Appendix I

Traffic Study

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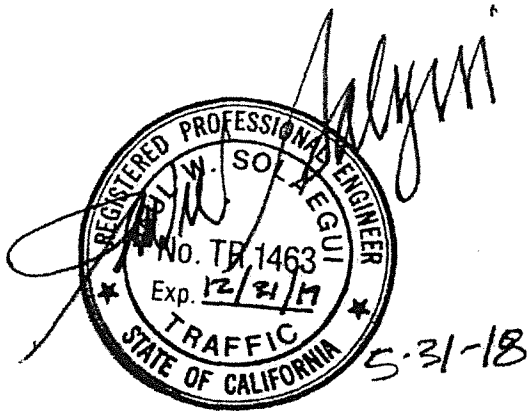
HAT CREEK
MATERIALS FACILITY

UPDATED TRAFFIC STUDY

MAY 2018



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HAT CREEK MATERIALS FACILITY

UPDATED TRAFFIC STUDY

EXECUTIVE SUMMARY

The Hat Creek Materials Facility is located in Lassen County, California. The project site is located east of Ward Lake Road and north of Center Road. The project site currently contains the existing Hat Creek Materials Facility. The purpose of this updated study is to address the project's impact upon the adjacent street network. The Center Road/Ward Lake Road and Center Road/Cutoff Road intersections have been identified for peak hour analysis for the existing and existing plus project scenarios. The typical AM and PM peak hours and a late night peak hour were identified for analysis. Center Road, Ward Lake Road, and Cutoff Road have been identified for daily traffic loading review for the existing and existing plus project scenarios.

The Hat Creek Materials Facility consists of a construction and materials facility. Access to the site is provided from Ward Lake Road via Center Road. The project is proposing to expand the daily hours of operation which will result in increased truck traffic to and from their facility. The expanded hours of operation are anticipated to generate 320 daily trips with 22 trips occurring during the AM peak hour, 22 trips occurring during the PM peak hour, and 22 trips occurring during the Night peak hour.

The increased traffic generated by the Hat Creek Materials Facility will have little impact on the adjacent street network.

No improvements are recommended at either the Center Road/Ward Lake Road intersection or the Center Road/Cutoff Road intersection.

INTRODUCTION

STUDY AREA

The Hat Creek Materials Facility is located in Lassen County, California. The project site is located east of Ward Lake Road and north of Center Road. Figure 1 shows the approximate location of the project site. The purpose of this updated study is to address the project's traffic impact on the adjacent street network. The Center Road/Ward Lake Road and Center Road/Cutoff Road intersections have been identified for peak hour analysis for the existing and existing plus project scenarios. The typical AM and PM peak hours and a late night peak hour were identified for analysis. Center Road, Ward Lake Road, and Cutoff Road have been identified for daily traffic loading review for the existing and existing plus project scenarios.

EXISTING AND PROPOSED LAND USES

The project site contains the existing Hat Creek Materials Facility. Adjacent properties generally include farm land with single family dwelling units to the southwest and undeveloped land to the north and west. The Hat Creek Materials Facility consists of a construction and materials facility. Access to the site is provided from Ward Lake Road via Center Road. The project is proposing to expand the daily hours of operation which will result in increased truck traffic to and from their facility.

EXISTING AND PROPOSED ROADWAYS AND INTERSECTIONS

Center Road is a rural, two-lane roadway with one through lane in each direction in the vicinity of the site. The speed limit is posted for 35 miles per hour generally east of Ward Lake Road, 45 miles per hour west of Ward Lake Road, and 55 miles per hour further west. Roadway improvements generally include ±1 wide paved shoulders with solid white edgelines and a striped centerline.

Ward Lake Road is a rural, two-lane roadway with one through lane in each direction north of Center Road. The speed limit is not posted. Roadway improvements generally include paved travel lanes with a striped centerline.

Cutoff Road is a rural, two-lane roadway with one through lane in each direction from US-395 to north of Center Road. The speed limit is not posted except for a 25 mile per hour zone on a curve. Roadway improvements generally include paved travel lanes with a striped centerline.

The Center Road/Ward Lake Road intersection is an unsignalized three-leg intersection with stop control at the north approach. The north approach contains one shared left turn-right turn lane. The west approach contains one shared left turn-through lane. The east approach contains one shared through-right turn lane.

The Center Road/Cutoff Road intersection is an unsignalized four-leg intersection with stop control at the north and south approaches. All approaches contain a shared left turn-through-right turn lane.

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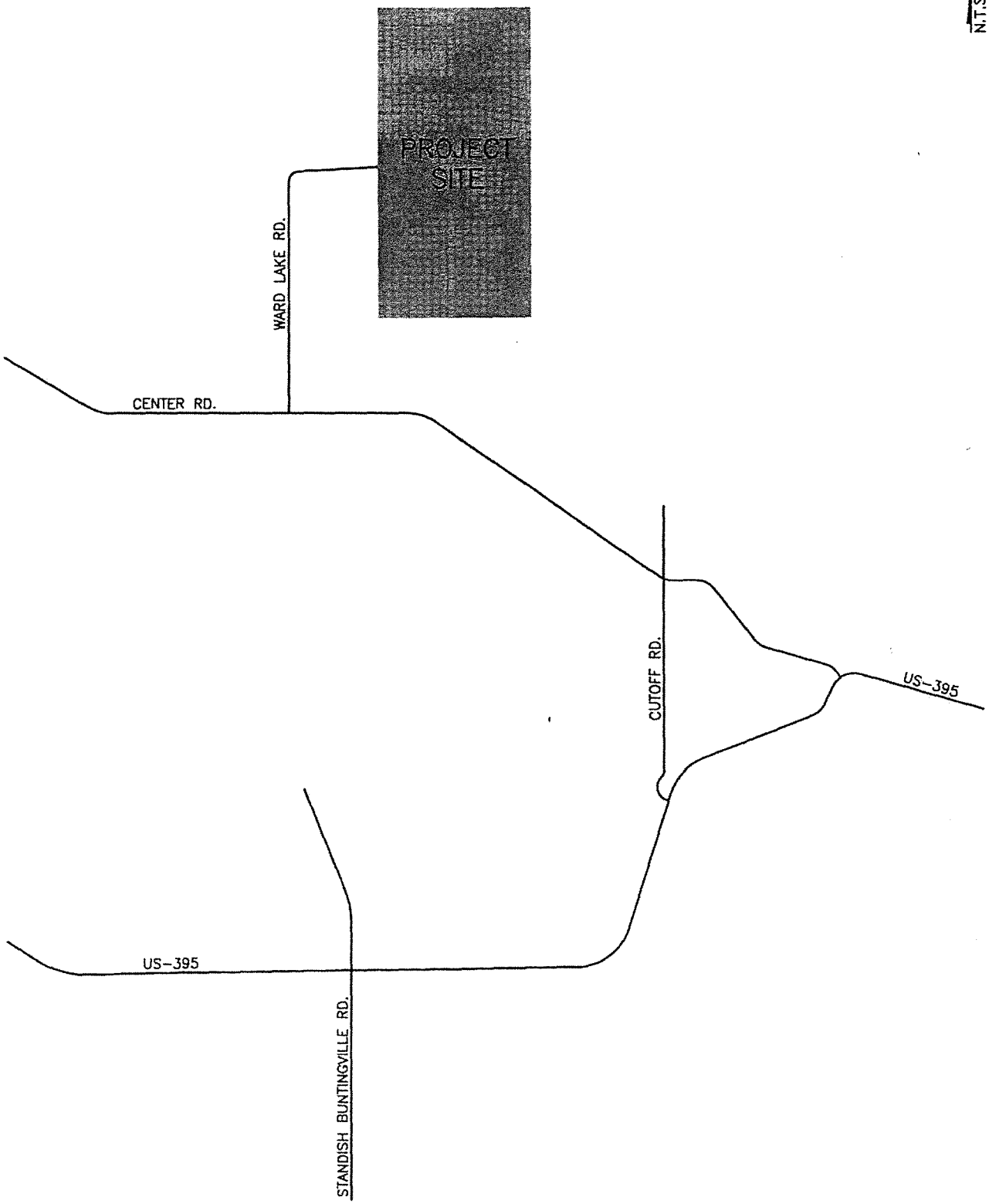

