



CORTARO FARMS ROAD/MAGEE ROAD

THORNYDALE ROAD TO ORACLE ROAD

Final Design Concept Report

Prepared For:

Pima County Department of Transportation
Arizona Department of Transportation

STP-PPM-0(209)A
0000 PM PPM SS693 01C

Prepared By:

AECOM

1860 East River Road, Suite 300
Tucson, Arizona 85718

March 2010



EXP-6-30-10

FINAL DESIGN CONCEPT REPORT

**Cortaro Farms Road/Magee Road Widening
Thornydale Road – Oracle Road (SR77)**

**4MCFTL Corridor Study, Thornydale Road to Oracle Road, Final
Design and Construction, Thornydale Road to Mona Lisa**

**4MRLCO Final Design and Construction, La Cañada Drive to
Oracle Road**

**4RTMLI Final Design and Construction, Mona Lisa to La Cañada
Drive**

Regional Transportation Authority Projects: 7a, 7b & 12

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TABLE OF CONTENTS

Executive Summary	1
1.0 Introduction	2
1.1 Project Overview	2
2.0 Project Description	3
3.0 Project Area Characteristics	3
3.1 Topography and Terrain.....	3
3.2 Existing Roadway.....	3
3.3 Watersheds and Drainages.....	4
3.4 Existing Drainage Structures.....	4
3.5 Existing Utilities.....	5
3.5.1 Underground Utilities.....	6
3.6 Existing Environmental Elements.....	6
4.0 Traffic and Accident Data	6
4.1 Existing Traffic Volumes.....	6
4.1.1 Existing Traffic Data	6
4.2 Alternative Modes	7
4.2.1 Transit	7
4.2.2 Bicycle, Pedestrian, and Equestrian Facilities.....	7
5.0 Design Standards and Criteria	7
5.1 Roadway Design.....	9
5.2 Drainage Design	9
5.2.1 Hydrology	9
5.2.2 Cross Drainage Criteria.....	9
5.2.3 Open Channel and Floodplain Hydraulics	10
5.2.4 Design Channel Criteria	10
5.2.5 Erosion and Sedimentation	10
5.2.6 Pavement Drainage Design.....	10
5.3 Access Control.....	10
6.0 Alternatives	11
6.1 Bridge Construction.....	11
6.2 Longitudinal Drainage	11
6.3 Frontage Road Segments	11

6.4 Magee Road/La Cholla Boulevard Intersection Improvements.....	11
6.4.1 "S" Curve Alternative	12
6.4.2 Traffic Roundabout Alternative.....	12
6.4.3 Flyover Alternative.....	13
6.4.4 Jug Handle Alternative (Recommended Alternative).....	13
6.4.5 Preferred Alternative	14
7.0 Major Design Features	15
7.1 Roadway	15
7.1.1 Roadway Typical Section	15
7.1.2 Right of Way.....	15
7.1.3 Earthwork	15
7.1.4 Pavement Design	15
7.1.5 Structures.....	15
7.1.6 Signalization, Lighting and ITS.....	15
7.2 Drainage	15
7.2.1 Watersheds and Drainages.....	15
7.2.2 Cross Drainage	16
7.2.3 Pavement Drainage.....	16
7.2.4 Permits and Regulatory Concerns.....	16
7.3 Design Exceptions	16
8.0 Social, Economic and Environmental Considerations	17
8.1 Impacts Requiring Mitigation.....	17
8.2 Jurisdiction and Ownership	17
8.3 Existing Land Use	18
8.4 Future Land Use	18
8.5 Title VI and Environmental Justice.....	18
8.6 Physical and Natural Environment.....	18
8.7 Topography/Physiology.....	18
8.8 Biological Resources	18
8.9 Water Resources and Floodplains	19
8.10 Visual Character	19
8.11 Air Quality	19
8.12 Noise.....	20
8.13 Hazardous Materials Concerns.....	20
8.14 Cultural Resources and Survey	20
8.15 Public Involvement.....	20

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9.0 Intergovernmental Agreements 21

10.0 Implementation, Cost and Funding 21

11.0 Conclusions and Recommendations 21

LIST OF FIGURES

Figure 1.1: Area Plan1

Figure 1.2: Location Plan2

Figure 1.3: Pima County Project Locations3

Figure 4.1: Existing Traffic Volumes6

Figure 6.1: “S” Curve Alternative12

Figure 6.2: Traffic Roundabout Alternative12

Figure 6.3: Flyover Alternative13

Figure 6.4: Jug Handle Alternative13

Figure 7.1: Magee Road Typical Section15

Figure 7.2: Carmack Wash Typical Section16

LIST OF TABLES

Table 3.1: Existing Cross Culverts5

Table 5.1: Design Criteria8

Table 5.2: Proposed Cross Culverts10

Table 6.1: Comparison of Alternatives14

Table 10.1: Projected Costs21

LIST OF APPENDICES

Appendix A: Stage I Plans

Appendix B: Cost Estimates for Phases 1 - 3



Executive Summary

This Design Concept Report documents the results of the preliminary design and analysis of proposed improvements to Cortaro Farms Road/Magee Road from Thornydale Road to Oracle Road as shown in Figure 1.1. The project is located in the northwestern part of metropolitan Tucson, Arizona. The existing roadway consists of one lane in each direction with intermittent center left turn lanes. There is a jog along Magee Road, at La Cholla Boulevard, consisting of two signalized tee intersections, one quarter mile apart. There are minimal pedestrian, bicycle and cross drainage facilities. Magee Road currently crosses the Cañada del Oro Wash via a two lane bridge.

On May 16, 2006, the voters of Pima County approved a \$2.1 billion Regional Transportation Plan. A half cent sales tax to fund the plan was also approved. The plan, as presented to the voters, proposed the following improvements for this project:

As stated on the Regional Transportation Authority (RTA) ballot, this roadway shall become “ a 4-lane divided arterial, eliminate the jog at La Cholla Blvd., provide bike lanes and sidewalks.”

The project’s goal is to improve roadway safety, capacity and traffic operations in a cost effective manner and in accordance with the requirements of the Regional Transportation Plan approved by the voters of Pima County. Additionally, the goal is to avoid environmental impacts where possible and minimize and/or mitigate impacts where it is not possible to avoid them.

The proposed improvements for this project consist of the reconstruction of Cortaro Farms Road/Magee Road from Thornydale Road through Oracle Road. The new roadway will have two travel lanes and a bicycle lane in each direction separated by a raised, landscaped median. The new roadway will closely follow its existing horizontal and vertical alignment except in the immediate area of La Cholla Boulevard. A new alignment has been developed between Como Drive and Zaragoza Drive to eliminate the jog at La Cholla Boulevard.

The recommended intersection improvements at La Cholla Boulevard will incorporate an at-grade loop (Jug Handle) to convey traffic from northbound La Cholla Boulevard to westbound Magee Road. The Jug Handle was recommended over several other alternatives based upon safety, capacity, traffic operations, environmental and cost considerations.

The existing bridge over the Cañada del Oro Wash will be widened to accommodate the proposed roadway improvements. Culverts will be placed to convey, under the roadway, storm flows that currently cross the road in dip sections. Major channel and culvert improvements are proposed for the Carmack Wash, at the Magee Road intersection with La Cholla Boulevard.

The proposed improvements are being funded by the half cent sales tax approved in 2006, the 1997 bond funds, impact fees and federal funding. The first phase of construction, improvements

to the intersection of Magee Road and La Cholla Boulevard, is scheduled to begin in late 2010 or early 2011.

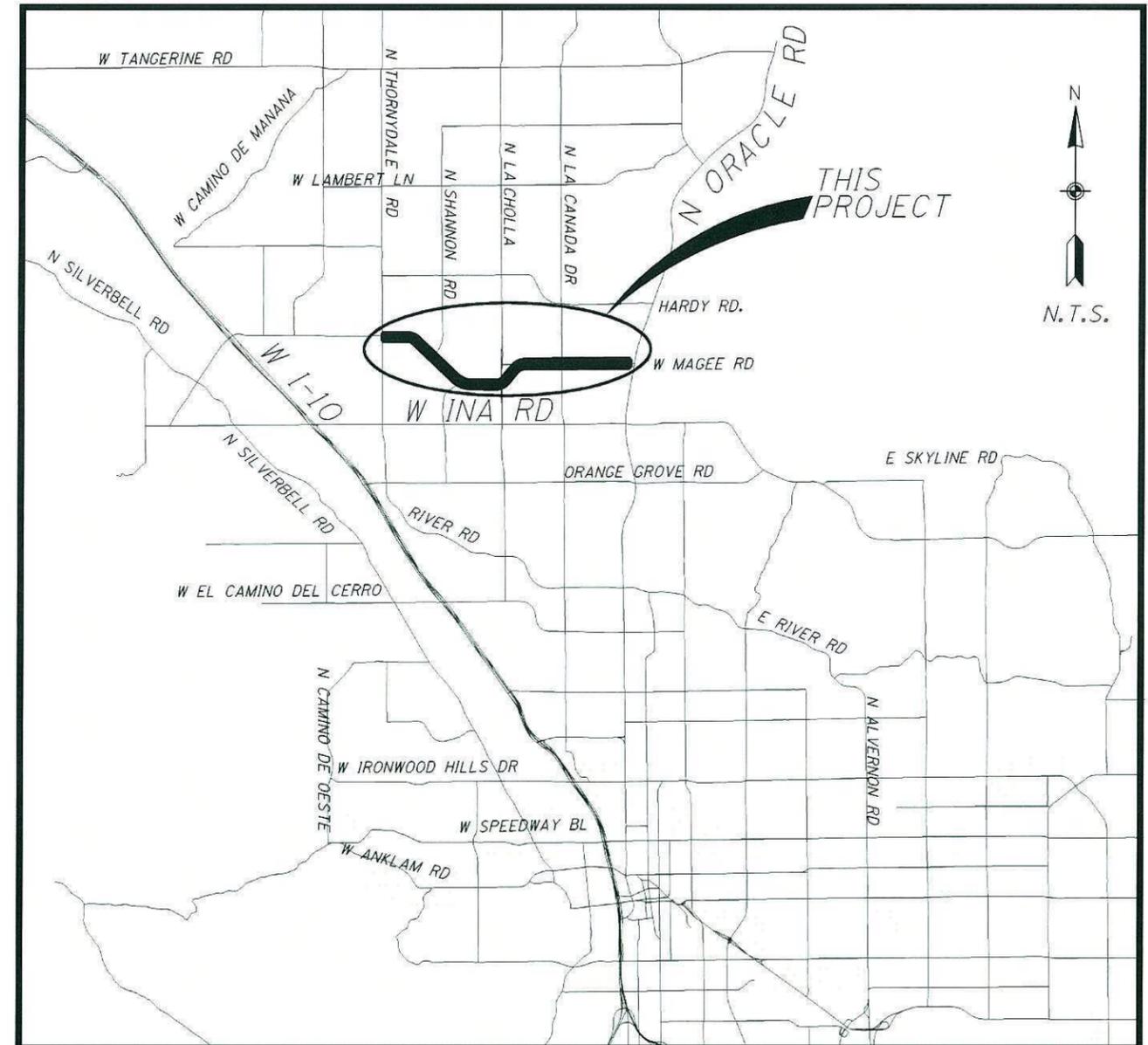


Figure 1.1: Area Plan



1.0 Introduction

This Design Concept Report (DCR) documents the results of the preliminary design and analysis of proposed improvements to Cortaro Farms Road/Magee Road from Thornydale Road to Oracle Road, as shown in Figure 1.2. The project goal is to improve the roadway's safety, capacity and traffic operations in a cost effective manner and in accordance with the requirements of the Regional Transportation Plan approved by the voters of Pima County. Additionally, the goal is to avoid environmental impacts where possible and minimize and/or mitigate impacts where it is not possible to avoid them.

1.1 Project Overview

On May 16, 2006, the voters of Pima County approved a \$2.1 billion Regional Transportation Plan. A half cent sales tax to fund the plan was also approved. The plan, as presented to the voters, proposed the following improvements for this project:

“...4-lane divided arterial, eliminates the jog at La Cholla Boulevard, bike lanes and sidewalks.”

This project is included in the 2006 Regional Transportation Authority (RTA) Implementation Plan as three separate segments (RTA projects 7a, 7b and 12).

