CONCEPT REPORT

SH-16, INT SUBSTATION ROAD, NEAR EMMETT

PROJECT NO. ST-3330(606)
KEY NO. 8238
WA NO. E023810

GEM COUNTY

List of Contents

SIX MILE ENGINEERING

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May 15, 2002

DESIGN STUDY REPORT NARRATIVE
SH-16, INT SUBSTATION ROAD, NEAR EMMETT
PROJECT NO. ST-3330(606), KEY NO. 8238

This is a state funded project to improve the State Highway 16 intersection with Substation Road east of Emmett in Gem County. The SH-16/Substation Road intersection is located at SH-16 milepost 12.56, approximately 1.4 miles east of the SH-16/SH-52 intersection in Emmett. The project is scheduled for construction during the 2004 fiscal year.

EXISTING CONDITIONS

ROADWAYS

SH-16 is a north-south corridor beginning at SH-44 west of Eagle and ending at SH-52 in Emmett. It is not on the National Highway System. A majority of the highway is aligned north-south; however, within the limits of this project, SH-16 is aligned east-west and is discussed as such in this Concept Report.

SH-16 West of Substation Road Looking East

The functional classification of SH-16 was upgraded by ITD at the March 2002 Board Meeting to a multiple-lane principal arterial. The existing average daily traffic (ADT) on SH-16 near the Substation Road intersection is 6,980 vehicles per day (vpd). The projected ADT is 7,640 vpd in 2006 and 9,850 in 2026. This increase represents an average annual growth rate of 1.28 percent.

Substation Road is classified as a minor arterial by Gem County and currently has one travel lane in each direction with no turn lanes at SH-16. Substation Road south of SH-16 is approximately 35 feet wide (from edge of pavement to face of curb) with curb, gutter and sidewalk on the east side beginning approximately 45 feet south of SH-16. Substation Road north of SH-16 is approximately 33 feet wide and has curb, gutter and sidewalk on the east side of the roadway beginning approximately 140 feet north of the intersection. The west side of Substation Road is a rural section north and south of SH-16.

MAJOR INTERSECTIONS

One major intersection is located within the project limits: SH-16 and Substation Road. The SH-16 approaches to the intersection have one through lane and one

left-turn lane eastbound and one through lane, one left-turn lane and one right-turn lane westbound. West of the intersection, SH-16 is a three-lane rural section with one travel lane in each direction and a two-way left-turn lane. East of the intersection, SH-16 has two lanes, one travel lane in each direction.

The SH-16/Substation Road intersection currently operates as a two-way stop-controlled intersection, stopping Substation Road traffic.

BRIDGES AND OTHER STRUCTURES

The bridge for SH-16 to cross the Black Canyon Irrigation Canal east of Substation Road is outside of the limits of this project. There are no other structures in the project vicinity.

RAILROAD CROSSINGS

There are no railroad crossings within the project limits.

STORM DRAIN FACILITIES

The existing storm drain facilities on SH-16 consist of roadside ditches parallel to the roadway. There are culverts crossing Substation Road on both sides of SH-16. Locations along Substation Road with curb and gutter appear to drain into a storm drain system through inlets. Locations without curb and gutter appear to drain onto adjacent private property.

Substation Road South of SH-16

IRRIGATION AND UTILITY FACILITIES

Irrigation boxes and ditches are located on the north side of SH-16 and appear to serve the properties on the northwest and northeast corners of the intersection. These boxes and ditches will be relocated or abandon based on discussion with the property owners and irrigation district. The irrigation district in the project area may include the Last Chance Irrigation District, the Emmett Irrigation District

or the Black Canyon Irrigation District. The appropriate district will be identified and contacted during preliminary design of the project.

The following utilities were located during the field surveys:

- Intermountain Gas, natural gas lines
- Qwest, telephone and fiber optic cable lines
- Idaho Power, overhead power lines
- Cable television (company to be determined), lines on power poles

The City of Emmett indicated during the field review that their water and sanitary sewer lines do not extend to the project location.

RIGHT-OF-WAY

The existing right-of-way width along SH-16 is 100 feet in the project limits. The existing right-of-way width along Substation Road is 65 feet.

RECENT CONSTRUCTION PROJECTS

A Cement Recycled Asphalt Base Stabilization (CRABS) pavement rehabilitation project was constructed on this section of SH-16 in 1998. This pavement will be retained for this project to the extent possible.

LOCAL AGENCY CONTACTS

Ed Mansfield, Gem County Board of Commissioners, Dennis Pulley, Director of the Gem County Road and Bridge Department and Bruce Evans, Superintendent of Public Works for the City of Emmett, attended the field review meeting on February 12, 2002. The complete comments and concerns expressed by the field review meeting attendees are discussed in the attached Meeting Notes dated February 13, 2002.

The primary concern expressed during the field review meeting was the ability of westbound trucks to stop at the proposed signal considering the 55 mph speed limit and the downhill grade approaching the intersection. This concern is discussed in detail in the safety evaluation section of the Alternate Solutions and Costs and it is demonstrated that sufficient sight distance will be available for trucks to safely stop at the intersection if a signal is installed.

It was suggested by the field review attendees to reduce the speed limit on SH-16 to 45 mph beginning near the bottom of Freezeout Hill. This suggestion was evaluated by District 3 and their study indicated that the existing speed limits on SH-16 are appropriate and will remain.

The field review attendees expressed concern with the sight distance for vehicles stopped at the southbound Substation Road approach to SH-16. Westbound SH-16 traffic intending to turn right onto Substation Road travels in the right-turn lane near the intersection and may block Substation Road drivers from viewing other vehicles traveling westbound on SH-16 in the through lane. This situation exists at any intersection with multiple lanes on an approach. A traffic signal will provide Substation Road drivers an assured opportunity to enter or cross SH-16 if they wait for the next green signal. With the signal, drivers may be more conservative with the gaps they accept in SH-16 traffic and may discourage drivers from turning onto SH-16 when they cannot see past the SH-16 westbound right-turning traffic.

