Maricopa County Department of Transportation Planning Division

87th Avenue Channel
Deer Valley Road to Williams Road

Ray Road Channel
Tuthill Road to Airport Road

Guadalupe Road Channel
at the Eastern Canal

Chandler Heights Road Channel
Greenfield Road to Power Road

CAR 97-M

FINAL

CANDIDATE ASSESSMENT REPORT

February 13, 1998

REGISTERED PROFESSIONAL ENGINEER (CIVIL)
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Prepared By:

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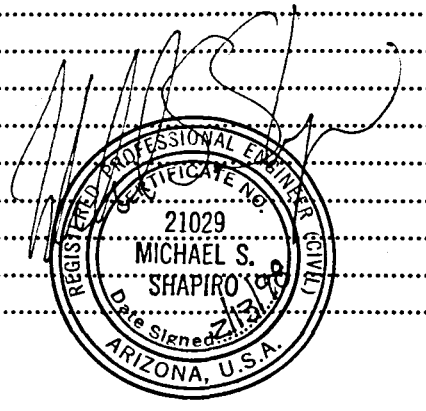

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CANDIDATE ASSESSMENT REPORT

FOR

4 DRAINAGE CHANNELS

C97-M

SEC. 15, T4N, R1E; SEC. 30, T1S, R2W; SEC. 3 and 10, T1S, R6E; and SEC. 25, 26 and 27, T2S, R6E, G&SRB&M

MARICOPA COUNTY DEPARTMENT OF

TRANSPORTATION PLANNING DIVISION

FEBRUARY 13, 1998 FINAL

Project Name: 4 Drainage Channels

Project Termini: 87th Avenue Channel; Ray Road Channel; Guadalupe Road Channel; Chandler Heights Road Channel.

Requested by: Flood Control District of Maricopa County

Improvement Requested: Improve or add channels and drainage crossings

PM_{10} Area? Yes

Length:
87th Avenue Channel – 0.80 km (0.5 mi.)
Ray Road Channel – 1.61 km (1.0 mi.)
Guadalupe Road Channel – 0.80 km (0.5 mi.)
Chandler Heights Road Channel 4.56 km (2.84mi)

Estimated Cost:	Full Cost	Low Cost	No Build
87th Avenue Channel	$1,027,292	$524,126	$0
Ray Road Channel	$1,051,646	$676,109	$120,317
Guadalupe Road Channel	$638,095	$0	$0
Chandler Heights Road Channel	$1,947,543	$1,545,922	$190,705

Problem Identification: Roadway and properties experience flooding.

1.0 BACKGROUND

1.1 General

This report consists of a study of four drainage channels: namely 87th Avenue Channel - Deer Valley Road to Williams Road; Ray Road Channel - Tuthill Road to Airport Road; Guadalupe Road Channel at the Eastern Canal; Chandler Heights Road Channel - Greenfield Road to Power Road.

1.1.1 87th Avenue Channel - Deer Valley Road to Williams Road

Project Name:
The name of the project is 87th Avenue Channel - Deer Valley Road to Williams Road (See Figure 1.1.1. Site Map on the following page).

General Description of the existing channel:
There is presently no drainage channel along 87th Avenue. The existing roadway is a half-width street meadering from the west to east side of the monument line.

Existing functional classification:
87th Avenue is a minor urban collector roadway, running north/south along the mid-section line and surrounded by 100% single family residential areas.

Location of the project area:
With the exception of the northeastern portion of the project site, which is located in the City of Peoria, the project site is located in Maricopa County and is zoned Rural-43. The site is within the City of Peoria planning area and designated as low density residential. See City Limits Maps in the Appendix.

Current structure, channel and roadway surfacing type:
87th Avenue is partly paved, and its width varies from 12.8 to 13.7 m (42 to 45 ft.) between monument line and the existing fence.

Current Roadway Geometry:
87th Avenue from Deer Valley Road to Via Montoya Drive is unpaved (gravel with an inverted crown); the roadway is located just west of the monument line and is 12.8 m (42 ft.) wide from the monument line to the stucco wall fence. From Via Montoya Drive north, the roadway shifts to the east side of the monument line in front of the Citrus Gardens Estates, where it is a paved, half street. The half street is 9.8 m (32 ft.) wide from the monument line to the face of curb with curb, gutter, and a 1.2 m (4 ft.) wide sidewalk and 13.7 m (45 ft.) to the fence. Just south of Williams Drive, the roadway shifts back to the west of the monument line and is unpaved (gravel).

Type of and reason for improvement:
The neighborhood has experienced periodic flooding due to drainage from the north overflowing the road onto to private yards and adjacent houses. A storm drainage system is required to direct drainage south to the existing storm drainage channels. A potential retention/detention basin north of Williams Road will be investigated.

CANDIDATE PROJECT
87TH AVENUE CHANNEL
Deer Valley Road to Williams Drive

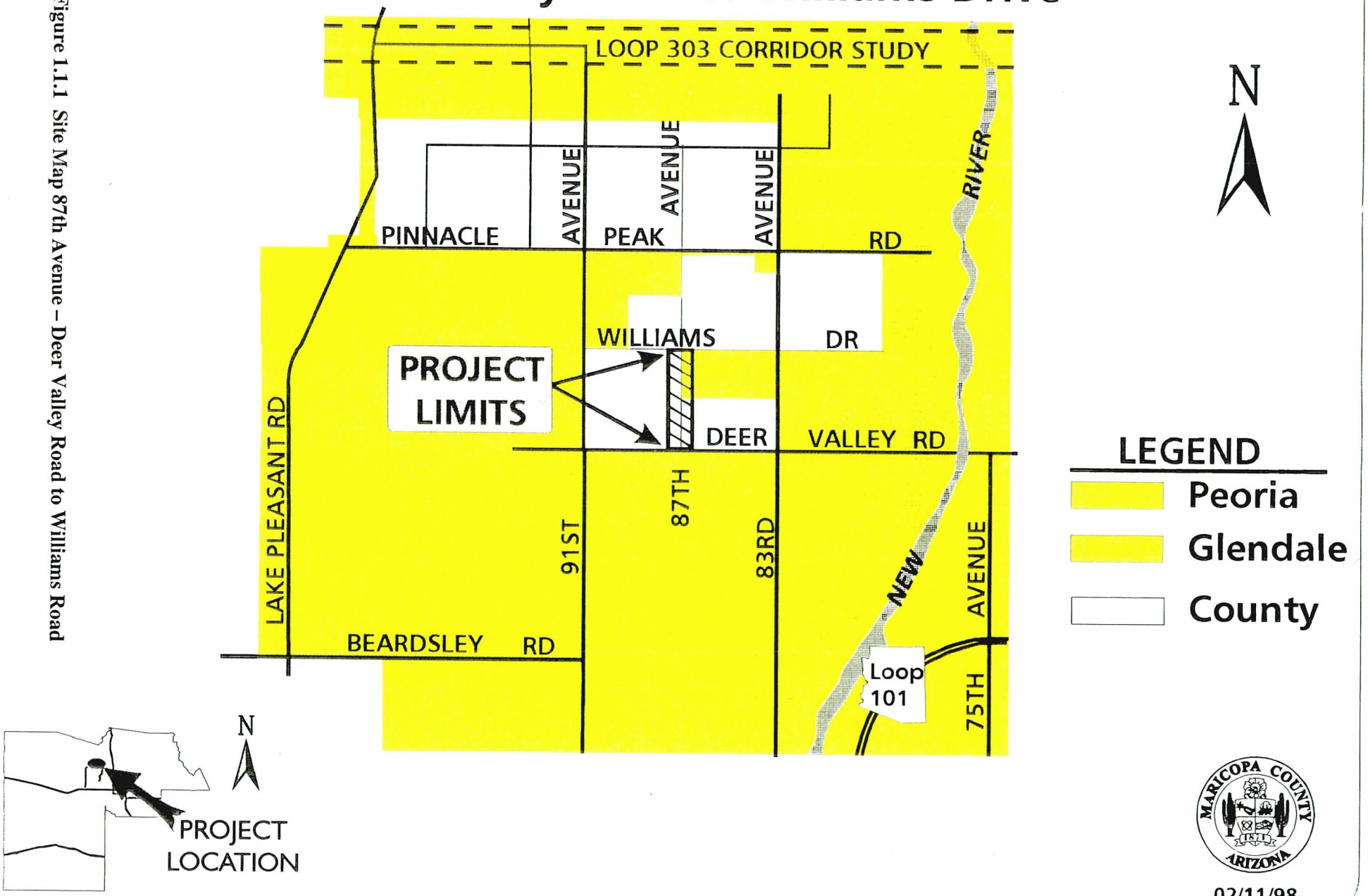

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Figure 1.1.1 Site Map 87th Avenue – Deer Valley Road to Williams Road

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1.1.2 Ray Road Channel - Tuthill Road to Airport Road

Project Name:
The name of the project is Ray Road Channel - Tuthill Road to Airport Road (See Figure 1.1.2 Site Map on the following page).

General Description of the existing channel:
The existing channel is located on the south side of Ray Road. Ray Road is an east/west roadway in a rural area of Maricopa County. The drainage flows from east to west and discharges into Waterman Wash. Dimensions of the channel vary. The bottom was measured at approximately 7.6 m (25 ft.) wide and 0.7 m deep at 137 m (450 ft.) upstream of Tuthill Road.

Existing functional classification:
Ray Road is a is a rural minor collector north of the section line. It has a paved surface with dirt shoulders.

Location of the project area:
The project site is in an area zoned Rural-43 in Maricopa County. Incorporated areas of the Town of Goodyear are within 1.6 km (1 mile) of the east end of the project.

Current bridge/structure and roadway surfacing type:
Ray road is a paved east/west two-lane roadway with paved asphalt surface.

Current Roadway Geometry:
Ray Road is a two lane roadway with no vertical or horizontal curves. The centerline of the existing roadway is offset approximately 5.49 m (18.0 ft.) north of the monument line. The channel is located on the south side of the roadway and crosses several paved and unpaved driveways. There is a dip crossing along Tuthill Road to convey drainage. Ray Road terminates at the Waterman Wash and goes north onto Airport Road through a sharp 90 degree curve.

Type of and reason for improvement:
The existing channel to the south of Ray Road has limited capacity, resulting in drainage diversion onto private property and periodic flooding. In addition, the guardrail at the corner of Airport Road is in bad disrepair and is in need of replacement.

1.1.3 Guadalupe Road Channel at the Eastern Canal

Project Name:
The name of the project is Guadalupe Road Channel at the Eastern Canal (See Figure 1.1.3 Site Map on the following pages).

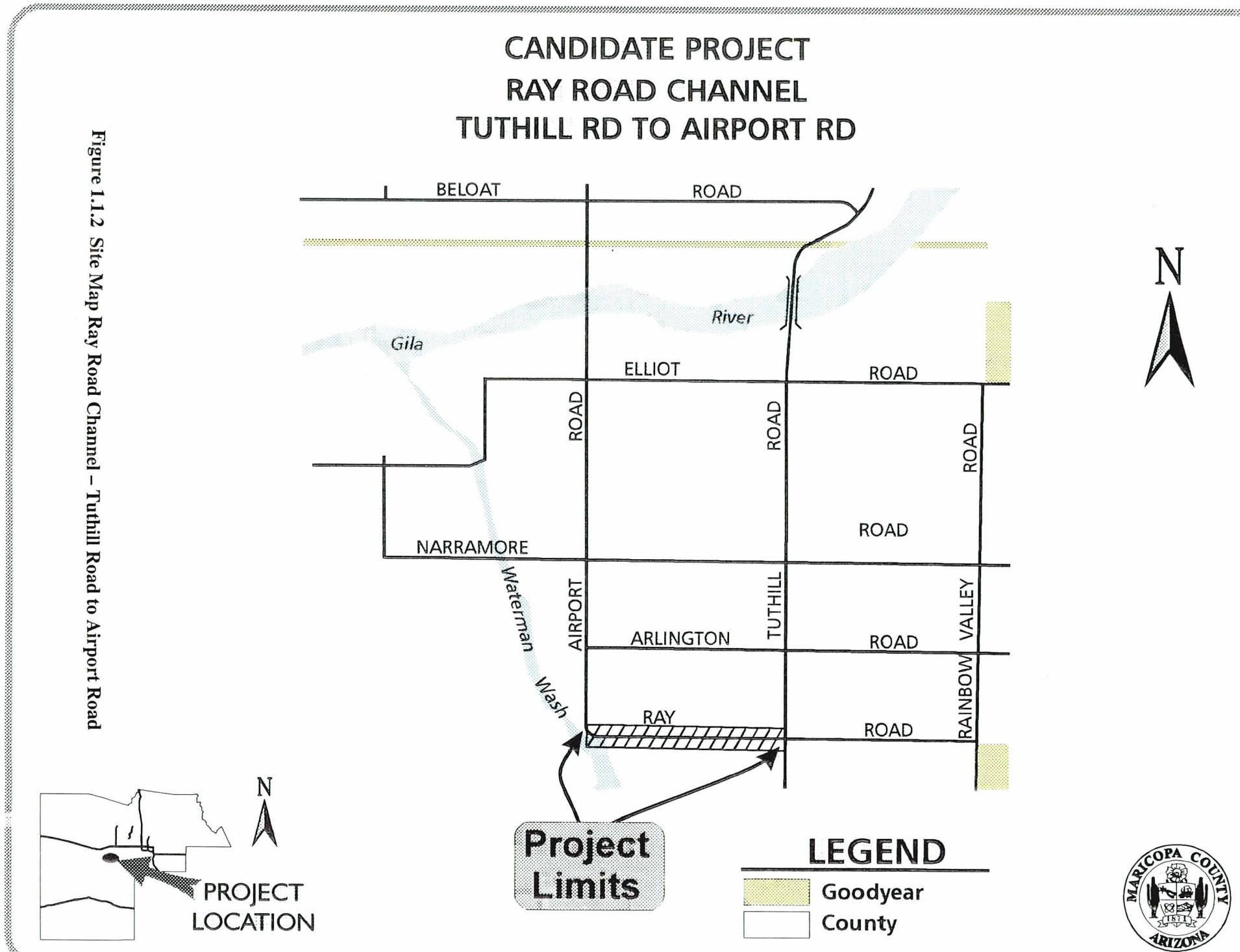

Figure 1.1.2 Site Map Ray Road Channel – Tuthill Road to Airport Road

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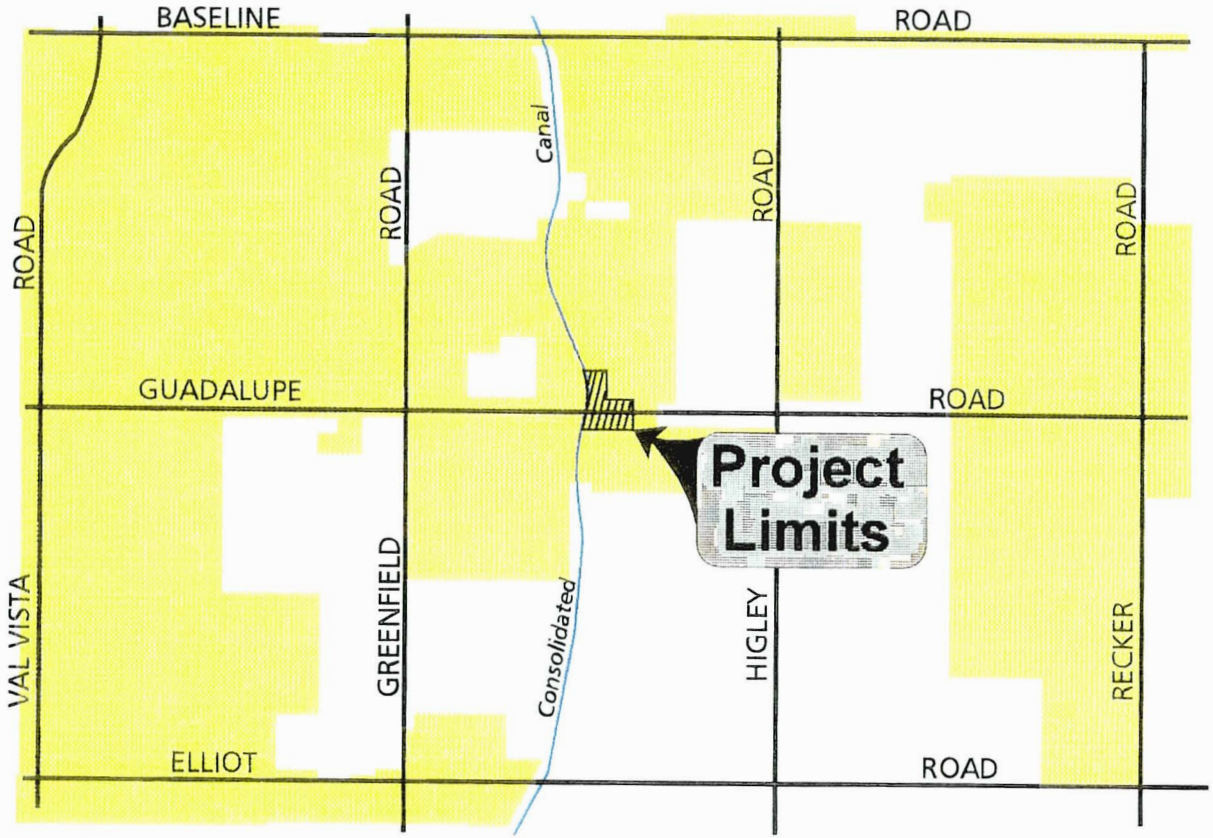
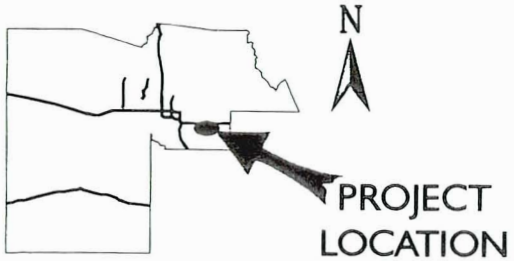
CANDIDATE PROJECT
GUADALUPE ROAD CHANNEL
@ EASTERN CANAL





LEGEND

Gilbert

County

MARICOPA COUNTY
ARIZONA

Figure 1.1.3 Site Map Guadalupe Road Channel – at Eastern Canal

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General Description of the existing channel:
Guadalupe Road Channel at the Eastern Canal is a north/south Roosevelt Water Conservation District (RWCD) tailwater drain ditch. The RWCD estimated that the capacity of this tailwater ditch is approximately 7.08 csm (250 cfs). The ditch is located on the east side of the Eastern Canal and crosses Guadalupe Road. There are two tailwater ditches on the north and south side of Guadalupe Road that drain from the east into the Guadalupe Channel.

Existing functional classification:
Guadalupe Road is a rural major collector constructed on the Section Line. It has a paved surface with dirt shoulders.

Location of the project area:
The project site is located within un-incorporated and incorporated limits of the City of Gilbert. See the City Limit Maps in the Appendix. The site is surrounded by single family residential development. Improvements in this area are part of the Greenfield Improvement District.

Current bridge/structure and roadway surfacing type:
Guadalupe Road is a two-lane east/west roadway with paved asphalt surface and dirt shoulders. At present two 910 mm (36 inch) diameter corragated metal pipes (CMPs) with headwalls convey tailwater across Guadalupe Road from north to south along the Guadalupe Road Channel.

Current Roadway Geometry:
The road is straight with no vertical and horizontal curvatures at the Eastern Canal crossing. It crosses Eastern Canal and is skewed at a 12-degree angle at the crossing.

Type of and reason for improvement:
The White Fence Farms in the un-incorporated area is experiencing flooding. Flooding problems on the east and north are due to ponding along the embankment of the Eastern Canal and the north shoulder of Guadalupe Road.

1.1.4 Chandler Heights Road Channel - Greenfield Road to Power Road

Project Name:
The name of the project is Chandler Heights Road Channel - Greenfield Road to Power Road (See Figure 1.1.4. Site Map on the following page).

General Description of the existing channel:
Chandler Heights Road Channel from Greenfield Road to Power Road is an east/west channel located on the south side of Chandler Heights Road. The channel crosses Power Road, 180th Street, Recker Road, Higley Road, and Greenfield Road. The channel narrows as it flows downstream toward the existing East Maricopa Floodway (EMF). The channel also conveys irrigation tailwater. The Santan Irrigation District estimated that approximately 0.14 cms (5 cfs) to 0.28 cms (10 cfs) of tailwater is conveyed within the channel.

Existing functional classification:
Chandler Heights Road is a rural major collector constructed on the Section Line . It has a paved surface with dirt shoulders.

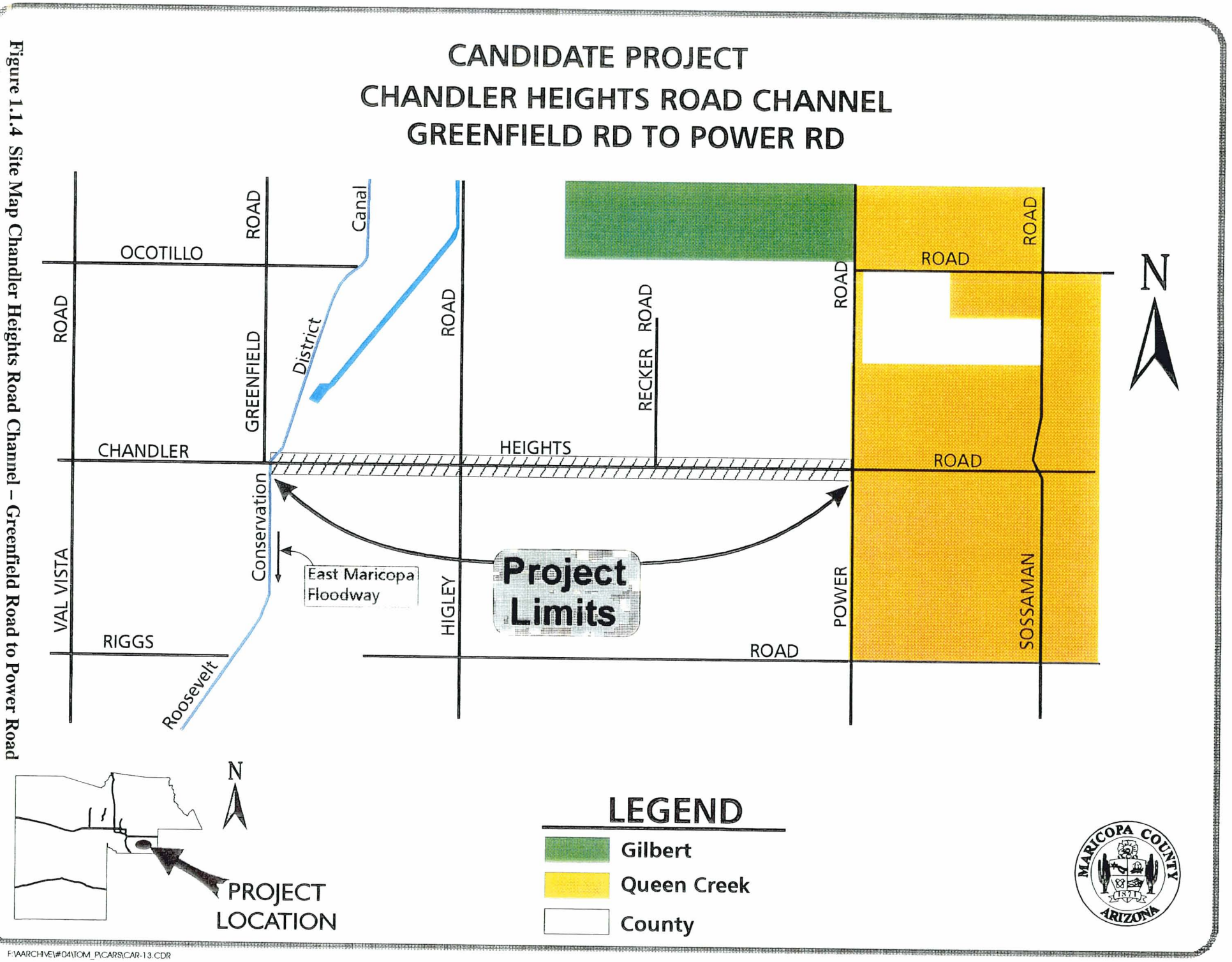

Figure 1.1.4 Site Map Chandler Heights Road Channel – Greenfield Road to Power Road

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Location of the project area:
The project site is located in Maricopa County. Properties west of Higley Road will be annexed into the City of Gilbert in the future. This area is currently not included in the Gilbert General Plan. The properties east of Higley Road will be annexed into the Town of Queen Creek in the future. Properties surrounding the site are presently agricultural in uses. See City Limit Map in the Appendix.

Current bridge/structure and roadway surfacing type:
Chandler Heights Road is a two-lane east/west roadway with paved asphalt surface and dirt shoulders. A existing two barrel 3.0 m by 1.2 m (10 ft. by 4 ft.) reinforced concrete box culvert (RCBC) crosses Power Road, immediately east of Chandler Heights Road. This RCBC was constructed by the Maricopa County Department of Transportation (MCDOT) approximately one year ago. Along the channel alignment there is a low flow crossing, using a standard cattle guard at 180th Street, three corraguted aluminum elliptical pipes (CAEP) crossing Higley Road and two CAEPs crossing the McKay property driveway (west of Higley Road). A major bridge structure crosses the EMF which is the outfall for the existing channel.

Current Roadway Geometry:
Chandler Heights Road is straight with no vertical and horizontal curvatures between Greenfield Road and Power Road except for the vertical crest curve over the EMF. The centerline of the existing roadway is approximately 5.97 m (19.6 ft.) north of the monument line.

Type of and reason for improvement:
The existing contributing drainage and tailwater ditch on the south side of the roadway has limited capacity and is in need of improvements. Off-site stormwater drainage from the south enters the channel and overflows at various locations causing flooding over the roadway and to the north on private property and residences.

1.2 Pavement Information

1.2.1 87th Avenue Channel - Deer Valley Road to Williams Road

87th Avenue from Deer Valley Road to Williams Road is a minor urban collector roadway. The portion of the roadway east of the mid-section line (in City of Peoria) is paved and the rest of the roadway is unpaved. There are no MCDOT records on the Pavement Condition Rating (PCR), Sufficiency Rating, or International Roughness Index Rating (IRI) for 87th Avenue.

1.2.2 Ray Road Channel - Tuthill Road to Airport Road

Ray Road from Tuthill Road to Airport Road is a paved secondary two-lane roadway. According to MCDOT records, it has a PCR of 93, a IRI of 180, and a Sufficiency Rating of 71.

1.2.3 Guadalupe Road Channel at the Eastern Canal

Guadalupe Road at the Eastern Canal is a paved secondary two-lane roadway. According to MCDOT records, it has a PCR of 87, a IRI of 181, and a Sufficiency Rating of 66.

1.2.4 Chandler Heights Road Channel - Greenfield Road to Power Road

Chandler Heights Road from Greenfield Road to Power Road is a paved secondary two-lane roadway. According to MCDOT records, it has a PCR of 82, a IRI of 117, and a Sufficiency Rating of 75.

2.0 TRAFFIC INFORMATION AND ANALYSIS

2.1 Traffic Counts and Projections

MCDOT provided daily traffic counts for Ray Road, Chandler Heights Road, and Guadalupe Road from 1988 to 1996. Only one set of traffic counts, for 1998, were available for 87th Avenue within the project limits. Therefore, a regression analysis could not be performed for 87th Avenue. To forecast 2001 traffic on Ray Road, Guadalupe Road, and Chandler Heights Road, a linear regression analysis was conducted on the traffic counts. The most recent traffic counts and year 2001 forecasted volume is shown in Table 2.1.1.

Table 2.1.1 Average Daily Traffic Volumes

Location	Year			
	1994	1995	1996	2001
87th Avenue **				
Ray Road, E. of Tuthill Road *	123	136	149	229
Guadalupe Road, E. of Greenfield Road	5459	5612	6324	9141
Chandler Heights Road, at Power Road *	3166	2721	2557	3348

* This is the closest available traffic count to the site.
** Only one set of counts were available for 87th Avenue therefore, projections could not be performed.

EMME/2 traffic projections for years 2001, 2010, and 2020 were also provided by MCDOT. The projected volumes are presented in Table 2.1.2. The calculated 2001 traffic volumes, shown previously, do not correspond well with the EMME/2 2001 projected traffic volumes for the roadways within the study area. The EMME/2 travel demand model indicates that the growth rate that has occurred in the past will not occur on these roadways in the near future. New developments proposed near the sites can significantly alter the traffic patterns and volumes on the surrounding roadways.

Table 2.1.2 Projected Average Volume and Average Annual Growth Rates

Location	2001 Volume	2010 Volume	2020 Volume	2001 - 2010 Growth Rate	2010 - 2020 Growth Rate
87th Avenue *					
Ray Road *	2,258	3,230	6,772	4.06%	7.68%
Guadalupe Road *	15,911	24,731	21,359	5.02%	-1.46%
Chandler Heights Road, W. of Power Road	2,884	5,607	4,134	7.67%	-3.00%

* The EMME/2 runs did not include traffic volumes for 87th Avenue.

The average annual growth rate for each roadway was computed using the EMME/2 traffic projections. These rates were used to develop estimated ADTs for every year from 2001 to 2020, shown in Table 2.1.3. Backup for the traffic volume projections are included in the Appendix.

Table 2.1.3 Estimated Traffic Volumes

Year	87th Avenue	Ray Road	Guadalupe Road	Chandler Heights Road
2001		2,258	15,911	2,884
2002		2,350	16,710	3,105
2003		2,445	17,549	3,343
2004		2,544	18,431	3,599
2005		2,647	19,357	3,875
2006		2,755	20,329	4,173
2007		2,867	21,350	4,492
2008		2,983	22,422	4,837
2009		3,104	23,548	5,208
2010		3,230	24,731	5,607
2011		3,478	24,371	5,439
2012		3,745	24,016	5,275
2013		4,033	23,667	5,117
2014		4,343	23,323	4,963
2015		4,677	22,983	4,814
2016		5,036	22,649	4,670
2017		5,423	22,319	4,530
2018		5,840	21,994	4,394
2019		6,289	21,674	4,262
2020		6,772	21,359	4,134

2.2 Traffic Analysis

The current week day, 24 hour traffic volume on 87th Avenue is 322 ADT, based on February 13, 1998 traffic count data. According to the MCDOT Roadway Design Manual, Table 2.1, this volume is within the ADT range for a rural, 2-lane, local roadway and a level of service of A or better is maintained. The existing roadway will not be modified as part of this project. Therefore, analysis of future traffic volumes was not completed for this study.

The current traffic volume on Ray Road is 149 ADT, based on 1996 traffic count data. According to the MCDOT Roadway Design Manual, Table 2.1, this volume is within the ADT range for an urban, 2-lane, major collector roadway and a level of service of C or better is maintained. Although the channel will be constructed to accommodate the ultimate cross section for the Ray Road, the roadway will not be constructed with this project. Ray Road will provide one lane in each direction of travel after the channel construction is complete. Therefore, analysis of future traffic volumes was not completed for this study.

The current traffic volume on Guadalupe Road is 6324 ADT, based on 1996 traffic count data. According to the MCDOT Roadway Design Manual, Table 2.1, this volume is within the ADT range for an urban, 2-lane, major collector roadway and a level of service of C or better is maintained. The channel project does not include any modifications to the existing roadway. Therefore, analysis of future traffic volumes was not completed for this study.

The current traffic volume on Chandler Heights Road is 2557 ADT, based on 1996 traffic count data. According to the MCDOT Roadway Design Manual, Table 2.1, this volume is within the ADT range for an urban, 2-lane, major collector roadway and a level of service of C or better is maintained. The channel project does not include any modifications to the existing roadway. Therefore, analysis of future traffic volumes with respect to roadway improvements was not completed for this study.

The future level of service, volume to capacity ratio, and average travel time were not calculated for this project.

2.3 Accident Information and Analysis

The accident history for the channel sites were gathered by MCDOT from current State accident databases and data obtained from the Maricopa County Sheriff Office records. The accident dates were checked from January 1, 1994, to December 31, 1996.

Accident rates were calculated using the formulas provided by MCDOT. The 1996 average daily traffic volume for each segment was adjusted using the City of Phoenix monthly and daily traffic factors to calculate the annual average daily traffic volumes. Accident rate calculations are included in the Appendix.

2.3.1 87th Avenue

There was only one accident for this time period within the project limits. The accident occurred during daylight hours, north of Via Montoya Drive, and involved the collision of vehicle with an existing overhead electric pole.

Accident Rate Calculations

87th Avenue AADT = unavailable
No. of accidents = 0.33 accidents/year
Project length = 0.5 mile or 0.8 km
Project accident rate = unable to calculate

Relocation of the existing overhead utility poles to the outer limits of the right-of-way will improve the safety or clear zone between traffic and poles. This will also reduce the potential for this type of accident.

2.3.2 Ray Road

There was only one accident for this time period within the project limits. The accident occurred at the curve transition between Ray Road and Airport Road. The accident did not involve the channel.

Accident Rate Calculations

Ray Road AADT = 162 vpd
No. of accidents = 0.33 accidents/year
Project length = 1.6 km (1.0 mile)
Project accident rate = 3.49 acc./MVKM (5.58 acc./MVM)

Guardrail at this location is recommended for replacement. This includes the no build alternative.

2.3.3 Guadalupe Road

No accidents have occurred for this time period within the project limits.

Accident Rate Calculations

Guadalupe Road AADT = 6,200 vpd
No. of accidents = 0.0 accidents/year
Project length = 1.6 km (1.0 mile)
Project accident rate = 0.00 acc./MVKM (0.00 acc./MVM)

2.3.4 Chandler Heights Road

There were nine accidents for this time period within the project limits. A summary of the accident is provided in Table 2.3.4. None of the accidents were apparently directly influenced by or involved the channel.

Table 2.3.4 Accident Summary for Chandler Heights Road

Accident	Location	Severity	Daylight
1	Chandler Heights Rd / Greenfield Rd Intersection	Property Damage Only	Daylight
2	Chandler Heights Rd, east of Greenfield Rd	Possible Injury	Daylight
3	Chandler Heights Rd, east of Greenfield Rd	Injury	Darkness
4	Chandler Heights Rd / Higley Rd Intersection	Property Damage Only	Darkness
5	Chandler Heights Rd / Higley Rd Intersection	Property Damage Only	Dusk
6	Chandler Heights Rd / Higley Rd Intersection	Property Damage Only	Daylight
7	Chandler Heights Rd, west of Recker Rd	Property Damage Only	Dawn
8	Chandler Heights Rd / 180th Street	Incapacitating Injury	Darkness
9	Chandler Heights Rd / 182nd Street	Property Damage Only	Daylight

Accident Rate Calculations

Chandler Heights Road AADT = 2,561 vpd
No. of accidents = 3.0 accidents/year
Project length = 4.8 km (3.0 miles)
Project accident rate = 0.67 acc./MVKM (1.07 acc./MVM)

Since the project does not improve Chandler Heights Road, this project is not envisioned to reduce or increase the accident rate on this roadway.

After analysis, there seems to be no predominant pattern to accidents at these locations. None of these projects involve the reconstruction or widening of the roadways. Construction of the new channels/storm drains is not anticipated to adversely impact the roadways or increase the existing accident rates.

2.4 Construction Traffic Management Evaluations and Recommendations

2.4.1 87th Avenue Channel – Deer Valley Drive to Williams Road

Since 87th Avenue within the project limits presently serve as a local collector providing direct access to adjacent properties, a complete road closure will not be possible. The low cost improvement recommends that the alignment of the roadway be offset from the monument line. The high cost improvement constructs a drainage channel on the west side of the roadway. Both alternatives will require grading the new roadway alignment to connect with the existing section of 87th Avenue that is paved. Traffic can be maintained on 87th Avenue during the construction. Temporary pavement will not be required for the construction. To be able to maintain traffic during the construction of the ultimate roadway section for 87th Avenue, the existing overhead power line and poles will need to be relocated to the outer limits of the existing right-of-way. There are adjacent properties with direct access to 87th Avenue. Driveway access will need to be maintained during construction.

To facilitate construction of the proposed RCBC across Deer Valley Road to a single phase, the roadways will need to be closed to through traffic. All detour routes will need to be established for the project. Access to local properties will need to be maintained.

2.4.2 Ray Road Channel – Tuthill Road to Airport Road

Existing traffic can be maintained during construction of the new channel. The new channel will be located to accommodate the future widening of Ray Road. The construction of the new channel will not affect traffic on Ray Road. To facilitate construction of the channel crossing of Tuthill Road to a single phase, the roadways will need to be closed to through traffic. All detour routes will need to be established for the project. Access to local properties will need to be maintained.

The construction of the channel will also require the reconstruction of private driveways/field entries from adjacent properties on the south side of Ray Road. The driveways are presently ford crossings or unpaved. It is assumed that the driveway will

be temporarily relocated during construction of the channel. It is assumed that the temporary driveway will be at grade and will not be paved. Therefore, temporary pavement was not included in the preliminary cost estimate for this project.

2.4.3 Guadalupe Road Channel at the Eastern Canal

The City of Gilbert will be reconstructing Guadalupe Road in the project limits as part of drainage improvement project. The roadway will be widened 20.7 m (68 ft.) from face of curb to face of curb. The full cost alternatives recommended improvement will construct a box culvert to replace the twin 1370 mm (54 inch) drainage pipes being installed by the City of Gilbert. Installation of the box culvert can occur while maintaining traffic on Guadalupe Road. To facilitate construction of the box culvert to a single phase, the roadways will need to be closed to through traffic. All detour routes will need to be established for the project. Access to local properties will need to be maintained.

2.4.4 Chandler Heights Road Channel – Greenfield Road to Power Road

This project will have the same issues for traffic control and construction sequencing as those associated with the Ray Road project. The reconstruction of the channel will not impact traffic on Chandler Heights Road. Both Recker Road and 180th Street are not paved south of Chandler Heights Road.

To facilitate construction of box culverts on Recker Road and Higley Road to a single phase, the roadways will need to be closed to through traffic. All detour routes will need to be established for the project. Access to local properties will need to be maintained.

The construction of the channel will also require the reconstruction of private driveways/field entries from adjacent properties on the south side of Chandler Heights Road. The driveways are presently concrete ford crossings with small box culverts or pipe culverts. It is assumed that the driveway will be temporarily relocated during construction of the channel. It is assumed that the temporary driveway will be at grade and will not be paved. Therefore, temporary pavement for driveway detours was not included in the preliminary cost estimate.

3.0 DRAINAGE INFORMATION

3.1 87th Avenue Channel – Deer Valley Road to Williams Road

3.1.1 Research

The project area is zoned "X" per the Federal Emergency Management Agency (FEMA) (see FIRM, panels 1180 and 1190 in the Appendix). Zone "X" is defined as "areas of 500-year flood; areas of 100 year flood with average depths of less than 1 foot or with

drainage areas less than 1 square mile; and areas protected by levees from 100-year flood".

Hydrology for the project area is contained in the "Final Drainage Report, Deer Village Units 1, 2, 3, and 4", revised December 12, 1996 by Coe and Van Loo Consultants, Inc., Phoenix, AZ.

A Glendale – Peoria Area Drainage Master Plan (ADMP) was prepared by Camp Dresser & McKee, Inc. and James M. Montgomery for the Flood Control District of Maricopa County (District), in May of 1987. The ADMP made a recommendation to design a 10-year storm drain facility within Pinnacle Peak Road, located one mile north of Deer Valley Road. The storm drain facilities would extend from 91st Avenue and outfall into the Agua Fria River and from 83rd Avenue and outfall into the New River. These projects, if implemented could be extended to capture, convey and discharge a major contributing drainage area, impacting 87th Avenue between Deer Valley Road and Williams Road.

In addition, MCDOT is working on a corridor study for the extension of Estrella Roadway from 99th Avenue to Interstate-17. The drainage systems proposed for this facility could help to mitigate some of the offsite drainage on 87th Avenue.

3.1.2 Calculations

The runoff from the 100-year, 6-hour storm (Q_{100}) at the upper end of the project (intersection of 87th Avenue and Williams Road) was calculated to be 10.0 cms (353 cfs). Q_{10} is calculated to be 26.7% of the Q_{100} value or 2.66 cms (94 cfs).

3.1.3 Cross Drainage Information

Runoff in the project area is sheet flow and is not concentrated in cross drainage.

3.1.4 Retention Basins or Potential Storm Drains

Retention basin north of Williams Road was initially investigated as a method to reduce runoff. The nearest vacant parcels of 8.09 ha (20 acres) are located 804.67 m (2640 feet) north of Williams Road. The retention basin was eliminated from the solution due to its minimal impact and high construction cost.

The outfall of any storm drains would tie into the storm drainage channels along 87th Avenue south of Deer Valley Drive. These channels are shallow, approximately 1.06 m (3.48 feet) deep and have a capacity of about 9.85 cms (348 cfs).

3.2 Ray Road Channel – Tuthill Road to Airport Road

3.2.1 Research

There is no existing hydrology for the area in which this project lies. The L-shaped intersection at Ray Road and Airport Road lies within the floodplain of Waterman Wash and is Zoned 'AE' by FEMA (see FIRM Panels 2510 and 2530 in the Appendix). However, no recommendations for improvements to remove the roadway from the floodplain are being made in this report per MCDOT request (see Alternative Development subsection).

3.2.2 Calculations

Due the fact that no prior hydrology had been done for this area, the design discharges were calculated and provided by the District. See the Drainage Calculations in the Appendix. Table 3.2.2 summarizes the peak discharge values estimated for the 5-year, 10-year, 50-year and 100-year return periods at the Ray Road Channel outlet at Waterman Wash.

Table 3.2.2 Ray Road Channel Peak Discharge at Outlet

5-Year Peak Q in cms	**10-Year Peak Q** in cms	**50-Year Peak Q** in cms	**100-Year Peak Q** in cms
7.4 (262 cfs)	10.6 (376 cfs)	20.3 (717 cfs)	24.1 (852 cfs)

The watershed contributing to this channel was delineated using the "Avondale SW" USGS Quad map. The total drainage area was estimated to be 2.05 sq. km (0.79 sq. mi.). The drainage area is comprised of typical desert vegetation with shrubs and scattered low trees.

3.2.3 Cross Drainage Information

Overland drainage was assessed through a field visit, aerial photography and USGS Quad. Flow within the watershed contributing to the Ray Road Channel flows to the northwest. Along Ray Road the average slope is 0.4% to the west between Tuthill Road and Airport Road.

3.2.4 Retention Basin and Channel Design

Retention basins are not a viable solution since the channel is the north boundary of the contributing watershed. No significant upper watershed area contributes to the channel.

The location of the improved channel will be adjacent and along the south side of Ray Road. The channel will have an offset which will allow for the construction of the future ultimate roadway. Table 3.2.4 summarizes the channel design components for the 50-year and 10-year peak discharges.

Table 3.2.4 Ray Road Channel Design Components

Storm Event	Channel Shape	Channel Slope (m/m)	Channel Depth (m)	Bottom Width (m)	Side Slopes (v:h)	Lining Type	Design Velocity (m/s)
10-year	'vee'	0.00083	1.95 (6.4 ft.)	0	1:4	earthen	0.99 (3.25 fps)
50-year	trapezoidal	0.0040	2.04 (6.7 ft.)	2.44 (8.0 ft.)	1:2	gabion	0.99 (3.26 fps)

Lining types that were evaluated, besides an earthen channel, were rip-rap [457.2 mm (18") thick], gabions [228.6 mm (9") thick] and concrete [152.4 mm (6") thick].

3.3 Guadalupe Road Channel at the Eastern Canal

3.3.1 Research

The property immediately north and south of Guadalupe Road, adjacent and east of the Eastern Canal is located in a FEMA 'AH' flood zone (See FIRM Panel 2680 in the Appendix). Zone 'AH' is defined as "Flood Depths of 0.31 to 0.91 meters (1 to 3 ft.) (usually areas of ponding) with base flood elevations determined." Ponding in this area is due to runoff from the northeast ponding behind the raised embankment of the canal. Neither the canal crossing nor the roadway are located in the FEMA floodplain.

Hydrology for Guadalupe Road at the Eastern Canal was provided by the District. The hydrology for the site is based on the Gilbert/ Chandler Flood Insurance Study (FIS). Guadalupe Road at the Eastern Canal has a contributing area of more than two square miles. The hydrologic model for the FIS is very complex and modifications for the proposed conditions are beyond the scope of this project. The HEC-1 model routes hydrographs between the ponding areas. Table 3.3.1 shows the 100-year FIS peak discharge upstream of Guadalupe Road.

Table 3.3.1 FIS 100-Year Peak Discharges at the Eastern Canal near Guadalupe Road

Conc. Pt.	Location	Peak Discharges in cms (cfs)
Pt6a	Eastern Canal upstream of Houston Rd.	15.74 (556)
Pt6b	Flow over Houston Rd. at the Eastern Canal	13.20 (466)
Pt8b	Eastern Canal upstream of Guadalupe Road	8.98 (317)

A tailwater ditch meanders along the east side of the Eastern Canal. North of Guadalupe Road the ditch has a nearly vertical side slope on the west side, a 1:1 side slope on the east side, a 1.5 m (5 ft.) bottom width and is approximately 2.4 to 3.0 m (8 to 10 ft.) deep.

South of Guadalupe Road, the ditch has 1:1 side slopes, a 0.9 to 1.2 m (3 to 4 ft.) bottom width and is approximately 1.8 to 2.4 m (6 to 8 ft.) deep. The channel narrows slightly as it proceeds southward.

There are two existing 910 mm (36-inch) CMP's which convey any tailwater in the ditch underneath Guadalupe Road. The City of Gilbert presently has plans to upgrade this two-barrel culvert to two 1370 mm (54-inch) CMP's. This is to accommodate tailwater flows only and will not help to alleviate any flooding problems due to storm runoff being captured by the ditch.

3.3.2 Calculations

After reviewing the peak discharges at the site, 8.98 cms (317 cfs) was selected as the design discharge for the high cost alternative.

The dynamics of the hydrology and hydraulics at the site preclude a detailed analysis. However, simplified hydraulic calculations and engineering judgment were used to develop alternatives. Calculations to size the new structure at Guadalupe Road was performed using the Federal Highway Administration's HY8 computer program. Output from the HY8 computer program are provided in the Appendix. The upstream channel was sized using normal depth. Normal depth calculations were performed to determine whether an energy gradient was available for a given alternative to flow hydraulically. Supporting calculations are provided in the Appendix.

3.3.3 Cross Drainage Information

Storm water volumes which exceed the available storage adjacent to the Eastern Canal are conveyed in either the Eastern Canal or parallel to the canal to the south. In general, storm water does not cross the Eastern Canal.

3.3.4 Retention Basins or Potential Storm Drain

Existing detention facilities are located immediately downstream of Guadalupe Road. No comprehensive analyses have been performed to date for this facility. The City of Gilbert has constructed a channel south of Guadalupe Road which is proposed to divert flood flows from the existing tailwater ditch to an existing retention basin. The spillway needed to divert these flood flows is not yet constructed. The diversion channel is trapezoidal in shape with a 1.8 m (6 ft.) bottom, 1:3 side slopes, and a depth of approximately 1.2 m (4 ft.). In addition to the diversion channel, the detention basin receives flow from two other directions.

The retention basin was constructed by the City of Gilbert and has a capacity of approximately 123,348 cubic meters (100 acre-feet). The basin is to be evacuated by a pump to the tailwater ditch after the storm recedes. The basin is approximately 1.6 hectares (4 acres) in size with a depth of approximately 6.7 m (22 ft.).

3.4 Chandler Heights Channel – Greenfield Road to Power Road

3.4.1 Research

The area contributing stormwater runoff to the Chandler Heights Road channel originates in the Santan Mountains south of the roadway. Runoff is generally conveyed north and west from the mountains to the channel. The channel directs stormwater west, ultimately, to the EMF. The area contributing to the channel is included in the Queen Creek Area Drainage Master Study (ADMS). The District revised the original ADMS hydrologic models to account for the channel and developed design storm discharges for any proposed improvements. Table 3.4.1 presents the results of the hydrologic modeling along Chandler Heights Road at the major cross-streets for the 5, 10, 50, and 100-year frequency, 24-hour duration storms. Table 3.4.2 presents the results of the District's hydrologic modeling along Chandler Heights Road at the major cross-streets for the 5, 10, 50, and 100-year frequency, 6-hour duration storms. Existing conditions represent current development within the contributing watershed. Future conditions represent ultimate build out of contributing watershed with 100-year, 2-hour retention for all new developments.

Table 3.4.1 Chandler Heights Road Channel Peak Discharge (24-hour storm duration)

Conc. Pt	Description	5-Year		10-Year		50-Year		100-Year	
		Existing	Future	Existing	Future	Existing	Future	Existing	Future
C550	Recker & Chandler	3.65 (129)	n.a.	6.26 (221)	n.a.	13.82 (488)	4.84 (171)	17.81 (629)	9.37 (331)
C568	Higley & Chandler	4.19 (148)	n.a.	7.22 (255)	n.a.	15.77 (557)	4.93 (174)	20.42 (721)	10.11 (357)
C574	Greenfield & Chandler	5.69 (201)	n.a.	9.83 (347)	n.a.	21.32 (753)	6.12 (216)	27.69 (978)	12.74 (450)

Note: Discharge is in cms (cfs)

Table 3.4.2 Chandler Heights Road Channel Peak Discharge (6-hour storm duration)

Conc. Pt	Description	5-Year		10-Year		50-Year		100-Year	
		Existing	Future	Existing	Future	Existing	Future	Existing	Future
C550	Recker & Chandler	3.96 (140)	n.a.	6.46 (228)	n.a.	14.87 (525)	2.18 (77)	18.60 (657)	7.42 (262)
C568	Higley & Chandler	4.45 (157)	n.a.	7.25 (256)	n.a.	16.76 (592)	1.16 (41)	20.98 (741)	7.11 (251)
C574	Greenfield & Chandler	5.95 (210)	n.a.	9.77 (345)	n.a.	22.57 (797)	1.02 (36)	28.18 (995)	7.48 (264)

Note: Discharge is in cms (cfs)

The proposed Greenfield Acres development, located at the southeast corner of Greenfield and Chandler Heights roads, will be constructing the channel along the south side of Chandler Heights Road along their entire frontage. The Greenfield Acre's channel will be sized for 14.16 cms (500 cfs).

3.4.2 Calculations

Upon review of the District's peak discharges, the 10-year existing and 100-year future discharges were selected for the low and full cost alternatives, respectively. The 100-year future condition discharge of 12.74 cms (450 cfs) is approximately equivalent to the 25-year storm event for existing conditions. Alternative channel types were evaluated for the various peak discharges. Earthen, riprap, gabion, and concrete channels were evaluated for both the high and low alternatives. A spreadsheet is provided in the Appendix which presents an initial comparison between the channel types. Using normal depth calculations to size the channels, it was determined that an earthen channel would be the most cost effective solution to convey the stormwater to the EMF.

Three existing crossings were identified along the Chandler Heights Road Channel; a private driveway west of Higley Road, three EACPs at Higley Road, and two low-flow crossings at Recker Road and 180th Street. Calculations to size new structures at these location were performed using the Federal Highway Administration's HY8 computer program. Output from the HY8 computer program are provided in the Drainage Calculations in the Appendix.

3.4.3 Cross Drainage Information

Stormwater does not cross Chandler Heights Road unless the peak discharges exceed the existing channel capacity. It should be noted that the original Queen Creek ADMS did not consider the impact of the existing channel.

3.4.4 Retention Basins or Potential Storm Drain

Detention facilities are considered impractical considering the size of the contributing area originating in the Santan Mountains.

10.5 Drainage Calculations

DMJM ARIZONA, INC.	PROJECT MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION CANDIDATE ASSESSMENT REPORT	PROJECT NO.6597		SHT. NO.
		BY JWG	DATE 2/10/98	
SUBJECT 87th Avenue, Deer Valley Road to Williams Road		REFERENCE		

1. Assumptions: Use hydrology from "Final Drainage Report, Deer Valley Units 1, 2, 3 & 4" Revised 12/12/96 by Coe amd Van Loo.
   1. 100 year Q at 87th Ave. and Deer Valley Road = 634 cfs
   2. 100 year Q at 87th Ave. and Williams Road = 353 cfs
   3. 87th Ave. channel South of Deer Valley Road: depth = 3.47' flow line = 1274.65

   Ground Slope between William Road and Deer Valley Road is 14' per 1/2 mile

   S = 14' / 2640' = 0.005 fpf

   From US Army Corps of Engineers Design Memorandum No. 2

Flood Frequency	Percent of SPF For Urbanized Watersheds
SPF	100
100 years	45
50 years	32
25 years	21
10 years	12
5 years	7
2 years	2

   Ratio of 100 year to 10 year = .12/.45 = 0.267

   10 year Q at 87th Ave. and Williams Road = 353 x .267 = 94 cfs

2. Check street capacity at full built-out. See attached Flow Master calculations.

   Q = 56 cfs Insufficient to convey either 100 year or 10 year flows.

3. Check conduit size required for Q = 353 cfs. See attached Flow Master Calculations.

   D = 76 inch Too large to match down stream conditions.

4. Check (by scale) if there is approximately 60 feet (18 m) available on the west side for a drainage easement in the front yards.

   No. There are 9 lots that do not qualify.

5. Find open channel configuration that will convey 353 cfs and meet the criteria for freeboard and Froude Number

   See atttached Flow Master Calculations.

6. Find open channel configuration that will convey 94 cfs and meet the criteria for freeboard and Froude Number

   See atttached Flow Master Calculations.

GILA RIVER BASIN
NEW RIVER
AND PHOENIX CITY STREAMS
ARIZONA

DESIGN MEMORANDUM NO. 2

HYDROLOGY

Part 2

U.S. Army Engineer District, Los Angeles
Corps of Engineers
1982

analysis were (1) to determine 100-year flood peak discharges for the design of ACDC and the delineation of the floodways below the authorized dams, and (2) to review previous results for the Agua Fria River. Design discharges for the urbanized watersheds below the authorized dams were determined from the discharge frequency relationships derived in the Part 1 hydrology report, which are summarized below. Revised discharge frequency values for the Agua Fria River downstream from Waddell Dam are based on the procedures discussed in this section.

6.02 Discharge Frequency Analysis for Urbanized Basins. Discharge frequency relationships for urbanized areas were derived in the Part 1 hydrology report from the discharge frequency curves for two stream gages located on catchments with significant percentages of impervious cover: Agua Fria Tributary at Youngtown (USGS No. 9-5137) and Tucson Arroyo at Vine Avenue (USGS No. 9-4830). Representing impervious cover of 40 percent and 60 percent, respectively, the ratios of n-year flood peak discharge to SPF peak discharge for the Youngtown gage frequency curve and for the Tucson gage frequency curve were averaged to derive the following adopted relationships for urbanized basins in the Phoenix region.

n-Year Flood	Percent of SPF for an urbanized watershed
SPF	100
100	45
50	32
25	21
10	12
5	7
2	3

i.e. 10 yr ≈ 26% of 100-yr

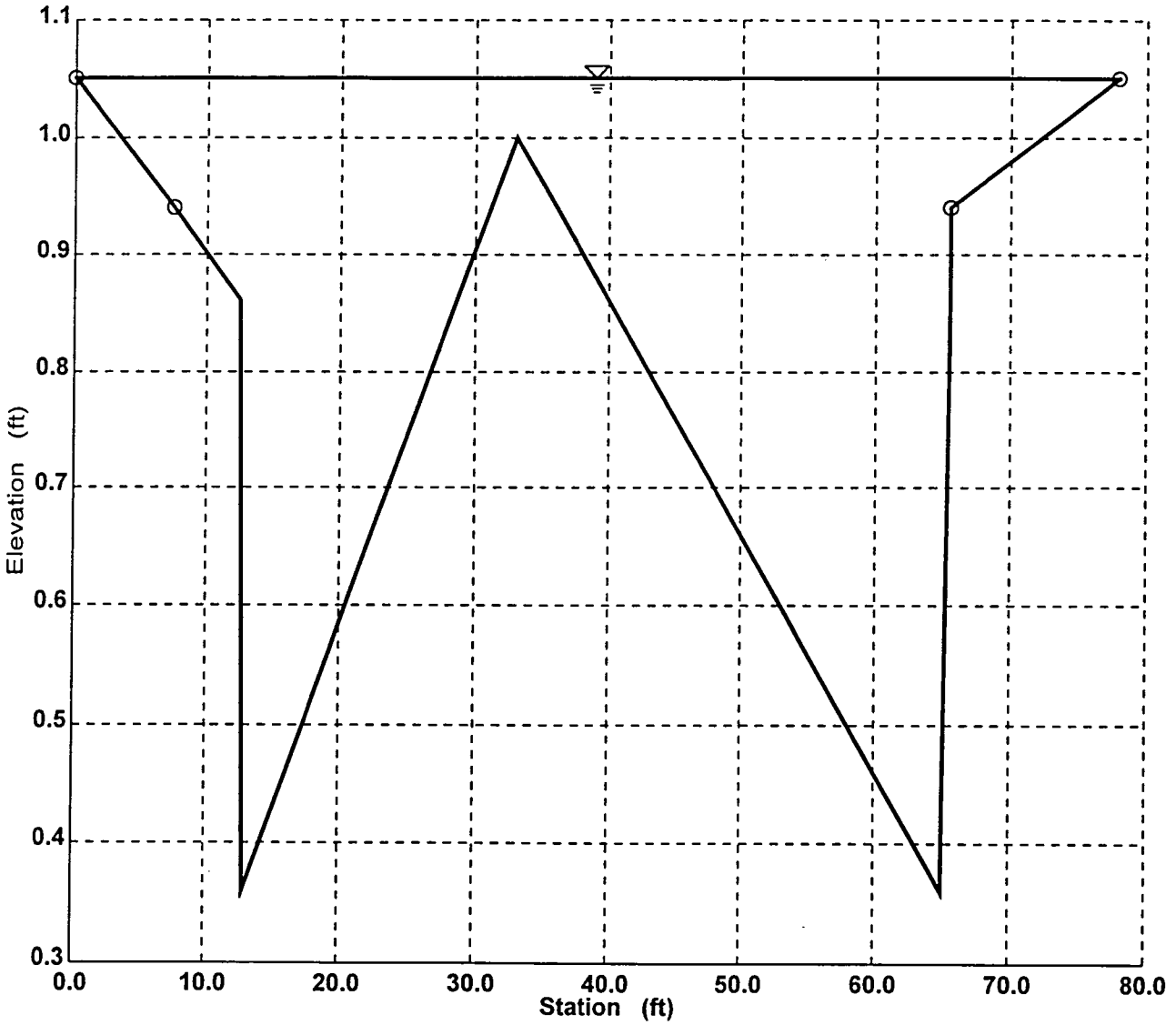
6.03 Discharge Frequency Analysis for Agua Fria River. The discharge frequency analysis for the Agua Fria River was complicated by the existence of Waddell Dam and the lack of long-term streamflow records below the dam. The available stream gage records are given in tables 7 through 11. The records at Avondale and El Mirage are not only short but, except for 1978-1980, occurred during a relatively dry period. Moreover, the accuracy of the large recorded flows at Avondale may be questionable. Therefore, discharge frequency values at points of interest were determined by routing n-year "balanced hydrographs," developed from Waddell Dam volume inflow frequency relationships, through the dam and downstream, adding local flows as appropriate.

a. Waddell Dam Inflow Frequency Analysis. Waddell Dam inflow frequency relationships were developed, where sufficient data were available, from a statistical analysis of the record given in table 7. An attempt to fill gaps in the recorded flows at Waddell Dam by correlation with the fairly long-term Mayer stream gage record failed to yield usable results. Several peak discharge estimates made by the Corps of Engineers and others have been published (ref. 8, 9, and 10). These estimates were evaluated and considered reasonable, based on rain gage records and flow records from other stream gages in the region. Additional estimates were made for this study by

87th Ave. Between Deer Valley and Williams RDs
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\87th&dvr.fm2
Worksheet	CAR- Deer Valley Road to Williams Road
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Section Data		
Wtd. Mannings Coefficient	0.017	
Channel Slope	0.005000	ft/ft
Water Surface Elevation	1.05	ft
Discharge	55.97	cfs



Capacity of 87th Ave.
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\87th&dvr.fm2
Worksheet	CAR- Deer Valley Road to Williams Road
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Channel Slope	0.005000	ft/ft
Water Surface Elevation	1.05	ft

Elevation range: 0.36 ft to 1.05 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	1.05	0.00	7.50	0.025
7.50	0.94	7.50	65.50	0.016
12.50	0.86	65.50	78.00	0.025
13.00	0.36			
33.00	1.00			
65.00	0.36			
65.50	0.86			
65.50	0.94			
78.00	1.05			

Results		
Wtd. Mannings Coefficient	0.017	
Discharge	55.97	cfs
Flow Area	21.53	ft²
Wetted Perimeter	78.51	ft
Top Width	78.00	ft
Height	0.69	ft
Critical Depth	1.02	ft
Critical Slope	0.006408	ft/ft
Velocity	2.60	ft/s
Velocity Head	0.11	ft
Specific Energy	1.16	ft
Froude Number	0.87	
Flow is subcritical.		

Storm drain in 87th Avenue
Worksheet for Circular Channel

Project Description	
Project File	c:\haestad\fmw\87th&dvr.fm2
Worksheet	CAR - Deer Valley Rd. to Williams Rd.
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.012	
Channel Slope	0.005000	ft/ft
Diameter	76.00	in
Discharge	353.00	cfs

Results		
Depth	58.7	in
Flow Area	26.10	ft^2
Wetted Perimeter	13.59	ft
Top Width	5.31	ft
Critical Depth	5.06	ft
Percent Full	77.20	
Critical Slope	0.004655	ft/ft
Velocity	13.53	ft/s
Velocity Head	2.84	ft
Specific Energy	7.73	ft
Froude Number	1.08	
Maximum Discharge	403.08	cfs
Full Flow Capacity	374.72	cfs
Full Flow Slope	0.004437	ft/ft
Flow is supercritical.		

Trap. Channel Low Cost Alternative
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\87th&dvr.fm2
Worksheet	CAR - Deer Valley to Williams
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.016	
Channel Slope	0.005000	ft/ft
Left Side Slope	1.000000	H : V
Right Side Slope	1.000000	H : V
Bottom Width	15.00	ft
Discharge	94.00	cfs

Results		
Depth	0.98	ft
Flow Area	15.60	ft²
Wetted Perimeter	17.76	ft
Top Width	16.95	ft
Critical Depth	1.04	ft
Critical Slope	0.004011	ft/ft
Velocity	6.02	ft/s
Velocity Head	0.56	ft
Specific Energy	1.54	ft
Froude Number	1.11	
Flow is supercritical.		

"U" Channel - Low Cost Alternative
Worksheet for Rectangular Channel

Project Description	
Project File	c:\haestad\fmw\87th&dvr.fm2
Worksheet	CAR - Deer Valley Road to Williams Road
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.016	
Channel Slope	0.005000	ft/ft
Bottom Width	5.00	ft
Discharge	94.00	cfs

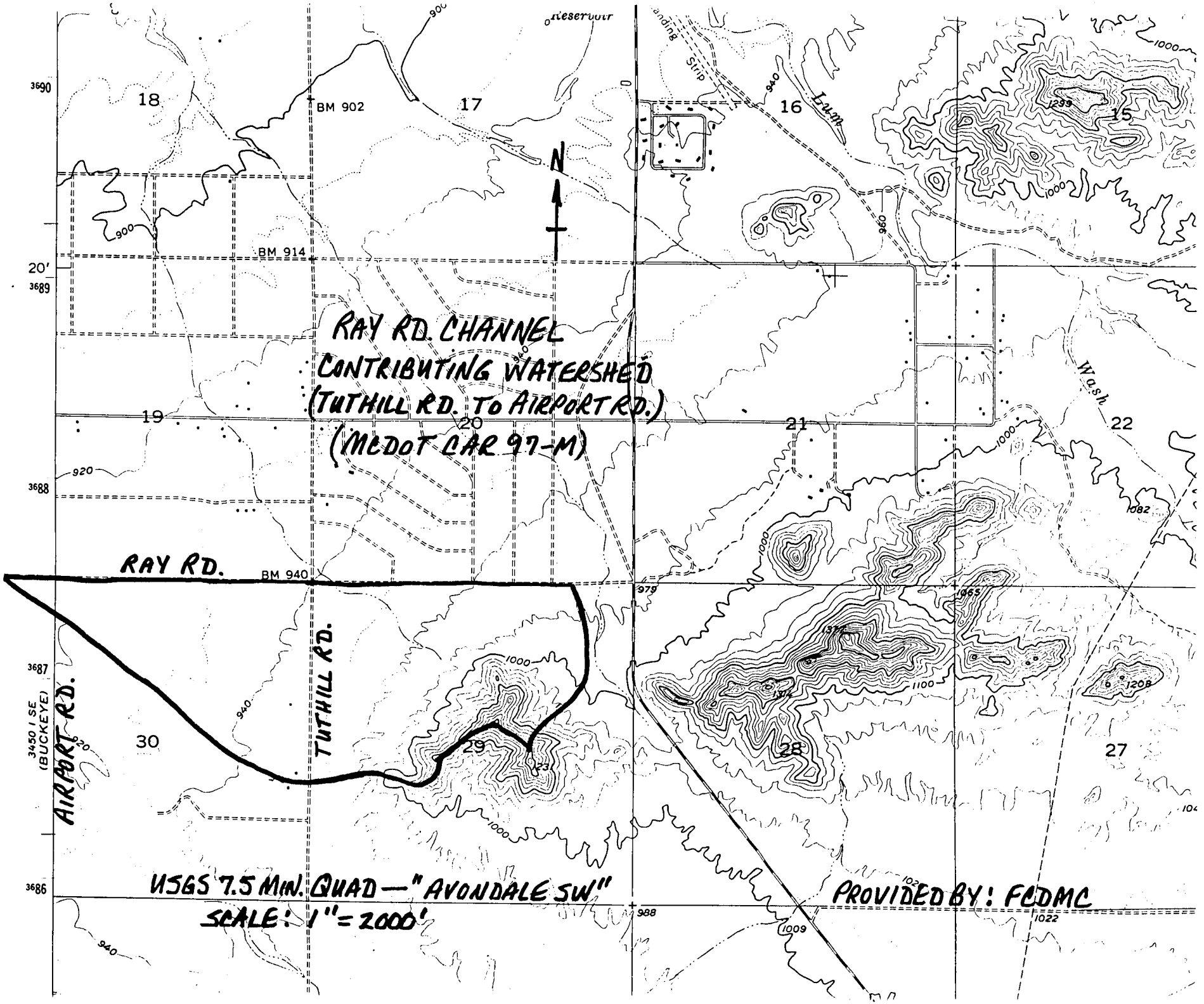
Results		
Depth	2.48	ft
Flow Area	12.38	ft²
Wetted Perimeter	9.95	ft
Top Width	5.00	ft
Critical Depth	2.22	ft
Critical Slope	0.006675	ft/ft
Velocity	7.59	ft/s
Velocity Head	0.90	ft
Specific Energy	3.37	ft
Froude Number	0.85	
Flow is subcritical.		

"U" Channel - Full Alternative
Worksheet for Rectangular Channel

Project Description	
Project File	c:\haestad\fmw\87th&dvr.fm2
Worksheet	CAR - Deer Valley Road to Williams Road
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.016	
Channel Slope	0.005000	ft/ft
Bottom Width	20.00	ft
Discharge	353.00	cfs

Results		
Depth	1.94	ft
Flow Area	38.86	ft²
Wetted Perimeter	23.89	ft
Top Width	20.00	ft
Critical Depth	2.13	ft
Critical Slope	0.003750	ft/ft
Velocity	9.08	ft/s
Velocity Head	1.28	ft
Specific Energy	3.23	ft
Froude Number	1.15	
Flow is supercritical.		


