Pioneer Trail/US 50 Intersection Safety Improvement Project

Intersection Control Evaluation

Prepared for:

03-ED-50-71.48
03-EA2H610

El Dorado County Department of Transportation

Executive Summary

GHD has prepared this Intersection Control Evaluation (ICE) report for El Dorado County Department of Transportation and California Department of Transportation (Caltrans) District 3 utilizing methodologies consistent with the ICE process currently implemented by Caltrans. The analysis compares safety and operations associated with the following proposed improvement alternatives (that are consistent with the Caltrans Traffic Operations Policy Directive (TOPD) 13-02). The Build Alternatives analyzed at the signalized intersection of the United States Highway 50 (US 50) and Pioneer Trail in the unincorporated community of Meyers, California, near South Lake Tahoe are as follows:

- **Single-Lane Roundabout Alternative** - The roundabout would include one through lane and one right-turn bypass lane on the northbound approach, a left-turn lane and a right turn bypass lane on the westbound approach, and a through bypass lane and a shared through/left turn lane on the southbound approach; and
- **Modified Traffic Signal Alternative** - The Modified Traffic Signal Alternative would increase capacity at the intersection by providing additional lanes through the intersection and providing a free right-turn lane from US 50 onto Pioneer Trail. The northbound approach would provide two through lanes, and the existing right-turn pocket would be replaced with a free right-turn lane. Therefore, drivers traveling north (or eastbound) on US 50 to Pioneer Trail would no longer be required to stop at the traffic signal. The southbound approach would be widened to include two through lanes and would maintain one left-turn lane. The Pioneer Trail westbound approach would be widened from a single lane to include two left-turn lanes and a right-turn lane

Included in this report is a comparison of operational feasibility, safety benefits, right of way impacts, and cost estimates of two Build Alternatives and a No Build Alternative for the signalized intersection of the United States Highway 50 (US 50) and Pioneer Trail for current and future traffic conditions.

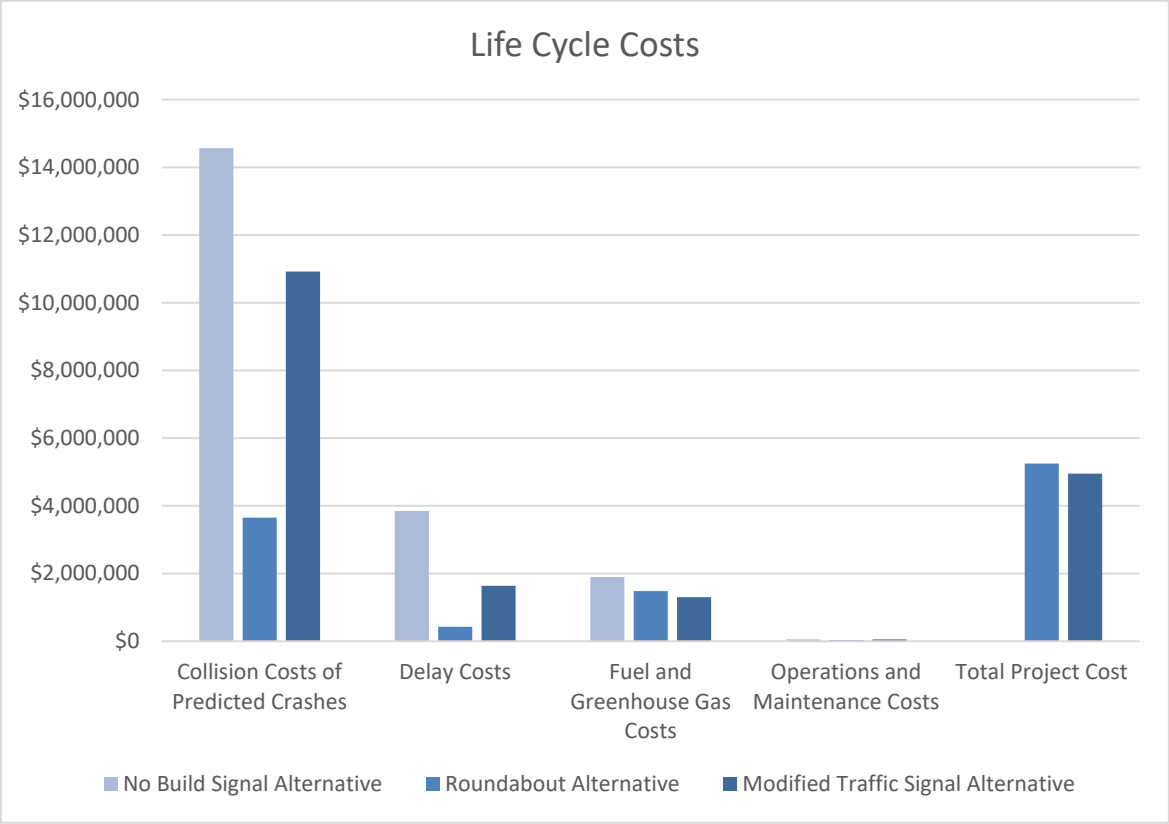
Based on the results of this analysis, the Roundabout Alternative has the highest return on investment for the study intersection. In addition, with a roundabout as the traffic control device, there is better efficiency and less delay, reduced conflict points and vehicular queue lengths. The Roundabout Alternative will also perform better when compared to the Modified Traffic Signal Alternative in terms of collision and mobility costs.

It is estimated the Roundabout Alternative will have slightly higher construction costs than the Modified Traffic Signal Alternative, but will provide overall better life cycle costs than both the No Build Alternative and Modified Traffic Signal Alternative. Figure EX-1 provides a summary of the expected life cycle costs for the No-Build and Build Alternatives over the project life.

The following El Dorado County Department of Transportation representatives were consulted during preparation of this ICE:

- John Kahling
- Donaldo Palaroan

Figure EX-1 Life Cycle Costs



As shown in Figure EX-1, the total life cycle costs of the No Build Alternative are generally higher than the Roundabout Alternative and the Modified Traffic Signal Alternative, with the exception of the total project cost. Also, the Modified Traffic Signal Alternative has higher collision and delay costs compared to the Roundabout Alternative. For additional detail regarding the project cost estimates and life cycle costs, refer to Appendix D (Cost Estimates and Life Cycle Costs).

Table of Contents

Figure Index

Table Index

Appendix Index

1. Introduction

This Intersection Control Evaluation (ICE) report has been prepared to present the results of the two Build Alternatives and the No Build Alternative. The report builds on the previous analysis in the August 2019 Traffic Operations Analysis Report (TOAR) and compares safety and operations associated with the Build Alternative improvements that are consistent with the Caltrans TOPD 13-02. The term “project,” as used in this report, will refer to the potential improvements at the US 50 and Pioneer Trail intersection. The project is located in El Dorado County within the unincorporated community of Meyers, California. Figure 1.1 presents the study area and the intersection analyzed within this report.

US 50 is a two-lane conventional highway in the project area with a posted speed limit of 40 miles per hour (mph) (reduced from 55 mph further north of the intersection). Pioneer Trail is a two-lane rural arterial with a posted speed limit of 40 mph in the project area. US 50 is a Terminal Access Route for Surface Transportation Assistance Act (STAA) trucks.

1.1 Need and Purpose

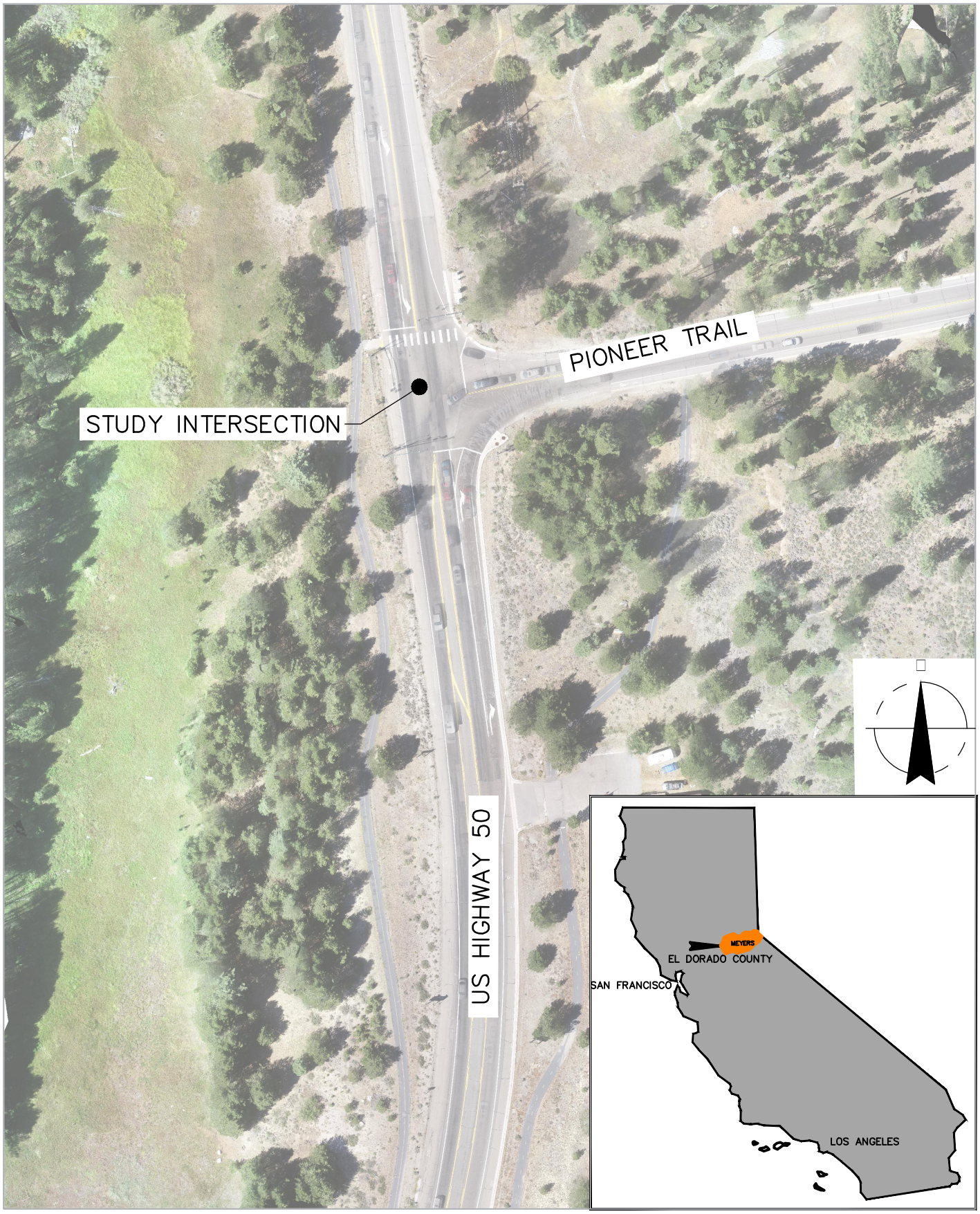
The purpose of this project is to improve safety at the US 50 and Pioneer Trail intersection for all modes of travel, improve traffic flow, reduce vehicle speeds through the intersection and into the Meyers area, reduce vehicle emissions associated with traffic delays, and improve access to nearby bikeways and trails.

Several prior plans and studies have identified a need for safety and transportation improvements at the study intersection. Three issues help define the need for improvements:

- High number of collisions;
- Disjointed pedestrian and bicycle facilities lack connectivity; and
- Unacceptable intersection level of service (LOS) during peak periods.

These issues correspond to three needs for this project, described in greater detail below:

- Enhance Safety;
- Provide Bicycle and Pedestrian Access; and
- Reducing speed and improving traffic flow through the corridor



El Dorado County Department of Transportation
US 50/Pioneer Trail Intersection Safety Improvement Project

Project Location Map

Project No. **11191432**
Report No. **R2610RPT002**
Date **January 16, 2020**

Figure 1.1

In 2012, the US 50 and Pioneer Trail intersection was identified as a high collision location.[1] It was determined that most collisions at the intersection were a result of drivers traveling at unsafe speeds in snowy or icy conditions. Most collisions occurred on the northbound right-turn movement onto Pioneer Trail. Collision data collected for the last three years showed that the most common collision type was broadside collisions.

When compared to traditional intersection controls, roundabouts have fewer conflict points for vehicles, bicyclists, and pedestrians. This directly correlates to improved safety. Roundabouts have the potential to reduce the number and severity of broadside collisions, reduce vehicle speeds, and reduce exposure for people bicycling and walking compared to traditional intersections. A study of 55 roundabouts in the United States concluded that roundabouts generally reduce crashes by 35 percent overall, reduce injury crashes by 76 percent, and reduce fatal crashes by 90 percent.[2]

At the study intersection, pedestrian crossings are currently only permitted in the crosswalk on the north leg of the intersection. All other pedestrian movements are prohibited. While this crosswalk connects to a shared use path on the west side of US 50, it does not connect to another pedestrian facility on the east side. A Class I shared use path parallel to US 50 on the west side does not connect to Class II bicycle lanes or the Class I shared use path on the east side of US 50. Accommodation for people walking, bicycling, and riding transit was identified as a need in the 2016 *Linking Tahoe: Active Transportation Plan* (amended in October 2018).

Both US 50 and Pioneer Trail are heavily traveled routes between Meyers and South Lake Tahoe. Traffic levels at this location are highly variable throughout the year, as the intersection serves tourist traffic to and from Lake Tahoe, Nevada, and a variety of other outdoor recreation opportunities. Traffic levels can vary significantly based on weather, economic conditions, special events, and other factors. The summer months typically have the highest traffic volumes due to the wide range of tourist attractions throughout the Tahoe Basin, but traffic congestion is typically worse in winter due to weather conditions, chain restrictions, and avalanche control operations.

LOS standards for the project are set by Caltrans, the Tahoe Regional Planning Agency (TRPA), and El Dorado County, as described further in Section 1.5 (Level of Service Criteria) of this report. The existing intersection currently operates at an unacceptable LOS during Sunday peak hours, with an LOS E or F between 10:45 AM and 2:00 PM. With no improvements, LOS at the intersection would continue to worsen and result in extensive delays and long queues. El Dorado County's 2018 *Meyers Area Plan* includes policy and implementation language that recommends reducing traffic speeds through Meyers without adversely affecting air quality and enhancing the intersection at US 50 and Pioneer Trail to improve LOS and traffic flow, reduce vehicle emissions, and improve bicycle and pedestrian safety.

[1] 2011 Annual Accident Location Survey (El Dorado County Department of Transportation, 2012)

[2] Roundabouts in the United States (National Cooperative Highway Research Program Report 572, 2007)

This report examines the traffic operations for Existing Conditions, No Build Alternative, and Build Alternatives for the Design Year (typically 20 years) conditions.

1.1.1 Project Funding

El Dorado County has identified several funding sources for the Pioneer Trail/U.S. 50 Intersection Safety Improvement Project in their *2019 Capital Improvement Program*. Also, the project is listed in the TRPA *Federal Transportation Improvement Program*. The project is expected to be funded through a combination of Highway Safety Improvement Program (HSIP) funds, TRPA/Air Quality funds, Regional Surface Transportation Program (RSTP) Exchange Funds through TRPA and Caltrans, Congestion Mitigation and Air Quality Program (CMAQ) funds, and other local funds.

1.1.2 Previous Studies

The project team was retained by El Dorado County to provide engineering as well as project approval and environmental document support for the project. In preparation for the Project Study Report/Project Development Support (PSR/PDS) document and subsequent Project Approval-Environmental Document (PA-ED) phase, a TOAR was prepared. This ICE report will build on the findings in the TOAR.

1.2 Data Collection and Analysis Time Periods

As described in the TOAR prepared for the project, the summer traffic (between the months of June and September) was found to be generally higher when compared to the other months. Because congestion in the project area is driven by weekend tourism rather than typical commute patterns, traffic operations have been quantified based on average Friday and Sunday peak hours, rather than the traditional AM and PM peak hours.

The TOAR included a summary of the three recent and relevant planning studies in the area that contain traffic volume information in the Meyers community. This information is provided in Appendix A (Traffic Volume Information from TOAR).

1.3 Level of Service Methodologies

The following section outlines the LOS methodologies and analysis parameters used to quantify traffic operations at the study location.

Levels of service (LOS) have been calculated for all intersection control types using the methods documented in the Transportation Research Board's *Highway Capacity Manual (HCM)* or SIDRA methodology. Traffic operations have been quantified through the determination of LOS. LOS is a qualitative measure of traffic operating conditions, whereby a letter grade A through F is assigned to an intersection or roadway segment representing progressively worsening traffic conditions. For a signalized or roundabout intersection, a LOS determination is based on the weighted calculated averaged delay for all approaches and movements.

The methodology for the Roundabout Alternative is based on the 6th edition of the HCM, which draws from a Federal Highway Administration (FHWA) report on capacity modeling for

roundabouts.[3] At signalized intersections and roundabouts, the HCM specifies that LOS is based on the average control delay for the entire intersection. Table 1.1 displays the control delay range associated with each LOS grade.

Table 1.1 Intersection Level of Service Thresholds

Level of Service	Average Control Delay (Seconds/Vehicle)		Description
	Signalized	Roundabout	
A	<10.0	<10.0	Very low delay. At signalized intersections, most vehicles do not stop.
B	10.0 to 20.0	10.0 to 15.0	Generally good progression of vehicles. Slight delays.
C	20.1 to 35.0	15.1 to 25.0	Fair progression. At signalized intersections, increased number of stopped vehicles.
D	35.1 to 55.0	25.1 to 35.0	Noticeable congestion. At signalized intersections, large portion of vehicles stopped.
E	55.1 to 80.0	35.1 to 50.0	Poor progression. High delays and frequent cycle failure.
F	>80.0	>50.0	Oversaturation. Forced flow. Extensive queuing.

Note: Highway Capacity Manual (Transportation Research Board 2016)

1.4 Technical Analysis Parameters

The software programs used to analyze the intersection include Synchro 10 for signalized intersection control, and SIDRA 8 for roundabouts. The Synchro and SIDRA outputs are included in Appendix B (Synchro and SIDRA LOS Worksheets).

The evaluation incorporated appropriate heavy vehicle adjustment factors, peak hour factors, and signal lost-time factors, and reported the resulting intersection delays and LOS as projected using HCM-based analysis methodologies. Lane widths for the Roundabout Alternative analysis were determined by measuring face of curb to face of curb.

The specific technical analysis parameters that have been used for this study are presented in Table 1.2. As mentioned in the TOAR for the project, these parameters were reviewed with Caltrans staff.

[3] Assessment of Roundabout Capacity Models for the Highway Capacity Manual: Volume 2 of Accelerating Roundabout Implementation in the United States (Report FHWA-SA-15-070)

Table 1.2 Intersection Technical Analysis Parameters

Technical Parameters[1]	Intersections
Grade[2]	Level
% Trucks[2]	Obtained from Caltrans US50/SR89 Study
Peak Hour Factor Design Hourly Volume	0.96 for Friday and 0.94 for Sunday based on 2017 count data
Minimum Signal Cycle Length[3]	120 seconds (based on field observations)
Lost Time per Critical Signal Phase	4 seconds (if applicable)
Left-Turn Critical Lane Volume[4]	1,900 vehicles per hour
Pedestrian Calls per Hour	5
SIDRA Environmental Factor	1.05 for Design Hourly Volumes
SIDRA Environmental Factor	1.00 for Sensitivity Analysis

Notes:
1. *Computer software defaults will be used for parameters not listed.*
2. *For Existing and Future conditions.*
3. *Will be optimized as appropriate.*
4. *A.k.a. Saturated Flow Rate.*

1.5 Level of Service Criteria

LOS standards for the project are set by Caltrans, TRPA, and El Dorado County. The applicable LOS guidelines are discussed below.

Caltrans identified standards for the project area in the *US 50 Transportation Concept Report/Corridor System Management Plan* (TCR/CSMP) in 2014. The minimum acceptable LOS for this segment of US 50 is LOS D.

TRPA identifies LOS thresholds in its *Linking Tahoe: Regional Transportation Plan* (RTP) in 2017. The acceptable LOS for Pioneer Trail is D, though the policy notes LOS E may be acceptable during peak periods in urban areas but not to exceed four hours per day. The policy also states, “These vehicle LOS standards may be exceeded when provisions for multi-modal amenities and/or services (such as transit, bicycling, and walking facilities) are adequate to provide mobility for users at a level that is proportional to the project-generated traffic in relation to overall traffic conditions on affected roadways.”

The *El Dorado County General Plan Transportation and Circulation Element* includes Policy TC-Xd that states, “Level of Service (LOS) for County-maintained roads and state highways within the unincorporated areas of the county shall not be worse than LOS E in the Community Regions or LOS D in the Rural Centers and Rural Regions.”

Based on the applicable standards discussed above, LOS D is the standard applied to this project. The intersection is also allowed to operate at LOS E for fewer than four hours per day during peak periods.

2. Existing Conditions

This section presents the analysis of current operations at the study location and establishes the baseline traffic conditions.

2.1 Multimodal Facilities

Currently, two Class I shared use paths provide bicycling and walking facilities in the project area. On the west side of US 50, a shared use path parallels the highway from State Route (SR) 89 past the project area to Sawmill Road. On the east side of US 50, a shared use path parallels the highway from SR 89/Luther Pass Road and terminates at Pioneer Trail, approximately 150 feet east of the intersection. No sidewalks exist at the intersection; the only pedestrian access is provided by the shared use path on the west side of US 50. Faded Class II bicycle markings exist on Pioneer Trail, and a southbound bicycle lane is marked on US 50 beginning at the Pioneer Trail intersection. The Class I shared use path parallel to US 50 on the west side does not connect to Class II bicycle lanes or the Class I shared use path on the east side of US 50.

At the US 50 and Pioneer Trail intersection, pedestrian crossings are only permitted in the crosswalk on the north leg of the intersection. All other pedestrian movements are prohibited. While this crosswalk connects to a shared use path on the west side of US 50, it does not connect to the pedestrian facility on the east side.

2.2 Intersection Operations

Traffic volumes at the US 50 and Pioneer Trail intersection, and in the Meyers community in general, are highly variable throughout the year since the intersection serves tourist traffic to and from Lake Tahoe, the State of Nevada, and a variety of other year-round outdoor recreation activities. Congestion in the project area is driven by weekend tourism rather than typical commute patterns, and therefore, traffic operations have been quantified based on average Friday and Sunday peak hours rather than the traditional AM and PM peak hours.

As described in the TOAR, the traffic volumes identified in the *Meyers Intersection Improvements at United States Highway (US) 50 and State Route (SR) 89 Initial Study with Negative Declaration* (provided in Appendix A [Traffic Volume Information from TOAR]) were used to analyze the LOS under existing conditions without and with the proposed intersection improvements. Caltrans staff concurred with this approach.

Based on this traffic volume data, the intersection generally operates at LOS D on Fridays and LOS E on Sundays. The intersection also experiences queues over 40 vehicles along US 50 traveling north (eastbound) on Fridays and Sundays as well as along Pioneer Trail traveling west on Sundays.

2.3 Safety Analysis

As summarized in the TOAR prepared for the project, the study intersection had the second highest number of collisions in the Meyers area[4], with 34 reported collisions between 2007 and 2015. Of these, six collisions resulted in injuries and 28 resulted in property damage only. No fatal collisions were reported within the intersection, however, one fatality was reported approximately 400 feet south of the intersection. According to the Statewide Integrated Traffic Records System (SWITRS) the fatal collision occurred in 2012 (Case ID Number 5638393). The collision involved a vehicle and a pedestrian. The pedestrian was crossing US 50 in the dark and SWITRS records indicate that alcohol was involved.

More recent collision data was collected from the SWITRS for the study intersection. To capture the collision patterns and any trends within the study area, the most recent three years were obtained from SWITRS (January 1, 2016 – December 31, 2018).

2.3.1 US 50 and Pioneer Trail Intersection Collisions

Table 2.1 displays the intersection collisions for the past three years from SWITRS. There was a total of 14 intersection collisions within the influence area of the intersection.

Table 2.1 US 50 and Pioneer Trail Intersection Collisions (2016-2018)

Intersection	Year			Total Collisions
	2016	2017	2018	
US 50 and Pioneer Trail	5	4	5	14

As presented in Tables 2.2 and 2.3, the collision severity, type, and primary collision factor are displayed for US 50 and Pioneer Trail intersection for 2016-2018. There were more Property Damage Only (PDO) collisions than injury collisions (12 vs. 2) and the most common collision type was broadside collisions (7). Broadside collisions are likely occurring due to the high free flow speed and limited gaps across US 50. In addition, the most common cited primary collision factor violation was unsafe speed (12).

Table 2.2 US 50 and Pioneer Trail Intersection – Collision Severity/Type

Collision Severity			Collision Type				
Injury (Other Visible)	Injury (Complaint of Pain)	PDO	Head-On	Sideswipe	Rear End	Broadside	Hit Object
1	1	12	1	3	2	7	1

Table 2.3 US 50 and Pioneer Trail – Primary Collision Factor

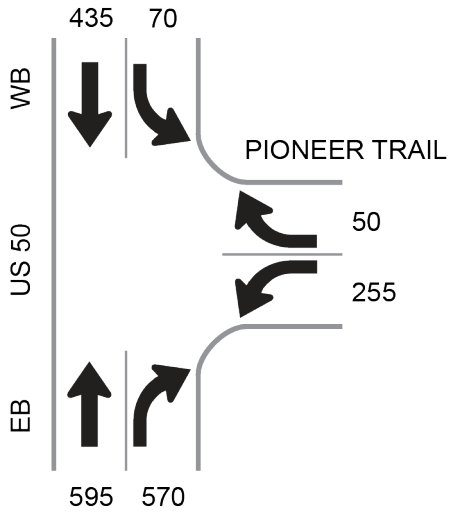
Intersection	Primary Collision Factor		
	DUI	Unsafe Speed	Wrong Side of Road
US 50 and Pioneer Trail	1	12	1

3. Design Year Forecasts

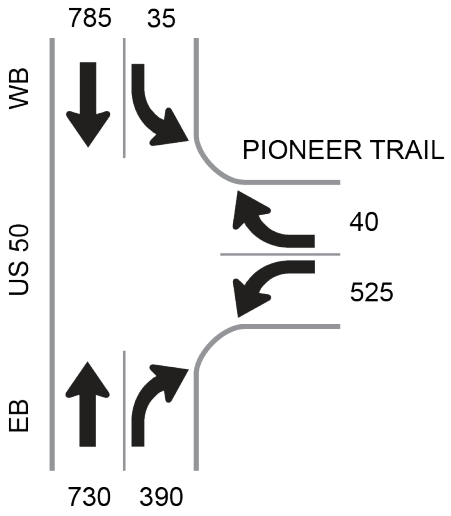
The TOAR for the project established the methodology to develop the traffic forecast for the Design Year at the study intersection. As previously stated, all project alternatives were evaluated for design hourly volumes identified in the *Meyers Intersection Improvements at United States Highway (US) 50 and State Route (SR) 89 Initial Study with Negative Declaration* (provided in Appendix A [Traffic Volume Information from TOAR]). Figure 3.1 illustrates the Design Year traffic volumes.

Figure 3.1 Design Year Traffic Volumes

Friday Summer Peak Hour Volumes



Sunday Summer Peak Hour Volumes



[4] 2016 Meyers Road Safety Audit

3.1 No Build Operational Analysis

Assuming the same lane geometries and traffic control at the study intersection, the No Build Alternative was analyzed using the Design Year traffic volumes. As presented in Table 3.1, the LOS degrades to an overall LOS D on Fridays and LOS E on Sundays with the increase in traffic volumes and no improvements. See Appendix B (Synchro and SIDRA LOS Worksheets) for additional details.

Table 3.1 also shows the 95th percentile queues for the US 50 and Pioneer Trail intersection for Design Year conditions. The longest queue length is on Sunday for eastbound US 50 traffic traveling north.

Table 3.1 Design Hourly Intersection Traffic Operations
No Build Conditions – Summer Weekend

	Friday			Sunday		
	Delay	LOS	Queue	Delay	LOS	Queue
North/Eastbound US 50	62.5	E	1,118	103.6	F	1,875
South/Westbound US 50	15.1	B	279	20.1	C	950
West/Southbound Pioneer Trail	45.6	D	361	66.8	E	1,025
Overall	**47.8**	**D**	**-**	**68.0**	**E**	**-**

Note: Analysis is based on the methodology and procedures in the HCM. Average delay is reported in seconds per vehicle. For signalized intersections, LOS is based on the average control delay for all approaches. Queue is reported in feet for the 95th percentile.

4. Build Conditions

4.1 Roundabout Alternative

The Roundabout Alternative would construct a three-legged roundabout at the US 50 and Pioneer Trail intersection. The roundabout would provide an inscribed circle diameter of 140 feet with one through lane and one right-turn bypass lane on the northbound approach, a left-turn lane and a right turn bypass lane on the westbound approach, and a through bypass lane and a shared through/left turn lane on the southbound approach. Figure 4.1 provides a visual of the proposed Roundabout Alternative design.