This project has been assigned the following Pima County project numbers and scopes of work:

- **4MCFTL-Corridor Study (DCR, Preliminary Plans and Environmental Documents), Final design and construction of Thornydale to Mona Lisa Segment**
- **4MRLCO-Final design and construction of La Cañada to Oracle Segment**
- **4RTMLI-Final design and construction of the Mona Lisa to La Cañada Segment**

The combined projects will connect to Pima County project number **4CFCOT** (Cortaro Farms Road, UPRR to Thornydale) being completed under Pima County's 1997 HURF Transportation Bond Program. When completed, there will be a continuous corridor along Cortaro Farms Road/Magee Road, from UPRR to Oracle Road. Other Pima County projects intersecting the project area include:

4TTICF	Thornydale – Ina to Cortaro Farms
4TTCLV	Thornydale – Cortaro Farms to Linda Vista
4BMCAN	Magee Road Bridge
4TJENM	Jensen/Magee Intersection
4SRIME	Shannon Rd – Ina to Magee
4MAMLR	Magee/Mona Lisa WB LT lane
4LCIMR	La Cholla – Omar to Magee
4RTLTM	La Cholla – Tangerine to Magee
4RTCCI	La Cañada – Ina to Calle Concordia
4MMDRN	Magee Road Drainage Channel

See Figure 1.3 for locations of other Pima County projects.

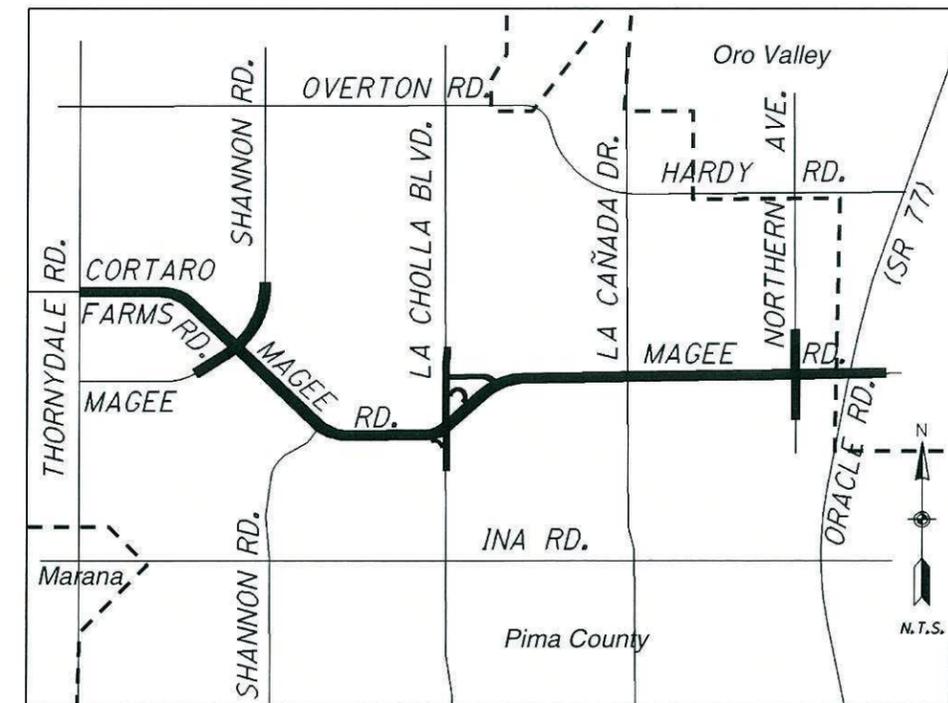


Figure 1.2: Location Plan

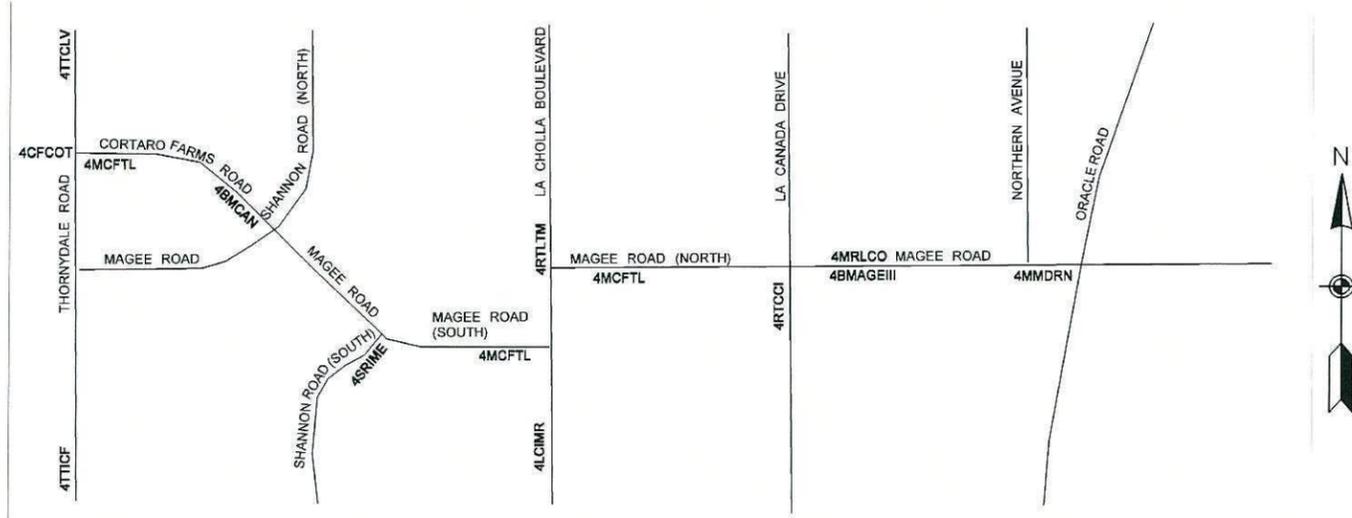


Figure 1.3: Pima County Project Locations

2.0 Project Description

The proposed improvements involve a complete reconstruction of Cortaro Farms Road/Magee Road from Thornydale Road to Oracle Road conforming to the Pima County *Typical Section for 4-Lane Divided Road (Urban)* found in the *Roadway Design Manual (RDM)*. There will be a major realignment of the Magee Road/La Cholla Boulevard intersection. The following intersections will be enhanced with additional turn lanes at the following intersections:

- Cortaro Farms Road/Magee Road and Shannon Road (North)
- Magee Road and Shannon Road (South)
- Magee Road and La Cholla Boulevard
- Magee Road and La Cañada Drive
- Magee Road and Oracle Road

The proposed improvements for this project consist of the reconstruction of Cortaro Farms Road/Magee Road from Thornydale Road through Oracle Road. The new roadway will have two travel lanes and a bicycle lane in each direction separated by a raised, landscaped median. The new roadway will closely follow its existing horizontal and vertical alignment except in the immediate area of La Cholla Boulevard. A new alignment has been developed between Como Drive and Zaragoza Drive to eliminate the jog at La Cholla Boulevard.

The recommended intersection improvements at La Cholla Boulevard will incorporate an at-grade loop (Jug Handle) to convey traffic from northbound La Cholla Boulevard to westbound

Magee Road. The Jug Handle was recommended over several other alternatives based upon safety, capacity, traffic operations, environmental and cost considerations.

The existing bridge over the Cañada del Oro Wash will be widened to accommodate the proposed roadway improvements. Cross culverts will be placed under the roadway to convey storm flows currently crossing over the roadway surface. Major channel and culvert improvements are proposed for the Carmack Wash, at the Magee Road intersection with La Cholla Boulevard.

A Public Art Master Plan for use throughout project design and construction is being created along with the Stage I plans. Drought-tolerant, low water use plants with associated irrigation will be incorporated in the project design.

3.0 Project Area Characteristics

3.1 Topography and Terrain

The topography in the area of the project generally slopes from the northeast to southwest. The southwesterly flowing Cañada del Oro (CDO) Wash crosses the project limits between Thornydale Road and La Cholla Boulevard. The Carmack Wash crosses Magee Road just east of La Cholla Boulevard and crosses the southern intersection of Magee Road and La Cholla Boulevard. The project area lies between approximately 2,300 feet and 2,580 feet above mean sea level on gently rolling terrain.

The intersection of Cortaro Farms and Thornydale Road is at an elevation of 2358 feet. From the intersection, the existing road climbs at an 0.8% grade for 4,000 feet, cresting at the west ridge of the CDO Wash valley, at an elevation of 2392 feet. The road then descends into the valley at a grade approaching 7.0%, crossing the existing bridge at an elevation of 2302 feet. The road then ascends to the east ridge of the valley at a grade approaching 8%, roughly leveling off at an elevation of 2410 feet near Como Drive.

From the south intersection of Magee Road and La Cholla Boulevard the roadway ascends at 0.9% for 1700 feet to the north Magee Road and La Cholla Boulevard intersection then continues the 0.9% rise for 2900 feet to Pelado Place. The slope increases to 2.5% before topping a hill just west of La Cañada Drive at an elevation of 2512 feet. The roadway then descends at 1.4% to Pegler Wash, ascends at a 2% grade to a point 400 feet west of North Oracle Road where the slope increases to 3.2% near the project terminus.

3.2 Existing Roadway

Cortaro Farms Road/Magee Road is a two lane roadway, with intermittent center, left turn lanes. In general, the roadway is located in a one hundred fifty foot wide right-of-way between Thornydale Road, on the west, and Oracle Road on the east. Pima County has designated the



roadway as a major/minor arterial and as a scenic route and an Environmentally Sensitive Roadway (ESR). The road has been widened in some areas as development has occurred along the corridor. A bridge was constructed in the 1980's to provide an all-weather crossing over the CDO Wash. Two-foot to ten-foot wide graded shoulders abut Cortaro Farms Road/Magee Road along its entire length.

Magee Road is discontinuous at La Cholla Boulevard, with the west and east segments being separated by a quarter mile. Through traffic along Magee Road must travel on La Cholla Boulevard between the two segments. There is a frontage road located on the south side of Magee Road, between Zaragoza Drive and Camino de Maximilian.

Street lighting is incorporated into all seven existing signalized intersections along the project. Street lighting also exists at Wheatfield Drive and Mona Lisa Road intersections.

3.3 Watersheds and Drainages

The following information regarding drainage is summarized from the *September 2009 Drainage Report* by Arroyo Engineering.

Upstream watersheds which concentrate runoff along the project reach generally drain from areas located northeast of the roadway alignment. The largest of these watersheds is the CDO Wash. The CDO Wash is currently channelized with soil-cement bank stabilization through the reach that crosses the project corridor. A two-lane bridge structure exists at the Magee Road crossing of the CDO Wash. The watershed area of the CDO Wash, upstream of Magee Road, is approximately 250 square miles.

The Carmack Wash has a watershed area of approximately 4.8 square miles at its concentration point at Magee Road, east of La Cholla Boulevard. The wash crosses the existing roadway corridor at three locations within at-grade dip crossings. At its most upstream point, the Carmack Wash crosses Magee Road east of La Cholla Boulevard. The wash then flows southwesterly to a dip section at La Cholla Boulevard, and continues further southwest where it crosses Magee Road again just west of La Cholla Boulevard.

The Peglar Wash has a watershed area of approximately 380 acres. The wash and two of its tributaries cross Magee Road in dip sections about a quarter mile east of La Cañada Drive. Numerous other watersheds, ranging in size from approximately 2 acres to 250 acres, concentrate flow along the project corridor. Most of these watercourses cross the existing roadway corridor within at-grade dip crossings, or as shallow sheet flow.

3.4 Existing Drainage Structures

A few small existing cross-drainage culverts convey runoff under the roadway at various concentration points along the project reach. Locations of the existing cross culverts are shown

in Table 3.1. In addition, a number of constructed channels and roadside ditches exist along the roadway corridor. These ditches convey flows, parallel to the roadway, to locations where flow crosses the roadway or outlets into a larger watercourse. Surface flows also enter the east end of the project limits via a storm drain and culvert which convey runoff from Oracle Road, as well as from watersheds located east of Oracle Road.



