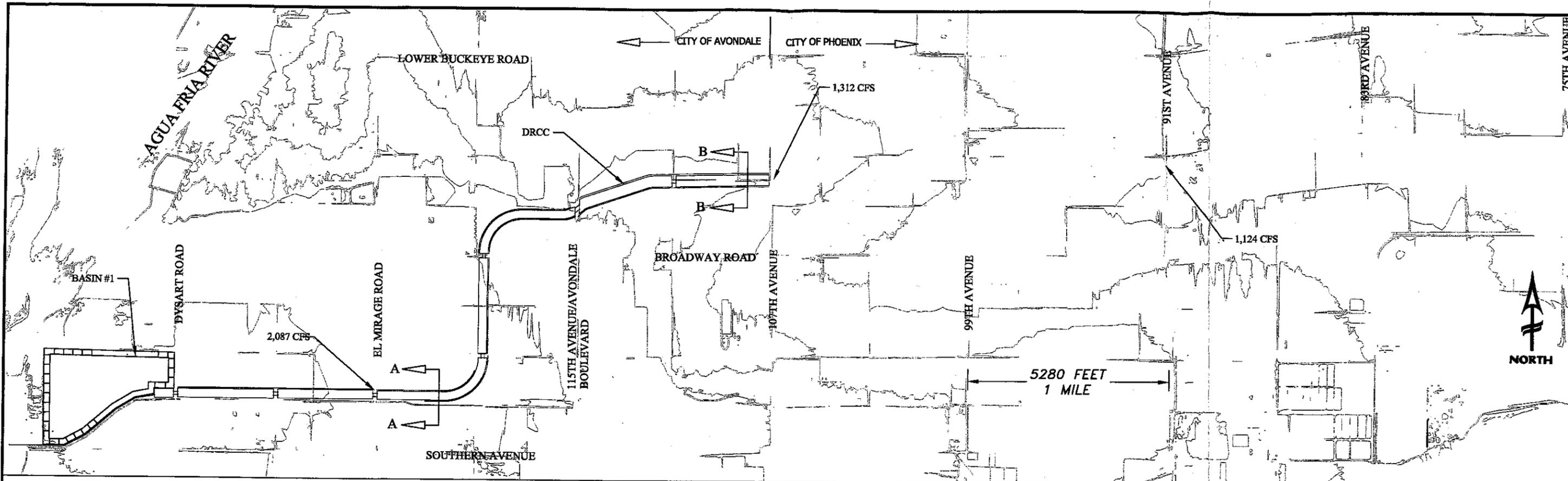
NOTES:  
ALL COSTS INCLUDE 30% CONTINGENCY.

Alternative 3: Future 100-Year, 2-Hour Retention Avondale DRCC

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DISTRICT OF MARICOPA COUNTY

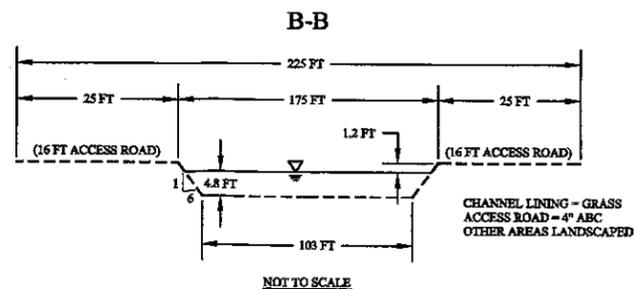
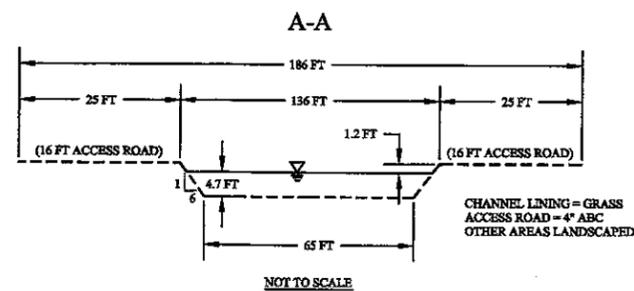
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FIGURE 4.3



**DRCC COST ESTIMATE USING GIVEN DISCHARGES**

ITEM/LOCAL	COST
AVONDALE	\$ 33,238,109
PHOENIX	\$ 0
<b>TOTAL</b>	<b>\$ 33,238,109</b>



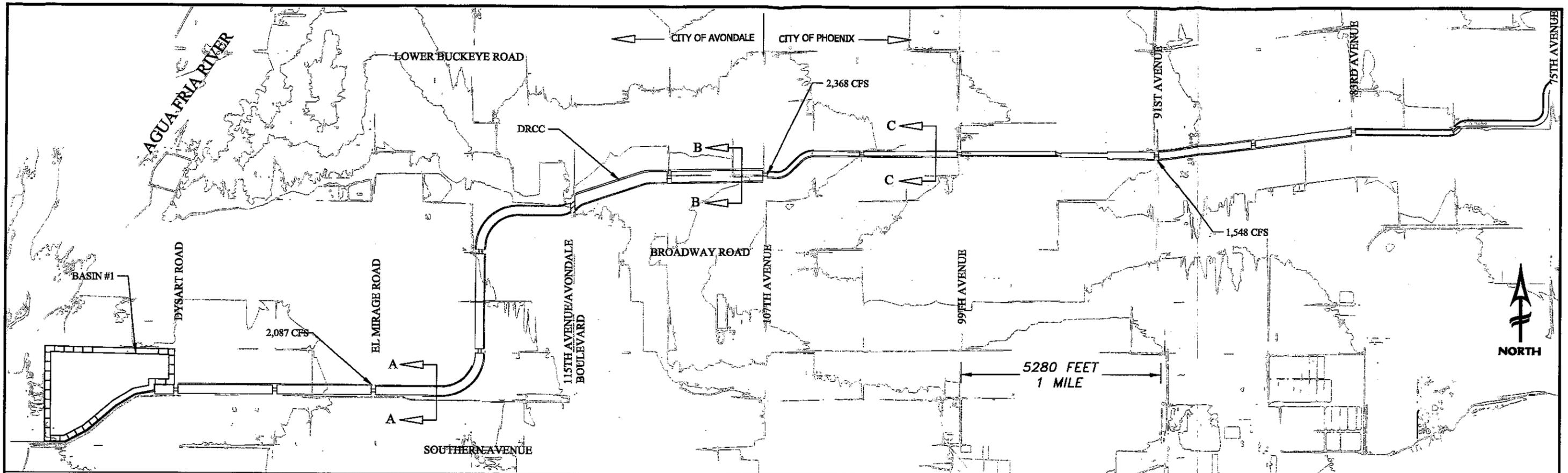
NOTES:  
ALL COSTS INCLUDE 30% CONTINGENCY.

*Alternative 4: Future First Flush Retention Avondale DRCC*

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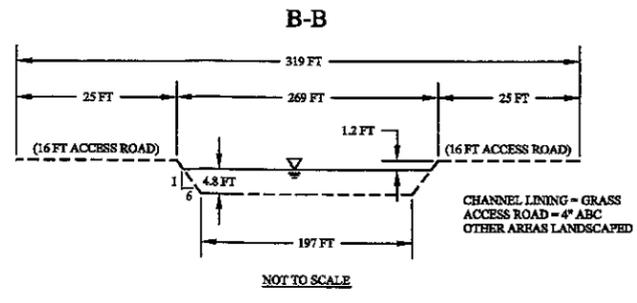
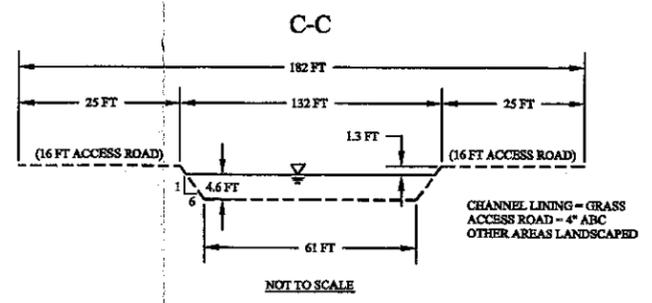
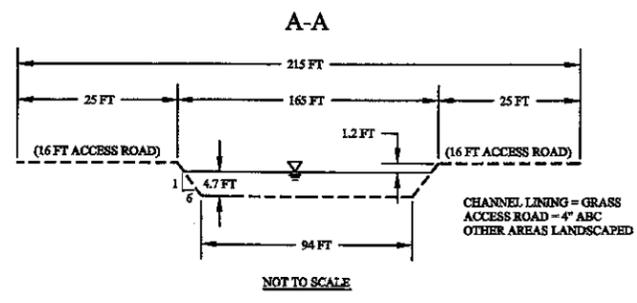
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FIGURE 4.4



**DRCC COST ESTIMATE USING GIVEN DISCHARGES**

ITEM/LOCAL	COST
AVONDALE	\$ 39,083,288
PHOENIX	\$ 23,884,959
<b>TOTAL</b>	<b>\$ 62,968,247</b>



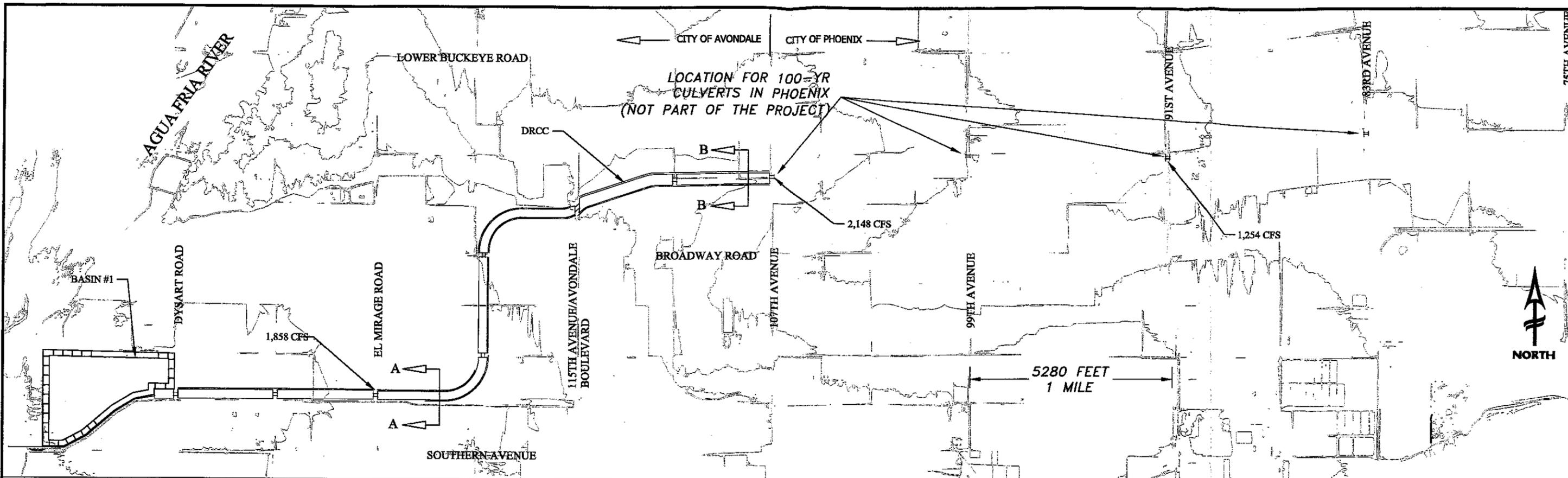
NOTES:  
ALL COSTS INCLUDE 30% CONTINGENCY.

*Alternative 5: Removed 95th Avenue Basin*

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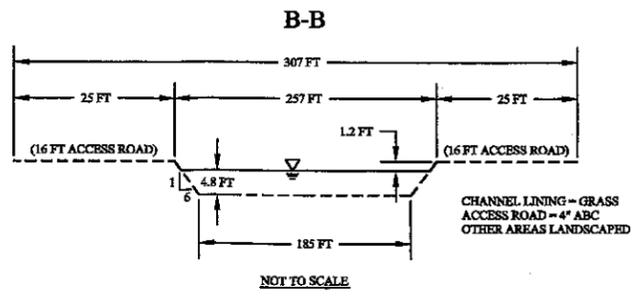
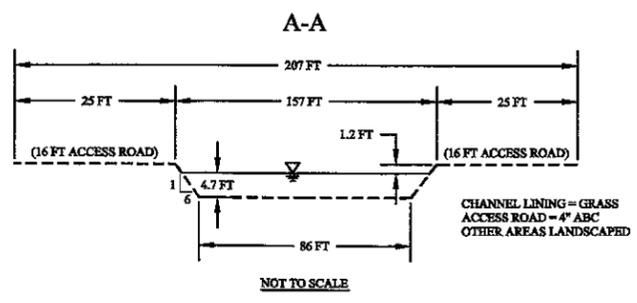
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FIGURE 4.5



**DRCC COST ESTIMATE USING GIVEN DISCHARGES**

ITEM/LOCAL	COST
AVONDALE	\$ 38,311,021
PHOENIX	\$ 0
TOTAL	\$ 38,311,021



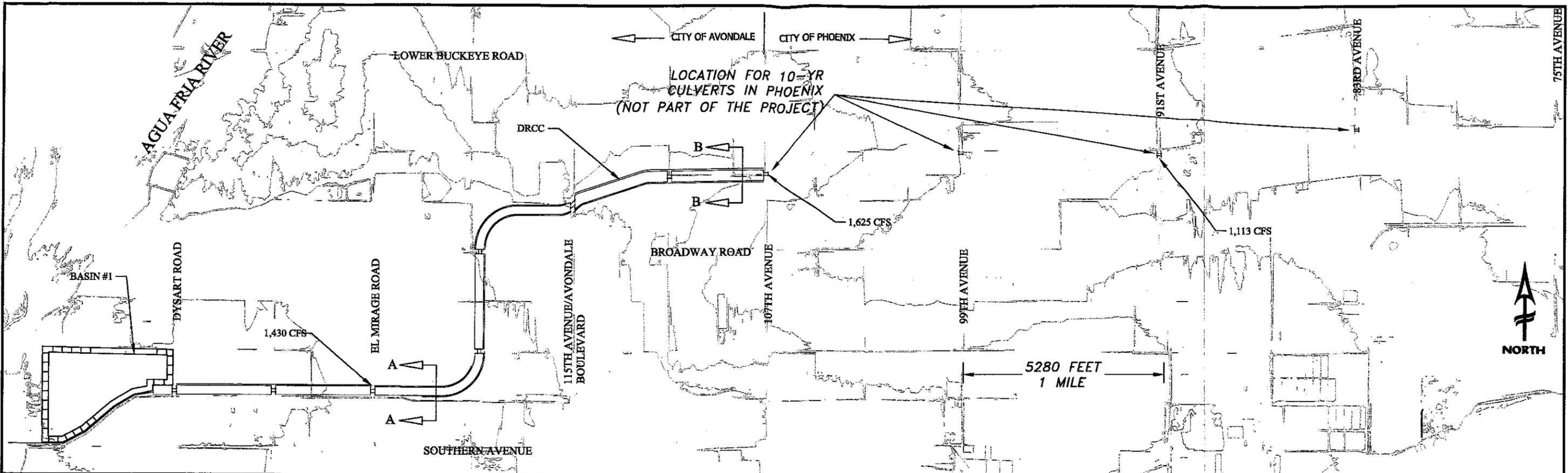
NOTES:  
ALL COSTS INCLUDE 30% CONTINGENCY.

Alternative 6: 100-Year Phoenix Culverts,  
100-Year 2-Hour Retention in Avondale

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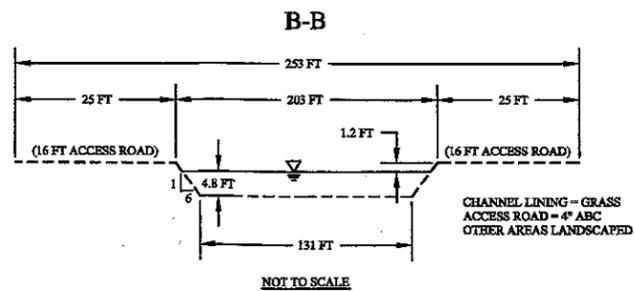
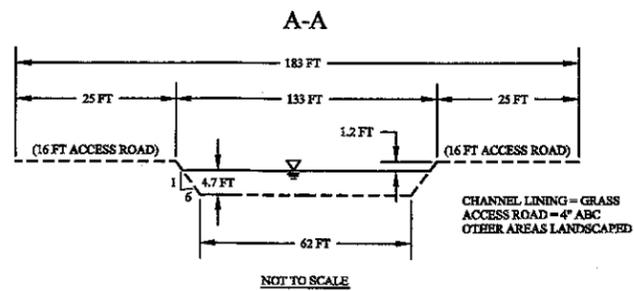
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FIGURE 4.6



**DRCC COST ESTIMATE USING GIVEN DISCHARGES**

ITEM/LOCAL	COST
AVONDALE	\$ 32,926,177
PHOENIX	\$ 0
TOTAL	\$ 32,926,177



NOTES:  
ALL COSTS INCLUDE 30% CONTINGENCY.

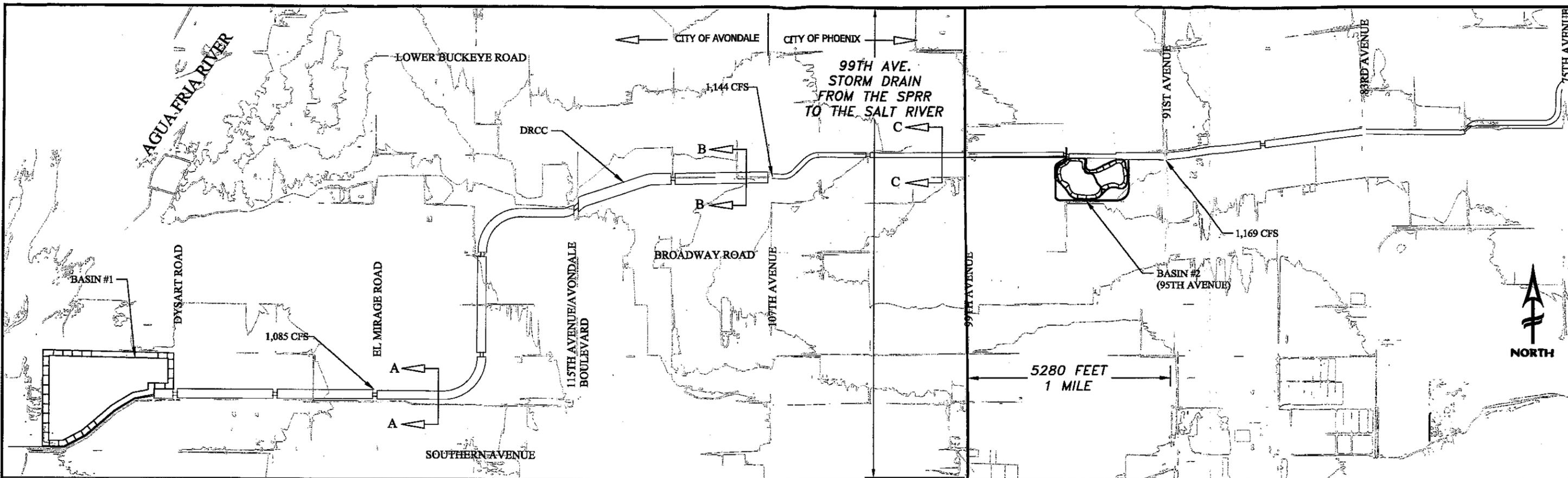
Alternative 7: 10-Year Phoenix Culverts,  
100-Year 2-Hour Retention in Avondale

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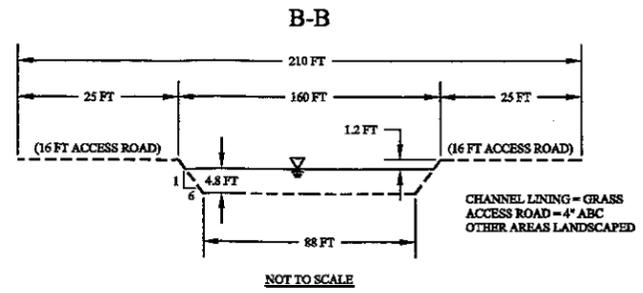
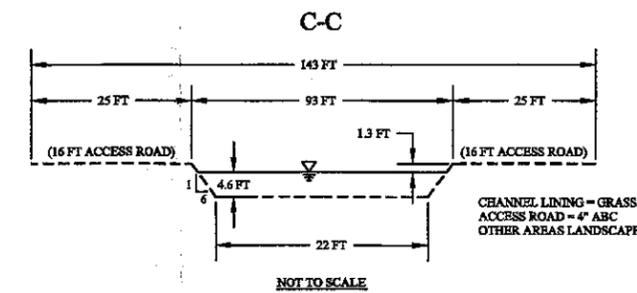
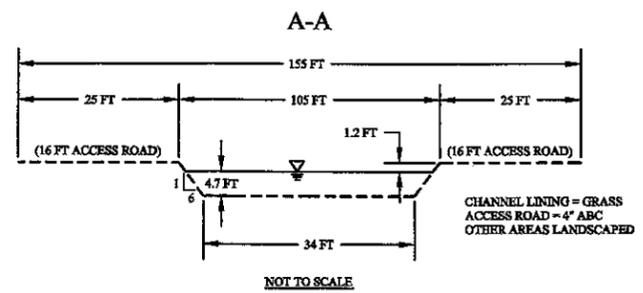
PROJECT NO. P1005

FIGURE 4.7



**DRCC COST ESTIMATE USING GIVEN DISCHARGES**

ITEM/LOCAL	COST
AVONDALE	\$ 27,471,851
PHOENIX	\$ 43,789,465
<b>TOTAL</b>	<b>\$ 71,261,316</b>



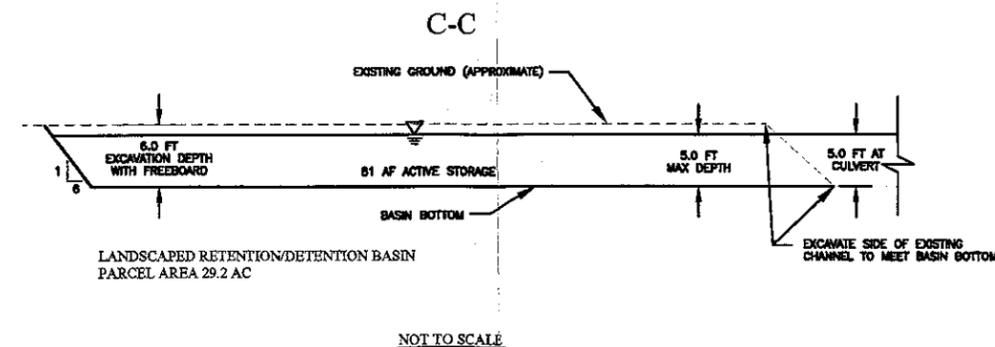
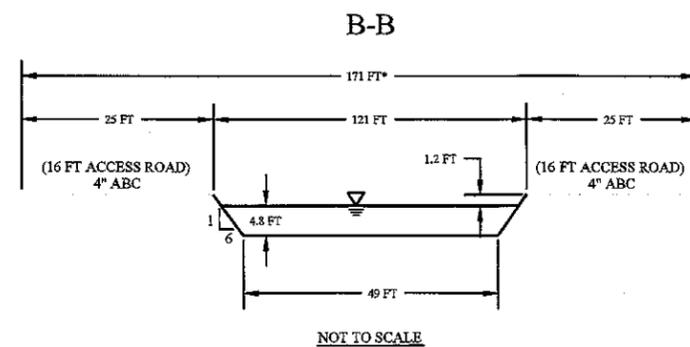
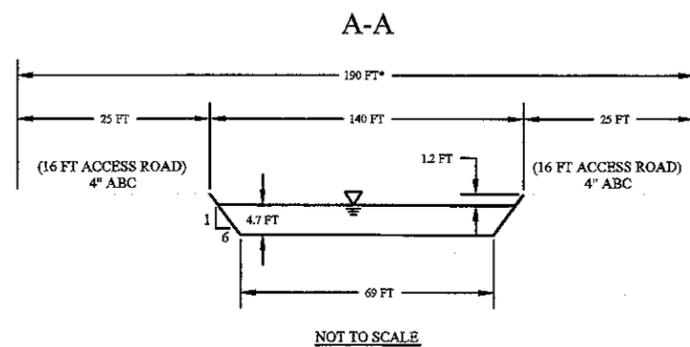
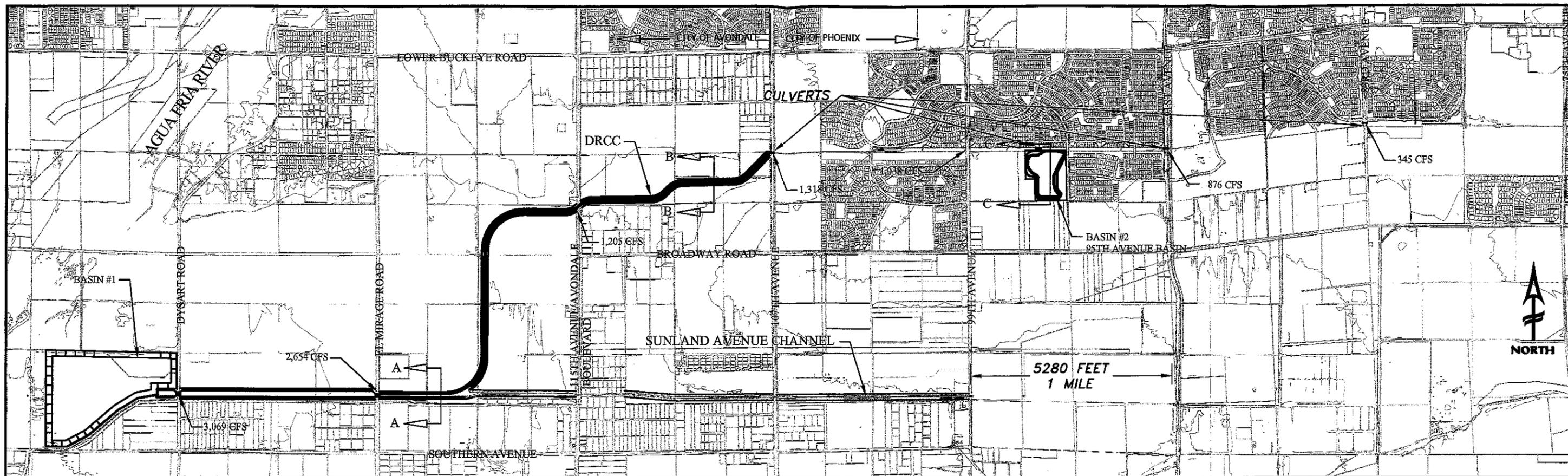
NOTES:  
ALL COSTS INCLUDE 30% CONTINGENCY.

Alternative 8: 99th Avenue Storm Drain

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FIGURE 4.8



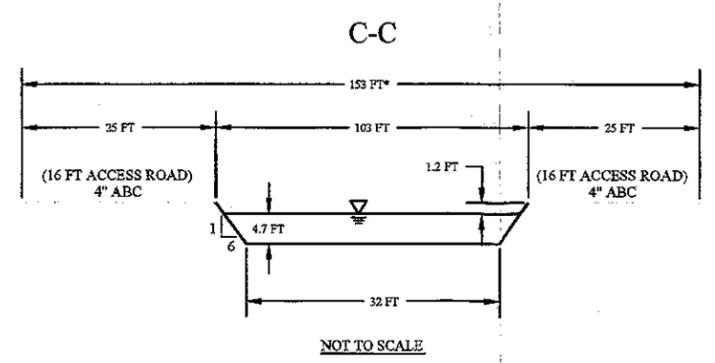
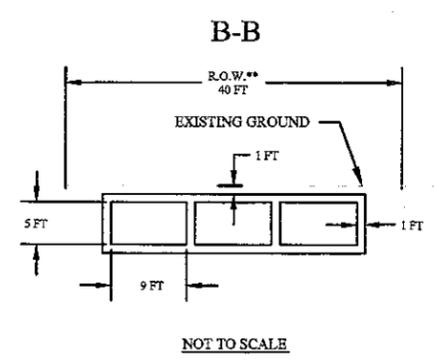
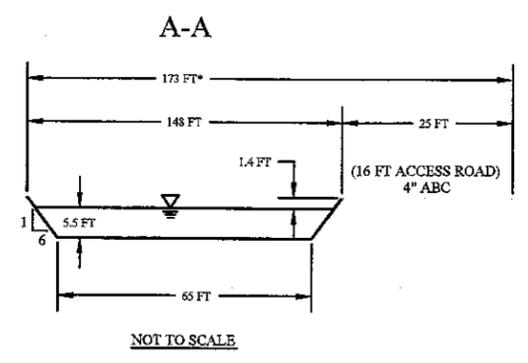
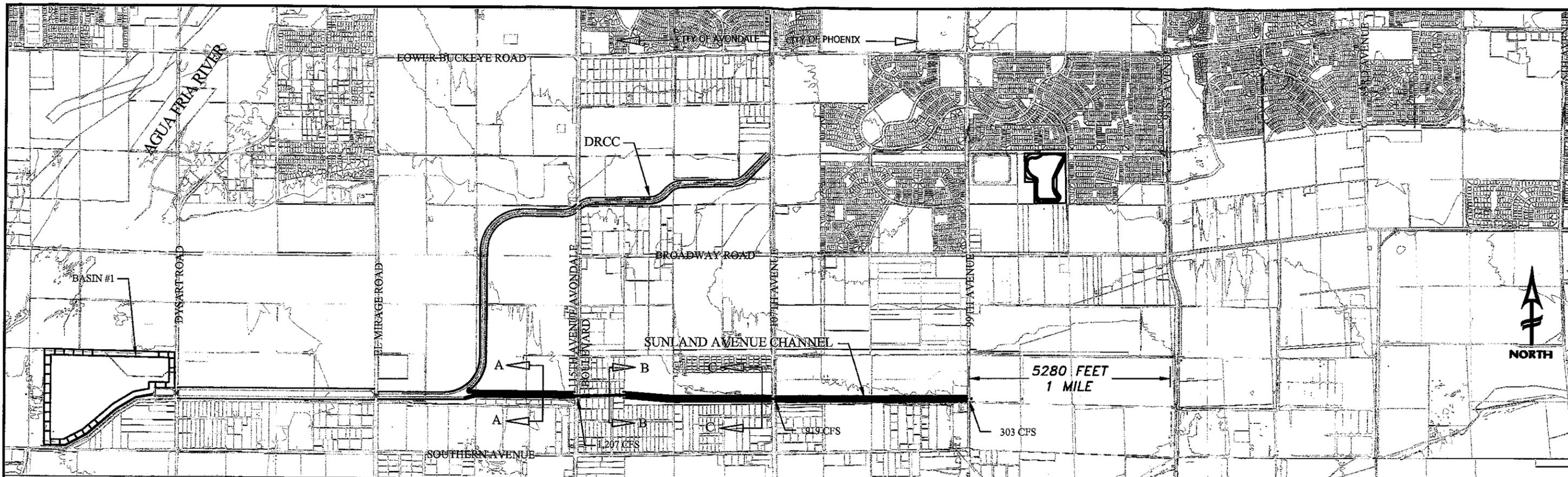
NOTES:  
 \*ADDITIONAL R.O.W. NEEDED FOR ASTHETICS. FCDMC PARTICIPATION IS LIMITED.  
 CHANNEL LINING IS GRASS. OTHER AREAS ARE LANDSCAPED.

**RECOMMENDED PLAN  
 DRCC**

CANDIDATE ASSESSMENT REPORT  
 DURANGO REGIONAL CONVEYANCE CHANNEL  
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 DISTRICT OF MARICOPA COUNTY

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PROJECT NO. P1005  
 FIGURE 5.1



NOTES:  
 \*ADDITIONAL R.O.W. NEEDED FOR ASTHETICS. FCDMC PARTICIPATION IS LIMITED.  
 CHANNEL LINING IS GRASS. OTHER AREAS ARE LANDSCAPED.  
 \*\* 40 FOOT EXISTING R.O.W. AT NARROWEST PART OF SUNLAND AVENUE.

**RECOMMENDED PLAN  
 SUNLAND CHANNEL**

CANDIDATE ASSESSMENT REPORT  
 DURANGO REGIONAL CONVEYANCE CHANNEL  
 PREPARED FOR THE FLOOD CONTROL  
 DISTRICT OF MARICOPA COUNTY

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PROJECT NO. P1005  
 FIGURE 5.2

**CANDIDATE ASSESSMENT REPORT  
DURANGO REGIONAL CONVEYANCE  
CHANNEL**

**APPENDIX B: Site Photographs.**

**February 2006**



06/09/05, ID1, Facing North



06/09/05, ID2, Facing West

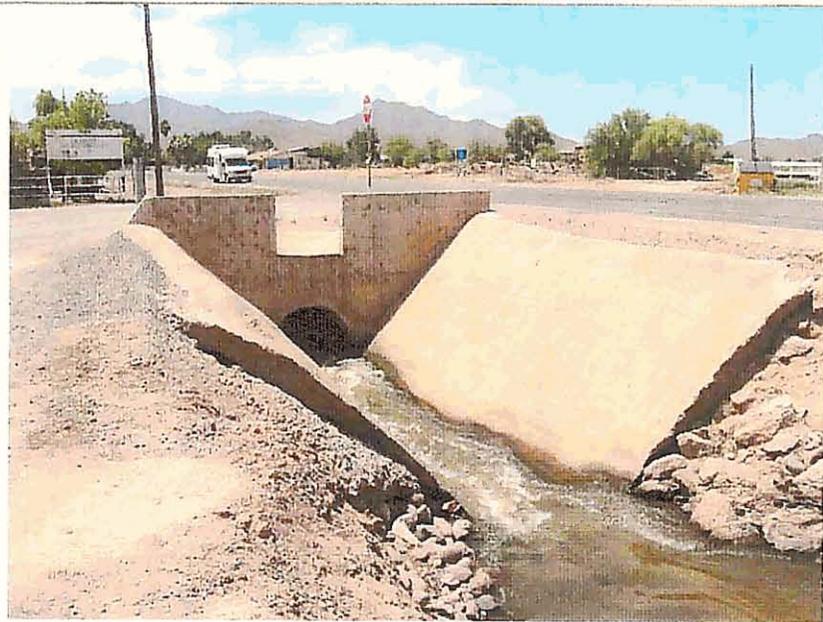


06/09/05, ID3, Facing East



06/09/05, ID4, Facing Northwest

Ground Photo Location ID (Refer to Report Exhibits) = ID##



06/09/05, ID5, Facing Southwest



06/09/05, ID6, Facing North



06/09/05, ID7, Facing West



06/09/05, ID8, Facing Northwest

Ground Photo Location ID (Refer to Report Exhibits) = ID##



06/09/05, ID9, Facing North



06/09/05, ID10, Facing North



06/09/05, ID11, Facing North



06/09/05, ID12, Facing North

Ground Photo Location ID (Refer to Report Exhibits) = ID##



06/09/05, ID13, Facing North



06/09/05, ID14, Facing East



06/09/05, ID15, Facing Northwest



06/09/05, ID16, Country Place Development Retention Basin

Ground Photo Location ID (Refer to Report Exhibits) = ID##



06/09/05, ID17, Country Place Development Retention Basin



06/09/05, ID18, Country Place Development Retention Basin



06/09/05, ID19, Facing South



06/09/05, ID20, Facing East

Ground Photo Location ID (Refer to Report Exhibits) = ID##



06/09/05, ID21, Facing South



06/09/05, ID22, Facing West



06/09/05, ID23, Facing North

Ground Photo Location ID (Refer to Report Exhibits) = ID##

**CANDIDATE ASSESSMENT REPORT  
DURANGO REGIONAL CONVEYANCE  
CHANNEL**

**APPENDIX C: Comparison to Previous DRCC ADMP  
Hydrology.**

**February 2006**

## COMPARISON TO PREVIOUS DRCC ADMP HYDROLOGY

The table below provides a comparison of the discharges used in this report assuming 100-year, 2-hour retention and full DRCC with the corresponding discharges developed for the original DRCC ADMP. There is a substantial difference, with the current discharges being lower.

Comparison of Future 100-Year, 2-Hour Retention Discharges with Previous DRCC ADMP Discharges.		
Concentration Point	Baseline Future Conditions Discharge, in cfs	Previous DRCC Discharge, in cfs*
83 <sup>rd</sup> Avenue	534	1,681
91 <sup>st</sup> Avenue	1,169	1,967
99 <sup>th</sup> Avenue	973	1,849
107 <sup>th</sup> Avenue	1,578	2,578
115 <sup>th</sup> Avenue	1,277	3,278
El Mirage Road	1,258	3,224
Agua Fria River	339	34
* From Dibble (2002).		

The difference in discharges is due to the fact that the hydrologic models described in this report contain features not included in the original DRCC future conditions model. Specifically, the current models include: 1) revised 100-year, 2-hour retention estimates; 2) modified routing parameters between subbasins; 3) the inclusion of the 75<sup>th</sup> Avenue Storm Drain; and, 4) the removal of the DRCC upstream of 75<sup>th</sup> Avenue. The expected effect of these modifications is described below.

1. **Revised 100-Year, 2-Hour Retention Estimates.** The 100-year, 2-hour retention estimates used in this study were obtained from estimating a runoff volume from each hydrologic subarea based on the 100-year, 2-hour runoff from the subarea assuming future development according to the future land use plan presented in the main report. The procedure used is described in the Maricopa County hydrology manual. Sub-basin retention estimates, with associated back-up calculations, are presented in the appendix to this report. Most of the retention estimates used in the HEC-1 models for this report were higher than those used in the HEC-1 models for the original ADMP. A higher amount of retention has the effect of lowering runoff volumes and peak flow rates.
  
2. **Modified Routing Parameters Between Subbasins.** The HEC-1 model routs simulated runoff between hydrologic subbasins using routing parameters that are considered representative of the conveyance channels that would carry these discharges. Typically, as a flood hydrograph traverses a channel, the peak flow rate is reduced, or attenuated, as a result of a flattening of the hydrograph through storage along the channel and in the adjacent floodplain. Typically, wider floodplains with slower-moving water have a more attenuating effect on discharges than do efficient channels with faster flow velocities.

Flow between subbasins in the DRCC drainage area is mostly along streets until the flow reaches the BFC or the DRCC. Under pre-development conditions the routing parameters are defined by streets bordered by agricultural fields, which would be expected to have a relatively high attenuating effect. The previous ADMP hydrology used routing parameters that were generally representative of the agricultural fields. Since it was assumed that streets would be improved as the area develops from a farming land use to a residential land use, the street routing parameters were changed in this study to reflect an expected future street section which would be more efficient than the agricultural fields. This would be expected to increase flood peaks over the original ADMP. However, the effect of increased retention, described under #1 above, had a greater effect on discharges than did changing the routing parameters, and the net effect was a lowering of discharges.

3. **75<sup>th</sup> Avenue Storm Drain.** It was found that including the the 75<sup>th</sup> Avenue Storm Drain into the hydrologic model has little effect on peak discharges.
4. **Removal of the DRCC upstream of 75<sup>th</sup> Avenue.** Removal of the DRCC upstream of 75<sup>th</sup> Avenue would have the effect of reducing DRCC discharges downstream of 75<sup>th</sup> Avenue for the reason that more flow would be conveyed to the south rather than across 75<sup>th</sup> and into the DRCC.