High-visibility marked crosswalks would be provided on all three legs, including refuge areas in the splitter islands that would allow people walking or bicycling to cross one lane of traffic at a time. Crosswalks would be set back at least one car-length from the roundabout, allowing drivers to yield to pedestrians and move past the crosswalk before waiting for a gap in traffic and entering the roundabout. Separating the crosswalk from the roundabout entry in this way allows drivers to focus their attention on one potential conflict at a time.

The Roundabout Alternative would include bypass lanes with splitter islands designed to reduce excessive delay and queueing, to avoid two-lane entrances for collision reduction, and to increase pedestrian safety by providing refuge when crossing.

Roundabout Alternative

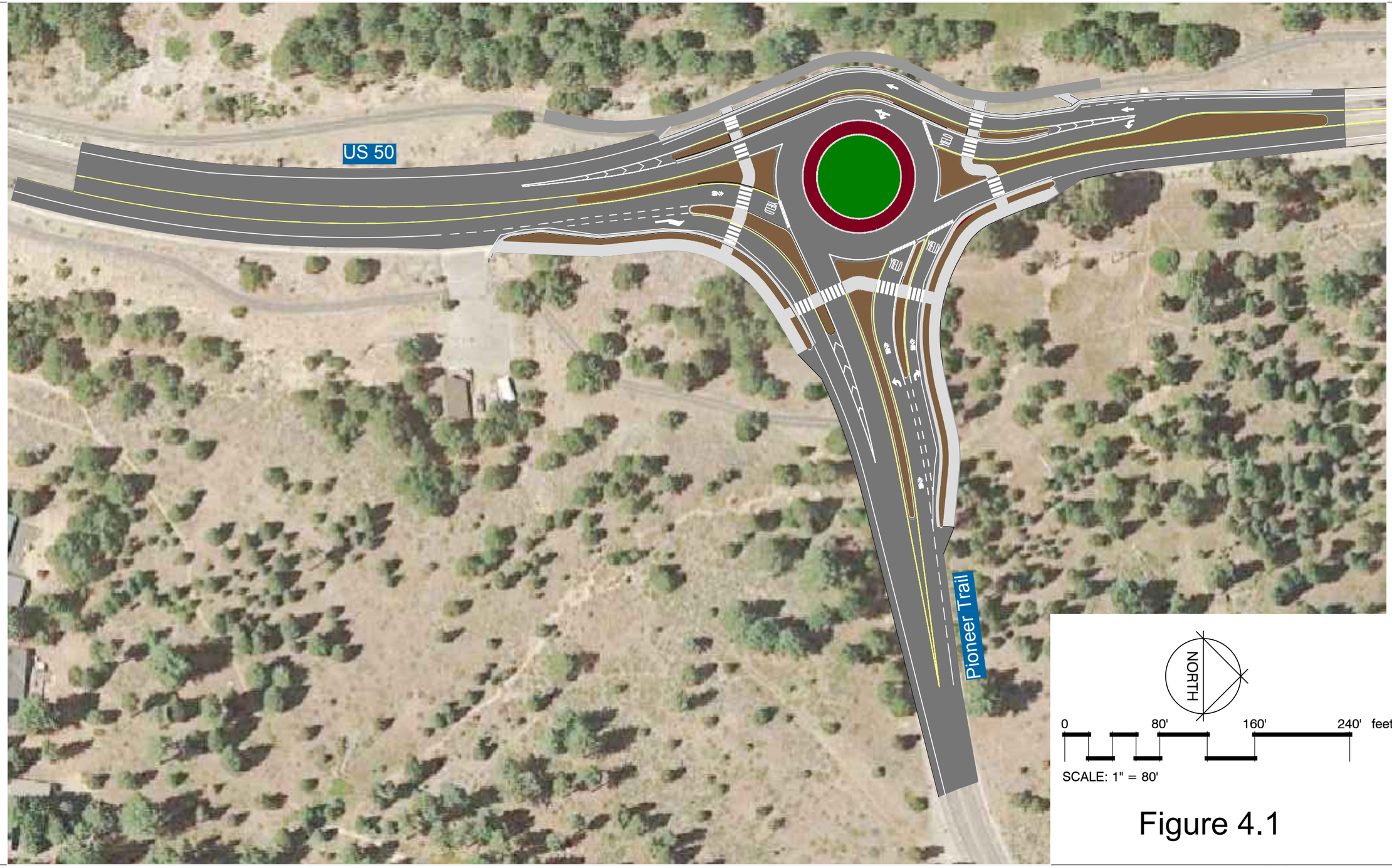


Figure 4.1

US 50 / Pioneer Trail Intersection Improvement Project

Meyers, California

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July 18, 2019
2610EX002.dwg

Sidewalks would be provided on the northeast and southeast corners of the intersection, and connections would be provided from crosswalks to the Class I shared use path on the west side of US 50. Directional bike ramps would provide bicyclists traveling in the roadway with access to the shared use path or sidewalks if they prefer to navigate the intersection using the crosswalks or path. A proposed connection to the shared use path on the east side of US 50 would provide a direct connection for people walking or bicycling to the crosswalks on the south and east legs of the intersection.

4.1.1 Roundabout Alternative Operational Analysis

Table 4.1 presents the peak hour intersection LOS for the Roundabout Alternative. LOS and delay were projected with SIDRA 8 software for the design hourly traffic volumes with the lane geometrics of the Roundabout Alternative.

Table 4.1 Design Hourly Intersection Traffic Operations Roundabout Conditions

	Friday			Sunday		
	Delay	LOS	Queue	Delay	LOS	Queue
North/Eastbound US 50	3.9	A	76	4.0	A	100
South/Westbound US 50	4.9	A	24	5.0	A	54
West/Southbound Pioneer Trail	12.0	B	43	16.6	B	152
Overall LOS	**5.4**	**A**	**-**	**7.2**	**A**	**-**

Note: Analysis is based on the methodology and procedures in the HCM. Average delay is reported in seconds per vehicle. For roundabout intersections, LOS is based on the average control delay for all approaches. Queue is reported in feet for the 95th percentile.

The intersection is projected to operate at an overall acceptable LOS A with improvements identified in the Roundabout Alternative. The intersection is projected to experience queues less than or equal to 6 vehicles for either time period.

4.2 Modified Traffic Signal Alternative

The Modified Traffic Signal Alternative would increase capacity at the intersection by providing additional lanes through the intersection and providing a free right-turn lane from US 50 onto Pioneer Trail. The northbound approach would provide two through lanes, and the existing right-turn pocket would be replaced with a free right-turn lane. Drivers traveling north (or eastbound) on US 50 to Pioneer Trail would no longer be required to stop at the traffic signal. The southbound approach would be widened to include two through lanes and would maintain one left-turn lane. The Pioneer Trail westbound approach would be widened from a single lane to include two left-turn lanes and a right-turn lane. Figure 4.2 provides a visual of the proposed Modified Traffic Signal Alternative design.

Modified Traffic Signal Alternative

Figure 4.2

US 50 / Pioneer Trail Intersection Improvement Project

Meyers, California

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Marked transverse crosswalks would be provided across the north and east legs of the intersection as well as across the free right-turn lane on the southeast corner. A crosswalk on the south leg of the intersection would require a pedestrian only phase resulting in increased green/cycle time and intersection delay. For this reason, the project team agreed to eliminate the crosswalk on the south leg as it would compromise the overall intersection operations.

Sidewalks would be provided on the northeast and southeast corners of the intersection, and connections would be provided from the crosswalks to the Class I shared use path on the west side of US 50. Directional ramps would provide southbound bicyclists traveling in the roadway on US 50 with access to the shared use path or sidewalks if they prefer to navigate the intersection using the crosswalks or path. A proposed connection of the shared use path on the east side of US 50 would provide a direct connection for people walking or bicycling to the crosswalks on the south and east legs of the intersection.

4.2.1 Modified Traffic Signal Alternative

Table 4.2 presents peak hour intersection LOS for the Modified Traffic Signal Alternative. LOS and delay were projected for the design hourly traffic volumes with the lane geometrics of the Modified Traffic Signal Alternative. Projections were developed using Synchro 10 software based on the HCM.

Table 4.2 Design Hourly Intersection Traffic Operations – Modified Traffic Signal Alternative

	Friday			Sunday		
	Delay	LOS	Queue	Delay	LOS	Queue
North/Eastbound US 50	12.4	B	208	16.5	B	491
South/Westbound US 50	12.3	B	218	17.7	B	331
West/Southbound Pioneer Trail	23.0	C	173	32.0	C	311
Overall LOS	**14.0**	**B**	**-**	**20.5**	**C**	**-**

Note: Analysis is based on the methodology and procedures in the HCM. Average delay is reported in seconds per vehicle. For signalized intersections, LOS is based on the average control delay for all approaches. Queue is reported in feet for the 95th percentile.

The intersection is projected to operate at acceptable LOS C or better with the improvements identified in the Modified Traffic Signal Alternative. The intersection is projected to experience queues less than or equal to 8 vehicles for the Friday peak period and 20 vehicles during the Sunday peak period.

5. Roundabout Performance Checks

Based on the traffic analysis, the Roundabout Alternative is further evaluated for performance based checks. The following design criteria were used to analyze the geometrics and safety performance of the proposed Roundabout Alternative:

- Criteria and methodologies to be consistent with Caltrans DIB 80-01, Caltrans *Highway Design Manual* (HDM), and Report 672 of the National Cooperative Highway Research

Program (NCHRP) titled *Roundabouts: An Informational Guide* (Second Edition). This document supersedes the original roundabout guide published by the Federal Highway Administration (FHWA) in 2000.

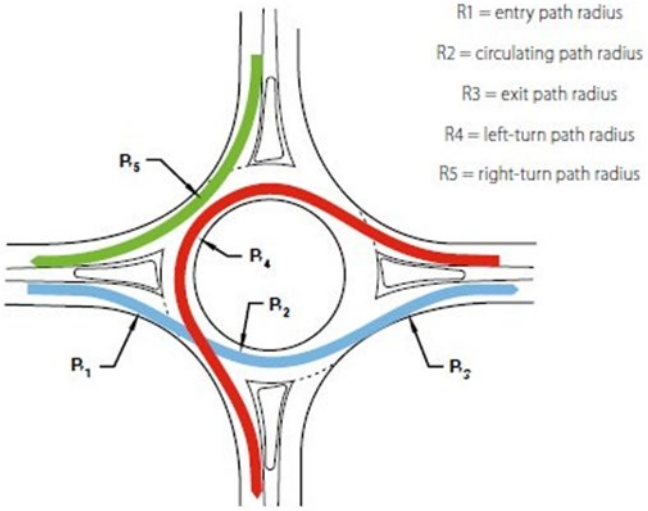
- The "STAA-Standard" design vehicle from the Caltrans HDM, 6th Edition (update September 2014) shall be accommodated on all movements from and to US 50.
- Fast path entry speeds on single-lane approaches should be 25 mph or less.
- Minimum stopping sight distance for posted speed limits should be provided for vehicles approaching roundabout entrances and pedestrian crosswalks.
- View angles for all legs of the roundabout should be no more than 15 degrees.
- Entry angles for all legs of the roundabout should be between 20 and 40 degrees.

5.1 Fastest Path and Vehicle Speed Checks

The "Fastest Path" represents the path that the most aggressive drivers could take through the roundabout and assumes no other traffic to be within the intersection. NCHRP Report 672 indicates that the recommended maximum vehicle entry speeds along the fastest path should be less than 25 mph at urban single-lane roundabouts, and less than 30 mph at urban multi-lane roundabouts. NCHRP Report 672 also indicates that the differential speed between consecutive or conflicting projected fast path speeds should be less than 15 mph.

Fast path speeds are determined for five locations per approach. These include entry speeds (referred to as V1); through movement circulating speeds (V2); exiting speeds (V3); left turn movement circulating speeds (V4); and right turn speeds (V5). A diagram of the described locations is shown in Figure 5.1.

Figure 5.1 Fast Path Critical Speed Locations



Fastest-path speeds for the Roundabout Alternative for vehicles entering, circulating, exiting, left, and right turns are provided in Table 5.1 and further performance based checks and exhibits are

provided in Appendix C (Roundabout Performance Based Checks). The fast path speeds for entering traffic are less than 25 mph, which is consistent with the NCHRP Report 672 recommendation for single-lane roundabouts.

Table 5.1 Fast Path Checks for Roundabout Alternative

FAST PATH SPEED (MPH)					
Movement	**Northbound US 50 (N#)**	**Northbound US 50 Right Bypass (N#)**	**Southbound US 50(S#)**	**Southbound US 50 Bypass(S#)**	**Westbound Pioneer Trail (W#)**
Entering (V1)	24.5	N/A	24.7	24.5	24.2
Circulating (V2)	18.2	N/A	19.7	20.0	N/A
Exiting (V3)	29.9	N/A	31.1	29.8	N/A
Left Turn (V4)	N/A	N/A	15.0	N/A	15.0
Right Turn (V5)	N/A	20.9	N/A	N/A	24.5

Notes:
All values are in miles per hour.
V3 exiting speeds are derived from vehicle acceleration formulas in NCHRP 672.
V3 fast path speed measured at exit crosswalk or 100 feet downstream from V2.
As acceleration potential of vehicle determines actual exiting speed, V3 presented is a conservative estimate.
N/A = Fastest path speed does not exist for this approach.
2% cross-slope assumed for determining fastest path.

6. Alternatives Comparison

For the alternatives comparison, the two Build Alternatives (Roundabout and Modified Traffic Signal) were compared to the No Build Alternative in the Design Year. This comparison analysis will consist of LOS and queue graphics, planning level cost estimates, and life cycle costs.

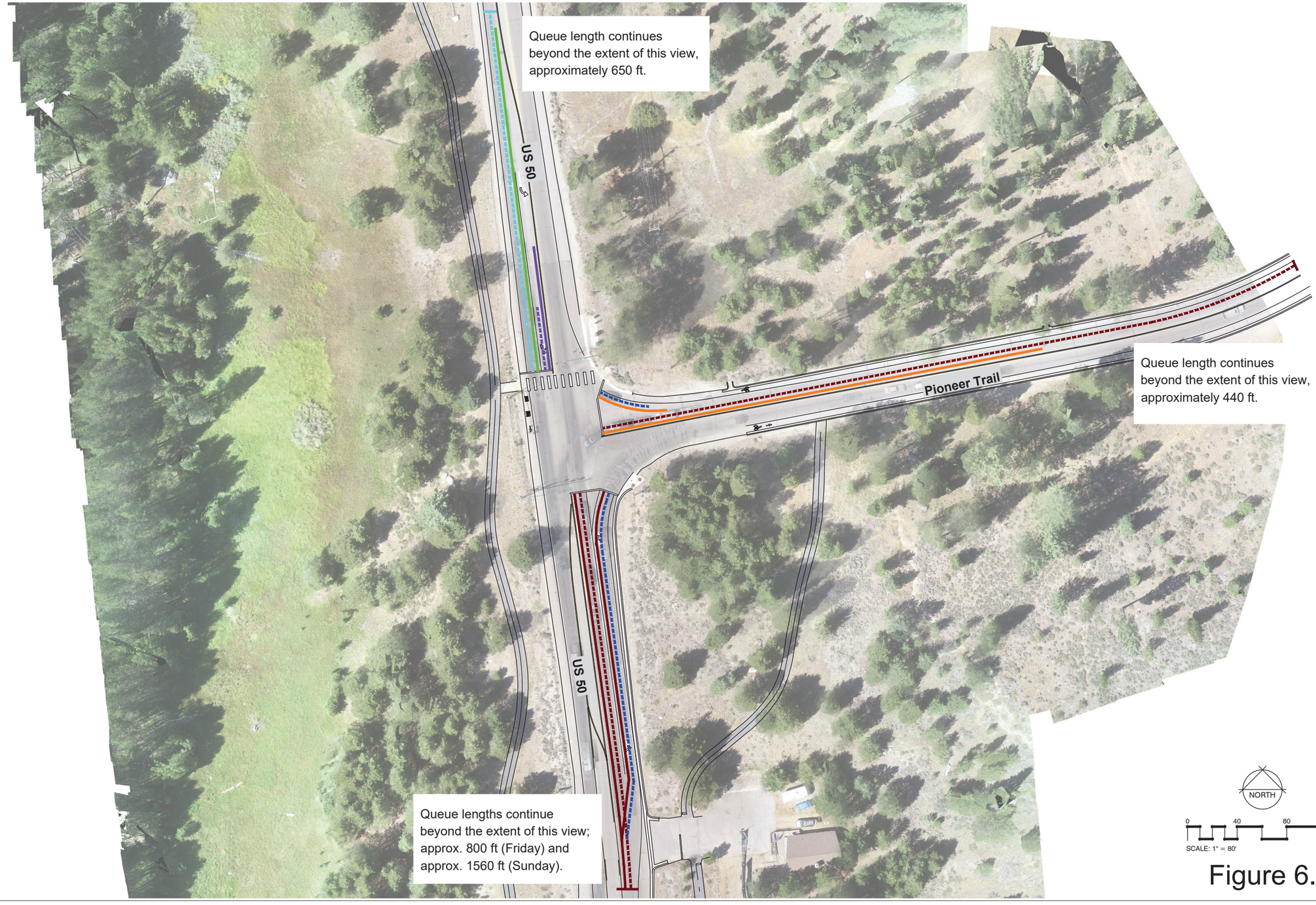
6.1 Level of Service and Queuing

Figure 6.1 illustrates the No Build Alternative LOS and 95th percentile queue lengths and LOS in the project study area. This figure shows the extensive queues for all directions of travel. With no improvements, traffic will continue to queue, causing delays and limiting access to private properties/businesses in the area.

Figure 6.2 illustrates the LOS and 95th percentile queues for both Build Alternatives. The Roundabout Alternative is expected to have better LOS and shorter queue lengths when compared to the Modified Traffic Signal Alternative.

95th Percentile Queue Lengths - No Build Alternative

No Build Alternative



LEGEND

FRIDAY	SUNDAY
- LOS A	- LOS A
- LOS B	- LOS B
- LOS C	- LOS C
- LOS D	- LOS D
- LOS E	- LOS E
- LOS F	- LOS F

NORTH

0 40 80 120 feet

SCALE: 1" = 80'

Figure 6.1

PIONEER TRAIL / US 50 INTERSECTION SAFETY IMPROVEMENT

Meyers, California

GHD

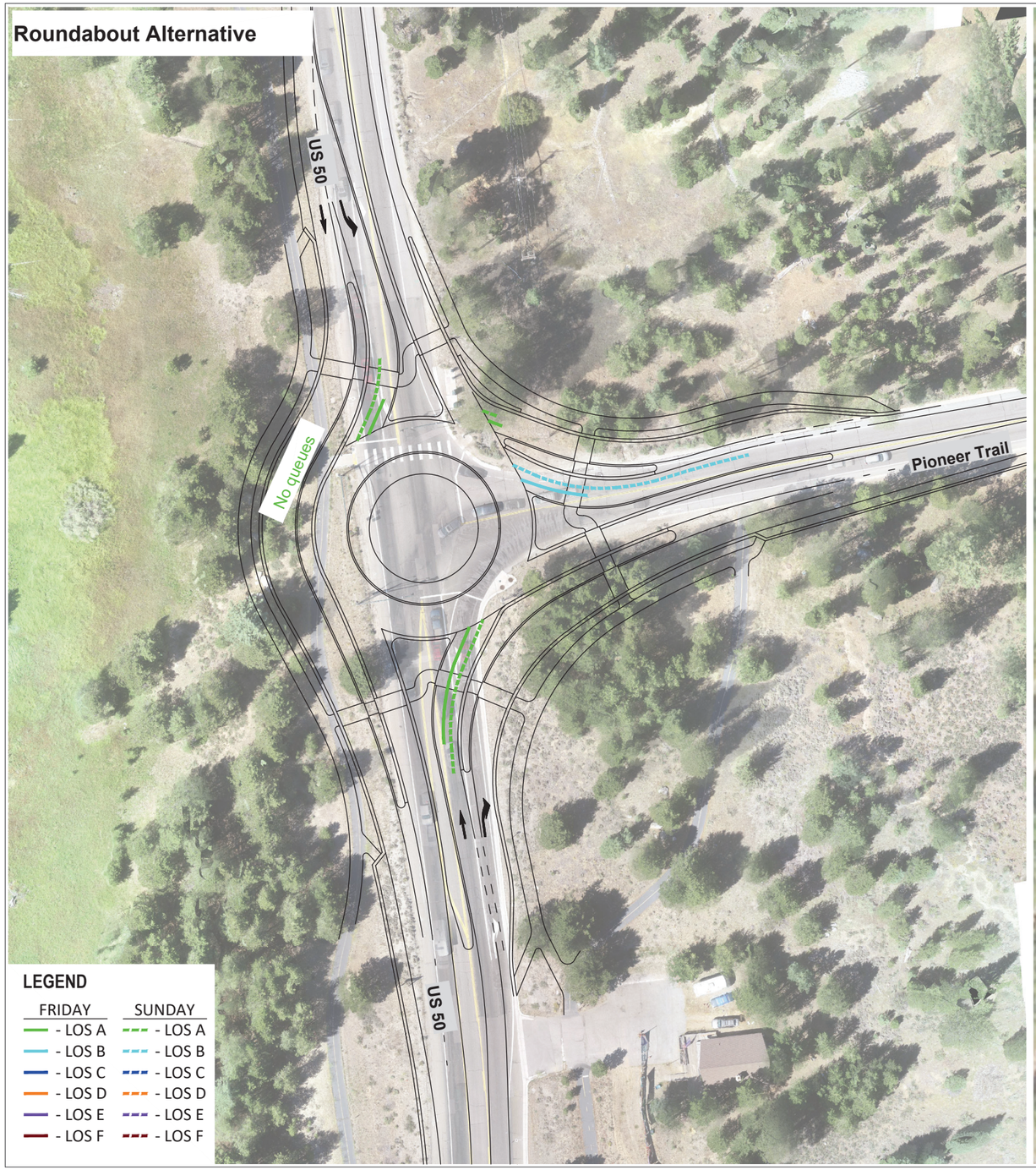
943 Reserve Drive, Suite 100
Roseville, CA 95678 USA
T 1 916 782 8688 **W** www.ghd.com

GHD Inc.

January 2020
2610EX006.dwg

95th Percentile Queue Lengths - Roundabout and Modified Traffic Signal Alternatives

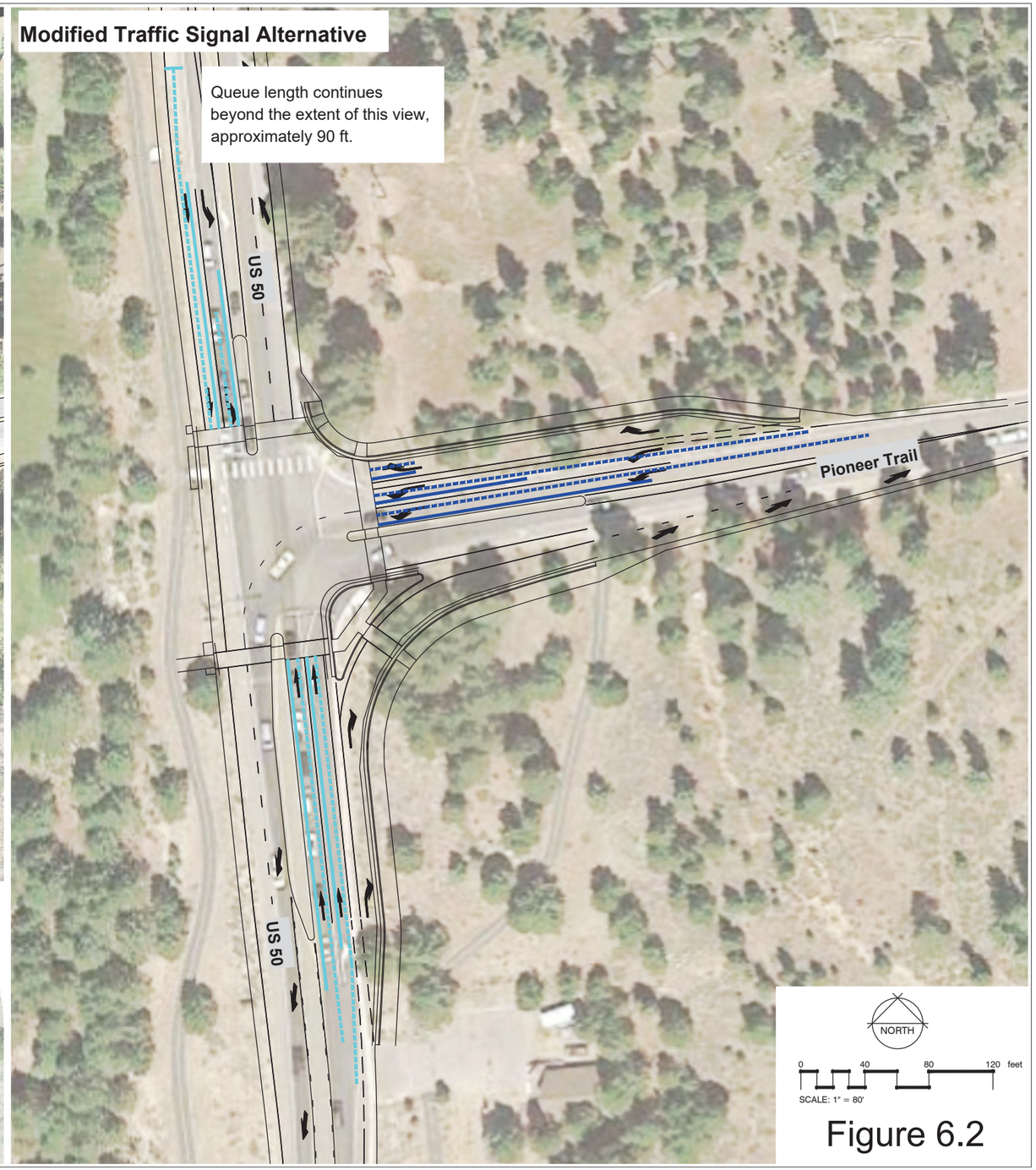
Roundabout Alternative



LEGEND

FRIDAY	SUNDAY
- LOS A	- LOS A
- LOS B	- LOS B
- LOS C	- LOS C
- LOS D	- LOS D
- LOS E	- LOS E
- LOS F	- LOS F

Modified Traffic Signal Alternative



NORTH

0 40 80 120 feet

SCALE: 1" = 80'

Figure 6.2

PIONEER TRAIL / US 50 INTERSECTION SAFETY IMPROVEMENT

Meyers, California

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6.2 Preliminary Cost Estimate

The Roundabout Alternative is estimated to cost $5,246,000 and the Modified Traffic Signal Alternative is estimated to cost $4,950,000 in the current year. Detailed cost estimates are provided in Appendix D (Cost Estimates and Life Cycle Costs).

6.3 Life-Cycle Costs

In evaluating the life-cycle costs of the project, a 20 year service life was used in comparing the No-Build and Build Alternatives (Roundabout and Modified Traffic Signal). In following Caltrans methodology and transportation economics, Caltrans Vehicle Operations Cost Parameters (2016 Current Dollar Value), the vehicle operations costs, collision costs, and emission cost parameters (CA rural area) were used. As presented in Table 6.1, the No Build Alternative is expected to have life-cycle costs of $20,366,000. The higher cost is mainly attributed to the predicted collision costs of $14,564,000. Table 6.2 shows both Build Alternatives have lower life cycle costs than the No Build Alternative, and the Roundabout Alternative is lower than the Modified Traffic Signal Alternative. This is primarily due to the predicted collision costs. The detailed life cycle costs are provided in Appendix D (Cost Estimates and Life Cycle Costs).

Table 6.1 Life Cycle Costs – No Build Alternative

Safety and Delay Costs	
Collision Costs of Predicted Crashes	$14,564,000
Delay Costs	$3,850,000
Fuel and Greenhouse Gas Emission Costs	$1,897,000
Project Costs (Design, Construction, and Maintenance)	
Operations & Maintenance Costs	$54,000
Project Costs (including soft costs)	$0
TOTAL LIFE CYCLE COSTS FOR NO BUILD ALTERNATIVE	**$20,365,000**

Table 6.2 Life Cycle Costs – Build Alternatives

Safety and Delay Costs*		
	Roundabout Alternative	**Modified Traffic Signal Alternative**
Collision Costs of Predicted Crashes	$3,652,000	$10,923,000
Delay Costs	$430,000	$1,640,000
Fuel and Greenhouse Gas Emission Costs	$1,484,000	$1,302,000
Project Costs (Design, Construction, and Maintenance)*		
	Roundabout Alternative	**Modified Traffic Signal Alternative**
Operations & Maintenance Costs	$31,000	$54,000
Project Costs (including soft costs)	$5,250,000	$4,950,000
TOTAL LIFE CYCLE COSTS FOR BUILD ALTERNATIVES	**$10,847,000**	**$18,869,000**

7. Conclusions

With no improvements to the US 50 and Pioneer Trail intersection, the delay will increase and the intersection will reach an overall LOS D on Fridays and LOS E on Sundays by the Design Year. Excessive queuing will continue in all directions of travel. Both Build Alternatives would improve the intersection and provide acceptable LOS and reduced queue lengths. However, compared to the Modified Traffic Signal Alternative that would provide LOS C operations, the Roundabout Alternative would provide LOS A operations and shorter queue lengths. In addition, over the design life of the project, the life cycle costs for the Roundabout Alternative would be more favorable than the Modified Traffic Signal Alternative.

about GHD

GHD is one of the world's leading professional services companies operating in the global markets of water, energy and resources, environment, property and buildings, and transportation. We provide engineering, environmental, and construction services to private and public sector clients.