HAT CREEK MATERIALS FACILITY

VICINITY MAP
FIGURE 1

TRIP GENERATION

In order to assess the magnitude of traffic impacts of the project's expanded operation on the adjacent street network, daily and peak hour trip generation volumes had to be determined. The peak hours occurring from 7:00 to 8:00 AM, 4:00 to 5:00 PM, and 9:00 to 10:00 PM were identified for analysis after consultation with Lassen County Department of Public Works staff (Bob McGarva).

The current project permit allows 10 material hauling trucks per day which includes 10 trucks arriving empty and 10 trucks departing full. The proposed operation is to include 145 material hauling trucks per day which amounts to 145 arriving trucks and 145 departing trucks per day. Deducting the existing 10 material hauling trucks per day results in an increase of 135 material hauling trucks per day. The existing 10 material hauling trucks were deducted because they are already included in the existing daily traffic volumes discussed in the Existing and Projected Traffic Volume section of this report. The daily trip generation for the proposed increase is therefore 270 material hauling trucks per day assuming 135 arriving trucks and 135 departing trucks. These material hauling trucks are assumed to be equally dispersed throughout a twelve-hour day resulting in 11 trips entering and 11 trips departing during both the 7:00 to 8:00 AM and 4:00 to 5:00 PM peak hours. During night operations, an increased total of 135 material hailing truck trips are again anticipated (135 empty trucks arriving and 135 full trucks departing). Again, these material hauling trucks are assumed to be equally dispersed throughout a twelve-hour night resulting in 11 entering and departing trips during the 9:00 to 10:00 PM peak hour.

Additional traffic entering and departing the site includes employees and suppliers. The proposed operation will include up to 20 seasonal employees and 5 supplier truck loads resulting in daily trip generation volumes of 40 employee trips per day (20 entering and 20 exiting) and 10 supplier truck trips per day (5 entering and 5 exiting). The increased employee trips will begin work around 6:00 AM and depart around 6:00 PM so they fall outside the 7:00 to 8:00 AM, 4:00 to 5:00 PM, and 9:00 to 10:00 PM peak hours. The increased supplier truck trips are also anticipated to occur outside the peak hours. Table 1 shows a summary of the daily traffic volumes and peak hour volumes generated by the expanded operation.

TABLE 1
TRIP GENERATION

LAND USE	DAILY	AM PEAK HOUR		PM PEAK HOUR		NIGHT PEAK HOUR	
		IN	OUT	IN	OUT	IN	OUT
Material Hauling Trucks	270	11	11	11	11	11	11
Seasonal Employees	40	0	0	0	0	0	0
Supplier Trucks	10	0	0	0	0	0	0
Total	320	11	11	11	11	11	11

Material hauling trucks include asphalt, base, concrete, etc. and supplier trucks include oil, cement, parts, etc.

TRIP DISTRIBUTION AND ASSIGNMENT

The distribution of the project traffic to the key roadways and intersections was based on existing peak hour traffic patterns and the locations of attractions and productions in the area. Figure 2 shows the anticipated trip distribution. The daily traffic and peak hour trips shown in Table 1 were subsequently assigned to the key roadways and intersections based on the trip distribution percentages. Figure 3 shows the daily trip assignment volumes on the key roadways and the peak hour traffic volumes at the key intersections.

EXISTING AND PROJECTED TRAFFIC VOLUMES

Figure 4 shows the existing traffic volumes at the key intersections during the AM and PM peak hours. The existing AM and PM peak hour traffic volumes at the intersections were obtained from manual traffic counts conducted by Solaegui Engineers in April of 2018.

Figure 4 also shows the existing daily traffic volumes on the adjacent roadway segments. The existing daily traffic volumes were not counted but were instead estimated by applying a 10% peak hour factor to the PM peak hour roadway volumes. The peak hour factor is the ratio of hourly traffic volume to the daily traffic volume. The daily traffic volumes on the various roadway segments were therefore calculated by dividing the peak hour link volumes by 10%. For example, the existing daily traffic volume on Center Road just west of Ward Creek Road (510 vehicles per day) was calculated by adding the eastbound left turn volume (2 vehicles per hour), eastbound through volume (19 vehicles per hour), westbound through volume (27 vehicles per hour), and southbound right turn volume (3 vehicles per hour) and then dividing the sum (51 vehicles per hour) by the 10% PM peak hour factor. This method of estimating daily traffic volumes was discussed with and subsequently approved by Lassen County Department of Public Works staff (Bob McGarva) during the scoping of the traffic study. The California Department of Transportation (Caltrans) publishes actual daily traffic volumes on some of their roadways. However, our research of Caltrans traffic volumes indicates that no count information is available on Center Road or Ward Lake Road.

Figure 5 shows the existing plus project traffic volumes at the key intersections during the AM and PM peak hours and the existing plus project daily traffic volumes on the key roadways. The existing plus project traffic volumes were obtained by adding the trip assignment volumes shown on Figure 3 to the existing traffic volumes shown on Figure 4.