# **CANDIDATE ASSESSMENT REPORT DURANGO REGIONAL CONVEYANCE CHANNEL**

**APPENDIX D: Sub-Basin Retention and 75th Avenue Storm  
Drain Calculations.**

**February 2006**

SUBBASIN RETENTION CALCULATIONS

**IC**  
 SUB = 0.461 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 295.04 ac  
 VOL = 47.7 af

% RET = 0.8  
 % x VOL = **38.1** af

**IB**  
 SUB = 0.479 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 306.56 ac  
 VOL = 49.5 af

% RET = 0.8  
 % x VOL = **39.6** af

**MB**  
 SUB = 0.995 mi<sup>2</sup>  
 C = 0.763  
 P = 2.73 in  
 SUB = 636.8 ac  
 VOL = 110.5 af

% RET = 0.8  
 % x VOL = **88.4** af

**ID1**  
 SUB = 0.204 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 130.56 ac  
 VOL = 21.1 af

% RET = 0.8  
 % x VOL = **16.9** af

**ID2**  
 SUB = 0.359 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 229.76 ac  
 VOL = 37.1 af

% RET = 0.8  
 % x VOL = **29.7** af

**IE**  
 SUB = 0.302 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 193.28 ac  
 VOL = 31.2 af

% RET = 0.8  
 % x VOL = **25.0** af

**MC**  
 SUB = 0.999 mi<sup>2</sup>  
 C = 0.820  
 P = 2.73 in  
 SUB = 639.36 ac  
 VOL = 119.3 af

% RET = 0.8  
 % x VOL = **95.4** af

**ED1**  
 SUB = 0.382 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 244.48 ac  
 VOL = 39.5 af

% RET = 0.8  
 % x VOL = **31.6** af

**ED2**  
 SUB = 0.114 mi<sup>2</sup>  
 C = 0.565  
 P = 2.73 in  
 SUB = 72.96 ac  
 VOL = 9.4 af

% RET = 0.8  
 % x VOL = **7.5** af

**EB**  
 SUB = 0.139 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 88.96 ac  
 VOL = 14.4 af

% RET = 0.8  
 % x VOL = **11.5** af

**MF**  
 SUB = 0.971 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 621.44 ac  
 VOL = 100.4 af

% RET = 0.8  
 % x VOL = **80.3** af

**JB1**  
 SUB = 0.494 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 316.16 ac  
 VOL = 51.1 af

% RET = 0.8  
 % x VOL = **40.9** af

**MG**  
 SUB = 0.082 mi<sup>2</sup>  
 C = 0.760  
 P = 2.73 in  
 SUB = 52.48 ac  
 VOL = 9.1 af

% RET = 0.8  
 % x VOL = **7.3** af

**MI**  
 SUB = 0.409 mi<sup>2</sup>  
 C = 0.740  
 P = 2.73 in  
 SUB = 261.76 ac  
 VOL = 44.1 af

% RET = 0.8  
 % x VOL = **35.3** af

**MD**  
 SUB = 0.255 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 163.2 ac  
 VOL = 26.4 af

% RET = 0.8  
 % x VOL = **21.1** af

**MH**  
 SUB = 0.239 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 152.96 ac  
 VOL = 24.7 af

% RET = 0.8  
 % x VOL = **19.8** af

SWIFT TRANSPORTATION DEV SWIFT TRANSPORTATION DEV SUNDANCE RANCH DEV

SUBBASIN RETENTION CALCULATIONS

totDUR6.dat 107th to AF

CHANGES MADE TO ACCOUNT FOR NO RETENTION IN EXISTING DEVELOPMENT

**BC1**  
 SUB = 0.137 mi<sup>2</sup>  
 C = 0.860  
 P = 2.73 in  
 SUB = 87.68 ac  
 VOL = 17.2 af  
 % RET = 0.8  
 % x VOL = 13.7 af

**BC2**  
 SUB = 0.493 mi<sup>2</sup>  
 C = 0.679  
 P = 2.73 in  
 SUB = 315.52 ac  
 VOL = 48.7 af  
 % RET = 0.8  
 % x VOL = 39.0 af

**CA1**  
 SUB = 0.143 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB RET = 72.7 ac  
 VOL = 11.7 af  
 % RET = 0.8  
 % x VOL = 9.4 af

**CA2**  
 SUB = 0.841 mi<sup>2</sup>  
 C = 0.565  
 P = 2.73 in  
 SUB = 538.24 ac  
 VOL = 69.2 af  
 % RET = 0.8  
 % x VOL = 55.3 af

**GC**  
 SUB = 0.215 mi<sup>2</sup>  
 C = 0.630  
 P = 2.73 in  
 SUB RET = 43.2 ac  
 VOL = 6.2 af  
 % RET = 0.8  
 % x VOL = 5.0 af

**GB**  
 SUB = 0.221 mi<sup>2</sup>  
 C = 0.620  
 P = 2.73 in  
 SUB RET = 73.9 ac  
 VOL = 10.4 af  
 % RET = 0.8  
 % x VOL = 8.3 af

**CB**  
 SUB = 0.739 mi<sup>2</sup>  
 C = 0.565  
 P = 2.73 in  
 SUB = 472.96 ac  
 VOL = 60.8 af  
 % RET = 0.8  
 % x VOL = 48.6 af

**GD1**  
 SUB = 0.629 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 402.56 ac  
 VOL = 65.0 af  
 % RET = 0.8  
 % x VOL = 52.0 af

**GD2**  
 SUB = 0.739 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 472.96 ac  
 VOL = 76.4 af  
 % RET = 0.8  
 % x VOL = 61.1 af

**HA**  
 SUB = 0.15 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 96 ac  
 VOL = 15.5 af  
 % RET = 0.8  
 % x VOL = 12.4 af

**CC**  
 SUB = 0.981 mi<sup>2</sup>  
 C = 0.565  
 P = 2.73 in  
 SUB RET = 422.8 ac  
 VOL = 54.3 af  
 % RET = 0.8  
 % x VOL = 43.5 af

**DA**  
 SUB = 0.328 mi<sup>2</sup>  
 C = 0.638  
 P = 2.73 in  
 SUB RET = 137 ac  
 VOL = 19.9 af  
 % RET = 0.8  
 % x VOL = 15.9 af

**HB**  
 SUB = 0.343 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB RET = 136.4 ac  
 VOL = 22.0 af  
 % RET = 0.8  
 % x VOL = 17.6 af

**IA**  
 SUB = 0.309 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB RET = 107 ac  
 VOL = 17.3 af  
 % RET = 0.8  
 % x VOL = 13.8 af

**MA**  
 SUB = 0.247 mi<sup>2</sup>  
 C = 0.565  
 P = 2.73 in  
 SUB = 158.08 ac  
 VOL = 20.3 af  
 % RET = 0.8  
 % x VOL = 16.3 af

**ME**  
 SUB = 0.326 mi<sup>2</sup>  
 C = 0.600  
 P = 2.73 in  
 SUB = 208.64 ac  
 VOL = 28.5 af  
 % RET = 0.8  
 % x VOL = 22.8 af

SUBBASIN RETENTION CALCULATIONS

totDUR6.dat REMAINING SUB

**KC**  
 SUB = 0.264 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 168.96 ac  
 VOL = 27.3 af

% RET = 0.8  
 % x VOL = 21.8af

**LB**  
 SUB = 0.249 mi<sup>2</sup>  
 C = 0.565  
 P = 2.73 in  
 SUB = 159.36 ac  
 VOL = 20.5 af

% RET = 0.8  
 % x VOL = 16.4af

**LD**  
 SUB = 0.278 mi<sup>2</sup>  
 C = 0.638  
 P = 2.73 in  
 SUB = 177.92 ac  
 VOL = 25.8 af

% RET = 0.8  
 % x VOL = 20.7af

**DD**  
 SUB = 0.133 mi<sup>2</sup>  
 C = 0.710  
 P = 2.73 in  
 SUB = 85.12 ac  
 VOL = 13.7 af

% RET = 0.8  
 % x VOL = 11.0af

**DC**  
 SUB = 0.83 mi<sup>2</sup>  
 C = 0.570  
 P = 2.73 in  
 SUB = 468.9 ac  
 VOL = 60.8 af

% RET = 0.8  
 % x VOL = 48.6af

**EA**  
 SUB = 1.321 mi<sup>2</sup>  
 C = 0.580  
 P = 2.73 in  
 SUB = 845.44 ac  
 VOL = 111.6 af

% RET = 0.8  
 % x VOL = 89.2af

**OC**  
 SUB = 0.31 mi<sup>2</sup>  
 C = 0.860  
 P = 2.73 in  
 SUB = 198.4 ac  
 VOL = 38.8 af

% RET = 0.8  
 % x VOL = 31.1af

**PA**  
 SUB = 0.477 mi<sup>2</sup>  
 C = 0.860  
 P = 2.73 in  
 SUB = 305.28 ac  
 VOL = 59.7 af

% RET = 0.8  
 % x VOL = 47.8af

**RI**  
 SUB = 0.232 mi<sup>2</sup>  
 C = 0.860  
 P = 2.73 in  
 SUB = 148.48 ac  
 VOL = 29.1 af

% RET = 0.8  
 % x VOL = 23.2af

**SD**  
 SUB = 0.168 mi<sup>2</sup>  
 C = 0.860  
 P = 2.73 in  
 SUB = 107.52 ac  
 VOL = 21.0 af

% RET = 0.8  
 % x VOL = 16.8af

**SB**  
 SUB = 0.168 mi<sup>2</sup>  
 C = 0.860  
 P = 2.73 in  
 SUB = 107.52 ac  
 VOL = 21.0 af

% RET = 0.8  
 % x VOL = 16.8af

**RJ**  
 SUB = 0.163 mi<sup>2</sup>  
 C = 0.860  
 P = 2.73 in  
 SUB = 104.32 ac  
 VOL = 20.4 af

% RET = 0.8  
 % x VOL = 16.3af

**SE**  
 SUB = 0.125 mi<sup>2</sup>  
 C = 0.860  
 P = 2.73 in  
 SUB = 80 ac  
 VOL = 15.7 af

% RET = 0.8  
 % x VOL = 12.5af

**SG**  
 SUB = 0.136 mi<sup>2</sup>  
 C = 0.860  
 P = 2.73 in  
 SUB = 87.04 ac  
 VOL = 17.0 af

% RET = 0.8  
 % x VOL = 13.6af

**SH**  
 SUB = 0.103 mi<sup>2</sup>  
 C = 0.860  
 P = 2.73 in  
 SUB = 65.92 ac  
 VOL = 12.9 af

% RET = 0.8  
 % x VOL = 10.3af

**SC**  
 SUB = 0.453 mi<sup>2</sup>  
 C = 0.860  
 P = 2.73 in  
 SUB = 289.92 ac  
 VOL = 56.7 af

% RET = 0.8  
 % x VOL = 45.4af

**TA**  
 SUB = 0.241 mi<sup>2</sup>  
 C = 0.860  
 P = 2.73 in  
 SUB = 154.24 ac  
 VOL = 30.2 af

% RET = 0.8  
 % x VOL = 24.1af

RET REMAINING SUB

SUBBASIN RETENTION CALCULATIONS

EE

SUB = 0.958 mi<sup>2</sup>  
 C = 0.565  
 P = 2.73 in  
 SUB = 613.12 ac  
 VOL = 78.8 af

% RET = 0.8  
 % x VOL = 63.0 af

JB2

SUB = 0.493 mi<sup>2</sup>  
 C = 0.565  
 P = 2.73 in  
 SUB = 315.52 ac  
 VOL = 40.6 af

% RET = 0.8  
 % x VOL = 32.4 af

FIRST FLUSH 12%  
 DC

SUB = mi<sup>2</sup>  
 C = 1.000  
 P = 0.5 in  
 SUB = 66 ac  
 VOL = 2.8 af

% RET = 0.8  
 % x VOL = 2.2 af

FULL RET 43%  
 DC

SUB = mi<sup>2</sup>  
 C = 0.570  
 P = 2.73 in  
 SUB = 228 ac  
 VOL = 29.6 af

% RET = 0.8  
 % x VOL = 23.7 af

EXISTING 45%  
 DC

SUB = mi<sup>2</sup>  
 C = 0.570  
 P = 2.73 in  
 SUB = 237 ac  
 VOL = 30.7 af

% RET = 0  
 % x VOL = 0.0 af

531.0 0.830

25.9

FIRST FLUSH 24%  
 CC

SUB = mi<sup>2</sup>  
 C = 1.000  
 P = 0.5 in  
 SUB = 126.9 ac  
 VOL = 5.3 af

% RET = 0.8  
 % x VOL = 4.2 af

FULL RET 54%  
 CC

SUB = mi<sup>2</sup>  
 C = 0.570  
 P = 2.73 in  
 SUB = 289.2 ac  
 VOL = 37.5 af

% RET = 0.8  
 % x VOL = 30.0 af

EXISTING 40%  
 CC

SUB = mi<sup>2</sup>  
 C = 0.570  
 P = 2.73 in  
 SUB = 211.7 ac  
 VOL = 27.5 af

% RET = 0  
 % x VOL = 0.0 af

627.8 0.981

34.2

SUBBASIN RETENTION CALCULATIONS  
"FIRST FLUSH"

**IC**  
SUB = 0.461 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 295.04 ac  
VOL = 12.3 af

% RET = 0.8  
% x VOL = 9.8 af

**IB**  
SUB = 0.479 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 306.56 ac  
VOL = 12.8 af

% RET = 0.8  
% x VOL = 10.2 af

**MB**  
SUB = 0.995 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 636.8 ac  
VOL = 26.5 af

% RET = 0.8  
% x VOL = 21.2 af

**ID1**  
SUB = 0.204 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 130.56 ac  
VOL = 5.4 af

% RET = 0.8  
% x VOL = 4.4 af

**ID2**  
SUB = 0.359 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 229.76 ac  
VOL = 9.6 af

% RET = 0.8  
% x VOL = 7.7 af

**IE**  
SUB = 0.302 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 193.28 ac  
VOL = 8.1 af

% RET = 0.8  
% x VOL = 6.4 af

**MC**  
SUB = 0.999 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 639.36 ac  
VOL = 26.6 af

% RET = 0.8  
% x VOL = 21.3 af

**ED1**  
SUB = 0.382 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 244.48 ac  
VOL = 10.2 af

% RET = 0.8  
% x VOL = 8.1 af

**ED2**  
SUB = 0.114 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 72.96 ac  
VOL = 3.0 af

% RET = 0.8  
% x VOL = 2.4 af

**EB**  
SUB = 0.139 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 88.96 ac  
VOL = 3.7 af

% RET = 0.8  
% x VOL = 3.0 af

**MF**  
SUB = 0.971 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 621.44 ac  
VOL = 25.9 af

% RET = 0.8  
% x VOL = 20.7 af

**JB1**  
SUB = 0.494 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 316.16 ac  
VOL = 13.2 af

% RET = 0.8  
% x VOL = 10.5 af

**MG**  
SUB = 0.082 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 52.48 ac  
VOL = 2.2 af

% RET = 0.8  
% x VOL = 1.7 af

**MI**  
SUB = 0.409 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 261.76 ac  
VOL = 10.9 af

% RET = 0.8  
% x VOL = 8.7 af

**MD**  
SUB = 0.255 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 163.2 ac  
VOL = 6.8 af

% RET = 0.8  
% x VOL = 5.4 af

**MH**  
SUB = 0.239 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 152.96 ac  
VOL = 6.4 af

% RET = 0.8  
% x VOL = 5.1 af

SWIFT TRANSPORTATION DEV SWIFT TRANSPORTATION DEV SUNDANCE RANCH DEV

SUBBASIN RETENTION CALCULATIONS  
"FIRST FLUSH"

**BC1**

SUB = 0.137 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 87.68 ac  
VOL = 3.7 af

% RET = 0.8  
% x VOL = 2.9 af

**BC2**

SUB = 0.493 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 315.52 ac  
VOL = 13.1 af

% RET = 0.8  
% x VOL = 10.5 af

**CA1**

SUB = 0.143 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB RET = 72.7 ac  
VOL = 3.0 af

% RET = 0.8  
% x VOL = 2.4 af

**CA2**

SUB = 0.841 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 538.24 ac  
VOL = 22.4 af

% RET = 0.8  
% x VOL = 17.9 af

**GC**

SUB = 0.215 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB RET = 43.2 ac  
VOL = 1.8 af

% RET = 0.8  
% x VOL = 1.4 af

**GB**

SUB = 0.221 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB RET = 73.9 ac  
VOL = 3.1 af

% RET = 0.8  
% x VOL = 2.5 af

**CB**

SUB = 0.739 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 472.96 ac  
VOL = 19.7 af

% RET = 0.8  
% x VOL = 15.8 af

**GD1**

SUB = 0.629 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 402.56 ac  
VOL = 16.8 af

% RET = 0.8  
% x VOL = 13.4 af

**GD2**

SUB = 0.739 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 472.96 ac  
VOL = 19.7 af

% RET = 0.8  
% x VOL = 15.8 af

**HA**

SUB = 0.15 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 96 ac  
VOL = 4.0 af

% RET = 0.8  
% x VOL = 3.2 af

**CC**

SUB = 0.981 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB RET = 422.8 ac  
VOL = 17.6 af

% RET = 0.8  
% x VOL = 14.1 af

**DA**

SUB = 0.328 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB RET = 137 ac  
VOL = 5.7 af

% RET = 0.8  
% x VOL = 4.6 af

**HB**

SUB = 0.343 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB RET = 136.4 ac  
VOL = 5.7 af

% RET = 0.8  
% x VOL = 4.5 af

**IA**

SUB = 0.309 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB RET = 107 ac  
VOL = 4.5 af

% RET = 0.8  
% x VOL = 3.6 af

**MA**

SUB = 0.247 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 158.08 ac  
VOL = 6.6 af

% RET = 0.8  
% x VOL = 5.3 af

**ME**

SUB = 0.326 mi<sup>2</sup>  
C = 1.000  
P = 0.5 in  
SUB = 208.64 ac  
VOL = 8.7 af

% RET = 0.8  
% x VOL = 7.0 af

SUBBASIN RETENTION CALCULATIONS  
"FIRST FLUSH"

<b>KC</b>	<b>LB</b>	<b>LD</b>	<b>DD</b>	<b>DC</b>
SUB = 0.264 mi <sup>2</sup>	SUB = 0.249 mi <sup>2</sup>	SUB = 0.278 mi <sup>2</sup>	SUB = 0.133 mi <sup>2</sup>	SUB = 0.83 mi <sup>2</sup>
C = 1.000				
P = 0.5 in				
SUB = 168.96 ac	SUB = 159.36 ac	SUB = 177.92 ac	SUB = 85.12 ac	SUB = 468.9 ac
VOL = 7.0 af	VOL = 6.6 af	VOL = 7.4 af	VOL = 3.5 af	VOL = 19.5 af
% RET = 0.8				
% x VOL = <u>5.6</u> af	% x VOL = <u>5.3</u> af	% x VOL = <u>5.9</u> af	% x VOL = <u>2.8</u> af	% x VOL = <u>15.6</u> af
<b>EA</b>	<b>OC</b>	<b>PA</b>	<b>RI</b>	<b>SD</b>
SUB = 1.321 mi <sup>2</sup>	SUB = 0.31 mi <sup>2</sup>	SUB = 0.477 mi <sup>2</sup>	SUB = 0.232 mi <sup>2</sup>	SUB = 0.168 mi <sup>2</sup>
C = 1.000				
P = 0.5 in				
SUB = 845.44 ac	SUB = 198.4 ac	SUB = 305.28 ac	SUB = 148.48 ac	SUB = 107.52 ac
VOL = 35.2 af	VOL = 8.3 af	VOL = 12.7 af	VOL = 6.2 af	VOL = 4.5 af
% RET = 0.8				
% x VOL = <u>28.2</u> af	% x VOL = <u>6.6</u> af	% x VOL = <u>10.2</u> af	% x VOL = <u>4.9</u> af	% x VOL = <u>3.6</u> af
<b>SB</b>	<b>RJ</b>	<b>SE</b>	<b>SG</b>	<b>SH</b>
SUB = 0.168 mi <sup>2</sup>	SUB = 0.163 mi <sup>2</sup>	SUB = 0.125 mi <sup>2</sup>	SUB = 0.136 mi <sup>2</sup>	SUB = 0.103 mi <sup>2</sup>
C = 1.000				
P = 0.5 in				
SUB = 107.52 ac	SUB = 104.32 ac	SUB = 80 ac	SUB = 87.04 ac	SUB = 65.92 ac
VOL = 4.5 af	VOL = 4.3 af	VOL = 3.3 af	VOL = 3.6 af	VOL = 2.7 af
% RET = 0.8				
% x VOL = <u>3.6</u> af	% x VOL = <u>3.5</u> af	% x VOL = <u>2.7</u> af	% x VOL = <u>2.9</u> af	% x VOL = <u>2.2</u> af
<b>SC</b>	<b>TA</b>			
SUB = 0.453 mi <sup>2</sup>	SUB = 0.241 mi <sup>2</sup>			
C = 1.000	C = 1.000			
P = 0.5 in	P = 0.5 in			
SUB = 289.92 ac	SUB = 154.24 ac			
VOL = 12.1 af	VOL = 6.4 af			
% RET = 0.8	% RET = 0.8			
% x VOL = <u>9.7</u> af	% x VOL = <u>5.1</u> af			

RET REMAINING SUB

With Current Plan Inlets and HEC-1 Laterals

SECTION	From	To	Existing				HEC-1			Slope FT/FT	Pipe Normal Depth Capacity (cfs)	Excess Capacity (cfs)
			Number of Inlets	Inlet Capacity (cfs)	Flow from Upstream (cfs)	Discharge from Basin (cfs)	Lateral Discharge (cfs)	Discharge to Storm Drain (cfs)	Design Pipe Size (inch)			
1	I-10	Buckeye	0	0	13	86.0	39	138.00	66	0.00211	155	17.00
2	Buckeye	Lower Buckeye	1	3			38	179.00	78	0.00205	238	59.00
3	Lower Buckeye	Broadway	0	0			41	220.00	78	0.00205	238	18.00
4	Broadway	Salt River	0					220.00	96	0.00092	277	57.00

Full Inlet Capacity (All Stub Outs Connected) with No laterals

SECTION	From	To	Existing				HEC-1			Slope FT/FT	Pipe Normal Depth Capacity (cfs)	Excess Capacity (cfs)	HEC-1 Discharge (cfs)	Storm Drain - HEC-1 (cfs)	Pipe Capacity - HEC-1 (cfs)
			Number of Inlets	Inlet Capacity (cfs)	Flow from Upstream (cfs)	Discharge from Basin (cfs)	Lateral Discharge (cfs)	Discharge to Storm Drain (cfs)	Design Pipe Size (inch)						
1	I-10	Buckeye	4	12	13	86.0		111.00	66	0.00211	155	44.00	105	6	50
2	Buckeye	Lower Buckeye	15	45				156.00	78	0.00205	238	82.00	172	-16	66
3	Lower Buckeye	Broadway	16	48				204.00	78	0.00205	238	34.00	252	-48	-14
4	Broadway	Salt River	0					204.00	96	0.00092	277	73.00	252	-48	25

Full Inlet Capacity (All Stub Outs Connected) with HEC-1 Laterals

SECTION	From	To	Existing				HEC-1			Slope FT/FT	Pipe Normal Depth Capacity (cfs)	Excess Capacity (cfs)	HEC-1 Discharge (cfs)	Storm Drain - HEC-1 (cfs)	Pipe Capacity - HEC-1 (cfs)
			Number of Inlets	Inlet Capacity (cfs)	Flow from Upstream (cfs)	Discharge from Basin (cfs)	Lateral Discharge (cfs)	Discharge to Storm Drain (cfs)	Design Pipe Size (inch)						
1	I-10	Buckeye	4	12	13	86.0	39	150.00	66	0.00211	155	5.00	105	45	50
2	Buckeye	Lower Buckeye	15	45			38	233.00	78	0.00205	238	5.00	172	61	66
3	Lower Buckeye	Broadway	16	48			41	322.00	78	0.00205	238	-84.00	252	70	-14
4	Broadway	Salt River	0					322.00	96	0.00092	277	-45.00	252	70	25

Notes:

Preliminary construction plans from Stantec specify one inlet and 34 stub outs for future inlets. The design capacity for inlets is 3 cfs per inlet. Existing Flow from Upstream is from an existing 24 inch storm drain identified in Stantec's report. Discharge from Basin is from the 71st Avenue basin also known as DRC Basin #4 and is the basin that was combined with the Target basin. This discharge comes from the HEC-1 model and was verified by Aspen. HEC-1 Lateral Discharge is the discharge identified in the totDur6.dat model, and all future land use Aspen models, as the flow coming into the 75<sup>th</sup> Avenue storm drain from future storm drains in Buckeye Road, Lower Buckeye Road and Broadway Road. Discharge to Storm Drain is the accounting of all water in the 75<sup>th</sup> Avenue main storm drain to Buckeye Road, Lower Buckeye Road, Broadway Road and the Salt River. Design Pipe Size and Slope are from Stantec preliminary construction plans. Pipe Normal Depth Capacity was calculated from the design pipe size and slope. Excess capacity is the difference between discharge to storm drain and normal depth capacity. HEC-1 Discharge is the peak flow rate in the 75<sup>th</sup> Avenue storm as modeled. Storm Drain – HEC-1 is the accounted for discharge to the storm drain minus the HEC-1 peak flow rate. Pipe Capacity – HEC-1 is the normal depth capacity minus the HEC-1 peak flow rate.

In conclusion, the Pipe Capacity – HEC-1 column shows that the HEC-1 model is effectively modeling the storm drain construction plans and that there is no excess capacity in the storm drain to divert any more surface flow from the roadway and thereby reducing the size of the DRCC. The values given in the Discharge to Storm Drain column are overestimated because they are simply added and not routed. The -14 cfs at Broadway is acceptable as it is 6% of the normal depth pipe capacity. The DRCC begins and heads directly west between Broadway and Lower Buckeye. The 25cfs between Broadway and the Salt River can not be utilized by the DRCC. Our recommendation to optimize the storm drain and the DRCC with respect to it is to build all of the stub outs as planned.



# Flood Control District of Maricopa County

*gy*

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Mary Rose Wilcox, District 5

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May 6, 2005

Mr. Mike Hale  
2801 S. 107<sup>th</sup> Ave.  
Phoenix Arizona, 85353

SUBJECT: Durango Regional Conveyance Channel (DRCC) - Reference Durango Area  
Drainage Master Plan (ADMP)

Dear Mr. Hale:

This letter is in response to your question concerning the proposed shifting of the alignment for the DRCC west of 107<sup>th</sup> Avenue, from that shown in the Durango ADMP final report. Please note that the Durango ADMP is a general planning document and it is subject to modification over time to account for changed conditions and opportunities. A primary purpose of the Durango ADMP is to provide general guidance to the public and private agencies for locating regional flood control solutions. The recommended alignment that is included in the Durango ADMP final report was developed to avoid and minimize impacts to the Salt River Project (SRP) facilities (the Buckeye Feeder Ditch). Earlier this year, the District was asked to review a minor shift in the alignment (See Attachment #1). This new alignment was proposed by local stakeholders/development interests in the area. The local stakeholders are now proposing to reconstruct the SRP facilities and shift the DRCC alignment. Even though this new alignment now impacts your property, it is more logical to locate the channel within the existing floodplain once the SRP facilities are piped.

As a point of record, the Flood Control District of Maricopa County (District) goes through a very extensive process to develop the proposed locations for the features included in any ADMP. The Durango ADMP used five (5) phases or steps in the development the final recommended plan. This process consists of the identification of flooding hazards and the existing conditions; the development of a wide range of alternatives; the refinement of these alternatives; the selection of the preferred alternative; and then the final development of the preferred/selected alternative. This process is discussed in more detail in the follow paragraphs:

During the initial phase, Data Collection, the District collected all of the available information and existing information on the study area. This included updating the existing conditions hydrology model; identification of historical flooding at the Buckeye Feeder Channel and 115<sup>th</sup> Avenue ; at 91<sup>st</sup> Avenue and Van Buren Street; along Van Buren Street from 95<sup>th</sup> to 96<sup>th</sup> Avenues, and north of the railroad; developing an existing conditions map of the existing and planned facilities; and performing a general environmental overview of the study area.

The Second Phase, Alternatives Development, used all of this information to develop 15 distinctly different alternatives, which were developed by the Review Committee. The Review Committee was a make up of representatives from the local jurisdictional agencies. The 15 alternatives are described in detail in the Durango ADMP Alternatives Report dated March, 2001. As part of this phase, the alternatives were then evaluated as to cost, engineering considerations, advantages and disadvantages for implementation, environmental impacts, and multi-use,

The Third Phase, Alternatives Evaluation, slightly overlapped the Second Phase in that the specific information developed in the Second Phase was used to develop a matrix and reduce the number of alternatives to four by the Review Committee. However, the Review Committee did not just accept the proposed alternatives verbatim. They used the information to screen the alternatives and select the *best* combination of alternative features to form comprehensive alternatives for the entire study area. The study team then took these alternatives and performed a more detailed analysis and refined the costs along with more specific advantages and disadvantages for each of these Alternatives.

The Fourth Phase, Alternative Selection, again slightly overlaps the previous phase and used the information developed to create another matrix to evaluate the proposed alternatives. The specific categories of the matrix criteria included capital cost, multiple use opportunities, acceptability to local residents, environmental impacts, maintenance, reduction of flooding hazard areas, partnering opportunities, and aesthetic value. The Review Committee recommended the attached alternative drawing. (See Attachment #2)

The Fifth Phase, Development of Selected Alternative, took the recommended plan and refined it to develop conceptual design plans and further refine the project costs. In the process, it was determined that the recommended plan did not reduce all of the flooding and again this "recommended" plan was modified. This plan is presented in the Durango ADMP Recommended Design Report dated, October 2002. This recommended plan is also attached, as Attachment #3.

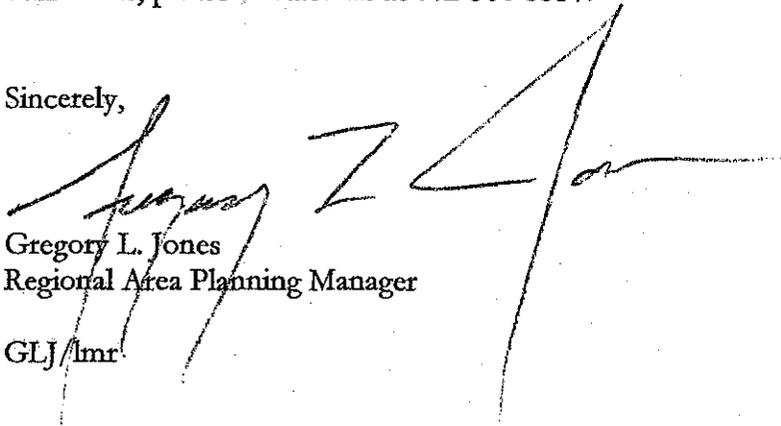
The process identified above does not highlight public input, which is a major component of the plan development. Public input is essential to the success of this project. There were five sets of public meetings held throughout the course of this study. Each set of public meetings occurred at two locations 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 meetings was held early in the process to allow public input to be incorporated into the entire planning process and to be included in the proposed alternatives for the ADMP.

The second set of public meetings was held just after the selection of the preferred alternative to allow opportunity for comment on the preferred alternative. A third set of meetings was held to show the draft floodplain delineation from the study. A fourth set of public meetings was held after a draft of the Recommend Design Report was completed to give the public the opportunity to see the preliminary results of the study. The fifth and final set of public meetings was held to present the modified recommended plan to the public. In all of the meetings, it was explained to the public that the ADMP was a plan, subject to change in the future. To date, the only features of the ADMP that have been approved for implementation by the District's Board of Directors are features east of 75<sup>th</sup> Avenue, in Phoenix.

During this process, the recommended/preferred alternative was modified to account for ongoing development, additional hydrologic/hydraulic information, and to account for public preferences. Thus, the District and the other jurisdictional agencies used these meetings to help select where the regional storm water drainage facilities should be located. The meetings also helped define the type(s) of storm water facilities that should be used in the project area based on the public comments. The District and jurisdictional agencies felt so strongly about the comments that each written comment was presented and used in a matrix for the selection of the preferred alternative.

I hope this clarifies the decision-making process used in the Study. The District is currently coordinating with the City of Avondale and the private interests in the vicinity of the DRCC. The proposed conceptual adjustments to the DRCC alignment are acceptable to the District, but may yet be changed in the future. Detailed review and approval of the technical designs have not been performed. If you need any additional information or clarification of our comments, please contact me at 602-506-5537.

Sincerely,



Gregory L. Jones  
Regional Area Planning Manager

GLJ/lmr

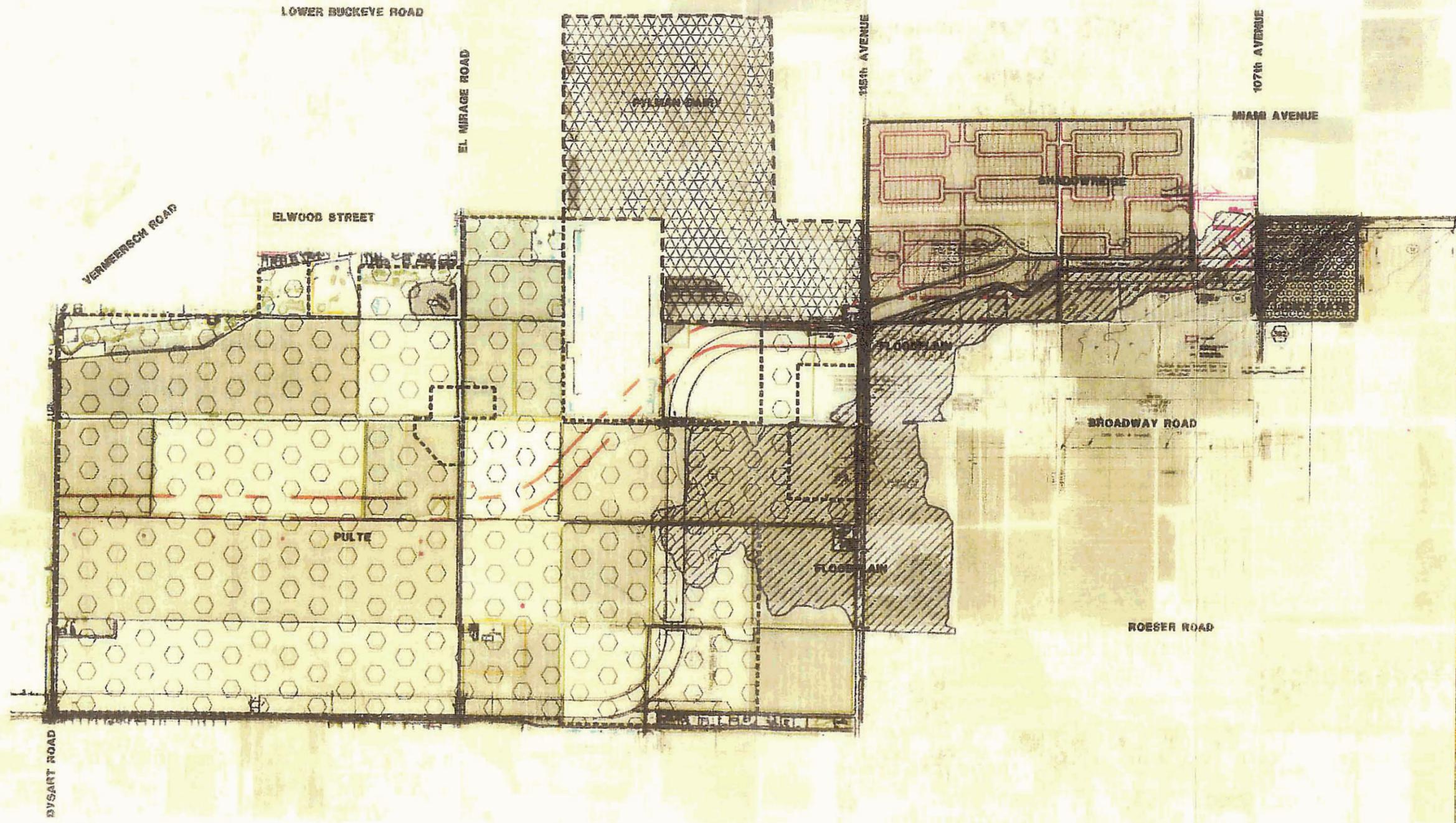
CC: Mr. Mike Hale  
1260 B East,  
3800 North  
Buhl, ID 83316

David Fitzhugh, P.E.  
Assistant City Manager,  
City of Avondale

Attachments

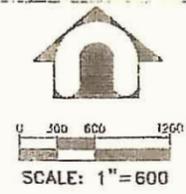
Coord: RGF

5/6/05



**LEGEND**

- |   |              |  |             |   |                  |
|---|--------------|--|-------------|---|------------------|
|  | PULTE        |  | LION'S GATE |  | SHADOWRIDGE      |
|  | PYLMAN DAIRY |  | FLOODPLAIN  |  | PROPOSED CHANNEL |



**Attachment 1**

**SHADOW RIDGE, AVONDALE, AZ  
PROPOSED DRCC CHANNEL ALIGNMENT**

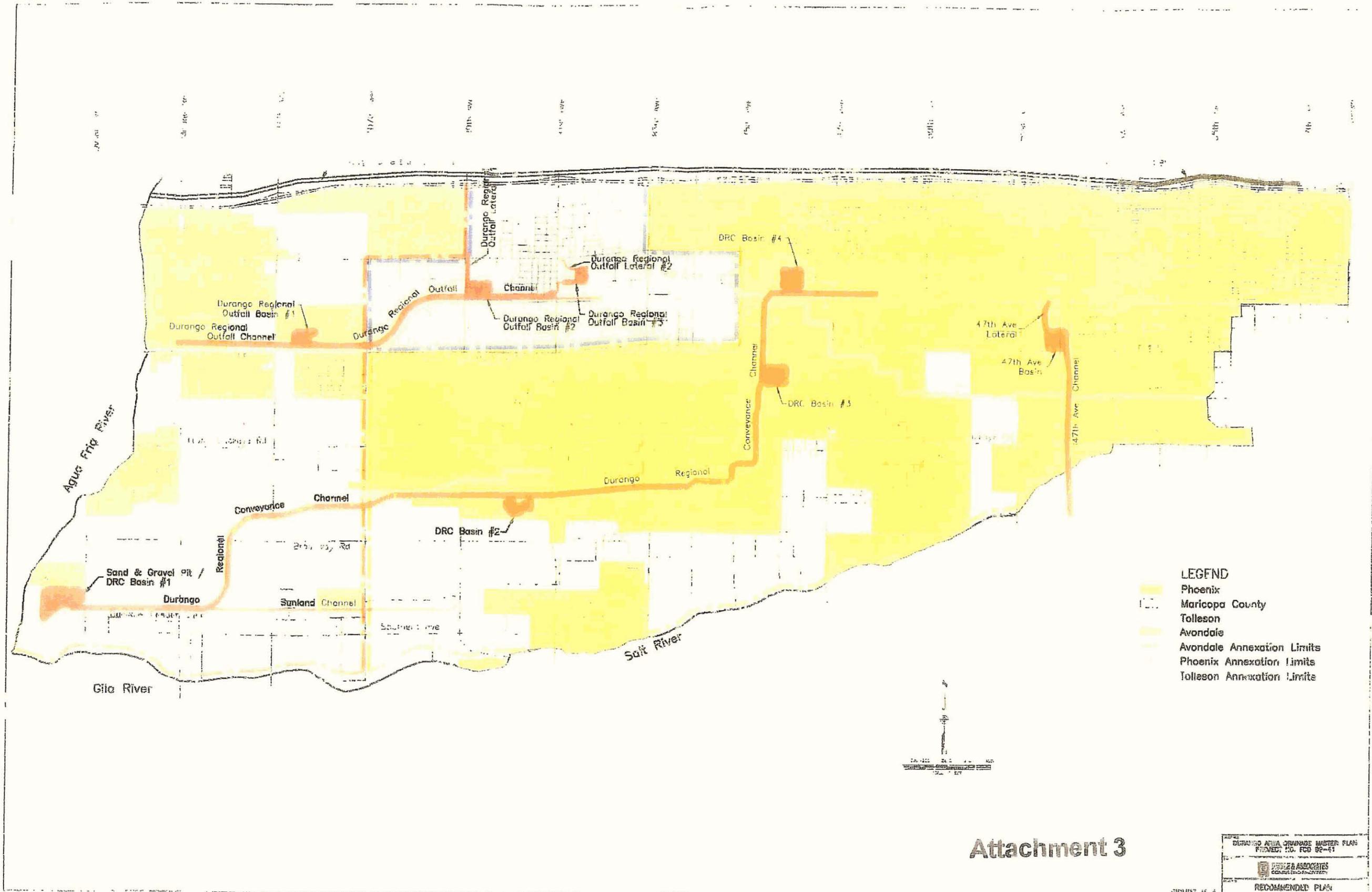
SCALE  
1" = 600'  
SECTION 19  
TOWNSHIP 17N  
RANGE 8E  
SHEET 1  
OF 1

**DAVID EVANS AND ASSOCIATES INC.**  
2101 East McDowell Avenue, Suite 200  
Phoenix, Arizona 85016  
Phone: (602) 991-1111

DRAWN BY: C.L.L.  
CHECKED BY:  
DATE: 02/05/04  
REVISION:

No. 1005 UPGRADE LOCAL DATE AND PUBLIC ALIGNMENT  
P.L.E.





# **CANDIDATE ASSESSMENT REPORT DURANGO REGIONAL CONVEYANCE CHANNEL**

**APPENDIX E: Design Data and Cost Estimates for  
Alternatives.**

**February 2006**

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

THIS SPREADSHEET PROVIDES THE DETAILED COST ESTIMATE FOR THE DRCC ASSUMING:

FULL DRCC IN AVONDALE AND PHOENIX  
100-YEAR, 2-HOUR RETENTION ADJACENT TO THE DRCC

THE SUMMARY SHEET PROVIDES A SUMMARY OF THE DRCC COST BY REACH.

AVONDALE AND PHOENIX COSTS ARE SEPARATED, AND A 30% CONTINGENCY IS ADDED.

THE BASIN#1 SHEET PROVIDES A COST ESTIMATE OF THE DETENTION BASIN  
DOWNSTREAM OF DYSART. THESE COSTS ARE THE SAME IN ALL SCENARIOS.

SUBSEQUENT SHEETS PROVIDE QUANTITY ESTIMATES AND COST ESTIMATES FOR EACH  
REACH OF THE DRCC AS DESCRIBED IN THE SHEET NAME.

