7.0 SOCIAL, ECONOMIC, AND ENVIRONMENTAL CONSIDERATIONS

7.01 Air Quality

To assist local jurisdictions in measuring and improving air quality, the United States Environmental Protection Agency (EPA) establishes maximum acceptable levels of pollution for six common air contaminants known as the National Ambient Air Quality Standards (NAAQS). These federal standards for outdoor or ambient air are set to protect the health of the public. When an area measures air pollutant levels above these standards, it is designated as a nonattainment area for that pollutant. The nonattainment area plan is incorporated in the State Implementation Plan (SIP) as a SIP amendment and must contain effective strategies for curtailing air pollution. For EPA approval, the plan must include financial and resource commitments for plan implementation.

Prior to 2000, the Tucson region was designated in nonattainment with the carbon monoxide (CO) health standard. A CO Limited Maintenance Plan (LMP) for the Tucson Air Planning Area (TAPA) was approved and put into effect in 2000. The Tucson area became and continues to be in attainment with the health standard for CO under the LMP. The region currently monitors levels that are less than a quarter of the standard and readings serve to reinforce that CO is no longer considered a health issue in the Tucson metropolitan area (see Figure 7.01 for the relationship of the project and the Tucson CO Maintenance Area).

The Pima Association of Governments is the designated air quality planning agency and the metropolitan planning organization for the greater Tucson region. The design and construction of this project has been included in the 2040 Regional Transportation Plan (RTP) and the 5-year Transportation Improvement Program (TIP) for 2013-2017. The Clean Air Act (CAA) Amendments of 1990 require that the RTP conform to regional air quality plans and insure that it will not cause or contribute to air quality violations of the NAAQS.

Figure 7.01. Tucson Carbon Monoxide Maintenance Area

By the adoption of the 2013-2017 TIP, the PAG Regional Council found that the Regional TIP for 2013-2017 is in conformity with the SIP and also affirmed that the TIP is consistent with the 2040 RTP. The regional CO emissions impact from motor vehicles was analyzed for the 2040 RTP project. Monitored CO levels continue to remain well below the EPA health standards and transportation control measures will continue to be implemented. Therefore, the Tangerine Road corridor project is considered to have an exempt air quality status per the 2013-2017 TIP.

In addition to monitoring CO levels, air quality levels for other pollutants are monitored on a regular basis by the Pima County Department of Environmental Quality (PDEQ) for adherence to the NAAQS. Those pollutants include ozone and particulate matter.

Currently the Tucson region is in attainment with the current health standard for ozone. However, 2010 EPA revisions to the NAAQS are more stringent and will likely place the Tucson region in nonattainment. There is an air monitoring station located in relatively undisturbed desert approximately 95 feet west of Camino de Oeste and 220 feet north of Tangerine Road. This site assesses background ozone concentrations and transport impacts from outlying sources during exceptional wind events. Occasionally, ozone concentration levels measured at this air monitoring station have been the highest in the Pima County monitoring network. This can possibly be attributed to the prevailing southwesterly winds transporting ozone from the urban area. Although concentrations can remain

high well into the night and early morning, the ozone levels remain near the current NAAQS.

The Tucson region is currently in attainment for both fine and course particulate matter (PM). Tailpipe emissions and dust from paved and unpaved roads are sources of PM. The Tangerine Road corridor widening project will produce a temporary increase in PM during construction primarily due to dust. This impact will be short term and there are always measures specified during construction to minimize this type of impact. Prior to any construction activities, the contractor must obtain an activity permit from PDEQ. Other common pollutants measured in Pima County are nitrogen dioxide and sulfur dioxide. Presently, both pollutants remain well below their respective health standards.

7.02 Biological Resources

7.02.1 Wildlife Crossings

As discussed in Section 3.09.1, the *Tangerine Road and La Cholla Boulevard Wildlife Mortality and Hotspot Evaluation* prepared by the Arizona Game and Fish Department (AGFD) provided recommendations for reducing wildlife-vehicle collisions and enhancing wildlife connectivity between the Tucson and Tortolita mountains. Specifically, the study recommended eight medium wildlife crossings of Tangerine Road to accommodate mid-sized mammals, and five large wildlife crossings of Tangerine Road to serve large mammals. Several crossings for small mammals and herpetofauna were also identified, but it is anticipated that the drainage crossings at those locations will be larger than the required dimensions for wildlife (1.5-foot diameter).

The TAC and the design team met with the AGFD on August 10, 2011 to assess the recommendations of the report and to prioritize the proposed wildlife crossings. The results are presented in Table 7.01. Some of the criteria used to prioritize the crossings included:

- Whether the crossing area is part of the Marana Draft Habitat Conservation Plan (HCP) or set aside under the Conservation Land System
- Adjacent land uses (current and proposed)
- Quality of adjacent vegetation
- Level of connectivity upstream and downstream within the wash
- Presence of significant light sources (such as signalized intersections)
- Impact on intersection sight distance and roadway grades

Table 7.01. Prioritization of Medium and Large Wildlife Crossings

Station	Wildlife Size Recommended by AZGF	Priority Level (TAC and AZGF)	Remarks
526+65	Medium	Low	No vegetative connectivity on the south side, future development. Likely future traffic signal with lighting at Breakers Rd
575+65	Large	High	In the HCP corridor. Consider a bridge instead of a box culvert
613+05	Medium	High	Pursue one of these two for the crossing
627+83	Medium		
661+87	Large	High	In the HCP corridor. Consider a bridge instead of a box culvert
672+56	Large	High	In the HCP corridor. Consider a bridge instead of a box culvert
735+69	Medium	High	Have connectivity and open space through existing development.
756+84	Medium	Low	Future development will restrict wildlife mobility, near a future signal at Camino de Oeste
772+32	Large	Moderate	Change to a medium crossing due to its proximity to Camino De Mañana and the associated constrains on road profile and sight visibility
828+00	Medium	High	Have connectivity through existing development
855+03	Medium	High	Good connectivity
885+40	Medium	High	Drainage needs already meets wildlife requirements
932+50	Medium	Low	Existing development and an existing box downstream restrict wildlife mobility

Following the meeting, the TAC and the design team decided to pursue the implementation of the high and moderate priority wildlife crossings, with two caveats:

1) The crossing at Sta. 772+32 was reduced to serve medium-size mammals due to its proximity to Camino de Mañana and impacts on the road profile.

2) Due to its proximity to the bridge/large animal crossing at Sta 661+87, the crossing at Sta 672+56 was changed to a multi-cell box culvert. Fencing was designed to guide wildlife to the large crossing, which is located less than ½ mile away. This decision was made based on recommendations from the Value analysis Study.

As a result, the project now includes three crossings for large mammals and six crossing for medium-size mammals.

The minimum sizing requirements for each type of wildlife crossing (medium or large) are defined in terms of crossing height and an openness index. The openness index (O.I.) is calculated as:

O.I. = Height x Width / Length (all dimensions are in meters)

The *Tangerine Road and La Cholla Boulevard Wildlife Mortality and Hotspot Evaluation* recommended that all crossings for large wildlife should be at least nine feet in height and have an O.I. greater than 0.75. Crossings for medium wildlife should be at least six feet in height and have an O.I. of at least 0.40. However, it should be noted that wildlife crossing data obtained by AZG&F for the Twin Peaks Road project has found that "local populations are willing to accept O.I. values lower than the suggested guidelines" (email from Shawn Lowery, April 26, 2012). Based on those findings, AGFD suggested that O.I. values for medium crossings could be lowered 0.23, but that minimum heights should still be 6 ft.

Table 7.02 presents the preliminary dimensions of the wildlife crossings incorporated into the project.

Table 7.02. Dimensions of Proposed Wildlife Crossings

Station	Wildlife Size	Min Height - Openness Index (O.I.)*	Dimensions for Wildlife	Length (ft)	Calculated O.I. (combining openings)	Calculated O.I.(single Opening)
575+65	Large	9' - 0.75	60' Bridge (48' Opening)	116	0.92	0.92
613+05	Medium	6' - 0.40	4-10'x6'	156	0.47	0.12
661+87	Large	9' - 0.75	104' Span Bridge (86' opening)	116	1.82	1.82
735+69	Medium	6' - 0.40	4-10'x6'	152	0.48	0.12
772+32	Medium	6' - 0.40	3-24'x7' Arch	138	1.11	0.37
828+00	Medium	6' - 0.40	4-10'x6'	125	0.59	0.15
855+03	Medium	6' - 0.40	2-32'x8' Arches & 1-36'x9' Arch	181	1.41	0.55
885+40	Medium	6' - 0.40	7-10'x6'	157	0.82	0.12

** For medium mammal crossings in this area an O.I. of 0.23 is acceptable per AGFD data*

It has been determined that for large mammals such as mule deer, the required O.I. should be accomplished as a single opening; otherwise, the animals will not use the crossings. Although there has not been a final resolution on this issue, it has been assumed that the OI for crossings for medium mammals such as coyotes and javelina can be calculated by adding the area of several openings. For example, a 4-cell RCBC, 10'x6'x150' (3.05mx1.83mx3.66mx45.72m) would have an O.I. of 0.49.

Given that for large wildlife the O.I. has to be achieved in a single opening, RCBCs are impractical for those locations. Although arches can provide a cost savings in terms of general use for drainage requirements, the extreme width needed for the O.I. is larger than typical arch sections, which makes construction of arch culverts cost prohibitive as well. Therefore, the preferred alternative for large wildlife cross culvert locations is the utilization of single span bridges. A bridge provides the required opening width and better wildlife access along with reduced 404 permit impacts potentially expediting ACOE approval.

For medium wildlife crossings, the design will typically consist of multi-cell RCBC. However two of the wildlife crossings were upgraded to pre-cast concrete arches in order to achieve as large an O.I. as possible (and financially reasonable) in a single opening. The two upsized medium crossings are located near Camino de Mañana (Sta 772+32) and near Shannon Road (855+03). Having those crossings upsized means that relatively large crossings will be available every two miles along the entire Tangerine road project.

Another critical element in the design of wildlife crossings is the fact that animals must have line of sight to the other side of the crossing. This effectively limits the use of drop inlet structures and in most cases requires raising the roadway profile. However, the TAC, the design team, and AZG&F verified that drops of 3 to 4 feet with inlet slopes of less than 10% maintain the sight line across the culvert. Therefore, this is an acceptable solution where needed, as long as an accessible surface (i.e., shotcrete) is provided. Wildlife has difficulty negotiating typical drop inlet surfaces such as riprap.

The surface through the culvert and at the outlet is also a concern for wildlife crossings. Natural substrate culverts are preferred, but concrete bottoms are acceptable. In this case, the bridges will provide a natural substrate (dirt) for large mammals, but concrete will be used for the bottom of the medium crossings due to aggradation/degradation of the washes in the project area. However, in order to provide some level of natural substrate, baffles will be incorporated at regular intervals to capture sediment on the concrete bottom of the culvert. A sample baffle treatment is shown in Figure 7.02.

The use of riprap at the outlet of the medium crossings will be limited to the central area of flow, with flat concrete areas on the sides to achieve an acceptable substrate and line of sight for the wildlife, while still providing the required energy dissipation. The concept shown in Figure 7.03 illustrates the outlet treatment agreed upon by the TAC, the design team and AGFD in a meeting on December 14, 2011.

Figure 7.02. Sample Baffle Treatment to Provide Natural Substrate

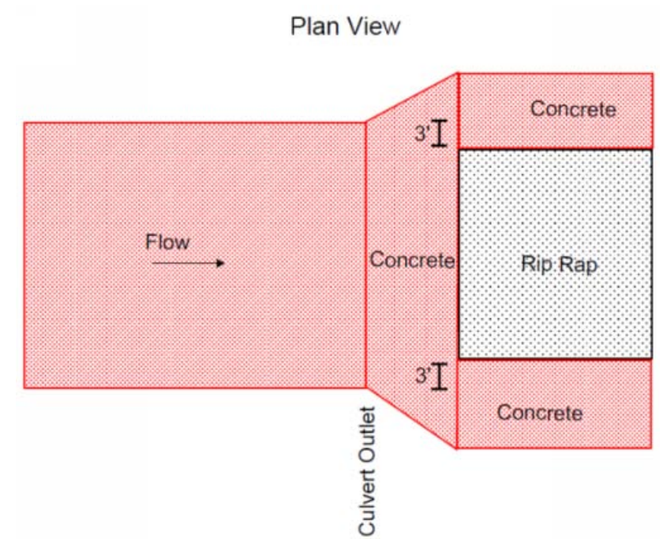


Figure 7.03. Conceptual Outlet Treatment for Medium Wildlife Crossing

An additional recommendation from the *Tangerine Road and La Cholla Boulevard Wildlife Mortality and Hotspot Evaluation* was to provide fencing to direct the wildlife towards the crossings and minimize vehicle-animal conflicts along the rest of the roadway. Figure 7.04 shows the wildlife fence installed along Twin Peaks Road, while Table 7.03 summarizes the limits and size of each fence segment. On the south side of the road, the fence will be installed at the new ROW line and will be tied into every culvert wingwall or headwall to avoid impacting flo w patterns. In the case of smaller culverts the fence will beplaced over the culvert near its end point.On the north side of the roadway the placement of the fence will be more complex because there are multiple locations where the roadway channelizes off-site drainage flows towards the culverts. As a result, there are multiple locations where the fence will not be placed at the ROW line. At those locations, the fence will be placed on the roadway embankment aobve the water surface elevation, but as far from the pedestrian path as possible to minimize visual impacts.

Figure 7.04. Wildlife Fence

Additional documentation regarding coordination of wildlife crossings is provided in Appendix 2, which includes minutes from meetings with AZG&F on December 2011 and January 2013.

Table 7.03. Limits and Size of Wildlife Fencing

From		To		Size	Side	Wildlife Crossing		Length
555+00	Pipe 3	593+00	Pipe 7	Large	Both	575+65	Bridge	7,600
593+00	Pipe 7	645+00	Pipe 11	Medium	Both	613+05	Box 5	10,400
645+00	Pipe 11	686+00	Ridge	Large	Both	661+87	Bridge	8,200
716+76*	Box 9	752+00	Cmo de Oeste	Medium	Both	735+69	Box 10	6,086
753+50	Cmo de Oeste	781+00	Pipe 19	Medium	Both	772+32	Arch 13	5,500
818+42	Pipe 4 Kittelson	847+26	Pipe 6 Kittelson	Medium	Both	828+00	Box 3 Kittelson	5,768
847+26	Pipe 6 Kittelson	868+80	Pipe 7 Kittelson	Medium	Both	855+03	Arch 1 Kittelson	4,308
868+80	Pipe 7 Kittelson	874+87	Pipe 8 Kittelson	Small	Both	At each end		1,214
874+87	Pipe 8 Kittelson	897+65	Pipe 11 Kittelson	Medium	Both	885+40	Box 5 Kittelson	4,556
							TOTAL	53,632

** On the south side of Tangerine Road, starts at Sta 726+38*

Once all the design parameters for the wildlife crossings were identified, the design team proceeded to develop a cost comparison of the original structures required for drainage with the revised configuration for wildlife. The primary items evaluated in the comparison included increased culvert size, additional roadway embankment, more elaborate inlet/outlet treatments, and the addition of wildlife fence. The purpose of this cost comparison was to pursue funding for the increased cost from the RTA's Critical Wildlife Linkages program (a part of the Environmental and Economic Vitality Plan Element). Table 7.04 summarizes the increased cost for each of the nine wildlife crossings, as well as the additional cost of the wildlife fence.

It should be noted that in June 2012 the RTA's Wildlife Linkages Working Group allocated $3,603,142 to fund wildlife crossings along the Tangerine Road corridor. That allocation was based on an earlier cost analysis. Grade control structures added to the two bridges have since increased the cost of the crossings to $4 million.

Table 7.04. Incremental Cost of Wildlife Crossings v. Drainage Structures

Station	Wildlife Type	Design Type	Structure Type/Size	Cost	Cost Difference
575+65	large	Drainage	3-10'x4' RCBC	$238,311	$1,219,333
		Wildlife	60' Bridge	$1,457,644	
613+05	medium	Drainage	1-10'x4' RCBC	$105,663	$279,896
		Wildlife	4-10'x6' RCBC	$385,559	
661+87	large	Drainage	6-10'x7' RCBC	$493,533	$1,462,520
			6-10'x4' RCBC	$398,777	
		Wildlife	104' Bridge	$2,354,830	
735+69	medium	Drainage	5-10'x4' RCBC	$347,159	$21,400
		Wildlife	4-10'x6' RCBC	$368,559	
772+32	medium	Drainage	6-10'x6' RCBC	$409,533	$351,300
		Wildlife	3-24'x7' Con Arch	$760,833	
828+00	medium	Drainage	4-10'x5' RCBC	$243,585	$72,274
		Wildlife	4-10'x6' RCBC	$315,859	
854+80	medium	Drainage	6-10'x5' RCBC	$460,533	$291,170
			6-10'x5' RCBC	$460,533	
		Wildlife	1-36'x9' & 2-32'x8' Arch	$1,212,237	
885+40	medium	Drainage	7-10'x6' RCBC	$510,607	$56,296
		Wildlife	7-10'x6' RCBC	$566,904	
Fencing	Large	15,800	$12.0/LF	$ 189,600	$261,775
	Medium	36,618	$5.5/LF	$ 201,399	
	Small	1,214	$4.0/LF	$ 4,856	
	R/W Fence	53,632	$2.5/LF	$ (134,080)	
				TOTAL	**$4,015,964**

7.02.2 Special Interest Species

A Biological Evaluation (BE) was prepared for the Town of Marana by Westland Resources, Inc. that addresses the potential impacts of the project on threatened and endangered species. The analysis of potential impacts on biological resources in the project area is limited to the special-interest species that were identified in Section 3.0 of this report. Thirty-four special-interest species were considered in a screening analysis to determine the potential for their occurrence within the project area. Special-interest species consist of those on the United States Fish and Wildlife Service (USFWS) Pima County list and species covered under the Town of Marana Draft Habitat Conservation Plan (HCP). The screening process indicated that the lesser long-nosed bat (endangered), the cactus ferruginous pygmy-owl (delisted), the groundsnake, and the Sonoran desert tortoise have the potential for occurrence within the project area. The project area does not contain any proposed or designated critical habitat for any threatened or endangered species.

The project will not directly alter critical cavern roosting habitat for lesser long-nosed bats, although, possible impacts to foraging resources, specifically through the removal of saguaro and agave may affect, but are not likely to adversely affect, the lesser long-nosed bat population.

Saguaros and xeroriparian vegetation along Tangerine Road could provide suitable habitat for the cactus ferruginous pygmy-owl, and the loss of some of these habitat features could affect this species. However, this species is currently not listed and it receives no special protection under the Endangered Species Act (ESA). Surveys to date have yielded negative results.