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Appendix A. Traffic Volume Information from TOAR

Existing Traffic Conditions

Existing Traffic Volumes

Traffic volumes at the study intersection and in the Meyers community in general are highly variable throughout the year, as the intersection serves tourist traffic to and from Lake Tahoe, the State of Nevada, and a variety of other year-round outdoor recreation activities. Based on discussion with the project team, the summer traffic (between the months of June and September) was found to be generally higher when compared to the other months.

This section reviews three recent and relevant planning studies in the area that contain traffic volume information in the Meyers community. An overview of the count data collected in these studies is presented in Table 5.1.

Table 5.1 Comparison of Traffic Counts Collected on US 50 between SR 89 and Pioneer Trail

	Count Year		
	2010	2016	2017
Agency	El Dorado County	Caltrans	El Dorado County
Number of Data points	1 day	12 weekends (over 3 months)a	6 days (2 weekends)
Location	US 50 between SR 89 and Pioneer Trail	US 50 between SR 89 and Pioneer Trail	US 50 between SR 89 and Pioneer Trail

Traffic Operations Analysis for the US Highway 50/Pioneer Trail Intersection Safety Improvement Project (El Dorado County, December 2017). This study cites two time frames (2010 and 2017) when counts were conducted at the study intersection during the summer months. One count was conducted in 2010, and six counts were conducted in 2017. Additionally, this study extrapolated 2010 traffic with a 0.6% growth increase to derive 2016 counts. As the 2016 data is derived and not based actual counts, these numbers are not included in Table 5.2, which presents the traffic volumes.

Table 5.2 Traffic Patterns on US 50 between SR 89 and Pioneer Trail (December 2017 Study)

	Aug 2010 Sunday	Aug 2017 Friday	Aug 2017 Saturday	Aug 2017 Sunday	Oct 2017 Friday	Oct 2017 Saturday	Oct 2017 Sunday
US 50 (EB)	1,243	1,075	1,130	872	1,115	796	637
US 50 (WB)	1,278	726	730	1,234	653	883	1,317
Total	**2,521**	**1,801**	**1,860**	**2,106**	**1,768**	**1,679**	**1,954**

Meyers Intersection Improvements at United States Highway (US) 50 and State Route (SR) 89 Initial Study with Negative Declaration (Caltrans, December 2016). This study utilized average summer traffic volumes representative of a three month summer period. Table 5.3 presents the average summer traffic volumes for 2016.

Table 5.3 Traffic Patterns on US 50 between SR 89 and Pioneer Trail (December 2016 Study)

	Average Summer 2016	
	Friday	Sunday
US 50 (EB)	1,161	1,119
US 50 (WB)	688	1,308
Total	**1,849**	**2,427**

Design Hourly Volumes

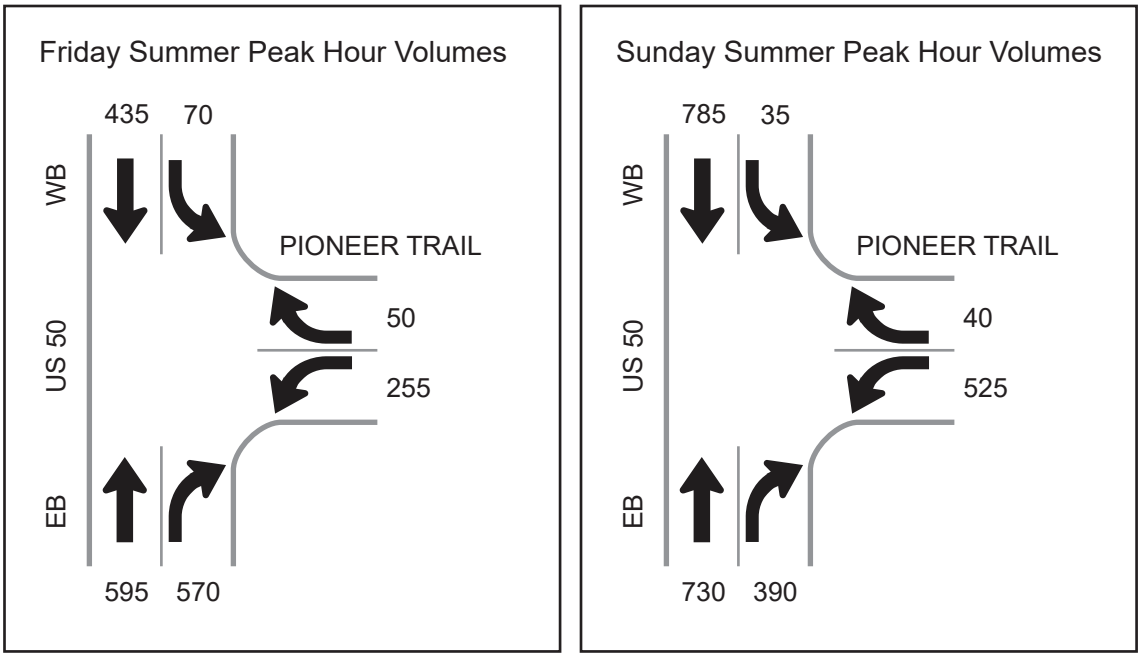
Because the 2016 traffic volumes are based on three months of counts, they are more likely to represent average traffic volumes for a summer weekend and less likely to reflect anomalies in traffic patterns. A comparison of Table 5.2 and Table 5.3 indicates that the average Friday and Sunday summer traffic volumes were greater in the 2016 study than in 2017. Using the higher volumes from 2016 represents a more conservative approach to this analysis of alternatives, as it accounts for increased traffic under current conditions as well as for the sensitivity analysis.

Furthermore, the traffic volumes from the 2016 study were used in the recently completed *Initial Study with Negative Declaration* for the US 50 and SR 89 roundabout project, which is currently under construction. Based on input from the project development team, which includes staff from TRPA, Caltrans, El Dorado County, and consultants, traffic volumes from the 2016 study have been used as the design hourly volumes in the preparation of this Traffic Operations Analysis Report. These design hourly volumes are shown in Appendix A.

Turning movements at the intersection were derived from the traffic split obtained from the 2017 counts. A review of these counts and turning movements revealed the following patterns:

- North/Eastbound US 50 traffic on a typical Friday as it approaches the intersection breaks up into two movements; 51 percent of traffic continues north/east on US 50 and 49 percent turns east/north onto Pioneer Trail. Westbound traffic on a typical Friday is made up of 37 percent from Pioneer Trail (southbound/westbound left) and 63 percent from US 50 (southbound/westbound through).
- North/Eastbound US 50 traffic on a typical Sunday as it approaches the intersection breaks up into two movements; 65 percent of traffic continues north/east on US 50 and 35 percent turns east/north onto Pioneer Trail. Westbound US 50 traffic is made up of 40 percent from Pioneer Trail (southbound/westbound left) and 60 percent from US 50 (southbound/westbound through).

Appendix A from TOAR



N

NOT TO SCALE

El Dorado County
US 50 and Pioneer Trail TOAR

Design Hourly Volumes

Project No. 11191432
Report No. R2610RPT001
Date 8/21/2019

Appendix Figure 1

Appendix B. Synchro and SIDRA LOS Worksheets

LANE SUMMARY

Site: 1v [Pioneer RB Summer No Build Friday]

No Build Design Volumes Signal Alternative
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 108 seconds (Site User-Given Phase Times)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Pioneer Trail													
Lane 1	266	3.0	379[1]	0.700	100	46.5	LOS D	14.1	360.4	Full	1600	0.0	0.0
Lane 2	52	1.0	399	0.131	100	41.1	LOS D	2.2	56.7	Short	50	0.0	NA
Approach	318	2.7		0.700		45.6	LOS D	14.1	360.4				
East: WB US 50													
Lane 1	73	1.0	199	0.366	100	57.3	LOS E	4.0	100.1	Short	165	0.0	NA
Lane 2	453	3.0	1247	0.363	100	8.3	LOS A	10.9	278.7	Full	1600	0.0	0.0
Approach	526	2.7		0.366		15.1	LOS B	10.9	278.7				
West: EB US 50													
Lane 1	620	3.0	616[1]	1.007	100	57.7	LOS F	43.7	1118.0	Full	1600	0.0	0.0
Lane 2	594	1.0	583[1]	1.018	100	67.5	LOS F	42.8	1077.4	Short	225	0.0	NA
Approach	1214	2.0		1.018		62.5	LOS E	43.7	1118.0				
Intersection	2057	2.3		1.018		47.8	LOS D	43.7	1118.0				

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

LANE SUMMARY

Site: 1 [Pioneer RB Summer Friday Peak Hour]

2019 Pioneer RB Sidra Standard EF 1.05
Site Category: (None)
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Pioneer Trail													
Lane 1[d]	266	3.0	1043	0.255	100	12.8	LOS B	1.7	42.4	Full	1600	0.0	0.0
Lane 2	52	1.0	700	0.074	100	8.0	LOS A	0.4	9.7	Short	200	0.0	NA
Approach	318	2.7		0.255		12.0	LOS B	1.7	42.4				
East: WB US 50													
Lane 1[d]	207	2.3	1309	0.158	95[6]	6.8	LOS A	0.9	23.6	Short	150	0.0	NA
Lane 2	319	3.0	1918	0.166	100	3.7	LOS A	0.0	0.0	Full	1600	0.0	0.0
Approach	526	2.7		0.166		4.9	LOS A	0.9	23.6				
West: EB US 50													
Lane 1[d]	620	3.0	1504	0.412	100	4.1	LOS A	2.9	75.4	Full	1600	0.0	0.0
Lane 2	594	1.0	1658	0.358	100	3.6	LOS A	0.0	0.0	Short	150	0.0	NA
Approach	1214	2.0		0.412		3.9	LOS A	2.9	75.4				
Intersection	2057	2.3		0.412		5.4	LOS A	2.9	75.4				

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

6 Lane under-utilisation due to downstream effects
d Dominant lane on roundabout approach

Summary of All Intervals

Run Number	1	10	2	3	4	5	6
Start Time	6:45	6:45	6:45	6:45	6:45	6:45	6:45
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	75	75	75	75	75	75	75
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	3	3	3	3	3	3	3
# of Recorded Intervals	2	2	2	2	2	2	2
Vehs Entered	1988	1894	1950	1961	2007	1923	1962
Vehs Exited	2000	1920	1963	1957	1995	1934	1946
Starting Vehs	43	63	34	37	49	48	31
Ending Vehs	31	37	21	41	61	37	47
Travel Distance (mi)	972	934	955	957	976	944	952
Travel Time (hr)	38.4	36.2	39.0	38.5	40.0	37.6	38.6
Total Delay (hr)	10.4	9.4	11.6	10.9	11.7	10.5	11.1
Total Stops	1055	989	1135	1098	1128	1052	1126
Fuel Used (gal)	33.4	31.6	33.3	32.8	33.5	32.5	33.1

Summary of All Intervals

Run Number	7	8	9	Avg
Start Time	6:45	6:45	6:45	6:45
End Time	8:00	8:00	8:00	8:00
Total Time (min)	75	75	75	75
Time Recorded (min)	60	60	60	60
# of Intervals	3	3	3	3
# of Recorded Intervals	2	2	2	2
Vehs Entered	1966	1909	2041	1960
Vehs Exited	1955	1909	2048	1963
Starting Vehs	29	33	45	41
Ending Vehs	40	33	38	39
Travel Distance (mi)	959	932	1002	958
Travel Time (hr)	38.3	37.0	40.3	38.4
Total Delay (hr)	10.7	10.2	11.4	10.8
Total Stops	1069	1051	1091	1079
Fuel Used (gal)	32.8	32.1	34.3	33.0

Interval #0 Information Seeding

Start Time	6:45
End Time	7:00
Total Time (min)	15

Volumes adjusted by Growth Factors.
No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	1	10	2	3	4	5	6
Vehs Entered	536	489	501	540	534	509	511
Vehs Exited	543	516	498	546	543	522	498
Starting Vehs	43	63	34	37	49	48	31
Ending Vehs	36	36	37	31	40	35	44
Travel Distance (mi)	264	246	244	266	266	251	246
Travel Time (hr)	10.6	9.5	10.3	11.1	10.8	10.3	10.0
Total Delay (hr)	3.0	2.4	3.3	3.5	3.1	3.1	2.9
Total Stops	284	248	303	308	289	285	295
Fuel Used (gal)	9.2	8.4	8.7	9.2	9.1	8.7	8.5

Interval #1 Information Recording

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	7	8	9	Avg
Vehs Entered	544	516	563	524
Vehs Exited	531	515	565	528
Starting Vehs	29	33	45	41
Ending Vehs	42	34	43	38
Travel Distance (mi)	264	249	274	257
Travel Time (hr)	10.9	10.1	11.3	10.5
Total Delay (hr)	3.3	2.9	3.5	3.1
Total Stops	309	282	291	291
Fuel Used (gal)	9.1	8.7	9.5	8.9

Interval #2 Information Recording

Start Time	7:15
End Time	8:00
Total Time (min)	45

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	10	2	3	4	5	6
Vehs Entered	1452	1405	1449	1421	1473	1414	1451
Vehs Exited	1457	1404	1465	1411	1452	1412	1448
Starting Vehs	36	36	37	31	40	35	44
Ending Vehs	31	37	21	41	61	37	47
Travel Distance (mi)	708	688	711	691	711	693	705
Travel Time (hr)	27.8	26.7	28.7	27.4	29.2	27.3	28.6
Total Delay (hr)	7.4	6.9	8.3	7.4	8.6	7.4	8.2
Total Stops	771	741	832	790	839	767	831
Fuel Used (gal)	24.2	23.2	24.6	23.6	24.4	23.8	24.7

Interval #2 Information Recording

Start Time	7:15
End Time	8:00
Total Time (min)	45

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	7	8	9	Avg
Vehs Entered	1422	1393	1478	1436
Vehs Exited	1424	1394	1483	1435
Starting Vehs	42	34	43	38
Ending Vehs	40	33	38	39
Travel Distance (mi)	695	683	728	701
Travel Time (hr)	27.4	26.9	29.0	27.9
Total Delay (hr)	7.4	7.3	8.0	7.7
Total Stops	760	769	800	790
Fuel Used (gal)	23.8	23.4	24.8	24.0

3: Performance by approach

Approach	WB	NB	SB	All
Denied Del/Veh (s)	3.5	0.0	0.0	0.5
Total Del/Veh (s)	23.0	12.4	12.3	14.0

Total Network Performance

Denied Del/Veh (s)	1.4
Total Del/Veh (s)	18.0

Intersection: 3:

Movement	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	L	R	T	T	R	L	T	T
Maximum Queue (ft)	195	162	36	245	237	210	115	187	160
Average Queue (ft)	107	26	12	134	80	102	52	87	33
95th Queue (ft)	173	96	28	208	183	174	98	155	103
Link Distance (ft)		719		540	540			447	447
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	325		300			225	300		
Storage Blk Time (%)					0	0			
Queuing Penalty (veh)					0	0			

Intersection: 5: Bend

Movement	SB
Directions Served	T
Maximum Queue (ft)	62
Average Queue (ft)	2
95th Queue (ft)	63
Link Distance (ft)	540
Upstream Blk Time (%)	0
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 1

LANE SUMMARY

Site: 1v [Pioneer RB Summer No Build Sunday]

No Build Design Volumes Signal Alternative
Site Category: (None)
Signals - Actuated Isolated Cycle Time = 110 seconds (Site User-Given Phase Times)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Pioneer Trail													
Lane 1	559	1.5	558[1]	1.002	100	69.4	LOS F	40.3	1020.8	Full	1600	0.0	0.0
Lane 2	43	1.0	536	0.079	100	33.4	LOS C	1.6	40.9	Short	50	0.0	NA
Approach	601	1.5		1.002		66.8	LOS E	40.3	1020.8				
East: WB US 50													
Lane 1	37	1.0	179	0.208	100	58.2	LOS E	2.0	51.0	Short	165	0.0	NA
Lane 2	835	1.5	1066[1]	0.783	100	18.4	LOS B	37.1	937.9	Full	1600	0.0	0.0
Approach	872	1.5		0.783		20.1	LOS C	37.1	937.9				
West: EB US 50													
Lane 1	777	1.1	637[1]	1.219	100	142.5	LOS F	74.6	1881.1	Full	1600	0.0	19.7
Lane 2	415	1.1	626[1]	0.663	100	30.7	LOS C	18.2	459.0	Short	225	0.0	NA
Approach	1191	1.1		1.219		103.6	LOS F	74.6	1881.1				
Intersection	2665	1.3		1.219		68.0	LOS E	74.6	1881.1				

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

LANE SUMMARY

Site: 1 [Pioneer RB Summer Sunday Peak Hour]

2019 Myers RB Sidra Standard EF 1.05
Site Category: (None)
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Pioneer Trail													
Lane 1[d]	559	1.5	956	0.584	100	17.2	LOS B	6.0	152.0	Full	1600	0.0	0.0
Lane 2	43	1.0	635	0.067	100	9.4	LOS A	0.4	9.0	Short	200	0.0	NA
Approach	601	1.5		0.584		16.6	LOS B	6.0	152.0				
East: WB US 50													
Lane 1[d]	289	1.4	1016	0.284	95[6]	7.2	LOS A	2.1	53.2	Short	150	0.0	NA
Lane 2	584	1.5	1947	0.300	100	4.0	LOS A	0.0	0.0	Full	1600	0.0	0.0
Approach	872	1.5		0.300		5.0	LOS A	2.1	53.2				
West: EB US 50													
Lane 1[d]	777	1.1	1706	0.455	100	4.1	LOS A	3.9	99.2	Full	1600	0.0	0.0
Lane 2	415	1.1	1656	0.250	100	3.7	LOS A	0.0	0.0	Short	150	0.0	NA
Approach	1191	1.1		0.455		4.0	LOS A	3.9	99.2				
Intersection	2665	1.3		0.584		7.2	LOS A	6.0	152.0				

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

6 Lane under-utilisation due to downstream effects
d Dominant lane on roundabout approach

Summary of All Intervals

Run Number	1	10	2	3	4	5	6
Start Time	6:50	6:50	6:50	6:50	6:50	6:50	6:50
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	70	70	70	70	70	70	70
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	3	3	3	3	3	3	3
# of Recorded Intervals	2	2	2	2	2	2	2
Vehs Entered	2602	2514	2433	2441	2476	2509	2433
Vehs Exited	2614	2513	2431	2451	2465	2505	2425
Starting Vehs	62	54	57	62	52	49	53
Ending Vehs	50	55	59	52	63	53	61
Travel Distance (mi)	1293	1258	1212	1217	1229	1251	1208
Travel Time (hr)	59.5	55.4	53.3	53.7	53.7	55.4	53.0
Total Delay (hr)	23.0	20.0	19.2	19.4	19.1	20.5	18.9
Total Stops	1862	1632	1695	1568	1647	1655	1636
Fuel Used (gal)	49.0	46.8	45.4	45.2	45.5	47.0	44.8

Summary of All Intervals

Run Number	7	8	9	Avg
Start Time	6:50	6:50	6:50	6:50
End Time	8:00	8:00	8:00	8:00
Total Time (min)	70	70	70	70
Time Recorded (min)	60	60	60	60
# of Intervals	3	3	3	3
# of Recorded Intervals	2	2	2	2
Vehs Entered	2498	2472	2528	2491
Vehs Exited	2510	2472	2532	2492
Starting Vehs	52	62	61	57
Ending Vehs	40	62	57	54
Travel Distance (mi)	1249	1226	1260	1240
Travel Time (hr)	56.5	54.4	60.1	55.5
Total Delay (hr)	21.4	19.9	24.5	20.6
Total Stops	1768	1683	1910	1706
Fuel Used (gal)	46.9	45.7	47.6	46.4

Interval #0 Information Seeding

Start Time	6:50
End Time	7:00
Total Time (min)	10

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	1	10	2	3	4	5	6
Vehs Entered	677	687	629	641	659	650	649
Vehs Exited	668	665	635	655	648	646	637
Starting Vehs	62	54	57	62	52	49	53
Ending Vehs	71	76	51	48	63	53	65
Travel Distance (mi)	333	338	316	323	327	320	321
Travel Time (hr)	15.8	15.6	14.2	15.1	14.7	14.3	14.7
Total Delay (hr)	6.3	6.1	5.3	6.0	5.5	5.3	5.7
Total Stops	499	486	454	479	465	440	475
Fuel Used (gal)	12.8	12.8	11.8	12.3	12.2	12.1	12.1

Interval #1 Information Recording

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	7	8	9	Avg
Vehs Entered	701	676	716	668
Vehs Exited	687	680	709	663
Starting Vehs	52	62	61	57
Ending Vehs	66	58	68	61
Travel Distance (mi)	346	335	353	331
Travel Time (hr)	16.7	16.1	19.3	15.6
Total Delay (hr)	6.9	6.6	9.3	6.3
Total Stops	534	541	663	504
Fuel Used (gal)	13.3	12.8	13.9	12.6

Interval #2 Information Recording

Start Time	7:15
End Time	8:00
Total Time (min)	45

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	10	2	3	4	5	6
Vehs Entered	1925	1827	1804	1800	1817	1859	1784
Vehs Exited	1946	1848	1796	1796	1817	1859	1788
Starting Vehs	71	76	51	48	63	53	65
Ending Vehs	50	55	59	52	63	53	61
Travel Distance (mi)	960	920	897	894	902	930	888
Travel Time (hr)	43.7	39.8	39.1	38.5	39.0	41.2	38.3
Total Delay (hr)	16.7	13.8	13.9	13.4	13.7	15.2	13.2
Total Stops	1363	1146	1241	1089	1182	1215	1161
Fuel Used (gal)	36.3	34.0	33.6	32.9	33.3	34.9	32.7

Interval #2 Information Recording

Start Time	7:15
End Time	8:00
Total Time (min)	45

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	7	8	9	Avg
Vehs Entered	1797	1796	1812	1822
Vehs Exited	1823	1792	1823	1829
Starting Vehs	66	58	68	61
Ending Vehs	40	62	57	54
Travel Distance (mi)	903	891	907	909
Travel Time (hr)	39.8	38.3	40.7	39.9
Total Delay (hr)	14.4	13.3	15.2	14.3
Total Stops	1234	1142	1247	1202
Fuel Used (gal)	33.6	32.9	33.7	33.8

3: Performance by approach Interval #1 7:00

Approach	WB	NB	SB	All
Denied Del/Veh (s)	3.3	0.0	0.0	0.7
Total Del/Veh (s)	36.7	18.6	19.2	23.1

3: Performance by approach Interval #2 7:15

Approach	WB	NB	SB	All
Denied Del/Veh (s)	3.3	0.0	0.0	0.7
Total Del/Veh (s)	29.5	15.6	17.0	19.2

3: Performance by approach Entire Run

Approach	WB	NB	SB	All
Denied Del/Veh (s)	3.3	0.0	0.0	0.7
Total Del/Veh (s)	32.0	16.5	17.7	20.5

Total Network Performance By Interval

Interval Start	7:00	7:15	All
Denied Del/Veh (s)	1.6	1.5	1.5
Total Del/Veh (s)	29.9	25.9	27.6

Intersection: 3: , Interval #1

Movement	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	L	R	T	T	R	L	T	T
Maximum Queue (ft)	316	282	28	282	254	118	65	315	284
Average Queue (ft)	245	167	12	199	152	74	36	211	159
95th Queue (ft)	348	324	32	300	272	132	72	330	291
Link Distance (ft)		719		540	540			447	447
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	325		300			225	300		
Storage Blk Time (%)	4	2			1			1	
Queuing Penalty (veh)	12	5			3			0	

Intersection: 3: , Interval #2

Movement	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	L	R	T	T	R	L	T	T
Maximum Queue (ft)	302	253	34	274	246	132	90	343	308
Average Queue (ft)	205	122	10	174	124	61	32	195	129
95th Queue (ft)	293	253	26	254	229	111	72	304	268
Link Distance (ft)		719		540	540			447	447
Upstream Blk Time (%)								0	0
Queuing Penalty (veh)								0	0
Storage Bay Dist (ft)	325		300			225	300		
Storage Blk Time (%)	0	0			0			1	
Queuing Penalty (veh)	1	0			1			0	

Intersection: 3: , All Intervals

Movement	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	L	R	T	T	R	L	T	T
Maximum Queue (ft)	329	293	37	295	262	156	92	354	327
Average Queue (ft)	215	133	11	180	131	64	33	199	136
95th Queue (ft)	311	274	28	268	241	117	72	311	275
Link Distance (ft)		719		540	540			447	447
Upstream Blk Time (%)								0	0
Queuing Penalty (veh)								0	0
Storage Bay Dist (ft)	325		300			225	300		
Storage Blk Time (%)	1	0			0			1	
Queuing Penalty (veh)	3	1			1			0	

Intersection: 5: Bend, Interval #1

Movement	SB	SB
Directions Served	T	
Maximum Queue (ft)	63	56
Average Queue (ft)	9	8
95th Queue (ft)	133	117
Link Distance (ft)	540	540
Upstream Blk Time (%)	0	0
Queuing Penalty (veh)	0	0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 5: Bend, Interval #2

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 5: Bend, All Intervals

Movement	SB	SB
Directions Served	T	
Maximum Queue (ft)	63	56
Average Queue (ft)	2	2
95th Queue (ft)	63	56
Link Distance (ft)	540	540
Upstream Blk Time (%)	0	0
Queuing Penalty (veh)	0	0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 6: Bend, Interval #1

Movement	NB	NB
Directions Served	T	
Maximum Queue (ft)	143	46
Average Queue (ft)	20	7
95th Queue (ft)	179	97
Link Distance (ft)	447	447
Upstream Blk Time (%)	0	0
Queuing Penalty (veh)	1	0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 6: Bend, Interval #2

Movement	NB
Directions Served	T
Maximum Queue (ft)	280
Average Queue (ft)	21
95th Queue (ft)	180
Link Distance (ft)	447
Upstream Blk Time (%)	0
Queuing Penalty (veh)	1
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 6: Bend, All Intervals

Movement	NB	NB
Directions Served	T	
Maximum Queue (ft)	330	46
Average Queue (ft)	21	2
95th Queue (ft)	180	46
Link Distance (ft)	447	447
Upstream Blk Time (%)	0	0
Queuing Penalty (veh)	1	0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty, Interval #1: 22
Network wide Queuing Penalty, Interval #2: 2
Network wide Queuing Penalty, All Intervals: 7

LANE SUMMARY

Site: 1 [Pioneer RB Summer Friday Peak Hour - Sensitivity]

2019 Pioneer RB Sidra Standard EF 1.05; sensitivity analysis 1% growth over 20 years, applied a 120% volume factor in SIDRA
Site Category: (None)
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Pioneer Trail													
Lane 1[d]	319	3.0	922	0.346	100	14.0	LOS B	2.5	64.0	Full	1600	0.0	0.0
Lane 2	63	1.0	625	0.100	100	9.2	LOS A	0.6	14.0	Short	200	0.0	NA
Approach	381	2.7		0.346		13.2	LOS B	2.5	64.0				
East: WB US 50													
Lane 1[d]	241	2.3	1245	0.193	95[6]	7.1	LOS A	1.2	30.8	Short	150	0.0	NA
Lane 2	390	3.0	1918	0.204	100	3.8	LOS A	0.0	0.0	Full	1600	0.0	0.0
Approach	631	2.7		0.204		5.0	LOS A	1.2	30.8				
West: EB US 50													
Lane 1[d]	744	3.0	1484	0.501	100	4.2	LOS A	4.1	104.7	Full	1600	0.0	0.0
Lane 2	712	1.0	1658	0.430	100	3.6	LOS A	0.0	0.0	Short	150	0.0	NA
Approach	1456	2.0		0.501		3.9	LOS A	4.1	104.7				
Intersection	2469	2.3		0.501		5.7	LOS A	4.1	104.7				

