



Montana Department of Transportation

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**Memorandum**

To: Bob Vosen, P.E. – Missoula District Administrator  
From: Stan Brelin II, P.E. – Traffic Operations Engineer *SB*  
Date: August 8, 2023  
Subject: Intersection Traffic Control Study  
US 93 & Adams Street – Lakeside

An intersection traffic control study including an evaluation of traffic signal warrants was completed for the intersection of US 93 and Adams Street in Lakeside, Montana. The purpose of this study is to determine the appropriate intersection control that addresses safety, operations, and considers the needs of all users. Data used in this study includes traffic and pedestrian counts from six different days as well a 10-year crash history review. Two counts were collected during summertime conditions and four other counts were collected in October when school was in session. **The study concluded – no further improvements are recommended at this time. Even if further improvements were justified, existing conditions prevent further pedestrian safety and intersection improvements without addressing the lack of pedestrian facilities, local access, and parking on the west side of US 93 and north of Bills Road.**

**Existing Conditions**

US 93 is a north-south principal arterial and part of the Non-interstate National Highway System. This segment of US 93 was constructed in 1934 and last improved in 2017. The Plains – NW project was a seal and cover project to improve and maintain the road surface. Typical sections for this segment are comprised of two 12-foot travel lanes (one in each direction) with a 14-foot center two-way-left-turn lane and 4-foot to 8-foot shoulders. At the intersection the shoulders are 8-foot on the southern side and 4-foot on the northern side. The west shoulder is used for pedestrians and has a painted divider to separate the pedestrians and vehicles. There is adequate sight distance both on and along the roadway as the alignment is primarily tangent and flat in this area. The intersection itself is on a slight curve. There are no centerline or shoulder rumble strips. Parking restrictions are not striped near the intersection, but adequate space is not provided on the shoulder. The posted speed limit in this area of US 93 is 35-mph.

Adams Street is an east-west off system local road. The base speed limit is 25-mph. On the western side of US 93, Adams Street has a 15-mph school zone. The paved road surface is approximately 20-foot wide and can accommodate two 10-foot travel lanes with no shoulder. Sidewalks only exist on the northeast corner of the intersection at Volunteer Park.

In general, there are three types of drivers utilizing the intersection: local, commuters, and recreationalists. The community of Lakeside is primarily based around recreational activities. The summer months bring an influx in traffic accessing Flathead Lake and traveling from Interstate 90 to Glacier National Park. During the winter, there is a draw because of the lake and Blacktail Mountain Ski Area. Year round there is local traffic from the residential development along Flathead Lake and west of US 93. Overall Adams Street is one of two primary accesses for most of the residential development into US 93. Many of the smaller communities along Flathead Lake are primarily centered around seasonal service industries which causes some individuals to commute to the larger towns and cities such as Kalispell for work.



**Figure 1: General Location of Intersection**



**Figure 2: Overview of the surrounding area**

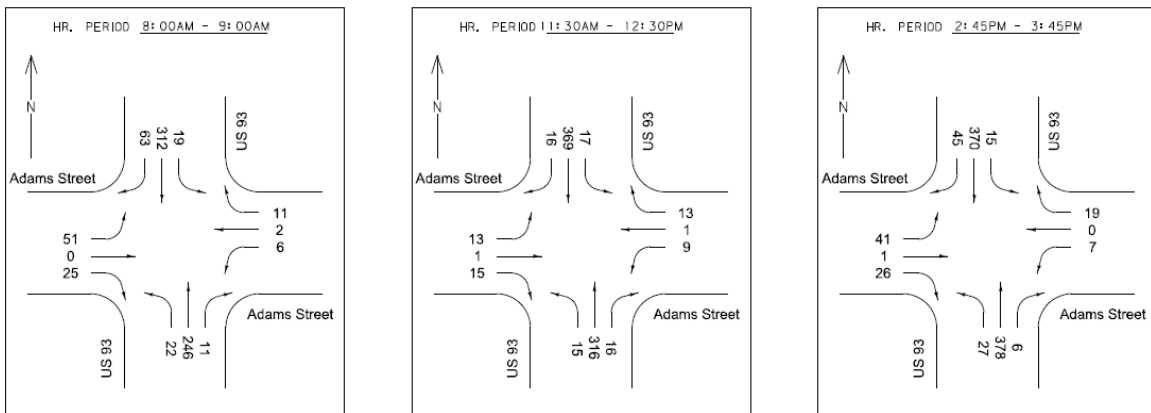
Currently the only traffic control on Adams Street is a stop sign for both the east and west legs of the intersection. US 93 traffic is uninterrupted except when a pedestrian utilizes the rectangular rapid flashing beacons (RRFB). The crosswalk is located on the northern leg of the intersection and is continental in style. Shark teeth were installed in 2023 along with restriping the crosswalk on US 93. There are no pavement markings on Adams Street. A real estate office occupies the southeast corner of the intersection whereas a church is on the southwest corner. On the northside of the intersection there is a park on the east side of US 93 and a building occupied by kayak rental business, gift shop, and restaurant on the west side of US93.



