US 93 AT PIERCE FERRY ROAD FEASIBILITY STUDY

Technical Memorandum No.1: Development of Alternatives

Project No.: T0230 01L

Federal Project No. MMO-0(222)T

Version 2, August 21, 2020

Prepared for:

ADOT

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1. INTRODUCTION

Mohave County and the Arizona Department of Transportation initiated this US 93 at Pierce Ferry Road Feasibility Study to evaluate potential improvements to the intersection of US 93 and Pierce Ferry Road, Mohave County, Arizona.

Background

US 93 is a state highway that connects Wickenburg, Arizona to the Las Vegas metropolitan area. Within Arizona, US 93 begins at the junction of US 60/US 93 in Wickenburg and ends at the Mike O'Callaghan-Pat Tillman Memorial Bridge at the Arizona/Nevada state line.

US 93 and Pierce Ferry Road (County Route 25) intersection (study area) is located at MP 41.8, approximately 25 miles northwest of Kingman, Arizona in Mohave County. The study area is illustrated in **Figure 1**.

The intersection is a primary gateway to Grand Canyon West and is heavily trafficked by international visitors, tour buses, passenger vehicles and vans.

Traffic count data shows that US 93 carries approximately 15,500 vehicles per day, and Piece Ferry Road carries 2,100 vehicles per day.

Crash data shows that the intersection experienced five fatal and nine serious injury crashes within a five-year period (2015-2019). Several of the crashes had multiple fatalities. All but two of the crashes were angle crashes associated with the intersection. Primary driver violations included "failed to yield right-of-way", "ran stop sign", and "no improper action."

Project Goals

US 93 and Pierce Ferry Road Feasibility Study project goals include:

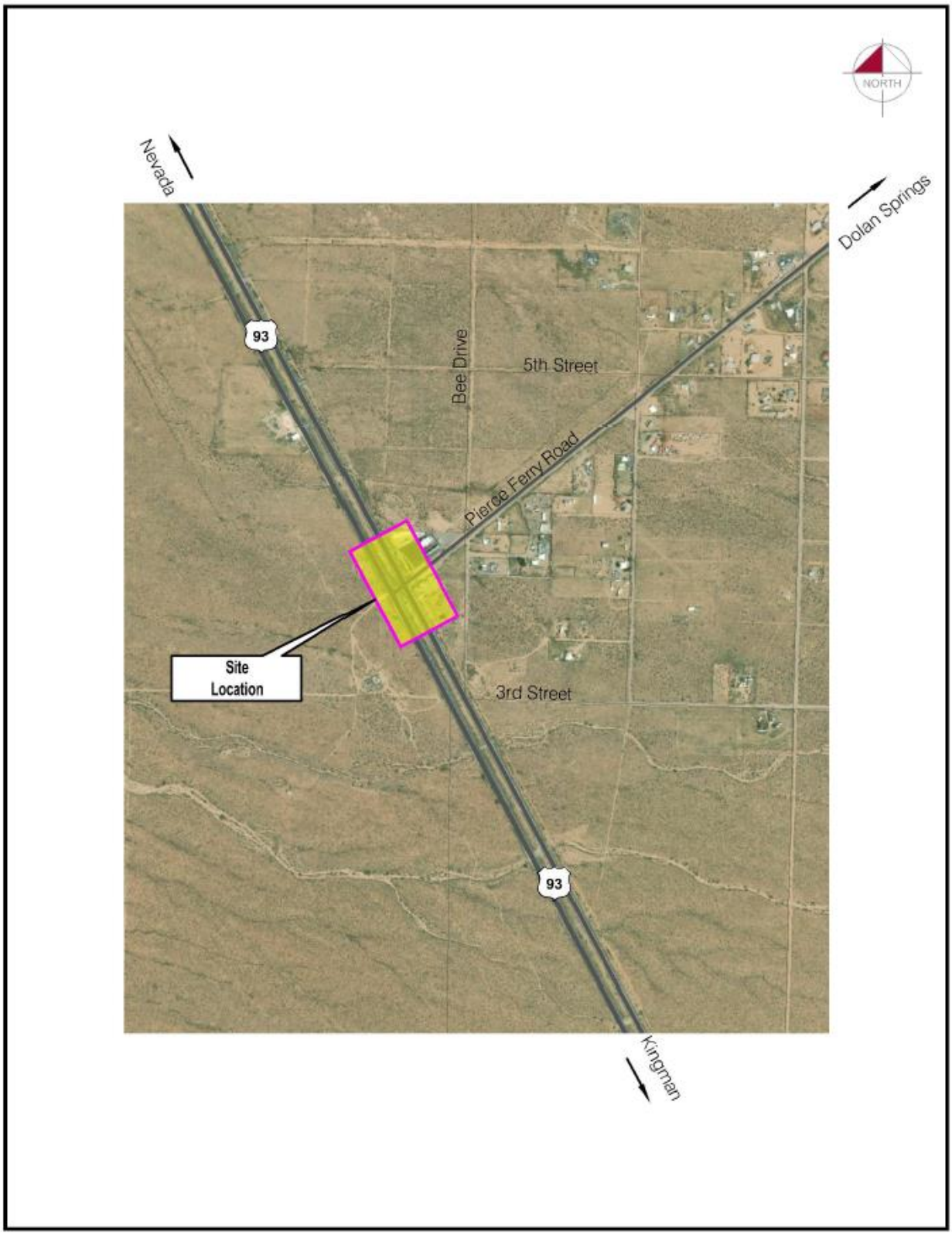
- Recommend intersection improvements to reduce the number and severity of crashes, provide the highest return on investment (benefit/cost ratio), and can be incorporated into the future Interstate 11 (I-11).

Project Activities

US 93 and Pierce Ferry Road Feasibility Study project activities include:

- Analyze crash data.
- Asses existing and projected traffic data.
- Identify alternatives that meet project goals.
- Develop alternatives for up to 2 grade-separation alternatives.
- Evaluate alternatives.
- Obtain community/stakeholder input.
- Prepare a benefit-cost analysis on recommended alternative.
- Refine recommended alternative.
- Prepare a feasibility report to document findings.