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

DRCC COST ESTIMATE SUMMARY  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

REACH	TOTAL COST, INCLUDING RIGHT OF WAY
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 430,205
Dysart to El Mirage	\$ 4,511,712
El Mirage to 115th Avenue	\$ 7,787,615
115th to 107th	\$ 6,755,082
Avondale Subtotal	\$ 23,493,866
Avondale Contingency 30%	\$ 7,048,160
Avondale Total	\$ 30,542,026
107th to 99th	\$ 3,993,463
99th to 91st	\$ 3,972,466
91st to 83rd	\$ 4,254,904
83rd to 75th	\$ 3,574,805
Phoenix Channel Subtotal	\$ 15,795,638
Basin #2	\$ 9,780,984
Phoenix Subtotal	\$ 25,576,622
Phoenix Contingency 30%	\$ 7,672,987
Phoenix Total	\$ 33,249,609
TOTAL	\$ 63,791,635

	DRCC COST IN AVONDALE	DRCC COST IN PHOENIX	DRCC TOTAL COST
WITH CONTINGENCY	\$ 30,542,026	\$ 33,249,609	\$ 63,791,635
WITHOUT CONTINGENCY	\$ 23,493,866	\$ 25,576,622	\$ 49,070,488



ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

	QUANTITY	UNIT	UNIT COST COST	
Excavation	975,399	Cubic Yards	\$ 6	\$ 5,852,394
Landscaping	203.1	Acres	\$ 78,408	\$ 15,924,665
Right of Way	209.1	Acres	\$ 100,000	\$ 20,910,000
Basin #1 Right of Way	137	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	5092.0	Cubic Yards	\$ 669	\$ 3,406,548
Maintenance Road	30	Acres	\$ 28,314	\$ 849,420
Miscellaneous Items				\$ 1,305,460
Subtotal				\$ 49,070,488
Contingency %30				\$ 14,721,147
Total Cost				\$ 63,791,635

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR BASIN #1 DOWNSTREAM OF DYSART

Basin Landscaping	24.0 AC	\$ 78,408	\$ 1,881,792	CHANNEL LANDSCAPING COST
Parcel Area	137.0 AC	\$ 6,000	\$ 822,000	LAND COST
Drain Pipe	500 LF	\$ 55.00	\$ 27,500	FROM DIBBLE
Manholes	2 EA	4500	\$ 9,000	FROM DIBBLE
Headwall	1 EA	\$ 1,100	\$ 1,100	FROM DIBBLE
Inflow Spillway	253572 SF	\$ 5	\$ 1,267,860	FROM DIBBLE
TOTAL COST			\$ 4,009,252	

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR DRCC DOWNSTREAM OF DYSART  
ASSUMING 100-YEAR, 2-HOUR RETENTION

Channel Length	500 Feet	
Channel Discharge	894 cfs	
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	35 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	415.36	
Channel Excavation Volume, CY	7,692 Cubic Yards	
Channel Wetted Perimeter	107 Feet	
Channel Top Width	106 Feet	
Channel Landscape Area, AC	1.2 AC	Channel Only
Channel Total Area	1.2 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	156 Feet	
DRCC Total Area, AC	1.8	Includes maintenance ROW
Culvert area required	101 Square Feet	
Culvert width	20 Feet (Assumes 4-foot height)	
Number barrels	2	
Barrel width	10 Feet	
Culvert Concrete Area	61 Square Feet	
Culvert number	0.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	124 Cubic Yards	

1.210164084

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	7,692	CY	\$ 6	\$ 46,152	CHANNEL EXCAVATION COST
Channel Landscaping	1.4	AC	\$ 78,408	\$ 109,771	CHANNEL LANDSCAPING COST
Channel Area*	1.8	AC	\$ 100,000	\$ 180,000	LAND COST
Culvert Concrete	124	CY	\$ 669	\$ 82,956	CULVERT COST
Maintenance Road**	0.4	AC	\$ 28,314	\$ 11,326	MAINTENANCE ROAD COST
Total Cost				\$ 430,205	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR DRCC FROM DYSART TO EL MIRAGE  
ASSUMING 100-YEAR 2-HOUR RETENTION

Channel Length	5026 Feet	
Channel Discharge	1258 cfs	
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	55 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	533.36	
Channel Excavation Volume, CY	99,284	Cubic Yards
Channel Wetted Perimeter	127 Feet	
Channel Top Width	126 Feet	
Channel Landscape Area, AC	14.7 AC	Channel Only
Channel Total Area	14.5 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	176 Feet	
DRCC Total Area, AC	20.3	Includes maintenance ROW
Culvert area required	142 Square Feet	
Culvert width	28 Feet	(Assumes 4-foot height)
Number barrels	3	
Barrel width	10 Feet	
Culvert Concrete Area	88 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	717	Cubic Yards

1.215176588

ALTERNATIVE 1  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	99,284	CY	\$ 6	\$ 595,704	CHANNEL EXCAVATION COST
Channel Landscaping	16.6	AC	\$ 78,408	\$ 1,301,573	CHANNEL LANDSCAPING COST
Channel Area*	20.3	AC	\$ 100,000	\$ 2,030,000	LAND COST
Culvert Concrete	717	CY	\$ 669	\$ 479,673	CULVERT COST
Maintenance Road**	3.7	AC	\$ 28,314	\$ 104,762	MAINTENANCE ROAD COST
Total Cost				\$ 4,511,712	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR DRCC FROM EL MIRAGE TO 115TH AVENUE  
ASSUMING 100-YEAR 2-HOUR RETENTION

Channel Length	9185 Feet	
Channel Discharge	1277 cfs	
Channel Slope	0.0017 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	49 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	497.96	
Channel Excavation Volume, CY	169,399	Cubic Yards
Channel Wetted Perimeter	121 Feet	
Channel Top Width	120 Feet	
Channel Landscape Area, AC	25.5 AC	Channel Only
Channel Total Area	25.3 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	170 Feet	
DRCC Total Area, AC	35.8	Includes maintenance ROW
Culvert area required	144	Square Feet
Culvert width	29 Feet	(Assumes 4-foot height)
Number barrels	3	
Barrel width	10 Feet	
Culvert Concrete Area	88	Square Feet
Culvert number	3	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1076	Cubic Yards

1.223084557

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	186,146	CY	\$ 6	\$ 1,116,876	CHANNEL EXCAVATION COST
Channel Landscaping	25.6	AC	\$ 78,408	\$ 2,007,245	CHANNEL LANDSCAPING COST
Channel Area*	29.4	AC	\$ 100,000	\$ 2,940,000	LAND COST
Culvert Concrete	872	CY	\$ 669	\$ 583,368	CULVERT COST
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593	MAINTENANCE ROAD COST
<b>Total Cost</b>				<b>\$ 6,755,082</b>	<b>TOTAL COST</b>

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR DRCC FROM 107TH AVENUE TO 99TH AVENUE  
ASSUMING 100-YEAR 2-HOUR RETENTION

Channel Length	5155 Feet	
Channel Discharge	1275 cfs	AVERAGE
Channel Slope	0.0032 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	34 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.6 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.8 Feet	
Channel excavation area	399.04	
Channel Excavation Volume, CY	76,187 Cubic Yards	
Channel Wetted Perimeter	105 Feet	
Channel Top Width	104 Feet	
Channel Landscape Area, AC	12.4 AC	Channel Only
Channel Total Area	12.3 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	154 Feet	
DRCC Total Area, AC	18.2 Includes maintenance ROW	
Culvert area required	146 Square Feet	
Culvert width	29 Feet (Assumes 4-foot height)	
Number barrels	3	
Barrel width	10 Feet	
Culvert Concrete Area	88 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	717 Cubic Yards	

1.228595453

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	76,187	CY	\$ 6	\$ 457,122	CHANNEL EXCAVATION COST
Channel Landscaping	14.4	AC	\$ 78,408	\$ 1,129,075	CHANNEL LANDSCAPING COST
Channel Area*	18.2	AC	\$ 100,000	\$ 1,820,000	LAND COST
Culvert Concrete	717	CY	\$ 669	\$ 479,673	CULVERT COST
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593	MAINTENANCE ROAD COST
Total Cost				\$ 3,993,463	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR DRCC FROM 99TH AVENUE TO 95TH AVENUE BASIN  
ASSUMING 100-YEAR 2-HOUR RETENTION

Channel Length	2778 Feet	
Channel Discharge	973 cfs	
Channel Slope	0.0027 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	25 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.6 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.8 Feet	
Channel excavation area	346.84	
Channel Excavation Volume, CY	35,686	Cubic Yards
Channel Wetted Perimeter	96 Feet	
Channel Top Width	95 Feet	
Channel Landscape Area, AC	6.1 AC	Channel Only
Channel Total Area	6.1 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	145 Feet	
DRCC Total Area, AC	9.2	Includes maintenance ROW
Culvert area required	111	Square Feet
Culvert width	22 Feet	(Assumes 4-foot height)
Number barrels	3	
Barrel width	8 Feet	
Culvert Concrete Area	76	Square Feet
Culvert number	1.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	464	Cubic Yards

1.21277586

ALTERNATIVE 1  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	35,686	CY	\$ 6	\$ 214,116	CHANNEL EXCAVATION COST
Channel Landscaping	7.2	AC	\$ 78,408	\$ 564,538	CHANNEL LANDSCAPING COST
Channel Area*	9.2	AC	\$ 100,000	\$ 920,000	LAND COST
Culvert Concrete	464	CY	\$ 669	\$ 310,416	CULVERT COST
Maintenance Road**	2.0	AC	\$ 28,314	\$ 56,628	MAINTENANCE ROAD COST
Total Cost				\$ 2,065,698	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR DRCC ADJACENT TO 95TH AVENUE BASIN  
ASSUMING 100-YEAR 2-HOUR RETENTION

Channel Length	1079 Feet	
Channel Discharge	998 cfs	
Channel Slope	0.002 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	33 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.6 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.8 Feet	
Channel excavation area	393.24	
Channel Excavation Volume, CY	15,715 Cubic Yards	
Channel Wetted Perimeter	104 Feet	
Channel Top Width	103 Feet	
Channel Landscape Area, AC	2.6 AC	Channel Only
Channel Total Area	2.6 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	153 Feet	
DRCC Total Area, AC	3.8	Includes maintenance ROW
Culvert area required	114 Square Feet	
Culvert width	23 Feet	(Assumes 4-foot height)
Number barrels	3	
Barrel width	8 Feet	
Culvert Concrete Area	76 Square Feet	
Culvert number	0	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	0 Cubic Yards	

1.199757014

ALTERNATIVE 1  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	27,067	CY	\$ 6	\$ 162,402	CHANNEL EXCAVATION COST
Channel Landscaping	4.4	AC	\$ 78,408	\$ 344,995	CHANNEL LANDSCAPING COST
Channel Area*	5.3	AC	\$ 100,000	\$ 530,000	LAND COST
Culvert Concrete	167	CY	\$ 669	\$ 111,723	CULVERT COST
Maintenance Road**	0.9	AC	\$ 28,314	\$ 25,483	MAINTENANCE ROAD COST
Total Cost				\$ 1,174,603	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR DRCC FROM 91ST AVENUE TO 83RD AVENUE  
ASSUMING 100-YEAR 2-HOUR RETENTION

Channel Length	5017 Feet	
Channel Discharge	852 cfs	AVERAGE
Channel Slope	0.0007 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	50 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	516	
Channel Excavation Volume, CY	95,880 Cubic Yards	
Channel Wetted Perimeter	123 Feet	
Channel Top Width	122 Feet	
Channel Landscape Area, AC	14.2 AC	Channel Only
Channel Total Area	14.1 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	172 Feet	
DRCC Total Area, AC	19.8 Includes maintenance ROW	
Culvert area required	95 Square Feet	
Culvert width	19 Feet (Assumes 4-foot height)	
Number barrels	2	
Barrel width	10 Feet	
Culvert Concrete Area	61 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	497 Cubic Yards	

1.219696925

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	95,880	CY	\$ 6	\$ 575,280	CHANNEL EXCAVATION COST
Channel Landscaping	16.1	AC	\$ 78,408	\$ 1,262,369	CHANNEL LANDSCAPING COST
Channel Area*	19.8	AC	\$ 100,000	\$ 1,980,000	LAND COST
Culvert Concrete	497	CY	\$ 669	\$ 332,493	CULVERT COST
Maintenance Road**	3.7	AC	\$ 28,314	\$ 104,762	MAINTENANCE ROAD COST
<b>Total Cost</b>				<b>\$ 4,254,904</b>	<b>TOTAL COST</b>

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR DRCC FROM 83RD AVENUE TO 75TH AVENUE  
ASSUMING 100-YEAR 2-HOUR RETENTION

Channel Length	5739 Feet	
Channel Discharge	534 cfs	
Channel Slope	0.0015 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	12 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	279.66	
Channel Excavation Volume, CY	59,443 Cubic Yards	
Channel Wetted Perimeter	84 Feet	
Channel Top Width	83 Feet	
Channel Landscape Area, AC	11.1 AC	Channel Only
Channel Total Area	10.9 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	133 Feet	
DRCC Total Area, AC	17.5 Includes maintenance ROW	
Culvert area required	60 Square Feet	
Culvert width	12 Feet (Assumes 4-foot height)	
Number barrels	2	
Barrel width	6 Feet	
Culvert Concrete Area	45 Square Feet	
Culvert number	2.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	458 Cubic Yards	

1.206009077

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	59,443	CY	\$ 6	\$ 356,658	CHANNEL EXCAVATION COST
Channel Landscaping	13.3	AC	\$ 78,408	\$ 1,042,826	CHANNEL LANDSCAPING COST
Channel Area*	17.5	AC	\$ 100,000	\$ 1,750,000	LAND COST
Culvert Concrete	458	CY	\$ 669	\$ 306,402	CULVERT COST
Maintenance Road**	4.2	AC	\$ 28,314	\$ 118,919	MAINTENANCE ROAD COST
Total Cost				\$ 3,574,805	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR DRCC 95TH AVENUE BASIN  
QUANTITIES ARE FROM DIBBLE MASTER PLAN

ITEM	QUANTITY	UNIT	UNIT COST	COST
Basin Excavation Volume	202,900	CY	\$ 6	\$ 1,217,400
Basin Landscaping	48.0	AC	\$ 78,408	\$ 3,763,584
Parcel Area	48.0	AC	\$ 100,000	\$ 4,800,000
Total Cost				\$ 9,780,984

ALTERNATIVE 1  
FULL DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	UNIT	UNIT COST
Channel Excavation Volume	CY	6
Channel Landscaping	AC	78408
Channel Area**	AC	100000
Culvert Concrete***	CY	668.75
Maintenance Road****	AC	28314
Total Cost		

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

THIS SPREADSHEET PROVIDES THE DETAILED COST ESTIMATE FOR THE DRCC ASSUMING:

FULL DRCC IN AVONDALE AND PHOENIX  
FIRST FLUSH RETENTION ADJACENT TO THE DRCC

THE SUMMARY SHEET PROVIDES A SUMMARY OF THE DRCC COST BY REACH.

AVONDALE AND PHOENIX COSTS ARE SEPARATED, AND A 30% CONTINGENCY IS ADDED.

THE BASIN#1 SHEET PROVIDES A COST ESTIMATE OF THE DETENTION BASIN  
DOWNSTREAM OF DYSART. THESE COSTS ARE THE SAME IN ALL SCENARIOS.

SUBSEQUENT SHEETS PROVIDE QUANTITY ESTIMATES AND COST ESTIMATES FOR EACH  
REACH OF THE DRCC AS DESCRIBED IN THE SHEET NAME.

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

COST ESTIMATE FOR BASIN #1 DOWNSTREAM OF DYSART

Basin Landscaping	24.0 AC	\$	78,408	\$	1,881,792	CHANNEL LANDSCAPING COST
Parcel Area	137.0 AC	\$	6,000	\$	822,000	LAND COST
Drain Pipe	500 LF	\$	55.00	\$	27,500	FROM DIBBLE
Manholes	2 EA		4500	\$	9,000	FROM DIBBLE
Headwall	1 EA	\$	1,100	\$	1,100	FROM DIBBLE
Inflow Spillway	253572 SF	\$	5	\$	1,267,860	FROM DIBBLE
TOTAL COST				\$	4,009,252	
				\$	5,212,028	

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

COST ESTIMATE FOR DRCC DOWNSTREAM OF DYSART  
ASSUMING FIRST FLUSH RETENTION

Channel Length	500 Feet	
Channel Discharge	2273 cfs	
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	112 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	869.66	
Channel Excavation Volume, CY	16,105 Cubic Yards	
Channel Wetted Perimeter	184 Feet	
Channel Top Width	183 Feet	
Channel Landscape Area, AC	2.1 AC	Channel Only
Channel Total Area	2.1 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	233 Feet	
DRCC Total Area, AC	2.7 Includes maintenance ROW	
Culvert area required	256 Square Feet	
Culvert width	51 Feet (Assumes 4-foot height)	
Number barrels	5	
Barrel width	10 Feet	
Culvert Concrete Area	142 Square Feet	
Culvert number	0.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	289 Cubic Yards	

1.221191415

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	16,105	CY	\$ 6	\$ 96,630	CHANNEL EXCAVATION COST
Channel Landscaping	2.3	AC	\$ 78,408	\$ 180,338	CHANNEL LANDSCAPING COST
Channel Area*	2.7	AC	\$ 100,000	\$ 270,000	LAND COST
Culvert Concrete	289	CY	\$ 669	\$ 193,341	CULVERT COST
Maintenance Road**	0.4	AC	\$ 28,314	\$ 11,326	MAINTENANCE ROAD COST
Total Cost				\$ 751,635	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

COST ESTIMATE FOR DRCC FROM DYSART TO EL MIRAGE  
ASSUMING FIRST FLUSH RETENTION

Channel Length	5026 Feet	
Channel Discharge	2180 cfs	AVERAGE
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	107 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	840.16	
Channel Excavation Volume, CY	156,394 Cubic Yards	
Channel Wetted Perimeter	179 Feet	
Channel Top Width	178 Feet	
Channel Landscape Area, AC	20.7 AC	Channel Only
Channel Total Area	20.5 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	228 Feet	
DRCC Total Area, AC	26.3 Includes maintenance ROW	
Culvert area required	246 Square Feet	
Culvert width	49 Feet (Assumes 4-foot height)	
Number barrels	5	
Barrel width	10 Feet	
Culvert Concrete Area	142 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1157 Cubic Yards	

1.220689671

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	156,394	CY	\$ 6	\$ 938,364	CHANNEL EXCAVATION COST
Channel Landscaping	22.6	AC	\$ 78,408	\$ 1,772,021	CHANNEL LANDSCAPING COST
Channel Area*	26.3	AC	\$ 100,000	\$ 2,630,000	LAND COST
Culvert Concrete	1157	CY	\$ 669	\$ 774,033	CULVERT COST
Maintenance Road**	3.7	AC	\$ 28,314	\$ 104,762	MAINTENANCE ROAD COST
Total Cost				\$ 6,219,180	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

COST ESTIMATE FOR DRCC FROM EL MIRAGE TO 115TH AVENUE  
ASSUMING FIRST FLUSH RETENTION

Channel Length	9185 Feet	
Channel Discharge	1944 cfs	
Channel Slope	0.0017 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	84 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	704.46	
Channel Excavation Volume, CY	239,647	Cubic Yards
Channel Wetted Perimeter	156 Feet	
Channel Top Width	155 Feet	
Channel Landscape Area, AC	32.9 AC	Channel Only
Channel Total Area	32.7 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	205 Feet	
DRCC Total Area, AC	43.2	Includes maintenance ROW
Culvert area required	219 Square Feet	
Culvert width	44 Feet	(Assumes 4-foot height)
Number barrels	5	
Barrel width	9 Feet	
Culvert Concrete Area	132 Square Feet	
Culvert number	3	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1613	Cubic Yards

1.227755195

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	239,647	CY	\$ 6	\$ 1,437,882	CHANNEL EXCAVATION COST
Channel Landscaping	36.5	AC	\$ 78,408	\$ 2,861,892	CHANNEL LANDSCAPING COST
Channel Area*	43.2	AC	\$ 100,000	\$ 4,320,000	LAND COST
Culvert Concrete	1613	CY	\$ 669	\$ 1,079,097	CULVERT COST
Maintenance Road**	6.7	AC	\$ 28,314	\$ 189,704	MAINTENANCE ROAD COST
Total Cost				\$ 9,888,575	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION**

**COST ESTIMATE FOR DRCC FROM 115TH AVENUE TO 107TH AVENUE  
ASSUMING FIRST FLUSH RETENTION**

Channel Length	5139 Feet	
Channel Discharge	2176 cfs	
Channel Slope	0.0005 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	181 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	1302	
Channel Excavation Volume, CY	247,814 Cubic Yards	
Channel Wetted Perimeter	254 Feet	
Channel Top Width	253 Feet	
Channel Landscape Area, AC	30.0 AC	Channel Only
Channel Total Area	29.8 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	303 Feet	
DRCC Total Area, AC	35.7 Includes maintenance ROW	
Culvert area required	242 Square Feet	
Culvert width	48 Feet (Assumes 4-foot height)	
Number barrels	6	
Barrel width	8 Feet	
Culvert Concrete Area	145 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1181 Cubic Yards	

1.218125019

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	247,814	CY	\$ 6	\$ 1,486,884	CHANNEL EXCAVATION COST
Channel Landscaping	31.9	AC	\$ 78,408	\$ 2,501,215	CHANNEL LANDSCAPING COST
Channel Area*	35.7	AC	\$ 100,000	\$ 3,570,000	LAND COST
Culvert Concrete	1181	CY	\$ 669	\$ 790,089	CULVERT COST
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593	MAINTENANCE ROAD COST
Total Cost				\$ 8,455,781	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION**

**COST ESTIMATE FOR DRCC FROM 107TH AVENUE TO 99TH AVENUE  
ASSUMING FIRST FLUSH RETENTION**

Channel Length	5155 Feet	
Channel Discharge	1713 cfs	AVERAGE
Channel Slope	0.0032 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	51 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.6 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.8 Feet	
Channel excavation area	497.64	
Channel Excavation Volume, CY	95,012 Cubic Yards	
Channel Wetted Perimeter	122 Feet	
Channel Top Width	121 Feet	
Channel Landscape Area, AC	14.4 AC	Channel Only
Channel Total Area	14.3 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	171 Feet	
DRCC Total Area, AC	20.2 Includes maintenance ROW	
Culvert area required	196 Square Feet	
Culvert width	39 Feet (Assumes 4-foot height)	
Number barrels	4	
Barrel width	10 Feet	
Culvert Concrete Area	115 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	937 Cubic Yards	

1.237138105

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	95,012	CY	\$ 6	\$ 570,072	CHANNEL EXCAVATION COST
Channel Landscaping	16.4	AC	\$ 78,408	\$ 1,285,891	CHANNEL LANDSCAPING COST
Channel Area*	20.2	AC	\$ 100,000	\$ 2,020,000	LAND COST
Culvert Concrete	937	CY	\$ 669	\$ 626,853	CULVERT COST
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593	MAINTENANCE ROAD COST
Total Cost				\$ 4,610,409	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION**

**COST ESTIMATE FOR DRCC FROM 99TH AVENUE TO 95TH AVENUE BASIN  
ASSUMING FIRST FLUSH RETENTION**

Channel Length	2778 Feet	
Channel Discharge	1050 cfs	
Channel Slope	0.0027 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	29 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.6 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.8 Feet	
Channel excavation area	370.04	
Channel Excavation Volume, CY	38,073 Cubic Yards	
Channel Wetted Perimeter	100 Feet	
Channel Top Width	99 Feet	
Channel Landscape Area, AC	6.4 AC	Channel Only
Channel Total Area	6.3 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	149 Feet	
DRCC Total Area, AC	9.5 Includes maintenance ROW	
Culvert area required	120 Square Feet	
Culvert width	24 Feet (Assumes 4-foot height)	
Number barrels	3	
Barrel width	8 Feet	
Culvert Concrete Area	76 Square Feet	
Culvert number	1.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	464 Cubic Yards	

1.213137039

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	38,073	CY	\$ 6	\$ 228,438	CHANNEL EXCAVATION COST
Channel Landscaping	7.5	AC	\$ 78,408	\$ 588,060	CHANNEL LANDSCAPING COST
Channel Area*	9.5	AC	\$ 100,000	\$ 950,000	LAND COST
Culvert Concrete	464	CY	\$ 669	\$ 310,416	CULVERT COST
Maintenance Road**	2.0	AC	\$ 28,314	\$ 56,628	MAINTENANCE ROAD COST
Total Cost				\$ 2,133,542	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION**

COST ESTIMATE FOR DRCC ADJACENT TO 95TH AVENUE BASIN  
ASSUMING FIRST FLUSH RETENTION

Channel Length	1079 Feet	
Channel Discharge	1532 cfs	
Channel Slope	0.002 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	60 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.6 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.8 Feet	
Channel excavation area	549.84	
Channel Excavation Volume, CY	21,973 Cubic Yards	
Channel Wetted Perimeter	131 Feet	
Channel Top Width	130 Feet	
Channel Landscape Area, AC	3.2 AC	Channel Only
Channel Total Area	3.2 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	180 Feet	
DRCC Total Area, AC	4.5 Includes maintenance ROW	
Culvert area required	175 Square Feet	
Culvert width	35 Feet (Assumes 4-foot height)	
Number barrels	4	
Barrel width	9 Feet	
Culvert Concrete Area	107 Square Feet	
Culvert number	0	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	0 Cubic Yards	

1.206110973

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	21,973	CY	\$ 6	\$ 131,838	CHANNEL EXCAVATION COST
Channel Landscaping	3.7	AC	\$ 78,408	\$ 290,110	CHANNEL LANDSCAPING COST
Channel Area*	4.5	AC	\$ 100,000	\$ 450,000	LAND COST
Culvert Concrete	0	CY	\$ 669	\$ -	CULVERT COST
Maintenance Road**	0.8	AC	\$ 28,314	\$ 22,651	MAINTENANCE ROAD COST
Total Cost				\$ 894,599	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION**

**COST ESTIMATE FOR DRCC FROM 95TH AVENUE BASIN TO 91ST AVENUE  
ASSUMING FIRST FLUSH RETENTION**

Channel Length	1250 Feet	
Channel Discharge	1548 cfs	
Channel Slope	0.001 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	92 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.6 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.8 Feet	
Channel excavation area	735.44	
Channel Excavation Volume, CY	34,048 Cubic Yards	
Channel Wetted Perimeter	163 Feet	
Channel Top Width	162 Feet	
Channel Landscape Area, AC	4.7 AC	Channel Only
Channel Total Area	4.6 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	212 Feet	
DRCC Total Area, AC	6.1	includes maintenance ROW
Culvert area required	177 Square Feet	
Culvert width	35 Feet	(Assumes 4-foot height)
Number barrels	4	
Barrel width	9 Feet	
Culvert Concrete Area	107 Square Feet	
Culvert number	0.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	218 Cubic Yards	

1.180733925

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	34,048	CY	\$ 6	\$ 204,288	CHANNEL EXCAVATION COST
Channel Landscaping	5.2	AC	\$ 78,408	\$ 407,722	CHANNEL LANDSCAPING COST
Channel Area*	6.1	AC	\$ 100,000	\$ 610,000	LAND COST
Culvert Concrete	218	CY	\$ 669	\$ 145,842	CULVERT COST
Maintenance Road**	0.9	AC	\$ 28,314	\$ 25,483	MAINTENANCE ROAD COST
Total Cost				\$1,393,335	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

COST ESTIMATE FOR DRCC FROM 91ST AVENUE TO 83RD AVENUE  
ASSUMING FIRST FLUSH RETENTION

Channel Length	5017 Feet	
Channel Discharge	1081 cfs	AVERAGE
Channel Slope	0.0007 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	67 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	618	
Channel Excavation Volume, CY	114,834 Cubic Yards	
Channel Wetted Perimeter	140 Feet	
Channel Top Width	139 Feet	
Channel Landscape Area, AC	16.1 AC	Channel Only
Channel Total Area	16.0 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	189 Feet	
DRCC Total Area, AC	21.8 Includes maintenance ROW	
Culvert area required	120 Square Feet	
Culvert width	24 Feet (Assumes 4-foot height)	
Number barrels	3	
Barrel width	8 Feet	
Culvert Concrete Area	76 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	619 Cubic Yards	

1.221453198

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	114,834	CY	\$ 6	\$ 689,004	CHANNEL EXCAVATION COST
Channel Landscaping	18.1	AC	\$ 78,408	\$ 1,419,185	CHANNEL LANDSCAPING COST
Channel Area*	21.8	AC	\$ 100,000	\$ 2,180,000	LAND COST
Culvert Concrete	619	CY	\$ 669	\$ 414,111	CULVERT COST
Maintenance Road**	3.7	AC	\$ 28,314	\$ 104,762	MAINTENANCE ROAD COST
Total Cost				\$ 4,807,062	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION**

**COST ESTIMATE FOR DRCC FROM 83RD AVENUE TO 75TH AVENUE  
ASSUMING FIRST FLUSH RETENTION**

Channel Length	5739 Feet	
Channel Discharge	613 cfs	
Channel Slope	0.0015 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	17 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	309.16	
Channel Excavation Volume, CY	65,714 Cubic Yards	
Channel Wetted Perimeter	89 Feet	
Channel Top Width	88 Feet	
Channel Landscape Area, AC	11.7 AC	Channel Only
Channel Total Area	11.6 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	138 Feet	
DRCC Total Area, AC	18.2 Includes maintenance ROW	
Culvert area required	69 Square Feet	
Culvert width	14 Feet (Assumes 4-foot height)	
Number barrels	2	
Barrel width	7 Feet	
Culvert Concrete Area	49 Square Feet	
Culvert number	2.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	499 Cubic Yards	

1.207322318

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	65,714	CY	\$ 6	\$ 394,284	CHANNEL EXCAVATION COST
Channel Landscaping	14.0	AC	\$ 78,408	\$ 1,097,712	CHANNEL LANDSCAPING COST
Channel Area*	18.2	AC	\$ 100,000	\$ 1,820,000	LAND COST
Culvert Concrete	499	CY	\$ 669	\$ 333,831	CULVERT COST
Maintenance Road**	4.2	AC	\$ 28,314	\$ 118,919	MAINTENANCE ROAD COST
Total Cost				\$ 3,764,746	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 2  
 FULL DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Basin Excavation Volume	202,900	CY	\$ 6	\$ 1,217,400	CHANNEL EXCAVATION COST
Basin Landscaping	48.0	AC	\$ 78,408	\$ 3,763,584	CHANNEL LANDSCAPING COST
Parcel Area	48.0	AC	\$ 100,000	\$ 4,800,000	LAND COST
Total Cost				\$ 9,780,984	TOTAL COST
				12715279.2	

ALTERNATIVE 2  
FULL DRCC, FIRST FLUSH RETENTION

ITEM	UNIT	UNIT COST
Channel Excavation Volume	CY	6
Channel Landscaping	AC	78408
Channel Area**	AC	100000
Culvert Concrete***	CY	668.75
Maintenance Road****	AC	28314
Total Cost		

\* Assumes 1-foot freeboard

\*\* Includes 50-foot Right of Way outside of channel proper.

\*\*\* Assumes three and a half 4 cell 8'x5' culverts

\*\*\*\* Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 3  
AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION

THIS SPREADSHEET PROVIDES THE DETAILED COST ESTIMATE FOR THE DRCC ASSUMING:

FULL DRCC IN AVONDALE AND PHOENIX  
100-YEAR 2-HOUR RETENTION

THE SUMMARY SHEET PROVIDES A SUMMARY OF THE DRCC COST BY REACH.

AVONDALE AND PHOENIX COSTS ARE SEPARATED, AND A 30% CONTINGENCY IS ADDED.

THE BASIN#1 SHEET PROVIDES A COST ESTIMATE OF THE DETENTION BASIN  
DOWNSTREAM OF DYSART. THESE COSTS ARE THE SAME IN ALL SCENARIOS.

SUBSEQUENT SHEETS PROVIDE QUANTITY ESTIMATES AND COST ESTIMATES FOR EACH  
REACH OF THE DRCC AS DESCRIBED IN THE SHEET NAME.

ALTERNATIVE 3  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION

DRCC COST ESTIMATE SUMMARY  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION

REACH	TOTAL COST, INCLUDING RIGHT OF WAY
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 428,237
Dysart to El Mirage	\$ 4,184,003
El Mirage to 115th Avenue	\$ 7,194,189
115th to 107th	\$ 5,969,556
Avondale Subtotal	\$ 21,785,237
Avondale Contingency 30%	\$ 6,535,571
Avondale Total	\$ 28,320,808

	DRCC COST IN AVONDALE	DRCC COST IN PHOENIX	DRCC TOTAL COST
WITH CONTINGENCY	\$ 28,320,808	\$ -	\$ 28,320,808
WITHOUT CONTINGENCY	\$ 21,785,237	\$ -	\$ 21,785,237



ALTERNATIVE 3  
AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION

	QUANTITY	UNIT	UNIT COST	COST
Excavation	403,731	Cubic Yards	\$ 6	\$ 2,422,386
Landscaping	90.6	Acres	\$ 78,408	\$ 7,103,765
Right of Way	81.2	Acres	\$ 100,000	\$ 8,120,000
Basin #1 Right of Way	137.0	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	2389.0	Cubic Yards	\$ 669	\$ 1,598,241
Maintenance Road	14.6	Acres	\$ 28,314	\$ 413,384
Miscellaneous Items				\$ 1,305,460
Subtotal				\$ 21,785,237
Contingency %30				\$ 6,535,571
Total Cost				\$ 28,320,808

ALTERNATIVE 3  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR BASIN #1 DOWNSTREAM OF DYSART

Basin Landscaping	24.0 AC	\$	78,408	\$	1,881,792	CHANNEL LANDSCAPING COST
Parcel Area	137.0 AC	\$	6,000	\$	822,000	LAND COST
Drain Pipe	500 LF	\$	55.00	\$	27,500	FROM DIBBLE
Manholes	2 EA		4500	\$	9,000	FROM DIBBLE
Headwall	1 EA	\$	1,100	\$	1,100	FROM DIBBLE
Inflow Spillway	253572 SF	\$	5	\$	1,267,860	FROM DIBBLE
<b>TOTAL COST</b>				\$	<b>4,009,252</b>	

ALTERNATIVE 3  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR DRCC DOWNSTREAM OF DYSART  
 ASSUMING 100-YEAR, 2-HOUR RETENTION  
 DRCC IN AVONDALE ONLY

Channel Length	500 Feet	
Channel Discharge	847 cfs	
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	32 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	397.66	
Channel Excavation Volume, CY	7,364 Cubic Yards	
Channel Wetted Perimeter	104 Feet	
Channel Top Width	103 Feet	
Channel Landscape Area, AC	1.2 AC	Channel Only
Channel Total Area	1.2 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	153 Feet	
DRCC Total Area, AC	1.8 Includes maintenance ROW	
Culvert area required	95 Square Feet	
Culvert width	19 Feet (Assumes 4-foot height)	
Number barrels	2	
Barrel width	10 Feet	
Culvert Concrete Area	61 Square Feet	
Culvert number	0.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	124 Cubic Yards	

1.209788224

ALTERNATIVE 3  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	7,364	CY	\$ 6	\$ 44,184	CHANNEL EXCAVATION COST
Channel Landscaping	1.4	AC	\$ 78,408	\$ 109,771	CHANNEL LANDSCAPING COST
Channel Area*	1.8	AC	\$ 100,000	\$ 180,000	LAND COST
Culvert Concrete	124	CY	\$ 669	\$ 82,956	CULVERT COST
Maintenance Road**	0.4	AC	\$ 28,314	\$ 11,326	MAINTENANCE ROAD COST
Total Cost				\$ 428,237	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 3  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR DRCC FROM DYSART TO EL MIRAGE  
 ASSUMING 100-YEAR 2-HOUR RETENTION  
 DRCC IN AVONDALE ONLY

Channel Length	5026 Feet	
Channel Discharge	1078 cfs	
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	45 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	474.36	
Channel Excavation Volume, CY	88,301 Cubic Yards	
Channel Wetted Perimeter	117 Feet	
Channel Top Width	116 Feet	
Channel Landscape Area, AC	13.5 AC	Channel Only
Channel Total Area	13.4 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	166 Feet	
DRCC Total Area, AC	19.2 Includes maintenance ROW	
Culvert area required	121 Square Feet	
Culvert width	24 Feet (Assumes 4-foot height)	
Number barrels	3	
Barrel width	8 Feet	
Culvert Concrete Area	76 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	619 Cubic Yards	

1.213113057

ALTERNATIVE 3  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	88,301	CY	\$ 6	\$ 529,806	CHANNEL EXCAVATION COST
Channel Landscaping	15.5	AC	\$ 78,408	\$ 1,215,324	CHANNEL LANDSCAPING COST
Channel Area*	19.2	AC	\$ 100,000	\$ 1,920,000	LAND COST
Culvert Concrete	619	CY	\$ 669	\$ 414,111	CULVERT COST
Maintenance Road**	3.7	AC	\$ 28,314	\$ 104,762	MAINTENANCE ROAD COST
Total Cost				\$ 4,184,003	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 3  
AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION**

**COST ESTIMATE FOR DRCC FROM EL MIRAGE TO 115TH AVENUE  
ASSUMING 100-YEAR 2-HOUR RETENTION  
DRCC IN AVONDALE ONLY**

Channel Length	9185 Feet	
Channel Discharge	1073 cfs	
Channel Slope	0.0017 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	39 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	438.96	
Channel Excavation Volume, CY	149,328	Cubic Yards
Channel Wetted Perimeter	111 Feet	
Channel Top Width	110 Feet	
Channel Landscape Area, AC	23.4 AC	Channel Only
Channel Total Area	23.2 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	160 Feet	
DRCC Total Area, AC	33.7	Includes maintenance ROW
Culvert area required	121	Square Feet
Culvert width	24 Feet	(Assumes 4-foot height)
Number barrels	3	
Barrel width	8 Feet	
Culvert Concrete Area	76	Square Feet
Culvert number	3	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	929	Cubic Yards
	315.84	

1.219804261

ALTERNATIVE 3  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	149,328	CY	\$ 6	\$ 895,968	CHANNEL EXCAVATION COST
Channel Landscaping	27.0	AC	\$ 78,408	\$ 2,117,016	CHANNEL LANDSCAPING COST
Channel Area*	33.7	AC	\$ 100,000	\$ 3,370,000	LAND COST
Culvert Concrete	929	CY	\$ 669	\$ 621,501	CULVERT COST
Maintenance Road**	6.7	AC	\$ 28,314	\$ 189,704	MAINTENANCE ROAD COST
Total Cost				\$ 7,194,189	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 3  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION

COST ESTIMATE FOR DRCC FROM 115TH AVENUE TO 107TH AVENUE  
 ASSUMING 100-YEAR 2-HOUR RETENTION  
 DRCC IN AVONDALE ONLY

Channel Length	5139 Feet	
Channel Discharge	1312 cfs	
Channel Slope	0.0005 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	103 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	834	
Channel Excavation Volume, CY	158,738 Cubic Yards	
Channel Wetted Perimeter	176 Feet	
Channel Top Width	175 Feet	
Channel Landscape Area, AC	20.8 AC	Channel Only
Channel Total Area	20.6 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	225 Feet	
DRCC Total Area, AC	26.5 Includes maintenance ROW	
Culvert area required	146 Square Feet	
Culvert width	29 Feet (Assumes 4-foot height)	
Number barrels	3	
Barrel width	10 Feet	
Culvert Concrete Area	88 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	717 Cubic Yards	
	632.64	

1.216695849

ALTERNATIVE 3  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	158,738	CY	\$ 6	\$ 952,428	CHANNEL EXCAVATION COST
Channel Landscaping	22.7	AC	\$ 78,408	\$ 1,779,862	CHANNEL LANDSCAPING COST
Channel Area*	26.5	AC	\$ 100,000	\$ 2,650,000	LAND COST
Culvert Concrete	717	CY	\$ 669	\$ 479,673	CULVERT COST
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593	MAINTENANCE ROAD COST
Total Cost				\$ 5,969,556	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 3  
AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION

ITEM	UNIT	UNIT COST
Channel Excavation Volume	CY	6
Channel Landscaping	AC	78408
Channel Area**	AC	100000
Culvert Concrete***	CY	668.75
Maintenance Road****	AC	28314
Total Cost		

\* Assumes 1-foot freeboard

\*\* Includes 50-foot Right of Way outside of channel proper.

\*\*\* Assumes three and a half 4 cell 8'x5' culverts

\*\*\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 4  
AVONDALE DRCC, FIRST FLUSH RETENTION

THIS SPREADSHEET PROVIDES THE DETAILED COST ESTIMATE FOR THE DRCC ASSUMING:

DRCC IN AVONDALE ONLY  
FIRST FLUSH RETENTION ADJACENT TO THE DRCC

THE SUMMARY SHEET PROVIDES A SUMMARY OF THE DRCC COST BY REACH.

AVONDALE AND PHOENIX COSTS ARE SEPARATED, AND A 30% CONTINGENCY IS ADDED.

THE BASIN#1 SHEET PROVIDES A COST ESTIMATE OF THE DETENTION BASIN  
DOWNSTREAM OF DYSART. THESE COSTS ARE THE SAME IN ALL SCENARIOS.

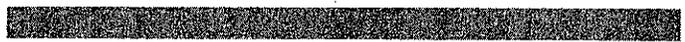
SUBSEQUENT SHEETS PROVIDE QUANTITY ESTIMATES AND COST ESTIMATES FOR EACH  
REACH OF THE DRCC AS DESCRIBED IN THE SHEET NAME.

ALTERNATIVE 4  
 AVONDALE DRCC, FIRST FLUSH RETENTION

DRCC COST ESTIMATE SUMMARY  
 AVONDALE DRCC, FIRST FLUSH RETENTION

REACH	TOTAL COST, INCLUDING RIGHT OF WAY
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 751,635
Dysart to El Mirage	\$ 6,095,245
El Mirage to 115th Avenue	\$ 8,742,088
115th to 107th	\$ 5,969,556
Avondale Subtotal	\$ 25,567,776
Avondale Contingency 30%	\$ 7,670,333
Avondale Total	\$ 33,238,109

	DRCC COST IN AVONDALE	DRCC COST IN PHOENIX	DRCC TOTAL COST
WITH CONTINGENCY	\$ 33,238,109	\$ -	\$ 33,238,109
WITHOUT CONTINGENCY	\$ 25,567,776	\$ -	\$ 25,567,776



ALTERNATIVE 4  
 AVONDALE DRCC, FIRST FLUSH RETENTION

	QUANTITY	UNIT	UNIT COST	COST
Excavation	527,258	Cubic Yards	\$ 6	\$ 3,163,548
Landscaping	103.5	Acres	\$ 78,408	\$ 8,115,228
Right of Way	94.1	Acres	\$ 100,000	\$ 9,410,000
Basin #1 Right of Way	137.0	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	3495.0	Cubic Yards	\$ 669	\$ 2,338,155
Maintenance Road	14.6	Acres	\$ 28,314	\$ 413,384
Miscellaneous Items				\$ 1,305,460
Subtotal				\$ 25,567,776
Contingency %30				\$ 7,670,333
Total Cost				\$ 33,238,109

ALTERNATIVE 4  
AVONDALE DRCC, FIRST FLUSH RETENTION

COST ESTIMATE FOR BASIN #1 DOWNSTREAM OF DYSART

Basin Landscaping	24.0 AC	\$ 78,408	\$ 1,881,792	CHANNEL LANDSCAPING COST
Parcel Area	137.0 AC	\$ 6,000	\$ 822,000	LAND COST
Drain Pipe	500 LF	\$ 55.00	\$ 27,500	FROM DIBBLE
Manholes	2 EA	4500	\$ 9,000	FROM DIBBLE
Headwall	1 EA	\$ 1,100	\$ 1,100	FROM DIBBLE
Inflow Spillway	253572 SF	\$ 5	\$ 1,267,860	FROM DIBBLE
TOTAL COST			\$ 4,009,252	

**ALTERNATIVE 4  
AVONDALE DRCC, FIRST FLUSH RETENTION**

**COST ESTIMATE FOR DRCC DOWNSTREAM OF DYSART  
ASSUMING FIRST FLUSH RETENTION  
DRCC IN AVONDALE ONLY**

Channel Length	500 Feet	
Channel Discharge	2273 cfs	
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	112 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	869.66	
Channel Excavation Volume, CY	16,105 Cubic Yards	
Channel Wetted Perimeter	184 Feet	
Channel Top Width	183 Feet	
Channel Landscape Area, AC	2.1 AC	Channel Only
Channel Total Area	2.1 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	233 Feet	
DRCC Total Area, AC	2.7 Includes maintenance ROW	
Culvert area required	256 Square Feet	
Culvert width	51 Feet (Assumes 4-foot height)	
Number barrels	5	
Barrel width	10 Feet	
Culvert Concrete Area	142 Square Feet	
Culvert number	0.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	289 Cubic Yards	

1.221191415

ALTERNATIVE 4  
 AVONDALE DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	16,105	CY	\$ 6	\$ 96,630	CHANNEL EXCAVATION COST
Channel Landscaping	2.3	AC	\$ 78,408	\$ 180,338	CHANNEL LANDSCAPING COST
Channel Area*	2.7	AC	\$ 100,000	\$ 270,000	LAND COST
Culvert Concrete	289	CY	\$ 669	\$ 193,341	CULVERT COST
Maintenance Road**	0.4	AC	\$ 28,314	\$ 11,326	MAINTENANCE ROAD COST
Total Cost				\$ 751,635	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-feet wide decomposed granite.

ALTERNATIVE 4  
AVONDALE DRCC, FIRST FLUSH RETENTION

COST ESTIMATE FOR DRCC FROM DYSART TO EL MIRAGE  
ASSUMING FIRST FLUSH RETENTION  
DRCC IN AVONDALE ONLY

Channel Length	5026 Feet	
Channel Discharge	2087 cfs	AVERAGE
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	102 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	810.66	
Channel Excavation Volume, CY	150,903 Cubic Yards	
Channel Wetted Perimeter	174 Feet	
Channel Top Width	173 Feet	
Channel Landscape Area, AC	20.1 AC	Channel Only
Channel Total Area	20.0 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	223 Feet	
DRCC Total Area, AC	25.7 Includes maintenance ROW	
Culvert area required	235 Square Feet	
Culvert width	47 Feet (Assumes 4-foot height)	
Number barrels	6	
Barrel width	8 Feet	
Culvert Concrete Area	145 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1181 Cubic Yards	

1.220152454

ALTERNATIVE 4  
 AVONDALE DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	150,903	CY	\$ 6	\$ 905,418	CHANNEL EXCAVATION COST
Channel Landscaping	22.0	AC	\$ 78,408	\$ 1,724,976	CHANNEL LANDSCAPING COST
Channel Area*	25.7	AC	\$ 100,000	\$ 2,570,000	LAND COST
Culvert Concrete	1181	CY	\$ 669	\$ 790,089	CULVERT COST
Maintenance Road**	3.7	AC	\$ 28,314	\$ 104,762	MAINTENANCE ROAD COST
Total Cost				\$ 6,095,245	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 4  
AVONDALE DRCC, FIRST FLUSH RETENTION**

**COST ESTIMATE FOR DRCC FROM EL MIRAGE TO 115TH AVENUE  
ASSUMING FIRST FLUSH RETENTION  
DRCC IN AVONDALE ONLY**

Channel Length	9185 Feet	
Channel Discharge	1580 cfs	AVERAGE
Channel Slope	0.0017 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	65 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	592.36	
Channel Excavation Volume, CY	201,512 Cubic Yards	
Channel Wetted Perimeter	137 Feet	
Channel Top Width	136 Feet	
Channel Landscape Area, AC	28.9 AC	Channel Only
Channel Total Area	28.7 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	186 Feet	
DRCC Total Area, AC	39.2 Includes maintenance ROW	
Culvert area required	178 Square Feet	
Culvert width	36 Feet (Assumes 4-foot height)	
Number barrels	4	
Barrel width	9 Feet	
Culvert Concrete Area	107 Square Feet	
Culvert number	3	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1308 Cubic Yards	
	438.04	

1.225505744

ALTERNATIVE 4  
 AVONDALE DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	201,512	CY	\$ 6	\$ 1,209,072	CHANNEL EXCAVATION COST
Channel Landscaping	32.5	AC	\$ 78,408	\$ 2,548,260	CHANNEL LANDSCAPING COST
Channel Area*	39.2	AC	\$ 100,000	\$ 3,920,000	LAND COST
Culvert Concrete	1308	CY	\$ 669	\$ 875,052	CULVERT COST
Maintenance Road**	6.7	AC	\$ 28,314	\$ 189,704	MAINTENANCE ROAD COST
Total Cost				\$ 8,742,088	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 4  
 AVONDALE DRCC, FIRST FLUSH RETENTION

COST ESTIMATE FOR DRCC FROM 115TH AVENUE TO 107TH AVENUE  
 ASSUMING FIRST FLUSH RETENTION  
 DRCC IN AVONDALE ONLY

Channel Length	5139 Feet	
Channel Discharge	1312 cfs	
Channel Slope	0.0005 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	103 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	834	
Channel Excavation Volume, CY	158,738 Cubic Yards	
Channel Wetted Perimeter	176 Feet	
Channel Top Width	175 Feet	
Channel Landscape Area, AC	20.8 AC	Channel Only
Channel Total Area	20.6 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	225 Feet	
DRCC Total Area, AC	26.5 Includes maintenance ROW	
Culvert area required	146 Square Feet	
Culvert width	29 Feet (Assumes 4-foot height)	
Number barrels	3	
Barrel width	10 Feet	
Culvert Concrete Area	88 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	717 Cubic Yards	
	632.64	

1.216695849

ALTERNATIVE 4  
 AVONDALE DRCC, FIRST FLUSH RETENTION

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	158,738	CY	\$ 6	\$ 952,428	CHANNEL EXCAVATION COST
Channel Landscaping	22.7	AC	\$ 78,408	\$ 1,779,862	CHANNEL LANDSCAPING COST
Channel Area*	26.5	AC	\$ 100,000	\$ 2,650,000	LAND COST
Culvert Concrete	717	CY	\$ 669	\$ 479,673	CULVERT COST
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593	MAINTENANCE ROAD COST
Total Cost				\$ 5,969,556	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-feet wide decomposed granite.