PURPOSE OF IMPROVEMENTS

The primary purpose of the project is to improve the safety and traffic operations of the SH-16/Substation Road intersection.

PROPOSED ALTERNATIVES

The alternatives described briefly below were evaluated for this project. Please refer to the Alternate Solutions and Costs for detailed descriptions and comparisons.

ALTERNATIVE 1 - DO-NOTHING

The Do-Nothing Alternative evaluates retaining the existing lane configuration on SH-16 and Substation Road and the existing intersection control.

ALTERNATIVE 2 - THREE-LANE ROADWAY, UNSIGNALIZED INTERSECTION

This alternative widens SH-16 near the Substation Road intersection to provide two travel lanes and a left-turn lane for the eastbound approach and

one travel lane, a left-turn lane and a right-turn lane for the westbound approach. East of the Substation Road intersection, two eastbound travel lanes and one westbound travel lane are provided.

Alternative 2 retains the existing stop control at the Substation Road/ SH-16 intersection.

ALTERNATIVE 3 - FOUR-LANE ROADWAY, UNSIGNALIZED INTERSECTION

This alternative widens SH-16 near the Substation Road intersection to provide two travel lanes and a left-turn lane for the eastbound approach and one travel lane, a left-turn lane and a right-turn lane for the westbound approach. East of the Substation Road intersection, two eastbound travel lanes and two westbound travel lanes are provided. Short retaining walls are required for approximately 300 feet to construct this alternative within the existing right-of-way.

Alternative 3 retains the existing stop control at the Substation Road/ SH-16 intersection.

ALTERNATIVE 4 - THREE-LANE ROADWAY, SIGNALIZED INTERSECTION

This alternative includes the Alternative 2 roadway improvements and replaces the stop-control with a fully-actuated traffic signal with vehicle detection loops at the Substation Road/SH-16 intersection.

ALTERNATIVE 5 - FOUR-LANE ROADWAY, SIGNALIZED INTERSECTION

This alternative includes the Alternative 3 roadway improvements and replaces the stop-control with a fully-actuated traffic signal with vehicle detection loops at the Substation Road/SH-16 intersection.

RECOMMENDED IMPROVEMENTS

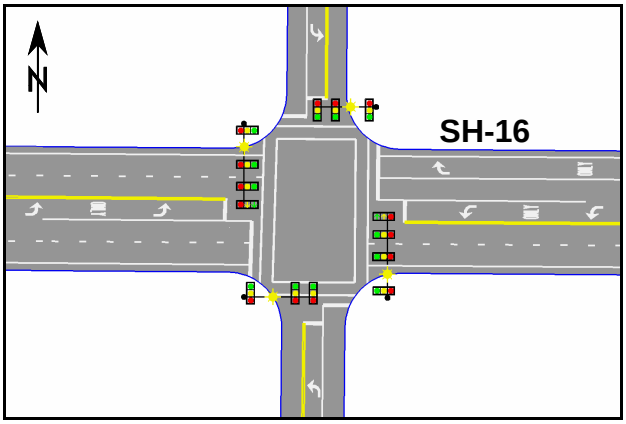
ROADWAY AND INTERSECTION IMPROVEMENTS

Following an analysis of the five alternatives, **Alternative 4 is recommended for this project**. Please refer to the Alternate Solutions and Costs section of the

Concept Report for a detailed description of each alternative and for the safety analysis, traffic analysis and estimated project costs.

The recommended roadway improvements at the intersection will provide two through lanes and a left-turn lane for the eastbound approach and one through lane, one left-turn lane and one right-turn lane for the westbound approach. Substation Road will be restriped to accommodate one shared through/right-turn lane and one left-turn lane at each approach. The existing width of Substation Road will accommodate the additional left-turn lane. The proposed lane configuration is shown in the figure below.

East of Substation Road, SH-16 will transition to one westbound travel lane and two eastbound travel lanes. This section will extend to the project limits, approximately 2000 feet east of the intersection and then transition to match the existing roadway. West of the Substation Road intersection, SH-16 will transition to match the existing three-lane section with one travel lane in each direction and a two-way left-turn lane.



Recommended SH-16/Substation Road Int.

As noted in the Alternate Solutions and Costs, we recommend installing a hazard identification beacon approximately 1,000 feet east of the Substation Road intersection and an advanced signal warning sign approximately one mile east of the intersection. Pictures of the recommended signing are included in the Alternate Solutions and Costs section of the Concept Report. These advanced warning devices will provide drivers with advanced notice of the signal and may reduce the potential for accidents at the intersection.

RIGHT-OF-WAY IMPACTS

As directed, the project will be designed for the improvements to be constructed within the existing right-of-way; therefore, additional right-of-way will not be necessary for this project. Temporary easements may be required to construct the traffic signal equipment or irrigation improvements.

ACCESS CONTROL

The access control was upgraded to Type IV at the March 2002 ITD Board Meeting.

CONSTRUCTION TRAFFIC CONTROL AND DETOURS

The proposed roadway improvements on SH-16 will be accomplished by widening the existing pavement. Approximately 30 feet of existing pavement will be retained, allowing traffic to travel on this section during construction. Traffic will likely be shifted on the existing pavement between construction phases to provide shoulders for traffic and sufficient area for construction workers and equipment. The contractor will be required to have one travel lane in each direction open and maintained during the morning peak hours (6:00 to 8:00) and afternoon peak hours (4:00 to 7:00). Construction will not be allowed at night due to the residential location of the project.

Barrels will be used to separate traffic from the construction area and tubular markers will be used to separate directions of traffic to provide additional safety. The speed limit through the work area will be reduced from 55 mph to 45 mph. Standard signing, temporary pavement markings, tapers and other traffic control devices, following ITD and MUTCD requirements, will be included in the project plans and specifications.