RAY RD. CHANNEL
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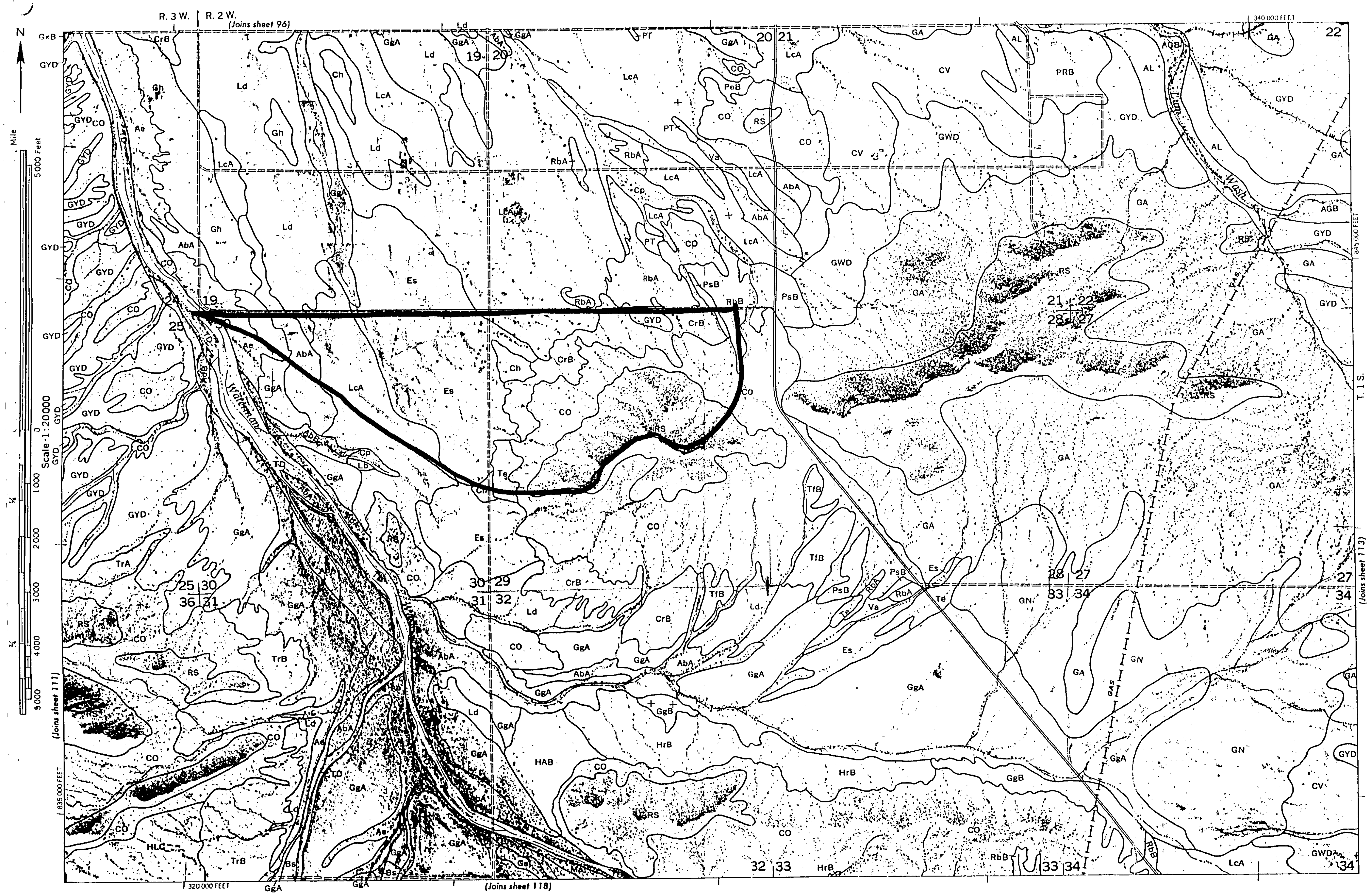
(TUTHILL RD. TO AIRPORT RD.)
(MEDOT CAR 97-M)
RAY RD.
AIRPORT RD.
TUTHILL RD.
BM 902
BM 914
BM 940
N
USGS 7.5 MIN. QUAD — "AVONDALE SW"
SCALE: 1" = 2000'
PROVIDED BY: FCDMC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GgA
AbA
RS
GA
CV
GWD
PRB
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AGB
GN
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CrB
HrB
HAB
GgB
PsB
RbA
RbB
PT
Cp
TrB
TrA
HLC
Te
Va

Landiscor
AERIAL INFORMATION
1710 East Indian School Road, Suite 201
Phoenix, Arizona 85016
phone: 602-248-8989 • fax: 602-266-8116
Phoenix • Denver • Tucson • Las Vegas • Salt Lake City • Dallas / Fort Worth • Houston

PHOTO DATE: JANU
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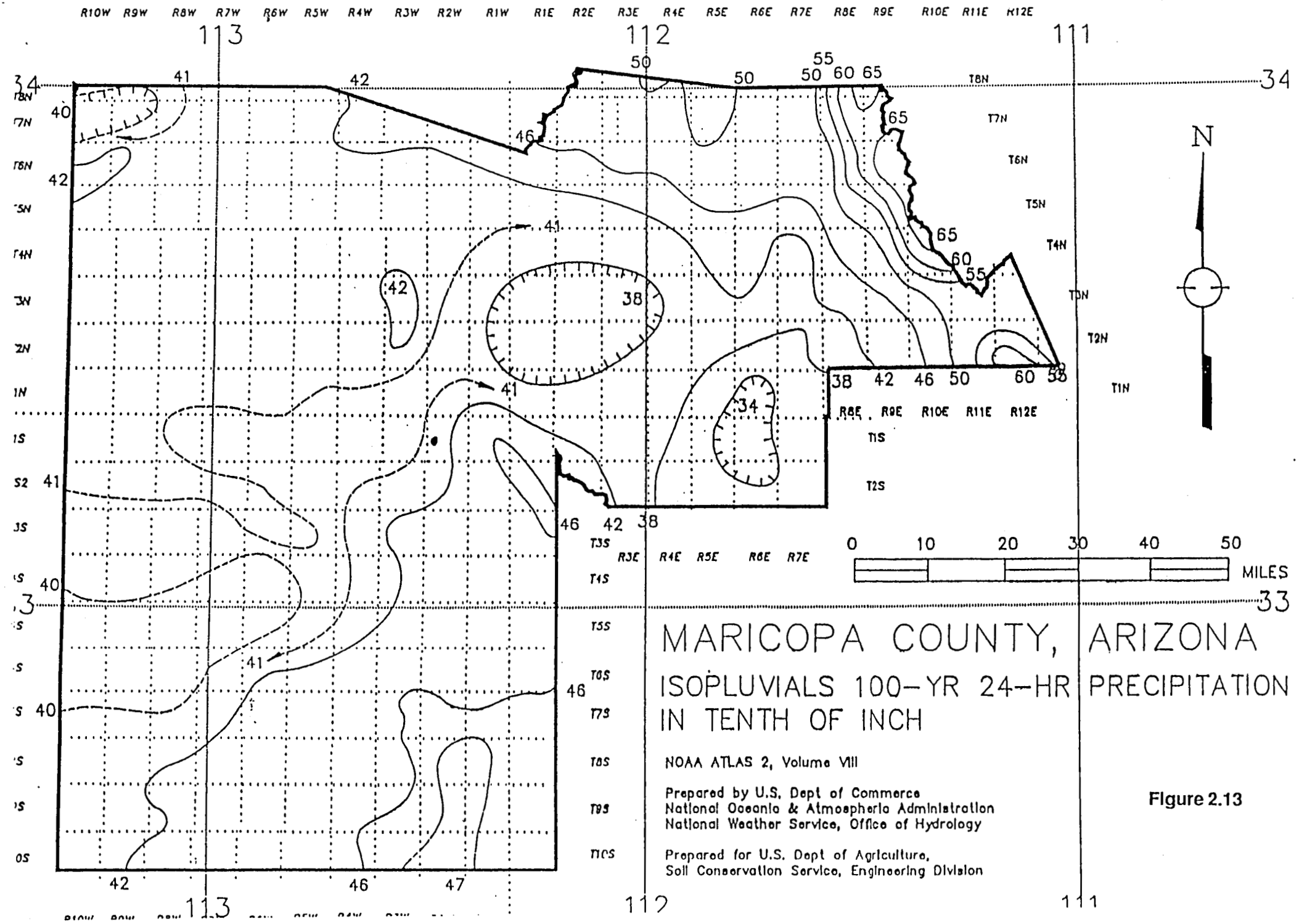
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R3E R4E R5E R6E R7E
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0 10 20 30 40 50
MILES
MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 100-YR 24-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division

Figure 2.13

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Rainfall Runoff PAGE 2 OF

DETAIL C COMPUTED DATE

CHECKED BY DATE

Rainfall - 1

Return	6-hr	24-hr
5	1.7	2.1
10	2.1	2.5
50	3.0	3.65
100	3.35	4.10

HEC1 Run names

Return	6-hr	24-hr
5	RA5-6	RA5-24
10	RA10-6	RA10-24
50	RA50-6	RA50-24
100	RA100-6	RA100-24

Q's

Return	6-hr	24-hr
5	153	262
10	233	376
50	455	717
100	546	852

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Ray Road Channel Hydrology PAGE 1 OF ____

DETAIL ____ COMPUTED ____ DATE ____

____ CHECKED BY ____ DATE ____

Planimeter: Scale factor = 3.788 for sq mi
= 95.83 for acres.

total area = .800
.794
.785
ave = .792

507 acres

Planimetered 3 times and average already taken

Soils = Ae = 5.3 acres	5
GgA = 7.3 acres	7
AbA = 8.9 acres	9
Ld = 1.6	2
LcA = 59.3 + 24.4 = 83.7	84
Es = 141.7	142
Ch = 8.9 + 3.3 = 12	12
CrB = 56.3	56
Te = 9.6	10
GYD = 6.3	6
Co = 82.4	82
RbB = 4.9	5
Rs = 91.6	92
493.7	512

L = 7.5" high elev = 1231' low elev = 920'

scale 3 in = 5000' $\frac{7.5 \text{ in} \mid 5000 \text{ ft}}{3 \text{ in}}$ = 12,500 ft = 2.37 mi

5-YEAR 6-HOUR STORM

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  02/02/1998  TIME  08:28:35 *
*                                       *
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
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X     X  XXXXXXX   XXXXX          X
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X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9.......10

            1           ID   RAY ROAD CHANNEL - MDCOT PROJECT
            2           ID   5-YEAR 6-HOUR STORM
            3           ID   DDM MCUHP1 RAY ROAD CHANNEL
            4           IT       5  2FEB98    0000     300
            5           IO       5
                        * DDM   ***** Updated *****

            6           KK       1
            7           KM   SUB-BASIN 1
            8           KM   6-HOUR RAINFALL, PATTERN NO. 1.40 WAS USED TO FIND TC & R FOR THIS BASIN
            9           KM     L = 2.37  Kb = .043  Adj. Slope =  131.0
           10           BA    .800
           11           IN      15
           12           PB    1.70
           13           KM   THE FOLLOWING PC RECORD USED A 6-HOUR STORM WITH A PATTERN No. OF 1.40
           14           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .075
           15           PC    .087    .099    .119    .148    .230    .407    .778    .881    .919    .945
           16           PC    .957    .968    .980    .990   1.000
           17           LG    .350    .350   4.500    .350  15.000
           18           UC   1.096    .928
           19           UA       0       3       5       8      12      20      43      75      90      96
           20           UA     100
           21           ZZ
```

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  02/02/1998  TIME  08:28:35 *
*                                       *
*****************************************
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```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

RAY ROAD CHANNEL - MDCOT PROJECT
5-YEAR 6-HOUR STORM
DDM MCUHP1 RAY ROAD CHANNEL

5 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	2FEB98	STARTING DATE
ITIME	0000	STARTING TIME
NQ	300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	3FEB98	ENDING DATE
NDTIME	0055	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET

	FLOW	CUBIC FEET PER SECOND
	STORAGE VOLUME	ACRE-FEET
	SURFACE AREA	ACRES
	TEMPERATURE	DEGREES FAHRENHEIT

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	1	153.	4.83	41.	10.	10.	.80		

*** NORMAL END OF HEC-1 ***

10-YEAR 6-HOUR STORM

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  02/02/1998  TIME  08:29:46 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
          LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

            1       ID   RAY ROAD CHANNEL - MDCOT PROJECT
            2       ID   10-YEAR 6-HOUR STORM
            3       ID   DDM MCUHP1 RAY ROAD CHANNEL
            4       IT       5  2FEB98    0000     300
            5       IO       5
                    * DDM   ***** Updated *****

            6       KK       1
            7       KM   SUB-BASIN 1
            8       KM   6-HOUR RAINFALL, PATTERN NO. 1.40 WAS USED TO FIND TC & R FOR THIS BASIN
            9       KM     L = 2.37  Kb = .043  Adj. Slope =  131.0
           10       BA    .800
           11       IN      15
           12       PB    2.10
           13       KM   THE FOLLOWING PC RECORD USED A 6-HOUR STORM WITH A PATTERN No. OF 1.40
           14       PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .075
           15       PC    .087    .099    .119    .148    .230    .407    .778    .881    .919    .945
           16       PC    .957    .968    .980    .990   1.000
           17       LG    .350    .350   4.500    .350  15.000
           18       UC   1.096    .928
           19       UA       0       3       5       8      12      20      43      75      90      96
           20       UA     100
           21       ZZ
```


```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  02/02/1998  TIME  08:29:46 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```


```
                    RAY ROAD CHANNEL - MDCOT PROJECT
                    10-YEAR 6-HOUR STORM
                    DDM MCUHP1 RAY ROAD CHANNEL

  5 IO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN          5  MINUTES IN COMPUTATION INTERVAL
                     IDATE     2FEB98  STARTING DATE
                     ITIME       0000  STARTING TIME
                        NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE     3FEB98  ENDING DATE
                    NDTIME       0055  ENDING TIME
                     ICENT         19  CENTURY MARK

                COMPUTATION INTERVAL      .08 HOURS
                    TOTAL TIME BASE   24.92 HOURS

            ENGLISH UNITS
                DRAINAGE AREA        SQUARE MILES
```

PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	1	233.	4.83	60.	15.	15.	.80		

*** NORMAL END OF HEC-1 ***

50-YEAR 6-HOUR STORM

```
**************************************
*                                    *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)*
*            SEPTEMBER 1990          *
*             VERSION 4.0            *
*                                    *
* RUN DATE  02/02/1998  TIME  08:30:48*
*                                    *
**************************************
```

```
**************************************
*                                    *
*   U.S. ARMY CORPS OF ENGINEERS     *
*   HYDROLOGIC ENGINEERING CENTER    *
*         609 SECOND STREET          *
*       DAVIS, CALIFORNIA 95616      *
*           (916) 756-1104           *
*                                    *
**************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

HEC-1 INPUT PAGE 1

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1           ID   RAY ROAD CHANNEL - MDCOT PROJECT
  2           ID   50-YEAR 6-HOUR STORM
  3           ID   DDM MCUHP1 RAY ROAD CHANNEL
  4           IT       5  2FEB98    0000     300
  5           IO       5
              * DDM   ***** Updated *****

  6           KK       1
  7           KM   SUB-BASIN 1
  8           KM   6-HOUR RAINFALL, PATTERN NO. 1.40 WAS USED TO FIND TC & R FOR THIS BASIN
  9           KM     L = 2.37  Kb = .043  Adj. Slope =  131.0
 10           BA    .800
 11           IN      15
 12           PB   3.00
 13           KM   THE FOLLOWING PC RECORD USED A 6-HOUR STORM WITH A PATTERN No. OF 1.40
 14           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .075
 15           PC    .087    .099    .119    .148    .230    .407    .778    .881    .919    .945
 16           PC    .957    .968    .980    .990   1.000
 17           LG    .350    .350   4.500    .350  15.000
 18           UC   1.096    .928
 19           UA       0       3       5       8      12      20      43      75      90      96
 20           UA     100
 21           ZZ
```


```
**************************************
*                                    *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)*
*            SEPTEMBER 1990          *
*             VERSION 4.0            *
*                                    *
* RUN DATE  02/02/1998  TIME  08:30:48*
*                                    *
**************************************
```

```
**************************************
*                                    *
*   U.S. ARMY CORPS OF ENGINEERS     *
*   HYDROLOGIC ENGINEERING CENTER    *
*         609 SECOND STREET          *
*       DAVIS, CALIFORNIA 95616      *
*           (916) 756-1104           *
*                                    *
**************************************
```


RAY ROAD CHANNEL - MDCOT PROJECT
50-YEAR 6-HOUR STORM
DDM MCUHP1 RAY ROAD CHANNEL

5 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	2FEB98	STARTING DATE
ITIME	0000	STARTING TIME
NQ	300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	3FEB98	ENDING DATE
NDTIME	0055	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS
DRAINAGE AREA SQUARE MILES

PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	1	455.	4.83	118.	30.	29.	.80		

*** NORMAL END OF HEC-1 ***

100-YEAR 6-HOUR STORM

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             SEPTEMBER 1990            *
*              VERSION 4.0              *
*                                       *
*  RUN DATE  02/02/1998  TIME  08:31:42 *
*                                       *
*****************************************
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```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
          LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

            1       ID   RAY ROAD CHANNEL - MDCOT PROJECT
            2       ID   100-YEAR 6-HOUR STORM
            3       ID   DDM MCUHP1 RAY ROAD CHANNEL
            4       IT       5  2FEB98    0000     300
            5       IO       5
                    * DDM   ***** Updated *****

            6       KK       1
            7       KM   SUB-BASIN 1
            8       KM   6-HOUR RAINFALL, PATTERN NO. 1.40 WAS USED TO FIND TC & R FOR THIS BASIN
            9       KM     L = 2.37  Kb = .043  Adj. Slope =  131.0
           10       BA    .800
           11       IN      15
           12       PB    3.35
           13       KM   THE FOLLOWING PC RECORD USED A 6-HOUR STORM WITH A PATTERN No. OF 1.40
           14       PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .075
           15       PC    .087    .099    .119    .148    .230    .407    .778    .881    .919    .945
           16       PC    .957    .968    .980    .990   1.000
           17       LG    .350    .350   4.500    .350  15.000
           18       UC   1.096    .928
           19       UA       0       3       5       8      12      20      43      75      90      96
           20       UA     100
           21       ZZ
```

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             SEPTEMBER 1990            *
*              VERSION 4.0              *
*                                       *
*  RUN DATE  02/02/1998  TIME  08:31:42 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

RAY ROAD CHANNEL - MDCOT PROJECT
100-YEAR 6-HOUR STORM
DDM MCUHP1 RAY ROAD CHANNEL

5 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	2FEB98	STARTING DATE
ITIME	0000	STARTING TIME
NQ	300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	3FEB98	ENDING DATE
NDTIME	0055	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT									
	1	546.	4.83	142.	36.	35.	.80		

*** NORMAL END OF HEC-1 ***

5-YEAR 24-HOUR STORM

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  02/02/1998  TIME  08:20:55 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX           XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
          LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

             1      ID   DDM MCUHP1 RAY ROAD CHANNEL
             2      ID   RAY ROAD CHANNEL - MCDOT PROJECT
             3      ID   5 YEAR 24 HOUR STORM
             4      IT       5  2FEB98    0000     300
             5      IO       5
                    * DDM   ***** Inserted *****

             6      KK       1
             7      KM   SUB-BASIN 1
             8      KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
             9      KM     L = 2.37  Kb = .043  Adj. Slope =  131.0
            10      BA    .800
            11      IN     15
            12      PB    2.1
            13      KM   THE FOLLOWING PC RECORD USED A 24-HR SCS TYPE II STORM
            14      PC    .000    .002    .005    .008    .011    .014    .017    .020    .023    .026
            15      PC    .029    .032    .035    .038    .041    .044    .048    .052    .056    .060
            16      PC    .064    .068    .072    .076    .080    .085    .090    .095    .100    .105
            17      PC    .110    .115    .120    .126    .133    .140    .147    .155    .163    .172
            18      PC    .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
            19      PC    .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
            20      PC    .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
            21      PC    .913    .918    .922    .926    .930    .934    .938    .942    .946    .950
            22      PC    .953    .956    .959    .962    .965    .968    .971    .974    .977    .980
            23      PC    .983    .986    .989    .992    .995    .998   1.000
            24      LG    .350    .350   4.500    .350  15.000
            25      UC    .525    .410
            26      UA       0       3       5       8      12      20      43      75      90      96
            27      UA     100
            28      ZZ
```

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  02/02/1998  TIME  08:20:55 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104              *
*                                       *
*****************************************
```

DDM MCUHP1 RAY ROAD CHANNEL
RAY ROAD CHANNEL - MCDOT PROJECT
5 YEAR 24 HOUR STORM

```
5 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

  IT          HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE     2FEB98  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ        300  NUMBER OF HYDROGRAPH ORDINATES
```

NDDATE	3FEB98	ENDING DATE
NDTIME	0055	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
	HYDROGRAPH AT									
+		1	262.	12.33	39.	12.	11.	.80		

*** NORMAL END OF HEC-1 ***

10-YEAR 24-HOUR STORM

```
**************************************
*                                    *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)*
*            SEPTEMBER 1990          *
*             VERSION 4.0            *
*                                    *
* RUN DATE  02/02/1998  TIME  08:25:20*
*                                    *
**************************************
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**************************************
*                                    *
*    U.S. ARMY CORPS OF ENGINEERS    *
*    HYDROLOGIC ENGINEERING CENTER   *
*          609 SECOND STREET         *
*       DAVIS, CALIFORNIA 95616      *
*           (916) 756-1104           *
*                                    *
**************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

HEC-1 INPUT PAGE 1

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1           ID   DDM MCUHP1 RAY ROAD CHANNEL
  2           ID   RAY ROAD CHANNEL - MCDOT PROJECT
  3           ID   10 YEAR 24 HOUR STORM
  4           IT       5  2FEB98    0000     300
  5           IO       5
              * DDM   ***** Inserted *****

  6           KK       1
  7           KM   SUB-BASIN 1
  8           KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
  9           KM     L = 2.37  Kb = .043  Adj. Slope =  131.0
 10           BA    .800
 11           IN      15
 12           PB     2.5
 13           KM   THE FOLLOWING PC RECORD USED A 24-HR SCS TYPE II STORM
 14           PC    .000    .002    .005    .008    .011    .014    .017    .020    .023    .026
 15           PC    .029    .032    .035    .038    .041    .044    .048    .052    .056    .060
 16           PC    .064    .068    .072    .076    .080    .085    .090    .095    .100    .105
 17           PC    .110    .115    .120    .126    .133    .140    .147    .155    .163    .172
 18           PC    .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
 19           PC    .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
 20           PC    .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
 21           PC    .913    .918    .922    .926    .930    .934    .938    .942    .946    .950
 22           PC    .953    .956    .959    .962    .965    .968    .971    .974    .977    .980
 23           PC    .983    .986    .989    .992    .995    .998   1.000
 24           LG    .350    .350   4.500    .350  15.000
 25           UC    .525    .410
 26           UA       0       3       5       8      12      20      43      75      90      96
 27           UA     100
 28           ZZ
```


```
**************************************
*                                    *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)*
*            SEPTEMBER 1990          *
*             VERSION 4.0            *
*                                    *
* RUN DATE  02/02/1998  TIME  08:25:20*
*                                    *
**************************************
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**************************************
*                                    *
*    U.S. ARMY CORPS OF ENGINEERS    *
*    HYDROLOGIC ENGINEERING CENTER   *
*          609 SECOND STREET         *
*       DAVIS, CALIFORNIA 95616      *
*           (916) 756-1104           *
*                                    *
**************************************
```


DDM MCUHP1 RAY ROAD CHANNEL
RAY ROAD CHANNEL - MCDOT PROJECT
10 YEAR 24 HOUR STORM

```
5 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

  IT          HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE     2FEB98  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE     3FEB98  ENDING DATE
```

NDTIME	0055	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT									
	1	376.	12.33	53.	16.	15.	.80		

*** NORMAL END OF HEC-1 ***

50-YEAR 24-HOUR STORM

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  02/02/1998  TIME  08:25:01 *
*                                       *
*****************************************
```

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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*            (916) 756-1104             *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
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DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
          LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

            1       ID   DDM MCUHP1 RAY ROAD CHANNEL
            2       ID   RAY ROAD CHANNEL - MCDOT PROJECT
            3       ID   50 YEAR 24 HOUR STORM
            4       IT       5  2FEB98    0000     300
            5       IO       5
                    * DDM   ***** Inserted *****

            6       KK       1
            7       KM   SUB-BASIN 1
            8       KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
            9       KM     L = 2.37  Kb = .043  Adj. Slope =  131.0
           10       BA    .800
           11       IN      15
           12       PB    3.65
           13       KM   THE FOLLOWING PC RECORD USED A 24-HR SCS TYPE II STORM
           14       PC    .000    .002    .005    .008    .011    .014    .017    .020    .023    .026
           15       PC    .029    .032    .035    .038    .041    .044    .048    .052    .056    .060
           16       PC    .064    .068    .072    .076    .080    .085    .090    .095    .100    .105
           17       PC    .110    .115    .120    .126    .133    .140    .147    .155    .163    .172
           18       PC    .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
           19       PC    .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
           20       PC    .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
           21       PC    .913    .918    .922    .926    .930    .934    .938    .942    .946    .950
           22       PC    .953    .956    .959    .962    .965    .968    .971    .974    .977    .980
           23       PC    .983    .986    .989    .992    .995    .998   1.000
           24       LG    .350    .350   4.500    .350  15.000
           25       UC    .525    .410
           26       UA       0       3       5       8      12      20      43      75      90      96
           27       UA     100
           28       ZZ
```


```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  02/02/1998  TIME  08:25:01 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*            (916) 756-1104             *
*                                       *
*****************************************
```


DDM MCUHP1 RAY ROAD CHANNEL
RAY ROAD CHANNEL - MCDOT PROJECT
50 YEAR 24 HOUR STORM

```
  5 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN           5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      2FEB98  STARTING DATE
                      ITIME        0000  STARTING TIME
```

NQ	300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	3FEB98	ENDING DATE
NDTIME	0055	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT									
	1	717.	12.33	99.	28.	27.	.80		

*** NORMAL END OF HEC-1 ***

100-YEAR 24-HOUR STORM

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  02/02/1998  TIME  08:26:26 *
*                                       *
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
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DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
          LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

             1          ID   DDM MCUHP1 RAY ROAD CHANNEL
             2          ID   RAY ROAD CHANNEL - MCDOT PROJECT
             3          ID   100-YEAR 24-HOUR STORM
             4          IT       5  2FEB98    0000     300
             5          IO       5
                        * DDM   ***** Inserted *****

             6          KK       1
             7          KM   SUB-BASIN 1
             8          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
             9          KM     L = 2.37  Kb = .043  Adj. Slope =  131.0
            10          BA    .800
            11          IN      15
            12          PB   4.10
            13          KM   THE FOLLOWING PC RECORD USED A 24-HR SCS TYPE II STORM
            14          PC    .000    .002    .005    .008    .011    .014    .017    .020    .023    .026
            15          PC    .029    .032    .035    .038    .041    .044    .048    .052    .056    .060
            16          PC    .064    .068    .072    .076    .080    .085    .090    .095    .100    .105
            17          PC    .110    .115    .120    .126    .133    .140    .147    .155    .163    .172
            18          PC    .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
            19          PC    .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
            20          PC    .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
            21          PC    .913    .918    .922    .926    .930    .934    .938    .942    .946    .950
            22          PC    .953    .956    .959    .962    .965    .968    .971    .974    .977    .980
            23          PC    .983    .986    .989    .992    .995    .998   1.000
            24          LG    .350    .350   4.500    .350  15.000
            25          UC    .525    .410
            26          UA       0       3       5       8      12      20      43      75      90      96
            27          UA     100
            28          ZZ
```


```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  02/02/1998  TIME  08:26:26 *
*                                       *
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```


```
                        DDM MCUHP1 RAY ROAD CHANNEL
                        RAY ROAD CHANNEL - MCDOT PROJECT
                        100-YEAR 24-HOUR STORM

    5 IO          OUTPUT CONTROL VARIABLES
                        IPRNT          5  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                         NMIN          5  MINUTES IN COMPUTATION INTERVAL
                        IDATE     2FEB98  STARTING DATE
                        ITIME       0000  STARTING TIME
```

NQ	300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	3FEB98	ENDING DATE
NDTIME	0055	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT									
	1	852.	12.33	118.	33.	32.	.80		

*** NORMAL END OF HEC-1 ***

MCDOT CAR
DMJM Proj#: 6597.03

Ray Road Channel Between Tuthill Road and Airport Road -- Channel Design Options

LOW COST 10-YEAR SOLUTION
PEAK Q = 376 cfs

Channel Type	ROW (sq.ft per foot)	Concrete Pipe (lin.ft)	Channel Exc. (cu.meters)	Bank Protection (cu.meter or sq. yard)	ROW ($/ft)	Concrete Pipe ($/ft)	Channel Exc. ($/ft)	Bank Protection ($/ft)	Channel Total ($/ft)	Channel Total ($)	Channel Total and Drop $'s
earth	67.2	0	4.6	-	$10.80	$0.00	$27.84	-	$39	$192,018	**$244,473.33**
rip-rap	52.8	0	3.0	1.6	$8.48	$0.00	$18.27	$81.46	$108	$537,832	**$537,831.77**
gabion	44.8	0	2.7	0.7	$7.20	$0.00	$16.26	$33.19	$57	$281,524	**$281,523.80**
concrete	33.6	0	1.7	2.4	$5.40	$0.00	$10.44	$52.74	$69	$340,846	**$343,242.99**

	Channel Design Depth (ft)	Bottom Width (ft)	Top Width (ft)	SideSlopes (h:1)	Lining Thickness (ft)
earth	6.4	0.0	51.2	4	-
rip-rap	4.8	8.0	36.8	3	1.50
gabions	5.2	8.0	28.8	2	0.75
concrete	4.8	8.0	17.6	1	0.50

DROP STRUCTURE CALCULATIONS

	Existing Slope (ft/ft)	Design Slope (ft/ft)	Elevation Difference	#of 3' Drop Structures	Drop Struct. Type	Drop Struct. Length	Drop Struct. Width	Riprap Volume (cu. yd.)	Drop Struct. Cost (ea.)	Drop Struct. Total Cost
earth	0.004	0.00083	15.8	6	riprap	39.0	52.8	229	$8,742.49	$52,454.94
concrete	0.004	0.0025	7.5	3	concrete	1.0	21.6	4	$799.13	$2,397.38

UNIT COSTS

		(English)	(SI)
ROW$:	$7,000.00	per acre	
Concrete Pipe$:	$0.00	per lf	
Channel Exc.$:	$6.00		per cu.meter
Rip-Rap$:	$50.00		per cu.meter
Gabions$:	$50.00		per cu.meter
Concrete$:	$22.00	per sq. yard	
Concrete$:	$200.00	per cu. yd.	
	Channel Inc. Length (ft)	Channel Total Length (ft)	
	1.0	4970.0	

10-yr - Ray Road Channel
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\rayrd10b.fm2
Worksheet	(2earthen) channel design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.025	
Channel Slope	0.000830	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	0.00	ft
Discharge	376.00	cfs

Results		
Depth	5.38	ft
Flow Area	115.83	ft²
Wetted Perimeter	44.37	ft
Top Width	43.05	ft
Critical Depth	3.53	ft
Critical Slope	0.007846	ft/ft
Velocity	3.25	ft/s
Velocity Head	0.16	ft
Specific Energy	5.54	ft
Froude Number	0.35	
Flow is subcritical.		

Notes:

'n' = 0.025 channel bottom is earth, sides are earth with grass and weeds.

Using 4:1 side slopes for earthen channel banks.

Channel will require bank protection for velocities higher than 0.99 m/s (3.25 ft/s).

10-yr - Ray Road Channel
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\rayrd10b.fm2
Worksheet	(3w/riprap) channel design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.032	
Channel Slope	0.004000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	8.00	ft
Discharge	376.00	cfs

Results		
Depth	3.79	ft
Flow Area	73.52	ft^2
Wetted Perimeter	31.99	ft
Top Width	30.76	ft
Critical Depth	2.89	ft
Critical Slope	0.012647	ft/ft
Velocity	5.11	ft/s
Velocity Head	0.41	ft
Specific Energy	4.20	ft
Froude Number	0.58	
Flow is subcritical.		

Notes:

'n' = 0.036 for riprap (maximum).

10-yr - Ray Road Channel
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\rayrd10b.fm2
Worksheet	(4w/gabions) channel design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.032	
Channel Slope	0.004000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	376.00	cfs

Results		
Depth	4.18	ft
Flow Area	68.38	ft^2
Wetted Perimeter	26.69	ft
Top Width	24.72	ft
Critical Depth	3.14	ft
Critical Slope	0.012624	ft/ft
Velocity	5.50	ft/s
Velocity Head	0.47	ft
Specific Energy	4.65	ft
Froude Number	0.58	
Flow is subcritical.		

Notes:

'n' = 0.036 for riprap (maximum).

10-yr - Ray Road Channel
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\rayrd10b.fm2
Worksheet	(5w/6"concrete lining) channel design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.016	
Channel Slope	0.002500	ft/ft
Left Side Slope	1.000000	H : V
Right Side Slope	1.000000	H : V
Bottom Width	8.00	ft
Discharge	376.00	cfs

Results		
Depth	3.82	ft
Flow Area	45.16	ft^2
Wetted Perimeter	18.81	ft
Top Width	15.64	ft
Critical Depth	3.51	ft
Critical Slope	0.003396	ft/ft
Velocity	8.33	ft/s
Velocity Head	1.08	ft
Specific Energy	4.90	ft
Froude Number	0.86	
Flow is subcritical.		

Notes:

'n' = 0.016 for concrete float finish (maximum).

CURRENT DATE: 02-10-1998
CURRENT TIME: 17:57:54

FILE DATE: 02-10-1998
FILE NAME: RAYCROSS

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.0

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	100.00	99.89	28.00	1 RCPE	6.33	4.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: RAYCROSS DATE: 02-10-1998

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
102.37	37.6	37.6	0.0	0.0	0.0	0.0	0.0	0.00	1
103.16	75.2	75.2	0.0	0.0	0.0	0.0	0.0	0.00	1
103.92	112.8	112.8	0.0	0.0	0.0	0.0	0.0	0.00	1
104.78	150.4	150.4	0.0	0.0	0.0	0.0	0.0	0.00	1
105.30	188.0	162.7	0.0	0.0	0.0	0.0	0.0	25.02	5
105.55	225.6	160.3	0.0	0.0	0.0	0.0	0.0	64.71	4
105.77	263.2	156.6	0.0	0.0	0.0	0.0	0.0	106.17	4
105.95	300.8	152.8	0.0	0.0	0.0	0.0	0.0	145.84	3
106.12	338.4	149.5	0.0	0.0	0.0	0.0	0.0	187.53	3
106.28	376.0	145.5	0.0	0.0	0.0	0.0	0.0	228.57	3
105.00	159.3	159.3	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: RAYCROSS DATE: 02-10-1998

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
100.00	0.000	0.00	0.00	0.00
102.37	0.000	37.60	0.00	0.00
103.16	0.000	75.20	0.00	0.00
103.92	0.000	112.80	0.00	0.00
104.78	0.000	150.40	0.00	0.00
105.30	-0.008	188.00	0.32	0.17
105.55	-0.002	225.60	0.57	0.25
105.77	-0.001	263.20	0.45	0.17
105.95	-0.006	300.80	2.17	0.72
106.12	-0.004	338.40	1.39	0.41
106.28	-0.005	376.00	1.94	0.52

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 02-10-1998
CURRENT TIME: 17:57:54

FILE DATE: 02-10-1998
FILE NAME: RAYCROSS

PERFORMANCE CURVE FOR CULVERT 1 - 1(6.33 (ft) BY 4.00 (ft)) RCPE

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	100.00	0.00	-0.11	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
37.60	102.37	1.83	2.37	3-M1t	1.24	1.38	2.27	2.27	3.15	1.83
75.20	103.16	2.89	3.16	1-S2n	1.78	2.01	1.86	2.94	7.97	2.17
112.80	103.92	3.68	3.92	1-S2n	2.27	2.51	2.36	3.43	9.04	2.40
150.40	104.78	4.45	4.78	5-S2n	2.75	2.92	2.80	3.82	9.93	2.58
162.66	105.30	4.73	5.30	4-FFt	2.92	3.04	4.00	4.15	7.92	2.73
160.32	105.55	4.67	5.55	4-FFt	2.88	3.02	4.00	4.44	7.80	2.86
156.58	105.76	4.59	5.76	4-FFt	2.83	2.98	4.00	4.71	7.62	2.97
152.78	105.95	4.50	5.95	4-FFt	2.78	2.95	4.00	4.95	7.43	3.07
149.47	106.12	4.43	6.12	4-FFt	2.74	2.91	4.00	5.17	7.27	3.16
145.48	106.27	4.34	6.27	4-FFt	2.69	2.87	4.00	5.38	7.08	3.25

El. inlet face invert 100.00 ft El. outlet invert 99.89 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	0.00 ft
INLET ELEVATION	100.00 ft
OUTLET STATION	28.00 ft
OUTLET ELEVATION	99.89 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0039
CULVERT LENGTH ALONG SLOPE	28.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	ELLIPTICAL
BARREL SPAN	6.33 ft
BARREL RISE	4.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTING
INLET DEPRESSION	NONE

CURRENT DATE: 02-10-1998
CURRENT TIME: 17:57:54

FILE DATE: 02-10-1998
FILE NAME: RAYCROSS

TAILWATER

****** REGULAR CHANNEL CROSS SECTION **********

SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.001
MANNING'S n (.01-0.1)	0.025
CHANNEL INVERT ELEVATION	99.89 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	99.89 ft

****** UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	99.89	0.000	0.00	0.00	0.00
37.60	102.16	0.214	2.27	1.83	0.12
75.20	102.83	0.223	2.94	2.17	0.15
112.80	103.32	0.229	3.43	2.40	0.18
150.40	103.71	0.233	3.82	2.58	0.20
188.00	104.04	0.236	4.15	2.73	0.22
225.60	104.33	0.239	4.44	2.86	0.23
263.20	104.60	0.241	4.71	2.97	0.24
300.80	104.84	0.243	4.95	3.07	0.26
338.40	105.06	0.245	5.17	3.16	0.27
376.00	105.27	0.247	5.38	3.25	0.28

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	16.00 ft
CREST LENGTH	52.00 ft
OVERTOPPING CREST ELEVATION	105.00 ft

MCDOT CAR
DMJM Proj#: 6597.03

Ray Road Channel Between Tuthill Road and Airport Road -- Channel Design Options

FULL COST 50-YEAR SOLUTION
PEAK Q = 717 cfs

Channel Type	ROW (sq.ft per foot)	Concrete Pipe (lin.ft)	Channel Exc. (cu.meters)/ft	Bank Protection (cu.meter or sq. yard)/ft	ROW ($/ft)	Concrete Pipe ($/ft)	Channel Exc. ($/ft)	Bank Protection ($/ft)	Channel Total ($/ft)	Channel Total ($)	Channel Total and Drop $'s
earth	105.4	0	8.8	-	$16.94	$0.00	$52.75	-	$70	$346,335	**$391,289**
rip-rap	60.6	0	4.5	2.0	$9.74	$0.00	$27.26	$98.92	$136	$675,522	**$675,522**
gabion	50.8	0	4.1	0.8	$8.16	$0.00	$24.36	$40.31	$73	$361,997	**$361,997**
concrete	37.2	0	2.7	3.0	$5.98	$0.00	$16.37	$65.19	$88	$435,060	**$438,023**

	Channel Design Depth (ft)	Bottom Width (ft)	Top Width (ft)	SideSlopes (h:1)	Lining Thickness (ft)
earth	4.3	55.0	89.4	4	-
rip-rap	6.1	8.0	44.6	3	1.50
gabions	6.7	8.0	34.8	2	0.75
concrete	6.6	8.0	21.2	1	0.50

DROP STRUCTURE CALCULATIONS

	Existing Slope (ft/ft)	Design Slope (ft/ft)	Elevation Difference	#of 3' Drop Structures	Drop Struct. Type	Drop Struct. Length	Drop Struct. Width	Riprap Volume (cu. yd.)	Drop Struct. Cost (ea.)	Drop Struct. Total Cost
earth	0.004	0.0008	15.9	6	riprap	39.0	90.5	392	$7,492.40	$44,954.42
concrete	0.004	0.0022	8.9	3	concrete	1.0	26.7	5	$987.69	$2,963.07

UNIT COSTS

		(English)	(SI)
ROW$:	$7,000.00	per acre	
Concrete Pipe$:	$0.00	per lf	
Channel Exc.$:	$6.00		per cu.meter
Rip-Rap$:	$50.00		per cu.meter
Gabions$:	$50.00		per cu.meter
Concrete$:	$22.00	per sq. yard	
Concrete$:	$200.00	per cu. yd.	
	Channel Inc. Length (ft)	Channel Total Length (ft)	
	1.0	4970.0	

50-yr - Ray Road Channel
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\rayrd50b.fm2
Worksheet	(2earthen) channel design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.025	
Channel Slope	0.000800	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	55.00	ft
Discharge	717.00	cfs

Results		
Depth	3.24	ft
Flow Area	220.24	ft^2
Wetted Perimeter	81.72	ft
Top Width	80.92	ft
Critical Depth	1.67	ft
Critical Slope	0.008008	ft/ft
Velocity	3.26	ft/s
Velocity Head	0.16	ft
Specific Energy	3.41	ft
Froude Number	0.35	
Flow is subcritical.		

Notes:

'n' = 0.025 channel bottom is earth, sides are earth with grass and weeds.

Using 4:1 side slopes for earthen channel banks.

Channel will require bank protection for velocities higher than 0.99 m/s (3.25 ft/s).

50-yr - Ray Road Channel
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\rayrd50.fm2
Worksheet	(3w/riprap) channel design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.032	
Channel Slope	0.004000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	8.00	ft
Discharge	717.00	cfs

Results		
Depth	5.10	ft
Flow Area	118.69	ft^2
Wetted Perimeter	40.23	ft
Top Width	38.58	ft
Critical Depth	4.00	ft
Critical Slope	0.011594	ft/ft
Velocity	6.04	ft/s
Velocity Head	0.57	ft
Specific Energy	5.66	ft
Froude Number	0.61	
Flow is subcritical.		

Notes:

'n' = 0.036 for riprap (maximum).

50-yr - Ray Road Channel
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\rayrd50b.fm2
Worksheet	(4w/gabions) channel design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.032	
Channel Slope	0.004000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	717.00	cfs

Results		
Depth	5.69	ft
Flow Area	110.23	ft^2
Wetted Perimeter	33.44	ft
Top Width	30.75	ft
Critical Depth	4.41	ft
Critical Slope	0.011618	ft/ft
Velocity	6.50	ft/s
Velocity Head	0.66	ft
Specific Energy	6.35	ft
Froude Number	0.61	
Flow is subcritical.		

Notes:

'n' = 0.036 for riprap (maximum).

CURRENT DATE: 02-10-1998
CURRENT TIME: 18:43:07

FILE DATE: 02-10-1998
FILE NAME: RAYCRS10

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.0

CULV NO.	SITE DATA: INLET ELEV. (ft)	SITE DATA: OUTLET ELEV. (ft)	SITE DATA: CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS / SHAPE / MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	100.00	99.89	28.00	2 RCB	8.00	7.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: RAYCRS10 DATE: 02-10-1998

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
101.84	71.7	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
102.76	143.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
103.49	215.1	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
104.11	286.8	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
104.67	358.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
105.19	430.2	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
105.41	501.9	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
105.69	573.6	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
106.05	645.3	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
106.50	717.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: RAYCRS10 DATE: 02-10-1998

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
0.00	0.000	0.00	0.00	0.00
101.84	0.000	71.70	0.00	0.00
102.76	0.000	143.40	0.00	0.00
103.49	0.000	215.10	0.00	0.00
104.11	0.000	286.80	0.00	0.00
104.67	0.000	358.50	0.00	0.00
105.19	0.000	430.20	0.00	0.00
105.41	0.000	501.90	0.00	0.00
105.69	0.000	573.60	0.00	0.00
106.05	0.000	645.30	0.00	0.00
106.50	0.000	717.00	0.00	0.00

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 02-10-1998
CURRENT TIME: 18:43:07

FILE DATE: 02-10-1998
FILE NAME: RAYCRS10

PERFORMANCE CURVE FOR CULVERT 1 - 2(8.00 (ft) BY 7.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	100.00	0.00	-0.11	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
71.70	101.84	1.31	1.84	3-M1t	0.76	0.86	1.78	1.78	2.52	3.48
143.40	102.76	2.08	2.76	3-M1t	1.19	1.36	2.57	2.57	3.48	4.24
215.10	103.49	2.72	3.49	3-M1t	1.58	1.78	3.17	3.17	4.24	4.74
286.80	104.11	3.30	4.11	3-M1t	1.93	2.16	3.66	3.66	4.90	5.12
358.50	104.67	3.84	4.67	3-M1t	2.26	2.50	4.08	4.08	5.49	5.43
430.20	105.19	4.34	5.19	3-M1t	2.57	2.83	4.46	4.46	6.03	5.70
501.90	105.41	4.82	5.41	1-S2n	2.87	3.13	2.97	4.81	10.57	5.93
573.60	105.69	5.27	5.69	1-S2n	3.16	3.42	3.26	5.12	11.00	6.14
645.30	106.05	5.71	6.05	1-S2n	3.45	3.70	3.54	5.41	11.39	6.33
717.00	106.50	6.13	6.50	1-S2n	3.73	3.97	3.81	5.69	11.75	6.51

El. inlet face invert 100.00 ft
El. inlet throat invert 0.00 ft
El. outlet invert 99.89 ft
El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	0.00 ft
INLET ELEVATION	100.00 ft
OUTLET STATION	28.00 ft
OUTLET ELEVATION	99.89 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0039
CULVERT LENGTH ALONG SLOPE	28.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	8.00 ft
BARREL RISE	7.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (30-75 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 02-10-1998
CURRENT TIME: 18:43:07

FILE DATE: 02-10-1998
FILE NAME: RAYCRS10

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	8.00 ft
SIDE SLOPE H/V (X:1)	2.0
CHANNEL SLOPE V/H (ft/ft)	0.004
MANNING'S n (.01-0.1)	0.032
CHANNEL INVERT ELEVATION	99.89 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	99.89 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	99.89	0.000	0.00	0.00	0.00
71.70	101.67	0.460	1.78	3.48	0.44
143.40	102.46	0.466	2.57	4.24	0.64
215.10	103.06	0.469	3.17	4.74	0.79
286.80	103.55	0.471	3.66	5.12	0.91
358.50	103.97	0.474	4.08	5.43	1.02
430.20	104.35	0.475	4.46	5.70	1.11
501.90	104.69	0.477	4.81	5.93	1.20
573.60	105.01	0.478	5.12	6.14	1.28
645.30	105.30	0.480	5.41	6.33	1.35
717.00	105.58	0.481	5.69	6.51	1.42

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	16.00 ft
CREST LENGTH	35.00 ft
OVERTOPPING CREST ELEVATION	107.00 ft

DMJM ARIZONA, INC.	PROJECT MCDOT CAR	PROJECT NO. 6597.03		SHT. NO. 1 of 2
		BY JRM	DATE 1/6/98	
SUBJECT **Guadalupe Road @ Eastern Canal**		REFERENCE		

Guadalupe Road at Eastern Canal

Keith Hubbard Plans: (Low Alt.)

2 — 54" RGRCP at Tailwater Ditch
Inv. U/S = 1272.15
Inv. D/S = 1271.80
Length = 113'
Slope = 0.003'/ft.
Town of Gilbert to Construct — No Cost

High Alternative:

1. Convey off-site flows through U/S subdivision using concrete "U" channel and box culvert at Guadalupe Road.

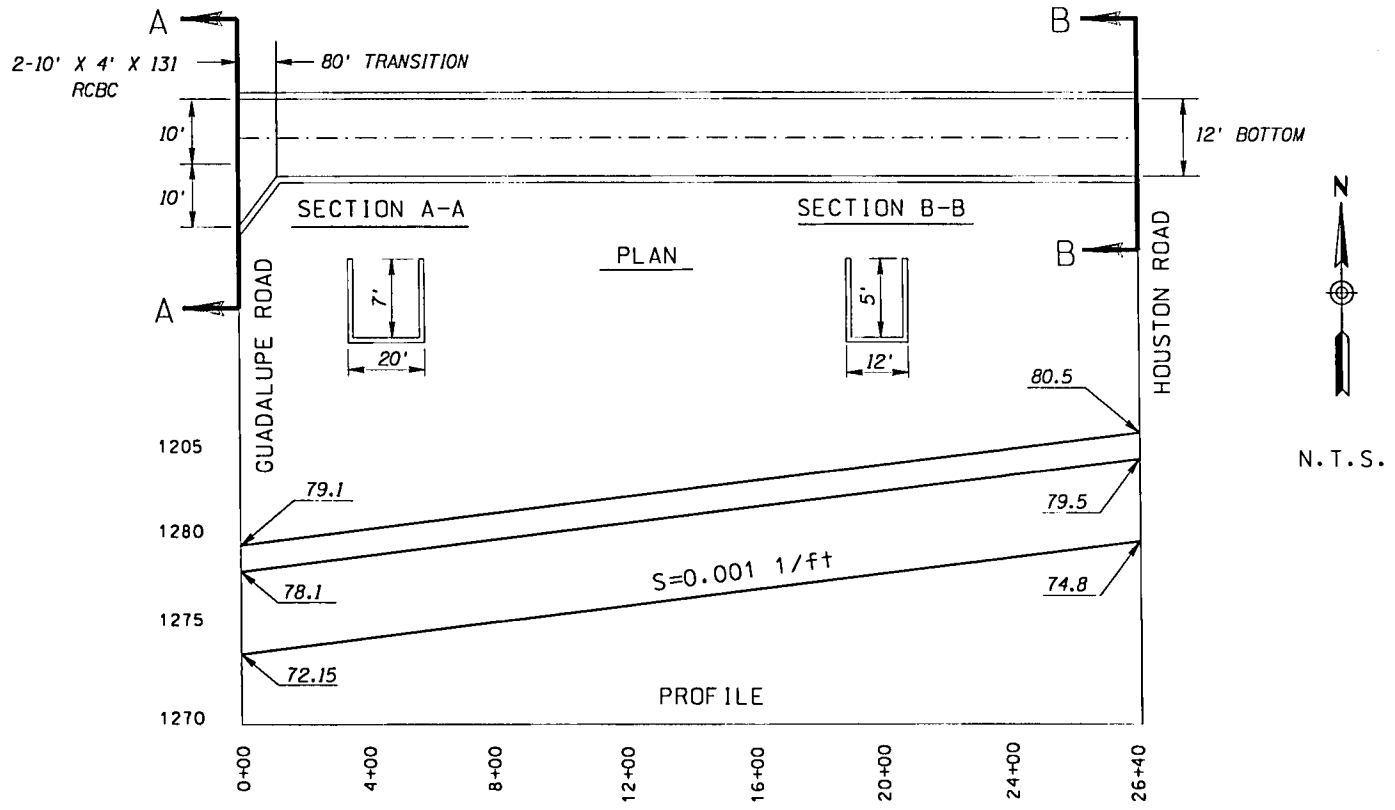
2. Use flapgated area inlets for inflow from subdivision to channel

Culvert Inv. El	=	12.72.15' (Guadalupe)
2640' @ 0.001'/ft.	=	+ 2.64' (Channel Slope)
Inv. @ Houston Rd.	=	1274.79'
Normal Depth	=	4.7'
WSE @ Houston Rd.	=	1279.50 ±
Ponding Elev. U/S Of Houston Rd.	=	– 1280.80
Drop in WSE to Channel	=	1.3' OK

3. Q(100-year) = 317cfs at Guadalupe Road

4. Dynamic hydrologic/hydraulic conditions requires detailed analyses

GUADALUPE ROAD @ EASTERN CANAL



DMJM ARIZONA INC.
300 WEST CLARENDON, SUITE 400
PHOENIX, ARIZONA 85013
(602) 264-0217
(602) 285-1984 FAX

PROJECT:
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION

PROJECT NO.	SHEET NO.
6597.03	
BY: BAL	DATE: 1-8-98

CURRENT DATE: 01-06-1998
CURRENT TIME: 20:41:35

FILE DATE: 01-06-1998
FILE NAME: GUAD

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.0

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1272.15	1271.80	113.00	2 RCB	10.00	4.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: GUAD DATE: 01-06-1998

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
1277.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
1277.70	31.7	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
1277.72	63.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
1277.74	95.1	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
1277.77	126.8	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
1277.80	158.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
1277.85	190.2	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
1277.90	221.9	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
1277.96	253.6	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
1278.03	285.3	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
1278.11	317.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: GUAD DATE: 01-06-1998

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1277.70	0.000	0.00	0.00	0.00
1277.70	0.000	31.70	0.00	0.00
1277.72	0.000	63.40	0.00	0.00
1277.74	0.000	95.10	0.00	0.00
1277.77	0.000	126.80	0.00	0.00
1277.80	0.000	158.50	0.00	0.00
1277.85	0.000	190.20	0.00	0.00
1277.90	0.000	221.90	0.00	0.00
1277.96	0.000	253.60	0.00	0.00
1278.03	0.000	285.30	0.00	0.00
1278.11	0.000	317.00	0.00	0.00

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 01-06-1998
CURRENT TIME: 20:41:35

FILE DATE: 01-06-1998
FILE NAME: GUAD

PERFORMANCE CURVE FOR CULVERT 1 - 2(10.00 (ft) BY 4.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1277.70	0.00	5.55	0-NF	0.00	0.00	0.00	5.90	0.00	0.00
31.70	1277.70	0.66	5.55	4-FFt	0.42	0.43	4.00	5.90	0.40	0.00
63.40	1277.72	1.04	5.57	4-FFt	0.64	0.68	4.00	5.90	0.79	0.00
95.10	1277.74	1.36	5.59	4-FFt	0.85	0.89	4.00	5.90	1.19	0.00
126.80	1277.77	1.65	5.62	4-FFt	1.01	1.08	4.00	5.90	1.59	0.00
158.50	1277.80	1.92	5.65	4-FFt	1.18	1.25	4.00	5.90	1.98	0.00
190.20	1277.85	2.17	5.70	4-FFt	1.33	1.41	4.00	5.90	2.38	0.00
221.90	1277.90	2.41	5.75	4-FFt	1.47	1.57	4.00	5.90	2.77	0.00
253.60	1277.96	2.64	5.81	4-FFt	1.61	1.71	4.00	5.90	3.17	0.00
285.30	1278.03	2.85	5.88	4-FFt	1.74	1.85	4.00	5.90	3.57	0.00
317.00	1278.11	3.06	5.96	4-FFt	1.86	1.99	4.00	5.90	3.96	0.00

El. inlet face invert 1272.15 ft El. outlet invert 1271.80 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	0.00 ft
INLET ELEVATION	1272.15 ft
OUTLET STATION	113.00 ft
OUTLET ELEVATION	1271.80 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0031
CULVERT LENGTH ALONG SLOPE	113.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	10.00 ft
BARREL RISE	4.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (30-75 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 01-06-1998
CURRENT TIME: 20:41:35

FILE DATE: 01-06-1998
FILE NAME: GUAD

TAILWATER

CONSTANT WATER SURFACE ELEVATION
1277.70

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED	
EMBANKMENT TOP WIDTH	80.00	ft
CREST LENGTH	60.00	ft
OVERTOPPING CREST ELEVATION	1280.00	ft

Guadalupe Road Channel
Worksheet for Rectangular Channel

Project Description	
Project File	n:\659703\calcs\guadalup.fm2
Worksheet	Guadalupe to Houston (Concrete)
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.016	
Channel Slope	0.001000	ft/ft
Bottom Width	12.00	ft
Discharge	317.00	cfs

Results		
Depth	4.71	ft
Flow Area	56.53	ft^2
Wetted Perimeter	21.42	ft
Top Width	12.00	ft
Critical Depth	2.79	ft
Critical Slope	0.004409	ft/ft
Velocity	5.61	ft/s
Velocity Head	0.49	ft
Specific Energy	5.20	ft
Froude Number	0.46	
Flow is subcritical.		

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             FEBRUARY 1981             *
*           REVISED 14 JUN 85           *
*                                       *
*       RUN DATE: 07/16/1990            *
*           TIME: 09:08:14.27           *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*                                       *
*  (916) 551-1748 OR (FTS) 448-3285     *
*                                       *
*****************************************
```


```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THE VERSION RELEASED 31JAN85 CONTAINS NEW OPTIONS ON RL AND BA RECORDS, AND ADDS THE HL RECORD. SEE JANUARY 1985 INPUT DESCRIPTION FOR NEW DEFINITIONS.

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::::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::::
:::            900 ORDINATES             :::
:::            Version 3.2c              :::
::::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::::
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        ============================
        H A E S T A D  M E T H O D S
        ============================

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1       ID         MARICOPA COUNTY FLOOD CONTROL DISTRICT
  2       ID         FLOOD INSURANCE STUDY
  3       ID         100 YEAR FLOOD DELINEATION STUDY
  4       ID         FILE: FSS03.IN - SUBAREA  3  EASTERN CANAL AND GUADALUPE RD
  5       IT      5                    900
  6       IO      5      0
          *DIAGRAM
  7       IN     15
  8       PG      1    3.8
  9       PC   .00    .00    .00    .01    .01    .01    .02    .02    .02    .03
 10       PC   .03    .03    .04    .04    .04    .04    .05    .05    .06    .06
 11       PC   .06    .07    .07    .08    .08    .08    .09    .10    .10    .11
 12       PC   .11    .12    .12    .13    .13    .14    .15    .15    .16    .17
 13       PC   .18    .19    .20    .22    .24    .26    .28    .39    .66    .71
 14       PC   .74    .76    .78    .79    .80    .81    .82    .83    .84    .85
 15       PC   .86    .86    .87    .88    .88    .89    .89    .90    .90    .91
 16       PC   .91    .92    .92    .93    .93    .93    .94    .94    .95    .95
 17       PC   .95    .96    .96    .96    .96    .97    .97    .97    .98    .98
 18       PC   .98    .99    .99    .99   1.00   1.00   1.00   1.00   1.00   1.00
          *

 19       KK   SUBA
 20       KM       RUNOFF FROM RESIDENTIAL SUBBASIN A (AC+) (80-)
 21       PR      1
 22       PW      1
 23       BA  0.080
 24       LU  1.279   0.250  21.600
 25       UC  0.300   0.233
 26       UA      0       5      16      30      65      77      84      90      94      97
 27       UA    100
          *

 28       KK    PTO
 29       KM       DIVERT RETENTION VOLUME
 30       KM       DUMMY ROUTING BASIN REPLACED FROM ORIGINAL MODEL
 31       DT   DPTO    2.00
 32       DI      0   10000
 33       DQ      0   10000
          *

 34       KK   0TO1
 35       KM       ROUTE HYDROGRAPH A FROM PTO TO PT1
 36       KM   ORIGINAL K-WAVE ROUTING REPLACED (3/22/90)
 37       RS      1   FLOW      -1
 38       RC  0.075   0.014   0.075   6250.   0.005
 39       RX      0       0     600     600     640     640    1240    1240
 40       RY    6.5     2.5       1       0       0       1     2.5     6.5
          *

 41       KK   SUBB1
 42       KM       RUNOFF FROM SUBBASIN B1, AGRICULTURE - ROW
 43       PR      1
 44       PW      1
 45       BA    .48
 46       LS             78    2.06
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 47       UD     1.3
          *

 48       KK   SUBB2
 49       KM        RUNOFF FROM SUBBASIN B2, AGRICULTURE - ORCHARD
 50       PR       1
 51       PW       1
 52       BA     .04
 53       LS              65    2.06
 54       UD    0.44
          *

 55       KK     PT1
 56       KM        COMBINE HYDROGRAPHS A & B, HIGLEY RD AND BASELINE RD
 57       HC       3
          *

 58       KK    1TO2
 59       KM        ROUTE HYDROGRAPH AB FROM PT1 TO PT2
 60       KM    ORIGINAL K-WAVE ROUTING REPLACED (3/22/90)
 61       RS       1    FLOW      -1
 62       RC   0.075   0.014   0.075   3350.   0.005
 63       RX       0       0     600     600     640     640    1240    1240
 64       RY     6.5     2.5       1       0       0       1     2.5     6.5
          *

 65       KK   SUBC1
 66       KM        RUNOFF FROM SUBBASIN C1, AGRICULTURE - ROW
 67       PR       1
 68       PW       1
 69       BA     .27
 70       LS              78    2.06
 71       UD    1.22
          *

 72       KK   SUBC2
 73       KM        RUNOFF FROM SUBBASIN C2, AGRICULTURE - ORCHARD
 74       PR       1
 75       PW       1
 76       BA     .11
 77       LS              65    2.06
 78       UD    0.60
          *

 79       KK    PT2a
 80       KM        COMBINE HYDROGRAPH AB WITH C, BASELINE RD & EASTERN CANAL
 81       HC       3
          *

 82       KK    PT2b
 83       KM        ROUTING RETENTION BASIN
 84       RS       1    STOR       0
 85       SA       0                      0.8    14.9    18.2    21.4    24.7   27.96    31.2
 86       SA    34.5    37.8
 87       SE  1277.1  1278.1  1279.2  1280.1  1282.4  1282.5  1282.6  1282.7  1282.8  1282.9
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 88       SE  1283.0  1283.1
 89       SQ     0    18.2    42.0      92     200     273     435     678    1008    1435
 90       SQ  1965    2786
          *

 91       KK   PT2c
 92       KM      DIVERT RUNOFF FLOW EXCEEDING CULVERT CAPACITY INTO EASTERN CANAL
 93       KM      @ GILBERT ROAD (SEE EASTERN CANAL ROUTING BELOW)
 94       DT  DIV2C
 95       DI     0     200     273     435     678    1008    1435    1965    2786
 96       DQ     0       0      69     223     462     790    1215    1743    2562
          *

 97       KK   2TO6
 98       KM       ROUTE FLOW (FROM CULVERTS) FROM PT2 (BASELINE) TO PT6 (1/2 MI. SOUTH)
 99       KM   ORIGINAL K-WAVE ROUTING REPLACED (3/22/90)
100       RS      1   FLOW      -1
101       RC  0.075   0.014   0.075    2640 0.00039
102       RX      0       0     600     600     640     640    1240    1240
103       RY    6.5     2.5       1       0       0       1     2.5     6.5
          *

104       KK   SUBD
105       KM       RUNOFF FROM SUBBASIN D,AGRICULTURE - ROW
106       PR      1
107       PW      1
108       BA    .06
109       LS             78    2.06
110       UD    .38
          *

111       KK   3TO4
112       KM       ROUTE HYDROGRAPH D FROM PT3 TO PT4
113       KM   ORIGINAL K-WAVE ROUTING REPLACED (3/22/90)
114       RS      1   FLOW      -1
115       RC  0.075   0.014   0.075   4700.   0.005
116       RX      0       0     600     600     640     640    1240    1240
117       RY    6.5     2.5       1       0       0       1     2.5     6.5
          *

118       KK   SUBE
119       KM       RUNOFF FROM RESIDENTIAL SUBBASIN E, (AC+) (80-)
120       PR      1
121       PW      1
122       BA  0.230
123       LU  1.279   0.250  21.600
124       UC  0.317   0.160
125       UA      0       5      16      30      65      77      84      90      94      97
126       UA    100
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 127      KK     PT4
 128      KM        DIVERT RETENTION VOLUME
 129      KM        DUMMY ROUTING BASIN REPLACED FROM ORIGINAL MODEL
 130      DT    DPT4    5.00
 131      DI       0   10000
 132      DQ       0   10000
          *

 133      KK   SUBEE
 134      KM        RUNOFF FROM SUBBASIN EE @ PT4A - OPEN
 135      PR       1
 136      PW       1
 137      BA    0.03
 138      LS              79    2.06
 139      UD    0.27
          *

 140      KK   4AT04
 141      KM        ROUTE HYDROGRAPH EE FROM PT4A TO PT4
 142      KM    ORIGINAL K-WAVE ROUTING REPLACED (3/22/90)
 143      RS       1    FLOW      -1
 144      RC   0.075   0.014   0.075   2700.   0.005
 145      RX       0       0     600     600     640     640    1240    1240
 146      RY     6.5     2.5       1       0       0       1     2.5     6.5
          *

 147      KK     PT4
 148      KM        COMBINE HYDROGRAPHS D & E, .5MI S. OF BASELINE & .5MI W. OF RECKER
 149      HC       3
          *

 150      KK    4TO5
 151      KM        ROUTE HYDROGRAPH DE FROM PT4 TO PT5
 152      KM    ORIGINAL K-WAVE ROUTING REPLACED (3/22/90)
 153      RS       1    FLOW      -1
 154      RC   0.075   0.014   0.075   3250.   0.005
 155      RX       0       0     600     600     640     640    1240    1240
 156      RY     6.5     2.5       1       0       0       1     2.5     6.5
          *                                      F RS

 157      KK    SUBF
 158      KM        RUNOFF FROM SUBBASIN F, AGRICULTURE - ROW
 159      PR       1
 160      PW       1
 161      BA     .30
 162      LS              78    2.06
 163      UD     .89
          *
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  164     KK     PT5
  165     KM       COMBINE HYDROGRAPH DE WITH F, HIGLEY RD & .5MI S. OF BASELINE
  166     HC       2
          *

  167     KK    5TO6
  168     KM        ROUTE HYDROGRAPH DEF FROM PT5 TO PT6
  169     KM    ORIGINAL K-WAVE ROUTING REPLACED (3/22/90)
  170     RS       1    FLOW      -1
  171     RC   0.075   0.014   0.075   3100.   0.005
  172     RX       0       0     600     600     640     640    1240    1240
  173     RY     6.5     2.5       1       0       0       1     2.5     6.5
          *

  174     KK    SUBG
  175     KM        RUNOFF FROM SUBBASIN G, AGRICULTURE - ROW
  176     PR       1
  177     PW       1
  178     BA     .28
  179     LS              78    2.06
  180     UD     .86
          *

  181     KK    PT6a
  182     KM        COMBINE HYDROGRAPHS DEF & AB,G .5MI S. OF BASELINE & EASTERN CANAL
  183     HC       3
          *

  184     KK    PT6b
  185     KM        ROUTING RETENTION BASIN
  186     RS       1    STOR       0
  187     SA    0.25    15.8    17.8    20.3    22.4    25.5    28.0    30.6    33.1    35.7
  188     SE      79      80    80.2    80.3    80.4    80.5    80.6    80.7    80.8    80.9
  189     SQ       0       0       0      19      63     133     231     360     522     720
          *

  190     KK    6TO8
  191     KM        ROUTE HYDROGRAPH A-G FROM PT6 TO PT8
  192     KM    ORIGINAL K-WAVE ROUTING REPLACED (3/22/90)
  193     RS       1    FLOW      -1
  194     RC   0.075   0.014   0.075   2600. 0.00039
  195     RX       0       0     600     600     640     640    1240    1240
  196     RY     6.5     2.5       1       0       0       1     2.5     6.5
          *