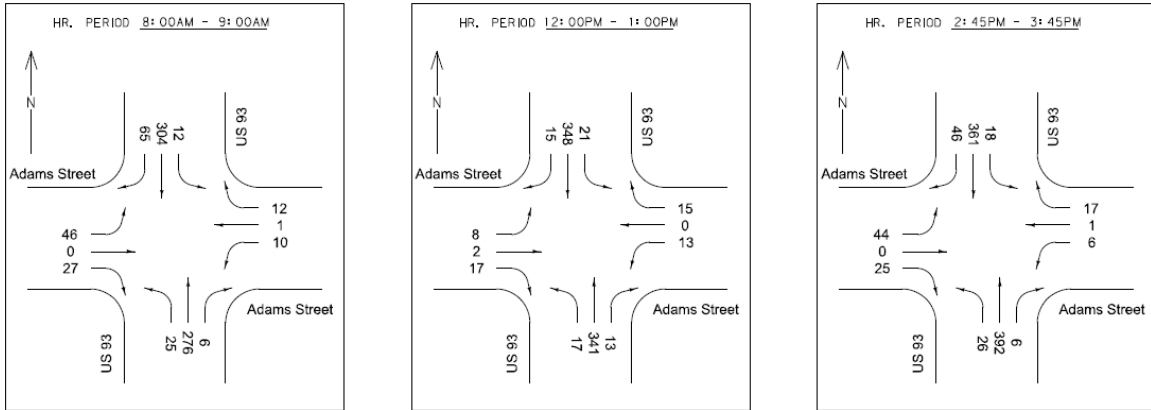
**Figure 3: Street View of Intersection**

**Traffic Volumes**

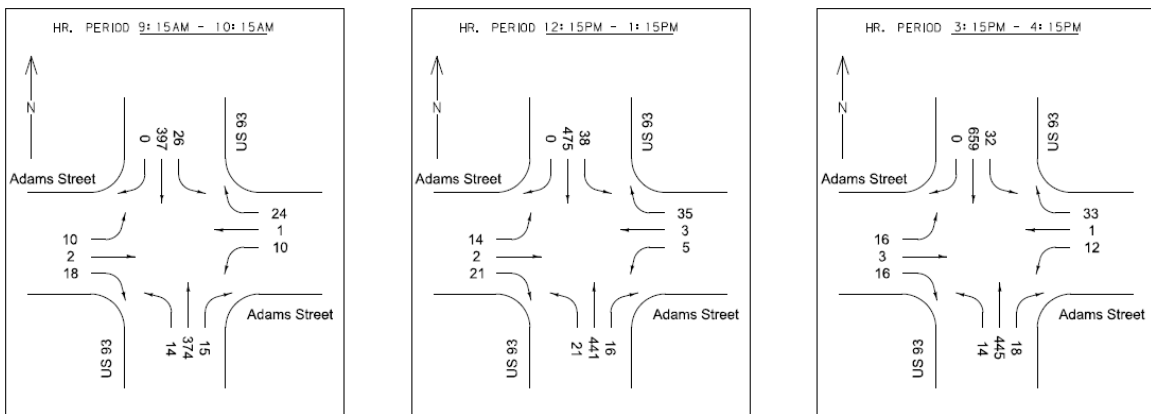
Automatic turning movement counts (TMCs) were taken at the intersection in October of 2021 and August of 2022 during the morning, midday, and afternoon peak traffic periods. The peak hour TMCs recorded during the morning, midday, and afternoon peak traffic periods are shown below in Figure 4 for October 6, 2021, Figure 5 for October 7, 2021, Figure 6 for August 9, 2022, and Figure 7 for August 30, 2022. Traffic data was collected on two other dates in October of 2021 but did not include the morning hours.



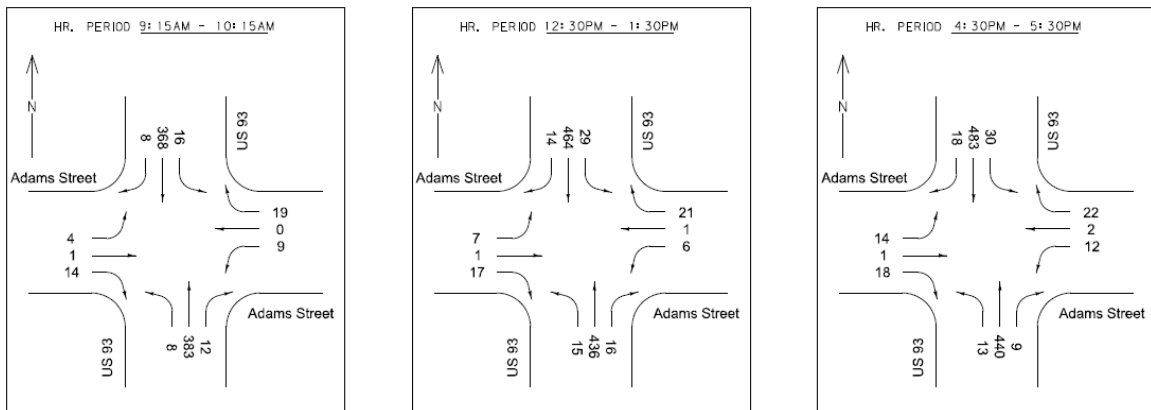
**Figure 4: October 6, 2021, Peak Hour Volumes**