There is suitable habitat for the Sonoran desert tortoise within the project area. During field reconnaissance, a desert tortoise was observed crossing Tangerine Road. Considering the suitable habitat and the positive tortoise sighting, it is recommended that tortoise surveys be

conducted prior to construction activities. Guidelines for handling desert tortoises developed by the Arizona Game and Fish Department (AGFD) should be followed.

In addition to the lesser long-nosed bat, the cactus ferruginous pygmy-owl and the Sonoran desert tortoise, the Marana Draft HCP includes four other species with the potential to be present in the Tangerine Road vicinity. These species are the groundsnake, Merriam's mesquite mouse, burrowing owl, and pale Townsend's big-eared bat. The groundsnake and Merriam's mesquite mouse are ground-dwelling species with limited mobility and they could be directly affected by construction activities. The burrowing owl is a ground-nesting species and its nests and young could be affected if construction activities are conducted during the breeding season. The pale Townsend's big-eared bat normally roosts in caves and abandoned mines, and it forages at night for flying insects. This bat is not likely to be affected by project activities.

Project impacts to pygmy-owls can be minimized by completing mass grading and plant salvage activities between August 1 and December 31 to avoid breeding season. The roadway improvements will be designed to retain habitat connectivity to the extent practicable by impacting the smallest area of upland desert scrub, washes and associated vegetation. Since the roadway improvements will result in a wider roadway, it will become more of a barrier to wildlife movements and an increased threat for wildlife that may attempt to cross. Proposed drainage structures along Tangerine Road were evaluated and sized for drainage first and for wildlife enhancements second. Each crossing location was evaluated for the type of wildlife that are expected in each area, and the structures were re-sized accordingly to facilitate wildlife movements across the improved roadway. Wildlife fencing will be utilized where necessary to help guide animals to the crossings. The Town of Marana has identified a one kilometer-wide wildlife corridor that runs perpendicular to Tangerine Road. A large wildlife crossing structure has been incorporated into this area on the design plans for the Tangerine Road improvements project (Marana Habitat Conservation Plan Public Draft, Recon Environmental, 2009).

Vegetation salvage and restoration will follow the requirements of the lead jurisdiction for each phase of the project; which may include the Town of Marana Land Development Code, the Pima County Watercourse and Riparian Habitat Protection Ordinance, the Pima County Department of Transportation (PCDOT) Environmentally Sensitive Roadway (ESR) design guidelines, and/or the Oro Valley Zoning Code to restore habitat quality. Saguaros and large trees will be avoided to the extent practicable or otherwise salvaged on site where feasible. Restoration and landscape design will include mitigation at wash crossings and within the median. Invasive species mitigation will be required during the construction process.

Project construction will temporarily disturb and expose soil along the right-of-way and temporarily introduce potential stormwater pollutants associated with construction equipment and materials. Disturbed areas should be stabilized immediately after grading is complete and restored with a native seed mix and landscaping to minimize erosion, maximize the establishment and recruitment of seedlings, and restore native species to disturbed areas. The project will follow the Stormwater Pollution Prevention Plan (SWPPP) prepared for this project to minimize erosion and pollution.

7.03 Community Resource Impact

Although no schools currently have direct access to Tangerine Road, there are two schools that will benefit from the roadway improvements in regards to regional access. Richard B. Wilson K-8 School is a combined Elementary and Middle School that is located ¼ mile south of Tangerine Road and ¼ mile west of La Cholla Boulevard on Glover Road. Ironwood Ridge High School is located approximately one mile south of Tangerine Road and ½ mile west of La

Cholla Boulevard on Naranja Drive. It is unlikely that either school will be adversely impacted by construction activities.

There are three churches located along the project limits that will benefit directly from the project. St. Mark Catholic Church is located along the south side of Tangerine Road and on the north side of Shannon Road. The church has one existing access point that will be relocated to the west where a median opening will be provided. Shannon Road will also have a median opening which will provide access to the church in the future. The Copper Mountain Assembly of God church is located on the north side of Tangerine Road, west of La Cholla Boulevard, and on the west side of Como Drive. A new right-in and right-out access will be provided at the current access point. A median opening and improved turnout access will be provided at Como Drive that can also be utilized by the church. The Episcopal Church of the Apostles is located on the north side of Tangerine Road and on the west side of La Cholla Boulevard. Current access is off La Cholla Boulevard and will not be affected by the improvements. The church also has access from Como Drive on the west side of the property where a full median opening will be provided. Access to St. Mark and Copper Mountain churches will be temporarily impacted by the construction of this project. Access to the Church of the Apostles will be temporarily affected (during construction)for traffic from the south of Tangerine Road but not as much from the north.

There are two fire stations in the vicinity of the project. The Northwest Fire District Station 339 is located within the project limits approximately 800 feet north of Tangerine Road on Thornydale Road. Station 339 has two access points on Thornydale Road that will not be modified. The project limits, though, extend beyond Station 339 and will therefore affect direct access to some extent during construction. Emergency access will be a priority during the construction operations and shall be available throughout the duration of the project. Access will be maintained or created as required in coordination with the Northwest Fire District operations. A traffic control plan will be prepared to ensure clear access for emergency vehicles. The Golder Ranch Fire District Station 375 is located beyond the project limits approximately 600 feet north of Tangerine Road and 1.5 miles east of La Cañada Drive on Woodburne Avenue. It is not anticipated that Station 375 will be directly impacted by the project.

The United States of America Postal Service has two post office branches within the project area. The Rillito Branch is located just west of the project limits southwest of Tangerine Road on the I-10 Frontage Road. The Oro Valley Branch is located just beyond the project limits on the southeast corner of Tangerine Road and La Cañada Drive. Neither facility is anticipated to be directly impacted by the project.

The Oro Valley Public Library, an affiliate of the Pima County Public Library system, is located beyond the project limits approximately one mile south of Tangerine Road on the southeast corner of La Cañada Drive and Naranja Drive. Also in that same location is the Oro Valley Police Department and the Oro Valley Town Hall. These facilities will not be directly impacted by the project and it is unlikely that there will be any impact.

Breakers Water Park, a recreational water park, is located along the western segment of the project approximately ¼ mile south of Tangerine Road on Breakers Road. Access to the park is limited to Tangerine Road. Improvements include an access turnout and full median opening at Breakers Road as part of this project. Construction operations will temporarily impact access to the park although access will be maintained.

Two other facilities adjacent to Tangerine Road on the north side include the TRICO Electric Co-Op office located just east of I-10 and the TRICO Thornydale Road substation located about half way between I-10 and Dove Mountain Boulevard. The TRICO building currently has two access points that will be improved with the project. The western turnout will include a full median opening and the eastern turnout will be right-in/right-out. The project will include

improved access to the Thornydale substation as well as the TEP power lines to the south with a full median opening access location. Both facilities will be temporarily impacted by construction operations although access will be maintained.

7.04 Hazardous Materials

There has not been a Preliminary Initial Survey Assessment (PISA) performed for this project to identify hazardous materials to date. It is anticipated that a Phase I Environmental Assessment study will be needed prior to the construction of the project. Additional studies may be recommended and will be completed as needed. Any necessary mitigation measures will be completed prior to construction.

7.05 Historic/Cultural Resources

A Class III inventory was conducted by Westland Resources, Inc. for the Town of Marana to determine whether the proposed project would adversely affect historic properties. The project area had been previously surveyed, but only a small portion occurred in the past 10 years. Therefore, a records search, literature review, and pedestrian survey were conducted for the portions of the project area that had not been surveyed in the past 10 years. This inventory identified 20 isolated archaeological occurrences and 20 archaeological sites present in the project area. See Table 7.05 for a summary of the sites.

No further archaeological work is required at 16 sites or at any of the isolated occurrences. Arizona State Museum (ASM) records incorrectly places five sites in the project area and the planned improvements to Tangerine Road will not affect 11 of the other sites. Of the four remaining sites that would be affected by the project improvements, one is register-eligible (AZ AA:12:422) and three are undetermined (AZ AA:12::82, AZ AA:12:726, and AZ AA:12:1118). The development of a phased data recovery program is recommended to mitigate for the potential effects at the four remaining sites. The archaeological methods should be directed at gathering the necessary information to 1) determine the National Register of Historic Places (NRHP) eligibility of three sites and determine the nature and extent of the archaeological deposits within the project area, and 2) gather the requisite data and information to resolve the adverse effects to the cultural resources.

In the event that any previously unidentified human remains are discovered during ground-disturbing activities, all activities in the vicinity of the discovery must cease and the Arizona State Museum and a qualified archaeologist must be notified pursuant to A.R.S. §41-844 and 865. Preliminarily, a total of $300,000 is estimated for testing, testing report, data recovery, and data recovery report.

Table 7.05. Archaeological Site Summary

ASM Site	Register Eligibility	Impact by Project	Recommended Action
AZ Z:2:40	Eligible	Not affected	No further work.
AZ AA:2:118	Eligible	Not affected	No further work.
AZ AA:12:82	Undetermined	Unknown	Phased data recovery.
AZ AA:12:298	Not Evaluated	Not in project area	No further work.
AZ AA:12:325	Not Evaluated	Not in project area	No further work.
AZ AA:12:422	Eligible	Affected	Phased data recovery.
AZ AA:12:722	Ineligible	None	No further work.
AZ AA:12:723	Not evaluated	Not in project area	No further work.
AZ AA:12:724	Ineligible	None	No further work.
AZ AA:12:726	Undetermined	Unknown	Phased data recovery.
AZ AA:12:727	Not evaluated	Not in project area	No further work.
AZ AA:12:728	Ineligible	Not affected	No further work.
AZ AA:12:870	Eligible	Not in project area	No further work.
AZ AA:12:1022	Eligible	Not affected	No further work.
ASM Site	**Register Eligibility**	**Impact by Project**	**Recommended Action**
AZ AA:12:1044	Eligible	Not affected	No further work.
AZ AA:12:1118	Undetermined	Unknown	Phased data recovery.
AZ AA:12:1119	Ineligible	None	No further work.
AZ AA:12:1120	Ineligible	None	No further work.
AZ AA:12:1121	Ineligible	None	No further work.
AZ AA:12:1122	Ineligible	None	No further work.

7.06 Neighborhood Impact

The project area consists of a variety of land uses including residential, commercial, institutional, industrial and vacant land. In general, the project will have a positive effect on the traffic and circulation in the area. The improvements will provide the current project area residents with improved accessibility to Interstate 10 and the greater Tucson area. The roadway improvements will also provide the needed capacity to support the planned developments along the Tangerine Road corridor.

Neighborhoods along the Tangerine Road corridor will see improved traffic circulation due to the Access Management Plan being implemented with this project. Median openings will typically be provided at generous spacing intervals of 1,000 to 1,200 feet and will provide refuge for vehicles attempting to turn from Tangerine Road.

Access to businesses, residences, schools and emergency services will be maintained throughout the project corridor during construction activities. No detours are anticipated for this project; although, additional pavement may be necessary to provide “shoe-fly” or temporary detours at specific and limited locations during certain construction operations. At least one lane of travel in each direction will remain open to provide full access to all parcels along the project area, but short-term and temporary closures may be experienced at times. Surrounding neighborhoods will be minimally impacted by construction activities as there are several roadways in close proximity to the project area that can provide an alternate route. During construction residents may experience an increase in dust, noise, and traffic delays within the project area. Standard measures to control dust and noise will be implemented during construction.

Overall, the proposed project will improve multi-modal transportation opportunities and access. The proposed project will improve neighborhood continuity by providing improved traffic efficiency, pedestrian circulation, compliance with the American Disabilities Act (ADA), multi-use lanes, and a multi-use path.

7.07 Noise

7.07.1 Traffic Noise and Abatement Standards

The Technical Advisory Committee (TAC), and the three jurisdictions partnering in this project agreed upon the use of Pima County Department of Transportation’s *Traffic Noise Analysis and Mitigation Guidance for Major Roadway Projects* (Procedure No. 03-5) dated December 2003 and Revised April 2008. It should also be noted that the use of the aforementioned policy is recommended by the RTA for use on projects included in the 20-year RTA Plan. Pima County’s *Traffic Noise Analysis and Mitigation Guidance for Major Roadway Projects*, includes the following provisions:

A. Mitigation Levels

For major roadway projects (such as Tangerine Road), after applying a 3-dBA benefit for the use of Rubberized Asphalt (ARAC) and rounding to the nearest decibel, traffic noise mitigation shall be considered if either:

1. The predicted exterior noise level for a sensitive receiver is 66 dBA L_{eq} or above; or,
2. The predicted exterior noise levels at a sensitive receiver “substantially” increases over existing (pre-project) levels as a result of the major roadway project. “Substantial” is defined as 15 dBA or greater.

B. Noise Barrier Criteria

1. Traffic noise barriers will be considered when all of the following criteria are met:
   a) Constructing a noise barrier shall achieve a meaningful noise reduction. To be meaningful, predicted noise levels at an affected sensitive receiver shall be reduced by at least 5 decibels. Sensitive receivers are individual housing units, multi-family or

single-family. Sensitive receivers also include facilities such as picnic areas, recreation areas, playgrounds, active sports areas, parks, schools, churches, libraries, hospitals, places of worship, and cemeteries.

b) The cost of providing noise abatement shall be reasonable. To be considered reasonable, sound mitigation shall not exceed $35,000 per benefited sensitive receiver. Sensitive receivers that will be considered as benefited are those for which noise mitigation will produce at least a 5 dBA noise reduction. Facilities which contain non-residential receivers such as picnic areas, recreation areas, playgrounds, active sports areas, parks, schools, churches, libraries, hospitals, places of worship, and cemeteries shall be counted for noise abatement unless they include a sensitive receiver as defined above. For the purposes of establishing reasonable cost, a barrier construction cost of $25 per square foot shall be used. This amount shall not include the cost of aesthetic or architectural features not contributing to noise mitigation. The barrier construction cost shall be reviewed periodically by Pima County to evaluate the impact of inflation and other factors of cost.

c) Noise barriers shall not be constructed unless two or more adjacent receivers are benefited.

d) Noise barriers shall not be constructed unless a majority of the property owners of benefited receivers for that barrier approve of the mitigation. Signatures from 50 percent plus one property owner of benefited receivers indicating a desire for noise barriers will be considered a majority.

e) Noise abatement shall be considered only for the first floor of multi-story residences.

f) Noise barriers in excess of 10 feet in height shall not be constructed. If the roadway is a Pima County-designated scenic route, a maximum barrier height of six feet shall apply.

g) Noise mitigation for undeveloped lands shall be considered only if a building permit has been issued prior to the date of approval of the final environmental documentation.

7.07.2 Methodology

Study Approach

Per direction from the project design team, RECON Environmental conducted a preliminary evaluation of the locations of potential sensitive noise receivers (receivers) adjacent to the Tangerine Road Project to determine if any might qualify for noise barriers, if warranted.

The Noise Barrier Criteria outlined above was used to guide the evaluation. Specifically, first considered were areas which contained a minimum of two adjacent receivers. Based on this initial screening, RECON determined the minimum noise barrier length using the principle that an effective barrier should be at least eight times as long as the distance between the receiver and the barrier; as referenced in the Federal Highway Administration (2001), PUBLICATION NO. FHWA-EP-01-004 HEPN/2-01(10M)E. Other factors influencing the effectiveness of noise barriers, such as driveway openings, were also considered. The cost of these barriers was then calculated using the maximum cost per benefited receiver ($35,000 per receiver, assuming $25 per square foot construction cost, maximum 10 feet high).

Figure 7.05 depicts and Table 7.06 identifies those sensitive receiver locations which would not qualify for noise abatement barriers, should future traffic noise conditions warrant it, and the reason for non-qualification.

Based on the evaluation, only one area (the south side of Tangerine Road between La Cholla Boulevard and La Cañada Drive) contained two or more adjacent receivers that may benefit from a noise abatement barrier. Therefore, the traffic noise analysis was focused on this area of the project.

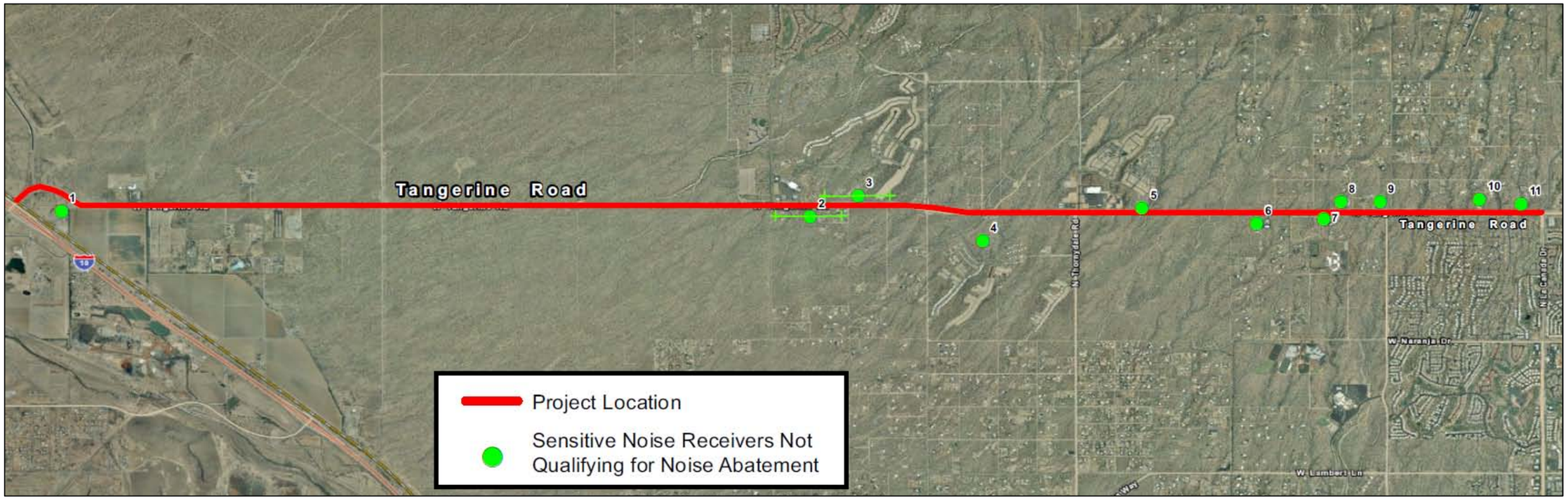


Figure 7.05. Sensitive Noise Receivers not Qualifying for Noise Abatement

Table 7.06. Tangerine Road Preliminary Noise Evaluation, Non-qualifying Receivers

Point	Parcel/Sensitive Receivers	Reason for Noise Abatement Barrier Nonqualification
1	A Bar A RV Park	Distance from ROW results in barrier cost >$35,000 per receiver
2	SE Corner of Tangerine & Dove Mountain (Parcels 216020130, 21602012A, 21602008E, 21602007C, 21602007B)	Distance from ROW results in barrier cost >$35,000 per receiver
3	Preserve Dove Mountain	Distance from ROW results in barrier cost >$35,000 per receiver
4	Sky Ranch	Distance from ROW results in barrier cost >$35,000 per receiver
5	Tangerine Crossing	Distance from ROW results in barrier cost >$35,000 per receiver
6	St. Mark Catholic Church	Isolated, no adjacent benefited receiver
7	Mesquite Sunset (Parcels 224110910 & 224110750) and adjacent Parcel 224110180	Distance from ROW results in barrier cost >$35,000 per receiver; Mesquite Sunset Pl would result in gap in barrier, significantly reducing effectiveness
8	AZ Council of Assemblies of God	Isolated, no adjacent benefited receiver
9	Episcopal Church of the Apostles	Isolated, no adjacent benefited receiver
10	Parcel 21947011A	Isolated, no adjacent benefited receiver
11	Parcel 219407160	Isolated, no adjacent benefited receiver

7.07.3 Existing Noise Environment

Field Noise Measurements

The existing noise environment of the east end of the project area was measured at five locations by RECON in April 2011 using Larson–Davis Model 720 Type 2 Integrating Sound Level Meters. Noise measurement locations are shown on Figure 7.06.