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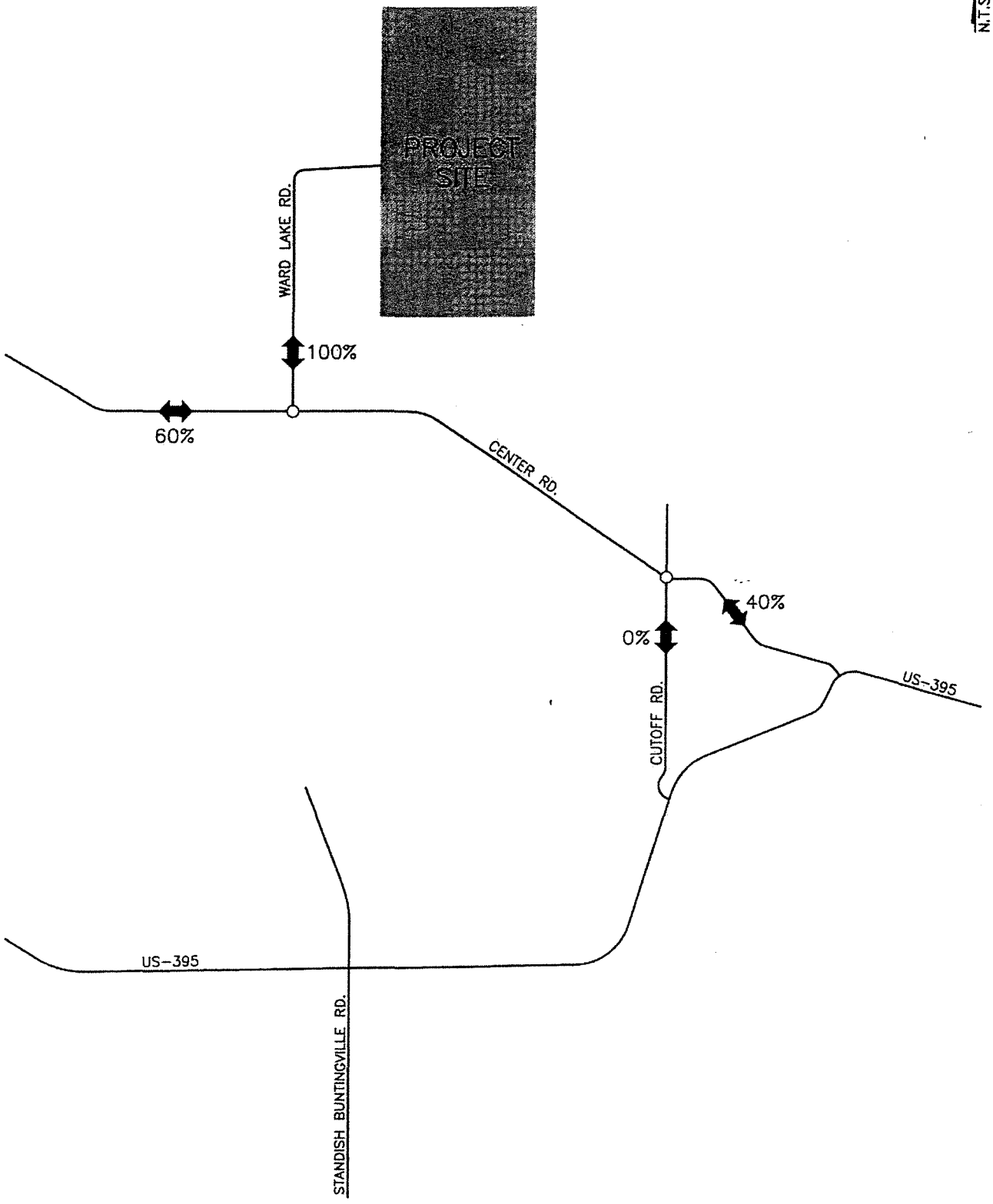

HAT CREEK MATERIALS FACILITY

TRIP DISTRIBUTION
FIGURE 2

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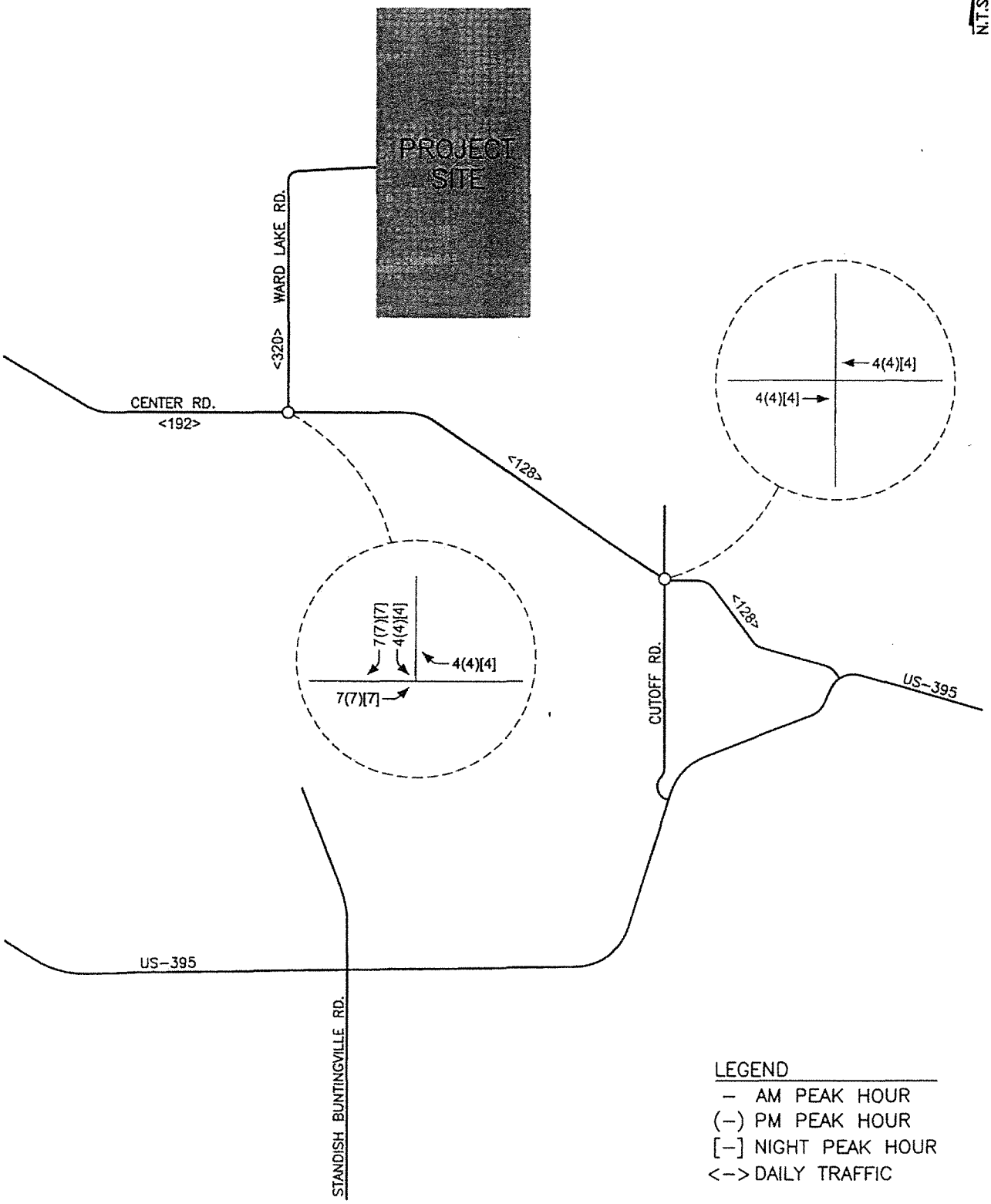