**Figure 5: October 7, 2021, Peak Hour Volumes**



**Figure 6: August 9, 2022, Peak Hour Volumes**



**Figure 7: August 30, 2022, Peak Hour Volumes**

Existing traffic flow for northbound and southbound directions have the highest traffic counts as this is through traffic traveling between Interstate 90 and the Kalispell region. The summer counts were found to have higher traffic volumes in comparison to the counts done while school was in session. Through traffic counts for northbound and southbound traffic were observed to be on average about 34-percent greater during the summer. However, total vehicle counts on Adams Street were approximately 22-percent less during the summer in comparison to the counts performed when school was in

session. Year round the primary movements from Adams Street are left and right turns. During the summer the most popular turning movement from Adams Street is a right onto US 93. When school is in session right turning movements are still prevalent but left turns becomes the primary movement for the west leg of Adams Street during peak hours. A similar trend in the turning movements off US 93 can also be observed. During the summer most of the turning movements exit US 93 onto Adams Street heading east whereas when school is in session most of the turning movements exit US 93 onto Adams Street heading west.

### **Capacity Analysis**

Capacity analysis of the intersection was performed using HCS 2010 software. The morning, midday, and afternoon peaks from October 2021 and August 2022 counts were used to calculate the level of service (LOS), delay(seconds), and v/c ratio.

The worst delay observed in August occurred for eastbound traffic during the afternoon peak hour. Eastbound traffic had an approximate delay of 56-seconds which represents a LOS F. During this time westbound traffic had a delay of about 33-seconds corresponding to a LOS D. However, the morning and midday peak hours show both approaches functioning at a LOS C with delays ranging from 15-seconds to 23-seconds. At all times US 93 maintained a LOS A and had a maximum delay of about 9-seconds.

**Table 1: August Peak Hour Capacity Analysis**

Morning Peak	Eastbound	Westbound	Northbound	Southbound
Movement	Through	Through	Through	Through
v/c Ratio	0.09	0.1	0.01	0.03
Delay	16.2	15.1	8.3	8.4
LOS	C	C	A	A

Midday Peak	Eastbound	Westbound	Northbound	Southbound
Movement	Through/Right	Through/Left	Left	Left
v/c Ratio	0.17	0.12	0.02	0.04
Delay	23.0	16.2	8.7	8.7
LOS	C	C	A	A

Afternoon Peak	Eastbound	Westbound	Northbound	Southbound
Movement	Through/Right	Through/Left	Left	Left
v/c Ratio	0.39	0.31	0.02	0.04
Delay	55.9	32.8	9.9	9.9
LOS	F	D	A	A

During the month of October, the maximum delay was observed during the afternoon peak hour on the west leg of the intersection. The delay was approximately 26-seconds and corresponded to a LOS D. For the most part delay ranged from about 14-seconds to 18-seconds on Adams Street representing a LOS B or C. US 93 had a LOS A during all peak hour periods.

**Table 2: October Peak Hour Capacity Analysis**

Morning Peak	Eastbound	Westbound	Northbound	Southbound
Movement	Through/Right	Through/Left	Left	Left
v/c Ratio	0.22	0.06	0.02	0.01
Delay	17.7	14.0	8.2	7.9
LOS	C	B	A	A

Midday Peak	Eastbound	Westbound	Northbound	Southbound
Movement	Through/Right	Through/Left	Left	Left
v/c Ratio	0.06	0.08	0.02	0.02
Delay	13.6	14.8	8.2	8.1
LOS	B	B	A	A

Afternoon Peak	Eastbound	Westbound	Northbound	Southbound
Movement	Through/Right	Through/Left	Left	Left
v/c Ratio	0.31	0.07	0.03	0.02
Delay	25.6	15.4	8.4	8.3
LOS	D	C	A	A

Pedestrian traffic was highest during the afternoon peak hour in August. A total of 128 pedestrians were observed with 96 traveling east or west and 32 traveling north or south. Considering the number of pedestrians observed during the afternoon peak hour was nearly double the number of pedestrians observed during the midday peak hour and almost four times larger than the morning peak hour, further analysis was performed. The pedestrian crossings during the afternoon peak hour added about 18-seconds of total delay. On the west leg there was almost 12-seconds of added delay from pedestrian crossings. The east leg only had about 6-seconds of added delay because of pedestrian crossings. There was less than 1-second of added delay between both the north and south legs of the intersection.