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

6 Lane under-utilisation due to downstream effects
d Dominant lane on roundabout approach

Summary of All Intervals

Run Number	1	10	2	3	4	5	6
Start Time	6:45	6:45	6:45	6:45	6:45	6:45	6:45
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	75	75	75	75	75	75	75
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	3	3	3	3	3	3	3
# of Recorded Intervals	2	2	2	2	2	2	2
Vehs Entered	2337	2289	2440	2316	2338	2328	2352
Vehs Exited	2327	2288	2445	2330	2325	2337	2358
Starting Vehs	41	45	48	56	53	46	45
Ending Vehs	51	46	43	42	66	37	39
Travel Distance (mi)	1141	1119	1196	1133	1138	1141	1152
Travel Time (hr)	48.8	47.0	52.6	47.7	48.3	48.6	49.0
Total Delay (hr)	16.0	14.9	18.2	14.9	15.5	15.9	15.9
Total Stops	1362	1312	1471	1323	1328	1385	1373
Fuel Used (gal)	39.8	39.0	42.9	39.5	39.5	40.2	40.5

Summary of All Intervals

Run Number	7	8	9	Avg
Start Time	6:45	6:45	6:45	6:45
End Time	8:00	8:00	8:00	8:00
Total Time (min)	75	75	75	75
Time Recorded (min)	60	60	60	60
# of Intervals	3	3	3	3
# of Recorded Intervals	2	2	2	2
Vehs Entered	2399	2364	2410	2356
Vehs Exited	2410	2361	2418	2360
Starting Vehs	38	56	46	46
Ending Vehs	27	59	38	43
Travel Distance (mi)	1175	1153	1176	1152
Travel Time (hr)	50.5	50.4	52.5	49.5
Total Delay (hr)	16.7	17.2	18.4	16.4
Total Stops	1423	1427	1523	1393
Fuel Used (gal)	41.3	40.9	41.8	40.5

Interval #0 Information Seeding

Start Time	6:45
End Time	7:00
Total Time (min)	15

Volumes adjusted by Growth Factors.
No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	1	10	2	3	4	5	6
Vehs Entered	607	610	652	615	625	599	616
Vehs Exited	587	600	644	628	631	603	621
Starting Vehs	41	45	48	56	53	46	45
Ending Vehs	61	55	56	43	47	42	40
Travel Distance (mi)	289	296	319	302	307	293	303
Travel Time (hr)	12.8	13.1	14.3	13.0	13.4	13.0	12.7
Total Delay (hr)	4.5	4.6	5.1	4.3	4.6	4.6	4.0
Total Stops	378	382	374	366	384	384	339
Fuel Used (gal)	10.3	10.6	11.8	10.7	10.8	10.5	10.6

Interval #1 Information Recording

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	7	8	9	Avg
Vehs Entered	650	667	658	630
Vehs Exited	633	656	645	624
Starting Vehs	38	56	46	46
Ending Vehs	55	67	59	52
Travel Distance (mi)	314	322	316	306
Travel Time (hr)	14.3	15.5	14.6	13.7
Total Delay (hr)	5.3	6.2	5.4	4.8
Total Stops	439	461	427	394
Fuel Used (gal)	11.4	12.1	11.4	11.0

Interval #2 Information Recording

Start Time	7:15
End Time	8:00
Total Time (min)	45

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	10	2	3	4	5	6
Vehs Entered	1730	1679	1788	1701	1713	1729	1736
Vehs Exited	1740	1688	1801	1702	1694	1734	1737
Starting Vehs	61	55	56	43	47	42	40
Ending Vehs	51	46	43	42	66	37	39
Travel Distance (mi)	852	823	877	831	831	848	849
Travel Time (hr)	36.0	34.0	38.3	34.7	34.9	35.6	36.4
Total Delay (hr)	11.5	10.2	13.1	10.7	10.9	11.3	11.9
Total Stops	984	930	1097	957	944	1001	1034
Fuel Used (gal)	29.5	28.5	31.1	28.8	28.7	29.7	29.9

Interval #2 Information Recording

Start Time	7:15
End Time	8:00
Total Time (min)	45

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	7	8	9	Avg
Vehs Entered	1749	1697	1752	1727
Vehs Exited	1777	1705	1773	1735
Starting Vehs	55	67	59	52
Ending Vehs	27	59	38	43
Travel Distance (mi)	862	831	860	846
Travel Time (hr)	36.2	34.9	37.9	35.9
Total Delay (hr)	11.4	11.0	13.1	11.5
Total Stops	984	966	1096	1000
Fuel Used (gal)	29.9	28.8	30.4	29.5

3: Performance by approach

Approach	WB	NB	SB	All
Denied Del/Veh (s)	3.4	0.0	0.0	0.5
Total Del/Veh (s)	26.0	16.1	14.3	17.2

Total Network Performance

Denied Del/Veh (s)	1.9
Total Del/Veh (s)	22.6

Intersection: 3:

Movement	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	L	R	T	T	R	L	T	T
Maximum Queue (ft)	240	195	44	267	307	296	141	211	178
Average Queue (ft)	133	47	15	162	119	147	66	111	44
95th Queue (ft)	207	148	32	246	250	263	117	187	132
Link Distance (ft)		719		540	540			447	447
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	325		300			225	300		
Storage Blk Time (%)					0	3			
Queuing Penalty (veh)					1	10			

Intersection: 6: Bend

Movement	NB	NB
Directions Served	T	
Maximum Queue (ft)	233	46
Average Queue (ft)	13	2
95th Queue (ft)	137	46
Link Distance (ft)	447	447
Upstream Blk Time (%)	0	0
Queuing Penalty (veh)	0	0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 12

LANE SUMMARY

Site: 1 [Pioneer RB Summer Sunday Peak Hour - Sensitivity]

2019 Myers RB Sidra Standard EF 1.05; sensitivity analysis 1% growth over 20 years, applied a 120% volume factor in SIDRA
Site Category: (None)
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: NB Pioneer Trail													
Lane 1[d]	670	1.5	813	0.824	100	31.9	LOS C	15.5	393.1	Full	1600	0.0	0.0
Lane 2	51	1.0	550	0.093	100	11.3	LOS B	0.5	13.7	Short	200	0.0	NA
Approach	721	1.5		0.824		30.4	LOS C	15.5	393.1				
East: WB US 50													
Lane 1[d]	313	1.4	876	0.357	95[6]	8.1	LOS A	2.9	74.4	Short	150	0.0	NA
Lane 2	734	1.5	1947	0.377	100	4.0	LOS A	0.0	0.0	Full	1600	0.0	0.0
Approach	1047	1.5		0.377		5.2	LOS A	2.9	74.4				
West: EB US 50													
Lane 1[d]	932	1.1	1692	0.551	100	4.2	LOS A	5.7	143.4	Full	1600	0.0	0.0
Lane 2	498	1.1	1656	0.301	100	3.7	LOS A	0.0	0.0	Short	150	0.0	NA
Approach	1430	1.1		0.551		4.0	LOS A	5.7	143.4				
Intersection	3198	1.3		0.824		10.4	LOS B	15.5	393.1				

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

6 Lane under-utilisation due to downstream effects
d Dominant lane on roundabout approach

Summary of All Intervals

Run Number	1	10	2	3	4	5	6
Start Time	6:45	6:45	6:45	6:45	6:45	6:45	6:45
End Time	8:00	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	75	75	75	75	75	75	75
Time Recorded (min)	60	60	60	60	60	60	60
# of Intervals	3	3	3	3	3	3	3
# of Recorded Intervals	2	2	2	2	2	2	2
Vehs Entered	3040	2988	2954	2878	2927	3018	3035
Vehs Exited	3035	2995	2977	2896	2888	3019	2982
Starting Vehs	83	91	83	87	63	94	58
Ending Vehs	88	84	60	69	102	93	111
Travel Distance (mi)	1511	1494	1480	1442	1446	1509	1494
Travel Time (hr)	98.3	75.8	84.6	73.4	80.4	93.5	91.9
Total Delay (hr)	55.8	33.9	43.0	32.9	39.8	51.1	49.9
Total Stops	3428	2636	3065	2408	2762	3207	3131
Fuel Used (gal)	65.3	58.8	60.7	56.3	58.7	63.5	62.4

Summary of All Intervals

Run Number	7	8	9	Avg
Start Time	6:45	6:45	6:45	6:45
End Time	8:00	8:00	8:00	8:00
Total Time (min)	75	75	75	75
Time Recorded (min)	60	60	60	60
# of Intervals	3	3	3	3
# of Recorded Intervals	2	2	2	2
Vehs Entered	3043	2947	3008	2984
Vehs Exited	3042	2959	3024	2982
Starting Vehs	68	83	86	79
Ending Vehs	69	71	70	81
Travel Distance (mi)	1518	1471	1502	1487
Travel Time (hr)	84.0	80.1	95.1	85.7
Total Delay (hr)	41.3	38.7	52.7	43.9
Total Stops	2998	2781	3290	2971
Fuel Used (gal)	61.2	59.1	63.7	61.0

Interval #0 Information Seeding

Start Time	6:45
End Time	7:00
Total Time (min)	15

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Seeding

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	1	10	2	3	4	5	6
Vehs Entered	827	779	801	772	784	776	787
Vehs Exited	766	790	775	759	751	771	735
Starting Vehs	83	91	83	87	63	94	58
Ending Vehs	144	80	109	100	96	99	110
Travel Distance (mi)	391	395	392	381	381	386	377
Travel Time (hr)	26.0	20.3	24.2	20.9	22.1	23.5	20.6
Total Delay (hr)	15.0	9.3	13.3	10.3	11.4	12.7	10.1
Total Stops	958	728	961	733	776	867	759
Fuel Used (gal)	17.1	15.6	16.6	15.2	15.7	16.0	15.2

Interval #1 Information Seeding

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	7	8	9	Avg
Vehs Entered	780	815	822	794
Vehs Exited	760	781	795	767
Starting Vehs	68	83	86	79
Ending Vehs	88	117	113	105
Travel Distance (mi)	385	396	400	388
Travel Time (hr)	22.1	23.8	27.6	23.1
Total Delay (hr)	11.3	12.7	16.3	12.2
Total Stops	764	927	1019	849
Fuel Used (gal)	15.7	16.4	17.6	16.1

Interval #2 Information Recording

Start Time	7:15
End Time	8:00
Total Time (min)	45

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	10	2	3	4	5	6
Vehs Entered	2213	2209	2153	2106	2143	2242	2248
Vehs Exited	2269	2205	2202	2137	2137	2248	2247
Starting Vehs	144	80	109	100	96	99	110
Ending Vehs	88	84	60	69	102	93	111
Travel Distance (mi)	1120	1099	1088	1061	1065	1123	1118
Travel Time (hr)	72.4	55.5	60.4	52.4	58.3	69.9	71.3
Total Delay (hr)	40.8	24.6	29.7	22.6	28.4	38.4	39.8
Total Stops	2470	1908	2104	1675	1986	2340	2372
Fuel Used (gal)	48.2	43.2	44.1	41.1	43.0	47.5	47.2

Interval #2 Information Recording

Start Time	7:15
End Time	8:00
Total Time (min)	45

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	7	8	9	Avg
Vehs Entered	2263	2132	2186	2190
Vehs Exited	2282	2178	2229	2213
Starting Vehs	88	117	113	105
Ending Vehs	69	71	70	81
Travel Distance (mi)	1134	1075	1101	1098
Travel Time (hr)	61.9	56.3	67.5	62.6
Total Delay (hr)	30.0	26.0	36.4	31.7
Total Stops	2234	1854	2271	2123
Fuel Used (gal)	45.5	42.7	46.1	44.9

3: Performance by approach

Approach	WB	NB	SB	All
Denied Del/Veh (s)	4.7	0.0	0.0	1.1
Total Del/Veh (s)	78.7	25.2	27.8	38.1

Total Network Performance

Denied Del/Veh (s)	2.3
Total Del/Veh (s)	49.4

Intersection: 3:

Movement	WB	WB	WB	NB	NB	NB	B5	SB	SB	SB	B6
Directions Served	L	L	R	T	T	R	T	L	T	T	T
Maximum Queue (ft)	408	642	217	462	454	283	7	204	472	431	158
Average Queue (ft)	338	351	35	260	224	104	0	44	288	239	10
95th Queue (ft)	468	681	177	410	400	230	8	148	445	421	110
Link Distance (ft)		719		540	540		1102		447	447	474
Upstream Blk Time (%)		4		0	0				2	0	0
Queuing Penalty (veh)		0		0	0				0	0	0
Storage Bay Dist (ft)	325		300			225		300			
Storage Blk Time (%)	38	14			5	0			11		
Queuing Penalty (veh)	137	52			25	0			5		

Intersection: 5: Bend

Movement	SB	SB
Directions Served	T	
Maximum Queue (ft)	586	165
Average Queue (ft)	69	8
95th Queue (ft)	374	114
Link Distance (ft)	540	540
Upstream Blk Time (%)	1	0
Queuing Penalty (veh)	4	0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 6: Bend

Movement	NB	NB
Directions Served	T	
Maximum Queue (ft)	488	435
Average Queue (ft)	111	31
95th Queue (ft)	439	221
Link Distance (ft)	447	447
Upstream Blk Time (%)	1	0
Queuing Penalty (veh)	5	1
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

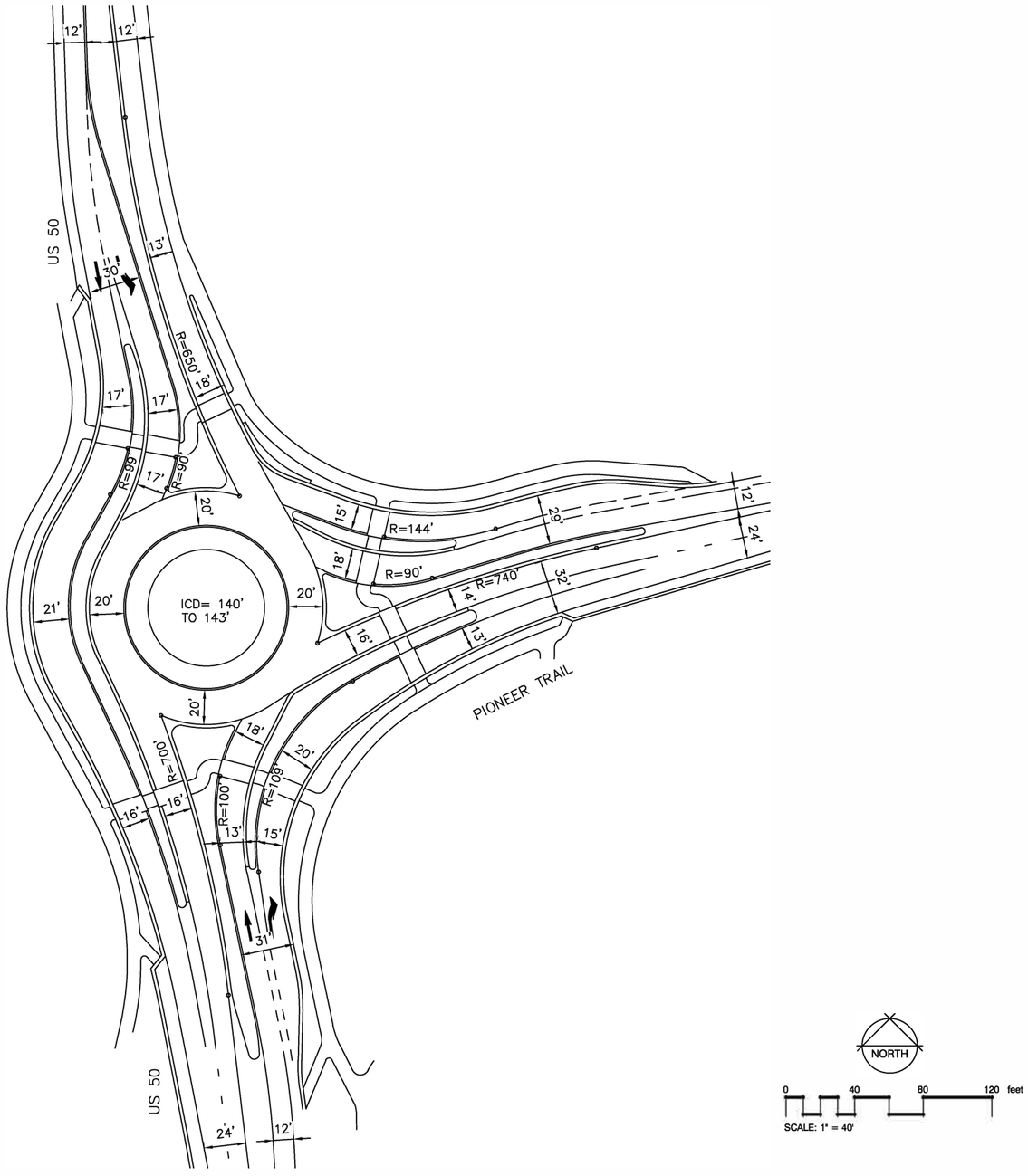
Network Summary

Network wide Queuing Penalty: 229

Appendix C. Roundabout Performance Based Checks

Roundabout Performance Based Checks

INDEX OF SHEETS



Pioneer Trail/US50 Intersection Safety Improvement Project

Meyers, California

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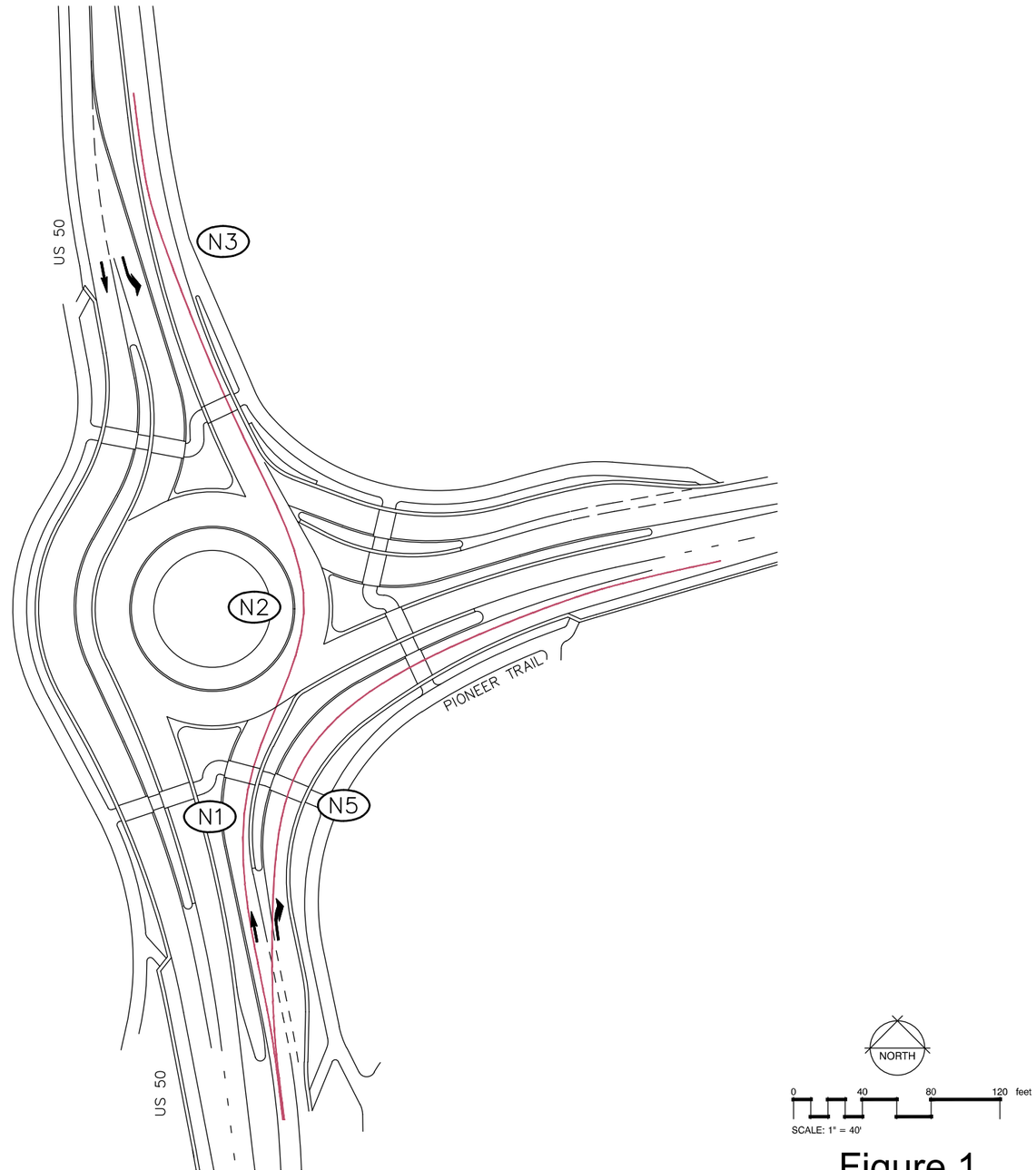
Fastpath (NB)

LEGEND:

FAST PATH

D# FAST PATH SPEED IDENTIFIER



Movement	Northbound US50 Radius (ft)	Northbound US50 Speed (N#)	Northbound US50 Right Bypass Radius (ft)	Northbound US50 Right Bypass Speed (N#)
Entering (V1)	161.0	24.5	N/A	N/A
Circulating (V2)	91.2	18.2	N/A	N/A
Exiting (V3)	979.4	29.9	N/A	N/A
Left Turn (V4)	N/A	N/A	N/A	N/A
Right Turn (V5)	N/A	N/A	106.7	20.9

Notes:

All values are in miles per hour

V3 exiting speeds are derived from vehicle acceleration formulas in NCHRP 672

V3 fast path speed measured at exit crosswalk or 100 feet downstream from V2.

As acceleration potential of vehicle determines actual exiting speed, V3 presented is a conservative estimate.

N/A = Fastest path speed does not exist for this approach

2% cross-slope assumed for determining Fastest path

NORTH

0 40 80 120 feet

SCALE: 1" = 40'

Figure 1

Pioneer Trail/US50 Intersection Safety Improvement Project

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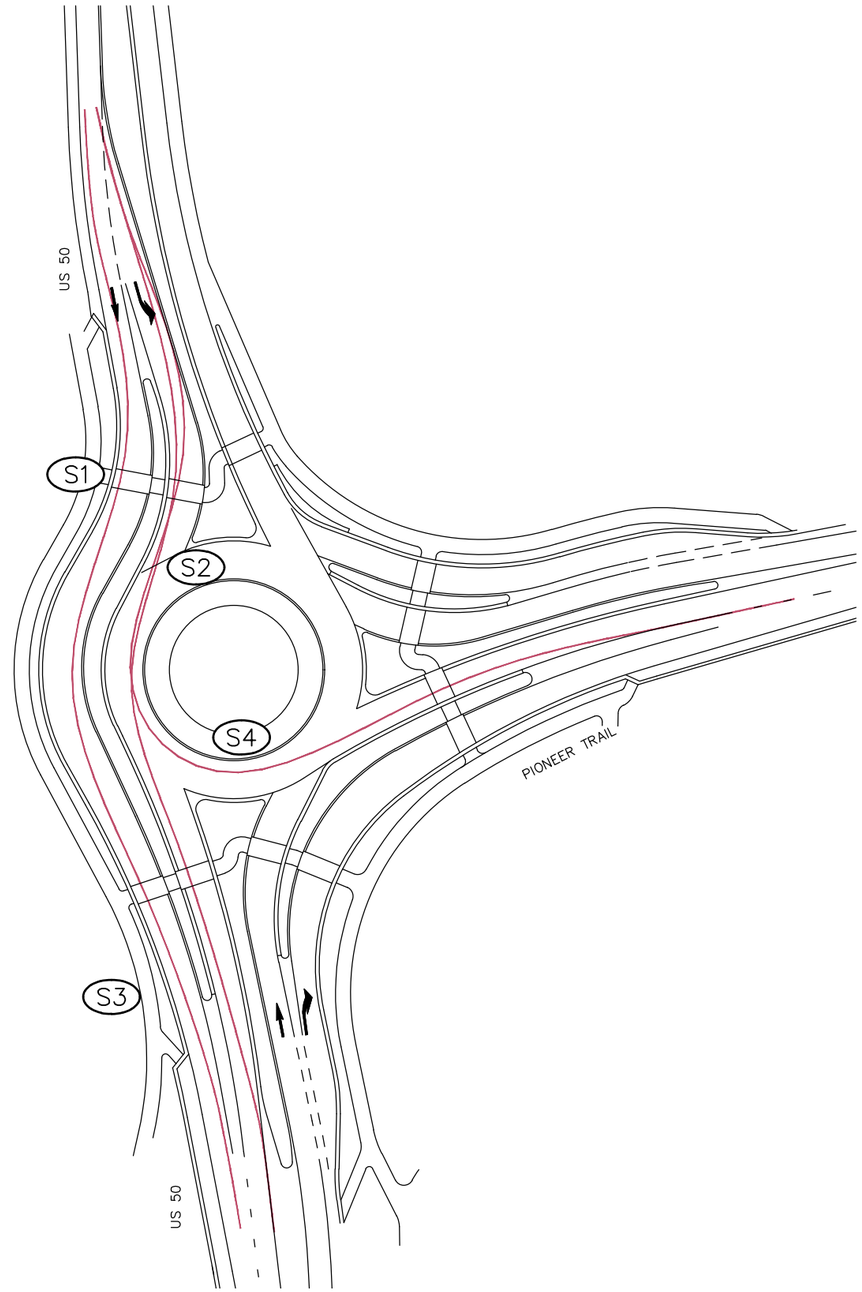
Fastpath (SB)

LEGEND:

FAST PATH

(D#) FAST PATH SPEED IDENTIFIER



Movement	Southbound US 50 Radius (ft)	Southbound US50 Speed (S#)	Southbound US 50 Radius (ft)	Southbound US50 Bypass Speed (S#)
Entering (V1)	164.8	24.7	162.0	24.5
Circulating (V2)	113.2	19.7	119.2	20.0
Exiting (V3)	N/A	31.1	75.9	29.8
Left Turn (V4)	N/A	15.0	N/A	N/A
Right Turn (V5)	N/A	N/A	N/A	N/A

Notes:

All values are in miles per hour

V3 exiting speeds are derived from vehicle acceleration formulas in NCHRP 672

V3 fast path speed measured at exit crosswalk or 100 feet downstream from V2.

As acceleration potential of vehicle determines actual exiting speed, V3 presented is a conservative estimate.

N/A = Fastest path speed does not exist for this approach

2% cross-slope assumed for determining Fastest path

NORTH

0 40 80 120 feet

SCALE: 1" = 40'

Figure 2

Pioneer Trail/US50 Intersection Safety Improvement Project

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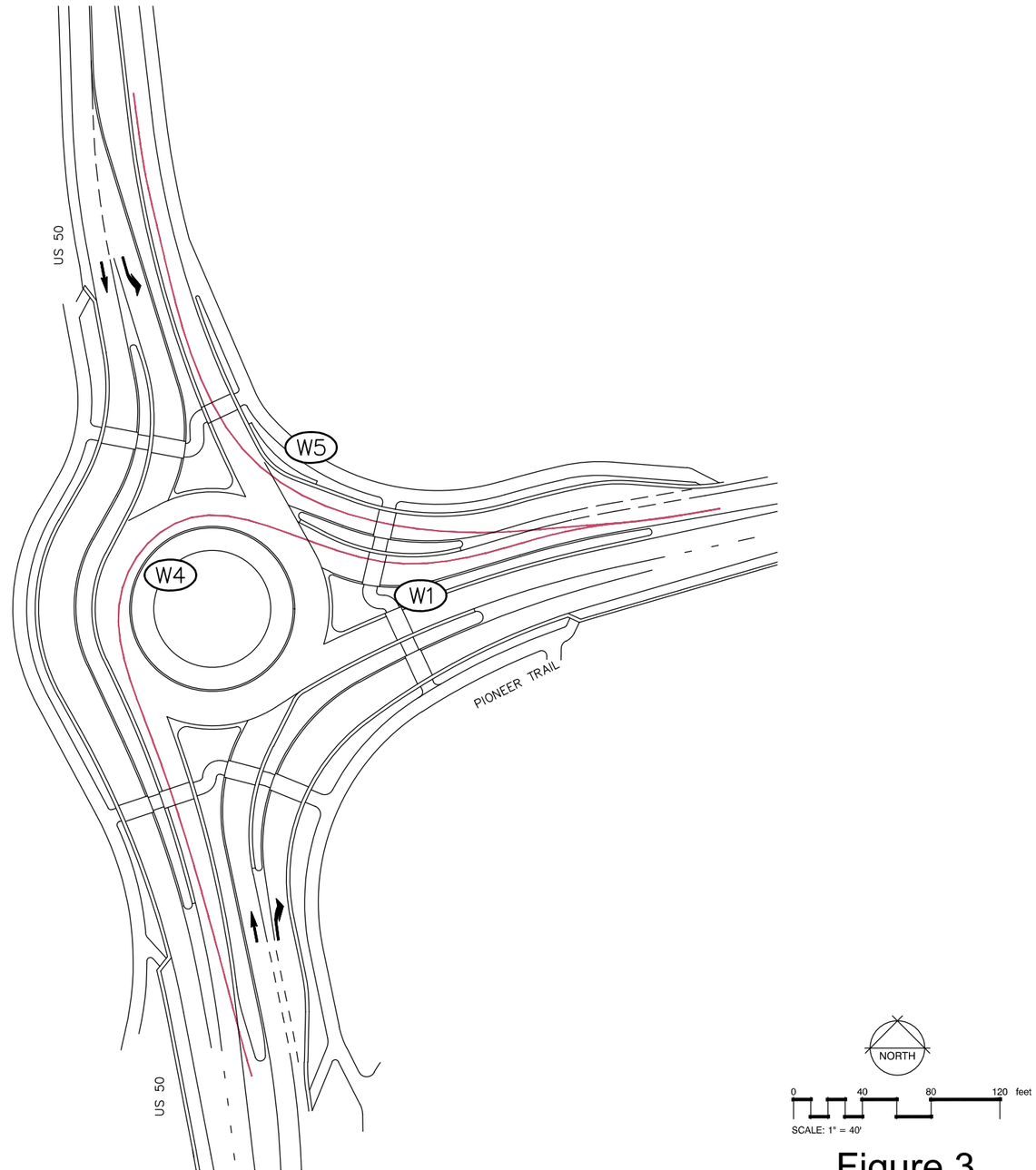
Fastpath (WB)

LEGEND:

FAST PATH

D# FAST PATH SPEED IDENTIFIER



Movement	Westbound Pioneer Trail Radius (ft)	Westbound Pioneer Trail Speed (W#)
Entering (V1)	156.4	24.2
Circulating (V2)	N/A	N/A
Exiting (V3)	N/A	N/A
Left Turn (V4)	53.7	15.0
Right Turn (V5)	161.1	24.5

Notes:

All values are in miles per hour

V3 exiting speeds are derived from vehicle acceleration formulas in NCHRP 672

V3 fast path speed measured at exit crosswalk or 100 feet downstream from V2.