HAT CREEK MATERIALS FACILITY

TRIP ASSIGNMENT
FIGURE 3

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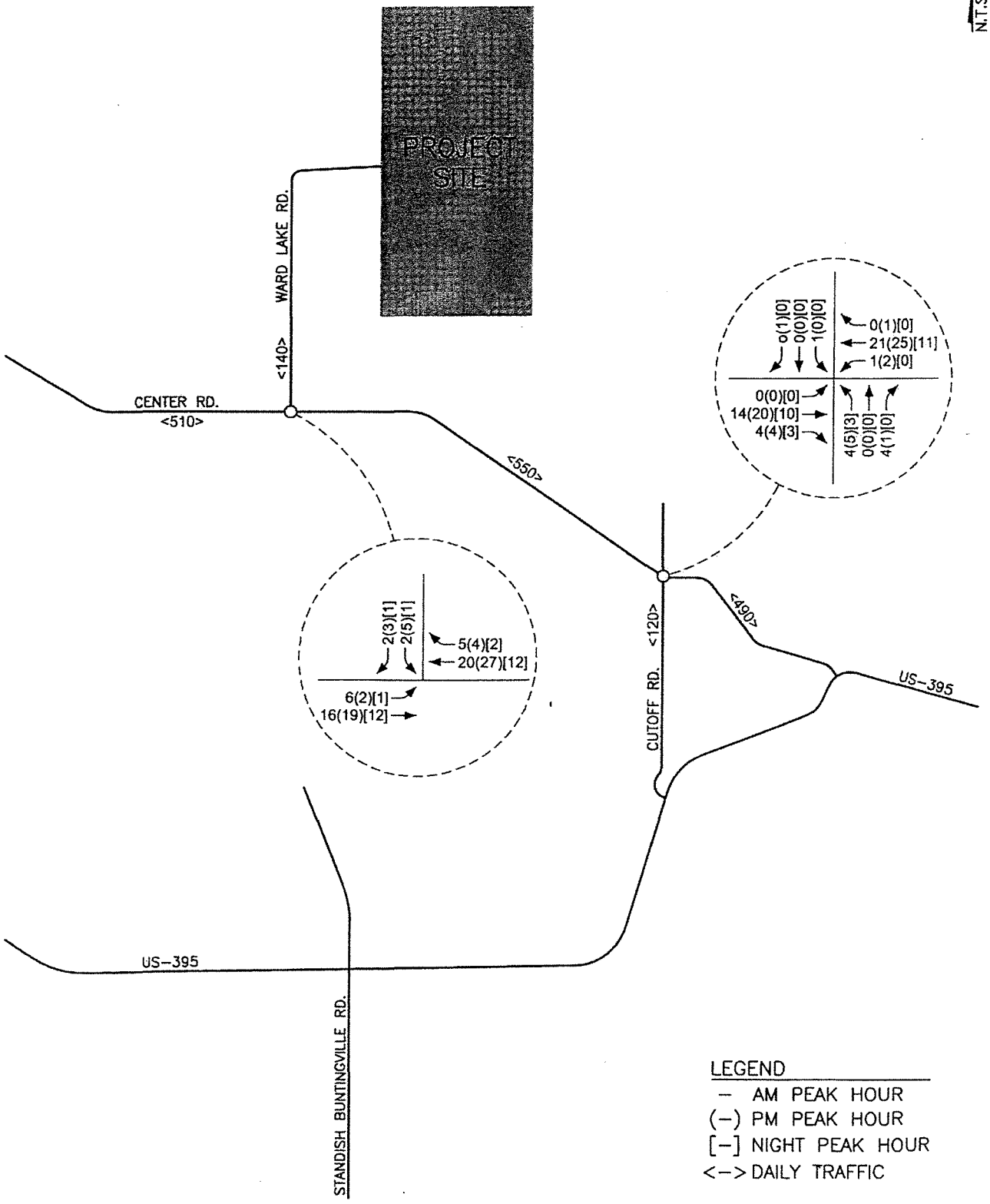

HAT CREEK MATERIALS FACILITY

EXISTING TRAFFIC VOLUMES

FIGURE 4

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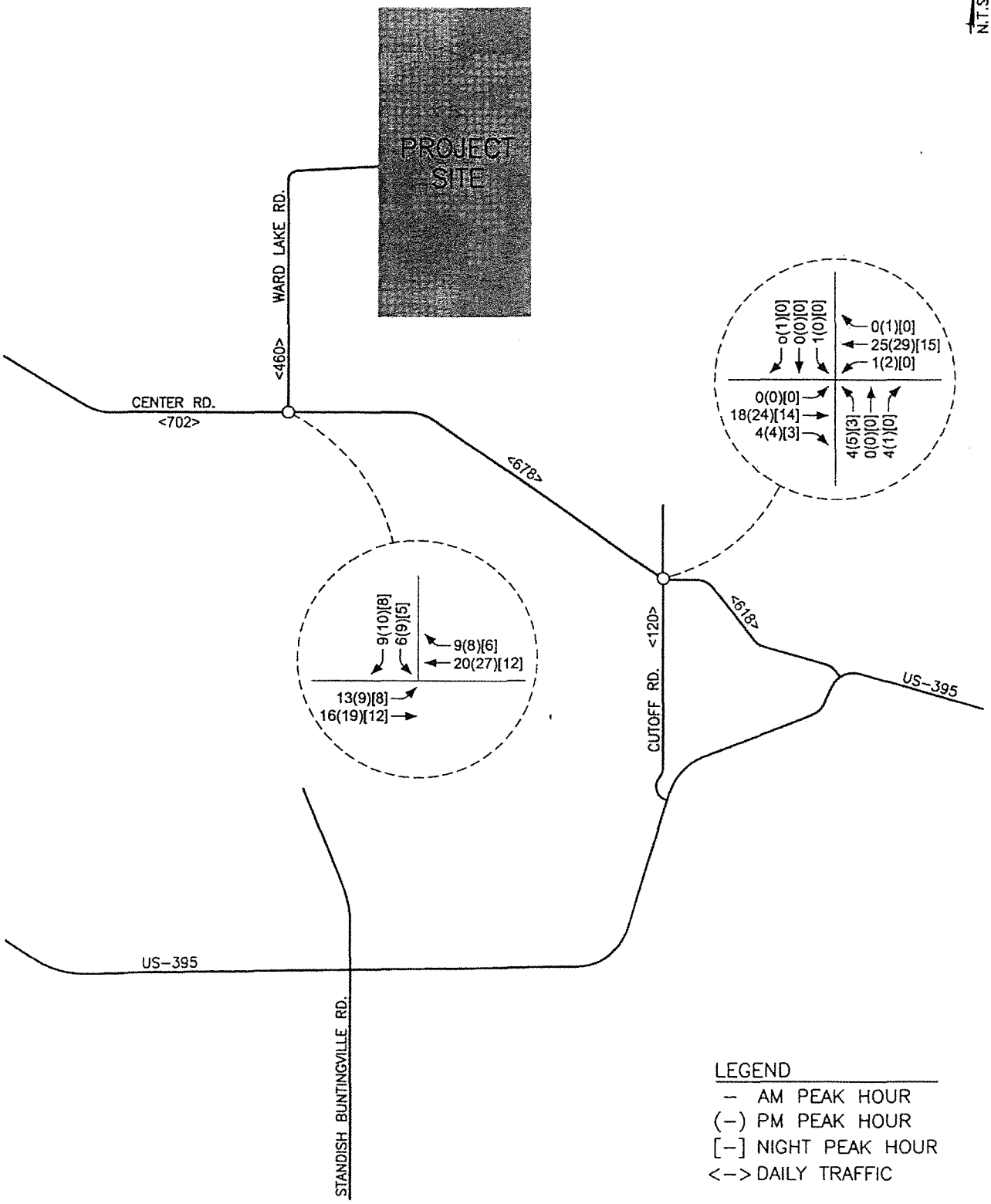


HAT CREEK MATERIALS FACILITY

EXISTING PLUS PROJECT TRAFFIC VOLUMES

FIGURE 5

INTERSECTION CAPACITY ANALYSIS

The Center Road/Ward Lake Road and Center Road/Cutoff Road intersections were analyzed for capacity based on procedures presented in the *Highway Capacity Manual (6th Edition)*, prepared by the Transportation Research Board, for unsignalized intersections using the latest version of the Highway Capacity software.

