IOWA DOT
I-80 Planning Study

INTERSTATE 80
PLANNING STUDY (PEL)

Diversion Strategies: Evaluation of Viability of Alternate Route Improvements

Office of Location and Environment | June 2017

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1. EXECUTIVE SUMMARY

The Iowa DOT is conducting a long-range planning study of the rural portions of I-80 in Iowa. This study is being conducted using the federally adopted Planning and Environmental Linkage (PEL) Study process. As such, the study's findings can be adopted by subsequent environmental and engineering studies for the implementation of the recommended improvements. The goal of the PEL Study is to identify the best long-term vision for improving the rural portions of the I-80 Corridor, extending from Council Bluffs to the Quad Cities. This will enable near-term improvements to be planned, designed and constructed in accordance with the long-term plan, as funding allows.

Within the PEL Study process, the Iowa DOT is evaluating a number of alternative improvement strategies, including the rehabilitation, reconstruction and possible widening of the existing I-80 infrastructure. As east-west travel within the Corridor is currently served by a network of parallel highways in Iowa, including the US 30 to the north and US 34 to the south, a combination of roadway improvements could improve the overall roadway system's performance. A system-wide assessment can identify the interactions between these parallel highways in serving the future needs of the Corridor. As a possible alternative strategy to solely improving the I-80 infrastructure, the purpose of this technical memorandum is to evaluate the possible benefits of improving these parallel routes in lieu of or in combination with improvements to I-80. It is important to note that If I-80 was improved simultaneously with either US 30 or US 34, and was to be completed in twenty years, it would take about half of available program dollars on an annual basis. Knowing this limitation, a review of where we may get the most out of the investment is an essential part to the conversation.

Improvements to the I-80 Corridor across Iowa, including the I-80, US 30 and US 34 routes, are being evaluated to meet the Corridor's future and long-term mobility needs, in addition to other considerations. Improvement strategies that do not effectively meet this goal would be deemed unreasonable and may be eliminated from further consideration. As a system evaluation, the intent of this technical memorandum is not to determine whether or not local improvements to US 30 and US 34 are needed, but rather how system wide improvements may benefit improvements to I-80. To measure the overall system's improved mobility, this study evaluated the changes in projected daily travel and delay, relative to the costs of the improvements, to assess the reasonableness of improving the alternative routes.

Extending the full length across Iowa and parallel to I-80, both US 30 and US 34 currently consist of combinations of 2-lane and 4-lane roadway sections. I-80 currently consists of four lanes in the rural portions of the Corridor. System wide improvements to these alternative routes would entail extending a 4-lane section fully across the State. A number of scenarios were evaluated to identify the potential travel benefits of improving the alternative routes in various combinations, as shown in Table 1.

Table 1. ALTERNATIVE ROUTE IMPROVEMENT SCENARIOS

Scenario	I-80	US 30	US 34	Purpose of Scenario
Base	No Build	No Build	No Build	Provides a basis for comparison for No Build
1	6 Lanes	No Build	No Build	Benefits of improving only I-80
2	No Build	4 Lanes	No Build	Benefits of improving only US 30
3	No Build	No Build	4 Lanes	Benefits of improving only US 34
4	6 Lanes	4 Lanes	No Build	Benefits of improving I-80 and US 30
5	6 Lanes	No Build	4 Lanes	Benefits of improving I-80 and US 34

The system wide 2040 daily travel and delay projections were estimated for each of these improvement scenarios. Comparing these projections with the Base Scenario and each other provides a measure of the relative effectiveness of improving overall system travel efficiencies for each scenario. It is projected that improving I-80 would reduce future system wide travel delay by roughly 25%. In contrast, improving either US 30 or US 34 would reduce delay by only 5% and 6%, respectively. If only one corridor was improved, it appears that improving I-80 would get roughly five times the decrease in total delay when compared to US 30 and roughly four times when compared to US 34. As for I-80, future traffic projects that almost 60 percent of that route would be operating at a poor level of service if it remained 4-lanes, and since this route has the highest amount of vehicle miles traveled, this delay would affect the most drivers. In review of these projections, the following conclusions are evident:

- Improving either or both US 30 and US 34 would not measurably reduce the traffic along I-80.
- Regardless of any future improvements to US 30 or US 34, 6-lane widening of I-80 is needed to efficiently serve future travel along I-80.