The meters were calibrated before the measurements. Measurements were taken at approximately five feet above the ground for 15 minutes each. Traffic counts and vehicle size classes were recorded simultaneously with the noise level measurements at the measurement locations. The purpose of these measurements was to obtain existing noise levels in and adjacent to the project area for use as a baseline level, as well as for use in calibrating the noise model to the specific site parameters.

Figure 7.06. Field Measurement Locations

The sound level data were downloaded from the meter and imported into a spreadsheet to calculate the average noise levels for each location. Peak-hour traffic volumes measured in January 2011 were 1,430 vehicles west of Verch Way and 1,458 vehicles east of Verch Way (data taken from the *Traffic Engineering Report* for this project). These traffic data were then used to adjust the field-measured noise levels and observed traffic volumes to determine the existing peak-hour noise levels using the following formula:

$$\Delta = 10\log\left(\frac{Vol_2}{Vol_1}\right)$$

Where Δ is the change in noise level, Vol2 is the peak-hour traffic volume, and Vol1 is the traffic volume recorded during noise measurements. The measured existing peak-hour noise levels are presented in Table 7.07.

Noise Model Calibration

After calculating the existing peak-hour traffic noise based on field measurements, a calibration run of TNM 2.5 was used to model the existing roadway configuration and make parameter adjustments to reflect site conditions. Table 7.07 shows the comparison of measured existing peak-hour noise levels to modeled existing peak-hour noise levels.

Table 7.07. Model Calibration

Measurement Location	Measured Peak-Hour dBA	Modeled Peak-Hour dBA
A	63.7	64.7
B	63.7	68.6
C	57.2	60.7
D	72.1	71.6
E	58.0	63.6

Table 7.07 shows that the modeled noise levels were, with one minor exception, higher than measured noise levels, indicating that the TNM results are generally conservative (i.e. overestimating actual noise levels).

Baseline Conditions

Existing peak-hour traffic noise was then modeled to establish a baseline for 25 sensitive receiver locations as depicted in Figure 7.07. These locations are within residential yards along the south side of Tangerine Road, most of which are surrounded by existing screen walls. The layout and dimensions of these walls were also included in the model.

7.07.4 Future Noise Environment

Future peak-hour traffic volumes for design year 2040 and the vehicle classification mix were taken from the project *Traffic Engineering Report* and are presented in Table 7.08. Future peak-hour traffic noise was then modeled using TNM for the same 25 locations depicted in Figure 7.07 and compared to the baseline peak-hour noise levels. Results are presented in Table 7.09.

Table 7.08. Traffic Noise Model Traffic Parameters

Roadway Segment	Traffic Speed	2040 Peak-Hour Traffic Volume	Vehicle Classification Mix
Tangerine Rd West of Verch Way	45	3,646	Cars – 88.4% Medium Trucks – 8.2% Heavy Trucks – 2.6% Buses – 0.4% Motorcycles – 0.4%
Tangerine Rd East of Verch Way	45	3,675	
La Cañada Dr North of Tangerine Rd	45	1,434	
La Cañada Dr South of Tangerine Rd	45	1,786	
Verch Way	15	140	

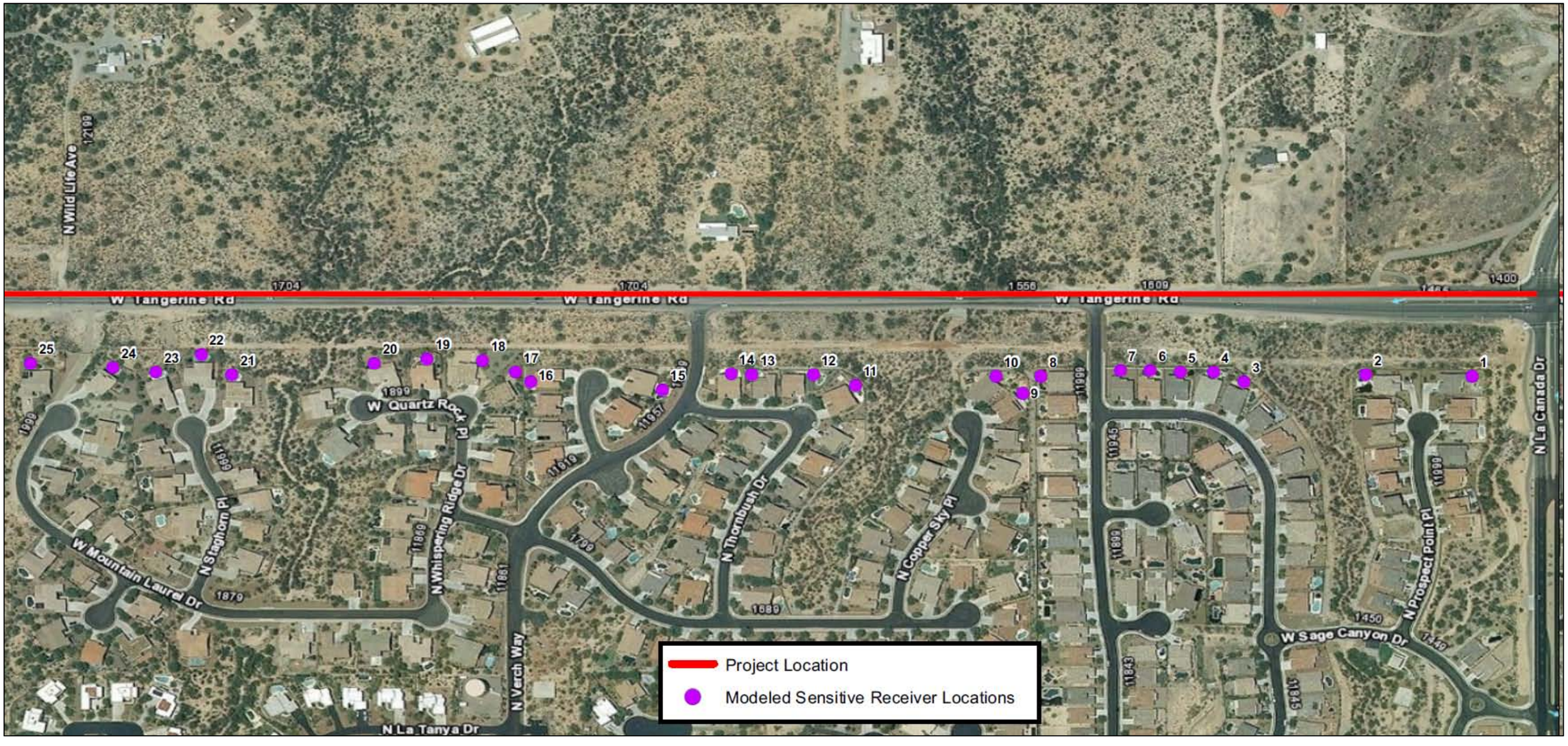


Figure 7.07. Modeled Sensitive Receiver Locations

Table 7.09. Modeled 2040 Noise Levels Compared To Existing (2011) Levels

Receiver Number	Existing (2011) Peak-Hour Noise Levels (dBA)	Predicted 2040 Peak-Hour Noise Levels (dBA) ‡	Noise Levels Increase (dBA)
1	58	61	3
2	58	61	3
3	53	56	3
4	52	55	3
5	52	55	3
6	51	53	2
7	60	63	3
8	55	57	2
9	55	58	3
10	60	62	2
11	59	61	3
12	56	58	2
13	56	59	3
14	60	62	2
15	56	58	3
16	58	61	3
17	57	61	4
18	59	64	5
19	59	62	3
20	59	61	2
21	59	62	3
22	58	61	4
23	55	57	2
24	56	58	2
25	55	56	1

‡ With 3 dBA credit for RAC.

As shown in Table 7.9, modeling of the proposed Tangerine Road design with 2040 peak-hour traffic indicated that the 66-dBA mitigation criteria level *would not* be exceeded at any sensitive receiver locations. Additionally, there *would not* be a 'substantial' increase in traffic noise at any sensitive receiver location. Therefore, no noise abatement or mitigation was recommended for this project.

It should be noted that following the completion of the traffic noise modeling and analysis presented in this report, the design alignment of Tangerine Road was shifted 25 ft to the north between Thornydale Road and La Cañada Boulevard. This shift was recommended in the RTA's Value Analysis (VA) effort as a way to reduce costs by avoiding TEP relocations and to provide additional buffer space to the developed areas south of the road.

Typically, sound levels measured from a line source (i.e. a roadway) decrease at a rate of 3 dBA per doubling of distance (FHWA 2011. Highway Traffic Noise: Analysis and Abatement Guidance. Document Number FHWA-HEP-10-025). For example, if the sound level from a line source at 25 ft was 64 dBA, at 50 ft it would be 61 dBA. Thus, the shift of alignment to the north would result in a reduction in the future noise levels presented in the report for the sensitive receivers on the south side of Tangerine Road (Table 7.09). Likewise, this shift would result in an increase in future noise for sensitive receivers on the north side of Tangerine Road (Receivers 8 -10, Figure 7.05). However, as previously discussed, these north side receivers are isolated from each other and would not qualify for noise abatement barriers.

Therefore, the conclusions from the original noise analysis are unchanged: the 66-dBA criteria level would not be exceeded by future conditions at any qualifying sensitive receiver locations and there would not be a 'substantial' increase in traffic noise at any qualifying sensitive receiver locations. Therefore, no walls are recommended for noise abatement or mitigation.

Based on the above evaluation and subsequent discussions with the partnering municipalities, rubberized asphalt will be considered the primary surface course pavement alternative to assist in reducing noise along the Tangerine Road corridor. There are several advantages to using rubberized asphalt pavement, some of which include:

- It reduces traffic noise between 3 dBA and 4 dBA, depending on site conditions
- It is less costly than constructing noise barrier walls, landscaped berms, or depressed roadways.
- It does not interrupt the views from residences or the traveling public, attract graffiti, create any safety hazards for vehicles, or interfere with any crime surveillance activities.
- Its effectiveness is not reduced by the need to provide access for driveways, alleys, side streets, and/or drainage ways.
- No additional right-of-way or easements are required for walls or other noise mitigation.

7.08 Visual/Aesthetic Resources

This section summarizes the findings of the *Visual and Aesthetic Resource Analysis, Tangerine Road – Interstate 10 to La Cañada Drive* prepared by McGann and Associates. Additional information can be found in that document.

The greater Tucson metropolitan area has a unique physical setting and climate which are major factors in attracting visitors and residents. The Tangerine Road corridor is one such location where the predominant views in the project area include the Tortolita Mountains to the north, the Santa Catalina Mountains to the east, the Tucson Mountains to the south, and the Silverbell Mountains to the west. A primary image for visitors and residents to the Town of Marana and the Town of Oro Valley is derived from those views along Tangerine Road. The Tangerine Road corridor is a major route that links resorts, recreational facilities and residences of two Towns with the interstate travel of I-10 and the state route travel of SR77. In general, the project improvements are not anticipated to adversely affect these views for the majority of the residence of the project upon its completion. In actuality, clearing of the dense vegetation to accommodate the roadway improvements may help improve views for those in the immediate vicinity of Tangerine Road.

Nonetheless, visual resources along the Tangerine Road corridor will be impacted in several ways due to the proposed project improvements. Since the roadway will be widened from a two-lane roadway to a four-lane divided roadway, the footprint of the paved area will more than double, resulting in a significantly wider swath of paved surface through the landscape. This in turn will result in a large amount of existing vegetation to be removed along the corridor. Construction is expected to disturb substantial areas of right-of-way and remove roadside vegetation that currently screens views to established residential areas. Existing vegetation will also be removed at existing drainage crossings which will have a noteworthy impact on visual resources. All viewer types will be affected with this impact.

Currently, the vertical alignment of the roadway dips and rises with the existing topography. The proposed improvements will provide a more continuous grade throughout the project limits that will improve both sight visibility and safety. Drainage structures will be designed and constructed to accommodate wildlife at drainage crossings and where wildlife movement is significant. At these locations, the roadway may rise as much as 14 feet above the existing ground. These fill slopes have the potential to be highly visible from adjacent properties. The viewer types affected by this impact will be roadway users and adjacent residents in the vicinity of drainage improvements.

There are numerous named and unnamed washes that cross perpendicular to Tangerine Road. Currently, the flows from many of these washes cross the roadway at grade, making travel difficult to impossible during heavy rains. The proposed improvements will eliminate the drainage dip crossings, allowing Tangerine Road to be an all-weather roadway. As mentioned

previously, many of these crossings will be upsized for wildlife considerations. Inlet and outlet headwalls, large and/or steep fill slopes, and the removal of vegetation during construction will make these areas highly visible from viewpoints adjacent to the roadway. The viewer types affected by these impacts will be adjacent residents in the vicinity of the drainage improvements.

Due to the width of the proposed construction limits, there will be existing vegetation removed in and around overhead utility lines and poles. Since the planting of trees and other tall plants under overhead electric lines and near poles is generally restricted by the utility owners, reproducing the density, size and composition of the currently present vegetation will be extremely difficult. Therefore, the removal of vegetation during construction combined with planting restrictions has the potential to change the visual composition significantly. All viewer types will be affected by this impact.

Goals for the Tangerine Road improvements should include:

- Preservation of views of prominent mountain ridge lines that form the limits of scenic view sheds and provides a natural backdrop for sensitively designed development.
- Preservation of view sheds which provide the observer with a visual perspective of the areas in terms of foreground, middle ground, and background.
- Preservation of the scenic quality of the desert and mountain environment through the retention of native vegetation and natural topography.
- Preservation of view windows through an aesthetic screening or siting of developmental elements incompatible with the natural qualities of the surrounding area.
- Landscaping should enhance and amplify the natural beauty of the corridor.

To help mitigate the visual and aesthetic impacts, several measures will be undertaken as part of the design. In terms of views from the roadway, the following measures will be applied:

1. Provide vegetation in the medians to mediate the effect of a wider pavement.
2. Re-vegetate the unimproved shoulder areas with appropriate native plant species and densities where vegetation is removed for roadway improvements.
3. Identify locations where existing screens to unattractive mid-ground views will be removed, or where new screening is appropriate, and provide new screening vegetation.
4. Enhance existing visual rhythm by providing openings to views of surrounding mountain ranges where appropriate.
5. Avoid screening views to mountain vistas that may have opened up because of changes in vertical alignment.
6. Use vegetation to frame significant views.
7. Plant in greater densities with native shrubs and scents to transition to natural open space areas.

In terms of views to the roadway, the following measures will be considered:

1. Provide screening vegetation wherever possible; at adjacent residential locations, at drainage structures, and at locations with increased vertical alignment.
2. Provide landscape that compliments commercial buffer yard areas and preserves views to store fronts and signage.
3. Select materials for the stabilization of fill slopes to blend with the existing landscape.
4. Select colors and finishes for structures that will blend with existing landscape.
5. Provide vegetation to break up long expanses of slope treatment.
6. Provide screening vegetation using native shrubs and accents where trees are not possible.

Landscape standards applicable to the Tangerine Road corridor include those discussed in Chapter 5.0 and specified in the Town of Marana Land Development Code, the Pima County DOT Landscape and Irrigation Guidelines, 2008, Pima County DOT ESR Design Guidelines,

and the Town of Oro Valley Zoning Code. These documents include regulations and guidelines regarding native plant preservation, landscaping, and roadway frontage standards.

The project will include a public art component. Project features that lend themselves to having public art integrated into them include:

- Safety railings at drainage structures and headwalls,
- Form liner detailing and block patterning of walls,
- Pedestrian amenities such as seating, elements in sidewalk or multi-use path, shade structures, and
- Paving and graded slopes such as median nose paving patterning and landform art.

The project could also utilize free standing sculptures such as an entry or gateway monument and/or stand-alone elements that are repeated throughout the project.

One possible theme for the art component is natural history which would include art inspired by flora, fauna, climate, hydrology, or community ecology. Possible themes would include:

- Flora: ironwood tree, hackberry, saguaro
- Flora: ethnobotany
- Fauna: crossing under and over the roadway
- Fauna: wild horses in the Tortolita Mountains
- Climate: the five seasons in the Sonoran Desert
- Hydrology/Community Ecology: the life of an ephemeral desert wash
- Community Ecology: the life in a decaying saguaro on the desert floor

Another theme would be cultural and draw inspiration from the pre-historical, historical, or current cultural context. Possible themes would include:

- Pre-history: trading corridors relating to Tangerine Road as a current transportation corridor
- Pre-history: the cultivation and use of agave by pre-historic peoples living in the Tortolita Mountains
- Historical: people and mountains in the Sonoran Desert
- Historical: the history of cotton
- Historical: early ranching and farming themes
- Current culture: health and fitness as a Sonoran Desert lifestyle

A third theme might be environmental and would integrate the natural context rather than the man-made context.

8.0 PUBLIC INVOLVEMENT

The public involvement process has been a joint effort of Kaneen Advertising & Public Relations, the Town of Marana, the Town of Oro Valley, Pima County Department of Transportation, the Regional Transportation Authority, Kittelson & Associates, and Psomas. In supporting the project goals and objectives, the project team recognizes that conveying and collecting accurate and easy-to-understand information is vital to the public involvement process and to the overall success of the project. Members of the public are provided an understanding of the basic project details in order to assist them with the ability to provide input and express concerns. Public outreach efforts focus on information exchange with the public that grants the design team an opportunity to understand the relevant and important issues of the public at an early stage. It also provides a way to respond to citizen concerns as an integral part of the design concept process. The following specific strategies have been used in order to involve residents, businesses, and other project stakeholders:

- Open houses
- Project website
- Meetings with individual stakeholders or groups
- Media releases

The advertisement, comment summaries and other aspects of the public meetings will meet Federal requirements to facilitate the National Environmental Policy Act (NEPA) documentation in the eventuality that Federal funding is obtained for future project phases.