  197     KK    SUBH
  198     KM        RUNOFF FROM SUBBASIN H, AGRICULTURE - ROW
  199     PR       1
  200     PW       1
  201     BA     .13
  202     LS              78    2.06
  203     UD     .60
          *
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  204     KK   7TO8
  205     KM        ROUTE HYDROGRAPH H FROM PT7 TO PT8
  206     KM    ORIGINAL K-WAVE ROUTING REPLACED (3/22/90)
  207     RS      1    FLOW      -1
  208     RC  0.075   0.014   0.075   1450.   0.005
  209     RX      0       0     600     600     640     640    1240    1240
  210     RY    6.5     2.5       1       0       0       1     2.5     6.5
          *

  211     KK   SUBI
  212     KM        RUNOFF FROM RESIDENTIAL SUBBASIN I,(AC+) (80-)
  213     PR      1
  214     PW      1
  215     BA  0.150
  216     LU  1.279   0.250  21.600
  217     UC  0.317   0.204
  218     UA      0       5      16      30      65      77      84      90      94      97
  219     UA    100
          *

  220     KK   PT8a
  221     KM        DIVERT RETENTION VOLUME
  222     KM        DUMMY ROUTING BASIN REPLACED FROM ORIGINAL MODEL
  223     DT  DPT8a    3.00
  224     DI      0   10000
  225     DQ      0   10000
          *

  226     KK   PT8b
  227     KM        COMBINE HYDROGRAPHS, A-G WITH H AND I @ EASTERN CANAL & GUADALUPE RD
  228     HC      3
          *

  229     KK   PT8c
  230     KM        ROUTING RETENTION BASIN
  231     RS      1    STOR       0       0
  232     SA      0      .1      .1      .1      .1      .1      .1      .1    1.78    21.1
  233     SA   38.5      40      40     100     100     100     100     100     100
  234     SE   72.2    72.7    73.2    73.7    74.2    74.7    75.2    75.5    76.0    78.0
  235     SE   79.3   79.35    79.4    79.5    79.6    79.7    79.8    79.9    80.0
  236     SQ      0     1.6     8.8    21.2    38.0    54.0    70.0    79.0    94.0   127.9
  237     SQ  150.0   157.0   172.0   249.0   348.0   545.0   831.0  1215.0  1709.0
          *

  238     KK   PT8d
  239     KM        DIVERT RUNOFF FLOWS THAT EXCEED THE CULVERT CAPACITY INTO THE
  240     KM        EASTERN CANAL ( ROUTING CONTINUES IN CANAL FILES BELOW AND IN
  241     KM        SUBAREA 4 - FSS04.IN)
  242     DT  DIV8C
  243     DI    1.6     8.8    21.2    38.0    54.0    70.0    79.0    94.0   127.9   150.0
  244     DI  157.0   172.0   249.0   348.0   545.0   831.0  1215.0  1709.0
  245     DQ      0       0       0       0       0       0       0       0       0       0
  246     DQ    2.0      12    67.0   184.0   379.0   663.0  1045.0  1537.0
          *
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 247      KK    PT8e
 248      KM        DIVERT FLOW INTO SUBAREA 4 TO THE SOUTH
 249      DT   DIV8e
 250      DI       0    4000
 251      DQ       0    4000
          *

 252      KK    PT8f
 253      KM        RETRIEVE FLOW DIVERTED INTO SUBAREA 4 AND SAVE ON UNIT 21
 254      KO                                      21
 255      DR   DIV8e
          *
          *
          *
          *  ***EASTERN CANAL ROUTING FROM THE SUPERSTITION FREEWAY TO GUADALUPE ROAD***
          *

 256      KK     WS1
 257      KM       *WATERSHED 1 * HYDROGRAPH OF FLOW IN EASTERN CANAL FROM RETENTION BASIN
 258      KM       NORTH OF FREEWAY
 259      BI   PT19e      22
          *

 260      KK   PTFw1
 261      KM        SPILL EXCESS Q OVER BANK INTO SUBAREA 2 (FILE: FSS02.IN) DUE TO SMALLER
 262      KM        CHANNEL CAPACITY SOUTH OF THE SUPERSTITION FREEWAY
 263      DT   DIVFw
 264      DI       0    1051    2000
 265      DQ       0       0     949
          *

 266      KK  FwTOBa
 267      KM        ROUTE HYDROGRAPH FROM FREEWAY TO BASELINE ROAD
 268      KM        ********NOTE: ELEVATIONS ON RY CARD REFLECT SRP DATUM********
 269      KM        ********THIS DATUM IS NOT COINCIDENT WITH DATUM FOR PLAN & PROFILES*****
 270      RS       1    FLOW      -1       0
 271      RC   0.023   0.018   0.023    3433 0.00057
 272      RX       0    15.0    16.0    23.0    44.5    51.5    54.0    77.0
 273      RY  1283.5 1284.30 1283.70 1277.70 1277.70 1283.60 1285.70 1284.50
          *

 274      KK   PTBa1
 275      KM        RETRIEVE FLOW DIVERTED INTO EASTERN CANAL AT BASELINE RD
 276      DR   DIV2C
          *

 277      KK   PTBa2
 278      KM        COMBINE CANAL FLOW HYDROGRAPH AND DIVERTED FLOW HYDROGRAPH
 279      HC       2
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 280      KK   PTBa3
 281      KM        DIVERT EXCESS FLOW WHICH OVERTOPS CANAL TO THE WEST @ BASELINE RD
 282      KM        THIS FLOW IS ADDED TO SUBAREA 2 (FSS02.IN)
 283      DT   DIVBa
 284      DI        0   718.2    2000
 285      DQ        0       0  1281.8
          *

 286      KK  BaTOGu
 287      KM        ROUTE HYDROGRAPH IN CANAL FROM BASELINE ROAD TO GUADALUPE ROAD
 288      KM        ********NOTE: ELEVATIONS ON RY CARD REFLECT SRP DATUM********
 289      KM        ********THIS DATUM IS NOT COINCIDENT WITH DATUM FOR PLAN & PROFILES*****
 290      RS        1    FLOW      -1       0
 291      RC    0.023   0.018   0.023    5766 0.00039
 292      RX        0      20    21.5    27.4    49.8    55.5      58      88
 293      RY   1281.1 1281.40 1280.70 1275.60 1275.60 1280.80 1282.10 1281.40
          *

 294      KK   PTGu1
 295      KM        RETRIEVE FLOW DIVERTED INTO EASTERN CANAL AT GUADALUPE ROAD
 296      DR   DIV8C
          *

 297      KK   PTGu2
 298      KM        COMBINE HYDROGRAPH OF EASTERN CANAL FLOW AND INFLOW AT GUADALUPE ROAD
 299      HC        2
          *

 300      KK   PTGu3
 301      KM        DIVERT FLOW WICH EXCEEDS CANAL CAPACITY INTO SUBAREA 2
 302      KM        SAVE CONTINUING FLOW ON UNIT 21 FOR INTRODUCTION INTO SUBAREA 4
 303      KO                                        21
 304      DT   DIVGu3
 305      DI        0     948    3000
 306      DQ        0       0    2052
          *

 307      KK   PTGu4
 308      KM        RETRIEVE OVERFLOW OCCURING AT GUADALUPE RD AND SAVE ON UNIT 10 FOR
 309      KM        INTRODUCTION INTO SUBAREA 2
 310      KO                                        10
 311      DR   DIVGu3
          *

 312      KK   PTFw1
 313      KM        RETRIEVE FLOW JUST SOUTH OF THE FREEWAY FOR STORING IN UNIT 10
 314      KM        FOR INTRODUCTION INTO SUBAREA 2
 315      KO                                        10
 316      DR   DIVFw
          *
```

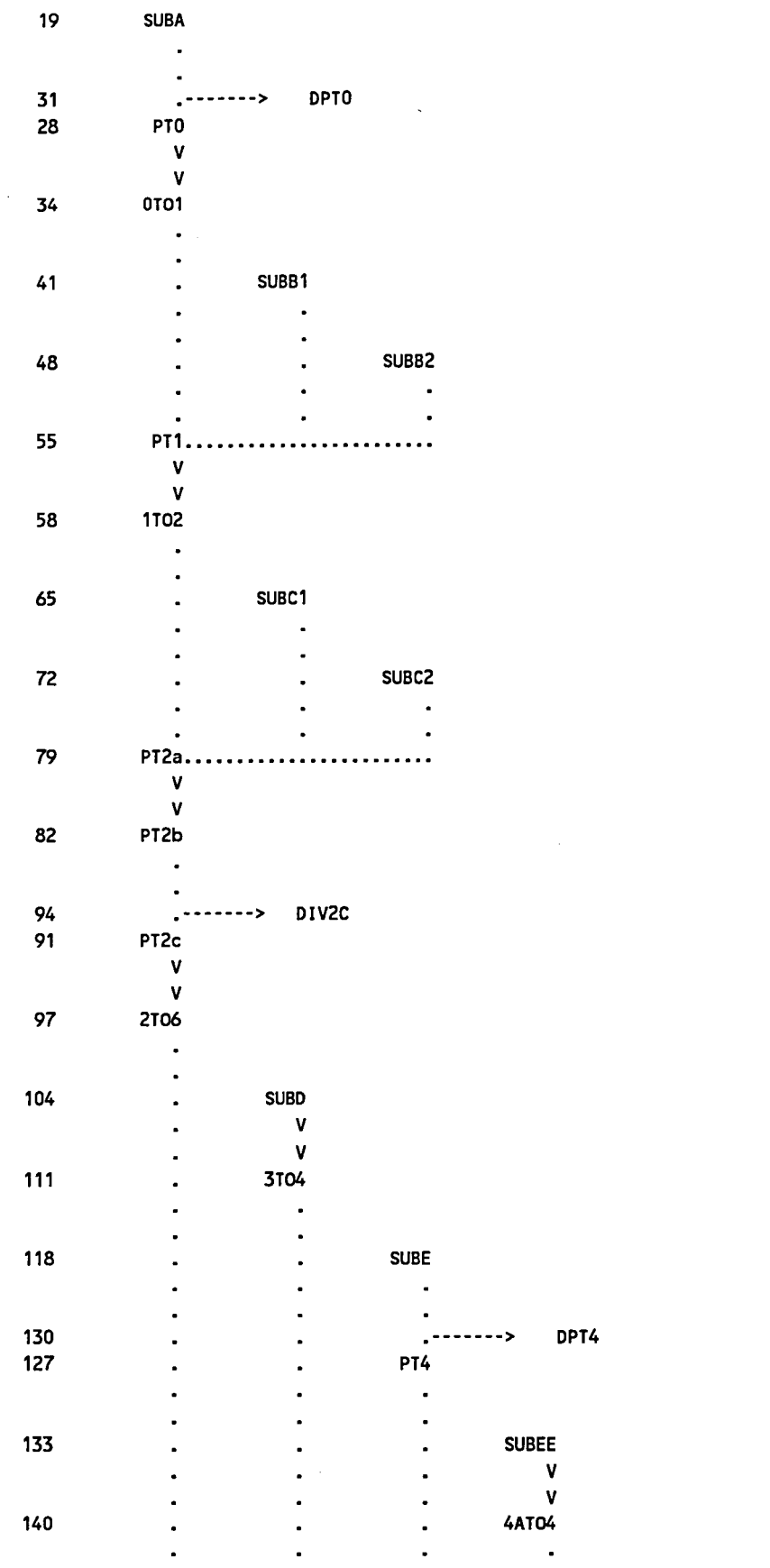
```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 317          KK   PTBa3
 318          KM        RETRIEVE FLOW DIVERTED AT BASELINE AND STORE IN UNIT 10 AND
 319          KM        INTRODUCE INTO SUBAREA 2
 320          KO                                        10
 321          DR   DIVBa
              *
 322          ZZ
```

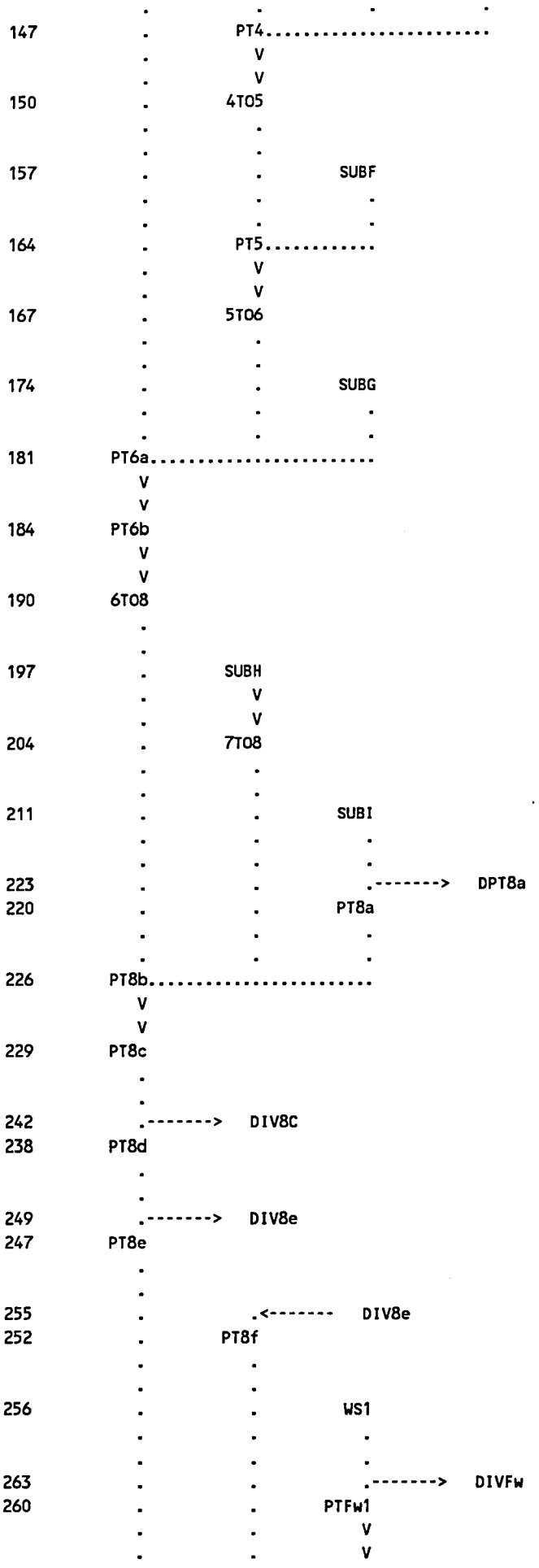
SCHEMATIC DIAGRAM OF STREAM NETWORK

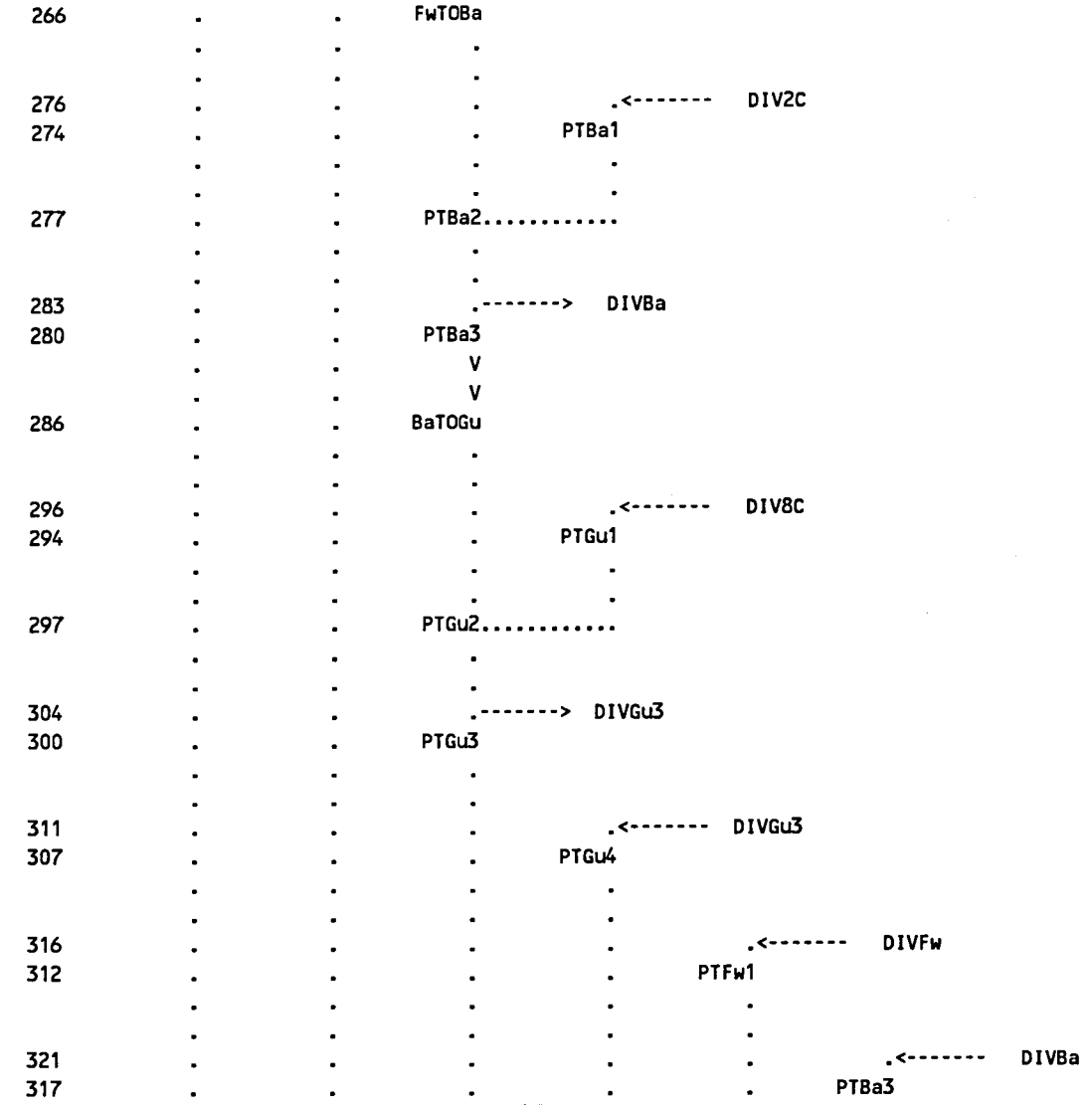
INPUT LINE NO.

(V) ROUTING (---->) DIVERSION OR PUMP FLOW

(.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW




147 PT4
150 4TO5
157 SUBF
164 PT5
167 5TO6
174 SUBG
181 PT6a
184 PT6b
190 6TO8
197 SUBH
204 7TO8
211 SUBI
223 DPT8a
220 PT8a
226 PT8b
229 PT8c
242 DIV8C
238 PT8d
249 DIV8e
247 PT8e
255 DIV8e
252 PT8f
256 WS1
263 DIVFW
260 PTFW1



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             FEBRUARY 1981             *
*           REVISED 14 JUN 85           *
*                                       *
*       RUN DATE: 07/16/1990            *
*           TIME: 09:08:59.42           *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*                                       *
*  (916) 551-1748 OR (FTS) 448-3285     *
*                                       *
*****************************************
```


MARICOPA COUNTY FLOOD CONTROL DISTRICT
FLOOD INSURANCE STUDY
100 YEAR FLOOD DELINEATION STUDY
FILE: FSS03.IN - SUBAREA 3 EASTERN CANAL AND GUADALUPE RD

6 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		900	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	4	0	ENDING DATE
NDTIME		0255	ENDING TIME

COMPUTATION INTERVAL 0.08 HOURS
TOTAL TIME BASE 74.92 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 0. TO 42.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 156. TO 304.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 21. TO 79.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** ***

```
**************
*            *
```

```
252 KK     *      PT8f  *
           *            *
           ***************

254 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         900  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       0.083  TIME INTERVAL IN HOURS


259 BI          READ STATION    PT19e HYDROGRAPH FROM UNIT 22


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           ***************
           *             *
300 KK     *     PTGu3   *
           *             *
           ***************

303 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                      IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         900  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           ***************
           *             *
307 KK     *     PTGu4   *
           *             *
           ***************

310 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                      IOUT          10  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         900  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
```

```
          **************
          *            *
312 KK    *     PTFw1  *
          *            *
          **************

315 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH          0  PUNCH COMPUTED HYDROGRAPH
                      IOUT         10  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2        900  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT      0.083  TIME INTERVAL IN HOURS
```