ALTERNATIVE 4  
AVONDALE DRCC, FIRST FLUSH RETENTION

ITEM	UNIT	UNIT COST
Channel Excavation Volume	CY	6
Channel Landscaping	AC	78408
Channel Area**	AC	100000
Culvert Concrete***	CY	668.75
Maintenance Road****	AC	28314
Total Cost		

\* Assumes 1-foot freeboard

\*\* Includes 50-foot Right of Way outside of channel proper.

\*\*\* Assumes three and a half 4 cell 8'x5' culverts

\*\*\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN

THIS SPREADSHEET PROVIDES THE DETAILED COST ESTIMATE FOR THE DRCC ASSUMING:

FULL DRCC IN AVONDALE AND PHOENIX  
FIRST FLUSH RETENTION ADJACENT TO THE DRCC  
NO 95TH AVENUE BASIN

THE SUMMARY SHEET PROVIDES A SUMMARY OF THE DRCC COST BY REACH.

AVONDALE AND PHOENIX COSTS ARE SEPARATED, AND A 30% CONTINGENCY IS ADDED.

THE BASIN#1 SHEET PROVIDES A COST ESTIMATE OF THE DETENTION BASIN  
DOWNSTREAM OF DYSART. THESE COSTS ARE THE SAME IN ALL SCENARIOS.

SUBSEQUENT SHEETS PROVIDE QUANTITY ESTIMATES AND COST ESTIMATES FOR EACH  
REACH OF THE DRCC AS DESCRIBED IN THE SHEET NAME.

ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN

DRCC COST ESTIMATE SUMMARY  
FIRST FLUSH RETENTION, NO 91ST AVENUE BASIN

REACH	TOTAL COST, INCLUDING RIGHT OF WAY
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 751,635
Dysart to El Mirage	\$ 6,219,180
El Mirage to 115th Avenue	\$ 10,114,051
115th to 107th	\$ 8,969,950
Avondale Subtotal	\$ 30,064,068
Avondale Contingency 30%	\$ 9,019,220
Avondale Total	\$ 39,083,288
107th to 99th	\$ 5,016,805
99th to 91st	\$ 4,784,432
91st to 83rd	\$ 4,807,062
83rd to 75th	\$ 3,764,746
Phoenix Channel Subtotal	\$ 18,373,045
Phoenix Contingency 30%	\$ 5,511,914
Phoenix Total	\$ 23,884,959
TOTAL	\$ 62,968,247

	DRCC COST IN AVONDALE	DRCC COST IN PHOENIX	DRCC TOTAL COST
WITH CONTINGENCY	\$ 39,083,288	\$ 23,884,959	\$ 62,968,247
WITHOUT CONTINGENCY	\$ 30,064,068	\$ 18,373,045	\$ 48,437,113



ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN

	QUANTITY	UNIT	UNIT COST	COST
Excavation	1,090,346	Cubic Yards	\$ 6	\$ 6,542,076
Landscaping	188.3	Acres	\$ 78,408	\$ 14,764,226
Right of Way	194.4	Acres	\$ 100,000	\$ 19,440,000
Basin #1 Right of Way	137	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	7042.0	Cubic Yards	\$ 669	\$ 4,711,098
Maintenance Road	30.1	Acres	\$ 28,314	\$ 852,251
Miscellaneous Items				\$ 1,305,460
Subtotal				\$ 48,437,113
Contingency %30				\$ 14,531,134
Total Cost				\$ 62,968,247

ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN

COST ESTIMATE FOR BASIN #1 DOWNSTREAM OF DYSART

Basin Land	24.0 AC	\$	78,408	\$ 1,881,792	CHANNEL LANDSCAPING COST
Parcel Area	137.0 AC	\$	6,000	\$ 822,000	LAND COST
Drain Pipe	500 LF	\$	55.00	\$ 27,500	FROM DIBBLE
Manholes	2 EA		4500	\$ 9,000	FROM DIBBLE
Headwall	1 EA	\$	1,100	\$ 1,100	FROM DIBBLE
Inflow Spill	253572 SF	\$	5	\$ 1,267,860	FROM DIBBLE
TOTAL COST				\$ 4,009,252	

**ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN**

**COST ESTIMATE FOR DRCC DOWNSTREAM OF DYSART  
ASSUMING FIRST FLUSH RETENTION AND NO 91ST AVENUE BASIN**

Channel Length	500 Feet	
Channel Discharge	2273 cfs	
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	112 feet	
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	869.66	
Channel Excavation Volume	16,105 Cubic Yards	
Channel Wetted Perimeter	184 Feet	
Channel Top Width	183 Feet	
Channel Landscape Area	2.1 AC	Channel Only
Channel Total Area	2.1 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	233 Feet	
DRCC Total Area, AC	2.7 Includes maintenance ROW	
Culvert area required	256 Square Feet	
Culvert width	51 Feet (Assumes 4-foot height)	
Number barrels	5	
Barrel width	10 Feet	
Culvert Concrete Area	142 Square Feet	
Culvert number	0.5	
Culvert Length	110 Feet	
Total Culvert Concrete	289 Cubic Yards	

ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	16,105	CY	\$ 6	\$ 96,630
Channel Landscaping	2.3	AC	\$ 78,408	\$ 180,338
Channel Area*	2.7	AC	\$ 100,000	\$ 270,000
Culvert Concrete	289	CY	\$ 669	\$ 193,341
Maintenance Road**	0.4	AC	\$ 28,314	\$ 11,326
Total Cost				\$ 751,635

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN**

**COST ESTIMATE FOR DRCC FROM DYSART TO EL MIRAGE  
ASSUMING FIRST FLUSH RETENTION AND NO 91ST AVENUE BASIN**

Channel Length	5026 Feet	
Channel Discharge	2180 cfs	AVERAGE
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	107 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	840.16	
Channel Excavation Volume, CY	156,394	Cubic Yards
Channel Wetted Perimeter	179 Feet	
Channel Top Width	178 Feet	
Channel Landscape Area, AC	20.7 AC	Channel Only
Channel Total Area	20.5 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	228 Feet	
DRCC Total Area, AC	26.3	Includes maintenance ROW
Culvert area required	246	Square Feet
Culvert width	49 Feet	(Assumes 4-foot height)
Number barrels	5	
Barrel width	10 Feet	
Culvert Concrete Area	142	Square Feet
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1157	Cubic Yards

ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	156,394	CY	\$ 6	\$ 938,364	CHANNEL EXCAVATION COST
Channel Landscaping	22.6	AC	\$ 78,408	\$ 1,772,021	CHANNEL LANDSCAPING COST
Channel Area*	26.3	AC	\$ 100,000	\$ 2,630,000	LAND COST
Culvert Concrete	1157	CY	\$ 669	\$ 774,033	CULVERT COST
Maintenance Road**	3.7	AC	\$ 28,314	\$ 104,762	MAINTENANCE ROAD COST
Total Cost				\$ 6,219,180	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN**

**COST ESTIMATE FOR DRCC FROM EL MIRAGE TO 115TH AVENUE  
ASSUMING FIRST FLUSH RETENTION AND NO 91ST AVENUE BASIN**

Channel Length	9185 Feet	
Channel Discharge	2145 cfs	
Channel Slope	0.0017 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	94 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	763.46	
Channel Excavation Volume, CY	259,718	Cubic Yards
Channel Wetted Perimeter	166 Feet	
Channel Top Width	165 Feet	
Channel Landscape Area, AC	35.0 AC	Channel Only
Channel Total Area	34.8 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	215 Feet	
DRCC Total Area, AC	45.3	Includes maintenance ROW
Culvert area required	242	Square Feet
Culvert width	48 Feet	(Assumes 4-foot height)
Number barrels	4	
Barrel width	8 Feet	
Culvert Concrete Area	99	Square Feet
Culvert number	3	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1210	Cubic Yards
	574.34	

*[Faint, illegible text, likely bleed-through from the reverse side of the page]*

ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	259,718	CY	\$ 6	\$ 1,558,308	CHANNEL EXCAVATION COST
Channel Landscaping	38.6	AC	\$ 78,408	\$ 3,026,549	CHANNEL LANDSCAPING COST
Channel Area*	45.3	AC	\$ 100,000	\$ 4,530,000	LAND COST
Culvert Concrete	1210	CY	\$ 669	\$ 809,490	CULVERT COST
Maintenance Road**	6.7	AC	\$ 28,314	\$ 189,704	MAINTENANCE ROAD COST
Total Cost				\$ 10,114,051	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN**

**COST ESTIMATE FOR DRCC FROM 115TH AVENUE TO 107TH AVENUE  
ASSUMING FIRST FLUSH RETENTION AND NO 91ST AVENUE BASIN**

Channel Length	5139 Feet	
Channel Discharge	2368 cfs	
Channel Slope	0.0005 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	197 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	1398	
Channel Excavation Volume, CY	266,086 Cubic Yards	
Channel Wetted Perimeter	270 Feet	
Channel Top Width	269 Feet	
Channel Landscape Area, AC	31.9 AC	Channel Only
Channel Total Area	31.7 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	319 Feet	
DRCC Total Area, AC	37.6 Includes maintenance ROW	
Culvert area required	263 Square Feet	
Culvert width	53 Feet (Assumes 4-foot height)	
Number barrels	6	
Barrel width	9 Feet	
Culvert Concrete Area	157 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1279 Cubic Yards	
	1083.84	

ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	266,086	CY	\$ 6	\$ 1,596,516	CHANNEL EXCAVATION COST
Channel Landscaping	33.8	AC	\$ 78,408	\$ 2,650,190	CHANNEL LANDSCAPING COST
Channel Area*	37.6	AC	\$ 100,000	\$ 3,760,000	LAND COST
Culvert Concrete	1279	CY	\$ 669	\$ 855,651	CULVERT COST
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593	MAINTENANCE ROAD COST
<b>Total Cost</b>				<b>\$ 8,969,950</b>	<b>TOTAL COST</b>

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN**

**COST ESTIMATE FOR DRCC FROM 107TH AVENUE TO 99TH AVENUE  
ASSUMING FIRST FLUSH RETENTION AND NO 91ST AVENUE BASIN**

Channel Length	5155 Feet	
Channel Discharge	1964 cfs	AVERAGE
Channel Slope	0.0032 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	61 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.6 Feet (From Master Plan)	
Channel Freeboard	1.3 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	568.76	
Channel Excavation Volume, CY	108,591	Cubic Yards
Channel Wetted Perimeter	133 Feet	
Channel Top Width	132 Feet	
Channel Landscape Area, AC	15.7 AC	Channel Only
Channel Total Area	15.6 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	182 Feet	
DRCC Total Area, AC	21.5	Includes maintenance ROW
Culvert area required	221	Square Feet
Culvert width	44 Feet	(Assumes 4-foot height)
Number barrels	5	
Barrel width	9 Feet	
Culvert Concrete Area	132	Square Feet
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1076	Cubic Yards
	407.56	

ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	108,591	CY	\$ 6	\$ 651,546	CHANNEL EXCAVATION COST
Channel Landscaping	17.7	AC	\$ 78,408	\$ 1,387,822	CHANNEL LANDSCAPING COST
Channel Area*	21.5	AC	\$ 100,000	\$ 2,150,000	LAND COST
Culvert Concrete	1076	CY	\$ 669	\$ 719,844	CULVERT COST
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593	MAINTENANCE ROAD COST
Total Cost				\$ 5,016,805	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN**

**COST ESTIMATE FOR DRCC FROM 99TH AVENUE TO 91ST AVENUE  
ASSUMING FIRST FLUSH RETENTION AND NO 91ST AVENUE BASIN**

Channel Length	5107 Feet	
Channel Discharge	1548 cfs	
Channel Slope	0.0021 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	59 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.6 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.8 Feet	
Channel excavation area	544.04	
Channel Excavation Volume, CY	102,904 Cubic Yards	
Channel Wetted Perimeter	130 Feet	
Channel Top Width	129 Feet	
Channel Landscape Area, AC	15.2 AC	Channel Only
Channel Total Area	15.1 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	179 Feet	
DRCC Total Area, AC	21.0	Includes maintenance ROW
Culvert area required	177 Square Feet	
Culvert width	35 Feet (Assumes 4-foot height)	
Number barrels	5	
Barrel width	7 Feet	
Culvert Concrete Area	112 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	913 Cubic Yards	

ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	102,904	CY	\$ 6	\$ 617,424	CHANNEL EXCAVATION COST
Channel Landscaping	17.2	AC	\$ 78,408	\$ 1,348,618	CHANNEL LANDSCAPING COST
Channel Area*	21.0	AC	\$ 100,000	\$ 2,100,000	LAND COST
Culvert Concrete	913	CY	\$ 669	\$ 610,797	CULVERT COST
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593	MAINTENANCE ROAD COST
Total Cost				\$ 4,784,432	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-feet wide decomposed granite.

**ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN**

**COST ESTIMATE FOR DRCC FROM 91ST AVENUE TO 83RD AVENUE  
ASSUMING FIRST FLUSH RETENTION AND NO 91ST AVENUE BASIN**

Channel Length	5017 Feet	
Channel Discharge	1081 cfs	AVERAGE
Channel Slope	0.0007 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	67 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	618	
Channel Excavation Volume, CY	114,834 Cubic Yards	
Channel Wetted Perimeter	140 Feet	
Channel Top Width	139 Feet	
Channel Landscape Area, AC	16.1 AC	Channel Only
Channel Total Area	16.0 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	189 Feet	
DRCC Total Area, AC	21.8 Includes maintenance ROW	
Culvert area required	120 Square Feet	
Culvert width	24 Feet (Assumes 4-foot height)	
Number barrels	3	
Barrel width	8 Feet	
Culvert Concrete Area	76 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	619 Cubic Yards	

ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	114,834	CY	\$ 6	\$ 689,004	CHANNEL EXCAVATION COST
Channel Landscaping	18.1	AC	\$ 78,408	\$ 1,419,185	CHANNEL LANDSCAPING COST
Channel Area*	21.8	AC	\$ 100,000	\$ 2,180,000	LAND COST
Culvert Concrete	619	CY	\$ 669	\$ 414,111	CULVERT COST
Maintenance Road**	3.7	AC	\$ 28,314	\$ 104,762	MAINTENANCE ROAD COST
Total Cost				\$ 4,807,062	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN**

**COST ESTIMATE FOR DRCC FROM 83RD AVENUE TO 75TH AVENUE  
ASSUMING FIRST FLUSH RETENTION AND NO 91ST AVENUE BASIN**

Channel Length	5739 Feet	
Channel Discharge	613 cfs	
Channel Slope	0.0015 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	17 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	309.16	
Channel Excavation Volume, CY	65,714 Cubic Yards	
Channel Wetted Perimeter	89 Feet	
Channel Top Width	88 Feet	
Channel Landscape Area, AC	11.7 AC	Channel Only
Channel Total Area	11.6 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	138 Feet	
DRCC Total Area, AC	18.2 Includes maintenance ROW	
Culvert area required	69 Square Feet	
Culvert width	14 Feet (Assumes 4-foot height)	
Number barrels	2	
Barrel width	7 Feet	
Culvert Concrete Area	49 Square Feet	
Culvert number	2.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	499 Cubic Yards	

ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	65,714	CY	\$ 6	\$ 394,284	CHANNEL EXCAVATION COST
Channel Landscaping	14.0	AC	\$ 78,408	\$ 1,097,712	CHANNEL LANDSCAPING COST
Channel Area*	18.2	AC	\$ 100,000	\$ 1,820,000	LAND COST
Culvert Concrete	499	CY	\$ 669	\$ 333,831	CULVERT COST
Maintenance Road**	4.2	AC	\$ 28,314	\$ 118,919	MAINTENANCE ROAD COST
<b>Total Cost</b>				<b>\$ 3,764,746</b>	<b>TOTAL COST</b>

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 5  
FIRST FLUSH RETENTION, NO 95TH AVENUE BASIN

ITEM	UNIT	UNIT COST
Channel Excavation Volume	CY	\$ 6
Channel Landscaping	AC	\$ 78,408
Channel Area**	AC	\$ 100,000
Culvert Concrete***	CY	\$ 669
Maintenance Road****	AC	\$ 28,314

ALTERNATIVE 6  
AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX

THIS SPREADSHEET PROVIDES THE DETAILED COST ESTIMATE FOR THE DRCC ASSUMING:

DRCC IN AVONDALE ONLY  
100-YEAR, 2-HOUR RETENTION ADJACENT TO THE DRCC IN AVONDALE  
FIRST FLUSH RETENTION ADJACENT TO THE DRCC IN PHOENIX  
EXISTING RETENTION IN THE DRCC ALIGNMENT IN THE CITY OF PHOENIX  
CONVERTED TO RETENTION USING 100-YEAR CULVERTS AT MAJOR ROADWAYS

THE SUMMARY SHEET PROVIDES A SUMMARY OF THE DRCC COST BY REACH.

AVONDALE AND PHOENIX COSTS ARE SEPARATED, AND A 30% CONTINGENCY IS ADDED.

THE BASIN#1 SHEET PROVIDES A COST ESTIMATE OF THE DETENTION BASIN  
DOWNSTREAM OF DYSART. THESE COSTS ARE THE SAME IN ALL SCENARIOS.

SUBSEQUENT SHEETS PROVIDE QUANTITY ESTIMATES AND COST ESTIMATES FOR EACH  
REACH OF THE DRCC AS DESCRIBED IN THE SHEET NAME.

ALTERNATIVE 6  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX

DRCC COST ESTIMATE SUMMARY  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION  
 100 YEAR CULVERTS IN PHOENIX

REACH	TOTAL COST, INCLUDING RIGHT OF WAY
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 622,501
Dysart to El Mirage	\$ 5,677,072
El Mirage to 115th Avenue	\$ 9,984,022
115th to 107th	\$ 8,572,393
Avondale Subtotal	\$ 28,865,240
Avondale Contingency 30%	\$ 8,659,572
Avondale Total	\$ 37,524,812
Phoenix Culverts	\$ 604,776
Phoenix Contingency 30%	\$ 181,433
Phoenix Total	\$ 786,209
Total Cost	\$ 38,311,021

	DRCC COST IN AVONDALE	DRCC COST IN PHOENIX	DRCC TOTAL COST
WITH CONTINGENCY	\$ 37,524,812	\$ 786,209	\$ 38,311,021
WITHOUT CONTINGENCY	\$ 28,865,240	\$ 604,776	\$ 29,470,016



ALTERNATIVE 6  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX

	QUANTITY	UNIT	UNIT COST	COST
Excavation	645,277	Cubic Yards	\$ 6	\$ 3,871,662
Landscaping	115.7	Acres	\$ 78,408	\$ 9,071,806
Right of Way	106.3	Acres	\$ 100,000	\$ 10,630,000
Basin #1 Right of Way	137.0	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	5016.0	Cubic Yards	\$ 669	\$ 3,355,704
Maintenance Road	14.6	Acres	\$ 28,314	\$ 413,384
Miscellaneous Items				\$ 1,305,460
Subtotal				\$ 29,470,016
Contingency %30				\$ 8,841,005
Total Cost				\$ 38,311,021

ALTERNATIVE 6  
AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX

COST ESTIMATE FOR BASIN #1 DOWNSTREAM OF DYSART

Basin Landscaping	24.0 AC	\$ 78,408	\$ 1,881,792	CHANNEL LANDSCAPING COST
Parcel Area	137.0 AC	\$ 6,000	\$ 822,000	LAND COST
Drain Pipe	500 LF	\$ 55.00	\$ 27,500	FROM DIBBLE
Manholes	2 EA	4500	\$ 9,000	FROM DIBBLE
Headwall	1 EA	\$ 1,100	\$ 1,100	FROM DIBBLE
Inflow Spillway	253572 SF	\$ 5	\$ 1,267,860	FROM DIBBLE
TOTAL COST			\$ 4,009,252	

ALTERNATIVE 6  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX

COST ESTIMATE FOR DRCC DOWNSTREAM OF DYSART  
 ASSUMING 100-YEAR CULVERTS IN PHOENIX

Channel Length	500 Feet	
Channel Discharge	1689 cfs	
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	80 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	680.86	
Channel Excavation Volume, CY	12,609 Cubic Yards	
Channel Wetted Perimeter	152 Feet	
Channel Top Width	151 Feet	
Channel Landscape Area, AC	1.7 AC	Channel Only
Channel Total Area	1.7 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	201 Feet	
DRCC Total Area, AC	2.3 Includes maintenance ROW	
Culvert area required	190 Square Feet	
Culvert width	38 Feet (Assumes 4-foot height)	
Number barrels	4	
Barrel width	10 Feet	
Culvert Concrete Area	115 Square Feet	
Culvert number	0.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	234 Cubic Yards	

1.217821631

ALTERNATIVE 6  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	12,609	CY	\$ 6	\$ 75,654	CHANNEL EXCAVATION COST
Channel Landscaping	1.9	AC	\$ 78,408	\$ 148,975	CHANNEL LANDSCAPING COST
Channel Area*	2.3	AC	\$ 100,000	\$ 230,000	LAND COST
Culvert Concrete	234	CY	\$ 669	\$ 156,546	CULVERT COST
Maintenance Road**	0.4	AC	\$ 28,314	\$ 11,326	MAINTENANCE ROAD COST
Total Cost				\$ 622,501	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 6  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX

COST ESTIMATE FOR DRCC FROM DYSART TO EL MIRAGE  
 ASSUMING 100-YEAR CULVERTS IN PHOENIX

Channel Length	5026 Feet	
Channel Discharge	1858 cfs	
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	89 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	733.96	
Channel Excavation Volume, CY	136,625	Cubic Yards
Channel Wetted Perimeter	161 Feet	
Channel Top Width	160 Feet	
Channel Landscape Area, AC	18.6 AC	Channel Only
Channel Total Area	18.5 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	210 Feet	
DRCC Total Area, AC	24.2	Includes maintenance ROW
Culvert area required	209 Square Feet	
Culvert width	42 Feet	(Assumes 4-foot height)
Number barrels	6	
Barrel width	7 Feet	
Culvert Concrete Area	133 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1084	Cubic Yards

1.219166666

ALTERNATIVE 6  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	136,625	CY	\$ 6	\$ 819,750	CHANNEL EXCAVATION COST
Channel Landscaping	20.5	AC	\$ 78,408	\$ 1,607,364	CHANNEL LANDSCAPING COST
Channel Area*	24.2	AC	\$ 100,000	\$ 2,420,000	LAND COST
Culvert Concrete	1084	CY	\$ 669	\$ 725,196	CULVERT COST
Maintenance Road**	3.7	AC	\$ 28,314	\$ 104,762	MAINTENANCE ROAD COST
Total Cost				\$ 5,677,072	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 6  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX

COST ESTIMATE FOR DRCC FROM EL MIRAGE TO 115TH AVENUE  
 ASSUMING 100-YEAR CULVERTS IN PHOENIX

Channel Length	9185 Feet	
Channel Discharge	1985 cfs	
Channel Slope	0.0017 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	86 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	716.26	
Channel Excavation Volume, CY	243,661	Cubic Yards
Channel Wetted Perimeter	158 Feet	
Channel Top Width	157 Feet	
Channel Landscape Area, AC	33.3 AC	Channel Only
Channel Total Area	33.1 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	207 Feet	
DRCC Total Area, AC	43.6	Includes maintenance ROW
Culvert area required	224	Square Feet
Culvert width	45 Feet	(Assumes 4-foot height)
Number barrels	5	
Barrel width	9 Feet	
Culvert Concrete Area	132	Square Feet
Culvert number	3	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1613	Cubic Yards
	536.74	

1.228094219

ALTERNATIVE 6  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	243,661	CY	\$ 6	\$ 1,461,966	CHANNEL EXCAVATION COST
Channel Landscaping	36.9	AC	\$ 78,408	\$ 2,893,255	CHANNEL LANDSCAPING COST
Channel Area*	43.6	AC	\$ 100,000	\$ 4,360,000	LAND COST
Culvert Concrete	1613	CY	\$ 669	\$ 1,079,097	CULVERT COST
Maintenance Road**	6.7	AC	\$ 28,314	\$ 189,704	MAINTENANCE ROAD COST
<b>Total Cost</b>				<b>\$ 9,984,022</b>	<b>TOTAL COST</b>

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-feet wide decomposed granite.

**ALTERNATIVE 6**  
**AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX**

**COST ESTIMATE FOR DRCC FROM 115TH AVENUE TO 107TH AVENUE  
 ASSUMING 100-YEAR CULVERTS IN PHOENIX**

Channel Length	5139 Feet	
Channel Discharge	2148 cfs	
Channel Slope	0.0005 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	185 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	1326	
Channel Excavation Volume, CY	252,382 Cubic Yards	
Channel Wetted Perimeter	258 Feet	
Channel Top Width	257 Feet	
Channel Landscape Area, AC	30.4 AC	Channel Only
Channel Total Area	30.3 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	307 Feet	
DRCC Total Area, AC	36.2 Includes maintenance ROW	
Culvert area required	238 Square Feet	
Culvert width	48 Feet (Assumes 4-foot height)	
Number barrels	6	
Barrel width	8 Feet	
Culvert Concrete Area	145 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1181 Cubic Yards	
	1026.24	

1.217006887

ALTERNATIVE 6  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	252,382	CY	\$ 6	\$ 1,514,292	CHANNEL EXCAVATION COST
Channel Landscaping	32.4	AC	\$ 78,408	\$ 2,540,419	CHANNEL LANDSCAPING COST
Channel Area*	36.2	AC	\$ 100,000	\$ 3,620,000	LAND COST
Culvert Concrete	1181	CY	\$ 669	\$ 790,089	CULVERT COST
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593	MAINTENANCE ROAD COST
Total Cost				\$ 8,572,393	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-feet wide decomposed granite.

ALTERNATIVE 6  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX

PHOENIX CULVERTS

100-year culverts

83RD AVENUE

Number barrels	1
Barrel width	8 Feet
Culvert Concrete Area	28 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete, CY	114 Cubic Yards

91ST AVENUE

Number barrels	2
Barrel width	8 Feet
Culvert Concrete Area	50 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete, CY	204 Cubic Yards

99TH AVENUE

Number barrels	3
Barrel width	6 Feet
Culvert Concrete Area	60 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete, CY	244 Cubic Yards

107TH AVENUE

Number barrels	3
Barrel width	10 Feet
Culvert Concrete Area	84 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete, CY	342 Cubic Yards

TOTAL CULVERT CONCRETE	904 CY	\$	669	\$	604,776
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ALTERNATIVE 6  
AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 100 YEAR CULVERTS IN PHOENIX

ITEM	UNIT	UNIT COST
Channel Excavation Volume	CY	6
Channel Landscaping	AC	78408
Channel Area**	AC	100000
Culvert Concrete***	CY	668.75
Maintenance Road****	AC	28314
Total Cost		

ALTERNATIVE 7

AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 10 YEAR CULVERTS IN PHOENIX

THIS SPREADSHEET PROVIDES THE DETAILED COST ESTIMATE FOR THE DRCC ASSUMING:

DRCC IN AVONDALE ONLY  
100-YEAR, 2-HOUR RETENTION ADJACENT TO THE DRCC IN AVONDALE  
FIRST FLUSH RETENTION ADJACENT TO THE DRCC IN PHOENIX  
EXISTING RETENTION IN THE DRCC ALIGNMENT IN THE CITY OF PHOENIX  
CONVERTED TO RETENTION USING 10-YEAR CULVERTS AT MAJOR ROADWAYS

THE SUMMARY SHEET PROVIDES A SUMMARY OF THE DRCC COST BY REACH.

AVONDALE AND PHOENIX COSTS ARE SEPARATED, AND A 30% CONTINGENCY IS ADDED.

THE BASIN#1 SHEET PROVIDES A COST ESTIMATE OF THE DETENTION BASIN  
DOWNSTREAM OF DYSART. THESE COSTS ARE THE SAME IN ALL SCENARIOS.

SUBSEQUENT SHEETS PROVIDE QUANTITY ESTIMATES AND COST ESTIMATES FOR EACH  
REACH OF THE DRCC AS DESCRIBED IN THE SHEET NAME.

ALTERNATIVE 7  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 10 YEAR CULVERTS IN PHOENIX

DRCC COST ESTIMATE SUMMARY  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION  
 10 YEAR CULVERTS IN PHOENIX

REACH	TOTAL COST, INCLUDING RIGHT OF WAY
Basin #1	\$ 4,009,252
Downstream of Dysart	\$ 537,569
Dysart to El Mirage	\$ 4,851,909
El Mirage to 115th Avenue	\$ 8,639,726
115th to 107th	\$ 6,853,853
Avondale Subtotal	\$ 24,892,309
Avondale Contingency 30%	\$ 7,467,693
Avondale Total	\$ 32,360,002
Phoenix Culverts	\$ 435,519
Phoenix Contingency 30%	\$ 130,656
Phoenix Total	\$ 566,175
Total Cost	\$ 32,926,177

	DRCC COST IN AVONDALE	DRCC COST IN PHOENIX	DRCC TOTAL COST
WITH CONTINGENCY	\$ 32,360,002	\$ 566,175	\$ 32,926,177
WITHOUT CONTINGENCY	\$ 24,892,309	\$ 435,519	\$ 25,327,828



ALTERNATIVE 7  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 10 YEAR CULVERTS IN PHOENIX

	QUANTITY	UNIT	UNIT COST	COST
Excavation	507,005	Cubic Yards	\$ 6	\$ 3,042,030
Landscaping	101.4	Acres	\$ 78,408	\$ 7,950,571
Right of Way	92.0	Acres	\$ 100,000	\$ 9,200,000
Basin #1 Right of Way	137.0	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	3878.0	Cubic Yards	\$ 669	\$ 2,594,382
Maintenance Road	14.6	Acres	\$ 28,314	\$ 413,384
Miscellaneous Items				\$ 1,305,460
Subtotal				\$ 25,327,828
Contingency %30				\$ 7,598,349
Total Cost				\$ 32,926,177

ALTERNATIVE 7  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 10 YEAR CULVERTS IN PHOENIX

COST ESTIMATE FOR BASIN #1 DOWNSTREAM OF DYSART

Basin Landscaping	24.0 AC	\$	78,408	\$	1,881,792	CHANNEL LANDSCAPING COST
Parcel Area	137.0 AC	\$	6,000	\$	822,000	LAND COST
Drain Pipe	500 LF	\$	55.00	\$	27,500	FROM DIBBLE
Manholes	2 EA		4500	\$	9,000	FROM DIBBLE
Headwall	1 EA	\$	1,100	\$	1,100	FROM DIBBLE
Inflow Spillway	253572 SF	\$	5	\$	1,267,860	FROM DIBBLE
TOTAL COST				\$	4,009,252	

ALTERNATIVE 7  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 10 YEAR CULVERTS IN PHOENIX

COST ESTIMATE FOR DRCC FROM EL MIRAGE TO 115TH AVENUE  
 ASSUMING 100-YEAR CULVERTS IN PHOENIX

Channel Length	9185 Feet	
Channel Discharge	1520 cfs	
Channel Slope	0.0017 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	62 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	574.66	
Channel Excavation Volume, CY	195,491	Cubic Yards
Channel Wetted Perimeter	134 Feet	
Channel Top Width	133 Feet	
Channel Landscape Area, AC	28.3 AC	Channel Only
Channel Total Area	28.0 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	183 Feet	
DRCC Total Area, AC	38.6	Includes maintenance ROW
Culvert area required	171	Square Feet
Culvert width	34 Feet	(Assumes 4-foot height)
Number barrels	5	
Barrel width	7 Feet	
Culvert Concrete Area	112	Square Feet
Culvert number	3	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	1369	Cubic Yards
	423.94	

1.224903675

ALTERNATIVE 7  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 10 YEAR CULVERTS IN PHOENIX

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	195,491	CY	\$ 6	\$ 1,172,946	CHANNEL EXCAVATION COST
Channel Landscaping	31.9	AC	\$ 78,408	\$ 2,501,215	CHANNEL LANDSCAPING COST
Channel Area*	38.6	AC	\$ 100,000	\$ 3,860,000	LAND COST
Culvert Concrete	1369	CY	\$ 669	\$ 915,861	CULVERT COST
Maintenance Road**	6.7	AC	\$ 28,314	\$ 189,704	MAINTENANCE ROAD COST
Total Cost				\$ 8,639,726	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-feet wide decomposed granite.

ALTERNATIVE 7  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 10 YEAR CULVERTS IN PHOENIX

COST ESTIMATE FOR DRCC FROM 115TH AVENUE TO 107TH AVENUE  
 ASSUMING 100-YEAR CULVERTS IN PHOENIX

Channel Length	5139 Feet	
Channel Discharge	1625 cfs	
Channel Slope	0.0005 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	131 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	1002	
Channel Excavation Volume, CY	190,714 Cubic Yards	
Channel Wetted Perimeter	204 Feet	
Channel Top Width	203 Feet	
Channel Landscape Area, AC	24.1 AC	Channel Only
Channel Total Area	23.9 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	253 Feet	
DRCC Total Area, AC	29.8	Includes maintenance ROW
Culvert area required	180 Square Feet	
Culvert width	36 Feet	(Assumes 4-foot height)
Number barrels	4	
Barrel width	9 Feet	
Culvert Concrete Area	107 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	872 Cubic Yards	
	767.04	

1.217423077

ALTERNATIVE 7  
 AVONDALE DRCC, 100-YEAR 2-HOUR RETENTION, 10 YEAR CULVERTS IN PHOENIX

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	190,714	CY	\$ 6	\$ 1,144,284	CHANNEL EXCAVATION COST
Channel Landscaping	26.0	AC	\$ 78,408	\$ 2,038,608	CHANNEL LANDSCAPING COST
Channel Area*	29.8	AC	\$ 100,000	\$ 2,980,000	LAND COST
Culvert Concrete	872	CY	\$ 669	\$ 583,368	CULVERT COST
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593	MAINTENANCE ROAD COST
Total Cost				\$ 6,853,853	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 8  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

	QUANTITY	UNIT	UNIT COST	COST
Excavation	879,611	Cubic Yards	\$ 6	\$ 5,277,666
Landscaping	193.2	Acres	\$ 78,408	\$ 15,148,426
Right of Way	199.2	Acres	\$ 100,000	\$ 19,920,000
Basin #1 Right of Way	137	Acres	\$ 6,000	\$ 822,000
Culvert Concrete	4,545	Cubic Yards	\$ 669	\$ 3,040,605
Maintenance Road	30.0	Acres	\$ 28,314	\$ 849,420
Miscellaneous Items				\$ 1,305,460
99th Avenue Storm Drain				\$ 8,452,820
Subtotal				\$ 54,816,397
Contingency %30				\$ 16,444,919
Total Cost				\$ 71,261,316

ALTERNATIVE 8  
FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

COST ESTIMATE FOR BASIN #1 DOWNSTREAM OF DYSART

Basin Landscaping	24.0 AC	\$ 78,408	\$ 1,881,792	CHANNEL LANDSCAPING COST
Parcel Area	137.0 AC	\$ 6,000	\$ 822,000	LAND COST
Drain Pipe	500 LF	\$ 55.00	\$ 27,500	FROM DIBBLE
Manholes	2 EA	4500	\$ 9,000	FROM DIBBLE
Headwall	1 EA	\$ 1,100	\$ 1,100	FROM DIBBLE
Inflow Spillway	253572 SF	\$ 5	\$ 1,267,860	FROM DIBBLE
TOTAL COST			\$ 4,009,252	

**ALTERNATIVE 8**  
**FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE**

**COST ESTIMATE FOR DRCC DOWNSTREAM OF DYSART  
 ASSUMING 100-YEAR, 2-HOUR RETENTION  
 DRCC IN AVONDALE AND PHOENIX  
 STORM DRAIN IN 99TH AVENUE**

Channel Length	500 Feet	
Channel Discharge	847 cfs	
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	32 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	397.66	
Channel Excavation Volume, CY	7,364 Cubic Yards	
Channel Wetted Perimeter	104 Feet	
Channel Top Width	103 Feet	
Channel Landscape Area, AC	1.2 AC	Channel Only
Channel Total Area	1.2 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	153 Feet	
DRCC Total Area, AC	1.8	Includes maintenance ROW
Culvert area required	95 Square Feet	
Culvert width	19 Feet	(Assumes 4-foot height)
Number barrels	2	
Barrel width	10 Feet	
Culvert Concrete Area	61 Square Feet	
Culvert number	0.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	124 Cubic Yards	

ALTERNATIVE 8  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	7,364	CY	\$ 6	\$ 44,184	CHANNEL EXCAVATION COST
Channel Landscaping	1.4	AC	\$ 78,408	\$ 109,771	CHANNEL LANDSCAPING COST
Channel Area*	1.8	AC	\$ 100,000	\$ 180,000	LAND COST
Culvert Concrete	124	CY	\$ 669	\$ 82,956	CULVERT COST
Maintenance Road**	0.4	AC	\$ 28,314	\$ 11,326	MAINTENANCE ROAD COST
Total Cost				\$ 428,237	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-feet wide decomposed granite.

**ALTERNATIVE 8**  
**FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE**

**COST ESTIMATE FOR DRCC FROM DYSART TO EL MIRAGE  
 ASSUMING 100-YEAR, 2-HOUR RETENTION  
 DRCC IN AVONDALE AND PHOENIX  
 STORM DRAIN IN 99TH AVENUE**

Channel Length	5026 Feet	
Channel Discharge	1085 cfs	
Channel Slope	0.0014 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	46 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	480.26	
Channel Excavation Volume, CY	89,400 Cubic Yards	
Channel Wetted Perimeter	118 Feet	
Channel Top Width	117 Feet	
Channel Landscape Area, AC	13.6 AC	Channel Only
Channel Total Area	13.5 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	167 Feet	
DRCC Total Area, AC	19.3 Includes maintenance ROW	
Culvert area required	122 Square Feet	
Culvert width	24 Feet (Assumes 4-foot height)	
Number barrels	3	
Barrel width	8 Feet	
Culvert Concrete Area	76 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	619 Cubic Yards	

ALTERNATIVE 8  
FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	89,400	CY	\$ 6	\$ 536,400	CHANNEL EXCAVATION COST
Channel Landscaping	15.6	AC	\$ 78,408	\$ 1,223,165	CHANNEL LANDSCAPING COST
Channel Area*	19.3	AC	\$ 100,000	\$ 1,930,000	LAND COST
Culvert Concrete	619	CY	\$ 669	\$ 414,111	CULVERT COST
Maintenance Road**	3.7	AC	\$ 28,314	\$ 104,762	MAINTENANCE ROAD COST
Total Cost				\$ 4,208,438	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 8**  
**FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE**

**COST ESTIMATE FOR DRCC FROM EL MIRAGE TO 115TH AVENUE**  
**ASSUMING 100-YEAR, 2-HOUR RETENTION**  
**DRCC IN AVONDALE AND PHOENIX**  
**STORM DRAIN IN 99TH AVENUE**

Channel Length	9185 Feet	
Channel Discharge	979 cfs	AVERAGE
Channel Slope	0.0017 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	34 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	409.46	
Channel Excavation Volume, CY	139,292 Cubic Yards	
Channel Wetted Perimeter	106 Feet	
Channel Top Width	105 Feet	
Channel Landscape Area, AC	22.4 AC	Channel Only
Channel Total Area	22.1 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	155 Feet	
DRCC Total Area, AC	32.7 Includes maintenance ROW	
Culvert area required	110 Square Feet	
Culvert width	22 Feet (Assumes 4-foot height)	
Number barrels	3	
Barrel width	8 Feet	
Culvert Concrete Area	76 Square Feet	
Culvert number	3	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	929 Cubic Yards	
	292.34	

ALTERNATIVE 8  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	139,292	CY	\$ 6	\$ 835,752	CHANNEL EXCAVATION COST
Channel Landscaping	26.0	AC	\$ 78,408	\$ 2,038,608	CHANNEL LANDSCAPING COST
Channel Area*	32.7	AC	\$ 100,000	\$ 3,270,000	LAND COST
Culvert Concrete	929	CY	\$ 669	\$ 621,501	CULVERT COST
Maintenance Road**	6.7	AC	\$ 28,314	\$ 189,704	MAINTENANCE ROAD COST
Total Cost				\$ 6,955,565	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 8  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

COST ESTIMATE FOR DRCC FROM 115TH AVENUE TO 107TH AVENUE  
 ASSUMING 100-YEAR, 2-HOUR RETENTION  
 DRCC IN AVONDALE AND PHOENIX  
 STORM DRAIN IN 99TH AVENUE

Channel Length	5139 Feet	
Channel Discharge	1144 cfs	
Channel Slope	0.0005 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	88 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	744	
Channel Excavation Volume, CY	141,608 Cubic Yards	
Channel Wetted Perimeter	161 Feet	
Channel Top Width	160 Feet	
Channel Landscape Area, AC	19.0 AC	Channel Only
Channel Total Area	18.9 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	210 Feet	
DRCC Total Area, AC	24.8	Includes maintenance ROW
Culvert area required	127 Square Feet	
Culvert width	25 Feet	(Assumes 4-foot height)
Number barrels	3	
Barrel width	9 Feet	
Culvert Concrete Area	82 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	668 Cubic Yards	
	560.64	

ALTERNATIVE 8  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	141,608	CY	\$ 6	\$ 849,648	CHANNEL EXCAVATION COST
Channel Landscaping	21.0	AC	\$ 78,408	\$ 1,646,568	CHANNEL LANDSCAPING COST
Channel Area*	24.8	AC	\$ 100,000	\$ 2,480,000	LAND COST
Culvert Concrete	668	CY	\$ 669	\$ 446,892	CULVERT COST
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593	MAINTENANCE ROAD COST
Total Cost				\$ 5,530,701	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-feet wide decomposed granite.

**ALTERNATIVE 8**  
**FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE**

**COST ESTIMATE FOR DRCC FROM 107TH AVENUE TO 99TH AVENUE**  
**ASSUMING 100-YEAR, 2-HOUR RETENTION**  
**DRCC IN AVONDALE AND PHOENIX**  
**STORM DRAIN IN 99TH AVENUE**

Channel Length	5155 Feet	
Channel Discharge	993 cfs	AVERAGE
Channel Slope	0.0032 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	22 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.6 Feet (From Master Plan)	
Channel Freeboard	1.3 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	338.66	
Channel Excavation Volume, CY	64,659 Cubic Yards	
Channel Wetted Perimeter	94 Feet	
Channel Top Width	93 Feet	
Channel Landscape Area, AC	11.1 AC	Channel Only
Channel Total Area	11.0 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	143 Feet	
DRCC Total Area, AC	16.9 Includes maintenance ROW	
Culvert area required	112 Square Feet	
Culvert width	22 Feet (Assumes 4-foot height)	
Number barrels	3	
Barrel width	8 Feet	
Culvert Concrete Area	76 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	619 Cubic Yards	
	228.16	

ALTERNATIVE 8  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	64,659	CY	\$ 6	\$ 387,954	CHANNEL EXCAVATION COST
Channel Landscaping	13.1	AC	\$ 78,408	\$ 1,027,145	CHANNEL LANDSCAPING COST
Channel Area*	16.9	AC	\$ 100,000	\$ 1,690,000	LAND COST
Culvert Concrete	619	CY	\$ 669	\$ 414,111	CULVERT COST
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593	MAINTENANCE ROAD COST
Total Cost				\$ 3,626,803	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 8  
FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE**

**COST ESTIMATE FOR DRCC FROM 99TH AVENUE TO 95TH AVENUE BASIN  
ASSUMING 100-YEAR, 2-HOUR RETENTION  
DRCC IN AVONDALE AND PHOENIX  
STORM DRAIN IN 99TH AVENUE**

Channel Length	2778 Feet	
Channel Discharge	998 cfs	
Channel Slope	0.0027 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	26 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.6 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.8 Feet	
Channel excavation area	352.64	
Channel Excavation Volume, CY	36,283	Cubic Yards
Channel Wetted Perimeter	97 Feet	
Channel Top Width	96 Feet	
Channel Landscape Area, AC	6.2 AC	Channel Only
Channel Total Area	6.1 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	146 Feet	
DRCC Total Area, AC	9.3	Includes maintenance ROW
Culvert area required	114	Square Feet
Culvert width	23 Feet	(Assumes 4-foot height)
Number barrels	3	
Barrel width	8 Feet	
Culvert Concrete Area	76	Square Feet
Culvert number	1.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	464	Cubic Yards

ALTERNATIVE 8  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	36,283	CY	\$ 6	\$ 217,698	CHANNEL EXCAVATION COST
Channel Landscaping	7.3	AC	\$ 78,408	\$ 572,378	CHANNEL LANDSCAPING COST
Channel Area*	9.3	AC	\$ 100,000	\$ 930,000	LAND COST
Culvert Concrete	464	CY	\$ 669	\$ 310,416	CULVERT COST
Maintenance Road**	2.0	AC	\$ 28,314	\$ 56,628	MAINTENANCE ROAD COST
Total Cost				\$ 2,087,120	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-feet wide decomposed granite.