SPECIAL EVENTS

The Woman's Challenge bicycle race uses this section of SH-16 as part of the course for their annual race. Provisions will be included in the contract specifications requiring the contractor to stop work that may impact the race or the ability of spectators to view the race. The contractor will also be required to maintain the roadway surface to the satisfaction of the race officials. We will coordinate with race officials during final design of the project to determine specific dates and requirements.

Provisions will also be included in the contract specifications requiring the contractor to stop work that may disrupt traffic during the Emmett Cherry Festival (second full week of June), Cruise Night (third weekend of July) and the Gem County Fair and Rodeo (anticipated to be July 28th – August 2nd, 2004).

BICYCLE AND PEDESTRIAN IMPACTS

The proposed improvements should have a positive impact for bicyclists and pedestrians. The traffic signal will include push-button operated controls to provide a protected crossing of SH-16 and Substation Road for bicyclists and pedestrians. Sidewalks are not included in the project improvements; however, crosswalks will be striped at the intersection. The roadway improvements include a paved shoulder of at least 4 feet and up to 8 feet in width. These widths meet the minimum requirements for a Shoulder Bikeway as discussed in the Design Manual.

STORM DRAIN FACILITIES

On the south side of SH-16, east of Substation Road, a seepage trench will be constructed parallel to SH-16. The seepage trench was designed to store the storm water anticipated with a 10-year storm below the roadway subbase material. The trench will be constructed of 2-inch washed drain rock and enclosed on all four sides with geotextile fabric to minimize fines entering the rock. Refer to the typical sections included in the Alternative Solutions and Costs section of the Concept Report for additional details.

On the north side of SH-16, east of Substation Road, the 3:1 fill slope will catch inside the existing right-of-way. However, there is not sufficient area to construct a ditch at the bottom of the fill slopes. A majority of the roadway in this location is superelevated to the south, so all of the storm water from the roadway will travel to the south side of the road into the seepage trench noted above. The remaining roadway, approximately 400 feet, will drain onto private property as does the existing roadway.

West of the Substation Road intersection, there is sufficient area to construct small ditches at the base of the fill slopes.

IRRIGATION AND UTILITY FACILITIES

Irrigation boxes and ditches will be relocated or abandon based on discussion with the property owners and irrigation district.

Existing utilities that conflict with the proposed improvements will be relocated or adjusted as necessary by the appropriate utility company. Electric service for the

proposed traffic signal, advanced warning signal and luminaires will be coordinated through Idaho Power during preliminary design of the project.

ESTIMATED PROJECT COSTS

The estimated project costs for Alternative 4 and the current programmed amount are shown in the table below. The construction costs shown include Mobilization, at 10 percent, and Contingencies, at 10 percent. Detailed construction cost estimates for each alternative are included following the Alternate Solutions and Costs section.

Estimated Costs	Programmed Funding	Alternative 4
Construction	$790,000	$824,800
Right-of-Way	$0	$0
Construction Engineering	$120,000	$82,500
Preliminary Engineering	$141,000	$141,000
Total Estimated Project Cost	**$1,051,000**	**$1,048,300**

ALTERNATE SOLUTIONS AND COSTS
SH-16, INT SUBSTATION ROAD, NEAR EMMETT
PROJECT NO. ST-3330(606), KEY NO. 8238

INTRODUCTION

This Alternate Solutions and Costs describes the alternatives for the proposed improvements to SH-16 and to the SH-16/Substation Road intersection and is organized as follows:

- Description of Alternatives
- Summary of Safety Benefits
- Summary of Traffic Operations
- Summary of Estimated Project Costs
- Recommendations

DESCRIPTION OF ALTERNATIVES

The following alternatives were evaluated for this project:

- Alternative 1 – Do Nothing
- Alternative 2 – Three-Lane Roadway, Unsignalized Intersection
- Alternative 3 – Four-Lane Roadway, Unsignalized Intersection
- Alternative 4 – Three-Lane Roadway, Signalized Intersection
- Alternative 5 – Four-Lane Roadway, Signalized Intersection

Variations in the lane configuration of Substation Road were discussed as additional alternatives. The existing northbound and southbound approaches have one shared left-turn/through/right-turn lane. The existing width of Substation Road is sufficient to accommodate left-turn lanes by modifying the pavement markings. Striping left-turn lanes for the approaches improves the operation and safety of the intersection without significant construction costs; therefore, these improvements are included in Alternatives 2 through 5.

Following is a detailed discussion of each alternative, and the advantages and disadvantages of each. The Safety Evaluation Forms, Highway Capacity Software reports and detailed costs estimates are included at the end of this section for each alternative.

ALTERNATIVE 1 - DO-NOTHING

The Do-Nothing Alternative evaluates retaining the existing lane configuration on SH-16 and Substation Road and the existing intersection control. The eastbound approach of SH-16 to the intersection has one through lane and a left-turn lane

and the westbound approach has one through lane, a left-turn lane and a right-turn lane. Substation Road currently has one travel lane in each direction with no turn lanes at the intersection of SH-16.

The SH-16/Substation Road intersection currently operates as a two-way stop-controlled intersection, stopping Substation Road traffic.

ALTERNATIVE 2 - THREE-LANE ROADWAY, UNSIGNALIZED INTERSECTION

This alternative includes the following roadway improvements on SH-16:

- Widening SH-16 near the Substation Road intersection to provide two travel lanes and a left-turn lane for the eastbound approach and one travel lane, a left-turn lane and a right-turn lane for the westbound approach.
- East of the Substation Road intersection, the roadway will transition to one westbound travel lane and two eastbound travel lanes to the project limits, approximately 2,000 feet east of the intersection and then transition to match the existing roadway with one travel lane in each direction.
- West of Substation Road, the roadway will transition to match the existing three-lane section approximately 800 feet west of the Substation Road intersection.

For the three-lane roadway section to be constructed within the existing right-of-way, a maximum embankment slope of 3:1 is required along the north side of SH-16. Along the south side, a foreslope of 4:1 was used to the bottom of the ditch above the seepage trench with a 4:1 backslope to the existing ground. Selected cross sections, representing a typical location of the three-lane roadway are included in the appendix showing additional detail.