**Table 3: Afternoon Peak Hour Capacity Pedestrian Comparison**

Afternoon Peak	Eastbound	Westbound	Northbound	Southbound
Movement	Through/Right	Through/Left	Left	Left
Delay with Pedestrians	55.9	32.8	9.9	9.9
Delay No Pedestrians	44.3	27.1	9.5	8.8
LOS with Pedestrians	F	D	A	A
LOS No Pedestrians	E	D	A	A

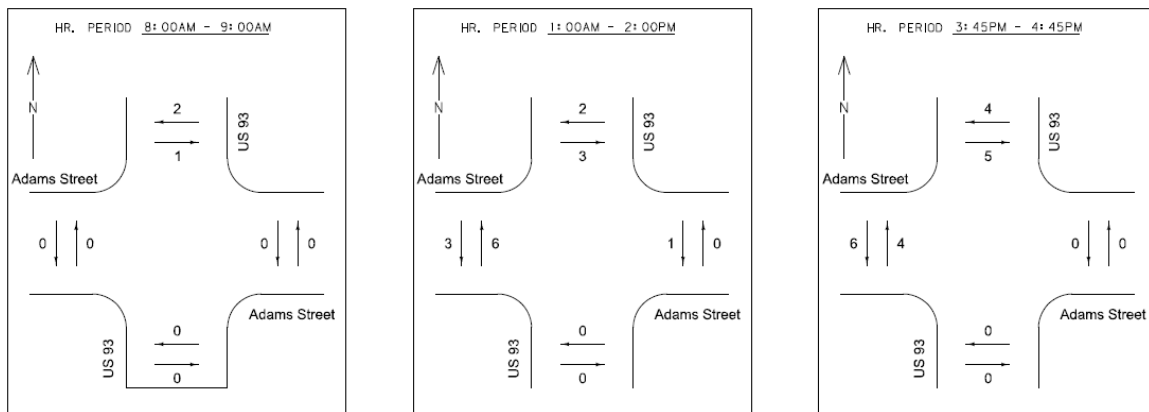
**Growth Rate**

Traffic volumes have been collected north and south of the community of Lakeside for the past 10-years. To the north of Lakeside traffic volumes have increased by about 81-percent. South of Lakeside traffic volumes have increased 25-percent over the past ten years. During that ten-year period the highest year over year increase in traffic volumes was 16-percent and occurred between 2020 and 2021. The greatest reduction in traffic volumes was 11-percent and occurred between 2013 and 2014. Based on the two count locations over the past ten years there has been on average a 4-percent growth in traffic volumes year over year on US 93.

There were no historical traffic counts available for Adams Street. However, census data is available for Lakeside from 2020, 2010, 2000, and 1990. Flathead County also has census data beginning in 1900. Based on the census data from Lakeside the community has seen a 2.95-percent increase in population year over year since 1990. Furthermore, Flathead County has seen a 2.03-percent increase in population year over year since 1900. The estimated growth rate for Adams Street is likely between two and three percent.

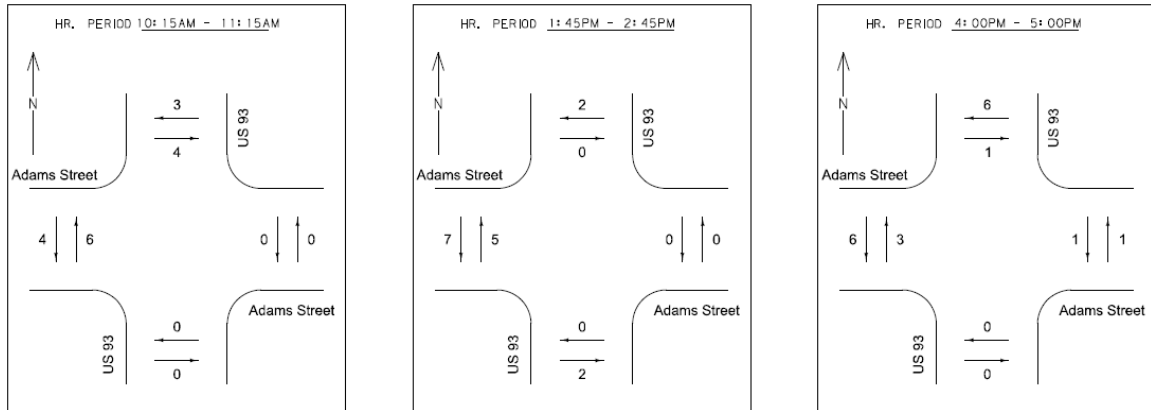
**Pedestrian Activity**

Pedestrian activity was observed in October of 2021 and August of 2022. Figures 8 through 11 show the morning, midday, and afternoon peak pedestrian volumes for October 6, 2021, October 7, 2021, August 9, 2022, and August 30, 2022. A significantly higher volume of pedestrians was observed during the summer.