There will be a total of four public meetings during the design concept stage. The first meeting was held after the initial data gathering was completed. The second and third meetings took place after submittal of the initial Preliminary Design Concept Report (DRC) and 15% plans. The two meetings covered similar content (preliminary design and design alternatives), but one was held in Marana and the other was in Oro Valley. The fourth and final meeting will occur after submittal of the Final DCR and30% plans. This meeting will present the selected corridor alternatives and will take place at a site selected by the partnering jurisdicions.

The public meetings are publicized through news releases distributed to the appropriate media and through display advertisements placed with the appropriate media and at strategic locations. A database was developed to include interested stakeholders and their contact information along with a website with the URL of www.tangerineroad.info. Figure 8.01 highlights the look of the website. Kittelson assisted the public participation process by developing a GIS-based comment form that was linked to the project website. The homepage and comment page of the website was launched in January 2011. Meeting announcements are mailed to the project contact list which is comprised of project area residents and businesses as well as elected officials. Corresponding information is posted on the dedicated project website. Comments submitted during a two-week period following each meeting are 1) documented and summarized for the project team and 2) responses are prepared for all questions. The public involvement results for the project are summarized on a separate document.

The first of 4 public open houses was conducted on April 7, 2011 at Heritage Highlands in Marana. Meeting notices were sent to 5,592 households in the vicinity of the project. In addition, stakeholders and business owners along the roadway, property owners, surrounding homeowner associations, and team members were sent open house notices. A newspaper ad was placed in the March 30, 2011 Explorer News.

There were 174 people that signed in at the first meeting, and many others that declined to do so. There were 31 signed attendees from Oro Valley. The format of the meeting included a short presentation followed by individual discussions at several project displays dispersed through the meeting room. The goals of the meeting were twofold; 1) to present the project information collected to date regarding existing conditions and 2) to obtain feedback regarding

the needs, issues and considerations of the public. The intent of the meeting was not to present design proposals (except for the typical roadway cross sections under consideration) but instead to present collected data such as existing traffic volumes, existing traffic speeds, existing drainage conditions, existing right-of-way, existing utilities, and results of a wildlife mortality study by the Arizona Game and Fish.

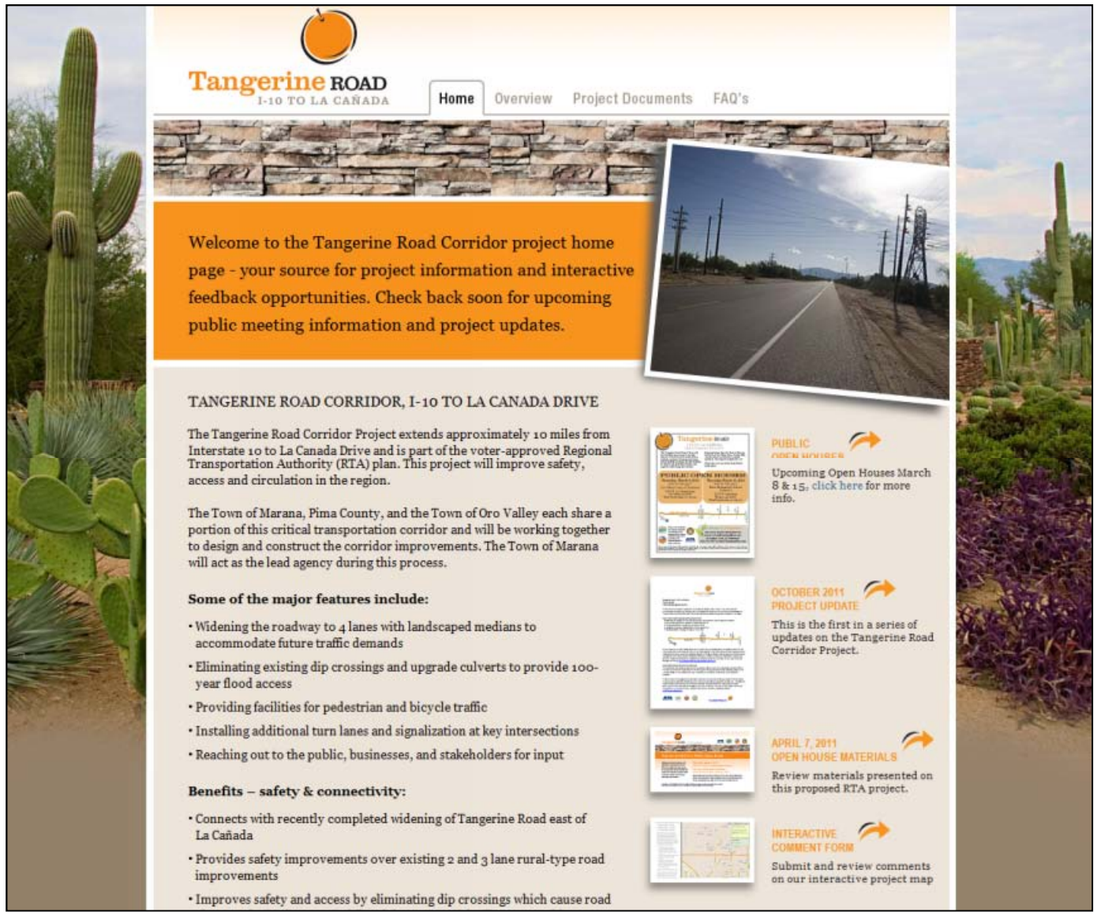


Figure 8.01. Tangerine Road Website Homepage

Significant positive feedback was received after the meeting and on the project website. Some of the more common issues were as follows:

- Extend the curbed section from Thornydale Road to Dove Mountain Boulevard
- Need for bicycle, pedestrian and equestrian facilities
- Need for wildlife crossings
- Desire for right turn deceleration lanes
- Questions about project schedule, particularly construction

Some of the attendees did not understand that this is a 15-year project with construction to begin in about four years. The thoughts were that construction would be starting sooner.
A list of frequently asked questions (FAQs) was added to the website that was developed per the open house responses as well as anticipated issues per the design team such as noise concerns, property acquisition, travel speeds, and access. Other project information can be found on the website, such as the open house power point presentation, aerial maps, existing traffic volumes, existing and future land use maps, typical roadway cross sections, a wildlife study map, and the access management plan.

The team, led by Kittelson and Associates, also held a workshop on June 23, 2011 to discuss the need for access management along the corridor, the benefits of access management, and the proposed access management plan including the location and spacing of median openings, driveways, and traffic signals. Business and property owners adjacent to the roadway, as well as other stakeholders and surrounding homeowner associations were invited to the meeting, which was held at the Oro Valley Council Chambers. Approximately 20 people attended and provided six comments.

The second open house meeting was held on March 8, 2012 in the Town of Oro Valley's Council Chambers. The design team presented an overview of the project including progress to date, design alternatives, schedule and funding status. 72 people signed in at the meeting

and submitted 10 forms with questions or comments related to emergency vehicle access, the Camino de Mañana realignment, wildlife crossings, neighborhood impacts (especially noise), bicycle conflicts with vehicular traffic, constructions sequencing, and funding.

The third open house meeting was held on Thursday March 15, 2012 at Ester Elementary School (11279 W Grier Road). The content of the meeting was the same presented the previous week in Oro Valley, but attendance was significantly lower. Five comments were received at this open house regarding construction impacts, noise and roadway aesthetics.

The fourth and final public open house has been scheduled for February 25, 2013 at the Town of Oro Valley's Council Chambers. The meeting will be an official public hearing to present the findings of this DCR and the associated plans, and to solicit feedback. The public input from his meeting will be recorder under a separate document.

9.0 AGENCY COORDINATION

The Tangerine Road corridor project is distinctive in that it spans three jurisdictions from the project beginning at the Interstate 10 westbound off-ramp to the project end near the La Cañada Drive intersection as part of the Regional Transportation Authority (RTA) plan. From west to east, the three jurisdictions are the Town of Marana, Pima County and the Town of Oro Valley. Pima County is represented on the project team by the Department of Transportation (PCDOT) and the Regional Flood Control District (PCRFCD). The three agencies are partnering to develop the project with the guidance of the RTA. The Town of Marana is the lead agency and is administering the contract while Oro Valley and Pima County are cooperating agencies. Coordination between the Town of Marana, the Town of Oro Valley, Pima County, the RTA, and the design team has been ongoing since the beginning of the project and has been accomplished through the creation of a Technical Advisory Committee (TAC) made up of representatives from the four agencies. The TAC has worked with the design team to make the major design decisions for the project at monthly progress meetings. A Project Charter was developed by the project team and approved by the three jurisdictions and the RTA. Approval of the document indicated an understanding of and commitment to the scope, budget, and schedule, as well as agreement that work on the project and the necessary resources should be committed as described in the document.

Close coordination has also been required with the Arizona Game and Fish Department (AGFD) in order to facilitate wildlife movements throughout the project area and particularly at the wildlife corridors. Wildlife linkage is an extremely important aspect of this project and several coordination meetings with the project team and the AFGD have taken place throughout the project development.

The design team has also coordinated with the State Land Department, which owns the majority of the land that is proposed as the new ROW for the project. The draft DCR and 15% plans were submitted to James Reese in April 2012. In June 2012, Sue Russell became the State Land Department Rights of Way Administrator for Pima County, and the primary point of contact for the project. Although several discussions have taken place about the possibility of advancing the acquisition of ROW from the State Land for the entire project, no comments have been received to date on the 15% plans.

Ongoing coordination will be required with the United States Army Corps of Engineers (ACOE) regarding jurisdictional delineations and 404 permitting, the United States Fish and Wildlife Service (USFWS) regarding federally listed threatened and endangered plant and animal species, and the Federal Emergency Management Agency (FEMA) regarding floodplain use and/or modification. Other environmental coordination will involve the Arizona Department of Environmental Quality (ADEQ), the Arizona Department of Agriculture, the State Historic Preservation Office (SHPO), the Pima County Cultural Resources and Historic Preservation, and the Pima County Department of Environmental Quality (PDEQ).

At the beginning of the project, the roadway will tie in with the Interstate 10 westbound ramps within the Arizona Department of Transportation (ADOT) and will cross over the Union Pacific Railroad (UPRR) tracks within the UPRR right-of-way. This portion of the project will be the last section constructed of the three proposed segments and construction is not anticipated to occur until approximately 2025. Therefore, detailed coordination with ADOT and UPRR is not anticipated until the design stages of the project. However, it should be noted that Tangerine Road has been designated as a State Route for 25 years. In the summer of 2011 there was some discussion between the partner jurisdictions as to whether Tangerine Road should be added to the State Highway System. Marana and Oro Valley expressed their desire that the roadway remain under local control and ownership, while Pima County would prefer that the State take over ownership of the road. At its meeting on September 16, 2011, the Arizona State Transportation Board voted to deny the request to add Tangerine Road to the State Highway System.

Utilities such as Tucson Water, Tucson Electric Power (TEP), TRICO Electric Cooperative, Southwest Gas (SWG), Cox Communications, and CenturyLink (CTL) were contacted to obtain as-built utility information and to determine utilities' plans with the project area. Meetings have been held with TRICO, TEP and CTL to coordinate the proposed roadway alignment and the overhead facilities for each utility. At various locations, both TRICO and TEP have senior rights within a State Land easement. TRICO and the Town of Marana will enter into a Memorandum of Understanding (MOU) with TRICO to relocate overhead facilities to the north edge of new right-of-way that will be acquired by the Town of Marana. Key provisions have been developed in order to begin the preparation process. Coordination will continue through the planning and design process with all utilities. The 30% preliminary project plans where submitted to the utility companies in January, 2013.

10.0 ALTERNATIVES

During the development of the design concept, several alternatives were considered for a variety of design facets of the project. Some of the more notable alternatives include the features discussed below.

10.01 Acquisition of New Right-of-Way

To date, just over 20% of the northern frontage and slightly less than 20% of the southern frontage has the planned 300 feet of ROW. Given these conditions, there are two alternatives with merit in terms of acquisition of the needed frontage. The entire planned ROW could be acquired or the acquisition could be limited to only the areas needed for the immediate project.

Acquisition of all the planned ROW would facilitate design and construction, but would require the purchase of almost 200 acres of undeveloped land (zoned low-density residential) from the Arizona State Land Trust Department (ASLD) and private property owners. It has been estimated that this acquisition could range from $5 to $10 million ($0.60 to $1.20 per square foot). Alternatively, the jurisdictions could continue to require dedication as part of the development process and acquire less property early on in the project phasing, but if land is needed prior to development for drainage, wildlife, water utilities or other uses, the purchase price may be significantly higher.

Initially, the Technical Advisory Committee decided to take advantage of the current real estate prices and directed the consultant team to assume the acquisition of the entire 300-foot ROW. However, following the RTA's Value Analysis the team agreed to pursue an initial ROW of 250 ft in the Marana and Pima County areas. The additional 50 ft will be obtained at a later time through development dedications and will allow for future widening, frontage roads, utility corridors, etc. The new ROW will include 150 ft north of the section line, and 100 ft south of the section line. The full planned ROW is being acquired on the north side of the section line to allow for drainage collection at the upstream end of the road, and to minimize utility relocations with prior rights along the south side of the road.

In Oro Valley, the 150 ft ROW south of the section line already exists in most areas. Therefore, the full 300 ft width will be pursued throughout the Oro Valley section

10.02 Typical Section Alternatives

Although the typical roadway cross sections were selected early in the planning stages as discussed in Section 5.08, there was some discussion as to whether it would be advantageous to construct the roadway with six lanes rather than four lanes. The projected volumes of 28,500 to 34,500 vehicles per day can be comfortably served with a four-lane roadway and good access management. The only segment of the corridor that would be nearing the necessity of six lanes in 2040 is the La Cholla Boulevard to La Cañada Drive segment which indicates a projected volume of 40,800 vehicles per day. A detailed intersection analysis was implemented for this segment and found that the intersections in that area would operate at LOS D or better in 2040. Both the Town of Marana and the Town of Oro Valley agreed that a level of service D would be the threshold for traffic operation analysis along the entire corridor. Therefore, given that the projections and intersection analysis seem to indicate that a four-lane section will be sufficient even when projecting out 30 years to 2040, the consensus of the project team was that a four-lane section would be adequate for the present and future needs of the corridor. A six-lane section would not be necessary until after the year 2040, and if and when a decision would be made to add an additional travel lane, it could be constructed with guardrail without the need to extend culverts or other drainage improvements. The project team also determined that the costs for adding another travel lane in the future would be borne by the developments that would require the additional capacity. This alternative could also include lowering the speed and adding median curb if warranted by the development conditions.

10.03 Tangerine Road Alignment Alternatives

The existing roadway alignment generally centers the roadway cross section on the section line. This type of alignment was decided by the project team as the preferred alternative to be applied wherever possible. The horizontal alignment presented in the 30% plans was selected through an alternatives evaluation process that took into account several alignment criteria and constraints in the development, selection, and application of the alternatives along the corridor. The criteria and constraints were as follows.

- Minimize private right-of-way acquisition;
- Minimize wash impacts and costs of drainage infrastructure; and
- Minimize impacts to utilities with exclusive easements.

Horizontal alignment alternatives for the Tangerine Road corridor were evaluated for three sections and the findings and selections are summarized below.

Interstate 10 to Dove Mountain Boulevard (Sta. 440+00 to 700+00). The critical constraint along this segment of the corridor is the overhead utility impacts that would occur from the TRICO building to Dove Mountain Boulevard. As mentioned in Section 3.07, TRICO owns a 25kV double circuit overhead facility on the north side and TEP owns a 46kV (I-10 to power alley at Sta. 568+00) and a 138kV double circuit overhead facility (east of Sta. 568+00) along the south side. Widening of the roadway to four lanes centered on the section line (between the two power lines) is not possible, because of concerns expressed by both utilities on the amount of fill allowed against the existing poles, vertical clearance concerns when the road is raised, and access needs to the poles for maintenance. Therefore, the other alternatives reviewed were to either move the alignment to the north or to the south, affecting only one of the overhead facilities. As previously mentioned, both utility companies have pre-existing lease agreements with the State Land Department for their lines (TEPs lease only covers the 138 kV line).

Moving the alignment to the north would impact the TRICO facilities but the TEP facilities would not be impacted. This alternative, though, would restrict the available width for a large drainage collector channel (approximately 75 feet wide) that is necessary along the north side of the roadway west of Breakers Road (Sta. 528+00). Additional drainage easements would need to be acquired.

Moving the alignment to the south would impact the TEP facilities but the TRICO facilities would not be impacted. This alternative would easily allow for the construction of the drainage collector channel within the proposed right-of-way and reduce the need for drainage easements. However, the cost of relocating the 138 kV TEP line would be significantly greater than the cost of relocating the TRICO lines. The 46 kV TEP line is inside the existing Tangerine Road right-of-way and does not have a State Land Department lease. Therefore, there would be no relocation costs (to be borne by the agencies) for that segment of the TEP lines.

It was decided that all three alternatives need to be utilized, but at different locations along this segment:

- I-10 to TRICO Building (Sta. 440+00 to 470+00): In this area the alignment will be centered within the ROW, as there are no power lines in the vicinity of the road.
- TRICO Building to power alley (Sta. 470+00 to Sta. 568+00): From the TRICO building to the power alley the road centerline will be parallel to but 25 feet south of the section line. This shift will allow the TRICO facilities to remain but will require TEP to relocate its facilities. This was preferred because it would provide the necessary width for the large collector channel required along the north side of the roadway west of Breakers Road (Sta. 528+00). In addition, the 46 kV TEP line does not have prior rights and would be relocated at no cost to the project.
- Power alley to Dove Mountain Boulevard (Sta. 568+00 to 700+00): In this area the road centerline will be parallel to but 25 feet north of the section line. This will allow the TEP

138 kV facilities to remain in place along this stretch. The TRICO facilities will have to be relocated, but the Town of Marana and the design team have already reached a tentative agreement in terms of costs and other stipulations for the relocation. The alignment shifts back to the section line at Dove Mountain Boulevard.

Thornydale Road Intersection (Sta. 786+00 to 825+00). Two alignment alternatives were evaluated for the Tangerine Road section within the vicinity of the Tangerine Road/Thornydale Road intersection, from approximately Sta. 768+00 to Sta. 825+00. One alternative is to widen Tangerine Road symmetrically about the section line and the other is to widen Tangerine Road to the north to minimize utility conflicts.

The first alternative is symmetrical widening. Key advantages of this alternative include:

- No shifting and transitioning in the horizontal alignment.
- Essentially equal impact footprints on both the north and south sides.
- More flexibility for widening Tangerine Road to six lanes in the future if needed.

Disadvantages of this alternative include:

- TEP has an existing easement of 25' on the south side, adjacent to the existing 50' south right-of-way lines. Located within this easement are high voltage transmission overhead lines and poles, and two communication stations. The widening would impact this equipment and thus require the existing TEP easement as well as equipment be relocated further to the south.
- TEP has a large concrete junction pole located in the southwest corner of the Tangerine Road/Thornydale Road intersection. This pole would be impacted by the symmetrical widening. TEP has restrictions on when such a pole can be relocated which could adversely affect construction schedule and phasing.
- The widening would impact both the TRICO overhead lines on the north side and the TEP overhead lines on the south side.