**ALTERNATIVE 8**  
**FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE**

**COST ESTIMATE FOR DRCC ADJACENT TO 95TH AVENUE BASIN.  
 ASSUMING 100-YEAR, 2-HOUR RETENTION  
 DRCC IN AVONDALE AND PHOENIX  
 STORM DRAIN IN 99TH AVENUE**

Channel Length	1079 Feet	
Channel Discharge	998 cfs	
Channel Slope	0.002 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	33 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.6 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.8 Feet	
Channel excavation area	393.24	
Channel Excavation Volume, CY	15,715 Cubic Yards	
Channel Wetted Perimeter	104 Feet	
Channel Top Width	103 Feet	
Channel Landscape Area, AC	2.6 AC	Channel Only
Channel Total Area	2.6 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	153 Feet	
DRCC Total Area, AC	3.8	Includes maintenance ROW
Culvert area required	114 Square Feet	
Culvert width	23 Feet	(Assumes 4-foot height)
Number barrels	3	
Barrel width	8 Feet	
Culvert Concrete Area	76 Square Feet	
Culvert number	0	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	0 Cubic Yards	

ALTERNATIVE 8  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	15,715	CY	\$ 6	\$ 94,290	CHANNEL EXCAVATION COST
Channel Landscaping	3.0	AC	\$ 78,408	\$ 235,224	CHANNEL LANDSCAPING COST
Channel Area*	3.8	AC	\$ 100,000	\$ 380,000	LAND COST
Culvert Concrete	0	CY	\$ 669	\$ -	CULVERT COST
Maintenance Road**	0.8	AC	\$ 28,314	\$ 22,651	MAINTENANCE ROAD COST
Total Cost				\$ 732,165	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 8**  
**FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE**

COST ESTIMATE FOR DRCC FROM 95TH AVENUE BASIN TO 91ST AVENUE  
 ASSUMING 100-YEAR, 2-HOUR RETENTION  
 DRCC IN AVONDALE AND PHOENIX  
 STORM DRAIN IN 99TH AVENUE

Channel Length	1250 Feet	
Channel Discharge	1169 cfs	
Channel Slope	0.001 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	66 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.6 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.8 Feet	
Channel excavation area	584.64	
Channel Excavation Volume, CY	27,067 Cubic Yards	
Channel Wetted Perimeter	137 Feet	
Channel Top Width	136 Feet	
Channel Landscape Area, AC	3.9 AC	Channel Only
Channel Total Area	3.9 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	186 Feet	
DRCC Total Area, AC	5.3	Includes maintenance ROW
Culvert area required	134 Square Feet	
Culvert width	27 Feet (Assumes 4-foot height)	
Number barrels	3	
Barrel width	9 Feet	
Culvert Concrete Area	82 Square Feet	
Culvert number	0.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	167 Cubic Yards	

ALTERNATIVE 8  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	27,067	CY	\$ 6	\$ 162,402	CHANNEL EXCAVATION COST
Channel Landscaping	4.4	AC	\$ 78,408	\$ 344,995	CHANNEL LANDSCAPING COST
Channel Area*	5.3	AC	\$ 100,000	\$ 530,000	LAND COST
Culvert Concrete	167	CY	\$ 669	\$ 111,723	CULVERT COST
Maintenance Road**	0.9	AC	\$ 28,314	\$ 25,483	MAINTENANCE ROAD COST
Total Cost				\$ 1,174,603	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 8**  
**FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE**

**COST ESTIMATE FOR DRCC FROM 91ST AVENUE TO 83RD AVENUE**  
**ASSUMING 100-YEAR, 2-HOUR RETENTION**  
**DRCC IN AVONDALE AND PHOENIX**  
**STORM DRAIN IN 99TH AVENUE**

Channel Length	5017 Feet	
Channel Discharge	852 cfs	AVERAGE
Channel Slope	0.0007 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	50 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	516	
Channel Excavation Volume, CY	95,880 Cubic Yards	
Channel Wetted Perimeter	123 Feet	
Channel Top Width	122 Feet	
Channel Landscape Area, AC	14.2 AC	Channel Only
Channel Total Area	14.1 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	172 Feet	
DRCC Total Area, AC	19.8 Includes maintenance ROW	
Culvert area required	95 Square Feet	
Culvert width	19 Feet (Assumes 4-foot height)	
Number barrels	2	
Barrel width	10 Feet	
Culvert Concrete Area	61 Square Feet	
Culvert number	2	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	497 Cubic Yards	

ALTERNATIVE 8  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	95,880	CY	\$ 6	\$ 575,280	CHANNEL EXCAVATION COST
Channel Landscaping	16.1	AC	\$ 78,408	\$ 1,262,369	CHANNEL LANDSCAPING COST
Channel Area*	19.8	AC	\$ 100,000	\$ 1,980,000	LAND COST
Culvert Concrete	497	CY	\$ 669	\$ 332,493	CULVERT COST
Maintenance Road**	3.7	AC	\$ 28,314	\$ 104,762	MAINTENANCE ROAD COST
Total Cost				\$ 4,254,904	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

**ALTERNATIVE 8**  
**FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE**

**COST ESTIMATE FOR DRCC FROM 83RD AVENUE TO 75TH AVENUE  
 ASSUMING 100-YEAR, 2-HOUR RETENTION  
 DRCC IN AVONDALE AND PHOENIX  
 STORM DRAIN IN 99TH AVENUE**

Channel Length	5739 Feet	
Channel Discharge	534 cfs	
Channel Slope	0.0015 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	12 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	279.66	
Channel Excavation Volume, CY	59,443 Cubic Yards	
Channel Wetted Perimeter	84 Feet	
Channel Top Width	83 Feet	
Channel Landscape Area, AC	11.1 AC	Channel Only
Channel Total Area	10.9 AC	Channel Only
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides	
DRCC Total ROW Width	133 Feet	
DRCC Total Area, AC	17.5	Includes maintenance ROW
Culvert area required	60 Square Feet	
Culvert width	12 Feet (Assumes 4-foot height)	
Number barrels	2	
Barrel width	6 Feet	
Culvert Concrete Area	45 Square Feet	
Culvert number	2.5	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	458 Cubic Yards	

ALTERNATIVE 8  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Channel Excavation Volume	59,443	CY	\$ 6	\$ 356,658	CHANNEL EXCAVATION COST
Channel Landscaping	13.3	AC	\$ 78,408	\$ 1,042,826	CHANNEL LANDSCAPING COST
Channel Area*	17.5	AC	\$ 100,000	\$ 1,750,000	LAND COST
Culvert Concrete	458	CY	\$ 669	\$ 306,402	CULVERT COST
Maintenance Road**	4.2	AC	\$ 28,314	\$ 118,919	MAINTENANCE ROAD COST
Total Cost				\$ 3,574,805	TOTAL COST

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

ALTERNATIVE 8  
FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

COST ESTIMATE FOR DRCC 95TH AVENUE BASIN  
QUANTITIES ARE FROM DIBBLE MASTER PLAN

ITEM	QUANTITY	UNIT	UNIT COST	COST	
Basin Excavation Volume	202,900	CY	\$ 6	\$ 1,217,400	CHANNEL EXCAVATION COST
Basin Landscaping	48.0	AC	\$ 78,408	\$ 3,763,584	CHANNEL LANDSCAPING COST
Parcel Area	48.0	AC	\$ 100,000	\$ 4,800,000	LAND COST
Total Cost				\$ 9,780,984	TOTAL COST

ALTERNATIVE 8  
 FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

Pipe Design of Conceptual 99th avenue Storm Drain  
 and Approximate Cost Estimate

Location	Discharge (cfs)	slope	mannings	design D in inch	Length ft	Cost per Linear Foot (Adapted From City of Phoenix Data)	Total Cost
railroad to Buckeye	82	0.00246354	0.013	54	2414	\$ 178	\$429,692.00
Lower Buckeye	474	0.00246354	0.013	102	5327	\$ 416	\$2,216,032.00
DRCC	607	0.00246354	0.013	108	2618	\$ 446	\$1,167,628.00
DRCC to Broadway	607	0.00246354	0.013	108	2558	\$ 446	\$1,140,868.00
Southern	745	0.00246354	0.013	114	5360	\$ 476	\$2,551,360.00
Gila river	745	0.00246354	0.013	114	1990	\$ 476	\$947,240.00
							\$8,452,820.00

20267

\$417.07

ALTERNATIVE 8  
FULL DRCC, 100-YEAR 2-HOUR RETENTION, STORM DRAIN IN 99TH AVENUE

ITEM	UNIT	UNIT COST
Channel Excavation Volume	CY	6
Channel Landscaping	AC	78408
Channel Area**	AC	100000
Culvert Concrete***	CY	668.75
Maintenance Road****	AC	28314
Total Cost		

\* Assumes 1-foot freeboard

\*\* Includes 50-foot Right of Way outside of channel proper.

\*\*\* Assumes three and a half 4 cell 8'x5' culverts

\*\*\*\*Two roads, 16-feet wide decomposed granite.

# **CANDIDATE ASSESSMENT REPORT DURANGO REGIONAL CONVEYANCE CHANNEL**

**APPENDIX F: Recommended (10%) Plan.**

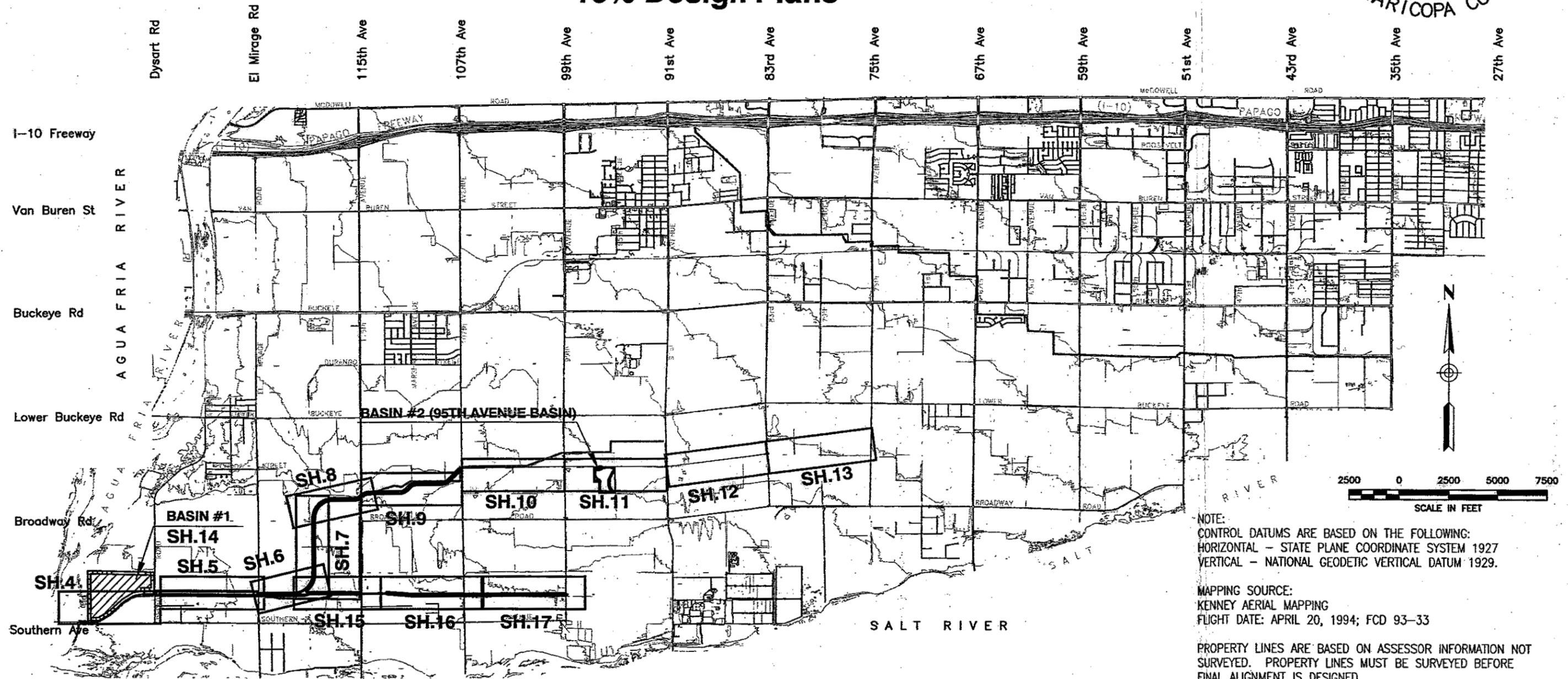
**February 2006**

# Durango Regional Conveyance Channel

## Candidate Assessment Report

### FCD #2004C027

### 10% Design Plans

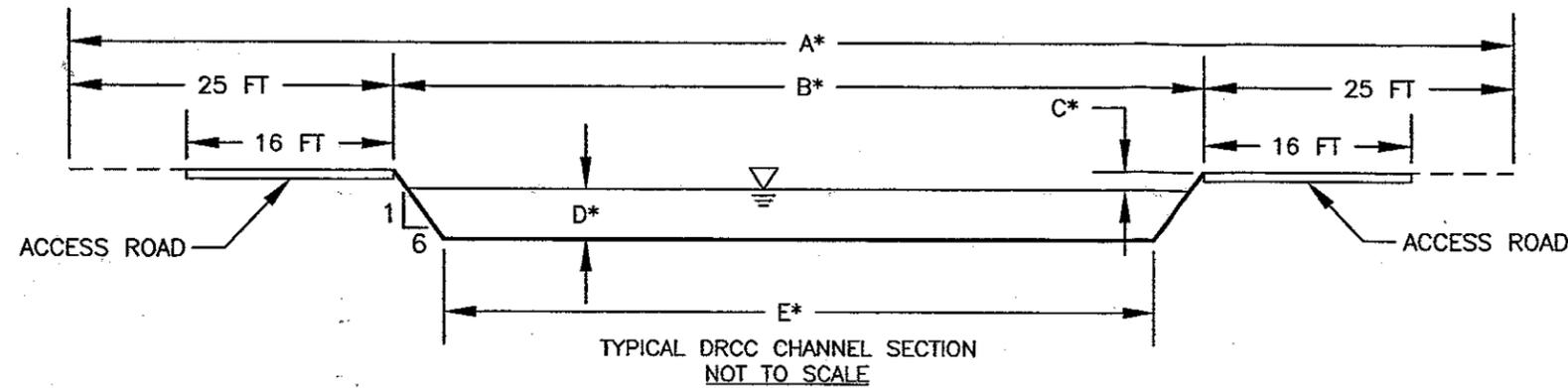


NOTE:  
 CONTROL DATUMS ARE BASED ON THE FOLLOWING:  
 HORIZONTAL - STATE PLANE COORDINATE SYSTEM 1927  
 VERTICAL - NATIONAL GEODETIC VERTICAL DATUM 1929.

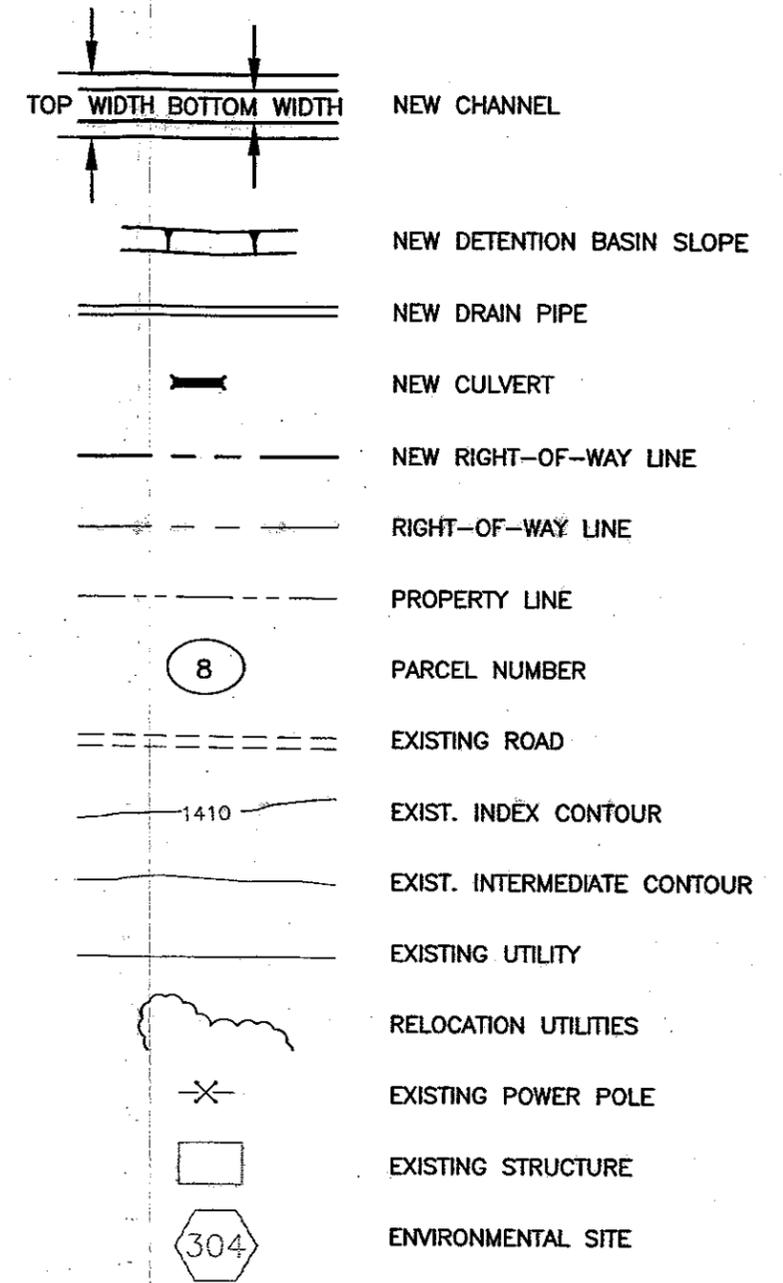
MAPPING SOURCE:  
 KENNEY AERIAL MAPPING  
 FLIGHT DATE: APRIL 20, 1994; FCD 93-33

PROPERTY LINES ARE BASED ON ASSESSOR INFORMATION NOT SURVEYED. PROPERTY LINES MUST BE SURVEYED BEFORE FINAL ALIGNMENT IS DESIGNED.

<b>Aspen</b> Consulting Engineers A Division of Aspen Environmental Group	DRN. JCS DATE: 02/14/06	SHEETS
	DES. JCS DATE: 02/14/06	
	CKD. POL DATE: 02/14/06	NO. 1 OF 17



**LEGEND**



**DRCC CHANNEL DIMENSIONS (SEE NOTES)**

CHANNEL REACH	DESIGN DISCHARGE, IN CFS	CHANNEL SLOPE, IN FEET PER FOOT	*DIMENSION NOTE				
			A	B	C	D	E
			RIGHT OF WAY WIDTH, IN FEET	CHANNEL TOP WIDTH, IN FEET	FREEBOARD, IN FEET	FLOW DEPTH, IN FEET	CHANNEL BOTTOM WIDTH, IN FEET
DOWNSREAM OF DYASRT ROAD (SHEETS 4 AND 14)	3,069	0.0014	277	227	1.2	4.7	156
DYSART ROAD TO EL MIRAGE ROAD (SHEET 5)	3,069	0.0014	277	227	1.2	4.7	156
EL MIRAGE ROAD TO SUNLAND CHANNEL (SHEET 6)	1,645	0.0017	190	140	1.2	4.7	69
SUNLAND CHANNEL TO 115TH AVENUE (SHEETS 6 TO 8)	1,205	0.0017	167	117	1.2	4.7	46
115TH AVENUE TO 107TH AVENUE (SHEET 9)	1,318	0.0017	171	121	1.2	4.8	49

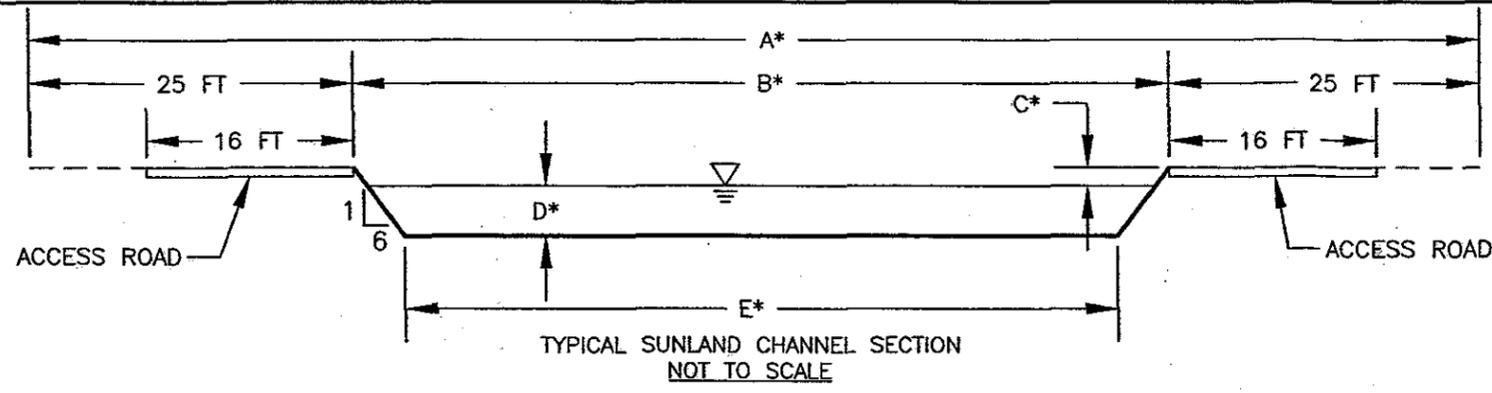
**DRCC REINFORCED CONCRETE BOX CULVERT DIMENSIONS**

CULVERT ROADWAY CROSSING	DESIGN DISCHARGE, IN CFS	HEADWATER, IN FEET	CULVERT HEIGHT, IN FEET	CULVERT WIDTH, IN FEET	NUMBER OF BARRELS	LENGTH, IN FEET
DYSART ROAD (SHEET 5)	3,069	5.9	4	9	9	110
EL MIRAGE ROAD (SHEET 6)	2,654	5.9	4	10	7	110
BROADWAY ROAD (SHEET 8)	1,205	5.9	4	8	4	110
AVONDALE BOULEVARD (SHEET 8)	1,318	6	4	7	5	211
107TH AVENUE (SHEET 10)	775	7	4	9	2	110
95TH AVENUE (SHEET 11)	388	7	4	9	1	110
91ST AVENUE (SHEET 12)	862	7	4	10	2	110
83RD AVENUE (SHEET 13)	345	7	4	8	1	110

**NOTE:**

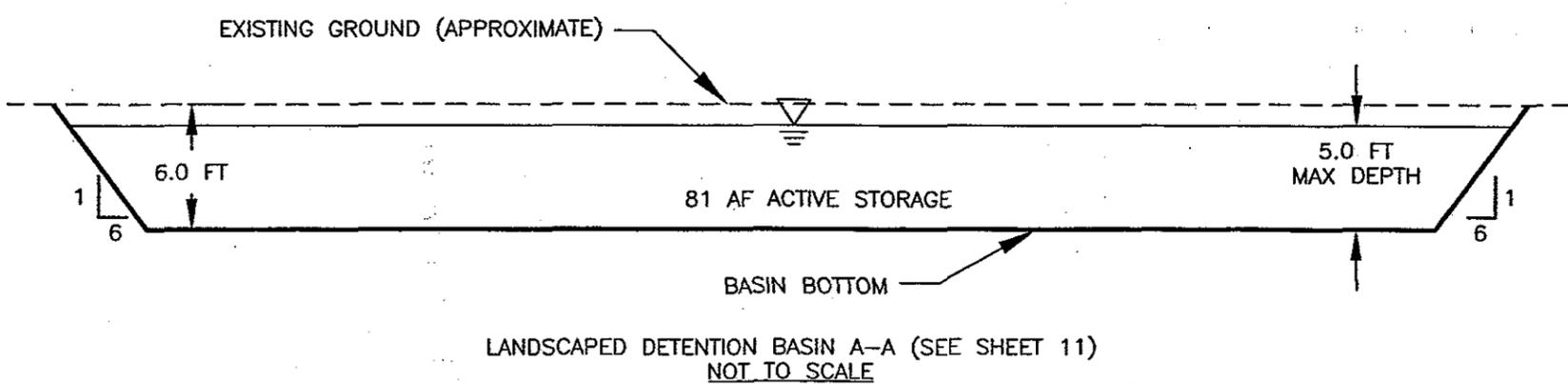
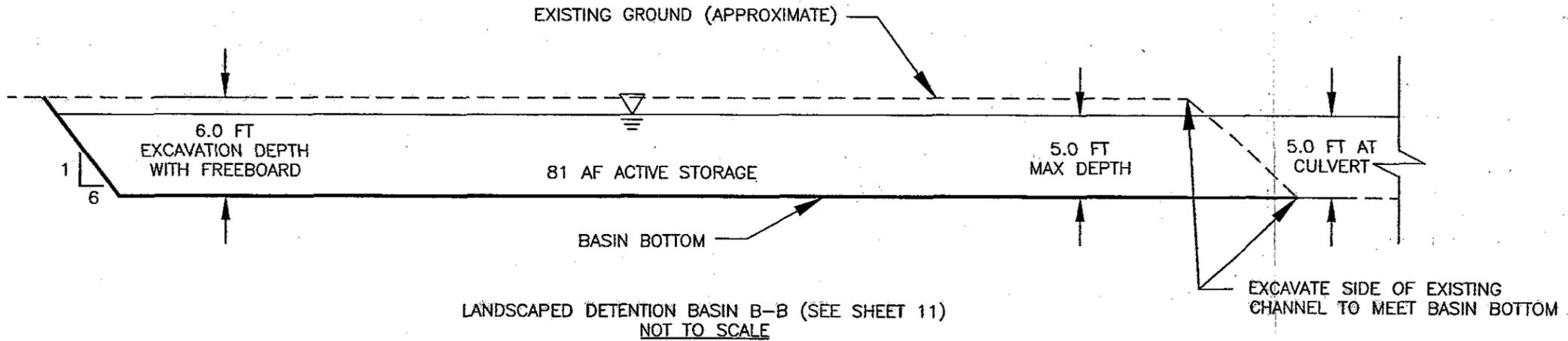
1. ENTIRE RIGHT OF WAY MINUS ACCESS ROADS TO BE LANDSCAPED. ACCESS ROADS 4' ABC. RIGHT OF WAY IS MINIMUM REQUIRED FOR DRAINAGE PURPOSES. ADDITIONAL RIGHT OF WAY MAY BE REQUIRED FOR RECREATION AESTHETIC PURPOSES.

	COUNTY PROJECT NO. 2004C027	10% DESIGN PLANS	
	DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT		
<b>Aspen</b> Consulting Engineers A Division of Aspen Environmental Group	DRNL JCS DATE 02/14/06	SCALE:	SHEETS
	DES. JCS DATE 02/14/06		NO. 2 OF 17
	CKD. POL. DATE 02/14/06		



SUNLAND CHANNEL REINFORCED CONCRETE BOX CULVERT DIMENSIONS						
CULVERT ROADWAY CROSSING	DESIGN DISCHARGE, IN CFS	HEADWATER, IN FEET	CULVERT HEIGHT, IN FEET	CULVERT WIDTH, IN FEET	NUMBER OF BARRELS	LENGTH, IN FEET
SUNLAND AVENUE (SHEET 16)	1,207	5.9	6	9	3	1,388
107TH AVENUE (SHEET 17)	919	5.9	4	8	3	110
99TH AVENUE (SHEET 17)	303	5.9	4	8	1	110

SUNLAND CHANNEL DIMENSIONS (SEE NOTES)							
CHANNEL REACH	DESIGN DISCHARGE, IN CFS	CHANNEL SLOPE, IN FEET PER FOOT	*DIMENSION NOTE				
			A	B	C	D	E
			RIGHT OF WAY WIDTH, IN FEET	CHANNEL TOP WIDTH, IN FEET	FREEBOARD, IN FEET	FLOW DEPTH, IN FEET	CHANNEL BOTTOM WIDTH, IN FEET
DRCC TO 115TH AVE. (SHEET 15)	1,207	0.0008	159	134	1.4	5.5	51
115TH AVE TO 107TH AVE. (SHEET 16)	1,207	0.0022	160	110	1.2	4.7	39
107TH AVE. TO 99TH AVE. (SHEET 17)	919	0.0018	151	101	1.2	4.7	30



- NOTE:
- ENTIRE RIGHT OF WAY MINUS ACCESS ROADS TO BE LANDSCAPED. ACCESS ROADS 4' ABC. RIGHT OF WAY IS MINIMUM REQUIRED FOR DRAINAGE PURPOSES. ADDITIONAL RIGHT OF WAY MAY BE REQUIRED FOR RECREATION AESTHETIC PURPOSES.
  - SUNLAND CHANNEL, DRCC TO 115TH 25 FOOT RIGHT OF WAY AND ACCESS ON ONE SIDE ONLY.

	COUNTY PROJECT NO. 2004C027	10% DESIGN PLANS		
	<b>DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT</b>			SHEETS
	<b>Aspen</b> Consulting Engineers A Division of Aspen Environmental Group	DRNL JCS DATE: 02/14/08 DES. JCS DATE: 02/14/08 CKD. POL. DATE: 02/14/08	SCALE	NO. 3 of 17



EL MIRAGE RD

CAUTION: Overhead High Voltage Electric Lines. Contact APS 602-371-6965

CAUTION: Overhead High Voltage Electric Lines. Contact SRP 602-236-5827

CAUTION: Buried Natural Gas Line. Contact El Paso Natural Gas Co. 915-496-5562

CENTER LINE

STA: 16+35.03  
OFFSET: 53.0000 L

STA: 22+22.12

STA: 29+48.73

STA: 39+57.93

STA: 45+52.32

STA: 50+53.42

OFFSET: 49.3261 R

STA: 50+68.50

3G

1-48" RCP

13°41'6"

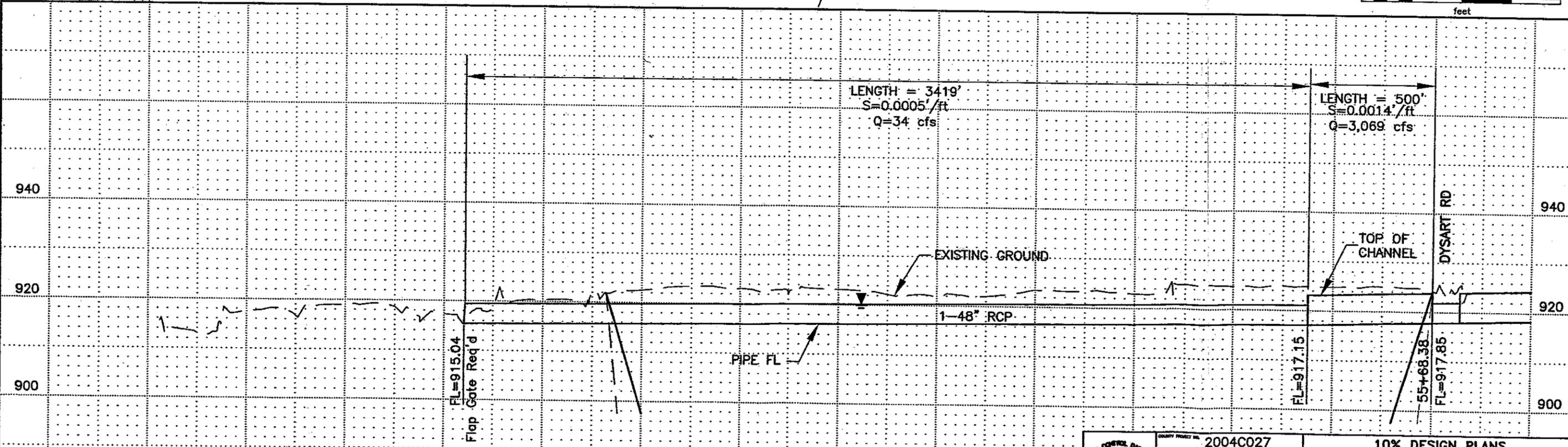
9°44'33"

12°50'28"

28°20'44"

DURANGO REGIONAL  
CONVEYANCE BASIN #1  
SEE SHEET 13

BOOK 500  
MAP 77



### DURANGO REGIONAL CONVEYANCE CHANNEL



COUNTY PROJECT NO. 2004C027 10% DESIGN PLANS

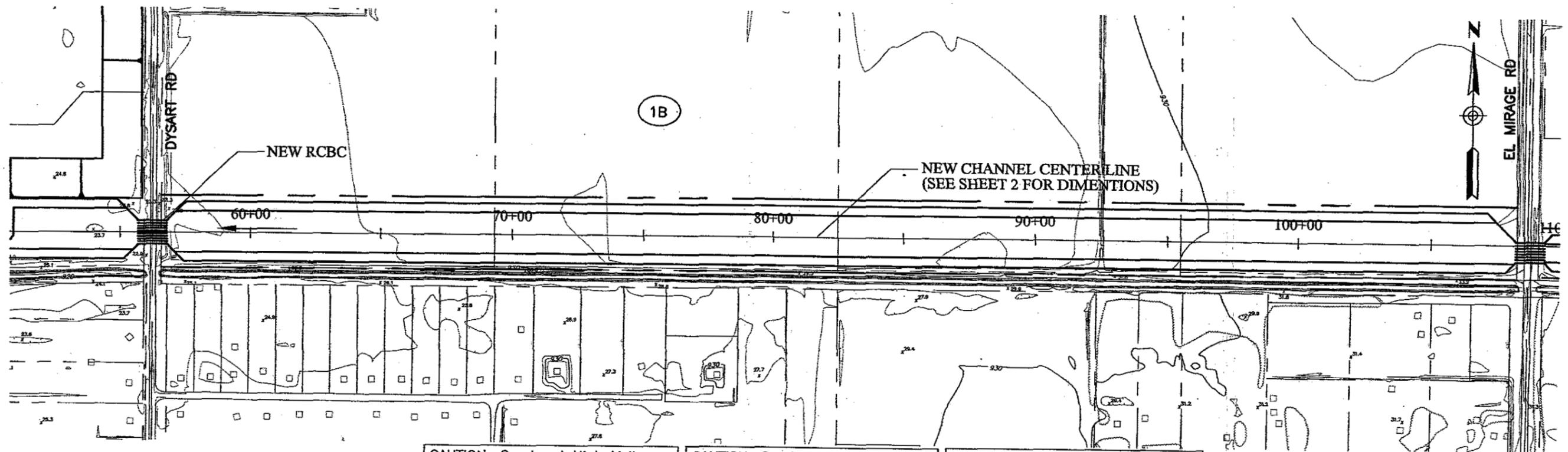
DURANGO REGIONAL CONVEYANCE CHANNEL  
CANDIDATE ASSESSMENT REPORT

Aspen Consulting Engineers  
A Division of Aspen Environmental Group

DRN. JCS DATE: 02/01/06 SCALE: HORIZONTAL  
DES. JCS DATE: 02/01/06 1"=400'  
CKD. PCL DATE: 02/01/06 1"=20' VERTICAL

SHEETS  
NO. 4 OF 17

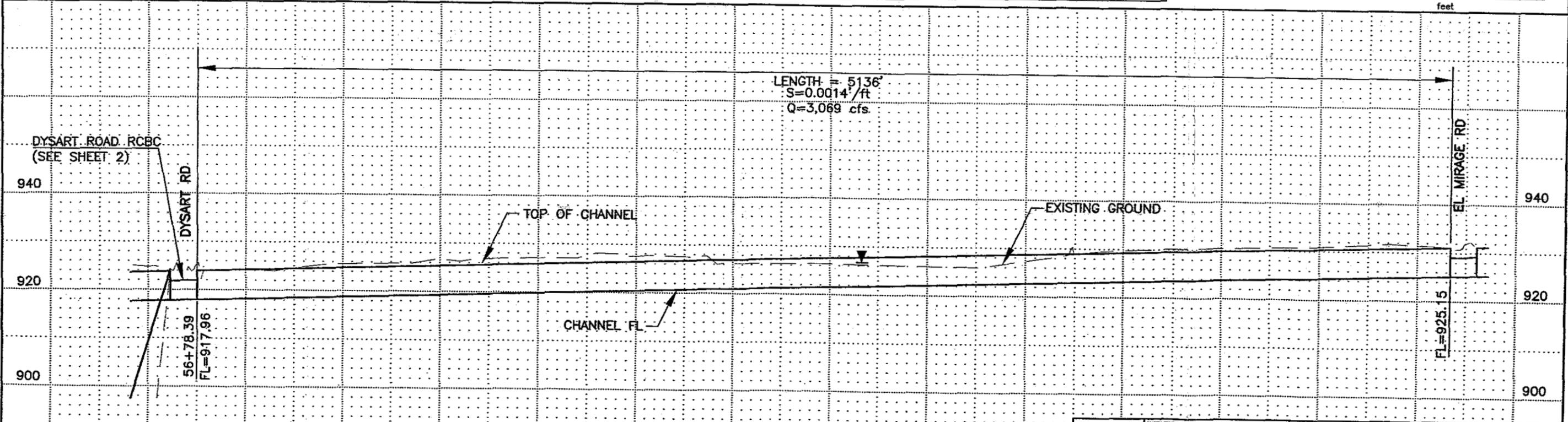
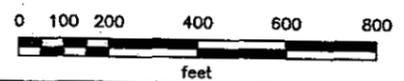
1B



CAUTION: Overhead High Voltage Electric Lines. Contact APS 602-371-6965

CAUTION: Overhead High Voltage Electric Lines. Contact SRP 602-236-5527

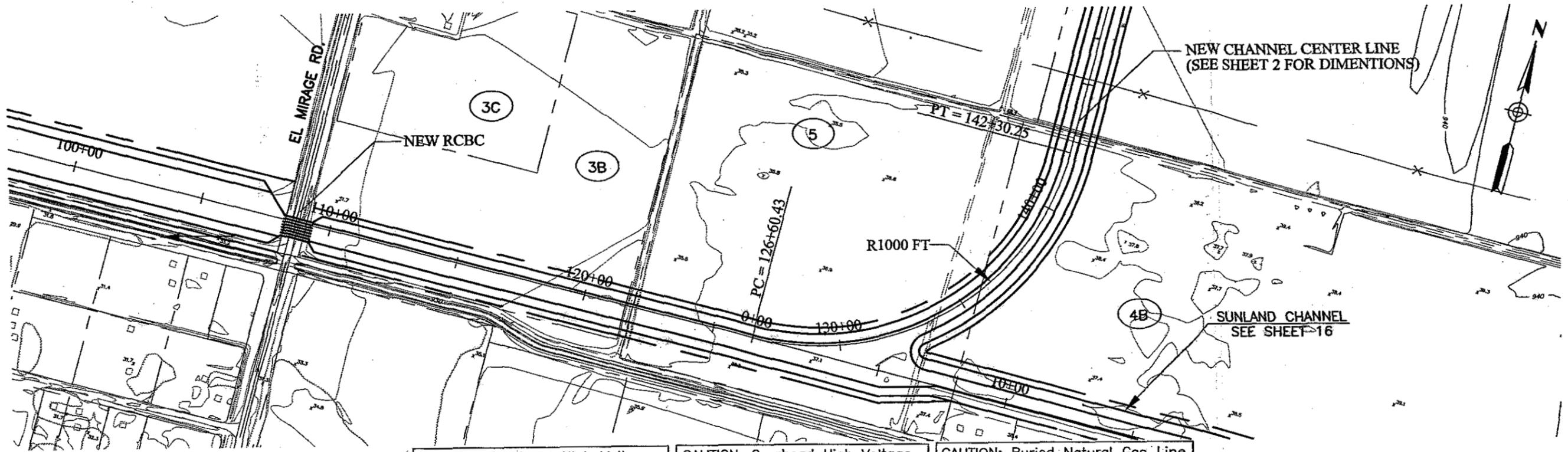
CAUTION: Buried Natural Gas Line Contact El Paso Natural Gas Co. 915-496-5562



DURANGO REGIONAL CONVEYANCE CHANNEL



COUNTY PROJECT NO.	2004C027	10% DESIGN PLANS	
DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT			
DRN. JCS DATE: 02/01/06	SCALE:	SHEETS	
DES. JCS DATE: 02/01/06	1"=400'	HORIZONTAL	
CKD. POL. DATE: 02/01/06	1"=20'	VERTICAL	
Aspen Consulting Engineers A Division of Aspen Environmental Group		NO. 5 OF 17	



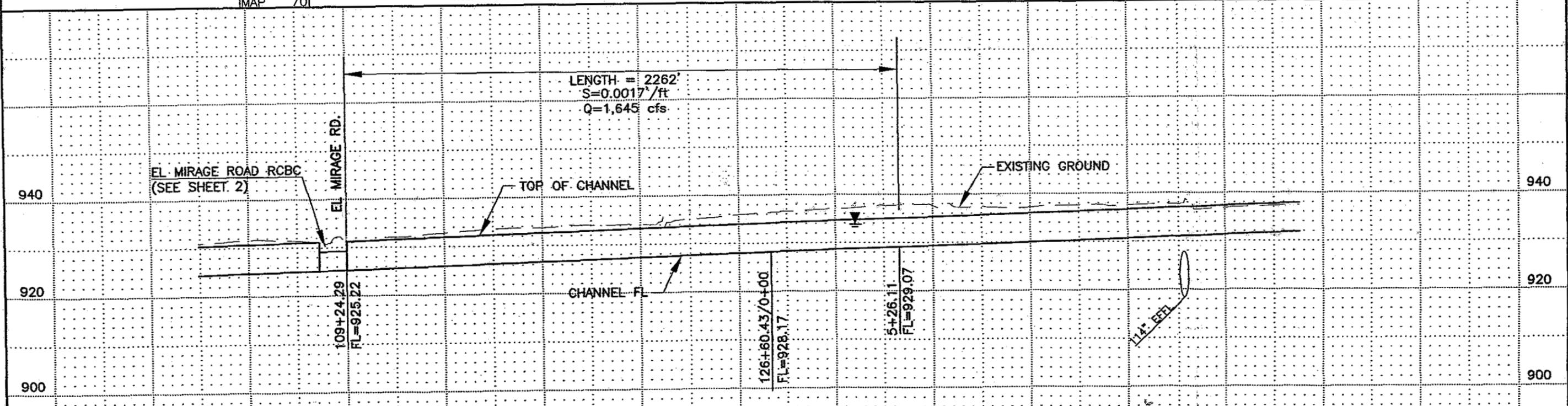
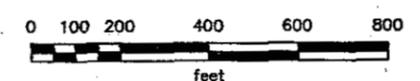
NEW CHANNEL CENTER LINE  
(SEE SHEET 2 FOR DIMENSIONS)