As acceleration potential of vehicle determines actual exiting speed, V3 presented is a conservative estimate.

N/A = Fastest path speed does not exist for this approach

2% cross-slope assumed for determining Fastest path

NORTH

0 40 80 120 feet

SCALE: 1" = 40'

Figure 3

Pioneer Trail/US50 Intersection Safety Improvement Project

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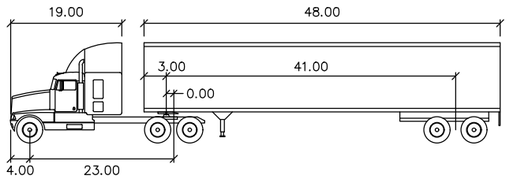
STAA Truck Turns (NB)

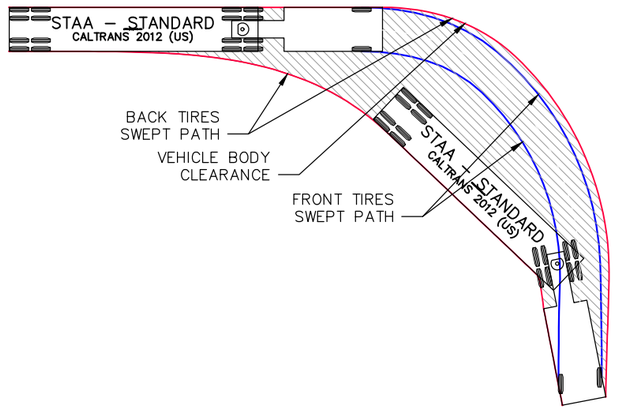
VEHICLE PROFILE

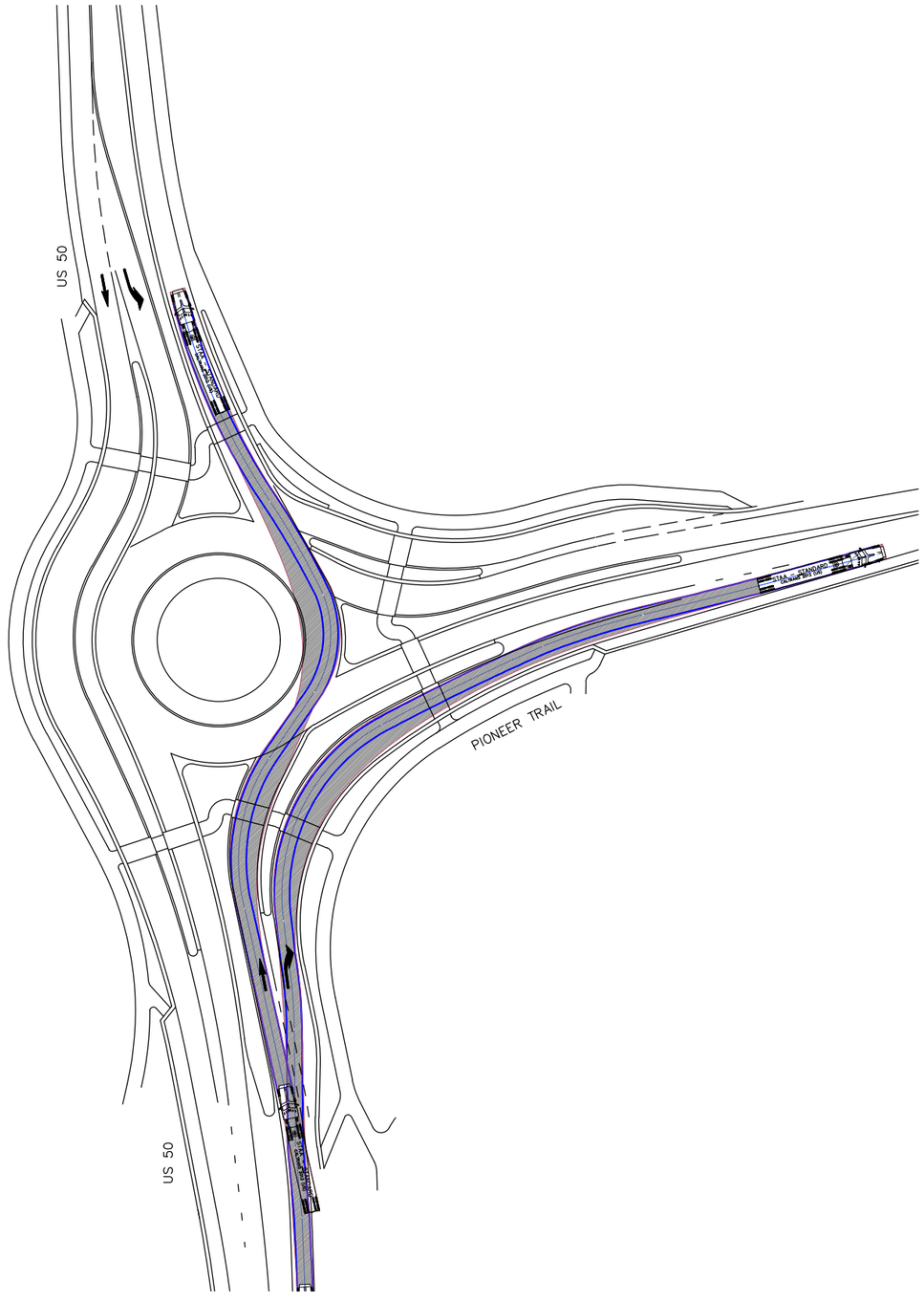


STAA – STANDARD feet

Tractor Width	: 8.50	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 26.3
Tractor Track	: 8.50	Articulating Angle	: 70.0
Trailer Track	: 8.50		

LEGEND





NORTH

0 40 80 120 feet

SCALE: 1" = 40'

Figure 4

Pioneer Trail/US50 Intersection Safety Improvement Project

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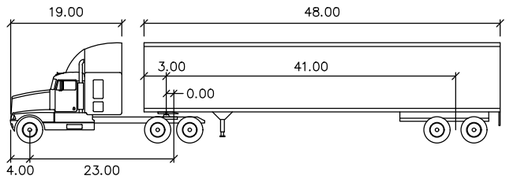
STAA Truck Turns (SB)

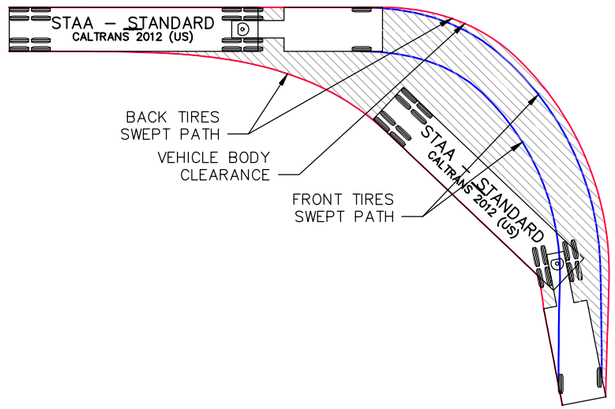
VEHICLE PROFILE



STAA – STANDARD feet

Tractor Width	: 8.50	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 26.3
Tractor Track	: 8.50	Articulating Angle	: 70.0
Trailer Track	: 8.50		

LEGEND



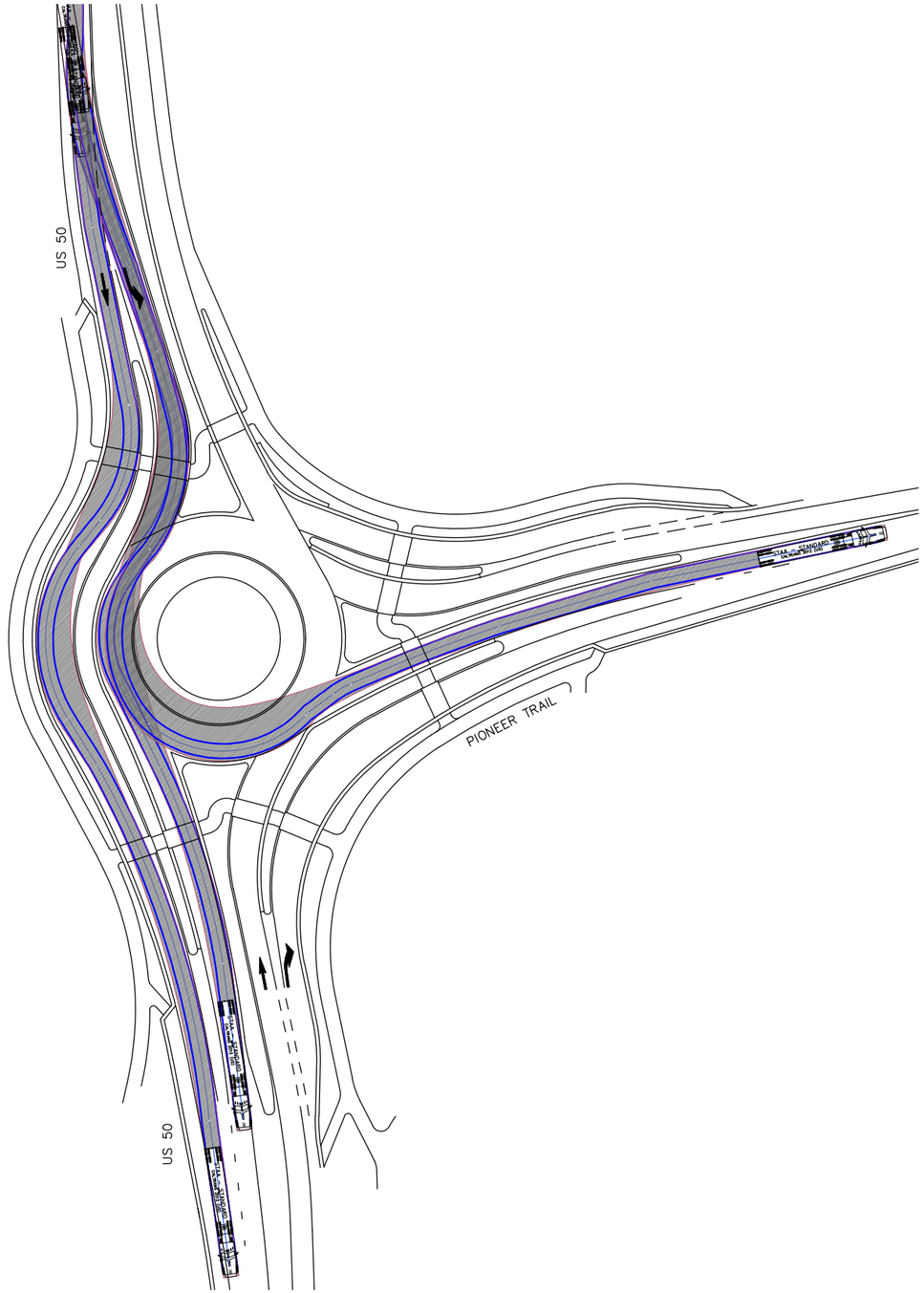


Figure 5

Pioneer Trail/US50 Intersection Safety Improvement Project

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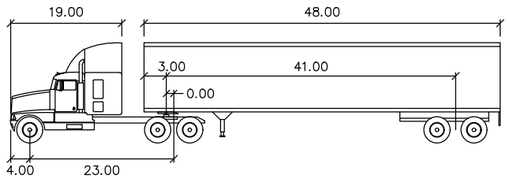
STAA Truck Turns (WB)

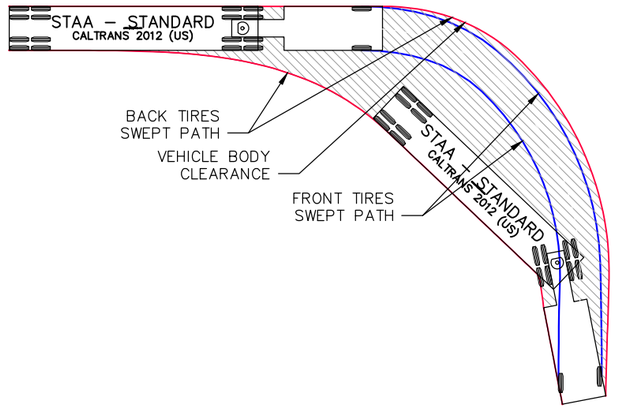
VEHICLE PROFILE

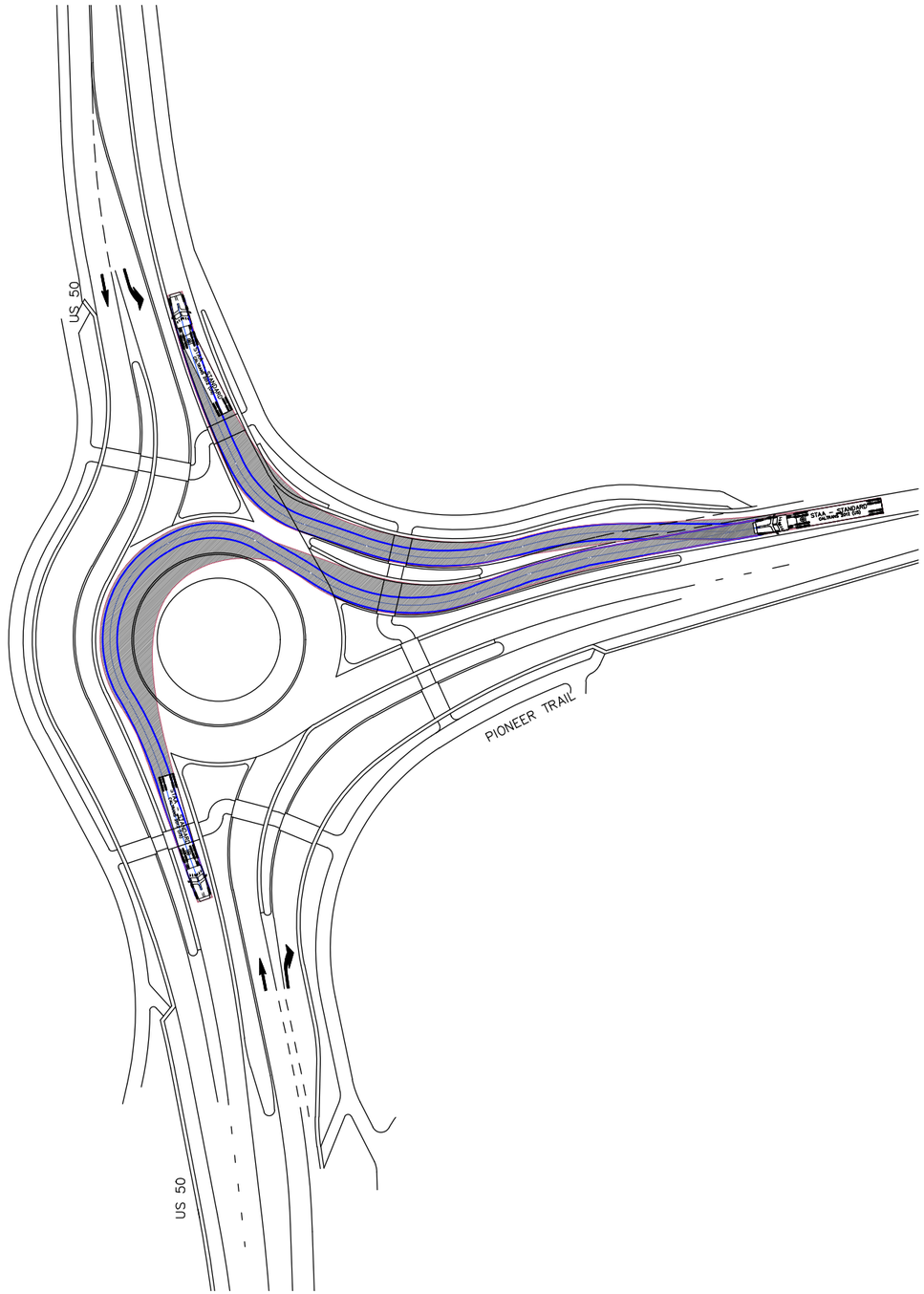


STAA – STANDARD feet

Tractor Width	: 8.50	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 26.3
Tractor Track	: 8.50	Articulating Angle	: 70.0
Trailer Track	: 8.50		

LEGEND





NORTH

0 40 80 120 feet

SCALE: 1" = 40'

Figure 6

Pioneer Trail/US50 Intersection Safety Improvement Project

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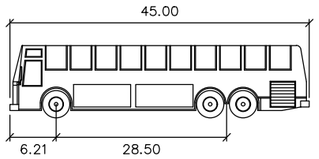
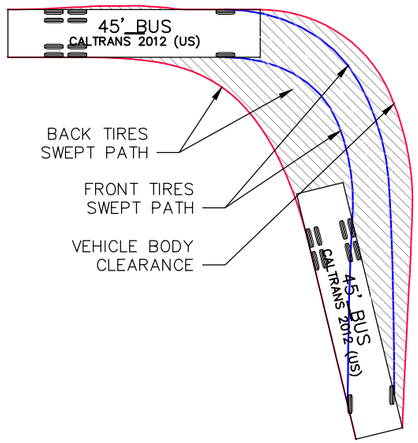
BUS 45 TURNS (NB)

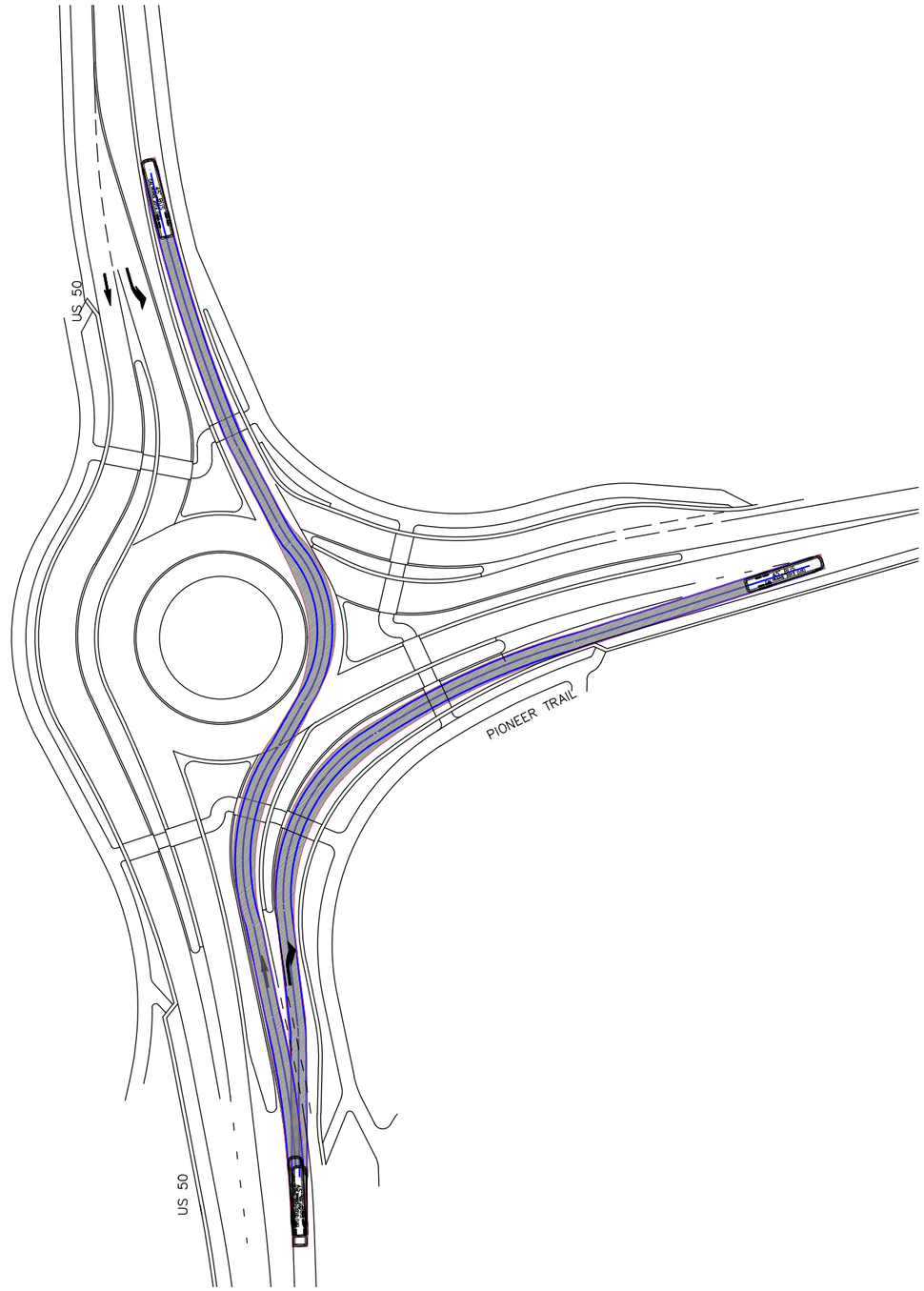
VEHICLE PROFILE



45' BUS	feet
Width	: 8.50
Track	: 8.50
Lock to Lock Time	: 6.0
Steering Angle	: 44.3

LEGEND





NORTH

0 40 80 120 feet

SCALE: 1" = 40'

Figure 7

Pioneer Trail/US50 Intersection Safety Improvement Project

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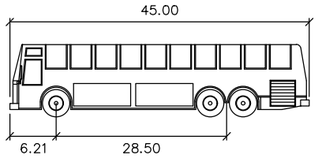
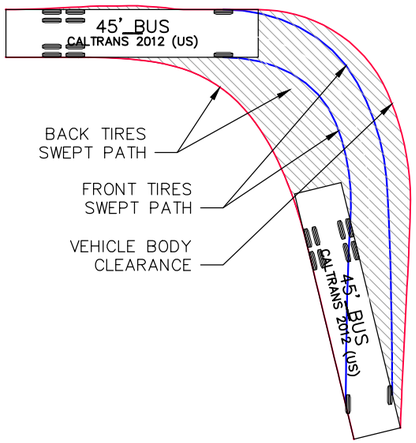
BUS 45 TURNS (SB)

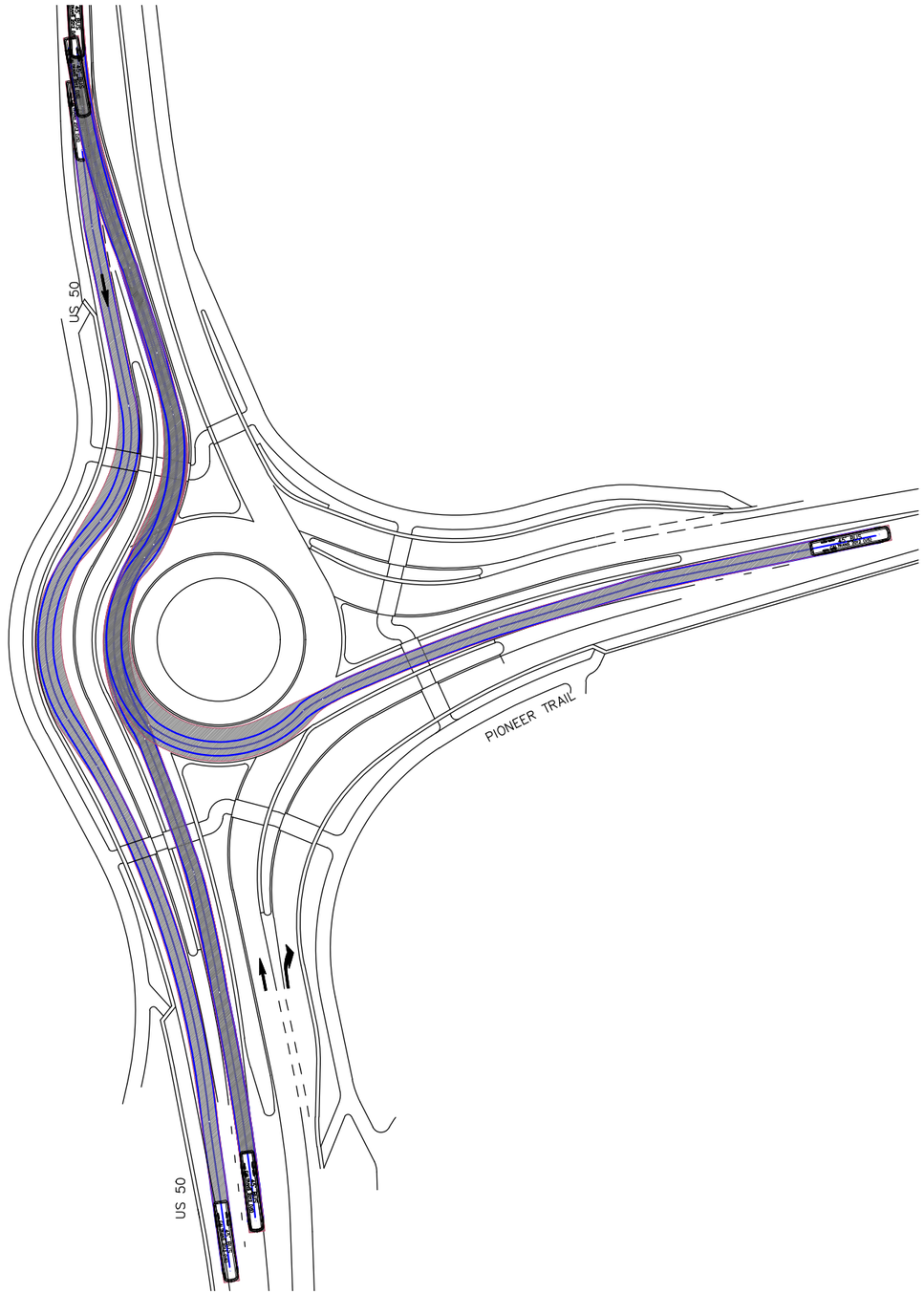
VEHICLE PROFILE



45' BUS	feet
Width	: 8.50
Track	: 8.50
Lock to Lock Time	: 6.0
Steering Angle	: 44.3

LEGEND





NORTH

0 40 80 120 feet

SCALE: 1" = 40'

Figure 8

Pioneer Trail/US50 Intersection Safety Improvement Project

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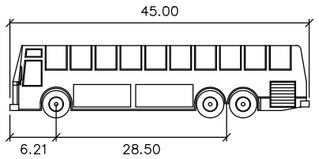
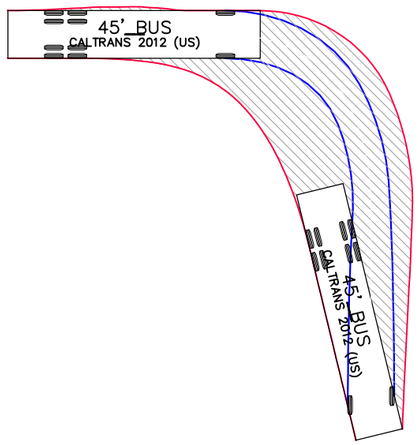
BUS 45 TURNS (WB)