Alternative 2 retains the existing stop control at the Substation Road/SH-16 intersection.

ALTERNATIVE 3 - FOUR-LANE ROADWAY, UNSIGNALIZED INTERSECTION

Alternative 3 includes the following roadway improvements on SH-16:

- Widening SH-16 near the Substation Road intersection to provide two travel lanes and a left-turn lane for the eastbound and westbound approaches.
- East of the Substation Road intersection, the roadway will transition to two eastbound and two westbound travel lanes and a four-foot painted median. This section will be extended to the project limits, approximately

2,000 feet east of the intersection and then will transition to match the existing roadway with one travel lane in each direction.
- West of Substation Road, the roadway will transition to match the existing three-lane section approximately 800 feet west of the Substation Road intersection.

For the four-lane roadway section to be constructed within the existing right-of-way, a typical embankment slope of 2:1 is necessary along the north side of SH-16. This slope does not satisfy the standard minimum sideslopes of 3:1 listed in Section C.3.8 of the Design Manual.

Along the south side of SH-16, a foreslope of 4:1 was used to the bottom of the ditch above the seepage trench. The backslope of the ditch varies from 4:1 to 2:1, with some locations not catching the existing ground within the existing right-of-way. A short retaining wall will be required at these locations, approximately 300 feet, to avoid purchase of new right-of-way. The maximum height of the retaining wall is estimated at approximately 4 to 5 feet depending on the required footing depth. Selected cross sections, showing a typical location with the retaining wall are included in the appendix.

The standard clear zone for projects not on the NHS are listed in Section C.3.9 of the Design Manual as 20 feet (6.0 m). The clear zone with Alternative 3 would be only the proposed shoulder width of either 4-feet or 8-feet. The embankment slopes of 2:1 are not included in the clear zone distance because they are considered critical slopes according to the AASHTO Roadside Design Guide and, “They will cause most vehicles to overturn and should be treated if they begin within the clear zone distance… and meet warrants for shielding…” The maximum embankment fill height is estimated at 6-7 feet. Based on Figure 6-8 Sheet 3 of 3 of the Design Manual, barrier would not be warranted in these locations. The existing fill slopes are approximately 2:1 and recent accident listings do not indicate a problem with vehicles running off the road in the project area. Based on the warrant and the lack of an accident problem, guardrail was not included in the cost estimates for the four-lane alternatives.

Alternative 3 retains the existing stop control at the Substation Road/SH-16 intersection.

ALTERNATIVE 4 - THREE-LANE ROADWAY, SIGNALIZED INTERSECTION

The roadway improvements and embankment slopes for Alternative 4 are similar to those discussed in Alternative 2.

Alternative 4 includes installing a fully-actuated traffic signal with vehicle detection loops at the Substation Road/SH-16 intersection. Signal operation details and assumptions are discussed in the traffic analysis section.

ALTERNATIVE 5 - FOUR-LANE ROADWAY, SIGNALIZED INTERSECTION

The roadway improvements, embankment slopes and retaining walls for Alternative 5 are similar to those discussed in Alternative 3.

Alternative 5 includes installing a fully-actuated traffic signal with vehicle detection loops at the Substation Road/SH-16 intersection. Signal operation details and assumptions are discussed in the traffic analysis section.

SUMMARY OF SAFETY BENEFITS

The anticipated safety benefits of each alternative were evaluated according to the Safety Index and Annual Safety Benefit, calculated using the ITD-2658, Safety Evaluation form. The Safety Index is a tool for evaluating the safety benefits of roadway improvements. It measures the accident cost savings to motorists expressed as a percentage of the capital cost of the project. The Annual Safety Benefit is the annual accident cost saving to motorists.

Table 1 summarizes the Safety Benefits, which compares the alternatives to the existing conditions or Alternative 1, Do-Nothing. The ITD-2658 forms for each alternative are attached. The Safety Index and Annual Safety Benefit were calculated for the SH-16/Substation Road intersection as a spot intersection. The Safety Evaluation form would preclude roadway improvements as necessary from a safety standpoint because the roadway accident rate is below the statewide average for similar facilities. Because the evaluation considers only the intersection improvements, the only difference between the two signalized alternatives and the two unsignalized alternatives is the estimated project cost.

Table 1. Summary of Safety Benefits

Alternative	Safety Index	Annual Safety Benefit
Alternative 2	2.77	$130,531
Alternative 3	2.42	$130,531
Alternative 4	3.47	$181,754
Alternative 5	3.06	$181,754

The alternatives with the intersection signalized provide a higher safety index and annual safety benefit than the alternatives with the intersection unsignalized. This benefit is because a new traffic signal with protected left-turn phasing and safety lighting provides a 40 percent accident reduction according to the ITD safety evaluation methodology.

There are some safety issues with a traffic signal at the Substation Road intersection that are not specifically addressed in the Safety Evaluation Form. The intersection is located at the base of Freezeout Hill. The grade at the Substation Road intersection is approximately 2.5 percent, increases to approximately 4.5 percent at the east end of the project and reaches maximum

grade of 5 percent beyond the east project limits. The downhill grade approaching the intersection will increase the distance required for vehicles to stop, particularly heavy trucks.

The first issue is the ability of westbound vehicles, especially trucks, to stop when approaching the intersection on a grade. AASHTO recommends 570 feet be provided for stopping sight distance on a level roadway at 60 mph. This distance is increased by 5 percent to 600 feet to account for the 3 percent downgrade. These distances are based on passenger car operation and do not explicitly consider design for truck operation. AASHTO provides the following guidance for variations of stopping sight distance for trucks:

> *"Trucks as a whole, especially the larger and heavier units, need longer stopping distances from a given speed than passenger vehicles. However, there is one factor that tends to balance the additional braking lengths for trucks with those for passenger cars. The truck driver is able to see substantially farther beyond vertical sight obstructions because of the higher position of the seat in the vehicle. Separate stopping sight distances for trucks and passenger cars, therefore, are not generally used in highway design."*

AASHTO also provides recommendations for Decision Sight Distance, which provides greater visibility distance to allow drivers to make unusual or unexpected maneuvers. Avoidance Maneuver A is appropriate for this situation, which provides additional perception and reaction time to stop on a rural roadway. The recommended decision sight distance at 60 mph for Avoidance Maneuver A is 610 feet. Increasing this distance by 5 percent to account for the grade, gives a decision sight distance of 640 feet.