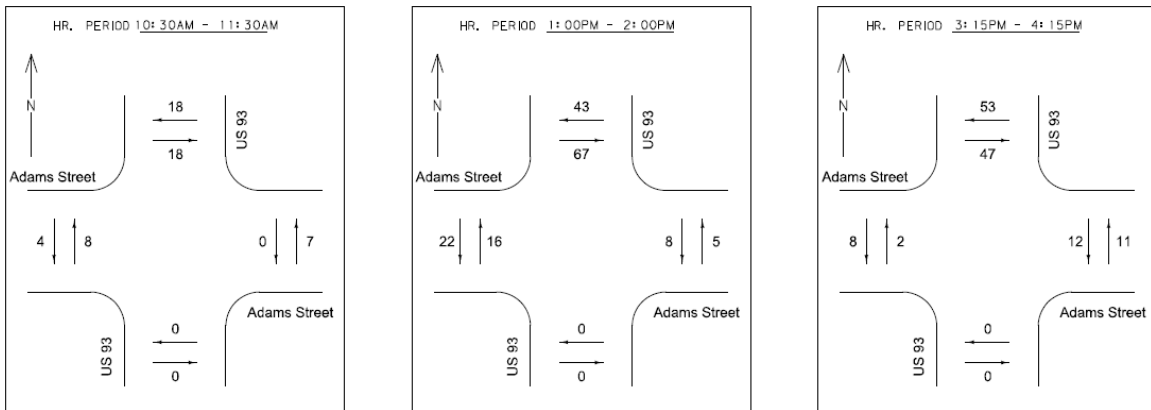
**Figure 8: Pedestrian Peak Hour Volumes for October 6, 2021**



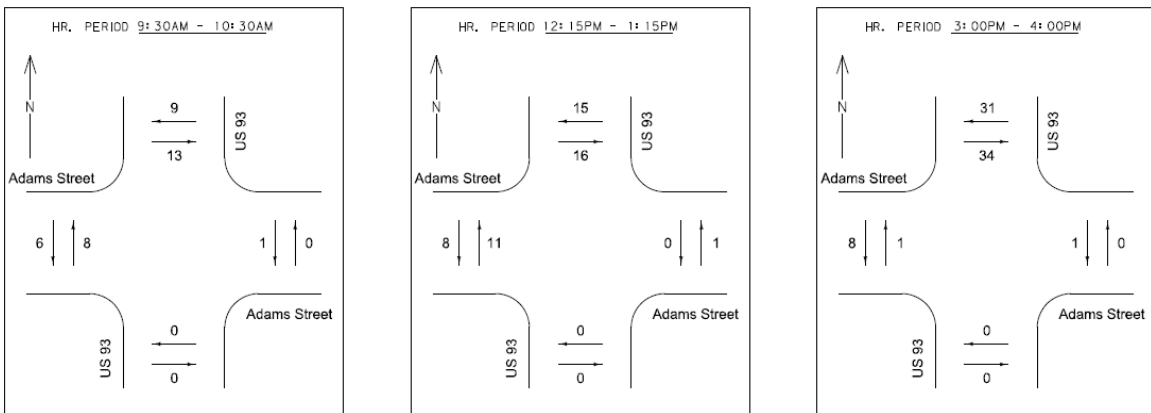


**Figure 9: Pedestrian Peak Hour Volumes for October 7, 2021**

Pedestrian volumes during the month of October were consistent from day to day. Approximately 6 pedestrians were observed crossing US 93 during the peak hours on average. About 8 pedestrians were observed during the peak hours crossing the west leg of Adams Street on average. Normally there were no pedestrians observed crossing the east leg of Adams Street.



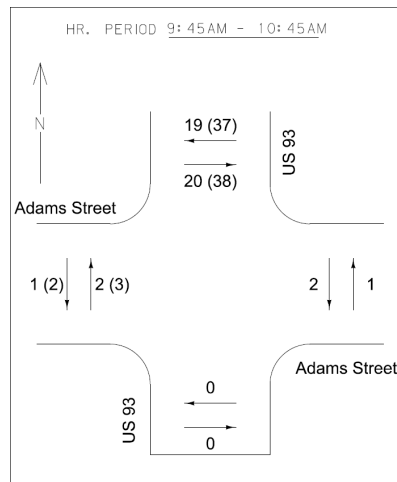
**Figure 10: Pedestrian Peak Hour Volumes August 9, 2022**



**Figure 11: Pedestrian Peak Hour Volumes August 30, 2022**

Between the beginning of August and the end of August there was some fluctuation in pedestrian volumes. Total pedestrian volumes during the peak hours were on average twice as much on the 9<sup>th</sup> of August in comparison to the 30<sup>th</sup> of August. There were no events and both days were Tuesdays. Temperatures were eight degrees cooler on the 30<sup>th</sup> compared to the 92-degree day observed on the 9<sup>th</sup>.