The second alternative is widening to the north. This alternative involves shifting the center of Tangerine Road 18' north of the section line. Notable advantages of this alternative include:

- Existing right-of-way is available on the north side. West of Thornydale Road, the north right-of-way is 175' wide and east of Thornydale Road, the north right-of- way is 150' wide. Few structures are located within the right-of-way so impacts are minimal.
- Shifting the alignment 18' north would avoid impacting the existing TEP easement as well as overhead lines, poles, and structures. It would still impact the TRICO overhead lines and poles on the north side. These TRICO facilities will be impacted by either widening alternatives; they will also be impacted by the Tangerine Road widening further west.
- Avoid impacting the TEP junction pole in the southwest corner of the intersection.
- Reduce the right-of-way acquisition need on the south side if desirable.

Disadvantages of this alternative include:

- Shifting the roadway to the north 18' creates an angle point in the horizontal alignment. For the 50 mph design speed, the minimum transition distance is 900'.
- Future widening of Tangerine Road (beyond four lanes) may still require the relocation of the TEP easement and equipment, which could be more expensive.

In evaluating the various impacts associated with the above alignment alternatives, the 'widening to the north' was found to best balance the competing criteria and meet the current project needs. Therefore, the project team recommended this alternative as the preferred horizontal alignment for this Tangerine Road section to move forward in the preliminary design process.

Thornydale Road to La Cañada Drive (Sta 825+00 to Sta 955+00). As previously mentioned, TEP has a 25 ft easement along the south side from Camino de Mañana to La Cañada Drive.

The easement accommodates high voltage transmission overhead lines with poles approximately 500' apart. Due to the vertical profile being raised at various wash locations to accommodate drainage structures, some of the TEP poles could be impacted by fill. Several alternatives were evaluated to minimize impacts to TEP and they are briefly described below.

1) Widen Tangerine Road symmetrically from the section line with a full build typical section. The full build typical section includes 10' multi-use paths on the south side of the roadway and a fill slope of 6:1 beyond the clear zone. Preliminary analysis indicated that roadway fill would occur at 18 TEP poles, out of 36 poles, between Tangerine Crossing Road and La Cañada Drive and may require pole relocation and or replacement. However, impacts to three (3) of those 18 poles could potentially be mitigated by building retaining walls (two feet or shorter) around their foundations.
2) Same as 1 but with a fill slope of 3:1 and no multi-use path on the south side. Preliminary analysis indicated that roadway fill would occur at 16 TEP poles. However, impacts to six (6) of those 16 poles could potentially be mitigated by building retaining walls (two feet or shorter) around their foundations.
3) Shift Tangerine Road centerline 25' north of the section line with a fill slope of 3:1 and no multi-use path on the south side. This combination of horizontal alignment shift and reduced roadway section completely avoids impact to the 36 TEP poles.
4) Shift Tangerine Road centerline 25' north of the section line with a fill slope of 4:1 and a multi-use path on the south side. This combination of horizontal alignment shift and reduced roadway section limits the impacts to 7 of the 36 TEP poles, and minimizes noise impacts to the subdivisions on the south side of Tangerine Road.

Although the agencies have initially expressed a preference for alternative 1, following the RTA's Value Analysis of the project, the team agreed to pursue alternative 4 to minimize TEP and noise impacts while maintaining the multi-use path.

10.04 Camino de Mañana Alignment Alternatives

Psomas evaluated two alternatives for the intersection of Tangerine Road and Camino de Mañana. Alternative 1 would be to preserve the present alignment of Camino de Mañana as it lies within the existing right-of-way. Currently though, the roadway alignment intersects with Tangerine Road at a 33-degree skew which presents some safety challenges. In fact, the *Pima County Roadway Design Manual* states that intersections skewed more than 20 degrees should be avoided.

Alternative 2 would be to re-align the roadway and reduce the skew to 15 degrees. The development of a 90-degree intersection (0-degree skew) is not feasible because it would require the acquisition of private (developable) lots within Sky Ranch, or the use of a 25 mph design speed. The 15 degree skew was selected because it meets the design and would likely result in significantly improved operational and safety performance of the intersection. The maximum design speed that can be provided without affecting individual lots within Sky Ranch is 35 mph. Still, a portion of a common area of Sky Ranch (approximately one acre) would need to be acquired for the realigned south leg of the intersection. The north leg of the intersection would all fall within a property currently owned by the Town of Marana.

In order to maintain the current speed limit of 35 mph, the Technical Advisory Committee (TAC) agreed to use the same design speed and posted speed limit. The proposed alignment would include dedicated left and right turn lanes in all directions, and is depicted in Figure 10.01. The Town of Marana and the TAC approved alternative 2 as the preferred alignment for Camino de Mañana.

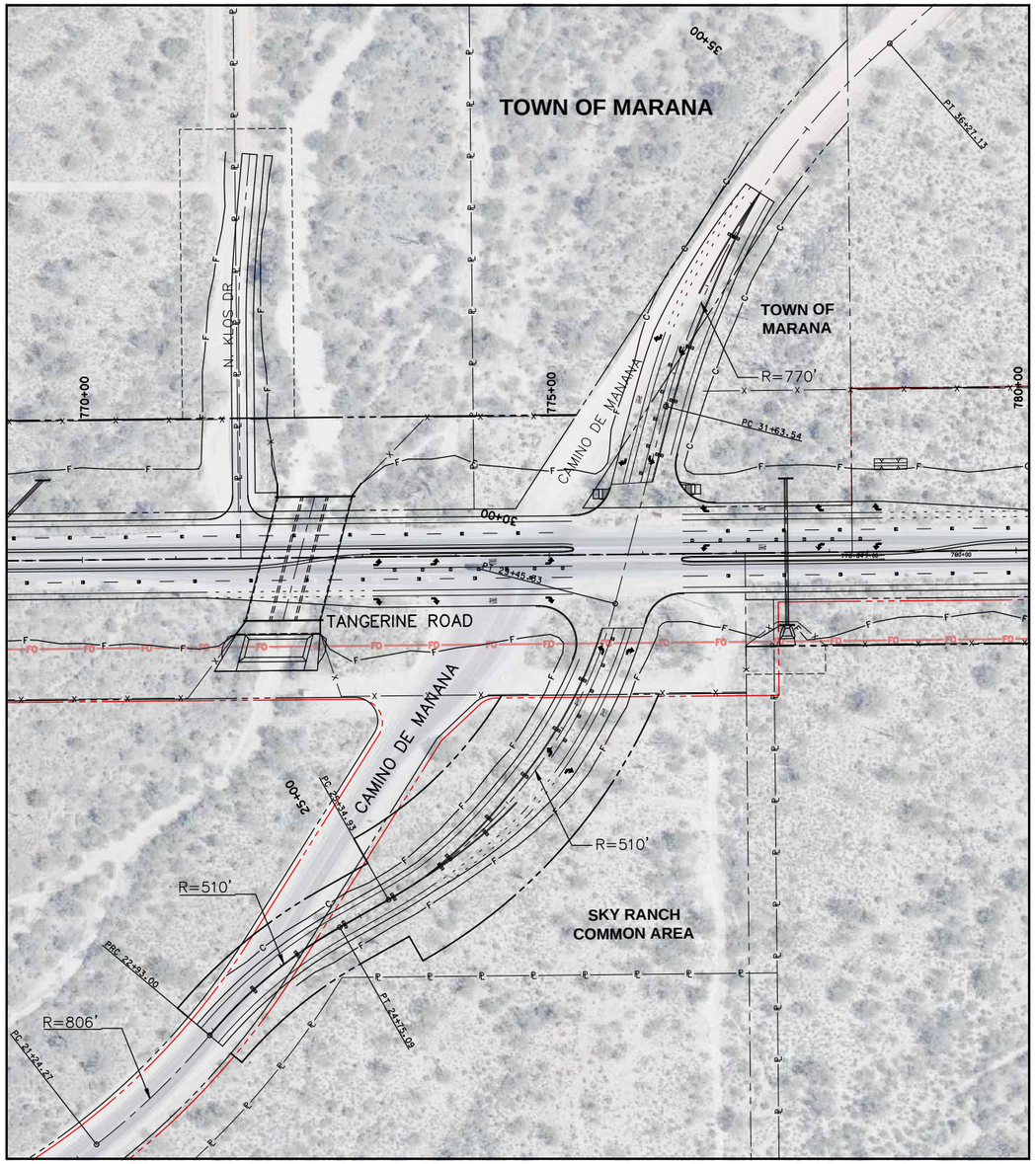


Figure 10.01. Camino de Mañana Intersection – Preferred Alternative

10.05 Thornydale Road Alignment Alternatives

The existing Thornydale Road horizontal alignment intersects Tangerine Road at a 15-degree skew. With the proposed lanes needed to accommodate the 2040 traffic demand, Thornydale Road will be widened from 55' to 108' at the intersection. Alignment variations were explored to minimize right-of-way acquisition and utility impacts. Two notable options are summarized below.

The first alternative is to widen the south leg of Thornydale Road symmetrically from the section line. The key advantage of this alternative is:

- The flexibility for future widening of Thornydale Road between Tangerine Road and Cortaro Farms Road.

Major disadvantages include:

- Need to acquire right-of-way on the west side of Thornydale Road. The east right-of-way is currently 75 feet and the west right-of-way is 30 feet.
- Need to relocate existing TEP overhead lines and poles along the west side. More importantly, the TEP junction pole at the southwest corner will also require relocation.
- The intersection skew would exceed 20 degrees.
- Additional right-of-way in the northwest corner may be required.

The second alternative is to widen the south leg of Thornydale Road to the west. The key advantages of this alternative are:

- A reduced skew at the intersection (10 degrees).
- No impacts to TEP facilities.

It should be noted that the existing TEP facilities are located within the clear zone (based on current clear zone standards) and the proposed widening would not exacerbate the issue.

Major disadvantages of this alternative include:

- Need additional right-of-way in the southeast corner. Currently it is 75 feet.
- The northbound travel lanes will be shifted much more than the southbound lanes.
- Future widening of Thornydale Road to the south, if widened symmetrically from the section line, will impose additional horizontal alignment shift.

In evaluating the various impacts associated with the above alignment alternatives, the second alternative was found to best balance the competing criteria and meet the current project needs. Therefore, the project team recommended this alternative as the preferred horizontal alignment for this Thornydale Road section.

10.06 Tangerine Road/La Cholla Boulevard Intersection Alternatives

The intersection of Tangerine Road and La Cholla Boulevard is expected to have the highest volumes (particularly left turns) of any intersection in the project area. Therefore, this intersection is expected to be the limiting intersection when determining the capacity of the roadway. Four design alternatives were evaluated for left turns at the intersection to determine if a non-typical design might best serve the volumes at that location and therefore extend the useful life of the roadway. The four alternatives include standard dual left turns with protected-only left turn phasing, standard dual left turns with permissive/protected left turn phasing (which Oro Valley is considering as long as sight distance, lighting and other parameters are in place), single indirect left turns (one u-turn lane for each direction), and dual indirect left turns (two u-turn lanes for each direction).

Both indirect left turn scenarios assume that all left turns will be made at the new intersections, as shown in Figure 10.02. The red path indicates how a driver on Tangerine Road would make a left turn onto La Cholla Boulevard, and the green path represents how a driver would make a left turn from La Cholla Boulevard onto Tangerine Road.

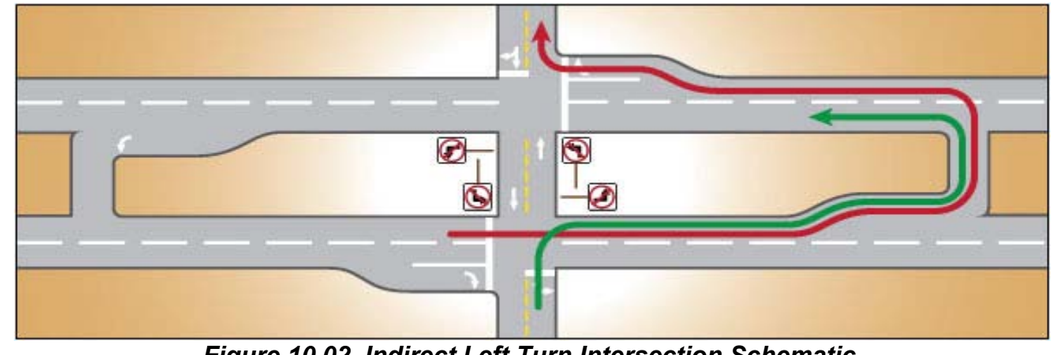


Figure 10.02. Indirect Left Turn Intersection Schematic

Table 10.01 summarizes the results of the analysis. The analysis shows that for the AM peak hour, the single indirect left turns provide a slight improvement over the standard left turns in average delay, though travel time remains mostly unchanged. In the PM peak hour, the permissive/protected standard left turns result in the lowest average delay, even when the dual indirect lefts are considered. It should also be noted that during non-peak period traffic, the standard intersection is also likely to provide a more efficient operation. A sensitivity analysis was also conducted, and the results can be found in the *Traffic Engineering Report*.

Given that dual indirect left turns create challenges when dealing with large trucks and result in fairly large intersections, their implementation is only justified if significant operational improvements can be demonstrated. In this case, the various alternatives are comparable, and the standard intersection configuration still provides an acceptable LOS (D). Therefore, the standard intersection configuration was selected.

Table 10.01. La Cholla Left Turn Analysis

Scenario - AM Peak Hour		Synchro Average Delay (sec/veh)	SimTraffic Total Travel Time (hrs)
2040 Base	Standard Prot Only LT	53.1	189.9
	Standard Perm/Prot LT	45.4	184.9
	Indirect LT	42.7	185.7
	Indirect Dual LT	39.6	178.4
% Difference Standard vs. Best Indirect Left		-26%	-6%
Scenario - PM Peak Hour		**Synchro Average Delay (sec/veh)**	**SimTraffic Total Travel Time (hrs)**
2040 Base	Standard Prot Only LT	42.1	185.7
	Standard Perm/Prot LT	36.6	181.3
	Indirect LT	41.7	190.8
	Indirect Dual LT	38.7	178.9
% Difference Standard vs. Best Indirect Left		-8%	-4%

10.07 Access Alternatives for Breakers Road and Rancho Palomitas

Rancho Palomitas is a planned commercial and industrial area located 0.3 miles east of Breakers Road that is expected to generate hundreds of peak hour trips, including a significant number of truck trips from a proposed waste transfer station. Rancho Palomitas is currently in the platting and development review process at the Town of Marana. An RV storage facility, Hayden Concrete (both of these already generate significant truck traffic) and Breakers Water Park are also located in that immediate area. The combined effects of the existing uses and Rancho Palomitas could result in an excessive amount of access in the area and potential safety conflicts unless a solution is identified early on and incorporated into the Rancho Palomitas development process. To that end, Psomas developed four alternatives that included various configurations of (one- or two-way) frontage roads, median openings, and potential signalized locations. Those alternatives are presented in Figure 10.03.

After considering the four alternatives, the Town of Marana decided to pursue Alternative 4 because it allows signalized access at Breakers Road and to Rancho Palomitas. The heavy vehicles accessing Hayden Concrete or the RV Storage facility from the east would also be able to make left turns in through a directional median opening. In addition, all uses between the RV storage and the eastern end of Rancho Palomitas would be connected by a two-way frontage road to allow trucks from all the parcels to exit to the west at the Rancho Palomitas signal without having to make a difficult u-turn. This configuration also avoids queuing issues between the frontage road and the Rancho Palomitas signalized access.

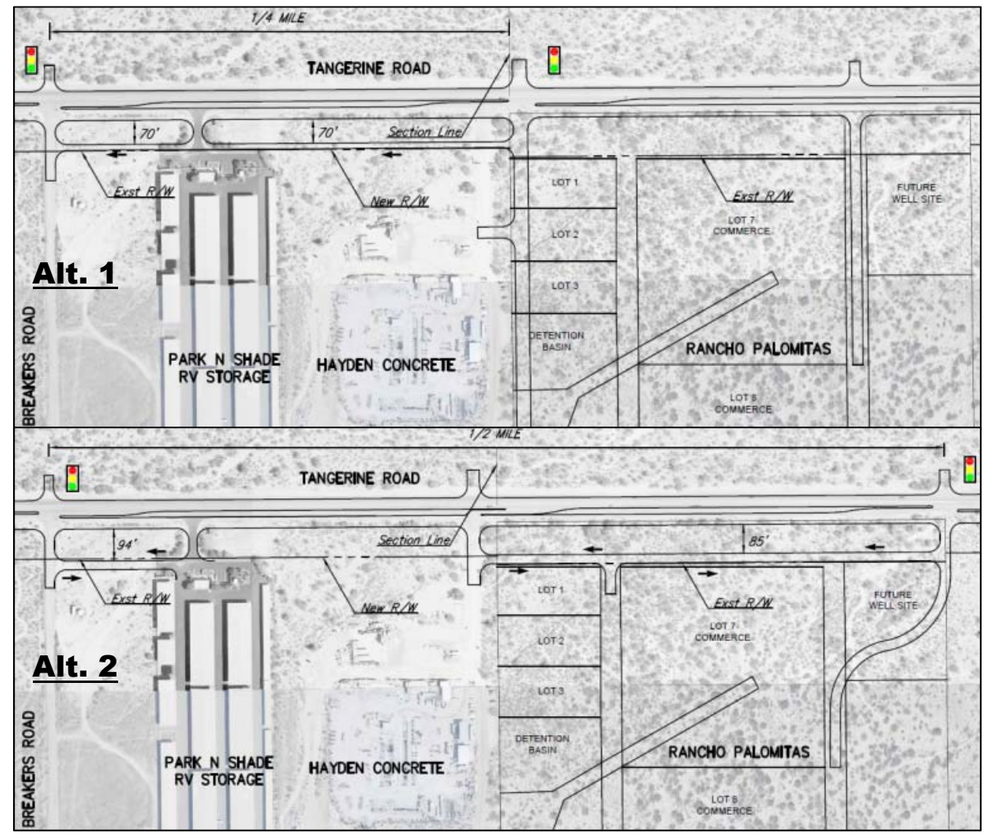


Figure 10.03. Access Alternatives for Breakers Road and Rancho Palomitas

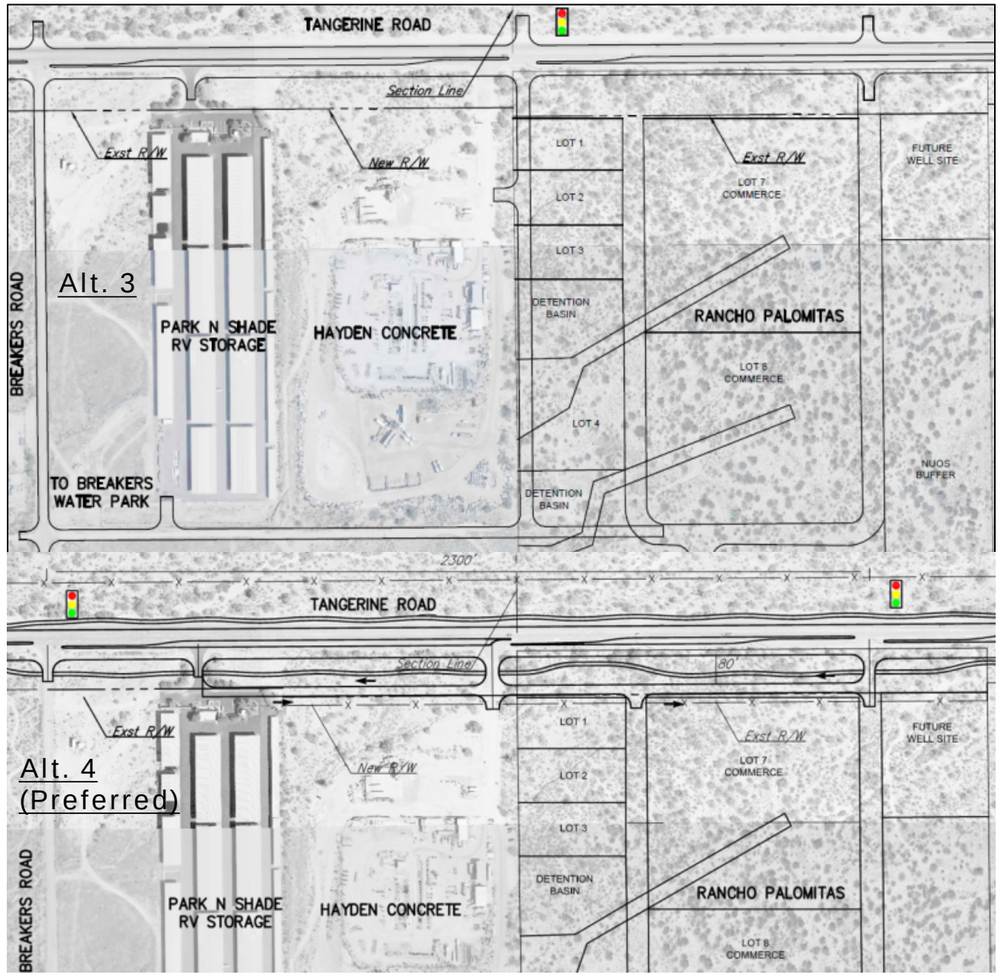


Figure 10.03. Access Alternatives for Breakers Road and Rancho Palomitas (cont'd)