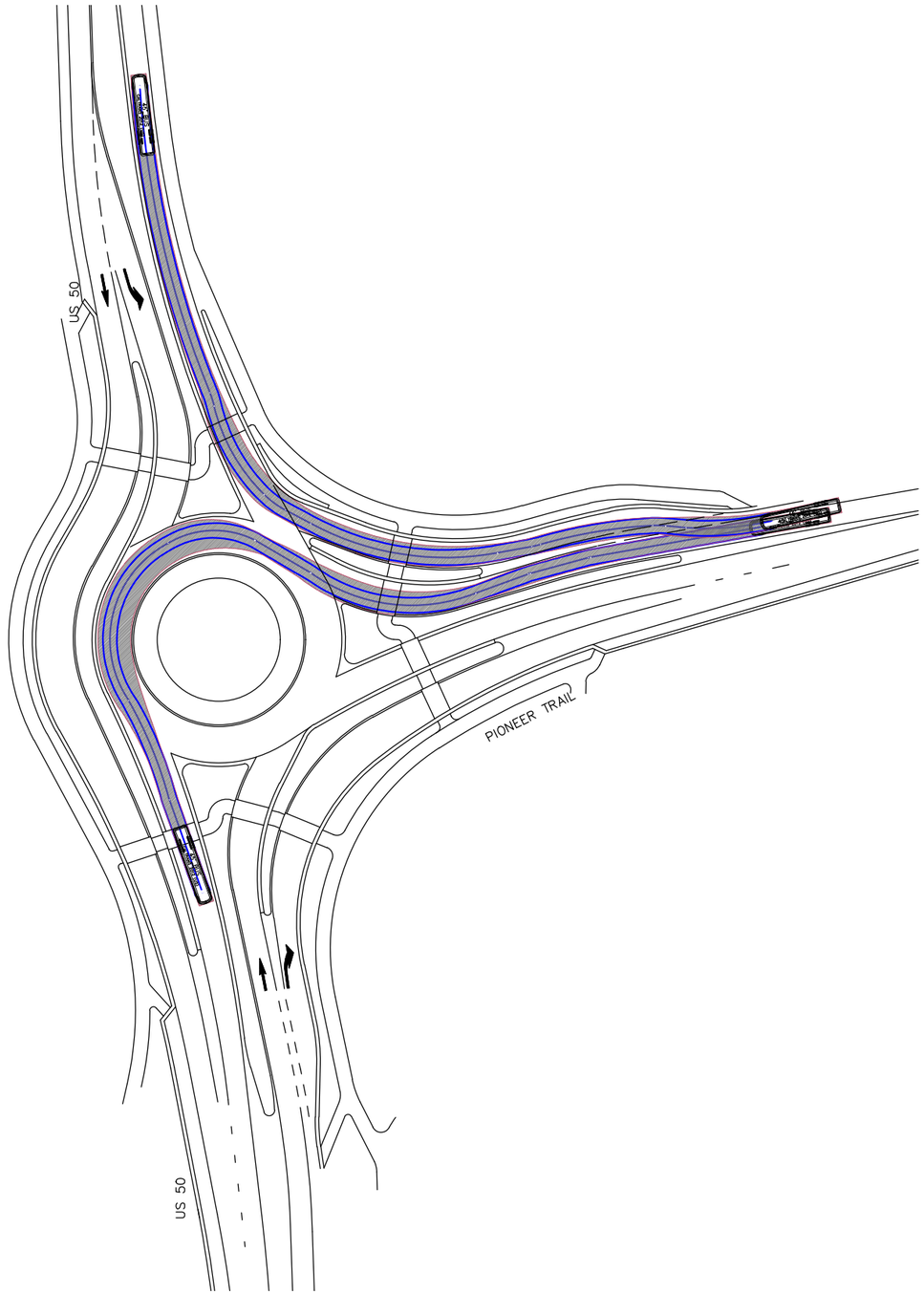
VEHICLE PROFILE



45' BUS	feet
Width	: 8.50
Track	: 8.50
Lock to Lock Time	: 6.0
Steering Angle	: 44.3

LEGEND





NORTH

0 40 80 120 feet

SCALE: 1" = 40'

Figure 9

Pioneer Trail/US50 Intersection Safety Improvement Project

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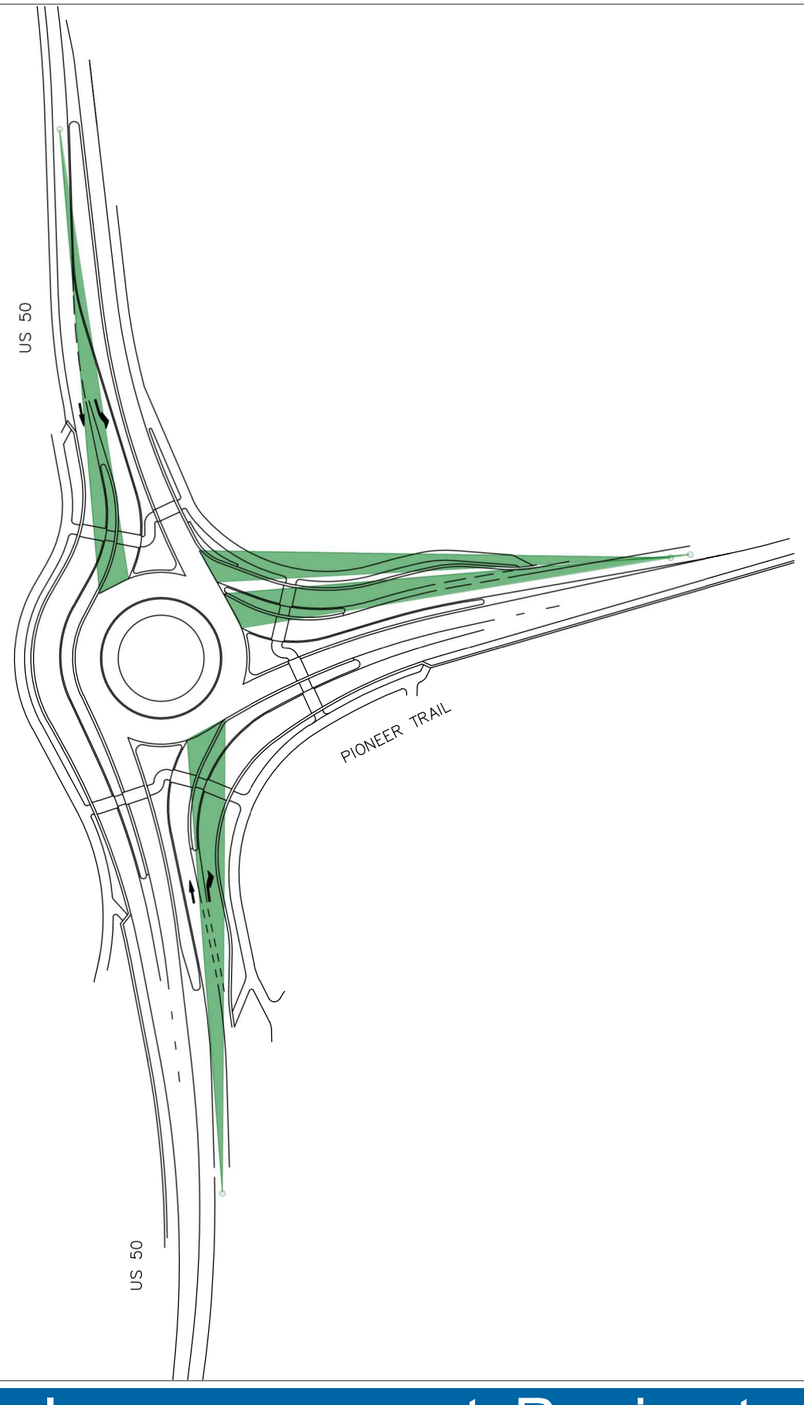
STOPPING SIGHT DISTANCE - YIELD LINE

LEGEND:
SIGHT TRIANGLE



Approach	Design Speed (mph)	Stopping Sight Distance (feet)
Northbound Entrance Route 50	45.0	360.0
Southbound Entrance Route 50	45.0	360.0
Westbound Entrance Pioneer Trail	45.0	360.0
Notes: Stopping Sight Distance criteria obtained from Caltrans HDM.		

NORTH

0 60 120 180 feet
SCALE: 1" = 60'

Figure 10

Pioneer Trail/US50 Intersection Safety Improvement Project

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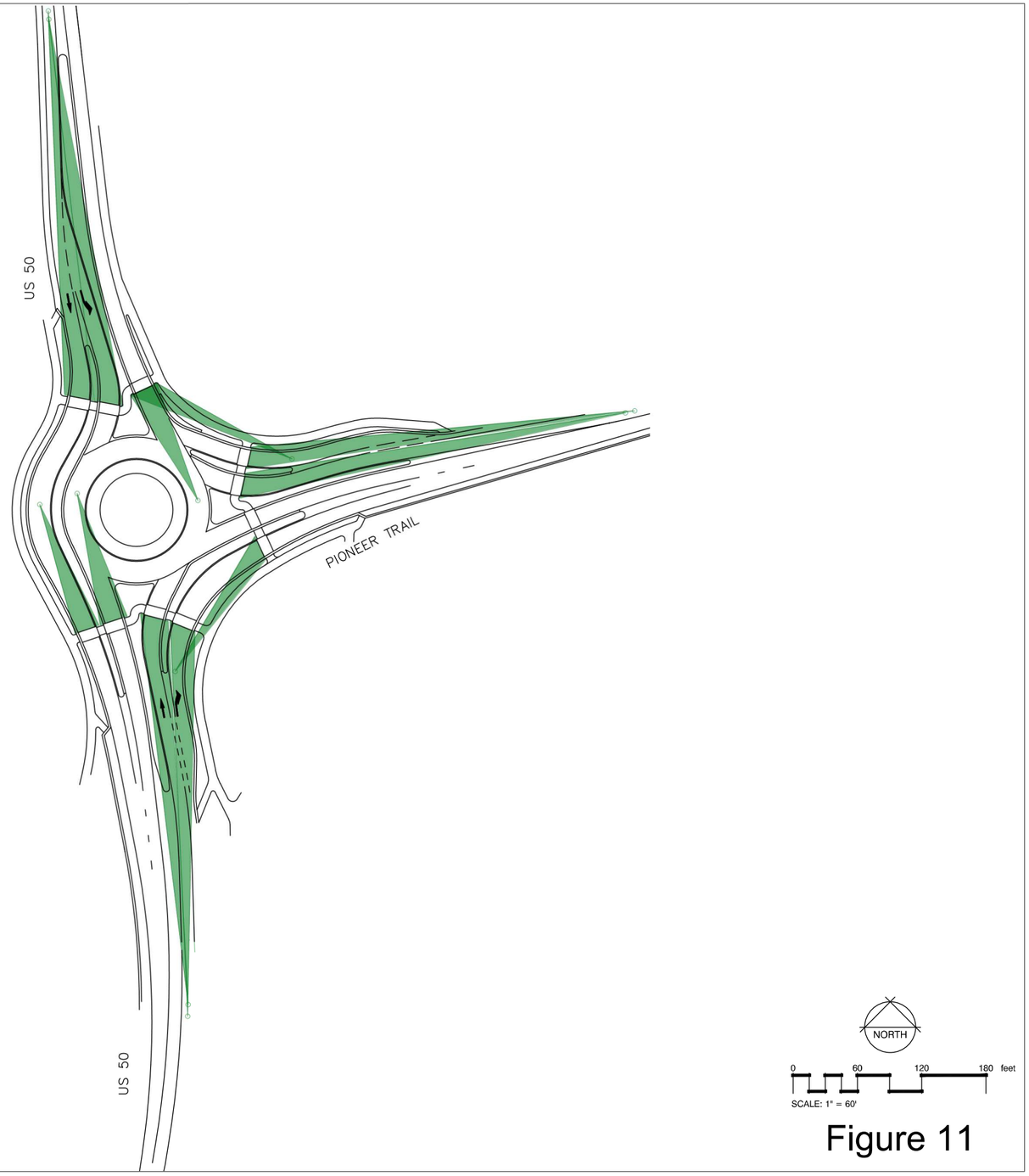
STOPPING SIGHT DISTANCE - PEDESTRIANS

LEGEND:
SIGHT TRIANGLE



Approach	Design Speed (mph)	Stopping Sight Distance (feet)
Northbound Entrance Route 50	45.0	360.0
Northbound Circulating from Route 50 (V2)	18.2	115.8
Northbound Right from Route 50	20.9	129.4
Southbound Entrance Route 50	45.0	360.0
Southbound Circulating Route 50 (V2)	19.7	123.3
Southbound Entrance from Route 50 Bypass	45.0	360.0
Southbound Circulating from Route 50 Bypass (V2)	20.0	125.2
Westbound Entrance from Pioneer Trail	45.0	360.0
Westbound Right from Pioneer Trail (V5)	24.5	147.4

Notes: 1. Stopping Sight Distance criteria obtained from Caltrans HDM.
2. To be conservative, fastpath speeds were used for right turn movements.

NORTH

0 60 120 180 feet
SCALE: 1" = 60'

Figure 11

Pioneer Trail/US50 Intersection Safety Improvement Project

Meyers, California

GHD
943 Reserve Drive, Suite 100
Roseville, CA 95678 USA
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GHD Inc. December, 2019 2610EX005.dwg

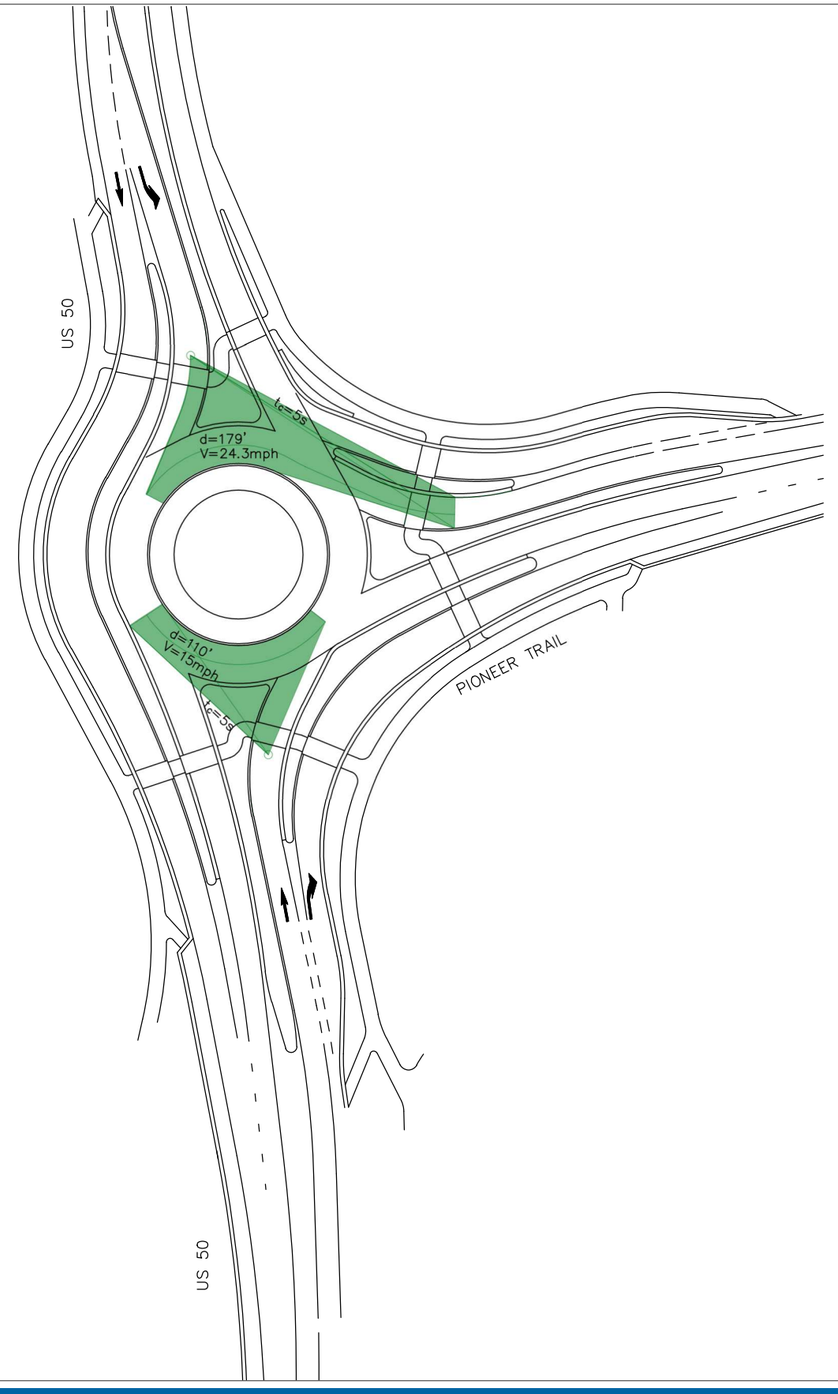
INTERSECTION SIGHT DISTANCE (NB/SB)

LEGEND:

SIGHT TRIANGLE

t_c CRITICAL HEADWAY FOR ENTERING THE MAJOR ROADS
V DESIGN SPEED (R4) OF CONFLICTING MOVEMENT (MPH)
d LENGTH OF ENTERING/CIRCULATING LEG OF SIGHT TRIANGLE

NOTE:
FOR CALCULATING THE SIGHT TRIANGLE FOR SOUTHBOUND TRAFFIC THE WESTBOUND LEFT LEFT TURN FASTPATH SPEED WAS USED DUE TO A LACK OF CIRCULATING CONFLICT SPEED.



Approach	Conflicting Speed (mph)	Sight Triangle Length (feet)
Northbound Route 50		
Entering Leg (D1, N/A)	N/A	N/A
Circulating Leg (D2, Northbound Route 50)	15.0	110.2
Southbound Route 50		
Entering Leg (D1, Pioneer Trail)	24.3	178.7
Circulating Leg (D2, N/A)	N/A	N/A
Notes: Intersection Sight Distance criteria obtained from NCHRP Report 672 with 5.0 second Critical Headway (tc)		

NORTH

0 40 80 120 feet

SCALE: 1" = 40'

Figure 12

Pioneer Trail/US50 Intersection Safety Improvement Project

Meyers, California

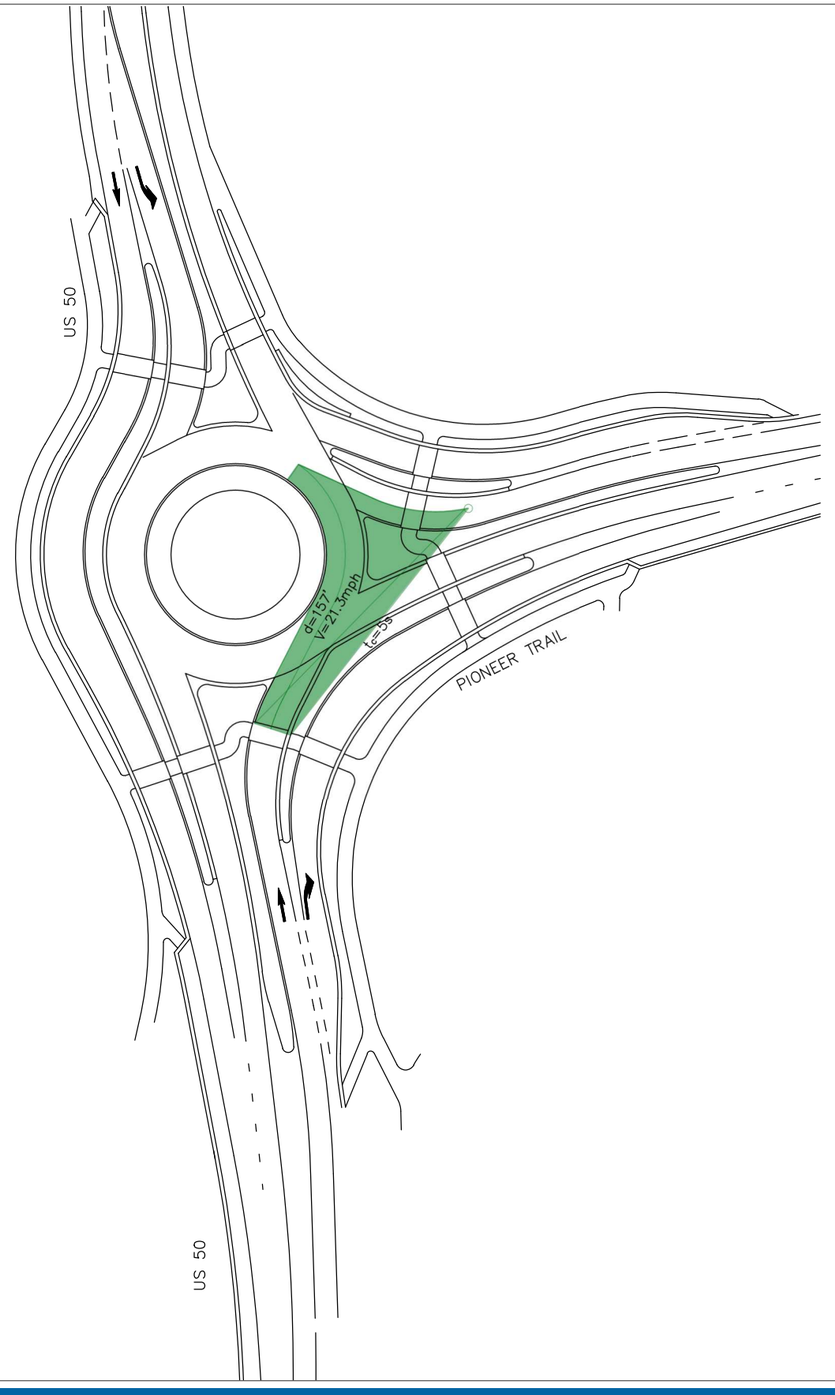
GHD
943 Reserve Drive, Suite 100
Roseville, CA 95678 USA
T 1 916 782 8688 W www.ghd.com

INTERSECTION SIGHT DISTANCE (WB)

LEGEND:

SIGHT TRIANGLE

t_c CRITICAL HEADWAY FOR ENTERING THE MAJOR ROADS
V DESIGN SPEED (R4) OF CONFLICTING MOVEMENT (MPH)
d LENGTH OF ENTERING/CIRCULATING LEG OF SIGHT TRIANGLE



Approach	Conflicting Speed (mph)	Sight Triangle Length (feet)
Westbound Pioneer Trail		
Entering Leg (D1, Southbound Route 50)	21.3	156.5
Circulating Leg (D2, N/A)	N/A	N/A
Notes: Intersection Sight Distance criteria obtained from NCHRP Report 672 with 5.0 second Critical Headway (tc)		

NORTH

0 40 80 120 feet

SCALE: 1" = 40'

Figure 13

Pioneer Trail/US50 Intersection Safety Improvement Project

Meyers, California

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Roseville, CA 95678 USA
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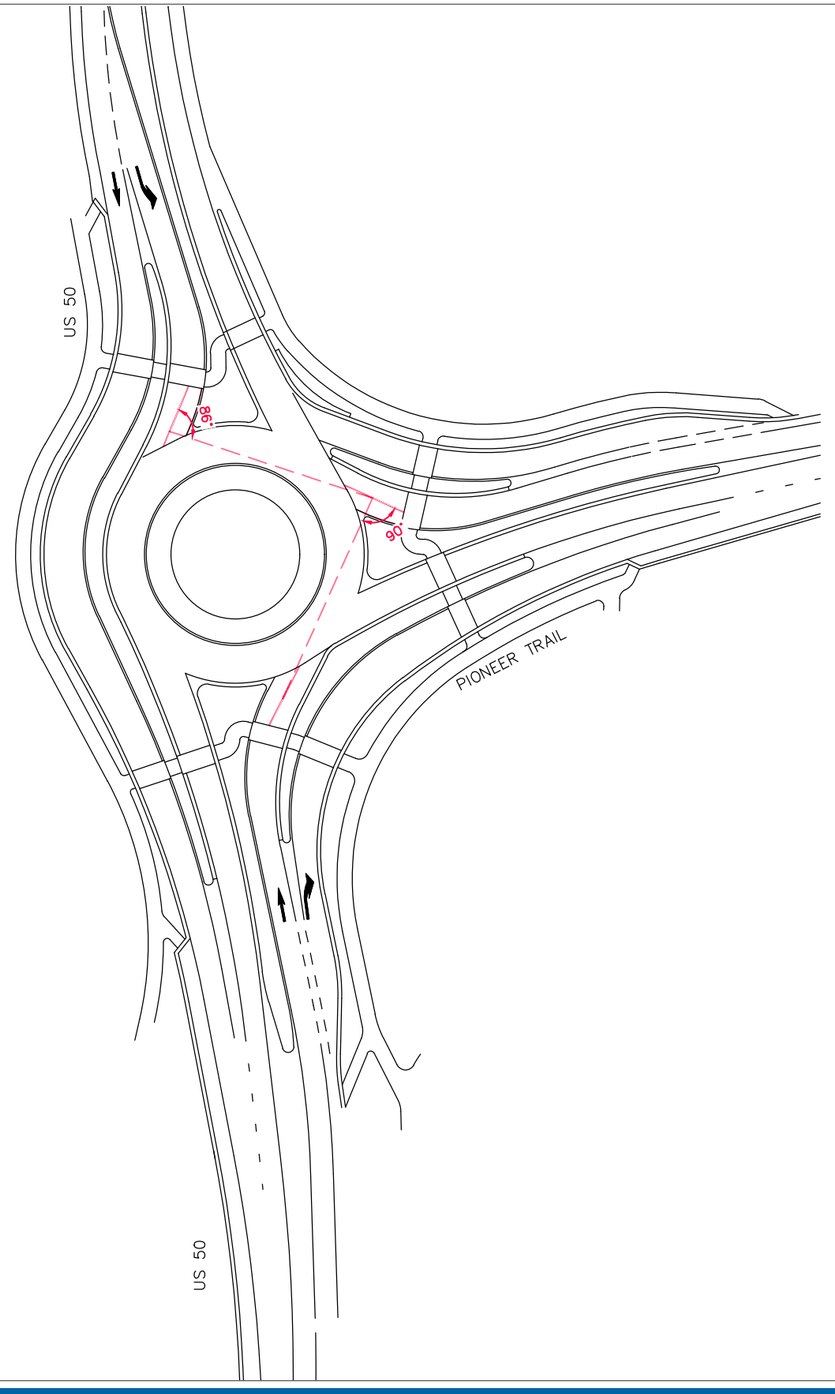
INTERSECTION VIEW ANGLES

NOTE:

VALUES SHOWN ARE THE ANGLE FOR THE DRIVER TO VIEW ONCOMING TRAFFIC WITHIN THE CIRCULATORY ROADWAY AND AT THE ROUNDABOUT ENTRANCE PER NCHRP 672 GUIDELINES. VIEW ANGLES SHOULD BE EQUAL TO OR GREATER THAN 75°.



NORTH

0 40 80 120 feet

SCALE: 1" = 40'

Figure 14

Pioneer Trail/US50 Intersection Safety Improvement Project

Meyers, California

GHD
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Roseville, CA 95678 USA
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Appendix D. Cost Estimates and Life Cycle Costs

Preliminary Cost Estimate

US 50 at Pioneer Trail Intersection Safety Improvement Project

Type of Estimate : Planning Level (PSR)
Program Code :
Project Limits : US 50 at Pioneer Trail Intersection
Description: Single lane roundabout with southbound bypass lane
Scope : Assumes 25% of existing pavement is overlaid with 3" HMA, 9"/24" in new pavement areas
Alternative :

	Current Cost	Escalated Cost
ROADWAY ITEMS	$ 5,245,500	$ 5,245,500
STRUCTURE ITEMS	$ -	$ -
SUBTOTAL CONSTRUCTION COST	$ 5,245,500	$ 5,245,500
RIGHT OF WAY	$ -	$ -
TOTAL CAPITAL OUTLAY COST	$ 5,246,000	$ 5,246,000
PR/ED SUPPORT	$ -	$ -
PS&E SUPPORT	$ -	$ -
RIGHT OF WAY SUPPORT	$ -	$ -
CONSTRUCTION SUPPORT	$ -	$ -
TOTAL CAPITAL OUTLAY SUPPORT COST*	$ -	$ -
TOTAL PROJECT COST	$ 5,250,000	$ 5,250,000

If Project has been programmed enter Programmed Amount $ -

	Month / Year
Date of Estimate (Month/Year)	1 / 2020
Estimated Date of Construction Start (Month/Year)	6 / 2022
Number of Working Days	150 Working Days
Estimated Mid-Point of Construction (Month/Year)	10 / 2022
Number of Plant Establishment Days	Days

Estimated Project Schedule

PID Approval	March-20
PA/ED Approval	December-20
PS&E	December-21
RTL	February-22
Begin Construction	June-22

Approved by Project Manager

(xxx) xxx-xxxx

Project Manager **Date** **Phone**

I. ROADWAY ITEMS SUMMARY

	Section		Cost
1	**Earthwork**	$	457,200
2	**Pavement Structural Section**	$	1,534,400
3	**Drainage**	$	255,100
4	**Specialty Items**	$	196,300
5	**Environmental**	$	315,300
6	**Traffic Items**	$	728,200
7	**Detours**	$	95,000
8	**Minor Items**	$	179,100
9	**Roadway Mobilization**	$	376,100
10	**Supplemental Work**	$	341,600
11	**State Furnished**	$	83,000
12	**Contingencies**	$	684,200
13	**Overhead**	$	-
	TOTAL ROADWAY ITEMS	**$**	**5,245,500**

Estimate Prepared By	Ron Boyle P.E.	1/14/2020	916 782 8688
	Name and Title	Date	Phone
Estimate Reviewed By			
	Name and Title	Date	Phone

By signing this estimate you are attesting that you have discussed your project with all functional units and have incorporated all their comments or have discussed with them why they will not be incorporated.