Table 3.1: Existing Cross Culverts

Location	Size	Material	Plan Reference
E side of Thornydale Rd. (Station 236+30)	8'x3'x430'	RCBC	RPP1- page 55
Cortaro Farms Rd. (W entrance to Cortaro Plaza) S side (Station 238+29)	2-10'x 4'	RCBC	RPP1- page 55
Cortaro Farms Rd. (E entrance to Cortaro Plaza) S side (Station 245+16)	Full length	Transverse Drain	RPP2- page 56
Cortaro Farms Rd. (E entrance to Cortaro Plaza) S side (Station 245+04)	2-6'x 4'	Arch	RPP2- page 56
Cortaro Farms Rd. (E entrance to Cortaro Plaza) S side (Station 245+37)	24"	CMP	RPP2- page 56
Cortaro Farms Rd. 1045' E of Thornydale Rd. – S side (Station 246+48)	2-6'x 4'	RCBC	RPP2- Page 56
Cortaro Farms Rd at Club Dr. (Station 265+88)	4-48"	RCP	RPP5- Page 59
Cortaro Farms Rd. 500' E of Club Dr. (Station 271+08)	24"	RCP	RPP5- Page 59
Cortaro Farms Rd at Wheatfield Dr. (Station 273+35)	24"	RCP	RPP6- Page 60
Cortaro Farms Rd W. of Magee Rd./ Shannon Rd. (North) (Station 285+40)	36"	RCP	RPP7- Page 61
Cortaro Farms Rd. at Magee Rd./ Shannon Rd. (North) Station 286+05	48"	RCP	RPP7- Page 61
Magee Rd W. of Cortina Place (Station 291+17)	36"	RCP	RPP8- Page 62
Magee Rd at Cortina Place (Station 292+07)	2-36"	RCP	RPP8- Page 62
Magee Rd. W. of Jensen Dr. (Station 297+30)	2-8'x 4'	RCBC	RPP8- Page 62
Magee Rd at Jensen Dr. (Station 299+01)	24"	CMP	RPP9- Page 63
Jensen Dr. S of Magee Rd. (Station 298+75)	2-8'x4'	RCBC	RPP9- Page 63
Magee Rd 200' W of Sun Flair Dr. (Station 309+13)	2-36"	CMP	RPP10- Page 64
Magee Rd at Sun Flair Dr. (Station 311+12)	2-36"	CMP	RPP10- Page 64
Magee Rd. at Tuscany Dr. (Station 318+91)	36"	RCP	RPP11- Page 65
Magee Rd 375' E of Tuscany Dr. (Station 322+82)	60"	SSPP	RPP11- Page 65

Location	Size	Material	Plan Reference
Magee Rd 425' E of Tuscany Dr. (YMCA-PCC entrance) (Station 323+05)	2- 24"	CMP	RPP11- Page 65
Magee Rd 585' E of Tuscany Dr. (Pvt drive) N side (Station 324+80)	2-36"x24"	CMPA	RPP11- Page 65
Magee Rd 250' W of Mona Lisa Rd. (Pvt drive) N side (Station 330+36)	24"	CMP	RPP12- Page 66
Magee Rd 120' W of Mona Lisa Rd. (Pvt drive) N side (Station 331+50)	24"	CMP	RPP12- Page 66
Magee Rd at Mona Lisa Rd. (Station 332+73)	18"	CMP	RPP12- Page 66
Magee Rd at Sendero Uno (Station 406+08)	18"	CMP	RPP21- Page 75
Magee Rd 400' E of Sendero Uno (Pvt drive) S side (Station 410+12)	18"	CMP	RPP21- Page 75
Magee Rd 525' E of La Cañada Dr. (Station 420+36)	24"	CMP	RPP23- Page 77
Paseo del Norte 25' S of Magee Rd. R/W (Station 454+71)	24"	CMP	RPP26- Page 80
Magee Rd 285' E of Northern Ave. (Pvt drive) S side (Station 470+59)	2-24"	CMP	RPP28- Page 82
Magee Rd 285' E of Northern Ave. (Pvt drive) S side (Station 470+24)	2-12'x 4'	ConArch	RPP28- Page 82
Magee Rd 540' E of Northern Ave. (Pvt drive) S side (Station 473+10)	2-24"	CMP	RPP29- Page 83
Magee Rd 280' W of SR 77 (Oracle Rd) (Pvt drive) S side (Station 476+38)	24"	CMP	RPP29- Page 83
Magee Rd 250' W of SR 77 (Oracle Rd) (Station 477+09)	18"	CMP	RPP29- Page 83
Magee Rd 200' W of SR 77 (Oracle Rd) (Pvt drive) N side (Station 476+09)	2-10'x 3'	RCBC	RPP29- Page 83
Magee Rd – SR 77 intersection N Side (Station 478+79)	2-8'x3'	RCBC	RPP29- Page 83
Magee Rd – SR 77 intersection (Station 479+30)	2-48"	CMP	RPP29- Page 83
Magee Rd 525' E of SR 77 (Oracle Rd) (Pvt drive) S side (Station 484+44)	2-24"	CMP	RPP30- Page 84

3.5.1 Existing Utilities

The existing utility features within the project limits have been located horizontally through the use of a utility locating service, field survey of surface features, “as built” and utility base maps. Based on field survey, “as-builts” and discussions with the individual utilities, the vertical location of the utility features has been approximated. This information is presented in the plan set included in Appendix A.



3.5.1 Underground Utilities

Tucson Electric Power (TEP), Tucson Water, Metropolitan Water, Southwest Gas, Qwest, Comcast Communications and the Pima County Regional Wastewater Reclamation Department (PCRWRD) all have underground facilities within the corridor.

Tucson Water's service area consists of an area at the northeast corner of Thornydale Road and Cortaro Farms Road and an area along Magee Road, east of La Cañada Drive. Tucson Water has a variety of facilities within these areas including a 24" diameter pipe along Cortaro Farms Road, just east of Thornydale Road. Tucson Water also has 12" and 8" diameter pipes located in Magee Road from La Cañada Drive to east of Oracle Road.

Metro Water's service area includes both sides of Magee Road, from Thornydale Road to La Cañada Drive. In this area, Metro Water facilities consist of transmission and distribution lines of various diameters. Metro Water also has a 24" diameter transmission line located along Magee Road, between a pump station located east of La Cañada Drive and a reservoir located about a quarter mile east of Oracle Road.

Water service to Samalayuca Estates, located on the south side of Magee Road, between La Cañada Drive and Paseo del Norte, is provided by the Samalayuca Improvement Association.

Qwest has an office and operations facility located on the south of Magee Road, just east of La Cañada Drive. Qwest has underground lines connected to this facility and throughout the project limits. Some of these underground lines are fiber optic and considered by Qwest to be of high significance.

3.6 Existing Environmental Elements

Social, Economic and Environmental Considerations are summarized from the *Environmental Assessment and Mitigation Report* by EcoPlan & Associates in Section 8 of this report.

4.0 Traffic and Accident Data

The following information regarding traffic is summarized from the *February 2009 Draft Final Traffic Engineering Report* by Kittelson & Associates. See the appendices associated with that report for detailed traffic and roadway capacity data.

The existing major signalized intersections are Cortaro Farms Road and Thornydale Road, Cortaro Farms Road and Shannon Road, Magee Road and Shannon Road, Magee Road (South) and La Cholla Boulevard, Magee Road (North) and La Cholla Boulevard, Magee Road and La Cañada Drive, Magee Road and Northern Avenue, Magee Road and Oracle Road.

The proposed major signalized intersections are the same as mentioned in the existing major signalized intersections with the exception of the two signalized intersections on Magee Road and La Cholla Boulevard will be eliminated and one signalized intersection will be constructed at the new intersection location. See Section 6.4 for a discussion of the Magee Road realignment at La Cholla Boulevard.

4.1 Existing Traffic Volumes

4.1.1 Existing Traffic Data

Study results showed Levels of Service (LOS) through ten intersections along the route varied from LOS B/C at the Magee Road-Tuscany Drive intersection through LOS E/F at the Magee Road-Jensen Road intersection. Existing traffic volumes are shown in Figure 4.1.

Accident numbers were also reviewed. Every Cortaro Farms Road/Magee Road roadway segment had a crash rate lower than the Pima County three-year average of 1.56 crashes per million entering vehicles. Two segments, Magee Road from Tuscany Road to Mona Lisa Road and Magee Road between La Cholla Boulevard and La Cañada Drive, had a severity index which exceeded the Pima County average of 1.63. Most of the accidents were rear-end collisions involving vehicles slowing or stopping to turn into a driveway.

Twenty-four hour speed data were collected at two locations along Magee Road. At Jensen Drive, the 85th percentile speed was 46 miles per hour (mph) for the eastbound direction and 48 mph for westbound direction. At Leonardo da Vinci Way, the 85th percentile speed was 43 mph for the eastbound direction and 46 mph for westbound direction.

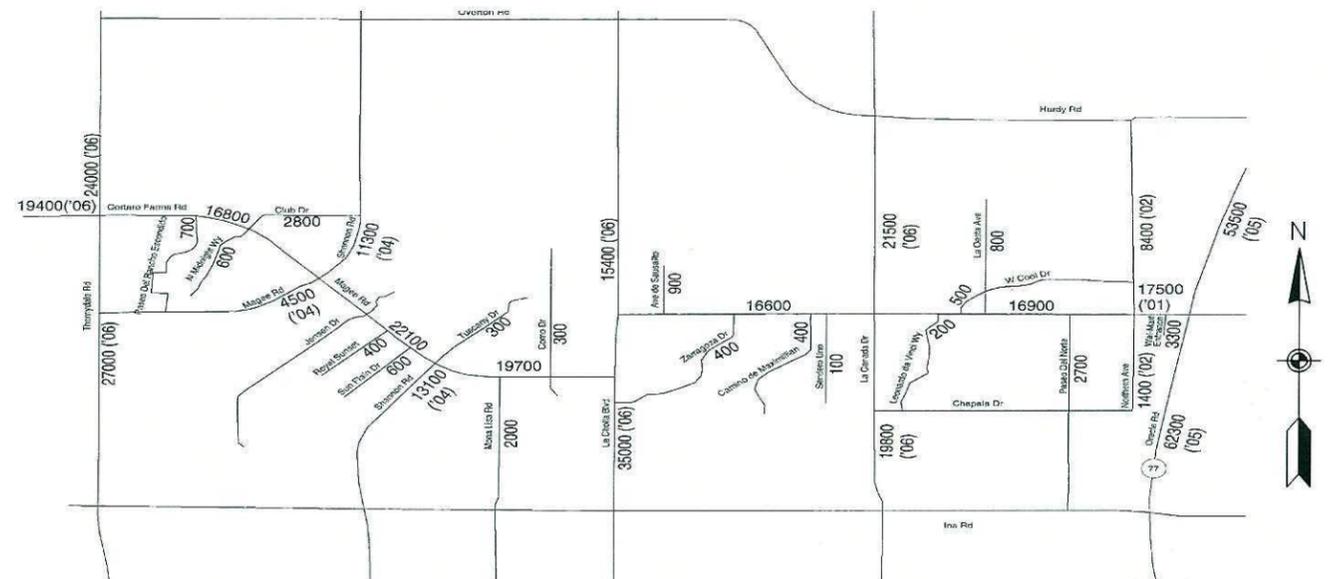


Figure 4.1: Existing Traffic Volumes



The *Draft Final Traffic Engineering Report* presented the following conclusions and recommendations:

- Traffic flow on Cortaro Farms Road/Magee Road is directional during the A.M. and P.M. peak periods. Different timing strategies should be implemented for different peak periods.
- The PAG regional traffic model predicts that traffic demand on Cortaro Farms Road/Magee Road will increase by 50% by 2030. To accommodate the predicted traffic demands, a 4-lane roadway is needed for the entire section of Cortaro Farms Road/Magee Road. Without improvements, most of the major intersections along the corridor would operate at an unacceptable level of service.
- The addition of through lanes and the proposed raised median to control access will improve the overall safety on Cortaro Farms Road/Magee Road.
- Traffic signal warrant studies were conducted at four unsignalized intersections, Club Drive, Jensen Drive, Mona Lisa Road, and Paseo Del Norte. None of the intersections meets the Pima County's signal warrants. However, considering future traffic demands, conduits and pullboxes are recommended at Club Drive and Mona Lisa Road. Conduits and pullboxes are recommended for the new intersection of Magee Road where southbound-to-eastbound La Cholla Boulevard traffic will enter Magee Road.
- Additional capacity on Oracle Road is needed at the Magee Road/Oracle Road intersection to serve the projected 2030 traffic demand. "Due to the heavy 2030 traffic projections, even significant at-grade improvements will not provide acceptable operations. To meet 2030 traffic demand, grade separation should be evaluated.
- Frontage Road between Zaragoza Drive and Camino de Maximillian can be converted to one-way roadway while maintaining acceptable access.

4.2 Alternative Modes

4.2.1 Transit

There is one regular and one express bus route that provide service along the project corridor – Route 61 (La Cholla Boulevard) and Route 102 (Ina Road Express). Route 61 originates and terminates at the Tohono Tadaí Transit Center. There are no stops for this route directly in the project area but service is provided to the Pima Community College Northwest Campus, the YMCA, and to the Foothills Mall complex.