SUNLAND CHANNEL  
SEE SHEET 16

CAUTION: Overhead High Voltage  
Electric Lines. Contact APS  
602-371-6965

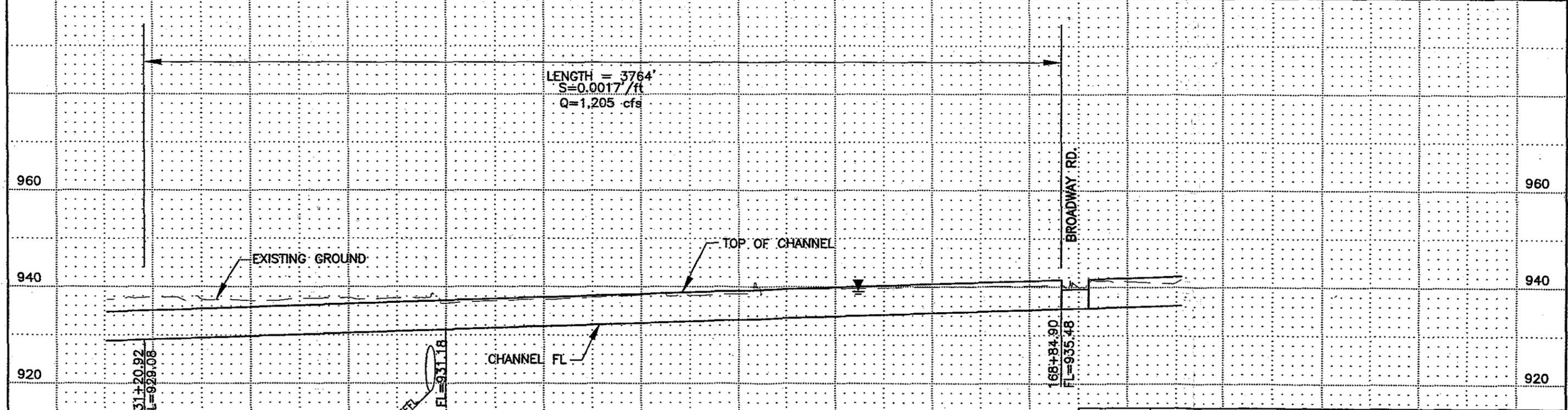
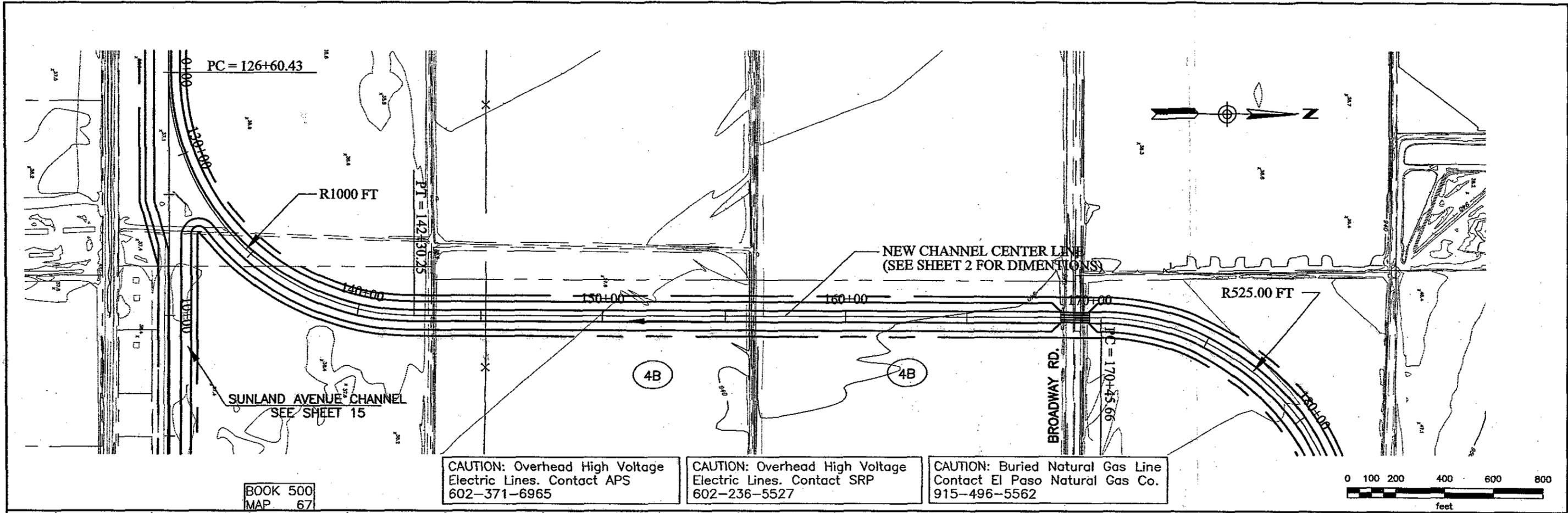
CAUTION: Overhead High Voltage  
Electric Lines. Contact SRP  
602-236-5527

CAUTION: Buried Natural Gas Line  
Contact El Paso Natural Gas Co.  
915-496-5562



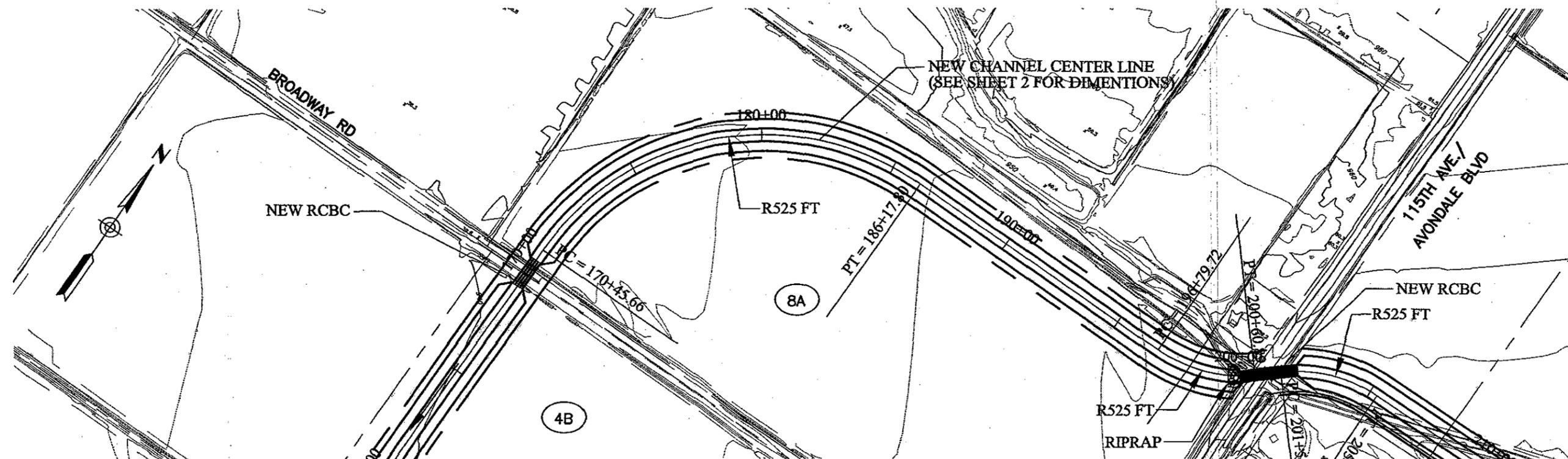
DURANGO REGIONAL CONVEYANCE CHANNEL

	COUNTY PROJECT NO. 2004C027	10% DESIGN PLANS		
	DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT			SHEETS
	Aspen Consulting Engineers A Division of Aspen Environmental Group	DRM. JCS DATE: 02/01/06 DES. JCS DATE: 02/01/06 CKD. POL. DATE: 02/01/06	SCALE: 1"=400' HORIZONTAL 1"=20' VERTICAL	NO. 6 OF 17



DURANGO REGIONAL CONVEYANCE CHANNEL

	COUNTY PROJECT NO. 2004C027	10% DESIGN PLANS
	DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT	
Aspen Consulting Engineers A Division of Aspen Environmental Group	DRN. JCS DATE: 02/01/06 SCALE: 1"=400' DES. JCS DATE: 02/01/06 HORIZONTAL CKD. POL. DATE: 02/01/06 1"=20' VERTICAL	SHEETS NO. 7 OF 17

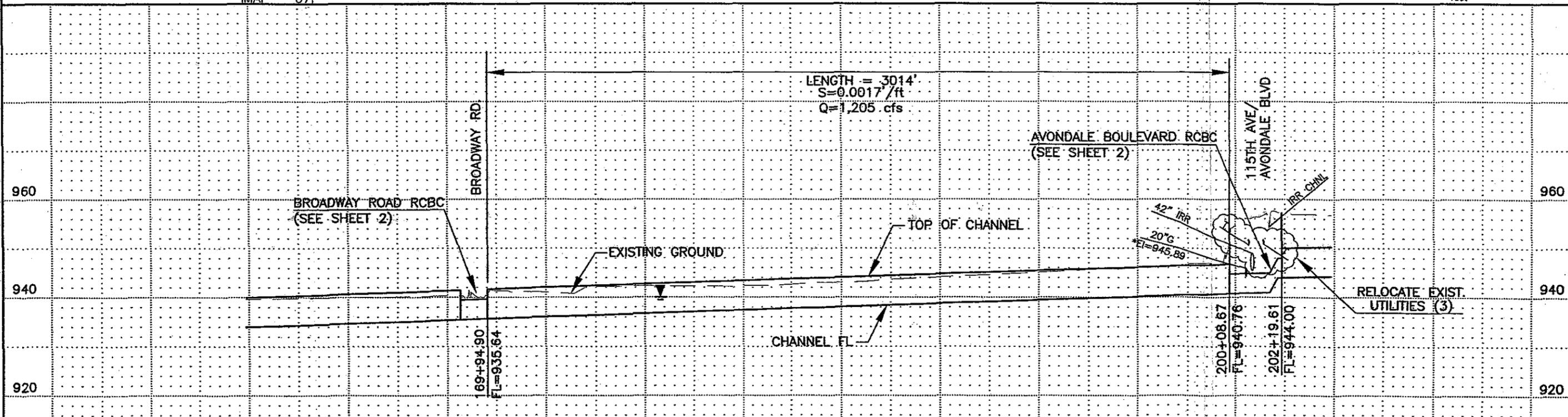
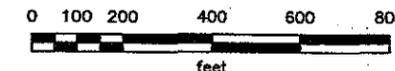


BOOK 500  
MAP 67

CAUTION: Overhead High Voltage Electric Lines. Contact APS 602-371-6965

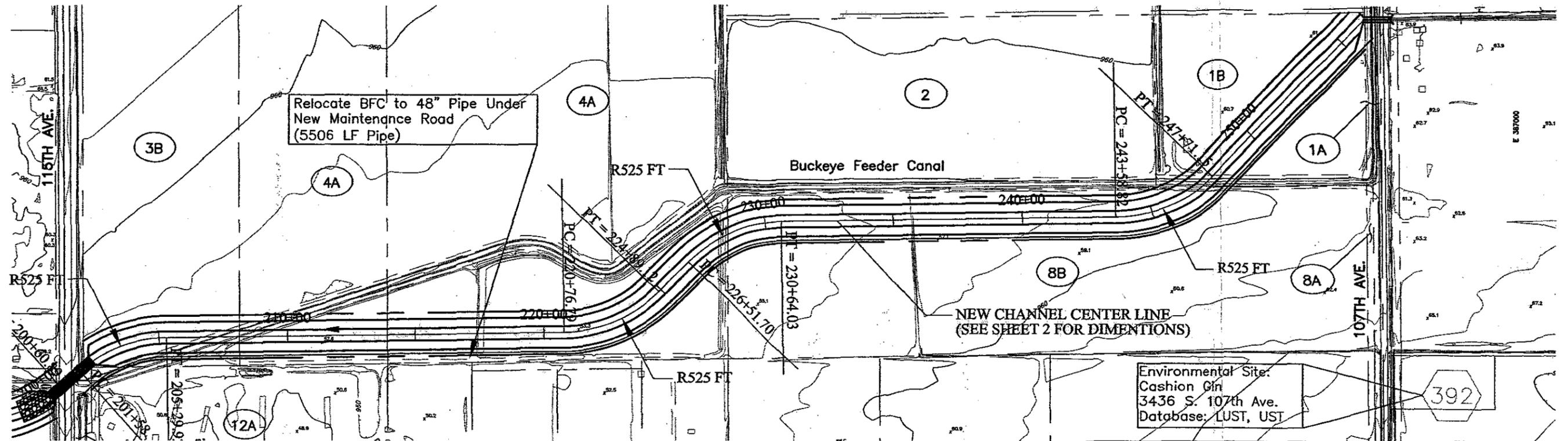
CAUTION: Overhead High Voltage Electric Lines. Contact SRP 602-236-5527

CAUTION: Buried Natural Gas Line Contact El Paso Natural Gas Co. 915-496-5562



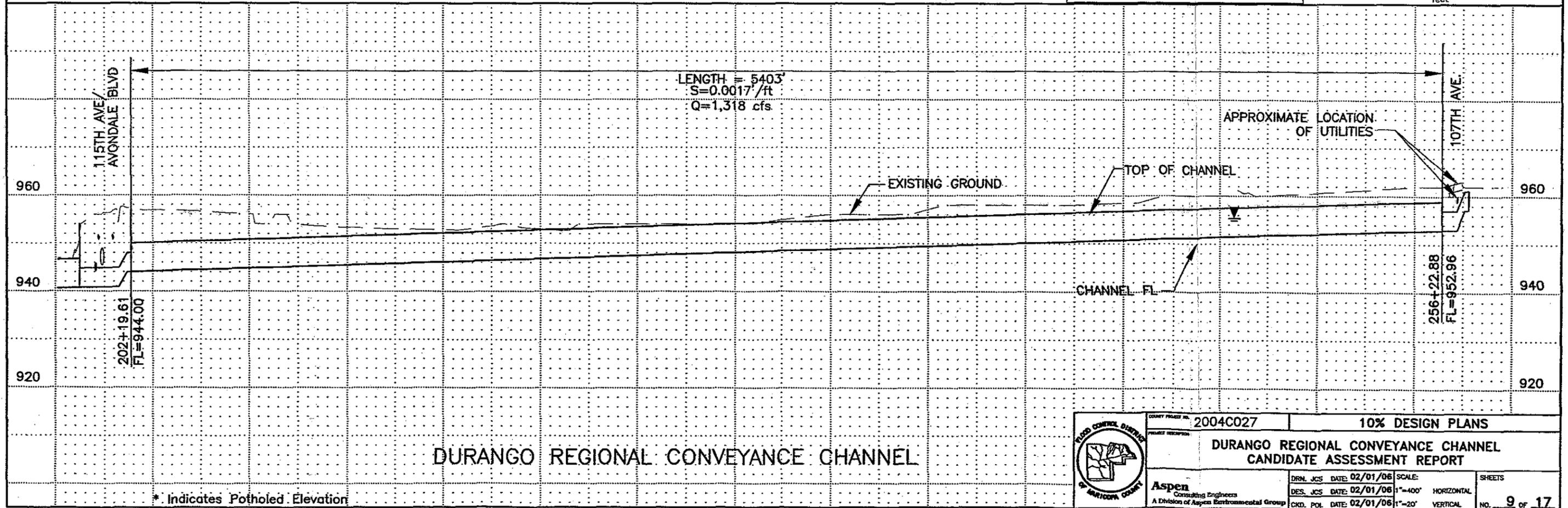
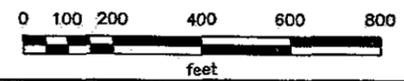
DURANGO REGIONAL CONVEYANCE CHANNEL

	COUNTY PROJECT NO. 2004C027	10% DESIGN PLANS		
	DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT			SHEETS
	Aspen Consulting Engineers A Division of Aspen Environmental Group	DRN. JCS DATE: 02/01/06 DES. JCS DATE: 02/01/06 CKD. POL. DATE: 02/01/06	SCALE: 1"=400' HORIZONTAL 1"=20' VERTICAL	NO. 8 OF 17



Environmental Site:  
Cashion Gln  
3436 S. 107th Ave.  
Database: LUST, UST

CAUTION: Buried Natural Gas Line  
Contact El Paso Natural Gas Co.  
915-496-5562



DURANGO REGIONAL CONVEYANCE CHANNEL

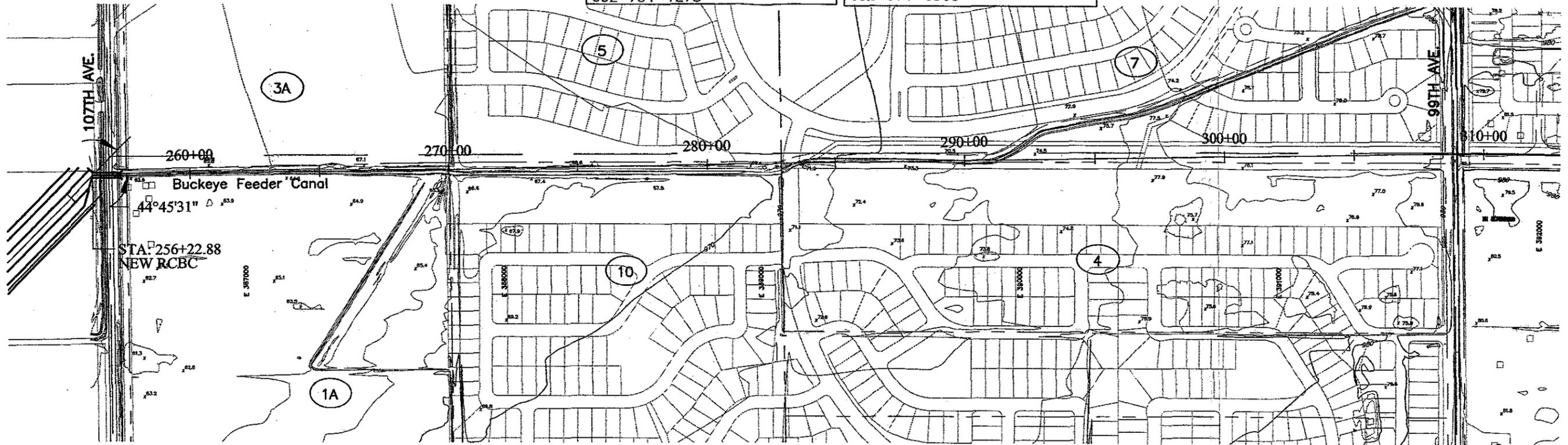


COUNTY FILED NO.	2004C027	10% DESIGN PLANS	
DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT			
DRN. JCS DATE: 02/01/06	SCALE:	SHEETS	
DES. JCS DATE: 02/01/06	1"=400'	HORIZONTAL	
CRD. POL. DATE: 02/01/06	1"=20'	VERTICAL	
Aspen Consulting Engineers A Division of Aspen Environmental Group			NO. 9 OF 17

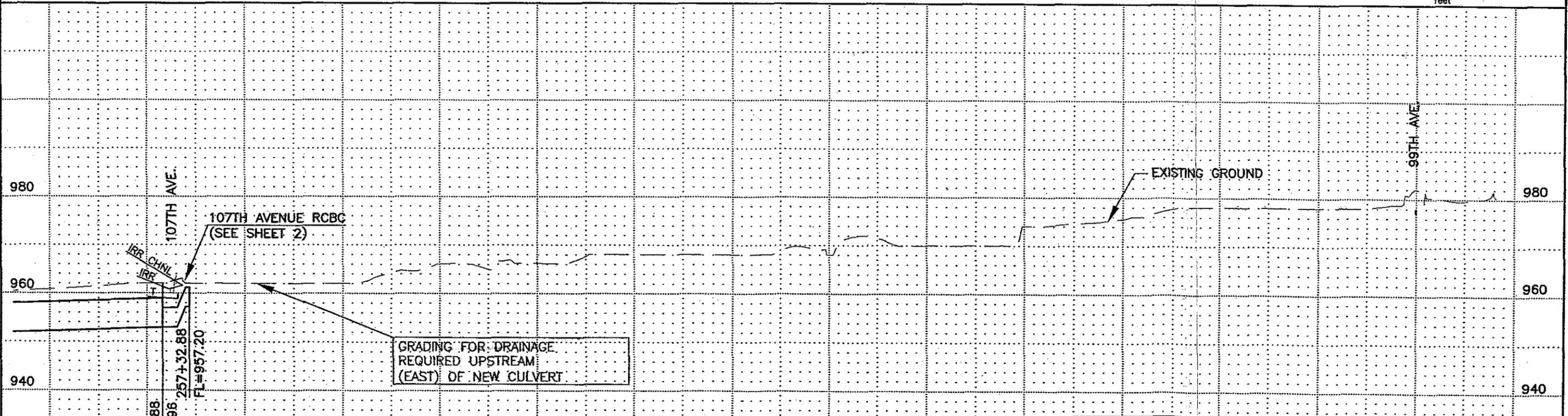
BOOK 101  
MAP 25

CAUTION: Buried Fiber Optic Cable  
Contact MCI WORLDCOM  
602-734-1273

CAUTION: Overhead High Voltage  
Electric Lines. Contact APS  
602-371-6965



CURRENT PARCEL MAPPING INCLUDED ON THIS SHEET.  
TOPOGRAPHY DOES NOT REFLECT DRAINAGE IMPROVEMENTS.



GRADING FOR DRAINAGE  
REQUIRED UPSTREAM  
(EAST) OF NEW CULVERT

	COUNTY PROJECT NO. 2004C027	10% DESIGN PLANS	
	DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT		
	DRNL JCS DATE: 02/14/06 DES. JCS DATE: 02/14/06 CKD. POL. DATE: 02/14/06	SCALE: 1"=400' HORIZONTAL 1"=20' VERTICAL	SHEETS NO. 10 OF 17

STA: 308+15.60

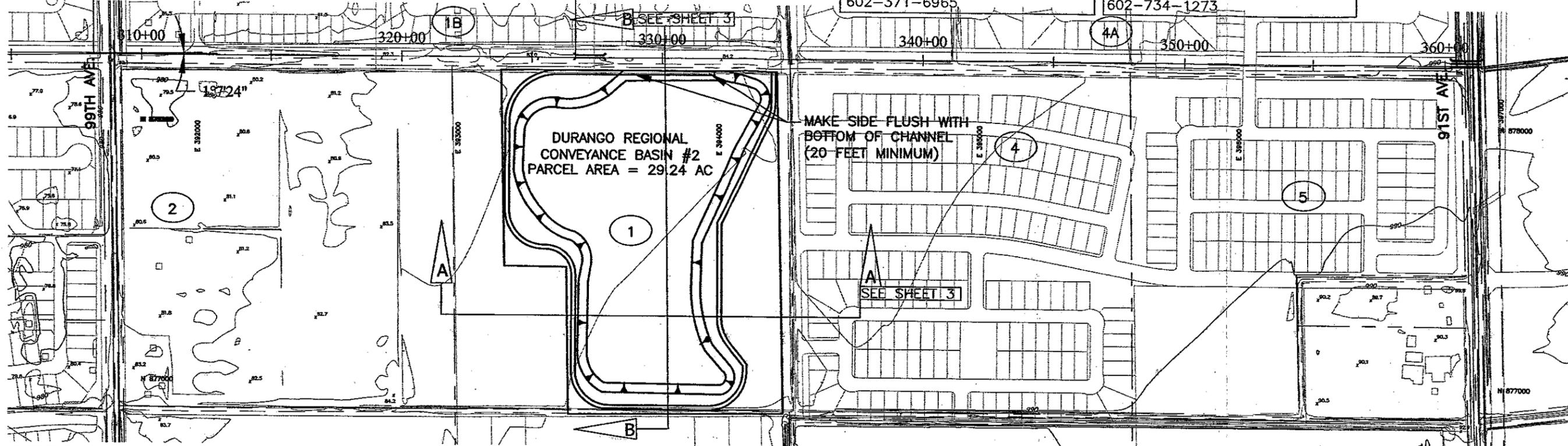
BOOK 101  
MAP 26

STA: 326+67.10  
NEW RCBC

CAUTION: Overhead High Voltage  
Electric Lines. Contact APS  
602-371-6965

CAUTION: Buried Fiber Optic Cable  
Contact MCI WORLDCOM  
602-734-1273

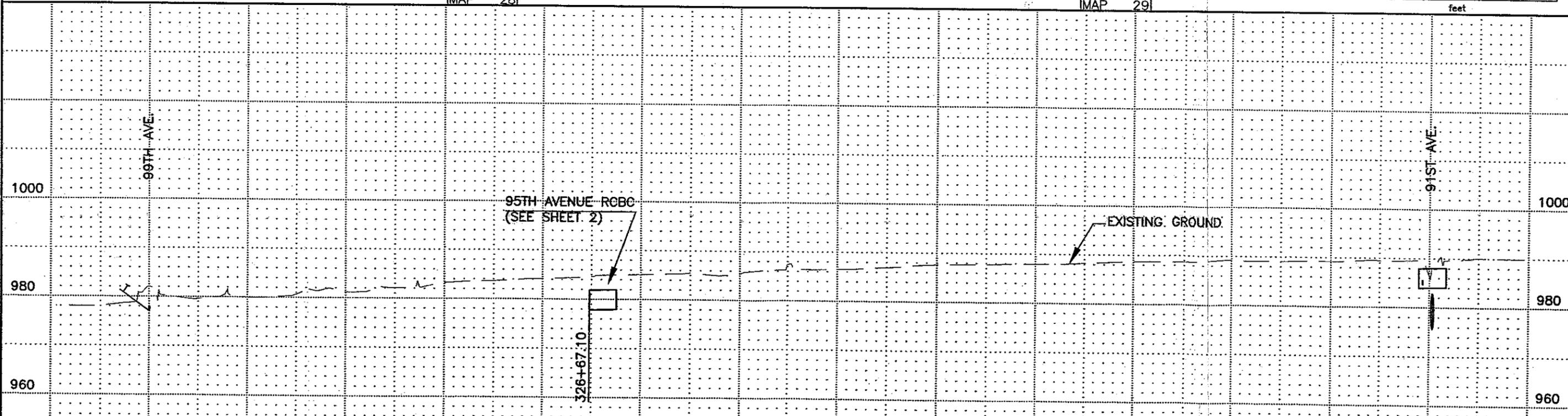
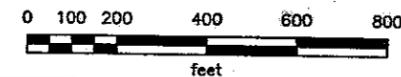
BOOK 101  
MAP 27



CURRENT PARCEL MAPPING INCLUDED ON THIS SHEET.  
TOPOGRAPHY DOES NOT REFLECT DRAINAGE IMPROVEMENTS.

BOOK 101  
MAP 28

BOOK 101  
MAP 29



NOTE:  
BASIN #2 CONFIGURATION MAY BE ALTERED IN FINAL DESIGN TO  
ACCOMMODATE RECREATIONAL AND ASTHETIC USES.



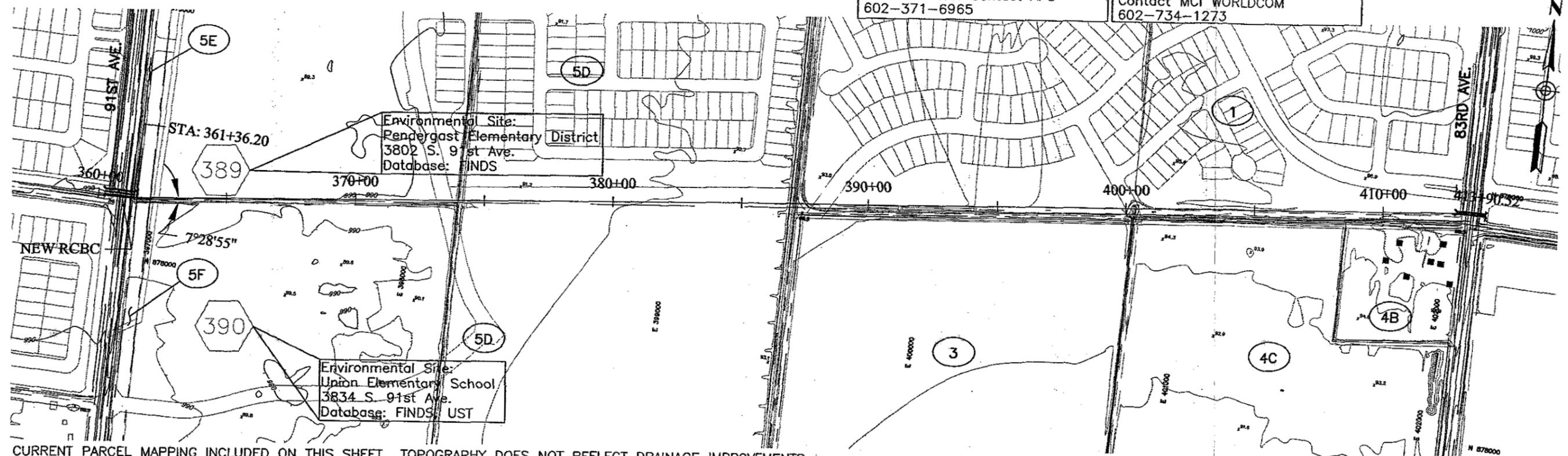
PROJECT NO.	2004C027	10% DESIGN PLANS	
<b>DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT</b>			
DRN. JCS DATE: 02/14/06	SCALE: 1"=400'	SHEETS	
DES. JCS DATE: 02/14/06	1"=20'	HORIZONTAL	NO. 11 OF 17
CKD. POL. DATE: 02/14/06	VERTICAL		

Aspen  
Consulting Engineers  
A Division of Aspen Environmental Group

BOOK 101  
MAP 30

CAUTION: Overhead High Voltage  
Electric Lines. Contact APS  
602-371-6965

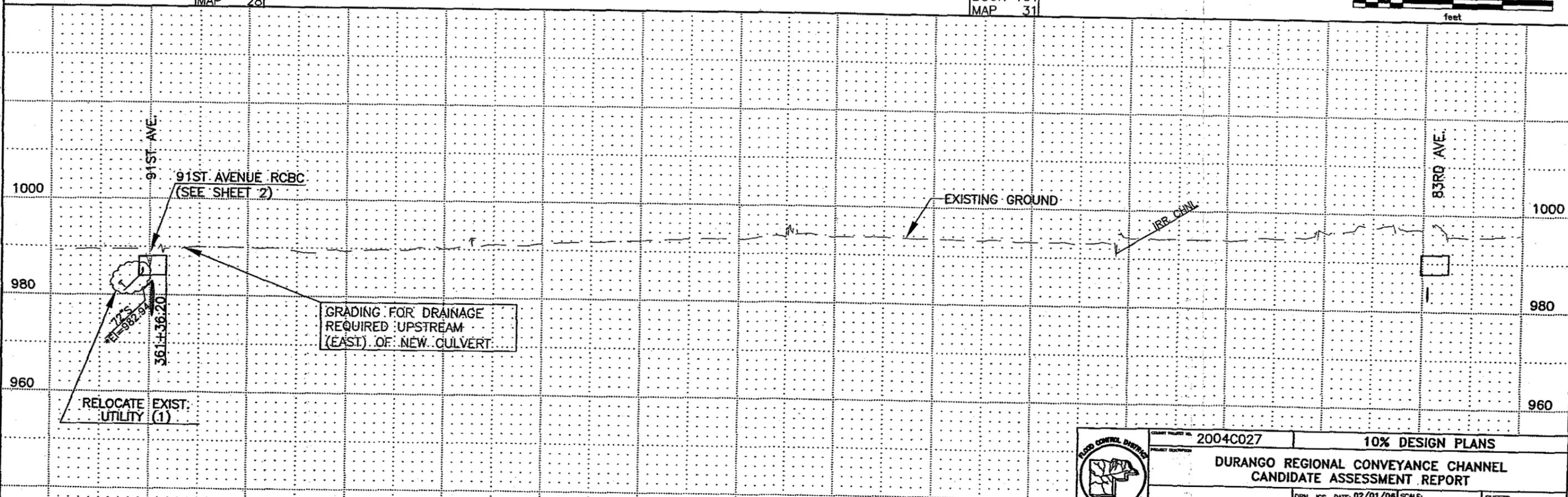
CAUTION: Buried Fiber Optic Cable  
Contact MCI WORLDCOM  
602-734-1273



CURRENT PARCEL MAPPING INCLUDED ON THIS SHEET. TOPOGRAPHY DOES NOT REFLECT DRAINAGE IMPROVEMENTS.

BOOK 101  
MAP 28

BOOK 101  
MAP 31



\* Indicates Potholed Elevation



PROJECT NO. 2004C027	10% DESIGN PLANS
<b>DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT</b>	
DRN. JCS DATE: 02/01/06	SCALE: HORIZONTAL
DES. JCS DATE: 02/01/06	1"=400'
CRD. POL. DATE: 02/01/06	1"=20'
Aspen Consulting Engineers A Division of Aspen Environmental Group	SHEETS NO. 12 OF 17

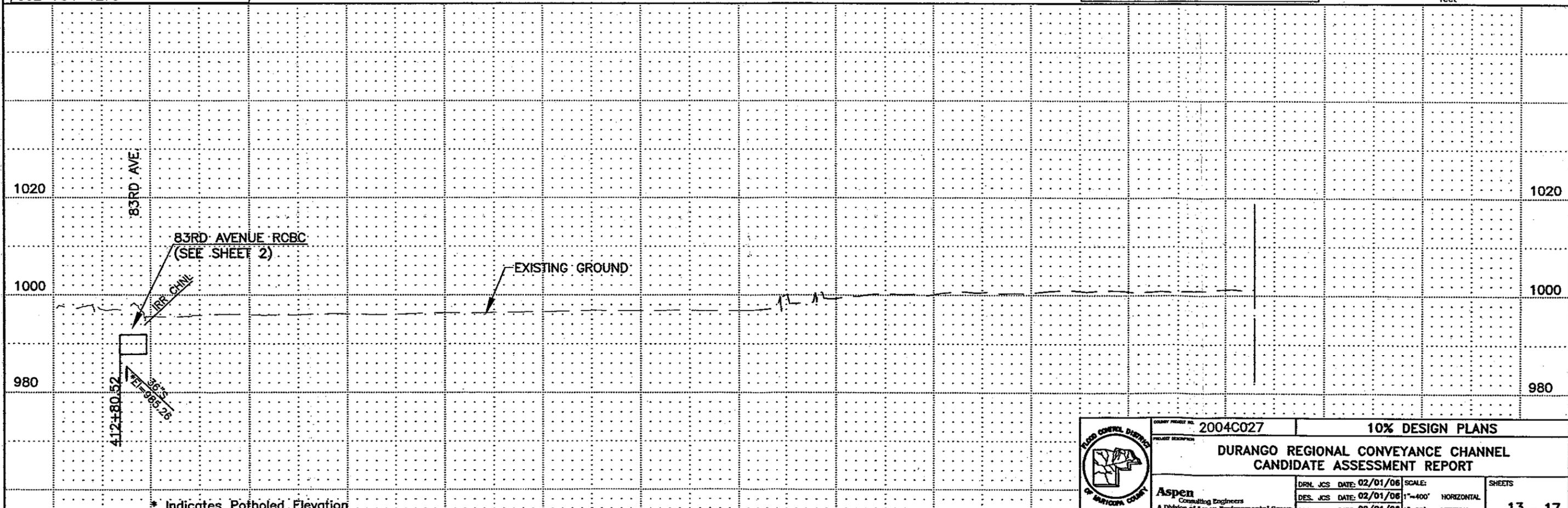
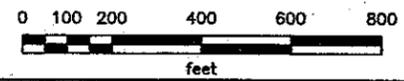


CAUTION: Buried Fiber Optic Cable  
Contact MCI WORLDCOM  
602-734-1273

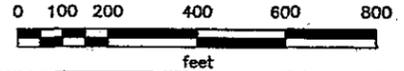
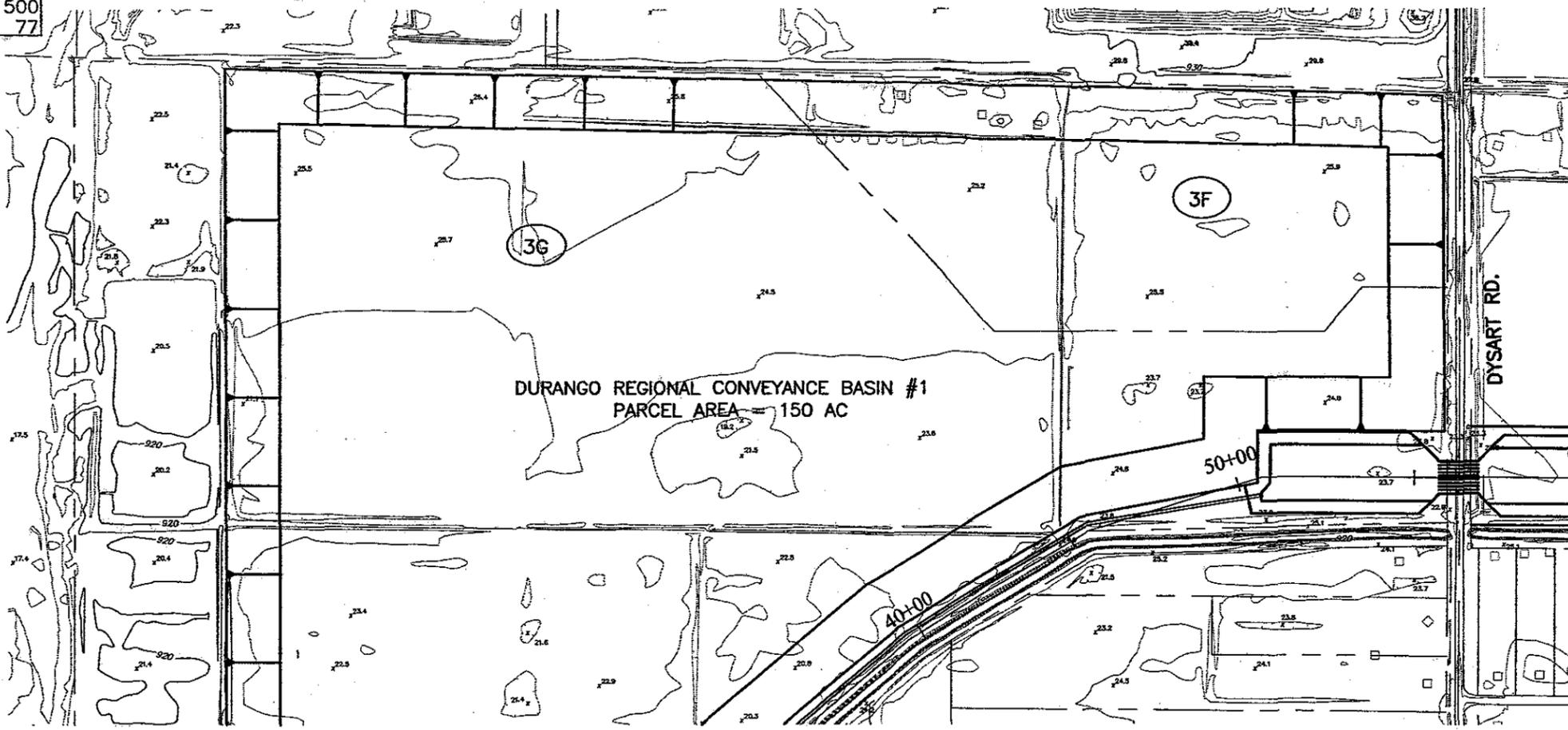
CURRENT PARCEL MAPPING INCLUDED ON THIS SHEET. TOPOGRAPHY DOES NOT REFLECT DRAINAGE IMPROVEMENTS.

CAUTION: Buried Fiber Optic Cable  
Contact Sprint  
602-417-0970

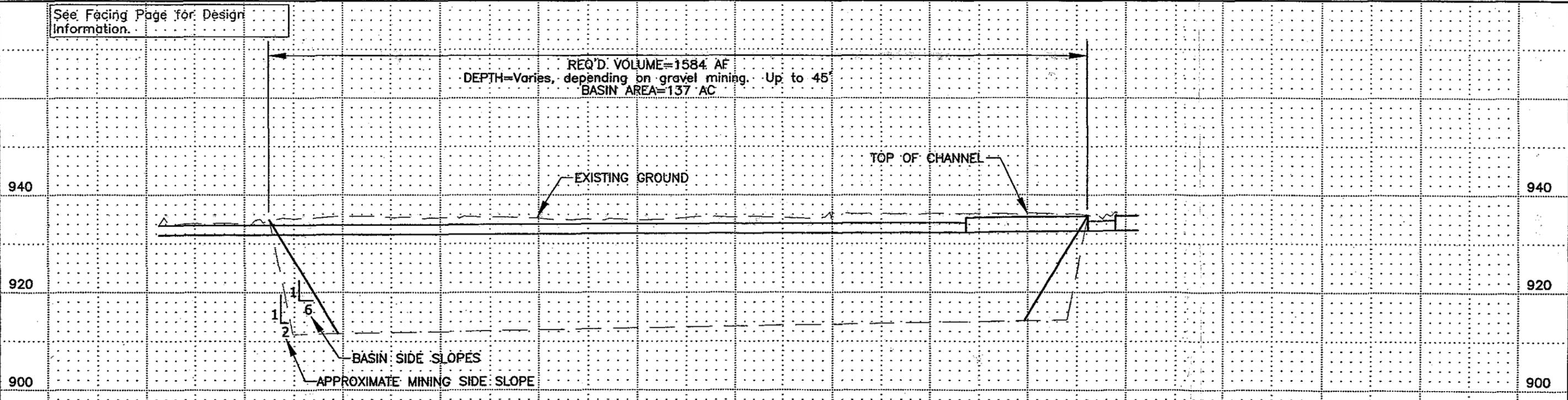
CAUTION: Overhead High Voltage  
Electric Lines. Contact APS  
602-371-6965



PROJECT NO.	2004C027	SCALE:	1"=400'	HORIZONTAL	SHEETS
PROJECT DESCRIPTION	10% DESIGN PLANS			VERTICAL	NO. 13 OF 17
DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT		DRN. JCS DATE: 02/01/06	DES. JCS DATE: 02/01/06	CKD. POL. DATE: 02/01/06	
Aspen Consulting Engineers A Division of Aspen Environmental Group					



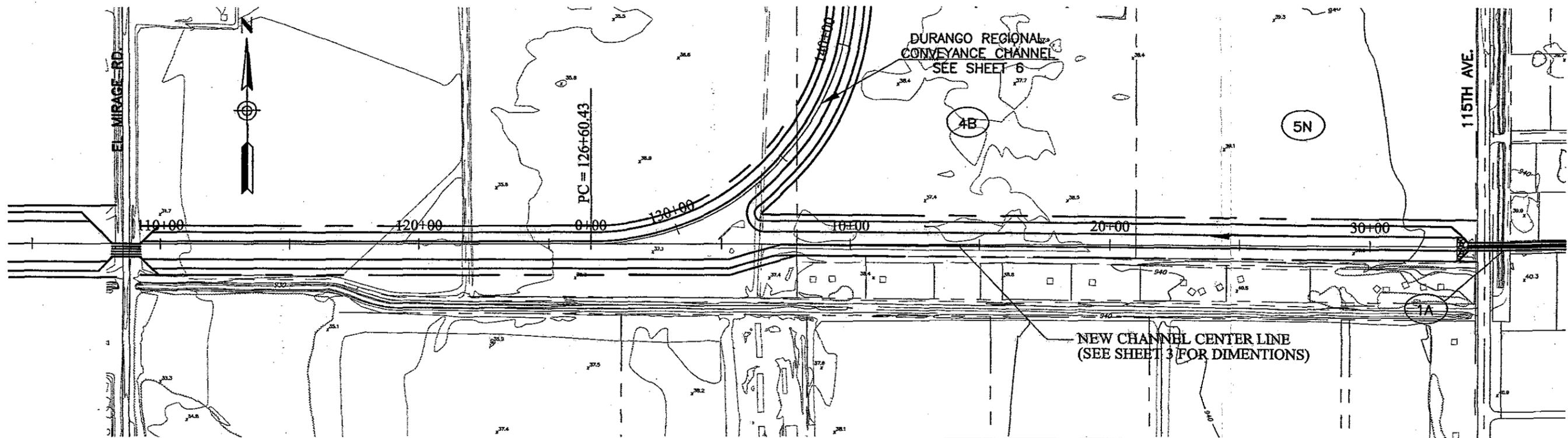
See Facing Page for Design Information.