In review of the various improvement scenarios, the travel efficiency analysis demonstrates that the three primary routes effectively serve east-west travel across southern Iowa. While the majority of existing and future travel is served by I-80, the combination of the three routes effectively serves all East-West travel. The results indicate little interdependencies between the routes on the western side of the State. However, on the east side, improving I-80 would shift a relatively significant amount of traffic from US 30, but not US 34. Conversely, improving US 30 would not significantly shift traffic away from I-80. This suggests that on the eastern side of the State, improving I-80 could affect the future need and timing of corridor wide improvements to US 30. The travel efficiency analysis shows that improving the alternative routes would not be a reasonable alternative strategy to improving I-80. While this analysis has determined that capacity improvements are needed on I-80 independent of US 30 and US 34, systematic improvements to these alternative routes should continue to be evaluated based on their individual needs, including local improvements, as funding and state wide priorities allow.

2. INTRODUCTION

As part of the Planning and Environmental Linkage (PEL) study for the I-80 Interstate system, an evaluation of where to best invest in Iowa's roadway infrastructure will be performed. The purpose of this tech memo is to evaluate if investment in the existing interstate infrastructure would be more cost effective for managing anticipated traffic growth than improvements elsewhere in an effort to offload increasing traffic to alternative routes. Due to the proximity of US 30 and 34 to Interstate 80, they offer plausible alternative routes for comparison and offered the most potential to impact traffic demand along Interstate 80. US 30 is located north of I-80 and US 34 is located south of I-80 and both run parallel to the Interstate in its entirety.

As there is an increasing demand for travel, there is a corresponding need to increase the capacity of the system [(1)]. Efforts are being made to improve both the operational capacity and operations of the system, but due to limited financial resources, an assessment needs to be made on the most cost effective approach for those improvements. This analysis will help start the discussion on where investments could make the most positive impact on the operations of the system.

Several criteria will be evaluated to see if capacity improvements on off alignment alternatives (i.e. parallel non-interstate routes) in lieu of Interstate 80 would be more cost effective. Capacity improvements along US 30 and 34 would require improving the two-lane segments along these two corridors, into a four-lane divided expressway. These improvements would result in a free flow 65 mph condition for travelers crossing the state.

The bulleted list below will be investigated within this analysis and does not include long term asset management costs or life-cycle costs for the different improvement strategies.

- Cost
- Traffic Demand
- Cost/Utilization
- Economic Impacts
- Affordability
- Environmental Impacts

3. EXISTING CONDITIONS

Different classifications of routes have varying degrees of access control. Table 2 provides the types of access control that can be found on these three corridors. The Iowa Primary Highway Access Management Policy (2) defines each priority type and additional information in regards to access control can be found in this policy.

Table 2. ACCESS CONTROL

Priority Type	Access Locations	Minimum Spacing
1	Interchanges	1 mile
2	Interchanges and selected at-grade intersections	1 mile preferred, ½ mile min.
3	Interchanges and at-grade intersections	1,000 feet
4(a)	At-grade intersections	600 feet
4(b)	At-grade intersections	300 feet

I-80

Outside of large metropolitan areas, I-80 is a 70 mph four-lane divided interstate with priority 1 access control.

US 30

US 30 varies on the type of access control and number of lanes throughout the state. This route includes sections that range from a two-lane highway with Priority 4 access control and a four-lane expressway with Priority 1 access control.

Three segments along US 30 remain a two-lane facility beginning from the US 30/I-29 interchange on the west side of the state, to the city of Clinton on the east side of the state. Table 3 provides the mileposts and route miles of the two-lane segments along US 30. This route has nearly 189 miles out of 331 total miles that remain as two-lanes. Along the two-lane sections of US 30, there are twenty-one communities where travelers have to reduce speeds or stop on occasion.

The segments that are not included in Table 3 have already been improved to a four-lane divided expressway. All of segment 2, as well as a bypass around the communities of Mount Vernon and Lisbon are slated for improvement to a four-lane expressway within the current five-year transportation improvement program.