Pedestrian volumes were not adjusted to account for child pedestrians except for October 8, 2021. On this date there were 36 school aged children observed crossing the northern leg of the intersection during the peak hour in Figure 12. It was estimated that a child pedestrian would need 14-second to cross the 46-foot-wide road surface plus an additional 3-seconds for perception reaction time. The total time a school aged-child pedestrian would require is 17-seconds. When these children were observed crossing US 93 there was one adult present and the lead child had an orange flag to wave while crossing with the RRFB activated.



**Figure 12: Peak School Age Children Pedestrian Crossings**

### **Gap Study**

As described above an acceptable gap for a school aged pedestrian is 17-seconds. There were multiple children observed crossing US 93 during the summer and while school was in session. Therefore, it would be reasonable to assume 17-seconds as an appropriate gap to use year-round for this crossing. An acceptable gap distribution is 1 gap per minute. The gap study was performed on August 9, 2022. Over the course of the day there was only an acceptable gap distribution at night during the 12-hours between 8:00PM and 8:00AM. During the peak hours in the morning, midday, afternoon for both vehicles and pedestrians, there was an average gap distribution of 25 gaps per hour. The lowest gap distribution during the peak hours was observed between 12:15PM and 1:15PM at about 1 gap every 4.5-minutes. Peak hour gap distribution was highest at 1 gap every 2-minutes during the peak afternoon hour from 3:15PM to 4:15PM. Yielding compliance was observed to be acceptable when pedestrians used the RRFB. Although an in-depth gap study was not performed on the other days, during the month of October pedestrians were not observed waiting for traffic before crossing.

## Travel Speeds

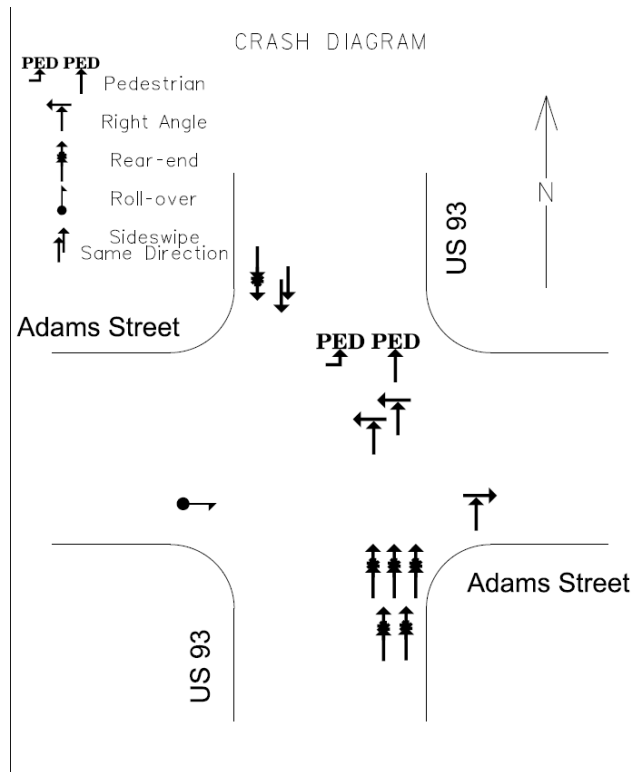
Vehicular travel speeds were sampled directionally at the intersection of US 93 and Adams Street. The posted speed limit is 35-mph for this area. The speed data indicates the prevailing speed for the area is around 34-mph which is 1-mph below the posted speed limit. A speed study has been requested to be completed in 2023 that will encompass the community of Lakeside.

## Crash and Citation History

The intersection of US 93 and Adams Street along with the surrounding area is of great concern to the public. Not only was an intersection control study requested, but pedestrian studies were requested for two other nearby intersections along with a speed study for the whole area. Therefore, crash history was reviewed for a ten-year period from January 1, 2011, to December 31, 2020, instead of the typical three-to five-years. There were 11 crashes related to the Adams Street intersection shown in Table 4 and Figure 13. Seven of the crashes were related to pedestrians in the crosswalk. Two of the pedestrians were hit. A fifth may have been pedestrian related but was only described as a rear-end collision because of traffic at Adams Street. Including the one pedestrian crash, five crashes involved left turning traffic. Four were vehicles turning left onto US 93 from Adams Street. Two of the crashes involved the driver entering US 93 in front of another vehicle and another involved the driver losing control of their vehicle when attempting a left. The last one was a pedestrian crash. Two other crashes were recorded near the intersection and resulted in a rear-end collision because of slowing traffic.