*** ***

```
          **************
          *            *
317 KK    *     PTBa3  *
          *            *
          **************

320 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH          0  PUNCH COMPUTED HYDROGRAPH
                      IOUT         10  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2        900  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT      0.083  TIME INTERVAL IN HOURS
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	SUBA	124.	12.08	14.	4.	1.	0.08		
DIVERSION TO	DPT0	66.	12.08	3.	1.	0.	0.08		
HYDROGRAPH AT	PT0	124.	12.08	11.	3.	1.	0.08		
ROUTED TO	0T01	62.	12.42	11.	3.	1.	0.08	0.38	12.42
HYDROGRAPH AT	SUBB1	168.	13.25	72.	23.	8.	0.48		
HYDROGRAPH AT	SUBB2	14.	12.42	3.	1.	0.	0.04		
3 COMBINED AT	PT1	197.	13.08	87.	27.	9.	0.60		
ROUTED TO	1T02	197.	13.17	86.	27.	9.	0.60	0.78	13.17
HYDROGRAPH AT	SUBC1	99.	13.17	41.	13.	4.	0.27		
HYDROGRAPH AT	SUBC2	32.	12.58	9.	3.	1.	0.11		
3 COMBINED AT	PT2a	313.	13.17	136.	43.	14.	0.98		
ROUTED TO	PT2b	224.	13.92	136.	43.	14.	0.98	1282.43	13.92
DIVERSION TO	DIV2C	22.	13.92	1.	0.	0.	0.98		
HYDROGRAPH AT	PT2c	201.	13.92	134.	42.	14.	0.98		
ROUTED TO	2T06	176.	15.00	133.	42.	14.	0.98	1.48	15.00
HYDROGRAPH AT	SUBD	48.	12.25	9.	3.	1.	0.06		
ROUTED TO	3T04	34.	12.50	9.	3.	1.	0.06	0.23	12.50
HYDROGRAPH AT	SUBE	417.	12.08	40.	12.	4.	0.23		
DIVERSION TO	DPT4	137.	12.08	9.	3.	1.	0.23		
HYDROGRAPH AT	PT4	417.	12.08	34.	9.	3.	0.23		
HYDROGRAPH AT	SUBEE	30.	12.17	5.	1.	0.	0.03		
ROUTED TO	4AT04	24.	12.33	5.	1.	0.	0.03	0.16	12.33
3 COMBINED AT	PT4	445.	12.08	48.	13.	4.	0.32		
ROUTED TO	4T05	345.	12.25	48.	13.	4.	0.32	1.09	12.25
HYDROGRAPH AT	SUBF	138.	12.83	46.	14.	5.	0.30		
2 COMBINED AT	PT5	413.	12.33	94.	28.	9.	0.62		
ROUTED TO	5T06	366.	12.50	94.	28.	9.	0.62	1.13	12.50
HYDROGRAPH AT	SUBG	132.	12.83	43.	13.	4.	0.28		
3 COMBINED AT	PT6a	556.	12.58	268.	83.	28.	1.88		

HOUSTON RD @ EASTERN CANAL

WTFLOW	ROUTED TO	PT6b	466.	12.92	252.	79.	26.	1.88	80.77	12.92
	ROUTED TO	6TO8	299.	14.17	241.	79.	26.	1.88	1.85	14.17
	HYDROGRAPH AT	SUBH	79.	12.50	20.	6.	2.	0.13		
	ROUTED TO	7TO8	78.	12.58	20.	6.	2.	0.13	0.43	12.58
	HYDROGRAPH AT	SUBI	246.	12.08	26.	8.	3.	0.15		
	DIVERSION TO	DPT8a	72.	12.08	5.	2.	1.	0.15		
	HYDROGRAPH AT	PT8a	246.	12.08	23.	6.	2.	0.15		
	3 COMBINED AT	PT8b	317.	13.92	266.	92.	31.	2.16	GUADALUPE @ EASTEX	
	ROUTED TO	PT8c	187.	18.08	160.	92.	31.	2.16	79.42	18.08
(TFLOW	DIVERSION TO	DIV8C	22.	18.08	6.	2.	1.	2.16		
	HYDROGRAPH AT	PT8d	164.	18.08	153.	90.	30.	2.16		
	DIVERSION TO	DIV8e	164.	0.08	153.	90.	30.	2.16		
	HYDROGRAPH AT	PT8e	0.	0.08	0.	0.	0.	2.16		
	HYDROGRAPH AT	PT8f	164.	18.08	153.	90.	30.	0.00		
	HYDROGRAPH AT	WS1	1482.	14.67	943.	479.	326.	11.21		
	DIVERSION TO	DIVFw	431.	14.25	111.	28.	9.	11.21		
	HYDROGRAPH AT	PTFw1	1051.	14.25	833.	452.	317.	11.21		
	ROUTED TO	FwTOBa	1051.	16.08	829.	452.	317.	11.21	1284.17	15.58
	HYDROGRAPH AT	PTBa1	22.	13.92	1.	0.	0.	0.00		
	2 COMBINED AT	PTBa2	1051.	16.08	829.	452.	317.	11.21		
	DIVERSION TO	DIVBa	333.	14.25	164.	41.	14.	11.21		
	HYDROGRAPH AT	PTBa3	718.	14.25	665.	411.	304.	11.21		
	ROUTED TO	BaTOGu	718.	17.67	659.	411.	304.	11.21	1281.32	17.75
	HYDROGRAPH AT	PTGu1	22.	18.08	6.	2.	1.	0.00		
	2 COMBINED AT	PTGu2	739.	17.75	665.	413.	304.	11.21		
	DIVERSION TO	DIVGu3	0.	17.75	0.	0.	0.	11.21		
	HYDROGRAPH AT	PTGu3	739.	17.75	665.	413.	304.	11.21		
	HYDROGRAPH AT	PTGu4	0.	0.08	0.	0.	0.	0.00		
	HYDROGRAPH AT	PTFw1	431.	14.67	111.	28.	9.	0.00		
	HYDROGRAPH AT	PTBa3	333.	16.08	164.	41.	14.	0.00		

*** NORMAL END OF HEC-1 ***

CHANDLER HEIGHTS RD CHANNEL Q's

ORIGINAL TO FILE 40.3 (6597.0

CC: MS, JK

Fax Cover Sheet

FLOOD CONTROL DISTRICT
OF
MARICOPA COUNTY

2801 West Durango Street
Phoenix, Arizona 85009
Telephone (602)506-1501
Fax (602)506-7346
TDD (602)506-5897

FLOODPLAIN MANAGEMENT BRANCH

To: JASON KELLY

Company or Department: DMJD

Fax Number:

From: DAVE DEGERNESS

Number of pages being sent including cover sheet: 2

If there are any problems or questions, please call (602)506-1501

Comments:

CHANDLER HEIGHTS ROAD TAILWATER DITCH

(Queen Creek ADMS modified to reflect subbasin flow in ditch)

Conc. Pt	Description	100-yr,24-hr flows		50-yr,24-hr flows		10-yr,24-hr flows		5-yr,24-hr flows	
		Existing	Future	Existing	Future	Existing	Future	Existing	Future
C550	Recker and Chandler hgts	629	331	488	171	221	0	129	0
C568	Higley and Chandler hgts	721	357	557	174	255	0	148	0
C574	Greenfield and EMF	978	450	753	216	347	0	201	0
		100-yr,6-hr flows		50-yr,6-hr flows		10-yr,6-hr flows		5-yr,6-hr flows	
		Exising	Future	Existing	Future	Existing	Future	Existing	Future
C550	"	657	262	525	77	228	0	140	0
C568	"	741	251	592	47	256	0	157	0
C574	"	995	264	797	38	344	0	210	0

MCDOT CAR
DMJM Proj#: 6597.03

Chandler Heights Channel Between East Maricopa Floodway and Power Road -- Channel Design Options

10-YEAR EXISTING CONDITIONS
LOW COST ALTERNATIVE (Q=345cfs)

Channel Type	ROW (sq.ft per foot)	Concrete Pipe (lin.ft)	Channel Exc. (cu.meters)	Bank Protection (cu.meter or sq. yard)	ROW ($/ft)	Concrete Pipe ($/ft)	Channel Exc. ($/ft)	Bank Protection ($/ft)	Channel Total ($/ft)	Channel Total ($)	Channel Total and Drop $'s
earth	66.0	0	4.3	-	$10.61	$0.00	$25.87	-	$36	$535,869	**$629,333**
rip-rap	53.4	0	3.1	1.7	$8.58	$0.00	$18.90	$82.81	$110	$1,620,316	**$1,620,316**
gabion	45.2	0	2.8	0.7	$7.26	$0.00	$16.75	$33.66	$58	$847,383	**$847,383**
concrete	33.2	0	1.6	2.3	$5.34	$0.00	$9.85	$51.36	$67	$977,639	**$979,974**

	Channel Design Depth (ft)	Bottom Width (ft)	Top Width (ft)	SideSlopes (h:1)	Lining Thickness (ft)
earth	5.3	8.0	50.0	4	-
rip-rap	4.9	8.0	37.4	3	1.50
gabions	5.3	8.0	29.2	2	0.75
concrete	4.6	8.0	17.2	1	0.50

DROP STRUCTURE CALCULATIONS

	Existing Slope (ft/ft)	Design Slope (ft/ft)	Elevation Difference	#of 3' Drop Structures	Drop Struct. Type	Drop Struct. Length	Drop Struct. Width	Riprap Volume (cu. yd.)	Drop Struct. Cost (ea.)	Drop Struct. Total Cost
earth	0.003	0.0009	30.9	11	riprap	39.0	51.3	222	$8,496.80	$93,464.83
concrete	0.003	0.0025	7.3	3	concrete	1.0	21.0	4	$778.18	$2,334.53

UNIT COSTS

		(English)	(SI)
ROW$:	$7,000.00	per acre	
Concrete Pipe$:	$0.00	per lf	
Channel Exc.$:	$6.00		per cu.meter
Rip-Rap$:	$50.00		per cu.meter
Gabions$:	$50.00		per cu.meter
Concrete$:	$22.00	per sq. yard	
Concrete$:	$200.00	per cu. yd.	
	Channel Inc. Length (ft)	Channel Total Length (ft)	
	1.0	14692.0	

10-Year Existing
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\chand100.fm2
Worksheet	EMF to Higley (earthen) LOW
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.025	
Channel Slope	0.000900	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	8.00	ft
Discharge	345.00	cfs

Results		
Depth	4.24	ft
Flow Area	106.02	ft^2
Wetted Perimeter	43.00	ft
Top Width	41.96	ft
Critical Depth	2.58	ft
Critical Slope	0.007934	ft/ft
Velocity	3.25	ft/s
Velocity Head	0.16	ft
Specific Energy	4.41	ft
Froude Number	0.36	
Flow is subcritical.		

10-Year Existing
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\chand2.fm2
Worksheet	EMF to Higley (riprap) LOW
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.032	
Channel Slope	0.003000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	8.00	ft
Discharge	345.00	cfs

Results		
Depth	3.90	ft
Flow Area	76.73	ft^2
Wetted Perimeter	32.65	ft
Top Width	31.38	ft
Critical Depth	2.76	ft
Critical Slope	0.012796	ft/ft
Velocity	4.50	ft/s
Velocity Head	0.31	ft
Specific Energy	4.21	ft
Froude Number	0.51	
Flow is subcritical.		

10-Year Existing
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\chand2.fm2
Worksheet	EMF to Higley (gabions) LOW
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.032	
Channel Slope	0.003000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	345.00	cfs

Results		
Depth	4.30	ft
Flow Area	71.36	ft^2
Wetted Perimeter	27.23	ft
Top Width	25.20	ft
Critical Depth	3.00	ft
Critical Slope	0.012766	ft/ft
Velocity	4.83	ft/s
Velocity Head	0.36	ft
Specific Energy	4.66	ft
Froude Number	0.51	
Flow is subcritical.		

10-Year Existing
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\chand2.fm2
Worksheet	EMF to Higley (concrete) LOW
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.016	
Channel Slope	0.002500	ft/ft
Left Side Slope	1.000000	H : V
Right Side Slope	1.000000	H : V
Bottom Width	8.00	ft
Discharge	345.00	cfs

Results		
Depth	3.64	ft
Flow Area	42.42	ft^2
Wetted Perimeter	18.31	ft
Top Width	15.29	ft
Critical Depth	3.34	ft
Critical Slope	0.003424	ft/ft
Velocity	8.13	ft/s
Velocity Head	1.03	ft
Specific Energy	4.67	ft
Froude Number	0.86	
Flow is subcritical.		

CURRENT DATE: 02-10-1998
CURRENT TIME: 10:52:27

FILE DATE: 02-10-1998
FILE NAME: CHANDLOW

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.0

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	100.00	99.88	40.00	3 RCPE	4.42	2.83	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: CHANDLOW DATE: 02-10-1998

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
101.43	34.5	34.5	0.0	0.0	0.0	0.0	0.0	0.00	1
102.09	69.0	69.0	0.0	0.0	0.0	0.0	0.0	0.00	1
102.70	103.5	103.5	0.0	0.0	0.0	0.0	0.0	0.00	1
103.13	138.0	138.0	0.0	0.0	0.0	0.0	0.0	0.00	1
103.68	172.5	172.5	0.0	0.0	0.0	0.0	0.0	0.00	1
104.07	207.0	185.3	0.0	0.0	0.0	0.0	0.0	20.47	4
104.31	241.5	185.6	0.0	0.0	0.0	0.0	0.0	55.51	4
104.51	276.0	182.6	0.0	0.0	0.0	0.0	0.0	90.70	3
104.70	310.5	180.0	0.0	0.0	0.0	0.0	0.0	128.43	3
104.86	345.0	177.3	0.0	0.0	0.0	0.0	0.0	166.54	3
103.80	178.7	178.7	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CHANDLOW DATE: 02-10-1998

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
100.00	0.000	0.00	0.00	0.00
101.43	0.000	34.50	0.00	0.00
102.09	0.000	69.00	0.00	0.00
102.70	0.000	103.50	0.00	0.00
103.13	0.000	138.00	0.00	0.00
103.68	0.000	172.50	0.00	0.00
104.07	-0.005	207.00	1.24	0.60
104.31	-0.001	241.50	0.43	0.18
104.51	-0.008	276.00	2.71	0.98
104.70	-0.006	310.50	2.04	0.66
104.86	-0.003	345.00	1.20	0.35

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 02-10-1998
CURRENT TIME: 10:52:27

FILE DATE: 02-10-1998
FILE NAME: CHANDLOW

PERFORMANCE CURVE FOR CULVERT 1 - 3(4.42 (ft) BY 2.83 (ft)) RCPE

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	100.00	0.00	-0.12	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
34.50	101.43	1.10	1.43	3-M1t	0.82	0.84	1.42	1.42	2.25	1.77
69.00	102.09	1.67	2.09	3-M1t	1.19	1.20	2.01	2.01	3.00	2.14
103.50	102.70	2.17	2.70	3-M1t	1.50	1.50	2.44	2.44	3.72	2.38
138.00	103.13	2.58	3.13	3-M1t	1.79	1.75	2.80	2.80	4.55	2.57
172.50	103.68	2.97	3.68	4-FFt	2.09	1.98	2.83	3.10	5.67	2.72
185.28	104.06	3.13	4.06	4-FFt	2.22	2.05	2.83	3.37	6.08	2.85
185.56	104.31	3.13	4.31	4-FFt	2.22	2.05	2.83	3.62	6.09	2.97
182.59	104.50	3.09	4.50	4-FFt	2.19	2.04	2.83	3.84	6.00	3.07
180.03	104.69	3.06	4.69	4-FFt	2.17	2.02	2.83	4.05	5.91	3.17
177.26	104.86	3.03	4.86	4-FFt	2.14	2.01	2.83	4.24	5.82	3.25

El. inlet face invert 100.00 ft
El. outlet invert 99.88 ft
El. inlet throat invert 0.00 ft
El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	0.00 ft
INLET ELEVATION	100.00 ft
OUTLET STATION	40.00 ft
OUTLET ELEVATION	99.88 ft
NUMBER OF BARRELS	3
SLOPE (V/H)	0.0030
CULVERT LENGTH ALONG SLOPE	40.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	ELLIPTICAL
BARREL SPAN	4.42 ft
BARREL RISE	2.83 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTING
INLET DEPRESSION	NONE

CURRENT DATE: 02-10-1998
CURRENT TIME: 10:52:27

FILE DATE: 02-10-1998
FILE NAME: CHANDLOW

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	8.00 ft
SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.001
MANNING'S n (.01-0.1)	0.025
CHANNEL INVERT ELEVATION	99.88 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	99.88 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	99.88	0.000	0.00	0.00	0.00
34.50	101.30	0.261	1.42	1.77	0.08
69.00	101.89	0.266	2.01	2.14	0.11
103.50	102.32	0.268	2.44	2.38	0.14
138.00	102.68	0.271	2.80	2.57	0.16
172.50	102.98	0.272	3.10	2.72	0.17
207.00	103.25	0.274	3.37	2.85	0.19
241.50	103.50	0.275	3.62	2.97	0.20
276.00	103.72	0.276	3.84	3.07	0.22
310.50	103.93	0.277	4.05	3.17	0.23
345.00	104.12	0.278	4.24	3.25	0.24

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	30.00 ft
CREST LENGTH	50.00 ft
OVERTOPPING CREST ELEVATION	103.80 ft

CURRENT DATE: 02-12-1998
CURRENT TIME: 14:00:08

FILE DATE: 02-12-1998
FILE NAME: CHANLOW2

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.0

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	100.00	99.74	88.00	1 RCB	10.00	5.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: CHANLOW2 DATE: 02-12-1998

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
101.46	34.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
102.19	69.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
102.76	103.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
103.33	138.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
103.58	172.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
103.85	207.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
104.13	241.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
104.47	276.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
104.88	310.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
105.30	345.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CHANLOW2 DATE: 02-12-1998

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
0.00	0.000	0.00	0.00	0.00
101.46	0.000	34.50	0.00	0.00
102.19	0.000	69.00	0.00	0.00
102.76	0.000	103.50	0.00	0.00
103.33	0.000	138.00	0.00	0.00
103.58	0.000	172.50	0.00	0.00
103.85	0.000	207.00	0.00	0.00
104.13	0.000	241.50	0.00	0.00
104.47	0.000	276.00	0.00	0.00
104.88	0.000	310.50	0.00	0.00
105.30	0.000	345.00	0.00	0.00

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 02-12-1998
CURRENT TIME: 14:00:08

FILE DATE: 02-12-1998
FILE NAME: CHANLOW2

PERFORMANCE CURVE FOR CULVERT 1 - 1(10.00 (ft) BY 5.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	100.00	0.00	-0.12	0-NF	0.00	0.00	0.00	0.14	0.00	0.00
34.50	101.46	1.10	1.46	3-M1t	0.68	0.72	1.56	1.56	2.21	1.77
69.00	102.19	1.75	2.19	3-M1t	1.08	1.14	2.15	2.15	3.21	2.14
103.50	102.76	2.29	2.76	3-M1t	1.42	1.50	2.58	2.58	4.01	2.38
138.00	103.33	2.78	3.33	1-S2n	1.71	1.81	1.71	2.94	8.05	2.57
172.50	103.58	3.24	3.58	1-S2n	2.00	2.10	2.00	3.24	8.62	2.72
207.00	103.85	3.66	3.85	1-S2n	2.26	2.37	2.26	3.51	9.16	2.85
241.50	104.13	4.06	4.13	1-S2n	2.52	2.63	2.52	3.76	9.59	2.97
276.00	104.47	4.44	4.47	1-S2n	2.76	2.88	2.76	3.98	10.00	3.07
310.50	104.88	4.83	4.88	1-S2n	3.00	3.11	3.00	4.19	10.34	3.17
345.00	105.30	5.22	5.30	5-S2n	3.23	3.34	3.23	4.38	10.67	3.25

El. inlet face invert 100.00 ft
El. outlet invert 99.74 ft
El. inlet throat invert 0.00 ft
El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	0.00 ft
INLET ELEVATION	100.00 ft
OUTLET STATION	88.00 ft
OUTLET ELEVATION	99.74 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0030
CULVERT LENGTH ALONG SLOPE	88.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	10.00 ft
BARREL RISE	5.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (30-75 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 02-12-1998
CURRENT TIME: 14:00:08

FILE DATE: 02-12-1998
FILE NAME: CHANLOW2

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	8.00 ft
SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.001
MANNING'S n (.01-0.1)	0.025
CHANNEL INVERT ELEVATION	99.88 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	99.74 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	99.88	0.000	0.00	0.00	0.00
34.50	101.30	0.261	1.42	1.77	0.08
69.00	101.89	0.266	2.01	2.14	0.11
103.50	102.32	0.268	2.44	2.38	0.14
138.00	102.68	0.271	2.80	2.57	0.16
172.50	102.98	0.272	3.10	2.72	0.17
207.00	103.25	0.274	3.37	2.85	0.19
241.50	103.50	0.275	3.62	2.97	0.20
276.00	103.72	0.276	3.84	3.07	0.22
310.50	103.93	0.277	4.05	3.17	0.23
345.00	104.12	0.278	4.24	3.25	0.24

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	30.00 ft
CREST LENGTH	52.00 ft
OVERTOPPING CREST ELEVATION	105.50 ft

MCDOT CAR
DMJM Proj#: 6597.03

Chandler Heights Channel Between East Maricopa Floodway and Power Road -- Channel Design Options

100-YEAR DEVELOPED CONDITIONS
FULL ALTERNATIVE (Q=450cfs)

Channel Type	ROW (sq.ft per foot)	Concrete Pipe (lin.ft)	Channel Exc. (cu.meters)/ft	Bank Protection (cu.meter or sq. yard)/ft	ROW ($/ft)	Concrete Pipe ($/ft)	Channel Exc. ($/ft)	Bank Protection ($/ft)	Channel Total ($/ft)	Channel Total ($)	Channel Total and Drop $'s
earth	74.8	0	5.5	-	$12.02	$0.00	$33.27	-	$45	$665,454	**$720,170**
rip-rap	57.0	0	3.8	1.8	$9.16	$0.00	$22.89	$90.87	$123	$1,805,930	**$1,805,930**
gabion	47.6	0	3.3	0.7	$7.65	$0.00	$19.85	$36.51	$64	$940,442	**$940,442**
concrete	34.4	0	1.9	2.5	$5.53	$0.00	$11.66	$55.51	$73	$1,068,079	**$1,070,602**

	Channel Design Depth (ft)	Bottom Width (ft)	Top Width (ft)	SideSlopes (h:1)	Lining Thickness (ft)
earth	5.1	18.0	58.8	4	-
rip-rap	5.5	8.0	41.0	3	1.50
gabions	5.9	8.0	31.6	2	0.75
concrete	5.2	8.0	18.4	1	0.50

DROP STRUCTURE CALCULATIONS

	Existing Slope (ft/ft)	Design Slope (ft/ft)	Elevation Difference	#of 3' Drop Structures	Drop Struct. Type	Drop Struct. Length	Drop Struct. Width	Riprap Volume (cu. yd.)	Drop Struct. Cost (ea.)	Drop Struct. Total Cost
earth	0.003	0.0008	32.3	11	riprap	39.0	60.1	260	$4,974.22	$54,716.39
concrete	0.003	0.0025	7.3	3	concrete	1.0	22.7	4	$841.03	$2,523.09

UNIT COSTS

		(English)	(SI)
ROW$:	$7,000.00	per acre	
Concrete Pipe$:	$0.00	per lf	
Channel Exc.$:	$6.00		per cu.meter
Rip-Rap$:	$50.00		per cu.meter
Gabions$:	$50.00		per cu.meter
Concrete$:	$22.00	per sq. yard	
Concrete$:	$200.00	per cu. yd.	
	Channel Inc. Length (ft)	Channel Total Length (ft)	
	1.0	14692.0	

100-Year Future
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\chand100.fm2
Worksheet	EMF to Higley (earthen)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.025	
Channel Slope	0.000800	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	18.00	ft
Discharge	450.00	cfs

Results		
Depth	4.05	ft
Flow Area	138.30	ft^2
Wetted Perimeter	51.36	ft
Top Width	50.37	ft
Critical Depth	2.26	ft
Critical Slope	0.007801	ft/ft
Velocity	3.25	ft/s
Velocity Head	0.16	ft
Specific Energy	4.21	ft
Froude Number	0.35	
Flow is subcritical.		

100-Year Future
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\chand2.fm2
Worksheet	EMF to Higley (riprap)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.032	
Channel Slope	0.003000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	8.00	ft
Discharge	450.00	cfs

Results		
Depth	4.40	ft
Flow Area	93.44	ft²
Wetted Perimeter	35.86	ft
Top Width	34.43	ft
Critical Depth	3.17	ft
Critical Slope	0.012342	ft/ft
Velocity	4.82	ft/s
Velocity Head	0.36	ft
Specific Energy	4.76	ft
Froude Number	0.52	
Flow is subcritical.		

100-Year Future
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\chand2.fm2
Worksheet	EMF to Higley (gabions)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.032	
Channel Slope	0.003000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	450.00	cfs

Results		
Depth	4.89	ft
Flow Area	86.83	ft^2
Wetted Perimeter	29.85	ft
Top Width	27.54	ft
Critical Depth	3.46	ft
Critical Slope	0.012333	ft/ft
Velocity	5.18	ft/s
Velocity Head	0.42	ft
Specific Energy	5.30	ft
Froude Number	0.51	
Flow is subcritical.		

100-Year Future
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\659703\calcs\chand2.fm2
Worksheet	EMF to Higley (concrete)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.016	
Channel Slope	0.002500	ft/ft
Left Side Slope	1.000000	H : V
Right Side Slope	1.000000	H : V
Bottom Width	8.00	ft
Discharge	450.00	cfs

Results		
Depth	4.21	ft
Flow Area	51.47	ft^2
Wetted Perimeter	19.92	ft
Top Width	16.43	ft
Critical Depth	3.89	ft
Critical Slope	0.003339	ft/ft
Velocity	8.74	ft/s
Velocity Head	1.19	ft
Specific Energy	5.40	ft
Froude Number	0.87	
Flow is subcritical.		

CURRENT DATE: 02-10-1998
CURRENT TIME: 11:52:43

FILE DATE: 02-10-1998
FILE NAME: CHANLOW3

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.0

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	100.00	99.88	40.00	4 RCPE	4.42	2.83	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: CHANLOW3 DATE: 02-10-1998

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
100.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
101.74	45.0	45.0	0.0	0.0	0.0	0.0	0.0	0.00	1
102.00	90.0	90.0	0.0	0.0	0.0	0.0	0.0	0.00	1
102.30	135.0	135.0	0.0	0.0	0.0	0.0	0.0	0.00	1
102.89	180.0	180.0	0.0	0.0	0.0	0.0	0.0	0.00	1
103.38	225.0	225.0	0.0	0.0	0.0	0.0	0.0	0.00	1
103.83	270.0	248.8	0.0	0.0	0.0	0.0	0.0	19.28	4
104.10	315.0	250.9	0.0	0.0	0.0	0.0	0.0	63.53	4
104.31	360.0	247.6	0.0	0.0	0.0	0.0	0.0	108.89	3
104.51	405.0	244.5	0.0	0.0	0.0	0.0	0.0	157.59	3
104.69	450.0	240.8	0.0	0.0	0.0	0.0	0.0	206.85	3
103.60	239.2	239.2	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CHANLOW3 DATE: 02-10-1998

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
100.00	0.000	0.00	0.00	0.00
101.74	0.000	45.00	0.00	0.00
102.00	0.000	90.00	0.00	0.00
102.30	0.000	135.00	0.00	0.00
102.89	0.000	180.00	0.00	0.00
103.38	0.000	225.00	0.00	0.00
103.83	-0.006	270.00	1.97	0.73
104.10	-0.001	315.00	0.55	0.17
104.31	-0.008	360.00	3.46	0.96
104.51	-0.007	405.00	2.91	0.72
104.69	-0.005	450.00	2.37	0.53

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 02-10-1998
CURRENT TIME: 11:52:43

FILE DATE: 02-10-1998
FILE NAME: CHANLOW3

PERFORMANCE CURVE FOR CULVERT 1 - 4(4.42 (ft) BY 2.83 (ft)) RCPE

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	100.00	0.00	-0.12	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
45.00	101.74	1.08	1.74	1-S2n	0.81	0.82	0.81	1.19	4.54	1.65
90.00	102.00	1.65	2.00	1-S2n	1.18	1.19	1.18	1.75	5.62	2.05
135.00	102.30	2.15	2.30	1-S2n	1.48	1.48	1.48	2.18	6.32	2.32
180.00	102.89	2.55	2.89	3-M1t	1.76	1.73	2.54	2.54	4.70	2.52
225.00	103.38	2.93	3.38	3-M1f	2.06	1.96	2.83	2.85	5.53	2.69
248.75	103.83	3.14	3.83	4-FFt	2.23	2.06	2.83	3.13	6.13	2.83
250.92	104.10	3.16	4.10	4-FFt	2.24	2.07	2.83	3.39	6.18	2.95
247.65	104.31	3.13	4.31	4-FFt	2.22	2.05	2.83	3.62	6.10	3.06
244.50	104.51	3.10	4.51	4-FFt	2.20	2.04	2.83	3.84	6.02	3.16
240.78	104.69	3.07	4.69	4-FFt	2.17	2.02	2.83	4.05	5.93	3.25

El. inlet face invert 100.00 ft El. outlet invert 99.88 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	0.00 ft
INLET ELEVATION	100.00 ft
OUTLET STATION	40.00 ft
OUTLET ELEVATION	99.88 ft
NUMBER OF BARRELS	4
SLOPE (V/H)	0.0030
CULVERT LENGTH ALONG SLOPE	40.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	ELLIPTICAL
BARREL SPAN	4.42 ft
BARREL RISE	2.83 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTING
INLET DEPRESSION	NONE

CURRENT DATE: 02-10-1998
CURRENT TIME: 11:52:43

FILE DATE: 02-10-1998
FILE NAME: CHANLOW3

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	18.00 ft
SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.001
MANNING'S n (.01-0.1)	0.025
CHANNEL INVERT ELEVATION	99.88 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	99.88 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	99.88	0.000	0.00	0.00	0.00
45.00	101.07	0.267	1.19	1.65	0.06
90.00	101.63	0.273	1.75	2.05	0.09
135.00	102.06	0.277	2.18	2.32	0.11
180.00	102.42	0.279	2.54	2.52	0.13
225.00	102.73	0.280	2.85	2.69	0.14
270.00	103.01	0.282	3.13	2.83	0.16
315.00	103.26	0.283	3.39	2.95	0.17
360.00	103.50	0.283	3.62	3.06	0.18
405.00	103.72	0.284	3.84	3.16	0.19
450.00	103.93	0.285	4.05	3.25	0.20

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	30.00 ft
CREST LENGTH	60.00 ft
OVERTOPPING CREST ELEVATION	103.60 ft

CURRENT DATE: 02-12-1998
CURRENT TIME: 13:58:43

FILE DATE: 02-12-1998
FILE NAME: CHANLOW4

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.0

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	100.00	99.74	88.00	2 RCB	10.00	4.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

FILE: CHANLOW4 CULVERT HEADWATER ELEVATION (ft) DATE: 02-12-1998

DISCHARGE (cfs)	1	2	3	4	5	6	ROADWAY
0	100.00	0.00	0.00	0.00	0.00	0.00	0.00
45	101.18	0.00	0.00	0.00	0.00	0.00	0.00
90	101.81	0.00	0.00	0.00	0.00	0.00	0.00
135	102.30	0.00	0.00	0.00	0.00	0.00	0.00
180	102.73	0.00	0.00	0.00	0.00	0.00	0.00
225	103.11	0.00	0.00	0.00	0.00	0.00	0.00
270	103.45	0.00	0.00	0.00	0.00	0.00	0.00
315	103.78	0.00	0.00	0.00	0.00	0.00	0.00
360	104.08	0.00	0.00	0.00	0.00	0.00	0.00
405	104.37	0.00	0.00	0.00	0.00	0.00	0.00
450	104.72	0.00	0.00	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The last row, if not 0, is for a point above the roadway.

CURRENT DATE: 02-12-1998
CURRENT TIME: 13:58:43

FILE DATE: 02-12-1998
FILE NAME: CHANLOW4

PERFORMANCE CURVE FOR CULVERT 1 - 2(10.00 (ft) BY 4.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	100.00	0.00	-0.12	0-NF	0.00	0.00	0.00	0.14	0.00	0.00
45.00	101.18	0.83	1.18	3-M1t	0.52	0.54	1.33	1.33	1.69	1.65
90.00	101.81	1.31	1.81	3-M1t	0.83	0.86	1.89	1.89	2.38	2.05
135.00	102.30	1.72	2.30	3-M1t	1.07	1.13	2.32	2.32	2.91	2.32
180.00	102.73	2.09	2.73	3-M1t	1.29	1.36	2.68	2.68	3.36	2.52
225.00	103.11	2.43	3.11	3-M1t	1.50	1.58	2.99	2.99	3.76	2.69
270.00	103.45	2.75	3.45	3-M1t	1.69	1.79	3.27	3.27	4.13	2.83
315.00	103.78	3.05	3.78	3-M1t	1.88	1.98	3.53	3.53	4.47	2.95
360.00	104.08	3.34	4.08	5-M1t	2.06	2.16	3.76	3.76	4.79	3.06
405.00	104.37	3.62	4.37	5-M1t	2.23	2.34	3.98	3.98	5.09	3.16
450.00	104.72	3.90	4.72	4-FFt	2.40	2.51	4.00	4.19	5.63	3.25

El. inlet face invert 100.00 ft El. outlet invert 99.74 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	0.00 ft
INLET ELEVATION	100.00 ft
OUTLET STATION	88.00 ft
OUTLET ELEVATION	99.74 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0030
CULVERT LENGTH ALONG SLOPE	88.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	10.00 ft
BARREL RISE	4.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (30-75 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 02-12-1998
CURRENT TIME: 13:58:43

FILE DATE: 02-12-1998
FILE NAME: CHANLOW4

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	18.00 ft
SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.001
MANNING'S n (.01-0.1)	0.025
CHANNEL INVERT ELEVATION	99.88 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	99.74 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	99.88	0.000	0.00	0.00	0.00
45.00	101.07	0.267	1.19	1.65	0.06
90.00	101.63	0.273	1.75	2.05	0.09
135.00	102.06	0.277	2.18	2.32	0.11
180.00	102.42	0.279	2.54	2.52	0.13
225.00	102.73	0.280	2.85	2.69	0.14
270.00	103.01	0.282	3.13	2.83	0.16
315.00	103.26	0.283	3.39	2.95	0.17
360.00	103.50	0.283	3.62	3.06	0.18
405.00	103.72	0.284	3.84	3.16	0.19
450.00	103.93	0.285	4.05	3.25	0.20

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	30.00 ft
CREST LENGTH	56.00 ft
OVERTOPPING CREST ELEVATION	107.00 ft

10.6 Right-of-Way Calculations

DMJM ARIZONA, INC.	PROJECT	MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION CANDIDATE ASSESSMENT REPORT	PROJECT NO. 6597.03		SHT. NO.
			BY JRM	DATE 2/12/98	
SUBJECT Right-of-Way Calculations			REFERENCE		

	Length	Width	Area	Area	Cost
	ft	ft	sq. ft	Ac	7000
	m	m	sq. m	ha	$/Ac

87th Avenue Channel

No right-of-way is required for either the full cost or low cost alternatives.

Ray Road Channel

Full Cost Alternative=	4970	75	372750	8.56	$59,900
	1514.9	22.86	34630	3.463	
Low Cost Alternative=	4970	92	457240	10.50	$73,478
	1514.9	28.04	42479	4.248	
No Build Alternative=	4970	75	372750	8.56	$59,900
	1514.9	22.86	34630	3.463	

Guadalupe Road Channel

No right-of-way is required for either the full cost or low cost alternatives.

Chandler Heights Road Channel

Full Cost Alternative:					
(Exist. 33')	10627	33	350691	8.05	$56,355
	3239.1	10.06	32580	3.258	
(Exist. 40')	4065	40	162600	3.73	$26,129
	1239	12.19	15106	1.511	
(Total New)	14692	119	1748348	40.14	$280,956
	4478.1	36.27	162427	16.243	
(New Purchase)			1235057	28.35	$198,471
			114741	11.474	
Low Cost Alternative:					
(Exist. 33')	10627	33	350691	8.05	$56,355
	3239.1	10.06	32580	3.258	
(Exist. 40')	4065	40	162600	3.73	$26,129
	1239	12.19	15106	1.511	

DMJM ARIZONA, INC.	PROJECT MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION CANDIDATE ASSESSMENT REPORT	PROJECT NO. 6597.03	SHT. NO.
		BY JRM / DATE 2/12/98	
SUBJECT Right-of-Way Calculations		REFERENCE	

	Length	Width	Area	Area	Cost
	ft	ft	sq. ft	Ac	7000
	m	m	sq. m	ha	$/Ac
(Total New)	14692	115	1689580	38.79	$271,512
	4478.1	35.05	156967	15.697	
(New Purchase)			1176289	27.00	$189,027
			109281	10.928	
No Build Alternative:					
(Exist. 33')	10627	33	350691	8.05	$56,355
	3239.1	10.06	32580	3.258	
(Exist. 40')	4065	40	162600	3.73	$26,129
	1239	12.19	15106	1.511	
(Total New)	14692	75	1101900	25.30	$177,073
	4478.1	22.86	102370	10.237	
(New Purchase)			588609	13.51	$94,588
			54684	5.468	

10.7 Field Visit Documentation

DANIEL, MANN, JOHNSON, & MENDENHALL

50 YEARS

Memorandum

To:	File	Date:	Dec. 14, 1997
From:	Steve Luk	Project:	CAR-97M
RE:	Field reviews on 12/10 & 12/11, 1997	Project No.	6597.03

Attendees: Tom P., Tom S., Greg W. (MCDOT) , Amir M. (FCDMC), Michael S., Marwan El D., Jason K., Kelley F. (DMJM)

DMJM, FCDMC, and MCDOT visited the following four CAR sites on Wednesday, December 10, 1997. The following is a summary of the observations made, the discussions amongst the team and the alternatives to be evaluated. Sketches are included that show our observations and field measurements for each site:

- 87th Avenue between Deer Valley Drive and Williams Road. This site is located at 87th Avenue between Williams Road and Deer Valley Road. Existing conditions include two new developments just south of Deer Valley Drive; a mostly unpaved, inverted crown, 87th Avenue from Deer Valley Drive to Pinnacle Peak; an abandoned concrete irrigation channel running along Williams Road and ending at 87th Avenue; and periodic flooding of houses upstream of this area. Possible low cost solutions include a retention area located at the northeast corner of Williams Road and 87th Avenue, a storm drain pipe or channel running south along 87th Avenue and discharging to the new drainage channel for the new developments just south of Deer Valley Drive. FCDMC recommended that DMJM contact Dan Nissan at the City of Peoria to confirm the half street width cross section and to collect the Drainage Reports for the new developments under construction. MCDOT recommended that DMJM plan for the future roadway improvements, but to not include these future roadway improvements in our cost and recommendations to solve the drainage issue. DMJM was directed to do a 100 year storm event solution

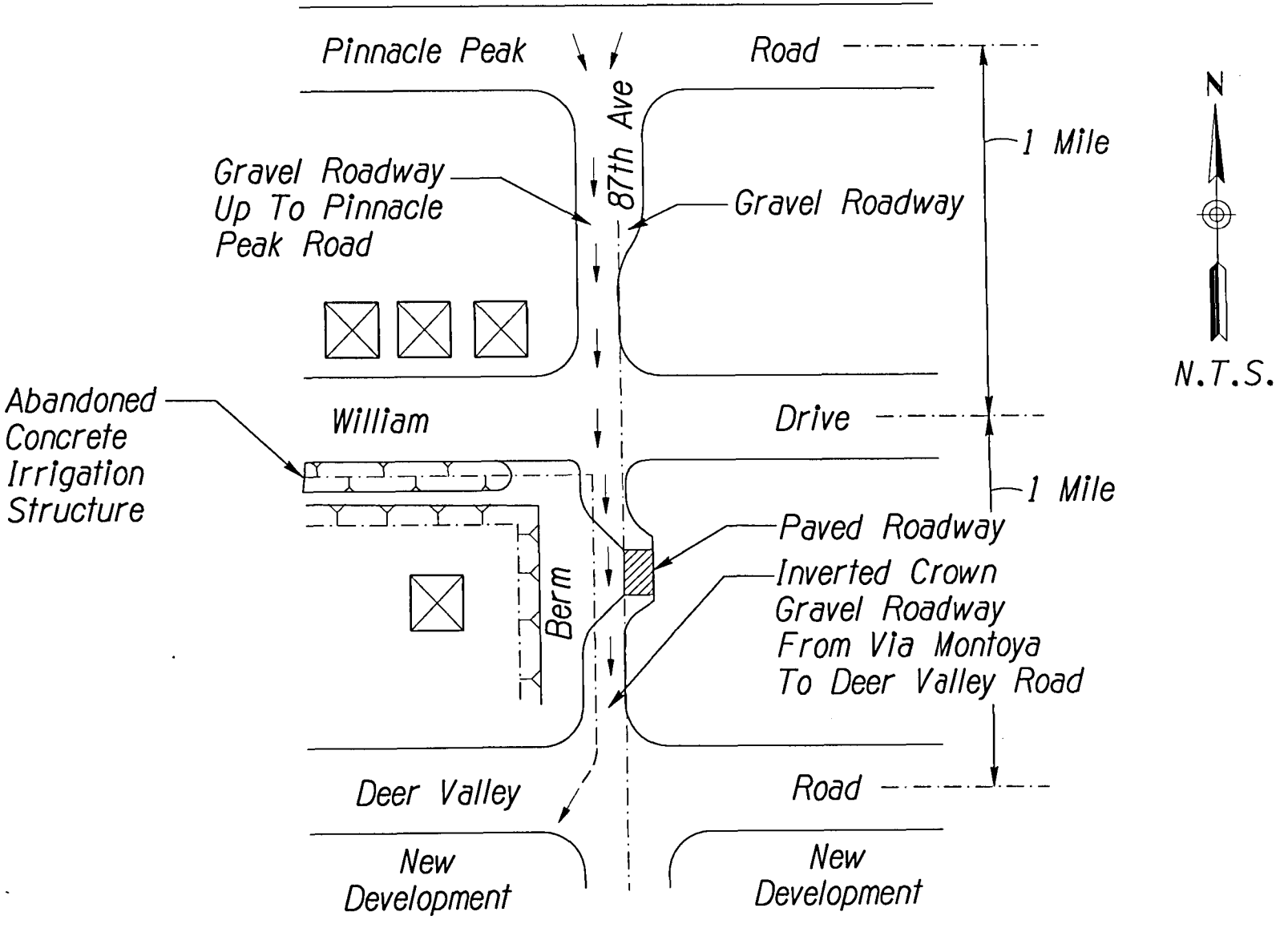
for the high cost and a 10 year storm event solution for the low cost. The new channels under construction in the new developments shall be used as an outfall.

- Ray Road between Tuthill Road and Airport Road. The existing channel, located along the south side of Ray Road between Tuthill Road and Airport Road, is a sandy bottom channel (filled with sediment). This drainage channel intercepts overland flow coming from the southeast. Residents northwest of the channel have been experiencing flooding problems due to insufficient capacity of the channel. Sedimentation of the channel is one contributing factor. Two existing concrete driveways cross the channel bottom. The no build alternative shall include stabilization measures at the driveway crossings. The guardrail along the roadway at the elbow at Ray Road and Airport Road was damaged and needed replacement. This should be included in each alternative including the no build alternative. The survey monument could not be found at the intersection of Ray Road and Tuthill Road. It was suggested that DMJM contact John Rose at MCDOT to get this information. At the downstream end of the channel, at it's outfall with Waterman Wash, the channel was incised with almost vertical side slopes. No hydrology study exists for this location. DMJM will be required to develop hydrology based on a regression equation for the area. MCDOT recommended that DMJM not look at making any improvements to the roadway but to plan the drainage improvements to include the ultimate roadway improvements. It was suggested that DMJM use the 50 or100 year storm event solution for the high cost and the 10 or 25 year storm event solution for the low cost alternative.

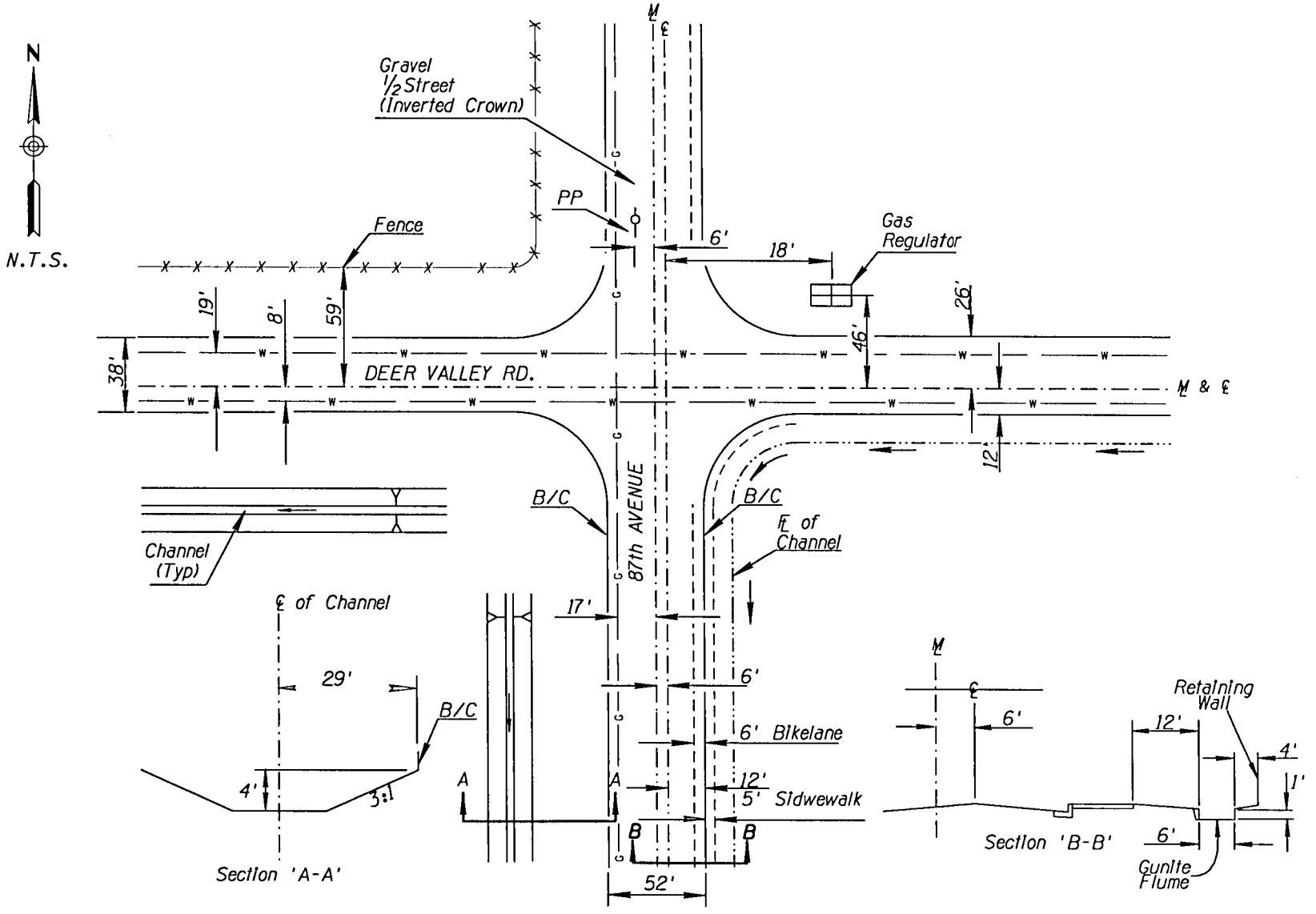
- Guadalupe Road at the Eastern Canal. The site is a tailwater ditch located along the east side of the Eastern Canal, extending a ½ mile north and ¼ mile south of Guadalupe Road. Amir Motamedi stated that flooding north and east of the Eastern Canal and Guadalupe Road happens on the first tier of homes due to the ponding of the Eastern Canal and Guadalupe Road. Amir Motamedi recommended that DMJM review the Flood Insurance Study prepared by SFC. Amir Motamedi and Tom Phelan made comments regarding the storm drain improvements planned by the City of Gilbert and whether or not it would alleviate the flooding problem. DMJM was advised to check into Gilbert's involvement and improvement plans to see whether a solution was needed. The City of Gilbert is presently studying solutions to alleviate the problem caused by storm water and irrigation water flowing into a low capacity tail water ditch. If the City is not solving the problem, then DMJM shall assess the situation and evaluate alternatives to solve the flooding issue.

- Chandler Heights Road between Power Road and Greenfield Road. The fourth site visited (on 12/10/97) is located along the south side of Chandler Heights Road, between Power Road and Greenfield Road. There is an existing box culvert that was constructed by MCDOT across Power Road to covey the flows from the south. DMJM should assume that the project will start at the outlet of the box culvert. Amir Motamedi stated that the channel gets smaller as you go downstream toward the East Maricopa Floodway (EMF). The FCDMC will provide DMJM with all of the hydrologic information. It was suggested that the maintenance of the channel be defined in the report. Amir said that Greefield Acres (a proposed development) will be channelizing the most western end of the channel as it enters the EMF. The FCDMC has instructed the developer to design this channel for 500 cfs. Therefore, DMJM can ignore this portion of the channel in the CAR. On the day of the visit, the existing earthen trapezoidal channel was filled with vegetation. The trapezoidal earthen channel was completely filled with desert shrubbery and tumbleweed. The channel also conveyed irrigation tailwater. The channel has several driveways crossing into orchards located south of Chandler Heights Road. Reduced drainage capacity compounded with driveways impeding the flows causes the storm water to flow across the road and flood houses along the north side of Chandler Heights Road. The area surrounding the site is dairy and farmland. Possible low cost solutions could be to clear shrubbery from channel and construct minor channel crossing in place of dip section driveways.

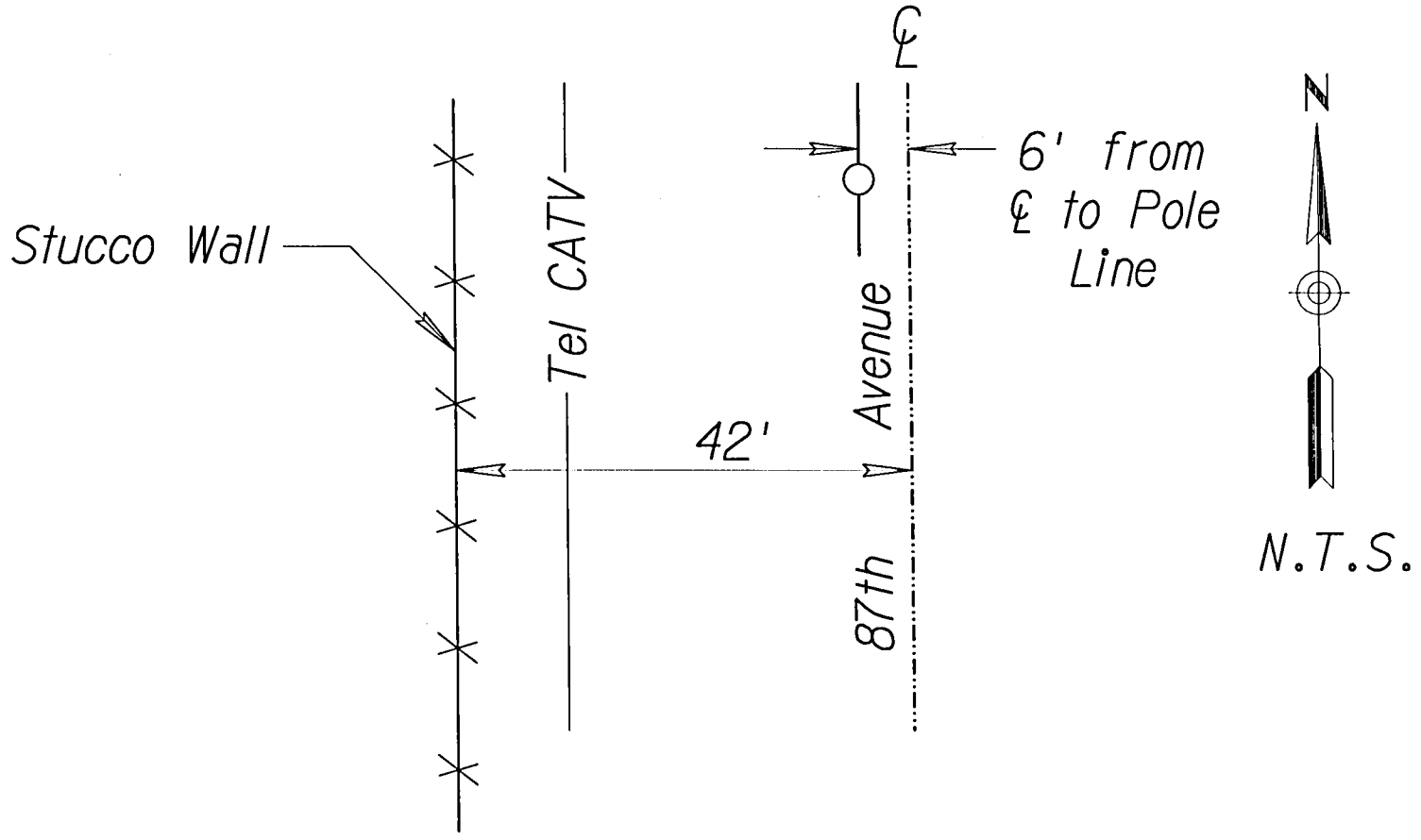
CHANNEL @ 87TH AVENUE BETWEEN PINNACLE PEAK RD & DEER VALLEY ROAD



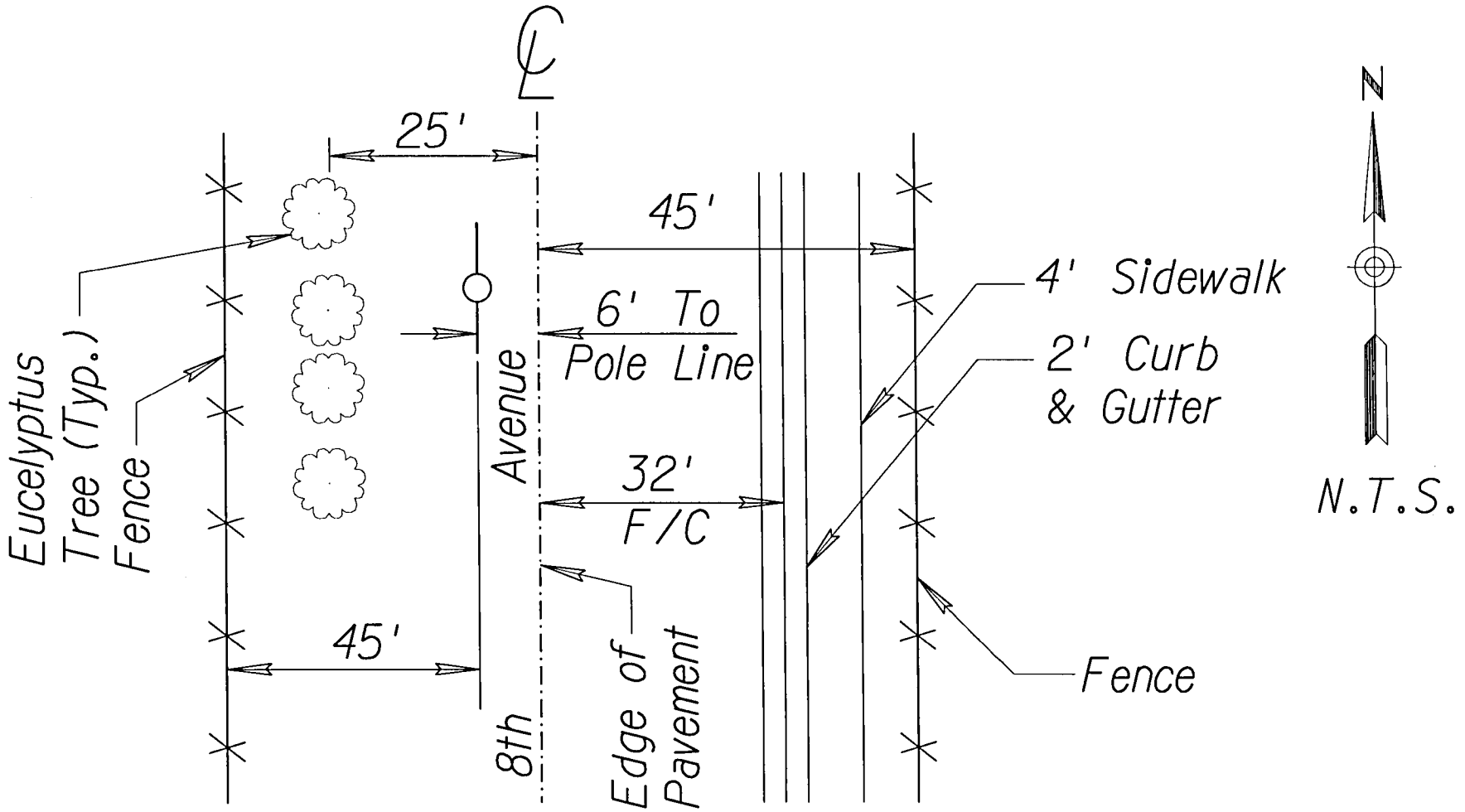
CHANNEL @ 87TH AVENUE BETWEEN PINNACLE PEAK ROAD & DEER VALLEY ROAD



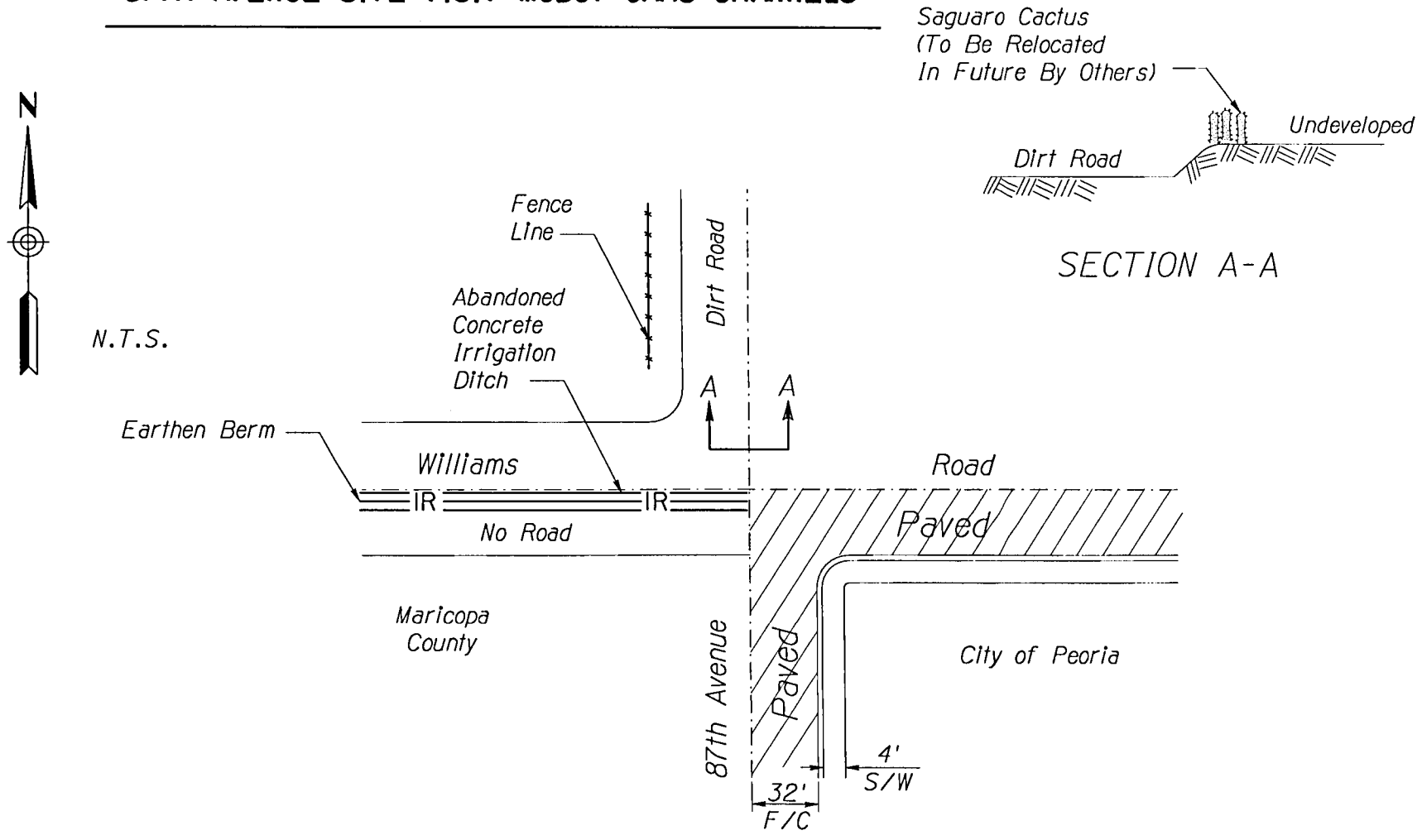
NORTH OF 87TH AVENUE BETWEEN DEER VALLEY DRIVE TO VIA MONTOYA



NORTH OF VIA MONTOYA TO WILLIAM DRIVE



87TH AVENUE SITE VISIT MCDOT CARS CHANNELS

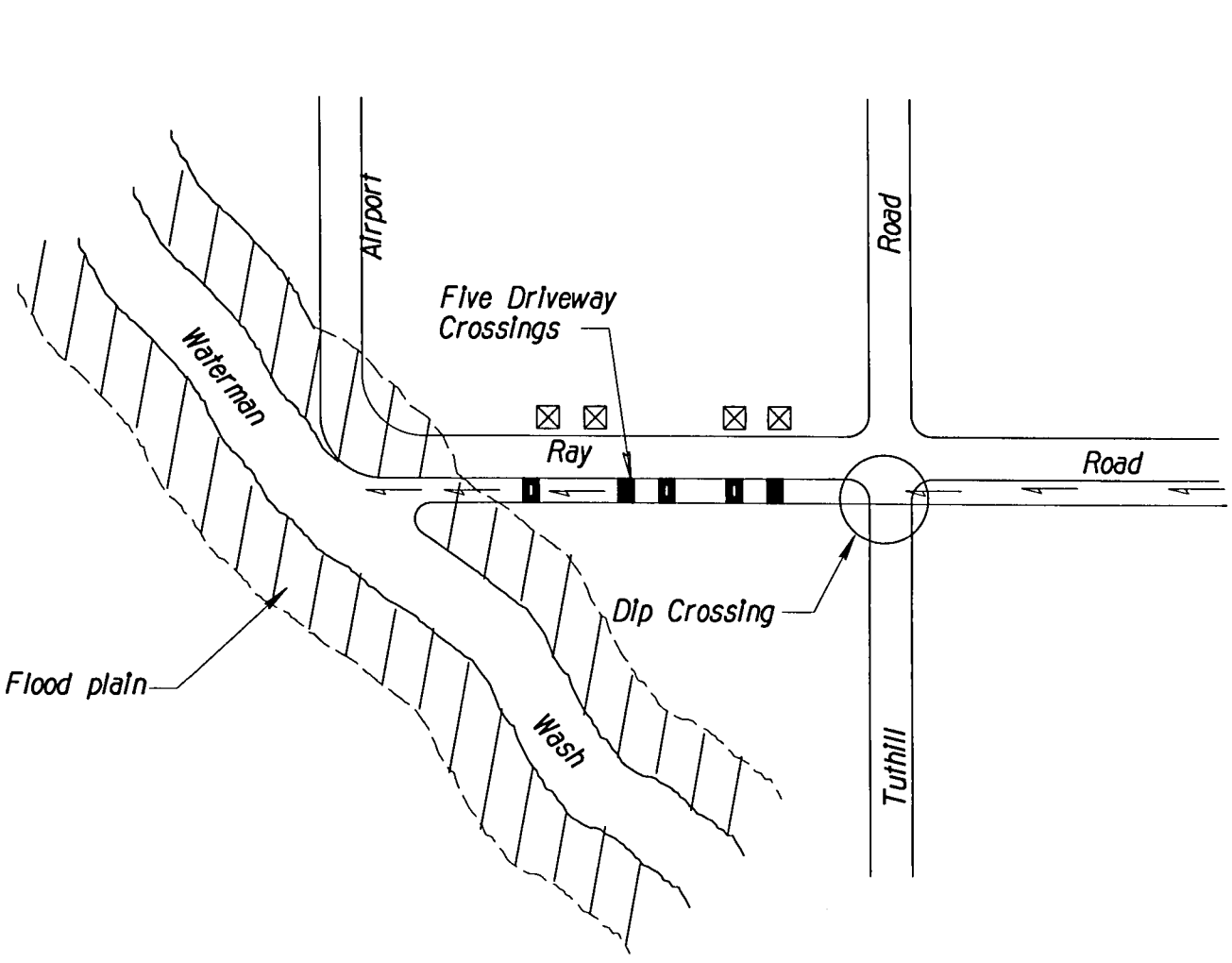


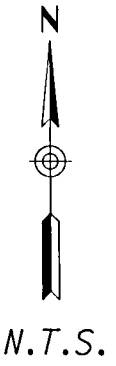
DMJM ARIZONA INC.
300 WEST CLARENDON, SUITE 400
PHOENIX, ARIZONA 85013
(602) 264-0217
(602) 285-1984 FAX

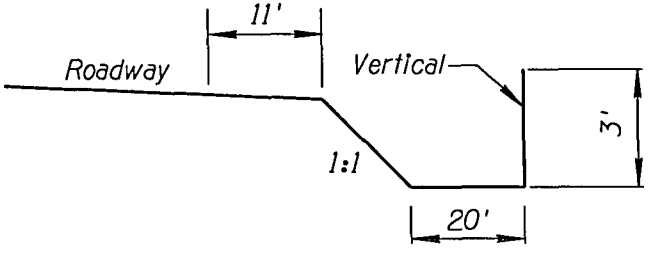
PROJECT:
MARICOPA COUNTY DEPARTMENT
OF TRANSPORTATION

PROJECT NO.		SHEET NO.
6597.03		
BY	DATE	
BAL	1-8-98	

CHANNEL @ RAY ROAD BTWN TUTHILL & AIRPORT-EXISTING CONDITIONS





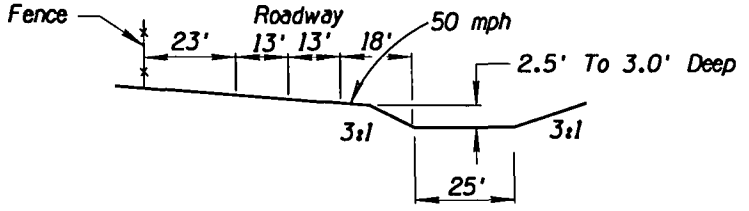


LOOKING UP-STREAM

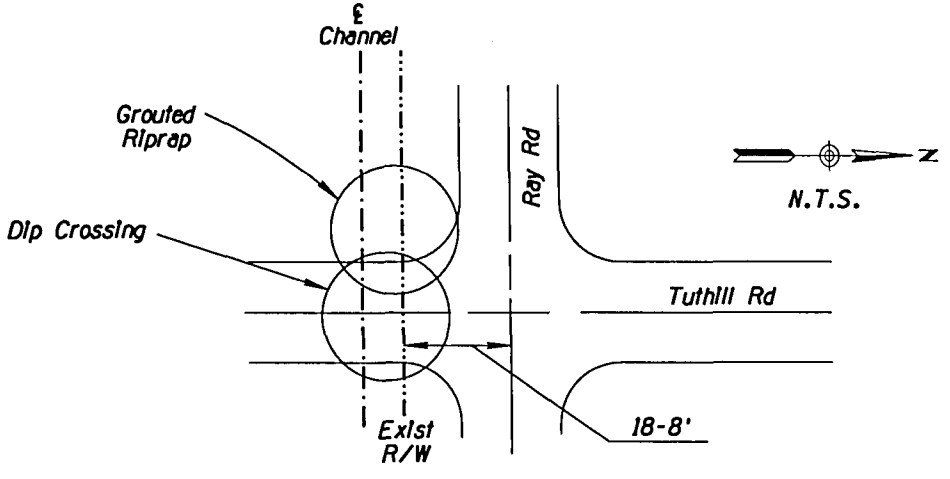
½ WAY BETWEEN AIRPORT & TUTHILL ROAD

N.T.S.

EXISTING RAY ROAD CHANNEL

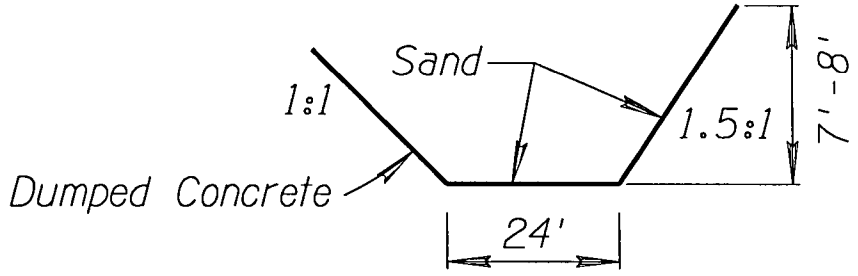


LOOKING UP-STREAM
450' EAST OF TUTHILL ROAD
(EXISTING CONDITIONS)

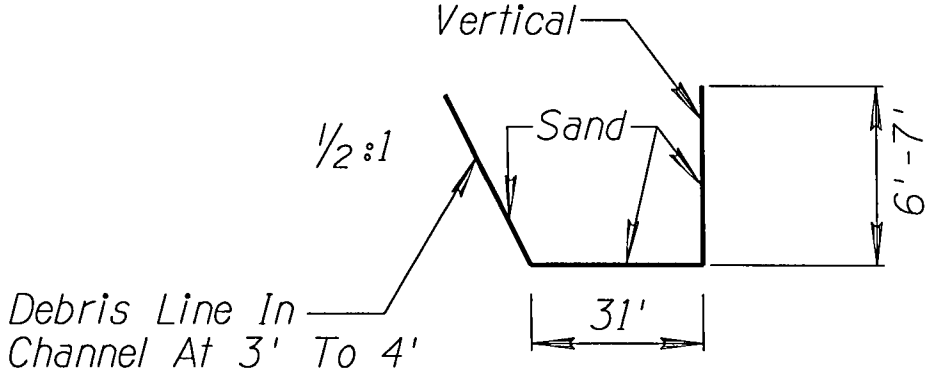


INTERSECTION OF
RAY ROAD & TUTHILL ROAD
(EXISTING CONDITIONS)

CHANNEL @ RAY ROAD



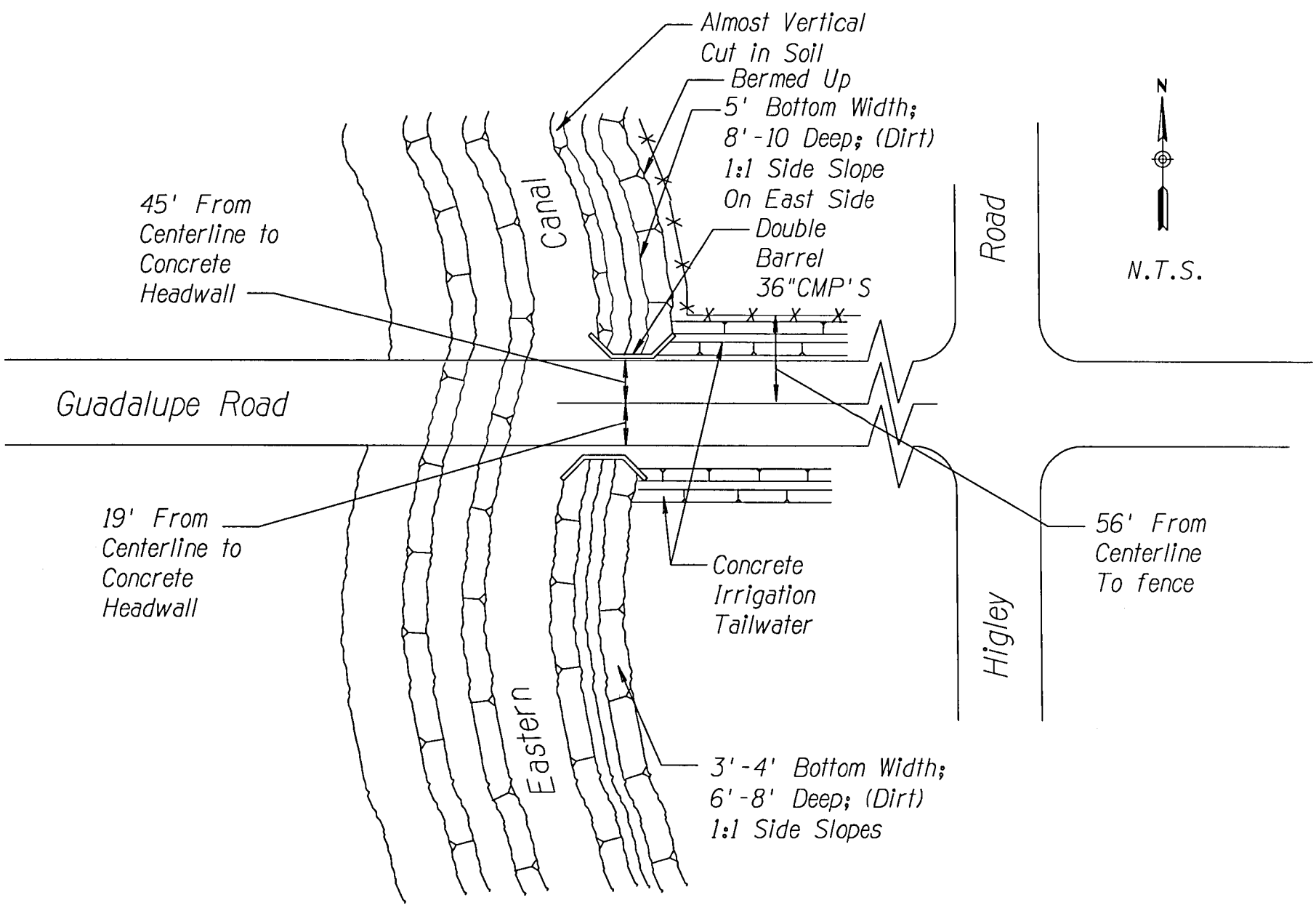
LOOKING UP-STREAM
AT OUTLET INTO WATERMAN WASH



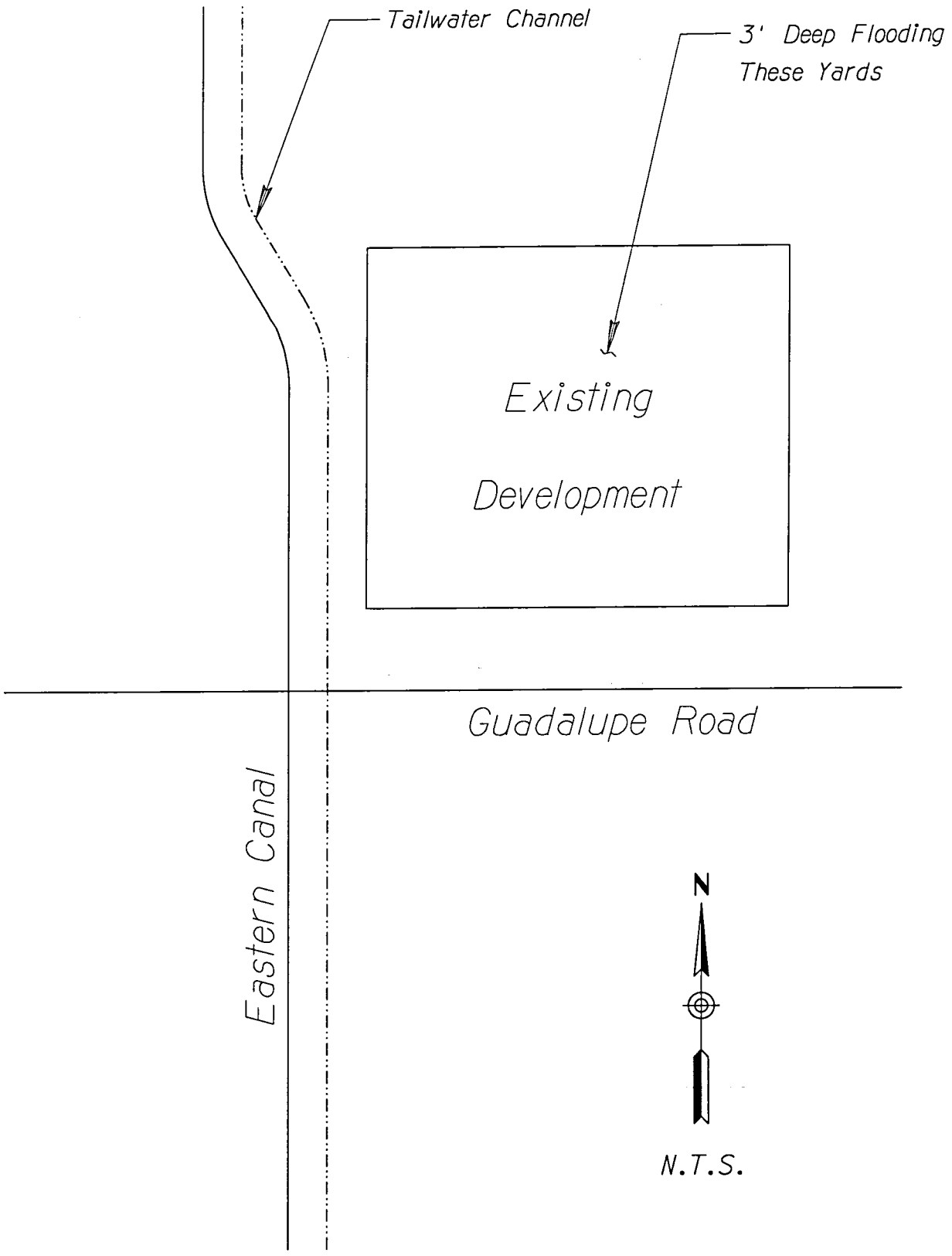
LOOKING UP-STREAM
500' UP-STREAM FROM WATERMAN WASH

EXISTING RAY ROAD CHANNEL

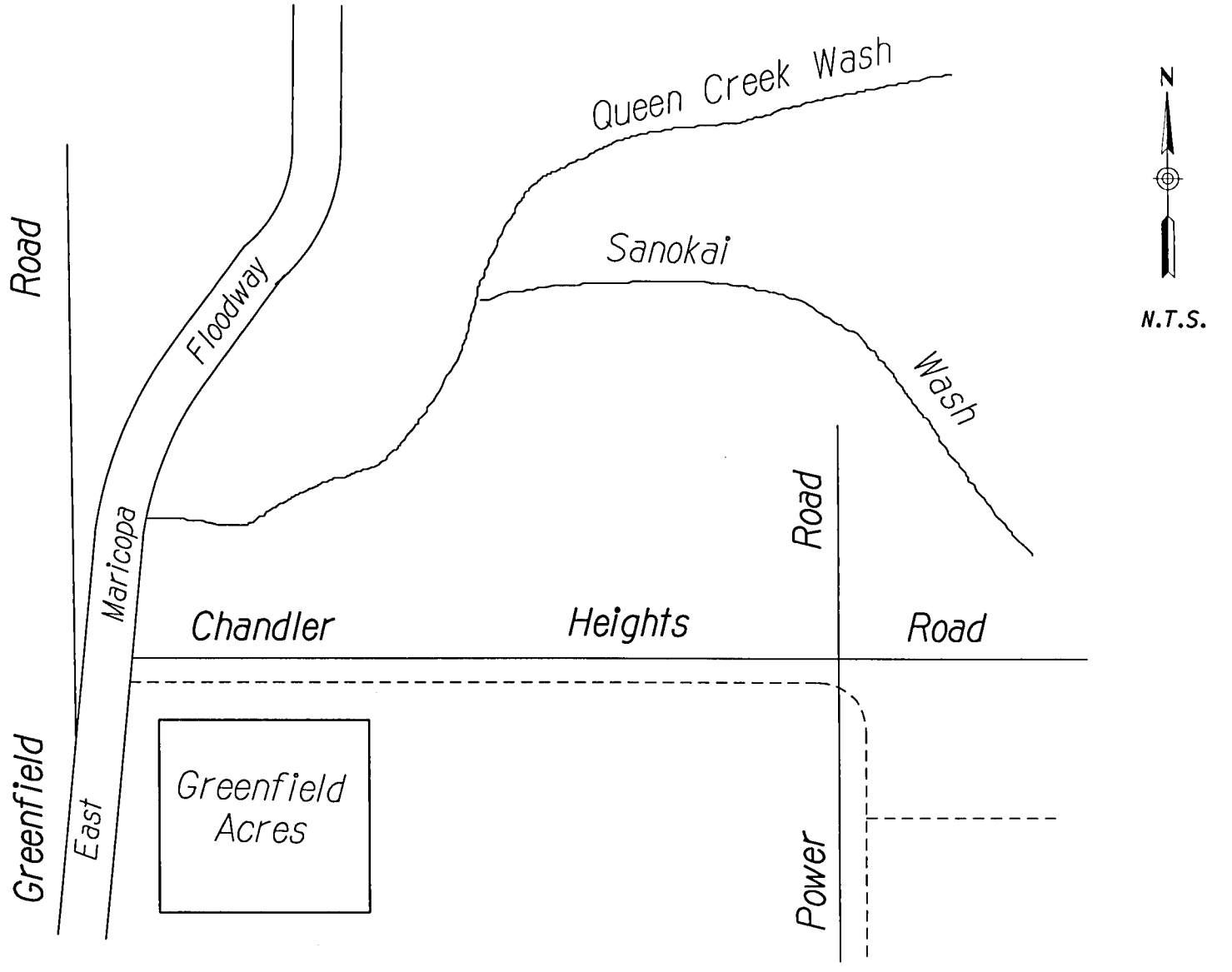
GUADALUPE ROAD @ THE EASTERN CANAL



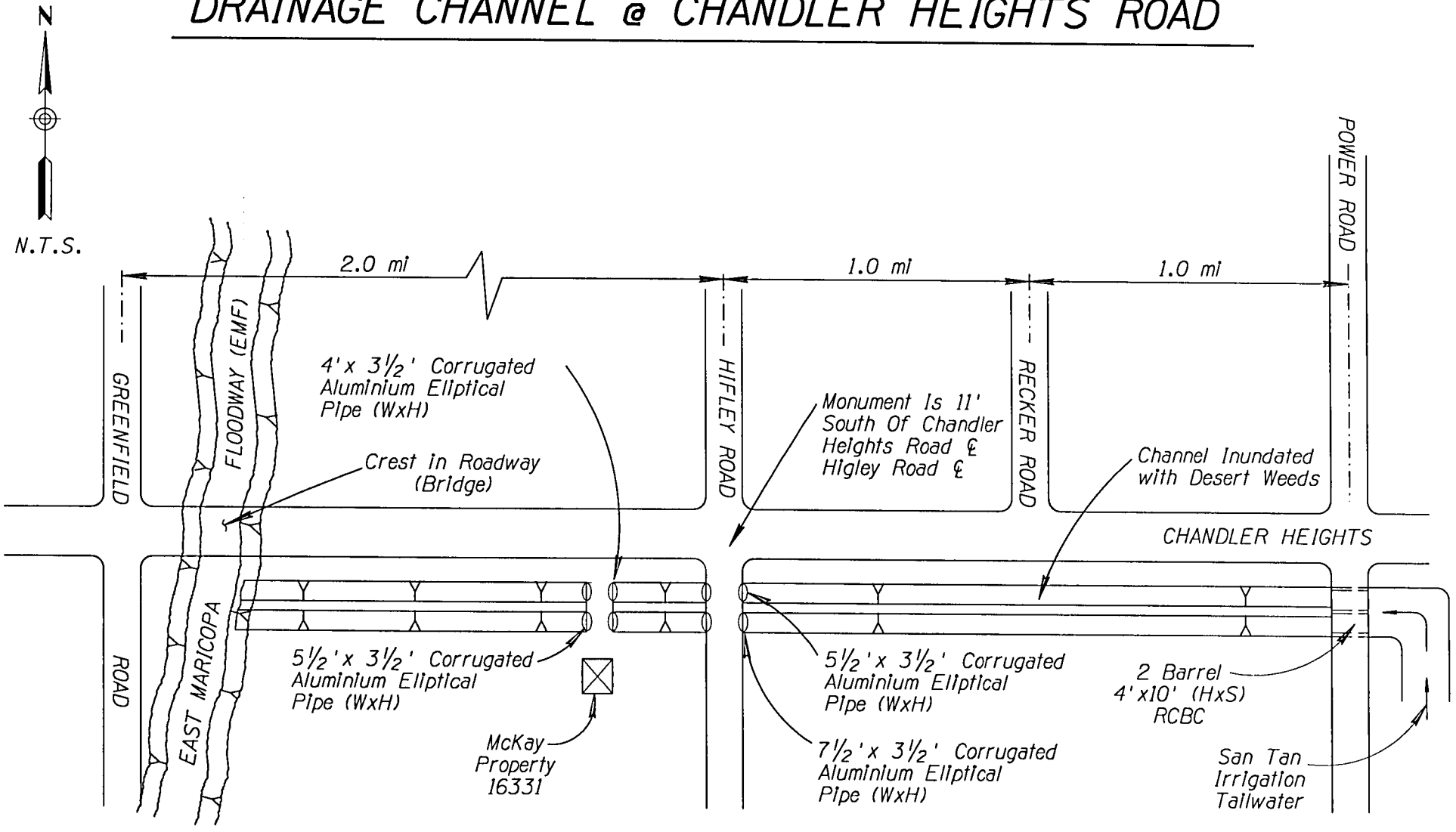
GUADALUPE ROAD @ EASTERN CANAL



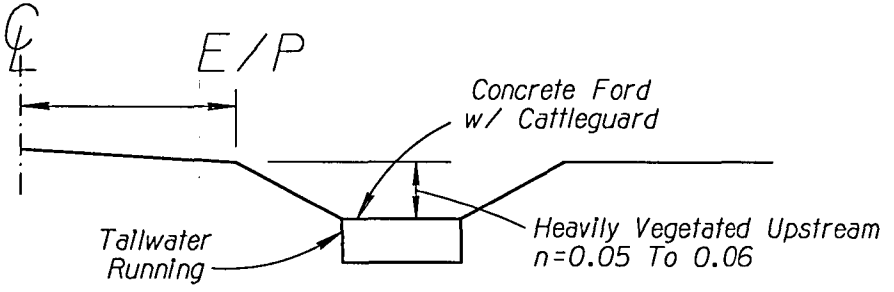
DRAINAGE CHANNEL ON CHANDLER HEIGHTS BETWEEN POWER ROAD AND GREENFIELD ROAD



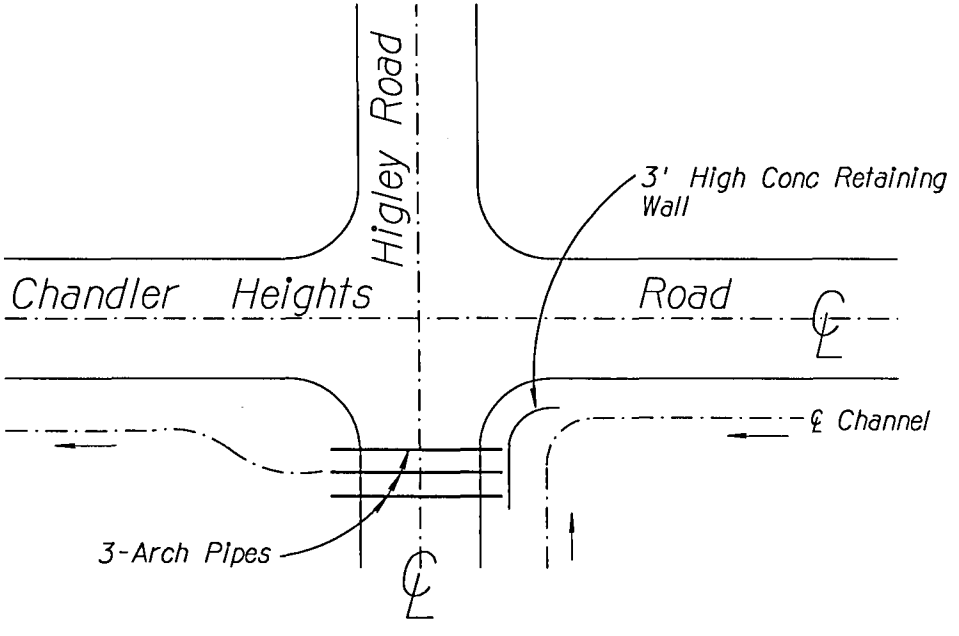
DRAINAGE CHANNEL @ CHANDLER HEIGHTS ROAD

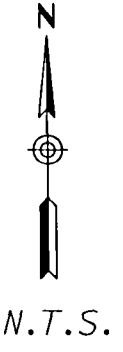


CHANDLER HEIGHTS CHANNEL



AT 180th ST ALIGNMENT





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10.8 Design Alternative Strip Maps

AMM
FCDMC
9/8/98

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION
Design Concept Report - 87th Avenue Drainage Improvements, Deer Valley Road to Williams Road
Work Order No. 68961
Kickoff Meeting 9/8/98
1:00 P.M.

AGENDA

Agenda Items

Introductions
- MCDOT Project Manager – Mike Marietti, P.E. (Senior)
- Consultant Project Manager – Chuck Wright P.E. (Amir Mosawi, P.E., Project Manager)
- Meeting Participants

Project Overview
- Purpose
- Limits
- Schedule

Utility Contact/Coordination

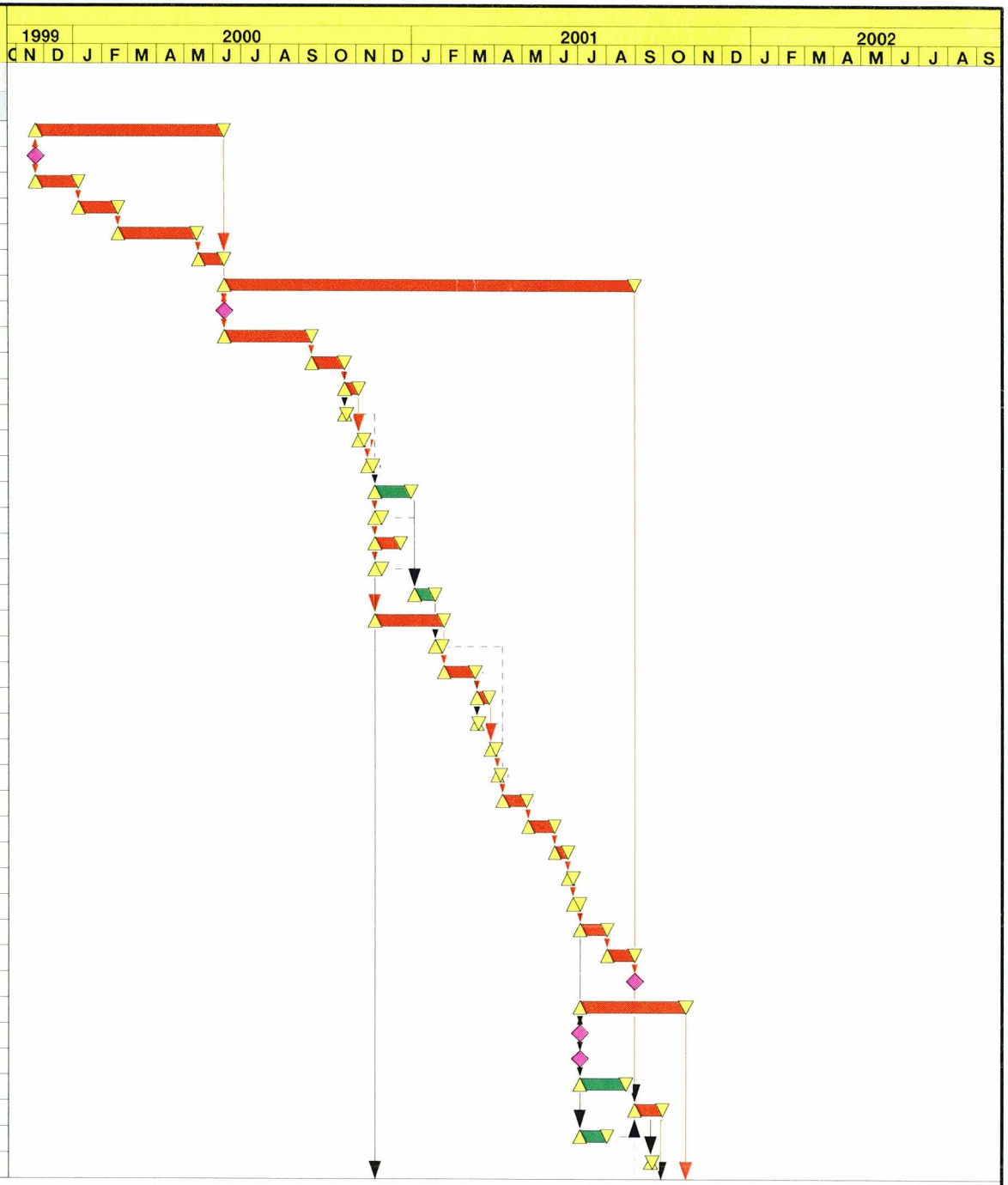
Other Agency Coordination

General Discussion

Rehearsal @ 14th

Public Meeting
Sept. 28th, 1998
Sun Rise Mnt. High School
6-8 pm

Activity ID	Activity Description	Orig Dur	Start Date	Finish Date
AM Amir Masowdi				
68961 87th Ave Channel - Deer Valley/Willi				
GU24EN400	DESIGN CONSULTANT	140*	11-22-99	06-12-00
GU24EN408	Begin Design Process	0	11-22-99	
GU24EN416	Scope Prepared	30	11-22-99	01-05-00
GU24EN430	Consultant Selection	30	01-06-00	02-17-00
GU24EN436	Award Contract	60	02-18-00	05-12-00
GU24EN444	Schedule Prepared & Approved	20	05-15-00	06-12-00
GU24EN600	DESIGN PHASE	307*	06-13-00	08-30-01
GU24EN604	Kickoff Meeting	0	06-13-00	
GU24EN608	Prep 40% Plans	65	06-13-00	09-13-00
GU24EN612	Rvw 40% Plans	25	09-14-00	10-19-00
GU24EN616	In-house 40% Consolidation Mtg of	10	10-20-00	11-02-00
GU24EN618	Public Meeting	1	10-20-00	10-20-00
GU24EN620	Consolidated 40% Comments to	5	11-03-00	11-09-00
GU24EN624	PM & Consultant 40% Resolution	5	11-13-00	11-17-00
GU23TR626	Striping Design	28	11-20-00	12-29-00
GU23TR628	Interconnect Design/Spec	5	11-20-00*	11-27-00
GU23TR630	Signal Design/Spec	20	11-20-00*	12-18-00
GU23TR632	Signing Design/Spec	5	11-20-00*	11-27-00
GU23TR634	Seal Traffic Plans	15	01-02-01	01-23-01
GU24EN636	Prep 70% Plans, Specs, Estimates	50	11-20-00	02-01-01
GU23EN638	Consolidate Rdwy Traffic Dsgn	5	01-24-01	01-30-01
GU24EN640	Rvw 70% Docs	25	02-02-01	03-09-01
GU24EN644	In-House 70% Consolidation Mtg of	10	03-12-01	03-23-01
GU24EN645	Public Meeting	1	03-12-01	03-12-01
GU24EN648	Consolidated 70% Comments to	5	03-26-01	03-30-01
GU24EN652	PM & Consultant 70% Resolution	5	04-02-01	04-06-01
GU24EN664	Prep 90% Docs	20	04-09-01	05-04-01
GU24EN668	Review 90% Docs	20	05-07-01	06-04-01
GU24EN672	In-house 90% Consolidation Mtg of	10	06-05-01	06-18-01
GU24EN676	Consolidated 90% Comments to	5	06-19-01	06-25-01
GU24EN680	PM & Consultant 90% Resolution	5	06-26-01	07-02-01
GU24EN684	Prep 100% Docs	20	07-03-01	07-31-01
GU24EN688	Rvw 100% Docs	22	08-01-01	08-30-01
GU24EN692	Design Docs Sealed	0		08-30-01
GU30CT700	BIDDING PHASE	77*	07-03-01	10-22-01
GU30CT705	PM Notifies Contracts of Bid	0	07-03-01	
GU31OP710	Const Mgt gets Plans, Specs;	0	07-03-01	
GU30CT715	Prep BOS Agenda Summary.	35	07-03-01	08-21-01
GU30CT730	Advertise Project	20	08-31-01	09-28-01
GU31OP740	Fee Proposal & Negotiation	20	07-03-01	07-31-01
GU31OP750	Pre-Bid Conference	1	09-17-01	09-17-01



Project Start	07-01-96
Project Finish	08-14-02
Data Date	08-15-98
Run Date	08-27-98

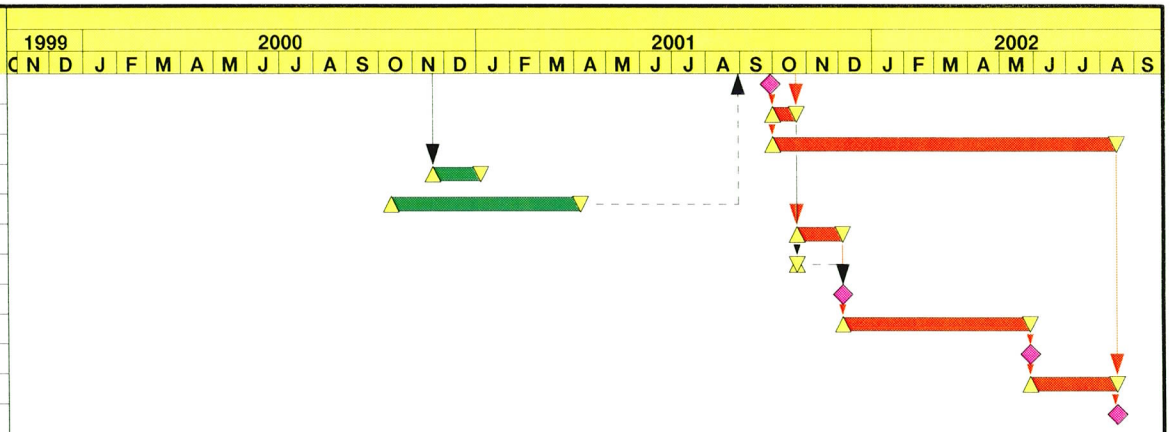
Early Bar
Progress Bar
Critical Activity

MDOT:8961

Sheet 1 of 2

MARICOPA CNTY DEPT OF TRANSPORTATION
87th Ave, Deer Valley - Williams Dr
MCDOT W.O. #68961

Activity ID	Activity Description	Orig Dur	Start Date	Finish Date
GU30CT755	Bid Opening & Verification	0		09-28-01
GU30CT765	Contractors Prep & Award	15	10-01-01	10-22-01
GU31OP800	CONSTRUCTION PHASE	219*	10-01-01	08-14-02
GU28UT805	Determine Prior Rights	30	11-20-00	01-03-01
GU28UT815	Utility Relocation	120	10-13-00	04-06-01
GU31OP840	Pre-Construct Activities	29	10-23-01	12-04-01
GU31OP845	Public Meeting	1	10-23-01	10-23-01
GU31OP905	Begin Construction	0	12-05-01	
GU31OP910	Construction	120	12-05-01	05-28-02
GU31OP920	Final Acceptance of Project	0		05-28-02
GU31OP950	Post Construction Activities	55	05-29-02	08-14-02
GU31OP985	Project Complete	0		08-14-02

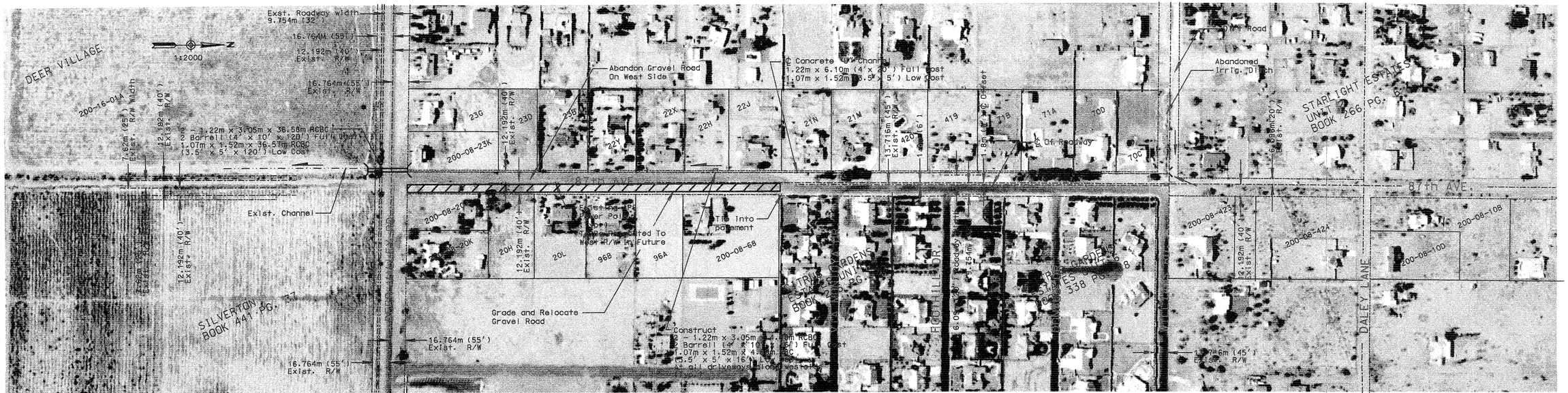


Project Start	07-01-96
Project Finish	08-14-02
Data Date	08-15-98
Run Date	08-27-98

Early Bar
Progress Bar
Critical Activity

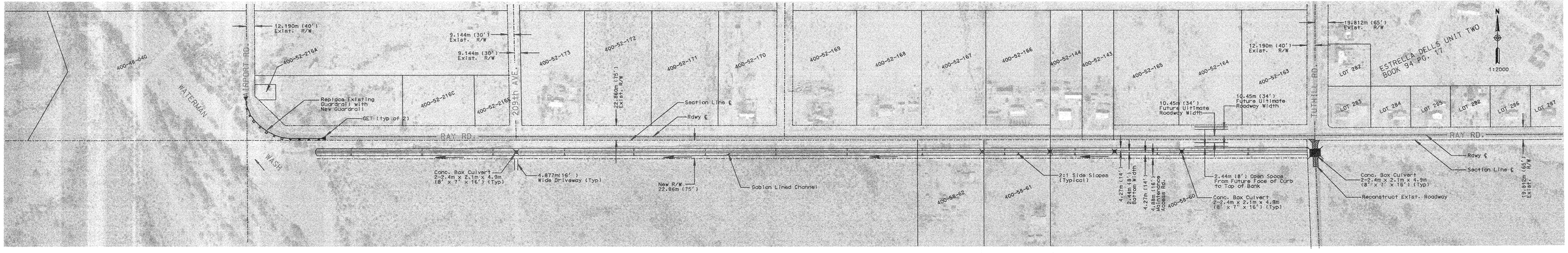
MDOT:8961

MARICOPA CNTY DEPT OF TRANSPORTATION
87th Ave, Deer Valley - Williams Dr
MCDOT W.O. #68961



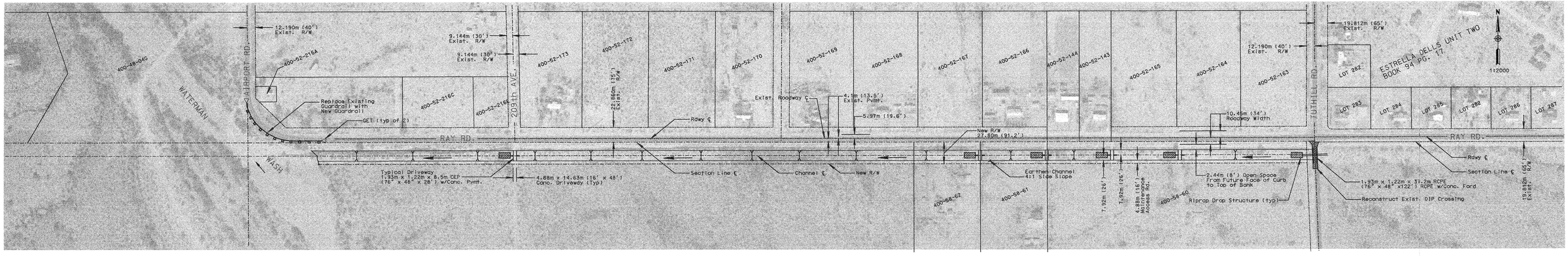
87th Avenue Drainage Channel
Deer Valley Road to Williams Road
Full & Low Cost Alternatives

N:/659703/DGN/87TH.DGN



RAY ROAD CHANNEL BETWEEN
TUTHILL ROAD AND AIRPORT ROAD

FULL COST ALTERNATIVE



RAY ROAD CHANNEL BETWEEN
TUTHILL ROAD AND AIRPORT ROAD
LOW COST ALTERNATIVE

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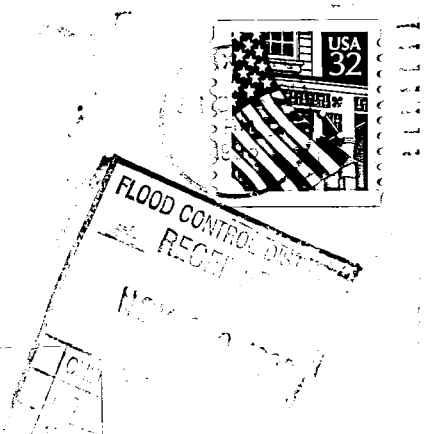
ARIZONA CONSTRUCTION SERVICES
740 East Flynn Lane, Suite C
Phoenix, Arizona 85014



Amir Motamedi
Flood Control District of Maricopa County
2801 W Durango St
Phoenix, AZ 85009

B3003X6433

We're Listening To Your Concerns