Route 102, the Ina Road Express, is served by busses stationed at the Ronstadt Transit Center with three morning runs and three evening runs. The route travels on the segment of La Cholla

Boulevard between Magee Road South and Magee Road North then continues along Magee Road between La Cholla Boulevard and Oracle Road. There are eight eastbound stops and eight westbound stops. There are no new proposed bus stops with bus pull outs planned for the segments of road mentioned.

4.2.2 Bicycle, Pedestrian and Equestrian Facilities

There are no designated bike routes or paved bike lanes located along the corridor.

There is no continuous sidewalk along the project corridor. A paved shared-use path is located on the north side of Magee Road between Paseo Del Norte and Northern Avenue. Sidewalk is located at the intersection of Cortaro Farms Road and Thornydale Road, the intersection of Magee Road and Shannon Road/Tuscany Drive, and the bridge over the CDO Wash.

There are no current equestrian trails located adjacent to or crossing the corridor. The nearest equestrian trail is located at Catalina State Park in Oro Valley.

5.0 Design Standards and Criteria

At the initiation of this project, the following Table 5.1 was developed for this project by the design team and is based on the *Pima County Roadway Design Manual, Second Edition* (RDM) published in December 2003.



Table 5.1 Design Criteria

Description	Design Criteria - Desirable	Criteria Source
Roadway Classification	Minor Arterial	RDM
Design Speed	Arterial 50 mph (See Note 1) Collector 35 mph Residential 25 mph	(60 mph Max) RDM 2.2 (See Note 9)
Horizontal Alignment		
Control Location	Centerline of Roadway	RDM Figure 2-7
Stopping Sight Distance	425' (50 mph Design Speed)	RDM 2.4, Table 2-3
Radius		See 2004 AASHTO p167
Max. Radius	22918' (0.25 Dc)	AASHTO 2001, p 147
Min. Radius	926' @ R/W Centerline	AASHTO 2004, p 147 (See Note 2)
Max. Degree of Curve	6.125 Dc	AASHTO 2004, p 147
Minimum Horz Curve Length	500'	RDM 2.2
Reverse Curves		RDM 2.2 (See Note 7)
Compound Curves	(to be avoided if possible) 1.5:1	RDM 2.2
Maximum Delta without Curve	1 degree 8 min	RDM 2.2
Superelevation (Maximum)	0.04 ft/ft (urban/suburban)	RDM 2.2, AASHTO 2004, pp 145-149 (See Note 3)
Superelevation Runoff/Tangent Runout		RDM 2.2, AASHTO 2004, pp 175-191
Vertical Alignment		
Control Location for Profile Grade and A/R	Lt & Rt Median Gutter Control	RDM Figure 2-7
Maximum Gradient	3% Max -flat, 7% Max -foothills	RDM 2.4
Minimum Gradient	0.5%	RDM 2.4
Vertical Grade Break	4% Max (side streets & int) 0.5% Max (roadway)	RDM 2.4
Vertical Curve Length	3 x Design Speed (Min.)	RDM 2.4
Vertical Clearance		
Over/Under Roadway	16' (New Structure)(allow for pvmt resurfacing)	AASHTO 2004 pp 472
Cross Sectional Elements		
Lane Widths		
Thru Lanes	13' (Inside w/curb), 12' (other)	RDM 2.2 (Table 2-1) RDM 2.4
Turning Lanes		RDM 2.2 (Table 2-1) (See Note 8)

Description	Design Criteria - Desirable	Criteria Source
Usable Shoulder Widths		
Inside	(1' shy next to curb - inc in 13' lane)	RDM 2.2 (Table 2-1)
Outside	6' (w/ curb) , 10' (w/ out curb) 6' paved 4' unpaved)	
Cross Slope (Lane & Shoulder)	-2% (Crowned Section)	RDM 2.2 (Table 2-2)
Medians	Raised	RDM Figure 2-7
Width	24' (20' Min)	RDM 2.2 (Table 2-2)
Side Slopes		
Within Clear Zone	6:1	RDM 2.2 (Table 2-2)
Outside Clear Zone	4:1 (cut & fill)	RDM 2.2 (Table 2-2)
Clear Zone Width (See Note 4)	24' (No curb); 24' (w/curb)	AASHTO 2002 Roadside Design Guide, Table 3.1
Sidewalk Width	5' (6' against curb)	RDM 2.6
Turnlanes		
Design Vehicle	WB-50	RDM 2.5
Taper Rate or Length	100' Lt, 150' Rt & 175' (dual lefts)	PC/COT PMDM Sht No. 4-6a & 4-7 (See Note 5)
Storage Length	150' (Min)	(For lengths see Kittelson Traffic Report)
Corner Radii	35'	RDM 2.5
Lane Addition	15:1	PC/COT PMDM Sht No. 4-7
Lane Drop	Design Speed :1	PC/COT PMDM Sht No. 4-1
Intersections		
Intersection Sight Distance	Driver eye ht=3.5', object vehicle ht=3.5'	(See Note 9)
Corner Radii	35'	RDM 2.5
Streets		
Design Vehicle	WB-50	RDM 2.5 (See Note 6)
Corner Radii	35'	RDM 2.5
Driveways		
Design Vehicle	BUS-40	AASHTO 2004 p 17
Corner Radii	35'	RDM 2.5
Skew	20 degree Max	RDM 2.5

Design Criteria Notes:
 Note 1: Posted speed 10 mph less than design. Current Posted Speed = 40 mph. 45mph Design Speed on Magee Rd at La Cholla Blvd.
 Note 2: Use 970' to Accommodate Outside Travel Lane, 711' @ R/W Centerline, DS= 45 mph
 Note 3: Keep superelevation transitions off of bridge structures
 Note 4: Assume ADT > 6000, DS=50 mph, 6:1 slopes
 Note 5: Taper rate
 Note 6: For dual lefts SU-30 Inside lane, WB-50 outside lane
 Note 7: Permitted only when separated by 4/3 the length of the longer superelevation runoff length
 Note 8: 13' (lt & rt w/ curb), 13' (lt& rt no curb) 12' (two-way left)
 Note 9: RDM 2.5, AASHTO 2004 pp 654-676 (ISD); AASHTO 2004 pp115-117 (DSD); RDM Table 2-3 (SSD)
 Note 9: 45 mph DS on Magee Rd La Cholla



The RDM references several national association documents to establish criteria including:

- The American Association of State Highway Transportation Officials (AASHTO) 2004, *Policy on Geometric Design of Highways and Streets*, 5th ed.
- AASHTO, 1999, *Guide for the Development of Bicycle Facilities*
- AASHTO *Roadside Design Guide*, 2002
- AASHTO, 1996, and revisions 1997 - 1999, *Standard Specifications for Highway Bridges*
- Federal Highway Administration (FHWA), 2000, *Manual on Uniform Traffic Control Devices (MUTCD 2000)*
- FHWA, 1983, *Hydraulic Design of Energy Dissipaters for Culverts and Channels*
- FHWA, 2001, *Urban Drainage Design Manual*, HEC-22
- FHWA *Evaluating Scour at Bridges*, HEC-18
- Arizona Department of Transportation (ADOT) *Roadway Design Guidelines*. January 2007
- ADOT *Materials Preliminary Engineering and Design Manual*
- ADOT *Bridge Design and Detailing Manual*
- Transportation Research Board *Highway Capacity Manual (HCM)*

The RDM references several Pima County documents as criteria sources, including:

- Pima County *Drainage and Channel Design Standards for Local Drainage*, 1984
- Pima County/City of Tucson *Standard Specifications for Public Improvements*, 2003
- Pima County/City of Tucson *Pavement Marking Design Manual*
- Pima County *Street Lighting and ITS Design Manual*
- Pima County *Traffic Signal Design Manual*
- Pima County *Environmentally Sensitive Roadway Guidelines*
- Pima County *Community Participation and Mitigation Ordinance*
- Pima County *Floodplain and Erosion Hazard Management Ordinance*
- Pima County/City of Tucson. *Standard Details for Arizona Land Boundary Surveys*
- Pima County. 1979. *Hydrology Manual for Engineering Design and Flood Plain Management*.

5.1 Roadway Design

The Cortaro Farms Road/Magee Road final configuration meets all of the criteria for an AASHTO Urban Minor Arterial. La Cholla Boulevard will be reconstructed between Zarragoza Drive and the north Magee Road/La Cholla Boulevard intersection. The new La Cholla Boulevard roadway section will generally follow *Typical Section for 6-Lane Divided Road (Urban)* as described in Figure 2-10 on Page 2-32 of the *RDM*.

5.2 Drainage Design

The following information regarding drainage is summarized from the *2009 Drainage Report* by Arroyo Engineering.

The drainage design criteria used for the various components of this project were specified in the Pima County Roadway Design Manual.

5.2.1 Hydrology

For all offsite watersheds, except the CDO Wash, the Pima County hydrology procedure from the "PC-HYDRO User Guide" (Arroyo Engineering, March 2007), was used to compute the 100-year peak discharges. The 100-year peak discharge for the CDO Wash was taken from a recently completed hydrologic analysis ("Letter of Map Revision for the CDO Wash," Arroyo Engineering, 2008).

5.2.2 Cross Drainage Criteria

The proposed cross-drainage structures were designed to convey the 100-year peak discharge under the proposed roadway. The U.S. Army Corps of Engineers HEC-RAS hydraulic model was used to evaluate most of the proposed cross-drainage structures and the impacts to the existing conditions floodplain limits. Bentley Culvert Master was also used to evaluate some of the proposed cross-drainage structures. A listing of proposed cross culverts is shown in Table 5.2. An alternative structures analysis for cross-drainage structures was also performed which included the analysis of reinforced concrete, steel plate arch culverts, high density polyethylene pipe (HDPE) and spiral rib high density polyethylene pipe (SRHDPE)

The proposed cross-drainage culverts were also evaluated to determine potential sedimentation impacts at the culvert inlets. The evaluation was completed using the methodology presented in Section 11.5 of the "City of Tucson Standards Manual for Drainage Design and Floodplain Management" (Simons, Li and Associates, Inc., 1989). Erosion at culvert outlets was evaluated using the methodology in "Drainage and Channel Design Standards for Local Drainage," (Pima County, 1984). The erosion potential was evaluated to determine the design parameters for erosion control measures at the culvert outlets.



Table 5.2: Proposed Cross Culverts

Location	Size	Material	Capacity	Plan Reference
Station 238+62	36"	RCP	62 cfs	RPP1-Page 55
Station 240+17	2-36"	RCP	107 cfs	RPP2-Page 56
Station 246+38	1-8'x4'	RCBC	341 cfs	RPP2-Page 56
Station 247+72	3-36"	RCP	139 cfs	RPP2-Page 56
Station 248+88	2-24"	RCP	25 cfs	RPP2-Page 56
Station 252+93	32"x50"	HERCP	72 cfs	RPP3-Page 57
Station 253+38	32"x50"	HERCP	70 cfs	RPP3-Page 57
Station 253+87	32"x50"	HERCP	67 cfs	RPP3-Page 57
Station 260+34	2-24"	RCP	35 cfs	RPP4-Page 58
Station 264+33	2-12'x5'	RCBC	858 cfs	RPP4-Page 58
Station 285+40	2-42"	RCP	97 cfs	RPP7-Page 61
Station 291+15	36"	RCP	23 cfs	RPP8-Page 62
Station 297+55	2-8'x4'	RCBC (extension)	684 cfs	RPP8-Page 62
Station 299+14	2-36"	RCP	74 cfs	RPP9-Page 63
Station 309+19	2-36"	RCP	125 cfs	RPP10-Page 64
Station 322+69	8'x4'	RCBC	221 cfs	RPP11-Page 65
Station 264+69 Carmack Wash at La Cholla Blvd.	8-10'x8'	RCBC	4800 cfs	RPP15-Page 69
Station 378+58 Carmack Wash at Magee Rd.	5-12'x10'	RCBC	4800 cfs	RPP18-Page 72
Station 420+33	30"	RCP	41 cfs	RPP23-Page 77
Station 425+27 Pegler Wash at Magee Rd.	4-12'x6'	RCBC	1497 cfs	RPP23-Page 77
Station 436+42	3-42"	RCP	92 cfs	RPP24-Page 78
Station 445+23	3-8'x4'	RCBC	732 cfs	RPP25-Page 79
Station 460+75	2-24"	RC P	39 cfs	RPP27-Page 81
Station 469+75 to Station 478+60	2-10'x3'	RCBC (extension)	665 cfs	RPP29-Page 83
Station 479+17	2-48"	CMP (extension)	130 cfs	RPP29-Page 83
Station 102+55 Northern Ave.	2-8'x4'	RCBC	665 cfs	RPP45-Page 99
Station 258+19 La Cholla Blvd.	2-8'x6'	RCBC	734 cfs	RPP32-Page 86

5.2.3 Open Channel and Floodplain Hydraulics

Open channel flow was evaluated using the HEC-RAS software program. This model was used to determine the existing conditions floodplain limits, as well as to evaluate most of the proposed cross-drainage structures.