FIGURE 1: STUDY INTERSECTION AND VICINITY MAP



2. BACKGROUND DATA

This section summarizes existing conditions of the intersection. Future developments to the study area are also summarized.

Previously Constructed Projects

Several improvements projects have been completed on US 93, as it has been improved from a two-lane roadway to a four-lane highway.

A review of improvements completed since 2000 identifies those as listed in **Table 1:**

- In 2000, a northbound left turn lane was added at Pierce Ferry Road; the southbound acceleration lane was extended, and the median cross over was milled and replaced.
- In 2019, a pavement preservation and crack seal
- Currently, in 2020, shoulder widening and a realignment of the left turn lanes at US 93 and Pierce Ferry Road is being constructed.

TABLE 1: PREVIOUS PROJECTS CONSTRUCTED

Project Number	Begin MP	End MP	Project Plans Date	As-Built Year	Description
H4902 01 C	36.20	58.40	2000	N/A	US 93 new NB left turn lane, extended SB acceleration and mill and replace crossover
H8916 01 C	36.00	50.00	2017	2019	US 93 pavement preservation and crack seal
H8658 01 C*	38.00	47.92	2020	N/A	Shoulder widening and realignment of left turn lanes at US 93 / Pierce Ferry Road intersection

** = Currently under construction, 2020.*

Existing Roadway and Intersection Features

US 93

- Functional Classification: Rural Principal Arterial
- Number of lanes: four (two northbound and two southbound)
- Lane width: 12'
- Speed limit: 65 MPH.
- Median: depressed median dividing northbound and southbound
- Median width: 66'
- Right of way: approximately 250'

Figure 2 are photos of current conditions. The photo on the left is a view of US 93 looking south from the median crossing. The photo on the right is US 93 viewing south from Pierce Ferry Road.

FIGURE 2: PHOTO, US 93 AT PIERCE FERRY ROAD

Left – US 93 SB viewing north from the median crossing.

Right – US 93 NB viewing south from Pierce Ferry Road.

Pierce Ferry Road

- Functional Classification: Rural Major Collector
- Number of lanes: three-lanes at intersection approach and adjacent to Chevron service station, with one travel lane eastbound, one westbound, and a two-way center left turn lane.
- Lane width: 12’
- Speed limit: 45 MPH
- Median: two-way left-turn lane
- Right of way: 100’

FIGURE 3: PHOTO, PIERCE FERRY ROAD

Top – Pierce Ferry Road viewing west

Bottom – Pierce Ferry Road viewing east

Intersection

- At the intersection there is a westbound through to provide access to US 93 southbound, a right turn lane to provide access to US 93 northbound, and an eastbound receiving lane.
- A median crossing enables US 93 southbound traffic to access Pierce Ferry Road, and westbound Pierce Ferry Road to access southbound US 93. The two-lane median crossing is 42’ wide and 66’ long.
- Northbound US 93 has 12’ designated right and left turn lanes, and a 12’-wide acceleration lane for vehicles turning right from westbound Pierce Ferry Road.
- Southbound US 93 has 12’ designated left turn lane to the median crossing, and a 12’ acceleration lane for vehicles crossing from westbound Pierce Ferry Road to southbound US 93.
- The intersection is STOP controlled with STOP signs located at westbound Pierce Ferry Road entrance to US 93 and in the median crossing where vehicles from US 93 southbound left must stop before crossing US 93 northbound.
- There are five existing luminaries near the intersection, one on each approach and one on the departing legs of US 93.

Figure 4 shows US 93 viewing south, from the median crossing. The difference in elevation between the northbound and southbound travel lanes is evident.

FIGURE 4: PHOTO, MEDIAN CROSSING AT PIERCE FERRY ROAD / US 93 INTERSECTION

Viewing south from north of median crossing

Adjacent Land Use

There is a Chevron service station and convenience store, parcel 326-03-121G, located on the northeast quadrant of the intersection, as illustrated in **Figure 5**.

There are two driveways to the Chevron gas station. The western driveway is located approximately 220' from the intersection, and the eastern driveway is located 370' from the intersection (as measured from the stop bar). There is a private gated road that is colinear with the median crossing on the westside of US 93.

FIGURE 5: ADJACENT PARCELS

Source: *Mohave County, GIS,* https://mcgis2.mohavecounty.us/html5/?viewer=moh

Each parcel adjacent to the intersection is privately owned. Property owners of parcels adjacent to the intersection are identified below.

TABLE 2: PROPERTY OWNERS ADJACENT TO INTERSECTION

Parcel Number	Name	Mailing Address
326-03-122C	WARD WALLACE H	2607 MIRABELLA ST HENDERSON, NV 89052-3172
326-03-126C	NU GEN LLC	8843 N CENTRAL AVE PHOENIX, AZ 85020-2816
326-03-121G	DOLAN SPRINGS INVESTMENT LLC	1131 DU FORT HILLS CT HENDERSON, NV 89002-6602 SITE ADDRESS: 14097 N PIERCE FERRY RD, DOLAN SPRING, AZ
326-03-121E	NU GEN LLC	8843 N CENTRAL AVE PHOENIX, AZ 85020-2816
326-03-126D	NU GEN LLC	8843 N CENTRAL AVE

Parcel Number	Name	Mailing Address
		PHOENIX, AZ 85020-2816
326-03-139D	CITIZENS UTILITIES RURAL CO	ATTN TAX DEPARTMENT 401 MERRITT 7, NORWALK, CT 068511000 SITE ADDRESS: 14033 N BEE DR, DOLAN SPRING, AZ
326-03-139C	WARD WALLACE HAMILTON TRUSTEE	2607 MIRABELLA ST HENDERSON, NV 890523172
326-03-140	NGUYEN TRI ETAL, LA THANH	6314 MOUNT EDEN AVE LAS VEGAS, NV 891397210

Utilities

Arizona Blue Stake was used to identify known utilities providers within the vicinity of the study area. **Table 3** is a list of the utility service companies with facilities in the project area, their representative and contact information.