As noted above, these distances are based on passenger car deceleration rates and AASHTO does not provide estimates for truck deceleration rates. The deceleration used for passenger cars is 11.2 feet per second per second. Even if this rate is reduced in half (assuming trucks decelerate at half the rate of cars), the required decision sight distance, including the downgrade correction, is approximately 1,000 feet.

The traffic signal, and therefore, the need to stop, will be visible to westbound traffic from at least 1,000 feet east of the intersection, where the grade is approximately 2.75 percent. Based on this analysis, it appears that trucks should have sufficient distance to view the signal, recognize the need to stop and stop safely before the intersection.

The second issue is the effect an additional westbound travel lane may have on drivers following slower moving trucks. This lane is included in Alternatives 3 and 5. The concern is that if trucks are traveling down Freezeout Hill toward the Substation Road intersection at a reduced speed, the additional lane may encourage passenger cars to pass the slower moving trucks. This would create a situation where cars are not only approaching an intersection on a downgrade but may be accelerating down the hill and toward the intersection.

The additional westbound lane would not be a concern if it extended to the top of Freezeout Hill, as will be the case when the Freezeout Hill Passing Lane project is constructed. With the longer passing lane, passenger cars would have sufficient time to pass slower trucks before the Substation Road intersection.

SUMMARY OF TRAFFIC OPERATIONS

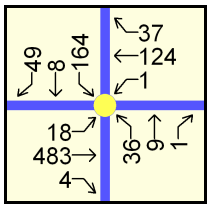
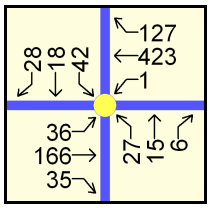
The traffic operations at the SH-16/Substation Road intersection were analyzed for the traffic situations listed below. Following ITD practice, 2006 is the construction year, which is two years beyond the programmed year of 2004, and 2026 is the design year, which is 20 years beyond the construction year.

- Existing AM Peak Hour
- Existing PM Peak Hour
- Year 2006 AM Peak Hour
- Year 2006 PM Peak Hour
- Year 2026 AM Peak Hour
- Year 2026 PM Peak Hour

EXISTING TRAFFIC

Existing turning movement counts were collected at the intersection during the PM peak hour on January 30, 2002, and during the AM peak hour on March 7, 2002. The existing turning movement counts are shown in Table 2 (north is oriented to the top of the traffic exhibits and SH-16 is oriented east-west).

Table 2. Existing Peak Hour Traffic Counts

SH-16/Substation Road AM Peak Hour	SH-16/Substation Road PM Peak Hour
	

PROJECTED 2006 AND 2026 TRAFFIC

ITD provided existing and projected Average Daily Traffic (ADT) volumes for SH-16 for years 2006 and 2026. The ADT projections indicate an average annual growth rate of 1.28 percent. This growth rate was applied to the existing peak hour counts to estimate the peak hour turning movements in 2006 and 2026 on the SH-16 approaches to the intersection.

The Gem County Planning and Zoning Department was contacted to discuss projected planning year traffic volumes on Substation Road. They recommended contacting the City of Emmett as developments in the area are annexed into the city before approval. We contacted John Blom with Holladay Engineering, the contracted City Engineer for Emmett. Mr. Blom recommended using an annual growth rate of 2.5 percent for the Substation Road traffic. The City of Emmett currently projects the population growth in the area at this rate and he felt it would be a reasonable representation of the projected traffic growth in the project area.

The projected annual growth rates discussed above were applied to the existing peak hour counts to estimate the 2006 and 2026 peak hour turning movement volumes. These volumes were used for the traffic analysis and signal warrant analysis and are shown in Tables 3 and 4.

Table 3. 2006 Peak Hour Traffic Counts

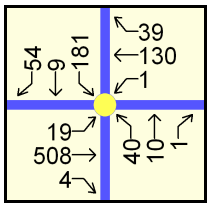
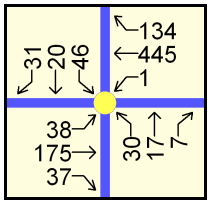
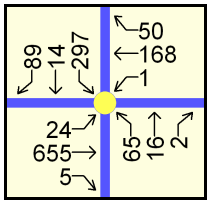
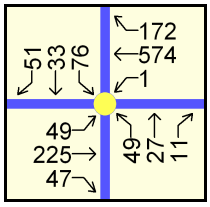
SH-16/Substation Road AM Peak Hour	SH-16/Substation Road PM Peak Hour
	

Table 4. 2026 Peak Hour Traffic Counts

SH-16/Substation Road AM Peak Hour	SH-16/Substation Road PM Peak Hour
	

TRAFFIC ANALYSIS RESULTS

For the alternatives with SH-16/Substation Road operating as a stop controlled intersection, the Highway Capacity Software module for unsignalized intersections was utilized to determine the average control delay and Level of

Service (LOS). The Highway Capacity Manual does not determine the average control delay and LOS for the intersection for two-way stop controlled intersections, but evaluates each movement for the minor street approaches and the left-turn movements from the major street.