SECTION 1: EARTHWORK

Item code		Unit	Quantity		Unit Price ($)			Cost
160101	Clearing & Grubbing	LS	1	x	50,000.00	=	$	50,000
170101	Develop Water Supply	LS	1	x	18,250.00	=	$	18,250
190101	Roadway Excavation	CY	7,928	x	41.00	=	$	325,048
190103	Roadway Excavation (Type Y) ADL	CY		x		=	$	-
190105	Roadway Excavation (Type Z-2) ADL	CY		x		=	$	-
192037	Structure Excavation (Retaining Wall)	CY		x		=	$	-
193013	Structure Backfill (Retaining Wall)	CY		x		=	$	-
193031	Pervious Backfill Material (Retaining Wall)	CY		x		=	$	-
194001	Ditch Excavation	CY		x		=	$	-
198001	Impored Borrow	CY	426	x	150.00	=	$	63,900
198007	Imported Material (Shoulder Backing)	TON		x		=	$	-

TOTAL EARTHWORK SECTION ITEMS	$	457,200

SECTION 2: PAVEMENT STRUCTURAL SECTION

Item code		Unit	Quantity		Unit Price ($)			Cost
150771	Remove Asphalt Concrete Dike	LF		x		=	$	-
150860	Remove Base and Surfacing	CY		x	68.00	=	$	-
153103	Cold Plane Asphalt Concrete Pavement	SQYD	2,023	x	10.00	=	$	20,230
1532XX	Remove Concrete (type)	CY		x		=	$	-
250401	Class 4 Aggregate Subbase	CY		x		=	$	-
260201	Class 2 Aggregate Base	CY	6,072	x	81.00	=	$	491,832
290201	Asphalt Treated Permeable Base	CY		x		=	$	-
365001	Sand Cover	TON		x		=	$	-
374002	Asphaltic Emulsion (Fog Seal Coat)	TON		x		=	$	-
374492	Asphaltic Emulsion (Polymer Modified)	TON		x		=	$	-
3750XX	Screenings (Type XX)	TON		x		=	$	-
377501	Slurry Seal	TON		x		=	$	-
390095	Replace Asphalt Concrete Surfacing	CY		x		=	$	-
390132	Hot Mix Asphalt (Type A)	TON	4,758	x	180.00	=	$	856,440
390136	Minor Hot Mix Asphalt	TON		x		=	$	-
390137	Rubberized Hot Mix Asphalt (Gap Graded)	TON		x		=	$	-
393003	Geosynthetic Pavement Interlayer	SQYD	10,747	x	9.50	=	$	102,097
39405X	Shoulder Rumber Strip *(HMA, Type XX Indentation)*	STA		x		=	$	-
394071	Place Hot Mix Asphalt Dike	LF		x		=	$	-
394090	Place Hot Mix Asphalt (Misc. Area)	SQYD		x		=	$	-
397005	Tack Coat	TON	5	x	2,600.00	=	$	13,000
401000	Concrete Pavement (truck apron)	CY	71	x	715.00	=	$	50,765
401108	Replace Concrete Pavement (Rapid Strength Concrete)	CY		x		=	$	-
404092	Seal Pavement Joint	LF		x		=	$	-
404094	Seal Longitudinal Isolation Joint	LF		x		=	$	-
413112A	Repair Spalled Joints (Polyester Grout)	SQYD		x		=	$	-
413115	Seal Existing Concrete Pavement Joint	LF		x		=	$	-
420102	Groove Existing Concrete Pavement	SQYD		x		=	$	-
420201	Grind Existing Concrete Pavement	SQYD		x		=	$	-
731502	Minor Concrete (Misc. Const)	CY		x		=	$	-
731530	Minor Concrete (Textured Paving)	SQFT		x		=	$	-
XXXXXX	Some Item			x		=	$	-

TOTAL STRUCTURAL SECTION ITEMS	$	1,534,400

SECTION 3: DRAINAGE

Item code		Unit	Quantity		Unit Price ($)			Cost
150206	Abandon Culvert	LF		x		=	$	-
150805	Remove Culvert	LF		x		=	$	-
150820	Modify Inlet	EA		x		=	$	-
152430	Adjust Inlet	LF		x		=	$	-
155003	Cap Inlet	EA		x		=	$	-
193114	Sand Backfill	CY		x		=	$	-
510502	Minor Concrete (Minor Structure)	CY		x		=	$	-
510512	Minor Concrete (Box Culvert)	CY		x		=	$	-
62XXXX	XXX" APC Pipe	LF		x		=	$	-
64XXXX	18" Plastic Pipe	LF	800	x	75.00	=	$	60,000
65XXXX	XXX" RCP Pipe	LF		x		=	$	-
66XXXX	XXX" CSP Pipe	LF		x		=	$	-
68XXXX	Edge Drain	LF		x		=	$	-
69XXXX	XXX" Pipe Downdrain	LF		x		=	$	-
70XXXX	XXX" Pipe Inlet	LF		x		=	$	-
70XXXX	XXX" Pipe Riser	LF		x		=	$	-
70XXXX	XXX" Flared End Section	EA	3	x	1,200.00	=	$	3,600
703233	Grated Line Drain	LF		x		=	$	-
72XXXX	Rock Slope Protection (Type and Method)	CY	15	x	100.00	=	$	1,500
721420	Concrete (Ditch Lining)	CY		x		=	$	-
721430	Concrete (Channel Lining)	CY		x		=	$	-
729010	Rock Slope Protection Fabric	SQYD		x		=	$	-
750001	Miscellaneous Iron and Steel	LB		x	4.75	=	$	-
XXXXXX	Additional Drainage - Water Quality	LS	1	x	100,000.00	=	$	100,000
510094	Structural Concrete Drainage Inlet	EA	20	x	4,500.00	=	$	90,000

TOTAL DRAINAGE ITEMS $ 255,100

SECTION 4: SPECIALTY ITEMS

Item code		Unit	Quantity		Unit Price ($)			Cost
070012	Progress Schedule (Critical Path Method)	LS	1	x	4,500.00	=	$	4,500
150662	Remove Metal Beam Guard Railing	LF		x		=	$	-
150668	Remove Terminal Systems	EA		x		=	$	-
1532XX	Remove Barrier (*Insert Type)*	LF		x		=	$	-
153250	Remove Sound Wall	SQFT		x		=	$	-
190110	Lead Compliance Plan	LS	1	x	3,000.00	=	$	3,000
49XXXX	CIDH Concrete Piling *(Insert Diameter)*	LF		x		=	$	-
510060	Structural Concrete (Retaining Wall)	CY		x		=	$	-
731504	Minor Concrete (curb and Gutter)	CY	94	x	853.00	=	$	80,182
731511	Minor Concrete (Island Paving)	CY	84	x	933.00	=	$	78,372
5110XX	Architectural Treatment *(Insert Type)*	SQFT		x		=	$	-
511048	Apply Anti-Graffiti Coating	SQFT		x		=	$	-
5136XX	Reinforced Concrete Crib Wall *(Insert Type)*	SQFT		x		=	$	-
518002	Sound Wall (Masonry Block)	SQFT		x		=	$	-
520103	Bar Reinf. Steel (Retaining Wall)	LB		x		=	$	-
80XXXX	Fence (*Insert Type*)	LF		x		=	$	-
832001	Metal Beam Guard Railing	LF		x		=	$	-
839310	Double Thrie Beam Barrier	LF		x		=	$	-
839521	Cable Railing	LF		x		=	$	-
83954X	Transition Railing *(Insert Type)*	EA		x		=	$	-
8395XX	Terminal System (Type CAT)	EA		x		=	$	-
8395XX	Alternative Flared Terminal System	EA		x		=	$	-
8395XX	End Anchor Assembly (*Insert Type*)	EA		x		=	$	-
839561	Rail Tensioning Assembly	EA		x		=	$	-
839XXX	Crash Cushion *(Insert Type)*	EA		x		=	$	-
83XXXX	Concrete Barrier *(Insert Type)*	LF		x		=	$	-
730070	Dectectable Warning Surface	SQFT	630	x	48.00	=	$	30,240

TOTAL SPECIALTY ITEMS $ 196,300

SECTION 5: ENVIRONMENTAL

5A - ENVIRONMENTAL MITIGATION

m code		Unit	Quantity		Unit Price ($)			Cost
	Biological Mitigation	LS		x		=	$	-
071325	TEMPORARY REINFORCED SILT FENCE	LF	1,200	x	5.00	=	$	6,000
071325	Temporary Fence (Type ESA)	LF	1,900	x	8.00	=	$	15,200

Subtotal Environmental $ 6,000

5B - LANDSCAPE AND IRRIGATION

m code		Unit	Quantity		Unit Price ($)			Cost
200001	Highway Planting	LS		x		=	$	-
20XXXX	XXX" (*Insert Type*) Conduit *(Use for Irrigation x-overs)*	LF		x		=	$	-
20XXXX	Extend XXX" *(Insert Type)* Conduit *Use for Extension of Irrigation x-overs)*	LF		x		=	$	-
201700	Imported Topsoil	CY		x		=	$	-
2030XX	Erosion Control (Type __)	SQYD	6,207	x	2.70	=	$	16,759
203021	Fiber Rolls	LF		x	15.00	=	$	-
203026	Move In/ Move Out (Erosion Control)	EA	6	x	500.00	=	$	3,000
204099	Plant Establishment Work	LS		x		=	$	-
205035	Wood Mulch	CY	228	x	120.00	=	$	27,360
208000	Irrigation System	LS		x		=	$	-
208304	Water Meter	EA		x		=	$	-
209801	Maintenance Vehicle Pullout	EA		x		=	$	-
036370	Unmortared Rock Blanket	SF	6,860	x	9.50	=	$	65,170
036376	Boulder	EA	12	x	800.00	=	$	9,600

Subtotal Landscape and Irrigation $ 47,119

5C - NPDES

m code		Unit	Quantity		Unit Price ($)			Cost
074016	Construction Site Management	LS	1	x	75,000.00	=	$	75,000
074017	Prepare WPCP	LS		x		=	$	-
074019	Prepare SWPPP	LS	1	x	3,200.00	=	$	3,200
130530	Temporary Hydraulic Mulch	SQYD	6,207	x	3.00	=	$	18,621
130570	Temporary Cover	SQYD	1,552	x	10.00	=	$	15,520
074028	Temporary Fiber Roll	LF	1,862	x	15.00	=	$	27,930
074032	Temporary Concrete Washout Facility	EA	1	x	5,000.00	=	$	5,000
074033	Temporary Construction Entrance	EA	1	x	5,000.00	=	$	5,000
074035	Temporary Check Dam	LF	100	x	13.00	=	$	1,300
074037	Move In/ Move Out (Temporary Erosion Control)	EA	6	x	600.00	=	$	3,600
074038	Temp. Drainage Inlet Protection	EA	6	x	325.00	=	$	1,950
074041	Street Sweeping	LS	1	x	100,000.00	=	$	100,000
074042	Temporary Concrete Washout (Portable)	LS	1	x	5,000.00	=	$	5,000
130310	Rain Event Action Plan	EA	9	x	500.00	=	$	4,500

Supplemental Work for NPDES

(These costs are not accounted in total here but under Supplemental Work on sheet 7 of 11).

066595	Water Pollution Control Maintenance Sharing*	LS		x		=	$	-
066596	Additional Water Pollution Control**	LS		x		=	$	-
066597	Storm Water Sampling and Analysis***	LS	1	x	3,500.00	=	$	3,500
XXXXXX	Some Item							

Subtotal NPDES (Without Supplemental Work) $ 262,121

*Applies to all SWPPPs and those WPCPs with sediment control or soil stabilization BMPs.

**Applies to both SWPPPs and WPCP projects.

*** Applies only to project with SWPPPs.

TOTAL ENVIRONMENTAL $ 315,300

SECTION 6: TRAFFIC ITEMS

6A - Traffic Electrical

Item code		Unit	Quantity		Unit Price ($)			Cost
150760	Remove Sign Structure	EA		x		=	$	-
151581	Reconstruct Sign Structure	EA		x		=	$	-
152641	Modify Sign Structure	EA		x		=	$	-
5602XX	Furnish Sign Structure	LB		x		=	$	-
5602XX	Install Sign Structure	LB		x		=	$	-
56XXXX	XXX" CIDHC Pile (Sign Foundation)	LF		x		=	$	-
860090	Maintain Existing Traffic Management System Elements During Construction	LS	1	x	5,000.00	=	$	5,000
860810	Inductive Loop Detectors	EA		x		=	$	-
86055X	Lighting & Sign Illumination	LS	1	x	100,000.00	=	$	100,000
8607XX	Interconnection Facilities	LS		x		=	$	-
8609XX	Traffic Monitoring Stations	LS		x		=	$	-
860XXX	Modify Existing Electrical/Remove Signal	LS	1	x	75,000.00	=	$	75,000
8611XX	Ramp Metering System (Location X)	LS		x		=	$	-
8611XX	Ramp Metering System (Location X)	LS		x		=	$	-
86XXXX	Fiber Optic Conduit System	LS		x		=	$	-
XXXXX	Flashing Beacon System	LS	1	x	25,000.00	=	$	25,000

Subtotal Traffic Electrical *$ 180,000*

6B - Traffic Signing and Striping

m code		Unit	Quantity		Unit Price ($)			Cost
120090	Construction Area Signs	LS	1	x	7,000.00	=	$	7,000
150701	Remove Yellow Painted Traffic Stripe	LF		x		=	$	-
150710	Remove Traffic Stripe	LF		x		=	$	-
150713	Remove Pavement Marking	SQFT		x		=	$	-
150742	Remove Roadside Sign	EA		x		=	$	-
152320	Reset Roadside Sign	EA		x		=	$	-
152390	Relocate Roadside Sign	EA		x		=	$	-
566011	Roadside Sign (One Post)	EA	30	x	250.00	=	$	7,500
566012	Roadside Sign (Two Post)	EA	6	x	750.00	=	$	4,500
560XXX	Furnish Sign Panels	SQFT		x		=	$	-
560XXX	Install Sign Panels	SQFT		x		=	$	-
82010X	Delineator (Class X)	EA		x		=	$	-
84XXXX	Permanent Pavement Delineation	LS	1	x	60,000.00	=	$	60,000

Subtotal Traffic Signing and Striping *$ 79,000*

6C - Stage Construction and Traffic Handling

m code		Unit	Quantity		Unit Price ($)			Cost
120100	Traffic Control System	LS	1	x	350,000.00	=	$	350,000
120120	Type III Barricade	EA	6	x	200.00	=	$	1,200
120143	Temporary Pavement Delineation	LF	10,000	x	1.00	=	$	10,000
12016X	Channelizer	EA		x		=	$	-
128650	Portable Changeable Message Signs	EA	3	x	7,500.00	=	$	22,500
129000	Temporary Railing (Type K)	LF	1,500	x	37.00	=	$	55,500
129100	Temp. Crash Cushion Module	EA		x		=	$	-
129099A	Traffic Plastic Drum	EA	100	x	90.00	=	$	9,000
839603A	Temporary Crash Cushion (ADIEM)	EA	6	x	3,500.00	=	$	21,000
XXXXXX	Some Item							

Subtotal Stage Construction and Traffic Handling *$ 469,200*

TOTAL TRAFFIC ITEMS **$ 728,200**

SECTION 7: DETOURS

Include constructing, maintaining, and removal

m code		Unit	Quantity		Unit Price ($)			Cost
0713XX	Temporary Fence	LF		x		=	$	-
07XXXX	Temporary Drainage	LS	1	x	10,000.00	=	$	10,000
120143	Temporary Pavement Delineation	LF	1	x	10,000.00	=	$	10,000
1286XX	Temporary Signals	EA	1	x	75,000.00	=	$	75,000
129000	Temporary Railing (Type K)	LF		x		=	$	-
190101	Roadway Excavation	CY		x		=	$	-
198001	Imported Borrow	CY		x		=	$	-
198050	Embankment	CY		x		=	$	-
250401	Class 4 Aggregate Subbase	CY		x		=	$	-
260201	Class 2 Aggregate Base	CY		x		=	$	-
390132	Hot Mix Asphalt (Type A)	TON		x		=	$	-
XXXXXX	Signs	LS		x		=	$	-

TOTAL DETOURS **$ 95,000**

SUBTOTAL SECTIONS 1-7 $ 3,581,500

SECTION 8: MINOR ITEMS

8A - Americans with Disabilities Act Items								
	ADA Items				1.0%		$	35,815
8B - Bike Path Items								
	Bike Path Items				1.0%		$	35,815
8C - Other Minor Items								
	Other Minor Items				3.0%		$	107,445
	Total of Section 1-7	$	3,581,500	x	5.0%	=	$	179,075

TOTAL MINOR ITEMS **$ 179,100**

SECTIONS 9: MOBILIZATION

ı code								
999990	Total Section 1-8	$	3,760,600	x	10%	=	$	376,060

TOTAL MOBILIZATION **$ 376,100**

SECTION 10: SUPPLEMENTAL WORK

m code		Unit	Quantity		Unit Price ($)			Cost
066015	Federal Trainee Program	LS		x		=	$	-
066063	Traffic Management Plan - Public Information	LS	1	x	50,000.00	=	$	50,000
066090	Maintain Traffic	LS	1	x	100,000.00	=	$	100,000
066094	Value Analysis	LS		x		=	$	-
066204	Remove Rock & Debris	LS		x		=	$	-
066222	Locate Existing Cross-Over	LS		x		=	$	-
066670	Payment Adjustments For Price Index Fluctuations	LS		x		=	$	-
066700	Partnering	LS		x		=	$	-
066866	Operation of Existing Traffic Management System Elements During Construction	LS		x		=	$	-
066920	Dispute Review Board	LS		x		=	$	-
XXXXXX	Some Item			x		=	$	-
	*Cost of **NPDES** Supplemental Work specified in Section 5C*					=	$	3,500
	Total Section 1-8	$	3,760,600		5%	=	$	188,030

TOTAL SUPPLEMENTAL WORK **$ 341,600**

SECTION 11: STATE FURNISHED MATERIALS AND EXPENSES

Item code		Unit	Quantity		Unit Price ($)		Cost
066063	Public Information	LS		x		=	$0
066105	RE Office	LS	1	x	35,000.00	=	$35,000
066803	Padlocks	LS		x		=	$0
066838	Reflective Numbers and Edge Sealer	LS		x		=	$0
066901	Water Expenses	LS		x		=	$0
066062A	COZEEP Expenses	LS	1	x	48,000.00	=	$48,000
06684X	Ramp Meter Controller Assembly	LS		x		=	$0
06684X	TMS Controller Assembly	LS		x		=	$0
06684X	Traffic Signal Controller Assembly	LS	0	x	35,000.00	=	$0
XXXXXX	Some Item						

Total Section 1-8	$	3,760,600	0%	=	$	-

TOTAL STATE FURNISHED	**$83,000**

SECTION 12: TIME-RELATED OVERHEAD

Estiamted Time-Releated Overhead (TRO) Percentage (0% to 10%) = 5%

Item code		Unit	Quantity		Unit Price ($)		Cost
070018	Time-Related Overhead	WD	150	X	0	=	$0

TOTAL TIME-RELATED OVERHEAD	**$0**

SECTION 13: CONTINGENCY

(Pre-PSR 30%-50%, PSR 25%, Draft PR 20%, PR 15%, after PR approval 10%, Final PS&E 5%)

Total Section 1-11	$	4,561,300	x	15%	=	$684,195

TOTAL CONTINGENCY	**$684,200**

II. STRUCTURE ITEMS

DATE OF ESTIMATE	00/00/00	00/00/00	00/00/00
Name	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
Bridge Number	57-XXX	57-XXX	57-XXX
Structure Type	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
Width (Feet) [out to out]	0.00 LF	0.00 LF	0.00 LF
Total Length (Feet)	0.00 LF	0.00 LF	0.00 LF
Total Area (Square Feet)	0 SQFT	0 SQFT	0 SQFT
Structure Depth (Feet)	0.00 LF	0.00 LF	0.00 LF
Footing Type (pile or spread)	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
Cost Per Square Foot	$0.00	$0.00	$0.00
COST OF EACH STRUCTURE	**$0.00**	**$0.00**	**$0.00**

DATE OF ESTIMATE	00/00/00	00/00/00	00/00/00
Name	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
Bridge Number	57-XXX	57-XXX	57-XXX
Structure Type	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
Width (Feet) [out to out]	0.00 LF	0.00 LF	0.00 LF
Total Length (Feet)	0.00 LF	0.00 LF	0.00 LF
Total Area (Square Feet)	0 SQFT	0.00 SQFT	0.0 SQFT
Structure Depth (Feet)	0.00 LF	0.00 LF	0.00 LF
Footing Type (pile or spread)	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
Cost Per Square Foot	$0.00	$0.00	$0.00
COST OF EACH STRUCTURE	**$0.00**	**$0.00**	**$0.00**

TOTAL COST OF BRIDGES	**$0.00**
TOTAL COST OF BUILDINGS	**$0.00**
TOTAL COST OF STRUCTURES[1]	**$0.00**

Estimate Prepared By: _____ _____
XXXXXXXXXXXXXXXX ------ Division of Structures Date

[1]Structure's Estimate includes Overhead and Mobilization.
Add more sheets if needed. Call them 9a, 9b, 9c, …, etc

III. RIGHT OF WAY

Fill in all of the available information from the Right of Way data sheet.

A)	A1)	Acquisition, including Excess Land Purchases, Damages & Goodwill,	$	0
	A2)	SB-1210	$	0
B)		Acquisition of Offsite Mitigation	$	0
C)	C1)	Utility Relocation (State Share)	$	0
	C2)	Potholing (Design Phase)	$	0
D)		Railroad Acquisition	$	0
E)		Clearance / Demolition	$	0
F)		Relocation Assistance (RAP and/or Last Resort Housing Costs)	$	0
G)		Title and Escrow	$	0
H)		Environmental Review	$	0
I)		Condemnation Settlements 0% (Items G & H applied to items A + B)	$	0
J)		Design Appreciation Factor 0%	$	0
K)		Utility Relocation (Construction Cost)	$	0

L) **TOTAL RIGHT OF WAY ESTIMATE $0**

(Excluding Item #8 - Hazardous Waste)

M) **TOTAL R/W ESTIMATE: Escalated $0**

N) **Right of Way Support $ 0**

Support Cost Estimate Prepared By	Project Coordinator[1]	Phone
Utility Estimate Prepared By	Utiliy Coordinator[2]	Phone
R/W Acquistion Estimate Prepared By	Right of Way Estimator[3]	Phone

[1] When estimate has Support Costs only [2] When estimate has Utility Relocation [3] When R/W Acquisition is required

Preliminary Cost Estimate

US 50 at Pioneer Trail Intersection Safety Improvement Project

Type of Estimate : Planning Level (PSR)
Program Code :
Project Limits : US 50 at Pioneer Trail Intersection
Description: Enlarged Intersection with Traffic Signal
Scope : Includes 3" HMA overlay of existing pavement and 9"/24" in new pavement areas
Alternative :

	Current Cost	Escalated Cost
ROADWAY ITEMS	$ 4,940,900	$ 4,940,900
STRUCTURE ITEMS	$ -	$ -
SUBTOTAL CONSTRUCTION COST	$ 4,940,900	$ 4,940,900
RIGHT OF WAY	$ -	$ -
TOTAL CAPITAL OUTLAY COST	$ 4,941,000	$ 4,941,000
PR/ED SUPPORT	$ -	$ -
PS&E SUPPORT	$ -	$ -
RIGHT OF WAY SUPPORT	$ -	$ -
CONSTRUCTION SUPPORT	$ -	$ -
TOTAL CAPITAL OUTLAY SUPPORT COST*	$ -	$ -
TOTAL PROJECT COST	$ 4,950,000	$ 4,950,000

If Project has been programmed enter Programmed Amount $ -

Month / Year
Date of Estimate (Month/Year) 1 / 2020

Estimated Date of Construction Start (Month/Year) 6 / 2022

Number of Working Days 125 Working Days

Month / Year
Estimated Mid-Point of Construction (Month/Year) 10 2022

Number of Plant Establishment Days Days

Estimated Project Schedule

PID Approval	March-20
PA/ED Approval	December-20
PS&E	December-21
RTL	February-22
Begin Construction	June-22

Approved by Project Manager

(xxx) xxx-xxxx

Project Manager **Date** **Phone**

I. ROADWAY ITEMS SUMMARY

	Section		Cost
1	**Earthwork**	$	282,500
2	**Pavement Structural Section**	$	1,527,600
3	**Drainage**	$	195,100
4	**Specialty Items**	$	94,000
5	**Environmental**	$	315,300
6	**Traffic Items**	$	898,700
7	**Detours**	$	20,000
8	**Minor Items**	$	166,700
9	**Roadway Mobilization**	$	350,000
10	**Supplemental Work**	$	328,500
11	**State Furnished**	$	118,000
12	**Contingencies**	$	644,500
13	**Overhead**	$	-
	TOTAL ROADWAY ITEMS	**$**	**4,940,900**

Estimate Prepared By	Ron Boyle P.E.	1/14/2020	916 782 8688
	Name and Title	Date	Phone
Estimate Reviewed By			
	Name and Title	Date	Phone

By signing this estimate you are attesting that you have discussed your project with all functional units and have incorporated all their comments or have discussed with them why they will not be incorporated.