TABLE 3: EXISTING UTILITIES

Utility	Utility Type	Contact
Unisource Energy Services – Kingman	Electric	Paul Martin 928-681-8924
Frontier Communications	Telephone	Jim Hanson 928-757-0218
Arizona Department of Transportation	Electric	Jason Dupee 928-681-6093
Arizona Department of Transportation	Culverts, Storm Drains	Gabriel Alvarado 928-681-6025
Mount Tipton Water Company	Water	Brenda Sisco 928-3713

Future Corridor Improvements

US 93 from Wickenburg up to the Arizona/Nevada state line is planned to be a part of the future Interstate-11. I-11 is planned to extend from the US/Mexico border in southern Arizona, through the Phoenix, metropolitan area, and to Las Vegas. Ultimately, the corridor will extend north to Canada.

Evaluation of intersection improvements at Pierce Ferry Road / US 93 should consider compatibility with a future interstate corridor. Considerations include:

- Grade separation of all movements
- Design speed to interstate standards
- Establishment of access control
- Minimize “throw-away” improvements

3. TRAFFIC ANALYSIS

A traffic analysis of the intersection of US 93 and Pierce Ferry Road was conducted to evaluate existing and future traffic and for use in a crash analysis.

Current Traffic Volumes

Daily Traffic Volumes

Average Annual Daily Traffic (AADT) and traffic information for US 93 and Pierce Ferry Road was obtained from ADOT's Transportation Data Management Systems (TDMS).

ADOT maintains a continuous count location on US 93 (Location ID: 102085) at milepost 47, south of the study intersection. Mohave County maintains a continuous count station on Pierce Ferry Road (Location ID: MC-9104) located 0.3 miles east of the intersection. **Table 4** summarizes information obtained from each of these count stations.

US 93 has a 2018 AADT of 15,626. From a review of historical data (2015-2019), an average annual growth rate of 3.6% is calculated.

Pierce Ferry Road also has a growth rate of 1.8% based on historic growth rates over the past 5 years (2015-2019).

TABLE 4: ROADWAY AADT AND TRAFFIC VOLUME INFORMATION

Route	Loc ID	AADT 2018	K Factor %	D Factor %	Historic Growth Rate %	2019 AADT (vpd)
US 93 South of PFR	102085	15,626	15%	51%	3.6%	16,189
US 93 North of PFR	-	-	-	-	-	-
Pierce Ferry Road	MC-9104	2,100	12%	63%	1.8%	2,138

Intersection Turning Movement Counts

Traditional methods of collecting turning movement counts (TMCs) at the intersection was not able to be conducted due to 2020 COVID-19 conditions, and the commensurate reduction in traffic volumes nationally.

As such, as substitute for ground counts, StreetLight data was purchased. StreetLight is "big data" which collects geospatial location data from mobile devices and processes the data to estimate travel patterns and metrics. Data obtained from StreetLight, in conjunction with historical data, were used to determine turning movement counts at the US 93 and Pierce Ferry Road intersection.

StreetLight turning movement counts were obtained for weekdays (Tuesday-Thursday), during the peak three-month period (April-June), 2019. The peak three-month period (April-June) was determined from the continuous count station located on Pierce Ferry Road.

Data showed the following daily and peak hour traffic volumes as illustrated in **Figure 6**, and listed below:

- Weekday AM Peak Period: 8:00 am to 9:00 am; 786 VPH
- ***Weekday Midday Peak Period: 1:00 pm to 2:00 pm; 1,451 VPH***
- Weekday PM Peak Period: 4:00 pm to 5:00 pm; 1,048 VPH
- Daily traffic volumes: 16,603 VPD

Streetlight data estimated a peak hour of the data from 1:00 PM to 2:00 PM, during which a total of 1,451 vehicles travel through the intersection. A mid-day peak hour is expected for this intersection that is used heavily by tourists.

Streetlight Data Validation

The Streetlight data average daily traffic (ADT) volumes for weekdays (Tuesday-Thursday) between April and June, peak three-months, of 2019 were compared to data from ADOT and WACOG TDMS. The StreetLight ADT during the peak three-months is 16,603 VPD, compared to 16,189 VPD for 2019 adjusted ADOT traffic volume, as illustrated in **Table 5.**

TABLE 5: STREETLIGHT DATA VALIDATION

Route	Streetlight Data Daily Traffic Volumes (April-June 2019)	2019 AADT (ADOT/WACOG Data)
US 93 South of PFR	14,940 vpd	16,189 vpd
US 93 North of PFR	15,703 vpd	-
Pierce Ferry Road	2,563 vpd	2,138 vpd

The directional factor (D Factor) for US 93 from StreetLight data is 50% and 51% using ADOT's TDMS. Pierce Ferry road has a D Factor from StreetLight of 64% and 63% using WACOG's TDMS. See these comparisons on **Table 6**.

TABLE 6: D FACTOR COMPARISON

Route	2018 D Factor % (ADOT TDMS)	2018 D Factor % (WACOG TDMS)	2019 StreetLight Data	Design D Factor %
US 93	51%	-	50%	50%
Pierce Ferry Road	-	63%	64%	64%

The K Factor from Streetlight and from available TDMS data show differences. StreetLight-calculated K Factors are 8.7% and 8.0% for US 93 and Pierce Ferry Road, respectively, while K Factors published on TDMS were 15% for US 93, and 12% for Pierce Ferry Road as illustrated in **Table 7**. For this analysis, a K Factor of 12% will be utilized for both roadways. **Table 8** lists all the design values. A K Factor of 12% was selected for Pierce Ferry Road to be conservative. US 93 2018 K Factor stems from a 2010 count and is relatively stale data. For the purpose of this analysis an average of the K Factors from 2018 TDMS, 15%, and 2019 StreetLight, 8.7%, of 12% is used.