5.2.4 Design Channel Criteria

The HEC-RAS hydraulic model was utilized to evaluate the proposed design improvements along the Carmack Wash for the 100-year design flow. The design hydraulic variables were used to develop bank heights, including freeboard and superelevation. These calculations were based upon the methodology presented in the "City of Tucson Standards Manual for Drainage Design and Floodplain Management" (Simons, Li and Associates, Inc., 1989).

5.2.5 Erosion and Sedimentation

Estimates of the scour depths to establish bank protection toe-down depths for the Carmack Wash design channel were calculated using the "City of Tucson Standards Manual for Drainage Design and Floodplain Management" (Simons, Li and Associates, Inc., 1989). Long-term aggradation/degradation trends were also evaluated in an equilibrium slope analysis to determine design parameters for potential grade control structures.

5.2.6 Pavement Drainage Design

Pavement drainage design will comply with Pima County Roadway Design Manual.

5.3 Access Control

Access control will adhere to the *Roadway Design Manual's* guidelines for an urban four-lane divided arterial.

The following information regarding traffic is summarized from the *February 2009 Draft Final Traffic Engineering Report* by Kittelson & Associates.

The current configuration of Cortaro Farms Road/Magee Road is a two-way left-turn lane throughout most of the corridor.

The Pima County Roadway Design Manual requires 24-foot raised median for this roadway. Based on Pima County guidelines, the minimum turn-bay length for a posted speed of 45 mph is 250 feet. This includes a 100-foot taper and 150 feet of storage.

A two-way frontage road on the south side of Magee Road, between Zarragoza Drive and Camino de Maximillian has a posted speed limit of 25 mph and provides access to seven residences. The Frontage Road is proposed to be converted to one-way to improve the flow of traffic and safety.

Another frontage road, undesignated and unpaved, exists on the north side of Magee Road between Leonardo da Vinci Way and Paseo del Norte.



An alternative access for the Fire Station on Magee Road just east of Northern Avenue was evaluated in order to provide full access to and from Magee Road. A median opening was provided, which falls within a left turn bay, to allow left in and left out movements.

6.0 Alternatives

The Cortaro Farms Road/Magee Road improvement project will add lanes to the existing road within the existing right-of-way for most of the project length. Alternatives to be considered, among others, involve these project components:

- Construction of a second bridge over the CDO Wash
- Longitudinal drainage configuration
- Possible realignment of two frontage road segments
- The alignment of a new La Cholla Boulevard/Magee Road intersection

6.1 Bridge Construction

At the project kickoff meeting there was discussion of replacing the existing bridge over the CDO Wash and if not where to locate a second bridge. The decision to add a second bridge south of the existing structures was reached after a preliminary analysis showed that location would have only minor impacts to ongoing improvements to the CDO Trail and was also the least expensive approach.

6.2 Longitudinal Drainage

Two possible approaches to conveying drainage along the road were evaluated. A system of curb-located catch basins connected by under-the-road trunk line storm drains was compared to having flows captured and conveyed in channels running parallel to the roadway outside the clear zone. The choice of drainage approach will depend largely upon prevalent roadside conditions.

6.3 Frontage Road Segments

One formal and one informal segment of frontage road provide access to residential properties along Magee Road east of La Cholla Boulevard.

West of La Cañada Drive, between Zaragoza Drive and Camino de Maximillian a number of existing residences are served by a two-way Frontage Road. Three new frontage road configurations including two-lane, two-way frontage road, a one-lane, two-way frontage road and a one-lane, one way frontage road were presented to the Citizens Advisory Committee (CAC) and an open house. The alternative with a one-way frontage road with an entrance offset from the Zaragoza Drive/Magee Road intersection was selected. The choice was based on safety and traffic studies and also was supported by public input.

East of La Cañada Drive residents utilize unimproved right-of-way to get to their driveways. A shared use path also occupies this segment of right-of-way between Northern Avenue and Paseo del Norte. Access to these residences will be accommodated by extending their driveways to curb cuts along the north edge of the new roadway.

6.4 Magee Road/La Cholla Boulevard Intersection Improvements

The Regional Transportation Plan approved by the voters in 2006 dictates that “the proposed improvements along Magee Road eliminate the jog at La Cholla Boulevard”. The results of the *Draft Final Traffic Engineering Report* prepared by Kittelson & Associates confirmed the need to eliminate the jog. In the year 2030, even if the two intersections that form the jog were to be improved, traffic in the area of the jog would not operate at an acceptable level of service.

Early in the design process, the design team developed and qualitatively evaluated over 10 alternative intersection configurations to eliminate the jog. A number of alternative intersection configurations were eliminated from further consideration as the analysis indicated that they were not feasible for this location due to cost, traffic operations or environmental impact considerations.

Four alternative configurations were further evaluated, both qualitatively and quantitatively. Each is described and presented in the following sections.

6.4.1 "S" Curve Alternative

The "S" Curve alternative configuration is presented in Figure 6.1. Some of the key characteristics of this alternative configuration are also presented. In general, east and west bound traffic would travel along a series of curves through one intersection at La Cholla Boulevard. Northbound and Southbound traffic on La Cholla Boulevard would function as it does today, however there will be one intersection at La Cholla Boulevard and Magee Road as opposed to two intersections.

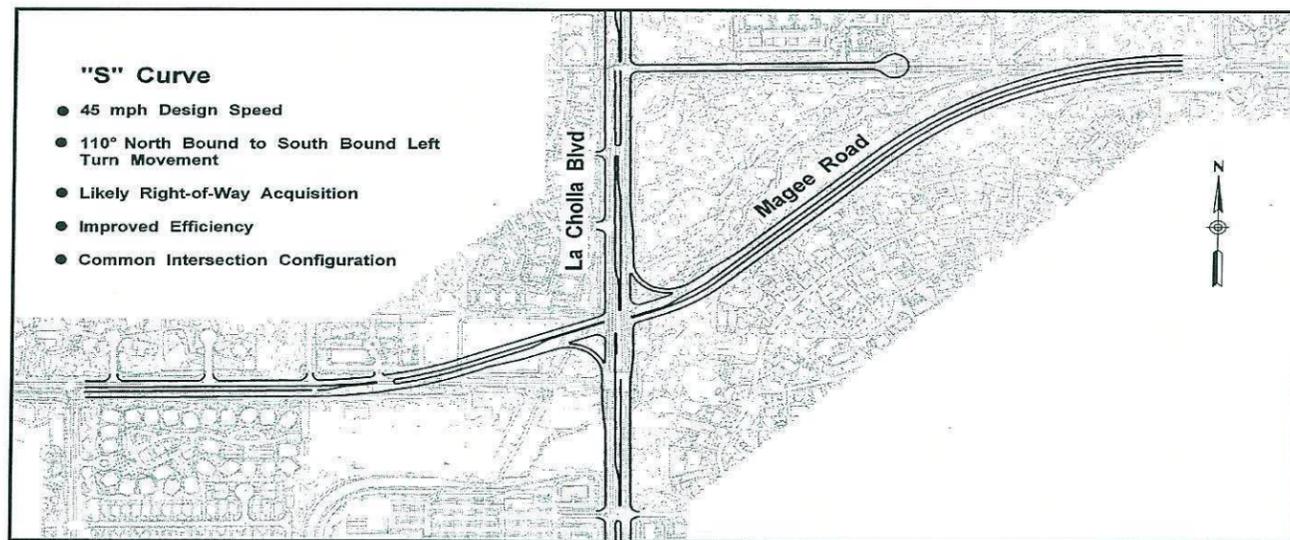


Figure 6.1: "S" Curve Alternative

6.4.2 Traffic Roundabout Alternative

The Traffic Roundabout alternative configuration is presented in Figure 6.2. Some of the key characteristics of this alternative configuration are also presented. In general, traffic from all four directions enters the roundabout and travels counterclockwise to a departure point.

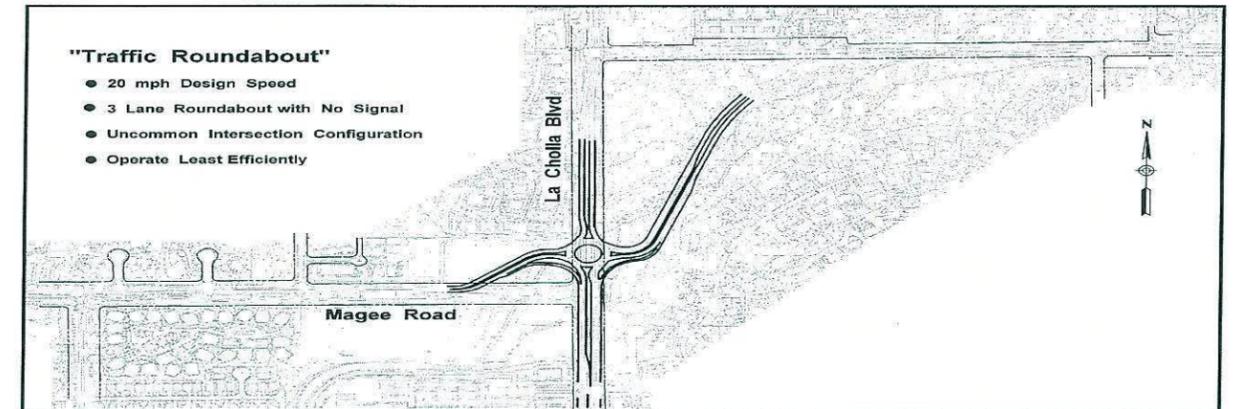


Figure 6.2: Traffic Roundabout Alternative

6.4.3 Flyover Alternative

The Flyover alternative configuration is presented in Figure 6.3. Some of the key characteristics of this alternative configuration are also presented. In general, traffic flow is similar to that of the “S” curve configuration. However, northbound to west bound traffic approaching the intersection would, prior to the intersection, exit to the right and travel over the intersection via a grade separated flyover ramp. The traffic would then enter the westbound lanes from the right.

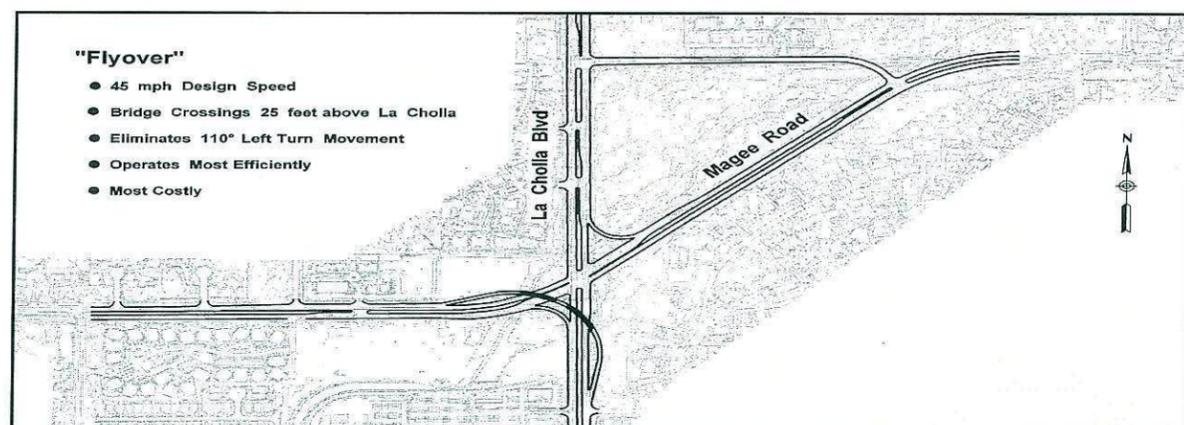


Figure 6.3: Flyover Alternative

6.4.4 Jug Handle Alternative (Preferred Alternative)

The Jug Handle alternative configuration is presented in Figure 6.4. Some of the key characteristics of this alternative configuration are also presented. In general, traffic flow is similar to that of the “S” curve configuration. However, northbound to westbound traffic would proceed through the intersection, exit to the right and travel to the westbound approach to the intersection via an at-grade loop ramp. Traffic would then proceed westbound through the intersection. Southbound to eastbound traffic would turn left, prior to the intersection, and proceed along the existing Magee Road alignment. Traffic would then turn left onto Magee Road, east of the intersection.