The result of capacity analysis is a level of service (LOS) rating for each unsignalized intersection minor movement. Level of service is a qualitative measure of traffic operating conditions where a letter grade "A" through "F", corresponding to progressively worsening traffic operation, is assigned to the intersection minor movement.

The *Highway Capacity Manual* defines level of service for stop controlled intersections in terms of computed or measured control delay for each minor movement. Level of service is not defined for the intersection as a whole. The level of service criteria for unsignalized intersections is shown in Table 2.

TABLE 2
LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS

LEVEL OF SERVICE	DELAY RANGE (SEC/VEH)
A	≤10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	>50

Table 3 shows the AM, PM, and Night peak hour level of service and delay results at the key intersections for the existing and existing plus project scenarios. The capacity worksheets are included in the Appendix.

TABLE 3
INTERSECTION LEVEL OF SERVICE AND DELAY RESULTS

INTERSECTION/MOVEMENT	EXISTING			EXISTING + PROJECT		
	AM	PM	NIGHT	AM	PM	NIGHT
Center Road & Ward Lake Road						
Eastbound Left	A7.3	A7.3	A7.3	A7.8	A7.8	A7.7
Southbound Left-Right	A8.6	A8.7	A8.5	A9.2	A9.3	A9.1
Center Road & Cutoff Road						
Eastbound Left	A7.3	A7.3	A7.3	A7.3	A7.3	A7.3
Westbound Left	A7.3	A7.3	A7.3	A7.3	A7.3	A7.3
Northbound Left-Thru-Right	A8.6	A8.8	A8.7	A8.7	A8.9	A8.7
Southbound Left-Thru-Right	A8.8	A8.5	A0.0	A8.8	A8.5	A0.0

Center Road/Ward Lake Road Intersection

The Center Road/Ward Lake Road intersection was analyzed as an unsignalized three-leg intersection with stop sign control at the north approach for the existing and existing plus project traffic volumes. The intersection minor movements currently operate at LOS A during the AM, PM, and Night peak hours. For the existing plus project traffic volumes the intersection minor movements continue to operate at LOS A during the AM, PM, and Night peak hours. The intersection was analyzed with the existing approach lanes for all scenarios.

The need for an exclusive eastbound left turn lane on Center Road at the Ward Lake Road intersection was reviewed based on Table 9-23 of the AASHTO publication *A Policy on Geometric Design of Highways and Streets*. A copy of this table is included in the Appendix. Table 9-23 shows traffic volumes and operating speeds which may trigger the need for a left turn lane on a two-lane highway. The traffic volumes to be considered include the advancing traffic volume (eastbound left turn plus eastbound through volumes), opposing traffic volume (westbound through plus westbound right turn volumes), and the percent of advancing traffic which is turning left (eastbound left turn volume divided by the sum of the eastbound left turn and through volumes). As shown in Table 9.23, for an estimated operating speed of 50 miles per hour on Center Road with 30% left turns, the volume threshold to warrant an exclusive left turn lane would be 135 advancing vehicles and 800 opposing vehicles or 295 advancing vehicles and 100 opposing vehicles. As shown on Figure 5, for the higher PM peak hour, the advancing volume amounts to 28 vehicles per hour, the opposing volume amounts to 35 vehicles per hour, and the percent of advancing traffic which is turning left is approximately 32%. These existing plus project traffic volumes are well below the AASHTO volume thresholds and therefore an exclusive left turn lane on Center Road is not recommended.

The need for an exclusive westbound right turn lane on Center Road at the Ward Lake Road intersection was reviewed based on the *Caltrans Highway Design Manual*. The manual states that right turn lanes can be justified on the basis of capacity, analysis, and frequent rear-end and sideswipe crash experience. Other factors such as a high volume of right turn traffic causing backup in the through lanes and pedestrians conflicts with right turn traffic may also contribute to the need for right turn lanes. A copy of Section 405.3 "Right Turn Channelization" from the *Caltrans Highway Design Manual* is include in the Appendix. The *Caltrans Highway Design Manual* does not specifically identify thresholds for intersection capacity, pedestrian and bicycle counts, and right turn volume. However, an exclusive right turn lane is not recommended at this location based on 1) the intersection is anticipated to operate well below capacity, LOS A as shown in Table 3, 2) right turn conflicts with pedestrians and bicycles are not anticipated due to the fact that no pedestrians or bicycles were observed at the intersection when the existing counts were performed, and 3) the projected right turn traffic is projected to be extremely low, only 9 vehicles during the highest peak hour. Traffic crash data was not made available to us at this location.

Center Road/Cutoff Road Intersection

The Center Road/Cutoff Road intersection was analyzed as an unsignalized four-leg intersection with stop sign control at the north and south approaches for the existing and existing plus project traffic volumes. The intersection minor movements currently operate at LOS A during the AM, PM, and Night peak hours. For the existing plus project traffic volumes the intersection minor movements continue to operate at LOS A during the AM, PM, and Night peak hours. The intersection was analyzed with the existing approach lanes for all scenarios. The need for an exclusive eastbound right turn lane on Center Road at the Cutoff Road intersection was not reviewed since the project developer has committed to send no trucks onto Cutoff Road.

RECOMMENDATIONS

The increased traffic generated by the Hat Creek Materials Facility will have little impact on the adjacent street network.

No improvements are recommended at either the Center Road/Ward Lake Road intersection or the Center Road/Cutoff Road intersection.

APPENDIX

HCS7 Two-Way Stop-Control Report

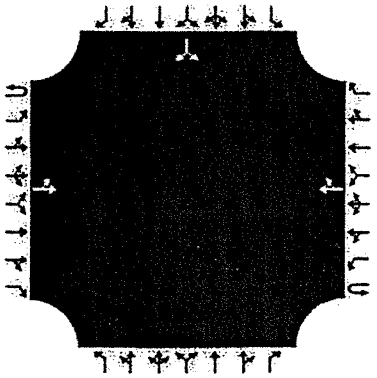
General Information

Analyst	MSH
Agency/Co.	Solaegui Engineers
Date Performed	4/18/2018
Analysis Year	2018
Time Analyzed	AM Existing
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	Center & Ward Lake
Jurisdiction	Lassen County
East/West Street	Center Road
North/South Street	Ward Lake Road
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		6	16				20	5						2		2
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		7													4	
Capacity, c (veh/h)		1577													993	
v/c Ratio		0.00													0.00	
95% Queue Length, Q_{95} (veh)		0.0													0.0	
Control Delay (s/veh)		7.3													8.6	
Level of Service, LOS		A													A	
Approach Delay (s/veh)		2.0												8.6		
Approach LOS														A		