For the signalized alternatives, the intersection traffic operations were analyzed using the SYNCHRO intersection capacity analysis software. The signal cycle length and splits were optimized by the software to produce the minimum overall intersection control delay. Based on Figure 12-305.4.1 in the ITD Traffic Manual, protected left-turn phases are not warranted with the projected traffic in 2006 for the SH-16 or Substation Road approaches to the intersection. The eastbound left-turn movement does warrant protected left-turn phasing during the PM peak in 2026 with the Alternative 5 lane configuration. Therefore, the Substation Road approaches were analyzed with permitted left-turn phasing in all cases and the SH-16 approaches were analyzed with permitted left-turn phasing in all cases except the Alternative 5 2026 PM peak hour.

The results of the traffic analysis are summarized in Table 5. Refer to the attached Highway Capacity Software and Synchro reports for additional details.

Table 5. Summary of Traffic Analysis

Alternative	Approach Delay (seconds)/LOS								Intersection Delay (seconds)/LOS	
	NB		SB		EB		WB			
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
EXISTING TRAFFIC										
Alternative 1 (Do Nothing)	21 C	23 C	36 E	21 C	8* A	9* A	9* A	8* A	N/A	N/A
PROJECTED YEAR 2006 TRAFFIC										
Alternative 1 (Do Nothing)	23 C	26 D	52 F	23 C	8* A	9* A	9* A	8* A	N/A	N/A
Alternative 2	24 C	25 C	18 C	19 C	8* A	9* A	9* A	8* A	N/A	N/A
Alternative 3	20 C	18 C	19 C	20 C	8* A	9* A	9* A	8* A	N/A	N/A
Alternative 4	5 A	7 A	5 A	5 A	13 B	8 A	9 A	10 B	10 B	9 A
Alternative 5	5 A	5 A	5 A	4 A	13 B	10 A	9 A	11 B	10 B	10 A
PROJECTED YEAR 2026 TRAFFIC										
Alternative 1 (Do Nothing)	55 F	87 F	509 F	96 F	8* A	10* B	9* A	8* A	N/A	N/A
Alternative 2	56 F	68 F	83 F	35 E	8* A	10* B	9* A	8* A	N/A	N/A
Alternative 3	36 E	29 D	98 F	42 E	8* A	10* B	9* A	8* A	N/A	N/A
Alternative 4	6 A	9 A	7 B	7 A	15 B	6 A	10 A	10 A	11 B	9 A
Alternative 5	6 A	10 B	7 A	8 A	15 B	11 B	9 A	13 B	11 B	12 B

* Left-turn movement only

As shown in Table 5, the southbound approach of Substation Road is expected to experience considerable delay during the AM peak hour by 2006 without any intersection improvements. The volume/capacity ratio for this movement in 2006 is 0.84 and the 95 percent queue length is estimated at over seven vehicles.

By 2026, the northbound and southbound approaches of Substation Road are anticipate to operate at LOS F during the AM and PM peak hours without any improvements. By this time, the southbound approach is significantly over capacity, with a volume/capacity ratio of 2.02 and expected 95 percent queue length of over 34 vehicles.

The intersection is anticipated to function with a reasonable LOS through 2006 as an unsignalized intersection, with the roadway improvements included with either Alternative 2 or Alternative 3. For these alternatives in 2026, the southbound approach is anticipated to operate at LOS F during the AM peak hour and LOS E during the PM peak hour. The left-turn movement is over capacity during the AM peak hour in 2026 with an expected 95 percent queue length of over 13 vehicles.

The alternatives with SH-16/Substation Road signalized, Alternative 4 and Alternative 5, are anticipated to operate with a LOS B through the 2026 design year. A 60 second cycle length was used for all of the alternatives with the left-turn phasing for SH-16 and Substation Road as discussed above.

Installing a traffic signal at the base of a steep grade may impact the traffic operations of SH-16 beyond the intersection. Heavy vehicles that are required to stop at the intersection must begin their assent up the grade from a stop condition. AASHTO provides empirical data for acceleration and deceleration rates on grades for a truck with a weight to power ratio of 200lbs/hp, which is a conservative figure. Assuming this truck currently is able to travel through the Substation Road intersection at 60 mph, it will decelerate to 30 mph approximately 3,300 feet up the 5 percent grade. The truck will continue to gradually decelerate to a maximum sustainable speed of 27 mph on a 5 percent grade. The same truck starting from a stop at Substation Road is able to accelerate to 27 mph in approximately 3,000 feet.

Alternatives 2 through 5 include two eastbound travel lanes at Substation Road and continuing east of the intersection. The acceleration lane is continued as far as possible within the project limits and ends approximately 720 feet before the project limit to provide sufficient merging length. This lane is intended to provide heavy vehicles time to accelerate in the right lane while faster passenger cars

may pass in the left lane. When the Freezeout Hill project is constructed, this lane will be extended to the top of the hill, providing passing opportunities for drivers along the entire grade.

TRAFFIC SIGNAL WARRANT ANALYSIS

The SH-16/Substation Road intersection was evaluated according to the traffic signal warrants from the 1988 Manual on Uniform Traffic Control Devices (MUTCD). For reference, the 2000 MUTCD revised the organization and warrant numbers for the various warrants; however, the criteria for satisfying the warrants was not revised.

Table 6 summarizes the Traffic Signal Warrant Analysis for each of the analysis years. Warrants for which data was not available are indicated in the table as n/a. Warrant 6 – Accident Experience was evaluated based on the accident history provided by ITD for SH-16 from January 1998 to December 2000. Warrant 10 – Peak Hour Delay was evaluated based on the estimated delay calculated by the Highway Capacity Software with the 2006 and 2026 projected traffic and without the roadway improvements, Alternative 1.