In addition, the team decided to add an eastbound acceleration lane on Tangerine Road for the truck traffic exiting Rancho Palomitas at the proposed signal. It is to be noted that the ADOT and AASHTO length requirements for acceleration lanes are different. The ADOT design consists of a shorter acceleration lane followed by a longer taper when compared to the AASHTO design. The ADOT design was selected because most of the users of the acceleration lane are anticipated to be unloaded waste transfer trucks. Trucks with heavy loads are expected to go the opposite direction towards I-10. Although unloaded trucks can accelerate faster, they would need the extra taper distance to merge into traffic.

10.08 Pavement Design Alternatives

The design team and the Technical Advisory Committee (TAC) held multiple discussions to identify the most effective and desirable pavement sections for this project. Psomas also prepared a cost comparison of the various pavement alternatives presented in Terracon's pavement design summary report, which is included in Table 10.02. The costs from each treatment/material were obtained from recent local bid tabulations. The following conclusions were drawn from the cost analysis:

- Using rubberized asphalt (ARAC) instead of AC for the surface cost does not increase the cost of the pavement section. Although ARAC is 15-20% more expensive per ton than AC, its structural coefficient is 25% greater than that of AC. In addition, ARAC provides beneficial noise mitigation.
- In areas with poor subgrades (Tangerine Road segments 1 and 4), the use of Cement Treated Subgrade (CTS) is more cost effective than using a thicker pavement section. In fact, using CTS reduces the paving costs by more than 20% in areas with poor subgrade, and would reduce the total paving costs in segments 1 and 4 by approximately $400,000. Even in areas within those segments that meet the requirements in the subgrade acceptance charts, using CTS will still be less expensive.

As a result of those findings, the TAC and the design team decided to use ARAC as the surface course for Tangerine Road and the major side streets, and to use CTS for the entire length of segments 1 and 4 of Tangerine Road (approximately one mile each).

Table 10.02. Cost Comparison of Pavement Section Alternatives

			ton	ton	cy	sy					
		Cost	$80.00	$70.00	$28.00	$4.70					
			Layer Thickness (in)				Layer cost for 1 SF surface area				
Segment #	Limits	Alt.	ARAC	AC	AB	CTS	ARAC	AC	AB	CTS	Total ($/SF Pavement)
1	I-10 to TRICO	A	0	7.5	9	0	-	3.00	0.78	-	$ 3.77
		B	0	8	8	0	-	3.20	0.69	-	$ 3.89
		C	2	5.5	8	0	0.91	2.20	0.69	-	$ 3.80
		D	1.5	6	8	0	0.69	2.40	0.69	-	$ 3.77
		F	**2**	**2.5**	**5**	**6**	**0.91**	**1.00**	**0.43**	**0.52**	**$ 2.87**
		G	1.5	3.5	5	6	0.69	1.40	0.43	0.52	$ 3.04
1	I-10 to TRICO (areas with acceptable subgrade)	H	0	7	8	0	-	2.80	0.69	-	$ 3.49
		I	2	4.5	8	0	0.91	1.80	0.69	-	$ 3.40
		J	1.5	5.5	7	0	0.69	2.20	0.60	-	$ 3.49
2	TRICO to Dove Mtn	A	0	5.5	8	0	-	2.20	0.69	-	$ 2.89
		B	0	6	6	0	-	2.40	0.52	-	$ 2.92
		C	**2**	**3**	**8**	**0**	**0.91**	**1.20**	**0.69**	**-**	**$ 2.80**
		D	1.5	4	8	0	0.69	1.60	0.69	-	$ 2.97
3	Dove Mtn to La Cholla	A	0	5.5	8	0	-	2.20	0.69	-	$ 2.89
		B	0	6	6	0	-	2.40	0.52	-	$ 2.92
		C	**2**	**3**	**8**	**0**	**0.91**	**1.20**	**0.69**	**-**	**$ 2.80**
		D	1.5	3.5	8	0	0.69	1.40	0.69	-	$ 2.77
4	La Cholla to La Canada	A	0	7.5	8	0	-	3.00	0.69	-	$ 3.69
		B	0	7	9	0	-	2.80	0.78	-	$ 3.57
		C	2	4.5	10	0	0.91	1.80	0.86	-	$ 3.58
		D	1.5	5	10	0	0.69	2.00	0.86	-	$ 3.55
		E	0	5	5	6	-	2.00	0.43	0.52	$ 2.95
		F	**2**	**2.5**	**5**	**6**	**0.91**	**1.00**	**0.43**	**0.52**	**$ 2.87**
		G	1.5	3.5	5	6	0.69	1.40	0.43	0.52	$ 3.04
4	La Cholla to La Canada (areas with acceptable subgrade)	H	0	6.5	7	0	-	2.60	0.60	-	$ 3.20
		I	2	4	7	0	0.91	1.60	0.60	-	$ 3.12
		J	1.5	4.5	7	0	0.69	1.80	0.60	-	$ 3.09
5	La Cholla	A	0	5	7	0	-	2.00	0.60	-	$ 2.60
		B	0	5.5	6	0	-	2.20	0.52	-	$ 2.72
		C	**2**	**3**	**5**	**0**	**0.91**	**1.20**	**0.43**	**-**	**$ 2.54**
		D	1.5	3.5	6	0	0.69	1.40	0.52	-	$ 2.60
6	Thornydale	A	0	5	5	0	-	2.00	0.43	-	$ 2.43
		B	**2**	**2.5**	**5**	**0**	**0.91**	**1.00**	**0.43**	**-**	**$ 2.34**
		C	1.5	3	5	0	0.69	1.20	0.43	-	$ 2.32

Although one ton of ARAC is more costly than one ton of AC, ARAC provides more pavement structural support than AC (i.e., pavement thickness is less). Since the use of ARAC does not increase the overall pavement costs for the project and provides noise mitigation, a 2-inch ARAC layer is the preferred surface course agreed upon by the project team. The only exception is the pavement section alon turn lanes. At those locations, AC will be used as the surface course instead of ARAC because vehicle braking in those areas often leads to ”pushing” the ARAC.

The use of cement treated subgrade (CTS) was considered at locations along the project limits with deficient subgrade criteria. There are two areas along the project corridor with subgrade that do not meet the soil design standards. Since the use of CTS is more cost efficient than a thicker pavement section, the project team agreed to the use of CTS at those locations.

10.09 Alternative Culvert Materials

Preliminary hydrology analysis indicated that the cross culverts along the project limits include 20 reinforced concrete box culverts (RCBC) and more than 13,000 linear feet of Reinforced Concrete Pipe (RCP). Therefore, considering the use of other materials for those culverts could result in substantial savings.

A variety of culvert materials were considered. For smaller discharge culvert locations, pipes will generally be used. Pipe material alternatives considered are spiral ribbed metal (SRP), corrugated metal (CMP), and high density polyethylene (HDPE) along with the standard RCP. The Town of Marana does not allow HDPE use for cross drainage because of its potential flammability in open systems. RCP is the preferred material, although SRP and CMP are viable alternatives that would provide slight cost savings. SRP and RCP are basically equal when it comes to hydraulic function. The comparison for accepted pipe material comes down

to cost, structural loading concerns and product design life which are mainly associated with potential corrosivity risks.

For large discharge culvert locations, a single or multiple cell RCBC is the typical structure of choice. Steel arches, aluminum arches and concrete arches (precast or cast in place) are all alternatives that were evaluated. At the request of the TAC, Psomas compared galvanized multi-plate steel arches and pre-cast concrete arches with RCBCs at three representative locations. The results indicated that galvanized multi-plate steel arches could provide 30-40% cost savings relative to RCBCs. Pre-cast concrete arch culverts, on the other hand, exceeded the cost of RCBCs so no further alternative comparisons were conducted with concrete arch culverts. In this case, the most common concern with multi-plate steel arches is also corrosivity.

Corrosivity potential is generally a function of the soil's pH, resistivity and sulfate content. The America Water Works Association (AWWA) has a corrosivity scale to identify when those elements become an issue. ADOT also has a pipe material selection flowchart that can be followed to determine if CMPs or other metal culverts should be used. In this case, the Geotechnical Engineering Report for the project indicated that the soils along Tangerine Road have resistivity greater than 2,000 ohm cm (in most cases over 6,000 ohm cm), a balanced pH (6.5-8.5), and no sulfates, except for three locations east of Thornydale Road. Therefore, the corrosivity risk appears to be extremely low.

The preceding information was discussed at Technical Advisory Committee (TAC) meetings and evaluated as part of the project Value Analysis. Based on these discussions, the TAC directed the design team to use RCP and RCBC structures for the preliminary design effort, but did not rule out the use of other materials as a potential cost saving measure during final design. The only exceptions at this point are two proposed concrete arch structures to accommodate wildlife crossings (near Camino de Mañana and near Shannon Road).

10.10 Western Segment Drainage Alternatives (CMG)

During the proposal and early project scoping stages of the Tangerine Road corridor project, it was identified that the western 1.3 miles of the project, which currently experiences widely dispersed sheet flow conditions and frequent roadway inundation, may require consideration of a regional drainage solution. Drainage currently sheet flows in a northeast to southwest direction and crosses Tangerine Road in the vicinity of the TRICO building. Flow continues to the UPRR tracks, turns and follows the tracks north, then crosses Tangerine Road again in the low-lying areas adjacent to the UPRR intersection. The lack of topographic relief and adequate downstream outfall channels in this area make conventional culvert crossings impractical. This area of the project appeared to need an expanded alternatives analysis of interceptor channels or training berms on the north side to collect and direct storm water and sediment to a constructed outfall channel and/or to regional storage facilities. The west end regional drainage study area includes the portion of Tangerine Road from the Union Pacific Railroad (UPRR) to approximate road station 507+00.

As part of the basic roadway project drainage design, a concept-level west-end alternatives analysis determined that a combination detention basin / interceptor channel system with 10-year flood capacity could be a viable solution to provide a dry roadway design for up to the 10-year flood event. It was also determined that drainage systems with 100-year capacity would require substantial offsite improvements that are considered too cost prohibitive for the project. Offsite improvements needed to provide for a 100-year design include, but are not limited to, 1) downstream 100-year channel improvements to convey flows to the Santa Cruz River, or 2) large 100-year capacity detention basins/collector channels in multiple locations that capture both direct upstream flows from the northeast, and indirect flows from the southeast that are diverted along the UPRR that impact the west end limits of the project.

Based on these findings, the TAC decided that a more detailed drainage study of this area should be conducted to determine a preferred alternative. This resulted in the West End

Regional Drainage Analysis being added to the project scope and completed as part of the Stage II Drainage Report submittal.

The west end study identified and evaluated nine preliminary drainage alternatives for the west 1.3 miles of Tangerine Road. The drainage alternatives analyzed as a part of this study are summarized in Table 10.03.

Table 10.03. Summary of Drainage Alternatives Analyses

Alternative ID	Description	Recommended for Further Analysis? Y/N
Alternatives without detention basins (Channelization only)		
1	No-build/maintain existing cross drainage	No – Small grid FLO-2D showed that Tangerine Road is subject to significant flooding during 100- and 10-year rainfall event.
2	No-basin/Channel-only	Yes – CMG to proceed with analysis and design for a 10-year capacity channel along the north side of Tangerine Road
3	Causeway/multiple small diameter culvert system	No – Cost estimated at $16 mil+ with large adverse maintenance issues. No further analysis recommended
Alternatives with detention basins		
4	Detention Basins east of Trico Property.	No – Known cultural resource conflicts
5	Combined Detention Basins east of Trico Property and east of UPRR @ MSP property.	No – Known cultural resource conflicts
6	Detention Basins on Tangerine Invest Partners LLC.	No – High commercial value of property makes unfeasible.
7	Channelization/Basin on MSP Property.	No – High cost (estimated to be $10.2 mil) associated with this Alternative makes it unfeasible.
8	Detention basin on Kai and other properties south of Tangerine Road	No – High cost (estimated to be $7.9 mil) associated with this Alternative makes it unfeasible.
9	Combination of Alt. 7 and Alt. 8 with detention basins on Kai property and at downstream MSP property location connected by new channels	No – High cost (estimated to be $9.8 mil) associated with this Alternative makes it unfeasible.

Alternative 1 involved a roadway design that would not change existing drainage patterns and conditions, Alternative 2 only considered an interceptor channel on the north side of the road, Alternative 3 proposed elevating Tangerine Road and placement of a series of 24-inch culverts beneath the roadway to convey the 100-year flood, and Alternatives 4 through 9 evaluated different detention basin locations and sizes and possible combinations with interceptor channels. Evaluation criteria included cost, presence of cultural resources, property commercial values, drainage impacts to adjoining properties, and flood reduction benefits derived. After completion of the evaluation process, Alternative 2 was selected by the TAC for detailed analysis and design to the 30% level.

Alternative 2 proposes a channel along the north side of Tangerine Road to convey the 10-year peak flow; while runoff exceeding the 10-year event could overtop the roadway and follow existing drainage patterns. The channel would intercept overland flow arriving along this section of the road and direct it west toward the northeast corner of Union Pacific Railroad (UPRR)/Tangerine Road intersection. At the channel terminus along the UPRR, flows would weir over the channel north bank and onto adjacent properties to return to shallow overland flow along the UPRR right-of-way. Standing water in the channel below the weir is currently designed to be discharged through a low-flow culvert into an existing swale within UPRR right of way. Alternatively, dry wells could be considered to drain standing water in the channel to minimize easement acquisition needs on the UPRR. The channel is proposed to extend northward away from Tangerine Road and along the UPRR approximately 230 feet to provide additional weir length for flow dispersion. The extended channel segment onto the adjacent property is limited to 100 feet wide.

Collection and conveyance of flows along the north side of Tangerine Road will divert flows away from the farmland on the south side of the road. Hydraulic studies completed as a part of the west end study determined that the farmland on the south side of Tangerine Road functions to attenuate peak flows. The hydraulic modeling for proposed conditions determined

that the peak flow rate at the northeast corner of UPRR/Tangerine Road will increase as a result of the proposed channelization.

Twenty-foot grid FLO-2D models were built to accurately characterize the terrain and were used to analyze existing drainage conditions and proposed drainage facilities. As shown on Figure 10.04, under existing conditions, 10-year runoff inundates Tangerine Road at multiple locations with flooding depths of up to 2.0 feet. Under proposed conditions, the FLO-2D model results indicate that Tangerine Road is dry in the 10-year rainfall event, even at the vicinity of UPRR and Tangerine Road intersection. Proposed conditions are also shown on Figure 10.04.

During the 100-year rainfall event, storm water does not overtop the proposed Tangerine Road improvements from roadway Station 454+00 to Station 503+50. Just east of the UPRR/Tangerine Road crossing, approximately 800 feet of the road is inundated with flow depths of up to 1.4 feet, which are measured at the inside lane of Tangerine Road. Inundation on roadway from Station 443+00 to Station 450+00 has flooding depths of 1.0 foot and above. The estimated duration for inundation with depths of 1.0 foot and above on Tangerine Road is 3 hours during the 100-year storm.

The West End Regional Drainage Analysis has been included as an appendix of the Stage II Drainage Report, and preliminary West End Regional Interceptor Channel plans have been prepared and included in the Tangerine Road 30% Improvement Plan set.