TABLE 7: K FACTOR COMPARISON

Route	2018 K Factor % (ADOT TDMS)	2018 K Factor % (WACOG TDMS)	2019 StreetLight Data	Design K Factor %
US 93	15%	-	8.7%	12%
Pierce Ferry Road	-	12%	8.0%	12%

TABLE 8: TRAFFIC DESIGN VALUES

Route	2019 Avg Daily Volume (Apr – Jun)	Design D Factor %	Design K Factor %	2019 Peak Hour Volume	Design Growth Rate %	2040 Peak Hour Volume	2040 Avg Daily Volume (Apr-Jun)
US 93 South of PFR	14,940 vpd	50%	12%	1,793 vph	3.6%	3,768 vph	31,398 vpd
US 93 North of PFR	15,703 vpd	50%	12%	1,884 vph	3.6%	3,960 vph	33,002 vpd
Pierce Ferry Road	2,563 vpd	64%	12%	308 vph	1.8%	373 vph	3,109 vpd

The design K Factor (12%) was applied to the StreetLight data to determine adjusted/validated turning movement counts. No other adjustments were made as other Streetlight Data and ADOT/WACOG data variables were similar (ADT, D Factor, growth rate).

A Peak Hour Volume for each leg was calculated by multiplying the K Factor (12%) and the 2019 Average Daily Volume (April – June) from StreetLight. US 93 South of PFR has a 2019 Peak Hour Volume of **1,793 VPH**. US 93 North of PFR has a 2019 Peak Hour Volume of **1,884 VPH**. Pierce Ferry Road east of the intersection has a 2019 Peak Hour Volume of **308 VPH**. Applying the same turning movement percentages from the StreetLight data and the design D Factor, a design mid-day peak turning movement count distribution is made and depicted in **Figure 6**.

Truck percentage is not available. The ADOT US 93/US 60 Corridor Profile Study, March 2017, identified a truck percentage of 7.5%.

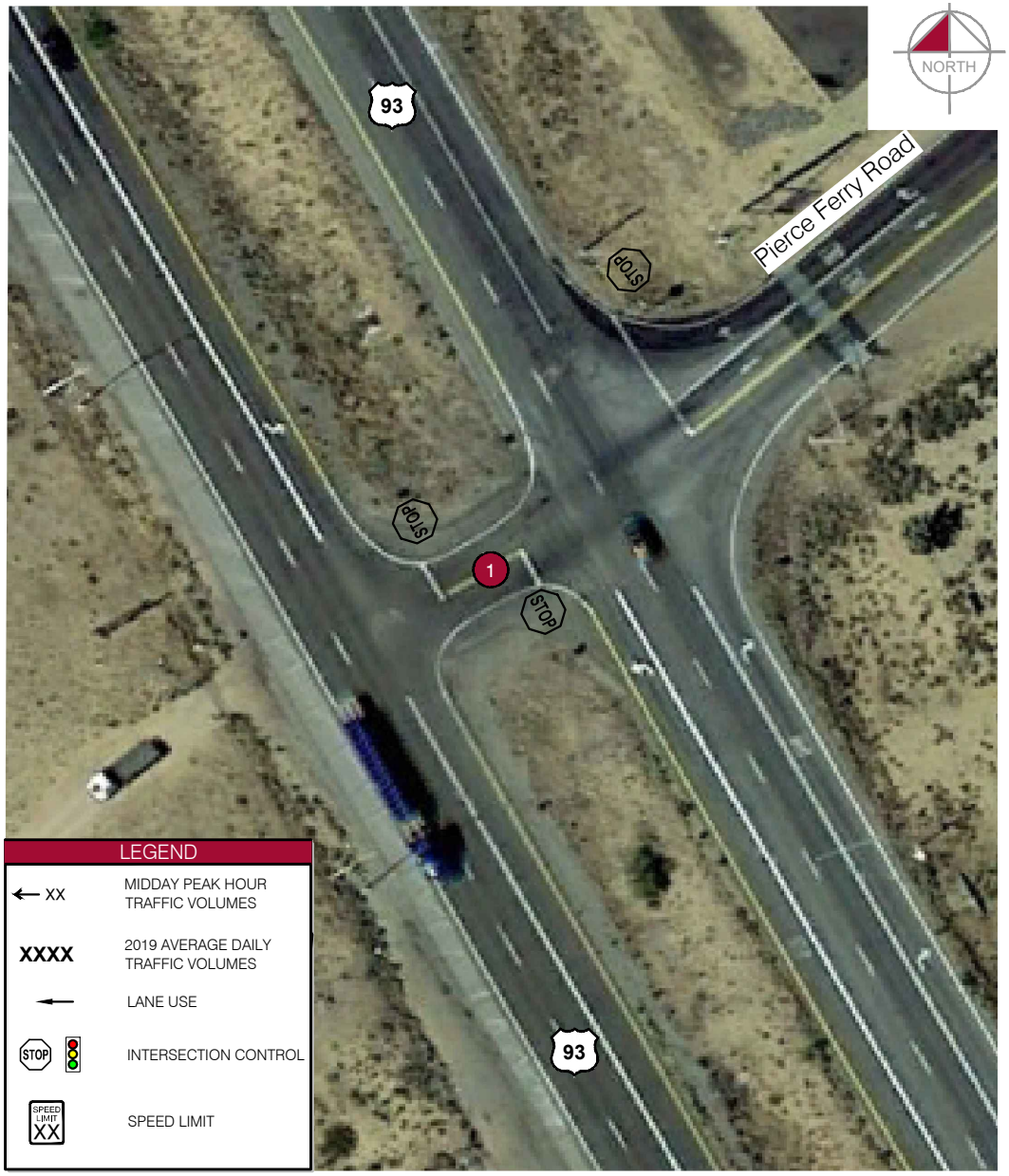


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Figure 6

Existing Conditions and 2019/2040 Weekday Traffic Counts

4. CRASH ANALYSIS

A crash analysis was completed for the intersection of US 93 and Pierce Ferry Road. Crash data was obtained from ADOT's Arizona Crash Information System (ACIS) for crashes occurring January 1, 2015 to December 31, 2019.

Figure 7 displays crashes by year for the analysis period. The data shows between 12 and 15 crashes occurred each year, from 2016-2019. Only 2 crashes were reported in 2015.