SECTION 1: EARTHWORK

Item code		Unit	Quantity		Unit Price ($)			Cost
160101	Clearing & Grubbing	LS	1	x	50,000.00	=	$	50,000
170101	Develop Water Supply	LS	1	x	18,250.00	=	$	18,250
190101	Roadway Excavation	CY	5,225	x	41.00	=	$	214,225
190103	Roadway Excavation (Type Y) ADL	CY		x		=	$	-
190105	Roadway Excavation (Type Z-2) ADL	CY		x		=	$	-
192037	Structure Excavation (Retaining Wall)	CY		x		=	$	-
193013	Structure Backfill (Retaining Wall)	CY		x		=	$	-
193031	Pervious Backfill Material (Retaining Wall)	CY		x		=	$	-
194001	Ditch Excavation	CY		x		=	$	-
198001	Impored Borrow	CY	0	x	150.00	=	$	-
198007	Imported Material (Shoulder Backing)	TON		x		=	$	-

TOTAL EARTHWORK SECTION ITEMS	$	282,500

SECTION 2: PAVEMENT STRUCTURAL SECTION

Item code		Unit	Quantity		Unit Price ($)			Cost
150771	Remove Asphalt Concrete Dike	LF		x		=	$	-
150860	Remove Base and Surfacing	CY		x	68.00	=	$	-
153103	Cold Plane Asphalt Concrete Pavement	SQYD	8,983	x	10.00	=	$	89,830
1532XX	Remove Concrete (type)	CY		x		=	$	-
250401	Class 4 Aggregate Subbase	CY		x		=	$	-
260201	Class 2 Aggregate Base	CY	4,450	x	81.00	=	$	360,450
290201	Asphalt Treated Permeable Base	CY		x		=	$	-
365001	Sand Cover	TON		x		=	$	-
374002	Asphaltic Emulsion (Fog Seal Coat)	TON		x		=	$	-
374492	Asphaltic Emulsion (Polymer Modified)	TON		x		=	$	-
3750XX	Screenings (Type XX)	TON		x		=	$	-
377501	Slurry Seal	TON		x		=	$	-
390095	Replace Asphalt Concrete Surfacing	CY		x		=	$	-
390132	Hot Mix Asphalt (Type A)	TON	4,711	x	180.00	=	$	847,980
390136	Minor Hot Mix Asphalt	TON		x		=	$	-
390137	Rubberized Hot Mix Asphalt (Gap Graded)	TON		x		=	$	-
393003	Geosynthetic Pavement Interlayer	SQYD	15,411	x	9.50	=	$	146,405
39405X	Shoulder Rumber Strip *(HMA, Type XX Indentation)*	STA		x		=	$	-
394071	Place Hot Mix Asphalt Dike	LF		x		=	$	-
394090	Place Hot Mix Asphalt (Misc. Area)	SQYD		x		=	$	-
397005	Tack Coat	TON	5	x	2,600.00	=	$	13,000
401000	Concrete Pavement (truck apron)	CY	0	x	715.00	=	$	-
401108	Replace Concrete Pavement (Rapid Strength Concrete)	CY		x		=	$	-
404092	Seal Pavement Joint	LF		x		=	$	-
404094	Seal Longitudinal Isolation Joint	LF		x		=	$	-
413112A	Repair Spalled Joints (Polyester Grout)	SQYD		x		=	$	-
413115	Seal Existing Concrete Pavement Joint	LF		x		=	$	-
420102	Groove Existing Concrete Pavement	SQYD		x		=	$	-
420201	Grind Existing Concrete Pavement	SQYD		x		=	$	-
731502	Minor Concrete (Misc. Const)	CY		x		=	$	-
731530	Minor Concrete (Textured Paving)	SQFT		x		=	$	-
XXXXXX	Bike Path	SQFT	3,492	x	20.00	=	$	69,840

TOTAL STRUCTURAL SECTION ITEMS	$	1,527,600

SECTION 3: DRAINAGE

Item code		Unit	Quantity		Unit Price ($)			Cost
150206	Abandon Culvert	LF		x		=	$	-
150805	Remove Culvert	LF		x		=	$	-
150820	Modify Inlet	EA		x		=	$	-
152430	Adjust Inlet	LF		x		=	$	-
155003	Cap Inlet	EA		x		=	$	-
193114	Sand Backfill	CY		x		=	$	-
510502	Minor Concrete (Minor Structure)	CY		x		=	$	-
510512	Minor Concrete (Box Culvert)	CY		x		=	$	-
62XXXX	XXX" APC Pipe	LF		x		=	$	-
64XXXX	18" Plastic Pipe	LF	600	x	75.00	=	$	45,000
65XXXX	XXX" RCP Pipe	LF		x		=	$	-
66XXXX	XXX" CSP Pipe	LF		x		=	$	-
68XXXX	Edge Drain	LF		x		=	$	-
69XXXX	XXX" Pipe Downdrain	LF		x		=	$	-
70XXXX	XXX" Pipe Inlet	LF		x		=	$	-
70XXXX	XXX" Pipe Riser	LF		x		=	$	-
70XXXX	XXX" Flared End Section	EA	3	x	1,200.00	=	$	3,600
703233	Grated Line Drain	LF		x		=	$	-
72XXXX	Rock Slope Protection (Type and Method)	CY	15	x	100.00	=	$	1,500
721420	Concrete (Ditch Lining)	CY		x		=	$	-
721430	Concrete (Channel Lining)	CY		x		=	$	-
729010	Rock Slope Protection Fabric	SQYD		x		=	$	-
750001	Miscellaneous Iron and Steel	LB		x	4.75	=	$	-
XXXXXX	Additional Drainage - Water Quality	LS	1	x	100,000.00	=	$	100,000
510094	Structural Concrete Drainage Inlet	EA	10	x	4,500.00	=	$	45,000

TOTAL DRAINAGE ITEMS $ 195,100

SECTION 4: SPECIALTY ITEMS

Item code		Unit	Quantity		Unit Price ($)			Cost
070012	Progress Schedule (Critical Path Method)	LS	1	x	4,500.00	=	$	4,500
150662	Remove Metal Beam Guard Railing	LF		x		=	$	-
150668	Remove Terminal Systems	EA		x		=	$	-
1532XX	Remove Barrier (*Insert Type)*	LF		x		=	$	-
153250	Remove Sound Wall	SQFT		x		=	$	-
190110	Lead Compliance Plan	LS	1	x	3,000.00	=	$	3,000
49XXXX	CIDH Concrete Piling *(Insert Diameter)*	LF		x		=	$	-
510060	Structural Concrete (Retaining Wall)	CY		x		=	$	-
731504	Minor Concrete (curb and Gutter)	CY	61	x	853.00	=	$	52,033
731511	Minor Concrete (Island Paving)	CY	23	x	933.00	=	$	21,459
5110XX	Architectural Treatment *(Insert Type)*	SQFT		x		=	$	-
511048	Apply Anti-Graffiti Coating	SQFT		x		=	$	-
5136XX	Reinforced Concrete Crib Wall *(Insert Type)*	SQFT		x		=	$	-
518002	Sound Wall (Masonry Block)	SQFT		x		=	$	-
520103	Bar Reinf. Steel (Retaining Wall)	LB		x		=	$	-
80XXXX	Fence (*Insert Type*)	LF		x		=	$	-
832001	Metal Beam Guard Railing	LF		x		=	$	-
839310	Double Thrie Beam Barrier	LF		x		=	$	-
839521	Cable Railing	LF		x		=	$	-
83954X	Transition Railing *(Insert Type)*	EA		x		=	$	-
8395XX	Terminal System (Type CAT)	EA		x		=	$	-
8395XX	Alternative Flared Terminal System	EA		x		=	$	-
8395XX	End Anchor Assembly (*Insert Type*)	EA		x		=	$	-
839561	Rail Tensioning Assembly	EA		x		=	$	-
839XXX	Crash Cushion *(Insert Type)*	EA		x		=	$	-
83XXXX	Concrete Barrier *(Insert Type)*	LF		x		=	$	-
730070	Dectectable Warning Surface	SQFT	270	x	48.00	=	$	12,960

TOTAL SPECIALTY ITEMS $ 94,000

SECTION 5: ENVIRONMENTAL

5A - ENVIRONMENTAL MITIGATION

Item code		Unit	Quantity		Unit Price ($)			Cost
	Biological Mitigation	LS		x		=	$	-
071325	TEMPORARY REINFORCED SILT FENCE	LF	1,200	x	5.00	=	$	6,000
071325	Temporary Fence (Type ESA)	LF	1,900	x	8.00	=	$	15,200

Subtotal Environmental $ 6,000

5B - LANDSCAPE AND IRRIGATION

Item code		Unit	Quantity		Unit Price ($)			Cost
200001	Highway Planting	LS		x		=	$	-
20XXXX	XXX" (*Insert Type*) Conduit *(Use for Irrigation x-overs)*	LF		x		=	$	-
20XXXX	Extend XXX" *(Insert Type)* Conduit *(Use for Extension of Irrigation x-overs)*	LF		x		=	$	-
201700	Imported Topsoil	CY		x		=	$	-
2030XX	Erosion Control (Type __)	SQYD	6,207	x	2.70	=	$	16,759
203021	Fiber Rolls	LF		x		=	$	-
203026	Move In/ Move Out (Erosion Control)	EA	6	x	500.00	=	$	3,000
204099	Plant Establishment Work	LS		x		=	$	-
205035	Wood Mulch	CY	228	x	120.00	=	$	27,360
208000	Irrigation System	LS		x		=	$	-
208304	Water Meter	EA		x		=	$	-
209801	Maintenance Vehicle Pullout	EA		x		=	$	-
036370	Unmortared Rock Blanket	SF	1,910	x	9.50	=	$	18,145
036376	Boulder	EA	0	x	800.00	=	$	-

Subtotal Landscape and Irrigation $ 47,119

5C - NPDES

Item code		Unit	Quantity		Unit Price ($)			Cost
074016	Construction Site Management	LS	1	x	75,000.00	=	$	75,000
074017	Prepare WPCP	LS		x		=	$	-
074019	Prepare SWPPP	LS	1	x	3,200.00	=	$	3,200
130530	Temporary Hydraulic Mulch	SQYD	6,207	x	3.00	=	$	18,621
130570	Temporary Cover	SQYD	1,552	x	10.00	=	$	15,520
074028	Temporary Fiber Roll	LF	1,862	x	15.00	=	$	27,930
074032	Temporary Concrete Washout Facility	EA	1	x	5,000.00	=	$	5,000
074033	Temporary Construction Entrance	EA	1	x	5,000.00	=	$	5,000
074035	Temporary Check Dam	LF	100	x	13.00	=	$	1,300
074037	Move In/ Move Out (Temporary Erosion Control)	EA	6	x	600.00	=	$	3,600
074038	Temp. Drainage Inlet Protection	EA	6	x	325.00	=	$	1,950
074041	Street Sweeping	LS	1	x	100,000.00	=	$	100,000
074042	Temporary Concrete Washout (Portable)	LS	1	x	5,000.00	=	$	5,000
130310	Rain Event Action Plan	EA	9	x	500.00	=	$	4,500

Supplemental Work for NPDES

(These costs are not accounted in total here but under Supplemental Work on sheet 7 of 11).

066595	Water Pollution Control Maintenance Sharing*	LS		x		=	$	-
066596	Additional Water Pollution Control**	LS		x		=	$	-
066597	Storm Water Sampling and Analysis***	LS	1	x	3,500.00	=	$	3,500
XXXXXX	Some Item							

Subtotal NPDES (Without Supplemental Work) $ 262,121

*Applies to all SWPPPs and those WPCPs with sediment control or soil stabilization BMPs.

**Applies to both SWPPPs and WPCP projects.

*** Applies only to project with SWPPPs.

TOTAL ENVIRONMENTAL $ 315,300

SECTION 6: TRAFFIC ITEMS

6A - Traffic Electrical

Item code		Unit	Quantity		Unit Price ($)			Cost
150760	Remove Sign Structure	EA		x		=	$	-
151581	Reconstruct Sign Structure	EA		x		=	$	-
152641	Modify Sign Structure	EA		x		=	$	-
5602XX	Furnish Sign Structure	LB		x		=	$	-
5602XX	Install Sign Structure	LB		x		=	$	-
56XXXX	XXX" CIDHC Pile (Sign Foundation)	LF		x		=	$	-
860090	Maintain Existing Traffic Management System Elements During Construction	LS	1	x	5,000.00	=	$	5,000
860810	Inductive Loop Detectors	EA		x		=	$	-
86055X	Lighting & Sign Illumination	LS	1	x	50,000.00	=	$	50,000
8607XX	Interconnection Facilities	LS		x		=	$	-
8609XX	Traffic Monitoring Stations	LS		x		=	$	-
860XXX	Modify Existing Electrical/Modify Signal	LS	1	x	450,000.00	=	$	450,000
8611XX	Ramp Metering System (Location X)	LS		x		=	$	-
8611XX	Ramp Metering System (Location X)	LS		x		=	$	-
86XXXX	Fiber Optic Conduit System	LS		x		=	$	-
XXXXX	Flashing Beacon System	LS	1	x	25,000.00	=	$	25,000

Subtotal Traffic Electrical *$ 505,000*

6B - Traffic Signing and Striping

Item code		Unit	Quantity		Unit Price ($)			Cost
120090	Construction Area Signs	LS	1	x	7,000.00	=	$	7,000
150701	Remove Yellow Painted Traffic Stripe	LF		x		=	$	-
150710	Remove Traffic Stripe	LF		x		=	$	-
150713	Remove Pavement Marking	SQFT		x		=	$	-
150742	Remove Roadside Sign	EA		x		=	$	-
152320	Reset Roadside Sign	EA		x		=	$	-
152390	Relocate Roadside Sign	EA		x		=	$	-
566011	Roadside Sign (One Post)	EA	12	x	250.00	=	$	3,000
566012	Roadside Sign (Two Post)	EA	6	x	750.00	=	$	4,500
560XXX	Furnish Sign Panels	SQFT		x		=	$	-
560XXX	Install Sign Panels	SQFT		x		=	$	-
82010X	Delineator (Class X)	EA		x		=	$	-
84XXXX	Permanent Pavement Delineation	LS	1	x	60,000.00	=	$	60,000

Subtotal Traffic Signing and Striping *$ 74,500*

6C - Stage Construction and Traffic Handling

Item code		Unit	Quantity		Unit Price ($)			Cost
120100	Traffic Control System	LS	1	x	200,000.00	=	$	200,000
120120	Type III Barricade	EA	6	x	200.00	=	$	1,200
120143	Temporary Pavement Delineation	LF	10,000	x	1.00	=	$	10,000
12016X	Channelizer	EA		x		=	$	-
128650	Portable Changeable Message Signs	EA	3	x	7,500.00	=	$	22,500
129000	Temporary Railing (Type K)	LF	1,500	x	37.00	=	$	55,500
129100	Temp. Crash Cushion Module	EA		x		=	$	-
129099A	Traffic Plastic Drum	EA	100	x	90.00	=	$	9,000
839603A	Temporary Crash Cushion (ADIEM)	EA	6	x	3,500.00	=	$	21,000
XXXXXX	Some Item							

Subtotal Stage Construction and Traffic Handling *$ 319,200*

TOTAL TRAFFIC ITEMS **$ 898,700**

SECTION 7: DETOURS

Include constructing, maintaining, and removal

Item code		Unit	Quantity		Unit Price ($)			Cost
0713XX	Temporary Fence	LF		x		=	$	-
07XXXX	Temporary Drainage	LS	1	x	10,000.00	=	$	10,000
120143	Temporary Pavement Delineation	LF	1	x	10,000.00	=	$	10,000
1286XX	Temporary Signals	EA		x		=	$	-
129000	Temporary Railing (Type K)	LF		x		=	$	-
190101	Roadway Excavation	CY		x		=	$	-
198001	Imported Borrow	CY		x		=	$	-
198050	Embankment	CY		x		=	$	-
250401	Class 4 Aggregate Subbase	CY		x		=	$	-
260201	Class 2 Aggregate Base	CY		x		=	$	-
390132	Hot Mix Asphalt (Type A)	TON		x		=	$	-
XXXXXX	Signs	LS		x		=	$	-

TOTAL DETOURS **$ 20,000**

SUBTOTAL SECTIONS 1-7 $ 3,333,200

SECTION 8: MINOR ITEMS

8A - Americans with Disabilities Act Items								
	ADA Items				1.0%		$	33,332
8B - Bike Path Items								
	Bike Path Items				1.0%		$	33,332
8C - Other Minor Items								
	Other Minor Items				3.0%		$	99,996
	Total of Section 1-7	$	3,333,200	x	5.0%	=	$	166,660

TOTAL MINOR ITEMS **$ 166,700**

SECTIONS 9: MOBILIZATION

Item code								
999990	Total Section 1-8	$	3,499,900	x	10%	=	$	349,990

TOTAL MOBILIZATION **$ 350,000**

SECTION 10: SUPPLEMENTAL WORK

Item code		Unit	Quantity		Unit Price ($)			Cost
066015	Federal Trainee Program	LS		x		=	$	-
066063	Traffic Management Plan - Public Information	LS	1	x	50,000.00	=	$	50,000
066090	Maintain Traffic	LS	1	x	100,000.00	=	$	100,000
066094	Value Analysis	LS		x		=	$	-
066204	Remove Rock & Debris	LS		x		=	$	-
066222	Locate Existing Cross-Over	LS		x		=	$	-
066670	Payment Adjustments For Price Index Fluctuations	LS		x		=	$	-
066700	Partnering	LS		x		=	$	-
066866	Operation of Existing Traffic Management System Elements During Construction	LS		x		=	$	-
066920	Dispute Review Board	LS		x		=	$	-
XXXXXX	Some Item			x		=	$	-

*Cost of **NPDES** Supplemental Work specified in Section 5C* = $ 3,500

	Total Section 1-8	$	3,499,900		5%	=	$	174,995

TOTAL SUPPLEMENTAL WORK **$ 328,500**

SECTION 11: STATE FURNISHED MATERIALS AND EXPENSES

Item code		Unit	Quantity		Unit Price ($)		Cost
066063	Public Information	LS		x		=	$0
066105	RE Office	LS	1	x	35,000.00	=	$35,000
066803	Padlocks	LS		x		=	$0
066838	Reflective Numbers and Edge Sealer	LS		x		=	$0
066901	Water Expenses	LS		x		=	$0
066062A	COZEEP Expenses	LS	1	x	48,000.00	=	$48,000
06684X	Ramp Meter Controller Assembly	LS		x		=	$0
06684X	TMS Controller Assembly	LS		x		=	$0
06684X	Traffic Signal Controller Assembly	LS	1	x	35,000.00	=	$35,000
XXXXXX	Some Item						

Total Section 1-8	$	3,499,900		0%	= $	-

TOTAL STATE FURNISHED	**$118,000**

SECTION 12: TIME-RELATED OVERHEAD

Estiamted Time-Releated Overhead (TRO) Percentage (0% to 10%) = 5%

Item code		Unit	Quantity		Unit Price ($)		Cost
070018	Time-Related Overhead	WD	125	X	0	=	$0

TOTAL TIME-RELATED OVERHEAD	**$0**

SECTION 13: CONTINGENCY

(Pre-PSR 30%-50%, PSR 25%, Draft PR 20%, PR 15%, after PR approval 10%, Final PS&E 5%)

Total Section 1-11	$	4,296,400	x	15%	=	$644,460

TOTAL CONTINGENCY	**$644,500**

II. STRUCTURE ITEMS

DATE OF ESTIMATE	00/00/00	00/00/00	00/00/00
Name	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
Bridge Number	57-XXX	57-XXX	57-XXX
Structure Type	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
Width (Feet) [out to out]	0.00 LF	0.00 LF	0.00 LF
Total Length (Feet)	0.00 LF	0.00 LF	0.00 LF
Total Area (Square Feet)	0 SQFT	0 SQFT	0 SQFT
Structure Depth (Feet)	0.00 LF	0.00 LF	0.00 LF
Footing Type (pile or spread)	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
Cost Per Square Foot	$0.00	$0.00	$0.00
COST OF EACH STRUCTURE	**$0.00**	**$0.00**	**$0.00**

DATE OF ESTIMATE	00/00/00	00/00/00	00/00/00
Name	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
Bridge Number	57-XXX	57-XXX	57-XXX
Structure Type	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
Width (Feet) [out to out]	0.00 LF	0.00 LF	0.00 LF
Total Length (Feet)	0.00 LF	0.00 LF	0.00 LF
Total Area (Square Feet)	0 SQFT	0.00 SQFT	0.0 SQFT
Structure Depth (Feet)	0.00 LF	0.00 LF	0.00 LF
Footing Type (pile or spread)	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
Cost Per Square Foot	$0.00	$0.00	$0.00
COST OF EACH STRUCTURE	**$0.00**	**$0.00**	**$0.00**

TOTAL COST OF BRIDGES	**$0.00**
TOTAL COST OF BUILDINGS	**$0.00**

TOTAL COST OF STRUCTURES[1]	**$0.00**

Estimate Prepared By: _____ _____
XXXXXXXXXXXXXXXX ------ Division of Structures Date

[1]Structure's Estimate includes Overhead and Mobilization.
Add more sheets if needed. Call them 9a, 9b, 9c, …, etc

III. RIGHT OF WAY

Fill in all of the available information from the Right of Way data sheet.

A)	A1)	Acquisition, including Excess Land Purchases, Damages & Goodwill,		$	0
	A2)	SB-1210		$	0
B)		Acquisition of Offsite Mitigation		$	0
C)	C1)	Utility Relocation (State Share)		$	0
	C2)	Potholing (Design Phase)		$	0
D)		Railroad Acquisition		$	0
E)		Clearance / Demolition		$	0
F)		Relocation Assistance (RAP and/or Last Resort Housing Costs)		$	0
G)		Title and Escrow		$	0
H)		Environmental Review		$	0
I)		Condemnation Settlements (Items G & H applied to items A + B)	0%	$	0
J)		Design Appreciation Factor	0%	$	0
K)		Utility Relocation (Construction Cost)		$	0

L) **TOTAL RIGHT OF WAY ESTIMATE** **$0**

(Excluding Item #8 - Hazardous Waste)

M) **TOTAL R/W ESTIMATE: Escalated** **$0**

N) **Right of Way Support** **$** **0**

Support Cost Estimate Prepared By _____ Project Coordinator[1] _____ Phone

Utility Estimate Prepared By _____ Utiliy Coordinator[2] _____ Phone

R/W Acquistion Estimate Prepared By _____ Right of Way Estimator[3] _____ Phone

[1] When estimate has Support Costs only [2] When estimate has Utility Relocation [3] When R/W Acquisition is required

US50/Pioneer Trail Intersection Improvement Project - Cost Benefit Analysis Summary

7/18/2019

Modified Traffic Signal compared to No Build Alternative

R2610C001.xls

Annual Costs	Modified Traffic Signal Alternative		No Build Traffic Signal Alternative	
Safety	**Predicted Annual Crashes**	**Safety Cost**	**Predicted Annual Crashes**	**Safety Cost**
Predicted Fatal/Injury Crashes	Safety Data Omitted	0	Safety Data Omitted	0
Predicted PDO Crashes	Safety Data Omitted	0	Safety Data Omitted	0
	Annual Costs of Predicted Crashes	**$ 803,733**	***Annual Costs of Predicted Crashes***	**$ 1,071,645**
Delay	**Annual Intersection Delay (person-hrs)**	**Delay Cost**	**Annual Intersection Delay (person-hrs)**	**Delay Cost**
Average Annual Person (in Vehicle) Delay	5912	**$ 79,000**	13919	**$ 184,000**
Operation and Maintenance	**Operation and Maintenance**	**O&M Cost**	**Operation and Maintenance**	**O&M Cost**
Annualized Cost of Signal Retiming		$ -	Signal Retiming Every 3 Years	$ 1,000
Annual Cost of Power for Signal		$ -	Power for Signal	$ 750
Annual Cost of Illumination	Intersection Illumination	$ 750	Intersection Illumination	$ 750
Annual Cost of Maintenance	Landscaping Costs	$ 1,500	Signal Maintenance Costs (power outage, detection, etc.)	$ 1,500
	Total Annual Operation and Maintenance Costs	**$ 2,250**	***Total Annual Operation and Maintenance Costs***	**$ 4,000**
Initial Capital Costs	**Total Capital Costs**	**Cost**	**Total Capital Costs**	**Cost**
Preliminary Engineering		$ -		$ -
Right-of-way and Utilities		$ -		$ -
Construction		**$ 4,950,000**		

***Delay cost is based upon an average of the AM and PM peak hours.**

Total Discounted Life Cycle Costs (2020 - 2040)	Modified Traffic Signal Alternative		No Build Traffic Signal Alternative	
Safety	**Total Predicted Crashes**	**Safety Cost**	**Total Predicted Crashes**	**Safety Cost**
	Costs of Predicted Crashes	**$ 10,923,000**	***Costs of Predicted Crashes***	**$ 14,564,000**
Delay	**Total Intersection Delay (person-hrs)**	**Delay Cost**	**Total Intersection Delay (person-hrs)**	**Delay Cost**
Total Person (in Vehicle) Delay	124100	**$ 1,640,000**	292300	**$ 3,850,000**
Fuel and GHG Cost	**Fuel and Green House Gas Cost**		**Fuel and Green House Gas Cost**	
		$ 1,302,000		**$ 1,897,000**
Operation and Maintenance	**Operation and Maintenance**	**O&M Cost**	**Operation and Maintenance**	**O&M Cost**
Annualized Cost of Signal Retiming	Signal Retiming Every 3 Years	$ 13,600	Signal Retiming Every 3 Years	$ 13,600
Annual Cost of Power for Signal	Power for Signal	$ 10,200	Power for Signal	$ 10,200
Annual Cost of Illumination	Intersection Illumination	$ 10,200	Intersection Illumination	$ 10,200
Annual Cost of Maintenance	Signal Maintenance Costs (power outage, detection, etc.)	$ 20,400	Signal Maintenance Costs (power outage, detection, etc.)	$ 20,400
	Total Annual Operation and Maintenance Costs	**$ 54,000**	***Total Annual Operation and Maintenance Costs***	**$ 54,000**
Initial Capital Costs	**Total Capital Costs**	**Cost**	**Total Capital Costs**	**Cost**
Preliminary Engineering		$ -		$ -
Right-of-way and Utilities		$ -		$ -
Construction		$ 4,950,000		$ -
	Total Initial Capital Costs	**$ 4,950,000**	***Total Initial Capital Costs***	**$ -**
Total Life Cycle Costs (Opening Year $)	**Net Present Value**	**$ 18,869,000**	**Net Present Value**	**$ 20,365,000**

***Delay cost is based upon an average of the AM and PM peak hours.**

Modified Traffic Signal Alternative

No Build Signal Alternative

Life Cycle Benefit/Cost Ratio

Modified Signal Alt vs.No Build Signal Alt	
Safety Benefit	$ 3,641,000
Delay Reduction Benefit	$ 2,210,000
Fuel and GHG Benefit	$ 595,000
Total Benefits	**$ 6,446,000**
Added Operations&Maintenance Costs	$ -
Added Capital Costs	$ 4,950,000
Total Costs	**$ 4,950,000**
Life Cycle Benefit/Cost Ratio	**1.3**

US50/Pioneer Trail Intersection Improvement Project - Cost Benefit Analysis Summary

7/18/2019

Roundabout Alternative compared to No Build Signal Alternative

R2610C002.xls

Annual Costs	Roundabout Alternative		No Build Signal Alternative	
Safety	**Predicted Annual Crashes**	**Safety Cost**	**Predicted Annual Crashes**	**Safety Cost**
Predicted Fatal/Injury Crashes	Safety Data Omitted	0	Safety Data Omitted	0
Predicted PDO Crashes	Safety Data Omitted	0	Safety Data Omitted	0
	Annual Costs of Predicted Crashes	**$ 268,721**	***Annual Costs of Predicted Crashes***	**$ 1,071,645**
Delay	**Annual Intersection Delay (person-hrs)**	**Delay Cost**	**Annual Intersection Delay (person-hrs)**	**Delay Cost**
Average Annual Person (in Vehicle) Delay	1529	**$ 21,000**	13919	**$ 184,000**
Operation and Maintenance	**Operation and Maintenance**	**O&M Cost**	**Operation and Maintenance**	**O&M Cost**
Annualized Cost of Signal Retiming		$ -	Signal Retiming Every 3 Years	$ 1,000
Annual Cost of Power for Signal		$ -	Power for Signal	$ 750
Annual Cost of Illumination	Intersection Illumination	$ 750	Intersection Illumination	$ 750
Annual Cost of Maintenance	Landscaping Costs	$ 1,500	Signal Maintenance Costs (power outage, detection, etc.)	$ 1,500
	Total Annual Operation and Maintenance Costs	**$ 2,250**	***Total Annual Operation and Maintenance Costs***	**$ 4,000**
Initial Capital Costs	**Total Capital Costs**	**Cost**	**Total Capital Costs**	**Cost**
Preliminary Engineering		$ -		$ -
Right-of-way and Utilities		$ -		$ -
Construction		**$ 5,250,000**		**$ -**

***Delay cost is based upon an average of the AM and PM peak hours.**

Total Discounted Life Cycle Costs (2020 - 2040)	Roundabout Alternative		No Build Signal Alternative	
Safety	**Total Predicted Crashes**	**Safety Cost**	**Total Predicted Crashes**	**Safety Cost**
Predicted Fatal/Injury Crashes	Safety Data Omitted	$ -	Safety Data Omitted	$ -
Predicted PDO Crashes	Safety Data Omitted	$ -	Safety Data Omitted	$ -
	Total Costs of Predicted Crashes	**$ 3,652,000**	***Total Costs of Predicted Crashes***	**$ 14,564,000**
Delay	**Total Intersection Delay (person-hrs)**	**Delay Cost**	**Total Intersection Delay (person-hrs)**	**Delay Cost**
Total Person (in Vehicle) Delay	32117	**$ 430,000**	292305	**$ 3,850,000**
Fuel and GHG Cost	**Fuel and Green House Gas Cost**		**Fuel and Green House Gas Cost**	
		$ 1,484,000		**$ 1,897,000**
Operation and Maintenance	**Operation and Maintenance**	**O&M Cost**	**Operation and Maintenance**	**O&M Cost**
Annualized Cost of Signal Retiming		$ -	Signal Retiming Every 3 Years	$ 13,600
Annual Cost of Power for Signal		$ -	Power for Signal	$ 10,200
Annual Cost of Illumination	Intersection Illumination	$ 10,200	Intersection Illumination	$ 10,200
Annual Cost of Maintenance	Landscaping Costs	$ 20,400	Signal Maintenance Costs (power outage, detection, etc.)	$ 20,400
	Total Annual Operation and Maintenance Costs	**$ 31,000**	***Total Annual Operation and Maintenance Costs***	**$ 54,000**
Initial Capital Costs	**Total Capital Costs**	**Cost**	**Total Capital Costs**	**Cost**
Preliminary Engineering		$ -		$ -
Right-of-way and Utilities		$ -		$ -
Construction		$ 5,250,000		$ -
	Total Initial Capital Costs	**$ 5,250,000**	***Total Initial Capital Costs***	**$ -**
Total Life Cycle Costs (Opening Year $)	**Net Present Value**	**$ 10,847,000**	**Net Present Value**	**$ 20,365,000**

***Delay cost is based upon an average of the AM and PM peak hours.**

Roundabout Alternative

No Build Signal Alternative

Life Cycle Benefit/Cost Ratio

Roundabout vs. No Build Signal Alternative	
Safety Benefit	$ 10,912,000
Delay Reduction Benefit	$ 3,420,000
Fuel and GHG Benefit	$ 413,000
Total Benefits	**$ 14,745,000**
Added Operations&Maintenance Costs	$ (23,000)
Added Capital Costs	$ 5,250,000
Total Costs	**$ 5,227,000**
Life Cycle Benefit/Cost Ratio	**2.8**

Roundabout Preferred