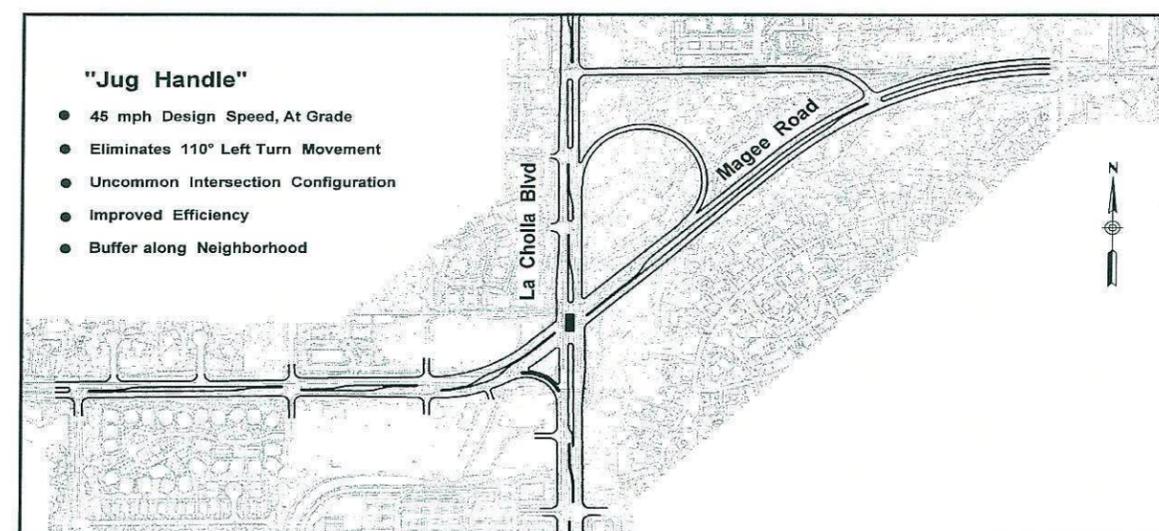


Figure 6.4: Jug Handle Alternative



6.4.5 Preferred Alternative

These four alternative intersection configurations were further evaluated. Based on public input, traffic analysis, cost estimating and evaluation of impacts, the Traffic Roundabout and Flyover were eliminated from further consideration. The Traffic Roundabout was eliminated due to its relatively poor traffic operations and the fact that roundabouts are uncommon to this area, especially a three lane roundabout. The Flyover was eliminated due to costs and environmental impact considerations.

A formal detailed alternatives analysis was then performed on the “S” Curve and Jug Handle alternative intersection configurations. A set of fifteen evaluation criteria was developed based on stakeholder input. The design team then compared the two alternatives based on each of the criteria. That comparison is presented in Table 6.1 and resulted in the selection of the Jug Handle as the preferred alternative. While there is not a significant advantage of the Jug Handle over the “S” Curve alternatives as shown in Table 6.1, the design team and stakeholders agreed that where the Jug Handle performed better than the “S” Curve, it performed significantly better. Where the “S” Curve alternative performed better than the Jug Handle, it performed marginally better, therefore the Jug Handle Alternative was selected.

Cortaro Farms Road/Magee Road

	S Curve	Jughandle	Notes
Operations	Equal	Equal	Both alternatives function at an acceptable operational level. The delay per vehicle (in seconds) for the S Curve is 41.3 during the am peak and 31.0 during the pm peak. The delay for the jug handle is 27.2 in the am and 46.7 in the pm.
Safety	Equal	Equal	Both alternatives meet minimum requirements for safety. The S curve has a greater than desirable left turn angle. The jug handle has a configuration that is unique to Tucson.
Cost	\$34.5 million	\$33.2 million	The project costs presented include construction, administration, right-of-way acquisition and business relocation costs. The additional costs for the S curve is due to right-of-way acquisition and business relocation.
Drainage	Equal	Equal	The drainage concept is similar for both alternatives. Floodplain impacts to numerous homes will be reduced or eliminated by either alternative.
Vegetation/Wildlife	Better	Worse	Both alternatives affect the same habitat and vegetative community, the Jughandle alternative would remove about 37 acres of vegetation, while the “S” curves would remove about 34 acres.
Historical, Cultural & Archaeological	Neutral	Neutral	Cultural Survey results indicate no sites present in the vicinity, thus no impacts with either alternative.
Air Quality	Equal	Equal	In general air quality is good in the project area and no exceedances of standards are expected with either alternative. Traffic delays which would impact air quality are roughly equivalent for both alternatives.
Water Quality/404 Permit	Equal	Equal	Assumed equal as the cross section of the Carmack Wash drainage facility does not substantially change with the intersection alternatives, an individual Permit would be required for either alternative. The degree of mitigation would be similar for each alternative with respect to drainage work.
Adjoining Land Use/Access	Worse	Better	Neither alternative would alter existing land uses. An undeveloped parcel in the NW corner would require R/W acquisition with the “S” and thus limit or reduce the develop options. Additionally the “s” curve would place traffic in closer proximity to existing residential properties, thus potentially requiring mitigation. Access impacts are similar with either option.
Recreation	Worse	Better	Both alternatives would limit future development options of the vacant 40-acre parcel east of La Cholla Boulevard. This parcel has been discussed as potential open space or recreation space. The Jughandle alternative creates the greatest obstacle to any future development and thus could be perceived as a better option with respect to retaining open space or recreation space.
Visual Character	Better	Worse	Both alternatives are at-grade facilities and thus would have similar general visual impacts. As the Jughandle alternative has larger footprint this alternative could be perceived as having greater impact on the area character.
Utilities	Equal	Equal	The alternatives are considered equal in that they impact the same utilities along Magee and La Cholla. Those utilities include telephone, gas, water, overhead and underground electric, CTV and sanitary sewer. There are no existing utilities in the undeveloped area to the southeast of Magee and La Cholla.
Noise	Worse	Better	The “S” curve brings the new roadway in closer proximity to approximately 12 residences (SE corner) and an apartment complex (on NW corner). It is expected that noise modeling will show higher impacts to receivers from the “s” curves it is about 100 feet closer to receivers than the Jughandle alternative.
Alternative Modes	Equal	Equal	Both alternatives include full accommodation of Alternative Travel Modes.
Hazardous Materials	Neutral	Neutral	No sites would be impacted by project.

Table 6.1: Comparison of Alternatives

7.0 Major Design Features

7.1 Roadway

7.1.1 Roadway Typical Section

Cortaro Farms Road/Magee Road typical section consists of two travel lanes and 6' bike lanes in each direction separated by a 24' wide raised median. Curb and sidewalk placement will be evaluated in final design. Magee Road typical section is presented in Figure 7.1

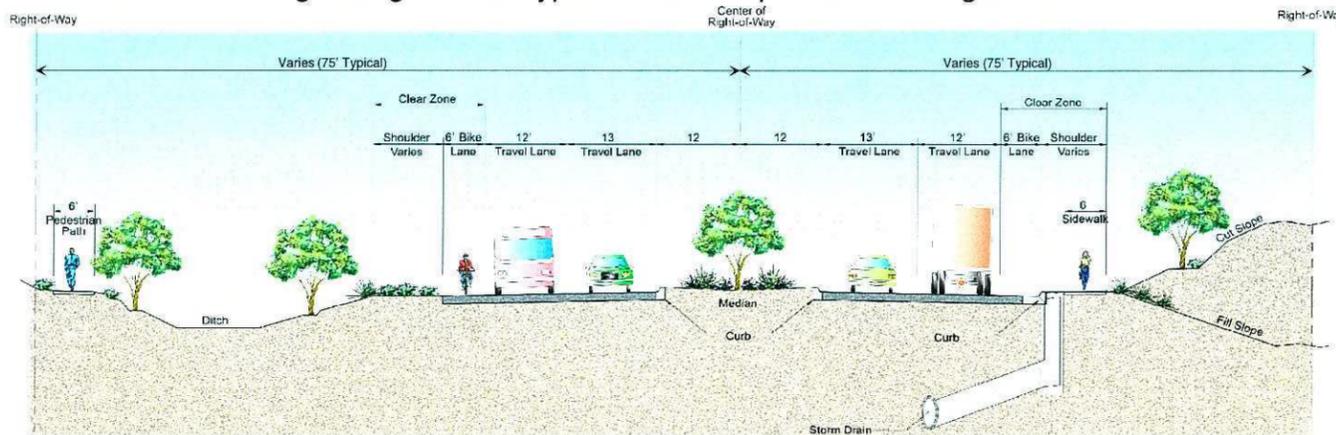


Figure 7.1: Magee Road Typical Section

7.1.2 Right of Way

About ten acres of new right-of-way, drainage easements and temporary construction easements are required for the project. Some new drainage easements are anticipated to accommodate proposed drainage structures. It will be necessary to transfer title to some portion of the southeast quadrant of the La Cholla Boulevard/Magee Road intersection from the Regional Flood Control District to Pima County for right-of-way.

7.1.3 Earthwork

The cut and fill for the project is generally balanced. Fill will be required to cross dip section drainages east of La Cañada Drive and to level the roadway east of Northern Avenue. Cortaro Farms Road is located within in an existing cut from Wheatfield Drive to Cortina Place and retaining walls are necessary to accommodate the widening.

7.1.4 Pavement Design

A Geotechnical Report and Pavement design will be performed as part of the final design of each phase of construction. The pavement structure assumed for this project was the one utilized for Pima County Project 4RTCCI - La Cañada Drive, Ina Road to Calle Concordia

7.1.5 Structures

A new bridge will be built south of the existing bridge over the CDO Wash to carry the additional lanes. A structures study will evaluate several alternatives and a structure selection decision will be made in the final design stage of the Magee Road widening from Thornydale Road to Mona Lisa Road project. Existing bank protection along the CDO Wash will be modified to accommodate the bridge.

7.1.6 Signalization, Lighting and ITS

Conduit, pull boxes, vaults and tracer wire for fiber optic Intelligent Transportation System communication will be installed throughout the project. The installation will be completed per the PCDOT Street Lighting & ITS Conduit Design Manual.

The existing major signalized intersections are Cortaro Farms Road and Thornydale Road, Cortaro Farms Road and Shannon Road, Magee Road and Shannon Road, Magee Road (South) and La Cholla Boulevard, Magee Road (North) and La Cholla Boulevard, Magee Road and La Cañada Drive, Magee Road and Northern Avenue, Magee Road and Oracle Road.

The proposed major signalized intersections are the same as mentioned in the existing major signalized intersections with the exception of the two signalized intersections on Magee Road and La Cholla Boulevard will be eliminated and one signalized intersection will be constructed at the new intersection location.

Street lighting will be provided at all signalized intersections and at non-signalized intersections that currently have street lighting. Street lighting will be provided for the new Magee Road and La Cholla Boulevard intersection because of the sharp curves and unusual turn movements associated with this intersection. Any additional street lighting will be evaluated in final design.

7.2 Drainage

The following information regarding drainage is summarized from the *April 2009 Drainage Report* by Arroyo Engineering.

7.2.1 Watersheds and Drainages

As the Carmack Wash approaches Magee Road from the north, an earthen berm along the west side of the floodplain, along with an earthen berm located on the north side of Magee Road, will be utilized to collect and direct the flows to a proposed drop structure and cross-drainage culvert located underneath the proposed Magee Road alignment. The proposed Magee culvert will convey the flow into a design channel that will continue southwesterly to La Cholla Boulevard, where a second proposed cross-drainage culvert will convey the flows to a second design channel segment. The second design channel segment will continue downstream

(southwesterly) to meet the existing Carmack Wash channel along the north side of the Wal-Mart parking lot.

With the exception of the CDO Wash and Carmack Wash, drainage improvements associated with the proposed roadway consist of cross-drainage structures that will collect and convey runoff under the roadway corridor. The proposed cross-drainage culverts will collect runoff without increasing the design flow depths upstream, and convey the runoff downstream concentration points which approximate existing conditions. Upstream collector channels will be utilized where necessary to collect widespread flows to the inlets of proposed cross-drainage structures. Erosion control measures will be utilized at the outlets of cross-drainage structures, where necessary.

The proposed improvements associated with the CDO Wash were based on the assumption that an additional bridge structure would be constructed, alongside the existing bridge, in order to provide the additional travel lanes that would be required at this location. Based on recent hydraulic modeling of the CDO Wash ("Letter of Map Revision for the CDO Wash," Arroyo Engineering, 2008), the existing bridge provides the required conveyance capacity and freeboard for the 100-year discharge associated with the CDO Wash.