Table 3. TWO-LANE SEGEMENTS OF US 30

Segments	Begin Milepost	Begin Location Description	End Milepost	End Location Description	Route Miles
1	9	I-29/US 30 Interchange	125.5	West of Ogden	116.5
2*	206	East of Tama	232	US 218	26
3**	263	West of Mt. Vernon	310	West of Dewitt	47

* Denotes this segment is programmed to be four-lane in the current five-year program
** Denotes 8 miles of this segment is programmed to be four-lane in the current five-year program (Lisbon / Mt. Vernon Bypass)

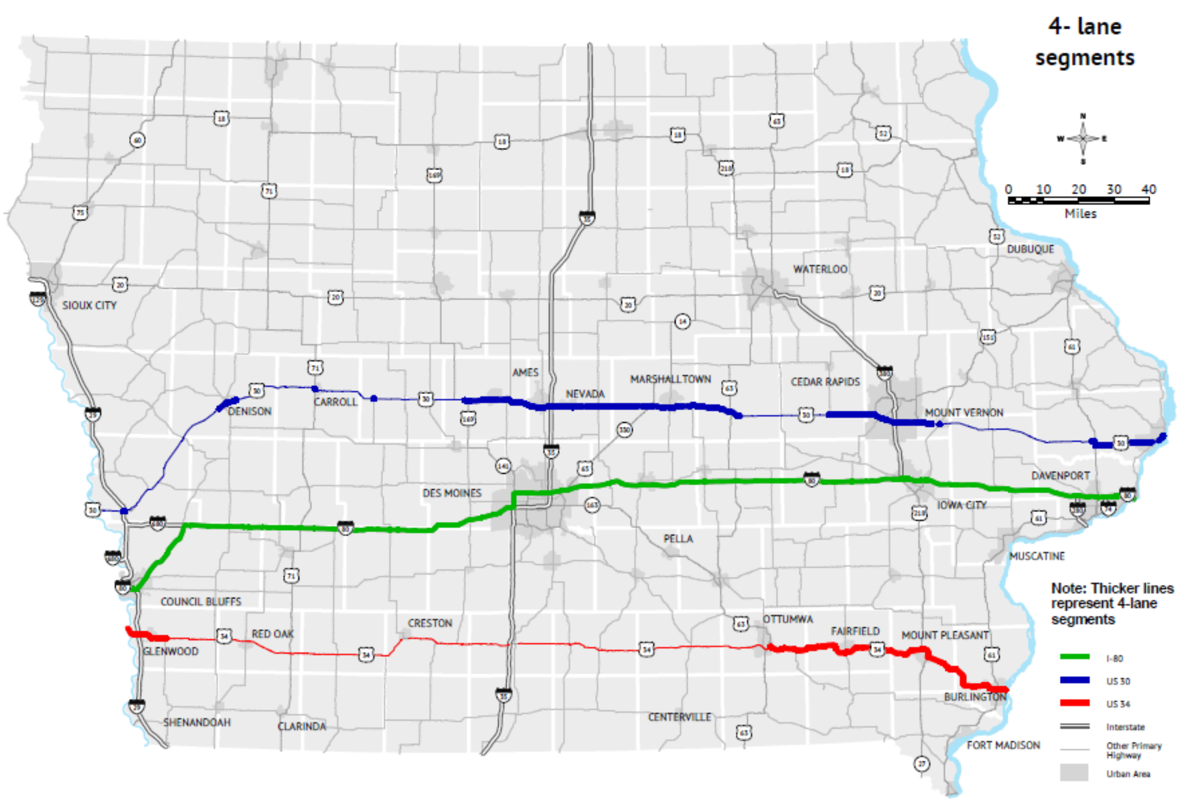
US 34

US 34 differs from US 30 in that there is essentially one segment that remains a two-lane facility and begins just east of Glenwood and stretches to just east of Ottumwa. US 34 also has more climbing/passing lanes than US 30. Similar to US 30, US 34 ranges from priority 1 and priority 4 access control. Table 4 below provides a more detailed description of this segment. Along US 34 there are nearly 182 miles out of 269 total miles that remain two-lane. This segment of US 34 includes nine communities where travelers have to reduce speeds or stop on occasion.