Table 6. Traffic Signal Warrant Analysis Summary

Warrant	Existing Traffic Counts	Projected 2006 Traffic	Projected 2026 Traffic
1 - Minimum Vehicular Volume	n/a	n/a	n/a
2 - Interruption of Continuous Traffic	n/a	n/a	n/a
3 - Minimum Pedestrian Volume	n/a	n/a	n/a
4 - School Crossing	n/a	n/a	n/a
5 - Progressive Movement	n/a	n/a	n/a
6 - Accident Experience	**YES**	n/a	n/a
7 - Systems Warrant	n/a	n/a	n/a
8 - Combination of Warrants	n/a	n/a	n/a
9 - Four Hour Volumes	n/a	n/a	n/a
10 - Peak Hour Delay	**NO**	**YES**	**YES**
11 - Peak Hour Volume	**YES**	**YES**	**YES**

The Peak Hour Delay warrant requires that the delay for one minor street approach to the intersection experiences over four vehicle-hours of delay with a one-lane approach. This warrant is satisfied during the AM peak hour in 2006 and both the AM and PM peak hour in 2026.

The Peak Hour Volume warrants requires that the peak hour volumes on the major street approaches and one minor street approach plot above the appropriate curve on the graph provided in the MUTCD. Figures 1 through 3 on the following pages show the peak hour volumes plotted on the MUTCD graph for each traffic scenario. As shown in the figures, the Peak Hour Volume warrant is satisfied at the intersection for the following scenarios:

- Existing AM Peak Hour
- 2006 AM Peak Hour
- 2026 AM Peak Hour
- 2026 PM Peak Hour

Figure 1. Peak Hour Warrant Graph for Existing Traffic

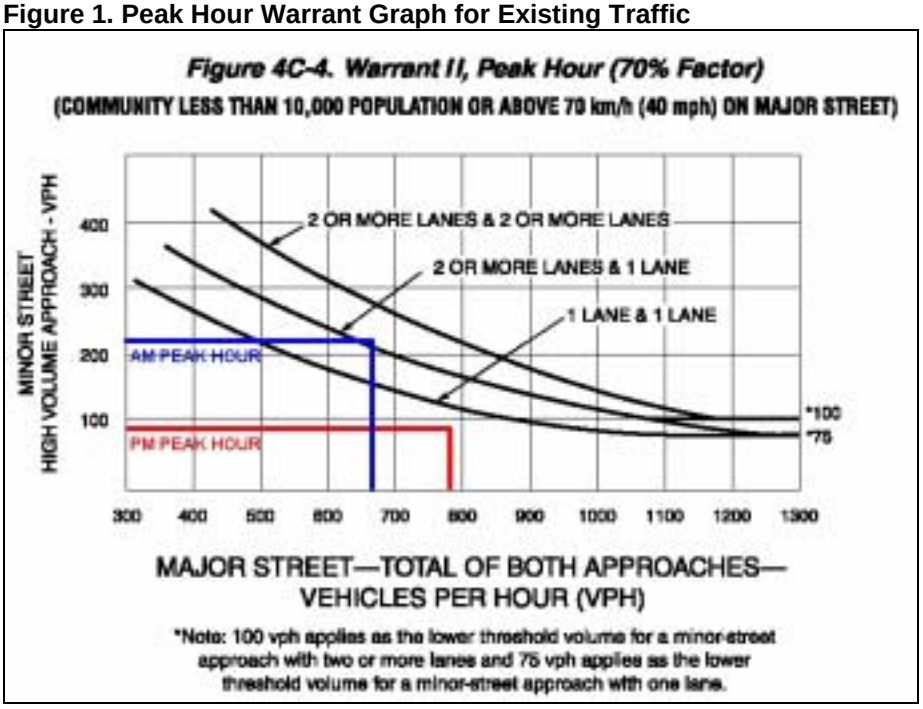


Figure 2. Peak Hour Warrant Graph for Projected 2006 Traffic

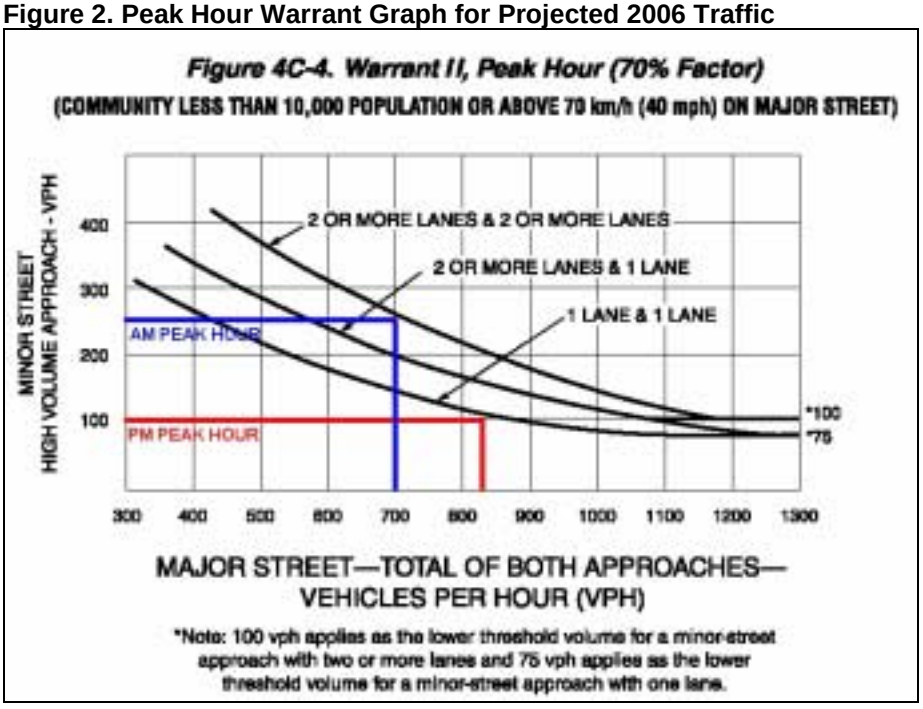
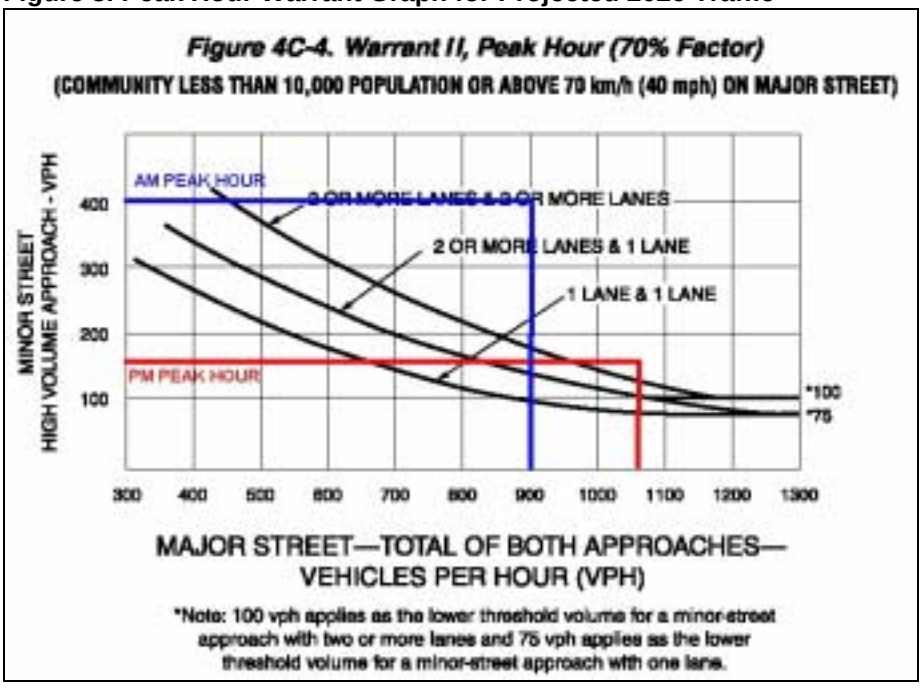