HCS7 Two-Way Stop-Control Report

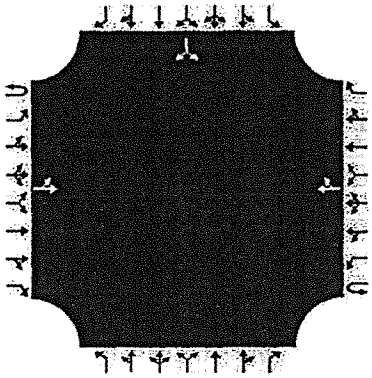
General Information

Analyst	MSH
Agency/Co.	Solaegui Engineers
Date Performed	4/18/2018
Analysis Year	2018
Time Analyzed	PM Existing
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	Center & Ward Lake
Jurisdiction	Lassen County
East/West Street	Center Road
North/South Street	Ward Lake Road
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		2	19				27	4						5		3
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		2													9	
Capacity, c (veh/h)		1569													978	
v/c Ratio		0.00													0.01	
95% Queue Length, Q_{95} (veh)		0.0													0.0	
Control Delay (s/veh)		7.3													8.7	
Level of Service, LOS		A													A	
Approach Delay (s/veh)		0.7												8.7		
Approach LOS														A		

HCS7 Two-Way Stop-Control Report

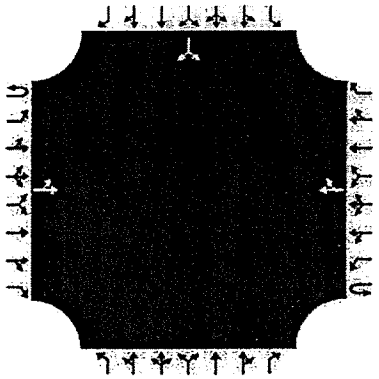
General Information

Analyst	MSH
Agency/Co.	Solaegui Engineers
Date Performed	4/18/2018
Analysis Year	2018
Time Analyzed	Night Existing
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	Center & Ward Lake
Jurisdiction	Lassen County
East/West Street	Center Road
North/South Street	Ward Lake Road
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		1	12				12	2						1		1
Percent Heavy Vehicles (%)		3												3		3
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		1													2	
Capacity, c (veh/h)		1593													1020	
v/c Ratio		0.00													0.00	
95% Queue Length, Q_{95} (veh)		0.0													0.0	
Control Delay (s/veh)		7.3													8.5	
Level of Service, LOS		A													A	
Approach Delay (s/veh)		0.6												8.5		
Approach LOS														A		

HCS7 Two-Way Stop-Control Report

eneral Information

Analyst	MSH
gency/Co.	Solaegui Engineers
ate Performed	4/18/2018
Analysis Year	2018
me Analyzed	AM Existing + Project
ntersection Orientation	East-West
Project Description	

Site Information

Intersection	Center & Ward Lake
Jurisdiction	Lassen County
East/West Street	Center Road
North/South Street	Ward Lake Road
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

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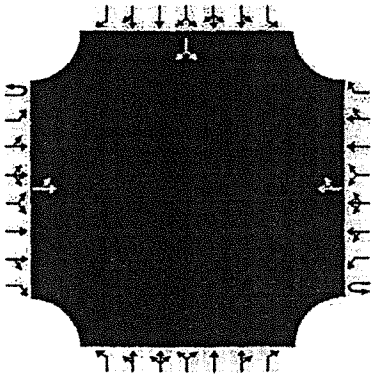


Major Street: East-West

ehicle Volumes and Adjustments

proach	Eastbound				Westbound				Northbound				Southbound			
ovement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
mber of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
olume, V (veh/h)		13	16				20	9						6		9
cent Heavy Vehicles (%)		50												50		50
Proportion Time Blocked																
cent Grade (%)														0		
ht Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

tical and Follow-up Headways

Base Critical Headway (sec)																
ical Headway (sec)																
e Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

ay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		14													17	
pacity, c (veh/h)		1320													878	
v Ratio		0.01													0.02	
95% Queue Length, Q_{95} (veh)		0.0													0.1	
trol Delay (s/veh)		7.8													9.2	
el of Service, LOS		A													A	
Approach Delay (s/veh)		3.5												9.2		
roach LOS														A		

HCS7 Two-Way Stop-Control Report

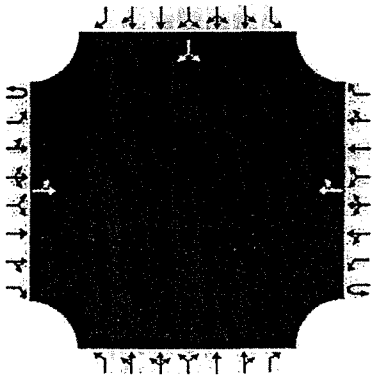
General Information

Analyst	MSH
Agency/Co.	Solaegui Engineers
Date Performed	4/18/2018
Analysis Year	2018
Time Analyzed	PM Existing + Project
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	Center & Ward Lake
Jurisdiction	Lassen County
East/West Street	Center Road
North/South Street	Ward Lake Road
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
Volume, V (veh/h)		9	19				27	8						9		10
Percent Heavy Vehicles (%)		50												50		50
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

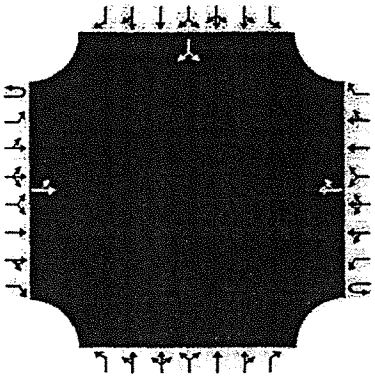
Flow Rate, v (veh/h)		10													21	
Capacity, c (veh/h)		1311													866	
v/c Ratio		0.01													0.02	
95% Queue Length, Q_{95} (veh)		0.0													0.1	
Control Delay (s/veh)		7.8													9.3	
Level of Service, LOS		A													A	
Approach Delay (s/veh)		2.5												9.3		
Approach LOS														A		

HCS7 Two-Way Stop-Control Report

eneral Information / Site Information

Analyst	MSH	Intersection	Center & Ward Lake
gency/Co.	Solaegui Engineers	Jurisdiction	Lassen County
ate Performed	4/18/2018	East/West Street	Center Road
Analysis Year	2018	North/South Street	Ward Lake Road
me Analyzed	Night Existing + Project	Peak Hour Factor	0.90
ntersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description			

nes



Vehicle Volumes and Adjustments

proach	Eastbound				Westbound				Northbound				Southbound			
ovement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
mber of Lanes	0	0	1	0	0	0	1	0		0	0	0		0	1	0
Configuration		LT						TR							LR	
olume, V (veh/h)		8	12				12	6						5		8
cent Heavy Vehicles (%)		50												50		50
Proportion Time Blocked																
cent Grade (%)														0		
ht Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

tical and Follow-up Headways

Base Critical Headway (sec)																
tical Headway (sec)																
e Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

ay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		9													14	
pacity, c (veh/h)		1334													901	
Ratio		0.01													0.02	
95% Queue Length, Q_{95} (veh)		0.0													0.0	
trol Delay (s/veh)		7.7													9.1	
el of Service, LOS		A													A	
Approach Delay (s/veh)		3.1												9.1		
roach LOS														A		