The Maricopa County Department of Transportation (MCDOT) will host a second open house meeting regarding potential improvements to 87th Avenue from Deer Valley Road to Williams Drive in Peoria.

This is a follow-up meeting to discuss concerns that residents voiced at a September meeting regarding MCDOT's proposed drainage improvements. MCDOT has been coordinating with the City of Peoria regarding residents' feedback from the initial meeting and would like to discuss new alternatives with the public.

The open house is:

Monday, November 23, 1998 — 5:00 p.m. to 7:00 p.m.
Sunrise Mountain High School Cafeteria
21200 N. 83rd Avenue, Peoria

For more information, contact
Amir Masowdi, project manager,
at 506-4688 or write to Masowdi at
MCDOT, 2901 West Durango Street,
Phoenix, AZ, 85009, or e-mail at
amirmasowdi@mail.maricopa.gov.

MARICOPA COUNTY
1871
ARIZONA

GUADALUPE ROAD CHANNEL AT THE EASTERN CANAL

FULL COST ALTERNATIVE

CHANDLER HEIGHTS DRAINAGE CHANNEL
GREENFIELD RD. TO POWER RD.

FULL AND LOW COST ALTERNATIVES

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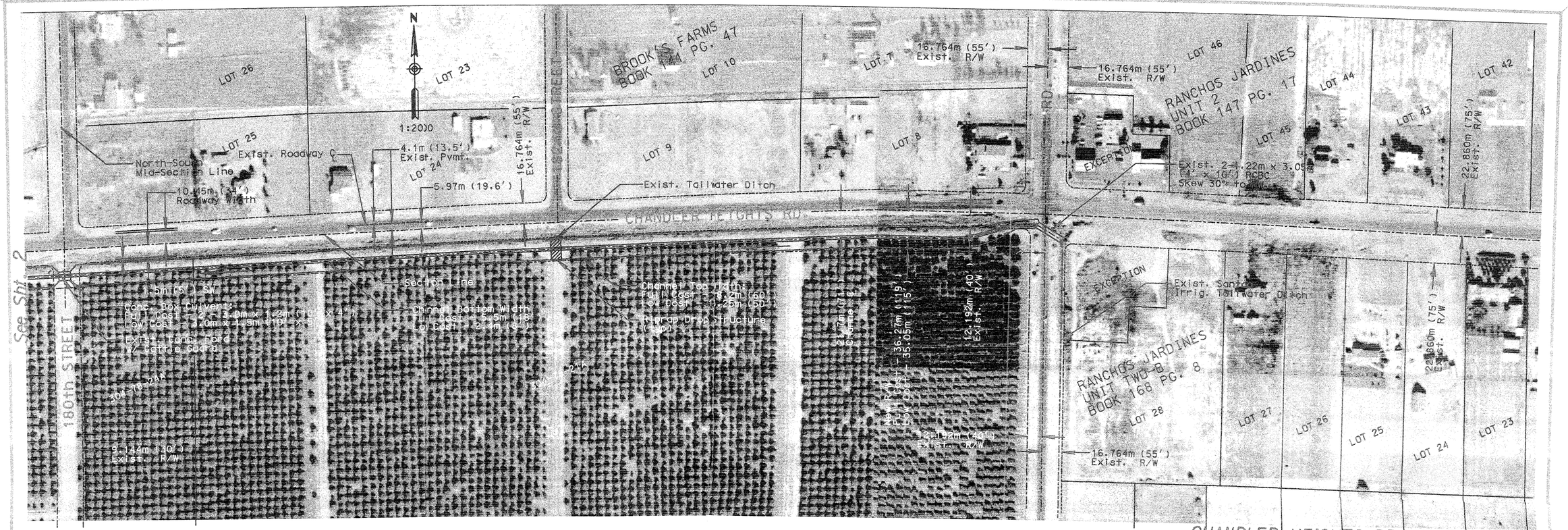

CHANDLER HEIGHTS DRAINAGE CHANNEL
GREENFIELD RD. TO POWER RD.

FULL AND LOW COST ALTERNATIVES

Sht. 3 of 3

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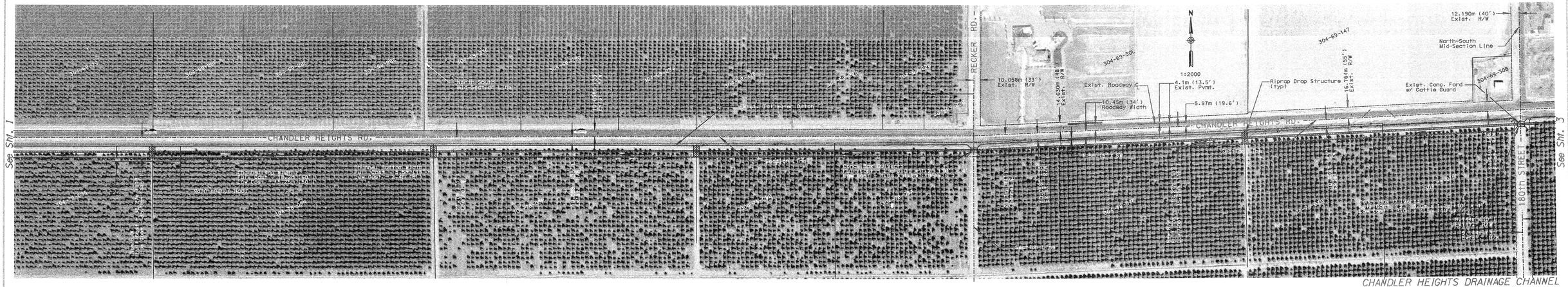

CHANDLER HEIGHTS DRAINAGE CHANNEL
GREENFIELD RD. TO POWER RD.

FULL AND LOW COST ALTERNATIVES

Sht. 2 of 3

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10.9 Preliminary Construction Cost

TABLE 9.1.1 SUMMARY COST

Project Name & Termini: **87th Avenue Channel - Deer Valley Road to Williams Road**
CAR No. or Work Order No: **97-M**

1997 CAR PRELIMINARY SUMMARY COST ESTIMATES (Current Dollars)

COST CATAGORIES	*Factors*	*No Build*	*Low Cost Alternative*	*Full Cost Alternative*
Construction		$0	$397,065	$778,251
Design (10% TO 15%)	10%	$0	$39,707	$77,825
Construction Management	15%	$0	$59,560	$116,738
Right-of-Way		$0	$0	$0
Utility Relocation		$0	$0	$0
Administration (8% TO 13%)	7%	$0	$27,795	$54,478
Total		**$0**	**$524,126**	**$1,027,292**

PRELIMINARY SUMMARY COST ESTIMATES (Adjusted for Inflation)

Assumed Annual Inflation Rate = 2.90%
Assumed Number of Years = 5

Adjusted Construction Cost		$0	$458,077	$897,835
Design		$0	$45,808	$89,784
Construction Management	15%	$0	$68,712	$134,675
Right-of-Way		$0	$0	$0
Utility Relocation		$0	$0	$0
Administration	7%	$0	$32,065	$62,848
Adjusted Total		**$0**	**$604,662**	**$1,185,143**

	1997 CAR ROAD CONSTRUCTION COST WORK SHEET					
	87th Avenue Channel - Deer Valley Road to Williams Road					
	Alternative: __ Grade, Drain & Pave (or Penetrate & Chip)					
Item #	*Description*	*Unit*	*Quantity*	*Unit Cost*	*Total*	
107.01100	N.P.D.E.S.	L.S.	1	$3,000.00	$3,000	Range 1.500 - 5.000
107.09200	Community Relations	Allowance	1	$15,000.00	$15,000	Range: 5.000 - 30.000
205.03000	Roadway Excavation	CM		$4.00		Gross Roadway Prism Excavation without shrink or swell
210.04200	Borrow Excavation (If anticipated)	CM		$7.25		Gross imported dirt quantitiy needed to finished roadway
215.00000	Channel & Retention Basin Excavation	CM	1,990	$6.00	$11,940	Includes Channels & Retention Basins outside roadway shoulder
	New Asphalt Pavement (See Pavement Sheet)	SQ M	29	$19.00	$551	Include printout of pavement computation sheet to document unit cost derivation.
	Asphalt Concrete .50 mm Overlay (See Pavement Sht)	SQ M		$4.75		Temporary pavement
	Penetration and Chip Seal on Base Materal (See Pav)	SQ M	3,702	$8.40	$31,097	Include printout of pavement computation sheet to document unit cost derivation.
	Chip Seal Surface on Pavement (See Pavement Sht)	SQ M		$1.15		Include printout of pavement computation sheet to document unit cost derivation.
336.08100	Pavement Sawcut	M	30	$4.50	$135	
340.01020	Single Curb	M		$32.00		Increase price for small quantities
340.01120	Conc. C & G	M		$30.00		Increase price for small quantities
	Conc S/W Ramp Std Det 231 Type "A"	EA		$700.00		
340.06950	Concrete Sidewalk Std Det 230	SQ M		$22.00		
340.09750	Concrete Driveway w/5' Wings, Std. Det. 250	SQ M		$40.00		
350.01110	Removal of Existing Improvements	L.S.		$25,000.00		Range 5.000 - 75.000
402.00000	Traffic Signing & Striping - 2 lanes	M		$3.20		
402.00000	Traffic Signing & Striping - 5 lanes	M		$5.80		
402.00000	Traffic Signing & Striping -7 lanes	M		$8.20		
402.00000	Traffic Signal, Full Intersection	EA		$90,000.00		
402.00000	Interconnect/Traffic Signals	M		$25.00		
402.00000	Traffic Signal, Future "Box-in"	EA		$4,900.00		
505.06125	Catch Basin	EA		$2,300.00		
510.03010	Scupper with 1 M to 2 M down drain	EA		$1,500.00		
	Drywell	EA		$7,000.00		Includes Inlet, grate and typical 20 M to 25 M depth
618.02318	460 mm (18") CMP	M		$80.00		
618.02318	460 mm (18") RGRCP, Class III	M		$120.00		For Drainage and Irrigation facilities NOT belonging to SRP
618.02324	610 mm (24") RGRCP, Class III	M		$145.00		For Drainage and Irrigation facilities NOT belonging to SRP
618.02336	760 mm & 910 mm (30" & 36") RGRCP, Class III	M		$195.00		Same
618.02348	1060 mm & 1220 mm (42" & 48") RGRCP, Class III	M		$250.00		Same
618.02348	1370 mm & 1520 mm (54" & 60") RGRCP, Class III	M		$300.00		Shoefly during construction
625.00000	1370 mm & 1520 mm Storm Drain/Irrigation Manhole	EA		$3,200.00		Same
	Headwall, 460 mm to 910 mm Pipe (MAG Details)	EA		$1,650.00		Same.
	Headwall, 1060 mm to 1520 mm Pipe (MAG Details)	EA		$3,200.00		Same
	Irrigation Headwall w/ Trashrack (Inlet)	EA		$2,800.00		Same
	Irrigation Junction Box (MAG Details)	EA		$2,500.00		Same
	Concrete lined drainage channel	M	782	$117.00	$91,494	Same: excludes length of driveways
	Hand rail for drainage channel	M	1,564	$72.00	$112,608	Same: excludes length of driveways
	Deer Valley Road Box Culvert	EA	1	$21,183.63	$21,184	Same
	Driveway Box Culvert (See Structure Sheet)	EA	14	$2,229.76	$31,217	
	Bridge < 100' (See Structure Sheet)	EA				
	Bridge > 100' (See Structure Sheet)	EA				
220.01400	Plain Riprap	CM		$50.00		Includes excavation for and placement of riprap
415.00000	Concrete Barrier	M		$75.00		
	"Quadguard"	EA		$20,000.00		
	Median Fine Grading, Pre-emergent Treatment & D.G.	SM		$22.00		
		Subtotal			$318,225	
110.01000	Mobilization @ 5%	L.S.	1	$15,911.00	$15,911	Auto Calculated @ 5% of Construction Cost
401.00000	Traffic Control @ 3.5%	L.S.	1	$11,138.00	$11,138	Auto Calculation @ 3.5%. Increase for special multi lane paved detour needs.
	Subtotal Construction				$345,274	
		Contingency		15%	$51,791	May be reduced by 5% in rural areas with few anticipated complications or utilities.
		Total			**$397,065**	

	1997 CAR ROAD CONSTRUCTION COST WORK SHEET					
	87th Avenue Channel - Deer Valley Road to Williams Road					
	Alternative: __ Grade, Drain & Pave (or Penetrate & Chip)					
Item #	***Description***	***Unit***	***Quantity***	***Unit Cost***	***Total***	
107.01100	N.P.D.E.S.	L.S.	1	$3,000.00	$3,000	Range 1,500 - 5,000
107.09200	Community Relations	Allowance	1	$15,000.00	$15,000	Range: 5,000 - 30,000
205.03000	Roadway Excavation	CM		$4.00	$0	Gross Roadway Prism Excavation without shrink or swell
210.04200	Borrow Excavation (If anticipated)	CM		$7.25	$0	Gross imported dirt quantitiy needed to finished roadway
215.00000	Channel & Retention Basin Excavation	CM	7,283	$6.00	$43,698	Includes Channels & Retention Basins outside roadway shoulder
	New Asphalt Pavement (See Pavement Sheet)	SQ M	99	$19.00	$1,881	Include printout of pavement computation sheet to document unit cost derivation.
	Asphalt Concrete .50 mm Overlay (See Pavement Sht)	SQ M		$4.75	$0	Temporary pavement
	Penetration and Chip Seal on Base Materal (See Pav)	SQ M	3,702	$8.40	$31,097	Include printout of pavement computation sheet to document unit cost derivation.
	Chip Seal Surface on Pavement (See Pavement Sht)	SQ M		$1.15	$0	Include printout of pavement computation sheet to document unit cost derivation.
336.08100	Pavement Sawcut	M	30	$4.50	$135	
340.01020	Single Curb	M		$32.00	$0	Increase price for small quantities
340.01120	Conc. C & G	M		$30.00	$0	Increase price for small quantities
	Conc S/W Ramp Std Det 231 Type "A"	EA		$700.00	$0	
340.06950	Concrete Sidewalk Std Det 230	SQ M		$22.00	$0	
340.09750	Concrete Driveway w/5' Wings, Std. Det. 250	SQ M		$40.00	$0	
350.01110	Removal of Existing Improvements	L.S.		$25,000.00	$0	Range 5,000 - 75,000
402.00000	Traffic Signing & Striping - 2 lanes	M		$3.20	$0	
402.00000	Traffic Signing & Striping - 5 lanes	M		$5.80	$0	
402.00000	Traffic Signing & Striping -7 lanes	M		$8.20	$0	
402.00000	Traffic Signal, Full Intersection	EA		$90,000.00	$0	
402.00000	Interconnect/Traffic Signals	M		$25.00	$0	
402.00000	Traffic Signal, Future "Box-in"	EA		$4,900.00	$0	
505.06125	Catch Basin	EA		$2,300.00	$0	
510.03010	Scupper with 1 M to 2 M down drain	EA		$1,500.00	$0	
	Drywell	EA		$7,000.00	$0	Includes Inlet, grate and typical 20 M to 25 M depth
618.02318	460 mm (18") CMP	M		$80.00	$0	
618.02318	460 mm (18") RGRCP, Class III	M		$120.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02324	610 mm (24") RGRCP, Class III	M		$145.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02336	760 mm & 910 mm (30" & 36") RGRCP, Class III	M		$195.00	$0	Same
618.02348	1060 mm & 1220 mm (42" & 48") RGRCP, Class III	M		$250.00	$0	Same
618.02348	1370 mm & 1520 mm (54" & 60") RGRCP, Class III	M		$300.00	$0	Shoefly during construction
625.00000	1370 mm & 1520 mm Storm Drain/Irrigation Manhole	EA		$3,200.00	$0	Same
	Headwall, 460 mm to 910 mm Pipe (MAG Details)	EA		$1,650.00	$0	Same,
	Headwall, 1060 mm to 1520 mm Pipe (MAG Details)	EA		$3,200.00	$0	Same
	Irrigation Headwall w/ Trashrack (Inlet)	EA		$2,800.00	$0	Same
	Irrigation Junction Box (MAG Details)	EA		$2,500.00	$0	Same
	Concrete lined drainage channel	M	782	$264.00	$206,448	Same; excludes length of driveways
	Hand rail for drainage channel	M	1,564	$72.00	$112,608	Same; excludes length of driveways
	Deer Valley Road Box Culvert	EA	1	$84,734.52	$84,735	Same
	Driveway Box Culvert (See Structure Sheet)	EA	14	$8,937.35	$125,123	
	Bridge < 100' (See Structure Sheet)	EA		$0.00	$0	
	Bridge > 100' (See Structure Sheet)	EA		$0.00	$0	
220.01400	Plain Riprap	CM		$50.00	$0	Includes excavation for and placement of riprap
415.00000	Concrete Barrier	M		$75.00	$0	
	"Quadguard"	EA		$20,000.00	$0	
	Median Fine Grading, Pre-emergent Treatment & D.G.	SM		$22.00	$0	
		Subtotal			$623,724	
110.01000	Mobilization @ 5%	L.S.	1	$31,186.00	$31,186	Auto Calculated @ 5% of Construction Cost
401.00000	Traffic Control @ 3.5%	L.S.	1	$21,830.00	$21,830	Auto Calculation @ 3.5%. Increase for special multi lane paved detour needs.
	Subtotal Construction				$676,740	
		Contingency		15%	$101,511	May be reduced by 5% in rural areas with few anticipated complications or utilities.
		Total			**$778,251**	

DERIVATION OF UNIT COST FOR PAVEMENT SECTIONS

Unit Cost Derivation for Arterial Section Shown:		Metric	Actual	Used	See	
1	Aggregate Base Thickness 250 mm	250 mm	9.843"	10"	Computations	
	Asphalt Concrete Thickness 100 mm	100 mm	3.93""	4"	Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
310.07100	Aggregate Base (10")	Ton	0.5250	$10.00	$5.25	Calculated at 1.89 tons per CY for 1 SY of 10" AB (.5250 tons SY)
315.07000	Bituminous Prime Coat (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons SY)
	Tack Coat	SY	1	$0.16	$0.16	
321.03100	Asphalt Concrete, C 3 4 (4")	Ton	0.2189	$33.70	$7.38	Calculated at 1.97 Tons per CY for 1 SY of 4" AC (0.2189 Tons SY)
333.07100	Fog Seal (Diluted 50:50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated at 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
301.02000	Subgrade Preparation (Under new pavement only)	SY	1	$2.50	$2.50	Variable; this work includes constructing fill sections and misc grading
	Pavement and Subgrade Preparation Cost Per SY				$15.88	
	Pavement and Subgrade Preparation Cost Per SQ M				$18.99	
Rounded	Unit Cost Per SQ M for 100 mm over 250 mm			Total	$19.00	Use for permenant pavement

Unit Cost Derivation for Collector Section Shown:		Metric	Actual	Used	See	
2	Aggregate Base Thickness 250 mm	250 mm	9.843"	10"	Computations	
	Asphalt Concrete Thickness 75 mm	75 mm	2.953"	3"	Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
310.07100	Aggregate Base (10")	Ton	0.5250	$10.00	$5.25	Calculated at 1.89 tons per CY for 1 SY of 10" AB (.5250 tons SY)
315.07000	Bituminous Prime Coat (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons SY)
321.03100	Asphalt Concrete, C 3 4 (3")	Ton	0.1642	$33.70	$5.53	Calculated at 1.97 Tons per CY for 1 SY of 3" AC (0.1642 Tons SY)
333.07100	Fog Seal (Diluted 50:50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated at 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
301.02000	Subgrade Preparation (Under new pavement only)	SY	1	$2.50	$2.50	Variable; this work includes constructing fill sections and misc grading
	Pavement and Subgrade Preparation Cost Per SY				$13.88	
	Pavement and Subgrade Preparation Cost Per SQ M				$16.60	
Rounded	Unit Cost Per SQ M for 75 mm over 250 mm			Total	$16.60	

Unit Cost Derivation for Local Road Section Shown:		Metric	Actual	Used	See	
3	Aggregate Base Thickness 150 mm	150 mm	5.906"	6"	Computations	
	Asphalt Concrete Thickness 75 mm	75 mm	2.953"	3"	Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
310.07100	Aggregate Base (6")	Ton	0.3150	$10.00	$3.15	Calculated at 1.89 tons per CY for 1 SY of 6" AB (0.3150 Tons SY)
315.07000	Bituminous Prime Coat (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons SY)
321.03100	Asphalt Concrete, C 3 4 (3")	Ton	0.1642	$33.70	$5.53	Calculated at 1.97 Tons per CY for 1 SY of 3" AC (0.1642 Tons SY)
333.07100	Fog Seal (Diluted 50:50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated at 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
301.02000	Subgrade Preparation (Under new pavement only)	SY	1	$2.20	$2.20	Variable; this work includes constructing fill sections and misc grading
	Pavement and Subgrade Preparation Cost Per SY				$11.48	
	Pavement and Subgrade Preparation Cost Per SQ M				$13.73	
Rounded	Unit Cost Per SQ M for 75 mm over 250 mm			Total	$13.75	

Unit Cost Derivation for Local Road, 300 Max ADT:		Metric	Actual	Used	See	
4	Aggregate Base Thickness 150 mm	150 mm	5.906"	6"	Computations	
	Asphalt Penetration and Chip Seal Surface				Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
301.02000	Subgrade Preparation (Under New Chip Seal Sfc Only)	SY	1	$2.50	$1.90	Variable; this work includes constructing fill sections and misc grading
310.07100	Aggregate Base (6")	Ton	0.3150	$10.00	$3.15	Calculated at 1.89 tons per CY for 1 SY of 6" AB (0.3150 Tons SY)
315.07000	Bituminous Prime Coat (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons SY)
330.07100	Stone Chips (Double Chip @ 44 lbs Per SY)	Ton	0.0220	$35.00	$0.77	Calculated at 0.0220 Tons SY for Double Chip Seal Application
330.07200	Asphalt Emulsion (Double Seal @ 0.8 gal Per SY)	Ton	0.0033	$185.00	$0.61	Calculated at 8.3 lbs per gal for 1 SY of Seal (0.0033 Tons SY)
333.07100	Fog Seal (Diluted 50:50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
	Pavement and Subgrade Preparation Cost Per SY				$7.02	
	Pavement and Subgrade Preparation Cost Per SQ M				$8.40	
Rounded	Unit Cost Per SQ M for Penetration and Chip Sfc			Total	$8.40	

Unit Cost Derivation for 50 mm A C Overlay:		Metric	Actual	Used	See	
5	Asphalt Concrete Thickness 50 mm	50 mm	1.969"	2"	Computations	
					Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
	Tack Coat	SY	1	$0.16	$0.16	Includes Surface Preparation
321.03100	Asphalt Concrete, C 3 4 (2")	Ton	0.1094	$33.70	$3.69	Calculated at 1.97 Tons per CY for 1 SY of 2" AC (0.1094 Tons SY)
333.07100	Fog Seal (Diluted 50:50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
	2" Asphalt Overlay Per SY				$3.96	
	50 mm Asphalt Overlay Per SQ M				$4.74	
Rounded	Cost Per SQ M for 50 mm Overlay			Total	$4.75	Use for temporary pavement

Unit Cost Derivation for Chip Seal over AC Pavement:		Metric	Actual	Used	See	
6	Chip Seal Surface Treatment				Computations	
					Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
	Tack Coat	SY	1	$0.16	$0.16	Includes Surface Preparation
330.07100	Stone Chips @ 22 lbs Per SY	Ton	0.0110	$35.00	$0.39	Calculated at 0.0220 Tons SY for Double Chip Seal Application
330.07200	Asphalt Emulsion @ 0.4 gal Per SY	Ton	0.0017	$185.00	$0.31	Calculated at 8.3 lbs per gal for 1 SY of Seal (0.0033 Tons SY)
333.07100	Fog Seal (Diluted 50:50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
	Chip Seal on Pavement Cost Per SY				$0.97	
	Chip seal on Pavement Cost Per SQ M				$1.16	
Rounded	Cost Per SQ M for Chip Seal on Pavement			Total	$1.15	

DRIVEWAY
BOX CULVERT COST CALCULATIONS

TYPE OF ROAD	BOX LENGTH	BOX DESCRIPTION	BOX WIDTH	TOP SFC AREA*	UNIT	COST**	TOTAL COST
URBAN MINOR ARTERIAL OR LESS (27 m or 88.58' for 5 Lanes & 2 Sidewalks)	27		0	0	SQ M	$380.00	$0.00
URBAN MINOR ARTERIAL W/ BIKE LANES (28.8 m or 94.49' for 5 Lanes, 2 B/L's & 2 S/W's)	28.8		0	0	SQ M	$380.00	$0.00
Low Cost Alternative	4.877	16'Lx5'Wx8.5"Thick top slab box culverts	1.524	7.432548	SQ M	$300.00	$2,229.76
Full Cost Alternative	4.887	16'Lx20'Wx12"Thick top slab box culverts	6.096	29.791152	SQ M	$300.00	$8,937.35

DEER VALLEY ROAD
BOX CULVERT COST CALCULATIONS

TYPE OF ROAD	BOX LENGTH	BOX DESCRIPTION	BOX WIDTH	TOP SFC AREA*	UNIT	COST**	TOTAL COST
URBAN MINOR ARTERIAL OR LESS (27 m or 88.58' for 5 Lanes & 2 Sidewalks)	27		0	0	SQ M	$380.00	$0.00
URBAN MINOR ARTERIAL W/ BIKE LANES (28.8 m or 94.49' for 5 Lanes, 2 B/L's & 2 S/W's)	28.8		0	0	SQ M	$380.00	$0.00
Low Cost Alternative	36.579	16'Lx5'Wx8.5"Thick top slab box culverts	1.524	55.746396	SQ M	$380.00	$21,183.63
Full Cost Alternative	36.579	16'Lx20'Wx12"Thick top slab box culverts	6.096	222.985584	SQ M	$380.00	$84,734.52

* Top Surface Area of box.

** Equivalent English unit cost is $25 to $30/SFT. Cost Includes Wing Walls

*** 16 m box with approval only. Generally a non-section line, low volume location.

BRIDGE COST CALCULATIONS

TYPE OF ROAD	BRIDGE LENGTH	DESCRIPTION	BRIDGE WIDTH	TOP SFC AREA*	UNIT	COST**	TOTAL COST
URBAN MINOR ARTERIAL OR LESS (27 m or 88.58' for 5 Lanes & 2 Sidewalks)	0		27	0	SQ M	$375.00	$0.00
URBAN MINOR ARTERIAL W/ BIKE LANES (28.8 m or 94.49' for 5 Lanes, 2 B/L's & 2 S/W's)	0		28.8	0	SQ M	$375.00	$0.00
URBAN MAJOR ARTERIAL (31.8 m or 104.33' for 7 Lanes & 2 S/W's)	0		31.8	0	SQ M	$375.00	$0.00
SPECIAL LOW VOLUME ROAD CONDITION *** (16 m or 52.49' for 2 Lanes with Shoulders)	0		16	0	SQ M	$375.00	$0.00

* Top Surface Area of bridge.

** Equivalent English unit cost is $35/sf for smaller bridge. Use $50/55 for long Salt or Gila River bridges (not shown). Cost Includes bridge railings, barriers, approach slabs, piers, and other items of bridge construction. Show cost of channel excavation, rip rap , and other bridge site work on roadway spread sheet.

*** 16 m bridge with approval only. Generally a non-section line, low volume location.

87th Avenue Channel - Deer Valley Road to Williams Road
Preliminary Construction Estimate - Utility Relocation

Alternative:					
Item #	***Description***	***Unit***	***Quantity***	***Unit Cost***	***Total***
1	Relocate 69 kv Power Pole	EA			
2	Other Poles associated w/ 69kv Power Line	EA			
3	SRP Facilities by SRP Forces (See Calc Sheet)	EA			
4	Railroad Crossing	EA			
**Note: Based on $30,000 per half mile of power line relocation (power line in easement).*					
	Subtotal Construction				
		Contingency		20%	
		Total			

TABLE 9.1.2 SUMMARY COST

Project Name & Termini: **Ray Road Channel - Tuthill Road to Airport Road**
CAR No. or Work Order No: **97-M**

1997 CAR PRELIMINARY SUMMARY COST ESTIMATES (Current Dollars)

COST CATAGORIES	*Factors*	*No Build*	*No Build w/ Erosion Protection*	*Low Cost Alternative*	*Full Cost Alternative*
Construction		$21,670	$44,753	$446,394	$734,627
Design (10% TO 15%)	10%	$2,167	$4,475	$44,639	$73,463
Construction Management	15%	$3,251	$6,713	$66,959	$110,194
Right-of-Way		$59,900	$59,900	$73,478	$59,900
Utility Relocation		$0	$0	$0	$0
Administration (8% TO 13%)	10%	$2,167	$4,475	$44,639	$73,463
Total		**$89,155**	**$120,317**	**$676,109**	**$1,051,646**

PRELIMINARY SUMMARY COST ESTIMATES (Adjusted for Inflation)

Assumed Annual Inflation Rate = 2.90%
Assumed Number of Years = 5

Adjusted Construction Cost		$25,000	$51,630	$514,985	$847,508
Design		$2,500	$5,163	$51,499	$84,751
Construction Management	15%	$3,750	$7,744	$77,248	$127,126
Right-of-Way		$69,104	$69,104	$84,768	$69,104
Utility Relocation		$0	$0	$0	$0
Administration	10%	$2,500	$5,163	$51,499	$84,751
Adjusted Total		**$102,854**	**$138,804**	**$779,999**	**$1,213,240**

	1997 CAR ROAD CONSTRUCTION COST WORK SHEET					
	Ray Road Channel - Tuthill Road to Airport Road					
	Alternative: Grade, Drain & Pave (or Penetrate & Chip)					
Item #	***Description***	***Unit***	***Quantity***	***Unit Cost***	***Total***	
107.01100	N.P.D.E.S.	L.S.	1	$1,500.00	$1,500	Range 1.500 - 5.000
107.09200	Community Relations	Allowance		$5,000.00	$0	Range: 5.000 - 30.000
205.03000	Roadway Excavation	CM		$4.00	$0	Gross Roadway Prism Excavation without shrink or swell
210.04200	Borrow Excavation (If anticipated)	CM		$7.25	$0	Gross imported dirt quantitiy needed to finished roadway
215.00000	Channel & Retention Basin Excavation	CM		$6.00	$0	Includes Channels & Retention Basins outside roadway shoulder
	New Asphalt Pavement (See Pavement Sheet)	SQ M		$19.00	$0	Include printout of pavement computation sheet to document unit cost derivation.
	Asphalt Concrete .50 mm Overlay (See Pavement Sht)	SQ M		$4.75	$0	Include printout of pavement computation sheet to document unit cost derivation.
	Penetration and Chip Seal on Base Materal (See Pav)	SQ M		$8.40	$0	Include printout of pavement computation sheet to document unit cost derivation.
	Chip Seal Surface on Pavement (See Pavement Sht)	SQ M		$1.15	$0	Include printout of pavement computation sheet to document unit cost derivation.
336.08100	Pavement Sawcut	M		$4.50	$0	
340.01020	Single Curb	M		$32.00	$0	Increase price for small quantities
340.01120	Conc. C & G	M		$30.00	$0	Increase price for small quantities
	Conc S/W Ramp Std Det 231 Type "A"	EA		$700.00	$0	
340.06950	Concrete Sidewalk Std Det 230	SQ M		$22.00	$0	
340.09750	Concrete Driveway w/5' Wings, Std. Det. 250	SQ M		$40.00	$0	
350.01110	Removal of Existing Improvements	L.S.		$25,000.00	$0	Range 5,000 - 75,000
402.00000	Traffic Signing & Striping - 2 lanes	M		$3.20	$0	
402.00000	Traffic Signing & Striping - 5 lanes	M		$5.80	$0	
402.00000	Traffic Signing & Striping -7 lanes	M		$8.20	$0	
402.00000	Traffic Signal, Full Intersection	EA		$90,000.00	$0	
402.00000	Interconnect/Traffic Signals	M		$25.00	$0	
402.00000	Traffic Signal, Future "Box-in"	EA		$4,900.00	$0	
505.06125	Catch Basin	EA		$2,300.00	$0	
510.03010	Scupper with 1 M to 2 M down drain	EA		$1,500.00	$0	
	Drywell	EA		$7,000.00	$0	Includes Inlet, grate and typical 20 M to 25 M depth
618.02318	460 mm (18") CMP	M		$80.00	$0	
618.02318	460 mm (18") RGRCP, Class III	M		$120.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02324	610 mm (24") RGRCP, Class III	M		$145.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02336	760 mm & 910 mm (30" & 36") RGRCP, Class III	M		$195.00	$0	Same
618.02348	1060 mm & 1220 mm (42" & 48") RGRCP, Class III	M		$250.00	$0	Same
618.02348	1370 mm & 1520 mm (54" & 60") RGRCP, Class III	M		$300.00	$0	Shoefly during construction
625.00000	1370 mm & 1520 mm Storm Drain/Irrigation Manhole	EA		$3,200.00	$0	Same
	Headwall, 460 mm to 910 mm Pipe (MAG Details)	EA		$1,650.00	$0	Same,
	Headwall, 1060 mm to 1520 mm Pipe (MAG Details)	EA		$3,200.00	$0	Same
	Irrigation Headwall w/ Trashrack (Inlet)	EA		$2,800.00	$0	Same
	Irrigation Junction Box (MAG Details)	EA		$2,500.00	$0	Same
	Concrete Slip Form Irrigation Ditch	M		$75.00	$0	Same; includes all costs associated with const of ditch
	Earth Irrigation Ditch/Special Drainage Ditch, 6' Top	M		$30.00	$0	Same
	Irrigation Structure w/ Gates	EA		$7,500.00	$0	Same
	Box Culvert (See Structure Sheet)	EA		$24,522.00	$0	Same
	Bridge < 100' (See Structure Sheet)	EA		$0.00	$0	
	Bridge > 100' (See Structure Sheet)	EA		$0.00	$0	
220.01400	Plain Riprap	CM	30	$50.00	$1,500	Riprap driveways
415.00000	Concrete Barrier	M		$75.00	$0	
	Guard rail	M	187	$39.40	$7,368	
	GET	EA	2	$3,500.00	$7,000	
		Subtotal			$17,368	
110.01000	Mobilization @ 5%	L.S.	1	$868.00	$868	Auto Calculated @ 5% of Construction Cost
401.00000	Traffic Control @ 3.5%	L.S.	1	$608.00	$608	Auto Calculation @ 3.5%. Increase for special multi lane paved detour needs.
	Subtotal Construction				$18,844	
		Contingency		15%	$2,827	May be reduced by 5% in rural areas with few anticipated complications or utilities.
		Total			**$21,670**	

Road Construction
No Build Alternative
w/ Erosion Protection

	1997 CAR ROAD CONSTRUCTION COST WORK SHEET					
	Ray Road Channel - Tuthill Road to Airport Road					
	Alternative: __ Grade, Drain & Pave (or Penetrate & Chip)					
Item #	***Description***	***Unit***	***Quantity***	***Unit Cost***	***Total***	
107.01100	N.P.D.E.S.	L.S.	1	$1,500.00	$1,500	Range 1,500 - 5,000
107.09200	Community Relations	Allowance	1	$5,000.00	$5,000	Range: 5,000 - 30,000
205.03000	Roadway Excavation	CM		$4.00	$0	Gross Roadway Prism Excavation without shrink or swell
210.04200	Borrow Excavation (If anticipated)	CM		$7.25	$0	Gross imported dirt quantitiy needed to finished roadway
215.00000	Channel & Retention Basin Excavation	CM		$6.00	$0	Includes Channels & Retention Basins outside roadway shoulder
	New Asphalt Pavement (See Pavement Sheet)	SQ M		$19.00	$0	Include printout of pavement computation sheet to document unit cost derivation.
	Asphalt Concrete .50 mm Overlay (See Pavement Sht)	SQ M		$4.75	$0	Include printout of pavement computation sheet to document unit cost derivation.
	Penetration and Chip Seal on Base Materal (See Pav)	SQ M		$8.40	$0	Include printout of pavement computation sheet to document unit cost derivation.
	Chip Seal Surface on Pavement (See Pavement Sht)	SQ M		$1.15	$0	Include printout of pavement computation sheet to document unit cost derivation.
336.08100	Pavement Sawcut	M		$4.50	$0	
340.01020	Single Curb	M		$32.00	$0	Increase price for small quantities
340.01120	Conc. C & G	M		$30.00	$0	Increase price for small quantities
	Conc S/W Ramp Std Det 231 Type "A"	EA		$700.00	$0	
340.06950	Concrete Sidewalk Std Det 230	SQ M		$22.00	$0	
340.09750	Concrete Driveway w/5' Wings, Std. Det. 250	SQ M		$40.00	$0	
350.01110	Removal of Existing Improvements	L.S.		$25,000.00	$0	Range 5,000 - 75,000
402.00000	Traffic Signing & Striping - 2 lanes	M		$3.20	$0	
402.00000	Traffic Signing & Striping - 5 lanes	M		$5.80	$0	
402.00000	Traffic Signing & Striping -7 lanes	M		$8.20	$0	
402.00000	Traffic Signal, Full Intersection	EA		$90,000.00	$0	
402.00000	Interconnect/Traffic Signals	M		$25.00	$0	
402.00000	Traffic Signal, Future "Box-in"	EA		$4,900.00	$0	
505.06125	Catch Basin	EA		$2,300.00	$0	
510.03010	Scupper with 1 M to 2 M down drain	EA		$1,500.00	$0	
	Drywell	EA		$7,000.00	$0	Includes Inlet, grate and typical 20 M to 25 M depth
618.02318	460 mm (18") CMP	M		$80.00	$0	
618.02318	460 mm (18") RGRCP, Class III	M		$120.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02324	610 mm (24") RGRCP, Class III	M		$145.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02336	760 mm & 910 mm (30" & 36") RGRCP, Class III	M		$195.00	$0	Same
618.02348	1060 mm & 1220 mm (42" & 48") RGRCP, Class III	M		$250.00	$0	Same
618.02348	1370 mm & 1520 mm (54" & 60") RGRCP, Class III	M		$300.00	$0	Shoefly during construction
625.00000	1370 mm & 1520 mm Storm Drain/Irrigation Manhole	EA		$3,200.00	$0	Same
	Headwall, 460 mm to 910 mm Pipe (MAG Details)	EA		$1,650.00	$0	Same,
	Headwall, 1060 mm to 1520 mm Pipe (MAG Details)	EA		$3,200.00	$0	Same
	Irrigation Headwall w/ Trashrack (Inlet)	EA		$2,800.00	$0	Same
	Irrigation Junction Box (MAG Details)	EA		$2,500.00	$0	Same
	Concrete Slip Form Irrigation Ditch	M		$75.00	$0	Same: includes all costs associated with const of ditch
	Earth Irrigation Ditch/Special Drainage Ditch, 6' Top	M		$30.00	$0	Same
	Irrigation Structure w/ Gates	EA		$7,500.00	$0	Same
	Box Culvert (See Structure Sheet)	EA		$24,522.00	$0	Same
	Bridge < 100' (See Structure Sheet)	EA		$0.00	$0	
	Bridge > 100' (See Structure Sheet)	EA		$0.00	$0	
220.01400	Plain Riprap	CM	300	$50.00	$15,000	Riprap at outlet to Waterman Wash and driveways
415.00000	Concrete Barrier	M		$75.00	$0	
	Guard rail	M	187	$39.40	$7,368	
	GET	EA	2	$3,500.00	$7,000	
		Subtotal			$35,868	
110.01000	Mobilization @ 5%	L.S.	1	$1,793.00	$1,793	Auto Calculated @ 5% of Construction Cost
401.00000	Traffic Control @ 3.5%	L.S.	1	$1,255.00	$1,255	Auto Calculation @ 3.5%. Increase for special multi lane paved detour needs.
	Subtotal Construction				$38,916	
		Contingency		15%	$5,837	May be reduced by 5% in rural areas with few anticipated complications or utilities.
		Total			**$44,753**	

Road Construction
Low Cost Alternative

	1997 CAR ROAD CONSTRUCTION COST WORK SHEET					
	Ray Road Channel - Tuthill Road to Airport Road					
Alternative:	***Grade, Drain & Pave (or Penetrate & Chip)***					
Item #	***Description***	***Unit***	***Quantity***	***Unit Cost***	***Total***	
107.01100	N.P.D.E.S.	L.S.	1	$3,000.00	$3,000	Range 1,500 - 5,000
107.09200	Community Relations	Allowance	1	$10,000.00	$10,000	Range: 5,000 - 30,000
205.03000	Roadway Excavation	CM		$4.00		Gross Roadway Prism Excavation without shrink or swell
210.04200	Borrow Excavation (If anticipated)	CM		$7.25		Gross imported dirt quantitiy needed to finished roadway
215.00000	Channel & Retention Basin Excavation	CM	24,353	$6.00	$146,118	Includes Channels & Retention Basins outside roadway shoulder
	New Asphalt Pavement (See Pavement Sheet)	SQ M	1,500	$19.00	$28,500	Include printout of pavement computation sheet to document unit cost derivation.
	Asphalt Concrete .50 mm Overlay (See Pavement Sht)	SQ M		$4.75		Temporary pavement
	Penetration and Chip Seal on Base Materal (See Pav)	SQ M	7,389	$2.50	$18,473	Gravel maintenance road for channel (4" AB)
	Chip Seal Surface on Pavement (See Pavement Sht)	SQ M		$1.15		Include printout of pavement computation sheet to document unit cost derivation.
336.08100	Pavement Sawcut	M		$4.50		
340.01020	Single Curb	M		$32.00		Increase price for small quantities
340.01120	Conc. C & G	M		$30.00		Increase price for small quantities
	Conc S/W Ramp Std Det 231 Type "A"	EA		$700.00		
340.06950	Concrete Sidewalk Std Det 230	SQ M		$22.00		
340.09750	Concrete Driveway w/5' Wings, Std. Det. 250	SQ M	375.0	$40.00	$15,000	
350.01110	Removal of Existing Improvements	L.S.	1	$15,000.00	$15,000	Range 5,000 - 75,000
402.00000	Traffic Signing & Striping - 2 lanes	M		$3.20		
402.00000	Traffic Signing & Striping - 5 lanes	M		$5.80		
402.00000	Traffic Signing & Striping -7 lanes	M		$8.20		
402.00000	Traffic Signal, Full Intersection	EA		$90,000.00		
402.00000	Interconnect/Traffic Signals	M		$25.00		
402.00000	Traffic Signal, Future "Box-in"	EA		$4,900.00		
505.06125	Catch Basin	EA		$2,300.00		
510.03010	Scupper with 1 M to 2 M down drain	EA		$1,500.00		
	Drywell	EA		$7,000.00		Includes Inlet, grate and typical 20 M to 25 M depth
618.02318	460 mm (18") CMP	M		$80.00		
618.02318	460 mm (18") RGRCP, Class III	M		$120.00		For Drainage and Irrigation facilities NOT belonging to SRP
618.02324	610 mm (24") RGRCP, Class III	M		$145.00		For Drainage and Irrigation facilities NOT belonging to SRP
618.02336	760 mm & 910 mm (30" & 36") RGRCP, Class III	M		$195.00		Same
618.02348	1060 mm & 1220 mm (42" & 48") RGRCP, Class III	M		$250.00		Same
618.02348	1370 mm & 1520 mm (54" & 60") RGRCP, Class III	M	60.00	$300.00	$18,000	5 driveway crossings & Tuthill crossing
625.00000	1370 mm & 1520 mm Storm Drain/Irrigation Manhole	EA		$3,200.00		Same
	Headwall, 460 mm to 910 mm Pipe (MAG Details)	EA		$1,650.00		Same,
	Headwall, 1060 mm to 1520 mm Pipe (MAG Details)	EA		$3,200.00		Same
	Irrigation Headwall w/ Trashrack (Inlet)	EA		$2,800.00		Same
	Irrigation Junction Box (MAG Details)	EA		$2,500.00		Same
	Concrete Slip Form Irrigation Ditch	M		$75.00		Same; includes all costs associated with const of ditch
	Earth Irrigation Ditch/Special Drainage Ditch, 6' Top	M		$30.00		Same
	Irrigation Structure w/ Gates	EA		$7,500.00		Same
	Box Culvert (See Structure Sheet)	EA		$24,522.00		Same
	Bridge < 100' (See Structure Sheet)	EA				
	Bridge > 100' (See Structure Sheet)	EA				
220.01400	Plain Riprap	CM	1,786	$50.00	$89,300.00	For drop structures & driveways erosion protection
415.00000	Concrete Barrier	M		$75.00		
	Guard rail	M	187	$39.40	$7,368	
	GET	EA	2	$3,500.00	$7,000	
		Subtotal			$357,758	
110.01000	Mobilization @ 5%	L.S.	1	$17,888.00	$17,888	Auto Calculated @ 5% of Construction Cost
401.00000	Traffic Control @ 3.5%	L.S.	1	$12,522.00	$12,522	Auto Calculation @ 3.5%. Increase for special multi lane paved detour needs.
	Subtotal Construction				$388,168	
		Contingency		15%	$58,225	May be reduced by 5% in rural areas with few anticipated complications or utilities.
		Total			**$446,394**	

	1997 CAR ROAD CONSTRUCTION COST WORK SHEET					
	Ray Road Channel - Tuthill Road to Airport Road					
	Alternative: __ Grade, Drain & Pave (or Penetrate & Chip)					
Item #	*Description*	*Unit*	*Quantity*	*Unit Cost*	*Total*	
107.01100	N.P.D.E.S.	L.S.	1	$3,000.00	$3,000	Range 1,500 - 5,000
107.09200	Community Relations	Allowance	1	$10,000.00	$10,000	Range: 5,000 - 30,000
205.03000	Roadway Excavation	CM		$4.00	$0	Gross Roadway Prism Excavation without shrink or swell
210.04200	Borrow Excavation (If anticipated)	CM		$7.25	$0	Gross imported dirt quantitiy needed to finished roadway
215.00000	Channel & Retention Basin Excavation	CM	25,522	$6.00	$153,132	Includes Channels & Retention Basins outside roadway shoulder
	New Asphalt Pavement (See Pavement Sheet)	SQ M	1,500	$19.00	$28,500	Include printout of pavement computation sheet to document unit cost derivation.
	Asphalt Concrete .50 mm Overlay (See Pavement Sht)	SQ M		$4.75	$0	Temporary pavement
	Penetration and Chip Seal on Base Materal (See Pav)	SQ M	7,389	$2.50	$18,473	Gravel maintenance road for channel (4" AB)
	Chip Seal Surface on Pavement (See Pavement Sht)	SQ M		$1.15	$0	Include printout of pavement computation sheet to document unit cost derivation.
336.08100	Pavement Sawcut	M	20	$4.50	$90	
340.01020	Single Curb	M		$32.00	$0	Increase price for small quantities
340.01120	Conc. C & G	M		$30.00	$0	Increase price for small quantities
	Conc S/W Ramp Std Det 231 Type "A"	EA		$700.00	$0	
340.06950	Concrete Sidewalk Std Det 230	SQ M		$22.00	$0	
340.09750	Concrete Driveway w/5' Wings, Std. Det. 250	SQ M	260.0	$40.00	$10,400	
350.01110	Removal of Existing Improvements	L.S.	1	$15,000.00	$15,000	Range 5,000 - 75,000
402.00000	Traffic Signing & Striping - 2 lanes	M		$3.20	$0	
402.00000	Traffic Signing & Striping - 5 lanes	M		$5.80	$0	
402.00000	Traffic Signing & Striping -7 lanes	M		$8.20	$0	
402.00000	Traffic Signal, Full Intersection	EA		$90,000.00	$0	
402.00000	Interconnect/Traffic Signals	M		$25.00	$0	
402.00000	Traffic Signal, Future "Box-in"	EA		$4,900.00	$0	
505.06125	Catch Basin	EA		$2,300.00	$0	
510.03010	Scupper with 1 M to 2 M down drain	EA		$1,500.00	$0	
	Drywell	EA		$7,000.00	$0	Includes Inlet, grate and typical 20 M to 25 M depth
618.02318	460 mm (18") CMP	M		$80.00	$0	
618.02318	460 mm (18") RGRCP, Class III	M		$120.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02324	610 mm (24") RGRCP, Class III	M		$145.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02336	760 mm & 910 mm (30" & 36") RGRCP, Class III	M		$195.00	$0	Same
618.02348	1060 mm & 1220 mm (42" & 48") RGRCP, Class III	M		$250.00	$0	Same
618.02348	1370 mm & 1520 mm (54" & 60") RGRCP, Class III	M		$300.00	$0	
625.00000	1370 mm & 1520 mm Storm Drain/Irrigation Manhole	EA		$3,200.00	$0	
	Headwall, 460 mm to 910 mm Pipe (MAG Details)	EA		$1,650.00	$0	
	Headwall, 1060 mm to 1520 mm Pipe (MAG Details)	EA		$3,200.00	$0	
	Irrigation Headwall w/ Trashrack (Inlet)	EA		$2,800.00	$0	
	Irrigation Junction Box (MAG Details)	EA		$2,500.00	$0	
	Concrete Slip Form Irrigation Ditch	M		$75.00	$0	Same; includes all costs associated with const of ditch
	Earth Irrigation Ditch/Special Drainage Ditch, 6' Top	M		$30.00	$0	
	Irrigation Structure w/ Gates	EA		$7,500.00	$0	
	Box Culvert (Tuthill Road)	EA	1	$57,072.28	$57,072	
	Box Culvert (Driveways)	EA	5	$12,894.11	$64,471	
	Bridge < 100' (See Structure Sheet)	EA		$0.00	$0	
	Bridge > 100' (See Structure Sheet)	EA		$0.00	$0	
220.01400	Plain Riprap	CM	3,826	$56.00	$214,256.00	Gabion channel lining
415.00000	Concrete Barrier	M		$75.00	$0	
	Guard rail	M	187	$39.40	$7,368	
	GET	EA	2	$3,500.00	$7,000	
		Subtotal			$588,761	
110.01000	Mobilization @ 5%	L.S.	1	$29,438.00	$29,438	Auto Calculated @ 5% of Construction Cost
401.00000	Traffic Control @ 3.5%	L.S.	1	$20,607.00	$20,607	Auto Calculation @ 3.5%. Increase for special multi lane paved detour needs.
	Subtotal Construction				$638,806	
		Contingency		15%	$95,821	May be reduced by 5% in rural areas with few anticipated complications or utilities.
		Total			**$734,627**	

DERIVATION OF UNIT COST FOR PAVEMENT SECTIONS

Unit Cost Derivation for Arterial Section Shown	Metric	Actual	Used	See
1 Aggregate Base Thickness 250 mm	250 mm	9.843"	10"	Computations
Asphalt Concrete Thickness 100 mm	100 mm	3.937"	4"	Below

Item #	Description	Unit	Quantity	Unit Cost	Total	
310.07100	Aggregate Base (10")	Ton	0.5250	$10.00	$5.25	Calculated at 1.89 tons per CY for 1 SY of 10" AB (.5250 tons/SY)
315.07000	Bituminous Prime Cost (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons/SY)
	Tack Cost	SY	1	$0.16	$0.16	
321.03100	Asphalt Concrete, C 3/4 (4")	Ton	0.2189	$33.70	$7.38	Calculated at 1.97 Tons per CY for 1 SY of 4" AC (0.2189 Tons/ SY)
333.07100	Fog Seal (Diluted 50/50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated at 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons/SY)
301.02000	Subgrade Preparation (Under new pavement only)	SY	1	$2.50	$2.50	Variable; this work includes constructing fill sections and misc grading.
	Pavement and Subgrade Preparation Cost Per SY				$15.88	
	Pavement and Subgrade Preparation Cost Per SQ M				$18.99	
Rounded	Unit Cost Per SQ M for 100 mm over 250 mm			Total	$19.00	Use for permanent pavement

Unit Cost Derivation for Collector Section Shown	Metric	Actual	Used	See
2 Aggregate Base Thickness 250 mm	250 mm	9.843"	10"	Computations
Asphalt Concrete Thickness 75 mm	75 mm	2.953"	3"	Below

Item #	Description	Unit	Quantity	Unit Cost	Total	
310.07100	Aggregate Base (10")	Ton	0.5250	$10.00	$5.25	Calculated at 1.89 tons per CY for 1 SY of 10" AB (.5250 tons/SY)
315.07000	Bituminous Prime Cost (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons/SY)
321.09100	Asphalt Concrete, C 3/4 (3")	Ton	0.1642	$33.70	$5.53	Calculated at 1.97 Tons per CY for 1 SY of 3" AC (0.1642 Tons/ SY)
333.07100	Fog Seal (Diluted 50/50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated at 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons/SY)
301.02000	Subgrade Preparation (Under new pavement only)	SY	1	$2.50	$2.50	Variable; this work includes constructing fill sections and misc grading.
	Pavement and Subgrade Preparation Cost Per SY				$15.88	
	Pavement and Subgrade Preparation Cost Per SQ M				$16.60	
Rounded	Unit Cost Per SQ M for 75 mm over 250 mm			Total	$16.60	

Unit Cost Derivation for Local Road Section Shown	Metric	Actual	Used	See
3 Aggregate Base Thickness 150 mm	150 mm	5.906"	6"	Computations
Asphalt Concrete Thickness 75 mm	75 mm	2.953"	3"	Below

Item #	Description	Unit	Quantity	Unit Cost	Total	
310.07100	Aggregate Base (6")	Ton	0.3150	$10.00	$3.15	Calculated at 1.89 tons per CY for 1 SY of 6" AB (0.3150 Tons/SY)
315.07000	Bituminous Prime Cost (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons/SY)
321.03100	Asphalt Concrete, C 3/4 (3")	Ton	0.1642	$33.70	$5.53	Calculated at 1.97 Tons per CY for 1 SY of 3" AC (0.1642 Tons/ SY)
333.07100	Fog Seal (Diluted 50/50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated at 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons/SY)
301.02000	Subgrade Preparation (Under new pavement only)	SY	1	$2.20	$2.20	Variable; this work includes constructing fill sections and misc grading.
	Pavement and Subgrade Preparation Cost Per SY				$11.48	
	Pavement and Subgrade Preparation Cost Per SQ M				$13.73	
Rounded	Unit Cost Per SQ M for 75 mm over 250 mm			Total	$13.75	

Unit Cost Derivation for Local Road, 300 Max ADT	Metric	Actual	Used	See
4 Aggregate Base Thickness 150 mm	150 mm	5.906"	6"	Computations
Asphalt Penetration and Chip Seal Surface				Below

Item #	Description	Unit	Quantity	Unit Cost	Total	
301.02000	Subgrade Preparation (Under New Chip Seal Sfc Only)	SY	1	$2.50	$1.90	Variable; this work includes constructing fill sections and misc grading.
310.07100	Aggregate Base (6")	Ton	0.3150	$10.00	$3.15	Calculated at 1.89 tons per CY for 1 SY of 6" AB (0.3150 Tons/SY)
315.07000	Bituminous Prime Cost (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons/SY)
330.07100	Stone Chips (Double Chip @ 44 lbs Per SY)	Ton	0.0220	$35.00	$0.77	Calculated at 0.0220 Tons/ SY for Double Chip Seal Application
330.07200	Asphalt Emulsion (Double Seal @ 0.8 gal Per SY)	Ton	0.0033	$185.00	$0.61	Calculated at 8.3 lbs per gal for 1 SY of Seal (0.0033 Tons/SY)
333.07100	Fog Seal (Diluted 50/50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons/SY)
	Pavement and Subgrade Preparation Cost Per SY				$7.02	
	Pavement and Subgrade Preparation Cost Per SQ M				$8.40	
Rounded	Unit Cost Per SQ M for Penetration and Chip Sfc			Total	$8.40	