DURANGO REGIONAL CONVEYANCE BASIN #1



COUNTY PROJECT NO.	2004C027	10% DESIGN PLANS	
DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT			
DRN. JCS DATE: 02/01/06	SCALE:	SHEETS	
DES. JCS DATE: 02/01/06	1"=400'	HORIZONTAL	
CKD. POL. DATE: 02/01/06	1"=20'	VERTICAL	
Aspen Consulting Engineers A Division of Aspen Environmental Group		NO. 14 OF 17	

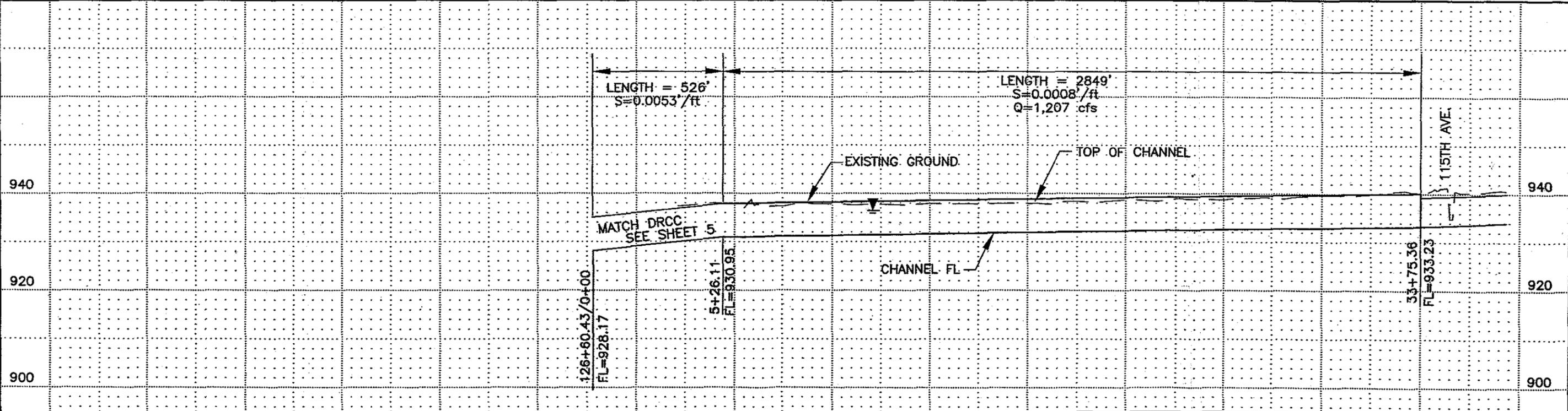
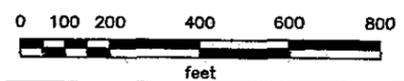


BOOK 500  
MAP 67

CAUTION: Overhead High Voltage  
Electric Lines. Contact APS  
602-371-6965

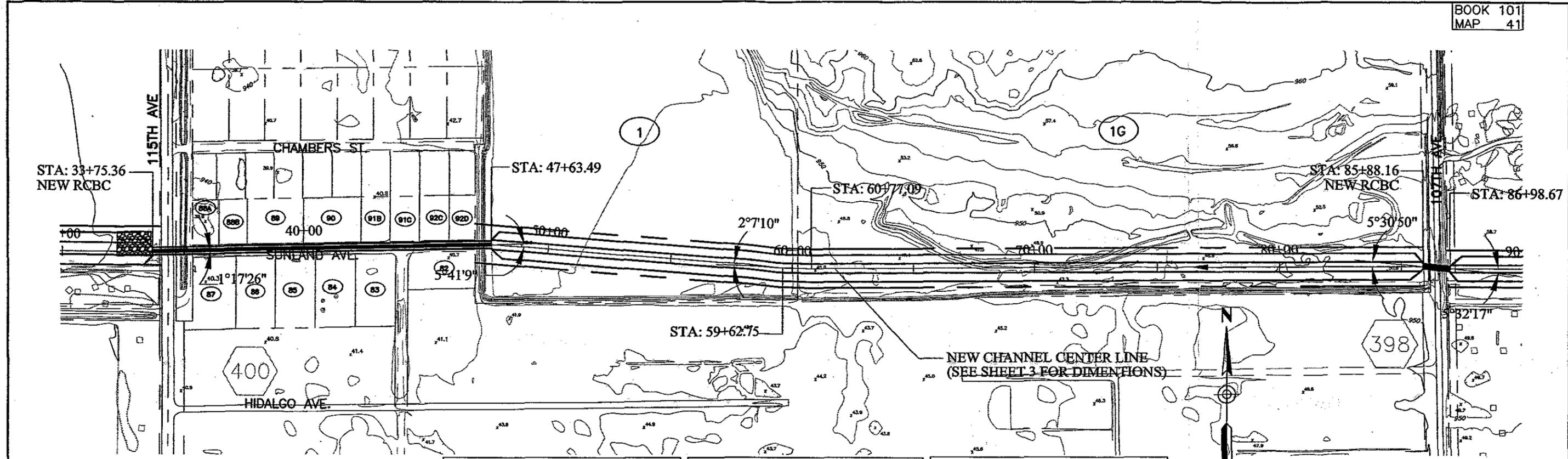
CAUTION: Overhead High Voltage  
Electric Lines. Contact SRP  
602-236-5527

CAUTION: Buried Natural Gas Line  
Contact El Paso Natural Gas Co.  
915-496-5562



SUNLAND CHANNEL

	COUNTY PROJECT NO.	2004C027		
	PROJECT DESCRIPTION	DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT		
<b>Aspen</b> Consulting Engineers A Division of Aspen Environmental Group	DRN. JCS DATE: 02/01/06	SCALE:	SHEETS	
	DES. JCS DATE: 02/01/06	1"=400'		HORIZONTAL
	CKD. POL. DATE: 02/01/06	1"=20'		VERTICAL
			NO. 15 OF 17	

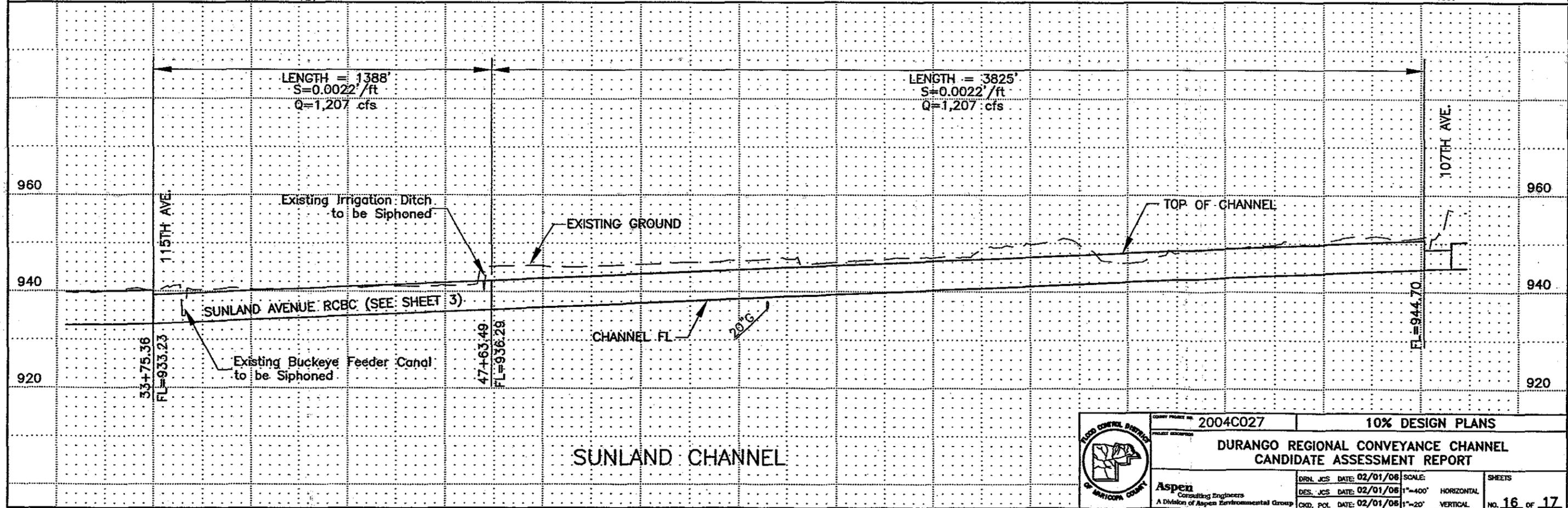
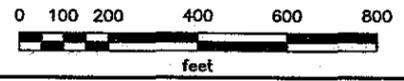


CAUTION: Overhead High Voltage  
Electric Lines. Contact APS  
602-371-6965

CAUTION: Overhead High Voltage  
Electric Lines. Contact SRP  
602-236-5527

CAUTION: Buried Natural Gas Line  
Contact El Paso Natural Gas Co.  
915-496-5562

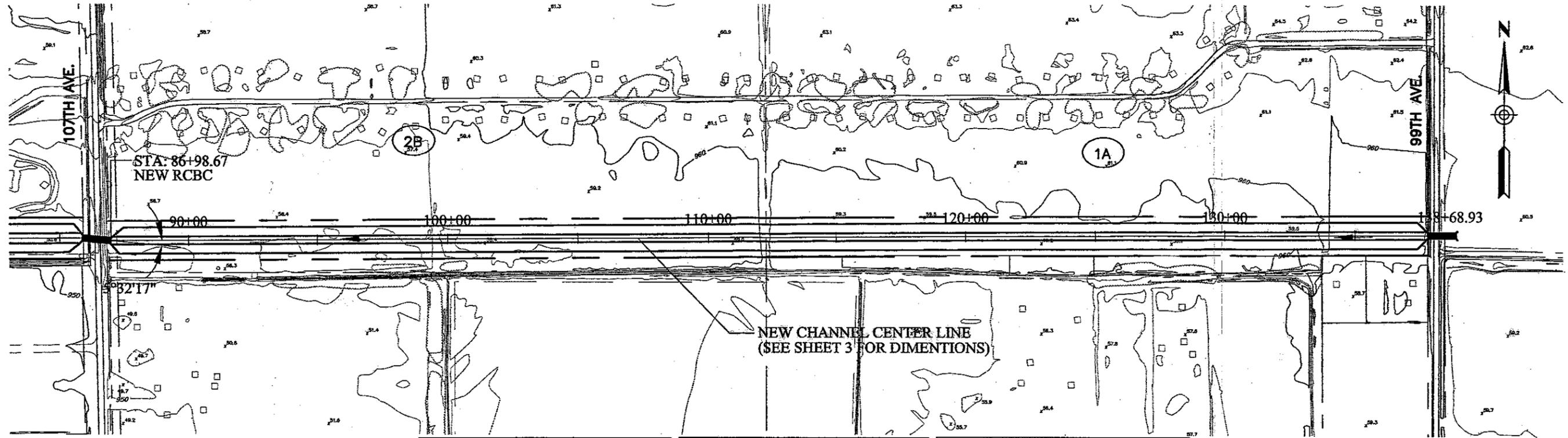
BOOK 101  
MAP 43



SUNLAND CHANNEL



PROJECT NUMBER: 2004C027	10% DESIGN PLANS
DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT	
DRN. JCS DATE: 02/01/08	SCALE: HORIZONTAL
DES. JCS DATE: 02/01/08	VERTICAL
ASPHEN CONSULTING ENGINEERS A Division of Aspen Environmental Group	SHEETS NO. 16 OF 17

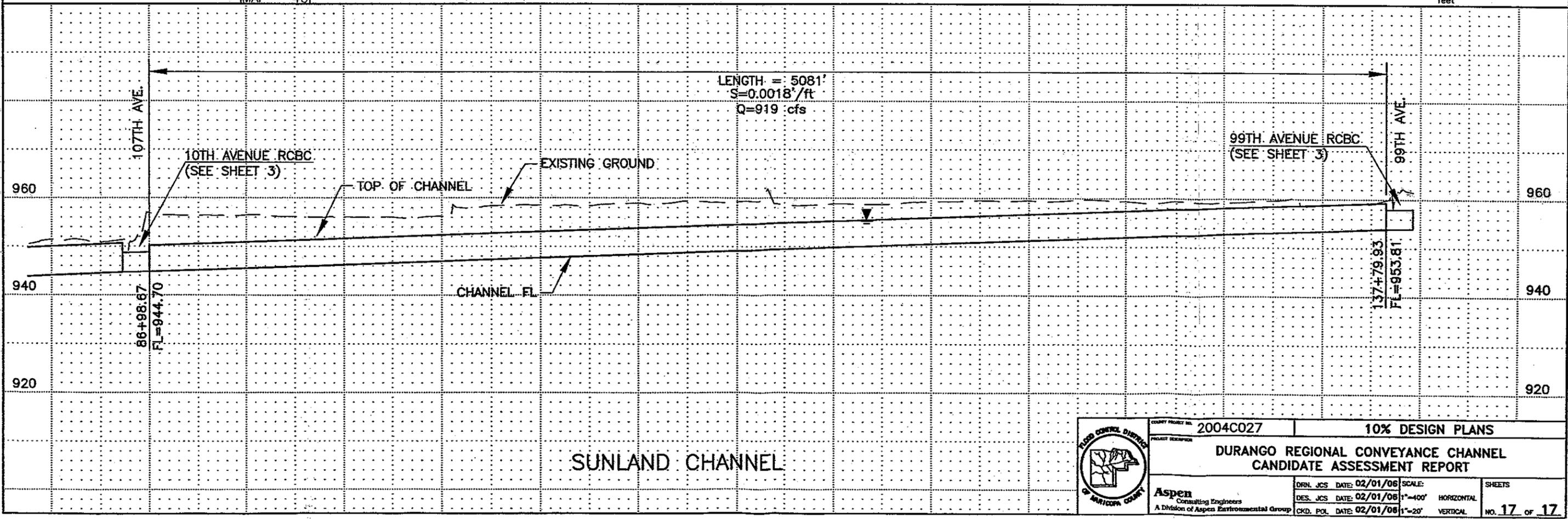


CAUTION: Overhead High Voltage  
Electric Lines. Contact APS  
602-371-6965

CAUTION: Overhead High Voltage  
Electric Lines. Contact SRP  
602-236-5527

CAUTION: Buried Natural Gas Line  
Contact El Paso Natural Gas Co.  
915-496-5562

BOOK 101  
MAP 40



SUNLAND CHANNEL



COUNTY PROJECT NO. 2004C027		10% DESIGN PLANS	
DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT			
DRN. JCS DATE: 02/01/06	SCALE: 1"=400'	SHEETS	
DES. JCS DATE: 02/01/06	HORIZONTAL	NO. 17 OF 17	
CKD. POL. DATE: 02/01/06	VERTICAL		

Aspen  
Consulting Engineers  
A Division of Aspen Environmental Group

# **CANDIDATE ASSESSMENT REPORT DURANGO REGIONAL CONVEYANCE CHANNEL**

**APPENDIX G: Design Data and Cost Estimate for  
Recommended Plan.**

**February 2006**

**DESIGN FLOW RATE SUMMARY TABLES FOR DRCC AND SUNLAND  
CHANNEL REACHS AND CULVERTS.**

The design flow rates presented in the table below are derived from the recommended plan HEC-1 models for the Durango Regional Conveyance Channel. The regulatory discharge is the higher of the two discharges produced by the 100-yr 6-hr or 100-yr 24-hr rainfall data. The design flow rate discussion column is meant to give an idea of the uncertainty of the chosen design flow rate given future development.

<b>DRCC Channel Reach</b>	<b>Design Flow Rate (cfs)</b>	<b>Design Flow Rate Discussion</b>
Downstream of Dysart Road	3,069	This discharge is the modeled flow rate calculated for the DRCC just downstream of Dysart Road.
Dysart Road to El Mirage Road	3,069	This number is the modeled flow rate calculated for the DRCC just upstream, east, of Dysart Road.
El Mirage Road to Sunland Channel	1,645	This number is the modeled flow rate calculated for the DRCC just upstream, east, of El Mirage Road.  The HEC-1 model assumes that flow from the Lakin and Silver Bullet developments will be routed down El Mirage Road. As development occurs, it is likely that several drainageways will be built to bring water to the DRCC from these developments. The effect of allowing development generated storm water to enter the DRCC upstream of El Mirage Road could be to increase the design discharge in this reach.
Sunland Channel to 115 <sup>th</sup> Avenue	1,205	Same as El Mirage Road to Sunland Channel comments.  This is the modeled flow rate calculated for the DRCC just downstream, west, of 115 <sup>th</sup> Avenue.
115 <sup>th</sup> Avenue to 107 <sup>th</sup> Avenue	1,318	This is the modeled flow rate calculated for the DRCC just downstream, west, of 107 <sup>th</sup> Avenue.

<b>DRCC Culvert</b>	<b>Design Flow Rate (cfs)</b>	<b>Design Flow Rate Discussion</b>
Dysart Road	3,069	This is the modeled flow rate calculated for the DRCC just downstream, west, of Dysart Road.
El Mirage Road	1,645	See DRCC Channel Reach El Mirage Road to Sunland Channel comments.  This is the modeled flow rate calculated for the DRCC just upstream, east, of El Mirage Road.
Broadway Road	1,205	See DRCC Channel Reach El Mirage Road to Sunland Channel comments.  This number is the modeled flow rate calculated for the DRCC just downstream, west, of 115 <sup>th</sup> Avenue.
115 <sup>th</sup> Avenue	1,318	This is the modeled flow rate calculated for the DRCC just downstream, west, of 107 <sup>th</sup> Avenue.
107 <sup>th</sup> Avenue	775	Approximate 10-year discharge estimated as a fraction of the 100-year flow rate at 107 <sup>th</sup> Avenue.
Detention Basin	388	This design discharge allows a maximum release rate to achieve approximately 1,300 cfs at 107 <sup>th</sup> Avenue.
91 <sup>st</sup> Avenue	862	Approximate 10-year flow rate for 91 <sup>st</sup> Avenue.
83 <sup>rd</sup> Avenue	345	Approximate 10-year flow rate for 83 <sup>rd</sup> Avenue.

<b>Sunland Channel Reach</b>	<b>Design Flow Rate (cfs)</b>	<b>Design Flow Rate Discussion</b>
DRCC to 115 <sup>th</sup> Avenue	1,207	This is the modeled flow rate calculated for the Sunland Channel just downstream of 115 <sup>th</sup> Avenue.
115 <sup>th</sup> Avenue to 107 <sup>th</sup> Avenue	1,207	See DRCC to 115 <sup>th</sup> Avenue
107 <sup>th</sup> Avenue to 99 <sup>th</sup> Avenue	919	This is the modeled flow rate calculated for the Sunland Channel just downstream of 107 <sup>th</sup> Avenue.

<b>Sunland Culvert</b>	<b>Design Flow Rate (cfs)</b>	<b>Design Flow Rate Discussion</b>
Sunland Avenue Culvert	1,207	Same as Sunland Channel Reach DRCC to 115 <sup>th</sup> Avenue
107 <sup>th</sup> Avenue	919	Same as Sunland Channel Reach 107 <sup>th</sup> Avenue to 99 <sup>th</sup> Avenue.
99 <sup>th</sup> Avenue	303	This is the modeled flow rate calculated for the Sunland Channel just downstream, west, of 99 <sup>th</sup> Avenue.

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

THIS SPREADSHEET PROVIDES THE DETAILED COST ESTIMATE FOR THE DRCC ASSUMING:

DRCC IN AVONDALE ONLY  
FIRST FLUSH RETENTION ADJACENT TO THE DRCC

THE SUMMARY SHEET PROVIDES A SUMMARY OF THE DRCC COST BY REACH.

AVONDALE AND PHOENIX COSTS ARE SEPARATED, AND A 30% CONTINGENCY IS ADDED.

THE BASIN#1 SHEET PROVIDES A COST ESTIMATE OF THE DETENTION BASIN  
DOWNSTREAM OF DYSART. THESE COSTS ARE THE SAME IN ALL SCENARIOS.

SUBSEQUENT SHEETS PROVIDE QUANTITY ESTIMATES AND COST ESTIMATES FOR EACH  
REACH OF THE DRCC AS DESCRIBED IN THE SHEET NAME.

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

RECOMMENDED PLAN  
 COST ESTIMATE  
 11/30/2005  
 COST SUMMARY

DRCC	COST
Basin #1	\$ 5,187,292
Channel Downstream of Dysart	\$ 1,441,116
Channel Dysart to El Mirage	\$ 8,567,444
Channel El Mirage to Sunland Channel	\$ 2,998,158
Channel Sunland Channel to 115th Avenue	\$ 6,667,743
Channel 115th to 107th	\$ 6,623,036
Avondale Subtotal	\$ 31,484,789
Avondale Contingency 30%	\$ 9,445,437
Avondale Total	\$ 40,930,226
95th Avenue Basin	\$ 7,563,049
Phoenix Culverts	\$ 436,857
Phoenix Channels	\$ 1,197,225
Phoenix Subtotal	\$ 9,197,131
Phoenix Contingency 30%	\$ 2,759,139
Phoenix Total	\$ 11,956,270
DRCC Total	\$ 52,886,496

SUNLAND CHANNEL	
Channel DRCC to 115th	\$ 2,728,993
Channel 115th to 107th	\$ 6,388,214
Channel 107th to 99th	\$ 4,542,594
Subtotal	\$ 13,659,801
Contingency 30%	\$ 4,097,940
Total	\$ 17,757,741

Channel costs include associated culvert costs

	DRCC COST IN AVONDALE	DRCC COST IN PHOENIX	DRCC TOTAL COST
WITH CONTINGENCY	\$ 40,930,226	\$ 11,956,270	\$ 52,886,496
WITHOUT CONTINGENCY	\$ 31,484,789	\$ 9,197,131	\$ 40,681,920

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

**DRCC**

ITEM	QUANTITY	UNIT	UNIT COST	COST	percent
Channel Excavation	530,832	CY	\$ 6	\$ 3,184,992	8%
Channel Landscaping	81.7	AC	\$ 78,408	\$ 6,405,934	16%
Channel Area*	98.0	AC	\$ 150,000	\$ 14,700,000	36%
Culvert Concrete	2,881	CY	\$ 669	\$ 1,927,389	5%
Maintenance Road**	16.3	AC	\$ 28,314	\$ 461,518	1%
BFC Replacement	5,506	LF	148	814,888	
Basin #1				\$ 5,187,292	13%
99 Basin				\$ 7,563,049	19%
Phoenix Culverts				\$ 436,857	1%
Subtotal				\$ 40,681,919	
Contingency 30%				\$ 12,204,576	
Total				\$ 52,886,495	

**Sunland Channel**

ITEM	QUANTITY	UNIT	UNIT COST	COST	percent
Channel Excavation	202,073	CY	\$ 6	\$ 1,212,438	9%
Channel Landscaping	34.5	AC	\$ 78,408	\$ 2,705,076	20%
Channel Area*	42.0	AC	\$ 150,000	\$ 6,300,000	46%
Culvert Concrete	4,828	CY	\$ 669	\$ 3,229,932	24%
Maintenance Road**	7.5	AC	\$ 28,314	\$ 212,355	2%
Subtotal				\$ 13,659,801	
Contingency 30%				\$ 4,097,940	
Total				\$ 17,757,741	

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

RECOMMENDED PLAN

11/30/2005

COST ESTIMATE FOR BASIN #1 DOWNSTREAM OF DYSART

Basin Landscaping	24 AC	\$ 78,408	\$ 1,881,792
Parcel Area	137 AC	\$ 10,000	\$ 1,370,000
Drain Pipe	4230 LF	\$ 148.00	\$ 626,040
Manholes	9 EA	4500	\$ 40,500
Headwall	1 EA	\$ 1,100	\$ 1,100
Inflow Spillway	253,572 SF	\$ 5	\$ 1,267,860
TOTAL COST			\$ 5,187,292

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

RECOMMENDED PLAN  
 COST ESTIMATE  
 DRCC CHANNEL DOWNSTREAM OF DYSART

Channel Length	500 Feet
Channel Discharge	3069 cfs
Channel Slope	0.0014 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	156 Feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet
Channel Freeboard	1.2 Feet
Channel Total Depth	5.9 Feet
Channel excavation area	1129.26 Square Feet
Channel Excavation Volume	20,912 Cubic Yards
Channel Wetted Perimeter	228 Feet
Channel Top Width	227 Feet
Channel Landscape Area	2.6 Acres
Channel Total Area	2.6 Acres
Maintenance ROW	50.0 Feet (25 feet both sides)
DRCC Total ROW Width	277 Feet
DRCC Total Area	3.2 Acres (Includes maintenance right of way)
Culvert area required	323 Square Feet
Culvert width	81 Feet (4-foot height)
Number of Culvert Barrels	9
Barrel width	9 Feet
Culvert Concrete Area	222 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete	904 Cubic Yards

COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation	20,912	CY	\$ 6	\$ 125,472
Channel Landscaping	2.8	AC	\$ 78,408	\$ 219,542
Channel Area*	3.2	AC	\$ 150,000	\$ 480,000
Culvert Concrete	904	CY	\$ 669	\$ 604,776
Maintenance Road**	0.4	AC	\$ 28,314	\$ 11,326
Total Cost				\$ 1,441,116

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

RECOMMENDED PLAN  
 COST ESTIMATE  
 DRCC FROM DYSART TO EL MIRAGE

Channel Length	5136 Feet
Channel Discharge	3069 cfs
Channel Slope	0.0014 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	156 Feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet
Channel Freeboard	1.2 Feet
Channel Total Depth	5.9 Feet
Channel excavation area	1129.26 Square Feet
Channel Excavation Volum	214,810 Cubic Yards
Channel Wetted Perimeter	228 Feet
Channel Top Width	227 Feet
Channel Landscape Area	26.9 Acres
Channel Total Area	26.8 Acres
Maintenance ROW	50.0 Feet (25 feet both sides)
DRCC Total ROW Width	277 Feet
DRCC Total Area	32.7 Acres (Includes maintenance right of way)
Culvert area required	323 Square Feet
Culvert width	81 Feet (4-foot height)
Number of Culvert Barrels	9
Barrel width	9 Feet
Culvert Concrete Area	222 Square Feet
Culvert number	0
Culvert Length	110 Feet
Total Culvert Concrete	0 Cubic Yards

COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation	214,810	CY	\$ 6	\$ 1,288,860
Channel Landscaping	28.9	AC	\$ 78,408	\$ 2,265,991
Channel Area*	32.7	AC	\$ 150,000	\$ 4,905,000
Culvert Concrete	0	CY	\$ 669	\$ -
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593
Total Cost				\$ 8,567,444

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-feet wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

RECOMMENDED PLAN  
 RECOMMENDED PLAN  
 DRCC FROM EL MIRAGE TO SUNLAND CHANNEL CONFLUENCE

Channel Length	2262 Feet
Channel Discharge	1645 cfs
Channel Slope	0.0017 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	69 Feet
Channel Roughness	0,04
Channel Flow Depth	4.7 Feet
Channel Freeboard	1.2 Feet
Channel Total Depth	5.9 Feet
Channel excavation area	615.96 Square Feet
Channel Excavation Volum	51,604 Cubic Yards
Channel Wetted Perimeter	141 Feet
Channel Top Width	140 Feet
Channel Landscape Area	7.3 Acres
Channel Total Area	7.3 Acres
Maintenance ROW	50.0 Feet (25 feet both sides)
DRCC Total ROW Width	190 Feet
DRCC Total Area	9.9 Acres (Includes maintenance right of way)
Culvert Discharge	2654.0
Culvert area required	279 Square Feet
Culvert width	70 Feet (4-foot height)
Number of Culvert Barrels	7
Barrel width	10 Feet
Culvert Concrete Area	188 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete, CY	765.9 Cubic Yards

COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volum	51,604	CY	\$ 6	\$ 309,624
Channel Landscaping	8.2	AC	\$ 78,408	\$ 642,946
Channel Area*	9.9	AC	\$ 150,000	\$ 1,485,000
Culvert Concrete	766	CY	\$ 669	\$ 512,454
Maintenance Road**	1.7	AC	\$ 28,314	\$ 48,134
Total Cost				\$ 2,998,158

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

COST ESTIMATE FOR DRCC FROM SUNLAND CHANNEL TO 115TH AVENUE  
 RECOMMENDED PLAN  
 DRCC FROM EL SUNLAND CHANNEL CONFLUENCE TO 115TH AVENUE

Channel Length	6778 Feet
Channel Discharge	1205 cfs
Channel Slope	0.0017 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	46 feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet (From Master Plan)
Channel Freeboard	1.2 Feet (From FCD Standards)
Channel Total Depth	5.9 Feet
Channel excavation area	480.26
Channel Excavation Volum	120,563 Cubic Yards
Channel Wetted Perimeter	118 Feet
Channel Top Width	117 Feet
Channel Landscape Area, ,	18.4 AC
Channel Total Area	18.2 AC
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides
DRCC Total ROW Width	167 Feet
DRCC Total Area, AC	26.0 Includes maintenance ROW
Culvert area required	127 Square Feet
Culvert width	32 Feet (Assumes 4-foot height)
Number barrels	4
Barrel width	8 Feet
Culvert Concrete Area	94 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete, CY	383 Cubic Yards

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volum	120,563	CY	\$ 6	\$ 723,378
Channel Landscaping	21.0	AC	\$ 78,408	\$ 1,646,568
Channel Area*	26.0	AC	\$ 150,000	\$ 3,900,000
Culvert Concrete	383	CY	\$ 669	\$ 256,227
Maintenance Road**	5.0	AC	\$ 28,314	\$ 141,570
Total Cost				\$ 6,667,743

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

COST ESTIMATE FOR DRCC FROM 115TH AVENUE TO 107TH AVENUE  
 ASSUMING FIRST FLUSH RETENTION  
 DRCC IN AVONDALE ONLY

Channel Length	5403 Feet	
Channel Discharge	1318 cfs	
Channel Slope	0.0017 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	49 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	510	
Channel Excavation Volum	102,057 Cubic Yards	
Channel Wetted Perimeter	122 Feet	
Channel Top Width	121 Feet	
Channel Landscape Area, ,	15.1 AC	Channel Only
Channel Total Area	15.0 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	171 Feet	
DRCC Total Area, AC	21.2	Includes maintenance ROW
Culvert area required	137 Square Feet	
Culvert width	34 Feet (Assumes 4-foot height)	
Number barrels	5	
Barrel width	7 Feet	
Culvert Concrete Area	106 Square Feet	
Culvert number	1	
Culvert Length	211 Feet	
Total Culvert Concrete, CY	828 Cubic Yards	

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volum	102,057	CY	\$ 6	\$ 612,342
Channel Landscaping	17.2	AC	\$ 78,408	\$ 1,348,618
Channel Area*	21.2	AC	\$ 150,000	\$ 3,180,000
Culvert Concrete	828	CY	\$ 669	\$ 553,932
Maintenance Road**	4.0	AC	\$ 28,314	\$ 113,256
Replace BFC w/ 48" RCP	5506	LF	\$ 148	\$ 814,888
Total Cost				\$ 6,623,036

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

RECOMMENDED PLAN

COST ESTIMATE

PHOENIX CHANNEL UPSTREAM OF 107TH AND 91ST

ASSUME SAME CHANNEL AS ALREADY IN PLACE DOWNSTREAM OF 99TH

CHANNEL LENGTH ASSUMED (1300FT UPSTREAM OF 107TH, 600FT UPSTREAM OF 91ST)

Channel Length	1900 Feet
Channel Side Slopes	3.2 Feet/Foot
Channel Bottom Width	20 Feet
Channel Total Depth	7 Feet
Channel excavation area	296.8 Square Feet
Channel Excavation Volum	20,886 Cubic Yards
Channel Wetted Perimeter	67 Feet
Channel Top Width	65 Feet
Channel Landscape Area	2.9 Acres
Channel Total Area	2.8 Acres
Maintenance ROW	50.0 Feet (25 feet both sides)
DRCC Total ROW Width	115 Feet
DRCC Total Area	5.0 Acres (Includes maintenance right of way)

COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation	20,886	CY	\$ 6	\$ 125,316
Channel Landscaping	3.6	AC	\$ 78,408	\$ 282,269
Channel Area*	5.0	AC	\$ 150,000	\$ 750,000
Maintenance Road**	1.4	AC	\$ 28,314	\$ 39,640
Total Cost				\$ 1,197,225

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

COST ESTIMATE FOR 95th Avenue Basin

EXCAVATION	161,446 CY	\$ 6.00	\$	968,676
Basin Landscaping	27.7 AC	\$ 78,408	\$	2,171,902
Parcel Area	29.2 AC	\$ 150,000	\$	4,380,000
MAINTENANCE ROAD	1.5 AC	\$ 28,314	\$	42,471

TOTAL COST \$ 7,563,049

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

PHOENIX CULVERTS

CULVERT DEPTH 4 FEET

Q Cap

83RD AVENUE

Number barrels	1	
Barrel width	8 Feet	345
Culvert Concrete Area	28 Square Feet	
Culvert number	1	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	114 Cubic Yards	

91ST AVENUE

Number barrels	2	
Barrel width	10 Feet	862
Culvert Concrete Area	58 Square Feet	
Culvert number	1	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	236 Cubic Yards	

107TH AVENUE

Number barrels	2	
Barrel width	9 Feet	775
Culvert Concrete Area	54 Square Feet	
Culvert number	1	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	220 Cubic Yards	

RETENTION BASIN

Number barrels	1	
Barrel width	9 Feet	388
Culvert Concrete Area	30 Square Feet	
Culvert number	1	
Culvert Length	75 Feet	
Total Culvert Concrete, CY	83 Cubic Yards	

		COST/CY	TOTAL COST
TOTAL CULVERT CONCR	653 CY	\$ 669	\$ 436,857

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

COST ESTIMATE FOR SUNLAND CHANNEL FROM DRCC TO 115TH AVENUE

Channel Length	2849 Feet	
Channel Discharge	1207 cfs	
Channel Slope	0.0008 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	51 feet	
Channel Roughness	0.04	
Channel Flow Depth	5.5 Feet (From Master Plan)	
Channel Freeboard	1.4 Feet (From FCD Standards)	
Channel Total Depth	6.9 Feet	
Channel excavation area	637.56	
Channel Excavation Volum	67,274 Cubic Yards	
Channel Wetted Perimeter	135 Feet	
Channel Top Width	134 Feet	
Channel Landscape Area, /	8.8 AC	Channel Only
Channel Total Area	8.8 AC	Channel Only
Maintenance ROW, FT	25.0 feet	assumes 25 feet one sides
DRCC Total ROW Width	159 Feet	
DRCC Total Area, AC	10.4	Includes maintenance ROW
Culvert area required	113 Square Feet	
Culvert width	28 Feet	(Assumes 4-foot height)
Number barrels	4	
Barrel width	7 Feet	
Culvert Concrete Area	86 Square Feet	
Culvert number	0	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	0 Cubic Yards	

channel depth increased by one foot to allow 6-foot culvert upstream  
no maintenance right of way on south side

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volum	67,274	CY	\$ 6	\$ 403,644
Channel Landscaping	9.4	AC	\$ 78,408	\$ 737,035
Channel Area*	10.4	AC	\$ 150,000	\$ 1,560,000
Culvert Concrete	0	CY	\$ 669	\$ -
Maintenance Road**	1.0	AC	\$ 28,314	\$ 28,314
Total Cost				\$ 2,728,993

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-foot wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

COST ESTIMATE FOR SUNLAND CHANNEL FROM 115TH AVENUE TO 107TH AVENUE

Channel Length	3825 Feet	
Channel Discharge	1207 cfs	
Channel Slope	0.0022 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	39 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (CALCULATED)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	438.96	
Channel Excavation Volum	62,186 Cubic Yards	
Channel Wetted Perimeter	111 Feet	
Channel Top Width	110 Feet	
Channel Landscape Area, ,	9.7 AC	Channel Only
Channel Total Area	10.9 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	160 Feet	
DRCC Total Area, AC	14.0	Includes maintenance ROW
CULVERT DISCHARGE	1207 CFS	
Culvert area required	147 Square Feet	
Culvert width	25 Feet (Assumes 6-foot height)	
Number barrels	3	
Barrel width	9 Feet	
Culvert Concrete Area	86 Square Feet	
Culvert number	1	
Culvert Length	1388 Feet	
Total Culvert Concrete, CY	4421 Cubic Yards	

Culvert design based on mannings using a slope of 0.0022. Culvert flowing full, checked inlet control. Culvert right of way width is 40 feet.

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volum	62,186	CY	\$ 6	\$ 373,116
Channel Landscaping	11.2	AC	\$ 78,408	\$ 878,170
Channel Area*	14.0	AC	\$ 150,000	\$ 2,100,000
Culvert Concrete	4421	CY	\$ 669	\$ 2,957,649
Maintenance Road**	2.8	AC	\$ 28,314	\$ 79,279
Total Cost				\$ 6,388,214

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-feet wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

COST ESTIMATE FOR SUNLAND CHANNEL FROM 107TH AVENUE TO 99TH AVENUE

Channel Length	5081 Feet	
Channel Discharge	919 cfs	
Channel Slope	0.0018 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	30 feet	
Channel Roughness	0.04	
Channel Flow Depth	4.7 Feet (CALCULATED)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	5.9 Feet	
Channel excavation area	385.86	
Channel Excavation Volume, t	72,613 Cubic Yards	
Channel Wetted Perimeter	102 Feet	
Channel Top Width	101 Feet	
Channel Landscape Area, AC	11.9 AC	Channel Only
Channel Total Area	11.8 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	151 Feet	
DRCC Total Area, AC	17.6	Includes maintenance ROW

107TH AVE CULVERT DISCH	919.0 CFS	
Culvert area required	97 Square Feet	
Culvert width	24 Feet (Assumes 4-foot height)	
Number barrels	3	
Barrel width	8 Feet	
Culvert Concrete Area	72 Square Feet	
Culvert number	1	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	293 Cubic Yards	

99TH AVE CULVERT DISCH/	303.0 CFS	
Culvert area required	32 Square Feet	
Culvert width	8 Feet (Assumes 4-foot height)	
Number barrels	1	
Barrel width	8 Feet	
Culvert Concrete Area	28 Square Feet	
Culvert number	1	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	114 Cubic Yards	

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	72,613	CY	\$ 6	\$ 435,678
Channel Landscaping	13.9	AC	\$ 78,408	\$ 1,089,871
Channel Area*	17.6	AC	\$ 150,000	\$ 2,640,000
Culvert Concrete	407	CY	\$ 669	\$ 272,283
Maintenance Road**	3.7	AC	\$ 28,314	\$ 104,762
Total Cost				\$ 4,542,594

\* Includes 50-foot Right of Way outside of channel proper.

\*\*Two roads, 16-feet wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

DRCC DIMENSION SUMMARY  
RECOMMENDED PLAN

DRCC CHANNEL REACH	Channel Discharge cfs	Channel Length Feet	Channel Slope Feet/Foot	Channel Flow Depth Feet	Channel Total Depth Feet	Channel Bottom Width Feet	Channel Top Width Feet	DRCC Total ROW Width Feet
Downstream of Dysart	3,069	500	0.0014	4.7	5.9	156	227	277
Dysart to El Mirage	3,069	5136	0.0014	4.7	5.9	156	227	277
EL MIRAGE TO SUNLAND	1,645	2262	0.0017	4.7	5.9	69	140	190
SUNLAND TO 115-107	1,205 1,318	6778 5403	0.0017 0.0017	4.7 4.8	5.9 6	46 49	117 121	167 171

SUNLAND CHANNEL

REACH	Channel Discharge cfs	Channel Length Feet	Channel Slope Feet/Foot	Channel Flow Depth Feet	Channel Total Depth Feet	Channel Bottom Width Feet	Channel Top Width Feet	DRCC Total ROW Width Feet
SDRCCTO115	1,207	2849	0.0008	5.5	6.9	51	134	159
S115TH TO 107TH	1,207	3825	0.0022	4.7	5.9	39	110	160
S107TH TO 99TH	919	5081	0.0018	4.7	5.9	30	101	151

Note: Manning's coefficient is 0.04. Side slopes are 6:1.

DRCC CULVERTS

REACH	Culvert Discharge cfs	Culvert area required Square Feet	Culvert width Feet (4-foot height)	Number of Culvert Barrels	Barrel width Feet	Culvert number	Culvert Length Feet
Downstream of Dysart	3,069	323	81	9	9	1	110
Dysart to El Mirage	3,069	323	81	9	9	0	110
EL MIRAGE TO SUNLAND	1,645	279	70	7	10	1	110
SUNLAND TO 115-107	1,205 1,318	127 137	32 34	4 5	8 7	1 1	110 211

SUNLAND CULVERTS

REACH	Culvert Discharge cfs	Culvert area required Square Feet	Culvert width Feet (4-foot height)	Number of Culvert Barrels	Barrel width Feet	Culvert number	Culvert Length Feet
SDRCCTO115	1,207	113	28	4	7	0	110
S115TH TO 107TH	1,207	147	25	3	9	1	1388
S107TH TO 99TH - 107TH	919	97	24	3	8	1	110
S107TH TO 99TH - 99TH	303	32	8	1	8	1	110

Note: Culvert heights are 4 feet except Sunland culvert S115TH TO 107TH which is 6 feet.

DESIGN DATA AND COST ESTIMATE FOR RECOMMENDED PLAN

ITEM	UNIT	UNIT COST
Channel Excavation Volume	CY	6
Channel Landscaping	AC	78408
Channel Area**	AC	100000
Culvert Concrete***	CY	668.75
Maintenance Road****	AC	28314
Total Cost		

\* Assumes 1-foot freeboard

\*\* Includes 50-foot Right of Way outside of channel proper.

\*\*\* Assumes three and a half 4 cell 8'x5' culverts

\*\*\*\*Two roads, 16-foot wide decomposed granite.

**Memorandum of Understanding  
for the  
Downtown Buckeye Regional Basin and Storm Drain Project**

**(PCN 211.XX.31)  
MOU FCD 2006U0XX**

1. This Memorandum of Understanding ("MOU") is between the Flood Control District of Maricopa County, a political subdivision of the State of Arizona, hereinafter called the "DISTRICT", and the Town of Buckeye, an Arizona municipal corporation, hereinafter called the "TOWN".
2. This MOU summarizes the intent and proposed activities of the DISTRICT and the TOWN to cooperate regarding the development and implementation of the design, rights-of-way acquisition, construction, construction management, and operation & maintenance of the Downtown Buckeye Regional Basin and Storm Drain Project (the "PROJECT") which is attended to provide a 10 year level of protection. The PROJECT features of the PROJECT are depicted by Exhibit A to this MOU.
3. The following are the proposed drainage and infrastructure features that are a part of and hereinafter referred to as the PROJECT, as set forth in detail in Exhibit B, attached hereto and made an integral part hereof:
  - I. A storm drain system in MC 85 from Miller Road to Apache Road and from Baseline Road to the divide of Monroe Avenue and MC 85 east of 9<sup>th</sup> Street.
  - II. Two basins: one detention basin to be located in the vicinity of Apache Road and Monroe Avenue and a basin outfall along Apache Road alignment to Beloit Road.
  - III. Channel improvements along 7<sup>th</sup> Street.
  - IV. Channel improvements along Beloit.
  - V. Channel improvements along Apache Road.
  - VI. Channel improvements for an outfall to the Gila River
4. The DISTRICT and the TOWN desire to implement the PROJECT by coordinating the PROJECT management and sharing the PROJECT costs. The TOWN will fully fund the PROJECT costs up front and the DISTRICT will reimburse the TOWN for its share upon completion of the PROJECT.
5. This joint coordination and implementation of the PROJECT is designed to provide the following benefits:
  - I. The PROJECT will reduce the flooding of approximately 500 structures located throughout the "historical" downtown region of Buckeye.
  - II. The PROJECT will provide a positive outfall into the Gila River since there is no existing natural drainage outfall within the PROJECT Area.
  - III. The PROJECT will reduce existing flooding hazards associated with the roadways.
  - IV. The PROJECT will provide the potential use of the project facilities for joint uses for recreation, including but not limited to parks, trails and other multi-use facilities.
6. The estimated cost of the PROJECT for predesign, design, right-of-way, utility relocations, construction, and construction management is \$4 million dollars. The overall PROJECT cost will be shared by the DISTRICT and the TOWN at 50%. Cost increases above the estimated cost shall require written approval by both parties.
7. There is currently no District Funds available in the current Capital Improvement Program, thus details on the funding and associated schedule shall be required to be identified in the Project Inter-Governmental Agreement.
8. The TOWN will be the lead for the design, rights-of-way acquisition, construction, construction management for the PROJECT.
9. The TOWN will be responsible for the operation and maintenance of the PROJECT.