HCS7 Two-Way Stop-Control Report

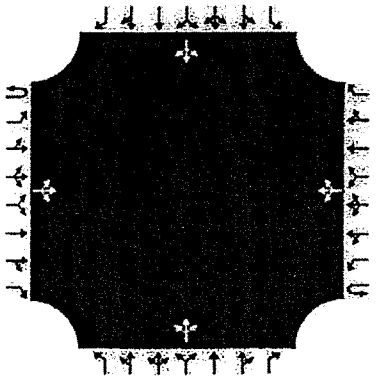
General Information

Analyst	MSH
Agency/Co.	Solaegui Engineers
Date Performed	4/18/2018
Analysis Year	2018
Time Analyzed	AM Existing
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	Center & Cutoff
Jurisdiction	Lassen County
East/West Street	Center Road
North/South Street	Cutoff Road
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		0	14	4		1	21	0		4	0	4		1	0	0
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		0				1					9				1	
Capacity, c (veh/h)		1584				1588					1004				948	
v/c Ratio		0.00				0.00					0.01				0.00	
95% Queue Length, Q_{95} (veh)		0.0				0.0					0.0				0.0	
Control Delay (s/veh)		7.3				7.3					8.6				8.8	
Level of Service, LOS		A				A					A				A	
Approach Delay (s/veh)		0.0				0.3				8.6				8.8		
Approach LOS										A				A		

HCS7 Two-Way Stop-Control Report

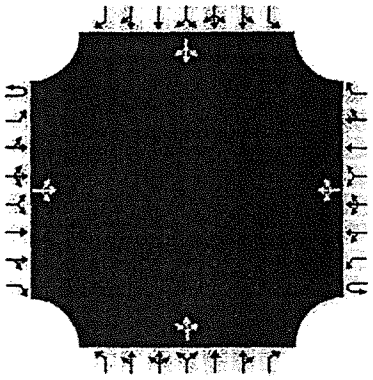
eneral Information

Analyst	MSH
gency/Co.	Solaegui Engineers
ate Performed	4/18/2018
Analysis Year	2018
ime Analyzed	PM Existing
ntersection Orientation	East-West
Project Description	

Site Information

Intersection	Center & Cutoff
Jurisdiction	Lassen County
East/West Street	Center Road
North/South Street	Cutoff Road
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

nes



Major Street: East-West

Vehicle Volumes and Adjustments

pproach	Eastbound				Westbound				Northbound				Southbound			
ovement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
umber of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		0	20	4		2	25	1		5	0	1		0	0	1
rcent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
rcent Grade (%)										0				0		
ght Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

tical and Follow-up Headways

Base Critical Headway (sec)																
tical Headway (sec)																
se Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

lay, Queue Length, and Level of Service

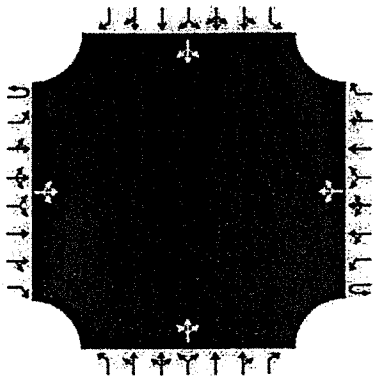
Flow Rate, v (veh/h)		0				2					7				1	
pacity, c (veh/h)		1576				1578					951				1043	
Ratio		0.00				0.00					0.01				0.00	
95% Queue Length, Q_{95} (veh)		0.0				0.0					0.0				0.0	
trol Delay (s/veh)		7.3				7.3					8.8				8.5	
el of Service, LOS		A				A					A				A	
Approach Delay (s/veh)		0.0				0.5					8.8				8.5	
Approach LOS											A				A	

HCS7 Two-Way Stop-Control Report

General Information

Analyst	MSH	Intersection	Center & Cutoff
Agency/Co.	Solaegui Engineers	Jurisdiction	Lassen County
Date Performed	4/18/2018	East/West Street	Center Road
Analysis Year	2018	North/South Street	Cutoff Road
Time Analyzed	Night Existing	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description			

Lanes



Major Street East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		0	10	3		0	11	0		3	0	0		0	0	0
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

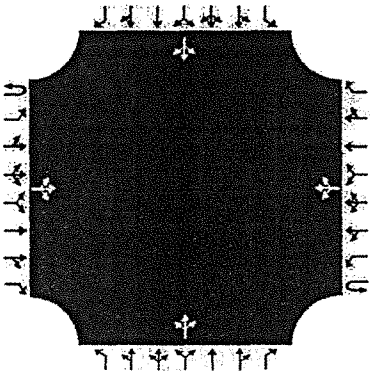
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		0				0					3				0	
Capacity, c (veh/h)		1598				1596					983				0	
v/c Ratio		0.00				0.00					0.00					
95% Queue Length, Q_{95} (veh)		0.0				0.0					0.0					
Control Delay (s/veh)		7.3				7.3					8.7				5.0	
Level of Service, LOS		A				A					A				A	
Approach Delay (s/veh)		0.0				0.0					8.7				5.0	
Approach LOS											A				A	

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	MSH	Intersection	Center & Cutoff
Agency/Co.	Solaegui Engineers	Jurisdiction	Lassen County
Date Performed	4/18/2018	East/West Street	Center Road
Analysis Year	2018	North/South Street	Cutoff Road
Time Analyzed	AM Existing + Project	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description			

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		0	18	4		1	25	0		4	0	4		1	0	0
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		0				1					9				1	
Capacity, c (veh/h)		1577				1582					994				936	
v/c Ratio		0.00				0.00					0.01				0.00	
95% Queue Length, Q_{95} (veh)		0.0				0.0					0.0				0.0	
Control Delay (s/veh)		7.3				7.3					8.7				8.8	
Level of Service, LOS		A				A					A				A	
Approach Delay (s/veh)		0.0				0.3					8.7				8.8	
Approach LOS											A				A	

HCS7 Two-Way Stop-Control Report

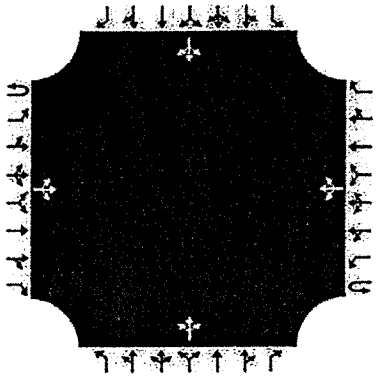
General Information

Analyst	MSH
Agency/Co.	Solaegui Engineers
Date Performed	4/18/2018
Analysis Year	2018
Time Analyzed	PM Existing + Project
Intersection Orientation	East-West
Project Description	

Site Information

Intersection	Center & Cutoff
Jurisdiction	Lassen County
East/West Street	Center Road
North/South Street	Cutoff Road
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		0	24	4		2	29	1		5	0	1		0	0	1
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

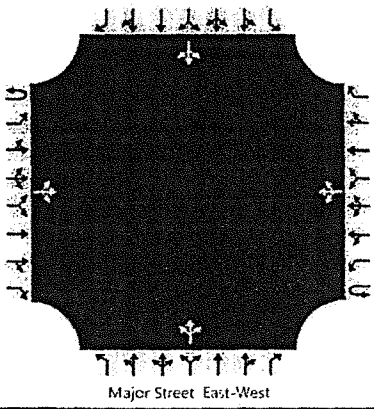
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		0				2					7				1	
Capacity, c (veh/h)		1570				1573					939				1037	
v/c Ratio		0.00				0.00					0.01				0.00	
95% Queue Length, Q_{95} (veh)		0.0				0.0					0.0				0.0	
Control Delay (s/veh)		7.3				7.3					8.9				8.5	
Level of Service, LOS		A				A					A				A	
Approach Delay (s/veh)		0.0				0.5				8.9				8.5		
Approach LOS										A				A		