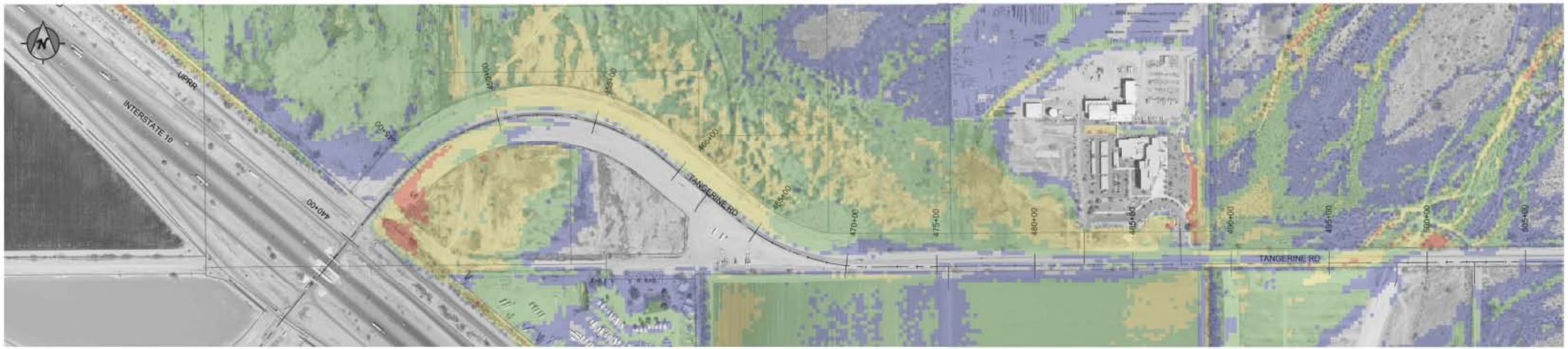
10.11 Width and Alignment of Multi-Use Paths

The team analyzed three alternatives for the width and alignment of the multi-use paths along Tangerine Road. The alternatives were as follows:

- Alternative 1: 12-foot wide, meandering paths outside the clear zone (at least 14 feet from the edge of pavement). All drainage structures would be extended beyond the paths.
- Alternative 2: 12-foot wide, meandering paths outside the clear zone (at least 14 feet from the edge of pavement). Drainage pipes would be extended beyond the paths, but the path would go down into the washes at the larger drainage structures (Reinforced Concrete box culverts, arches or bridges).
- Alternative 3: 10-foot wide, meandering paths at least six feet from the edge of pavement at large drainage crossings, and outside the clear zone elsewhere. All drainage structures would be extended beyond the paths.

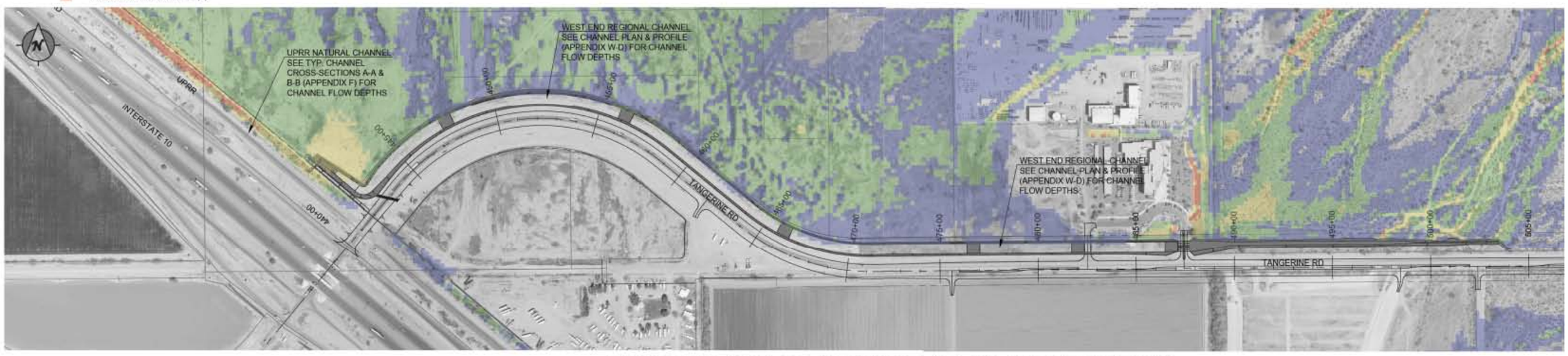
After several discussions, the TAC and the design team agreed to pursue Alternative 3 because it provides the most effective solution in terms of balancing the initial capital cost and the long-term maintenance costs. Having the paths go over all the culverts instead of into the washes, eliminates potential ADA issues, avoids the cleaning of the paths after every storm, and eliminates the need to construct cut-off walls to avoid the deterioration of the path. Still, given the significant number of major washes in the corridor, the team agreed that it was most effective to bring the paths closer to the roadway at those locations in order to avoid hundreds of thousands of dollars in box culvert extensions. Since the AASHTO *Guide for the Design of Bicycle Facilities* recommends a minimum separation of five (5) feet between the edge of pavement and the paths, a minimum separation of six (6) feet was agreed upon at major drainage crossings. This solution will reduce the length of the major drainage structures by an average of 28 feet when you take into account the skew of the washes and the reduction in length of both the upstream and downstream ends.

It should also be noted that the 15% design included multi-use paths on both sides of the road. As a result of the RTA's Value Analysis, Marana,Oro Valley and Pima County agreed to construct the multi-use path only on one side of Tangerine Road, while the path on the other side of the road will be built over time as the vacant land adjacent to the project is developed. The following summarizes the alignment of the path within the project limits:



LEGEND
10-YR EXT FLOW DEPTH
- FLOW DEPTH 0.1 to 0.5 (ft)
- FLOW DEPTH 0.5 to 1.0 (ft)
- FLOW DEPTH 1.0 to 2.0 (ft)
- FLOW DEPTH 2.0 to MAX (ft)

EXISTING 10-YEAR FLOW DEPTHS AT TANGERINE ROAD



PROPOSED 10-YEAR FLOW DEPTHS AT TANGERINE ROAD

Figure 10.04. 10-Year Flow Depths at West End of Tangerine Rd (Existing/Proposed)

- La Cañada Drive to Thornydale Road: the path will be constructed along the south side of Tangerine Road to maximize use, as most of the developed parcels are located on that side of the road; and to provide connectivity, as the segment of Tangerine Road east of La Cañada drive also has the multi-use path on the south side of the road. Alternative 3 will still apply in terms of path width and separation from the roadway.
- Tangerine Crossing Drive (0.4 mi east of Thornydale Road) to I-10: the path will be constructed along the north side of Tangerine Road because the vast majority of the developed land is located along that side of the road. The stretch between Thornydale Road and Tangerine Crossing Drive will have multi-use paths on both sides of the road to allow users from the Tangerine Crossing subdivision to walk or bike west to Thornydale Road and then cross there to the path on the south side of the road.

In addition, the Town of Marana agreed to use 10-foot paths to reduce the necessary culvert lengths by an additional four feet (two feet on each side). This will also result in a smaller paving quantity for the paths. The TAC agreed to use a pavement section of two inches of asphaltic concrete (AC) on four inches of aggregate base (AB) for the multi-use paths.

10.12 RTA Value Analysis

Given the funding challenges associated with the present state of the economy, the RTA has developed a practice of performing week-long Value Analysis (VA) workshops for all corridor projects with construction costs exceeding $10M. Following the workshops, the proposals generated by the VA team are evaluated by a review board comprised of representatives from the RTA's Technical/Management Committee's (TMC) Policy Subcommittee.

The Tangerine Road corridor VA workshop took place during the week of March 19-23, 2012, shortly after the completion of the 15% plans and Initial DCR. More than 100 ideas brainstormed at the workshop resulted in 41 value proposals and 13 supplemental recommendations (ideas that can enhance the project but do not provide savings) being advanced to the review board. The final Tangerine Road VA study was released in May 2012.

Following the release of the final study, the project's TAC advisory committee met (on June 1, 2012) to analyze the value proposals endorsed by the review board. The TAC agreed on one of three possible dispositions for each value proposal: implement now (A), implement in final design (B), or decline to implement (C). Table 10.04 summarizes the value proposals generated at the VA workshop, and the decisions from the TAC in regard to each proposal.

Estimated savings from VA proposals are not additive because there is significant overlap between various proposals in terms of ROW, paving or drainage savings, among others. However, the design team totaled the estimated savings stemming from the proposals accepted by the TAC in order to provide a general idea of the effect of the proposed measures. The proposals accepted for incorporation in the DCR/30% plans add up to $18.8M, while proposals to be considered in final design represent an additional $8.9M.

Table 10.04. Summary of Value Analysis Recommendations and Dispositions

PROPOSAL or SR NO.	VE PROPOSAL DESCRIPTION	RTA REVIEW BOARD DISPOSITION 1 = ACCEPT 2 = ACCEPT w/ MODIFICATIONS 3 = DECLINE	RTA REVIEW BOARD COMMENTS	TANGERINE TAC DISPOSITION A= YES, NOW B = YES, FINAL DESIGN, C = DECLINE	TANGERINE TAC COMMENT
RIGHT-OF-WAY					
P01-014	Define the proposed Right-of Way (ROW) width for Tangerine Road at 250 feet. *Initial Est. Savings: $1,800,000* *Future Est. Savings: $0,000* *Total Est. Savings: $1,800,000*	2	Acquire only 250' width with project funds. Should jurisdiction wish to pursue additional width, it should be through development exaction	A	150 ft to the North, 100 ft to the South with this project. The planned ROW will remain at 300 ft to allow future frontage roads, utility corridors, bike/ped amenities. Dedications will be required from future developments. Oro Valley ROW to remain at 300 ft total as most of the South side is already dedicated
P01-055	Pursue advance acquisition of all the State-owned property for the project *Initial Est. Savings: $3,900,000* *Future Est. Savings: $0,000* *Total Est. Savings: $3,900,000*	1		A	
ROADWAY ELEMENTS					
P01-071	Modify the profile to reduce the amount of fill required *Initial Est. Savings: $1,600,000* *Future Est. Savings: $0,000* *Total Est. Savings: $1,600,000*	1		A	
P01-036	Narrow travel lanes from12 foot to 11 foot throughout the entire corridor. *Initial Est. Savings: $1,260,000* *Future Est. Savings: $0,000* *Total Est. Savings: $1,260,000*	3		C	
P01-018	Shift the road centerline 25 ft to the north between Thornydale Road and La Cañada Drive to minimize Tucson Electric Power (TEP) power line relocations. *Initial Est. Savings: $550,000* *Future Est. Savings: $0,000* *Total Est. Savings: $550,000*	1		A	
P01-040	Narrow the 6-foot wide bike lane/shoulder to 5-foot lane though the corridor. *Initial Est. Savings: $450,000* *Future Est. Savings: $0,000* *Total Est. Savings: $450,000*	3		C	
P01-094	Modify cross section to extend 5-Lane cross section to Breakers Road *Initial Est. Savings: $300,000* *Future Est. Savings: $0,000* *Total Est. Savings: $300,000*	3		C	
P01-006	Reduce the inside shoulders from 3 ft. to 2 ft. between I-10 and Camino De Manana. *Initial Est. Savings: $190,000* *Future Est. Savings: $0,000* *Total Est. Savings: $190,000*	3		C	
P01-051	Eliminate the two-way left-turn lane on the western 0.6 miles of the project (I-10 to TRICO) *Initial Est. Savings: $100,000* *Future Est. Savings: $0,000* *Total Est. Savings: $100,000*	3		C	
P01-001	Delete the median curb west of La Cholla Blvd. *Initial Est. Savings: 200,000 to 370,000* *Future Est. Savings: $0,000* *Total Est. Savings: 200,000 to 370,000*	3		C	
DRAINAGE					
P01-011	Allow culvert alternatives in bid documents. *Initial Est. Savings: 920,000 to $1,100,000* *Future Est. Savings: $0,000* *Total Est. Savings: 920,000 to $1,100,000*	1		B	Alternatives to be identified in final design

PROPOSAL or SR NO.	VE PROPOSAL DESCRIPTION	RTA REVIEW BOARD DISPOSITION 1 = ACCEPT 2 = ACCEPT w/ MODIFICATIONS 3 = DECLINE	RTA REVIEW BOARD COMMENTS	TANGERINE TAC DISPOSITION A= YES, NOW B = YES, FINAL DESIGN, C = DECLINE	TANGERINE TAC COMMENT
DRAINAGE					
P01-041	Modify culvert design parameters to optimize road profile and culvert sizes. *Initial Est. Savings: 800,000-2,000,000* *Future Est. Savings: $0,000* *Total Est. Savings: 800,000-2,000,000*	2	Evaluate the potential to optimize the sizes	C	Some culverts will be revised based on the normal iterative design process, but the approach to return period, sediment transport, headwater, etc. will remain the same
P01-023	Use corrugated metal pipe for culverts instead of reinforced concrete pipe *Initial Est. Savings: $920,000* *Future Est. Savings: $0,000* *Total Est. Savings: $920,000*	3		C	
P05-005	Evaluate using recycled precast concrete girder bridges from Ina Road Bridge for wildlife crossing bridges and to substitute for reinforced concrete box culverts. *Initial Est. Savings: $1,400,000* *Future Est. Savings: $0,000* *Total Est. Savings: $1,400,000*	3		C	
P01-010	Evaluate alternatives for erosion protection in the roadside collector channel and embankment lining. *Initial Est. Savings: $188,000* *Future Est. Savings: $0,000* *Total Est. Savings: $188,000*	1		A	Use colored shotcrete instead of wire-tied riprap
P01-005	Size culverts for 50-year flood. *Initial Est. Savings: $900,000* *Future Est. Savings: $0,000* *Total Est. Savings: $900,000*	3		C	
P08-007	Eliminate the culverts on the south side of La Cholla Blvd *Initial Est. Savings: $220,000* *Future Est. Savings: $0,000* *Total Est. Savings: $220,000*	3	Tap La Cholla project for funding of the culversts, as they were in the original cost estimate for La Cholla	C	
WILDLIFE					
P01-012	Utilize alternative RTA funds earmarked for wildlife crossings to fund the additional costs required to accommodate wildlife features within the Tangerine Road Improvement Project *Initial Est. Savings: $3,800,000* *Future Est. Savings: $0,000* *Total Est. Savings: $3,800,000*	1		A	
P01-050	Consolidate two wildlife crossings into one bridge structure at Prospect Wash. *Initial Est. Savings: $1,100,000* *Future Est. Savings: $0,000* *Total Est. Savings: $1,100,000*	2	Evaluate the proposal in final design	A	Eastern brige will be replaced with a multi-cell box
P01-013	Replace programmed large game fence with medium game fence and reduce length of game fence along the project area. *Initial Est. Savings: $100,000* *Future Est. Savings: $0,000* *Total Est. Savings: $100,000*	2	Evaluate the proposal in final design	C	Per Game and Fish, the 4' medium fence does not prevent deer from crossing the road
P01-061	Reduce cultural resource compliance costs by performing work only to the standards established by Section 106 of the National Historic Preservation Act and applicable local standards. *Initial Est. Savings: $100,000* *Future Est. Savings: $0,000* *Total Est. Savings: $100,000*	2	Evaluate the proposal in final design	C	Agency concerns about insurance, liability - a consultant is prefered over students

Table 10.04. Summary of Value Analysis Recommendations and Dispositions(cont'd)

PROPOSAL or SR NO.	VE PROPOSAL DESCRIPTION	RTA REVIEW BOARD DISPOSITION 1 = ACCEPT 2 = ACCEPT w/ MODIFICATIONS 3 = DECLINE	RTA REVIEW BOARD COMMENTS	TANGERINE TAC DISPOSITION A= YES, NOW B = YES, FINAL DESIGN, C = DECLINE	TANGERINE TAC COMMENT
WILDLIFE					
P01-064	Consolidate the three wildlife crossings between Thornydale Road and La Cholla Blvd. into one wildlife crossing. *Initial Est. Savings: $130,000* *Future Est. Savings: $0,000* *Total Est. Savings: $130,000*	2	Evaluate the proposal in final design	C	A prioritization process was already used to identify crossing locations. In addition, the savings from removing the crossings would be minimal and may be further reduced by redesign costs
MULTI-USE PATH					
P01-002	Reduce or eliminate the multi-use path(s), but retain the bi-directional bike lanes. *Initial Est. Savings: 950,000 - 1,900,000* *Future Est. Savings: 60,000 - 120,000* *Total Est. Savings: 1,000,000 - 2,000,000*	2	Evaluate the use of a single path	A	Provide a single path. The path will run on the south side of the road from La Cañada to Thornydale to match the existing Oro Valley section. The path will run on the north side from Thornydale Crossing to I-10. There will be a 1,900 ft section (thornydale to Thornydale crossing) with path on both sides to facilitate crossing of Tangerine at Thornydale.
P01-086	Replace the Asphaltic Concrete Multi-use Path with Soil Cement *Initial Est. Savings: $6,250,000* *Future Est. Savings: $0,000* *Total Est. Savings: $625,000*	2	Evaluate the proposal in final design	C	Concerns about durability and long-term ADA compliance
P01-009	Delete the multi-use path striping *Initial Est. Savings: $30,000* *Future Est. Savings: $0,000* *Total Est. Savings: $30,000*	1		A	
MATERIALS					
P01-088	Use excess material from area ADOT projects for borrow source *Initial Est. Savings: $3,300,000* *Future Est. Savings: $0,000* *Total Est. Savings: $3,300,000*	2	Evaluate the proposal at time of bid	B	Evaluate the proposal at time of bid
P01-004	Have the Owner provide the owner provide the import in-fill source. *Initial Est. Savings: $4,600,000* *Future Est. Savings: $0,000* *Total Est. Savings: $4,600,000*	2	Evaluate the proposal at time of bid	B	Evaluate the proposal at time of bid
P01-073	Use decomposed granite instead of median pavers *Initial Est. Savings: $380,000* *Future Est. Savings: $0,000* *Total Est. Savings: $380,000*	2	Consider other materials such as concrete	C	All three agencies prefer pavers due to reduced maintenance
P01-078	Reduce pavement section on bridges and Reinforced Concrete Box Culverts *Initial Est. Savings: $340,000* *Future Est. Savings: $0,000* *Total Est. Savings: $340,000*	3		C	
P01-003	Offer option to use Geogrid material or cat-ionic chemicals to stabilize road sub-base in areas that have existing material with insufficient compaction characteristics. *Initial Est. Savings: $160,000* *Future Est. Savings: $0,000* *Total Est. Savings: $160,000*	2	Evaluate the proposal in final design	C	Proposal was evaluated. Material not suited for Cat-ionic stabilization. Geogrid does not provide savings because it requires an aditional 1/2" of AC for the entire project, which eliminates all the savings
P01-016	Use a 2 inch rubber AC course in lieu of the 1.5 inch rubber AC course *Initial Est. Savings: $320,000* *Future Est. Savings: $0,000* *Total Est. Savings: $320,000*	1		A	
P01-027	Specify Terminal Blend Asphalt Rubber instead of Crumb Rubber *Initial Est. Savings: $100,000* *Future Est. Savings: $0,000* *Total Est. Savings: $100,000*	3		C	

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MATERIALS					
P04-003	Use Reclaimed Asphalt Pavement (RAP) in Pima Association of Governments (PAG) 1 and PAG 2 Mixes *Initial Est. Savings: 110,000 to $270,000* *Future Est. Savings: $0,000* *Total Est. Savings: 110,000 to $270,000*	1		A	
P01-095	Use no.2 asphalt mix as a surface course in all turn lanes instead of ARAC. *Initial Est. Savings: $54,000* *Future Est. Savings: $0,000* *Total Est. Savings: $54,000*	1		A	
PHASING					
P02-001	Construct Tangerine Rd. from La Cañada Dr. to Dove Mountain Blvd. as a single phase *Initial Est. Savings: $2,700,000 to $3,600,000* *Future Est. Savings: $0,000* *Total Est. Savings: $2,700,000 to $3,600,000*	2	If local match funding is available, this would be both cost beneficial and better for public	A	The project will be designed in two phases: 1. La Cañada to Dove Mountain, 2. Dove Mountain to I-10. However, since there is some uncertainty on the funding availability for construction, phase 1 will be divided into two separate plan sets as follows: Phase 1A - La Cañada to Thornydale; Phase 1B - Thornydale to Dove Mountain. This way, tapers can be easily added to split the construction if funding becomes an issue.
LANDSCAPING					
P01-046	Modify the Native Plant Protection Obligations (NPPO) to allow sustainable landscape development along the Tangerine Road Corridor *Initial Est. Savings: $600,000* *Future Est. Savings: $0,000* *Total Est. Savings: $600,000*	2	Should be escalated locally	A	Landscape budget limited to 4% of construction per RTA guidelines
P01-026	Utilize landscaping that minimizes irrigation requirements and relies on water harvesting *Initial Est. Savings: $600,000* *Future Est. Savings: $0,000* *Total Est. Savings: $600,000*	1		A	
P08-001	Use stormwater harvesting galleries in-lieu of catch basins for median drainage. *Initial Est. Savings: $600,000* *Future Est. Savings: $0,000* *Total Est. Savings: $600,000*	2	Evaluate the proposal in final design	C	Concerns with increased maintenance of the filter, cleaning of the roadway after storms
MISCELLANEOUS					
P01-044	Limit paving on side streets of Tangerine Road to the curb returns. *Initial Est. Savings: $50,000* *Future Est. Savings: $0,000* *Total Est. Savings: $50,000*	2	Evaluate the proposal in final design	C	Infeasible; paving limits need to extend to the match point in the profile.
P01-093	Reduce roadway improvements on La Cholla Blvd north of Tangerine Road. *Initial Est. Savings: $30,000* *Future Est. Savings: $0,000* *Total Est. Savings: $30,000*	3		C	Reduces the service life of the project. No savings would be achieved after accounting for re-design
P01-067	Specify LED street lights instead of High Pressure Sodium Street Lights *Initial Est. Savings: -$33,500* *Future Est. Savings: $55,000* *Total Est. Savings: $16,500*	1	Higher project capital cost, but lower overall cost	A	

11.0 CONCLUSIONS AND RECOMMENDATIONS

- As the Towns of Marana and Oro Valley continue to grow and rapid development of residential communities and businesses flourish, a roadway system that can handle the expected traffic increases is vital. Tangerine Road is, and will continue to be, a major east-west arterial corridor serving regional traffic, as well as residential and commercial land uses of northwest Tucson. It is therefore a necessity to ensure that Tangerine Road will be able to provide sufficient vehicular mobility while also safely serving users of alternative modes of travel. Implementation of the following items is recommended to achieve those objectives.