The Carmack Wash will be channelized as the result of the major changes to the roadway alignments in the vicinity of the intersection of Magee Road and La Cholla Boulevard. A series of hydraulic structures are proposed to collect the flood waters at Magee Road, convey the flows southwesterly through the area of the roadway improvements, and discharge the flows into the existing channel located west of La Cholla Boulevard. The proposed channel and associated hydraulic structures will be designed for the 100-year discharge.

2500 feet of new bank protection will be added to the Carmack Wash to handle the 4800-plus cfs regulatory flood. Carmack Wash typical section is presented in Figure 7.2.

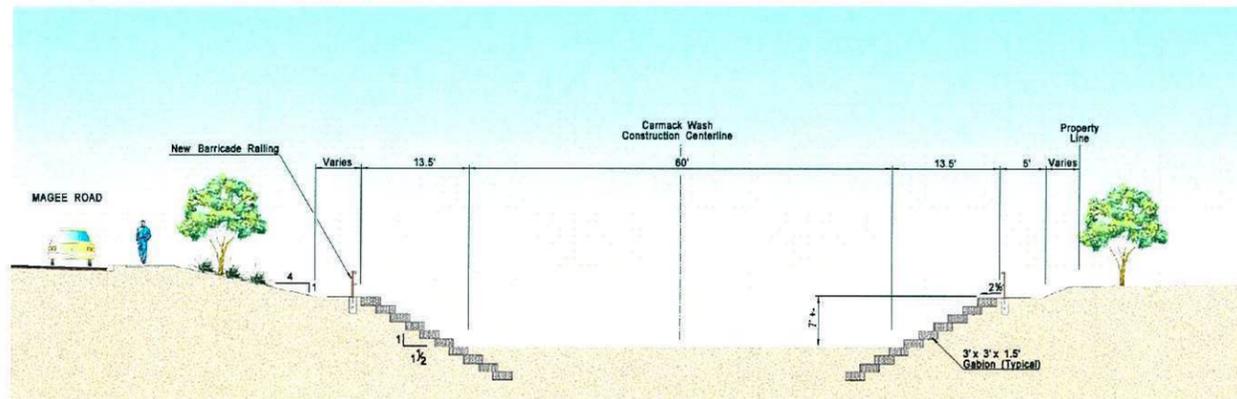


Figure 7.2: Carmack Wash Typical Section

7.2.2 Cross Drainage

In conjunction with the design of the proposed roadway, cross-drainage culverts will be used to convey the 100-year discharges under the new roadway. The proposed cross-drainage structures were designed so that there would be no negative impacts to the existing floodplains by increase the existing 100-year water surface elevations. In addition, erosion mitigation measures will be incorporated to eliminate negative impacts associated with concentrated flow at the culvert outlets.

7.2.3 Pavement Drainage

New culverts will be added and existing culverts extended to convey the Regulatory Flood Event (previously 100-year flood) under the roadway. Longitudinal drainage will be conveyed in ditches along the roadway or in a system of catch basins and storm drains, depending on existing conditions.

7.2.4 Permits and Regulatory Concerns

Preliminary design indicates an Individual Section 404/401 Clean Water Act Permit will be required for a new bridge crossing of the CDO Wash, channelization of portions of Carmack Wash and multiple small wash crossings. Additionally, an Arizona Pollutant Discharge Elimination System (AZPDES) will be required because there will be more than 1 acre of surface disturbance during construction (Section 402 of Clean Water Act).

7.3 Design Exceptions

Design Exceptions need to be approved by the Pima County Department of Transportation. The following design elements may need PCDOT approval:

- No Location Report completed though a report is called for in Appendix I-A-3 Section 4.3
- Median openings less than 660' (Appendix I-A-11 Section 7.4 says 1/4 mile suggested).

Locations are:

1. Between private drive west of Shannon Road and Shannon Road.
2. Between Shannon Road/Magee Road and Cortina Place.
3. Between Jensen Drive and Royal Sunset Drive.
4. Between Royal Sunset Drive and Sunflair Drive.
5. Between Como Drive and a private drive to the east.
6. Between Totavi Trail and Camino de Maximillian.
7. Between Camino de Maximillian and Sendero Uno
8. Between La Cañada Drive and a private drive to the east.
9. Between Private drive and Leonardo de Vinci Way.
10. Between Leonardo de Vinci Way and Cool Drive.
11. Between the private drive to the west and Northern Avenue.
12. Between Northern Avenue and the private drive to the east.
13. Between the private drive to the west and Oracle Road.



- Storage for dual northbound left turn at Oracle Road conflicts with median opening into major shopping center and with storage for southbound left turn onto Northern Avenue.
- A portion of the existing Magee Road grade between Tuscan Drive and Mona Lisa Drive is 8%. Section 2.4 Vertical Alignment specifies a 7% maximum grade.
- Southwest left turn storage length at Sun Flair Drive is reduced to avoid impacting the CDO Wash bridge northwest joint therefore eliminating a maintenance and safety issue. Other left turn lane locations that do not meet the minimum 150 ft of storage include the westbound left at Como Drive, the eastbound left at Cool Drive, the northbound left at Zaragoza Drive and the westbound left, west of Oracle Road due to physical constraints.
- The proposed drainage channel to carry Carmack Wash flows is sized to match existing downstream capacities which is less than the current measured flows.
- Existing downstream capacities may instigate exceptions for cross drainage structure size in some locations.
- Horizontal Curves less than 500' in length. Locations are:
 1. Magee Road at the reverse curve just west of the CDO Wash. The curve length measures 484 ft and has a very large radius and does not present any safety issues,
 2. Magee Road just east of Oracle Road. Speed is very low and serves as more of a driveway or collector.
 3. Access Road just west of Magee Road intersection. Approaching a stop, T-intersection condition.
 4. The bicycle loop at the northeast corner of La Cholla Boulevard and Magee Road. Bicycle facility can be less than 500 ft.
 5. Free right turn lane at the southwest corner of Magee Road and La Cholla Boulevard. Free rights typically less than 500 ft.
 6. Reverse curves at the Frontage Road entrance and exit. Very low speed, serves as a residential collector.
- Exception in design Speed 45 mph on Magee Road at La Cholla Boulevard. The limits of the 45 mph design speed occur along Magee Road between Como Drive and Romero Avenue. The design speed was reduced from 50 mph to 45 mph in order to get the geometry to fit within the area available, without having to impact residences along the south side of Magee Road, east of La Cholla Boulevard.
- Greater than 20° Skew at Magee Road and La Cholla Boulevard Intersection.

8.0 Social, Economic and Environmental Considerations

The following information regarding Social, Economic and Environmental Considerations is summarized from the *Environmental Assessment* by EcoPlan & Associates. See that report and its appendices for detailed Social, Economic and Environmental Considerations data.

The Environmental Assessment (EA) was prepared to meet the requirements of the Pima County Environmental Assessment and Mitigation Report (EAMR) and the Federal Highway

Administration guidance for the National Environmental Policy Act (NEPA) as codified in 23 CFR 771. Due to federal funding, the environmental clearance process is administered by Pima County and the Arizona Department of Transportation, with Federal Highway Administration approval.

8.1 Impacts Requiring Mitigation

The EA provides a full list of recommended mitigation measures. The following is a summary of non-standard measures (standard measures include typical construction activities – dust control, public notification, traffic control plan, etc.):

- Due to demolition of existing reinforced concrete pipes and modifications to the CDO Wash Bridge, PCDOT will test for asbestos.
- PCDOT will continue to coordinate with Pima County Natural Resources Parks and Recreation to insure no impacts occur to the Cañada Del Oro Linear Park multi-use trail.
- Impacts are expected to native vegetation and riparian areas. Mitigation will follow a combination of US Army Corp of Engineers Section 404 Permit requirements, Pima County Flood Control District Floodplain Ordinance measures and PCDOT Environmentally Sensitive Roadway measures.
- Impacts will occur to Waters of the US. PCDOT will secure an Individual Clean Water Act Section 404/401 Permit prior to construction.
- As more than one acre of surface disturbance will occur, an Arizona Pollutant Discharge Elimination System permit will be required. A Storm Water Pollution Prevention Plan and appropriate Notice of Intent and Notice of Termination will be prepared for the Arizona Department of Environmental Quality.
- Noise mitigation in the form of barrier walls will occur at 7 locations. Additionally PCDOT will utilize rubberized asphaltic concrete paving material to reduce noise.
- PCDOT will continue to conduct annual cactus ferruginous pygmy-owl surveys until project construction is underway.

8.2 Jurisdiction and Ownership

The study area falls mostly in the jurisdictional boundary of unincorporated Pima County. A segment of the eastern study area is located in the Town of Oro Valley. Private lands exist in the study area and compose the majority of the land ownership. The Preferred Alternative would not require displacing any residents but will require right-of-way (R/W) acquisition from private property.



8.3 Existing Land Use

Land uses were verified using aerial photography and a field survey of the study area. Existing land use in the study area is primarily developed lands and consist of commercial, public/institutional, residential, recreation, and vacant.

Commercial land uses, including commercial development, shopping centers, office buildings, and an assisted living complex are located throughout the corridor. Most commercial development is at the major intersections (i.e., at Thornydale Road, La Cholla Boulevard, La Cañada Drive, and Oracle Road [SR 77]). No public schools, hospitals, or social services agencies exist immediately adjacent to the corridor. A private school association with the Lutheran Church is adjacent to the project. Within the study area there nearby public schools and the Pima Community College - Northwest Campus.

Residential development (e.g., single-family houses, apartments, townhouses) are present throughout the project area, and land use varies from low-density, single-family houses to apartment complexes. There are vacant lots near the intersection with the La Cholla Boulevard intersection, and there are no industrial developments in the project vicinity.

Recreational areas include the Northwest YMCA, Northwest Community Center Park at Shannon Road, Cañada Del Oro Linear Park, several Eastern Pima County Trail system multi-use trails, and the Omni Tucson National Golf Resort located north of the project limits at Shannon Road.

8.4 Future Land Use

Future land use within unincorporated Pima County is based upon the Planned Land Use map (Northwest Subregion) in the Pima County Comprehensive Land Use Plan (2001). There are two areas within the project limits that are designated as Urban Intensity Categories and shall be applied to designated planned use within urban areas only. Future land use at the intersection of Cortaro Farms Road and Thornydale Road is designated as Community Activity Center. The intersection of Magee Road and La Cholla Boulevard is designated as Regional Activity Center.

The remainder of the project area is designated as Urban Intensity Categories Medium/High Intensity Urban, Medium Intensity Urban or Low Intensity Urban (Pima County 2001). These land uses are a mix of residential and commercial, consistent with current uses.

Future land use within the Town of Oro Valley is based upon the Planned Land Use map in the Town of Oro Valley General Plan Update 2020 (2005). The portion of the project area within the Town of Oro Valley limits is between Northern Avenue and Oracle Road (SR77). The area on the north side of Magee Road is designated Neighborhood Commercial/Office. The area on the south side of Magee Road is designated Community/Regional Commercial.

8.5 Title VI and Environmental Justice

Title VI of the Civil Rights Act of 1964 and related statutes ensure that individuals are not excluded from participation in, denied the benefits of, or subjected to discrimination under any program or activity receiving federal financial assistance on the basis of race, color, national origin, age, sex, and disability. Executive Order 12898 directs that federal programs, policies, and activities do not have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

No impacts to protected populations are expected.

8.6 Physical and Natural Environment

The inventory of the physical and natural environment of the study area consisted of gathering resource data and information from various local, state, and federal agencies, including the Arizona Department of Environmental Quality (ADEQ), the Arizona Game and Fish Department, and the U.S. Fish and Wildlife Service (USFWS). The characteristics of the physical and natural environment were also identified based on a site visit to the study area by a qualified biologist. The study area does not occur in any critical habitat, designated or proposed, under the Endangered Species Act (16 U.S. Code [USC] 1531–1544, as amended).

8.7 Topography/Physiology

The study area is located in the Basin and Range Physiographic Province of Central Arizona, which is characterized by numerous mountain ranges rising abruptly from broad valleys or basins. Ranges and associated basins typically have a north-to-northeast trend with through-flowing drainages. Rocks exposed in this province consist of well-represented varieties of the three major types: igneous, metamorphic, and sedimentary (Hendricks 1985).

The project area lies between approximately 2,300 feet and 2,580 feet elevation above mean sea level on gently rolling terrain on the bajada extending southwest of the Santa Catalina Mountains and the bajada extending south of the Tortolita Mountains.