HCS7 Two-Way Stop-Control Report

General Information		Site Information	
Analyst	MSH	Intersection	Center & Cutoff
Agency/Co.	Solaegui Engineers	Jurisdiction	Lassen County
Date Performed	4/18/2018	East/West Street	Center Road
Analysis Year	2018	North/South Street	Cutoff Road
Time Analyzed	Night Existing + Project	Peak Hour Factor	0.90
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25
Project Description			

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	0	1	0	0	0	1	0		0	1	0		0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume, V (veh/h)		0	14	3		0	15	0		3	0	0		0	0	0
Percent Heavy Vehicles (%)		3				3				3	3	3		3	3	3
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		0				0					3				0	
Capacity, c (veh/h)		1592				1589					970				0	
v/c Ratio		0.00				0.00					0.00					
95% Queue Length, Q_{95} (veh)		0.0				0.0					0.0					
Control Delay (s/veh)		7.3				7.3					8.7				5.0	
Level of Service, LOS		A				A					A				A	
Approach Delay (s/veh)		0.0				0.0					8.7				5.0	
Approach LOS											A				A	

A Policy on Geometric Design of Highways and Streets

2011

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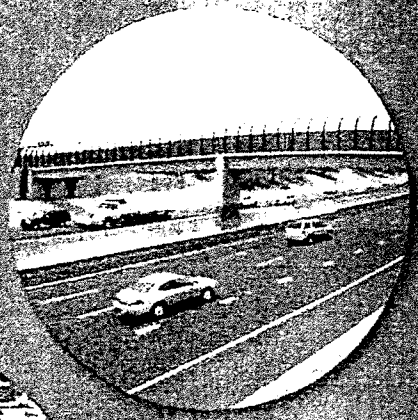

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THE VOICE OF TRANSPORTATION

Table 9-23. Guide for Left-Turn Lanes on Two-Lane Highways (*10*)

Metric					U.S. Customary				
	Advancing Volume (veh/h)					Advancing Volume (veh/h)			
Opposing Volume (veh/h)	5% Left Turns	10% Left Turns	20% Left Turns	30% Left Turns	Opposing Volume (veh/h)	5% Left Turns	10% Left Turns	20% Left Turns	30% Left Turns
60-km/h Operating Speed					40-mph Operating Speed				
800	330	240	180	160	800	330	240	180	160
600	410	305	225	200	600	410	305	225	200
400	510	380	275	245	400	510	380	275	245
200	640	470	350	305	200	640	470	350	305
100	720	515	390	340	100	720	515	390	340
80-km/h Operating Speed					50-mph Operating Speed				
800	280	210	165	135	800	280	210	165	135
600	350	260	195	170	600	350	260	195	170
400	430	320	240	210	400	430	320	240	210
200	550	400	300	270	200	550	400	300	270
100	615	445	335	295	100	615	445	335	295
100-km/h Operating Speed					60-mph Operating Speed				
800	230	170	125	115	800	230	170	125	115
600	290	210	160	140	600	290	210	160	140
400	365	270	200	175	400	365	270	200	175
200	450	330	250	215	200	450	330	250	215
100	505	370	275	240	100	505	370	275	240

Additional information on left-turn lanes, including their suggested lengths, can be found in *Highway Research Record 211*, NCHRP Report 225, and NCHRP Report 279 (*10, 19, 17*). In the case of double left-turn lanes, a capacity analysis of the intersection should be performed to determine what traffic controls are needed in order for it to function properly.

Local conditions and the cost of right-of-way often influence the type of intersection selected as well as many of the design details. Limited sight distance, for example, may make it desirable to control traffic by yield signs, stop signs, or traffic signals when the traffic densities are less than those ordinarily considered appropriate for such control. The alignment and grade of the intersecting roads and the angle of intersection may make it advisable to channelize or use auxiliary pavement areas, regardless of the traffic densities. In general, traffic service, highway design designation, physical conditions, and cost of right-of-way are considered jointly in choosing the type of intersection.

For the general benefit of through-traffic movements, the number of crossroads, intersecting roads, or intersecting streets should be minimized. Where intersections are closely spaced on a two-way facility, it is seldom practical to provide signals for completely coordinated traffic movements at reasonable speeds in opposing directions on that facility. At the same time, the resultant road or street patterns should permit travel on roadways other than the predominant highway without too much inconvenience. Traffic analysis

California Department of Transportation

Highway Design Manual

U.S. Customary Units

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(3) *Double Left-turn Lanes.* At signalized intersections on multilane conventional highways and on multilane ramp terminals, double left-turn lanes should be considered if the left-turn demand is 300 vehicles per hour or more. The lane widths and other design elements of left-turn lanes given under Index 405.2(2) applies to double as well as single left-turn lanes.

The design of double left-turn lanes can be accomplished by adding one or two lanes in the median. See "Guidelines for Reconstruction of Intersections", published by Headquarters, Division of Traffic Operations, for the various treatments of double left-turn lanes.

(4) *Two-way Left-turn Lane (TWLTL).* The TWLTL consists of a striped lane in the median of an arterial and is devised to address the special capacity and safety problems associated with high-density strip development. It can be used on 2-lane highways as well as multilane highways. Normally, the District Traffic Operations Branch should determine the need for a TWLTL.

The minimum width for a TWLTL shall be 12 feet (see Index 301.1). The preferred width is 14 feet. Wider TWLTL's are occasionally provided to conform with local agency standards. However, TWLTL's wider than 14 feet are not recommended, and in no case should the width of a TWLTL exceed 16 feet. Additional width may encourage drivers in opposite directions to use the TWLTL simultaneously.

405.3 Right-turn Channelization

(1) *General.* For right-turning traffic, delays are less critical and conflicts less severe than for left-turning traffic. Nevertheless, right-turn lanes can be justified on the basis of capacity, analysis, and crash experience.

In rural areas a history of high speed rear-end collisions may warrant the addition of a right-turn lane.

In urban areas other factors may contribute to the need such as:

- High volumes of right-turning traffic causing backup and delay on the through lanes.
- Conflicts between crossing pedestrians and right-turning vehicles and bicycles.
- Frequent rear-end and sideswipe collisions involving right-turning vehicles.

Where right-turn channelization is proposed, lower speed right-turn lanes should be provided to reduce the likelihood of conflicts between vehicles, pedestrians, and bicyclists.

(2) *Design Elements.*

(a) Lane and Shoulder Width--**Index 301.1 shall be used for right-turn lane width requirements. Shoulder width shall be a minimum of 4 feet.** Although not desirable, lane and shoulder widths less than those given above can be considered for right-turn lanes under the following conditions pursuant to Index 82.2:

- In urban, city or town centers (rural main streets) with posted speeds less than 40 miles per hour in severely constrained situations, if truck or bus use is low, consideration may be given to reducing the right-turn lane width to 10 feet.
- Shoulder widths may also be considered for reduction under constricted situations. Whenever possible, at least a 2-foot shoulder should be provided where the right-turn lane is adjacent to a curb. Entire omission of the shoulder should only be considered in constrained situations and where an 11-foot lane can be constructed.

  Gutter pans can be included within a shoulder, but cannot be included as part of the travel lane width. Additional right of way for a future right-turn lane should be considered when an intersection is being designed.