Figure 3. Peak Hour Warrant Graph for Projected 2026 Traffic



There were a total of 19 accidents reported at the SH-16/Substation Road intersection between January 1, 1998 and December 31, 2000. Of these accidents, 12 occurred during 1999 and 10 of these involved two vehicles turning at the intersection. These type of accidents are typically of the type susceptible to correction with a traffic signal.

The Accident Experience warrant requires five or more accidents of the type susceptible to correction with a traffic signal to occur within a 12-month period. This part of the warrant is satisfied with the accident data and the minimum volume and traffic progression requirements are satisfied. However, the warrant also requires that adequate trial of less restrictive remedies with satisfactory observance and enforcement has failed to reduce the accident frequency. To our knowledge, other accident reduction remedies have not been tried at this intersection. However, as noted above, the intersection satisfies the peak hour delay and volume warrants by the construction year and the accident experience could serve as additional justification for the signal.

SUMMARY OF ESTIMATED PROJECT COSTS

The Estimated project costs for each alternative are summarized in Table 7. The construction costs shown include Mobilization, at 10 percent, and Contingencies, at 10 percent.

We assumed that if Alternative 2 or Alternative 3 were selected for this project, the signal would be designed as part of project and the pole foundations, luminaire poles, service pedestal/signal controller foundation and underground conduit would be installed with this project. With this approach, the signal mast arms, signal heads, detection loops and cabling could be installed at a future date with little interruption to traffic.

Table 7. Summary of Estimated Project Costs

Estimated Costs (Programmed Funding)	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Construction ($790,000)	$0	$728,800	$854,000	$824,800	$950,000
Right-of-Way ($0)	$0	$0	$0	$0	$0
Construction Engineering ($120,000)	$0	$72,900	$85,400	$82,500	$95,000
Preliminary Engineering ($141,000)	$0	$141,000	$141,000	$141,000	$141,000
Total Estimated Project Cost ($1,051,000)	**$0**	**$942,700**	**$1,080,400**	**$1,048,300**	**$1,186,000**

The estimated project costs for Alternatives 3 and 5 are $29,400 and $135,800 respectively above the programmed funding for the project. The estimated project costs for Alternatives 2 and 4 are within the programmed amount.

RECOMMENDATIONS

The SH-16/Substation Road intersection satisfies the Peak Hour Delay and Peak Hour Volume warrants and the accident history part of the Accident Experience warrant. Based on ITD safety evaluation methodology, installing a signal at the intersection will provide additional safety benefits compared to an unsignalized intersection.

Because of the safety benefits and traffic operations, the alternatives that include installing a traffic signal at the SH-16/Substation Road intersection are preferred, Alternative 4 and Alternative 5. The difference between the designs of these alternatives is the lane configuration east of the intersection, with Alternative 4 providing two eastbound travel lanes and one westbound travel lane and Alternative 5 providing two eastbound and westbound travel lanes.

Alternative 4 and Alternative 5 are virtually the same from a traffic operations perspective. Alternative 5 includes the additional westbound travel lane, which was noted as a safety concern on page 7. Alternative 5 is estimated to cost $137,700 more than Alternative 4 because of the additional pavement and the retaining wall. For these reasons, **Alternative 4 is the recommended alternative**.

As noted in the Design Study Report Narrative, local officials and residents are concerned with the ability of trucks approaching the intersection from the east to stop at a signalized intersection. This situation was discussed in detail in the safety evaluation section of the report and it was demonstrated that sufficient sight distance will be available for trucks to safely stop at the intersection.

However, we recommended installing a hazard identification beacon (Figure 4 on the following page) approximately 1,000 east of the Substation Road intersection and an advanced signal warning sign (Figure 5) approximately one mile east of the intersection. These signs will provide drivers with advanced notice of the signal and may reduce the potential for accidents at the intersection.

Local officials and residents also noted concern for the ability of trucks to accelerate from a stop condition up the Freezeout Hill grade. As discussed in detail earlier, trucks will be traveling at 27-30 mph approximately 3,000-feet from the intersection with or without the traffic signal. The additional eastbound through lane will provide some passing opportunities for faster passenger cars until the Freezeout Hill project is completed.

Figure 4. Hazard Identification Beacon

Figure 5. Advanced Signal Warning Sign