Unit Cost Derivation for 50 mm A.C. Overlay	Metric	Actual	Used	See
5 Asphalt Concrete Thickness 50 mm	50 mm	1.969"	2"	Computations
				Below

Item #	Description	Unit	Quantity	Unit Cost	Total	
	Tack Cost	SY	1	$0.16	$0.16	Includes Surface Preparation
321.03100	Asphalt Concrete, C 3/4 (2")	Ton	0.1094	$33.70	$3.69	Calculated at 1.97 Tons per CY for 1 SY of 2" AC (0.1094 Tons/ SY)
333.07100	Fog Seal (Diluted 50/50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons/SY)
	2" Asphalt Overlay Per SY				$3.96	
	50 mm Asphalt Overlay Per SQ M				$4.74	
Rounded	Cost Per SQ M for 50 mm Overlay			Total	$4.75	Use for temporary pavement

Unit Cost Derivation for Chip Seal over AC Pavements	Metric	Actual	Used	See
6 Chip Seal Surface Treatment				Computations
				Below

Item #	Description	Unit	Quantity	Unit Cost	Total	
	Tack Cost	SY	1	$0.16	$0.16	Includes Surface Preparation
330.07100	Stone Chips @ 22 lbs Per SY	Ton	0.0110	$35.00	$0.39	Calculated at 0.0220 Tons/ SY for Double Chip Seal Application
330.07200	Asphalt Emulsion @ 0.4 gal Per SY	Ton	0.0017	$185.00	$0.31	Calculated at 8.3 lbs per gal for 1 SY of Seal (0.0033 Tons/SY)
333.07100	Fog Seal (Diluted 50/50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons/SY)
	Chip Seal on Pavement Cost Per SY				$0.97	
	Chip seal on Pavement Cost Per SQ M				$1.16	
Rounded	Cost Per SQ M for Chip Seal on Pavement			Total	$1.15	

BOX CULVERT COST CALCULATIONS
Full Cost Alternative

TYPE OF ROAD	BOX LENGTH	BOX DESCRIPTION	BOX WIDTH	TOP SFC AREA*	UNIT	COST**	TOTAL COST
URBAN MINOR ARTERIAL OR LESS (27 m or 88.58' for 5 Lanes & 2 Sidewalks)	27	Tuthill Road (2 - 8' x 7' x 87')	5.56	150.19	SQM	$380.00	$57,072.28
URBAN MINOR ARTERIAL W/ BIKE LANES (28.8 m or 94.49' for 5 Lanes, 2 B/L's & 2 S/W's)	28.8		0.00	0.00	SQM	$380.00	$0.00
URBAN MAJOR ARTERIAL (31.8 m or 104.33' for 7 Lanes & 2 S/W's)	31.8		0.00	0.00	SQM	$380.00	$0.00
SPECIAL LOW VOLUME ROAD CONDITION *** (6.1 m or 20' Driveways w/o Shoulders)	6.1	Driveway access (2 - 8' x 7' x 20')	5.56	33.93	SQM	$380.00	$12,894.11

* Top Surface Area of box.

** Equivalent English unit cost is $25 to $30/SFT. Cost Includes Wing Walls

*** 16 m box with approval only. Generally a non-section line, low volume location.

BRIDGE COST CALCULATIONS

TYPE OF ROAD	BRIDGE LENGTH	DESCRIPTION	BRIDGE WIDTH	TOP SFC AREA*	UNIT	COST**	TOTAL COST
URBAN MINOR ARTERIAL OR LESS (27 m or 88.58' for 5 Lanes & 2 Sidewalks)	0		27	0	SQM	$375.00	$0.00
URBAN MINOR ARTERIAL W/ BIKE LANES (28.8 m or 94.49' for 5 Lanes, 2 B/L's & 2 S/W's)	0		28.8	0	SQM	$375.00	$0.00
URBAN MAJOR ARTERIAL (31.8 m or 104.33' for 7 Lanes & 2 S/W's)	0		31.8	0	SQM	$375.00	$0.00
SPECIAL LOW VOLUME ROAD CONDITION *** (16 m or 52.49' for 2 Lanes with Shoulders)	0		16	0	SQM	$375.00	$0.00

* Top Surface Area of bridge.

** Equivalent English unit cost is $35/sf for smaller bridge. Use $50/55 for long Salt or Gila River bridges (not shown). Cost Includes bridge railings, barriers, approach slabs, piers, and other items of bridge construction. Show cost of channel excavation, rip rap , and other bridge site work on roadway spread sheet.

*** 16 m bridge with approval only. Generally a non-section line, low volume location.

Alternative:					
Item #	***Description***	***Unit***	***Quantity***	***Unit Cost***	***Total***
1	Relocate 69 kv Power Pole	EA		$10,000.00	
2	Other Poles associated w/ 69kv Power Line	EA		$4,000.00	
3	SRP Facilities by SRP Forces (See Calc Sheet)	EA			
4	Railroad Crossing	EA			
	Subtotal Construction				
	Contingency			20%	
	Total				

TABLE 9.1.3 SUMMARY COST

Project Name & Termini: **Guadalupe Road Channel at the Eastern Canal**
CAR No. or Work Order No: **97-M**

1997 CAR PRELIMINARY SUMMARY COST ESTIMATES (Current Dollars)

COST CATAGORIES	*Factors*	*No Build*	**Low Cost Alternative*	*Full Cost Alternative*
Construction		$0	$0	$472,663
Design (10% TO 15%)	10%	$0	$0	$47,266
Construction Management	15%	$0	$0	$70,899
Right-of-Way		$0	$0	$0
Utility Relocation		$0	$0	$0
Administration (8% TO 13%)	10%	$0	$0	$47,266
Total		**$0**	**$0**	**$638,095**

*The low cost alternative includes improvements to be performed by the City of Gilbert.

PRELIMINARY SUMMARY COST ESTIMATES (Adjusted for Inflation)

Assumed Annual Inflation Rate = 2.90%
Assumed Number of Years = 5

Adjusted Construction Cost		$0	$0	$545,291
Design		$0	$0	$54,529
Construction Management	15%	$0	$0	$81,794
Right-of-Way		$0	$0	$0
Utility Relocation		$0	$0	$0
Administration	10%	$0	$0	$54,529
Adjusted Total		**$0**	**$0**	**$736,143**

1997 CAR ROAD CONSTRUCTION COST WORK SHEET

Guadalupe Road Channel at the Eastern Canal

Alternative: Grade, Drain & Pave (or Penetrate & Chip)

Item #	*Description*	*Unit*	*Quantity*	*Unit Cost*	*Total*	
107.01100	N.P.D.E.S.	L.S.		$3,000.00		Range 1,500 - 5,000
107.09200	Community Relations	Allowance		$15,000.00		Range: 5,000 - 30,000
205.03000	Roadway Excavation	CM		$4.00		Gross Roadway Prism Excavation without shrink or swell
210.04200	Borrow Excavation (If anticipated)	CM		$7.25		Gross imported dirt quantity needed to finished roadway
215.00000	Channel & Retention Basin Excavation	CM		$6.00		Includes Channels & Retention Basins outside roadway shoulder
	New Asphalt Pavement (See Pavement Sheet)	SQ M		$19.00		Include printout of pavement computation sheet to document unit cost derivation.
	Asphalt Concrete .50 mm Overlay (See Pavement Sht)	SQ M		$4.75		Include printout of pavement computation sheet to document unit cost derivation.
	Penetration and Chip Seal on Base Materal (See Pav)	SQ M		$8.40		Include printout of pavement computation sheet to document unit cost derivation.
	Chip Seal Surface on Pavement (See Pavement Sht)	SQ M		$1.15		Include printout of pavement computation sheet to document unit cost derivation.
336.08100	Pavement Sawcut	M		$4.50		
340.01020	Single Curb	M		$32.00		Increase price for small quantities
340.01120	Conc. C & G	M		$30.00		Increase price for small quantities
	Conc S/W Ramp Std Det 231 Type "A"	EA		$700.00		
340.06950	Concrete Sidewalk Std Det 230	SQ M		$22.00		
340.09750	Concrete Driveway w/5' Wings, Std. Det. 250	SQ M		$40.00		
350.01110	Removal of Existing Improvements	L.S.		$25,000.00		Range 5,000 - 75,000
402.00000	Traffic Signing & Striping - 2 lanes	M		$3.20		
402.00000	Traffic Signing & Striping - 5 lanes	M		$5.80		
402.00000	Traffic Signing & Striping -7 lanes	M		$8.20		
402.00000	Traffic Signal, Full Intersection	EA		$90,000.00		
402.00000	Interconnect/Traffic Signals	M		$25.00		
402.00000	Traffic Signal, Future "Box-in"	EA		$4,900.00		
505.06125	Catch Basin	EA		$2,300.00		
510.03010	Scupper with 1 M to 2 M down drain	EA		$1,500.00		
	Drywell	EA		$7,000.00		Includes Inlet, grate and typical 20 M to 25 M depth
618.02318	460 mm (18") CMP	M		$80.00		
618.02318	460 mm (18") RGRCP, Class III	M		$120.00		For Drainage and Irrigation facilities NOT belonging to SRP
618.02324	610 mm (24") RGRCP, Class III	M		$145.00		For Drainage and Irrigation facilities NOT belonging to SRP
618.02336	760 mm & 910 mm (30" & 36") RGRCP, Class III	M		$195.00		Same
618.02348	1060 mm & 1220 mm (42" & 48") RGRCP, Class III	M		$250.00		Same
618.02348	1370 mm & 1520 mm (54" & 60") RGRCP, Class III	M		$300.00		Shoefly during construction
625.00000	1370 mm & 1520 mm Storm Drain/Irrigation Manhole	EA		$3,200.00		Same
	Headwall, 460 mm to 910 mm Pipe (MAG Details)	EA		$1,650.00		Same,
	Headwall, 1060 mm to 1520 mm Pipe (MAG Details)	EA		$3,200.00		Same
	Irrigation Headwall w/ Trashrack (Inlet)	EA		$2,800.00		Same
	Irrigation Junction Box (MAG Details)	EA		$2,500.00		Same
	Concrete Slip Form Irrigation Ditch	M		$75.00		Same; includes all costs associated with const of ditch
	Earth Irrigation Ditch/Special Drainage Ditch, 6' Top	M		$30.00		Same
	Irrigation Structure w/ Gates	EA		$7,500.00		Same
	Box Culvert (See Structure Sheet)	EA		$24,522.00		Same
	Bridge < 100' (See Structure Sheet)	EA				
	Bridge > 100' (See Structure Sheet)	EA				
220.01400	Plain Riprap	CM		$50.00		Includes excavation for and placement of riprap
415.00000	Concrete Barrier	M		$75.00		
	"Quadguard"	EA		$20,000.00		
	Median Fine Grading, Pre-emergent Treatment & D.G.	SM		$22.00		
		Subtotal				
110.01000	Mobilization @ 5%	L.S.	1			Auto Calculated @ 5% of Construction Cost
401.00000	Traffic Control @ 3.5%	L.S.	1			Auto Calculation @ 3.5%. Increase for special multi lane paved detour needs.
		Subtotal Construction				
		ontingency		15%		May be reduced by 5% in rural areas with few anticipated complications or utilities.
		Total				

1997 CAR ROAD CONSTRUCTION COST WORK SHEET

Guadalupe Road Channel at the Eastern Canal

Alternative: Grade, Drain & Pave (or Penetrate & Chip)

Item #	*Description*	*Unit*	*Quantity*	*Unit Cost*	*Total*	
107.01100	N.P.D.E.S.	L.S.	1	$3,000.00	$3,000	Range 1,500 - 5,000
107.09200	Community Relations	Allowance	1	$15,000.00	$15,000	Range: 5,000 - 30,000
205.03000	Roadway Excavation	CM		$4.00	$0	Gross Roadway Prism Excavation without shrink or swell
210.04200	Borrow Excavation (If anticipated)	CM		$7.25	$0	Gross imported dirt quantity needed to finished roadway
215.00000	Channel & Retention Basin Excavation	CM	3,280	$6.00	$19,680	Includes Channels & Retention Basins outside roadway shoulder
	New Asphalt Pavement (See Pavement Sheet)	SQ.M	62.4	$19.00	$1,186	Include printout of pavement computation sheet to document unit cost derivation
	Asphalt Concrete .50 mm Overlay (See Pavement Sht)	SQ.M		$4.75	$0	Include printout of pavement computation sheet to document unit cost derivation
	Penetration and Chip Seal on Base Materal (See Pav)	SQ.M		$8.40	$0	Include printout of pavement computation sheet to document unit cost derivation.
	Chip Seal Surface on Pavement (See Pavement Sht)	SQ.M		$1.15	$0	Include printout of pavement computation sheet to document unit cost derivation
336.08100	Pavement Sawcut	M	17	$4.50	$77	
340.01020	Single Curb	M		$32.00	$0	Increase price for small quantities
340.01120	Conc. C & G	M		$30.00	$0	Increase price for small quantities
	Conc S/W Ramp Std Det 231 Type "A"	EA		$700.00	$0	
340.06950	Concrete Sidewalk Std Det 230	SQ.M		$22.00	$0	
340.09750	Concrete Driveway w/5' Wings, Std. Det. 250	SQ.M		$40.00	$0	
350.01110	Removal of Existing Improvements	L.S.		$25,000.00	$0	Range 5,000 - 75,000
402.00000	Traffic Signing & Striping - 2 lanes	M		$3.20	$0	
402.00000	Traffic Signing & Striping - 5 lanes	M		$5.80	$0	
402.00000	Traffic Signing & Striping -7 lanes	M		$8.20	$0	
402.00000	Traffic Signal, Full Intersection	EA		$90,000.00	$0	
402.00000	Interconnect/Traffic Signals	M		$25.00	$0	
402.00000	Traffic Signal, Future "Box-in"	EA		$4,900.00	$0	
505.06125	Catch Basin	EA		$2,300.00	$0	
510.03010	Scupper with 1 M to 2 M down drain	EA		$1,500.00	$0	
	Drywell	EA		$7,000.00	$0	Includes Inlet, grate and typical 20 M to 25 M depth
618.02318	460 mm (18") CMP	M		$80.00	$0	
618.02318	460 mm (18") RGRCP, Class III	M		$120.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02324	610 mm (24") RGRCP, Class III	M		$145.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02336	760 mm & 910 mm (30" & 36") RGRCP, Class III	M		$195.00	$0	Same
618.02348	1060 mm & 1220 mm (42" & 48") RGRCP, Class III	M		$250.00	$0	Same
618.02348	1370 mm & 1520 mm (54" & 60") RGRCP, Class III	M		$300.00	$0	Same
625.00000	1370 mm & 1520 mm Storm Drain/Irrigation Manhole	EA		$3,200.00	$0	Same
	Headwall, 460 mm to 910 mm Pipe (MAG Details)	EA		$1,650.00	$0	Same.
	Headwall, 1060 mm to 1520 mm Pipe (MAG Details)	EA		$3,200.00	$0	Same
	Irrigation Headwall w/ Trashrack (Inlet)	EA		$2,800.00	$0	Same
	Irrigation Junction Box (MAG Details)	EA		$2,500.00	$0	Same
	Concrete lined U-shaped channel 5.5' D x 12' W	M	780	$233.00	$181,740	Same; includes all costs associated with const of ditch
	Concrete lined U-shaped channel transition to 7' D x 20' W	M	24.4	$295.00	$7,198	Same
	Hand rail	M	804.4	$72.00	$57,917	Same
	Box Culvert (See Structure Sheet)	EA	2	$46,278.87	$92,558	Same
	Bridge < 100' (See Structure Sheet)	EA		$0.00	$0	
	Bridge > 100' (See Structure Sheet)	EA		$0.00	$0	
220.01400	Plain Riprap	CM		$50.00	$0	Includes excavation for and placement of riprap
415.00000	Concrete Barrier	M	6	$75.00	$458	
	"Quadguard"	EA		$20,000.00	$0	
	Median Fine Grading, Pre-emergent Treatment & D.G.	SM		$22.00	$0	
		Subtotal			$378,812	
110.01000	Mobilization @ 5%	L.S.	1	$18,941.00	$18,941	Auto Calculated @ 5% of Construction Cost
401.00000	Traffic Control @ 3.5%	L.S.	1	$13,258.00	$13,258	Auto Calculation @ 3.5%. Increase for special multi lane paved detour needs.
	Subtotal Construction				$411,011	
	Contingency			15%	$61,652	May be reduced by 5% in rural areas with few anticipated complications or utilities.
	Total				$472,663	

DERIVATION OF UNIT COST FOR PAVEMENT SECTIONS

Unit Cost Derivation for Arterial Section Shown:		Metric	Actual	Used	See	
1	Aggregate Base Thickness 250 mm	250 mm	9.843"	10"	Computations	
	Asphalt Concrete Thickness 100 mm	100 mm	3.93""	4"	Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
310.07100	Aggregate Base (10")	Ton	0.5250	$10.00	$5.25	Calculated at 1.89 tons per CY for 1 SY of 10" AB (.5250 tons SY)
315.07000	Bituminous Prime Coat (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons SY)
	Tack Coat	SY	1	$0.16	$0.16	
321.03100	Asphalt Concrete, C 3 4 (4")	Ton	0.2189	$33.70	$7.38	Calculated at 1.97 Tons per CY for 1 SY of 4" AC (0.2189 Tons SY)
333.07100	Fog Seal (Diluted 50 50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated at 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
301.02000	Subgrade Preparation (Under new pavement only)	SY	1	$2.50	$2.50	Variable; this work includes constructing fill sections and misc grading
	Pavement and Subgrade Preparation Cost Per SY				$15.88	
	Pavement and Subgrade Preparation Cost Per SQ M				$18.99	
Rounded	Unit Cost Per SQ M for 100 mm over 250 mm			Total	$19.00	Use for permenant pavement

Unit Cost Derivation for Collector Section Shown:		Metric	Actual	Used	See	
2	Aggregate Base Thickness 250 mm	250 mm	9.843"	10"	Computations	
	Asphalt Concrete Thickness 75 mm	75 mm	2.953"	3"	Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
310.07100	Aggregate Base (10")	Ton	0.5250	$10.00	$5.25	Calculated at 1.89 tons per CY for 1 SY of 10" AB (.5250 tons SY)
315.07000	Bituminous Prime Coat (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons SY)
321.03100	Asphalt Concrete, C 3 4 (3")	Ton	0.1642	$33.70	$5.53	Calculated at 1.97 Tons per CY for 1 SY of 3" AC (0.1642 Tons SY)
333.07100	Fog Seal (Diluted 50 50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated at 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
301.02000	Subgrade Preparation (Under new pavement only)	SY	1	$2.50	$2.50	Variable; this work includes constructing fill sections and misc grading
	Pavement and Subgrade Preparation Cost Per SY				$13.88	
	Pavement and Subgrade Preparation Cost Per SQ M				$16.60	
Rounded	Unit Cost Per SQ M for 75 mm over 250 mm			Total	$16.60	

Unit Cost Derivation for Local Road Section Shown:		Metric	Actual	Used	See	
3	Aggregate Base Thickness 150 mm	150 mm	5.906"	6"	Computations	
	Asphalt Concrete Thickness 75 mm	75 mm	2.953"	3"	Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
310.07100	Aggregate Base (6")	Ton	0.3150	$10.00	$3.15	Calculated at 1.89 tons per CY for 1 SY of 6" AB (0.3150 Tons SY)
315.07000	Bituminous Prime Coat (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons SY)
321.03100	Asphalt Concrete, C 3 4 (3")	Ton	0.1642	$33.70	$5.53	Calculated at 1.97 Tons per CY for 1 SY of 3" AC (0.1642 Tons SY)
333.07100	Fog Seal (Diluted 50 50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated at 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
301.02000	Subgrade Preparation (Under new pavement only)	SY	1	$2.20	$2.20	Variable; this work includes constructing fill sections and misc grading
	Pavement and Subgrade Preparation Cost Per SY				$11.48	
	Pavement and Subgrade Preparation Cost Per SQ M				$13.73	
Rounded	Unit Cost Per SQ M for 75 mm over 250 mm			Total	$13.75	

Unit Cost Derivation for Local Road, 200 Max ADT:		Metric	Actual	Used	See	
4	Aggregate Base Thickness 150 mm	150 mm	5.906"	6"	Computations	
	Asphalt Penetration and Chip Seal Surface				Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
301.02000	Subgrade Preparation (Under New Chip Seal Sfc Only)	SY	1	$2.50	$1.90	Variable; this work includes constructing fill sections and misc grading
310.07100	Aggregate Base (6")	Ton	0.3150	$10.00	$3.15	Calculated at 1.89 tons per CY for 1 SY of 6" AB (0.3150 Tons SY)
315.07000	Bituminous Prime Coat (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons SY)
330.07100	Stone Chips (Double Chip @ 44 lbs Per SY)	Ton	0.0220	$35.00	$0.77	Calculated at 0.0220 Tons SY for Double Chip Seal Application
330.07200	Asphalt Emulsion (Double Seal @ 0.8 gal Per SY)	Ton	0.0033	$185.00	$0.61	Calculated at 8.3 lbs per gal for 1 SY of Seal (0.0033 Tons SY)
333.07100	Fog Seal (Diluted 50 50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
	Pavement and Subgrade Preparation Cost Per SY				$7.02	
	Pavement and Subgrade Preparation Cost Per SQ M				$8.40	
Rounded	Unit Cost Per SQ M for Penetration and Chip Sfc			Total	$8.40	

Unit Cost Derivation for 50 mm A C Overlay:		Metric	Actual	Used	See	
5	Asphalt Concrete Thickness 50 mm	50 mm	1.969"	2"	Computations	
					Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
	Tack Coat	SY	1	$0.16	$0.16	Includes Surface Preparation
321.03100	Asphalt Concrete, C 3 4 (2")	Ton	0.1094	$33.70	$3.69	Calculated at 1.97 Tons per CY for 1 SY of 2" AC (0.1094 Tons SY)
333.07100	Fog Seal (Diluted 50 50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
	2" Asphalt Overlay Per SY				$3.96	
	50 mm Asphalt Overlay Per SQ M				$4.74	
Rounded	Cost Per SQ M for 50 mm Overlay			Total	$4.75	Use for temporary pavement

Unit Cost Derivation for Chip Seal over AC Pavement:		Metric	Actual	Used	See	
6	Chip Seal Surface Treatment				Computations	
					Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
	Tack Coat	SY	1	$0.16	$0.16	Includes Surface Preparation
330.07100	Stone Chips @ 22 lbs Per SY	Ton	0.0110	$35.00	$0.39	Calculated at 0.0220 Tons SY for Double Chip Seal Application
330.07200	Asphalt Emulsion @ 0.4 gal Per SY	Ton	0.0017	$185.00	$0.31	Calculated at 8.3 lbs per gal for 1 SY of Seal (0.0033 Tons SY)
333.07100	Fog Seal (Diluted 50 50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
	Chip Seal on Pavement Cost Per SY				$0.97	
	Chip seal on Pavement Cost Per SQ M				$1.16	
Rounded	Cost Per SQ M for Chip Seal on Pavement			Total	$1.15	

TYPE OF ROAD	BOX LENGTH	BOX DESCRIPTION	BOX WIDTH	TOP SFC AREA*	UNIT	COST**	TOTAL COST
Full Cost Alternative	39.93	**10' x 4' RCBC**	3.05	121.79	SQ M	$380.00	$46,278.87
URBAN MINOR ARTERIAL W/ BIKE LANES (28.8 m or 94.49' for 5 Lanes, 2 B/L's & 2 S/W's)	28.8		0	0	SQ M	$380.00	$0.00
URBAN MAJOR ARTERIAL (31.8 m or 104.33' for 7 Lanes & 2 S/W's)	31.8		0	0	SQ M	$380.00	$0.00
SPECIAL LOW VOLUME ROAD CONDITION *** (16 m or 52.49' for 2 Lanes with Shoulders)	16		0	0	SQ M	$380.00	$0.00

* *Top Surface Area of box.*

** Equivalent English unit cost is $25 to $30/SFT. Cost Includes Wing Walls

*** 16 m box with approval only. Generally a non-section line, low volume location.

BRIDGE COST CALCULATIONS

TYPE OF ROAD	BRIDGE LENGTH	DESCRIPTION	BRIDGE WIDTH	TOP SFC AREA*	UNIT	COST**	TOTAL COST
URBAN MINOR ARTERIAL OR LESS (27 m or 88.58' for 5 Lanes & 2 Sidewalks)	0		27	0	SQ M	$375.00	$0.00
URBAN MINOR ARTERIAL W/ BIKE LANES (28.8 m or 94.49' for 5 Lanes, 2 B/L's & 2 S/W's)	0		28.8	0	SQ M	$375.00	$0.00
URBAN MAJOR ARTERIAL (31.8 m or 104.33' for 7 Lanes & 2 S/W's)	0		31.8	0	SQ M	$375.00	$0.00
SPECIAL LOW VOLUME ROAD CONDITION *** (16 m or 52.49' for 2 Lanes with Shoulders)	0		16	0	SQ M	$375.00	$0.00

* Top Surface Area of bridge.

** Equivalent English unit cost is $35/sf for smaller bridge. Use $50/55 for long Salt or Gila River bridges (not shown). Cost Includes bridge railings, barriers, approach slabs, piers, and other items of bridge construction. Show cost of channel excavation, rip rap , and other bridge site work on roadway spread sheet.

*** 16 m bridge with approval only. Generally a non-section line, low volume location.

Guadalupe Road Channel at the Eastern Canal
Preliminary Construction Estimate - Utility Relocation

Alternative:					
Item #	***Description***	***Unit***	***Quantity***	***Unit Cost***	***Total***
1	Relocate 69 kv Power Pole	EA		$10,000.00	
2	Other Poles associated w/ 69kv Power Line	EA			
3	SRP Facilities by SRP Forces (See Calc Sheet)	EA			
4	Railroad Crossing	EA			
	Subtotal Construction				
		Contingency		20%	
		Total			

TABLE 9.1.4 SUMMARY COST

Project Name & Termini: **Chandler Heights Road Channel - Greenfield Road to Power Road**
CAR No. or Work Order No: **97-M**

1997 CAR PRELIMINARY SUMMARY COST ESTIMATES (Current Dollars)

COST CATAGORIES	*Factors*	*No Build*	*Low Cost Alternative*	*Full Cost Alternative*
Construction		$71,198	$1,005,107	$1,295,609
Design (10% TO 15%)	10%	$7,120	$100,511	$129,561
Construction Management	15%	$10,680	$150,766	$194,341
Right-of-Way		$94,588	$189,027	$198,471
Utility Relocation		$0	$0	$0
Administration (8% TO 13%)	10%	$7,120	$100,511	$129,561
Total		**$190,705**	**$1,545,922**	**$1,947,543**

PRELIMINARY SUMMARY COST ESTIMATES (Adjusted for Inflation)

Assumed Annual Inflation Rate = 2.90%
Assumed Number of Years = 5

Adjusted Construction Cost		$82,138	$1,159,550	$1,494,689
Design		$8,214	$115,955	$149,469
Construction Management	15%	$12,321	$173,932	$224,203
Right-of-Way		$109,122	$218,072	$228,968
Utility Relocation		$0	$0	$0
Administration	10%	$8,214	$115,955	$149,469
Adjusted Total		**$220,008**	**$1,783,465**	**$2,246,798**

	1997 CAR ROAD CONSTRUCTION COST WORK SHEET					
	Chandler Heights Road Channel - Greenfield Road to Power Road					
	Alternative: __ Grade, Drain & Pave (or Penetrate & Chip)					
Item #	*Description*	*Unit*	*Quantity*	*Unit Cost*	*Total*	
107.01100	N.P.D.E.S.	L.S.	1	$1,500.00	$1,500	Range 1,500 - 5,000
107.09200	Community Relations	Allowance	1	$5,000.00	$5,000	Range: 5,000 - 30,000
205.03000	Roadway Excavation	CM		$4.00	$0	Gross Roadway Prism Excavation without shrink or swell
210.04200	Borrow Excavation (If anticipated)	CM		$7.25	$0	Gross imported dirt quantitiy needed to finished roadway
215.00000	Channel & Retention Basin Excavation	CM		$6.00	$0	Includes Channels & Retention Basins outside roadway shoulder
	New Asphalt Pavement (See Pavement Sheet)	SQ M		$19.00	$0	Include printout of pavement computation sheet to document unit cost derivation.
	Asphalt Concrete .50 mm Overlay (See Pavement Sht)	SQ M		$4.75	$0	Include printout of pavement computation sheet to document unit cost derivation.
	Penetration and Chip Seal on Base Materal (See Pav)	SQ M		$8.40	$0	Include printout of pavement computation sheet to document unit cost derivation.
	Chip Seal Surface on Pavement (See Pavement Sht)	SQ M		$1.15	$0	Include printout of pavement computation sheet to document unit cost derivation.
336.08100	Pavement Sawcut	M		$4.50	$0	
340.01020	Single Curb	M		$32.00	$0	Increase price for small quantities
340.01120	Conc. C & G	M		$30.00	$0	Increase price for small quantities
	Conc S/W Ramp Std Det 231 Type "A"	EA		$700.00	$0	
340.06950	Concrete Sidewalk Std Det 230	SQ M		$22.00	$0	
340.09750	Concrete Driveway w/5' Wings, Std. Det. 250	SQ M		$40.00	$0	
350.01110	Removal of Existing Improvements	L.S.		$25,000.00	$0	Range 5,000 - 75,000
402.00000	Traffic Signing & Striping - 2 lanes	M		$3.20	$0	
402.00000	Traffic Signing & Striping - 5 lanes	M		$5.80	$0	
402.00000	Traffic Signing & Striping -7 lanes	M		$8.20	$0	
402.00000	Traffic Signal, Full Intersection	EA		$90,000.00	$0	
402.00000	Interconnect/Traffic Signals	M		$25.00	$0	
402.00000	Traffic Signal, Future "Box-in"	EA		$4,900.00	$0	
505.06125	Catch Basin	EA		$2,300.00	$0	
510.03010	Scupper with 1 M to 2 M down drain	EA		$1,500.00	$0	
	Drywell	EA		$7,000.00	$0	Includes Inlet, grate and typical 20 M to 25 M depth
618.02318	460 mm (18") CMP	M		$80.00	$0	
618.02318	460 mm (18") RGRCP, Class III	M		$120.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02324	610 mm (24") RGRCP, Class III	M		$145.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02336	760 mm & 910 mm (30" & 36") RGRCP, Class III	M		$195.00	$0	Same
618.02348	1060 mm & 1220 mm (42" & 48") RGRCP, Class III	M	14.60	$250.00	$3,650	Same
618.02348	1370 mm & 1520 mm (54" & 60") RGRCP, Class III	M		$300.00	$0	Shoefly during construction
625.00000	1370 mm & 1520 mm Storm Drain/Irrigation Manhole	EA		$3,200.00	$0	Same
	Headwall, 460 mm to 910 mm Pipe (MAG Details)	EA		$1,650.00	$0	Same,
	Headwall, 1060 mm to 1520 mm Pipe (MAG Details)	EA	6	$3,200.00	$19,200	Same
	Irrigation Headwall w/ Trashrack (Inlet)	EA		$2,800.00	$0	Same
	Irrigation Junction Box (MAG Details)	EA		$2,500.00	$0	Same
	Concrete Slip Form Irrigation Ditch	M		$75.00	$0	Same; includes all costs associated with const of ditch
	Earth Irrigation Ditch/Special Drainage Ditch, 6' Top	M		$30.00	$0	Same
	Irrigation Structure w/ Gates	EA		$7,500.00	$0	Same
	Box Culvert (See Structure Sheet)	EA		$24,522.00	$0	Same
	Bridge < 100' (See Structure Sheet)	EA		$0.00	$0	
	Bridge > 100' (See Structure Sheet)	EA		$0.00	$0	
220.01400	Plain Riprap	CM		$50.00	$0	Includes excavation for and placement of riprap
415.00000	Concrete Barrier	M		$75.00	$0	
	Guard rail	M	348	$39.40	$13,711	
	GET	EA	4	$3,500.00	$14,000	
		Subtotal			$57,061	
110.01000	Mobilization @ 5%	L.S.	1	$2,853.00	$2,853	Auto Calculated @ 5% of Construction Cost
401.00000	Traffic Control @ 3.5%	L.S.	1	$1,997.00	$1,997	Auto Calculation @ 3.5%. Increase for special multi lane paved detour needs.
		Subtotal Construction			$61,911	
		Contingency		15%	$9,287	May be reduced by 5% in rural areas with few anticipated complications or utilities.
		Total			**$71,198**	

	1997 CAR ROAD CONSTRUCTION COST WORK SHEET					
	Chandler Heights Road Channel - Greenfield Road to Power Road					
Alternative: __	*Grade, Drain & Pave (or Penetrate & Chip)*					
Item #	***Description***	***Unit***	***Quantity***	***Unit Cost***	***Total***	
107.01100	N.P.D.E.S.	L.S.	1	$3,000.00	$3,000	Range 1,500 - 5,000
107.09200	Community Relations	Allowance	1	$15,000.00	$15,000	Range: 5,000 - 30,000
205.03000	Roadway Excavation	CM		$4.00		Gross Roadway Prism Excavation without shrink or swell
210.04200	Borrow Excavation (If anticipated)	CM		$7.25		Gross imported dirt quantitiy needed to finished roadway
215.00000	Channel & Retention Basin Excavation	CM	62,642	$6.00	$375,852	Includes Channels & Retention Basins outside roadway shoulder
	New Asphalt Pavement (See Pavement Sheet)	SQ M	156.0	$19.00	$2,964	Include printout of pavement computation sheet to document unit cost derivation.
	Asphalt Concrete .50 mm Overlay (See Pavement Sht)	SQ M		$4.75		Temporary pavement
	Penetration and Chip Seal on Base Materal (See Pav)	SQ M	21,449	$2.50	$53,623	Gravel maintenance road for channel (4" AB)
	Chip Seal Surface on Pavement (See Pavement Sht)	SQ M		$1.15		Include printout of pavement computation sheet to document unit cost derivation.
336.08100	Pavement Sawcut	M	84	$4.50	$378	
340.01020	Single Curb	M		$32.00		Increase price for small quantities
340.01120	Conc. C & G	M		$30.00		Increase price for small quantities
	Conc S/W Ramp Std Det 231 Type "A"	EA		$700.00		
340.06950	Concrete Sidewalk Std Det 230	SQ M		$22.00		
340.09750	Concrete Driveway w/5' Wings, Std. Det. 250	SQ M	75	$40.00	$3,000	
350.01110	Removal of Existing Improvements	L.S.	1	$15,000.00	$15,000	Range 5,000 - 75,000
402.00000	Traffic Signing & Striping - 2 lanes	M		$3.20		
402.00000	Traffic Signing & Striping - 5 lanes	M		$5.80		
402.00000	Traffic Signing & Striping -7 lanes	M		$8.20		
402.00000	Traffic Signal, Full Intersection	EA		$90,000.00		
402.00000	Interconnect/Traffic Signals	M		$25.00		
402.00000	Traffic Signal, Future "Box-in"	EA		$4,900.00		
505.06125	Catch Basin	EA		$2,300.00		
510.03010	Scupper with 1 M to 2 M down drain	EA		$1,500.00		
	Drywell	EA		$7,000.00		Includes Inlet, grate and typical 20 M to 25 M depth
618.02318	460 mm (18") CMP	M		$80.00		
618.02318	460 mm (18") RGRCP, Class III	M		$120.00		For Drainage and Irrigation facilities NOT belonging to SRP
618.02324	610 mm (24") RGRCP, Class III	M		$145.00		For Drainage and Irrigation facilities NOT belonging to SRP
618.02336	760 mm & 910 mm (30" & 36") RGRCP, Class III	M		$195.00		Same
618.02348	1060 mm & 1220 mm (42" & 48") RGRCP, Class III	M		$250.00		Same
618.02348	1370 mm & 1520 mm (54" & 60") RGRCP, Class III	M	37	$300.00	$11,100	Shoefly during construction
625.00000	1370 mm & 1520 mm Storm Drain/Irrigation Manhole	EA		$3,200.00		Same
	Headwall, 460 mm to 910 mm Pipe (MAG Details)	EA		$1,650.00		Same.
	Headwall, 1060 mm to 1520 mm Pipe (MAG Details)	EA	2	$3,200.00	$6,400	Same
	Irrigation Headwall w/ Trashrack (Inlet)	EA		$2,800.00		Same
	Irrigation Junction Box (MAG Details)	EA		$2,500.00		Same
	Concrete Slip Form Irrigation Ditch	M		$75.00		Same; includes all costs associated with const of ditch
	Earth Irrigation Ditch/Special Drainage Ditch, 6' Top	M	4,398	$30.00	$131,940	Same
	Irrigation Structure w/ Gates	EA		$7,500.00		Same
	Box Culvert (See Structure Sheet)	EA	3	$31,293.00	$93,879	Same
	Bridge < 100' (See Structure Sheet)	EA				
	Bridge > 100' (See Structure Sheet)	EA				
220.01400	Plain Riprap	CM	1,868.00	$50.00	$93,400	Includes excavation for and placement of riprap (for drop structures)
415.00000	Concrete Barrier	M		$75.00		
	Guard rail	M		$39.40		
	GET	EA		$3,500.00		
		Subtotal			$805,536	
110.01000	Mobilization @ 5%	L.S.	1	$40,277.00	$40,277	Auto Calculated @ 5% of Construction Cost
401.00000	Traffic Control @ 3.5%	L.S.	1	$28,194.00	$28,194	Auto Calculation @ 3.5%. Increase for special multi lane paved detour needs.
	Subtotal Construction				$874,007	
		Contingency		15%	$131,101	May be reduced by 5% in rural areas with few anticipated complications or utilities.
		Total			**$1,005,107**	

	1997 CAR ROAD CONSTRUCTION COST WORK SHEET					
	Chandler Heights Road Channel - Greenfield Road to Power Road					
	Alternative: ___ Grade, Drain & Pave (or Penetrate & Chip)					
Item #	*Description*	*Unit*	*Quantity*	*Unit Cost*	*Total*	
107.01100	N.P.D.E.S.	L.S.	1	$3,000.00	$3,000	Range 1,500 - 5,000
107.09200	Community Relations	Allowance	1	$15,000.00	$15,000	Range: 5,000 - 30,000
205.03000	Roadway Excavation	CM		$4.00	$0	Gross Roadway Prism Excavation without shrink or swell
210.04200	Borrow Excavation (If anticipated)	CM		$7.25	$0	Gross imported dirt quantitiy needed to finished roadway
215.00000	Channel & Retention Basin Excavation	CM	80,476	$6.00	$482,856	Includes Channels & Retention Basins outside roadway shoulder
	New Asphalt Pavement (See Pavement Sheet)	SQ M	292.0	$19.00	$5,548	Include printout of pavement computation sheet to document unit cost derivation.
	Asphalt Concrete .50 mm Overlay (See Pavement Sht)	SQ M		$4.75	$0	Temporary pavement
	Penetration and Chip Seal on Base Material (See Pav)	SQ M	21,449	$2.50	$53,623	Gravel maintenance road for channel (4" AB)
	Chip Seal Surface on Pavement (See Pavement Sht)	SQ M		$1.15	$0	*Include printout of pavement computation sheet to document unit cost derivation.*
336.08100	Pavement Sawcut	M	84	$4.50	$378	
340.01020	Single Curb	M		$32.00	$0	Increase price for small quantities
340.01120	Conc. C & G	M		$30.00	$0	Increase price for small quantities
	Conc S/W Ramp Std Det 231 Type "A"	EA		$700.00	$0	
340.06950	Concrete Sidewalk Std Det 230	SQ M		$22.00	$0	
340.09750	Concrete Driveway w/5' Wings, Std. Det. 250	SQ M	88	$40.00	$3,520	
350.01110	Removal of Existing Improvements	L.S.	1	$15,000.00	$15,000	Range 5,000 - 75,000
402.00000	Traffic Signing & Striping - 2 lanes	M		$3.20	$0	
402.00000	Traffic Signing & Striping - 5 lanes	M		$5.80	$0	
402.00000	Traffic Signing & Striping -7 lanes	M		$8.20	$0	
402.00000	Traffic Signal, Full Intersection	EA		$90,000.00	$0	
402.00000	Interconnect/Traffic Signals	M		$25.00	$0	
402.00000	Traffic Signal, Future "Box-in"	EA		$4,900.00	$0	
505.06125	Catch Basin	EA		$2,300.00	$0	
510.03010	Scupper with 1 M to 2 M down drain	EA		$1,500.00	$0	
	Drywell	EA		$7,000.00	$0	Includes Inlet, grate and typical 20 M to 25 M depth
618.02318	460 mm (18") CMP	M		$80.00	$0	
618.02318	460 mm (18") RGRCP, Class III	M		$120.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02324	610 mm (24") RGRCP, Class III	M		$145.00	$0	For Drainage and Irrigation facilities NOT belonging to SRP
618.02336	760 mm & 910 mm (30" & 36") RGRCP, Class III	M		$195.00	$0	Same
618.02348	1060 mm & 1220 mm (42" & 48") RGRCP, Class III	M		$250.00	$0	Same
618.02348	1370 mm & 1520 mm (54" & 60") RGRCP, Class III	M	49	$300.00	$14,700	Shoefly during construction
625.00000	1370 mm & 1520 mm Storm Drain/Irrigation Manhole	EA		$3,200.00	$0	Same
	Headwall, 460 mm to 910 mm Pipe (MAG Details)	EA		$1,650.00	$0	Same,
	Headwall, 1060 mm to 1520 mm Pipe (MAG Details)	EA	2	$3,200.00	$6,400	Same
	Irrigation Headwall w/ Trashrack (Inlet)	EA		$2,800.00	$0	Same
	Irrigation Junction Box (MAG Details)	EA		$2,500.00	$0	Same
	Concrete Slip Form Irrigation Ditch	M		$75.00	$0	Same; includes all costs associated with const of ditch
	Earth Irrigation Ditch/Special Drainage Ditch, 6' Top	M	4,398	$30.00	$131,940	Same
	Irrigation Structure w/ Gates	EA		$7,500.00	$0	Same
	Box Culvert (See Structure Sheet)	EA	3	$65,664.00	$196,992	Same
	Bridge < 100' (See Structure Sheet)	EA		$0.00	$0	
	Bridge > 100' (See Structure Sheet)	EA		$0.00	$0	
220.01400	Plain Riprap	CM	2,188	$50.00	$109,400	Includes excavation for and placement of riprap (for drop structures)
415.00000	Concrete Barrier	M		$75.00	$0	
	Guard rail	M		$39.40	$0	
	GET	EA		$3,500.00	$0	
		Subtotal			$1,038,357	
110.01000	Mobilization @ 5%	L.S.	1	$51,918.00	$51,918	Auto Calculated @ 5% of Construction Cost
401.00000	Traffic Control @ 3.5%	L.S.	1	$36,342.00	$36,342	Auto Calculation @ 3.5%. Increase for special multi lane paved detour needs.
	Subtotal Construction				$1,126,617	
	Contingency			15%	$168,992	May be reduced by 5% in rural areas with few anticipated complications or utilities.
	Total				**$1,295,609**	

DERIVATION OF UNIT COST FOR PAVEMENT SECTIONS

Unit Cost Derivation for Arterial Section Shown:		Metric	Actual	Used	See	
1	Aggregate Base Thickness 250 mm	250 mm	9.843"	10"	Computations	
	Asphalt Concrete Thickness 100 mm	100 mm	3.937"	4"	Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
310.07100	Aggregate Base (10")	Ton	0.5250	$10.00	$5.25	Calculated at 1.89 tons per CY for 1 SY of 10" AB (5250 tons SY)
315.07000	Bituminous Prime Coat (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons SY)
	Tack Coat	SY	1	$0.16	$0.16	
321.03100	Asphalt Concrete, C 3 4 (4")	Ton	0.2189	$33.70	$7.38	Calculated at 1.97 Tons per CY for 1 SY of 4" AC (0.2189 Tons SY)
333.07100	Fog Seal (Diluted 50 50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated at 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
301.02000	Subgrade Preparation (Under new pavement only)	SY	1	$2.50	$2.50	Variable; this work includes constructing fill sections and misc grading
	Pavement and Subgrade Preparation Cost Per SY				$15.88	
	Pavement and Subgrade Preparation Cost Per SQ M				$18.99	
Rounded	Unit Cost Per SQ M for 100 mm over 250 mm			Total	$19.00	Use for permenant pavement

Unit Cost Derivation for Collector Section Shown:		Metric	Actual	Used	See	
2	Aggregate Base Thickness 250 mm	250 mm	9.843"	10"	Computations	
	Asphalt Concrete Thickness 75 mm	75 mm	2.953"	3"	Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
310.07100	Aggregate Base (10")	Ton	0.5250	$10.00	$5.25	Calculated at 1.89 tons per CY for 1 SY of 10" AB (5250 tons SY)
315.07000	Bituminous Prime Coat (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons SY)
321.03100	Asphalt Concrete, C 3 4 (3")	Ton	0.1642	$33.70	$5.53	Calculated at 1.97 Tons per CY for 1 SY of 3" AC (0.1642 Tons SY)
333.07100	Fog Seal (Diluted 50 50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated at 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
301.02000	Subgrade Preparation (Under new pavement only)	SY	1	$2.50	$2.50	Variable; this work includes constructing fill sections and misc grading
	Pavement and Subgrade Preparation Cost Per SY				$13.88	
	Pavement and Subgrade Preparation Cost Per SQ M				$16.60	
Rounded	Unit Cost Per SQ M for 75 mm over 250 mm			Total	$16.60	

Unit Cost Derivation for Local Road Section Shown:		Metric	Actual	Used	See	
3	Aggregate Base Thickness 150 mm	150 mm	5.906"	6"	Computations	
	Asphalt Concrete Thickness 75 mm	75 mm	2.953"	3"	Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
310.07100	Aggregate Base (6")	Ton	0.3150	$10.00	$3.15	Calculated at 1.89 tons per CY for 1 SY of 6" AB (0.3150 Tons SY)
315.07000	Bituminous Prime Coat (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons SY)
321.03100	Asphalt Concrete, C 3 4 (3")	Ton	0.1642	$33.70	$5.53	Calculated at 1.97 Tons per CY for 1 SY of 3" AC (0.1642 Tons SY)
333.07100	Fog Seal (Diluted 50 50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated at 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
301.02000	Subgrade Preparation (Under new pavement only)	SY	1	$2.20	$2.20	Variable; this work includes constructing fill sections and misc grading
	Pavement and Subgrade Preparation Cost Per SY				$11.48	
	Pavement and Subgrade Preparation Cost Per SQ M				$13.73	
Rounded	Unit Cost Per SQ M for 75 mm over 250 mm			Total	$13.75	

Unit Cost Derivation for Local Road, 300 Max ADT:		Metric	Actual	Used	See	
4	Aggregate Base Thickness 150 mm	150 mm	5.906"	6"	Computations	
	Asphalt Penetration and Chip Seal Surface				Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
301.02000	Subgrade Preparation (Under New Chip Seal Sfc Only)	SY	1	$2.50	$1.90	Variable; this work includes constructing fill sections and misc grading
310.07100	Aggregate Base (6")	Ton	0.3150	$10.00	$3.15	Calculated at 1.89 tons per CY for 1 SY of 6" AB (0.3150 Tons SY)
315.07000	Bituminous Prime Coat (0.4 gal per SY)	Ton	0.0016	$300.00	$0.48	Calculated at 8.0 lbs per gal for 1 SY of Prime (0.0016 Tons SY)
330.07100	Stone Chips (Double Chip @ 44 lbs Per SY)	Ton	0.0220	$35.00	$0.77	Calculated at 0.0220 Tons SY for Double Chip Seal Application
330.07200	Asphalt Emulsion (Double Seal @ 0.8 gal Per SY)	Ton	0.0033	$185.00	$0.61	Calculated at 8.3 lbs per gal for 1 SY of Seal (0.0033 Tons SY)
333.07100	Fog Seal (Diluted 50 50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
	Pavement and Subgrade Preparation Cost Per SY				$7.02	
	Pavement and Subgrade Preparation Cost Per SQ M				$8.40	
Rounded	Unit Cost Per SQ M for Penetration and Chip Sfc			Total	$8.40	

Unit Cost Derivation for 50 mm A C Overlay:		Metric	Actual	Used	See	
5	Asphalt Concrete Thickness 50 mm	50 mm	1.969"	2"	Computations	
					Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
	Tack Coat	SY	1	$0.16	$0.16	Includes Surface Preparation
321.03100	Asphalt Concrete, C 3 4 (2")	Ton	0.1094	$33.70	$3.69	Calculated at 1.97 Tons per CY for 1 SY of 2" AC (0.1094 Tons SY)
333.07100	Fog Seal (Diluted 50 50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
	2" Asphalt Overlay Per SY				$3.96	
	50 mm Asphalt Overlay Per SQ M				$4.74	
Rounded	Cost Per SQ M for 50 mm Overlay			Total	$4.75	Use for temporary pavement

Unit Cost Derivation for Chip Seal over AC Pavement:		Metric	Actual	Used	See	
6	Chip Seal Surface Treatment				Computations	
					Below	
Item #	Description	Unit	Quantity	Unit Cost	Total	
	Tack Coat	SY	1	$0.16	$0.16	Includes Surface Preparation
330.07100	Stone Chips @ 22 lbs Per SY	Ton	0.0110	$35.00	$0.39	Calculated at 0.0220 Tons SY for Double Chip Seal Application
330.07200	Asphalt Emulsion @ 0.4 gal Per SY	Ton	0.0017	$185.00	$0.31	Calculated at 8.3 lbs per gal for 1 SY of Seal (0.0033 Tons SY)
333.07100	Fog Seal (Diluted 50 50; 0.1 gal per SY)	Ton	0.0004	$285.00	$0.11	Calculated 8.3 lbs per gal for 1 SY of Fog (0.0004 Tons SY)
	Chip Seal on Pavement Cost Per SY				$0.97	
	Chip seal on Pavement Cost Per SQ M				$1.16	
Rounded	Cost Per SQ M for Chip Seal on Pavement			Total	$1.15	

BOX CULVERT COST CALCULATIONS

TYPE OF ROAD	BOX LENGTH	BOX DESCRIPTION	BOX WIDTH	TOP SFC AREA*	UNIT	COST**	TOTAL COST
URBAN MINOR ARTERIAL OR LESS (27 m or 88.58' for 5 Lanes & 2 Sidewalks)	27.0	**Low Cost: 10'x5' RCBC (88' Long mile x-ing)**	3.05	82.35	SQ M	$380.00	$31,293.00
URBAN MINOR ARTERIAL OR LESS (27 m or 88.58' for 5 Lanes & 2 Sidewalks)	27.0	**Full Cost: 2-10'x4' RCBC (88' Long mile x-ing)**	6.4	172.8	SQ M	$380.00	$65,664.00
			0	0	SQ M	$380.00	$0.00
			0	0	SQ M	$380.00	$0.00

* Top Surface Area of box.

** Equivalent English unit cost is $25 to $30/SFT. Cost Includes Wing Walls

*** 16 m box with approval only. Generally a non-section line, low volume location.

BRIDGE COST CALCULATIONS

TYPE OF ROAD	BRIDGE LENGTH	DESCRIPTION	RIDGE WIDT	TOP SFC AREA*	UNIT	COST**	TOTAL COST
URBAN MINOR ARTERIAL OR LESS (27 m or 88.58' for 5 Lanes & 2 Sidewalks)	0		27	0	SQ M	$375.00	$0.00
URBAN MINOR ARTERIAL W/ BIKE LANES (28.8 m or 94.49' for 5 Lanes, 2 B/L's & 2 S/W's)	0		28.8	0	SQ M	$375.00	$0.00
URBAN MAJOR ARTERIAL (31.8 m or 104.33' for 7 Lanes & 2 S/W's)	0		31.8	0	SQ M	$375.00	$0.00
SPECIAL LOW VOLUME ROAD CONDITION *** (16 m or 52.49' for 2 Lanes with Shoulders)	0		16	0	SQ M	$375.00	$0.00

* Top Surface Area of bridge.

** Equivalent English unit cost is $35/sf for smaller bridge. Use $50/55 for long Salt or Gila River bridges (not shown). Cost Includes bridge railings, barriers, approach slabs, piers, and other items of bridge construction. Show cost of channel excavation, rip rap , and other bridge site work on roadway spread sheet.

*** 16 m bridge with approval only. Generally a non-section line, low volume location.

Chandler Heights Road Channel - Greenfield Road to Power Road