**Table 4: US 93 and Adams Street Crashes from 2011 through 2020**

<b>Date</b>	<b>Time</b>	<b>Weather</b>	<b>Road Condition</b>	<b>Light Condition</b>	<b>Crash Type</b>
6/15/2011	10:15:00	Cloudy	DRY	DAYLIGHT	Pedestrian
7/02/2012	14:50:00	Cloudy	DRY	DAYLIGHT	Sideswipe, Opposite Direction
7/03/2014	14:45:00	Clear	DRY	DAYLIGHT	Pedestrian
7/13/2015	13:50:00	Clear	DRY	DAYLIGHT	Right Angle
8/15/2015	18:10:00	Cloudy	DRY	DAYLIGHT	Rear-End
5/09/2016	20:00:00	Clear	DRY	DAYLIGHT	Rear-End
7/07/2016	10:25:00	Clear	DRY	DAYLIGHT	Rear-End
7/24/2016	15:00:00	Clear	DRY	DAYLIGHT	Right Angle
6/09/2017	1:26:00	Cloudy	WET	DARK- LIGHTED	Roll Over
7/26/2017	14:10:00	Clear	DRY	DAYLIGHT	Rear-End
6/29/2019	13:15:00	Clear	DRY	DAYLIGHT	Sideswipe, Same Direction
7/28/2019	17:45:00	Clear	DRY	DAYLIGHT	Rear-End
2/19/2020	12:22:00	Clear	DRY	DAYLIGHT	Rear-End



**Figure 13: US 93 and Adams Steet Crash Diagram from 2011 through 2020**

**Stop Control Analysis**

The 2009 edition of the Manual on Uniform Traffic Control Devices (MUTCD) states multi-way stop control may be considered based on an engineering study that accounts for signal justification, crashes, and traffic volumes. Traffic counts for October 5, 6, and 7, 2021 and August 9 and 30, 2022 were used when determining if a multi-way stop control could be considered for the intersection.

Crashes were looked at over a ten-year period. A multi-way stop controlled intersection may be considered if there are five or more crashes within a 12-month period that are addressable by a multi-way stop installation. The largest number of crashes recorded occurred in 2016 at three. One could be considered addressable. In total there were 4 crashes that could be considered addressable over the ten-year period.

The traffic volumes entering this intersection on the major approaches are well above the 300 vehicles per hour for any 8 hours of an average day referenced by the MUTCD. Traffic volumes entering from the minor approaches including bicycles and pedestrians are required to be over 200 units per hour for the same 8-hour period of time. There were only two hours on the 9<sup>th</sup> of August 2022 where traffic volumes of vehicles, pedestrians, and bicyclists were at or above 200 vehicles an hour.

If none of the traffic volume or crash criteria are met, consideration of a multi-way stop controlled intersection can be made if all values are met at 80-percent: 4 crashes, 240 vehicles per hour on the major legs, and 160 vehicles per hour on the minor legs. Once

again only the traffic volumes on the major street were met. There are a high number of pedestrians observed at this location during the summer months. However, pedestrian counts were much lower the rest of the year. Improvements to allow for pedestrians to cross US 93 more readily should be considered before interrupting traffic flow with the installation of a multi-way stop control intersection. Discussions on the justification of a signalized intersection are found in the next section.

### **Traffic Signal Control Analysis**

The 2009 edition of the Manual on Uniform Traffic Control Devices (MUTCD) states that traffic signal control may be considered if one or more of nine traffic signal warrants are met. Traffic counts for October 5, 6, and 7, 2021 and August 9 and 30, 2022 were used when determining if any of the following warrants were met:

Warrant 4 – Pedestrian volume warrant was met on August 9, 2022, for the four-hour and single-hour criteria. Vehicle and pedestrian counts were at or above the four-hour minimum thresholds for the hours between 12:15PM and 8:00PM. The single-hour criteria was met for the hours between 12:30PM and 2:15PM, 2:45PM and 4:30PM, and 4:00PM and 5:30PM. This warrant was not met on any other day that was studied.

Warrants 1, 2, 3, 5, and 7 were considered but were not met. Even after factoring in growth, the intersection is not expected to meet warrants 1, 2, or 3 in the next 5 years.

Warrants 6, 8, and 9 were not applicable to the intersection.

Although Warrant 4 was satisfied installation of a signal will not be considered at this location. The warrant was only met on one day during the summer months. Pedestrian counts were well below the crossing thresholds the rest of the year. Improvements to allow for pedestrians to cross US 93 more readily should be considered before interrupting traffic flow by signalizing the intersection.

### **Roundabout Analysis**

As part of the intersection evaluation, it is a requirement to analyze the installation of a roundabout. The SIDRA analysis showed a roundabout at this location would operate at a LOS D or better for peak times. Preliminary geometric design shows this location could possibly accommodate a 140-foot roundabout (160-feet if including pedestrian facilities). The intersection would need to be shifted northeast and right of way would have to be obtained from the county and local businesses. Further analysis for future projected traffic volumes 20-years out indicates the southbound leg of US 93 would function at a LOS F and the northbound leg would function at a LOS E. Both approaches for Adams Street are shown to function at a LOS B.

Under existing conditions with Adams Street as stop-controlled, the intersection was shown to operate at a LOS B or better for all peak hours. Further analysis for future projected traffic volumes 20-years out indicates under existing conditions the approaches

for US 93 would function at a LOS A. The east approach for Adams Street would function at a LOS D and the west leg would function at a LOS C. A roundabout at this location would reduce the number of right-angle crashes and speeds for pedestrians. However, the number of crashes it may possibly address does not justify reconfiguring the intersection. Furthermore, it is not recommended to reconfigure an intersection functioning at a LOS B or better to one that will function at a LOS D or better as of today and one that will operate at a LOS F in the future. The amount of right of way required to install a roundabout and shifting it into the city park would likely prohibit the installation of this type of improvement.