During the analysis period, 57 crashes were reported. **Figure 8** summarizes the crashes by injury severity. Of these 57 crashes, 5 fatal crashes resulted in 10 fatalities. Of the 57 crashes 25% resulted in Fatal (5) or suspected serious injury (9).

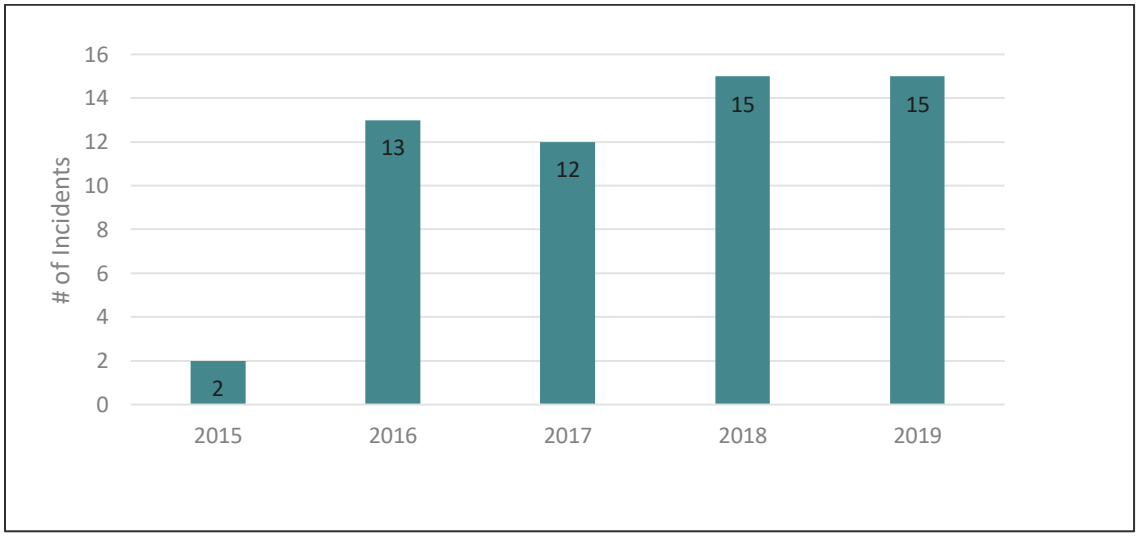

FIGURE 7: CRASHES PER YEAR

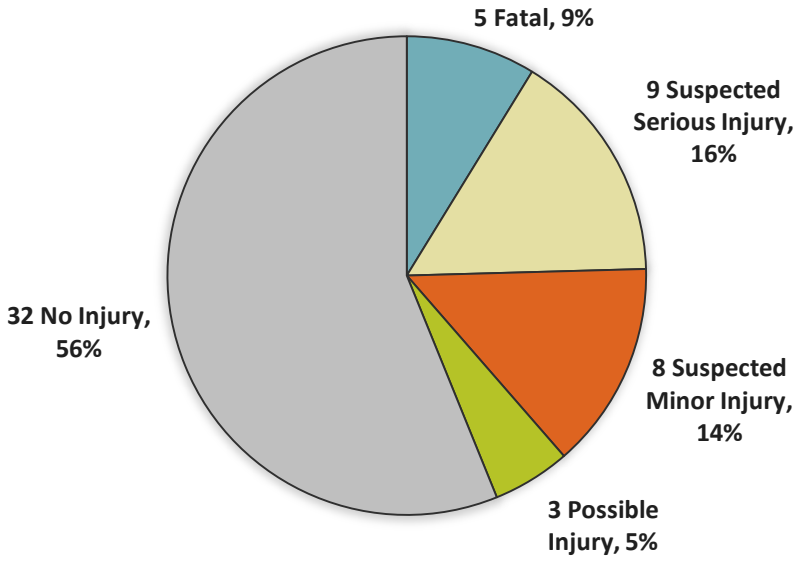

FIGURE 8: CRASHES BY INJURY SEVERITY

Incident Collision Manner

Incident collision manner describes the type of crash.

This describes the actual type of accident. The choices are self-descriptive and are summarized in **Table 9**.

Summary

- 36 (63%) of the total crash's collision manner are angle crashes
- Single vehicle crashes account for the 12 (21%) crashes.
- All (100%) of the fatal crashes are angle crashes, and 78% (7) of the serious injury incidents are angle crashes.

TABLE 9: COLLISION MANNER BY SEVERITY

Collision Manner	Crashes	%	Fatal	%	Serious Injury	%	Injury	%	PDO	%
Angle	36	63%	5	100%	7	78%	9	82%	15	47%
Rear End	5	9%	0	0%	0	0%	0	0%	5	16%
Sideswipe Same Direction	3	5%	0	0%	0	0%	1	9%	2	6%
Single Vehicle	12	21%	0	0%	1	11%	1	9%	10	31%
Other	1	2%	0	0%	1	11%	0	0%	0	0%
Total	57		5		9		11		32	

Person Violation

The violation crash description identifies the driver behavior, if applicable, that is responsible for the incident. These descriptors can provide insight to the driver and behavioral characteristics. **Table 10** summarizes the person violations by type.

Summary

- Failure to yield right of way is the most common person violation with 32 (56%) of crashes.
- Violation for 4 fatal crashes, and 8 suspected serious injury crashes were failure to yield right of way, representing 86% of the 14 fatal or suspected serious injury crashes.
- Speed too fast for conditions is the second leading violation with 11 (19%) of crashes.
- Violations for suspected serious injury crashes were failure to yield right of way with 8 crashes (89%), and speed too fast for conditions with 1 (11%).