Preliminary Construction Estimate - Utility Relocation

Alternative:					
Item #	***Description***	***Unit***	***Quantity***	***Unit Cost***	***Total***
1	Relocate 69 kv Power Pole	EA		$10,000.00	
2	Other Poles associated w/ 69kv Power Line	EA			
3	SRP Facilities by SRP Forces (See Calc Sheet)	EA			
4	Railroad Crossing	EA			
	Subtotal Construction				
		Contingency		20%	
		Total			

10.10 Quantity Calculations

DMJM ARIZONA, INC.	PROJECT MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION CANDIDATE ASSESSMENT REPORT	PROJECT NO.6597		SHT. NO.
		BY JWG	DATE 2/10/98	
SUBJECT 87th Avenue, Deer Valley Road to Williams Road		REFERENCE		

QUANTITIES AND UNIT COSTS

1. Project Length: 850 m

2. Channel Excavation - Low Cost Alternative
   - 1.067 m depth + .15 m slab = 1.217 m
   - 1.524 m base + .2 m walls = 1.924 m
   - Volume = 850 x 1.217 x 1.924 = 1990.2818 m3

3. Channel Excavation - Full Cost Alternative
   - 1.219 m depth + .15 m slab = 1.369 m
   - 6.096 m base + .2 m walls = 6.496 m
   - Volume = 850 x 1.369 x 6.496 = 7282.9904 m3

4. Channel Lining - Low Cost Alternative
   - Based on Unit Cost of $33.25 psm walls, $30 psm slab
   - 1 meter of channel wall 2 x 1.067 m = 2.134 m2
   - 1 meter of channel slab = 1.524 m2
   - Cost = 2.134 x 33.25 + 1.524 x 30 = 116.6755 Say $117

5. Channel Lining - Full Cost Alternative
   - Based on Unit Cost of $33.25 psm walls, $30 psm slab
   - 1 meter of channel wall 2 x 1.219 m = 2.438 m2
   - 1 meter of channel slab = 6.096 m2
   - Cost = 2.438 x 33.25 + 6.096 x 30 = 263.9435 Say $264

6. Channel Length -
   - 850 m - 14 driveway box culverts
   - Driveway Box Culverts length = 16' = 4.877 m
   - Length = 850 - (14 x 4.877) = 781.722 Say 782 m

7. Gravel Roadway -
   - Length = 1330 ft = 405 m
   - Width = 30 ft = 9.14 m
   - Surface area = 405 x 9.14 = 3701.7 m2

8. Sawcut Existing Road - width = 50 ft = 15.2 m Sawcut 2 x 15.2 = 30.4 Say 30 m

9. Pavement Replacement

Low Cost Alternative 15.2 x 1.924 = 29.245 m2 Say 29 m2

Full Cost Alternative 15.2 x 6.496 = 98.739 m2 Say 99 m2

DMJM ARIZONA, INC.	PROJECT MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION CANDIDATE ASSESSMENT REPORT	PROJECT NO. 6597.03	SHT. NO.
		BY JRM / DATE 2/12/98	
SUBJECT Ray Road Channel		REFERENCE	

QUANTITIES AND UNIT COSTS

1. Project Length 4970 ft = 1515 m

2. Saw Cut Pavements Width = 10 m each location x 2 = 20 m

3. Pavement Replacements - Tuthill Road

   Full and Low Cost Alts: 20m x 75m = 1500 m2

4. Channel Excavation - Low Cost Alternative Earthern Channel - See attached spread sheet

   4.6 cm/ft channel excavation

   Channel length = 4970 ft Chan Ex. = 24353 m3

   Total 24353 m3

   Full Cost Alternative Gabion Channel - See attached spread sheet

   4.9 cm/ft channel excavation

   4970' - 5(20') - 88' = 4782 ft Chan Ex. = 23431.8 m3

   RCBC Excavation = 5 x 2 x 5.56 x 20 = 1112 m3
   RCBC Excavation = 1 x 2 x 5.56 x 88 = 979

   Total 25522 m3

5. Gabions Full Cost Alternative Gabion Channel - See attached spread sheet

   0.8 cu m /ft Gabion Volume

   4970' - 5(20') - 88' = 4782 ft Gabions = 3826 m3

6. Drop Structures Low Cost Alternative Earthern Channel - See attached spread sheet

   Total Drop Structures = 6 Riprap Volume = 229 cy = 297.7 m3 each

   Total Volume = 1786.2 m3

7. Driveway Crossing

Low Cost Alternative Earthern Channel - See attached spread sheet

Top Width = 50 ft = 15.24 m, Length = 16 ft = 4.877 m

Area = 15.24 x 4.877 = 74.325 m2 Say 75 m2 x 5 crossings = 375 m2

Full Cost Alternative Earthern Channel - See attached spread sheet

Top Width = 35 ft = 10.67 m, Length = 16 ft = 4.877 m

Area = 10.67 x 4.877 = 52.038 m2 Say 52 m2 x 5 crossings = 260 m2

8. Maintenance Access Road - all alternatives

Width = 16 ft = 4.877 m, length = 1515 m

Area = 4.877 x 1515 = 7389 m2

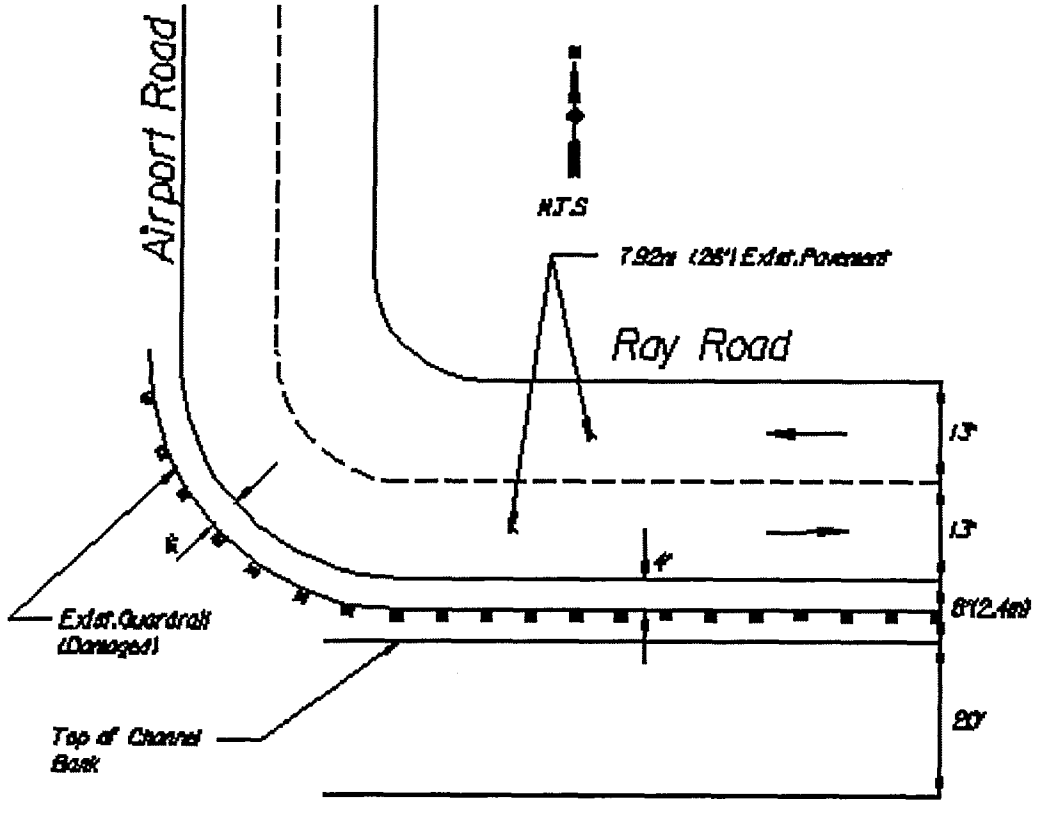
9. Pipe Llengths - Low Cost Alternatives

Driveway crossings:

5 x 28' = 140' Total of 200' say 60m
1 x 60' = 60'

DMJM ARIZONA, INC.	PROJECT MCDOT CAR	PROJECT NO. 6597.03		SHT. NO. 1 of 2
		BY MSS	DATE 1/6/98	
SUBJECT **Ray Road Channel**		REFERENCE		

RAY ROAD GUARDRAIL



Length of need calculation
Assume no flare of guardrail

$$\text{Length of need} = \frac{L_H - L_2}{(L_H)/(L_R)}$$

L_H = 41 feet
L_2 = 17 ft. (13 ft. + 4 ft.)
L_R = 360 ft. from Table 5.6 of RDG for 55 mph

DMJ ARIZONA,	PROJECT MCDOT CAR	PROJECT NO. 6597.03		SHT. NO. 2 of 2
		BY JRM	DAT 1/6/98	
SUBJECT **Guadalupe Road @ Eastern Canal**		REFERENCE		

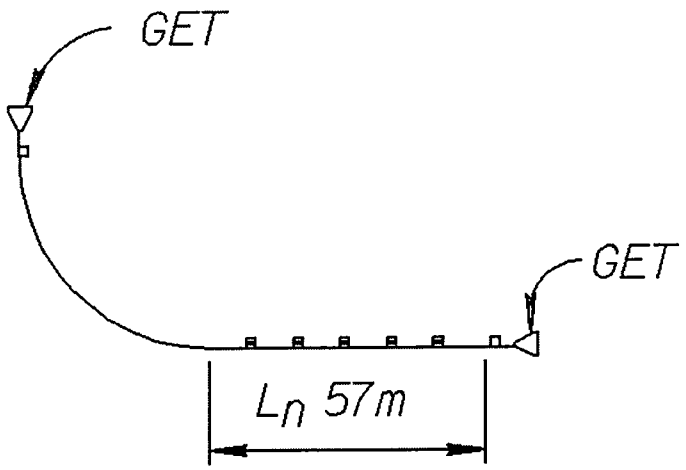
LN WB/NB

L_H = 41 feet

L_2 = 17 ft.

L_R = 360 ft.

LN WB/NB = $\frac{41 - 17}{41/360}$ = 211 feet = 55.53 meters



Need in increments of 3.8 m

∴ use 57 m

57 M

Need to install 2 gets also

Length of Guard Rail

R + 57 M

MCDOT CAR
DMJM Proj#: 6597.03

Ray Road Channel Between Tuthill Road and Airport Road -- Channel Design Options

FULL COST 50-YEAR SOLUTION
PEAK Q = 717 cfs

Channel Type	ROW (sq.ft per foot)	Concrete Pipe (lin.ft)	Channel Exc. (cu.meters)/ft	Bank Protection (cu.meter or sq. yard)/ft	ROW ($/ft)	Concrete Pipe ($/ft)	Channel Exc. ($/ft)	Bank Protection ($/ft)	Channel Total ($/ft)	Channel Total ($)	Channel Total and Drop $'s
earth	105.4	0	8.8	-	$16.94	$0.00	$52.75	-	$70	$346,335	**$391,289**
rip-rap	60.6	0	4.5	2.0	$9.74	$0.00	$27.26	$98.92	$136	$675,522	**$675,522**
gabion	50.8	0	4.1	0.8	$8.16	$0.00	$24.36	$40.31	$73	$361,997	**$361,997**
concrete	37.2	0	2.7	3.0	$5.98	$0.00	$16.37	$65.19	$88	$435,060	**$438,023**

	Channel Design Depth (ft)	Bottom Width (ft)	Top Width (ft)	SideSlopes (h:1)	Lining Thickness (ft)
earth	4.3	55.0	89.4	4	-
rip-rap	6.1	8.0	44.6	3	1.50
gabions	6.7	8.0	34.8	2	0.75
concrete	6.6	8.0	21.2	1	0.50

DROP STRUCTURE CALCULATIONS

	Existing Slope (ft/ft)	Design Slope (ft/ft)	Elevation Difference	#of 3' Drop Structures	Drop Struct. Type	Drop Struct. Length	Drop Struct. Width	Riprap Volume (cu. yd.)	Drop Struct. Cost (ea.)	Drop Struct. Total Cost
earth	0.004	0.0008	15.9	6	riprap	39.0	90.5	392	$7,492.40	$44,954.42
concrete	0.004	0.0022	8.9	3	concrete	1.0	26.7	5	$987.69	$2,963.07

UNIT COSTS

		(English)	(SI)
ROW$:	$7,000.00	per acre	
Concrete Pipe$:	$0.00	per lf	
Channel Exc.$:	$6.00		per cu.meter
Rip-Rap$:	$50.00		per cu.meter
Gabions$:	$50.00		per cu.meter
Concrete$:	$22.00	per sq. yard	
Concrete$:	$200.00	per cu. yd.	
	Channel Inc. Length (ft)	Channel Total Length (ft)	
	1.0	4970.0	

MCDOT CAR
DMJM Proj#: 6597.03

Ray Road Channel Between Tuthill Road and Airport Road – Channel Design Options

LOW COST 10-YEAR SOLUTION
PEAK Q = 376 cfs

Channel Type	ROW (sq.ft per foot)	Concrete Pipe (lin.ft)	Channel Exc. (cu.meters)	Bank Protection (cu.meter or sq. yard)	ROW ($/ft)	Concrete Pipe ($/ft)	Channel Exc. ($/ft)	Bank Protection ($/ft)	Channel Total ($/ft)	Channel Total ($)	Channel Total and Drop $'s
earth	67.2	0	4.6	-	$10.80	$0.00	$27.84	-	$39	$192,018	**$244,473.33**
rip-rap	52.8	0	3.0	1.6	$8.48	$0.00	$18.27	$81.46	$108	$537,832	**$537,831.77**
gabion	44.8	0	2.7	0.7	$7.20	$0.00	$16.26	$33.19	$57	$281,524	**$281,523.80**
concrete	33.6	0	1.7	2.4	$5.40	$0.00	$10.44	$52.74	$69	$340,846	**$343,242.99**

	Channel Design Depth (ft)	Bottom Width (ft)	Top Width (ft)	SideSlopes (h:1)	Lining Thickness (ft)
earth	6.4	0.0	51.2	4	-
rip-rap	4.8	8.0	36.8	3	1.50
gabions	5.2	8.0	28.8	2	0.75
concrete	4.8	8.0	17.6	1	0.50

DROP STRUCTURE CALCULATIONS

	Existing Slope (ft/ft)	Design Slope (ft/ft)	Elevation Difference	#of 3' Drop Structures	Drop Struct. Type	Drop Struct. Length	Drop Struct. Width	Riprap Volume (cu. yd.)	Drop Struct. Cost (ea.)	Drop Struct. Total Cost
earth	0.004	0.00083	15.8	6	riprap	39.0	52.8	229	$8,742.49	$52,454.94
concrete	0.004	0.0025	7.5	3	concrete	1.0	21.6	4	$799.13	$2,397.38

UNIT COSTS

		(English)	(SI)
ROW$:	$7,000.00	per acre	
Concrete Pipe$:	$0.00	per lf	
Channel Exc.$:	$6.00		per cu.meter
Rip-Rap$:	$50.00		per cu.meter
Gabions$:	$50.00		per cu.meter
Concrete$:	$22.00	per sq. yard	
Concrete$:	$200.00	per cu. yd.	
	Channel Inc. Length (ft)	Channel Total Length (ft)	
	1.0	4970.0	

DMJM ARIZONA, INC	PROJECT MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION CANDIDATE ASSESSMENT REPORT	PROJECT NO. 6597	SHT. NO.
		BY JWG / DATE 2/10/98	
SUBJECT Guadalupe Road Channel @ Eastern Canal		REFERENCE	

QUANTITIES AND UNIT COSTS

1. Channel Length - 2560 ft = 780 m

2. Channel Excavation -

1.6764 m depth + .15 m slab =	1.8264	m
3.6576 m base + .2 m walls =	4.0576	m
Volume = 780 x 1.8264 x 4.0576 =	6299.180544	m3

3. Channel Lining - Based on Unit Cost of $33.25 psm walls, $30 psm slab

1 meter of channel wall 2 x 1.6764 m =	3.3528	m2
1 meter of channel slab =	4.0576	m2
Cost = 3.3528 x 33.25 + 4.0576 x 30 =	233.2086	Say $233

4. Length of Transition - 80 ft = 24.38 m

5. Transition Excavation -

Average Depth $\frac{1.6764 + 2.1336}{2}$ m + .15 m slab =	2.055	m
Average Base $\frac{3.6576 + 6.096}{2}$ m + .2 m walls =	5.2768	m
Volume = 24.38 x 2.055 x 5.2768 =	264.3724291	m3

6. Total Excavation Volume - Assumed that only 1/2 of excavation is required as channel replaces existing

$\frac{6299+264}{2}$ = 3281.5 m3 say 3280 m3

7. Transition Lining - Based on Unit Cost of $33.25 psm walls, $30 psm slab

1 meter of transition wall 2 x 2.055 m =	4.11	m2
1 meter of channel slab =	5.2768	m2
Cost = 4.11 x 33.25 + 5.2768 x 30 =	294.9615	Say $295

DMJM ARIZONA, INC	PROJECT MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION CANDIDATE ASSESSMENT REPORT	PROJECT NO. 6597 BY JWG / DATE 2/10/98	SHT. NO.
SUBJECT Guadalupe Road Channel @ Eastern Canal		REFERENCE	

8. Guardrail on RCBC - 2 x width of box (3.05 m) = 6.1 m Say 6 m

9. Sawcut Pavement - width = 28 ft = 8.5344 m 2 x 8.5344 m = 17.0688 m Say 17 m

10. Pavement Replacement - 28 ft x 24 ft = 8.5344 m x 7.315 m = 62.429136 m2 Say 62.4 m2

DMJM ARIZONA, INC.	PROJECT MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION CANDIDATE ASSESSMENT REPORT	PROJECT NO. 6597.03	SHT. NO.
		BY JWG / DATE 2/12/98	
	SUBJECT Chandler Heights Road Drainage Channel	REFERENCE	

QUANTITIES AND UNIT COSTS

1. Project Length — 14692 ft = 4478.12 m Say 4478 m

2. Saw Cut Pavements
   - Width = 46 ft = 14.02 m each location x 2 = 28.04 m Say 28m
   - Higley, Recker and 108th Street - 3 x 28 = 84 m

3. Pavement Replacements -
   - Low Cost Alternative 10' x 5' RCBC = 3.05 + .33 +.33= 3.71 m
   - Full Cost Alternative 2-10' x 4 RCBC = 2 x 3.05+3 x .28= 6.94 m
   - Low Cost - 14.02 x 3.71 x 3 = 156.04 m2 Say 156 m2
   - Full Cost - 14.02 x 6.94 x 3 = 291.90 m2 Say 292 m2

4. Channel Excavation -
   - Low Cost Alternative Earthern Channel - See attached spread sheet
   - 4478 m - 3 x 26.8 m = 4397.6 m Say 4398 m
   - 4.3 cm per ft = 14.108 cm per m Channel Ex = 62045 cm
   - RCBC Excavation = 3 x 3.71 x 26.8 x 2.0 = 597 cm
   - Total 62642 cm
   - Full Cost Alternative Earthern Channel - See attached spread sheet
   - 4478 m - 3 x 26.8 m = 4397.6 m Say 4398 m
   - 5.5 cm per ft = 18.045 cm per m Channel Ex = 79360 cm
   - RCBC Excavation = 3 x 6.94 x 26.8 x 2.0 = 1116 cm
   - Total 80476 cm

5. Drop Structures
   - Low Cost Alternative Earthern Channel - See attached spread sheet
   - Total Drop Structures = 11 Riprap Volume = 222 cy = 169.83 cm each
   - Total Volume = 1868 cm

Full Cost Alternative Earthern Channel - See attached spread sheet

Total Drop Structures = 11 Riprap Volume = 260 cy = 198.9 cm each

Total Volume = 2188 cm

6. Driveway Crossing

Low Cost Alternative Earthern Channel - See attached spread sheet

Top Width = 50 ft = 15.24 m, Length = 16 ft = 4.877 m

Area = 15.24 x 4.877 = 74.325 m2 Say 75 m2

Full Cost Alternative Earthern Channel - See attached spread sheet

Top Width = 58.8 ft = 17.92 m, Length = 16 ft = 4.877 m

Area = 17.92 x 4.877 = 87.396 m2 Say 88 m2

7. Maintenance Access Road - all alternatives

Width = 16 ft = 4.877 m, length = 4398

Area = 4.877 x 4398 = 21449 m2

MCDOT CAR
DMJM Proj#: 6597.03

Chandler Heights Channel Between East Maricopa Floodway and Power Road -- Channel Design Options

100-YEAR DEVELOPED CONDITIONS
FULL ALTERNATIVE (Q=450cfs)

Channel Type	ROW (sq.ft per foot)	Concrete Pipe (lin.ft)	Channel Exc. (cu.meters)/ft	Bank Protection (cu.meter or sq. yard)/ft	ROW ($/ft)	Concrete Pipe ($/ft)	Channel Exc. ($/ft)	Bank Protection ($/ft)	Channel Total ($/ft)	Channel Total ($)	Channel Total and Drop $'s
earth	74.8	0	5.5	-	$12.02	$0.00	$33.27	-	$45	$665,454	**$720,170**
rip-rap	57.0	0	3.8	1.8	$9.16	$0.00	$22.89	$90.87	$123	$1,805,930	**$1,805,930**
gabion	47.6	0	3.3	0.7	$7.65	$0.00	$19.85	$36.51	$64	$940,442	**$940,442**
concrete	34.4	0	1.9	2.5	$5.53	$0.00	$11.66	$55.51	$73	$1,068,079	**$1,070,602**

	Channel Design Depth (ft)	Bottom Width (ft)	Top Width (ft)	SideSlopes (h:1)	Lining Thickness (ft)
earth	5.1	18.0	58.8	4	-
rip-rap	5.5	8.0	41.0	3	1.50
gabions	5.9	8.0	31.6	2	0.75
concrete	5.2	8.0	18.4	1	0.50

DROP STRUCTURE CALCULATIONS

	Existing Slope (ft/ft)	Design Slope (ft/ft)	Elevation Difference	#of 3' Drop Structures	Drop Struct. Type	Drop Struct. Length	Drop Struct. Width	Riprap Volume (cu. yd.)	Drop Struct. Cost (ea.)	Drop Struct. Total Cost
earth	0.003	0.0008	32.3	11	riprap	39.0	60.1	260	$4,974.22	$54,716.39
concrete	0.003	0.0025	7.3	3	concrete	1.0	22.7	4	$841.03	$2,523.09

UNIT COSTS

		(English)	(SI)
ROW$:	$7,000.00	per acre	
Concrete Pipe$:	$0.00	per lf	
Channel Exc.$:	$6.00		per cu.meter
Rip-Rap$:	$50.00		per cu.meter
Gabions$:	$50.00		per cu.meter
Concrete$:	$22.00	per sq. yard	
Concrete$:	$200.00	per cu. yd.	
	Channel Inc. Length (ft)	Channel Total Length (ft)	
	1.0	14692.0	

MCDOT CAR
DMJM Proj#: 6597.03

Chandler Heights Channel Between East Maricopa Floodway and Power Road -- Channel Design Options

10-YEAR EXISTING CONDITIONS
LOW COST ALTERNATIVE (Q=345cfs)

Channel Type	ROW (sq.ft per foot)	Concrete Pipe (lin.ft)	Channel Exc. (cu.meters)	Bank Protection (cu.meter or sq. yard)	ROW ($/ft)	Concrete Pipe ($/ft)	Channel Exc. ($/ft)	Bank Protection ($/ft)	Channel Total ($/ft)	Channel Total ($)	Channel Total and Drop $'s
earth	66.0	0	4.3	-	$10.61	$0.00	$25.87	-	$36	$535,869	**$629,333**
rip-rap	53.4	0	3.1	1.7	$8.58	$0.00	$18.90	$82.81	$110	$1,620,316	**$1,620,316**
gabion	45.2	0	2.8	0.7	$7.26	$0.00	$16.75	$33.66	$58	$847,383	**$847,383**
concrete	33.2	0	1.6	2.3	$5.34	$0.00	$9.85	$51.36	$67	$977,639	**$979,974**

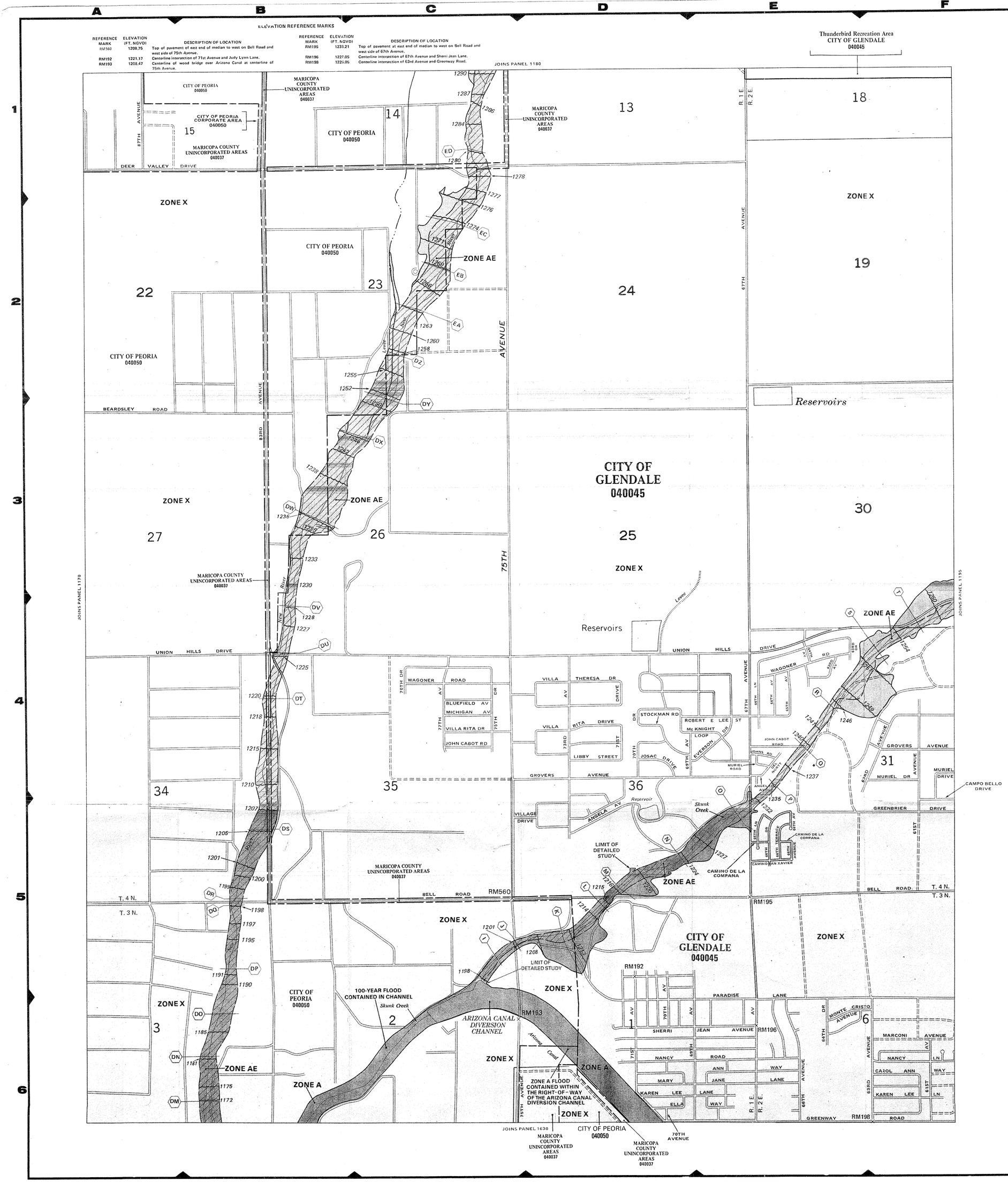
	Channel Design Depth (ft)	Bottom Width (ft)	Top Width (ft)	SideSlopes (h:1)	Lining Thickness (ft)
earth	5.3	8.0	50.0	4	-
rip-rap	4.9	8.0	37.4	3	1.50
gabions	5.3	8.0	29.2	2	0.75
concrete	4.6	8.0	17.2	1	0.50

DROP STRUCTURE CALCULATIONS

	Existing Slope (ft/ft)	Design Slope (ft/ft)	Elevation Difference	#of 3' Drop Structures	Drop Struct. Type	Drop Struct. Length	Drop Struct. Width	Riprap Volume (cu. yd.)	Drop Struct. Cost (ea.)	Drop Struct. Total Cost
earth	0.003	0.0009	30.9	11	riprap	39.0	51.3	222	$8,496.80	$93,464.83
concrete	0.003	0.0025	7.3	3	concrete	1.0	21.0	4	$778.18	$2,334.53

UNIT COSTS

		(English)	(SI)
ROW$:	$7,000.00	per acre	
Concrete Pipe$:	$0.00	per lf	
Channel Exc.$:	$6.00		per cu.meter
Rip-Rap$:	$50.00		per cu.meter
Gabions$:	$50.00		per cu.meter
Concrete$:	$22.00	per sq. yard	
Concrete$:	$200.00	per cu. yd.	
	Channel Inc. Length (ft)	Channel Total Length (ft)	
	1.0	14692.0	



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** — No base flood elevations determined.
- **ZONE AE** — Base flood elevations determined.
- **ZONE AH** — Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** — To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
- **ZONE V** — Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** — Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** — Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** — Areas determined to be outside 500-year flood plain.
- **ZONE D** — Areas in which flood hazards are undetermined.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet*

D — D — Cross Section Line

(EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone*

$RM7_X$ — Elevation Reference Mark

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.

Areas of special flood hazard (100-year flood) include Zones A, A1-30, AE, AH, AO, A99, V, V1-30 AND VE.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Floodway widths are provided in the Flood Insurance Study Report.

Coastal base flood elevations apply only landward of the shoreline.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of the map.

For community map revision history prior to countywide mapping, see Section 6.0 of the Flood Insurance Study Report.

For adjoining map panels see separately printed Map Index

MAP REPOSITORY
Refer to Repository Listing on Index Map

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:
APRIL 15, 1988

EFFECTIVE DATE (S) OF REVISION (S) TO THIS PANEL:

Map revised September 29, 1989 to change base flood elevations and special flood hazard areas, to add base flood elevations and special flood hazard areas, to change zone designations, to reflect updated topographic information, to incorporate previously issued letters of map revision and map amendment, and to update map format.

Map revised DECEMBER 3, 1993 to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to change special flood hazard areas, to change zone designations, to update map format, to add roads and road names, to reflect updated topographic information, and to incorporate previously issued letters of map revision.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET
1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 1190 OF 4350

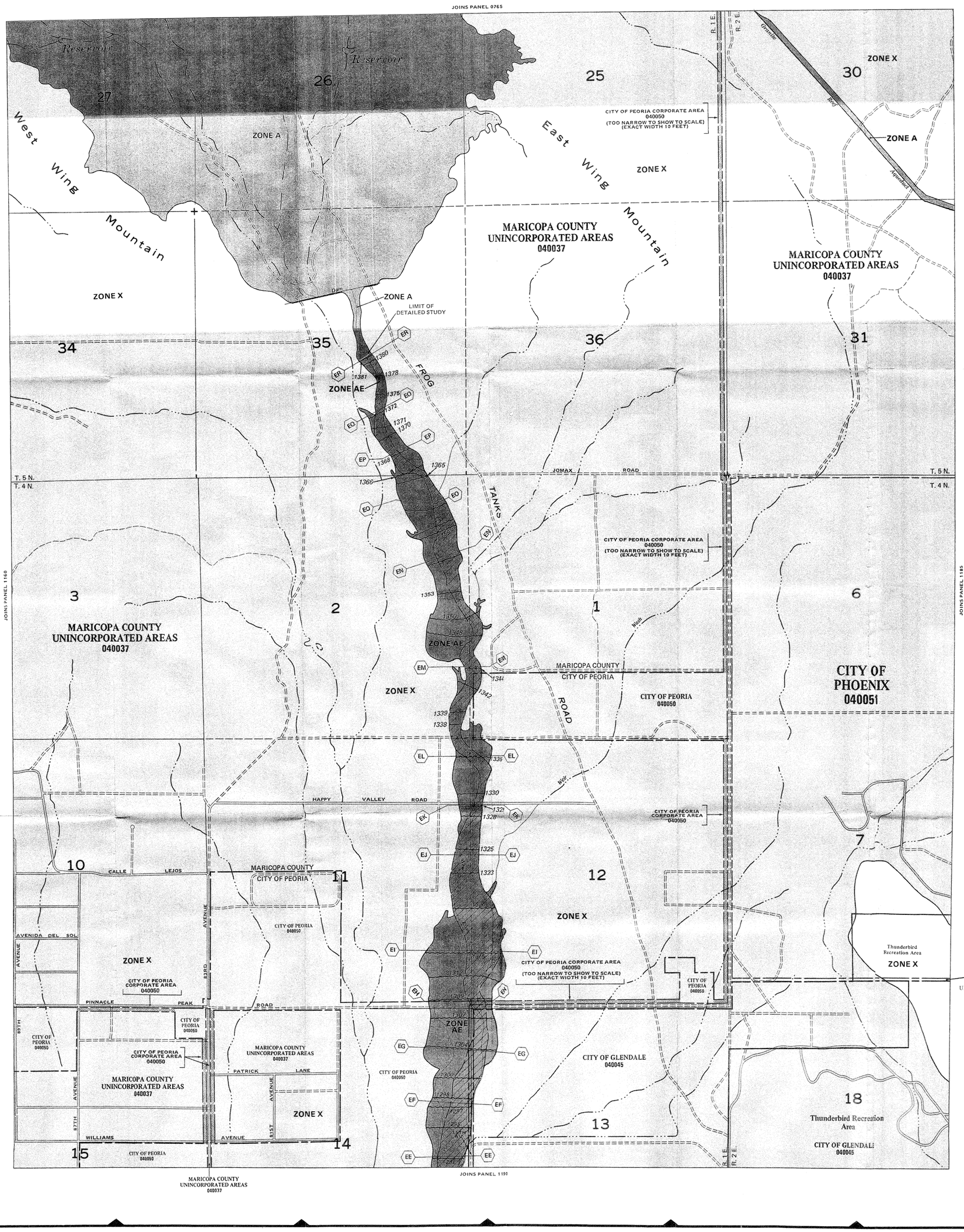
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GLENDALE, CITY OF	040045	1190	F
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	1190	F
PEORIA, CITY OF	040050	1190	F

MAP NUMBER
04013C1190 F

MAP REVISED:
DECEMBER 3, 1993

Federal Emergency Management Agency



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** — No base flood elevations determined.
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- **ZONE A99** — To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
- **ZONE V** — Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** — Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** — Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** — Areas determined to be outside 500-year flood plain.
- **ZONE D** — Areas in which flood hazards are undetermined.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

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(EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone*

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NOTES

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Areas of special flood hazard (100-year flood) include Zones A, A1-30, AE, AH, AO, A99, V, V1-30 AND VE.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Floodway widths are provided in the Flood Insurance Study Report.

Coastal base flood elevations apply only landward of the shoreline.

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For adjoining map panels see separately printed Map Index

MAP REPOSITORY

Refer to Repository Listing on Index Map

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:

APRIL 15, 1988

EFFECTIVE DATE (S) OF REVISION (S) TO THIS PANEL:

Map revised SEPTEMBER 29, 1989 to change base flood elevations and special flood hazard areas, to add base flood elevations and special flood hazard areas, to change zone designations, to reflect updated topographic information, to incorporate previously issued letters of map revision and map amendment, and to update map format.

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APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 1180 OF 4350

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GLENDALE, CITY OF	040045	1180	E
MARICOPA COUNTY UNINCORPORATED AREAS	040037	1180	E
PEORIA, CITY OF	040050	1180	E
PHOENIX, CITY OF	040051	1180	E

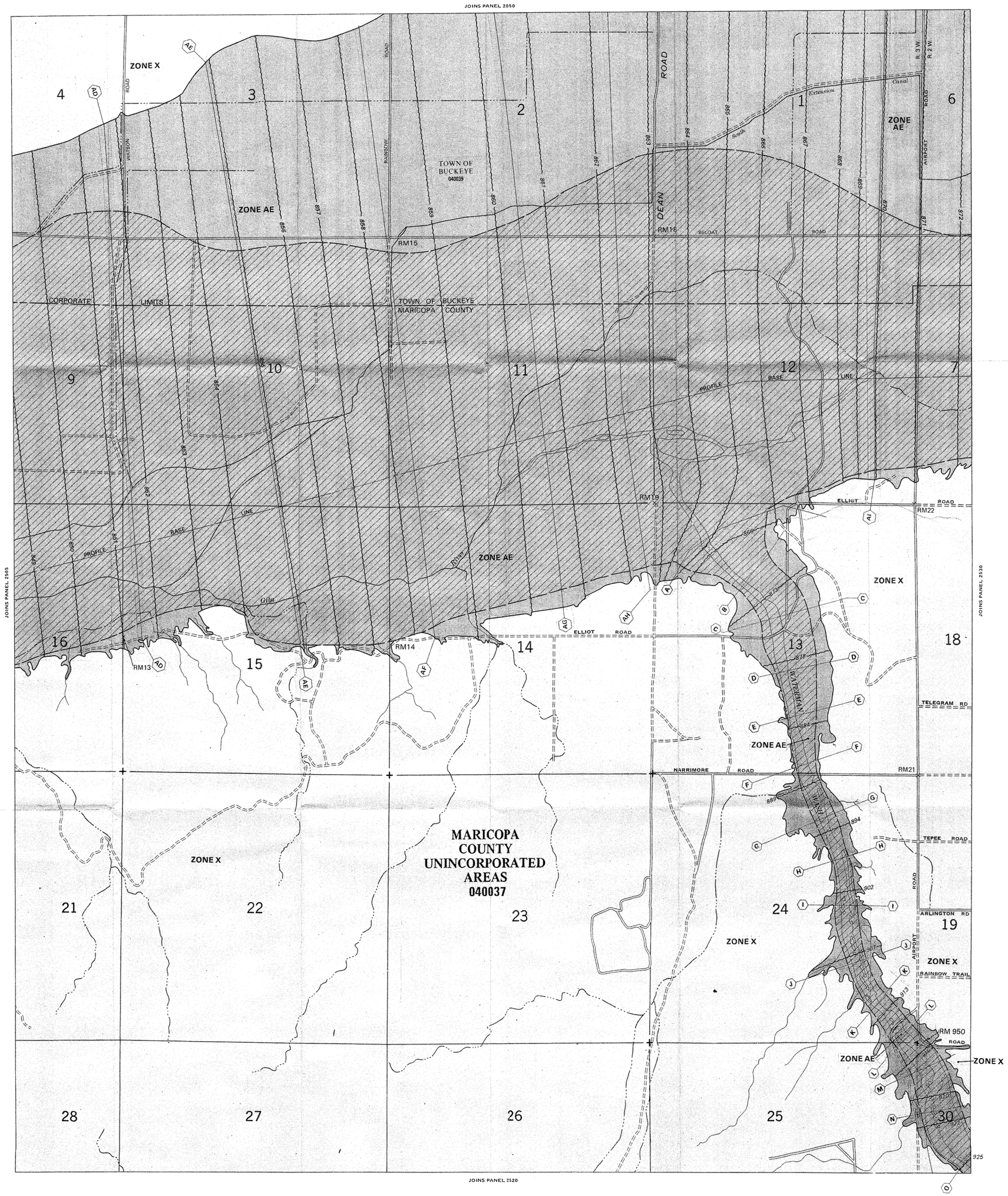
MAP NUMBER
04013C1180 E

MAP REVISED:
SEPTEMBER 29, 1989

Federal Emergency Management Agency

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM13	847.48	Government Land Office brass cap at quarter corner Sections 15 and 16, T1S, R3W.
RM14	854.09	Government Land Office brass cap at quarter corner of Sections 14 and 15, T1S, R3W.
RM15	858.49	PK nail at centerline intersection of Beloat Road and Rainbow Road.
RM18	860.87	Top of pavement at centerline intersection of Beloat Road and Dean Road.
RM19	856.62	Government Land Office brass cap at Section corner marked 11-12-13-14, T1S, R3W.
RM21	905.80	Top of pavement at centerline intersection of Narrimore Road and Airport Road.
RM22	880.45	U.S. Army Corps of Engineers brass cap at northwest corner of Airport Road and Elliot Road, Marked TL-ZJ-11.
RM950	915.76	Chiseled "+" on south end of headwall on east side of Airport Road, 245 feet north of intersection Airport and Ray Roads.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 1 SOUTH, RANGE 2 WEST AND TOWNSHIP 1 SOUTH, RANGE 3 WEST

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

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- **ZONE VE** — Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

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Floodway Boundary

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D — D — Cross Section Line

(EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone*

$RM7_X$ — Elevation Reference Mark

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

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Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of the map.

For community map revision history prior to countywide mapping, see Section 6.0 of the Flood Insurance Study Report.

For adjoining map panels see separately printed Map Index

MAP REPOSITORY

Refer to Repository Listing on Index Map

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:

APRIL 15, 1988

EFFECTIVE DATE (S) OF REVISION (S) TO THIS PANEL:

Map revised September 4, 1991 to update corporate limits, to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to change special flood hazard areas, to change zone designations, to update map format, to add roads and road names and to incorporate previously issued letter of map revision.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 2510 OF 4350

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BUCKEYE, TOWN OF	040039	2510	E
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	2510	E

MAP NUMBER
04013C2510 E

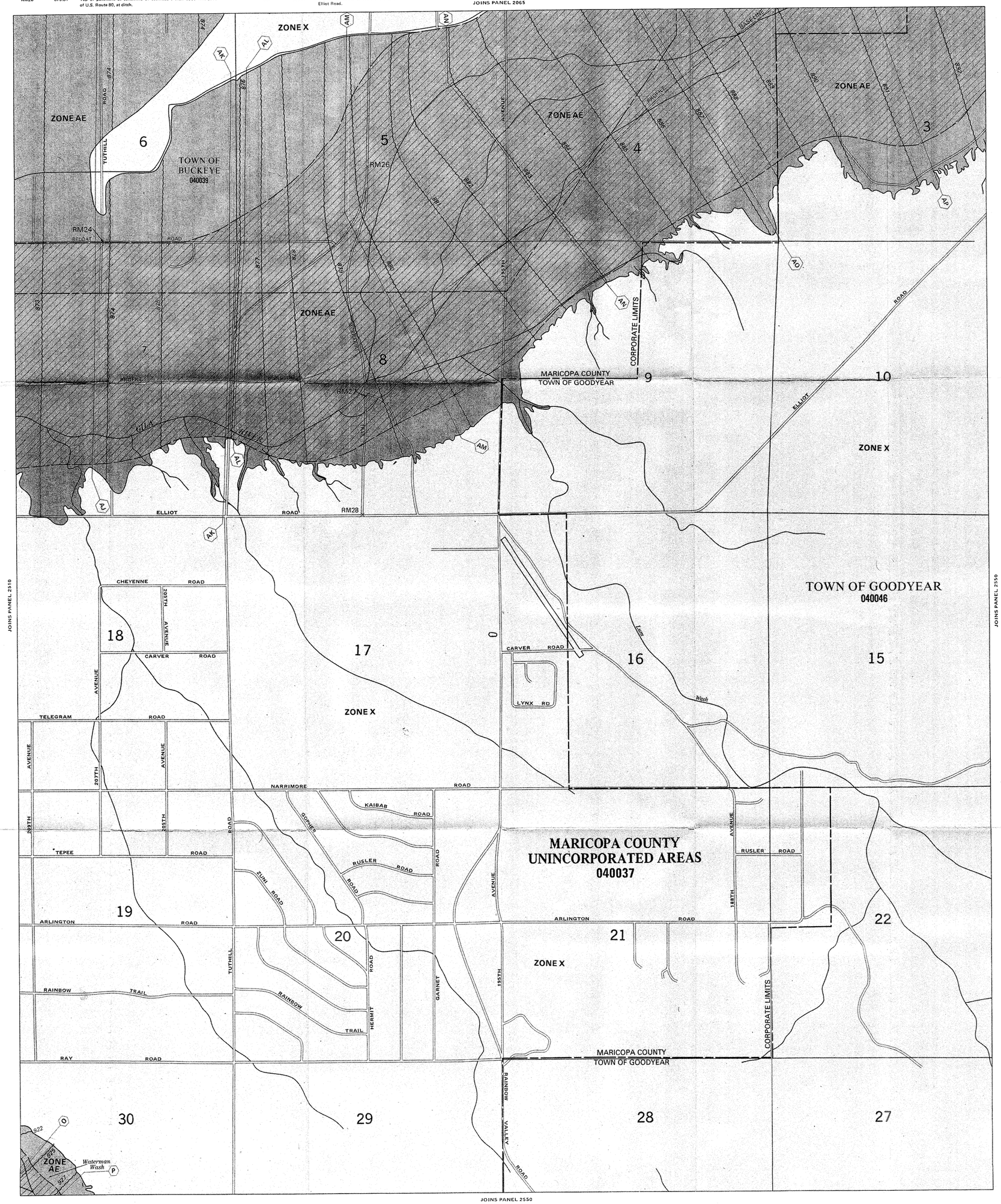
MAP REVISED:
SEPTEMBER 4, 1991

Federal Emergency Management Agency

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM24	870.07	Top of pavement at centerline intersection of Beloat Road and Tuthill Road.
RM26	875.81	Top of pavement at centerline of Jackrabbit Trail 3900 feet south of U.S. Route 80, at ditch.
RM27	867.35	Top of pavement at centerline of Jackrabbit Trail at north end of Gila River bridge.
RM28	902.74	Top of pavement at centerline intersection of Jackrabbit Trail and Elliot Road.

JOINS PANEL 2065



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 1 SOUTH, RANGE 2 WEST

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** — No base flood elevations determined.
- **ZONE AE** — Base flood elevations determined.
- **ZONE AH** — Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** — To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
- **ZONE V** — Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** — Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** — Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** — Areas determined to be outside 500-year flood plain.
- **ZONE D** — Areas in which flood hazards are undetermined.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet*

D — D — Cross Section Line

(EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone*

RM7X — Elevation Reference Mark

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.

Areas of special flood hazard (100-year flood) include Zones A, A1-30, AE, AH, AO, A99, V, V1-30 AND VE.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Floodway widths are provided in the Flood Insurance Study Report.

Coastal base flood elevations apply only landward of the shoreline.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of the map.

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For adjoining map panels see separately printed Map Index.

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APRIL 15, 1988

EFFECTIVE DATE (S) OF REVISION (S) TO THIS PANEL:

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APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 2530 OF 4350

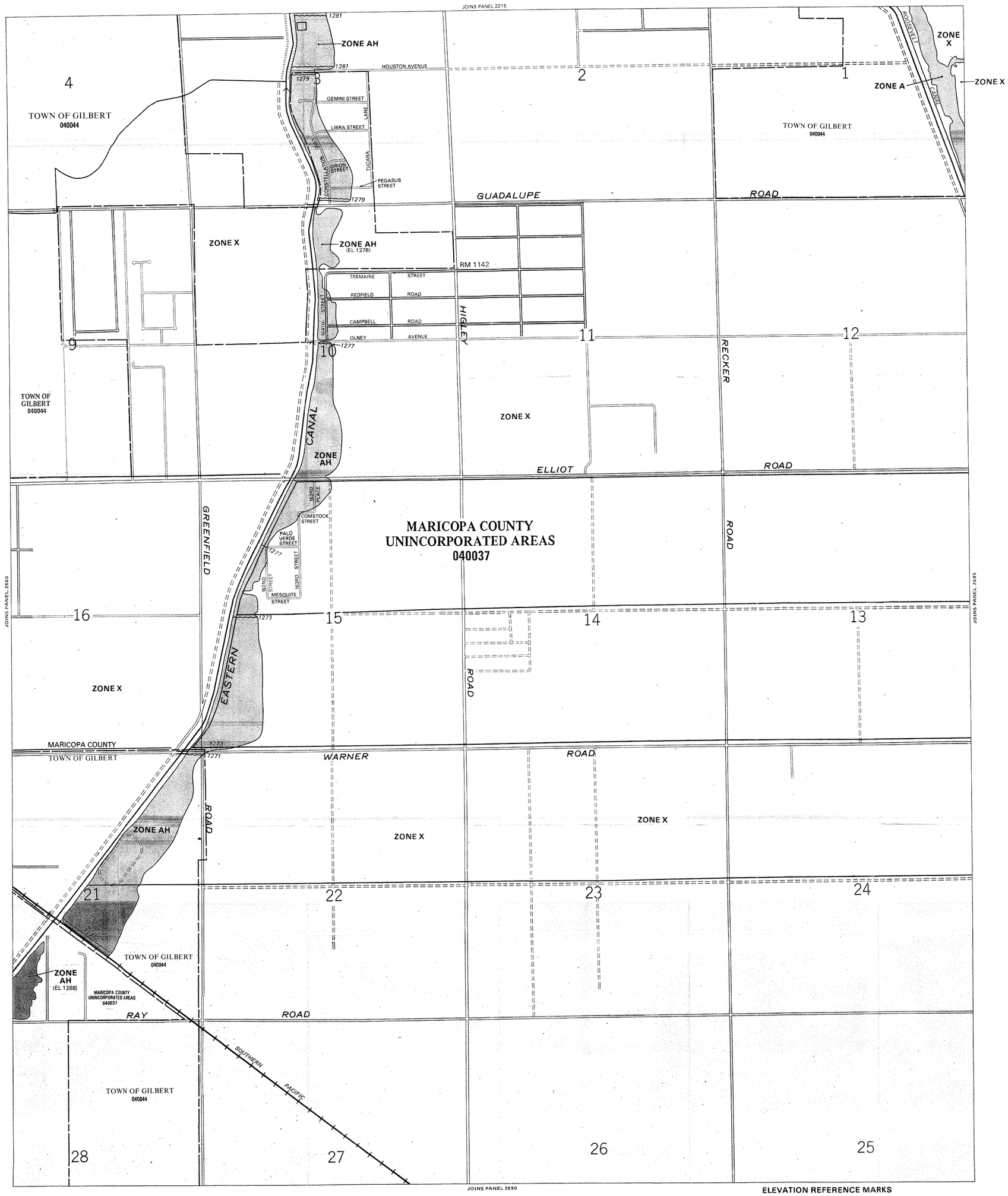
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BUCKEYE, TOWN OF	040039	2530	E
GOODYEAR, TOWN OF	040046	2530	E
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	2530	E

MAP NUMBER
04013C2530 E

MAP REVISED:
SEPTEMBER 4, 1991

Federal Emergency Management Agency



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 1 SOUTH, RANGE 6 EAST.

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM 1142	1286.45	Brass cap at the intersection of Tremaine Street and Higley Road.

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** — No base flood elevations determined.
- **ZONE AE** — Base flood elevations determined.
- **ZONE AH** — Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
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FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** — Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** — Areas determined to be outside 500-year flood plain.
- **ZONE D** — Areas in which flood hazards are undetermined.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones,

513 — Base Flood Elevation Line; Elevation in Feet*

D — D — Cross Section Line

(EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone*

$RM7_X$ — Elevation Reference Mark

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.

Areas of special flood hazard (100-year flood) include Zones A, A1-30, AE, AH, AO, A99, V, V1-30 AND VE.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Floodway widths are provided in the Flood Insurance Study Report.

Coastal base flood elevations apply only landward of the shoreline.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of the map.

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For adjoining map panels see separately printed Map Index

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APRIL 15, 1988

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Map revised DECEMBER 3,1993 to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to change special flood hazard areas, to change zone designations, to update map format, to add roads and road names, to reflect updated topographic information, and to incorporate previously issued letters of map revision.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 2680 OF 4350

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GILBERT TOWN OF	040044	2680	F
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	2680	F

MAP NUMBER
04013C2680 F

MAP REVISED:
DECEMBER 3, 1993

Federal Emergency Management Agency

4.0 LAND USE

4.1 87th Avenue Channel - Williams Road to Deer Valley Road

The western portion and the southeastern portion of the site are located in Maricopa County and zoned Rural-43. See Figure 4.1.1 for Zoning Map. The northeastern portion of the site is located in the City of Peoria and zoned R1-18. 100% of the surrounding land use is comprised of existing single family subdivisions. The site is within the City of Peoria Planning area and designated as low density residential. See Figure 4.1.2 for the City of Peoria Comprehensive Master Plan. There are three single family residential developments (Deer Village Units I-IV, Sunrise at Desert Mountain and Silverton) all zoned Planned Area Development (P.A.D.) between 83rd Avenue and 91st Avenue, south of Deer Valley Drive, currently being constructed. There is another single family residential development (Fletcher Heights) zoned P.A.D. east of 83rd Avenue north and south of Deer Valley Drive currently being developed.

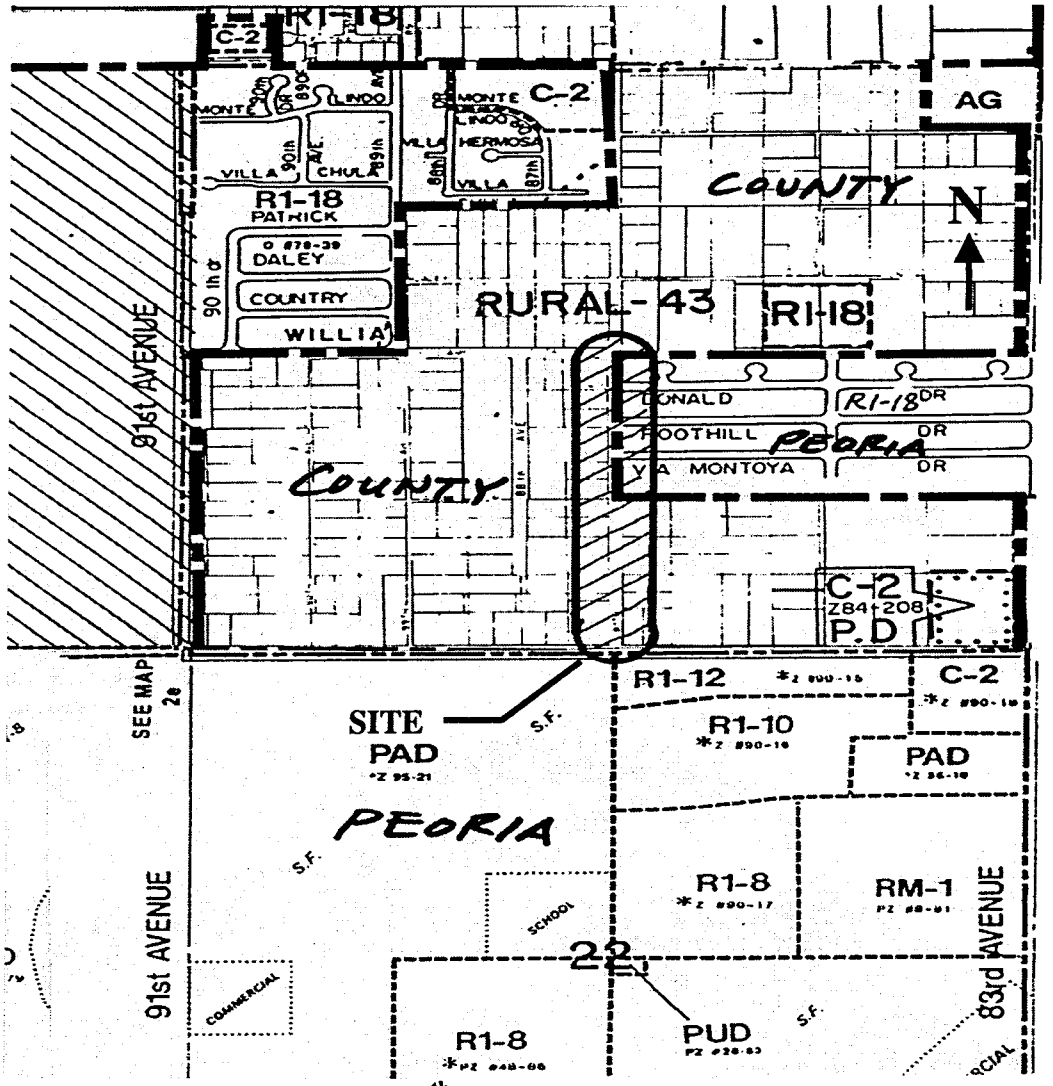


Figure 4.1.1 Zoning Map for 87th Avenue Channel

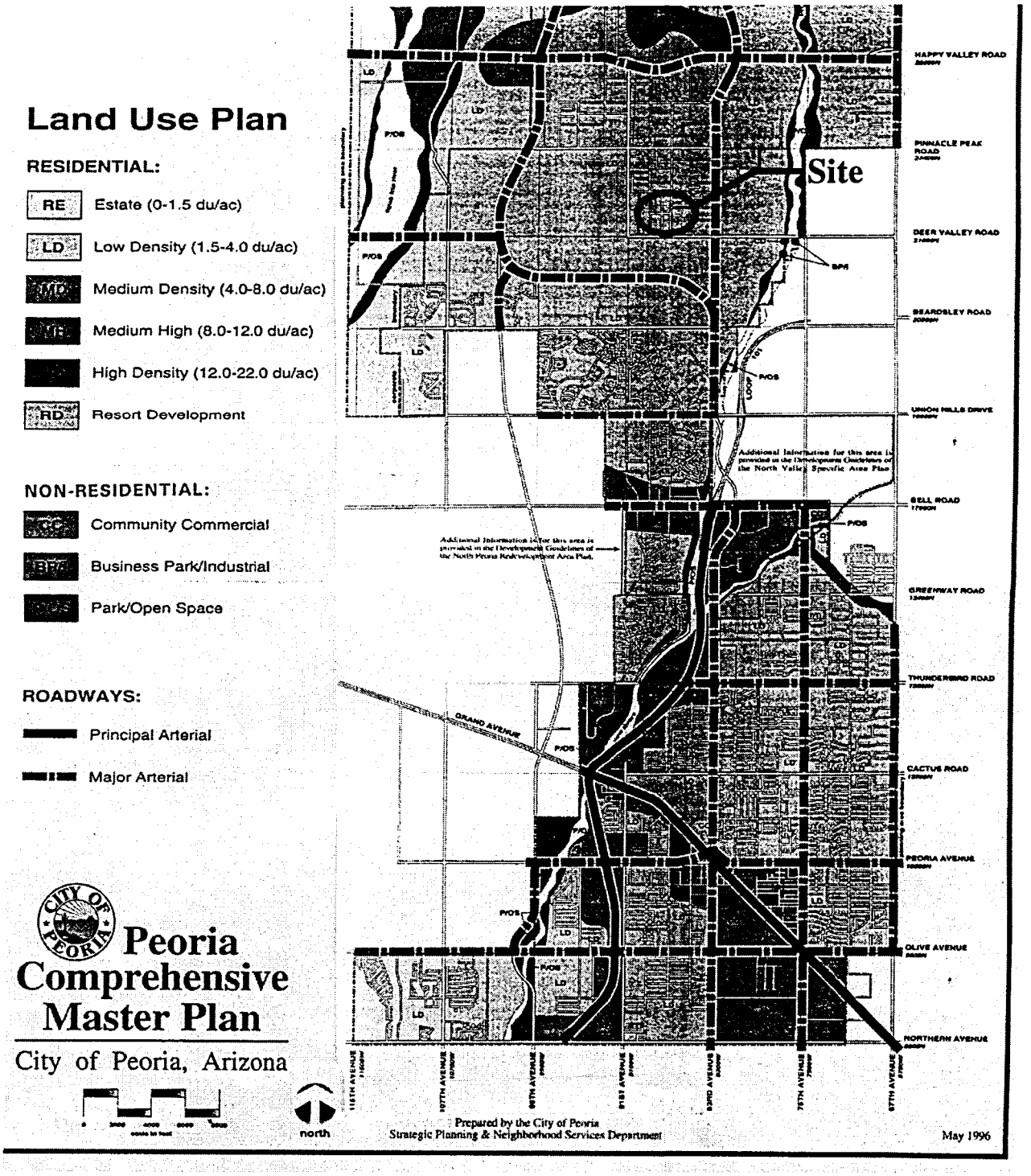


Figure 4.1.2 City of Peoria Comprehensive Master Plan

4.2 Ray Road Channel - Tuthill Road to Airport Road

The entire site is located in Maricopa County. Properties north of Ray Road between Airport Road and Garnet Road are zoned R1-35. Properties south of Ray Road and west of Airport Road are zoned Rural-43. The existing land use surrounding the site is 100% single family residential to the north, 100 % vacant open desert to the south, 100% residential north of Ray Road and East of Tuthill Road and 100% vacant desert to the east of Airport Road. According to the Maricopa County Planning Department, there are no current or planned developments in the immediate area. See Figure 4.2 for the Zoning Map.

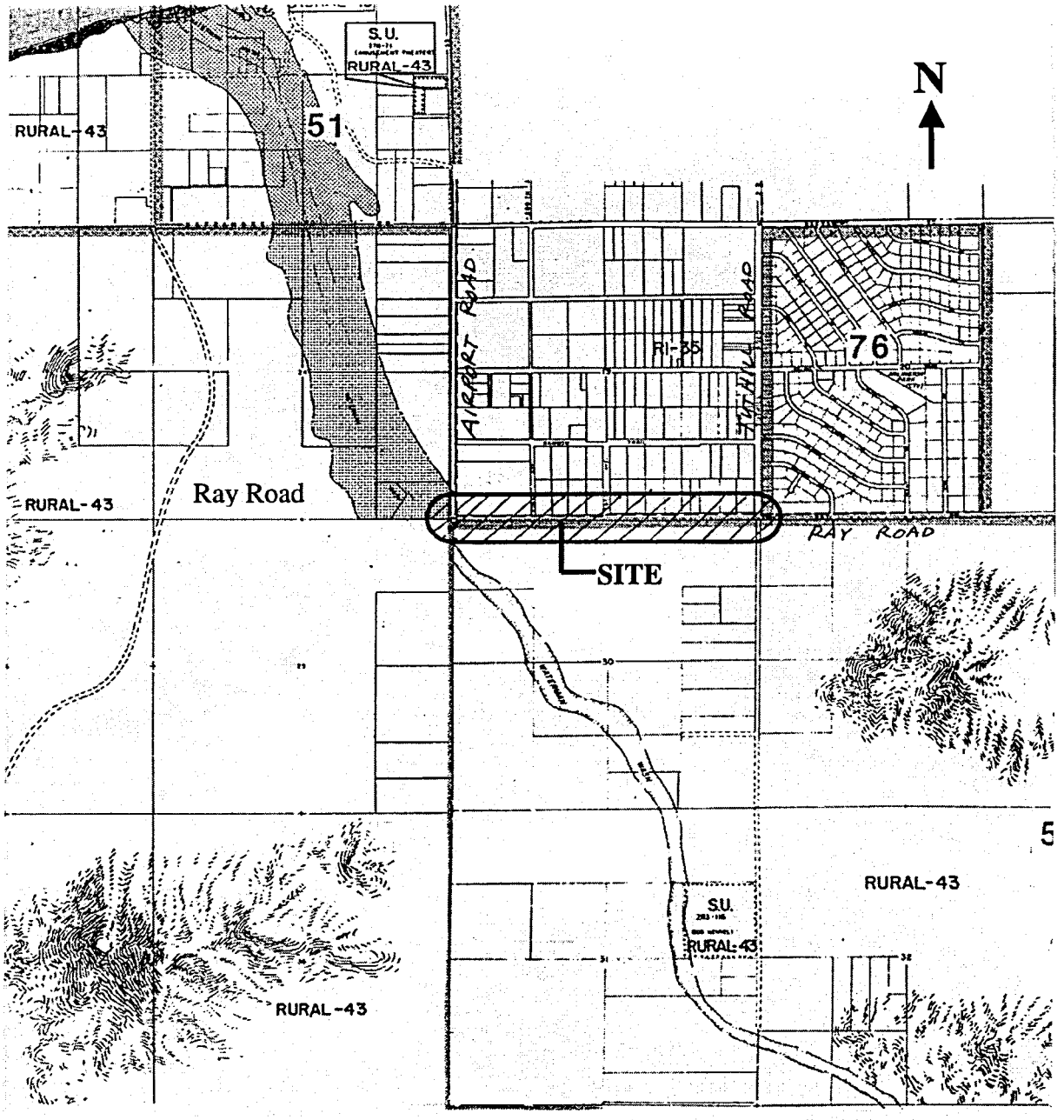


Figure 4.2 Zoning Map for Ray Road Channel

4.3 Guadalupe Road Channel at Eastern Canal:

The site is completely within the City of Gilbert. Adjacent zoning is as follows: South - R1-43; Northeast - R1-43; and Northwest - R1-20. See Figure 4.3.1 for the Zoning Map. The site is surrounded 100% by single family residential development. The City of Gilbert Land Use Plan designates this area as "Low Residential". See Figure 4.3.2 for the City of Gilbert Land Use Plan and Figure 4.3.3 for the City of Gilbert General Plan Summary Land Use Data. The City of Gilbert is in the process of developing a canal enhancement plan. The plan is completed for the Consolidated Canal but has yet to be prepared for the Eastern Canal. This plan may effect the design and development of any drainage structures at this location

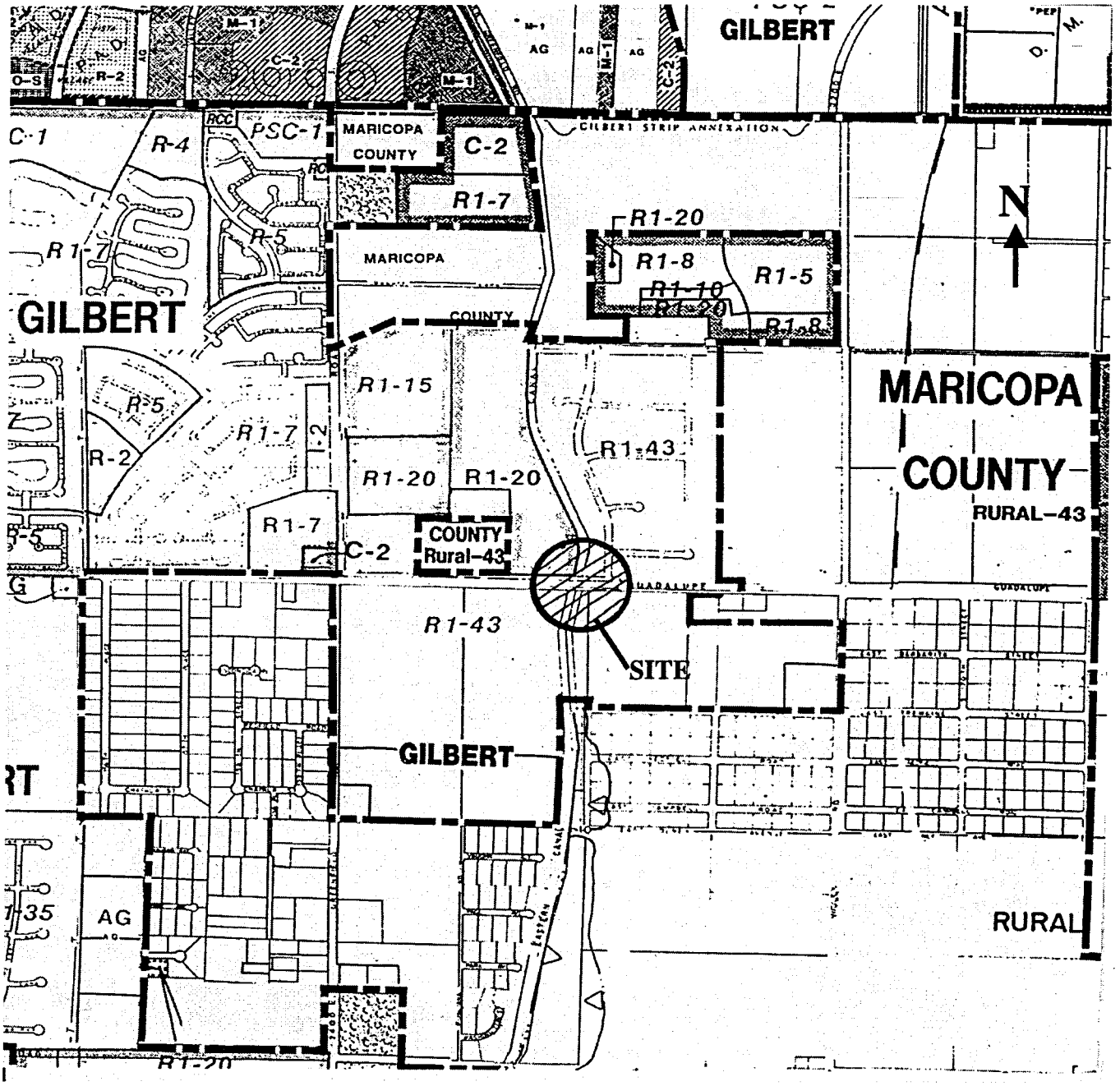


Figure 4.3.1 Zoning Map for Guadalupe Road Channel

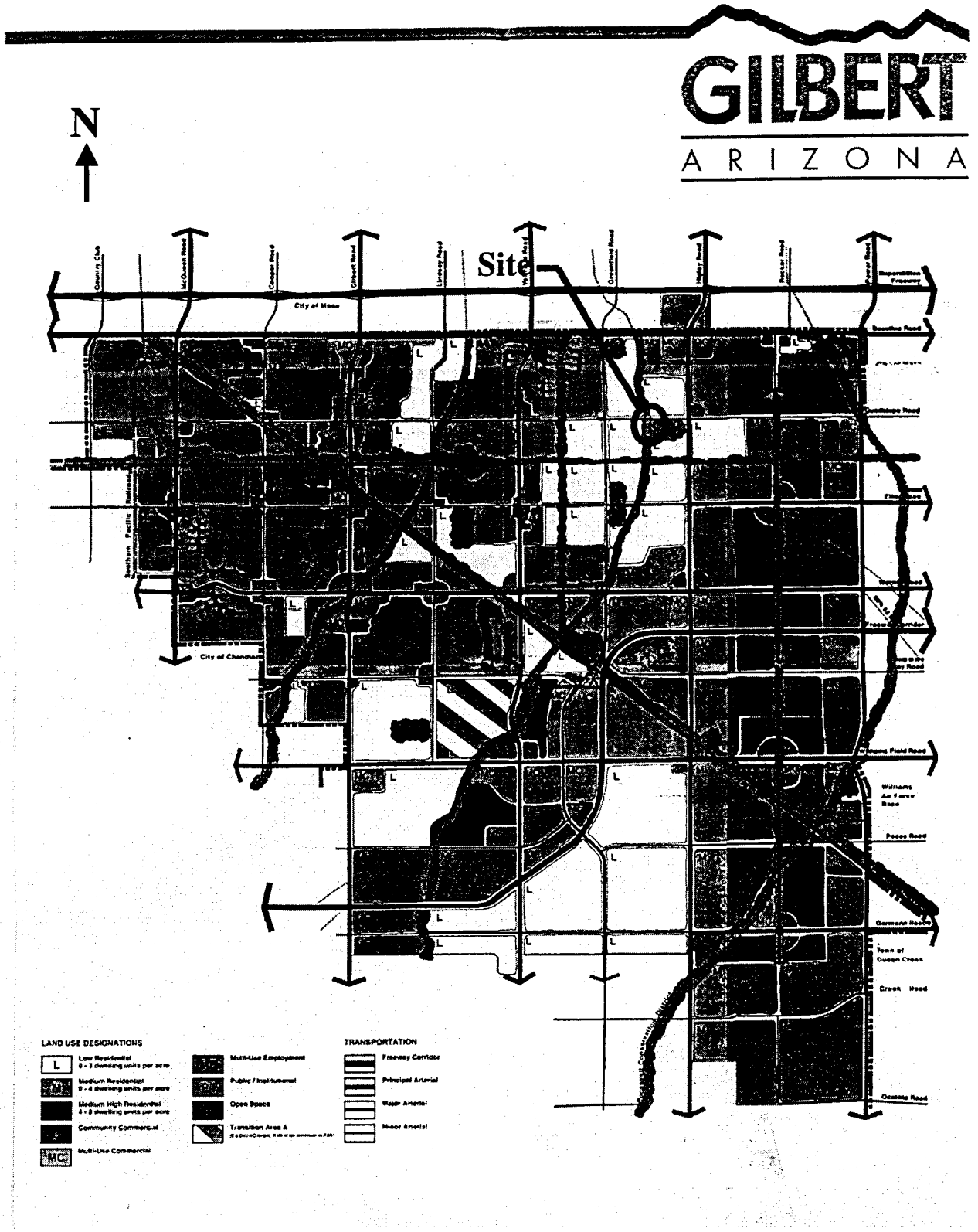


Figure 4.3.2 City of Gilbert Land Use Plan

Gilbert Planning Area

The Land Use Summary identifies planned land use classifications, gross acres, dwelling units and percentage of total land use for the Town of Gilbert General Plan. The table reflects land use assumptions for projected open space and the proportional mix of land uses within each multi-use classification.

LAND USE CLASSIFICATION	Planned Acres	Dwelling Units	% of Total
RESIDENTIAL			
L-Low (0-3 du/ac)	7,012	14,024	19.3%
M-Medium (0-4 du/ac)	13,603	45,741	37.5%
MH-Medium High (4-8 du/ac)	2,084	15,516	5.7%
H-High (8-22 du/ac)	1,528	18,336	4.2%
Residential Total (a)	24,227	93,617	66.7%
COMMERCIAL/EMPLOYMENT			
C-Community Commercial	2,055		5.7%
MC-Multi-Use Commercial	2,498		6.9%
ME-Multi-Use Employment	3,482		9.6%
Commercial and Employment Total (b)	8,035		22.2%
OPEN SPACE			
PL-Public Linkage (c)	485		
PP-Public Parks (d)	1,228		
POS-Project Open Space (e)	1,695		
GC-Golf Course (f)	630		
Open Space Total	4,038		11.1%
TOTAL	36,380		100%

(a) Residential acres less open space
(b) Commercial/Employment less 20% target for high density residential
(c) Estimated future open space along canal, railroad and transmission R-O-W's
(d) Estimated existing and future regional/district park allocation
(e) Estimated 7% of project related open space
(f) Estimated existing and future golf courses

Figure 4.3.3 City of Gilbert General Plan Summary Land Use Data

4.4 Chandler Heights Channel - Greenfield Road to Power Road

The entire site is located within Maricopa County and is zoned Rural -43 with the exception of the northwest and southwest corners of Power Road and Chandler Heights Road which are zoned C-3. Properties north of Chandler Heights Road are a mixture of single family residential and manufactured homes on large lots (17%) and agricultural uses (83%). See Figure 4.4.1 for the Zoning Map. The properties west of Higley Road will be annexed into the City of Gilbert at a future date, however this area is not currently included in the Gilbert General Plan. See Figure 4.3.2 for City of Gilbert Land Use Plan and Figure 4.3.3 for City of Gilbert General Plan Summary Land Use Data. The properties east of Higley Road will be annexed into the Town of Queen Creek at a future date. Properties east of Power Road are located in the Town of Queen Creek. The property at the northeast corner of Power Road and Chandler Heights Road is zoned C-2 - General Commercial and is developed with a convenience store. The property at the southeast corner of Power Road and Chandler Heights Road is zoned C-2 - General Commercial and is currently vacant. The remaining areas east of Power Road are zoned R-43 and are a mix of 40% residential and 60% agricultural uses. The Land Use designation for the properties east of Power Road are "Very Low Residential" which allows for 0-1 units per acre. The only current development being planned is named Greenfield Acres, a 32 lot single family one acre subdivision on 40 acres located at the southeast corner of Greenfield and Chandler Heights roads.

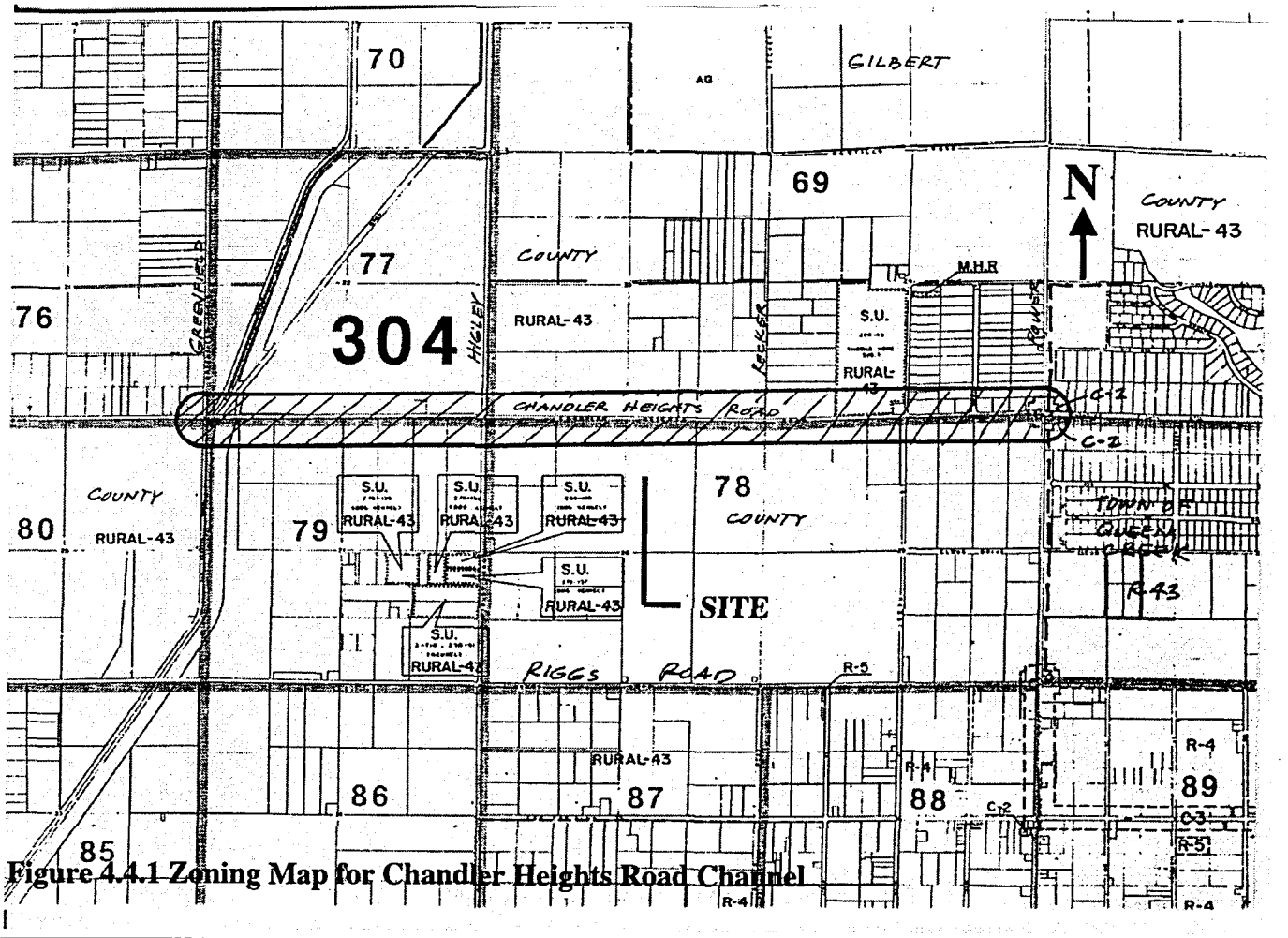


Figure 4.4.1 Zoning Map for Chandler Heights Road Channel

5.0 RIGHT-OF-WAY

Right-of-way calculations are included in the Appendix.

5.1 87th Avenue Channel - Deer Valley Road to Williams Road

The existing east right-of-way for 87th Avenue from Via Montoya Drive to Williams Road is 13.72 m (45 ft.) wide. The existing east right-of-way for 87th Avenue from Deer Valley Drive to Via Montoya Drive and the west right-of-way is 12.2 m (40 ft.) wide.

5.1.1 Full Cost Alternative

The full cost alternative will fit within the existing right-of-way.

5.1.2 Low Cost Alternative

The low cost alternative will fit within the existing right-of-way.

5.2 Ray Road Channel - Tuthill Road to Airport Road

The existing right-of-way for Ray Road is 22.86 m (75 ft.) wide and lies north of the Section Line, only.

5.2.1 Full Cost Alternative

For this alternative new right-of-way will be required on the south side of the Section Line for construction of the channel. The new right-of-way will be 22.86 m (75 ft.) wide and will be approximately 3.463 ha or 34,630 square meters (8.56 acres).

5.2.2 Low Cost Alternative

For this alternative, new right-of-way will be required on the south side of the Section Line for construction of the channel. The new right-of-way will be 28.041 m (92 ft.) and will be approximately 4.48 ha or 42,479 square meters (10.50 acres).

5.2.3 No Build Alternative

New right-of-way is recommended for the no build alternative to permit channel maintenance. The new right-of-way will be 22.86 m (75 ft.) wide and will be approximately 3.463 ha or 34,630 square meters (8.56 acres).

5.3 Guadalupe Road Channel at the Eastern Canal

The existing right-of-way for the eastern canal is 42.768 m (141 ft.) centered along the canal. The existing right-of-way for Guadalupe Road at the Eastern Canal is 20.12 m (66 ft.) wide. The existing roadway is centered in the right-of-way. At the Eastern Canal crossing, the right-of-way width is 16.76 m (55 ft.) to the south and 16.76 m (55 ft.) to the north.

5.3.1 High Cost Alternative

No new right-of-way will be required for this alternative.

5.3.2 Low Cost Alternative

No new right-of-way will be required for this alternative.

5.4 Chandler Heights Road Channel - Greenfield Road to Power Road

The existing north and south right-of-way for Chandler Heights Road from Greenfield Road to Recker road is 12.19 m (40 ft.). The north right-of-way from Recker Road to Power Road varies from 14.63 m (48 ft.) to 16.76 m (55 ft.), and the south right-of-way from Recker Road to Power Road varies from 10.06 m (33 ft.) to 12.19 m (40 ft.).

5.4.1 Full Cost Alternative

For this alternative, new right-of-way will be required to widen existing right-of-way to 36.27 m (119 ft.) south of the Section Line for the channel. The new right-of-way is estimated to be a total of 11.474 ha or 114,741 square meters (28.35 acres).

5.4.2 Low Cost Alternative

For this alternative, new right-of-way will be required to widen existing right-of-way to 35.05 m (115 ft.) south of the Section Line for the channel. The new right-of-way is estimated to be a total of 10.928 ha or 109,281 square meters (27.00 acres).

5.4.3 No Build Alternative

New right-of-way is recommended for the no build alternative to permit channel maintenance. The new right-of-way will be 22.86 m (75 ft.) wide and will be approximately 10.237 ha or 102,370 square meters (25.30 acres).

6.0 ENVIRONMENTAL INFORMATION

Two of the projects are located in rural areas of Maricopa County (Ray Road Channel and Chandler Heights Road Channel). The areas around 87th Avenue and Guadalupe Road Channel are in rapidly developing areas of low to moderate density homes. Natural desert is the predominate vegetation along Ray Road Channel and agricultural fields are along Chandler Heights Road.

Guadalupe Road and 87th Avenue are mostly disturbed areas with an exception on the north of the 87th Avenue project where a few native desert species are in the middle of the project right-of-way. Chilean mesquite, palo verde, and saguaro were identified as potentially being impacted by project actions along 87th Avenue, if the project continued north of Williams Road. A native plant permit will be necessary to remove those plants identified at the north end of 87th Avenue. An underground gas pipeline is located on the northeast corner of the Deer Valley Road and 87th Avenue intersection.

In the area of Ray Road, the areas along the western end of the channel have extensive head cutting and bank cutting form storm occurrences. At the extreme western end of this stretch, roadway safety has been jeopardized as the roadway is slowly being undermined and shoulder width narrowed with certain portions dropping off into the wash up to 3.4 m (11 ft.) in areas. Should action be required on the western end of this channel near the channel discharge into Waterman Wash the U.S. Army Corps of Engineer and the Arizona Department of Environmental Quality should be contacted for Section 404 Permit and Section 401 Certification of the Clean Water Act.

Three of the four projects, Guadalupe Road, 87th Avenue and Chandler Heights Road) will not produce any significant environmental impacts. The drainage improvement along Ray Road should be evaluated due to the proximity to Waterman Wash and the riparian habitat community. The potential for sensitive species needs to be evaluated with close communication with the Arizona Game and Fish Department and U.S. Fish and Wildlife Service. The U.S. Army Corps of Engineers may require the issuance of a Nationwide Permit.

The potential for sensitive resources exists and a cultural resource study in areas for each of the channels will be required to be evaluated for impacts. No hazardous waste sites or landfills are located within a mile radius of any of the four channels. Noise or dust emissions will not increase except for the short construction periods when dust control measures would be in effect.

7.0 DESIGN ALTERNATIVES

7.1 Project Meeting

DMJM met with MCDOT staff at the four project locations on December 10 and 11, 1997 to identify the existing problems, the proposed roadway and drainage design alternatives and to document existing conditions with video, photography and field measurements. Documentation of the field visits and are included in the Appendix. The alternatives discussed are presented in the following paragraphs.

7.2 Plan Views

Design Alternative Strip Maps are included in the Appendix.

7.3 Alternative Development

Table 7.3.1 through 7.3.4 shows the major design criteria used to develop each of the alternatives for each site.

Table 7.3.1 Major Design Criteria for 87th Avenue Channel

Future Typical Section:	Minor Urban Collector
Design Year:	2020
Design Load:	HS 20-44
Design Speed:	65 km/h (40 mph)
Pavement Design Life:	20 Years
Number of Lanes:	2 Lanes, 15.8 m (52 ft.) fact to face of curb
Drainage Structure Q_{100}: *Q_{10}:*	9.97 cms (352 cfs) 2.66 cms (94 cfs)
Standard Right-of-Way Requirements:	13.716 m (45 ft.) Minimum Each Side or 12.192 m (40 ft.) Each Side
Clear Zone Width:	2.4 m (8 ft.) – Rural Condition 1.0 m (3 ft.) – Urban Condition

Table 7.3.2 Major Design Criteria for Ray Road Channel

Future Typical Section:	Urban Minor Arterial
Design Year:	2020
Design Load:	HS 20-44
Design Speed:	90 km/h (55 mph)
Pavement Design Life:	20 Years
Number of Lanes:	4 Lanes with Continuous Left Turn Lane
Drainage Structure Q_{50}:	20.3 cms (717 cfs)
Q_{10}:	10.6 cms (376 cfs)
Standard Right-of-Way Requirements:	16.768 m (55 ft.) Minimum Each Side
Clear Zone Width:	9.2 m (30 ft.) – Rural Condition 1.0 m (3 ft.) – Urban Condition

Table 7.3.3 Major Design Criteria for Guadalupe Road Channel

Future Typical Section:	Urban Minor Arterial
Design Year:	2020
Design Load:	HS 20-44
Design Speed:	90 km/h (55 mph)
Pavement Design Life:	20 Years
Number of Lanes:	4 Lanes with Continuous Left Turn Lane
Drainage Structure Q_{100}:	8.98 cms (317 cfs)
Standard Right-of-Way Requirements:	16.768 m (55 ft.) Minimum Each Side
Clear Zone Width:	9.2 m (30 ft.) – Rural Condition 1.0 m (3 ft.) – Urban Condition

Table 7.3.4 Major Design Criteria for Chandler Heights Road Channel

Future Typical Section:	Urban Minor Arterial
Design Year:	2020