10. Either the TOWN or the DISTRICT may receive credit toward their PROJECT cost share up to 25% of the total PROJECT cost from land donation and/or PROJECT features that either party caused to be completed provided that the feature(s) are approved in writing by both parties.

11. The TOWN and the DISTRICT are responsible for their own internal administrative costs associated with the PROJECT. Internal administrative costs are not included as a part of PROJECT costs.
12. The TOWN shall provide a full time Project Manager for the PROJECT and the DISTRICT shall have regularly scheduled project meetings. The TOWN and the DISTRICT may alternate hosting the PROJECT meetings.
13. The DISTRICT and the TOWN acknowledge and understand that this document reflects the mutual understanding of the intention of the parties to the MOU, and is not legally binding on the Board of Directors of the DISTRICT, the Board of Supervisors of Maricopa County, and the TOWN.

IN WITNESS WHEREOF, the parties hereto have executed this Memorandum of Understanding,

Chief Engineer and General Manager,  
Flood Control District of Maricopa County

Timothy S. Phillips P.E.

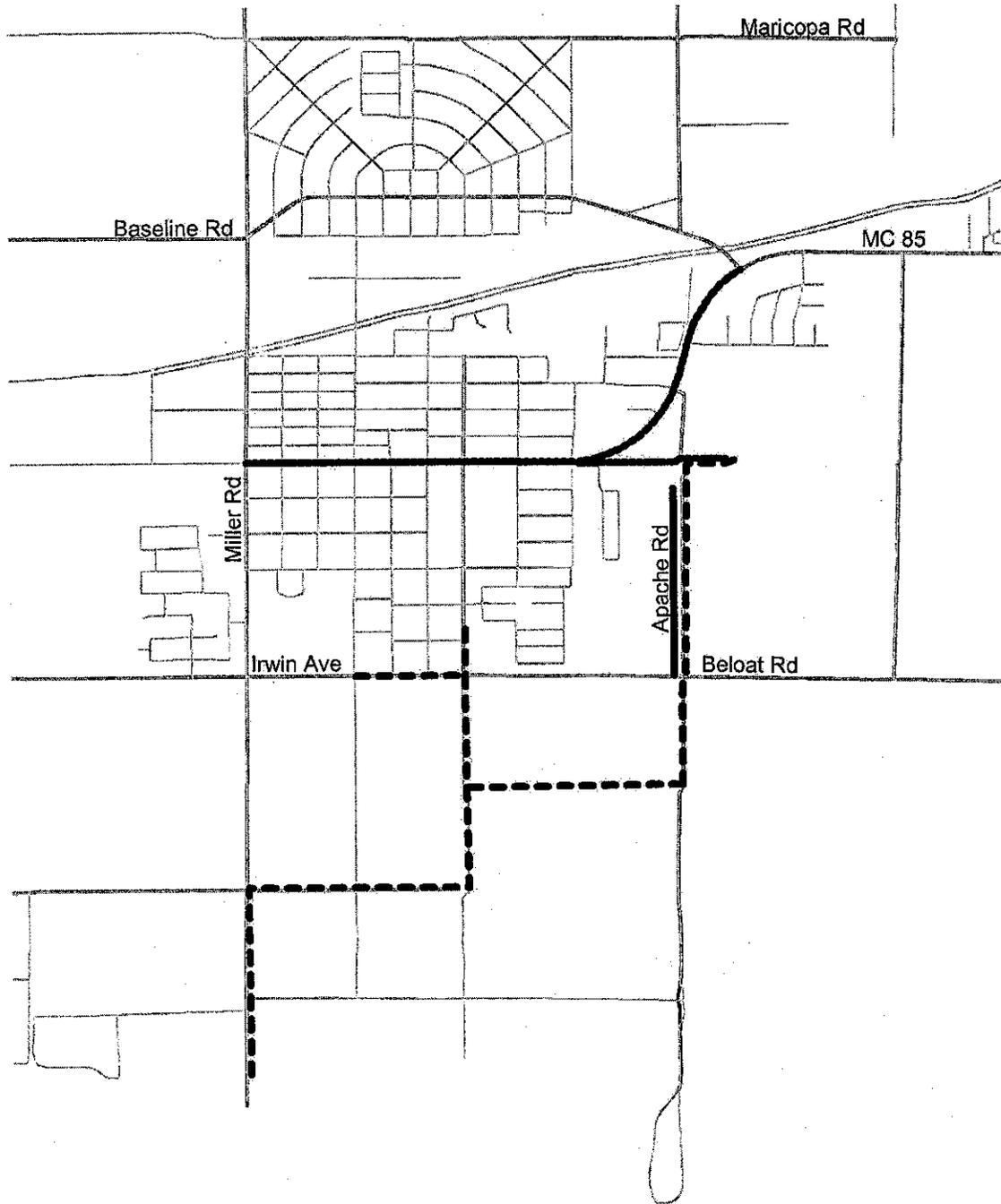
Date

TOWN Manager,  
TOWN of Buckeye

Carol Reynolds, P.E.

Date

Exhibit A



LEGEND

-  Potential Storm Drain Alignments
-  Potential Pipe Outfall Alignments
-  Potential Open Channel Outfalls
-  Street Centerlines



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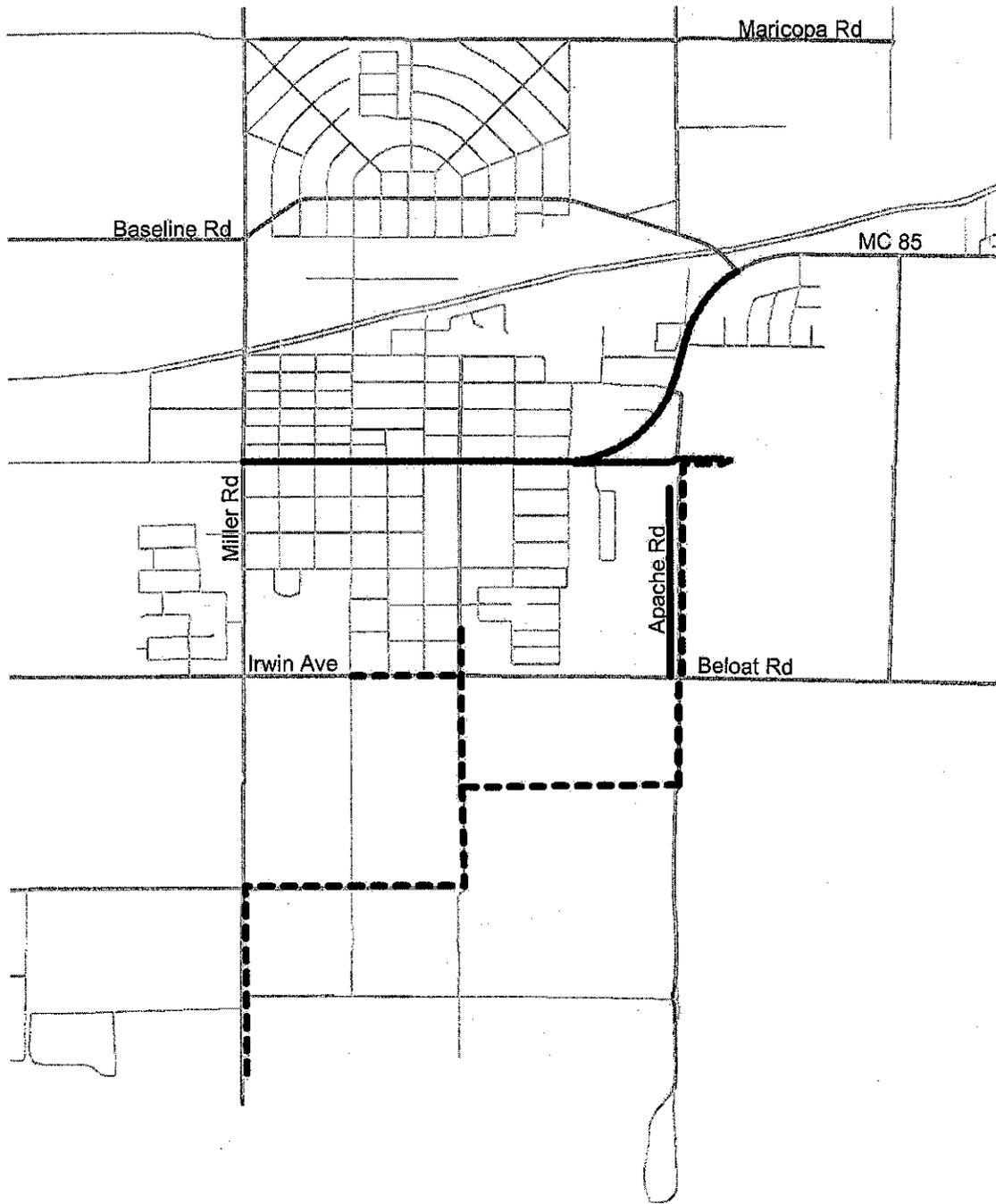
Date

TOWN Manager,  
TOWN of Buckeye

Carol Reynolds, P.E.

Date

Exhibit A



LEGEND

-  Potential Storm Drain Alignments
-  Potential Pipe Outfall Alignments
-  Potential Open Channel Outfalls
-  Street Centerlines



**Memorandum of Understanding  
for the  
Downtown Buckeye Regional Basin and Storm Drain Project**

**(PCN 211.XX.31)  
MOU FCD 2006U0XX**

1. This Memorandum of Understanding ("MOU") is between the Flood Control District of Maricopa County, a political subdivision of the State of Arizona, hereinafter called the "DISTRICT", and the Town of Buckeye, an Arizona municipal corporation, hereinafter called the "TOWN".
2. This MOU summarizes the intent and proposed activities of the DISTRICT and the TOWN to cooperate regarding the development and implementation of the design, rights-of-way acquisition, construction, construction management, and operation & maintenance of the Downtown Buckeye Regional Basin and Storm Drain Project (the "PROJECT") which is attended to provide a 10 year level of protection. The PROJECT features of the PROJECT are depicted by Exhibit A to this MOU.
3. The following are the proposed drainage and infrastructure features that are a part of and hereinafter referred to as the PROJECT, as set forth in detail in Exhibit B, attached hereto and made an integral part hereof:
  - I. A storm drain system in MC 85 from Miller Road to Apache Road and from Baseline Road to the divide of Monroe Avenue and MC 85 east of 9<sup>th</sup> Street.
  - II. Two basins: one detention basin to be located in the vicinity of Apache Road and Monroe Avenue and a basin outfall along Apache Road alignment to Beloat Road.
  - III. Channel improvements along 7<sup>th</sup> Street.
  - IV. Channel improvements along Beloat.
  - V. Channel improvements along Apache Road.
  - VI. Channel improvements for an outfall to the Gila River
4. The DISTRICT and the TOWN desire to implement the PROJECT by coordinating the PROJECT management and sharing the PROJECT costs. The TOWN will fully fund the PROJECT costs up front and the DISTRICT will reimburse the TOWN for its share upon completion of the PROJECT.
5. This joint coordination and implementation of the PROJECT is designed to provide the following benefits:
  - I. The PROJECT will reduce the flooding of approximately 500 structures located throughout the "historical" downtown region of Buckeye.
  - II. The PROJECT will provide a positive outfall into the Gila River since there is no existing natural drainage outfall within the PROJECT Area.
  - III. The PROJECT will reduce existing flooding hazards associated with the roadways.
  - IV. The PROJECT will provide the potential use of the project facilities for joint uses for recreation, including but not limited to parks, trails and other multi-use facilities.
6. The estimated cost of the PROJECT for pre-design, design, right-of-way, utility relocations, construction, and construction management is \$4 million dollars. The overall PROJECT cost will be shared by the DISTRICT and the TOWN at 50%. Cost increases above the estimated cost shall require written approval by both parties.
7. There is currently no District Funds available in the current Capital Improvement Program, thus details on the funding and associated schedule shall be required to be identified in the Project Inter-Governmental Agreement.
8. The TOWN will be the lead for the design, rights-of-way acquisition, construction, construction management for the PROJECT.
9. The TOWN will be responsible for the operation and maintenance of the PROJECT.

10. Either the TOWN or the DISTRICT may receive credit toward their PROJECT cost share up to 25% of the total PROJECT cost from land donation and/or PROJECT features that either party caused to be completed provided that the feature(s) are approved in writing by both parties.

11. The TOWN and the DISTRICT are responsible for their own internal administrative costs associated with the PROJECT. Internal administrative costs are not included as a part of PROJECT costs.
12. The TOWN shall provide a full time Project Manager for the PROJECT and the DISTRICT shall have regularly scheduled project meetings. The TOWN and the DISTRICT 10.13 alternate hosting the PROJECT meetings.
13. The DISTRICT and the TOWN acknowledge and understand that this document reflects the mutual understanding of the intention of the parties to the MOU, and is not legally binding on the Board of Directors of the DISTRICT, the Board of Supervisors of Maricopa County, and the TOWN.

IN WITNESS WHEREOF, the parties hereto have executed this Memorandum of Understanding,

Chief Engineer and General Manager,  
Flood Control District of Maricopa County

Timothy S. Phillips P.E.

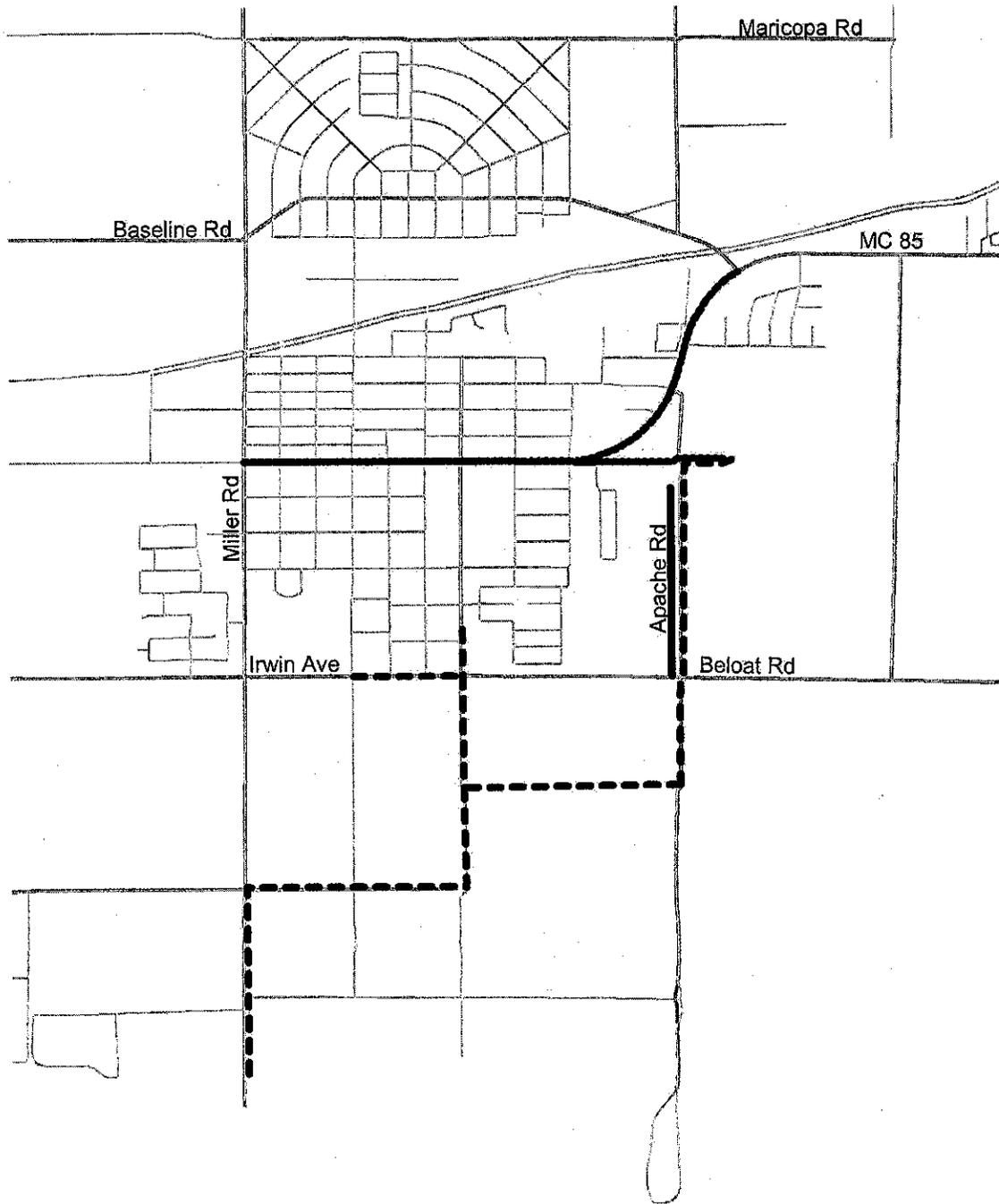
Date

TOWN Manager,  
TOWN of Buckeye

Carol Reynolds, P.E.

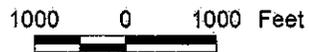
Date

Exhibit A



LEGEND

-  Potential Storm Drain Alignments
-  Potential Pipe Outfall Alignments
-  Potential Open Channel Outfalls
-  Street Centerlines



**Memorandum of Understanding  
for the  
Durango Regional Conveyance Channel Project  
(PCN 565.XX.31)**

**MOU FCD 2006U001**

1. This Memorandum of Understanding (MOU) is between the Flood Control District of Maricopa County hereinafter called the DISTRICT, and the City of Avondale, hereinafter called the CITY.
2. This MOU summarizes the activities and intent of the DISTRICT and the CITY to cooperate regarding the development and implementation of the pre-design, design, rights-of-way acquisition, construction, landscape and aesthetic features allowed by the DISTRICT's "Policy for Aesthetic Treatment and Landscaping of Flood Control Projects", construction management, and operation & maintenance of the Durango Regional Conveyance Corridor (DRCC) Project and Sunland Channel Project lying west of 107<sup>th</sup> Avenue within the boundaries of the City of Avondale.
3. The District shall be the lead agency on all matters pertaining to the administration and execution of this project with concurrence of the City.
4. The following are the proposed drainage features that are to be integrated into and herein referred to as the PROJECT:
  - I. The Durango Regional Conveyance Channel and basin within the City of Avondale and west of 107<sup>th</sup> Avenue as indicated on Exhibit A.
  - II. The Sunland Channel as indicated on Exhibit A within the City of Avondale and west of 107<sup>th</sup> Avenue.
5. The DISTRICT and the CITY desire to implement the PROJECT.
6. Implementation of the PROJECT will provide the following benefits:
  - I. The PROJECT will remove the identified flood hazard area currently affecting approximately 25 structures from the flood hazard area identified in the Durango Regional Drainage Master Plan.
  - II. The PROJECT will provide a positive outfall into the Agua Fria River since there is no existing natural drainage outfall within the project area.
  - III. The PROJECT will reduce existing flooding hazards associated with the roadways.
  - IV. The PROJECT will provide the potential for joint uses for recreation, including but not limited to parks, trails and other multi-use facilities.
7. The estimated cost of the PROJECT within Avondale's planning area for predesign, design, right-of-way, utility relocations, construction, landscape and aesthetic features allowed by the DISTRICT's policy and construction management is approximately \$40 million dollars for the Durango Regional Conveyance Channel and \$18 million dollars for the Sunland Channel. Of the \$40 million dollars for the Durango Regional Conveyance Channel, the Candidate Assessment Report for the Durango Regional Conveyance Channel indicated that \$16.7 million dollars should be contributed by developers along the alignment for drainage costs that they would have had to accrue in absence of the PROJECT.
8. The total PROJECT cost will be capped at \$40 million dollars for the Durango Regional Conveyance Channel and \$18 million dollars for the Sunland Channel and can be exceeded only with future agreement between all parties to the PROJECT. The PROJECT cost to be shared 50% by the City CITY and 50% by the DISTRICT is \$38.3 million dollar, \$23.3 million for the Durango Regional Conveyance Channel and \$15 million dollars for the Sunland Channel, with the remaining to be

collected from the developers by the CITY. PROJECT cost increases above the estimated PROJECT cost requires the written approval by both parties.

9. There are limited DISTRICT Funds available in the current Capital Improvement Program for this PROJECT, thus details on the funding and the associated schedule shall be required to be identified in the Project Inter-Governmental Agreement.
10. The TOWN will be the Lead for the pre-design, design, rights-of-way acquisition, construction, construction management for the PROJECT.
11. At the request of the City, additional landscaping, aesthetic features and other non-flood control related facilities, if compatible with the PROJECT function, may be included in the PROJECT construction solely at the CITY's expense for the construction and construction management costs.
12. The City of Avondale will provide operation and maintenance of the channel including recreational and landscaped park features. The DISTRICT will maintain the hard features and structures and make a financial contribution to the on-going operations and maintenance of the channel exclusive of the City's landscape features. (This needs to be re-written. I do not think that we want to get into a IGA that we have to pay yearly O&M and the Calcs....)
13. Either the TOWN or the DISTRICT may receive credit toward their PROJECT cost share up to 25% of the total PROJECT cost from land donation and/or PROJECT features that either party caused to be completed provided that the feature(s) are approved in writing by both parties.
14. Neither the City nor the DISTRICT shall receive credit for internal administration costs.
15. The CITY shall provide a full time Project Manager for this project and the DISTRICT shall have regularly scheduled project meetings. Additionally, the CITY and the DISTRICT shall alternate hosting the PROJECT meetings.
16. The DISTRICT and the CITY acknowledge and understand that this document is not binding on:

The Board of Directors of the DISTRICT,  
The Board of Supervisors of Maricopa County,  
and the City Council of the CITY.

IN WITNESS WHEREOF, the parties hereto have executed this Memorandum of Understanding

Chief Engineer and General Manager,  
Flood Control District of Maricopa County

Timothy S. Phillips, PE

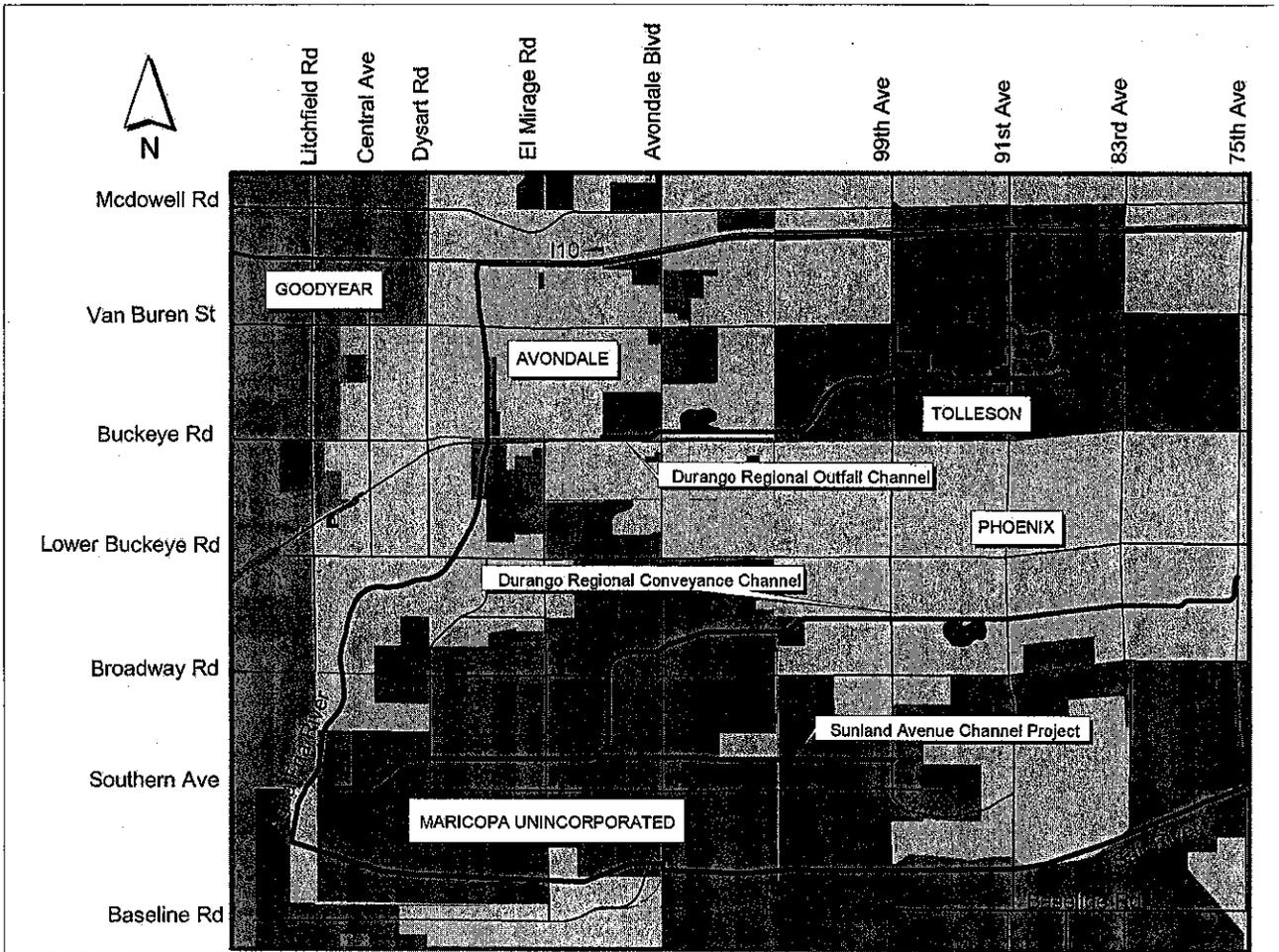
Assistant City Manager,  
City of Avondale

David Fitzhugh, P.E.

Date

DRAFT

Exhibit A



**Memorandum of Understanding  
for the  
Durango Regional Conveyance Channel Project  
(PCN 565.XX.31)**

**MOU FCD 2006U001**

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5. The DISTRICT and the CITY desire to implement the PROJECT.
6. Implementation of the PROJECT will provide the following benefits:
  - I. The PROJECT will remove the identified flood hazard area currently affecting approximately 25 structures from the flood hazard area identified in the Durango Regional Drainage Master Plan.
  - II. The PROJECT will provide a positive outfall into the Agua Fria River since there is no existing natural drainage outfall within the project area.
  - III. The PROJECT will reduce existing flooding hazards associated with the roadways.
  - IV. The PROJECT will provide the potential for joint uses for recreation, including but not limited to parks, trails and other multi-use facilities.
7. The estimated cost of the PROJECT within Avondale's planning area for predesign, design, right-of-way, utility relocations, construction, landscape and aesthetic features allowed by the DISTRICT's policy and construction management is approximately \$40 million dollars for the Durango Regional Conveyance Channel and \$18 million dollars for the Sunland Channel. Of the \$40 million dollars for the Durango Regional Conveyance Channel, the Candidate Assessment Report for the Durango Regional Conveyance Channel indicated that \$15.7 million dollars should be contributed by developers along the alignment for drainage costs that they would have had to accrue in absence of the PROJECT.
8. The total PROJECT cost will be capped at \$40 million dollars for the Durango Regional Conveyance Channel and \$18 million dollars for the Sunland Channel and can be exceeded only with future agreement between all parties to the PROJECT. The PROJECT cost to be shared 50% by the City CITY and 50% by the DISTRICT is \$38.3 million dollar, \$23.3 million for the Durango Regional Conveyance Channel and \$15 million dollars for the Sunland Channel, with the remaining to be

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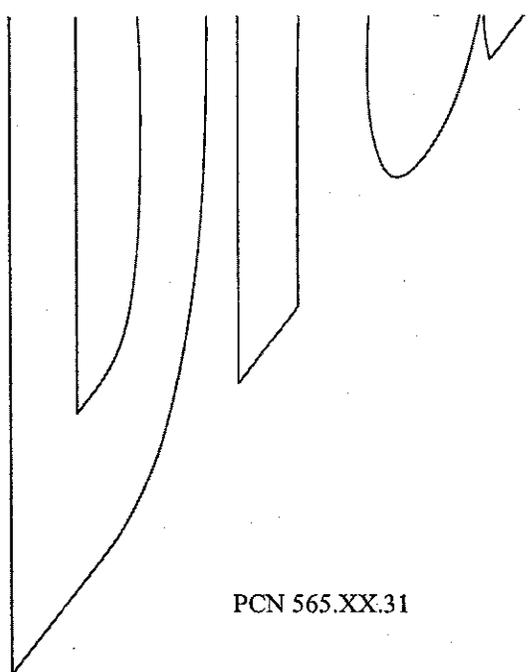
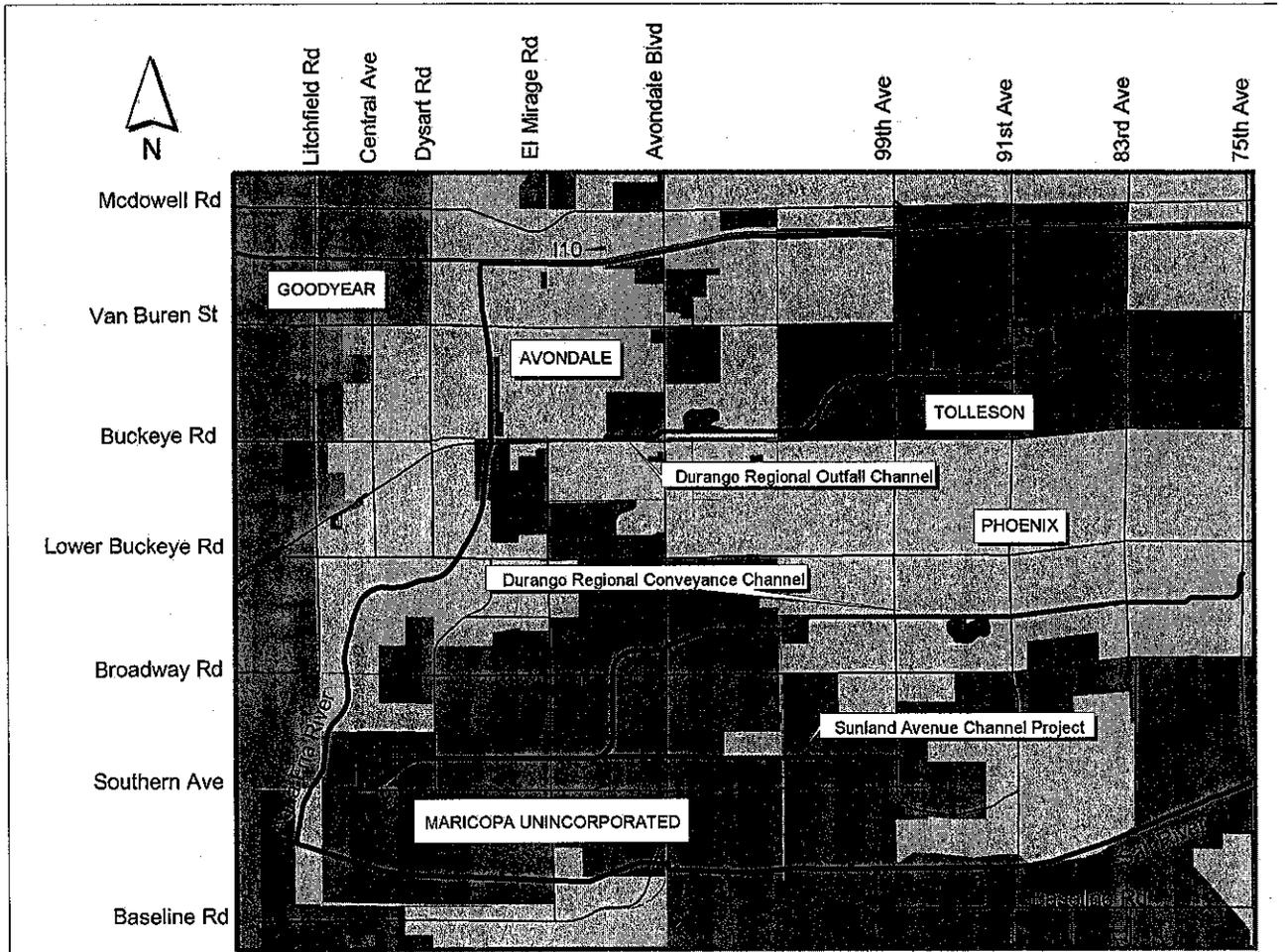
Assistant City Manager,  
City of Avondale

David Fitzhugh, P.E.

Date

DRAFT

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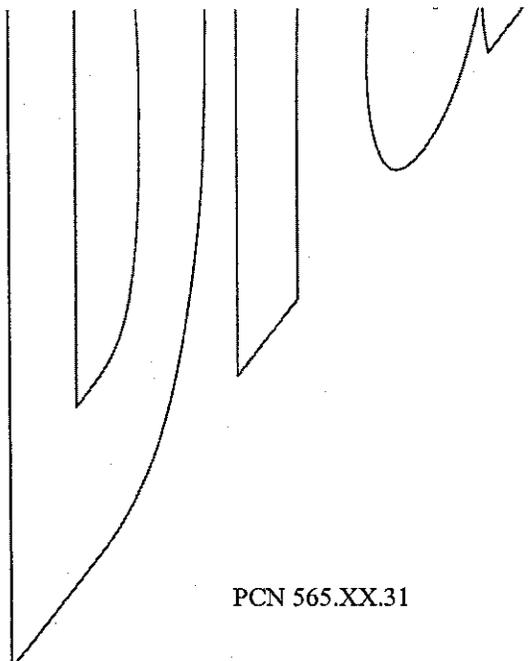
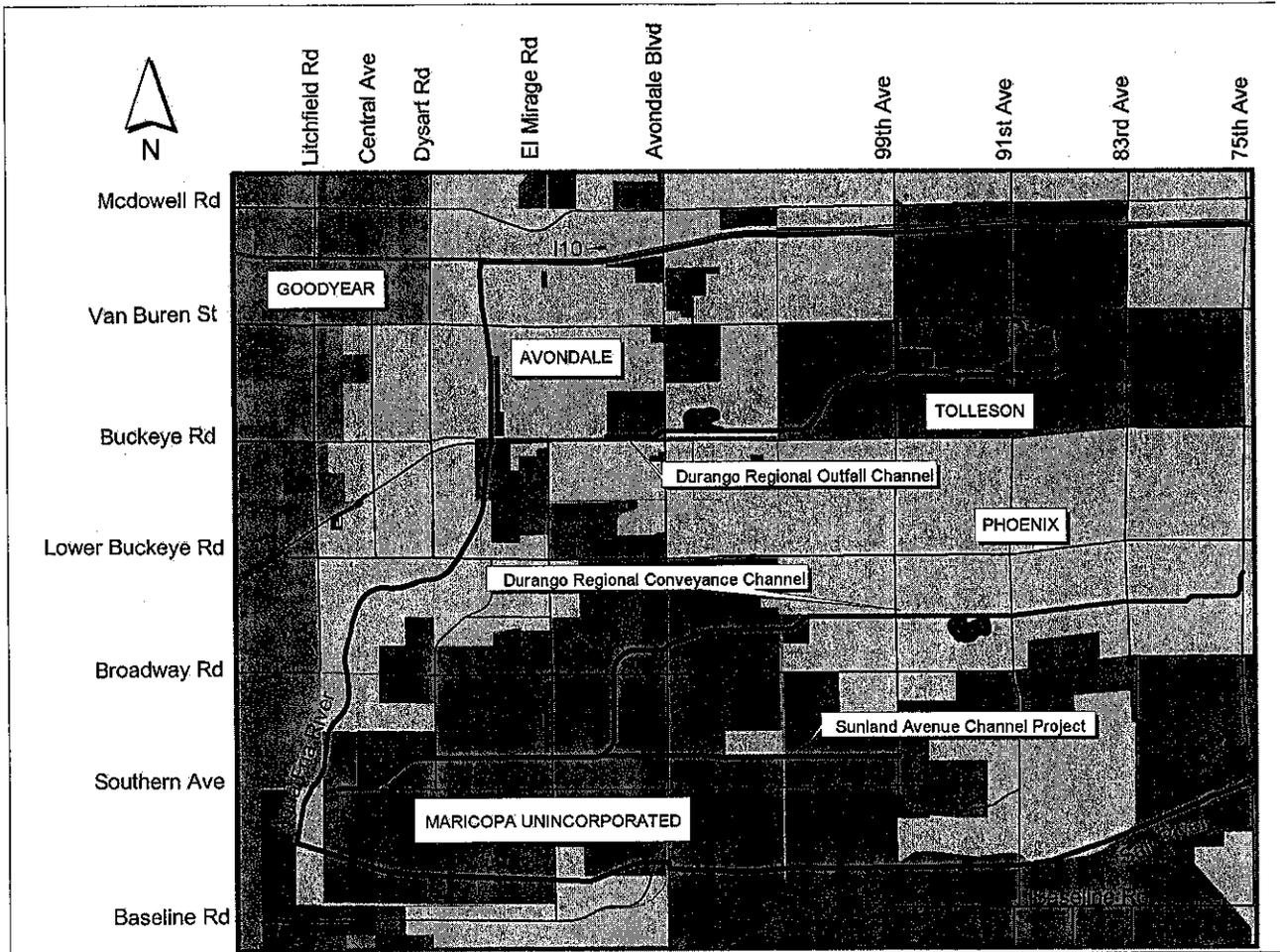
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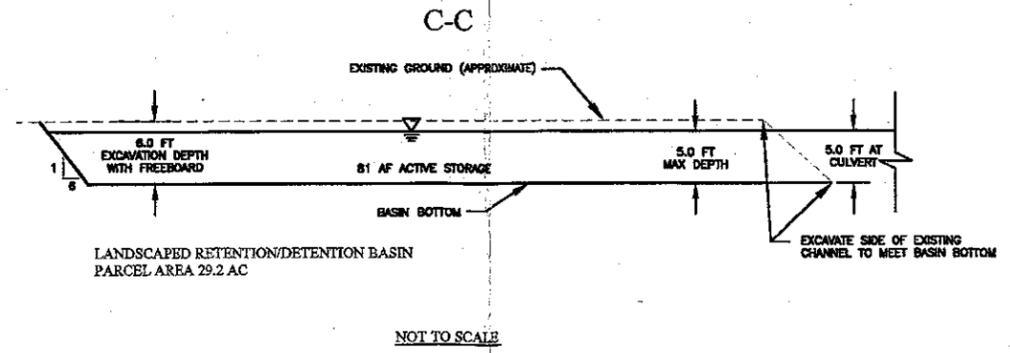
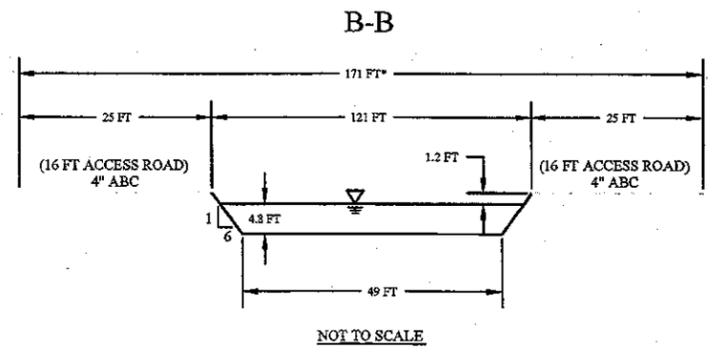
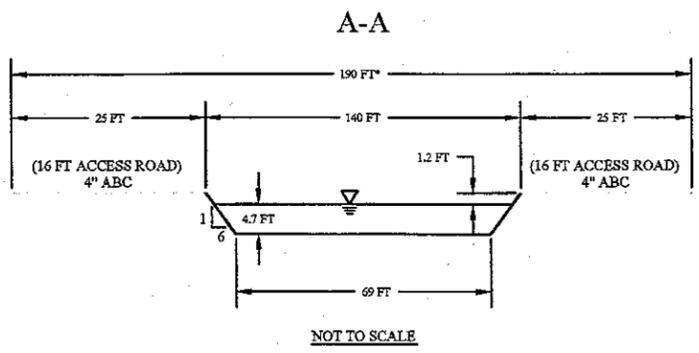
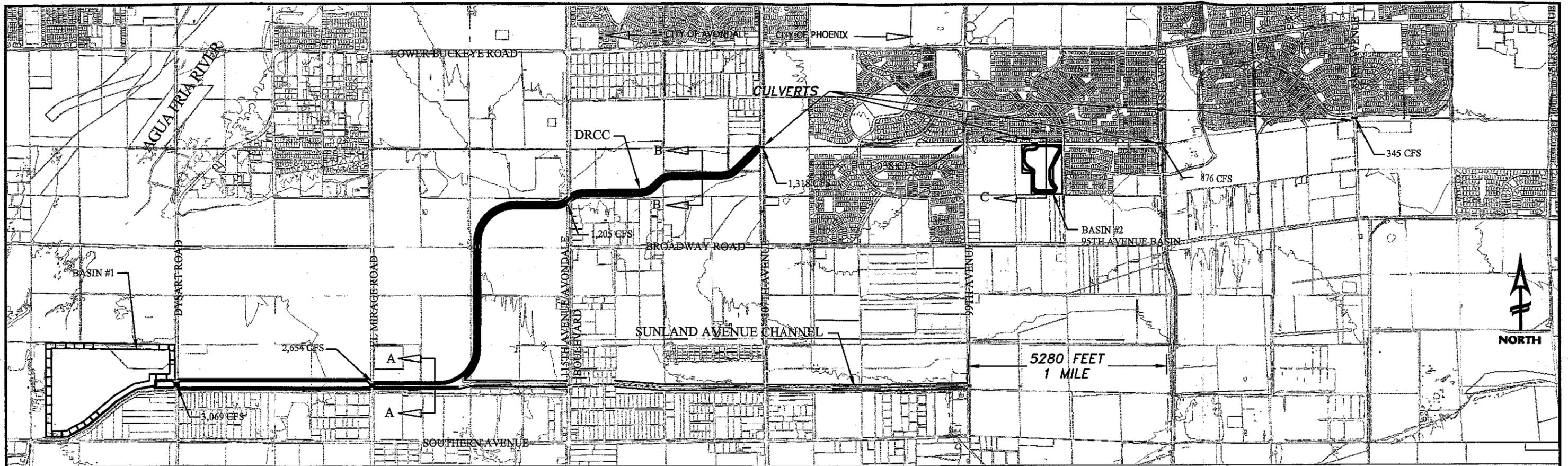
David Fitzhugh, P.E.

Date

DRAFT

Exhibit A





NOTES:  
 \*ADDITIONAL R.O.W. NEEDED FOR ASTHETICS. FCDMC PARTICIPATION IS LIMITED.  
 CHANNEL LINING IS GRASS. OTHER AREAS ARE LANDSCAPED.

**RECOMMENDED PLAN  
 DRCC**

CANDIDATE ASSESSMENT REPORT  
 DURANGO REGIONAL CONVEYANCE CHANNEL  
 PREPARED FOR THE FLOOD CONTROL  
 DISTRICT OF MARICOPA COUNTY

**Aspen** Consulting Engineers  
 A Division of **Aspen Environmental Group**  
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 Phoenix, AZ 85008  
 Phone: (602) 251-9221  
 Fax: (602) 251-8977  
 www.aspeneg.com

PROJECT NO. P1005  
 FIGURE 5.1