TABLE 10: PERSON VIOLATION BY SEVERITY

Person Violation	Crashes	%	Fatal	%	Serious Injury	%	Injury	%	PDO	%
Aggressive Driving	1	2%	0	0%	0	0%	0	0%	1	3%
Failed to Yield Right of Way	32	56%	4	80%	8	89%	9	82%	11	34%
Followed Too Closely	2	3%	0	0%	0	0%	0	0%	2	6%
Made Improper Turn	1	2%	0	0%	0	0%	0	0%	1	3%
No Improper Action	3	5%	0	0%	0	0%	0	0%	3	9%
Other	2	4%	0	0%	0	0%	0	0%	2	6%
Ran Stop Sign	4	7%	1	20%	0	0%	1	9%	2	6%
Speed Too Fast for Conditions	11	19%	0	0%	1	11%	1	9%	9	28%
Unsafe Lane Change	1	2%	0	0%	0	0%	0	0%	1	3%

Crash Report Review

Submitted police reports for all fatal and suspected serious injury crashes were obtained from ADOT's Traffic Safety Section. These reports provide a detailed account of the crash, with statements from those involved and witnesses, roadway and environmental conditions, and a collision diagram.

A review of the written narratives for the 14 fatal (5) and suspected serious injury (9) crashes shows that most of the crashes involved a southbound US 93 vehicle turning left to eastbound Pierce Ferry Road, and a vehicle headed northbound on US 93. This condition is described in 11 of the 14 crashes.

The reports describe that the southbound vehicle, that desires to turn left, fails to yield right of way to the northbound approaching vehicle. Vehicles fail to see the northbound vehicle approaching or underestimated its speed for distance from the intersection.

Weather, time of day, and other environmental factors do not appear to be a contributing factor. 53 of the 57 incidents are recorded during daylight with clear weather conditions.

Historical Comparison

The *WACOG Strategic Transportation Safety Plan (STSP)* analyzed crashes for 2011-2015 and applied a Priority Index (PI) rating. The PI ranking is a combination of crash frequency, crash rate, and severity index, giving equal weighting to each.

- Crash frequency is the number of crashes that occurred within the five-year analysis period.
- Crash rate is the number of crashes that occurred per million vehicles entering the intersection.
- Severity index represents a weighted score based on the weighted distribution of the five crash severity levels at the intersection.

In the 2011-2015 period, there were 12 crashes at this intersection (crash frequency). The *WACOG STSP* identified a crash rate of 0.17 crashes per million vehicles entering the intersection (MEV) and a severity index of 3.17 at the intersection of US 93 and Pierce Ferry Road. Based on the 2011-2015 data, this has a PI ranking of 29 (out of 137 ranked intersections).

Crash analysis of the most five-year period (2015 to 2019) shows an increase as compared to the 2011-2015 period, with 57 crashes at the intersection of US 93 and Pierce Ferry Road. As summarized **Table 11**, the intersection crash rate increased to 1.88 (+1.71) crashes per MEV and the severity index decreased 2.37 (-0.8) as compared to the *WACOG STSP* analysis. The decrease in the severity index is attributed to an increase in overall crashes between the two analysis periods. The number of fatal and severe injury crashes is a smaller percentage of the overall number of crashes.

TABLE 11: CRASH RATE AND SEVERITY INDEX CALCULATION

Crash Rate Equation	
$CR = \frac{1,000,000 * Crashes}{365 * Years * Volume}$	$CR = \frac{1,000,000 * 57}{365 * 5 * 16,603}$ **CR = 1.88 crashes per MEV**
Fatal Crash Rate	
$CR = \frac{1,000,000 * Fatal}{365 * Years * Volume}$	$FCR = \frac{1,000,000 * 5}{365 * 5 * 16,603}$ **FCR = 0.17 crashes per MEV**
Severity Index	
$SI = \frac{(5.8 * (K + A) + 2 * (B + C) + PDO}{\text{Total Crashes}}$	$SI = \frac{(5.8 * (5 + 9) + 2 * (8 + 3) + 32}{57}$ **SI = 2.37**

TABLE 12: CRASH RATE AND SEVERITY INDEX FOR US 93/PIERCE FERRY ROAD

Injury Severity	Occurrence	%
Fatal	5	9%
Suspected Serious Injury	9	16%
Minor Injury	8	14%
No Injury	3	5%
Property Damage Only	32	56%

AADT 2019 (StreetLight)	16,603
PFR / US 93 Crash Rate (MEV) (2015-2019)	**1.88**
WACOG STSP Crash Rate (2011-2015)	*0.17*
PFR / US 93 Severity Index (2015-2019)	**2.37**
WACOG STSP Severity Index (2011-2015)	*3.17*

Table 13 summarizes each of the fatal crashes in the 2015-2019 analysis period. All of the fatal crashes involved a southbound vehicle on US 93 that was making a left turn into the median refuge and proceeding across northbound US 93 and colliding with a northbound vehicle. All the crashes were a result of driver error for the southbound US 93 vehicle.

The analysis of the 57 crashes (2015-2019) shows that the crash rate at US 93 and Pierce Ferry Road has increased from 0.17 (2011-2015) to 1.88 (2015-2019).

The severity index decreased from 3.17 (2011-2015) to 2.37 (2015-2019) due to an overall increase in the number of crashes that occurred in the most recent 5-year period.

Summary

Angle collision manner is the most common at the intersection accounting for 36 crashes (63%). All five fatal crashes and seven suspected serious injury crashes (78%) are due to angle collisions that occurred when a vehicle traveling southbound on US 93 makes a left turn onto Pierce Ferry and colliding with a vehicle traveling northbound on US 93.

A main contributor to these incidents is failure to yield the right of way accounting for 32 (56%) crashes. This violation accounts for four of the five fatal crashes and the other is failure to yield at stop signs.