8.8 Biological Resources

No threatened, endangered, proposed, candidate, or AGFD special status plant species are likely to occur in the study area; therefore, the Preferred Alternative would have no effect on these plant species. The Preferred Alternative would have no impact on threatened, endangered, proposed, or candidate wildlife species in the study area. Though the cactus ferruginous pygmy-owl is not listed with the USFWS, it remains on the AGFD's list of Wildlife of Special Concern in Arizona and the county's Priority Vulnerable Species list. Loss of potentially suitable habitat would occur primarily at Carmack Wash.

The Preferred Alternative would impact almost 62 acres of vegetated areas within the project limits, impacting native plants protected by the Arizona Native Plant Law and the Environmentally Sensitive Roadway Guidelines (ESR). The Preferred Alternative would impact



approximately 8.4 acres of riparian habitat. The impacted habitat falls into the following three categories: Important Riparian Habitat (0.73 acre), Xeroriparian B habitat (1.63 acres), and Xeroriparian C habitat (6.05 acres).

Potential impacts on wildlife and wildlife habitat from the Preferred Alternative, including Carmack Wash channelization, could include loss of suitable habitat within the construction footprint, temporary noise impacts from construction activities, and impeded wildlife movement across Cortaro Farms Road/Magee Road. Wildlife connectivity from the channelized Carmack Wash to the north would be accommodated through large box culverts or arched culverts at Magee Road. The large culverts will provide north/south wildlife connectivity across Cortaro Farms Road and Magee Road.

8.9 Water Resources and Floodplains

A review of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map panels for the study area (FEMA 2008) indicated the existing Cortaro Farms Road/Magee Road roadway is located within Special Flood Hazard Areas Inundated by 100-year Floods in Zone A (no base flood elevations determined) (Map Number 04019C1610K) of an unnamed wash immediately east of Thornydale Road. The project limits are also located within Special Flood Hazard Areas Inundated by 100-year Floods and Floodway Areas in Zone AE (base flood elevations are determined to be at 2290 feet) at the CDO Wash (between Thornydale Road and La Cholla Boulevard). Impacts to floodplains are expected to be positive through the reduction of flood hazard at Carmack Wash.

Waters of the US are regulated by the US Army Corps of Engineers. A preliminary jurisdictional delineation determined the CDO Wash, Massingale Wash, Carmack Wash, Pegler Wash, and 8 unnamed washes to be Waters of the US. As more than ½ acre of permanent impacts will occur, PCDOT will apply for a Clean Water Act Section 404/401 Individual Permit. Mitigation would include in-lieu fees and on-site mitigation consistent with the Pima County Floodplain Ordinance and ESR guidelines.

8.10 Visual Character

The viewsheds within the project area are largely defined by level of development, natural drainage features, vegetation type, and regional topography. Foreground (less than ¼ from observer) and middleground (¼ mile to 1 mile from observer) viewsheds vary in quality depending on the location of the viewer within the project area. Background views (beyond one mile) are also considered of above average quality and consist of views of mountain ranges at nearly all locations from within the project area. These mountain ranges provide the backdrop for the dramatic sunsets that characterize the Tucson area.

The Preferred Alternative would have moderate visual impacts on foreground and middle-ground views by removing some of the native vegetation that provides the rural feel of the area surrounding Carmack Wash and other ephemeral washes as well as in the residential areas of

the study area. To restore some of these foreground views, native vegetation would be replanted within the right-of-way and in the vicinity of Carmack Wash upon completion of construction as part of the Preferred Alternative. The installation of public art treatments could soften structural impacts or create points of visual interest. Landscaping would help screen adjacent properties and provide the motorist with a consistent roadway character. The channelization of Carmack Wash, however, would affect foreground views of nearby residents and, to some extent, motorists on Magee Road. The Preferred Alternative would not affect background views from within the project limits.

New street lighting fixtures would be shielded or directional to limit light intrusion into neighborhoods in accordance with the *Street Lighting and ITS Conduit Design Manual* (PCDOT 2006). The construction of the Preferred Alternative would not be expected to diminish the ESR classification and, therefore, Pima County is not expected to reclassify the corridor.

8.11 Air Quality

The 1990 Clean Air Act Amendments and NEPA require that air quality impacts be addressed in the preparation of environmental documents. Further, the Clean Air Act Amendments and NEPA established National Ambient Air Quality Standards (NAAQS) for six pollutants. These pollutants, referred to as the “criteria pollutants,” include carbon monoxide (CO), nitrogen dioxide (NO₂), ozone (O₃), particulate matter (PM_{2.5} and PM₁₀), sulfur dioxide (SO₂), and lead (Pb). Primary and secondary standards for NAAQS were established for most of the criteria pollutants.

The air quality analysis performed for the project focused on vehicle emissions of CO. Other pollutants, such as particulate matter and oxides of nitrogen, are also components of vehicular emissions; however, CO is the primary pollutant for which the EPA has developed guidelines for quantifying impacts. Ozone, nitrogen oxides, and hydrocarbons are pollutants that are regional in nature and, as such, meaningful evaluation at the project level is not possible.

In addition to the NAAQS criteria air pollutants, the EPA also regulates air toxics (Mobile Source Air Toxics, MSAT). Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners) and stationary sources (e.g., factories or refineries).

The long-term impacts associated with the proposed improvements are not expected to cause or contribute to an exceedance of air quality standards. Results of the microscale modeling performed indicate that impacts to ambient 1-hour average concentrations of CO are predicted to generally be less than 2 ppm. Impacts to the remaining criteria pollutants are also expected to be low. Short-term impacts to ambient levels of CO may occur during construction due to the interruption of normal traffic flow.

Short-term impacts to PM_{2.5}/PM₁₀ may also occur during the construction phase, but these may be reduced through the use of watering or other dust-control measures to ensure compliance with appropriate federal, state, and local rules or ordinances. A qualitative analysis of the potential impacts to ambient levels of particulate matter (PM₁₀) indicated that the net effect of the



Preferred Alternative would be to reduce ambient levels of PM₁₀. Future MSAT emissions will be significantly lower than current emissions due to stricter controls on vehicle emissions.

8.12 Noise

Under federal noise abatement guidelines, noise impacts are analyzed based on the land use activity and noise abatement criteria (NAC) for each of the land use categories. Analysis was conducted in accordance with the PCDOT *Traffic Noise Analysis and Mitigation Guidance for Major Roadway Projects*, December 2003 (amended April 2008) and the FHWA *Procedure for Abatement of Highway Traffic and Construction Noise* (23 CFR 772). Mitigation for roadway improvement projects is considered when noise levels approach 67 A-weighted decibels (dBA). Approach is defined by PCDOT and the FHWA as 66 dBA. For Category B land uses (e.g., residential properties, motels/hotels, churches, hospitals, playgrounds, parks), mitigation would be considered if the projected noise levels substantially exceed the existing noise level, defined as an increase of 15 dBA or greater.

Implementation of the Preferred Alternative would result in a noise level of 66 dBA at 22 locations. For federally funded projects, FHWA criteria does not allow a 3-dBA reduction in noise with the application of Residents per Acre (RAC). Both FHWA and PCDOT policies allow for consideration of whether a potential noise abatement strategy would be reasonable and feasible. As a result, the use of a noise barrier at 15 of the 22 potential barrier locations was not deemed reasonable and feasible because the barrier would not be effective (e.g., breaks in a wall for driveway access); the barrier would benefit only a single, impacted receiver, or the cost per benefited receiver exceeded \$35,000. Potential noise barrier locations that were recommended as reasonable and feasible and includes the required barrier size, benefited receivers (receiving a 5-dBA noise reduction or more), and the cost per benefited receiver for each area with impacted receivers are detailed in the EA.

8.13 Hazardous Materials Concerns

A Preliminary Initial Site Assessment for hazardous materials was conducted for the 5-mile-long study area. An evaluation was completed to determine the potential for encountering environmental contamination from hazardous materials due to previous and/or existing activities in the right-of-way for the Preferred Alternative. Field reconnaissance was conducted on November 15, 2007, to identify potential hazardous material contamination based on observations of existing and former land uses, construction materials, chemicals, soil conditions, and on-site equipment.

No hazardous materials or similar environmental concerns were reported for the project limits; therefore, implementation of the Preferred Alternative would not be affected by the presence of hazardous materials. Furthermore, the Preferred Alternative would not be expected to affect hazardous material sites. The Preferred Alternative would require the removal of a number of concrete pipes, which could contain asbestos. Mitigation commitments related to this potential have been incorporated into the Preferred Alternative.

8.14 Cultural Resources and Survey

Cultural resources are sites, buildings, structures, districts, and objects as defined by the National Historic Preservation Agency (NHPA), as amended. Cultural resources included in, or eligible for inclusion in, the National Register of Historic Places (NRHP) are termed "historic properties" regardless of their age. "Traditional cultural properties" having heritage value for contemporary communities (often, but not necessarily, Native American groups) also can be listed in the NRHP because of their association with historic cultural practices or beliefs that are important in maintaining the cultural identities of such communities.

As the lead federal agency, the Federal Highway Administration (FHWA), assisted by Arizona Department of Transportation (ADOT), would be required to comply with Section 106 of the NHPA. Section 106 of the NHPA requires federal agencies to take into account the effects of their activities and programs on NRHP-eligible properties. Regulations for *Protection of Historic Properties* (36 CFR Part 800) define a process for federal agencies to consult with the State Historic Preservation Office (SHPO), Native American groups, other interested parties, and when appropriate, the Advisory Council on Historic Preservation (ACHP) to ensure that historic properties are duly considered as federal projects are planned and implemented.

No impacts to NRHP-eligible cultural resources are anticipated with the Preferred Alternative because (1) the Oracle-Tucson transmission line is not eligible for NRHP listing, and (2) the segment of SR 77 within the Area of Potential Effect (APE) is recommended as non-contributing. As such, none of the characteristics that qualify SR 77 and the Historic State Highway System (HSHS) for inclusion in the NRHP would be altered. Therefore, a determination of "no historic properties affected" is anticipated. Consultation is pending.

8.15 Public Involvement

To ensure that agencies and the public have sufficient opportunity to provide comments and to be involved in the development and evaluation of alternatives, this study has included an extensive public involvement program. This program is both consistent with NEPA guidance and the Pima County *Roadway Design Manual*. This program includes the scoping of interested agencies and stakeholders and the formation of a Citizens Advisory Committee (CAC). Public information meetings have been conducted, and a federal public hearing will be held to provide detailed project information and to solicit public input. A project Web site was also used to disseminate project information and to collect comments.

A summary of the public meetings, CAC meetings and agency scoping is located in the EA. There were 9 CAC meetings and 3 public meetings leading up to the completion of the Draft DCR/EA. Project concerns focused on the intersection alternatives at La Cholla Boulevard/Magee Road, noise impacts, and traffic signal needs at currently un-signalized intersections.



9.0 Intergovernmental Agreements

RTA Resolution 2006-04 states that an Intergovernmental Agreement between the RTA and Pima County and other local agencies as appropriate, is required for every project before reimbursable expenditures may be initiated. Magee Road runs through the Town of Oro Valley between Northern Avenue and Oracle Road. Oracle Road (SR 77) is a State Highway running in ADOT right-of-way. Intergovernmental agreements with either or both jurisdictions may be required.

10.0 Implementation, Cost and Funding

Based on design, construction and funding issues, the following construction implementation plan is recommended for this project. Table 10.1 presents a breakdown of costs for each phase of construction. Detailed cost estimates are located in Appendix B of this report.

Phase	I	II	III
Pima Co. Project No.			
Project Limits	Mona Lisa Rd. To La Cañada Dr.	La Cañada Dr. To Oracle Rd.	Thornycroft Rd. To Mona Lisa Rd.
Begin Construction			
Construction Duration			
Engineering Design (10%)	\$2,404,657.00	\$1,179,715.00	\$1,851,182.00
Contingencies (25%)	\$6,011,643.00	\$2,949,287.00	\$4,627,954.00
Utility Relocation	\$500,000.00	\$250,000.00	\$300,000.00
Public Art (1%)	\$240,466.00	\$117,971.00	\$185,118.00
Right of Way Cost	\$ 305,734.00	\$103,895.00	\$363,340.00
Post Design Services (1%)	\$240,466.00	\$117,971.00	\$185,118.00
Constr. Administration (15%)	\$3,606,986.00	\$1,769,572.00	\$2,776,772.00
Total Construction Cost	\$37,356,522.00	\$18,285,560.00	\$28,801,299.00
Total Project Cost	\$37,356,522.00	\$18,285,560.00	\$28,801,299.00
Funding Source(s)			

Table 10.1: Projected Costs

11.0 Conclusions and Recommendations

The recommendation is for Pima County to proceed with the final design, right-of-way acquisition, permitting and utility coordination for Phase I of construction.



Appendix A: Stage I Plans