**Pedestrian Improvements**

There were at least 14 pedestrians observed using the crosswalk between the hours of 11:45AM and 11:30PM on August 9, 2022, and between the hours of 9:00AM and 11:45AM on the August 10, 2022. US 93 is a two-lane highway with a center turn lane in this area with prevailing speeds of 34-mph. The AADT for 2021 was estimated around 10,500 vehicles.

2 Lane Facility					
Speed MPH	0 - 8,000 ADT	8,000 - 11,000 ADT	11,000 - 14,000 ADT	14,000 - 17,000 ADT	>17,000 ADT
0 - 30	C	C	C	E	A
35	C	C	E	E	A
40+	E	E	A	A	A
LEGEND					
An engineering study should be completed prior to selecting and installing any crossing treatments.					
C	Consider marked crosswalk with appropriate signage.				
E	Consider marked crosswalk with enhancements, such as traffic calming, refuge islands, curb extensions, advanced yield markings, raised crosswalks, flashing beacons, or other high-visibility treatments.				
A	Consider pedestrian-actuated beacons (i.e., rectangular rapid flashing beacons or pedestrian hybrid beacons) or pedestrian signal. MUTCD warrants for pedestrian hybrid beacons and pedestrian signals should be evaluated.				
[X]	Treatment option in brackets indicates treatment is applicable with installation of raised median				

**Figure 14: MDT Pedestrian Crossing Treatment Matrix**

Based on these observations and Figure 14 a marked crosswalk with appropriate signage and other possible enhancements should be considered. However, if there are volumes of greater than 25 people per hour a higher degree of treatment may be considered. During the summer months hourly pedestrian volumes can easily be over 25 people per hour especially after accounting for children and adults that may need extra time crossing the street. Based on the two days of data collection in August adjusted hourly volumes of 25

people were observed at least 40-percent of the day. Furthermore, when school is in session children are observed using the crosswalk. On October 8, 2021, 36 school aged children observed crossing US 93 during the peak hour. The high pedestrian volumes during the summer and large number of school aged children indicate considerations for a pedestrian actuated beacon should be installed. Currently, there is an RRFB installed at the crosswalk on the northern leg of the intersection.

There is a sidewalk on the northeast side of the intersection, but not on the northwest side. In Lakeside the west shoulder of US 93 is used as a shared use path and striped to separate vehicles from it. Considering the pedestrian volumes adding sidewalk from Adams Street to connect with the portion just south of Bierney Creek Road on the west side of US 93 and from just south of Bills Road on the east side of US 93 to Bierney Creek Road should be considered. Further review of the intersections with Bills Road and Bierney Creek Road will be done in subsequent reports.

### **Conclusions**

- Current growth rate on US 93 is approximately 4-percent.
- The growth rate for the community of Lakeside and Adams Street is between 2-percent and 3-percent.
- Warrant 4 was met for the pedestrian traffic on one of the observed days during the summer but at no other point.
- A RRFB currently draws attention to the pedestrians crossing US 93.
- There were 4 crashes over a ten-year period that may be addressable by signalization or altering the existing intersection traffic control. Typically, only a three-to-five-year period is reviewed.
- The existing intersection currently operates at a LOS C for the most part.
- During heavy traffic, capacity on the western leg functions between a LOS D and LOS F depending on the pedestrian traffic.
- Traffic directions shift from mostly eastbound off US 93 during the summer to mostly westbound when school is in session.
- Pedestrian traffic is highest during the summer months.
- During the school year we observed a class crossing with one teacher.
- No crossing guards were observed.
- There is adequate room to install a signal, but one is not recommended.
- Installing a roundabout would be difficult because of right of way constraints and cause the intersection to perform at a worse level of service.
- The existing posted speed limit is 35-mph but will be reviewed during the summer of 2023.
- Recent speed data indicates the prevailing speeds around 34-mph.
- Pedestrians are adequately visible but must rely on the RRFB to cross US 93.
- Pedestrian signing and pavement markings are present.
- Signal warrants and all-way stop-control recommendations are not projected to be met within the next 8-years.

## **Recommendation**

**MDT recommends no additional enhanced traffic control devices to the existing intersection at this time. Although the number of pedestrians during the summer may warrant a signal occasionally, the existing RRFB is functioning as intended and bringing attention to the pedestrians wanting to cross US 93. No other warrants were met and any changes to the intersection traffic control (roundabout, all-way stop-control, or signalization) would likely cause the intersection to perform worse with a lower level of service. Even if further improvements were justified, existing conditions prevent further pedestrian safety and intersection improvements without addressing the lack of pedestrian facilities, local access, and parking on the west side of US 93 and north of Bills Road.**

e-copies:

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