- Improve Tangerine Road to a four-lane divided roadway between Interstate 10 and La Cañada Drive. In order to blend with the desert environment, curbing will not be used on the outside edge of pavement along the entire project limits except at intersections.

- Construct Tangerine road from I-10 to Camino de Mañana as desert parkway with a design speed of 55 mph, posted speed of 50 mph, and an uncurbed median. From Camino de Mañana to La Cañada Drive, the roadway should be an arterial design with a design speed of 50 mph, posted at 45 mph, and vertical curb for the median only.

- Improve Thornydale Road and La Cholla Boulevard in the vicinity of Tangerine Road to increase intersection capacity and enhance safety.

- Realign Camino de Mañana to provide a safer angle of intersection with Tangerine Road.

- Provide paved multi-use lanes and a continuous paved multi-use path

- Use rubberized asphalt as the pavement surface course throughout the project limits (except for turn lanes) to take advantage of its noise reduction properties. Cement treated subgrade will be utilized at soil locations of deficient structural properties.

- Implement the proposed Access Management plan to extend the service life of the roadway and improve safety and operations. It is recommended that traffic signals be spaced at one-mile intervals and full access median openings spaced every 1,200 feet from I-10 to Camino de Mañana and 1,000 feet from Camino de Mañana to La Cañada Drive. Directional or partial median openings can be provided at 1/8 mile intervals at key locations with high concentrations of turning volumes. Right turn access only locations should be separated with at least 1/8 mile spacing. At certain locations, existing conditions may require minor deviations from this policy, but those should be evaluated on a case-by-case basis.

- Maintain the existing traffic signal operations at the Interstate 10 WB ramps and at La Cañada Drive. The existing signals at Dove Mountain Boulevard/Twin Peaks Road, Thornydale Road, and La Cholla Boulevard will be maintained and upgraded to accommodate the proposed roadway improvements. The existing signal at the Tangerine Crossing Retail Center will be removed and a new signal will be installed at Camino de Mañana. For the intersections at Breakers Road, the Rancho Palomitas eastern driveway, Camino de Oeste, and Shannon Road, signals will be designed as part of the roadway improvements, but the installation of those signals will depend on the level of development in those areas. Conduit will be installed at a minimum.

- A significant amount of right-of-way and easements will be required as part of the project. It is recommended that negotiations begin as soon as possible with the major land owners (such as the State Land Department) to obtain the width required to build the improvements. In addition, dedication of the recommended right-of-way for new re-

zonings, development plans, and subdivision plats should be accomplished. Drainage easements will be required at drainage training berms that will be designed along the washes and watersheds of the project.

- Culverts are sized according to drainage and wildlife requirements. Culverts designed for medium sized wildlife will have 6 feet of vertical clearance. Two single span bridges will be constructed along the project limits to provide sufficient size for drainage requirements as well as sufficient openness for large sized wildlife. The owners of the project have secured additional funding for the wildlife crossings from the RTA Environmental Element category.

- Extensive relocation of overhead electric lines will be required. A tentative agreement has already been reached with TRICO Electric Cooperative to relocate 2.3 miles of their existing line. Specific relocations of the 138 kV TEP line have not been identified by TEP, but it is anticipated that several poles will require relocation.

- In order to maintain the natural environmental, continuous street lighting should not be installed along Tangerine Road. However, LED lighting should be installed for safety reasons at all signalized intersections and at select unsignalized median openings with high volumes or visibility issues.

- The construction of the improvements should be phased in order to maximize the benefits to the community, minimize construction impacts, and consider the scheduling constraints related to funding availability, permitting requirements and utility relocations. The preliminary construction sequencing recommendation is:
    - Phase 1A: Thornydale Rd to La Cañada Drive, approximately 3 miles
    - Phase 1B: Dove Mountain Blvd to Thornydale Rd, approximately 2 miles (concurrent with Phase 1A unless precluded by funding limitations)
    - Phase 2: Interstate 10 to Dove Mountain Blvd, approximately 5 miles

- Increases in construction costs over time can potentially create a sizeable funding gap for the project. As a result, it will be critical for the project partners to consider long-term cost saving alternatives such as accelerating construction where possible, pursuing other regional or federal funds for the project, or evaluating potential scope reductions.

12.0 COST ESTIMATE

An engineer's preliminary cost estimate was prepared for each segment identified in Section 6.13, and for the overall project. Table 12.01 presents a summary of the major cost categories for each segment of the project. The itemized and detailed engineers' estimate can be found in Appendix 3.

Table 12.01. Cost Summary for Tangerine Road Corridor

	Segment 2 (I-10 to Dove Mtn Blvd), 5 Mi	Segment 1B (Dove Mtn Blvd to Thornydale Rd), 2 Mi	Segment 1A (Thornydale Rd to La Cañada Dr), 3 Mi	Total (I-10 to La Cañada Dr)
Removals	$311,006	$162,138	$240,198	**$713,342**
Grading/Paving/Roadway Construction	$9,640,473	$4,088,884	$8,780,822	**$22,510,179**
Bridges/Underpasses	$3,609,500	$0	$0	**$3,609,500**
Drainage	$5,781,225	$2,855,440	$5,785,535	**$14,422,200**
Traffic (Signing, Striping, Signals, F.O., Traffic Control)	$2,181,180	$1,314,655	$1,660,000	**$5,155,835**
Landscape and Irrigation	$1,100,000	$460,000	$850,000	**$2,410,000**
Lump sums (Mobilization, PDES, Field Office, Survey)	$1,930,000	$870,000	$1,500,000	**$4,300,000**
Construction Subtotal	$24,553,384	$9,751,117	$18,816,555	**$53,121,056**
Contingency (20%)	$4,910,677	$1,950,223	$3,763,311	**$10,624,211**
Construction Total	**$29,464,061**	**$11,701,340**	**$22,579,866**	**$63,745,267**
Final Design (10%)	$2,946,406	$1,170,134	$2,257,987	**$6,374,527**
Construction Management (10%)	$2,946,406	$1,170,134	$2,257,987	**$6,374,527**
Environmental Mitigation (404 In Lieu, Archeology)	$213,700	$31,850	$181,850	**$427,400**
Utility Relocations (TEP, TRICO)	$460,000	$550,000	$330,000	**$1,340,000**
UPRR Improvements	$250,000	$0	$0	**$250,000**
Right-of-Way	$3,351,007	$615,531	$2,237,466	**$6,204,003**
Project Total	**$39,631,579**	**$15,238,989**	**$29,845,155**	**$84,715,723**

13.0 BUDGET CONSIDERATIONS

Financing for the Tangerine Road corridor will be through the Regional Transportation Authority (RTA) and through local funding, such as impact fees. The RTA plan identified a total of $74,215,000 in funds available for Tangerine Road between I-10 and La Cañada Drive (10 miles). $45,325,000 of that amount will come from the half-cent tax approved by voters in 2006. The RTA funding is expected to be available in periods 2 (FY 2012-FY 2016), 3 (FY 2017-FY 2021), and 4 (FY 2022-2026) of the plan. The remaining $28,890,000 funds will come from local funding already in reserve or anticipated for the future from the Towns of Marana ($21,390,000) and Oro Valley ($1,000,000) and contributions from Pima County ($6,500,000).

Additional monies are allocated from RTA Wildlife Linkages element ($3,603,000). Including the wildlife linkages funds, the total funding committed to the project is $77,818,000. The following is a breakdown of the total estimated budget by agency and category:

$ 45,325,000	RTA Roadway Element
$ 3,603,142	RTA Wildlife Linkages
$ 21,390,000	Town of Marana
$ 6,500,000	Pima County
$ 1,000,000	Town of Oro Valley

Since the total project estimate is $84,715,723, there is a funding gap of approximately $7 million. Given the long term delivery schedule for this project and the volatility in bid prices, the team and the participating agencies should continue to monitor costs closely and work on identifying additional funding sources (local or federal), potential scope reductions, or ways to achieve cost savings without compromising the functionality of the project. One example is to consider the early acquisition of the required right-of-way to take advantage of the current real estate prices.

One additional budgetary challenge is the fact that the $77.8 M committed to the project are in current dollars, while the construction cost of the project presented here is in constant dollars. In other words, the funding for the project will not be indexed, while the construction cost is likely to increase over time as material and labor costs increase. While this may not be a significant issue for the early construction phases, it will have a major impact on the construction phases programmed for period 4 of the RTA (2022-2026).

The chart below (Figure 13.01) depicts the historical evolution of the Construction Cost Index (CCI) calculated by Engineering News Record (ENR) for the last 25 years. The CCI is based on a combination of costs for labor and for common construction materials such as concrete, steel and lumber; and represents the general trend of the construction industry.

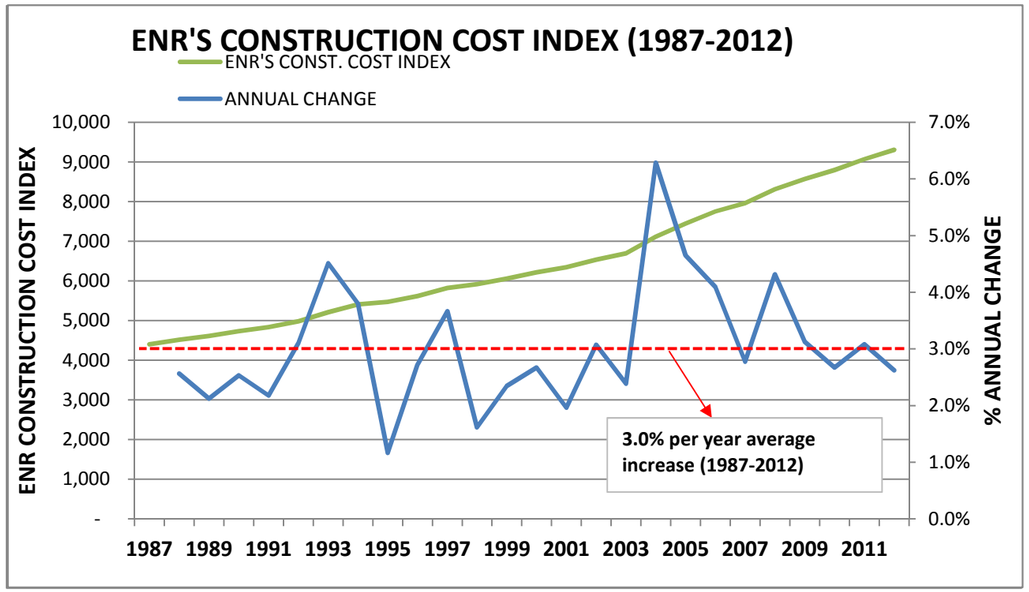

Figure 13.01. ENR's Construction Cost Index, 1987-2012

From the chart, the average annual CCI increase during the last 25 years has been 3.0%. Extrapolating that rate for the next 15 years results in the following construction costs for Tangerine Road in terms of current dollars (Table 13.01). The table assumes construction of segment 1 in 2015, and segment 2 in 2024.

Table 13.01. Tangerine Road Construction Costs in Current Dollars

		Segment 1 (Dove Mtn Blvd to La Cañada Dr)		Segment 2 (I-10 to Dove Mtn Blvd)	
YEAR	CCI Forecast	Cost (2012 Constant $)	Cost (Current $)	Cost (2012 Constant $)	Cost (Current $)
2012	9,308	$ 45,084,144	$ 45,084,144	$ 39,631,579	$ 39,631,579
2013	9,587	$ 45,084,144	$ 46,436,668	$ 39,631,579	$ 40,820,526
2014	9,875	$ 45,084,144	$ 47,829,768	$ 39,631,579	$ 42,045,142
2015	10,171	$ 45,084,144	**$ 49,264,661**	$ 39,631,579	$ 43,306,496
2016	10,476			$ 39,631,579	$ 44,605,691
2017	10,791			$ 39,631,579	$ 45,943,862
2018	11,114			$ 39,631,579	$ 47,322,178
2019	11,448			$ 39,631,579	$ 48,741,843
2020	11,791			$ 39,631,579	$ 50,204,099
2021	12,145			$ 39,631,579	$ 51,710,222
2022	12,509			$ 39,631,579	$ 53,261,528
2023	12,884			$ 39,631,579	$ 54,859,374
2024	13,271			$ 39,631,579	**$ 56,505,155**

TOTAL CONSTRUCTION COST CONSTANT DOLLARS	$ 84,715,723
TOTAL CONSTRUCTION COST CURRENT DOLLARS	$105,769,817

As shown in the table, when the projected increases in construction costs are taken into consideration, the total cost of the project increases by approximately $21M, or 25%. This analysis underscores the importance of accelerating construction where possible, pursuing other regional or federal funds for the project, or evaluating potential scope reductions.

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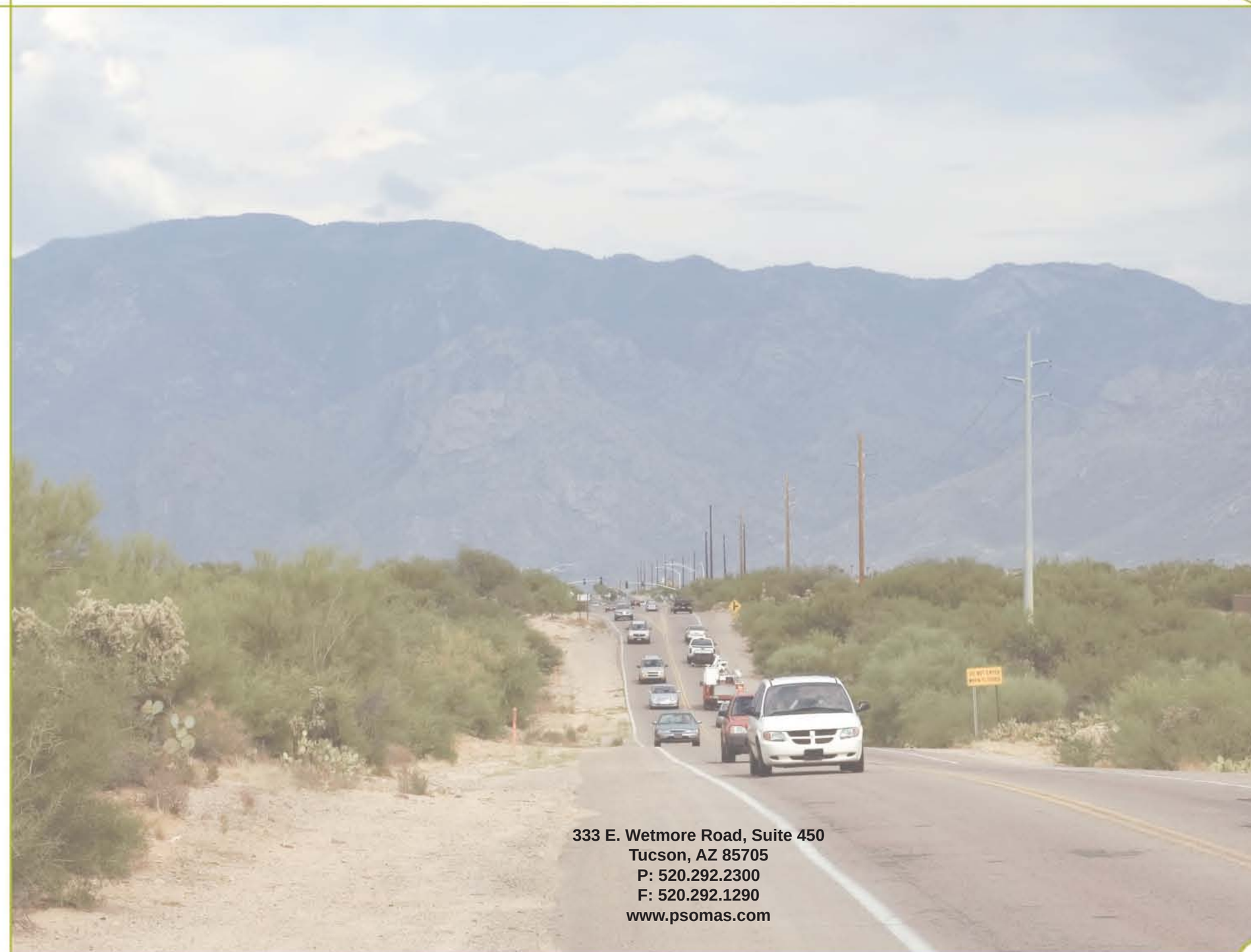

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