TABLE 13: FATAL CRASHES SUMMARY

Incident ID	Incident Date & Time	Unit Number	Incident Injury Severity Description	Residence of Crash Victims	Incident Collision Manner Desc	Incident Light Condition Desc	Incident Weather Desc	Unit Body Style Desc	Unit Travel Direction Desc	Unit Surface Condition Desc1	Person Violation Desc1	Narrative Summary
3089758	4/21/2016 12:02:00 PM	1	Fatal	Diamond Bar, CA (Chinese national)	***Angle (Front To Side) (Other Than Left Turn)***	Daylight	Clear	Passenger 4Dsd Sedan 4 Dr	6 - Northeast	Dry	***Ran Stop Sign***	Unit 1 turned from SB US 93 to EB Pierce Ferry Road. Vehicle 1 did not stop at the stop sign at US 93 and crossed in front of the on-coming vehicle. Two individuals in Unit 1 were deceased.
		2		Layton, UT	***Angle (Front To Side) (Other Than Left Turn)***	Daylight	Clear	Passenger 12Pu Pickup 1 2 Ton	5 - Northwest	Dry	No Improper Action	
3117584	7/24/2016 1:40:00 PM	1	Fatal	China	***Angle (Front To Side) (Other Than Left Turn)***	Daylight	Clear	Truck Vn Van	3 - East	Dry	***Failed To Yield Right Of Way***	Unit 1 failed to yield to NB US 93 unit 2. Unit 2 was a large RV/Bus. The collision resulted in 4 fatalities, all of whom were in Unit 1.
		2		Lancaster, TX	***Angle (Front To Side) (Other Than Left Turn)***	Daylight	Clear	Truck Bs Bus	1 - North	Dry	No Improper Action	
3314678	12/24/2017 2:19:00 PM	1	Fatal	Chesterton, Indiana	***Angle (Front To Side) (Other Than Left Turn)***	Daylight	Clear	Passenger 4Dsd Sedan 4 Dr	3 - East	Dry	***Failed To Yield Right Of Way***	Unit 1 (traveling SB US 93 making a left turn to EB Pierce Ferry Road) failed to yield right of way to Unit 2, traveling NB US 93. Fatal victim was in Unit 2.
		2		Pahrump, Nevada	***Angle (Front To Side) (Other Than Left Turn)***	Daylight	Clear	Passenger 12Pu Pickup 1 2 Ton	1 - North	Dry	No Improper Action	
3340144	3/1/2018 1:36:00 PM	1	Fatal	Alhambra, California (Chinese nationals)	***Angle (Front To Side) (Other Than Left Turn)***	Daylight	Clear	Passenger Sw Station Wagon	3 - East	Dry	***Failed To Yield Right Of Way***	Unit 1 (traveling SB US 93 to EB Pierce Ferry Road failed to stop at the stop sign at NB US 93. Unit 2 on NB US 93, a cargo van, struck Unit 1. Two individuals in Unit 1 were deceased.
		2		Phoenix, Arizona	***Angle (Front To Side) (Other Than Left Turn)***	Daylight	Clear	Truck 1Tvn Van 1 Ton	1 - North	Dry	No Improper Action	
3532255	6/26/2019 10:46:00 AM	1	Fatal	Chinese national	***Angle (Front To Side) (Other Than Left Turn)***	Daylight	Clear	Truck Vn Van	3 - East	Dry	***Failed To Yield Right Of Way***	Unit 1 turned from SB US 93 to eastbound Pierce Ferry Road. Unit 1 stopped at the stop sign, and then proceed into the intersection where it was struck by Unit 2. The deceased individual was a passenger in Unit 1. Unit 1 had 10 passengers.
		2		Mesa, Arizona	***Angle (Front To Side) (Other Than Left Turn)***	Daylight	Clear	Passenger 34Pu Pickup 3 4 Ton	1 - North	Dry	No Improper Action	

5. ALTERNATIVES

This section introduces grade-separation intersection improvement alternatives that will be considered and evaluated within this study. Each design alternative is intended to improve intersection safety and reduce the frequency and severity of crashes at the intersection.

The alternatives are focused on grade-separation to mitigate the most problematic movement – a southbound vehicle on US 93 making a left turn to eastbound Pierce Ferry Road. Three alternatives are introduced:

- Alternative 1 – Half TI, Northbound US 93 Over Pierce Ferry Road
- Alternative 2 – Flyover Ramp, Southbound US 93 to Pierce Ferry Road

Based on input from the Technical Advisory Committee, Alternatives 1b and Alternative 3 will be carried forward.

Alternative 1 – Half TI, Northbound US 93 Over Pierce Ferry Road

See Alternative 1, Appendix A

Alternative 1 removes the conflict between the northbound US 93 traffic vehicles traveling from southbound US 93 to eastbound Pierce Ferry Road, by elevating the northbound lanes of US 93 over Pierce Ferry Road. A new bridge would be constructed for northbound US 93 over Pierce Ferry Road. The US 93 northbound profile would be elevated to accommodate the new structure. New taper-type ramps, which are typically used in rural areas per Arizona Department of Transportation's (ADOT) *Roadway Design Guidelines* (RDG), would be installed: an off-ramp connecting US 93 northbound to Pierce Ferry Road and an on-ramp connecting Pierce Ferry Road to US 93 northbound.

A stop-controlled intersection at the on-ramp/off-ramp/Pierce Ferry Road intersection will impact the west end of the adjacent Chevron service station parking area. Business driveways will remain and not require reconstruction. Geometrics for US 93 southbound and Pierce Ferry Road would remain intact as is. New right-of-way will be required for the northbound new ramps.

Alternative 2 – Flyover Ramp, Southbound US 93 to Pierce Ferry Road

See Alternative 2, Appendix B

Alternative 2 removes the conflict between the northbound US 93 traffic and the vehicles traveling from southbound US 93 to eastbound Pierce Ferry Road by elevating the exiting southbound traffic over US 93 and providing direct access to Pierce Ferry Road. The flyover ramp bridge will be a curved and super-elevated one-lane structure with a 25-mph design speed. ADOT's RDG states that desirable speed through the main body of the ramp should be 50 mph but lower design speeds may be used to accommodate loop ramps and other geometric features. Signing and rumble strips may be used to keep drivers alert to the changing conditions.