Design Load:	HS 20-44
Design Speed:	90 km/h (55 mph)
Pavement Design Life:	20 Years
Number of Lanes:	4 Lanes with Continuous Left Turn Lane
Drainage Structure Q_{100} (Future): *Q_{10} (Existing):*	12.74 cms (450 cfs) 9.77 cms (345 cfs)
Standard Right-of-Way Requirements:	16.768 m (55 ft.) Minimum Each Side
Clear Zone Width:	9.2 m (30 ft.) – Rural Condition 1.0 m (3 ft.) – Urban Condition

7.3.1 87th Avenue Channel – Deer Valley Road to Williams Road

South of Deer Valley Drive the runoff is conveyed south using the full right-of-way cross section and a 9.11 m (30 ft.) drainage easement containing a shallow trapezoidal channel. The western properties in the project area north of Deer Valley Drive were checked to determine if there was at least 18 m (59.06 ft) available in the front or side yards for a drainage easement and allow sufficient property line setbacks. Approximately half of the properties on the west side of 87th Avenue would require acquisition as the main structures would be impacted. This alternative was rejected because the property acquisition, relocation and demolition would approach $3 million.

A closed conduit system to convey either the 100-year or the 10-year runoff was rejected due to the shallowness of the down stream channels south of Deer Valley Drive.

The preferred alternative is to provide an open channel on the west side of 87th Avenue, sized to convey the runoff entering the project area south to Deer Valley Drive. The most efficient cross section is a concrete lined "U" channel adjacent to the western right-of-way line which will cross Deer Valley Drive with a RCBC. Driveway access to each property will use a RCBC. The channel is extended north of the abandoned irrigation canal and will include an inlet and access grate to drain this area. A protective pedestrian railing/fence along the channel is provided for safety reasons.

7.3.1.1 Full Cost Alternative

This alternative conveys the 100-year peak discharge of 10.0 cms (353 cfs) by means of a 1.219 m by 6.096 m (4 ft. by 20 ft.) concrete lined "U" channel extending from north of the abandoned irrigation ditch on Williams Road to south of Deer Valley Road. In the interim, prior to developing 87th Avenue to its ultimate cross section, that section of unpaved roadway south of Via Montoya Drive will be relocated from the west side of the monument line to the east side and the power pole alignment can remain in place. When 87th Avenue is constructed to its ultimate cross section. The roadway centerline must be shifted east by 1.83 m (6 ft.) to allow sufficient clearance between the concrete lined channel and the curb line. It is suggested that he power poles be relocated to the west side of the channel at this time. The reinforced box culverts under the driveways and Deer Valley Road are sized to match the widths and depths of the channel. Roadway alignment transitions at the north and south ends of the project are required to match the roadways outside the project limits. Refer to Figures 7.3.1.1.1, 7.3.1.1.2 and 7.3.1.1.3 for cross section for 87th Avenue for existing, interim and ultimate conditions.

7.3.1.2 Low Cost Alternative

This alternative conveys the 10-year peak discharge of 2.67 cms (94 cfs) by means of a 1.067 m by 1.524 m (3.5 ft by 5 ft) concrete lined "U" channel. All elements of the high cost alternative are the same for this alternative . A trapezoidal channel with 1:1 side slopes was investigated and rejected due to poor hydraulic (unstable flow) performance.

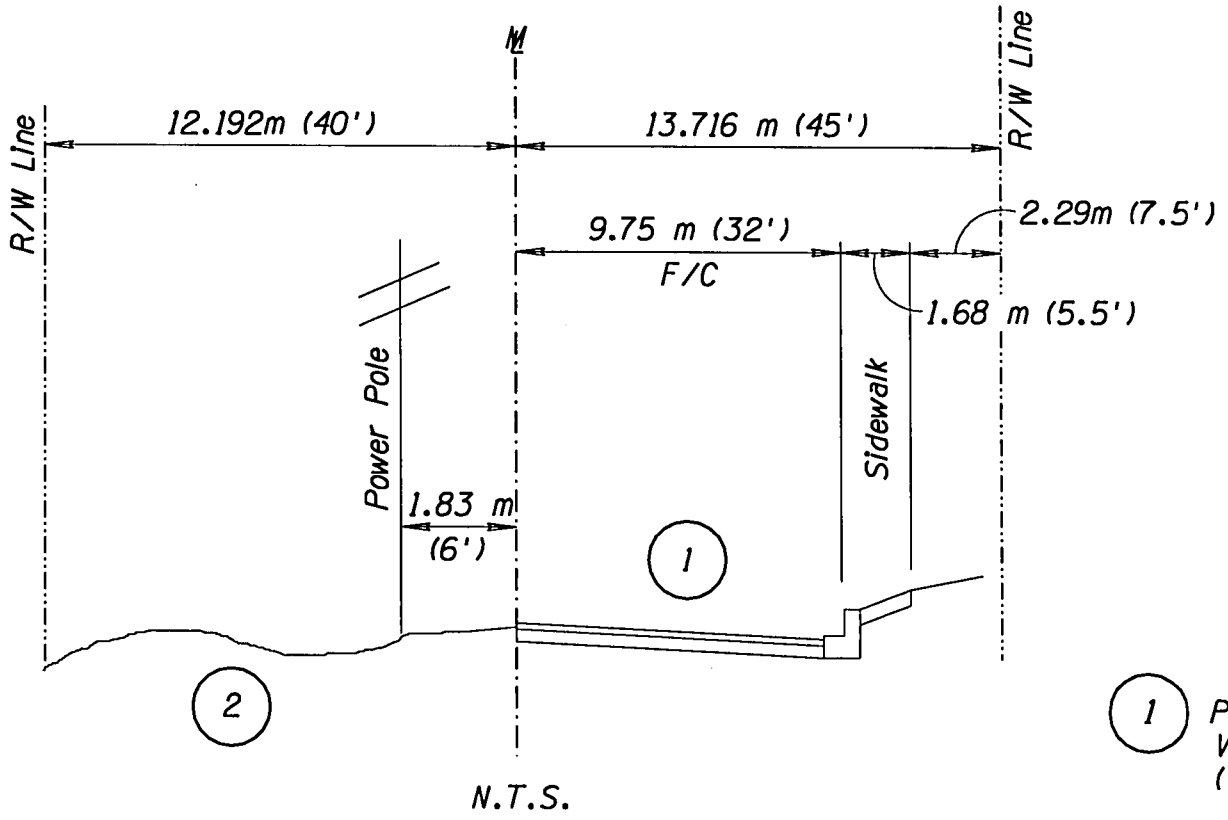
7.3.2 Ray Road Channel – Tuthill Road to Airport Road

7.3.2.1 Full Cost Alternative

For this alternative, a new 2.04 m (6.7 ft.) deep, trapezoidal gabion lined channel with a bottom width of 2.44 m (8ft.) is proposed beginning at the downstream end of Tuthill Road and outletting into Waterman Wash. The channel design conveys the estimated 50-year peak discharge allowing for 0.30 m (1.0 ft.) of freeboard. Box culverts, that are two barrels of 2.4 m by 2.13 m by 4.88 m (8 ft. by 7 ft. by 16 ft.) are required at each crossing to keep the flood flows within the channel. Low-flow pipes with fords force the stormwater out of the channel due to outlet control conditions. Figure 7.3.2.1 shows a typical section for the Full Cost Alternative.

Four design options were evaluated for the full cost alternative (see Channel Design Spreadsheet in Drainage Calculations in the Appendix). The design option selected (for both alternatives) was based on optimizing the total cost using a preliminary cost estimate. The evaluation was based on the costing of right-of-way, channel excavation and drop structures.

EXISTING CONDITIONS 87TH AVENUE/ DEER VALLEY ROAD TO WILLIAMS ROAD



1 Paved (1/2 Street) Between Via Montoya Drive and William Road (± 1/4 Mile).

2 Gravel (1/2 Street) Between Deer Valley Road and Via Montoya (± 1/4 Mile). Right of Way Is 80'

Figure 7.3.1.1.1

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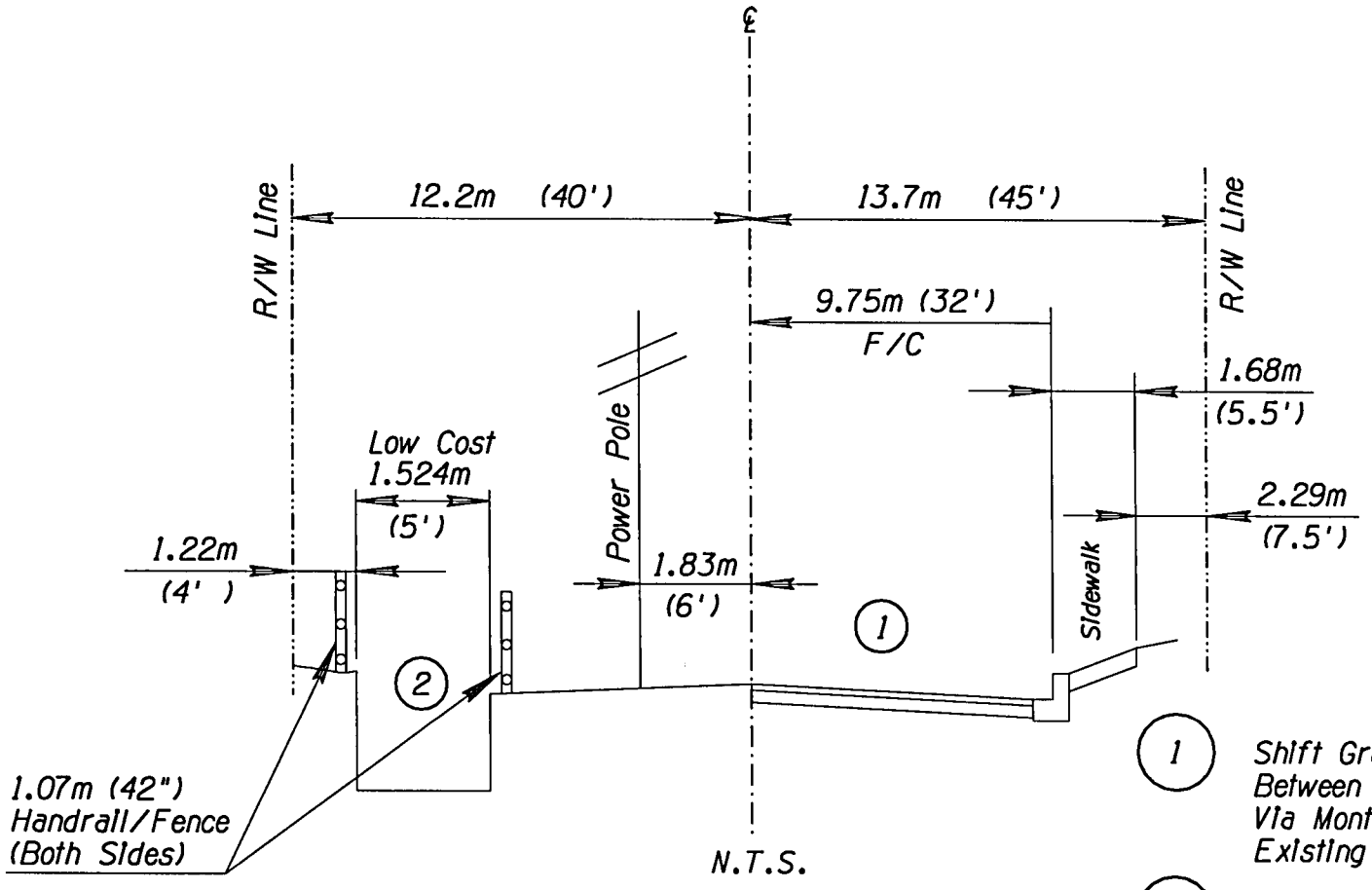
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION

PROJECT NO. 6597.03
BY BAL
DATE 2-12-98
SHEET NO.

INTERIM CONDITION - ALTERNATIVE 87TH AVENUE/ DEER VALLEY ROAD TO WILLIAMS ROAD



(1) Shift Gravel Road To East Side Between Deer Valley Road and Via Montoya Drive and Tie Into Existing Paved Road.

(2) Construct Concrete "U" Channel:
Low Cost - 1.524m x 1.067
(5'x3.5') Q_{10} =2.66cms (94 cfs).
Full Cost - 6.096m x 1.219m
(20' x 4') Q_{100} =9.97cms (352 cfs).

Figure 7.3.1.1.2

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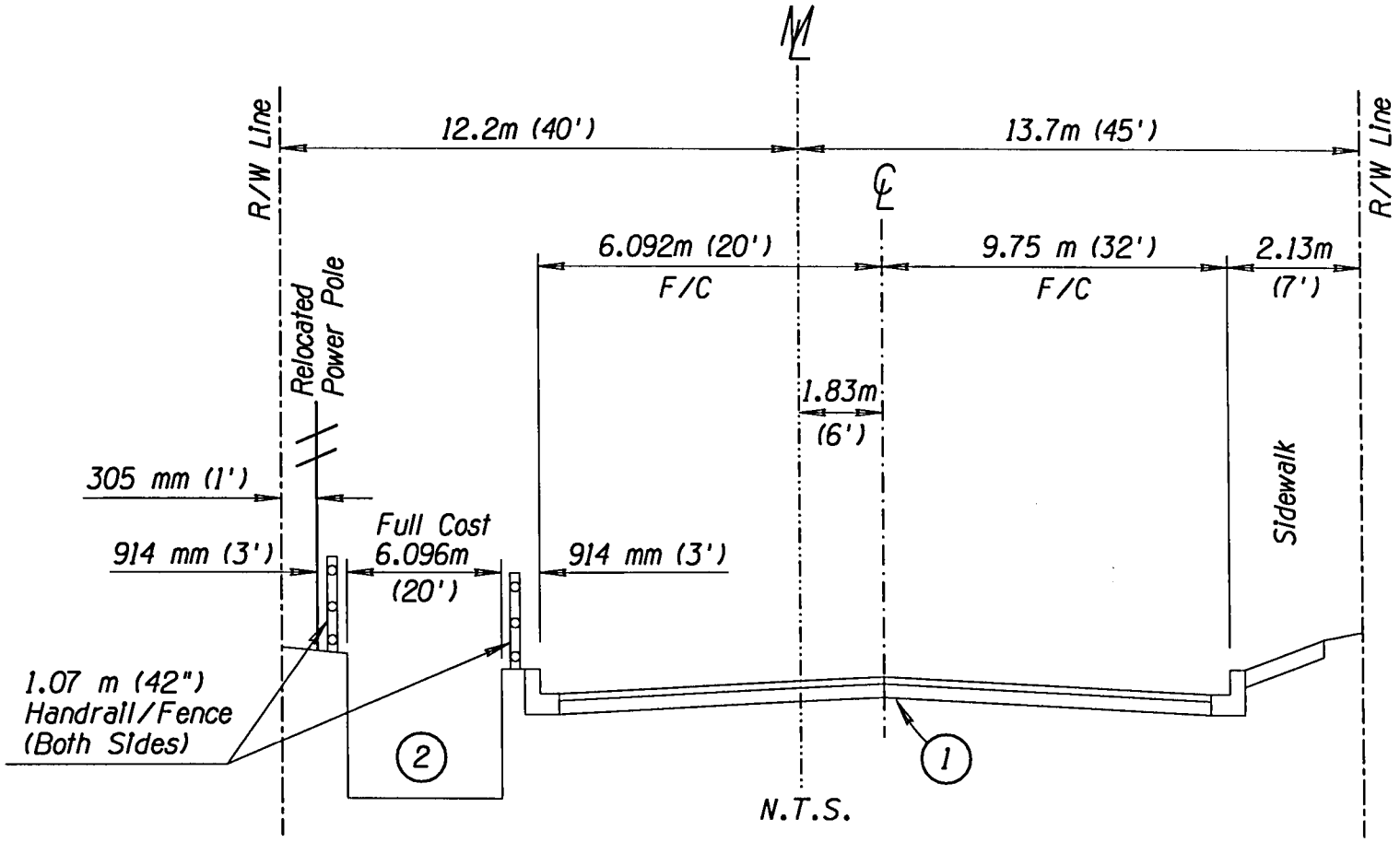
ULTIMATE CONDITION- 87TH AVENUE/DEER VALLEY ROAD TO WILLIAMS ROAD



(1) *87th Avenue Realigned 1.83 m (6') East of Monument Line Between Deer Valley Road & Williams Road and Reconstructed to Full Width*

(2) *Construct Concrete "U" Channel:*
Low Cost - 1.524m x 1.067 (5'x3.5') Q_{10} =2.66cms (94 cfs).
Full Cost - 6.096m x 1.219m (20' x 4') Q_{100} =9.97cms (352 cfs).

Figure 7.3.1.1.3

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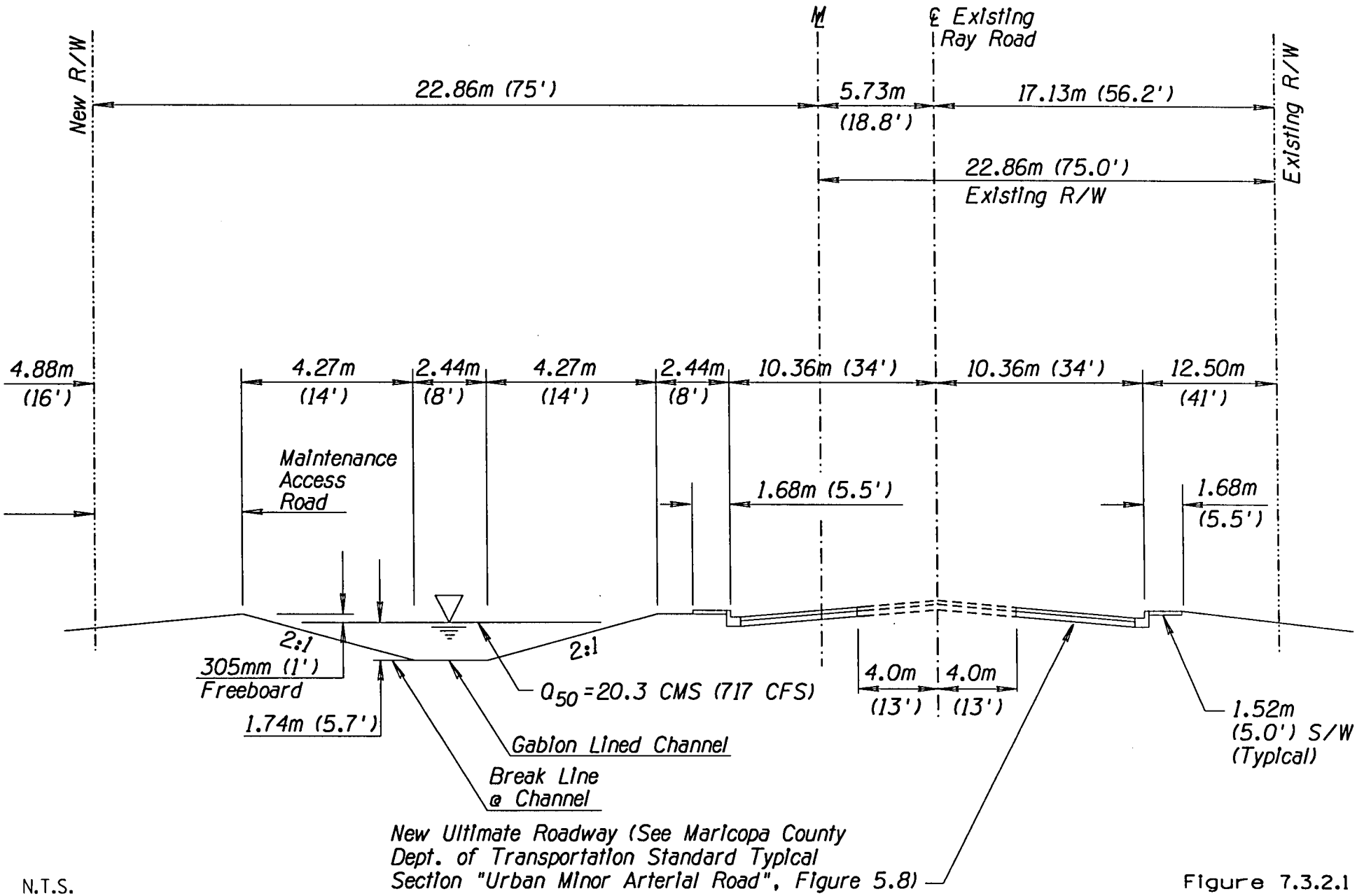
RAY ROAD FULL COST ALTERNATIVE (50-YEAR SOLUTION)



N.T.S.

Figure 7.3.2.1

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7.3.2.2 Low Cost Alternative

For this alternative, a new 1.95 (6.4 foot) deep, earthen 'vee' channel will be constructed beginning at the downstream end of Tuthill Road and outletting into Waterman Wash. The channel will be located at an offset south of the existing roadway to allow for construction of the future ultimate roadway. The channel design conveys the estimated 10-year peak discharge allowing for 0.30 m (1.0 ft.) of freeboard. The slope of the channel is shallow to reduce the velocity of flow. This will prevent erosion and will eliminate the need for bank protection. To make up the difference between the existing slope and design slope, six 0.91 meter (3.0 foot) rip-rap drop structures will be constructed. Figure 7.3.2.2 shows a typical section for the Low Cost Alternative. The five new concrete driveways spanning the new channel have a recommended width of 4.88 m (16.0 ft.), an elevation equal to approximately 0.30 m (1.0 ft.) below the design water surface elevation. The downstream bank of each driveway will require erosion protection. A new crossing is also recommended at Tuthill Road with the same capacity as the driveway crossings.

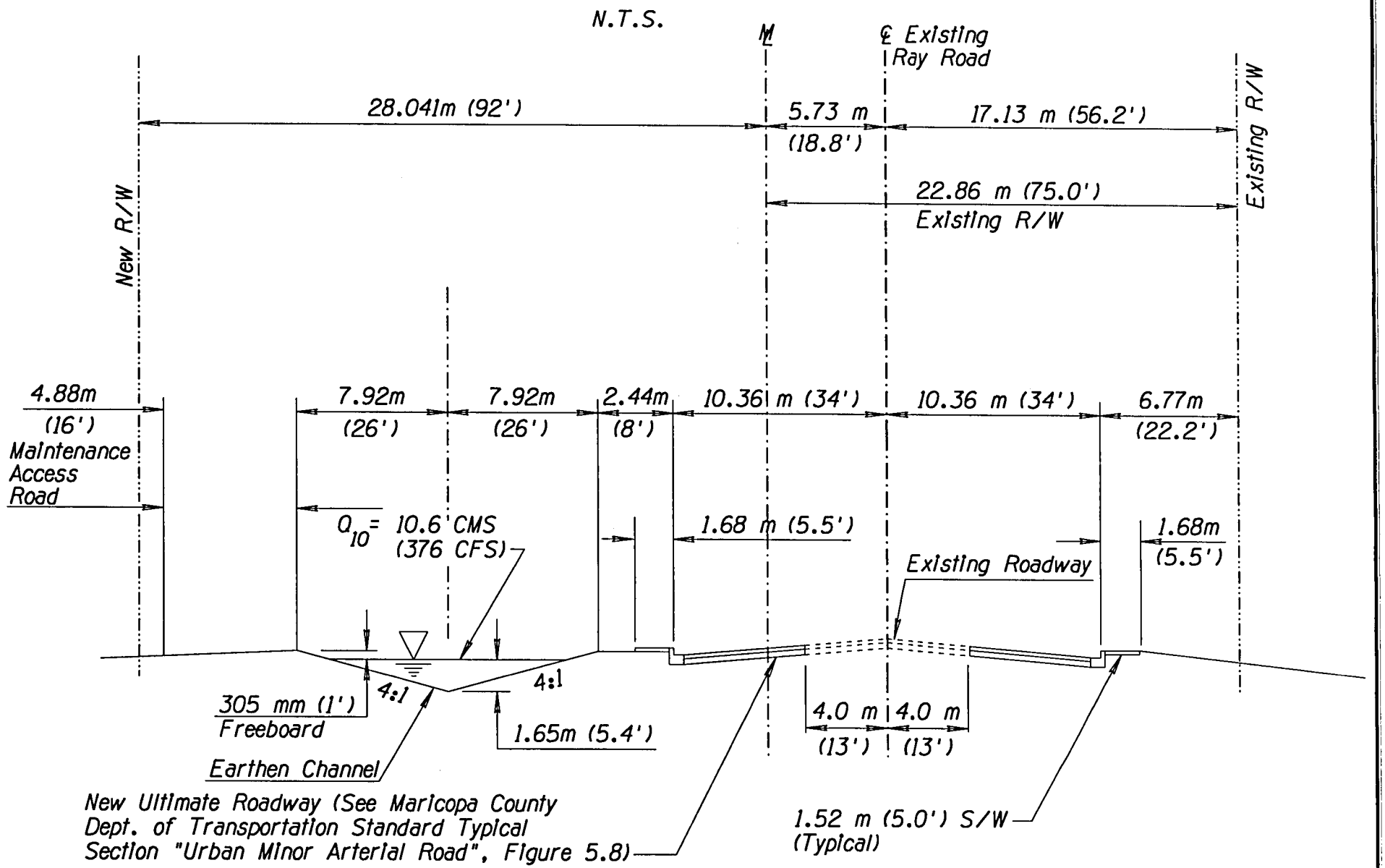
7.3.2.3 No-Build Alternative

There are several base issues needing to be addressed at the Ray Road channel. Channel clearing, grading and excavation to match the upstream section geometry needs to be done on the existing channel from a ¼ mile west of Tuthill Road for 152 meters (500 feet) to the west. The five existing driveway dip crossings need upstream and downstream erosion protection. Existing guardrail along the west edge of the curve at Airport Road and Ray Road needs to be replaced. New guardrail needs to be installed along the south side of Ray Road beginning at the ½ mile to Airport Road. It is recommended that 22.86 m (75 ft.) of right-of-way be purchased south of the Section Line to ensure that the existing channel can be maintained. The existing roadway may continue to scour which can add additional repair costs in the future. The existing channel needs erosion protection at Waterman Wash to protect Ray Road.

7.3.3 Guadalupe Road Channel at the Eastern Canal

Guadalupe Road at the Eastern Canal impounds storm water behind the roadway and irrigation canal embankments. The impounded storm water results in flood damage to the White Fence Farms subdivision north of Guadalupe Road. It was assumed that a concrete lined channel could convey the 100-year flood within the Eastern Canal right-of-way to a proposed RCBC crossing Guadalupe Road. The FIS hydrologic model indicates that the local contributing area and the off-site contributing areas do not have coincident peaks. Therefore, a system was devised which separates the on-site and off-site stormwater. It is recommended that a Design Concept Report be undertaken to define the full solution due to the complexity of the hydrologic analysis. Figures 7.3.3.1 and 7.3.3.2 show the typical sections for both existing conditions and for the Full Cost Alternative.

RAY ROAD LOW COST ALTERNATIVE (10-YEAR SOLUTION)



N.T.S.

Figure 7.3.2.2

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GUADALUPE ROAD AT THE EASTERN CANAL
EXISTING CONDITIONS
(LOOKING NORTH)

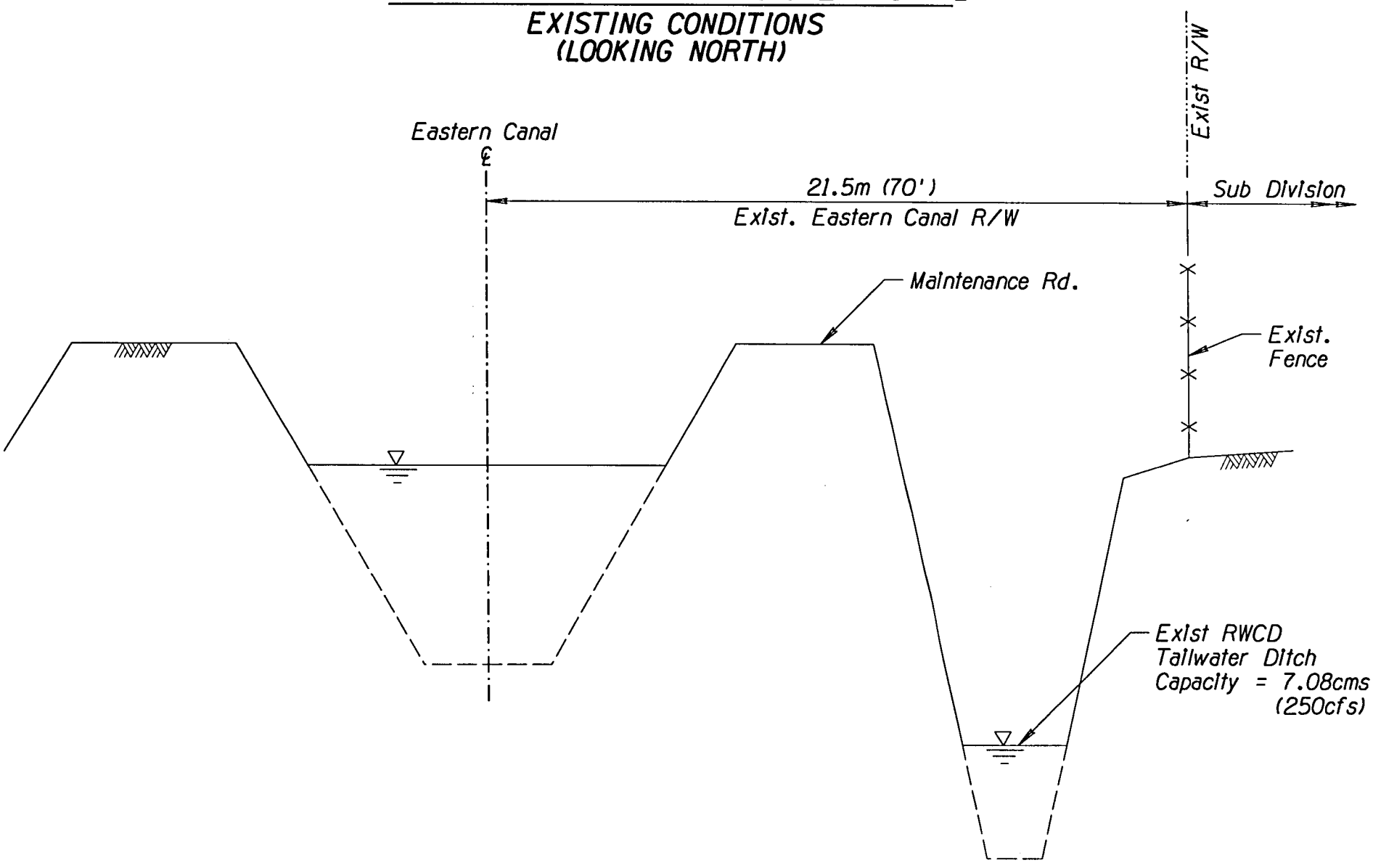

Figure 7.3.3.1

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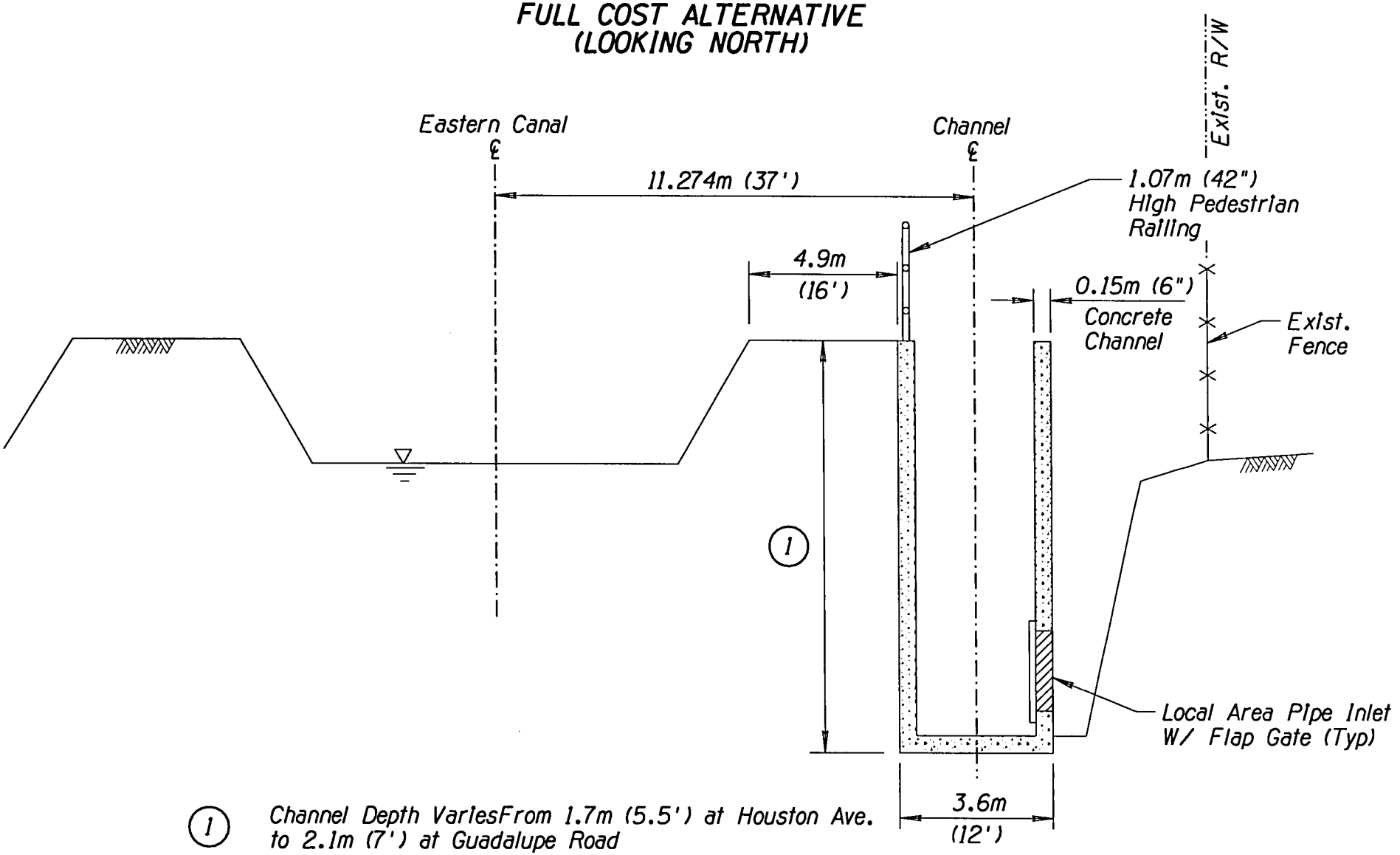
GUADALUPE ROAD AT THE EASTERN CANAL
FULL COST ALTERNATIVE
(LOOKING NORTH)



(1) Channel Depth VariesFrom 1.7m (5.5') at Houston Ave. to 2.1m (7') at Guadalupe Road

Figure 7.3.3.2

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DATE 2-12-98

SHEET NO.

7.3.3.1 Full Cost Alternative

The full cost alternative uses a concrete "U" channel with a pedestrian railing from Houston Road to Guadalupe Road. The channel is estimated to be 3.66m (12 ft.) wide with a depth varying from 1.7 m to 2.1 m (5.5 to 6 ft.). The concrete channel would be approximately 805 m (2640 ft.) in length. A 24.4 m (80 ft.) channel transition would be required upstream of Guadalupe Road to convey the stormwater to a two barrel 3.0 m by 1.2 m (10 ft. by 4 ft.) RCBC. The RCBC would be approximately 26.8 m (88 ft.) long. It is assumed that a portion of the outflows from the culvert would be diverted to the existing detention basin constructed by the City of Gilbert. It appears that the entire facility could be constructed within the Eastern Canal right-of-way. It was assumed that the east bank of the Eastern canal could be limited to 4.88 m (16 ft.) when the new channel was sited. The channel centerline is proposed to offset the Eastern Canal centerline by 11.3 m (37 ft.). Maintenance of the channel would be from the Eastern Canal's maintenance road. Construction of this facility would require community support, and cooperation with the RWCD, Salt River Project, and the City of Gilbert.

In addition to the concrete lined channel, local area drains would be required to drain stormwater generated by the subdivision to the new channel. These area inlets would require flapgates to prevent back flow during peak flood wave from the off-site contributing area. Dynamic hydrologic and hydraulic routing will be required for final design to confirm the applicability of this concept.

7.3.3.2 Low Cost Alternative

The low cost alternative is the two barrel 1370 mm (54 inch) pipe crossing proposed by the City of Gilbert as a part of Roadway Improvements, Greenfield Road and Guadalupe Road Project No. 96342. These pipes are sized mostly for the tailwater irrigation flows at Guadalupe Road but are significantly larger than the existing two barrel 910 mm (36 inch) pipes at the crossing for the tailwater ditch. No cost is associated with the low cost alternative for MCDOT.

7.3.4 Chandler Heights Road Channel – Greenfield Road to Power Road

The existing Chandler Heights Road is a paved two lane roadway north of the Section Line. It was assumed that the ultimate roadway section would be centered on the Section Line. The distance from the section line to the back of sidewalk was assumed to be 11.95 m (39.5 ft.). The center of the channel was calculated to be 21.7 m (71 ft.). A qunite lined 1.2 m (4 ft.) wide by 0.6 m (2 ft.) deep low-flow channel is recommended for either alternative to convey irrigation tailwater to the EMF. According to the Santan Irrigation District approximately 0.14 cms (5 cfs) to 0.28 cms (10 cfs) tailwater flows within the drainage facility. The low-flow lined channel should reduce the maintenance costs associated with the tailwater. The alternatives assume that the properties south of the channel will be provided access to Chandler Heights Road. Figures 7.3.4.1 and 7.3.4.2 show existing and ultimate typical sections.

At the EMF a new development (Greenfield Acres) will construct a new channel along Chandler Heights Road to convey 14.16 cms (500 cfs). It was assumed that the proposed

CHANDLER HEIGHTS DRAINAGE CHANNEL
EXISTING ROADWAY
(LOOKING EAST)

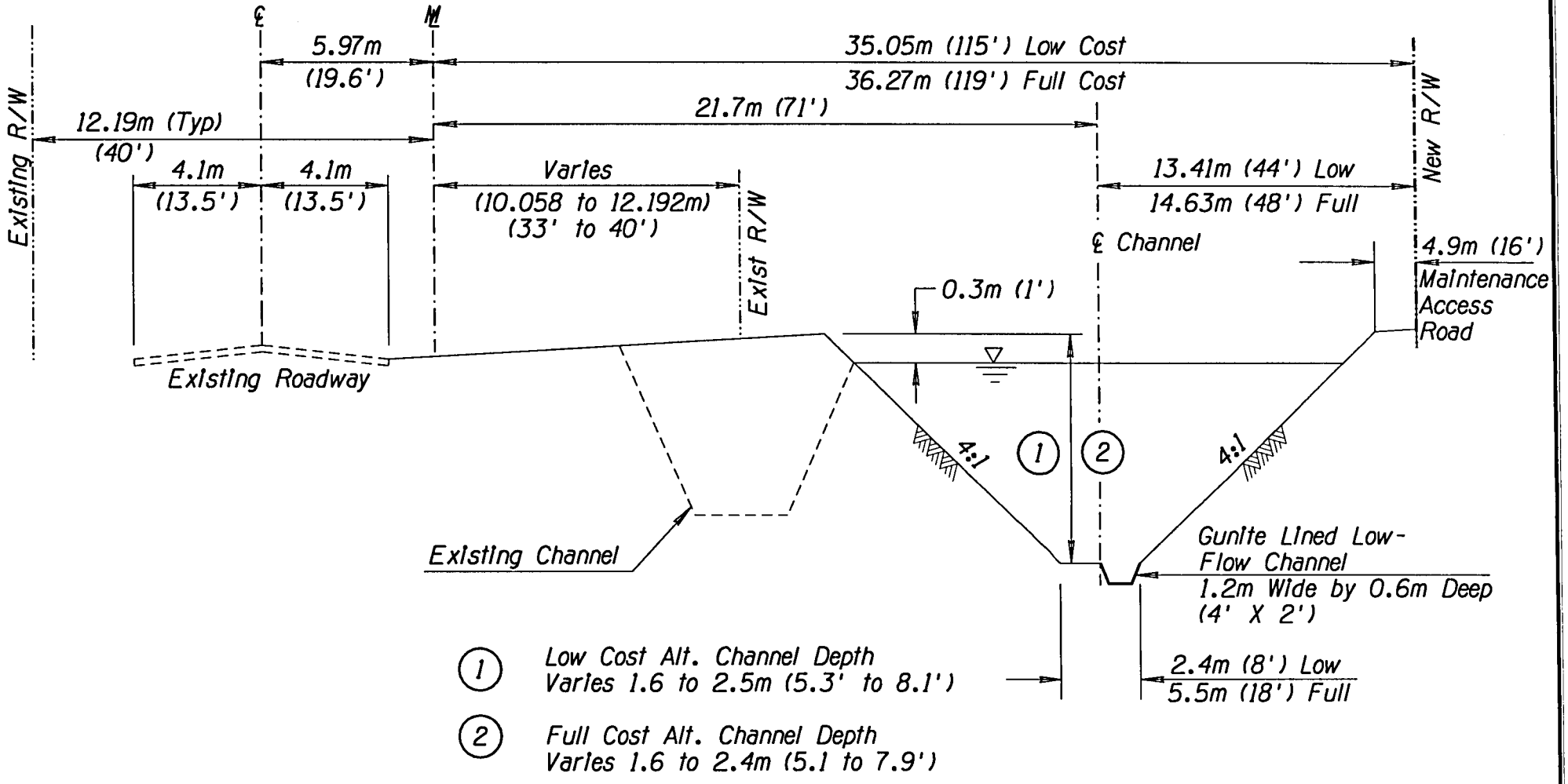

Figure 7.3.4.1

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CHANDLER HEIGHTS DRAINAGE CHANNEL
ULTIMATE ROADWAY
(LOOKING EAST)

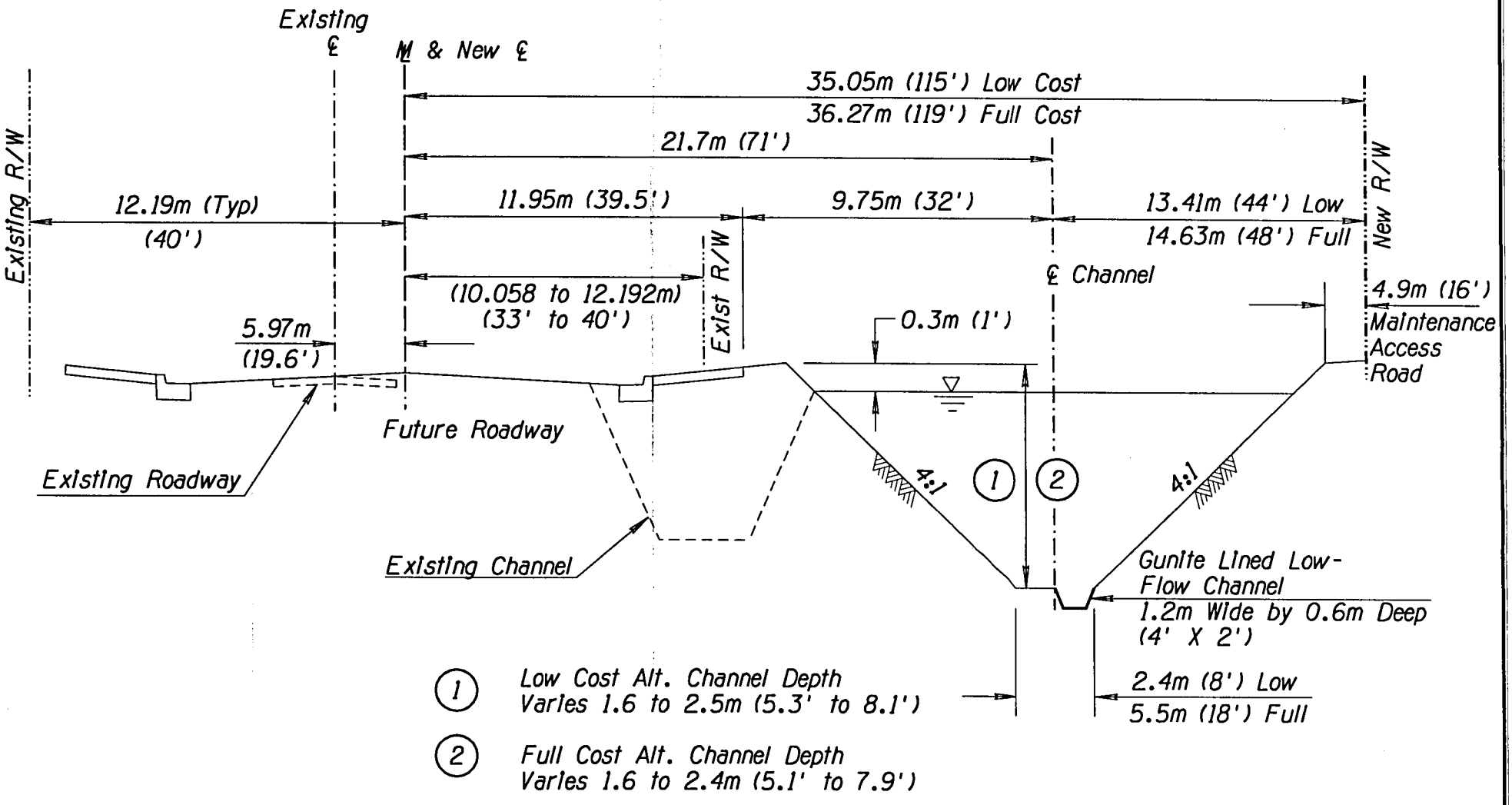

Figure 7.3.4.2

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alternatives would convey no more storm water than the Greenfield Acres channel could convey. The proposed channel was estimated to be 4563 m (14,970 ft.) in length.

7.3.4.1 Full Cost Alternative

The high cost alternative uses an earthen channel to convey the future 100-year, 24-hour storm event peak discharge of 12.74 cms (450 cfs). The earthen channel was designed at a 0.0008 m/m slope to keep the velocities at or below erodable levels 0.99 m /sec (3.25 fps). The typical channel section is trapezoidal in shape with a 5.5 m (18 ft.) bottom and 1:4 side slopes. The average channel depth would be 1.6 m (5.1 ft.). Riprap grade control structures would be required at quarter mile intervals. New right-of-way would be required for 36.27m (119 ft.) south of the section line for the channel. The location of the channel south of the section will preclude the need for guardrail adjacent to the channel in the interim condition. However, guardrail will be required at the beginning of the project near the Power Road intersection. It should be noted that the channel depth or width could be reduced upstream of Higley Road to correspond with the variation in discharge along Chandler Heights Road. Upstream cross-section modifications were assumed to be final design details.

The driveway and low flow crossing are proposed to be designed using four-1.35 m by 0.863 m concrete elliptical pipes (CEPs). The paved low-flow crossings would be 4.88 m (16 ft.) wide and be overtopped during the design storm event. Low-flow crossings are proposed at the McKay property west of Higley Road. Double 3.0 m by 1.2 m (10 ft. by 4 ft.) RCBC's are proposed at Higley Road, Recker Road, and 180th Street to cross the channel and keep the roadway dry during the design storm event.

7.3.4.2 Low Cost Alternative

The low cost alternative uses an earthen channel to convey the existing 10-year event peak discharge of 9.77 cms (345 cfs). The channel for the low cost alternative requires 35.05 m (115 ft.) of new right-of-way. The trapezoidal section is 1.6 m (5.3 ft.) deep with a bottom width of 2.4 m (7.9 ft.).

The low-flow crossings for the low cost alternative requires three 1.35 m by 0.86 m (53 inch by 34 inch) CEP's. A low cost alternative at Higley Road would require a 3.0 m by 1.5 m (10 ft.by 5 ft.) RCBC.

7.3.4.3 No Build Alternative

This alternative will include construction of guardrail at the Power Road and Higley Road intersections, only. It is recommended that right-of-way be acquired to permit maintenance of the existing channel.

7.4 Preliminary Construction Costs

Preliminary construction cost for each crossing, for each alternative are included in the Appendix. Major items of work and quantities have been developed for each crossing, for each alternative. Quantity calculations are included in the Appendix. Construction costs also include utility relocation and a 15 percent contingency.

7.5 Partnership

The following paragraphs describe the proposed recommendations for agency partnering or joint projects for the four channel projects.

7.5.1 87th Avenue Channel – Deer Valley Road to Williams Road

It is recommended that the District cost share with MCDOT for design and that MCDOT and the City of Peoria cost share for right-of-way acquisition and construction.

7.5.2 Ray Road Channel – Tuthill Road to Airport Road

It is recommended that the District cost share with MCDOT for design and construction and that the Town of Goodyear and MCDOT cost share for right-of-way acquisition and share maintenance responsibilities.

7.5.3 Guadalupe Road Channel at the Eastern Canal

It is recommended that the District, MCDOT and the City of Gilbert cost share for design and construction with the City of Gilbert taking over the maintenance for the proposed improvements.

7.5.4 Chandler Heights Road Channel – Greenfield Road to Power Road

It is recommended that the District and MCDOT cost share for the design and construction. MCDOT to be responsible for the acquisition of right-of-way and maintenance of the improvements.

7.6 Preferred Alternatives

7.6.1 87th Avenue Channel – Deer Valley Road to Williams Road

The low cost alternative is recommended. The low cost will capture, convey and discharge the 10-year storm event without acquisition of right-of-way.

7.6.2 Ray Road Channel – Tuthill Road to Airport Road

The preferred alternative at this location shall be determined at a later date. See Section 7.3.2 for description of alternatives.

7.6.3 Guadalupe Road Channel at the Eastern Canal

It is recommended that the no build alternative be the preferred alternative due to the fact that it is not known at this time if either of the alternatives will provide a complete solution. This is due to the complexity of the hydrologic analysis that is required to make this determination. It is recommended that Design Concept Report be undertaken to determine the full solution.

7.6.4 Chandler Heights Road Channel – Greenfield Road to Power Road

The full cost alternative is recommended. This will allow for the future 100-year, 24-hour storm event to be conveyed through the channel using a concrete lined gunite channel to convey irrigation tailwater flows, minimizing maintenance requirements.

8.0 UTILITY INFORMATION

8.1 General

8.1.1 87th Avenue Channel - Deer Valley Road to Williams Road

There is a City of Peoria 250 mm (10inch) water line in 87th Avenue located 1.8 m (6.0 ft.) east of the mid-section line. There is an APS overhead power line in the roadway located 1.8 m (6 ft.) west of the mid-section line. There is also a US West underground telephone line and Cox Communications cable TV line in the right-of-way. There is an abandoned concrete lined irrigation delivery ditch on the south side of Williams Road just west of 87th Avenue.

8.1.2 Ray Road Channel - Tuthill Road to Airport Road

Existing utilities in Ray Road include an APS overhead 12 kV power line and US West telephone line on the north side of the roadway.

8.1.3 Guadalupe Road Channel at the Eastern Canal

Existing utilities in the Guadalupe Road Channel project site include a City of Gilbert waterline in Guadalupe Road (strapped to the side of the bridge at the crossing of Eastern Canal), an underground Southwest Gas gas line, SRP overhead and underground 12 kV power lines, and US West underground telephone.

8.1.4 Chandler Heights Road Channel - Greenfield Road to Power Road

There is an SRP 12 kV overhead power line and an underground US West telephone line at Chandler Heights Road. The box culvert at the Chandler Heights Road channel and Power Road crossing was built approximately a year ago by MCDOT.

8.2 Utility Relocation Costs

8.2.1 87th Avenue Channel - Deer Valley Road to Williams Road

8.2.1.1 High Cost Alternative

The alternative will require the future relocation of the existing APS 12 kV overhead power line to the west right-of-way line, once the ultimate roadway is constructed. The power line may be in easement, therefore the relocation costs should be included in the project costs

8.2.1.2 Low Cost Alternative

The utility relocation costs for this alternative is the same as the high cost alternative.

8.2.2 Ray Road Channel - Tuthill Road to Airport Road

8.2.2.1 High Cost Alternative

This alternative will not include any utility relocation costs.

8.2.2.2 Low Cost Alternative

This alternative will not include any utility relocation costs.

8.2.2.3 No Build Alternative

This alternative will not include any utility relocation costs.

8.2.3 Guadalupe Road Channel at the Eastern Canal

8.2.3.1 High Cost Alternative

This alternative will not have any utility relocation costs. Improvements to the tailwater ditch and its crossing at Guadalupe Road is included in the total project costs.

8.2.3.2 Low Cost Alternative

This alternative will not have any utility relocation costs.

8.2.4 Chandler Heights Road Channel - Greenfield Road to Power Road

8.2.4.1 High Cost Alternative

This alternative will not have any utility relocation costs.

8.2.4.2 Low Cost Alternative

This alternative will not have any utility relocation costs.

8.2.4.3 No Build Alternative

This alternative will not have any utility relocation costs.

9.0 FULL PROJECT COSTS

9.1 Full Project Costs

Tables 9.1.1, 9.1.2, 9.1.3, and 9.1.4 show the preliminary summary costs in current dollars and for an adjustment for inflation for each crossing for each alternative. The summary includes the cost for construction design, construction management, right-of-way, utility relocation and administration. Relocation cost for irrigation facilities are included in the cost for construction.

9.2 Summary Tables

Summary Tables 9.2.1, 9.2.2, 9.2.3, and 9.2.4 for each of the crossings have been included after the preliminary summary costs. (Information in the shaded area shall be completed by MCDOT).

TABLE 9.1.1 SUMMARY COST

Project Name & Termini: **87th Avenue Channel - Deer Valley Road to Williams Road**
CAR No. or Work Order No: **97-M**

1997 CAR PRELIMINARY SUMMARY COST ESTIMATES (Current Dollars)

COST CATAGORIES	*Factors*	*No Build*	*Low Cost Alternative*	*Full Cost Alternative*
Construction		$0	$397,065	$778,251
Design (10% TO 15%)	10%	$0	$39,707	$77,825
Construction Management	15%	$0	$59,560	$116,738
Right-of-Way		$0	$0	$0
Utility Relocation		$0	$0	$0
Administration (8% TO 13%)	7%	$0	$27,795	$54,478
Total		**$0**	**$524,126**	**$1,027,292**

PRELIMINARY SUMMARY COST ESTIMATES (Adjusted for Inflation)

Assumed Annual Inflation Rate = 2.90%
Assumed Number of Years = 5

Adjusted Construction Cost		$0	$458,077	$897,835
Design		$0	$45,808	$89,784
Construction Management	15%	$0	$68,712	$134,675
Right-of-Way		$0	$0	$0
Utility Relocation		$0	$0	$0
Administration	7%	$0	$32,065	$62,848
Adjusted Total		**$0**	**$604,662**	**$1,185,143**

TABLE 9.1.2 SUMMARY COST

Project Name & Termini: **Ray Road Channel - Tuthill Road to Airport Road**
CAR No. or Work Order No: **97-M**

1997 CAR PRELIMINARY SUMMARY COST ESTIMATES (Current Dollars)

COST CATAGORIES	*Factors*	*No Build*	*No Build w/ Erosion Protection*	*Low Cost Alternative*	*Full Cost Alternative*
Construction		$21,670	$44,753	$446,394	$734,627
Design (10% TO 15%)	10%	$2,167	$4,475	$44,639	$73,463
Construction Management	15%	$3,251	$6,713	$66,959	$110,194
Right-of-Way		$59,900	$59,900	$73,478	$59,900
Utility Relocation		$0	$0	$0	$0
Administration (8% TO 13%)	10%	$2,167	$4,475	$44,639	$73,463
Total		**$89,155**	**$120,317**	**$676,109**	**$1,051,646**

PRELIMINARY SUMMARY COST ESTIMATES (Adjusted for Inflation)

Assumed Annual Inflation Rate = 2.90%
Assumed Number of Years = 5

Adjusted Construction Cost		$25,000	$51,630	$514,985	$847,508
Design		$2,500	$5,163	$51,499	$84,751
Construction Management	15%	$3,750	$7,744	$77,248	$127,126
Right-of-Way		$69,104	$69,104	$84,768	$69,104
Utility Relocation		$0	$0	$0	$0
Administration	10%	$2,500	$5,163	$51,499	$84,751
Adjusted Total		**$102,854**	**$138,804**	**$779,999**	**$1,213,240**

TABLE 9.1.3 SUMMARY COST

Project Name & Termini: **Guadalupe Road Channel at the Eastern Canal**
CAR No. or Work Order No: **97-M**

1997 CAR PRELIMINARY SUMMARY COST ESTIMATES (Current Dollars)

COST CATAGORIES	*Factors*	*No Build*	**Low Cost Alternative*	*Full Cost Alternative*
Construction		$0	$0	$472,663
Design (10% TO 15%)	10%	$0	$0	$47,266
Construction Management	15%	$0	$0	$70,899
Right-of-Way		$0	$0	$0
Utility Relocation		$0	$0	$0
Administration (8% TO 13%)	10%	$0	$0	$47,266
Total		**$0**	**$0**	**$638,095**

*The low cost alternative includes improvements to be performed by the City of Gilbert.

PRELIMINARY SUMMARY COST ESTIMATES (Adjusted for Inflation)

Assumed Annual Inflation Rate = 2.90%
Assumed Number of Years = 5

Adjusted Construction Cost		$0	$0	$545,291
Design		$0	$0	$54,529
Construction Management	15%	$0	$0	$81,794
Right-of-Way		$0	$0	$0
Utility Relocation		$0	$0	$0
Administration	10%	$0	$0	$54,529
Adjusted Total		**$0**	**$0**	**$736,143**

TABLE 9.1.4 SUMMARY COST

Project Name & Termini: **Chandler Heights Road Channel - Greenfield Road to Power Road**
CAR No. or Work Order No: **97-M**

1997 CAR PRELIMINARY SUMMARY COST ESTIMATES (Current Dollars)

COST CATAGORIES	*Factors*	*No Build*	*Low Cost Alternative*	*Full Cost Alternative*
Construction		$71,198	$1,005,107	$1,295,609
Design (10% TO 15%)	10%	$7,120	$100,511	$129,561
Construction Management	15%	$10,680	$150,766	$194,341
Right-of-Way		$94,588	$189,027	$198,471
Utility Relocation		$0	$0	$0
Administration (8% TO 13%)	10%	$7,120	$100,511	$129,561
Total		**$190,705**	**$1,545,922**	**$1,947,543**

PRELIMINARY SUMMARY COST ESTIMATES (Adjusted for Inflation)

Assumed Annual Inflation Rate = 2.90%
Assumed Number of Years = 5

Adjusted Construction Cost		$82,138	$1,159,550	$1,494,689
Design		$8,214	$115,955	$149,469
Construction Management	15%	$12,321	$173,932	$224,203
Right-of-Way		$109,122	$218,072	$228,968
Utility Relocation		$0	$0	$0
Administration	10%	$8,214	$115,955	$149,469
Adjusted Total		**$220,008**	**$1,783,465**	**$2,246,798**

Table 9.2.1
Summary Table for 87th Avenue Channel

MCDOT Rating System Data Input (Data for the shaded areas will be provided by MCDOT)				
Criteria	Category	Type of Data Input	Data	
Safety	Accident Rate &Type of Accident 1. Fatal 2. Incapacitating 3. Evident 4. Possible 5. Property Damage Only	Annual Accidents per Million Vehicle Miles of Travel and number of accidents by type Rate = (Total Accidents/Yr) (1,000,000) (ADT * Project Length) (334/Days/Yr)	Accident Rate unable to calculate Fatal 0 Incapacitating 0 Evident 0 Possible 0 Property Damage 1	
	Accident Severity by Type (5) and Cost of Accidents	Annual dollars cost per million vehicle Miles of Travel		
	Sufficiency Rating	0-100 100 = New Road		
	Pavement Condition Rating (PCR)	0-100 100 = Excellent Pavement		
	International Roughness Index (IRI)	0-500 0 = Smooth Road		
Land Use, Regional Travel, and Environmental Factors	Environmental Factors	Project is in a Non Attainment Area and One of the Following Two Criteria	Yes or No	
		Project Paves a Dirt Road	Yes or No	
		Project Provides Paved Shoulders or Curbs.	Yes or No	
	Regional Travel	Percent Regional Travel Usage		
	Project Location Percent of the project area in or out of a city, town or Indian Community		Percent 25% (in)	
Current and Future Volume to Capacity Ratios	Current (2001) V/C Ratio	Volume and Capacity from the MAG Transportation Model or Consultant	Vol. Unavailable	Cap 500/lane
	Future (2020) V/C Ratio	Volume and Capacity from the MAG Transportation Model or Consultant	Vol. Unavailable	Cap 3,500/lane
Project Benefits and Costs	Benefits and Costs for a 20 Year Period	Costs for: design, Right-of-way, construction, construction management and, administration.	$524,126	
		Benefits		
Joint Sponsorship	Local Partnership Contribution	Percent a local city or town is willing to Cost Share 0%		
	Included in a Local Jurisdiction's CIP	Yes or No NO	Yes or No	
Bonus	**Intelligent Transportation System (ITS)**			
	ITE Corridor	Yes or No		
	Signal System Interconnect	Yes or No		
	Regional Traveler Info. System Data Collection	Yes or No		
	Surveillance & Monitoring of the Corridor	Yes or No		
	Roadway/Transit/Pedestrian/Bicycle			
	Bike Lanes	No		
	Sidewalks	No		
	Landscaping	No		
	Bus Pull Outs	No		
	Environmental Components			
	Environmental Enhancements	Yes or No		
	Avoidance of Significant Archaeological Sites	Yes or No		
	Environmental Restoration of Old Roadways	Yes or No		
	HAZMAT Site Cleanup Partnering	Yes or No		

Table 9.2.2
Summary Table for Ray Road Channel

MCDOT Rating System Data Input (Data for the shaded areas will be provided by MCDOT)				
Criteria	Category	Type of Data Input	Data	
Safety	Accident Rate &Type of Accident 1. Fatal 2. Incapacitating 3. Evident 4. Possible 5. Property Damage Only	Annual Accidents per Million Vehicle Miles of Travel and number of accidents by type Rate = (Total Accidents/Yr) (1,000,000) (ADT * Project Length) (334/Days/Yr)	Accident Rate 5.58 Fatal 0 Incapacitating 0 Evident 1 Possible 0 Property Damage 0	
	Accident Severity by Type (5) and Cost of Accidents	Annual dollars cost per million vehicle Miles of Travel		
	Sufficiency Rating	0-100 100 = New Road		
	Pavement Condition Rating (PCR)	0-100 100 = Excellent Pavement		
	International Roughness Index (IRI)	0-500 0 = Smooth Road		
Land Use, Regional Travel, and Environmental Factors	Environmental Factors	Project is in a Non Attainment Area and One of the Following Two Criteria	Yes or No	
		Project Paves a Dirt Road	Yes or No	
		Project Provides Paved Shoulders or Curbs.	Yes or No	
	Regional Travel	Percent Regional Travel Usage		
	Project Location Percent of the project area in or out of a city, town or Indian Community		Percent 0% (in)	
Current and Future Volume to Capacity Ratios	Current (2001) V/C Ratio	Volume and Capacity from the MAG Transportation Model or Consultant	Vol 149	Cap 3,000/lane
	Future (2020) V/C Ratio	Volume and Capacity from the MAG Transportation Model or Consultant	Voll 6,772	Cap 5,500/lane
Project Benefits and Costs	Benefits and Costs for a 20 Year Period	Costs for: design, Right-of-way, construction, construction management and, administration.	See Summary Costs	
		Benefits		
Joint Sponsorship	Local Partnership Contribution	Percent a local city or town is willing to Cost Share 0%		
	Included in a Local Jurisdiction's CIP	Yes or No NO	Yes or No	
Bonus	**Intelligent Transportation System (ITS)**			
	ITE Corridor	Yes or No		
	Signal System Interconnect	Yes or No		
	Regional Traveler Info. System Data Collection	Yes or No		
	Surveillance & Monitoring of the Corridor	Yes or No		
	Roadway/Transit/Pedestrian/Bicycle			
	Bike Lanes	No		
	Sidewalks	No		
	Landscaping	No		
	Bus Pull Outs	No		
	Environmental Components			
	Environmental Enhancements	Yes or No		
	Avoidance of Significant Archaeological Sites	Yes or No		
	Environmental Restoration of Old Roadways	Yes or No		
	HAZMAT Site Cleanup Partnering	Yes or No		

Table 9.2.3
Summary Table for Guadalupe Road Channel

MCDOT Rating System Data Input (Data for the shaded areas will be provided by MCDOT)				
Criteria	Category	Type of Data Input	Data	
Safety	Accident Rate &Type of Accident 1. Fatal 2. Incapacitating 3. Evident 4. Possible 5. Property Damage Only	Annual Accidents per Million Vehicle Miles of Travel and number of accidents by type Rate = (Total Accidents/Yr) (1,000,000) (ADT * Project Length) (334/Days/Yr)	Accident Rate 0 Fatal 0 Incapacitating 0 Evident 0 Possible 0 Property Damage 0	
	Accident Severity by Type (5) and Cost of Accidents	Annual dollars cost per million vehicle Miles of Travel		
	Sufficiency Rating	0-100 100 = New Road		
	Pavement Condition Rating (PCR)	0-100 100 = Excellent Pavement		
	International Roughness Index (IRI)	0-500 0 = Smooth Road		
Land Use, Regional Travel, and Environmental Factors	Environmental Factors	Project is in a Non Attainment Area and One of the Following Two Criteria	Yes or No	
		Project Paves a Dirt Road	Yes or No	
		Project Provides Paved Shoulders or Curbs.	Yes or No	
	Regional Travel	Percent Regional Travel Usage		
	Project Location Percent of the project area in or out of a city, town or Indian Community		Percent 100% (in)	
Current and Future Volume to Capacity Ratios	Current (2001) V/C Ratio	Volume and Capacity from the MAG Transportation Model or Consultant	Vol 6,224	Cap 5,500/lane
	Future (2020) V/C Ratio	Volume and Capacity from the MAG Transportation Model or Consultant	Voll 21,359	Cap 5,500/lane
Project Benefits and Costs	Benefits and Costs for a 20 Year Period	Costs for: design, Right-of-way, construction, construction management and, administration.	$0	
		Benefits		
Joint Sponsorship	Local Partnership Contribution	Percent a local city or town is willing to Cost Share 0%		
	Included in a Local Jurisdiction's CIP	Yes or No NO	Yes or No	
Bonus	**Intelligent Transportation System (ITS)**			
	ITE Corridor	Yes or No		
	Signal System Interconnect	Yes or No		
	Regional Traveler Info. System Data Collection	Yes or No		
	Surveillance & Monitoring of the Corridor	Yes or No		
	Roadway/Transit/Pedestrian/Bicycle			
	Bike Lanes	No		
	Sidewalks	No		
	Landscaping	No		
	Bus Pull Outs	No		
	Environmental Components			
	Environmental Enhancements	Yes or No		
	Avoidance of Significant Archaeological Sites	Yes or No		
	Environmental Restoration of Old Roadways	Yes or No		
	HAZMAT Site Cleanup Partnering	Yes or No		

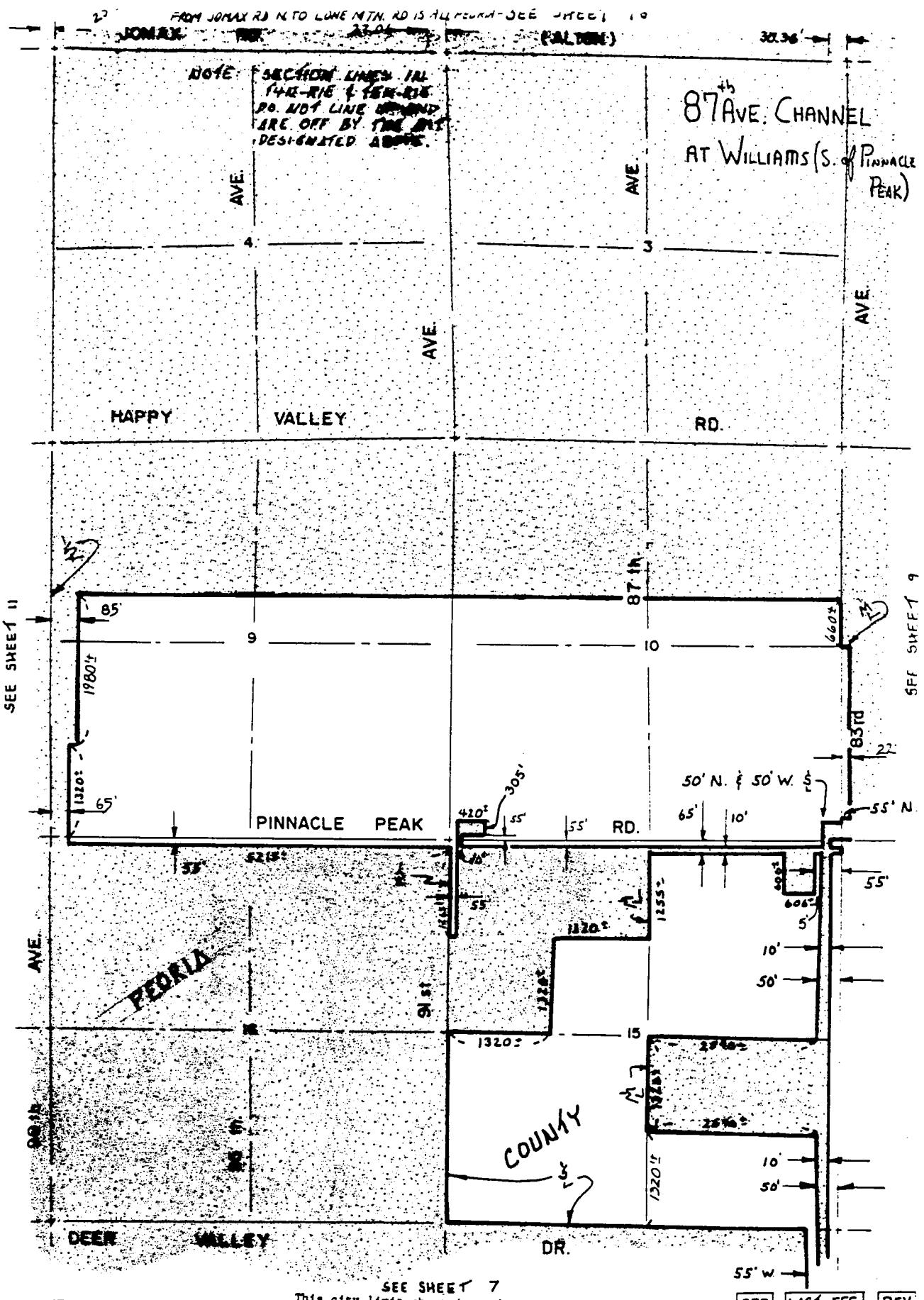
Table 9.2.4
Summary Table for Chandler Heights Road

MCDOT Rating System Data Input (Data for the shaded areas will be provided by MCDOT)				
Criteria	Category	Type of Data Input	Data	
Safety	Accident Rate &Type of Accident 1. Fatal 2. Incapacitating 3. Evident 4. Possible 5. Property Damage Only	Annual Accidents per Million Vehicle Miles of Travel and number of accidents by type Rate = (Total Accidents/Yr) (1,000,000) (ADT * Project Length) (334/Days/Yr)	Accident Rate 1.07 Fatal 0 Incapacitating 1 Evident 1 Possible 1 Property Damage 6	
	Accident Severity by Type (5) and Cost of Accidents	Annual dollars cost per million vehicle Miles of Travel		
	Sufficiency Rating	0-100 100 = New Road		
	Pavement Condition Rating (PCR)	0-100 100 = Excellent Pavement		
	International Roughness Index (IRI)	0-500 0 = Smooth Road		
Land Use, Regional Travel, and Environmental Factors	Environmental Factors	Project is in a Non Attainment Area and One of the Following Two Criteria	Yes or No	
		Project Paves a Dirt Road	Yes or No	
		Project Provides Paved Shoulders or Curbs.	Yes or No	
	Regional Travel	Percent Regional Travel Usage		
	Project Location Percent of the project area in or out of a city, town or Indian Community		Percent 0% (in)	
Current and Future Volume to Capacity Ratios	Current (2001) V/C Ratio	Volume and Capacity from the MAG Transportation Model or Consultant	Vol 2,557	Cap 4,000/lane
	Future (2020) V/C Ratio	Volume and Capacity from the MAG Transportation Model or Consultant	Voll 4,134	Cap 5,500/lane
Project Benefits and Costs	Benefits and Costs for a 20 Year Period	Costs for: design, Right-of-way, construction, construction management and, administration.	$1,725,297	
		Benefits		
Joint Sponsorship	Local Partnership Contribution	Percent a local city or town is willing to Cost Share 0%		
	Included in a Local Jurisdiction's CIP	Yes or No NO	Yes or No	
Bonus	**Intelligent Transportation System (ITS)**			
	ITE Corridor	Yes or No		
	Signal System Interconnect	Yes or No		
	Regional Traveler Info. System Data Collection	Yes or No		
	Surveillance & Monitoring of the Corridor	Yes or No		
	Roadway/Transit/Pedestrian/Bicycle			
	Bike Lanes	No		
	Sidewalks	No		
	Landscaping	No		
	Bus Pull Outs	No		
	Environmental Components			
	Environmental Enhancements	Yes or No		
	Avoidance of Significant Archaeological Sites	Yes or No		
	Environmental Restoration of Old Roadways	Yes or No		
	HAZMAT Site Cleanup Partnering	Yes or No		

10.0 APPENDICES

10.1 City Limit Maps

P09



This city limit sheet is to be used as a GUIDE ONLY! Maricopa County will not be responsible for errors or omissions that might occur.

T4N-RIE

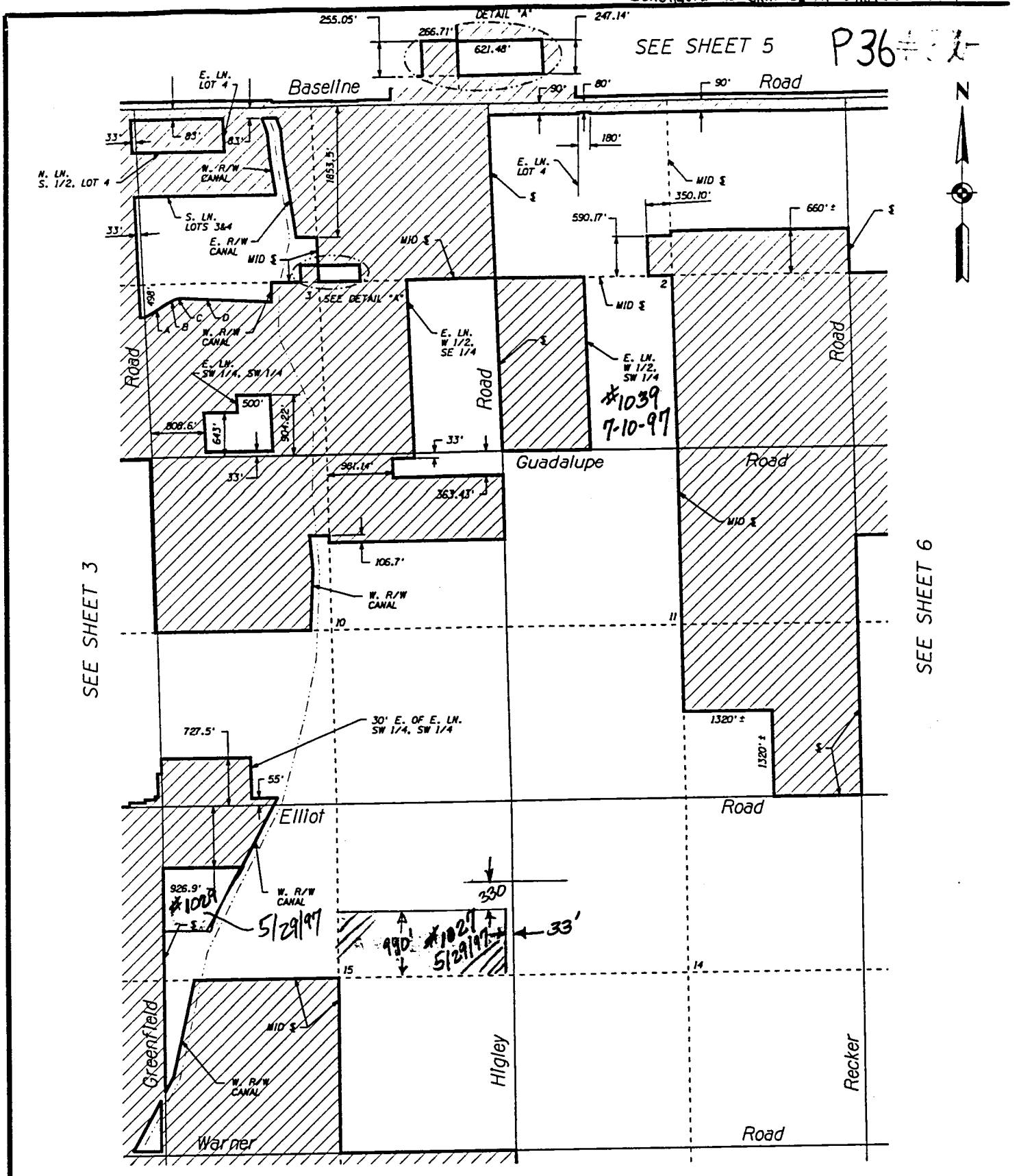
CITY OF PEORIA

N

10

ORD. NO.	LAST EFF. ANNEX DATE	REV. BY
83-45	NOV. 8 '83	JERRY
89-34	12-12-89	KDS

GUADALUPE RD CHANNEL AT EASTERN CANAL



A. N 59°52'33" E 424.43'
B. R=1280.00', Δ=4°20'13", L=96.89'
C. R=210.00', Δ=28°14'14", L=103.49'
D. S 87°33'00" E 756.48'±

SEE SHEET 10

ORD NO	ANNEXATION EFF DATE	REV BY
981	7-04-96	RD
1013	2-21-97	RD
	- -	
	- -	
	- -	
	- -	
	- -	
	- -	

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= Incorporated Area

T1S - R6E

(4)

GILBERT

10.2 Backup for Traffic Volume Projections

Candidate Assessment Report
Location: Channel Projects
Project No.: 6597.03

REGRESSION ANALYSIS
Ray Road, E. of Tuthill Road

	Year (x)	Volume (y)
	1993	101
	1994	123
	1995	136
	1996	149
Sum	7978	509
Sum of sqrs	15912126	66027
Sum sqrd	63648484	259081
Sum prod.	1015279	
Avg	1994.5	127.25
No. Years	4	
m =	15.7	
b =	-31186.4	
r =	0.9903	

Forecast Year	Forecast Volume
2001	229

Candidate Assessment Report
Location: Channel Projects
Project No.: 6597.03

EMME/2 Model Runs

	Ray Road, East of Airport Rd.	
Year	**Volume**	**Average Annual Growth Rate**
2001	2258	
2010	3230	4.06%
2020	6772	7.68%

Year	Volume
2001	2258
2002	2350
2003	2445
2004	2544
2005	2647
2006	2755
2007	2867
2008	2983
2009	3104
2010	3230
2011	3478
2012	3745
2013	4033
2014	4343
2015	4677
2016	5036
2017	5423
2018	5840
2019	6289
2020	6772

Candidate Assessment Report
Location: Channel Projects
Project No.: 6597.03

REGRESSION ANALYSIS
Guadalupe Road, East of Greenfield Road

	Year (x)	Volume (y)
	1988	1992
	1989	2465
	1990	2341
	1991	2139
	1994	5459
	1995	5612
	1996	6324
Sum	13943	26332
Sum of sqrs	27772523	121388092
Sum sqrd	194407249	693374224
Sum prod.	52484210	
Avg	1991.857143	3761.71
No. Years	7	
m =	588.3349515	
b =	-1168117.46	
r =	0.9551	

Forecast Year	Forecast Volume
2001	9141

Candidate Assessment Report
Location: Channel Projects
Project No.: 6597.03

EMME/2 Model Runs

	Guadalupe Rd, E. of Greenfield Rd	
Year	**Volume**	**Average Annual Growth Rate**
2001	15911	
2010	24731	5.02%
2020	21359	-1.46%

Year	Volume
2001	15911
2002	16710
2003	17549
2004	18431
2005	19357
2006	20329
2007	21350
2008	22422
2009	23548
2010	24731
2011	24371
2012	24016
2013	23667
2014	23323
2015	22983
2016	22649
2017	22319
2018	21994
2019	21674
2020	21359

Candidate Assessment Report
Location: Channel Projects
Project No.: 6597.03

REGRESSION ANALYSIS
Chandler Heights Road, at Power Road

	Year (x)	Volume (y)
	1988	1894
	1989	2181
	1990	2134
	1991	1748
	1993	2218
	1994	3166
	1995	2721
	1996	2557
Sum	15936	18619
Sum of sqrs	31744572	44838627
Sum sqrd	253956096	346667161
Sum prod.	37095854	
Avg	1992	2327.38
No. Years	8	
m =	113.4333333	
b =	-223631.825	
r =	0.7162	

Forecast Year	Forecast Volume
2001	3348

Candidate Assessment Report
Location: Channel Projects
Project No.: 6597.03

EMME/2 Model Runs

	Chandler Hts Rd, W. of Power Rd	
Year	**Volume**	**Average Annual Growth Rate**
2001	2884	
2010	5607	7.67%
2020	4134	-3.00%

Year	**Volume**
2001	2884
2002	3105
2003	3343
2004	3599
2005	3875
2006	4173
2007	4492
2008	4837
2009	5208
2010	5607
2011	5439
2012	5275
2013	5117
2014	4963
2015	4814
2016	4670
2017	4530
2018	4394
2019	4262
2020	4134

10.3 Backup for Accident Rate Calculations

Candidate Assessment Report
Location: Channel Projects
Project No.: 6597.03

Ray Road, Tuthill Road to Airport Road

Segment Accident Rate

Ave. No. of Accidents per year = 1 accident/3 years = 0.33 accidents/year
Ray Road Ave. Annual Daily Traffic Volume = 162 vpd
Segment Length = 1.6 km = 1.0 mi
Accident Rate = $\frac{0.33 \times 1{,}000{,}000}{162 \times 365 \times 1.6}$ = 3.49 accidents/MVkm

Accident Rate = $\frac{0.33 \times 1{,}000{,}000}{162 \times 365 \times 1.0}$ = 5.58 accidents/MVM

Chandler Heights Road, Greenfield Road to Power Road

Segment Accident Rate

Ave. No. of Accidents per year = 9 accident/3 years = 3.0 accidents/year
Chandler Heights Road Ave. Annual Daily Traffic Volume = 2561 vpd
Segment Length = 2.4 km = 3.0 mi
Accident Rate = $\frac{3.0 \times 1{,}000{,}000}{2561 \times 365 \times 2.4}$ = 0.67 accidents/MVkm

Accident Rate = $\frac{3.0 \times 1{,}000{,}000}{2561 \times 365 \times 3.0}$ = 1.07 accidents/MVM

87th Avenue, Deer Valley Road to Williams Road

Segment Accident Rate

Ave. No. of Accidents per year = 1 accident/3 years = 0.33 accidents/year
87th Avenue Ave. Annual Daily Traffic Volume = unavailable
Segment Length = 0.8 km = 0.5 mi
Accident Rate = unable to calculate

Guadalupe Road at the Eastern Canal

Segment Accident Rate

Ave. No. of Accidents per year = 0 accident/3 years = 0.0 accidents/year
Guadalupe Road Ave. Annual Daily Traffic Volume = 6200 vpd
Segment Length = 0.8 km = 0.5 mi
Accident Rate = $\frac{0.0 \times 1{,}000{,}000}{6200 \times 365 \times 0.8}$ = 0.0 accidents/MVkm

Accident Rate = $\frac{0.0 \times 1{,}000{,}000}{6200 \times 365 \times 0.5}$ = 0.0 accidents/MVM

10.4 FIRM Panels