The structure footprint will be extensive in the southeast quadrant to accommodate the curve geometrics and vertical impacts such as walls and embankment slopes. The flyover ramp will merge onto Pierce Ferry Road. Driveways at the service station will not be impacted. Parcels along the east side of Pierce Ferry Road that have access at the merge lane will be cut off and driveways will have to be closed and accesses pushed eastward. Geometrics for US 93 northbound and Pierce Ferry Road would remain intact as is. Southbound US 93 through traffic will continue to use existing roadway facilities. Northbound US 93 will also continue to use existing roadway facilities. New right-of-way will be required for the southbound new taper-type exit ramp and the fly-over structure in the southeast quadrant.

Project No.: T0230 01L
Federal Project No. MMO-0(222)T

APPENDIX A – ALTERNATIVE 1

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	T0230 01L	2	3	

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

LEGEND

- Reconstruction Limits - Highway, Ramps, and Crossroad
- New Bridge

	NAME	DATE
DESIGN	RADDEMAN	7/20
DRAWN	RADDEMAN	7/20
CHECKED	TAPIA/HATHCOCK	7/20

Kimley»Horn

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

ALTERNATIVE I
HALF TI, NORTHBOUND US 93
OVER PIERCE FERRY RD

PRELIMINARY
NOT FOR
CONSTRUCTION
OR
RECORDING

ROUTE	LOCATION	DWG NO.
US 93	US 93 AND PIERCE FERRY RD	
TRACS NO. T0230 01L	-	___ OF ___

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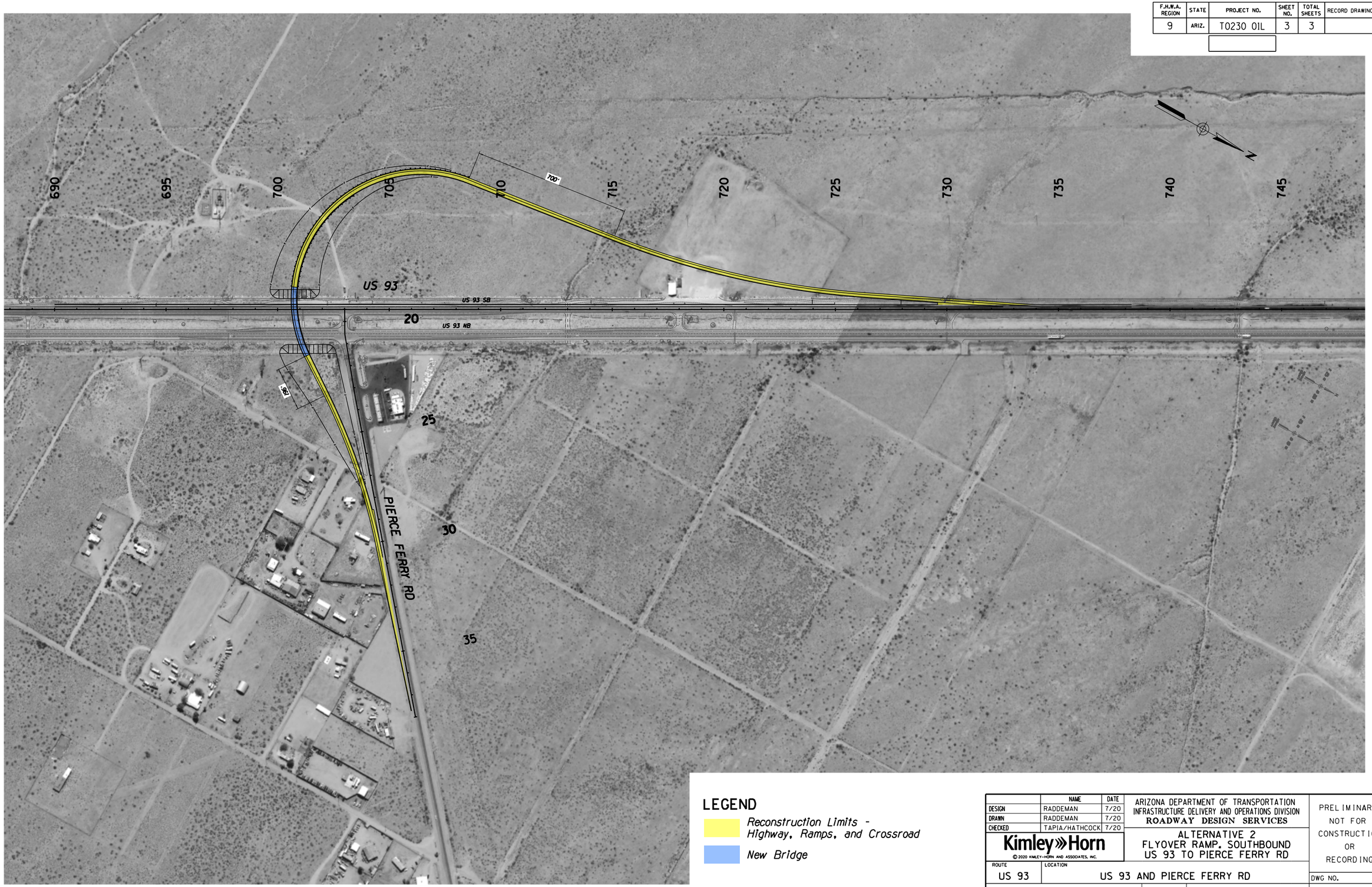
Project No.: T0230 01L
Federal Project No. MMO-0(222)T

APPENDIX B – ALTERNATIVE 2

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	T0230 01L	3	3	

DATE- | LOCATION- | REVISIONS- | FINISHED PLANS- | SURVEY NO.



LEGEND

Reconstruction Limits - Highway, Ramps, and Crossroad

New Bridge

	NAME	DATE
DESIGN	RADDEMAN	7/20
DRAWN	RADDEMAN	7/20
CHECKED	TAPIA/HATHCOCK	7/20

Kimley»Horn

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

ALTERNATIVE 2
FLYOVER RAMP, SOUTHBOUND
US 93 TO PIERCE FERRY RD

PRELIMINARY
NOT FOR
CONSTRUCTION
OR
RECORDING

ROUTE	LOCATION	DWG NO.
US 93	US 93 AND PIERCE FERRY RD	___ OF ___
TRACS NO. T0230 01L	-	

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