Table 4. TWO-LANE SEGMENTS OF US 34

Segments	Begin Milepost	Begin Location Description	End Milepost	End Location Description	Route Miles
1	12	East of Glenwood	194	East of Ottumwa	182

For a visual representation of where the four-lane segments are located on these three routes refer to Figure 1 where the bold line-work reflects the 4-lane sections.



Source: IDOT, Office of Systems Planning

Figure 1. Four-lane segments: I-80, US 30 and US 34

4. COST ANALYSIS

As noted earlier, one criterion in evaluating where to best invest in our infrastructure is related to the financial aspects of making capacity improvements. Within this portion of the tech memo, we intend to perform a high level cost estimate to determine how much funding would be needed to improve the two-lane segments of US 30 and US 34 to a four-lane expressway and I-80 to six-lanes in the rural areas. This cost estimate should be considered very preliminary and does not involve a detailed analysis of costs. The following assumptions were used in completing this cost estimate:

- All communities within the two-lane segments were bypassed with a four-lane divided roadway on new alignment.
- A grade separated diamond interchange was included for access at every community along the corridor.
- Segments that are currently four-lane expressway were not considered for further improvements.
- Costs include roadway, bridges, drainage structures, interchanges and right-of-way (ROW).
- Utilities were not included in these costs.
- When expanding the existing roadway, the cost of reconstructing the existing lanes was included.
- The dollar amounts provided in this tech memo are based on 2016 bid item prices.
- The cost estimate for US 30 excludes the Mt. Vernon/Lisbon bypass and the segment from east of Tama to US 218 (segment 2 in Table 3). Both of which are currently in the five-year program.
- Cost estimate for I-80 are based on improving 273 route miles outside the metro areas. The major metropolitan areas of Council Bluffs, Des Moines, Iowa City, and Quad Cities were excluded from this study. Improvements within the metro areas to keep pace with the growth in traffic will be required regardless of improvements in the rural portions of the interstate and are being examined by other independent studies and portions have already been funded within the current five-year program.

For comparison purposes, the total costs for the two corridors and I-80 are provided in Table 5 below. Due to relatively close numbers of two-lane miles, the cost of improving US 34 and US 30 are nearly the same. Although US 30 has slightly less route miles to improve, they have more than double the amount of communities that are anticipated to be bypassed. Bypasses require the new four-lanes to be constructed in undeveloped areas and are costlier than constructing a four-lane divided highway when 2-lanes already exist.

Table 5. ESTIMATED 2016 COSTS

Route	Type of Improvement	Total Estimated Cost ($ Millions)
US 30	Two-lanes to four-lanes	1,500
US 34	Two-lanes to four-lanes	1,500
I-80	Four-lanes to six lanes	3,400

5. TRAFFIC ANALYSIS

Traffic volumes play an important role in the operations and level of service of a roadway. This section will evaluate how forecasted traffic volumes impact these metrics for the three corridors. Five scenarios were analyzed for the year 2040 with US 30 and US 34 being evaluated independently and synchronously with I-80. Each of the five scenarios is summarized below with no build being defined as the roadways in their configuration after the five year improvements are completed. These improvements include the Mt. Vernon/Lisbon bypass and the segment that is east of Tama to US 218 improved to a four-lane expressway on US 30.

Table 6. TRAFFIC SCENARIOS

Scenario	Interstate 80	US 30	US 34
Base	No Build	No Build	No Build
1	6 Lanes	No Build	No Build
2	No Build	4 Lanes	No Build
3	No Build	No Build	4 Lanes
4	6 Lanes	4 Lanes	No Build
5	6 Lanes	No Build	4 Lanes

The scenarios were selected to attempt to answer the questions below (next to each) regarding what impacts different corridor improvements have on one another and what impacts capacity improvements have on Level of Service (LOS), Vehicle Miles Traveled (VMT), and Total Daily Delay. The responses to the questions are provided in green under the traffic analysis results.

Scenario 1: If investments were made to 6-lane I-80 and nothing was done to either US 30 or US 34, would projected traffic demand show a need to four-lane US 30 or US 34 to maintain an acceptable level of service on those routes?

Scenario 2: If investments were made to 4-lane US 30 in lieu of 6-laning Interstate 80, how much traffic diverts from I-80 to US 30 and how much of Interstate maintains a good level of service?

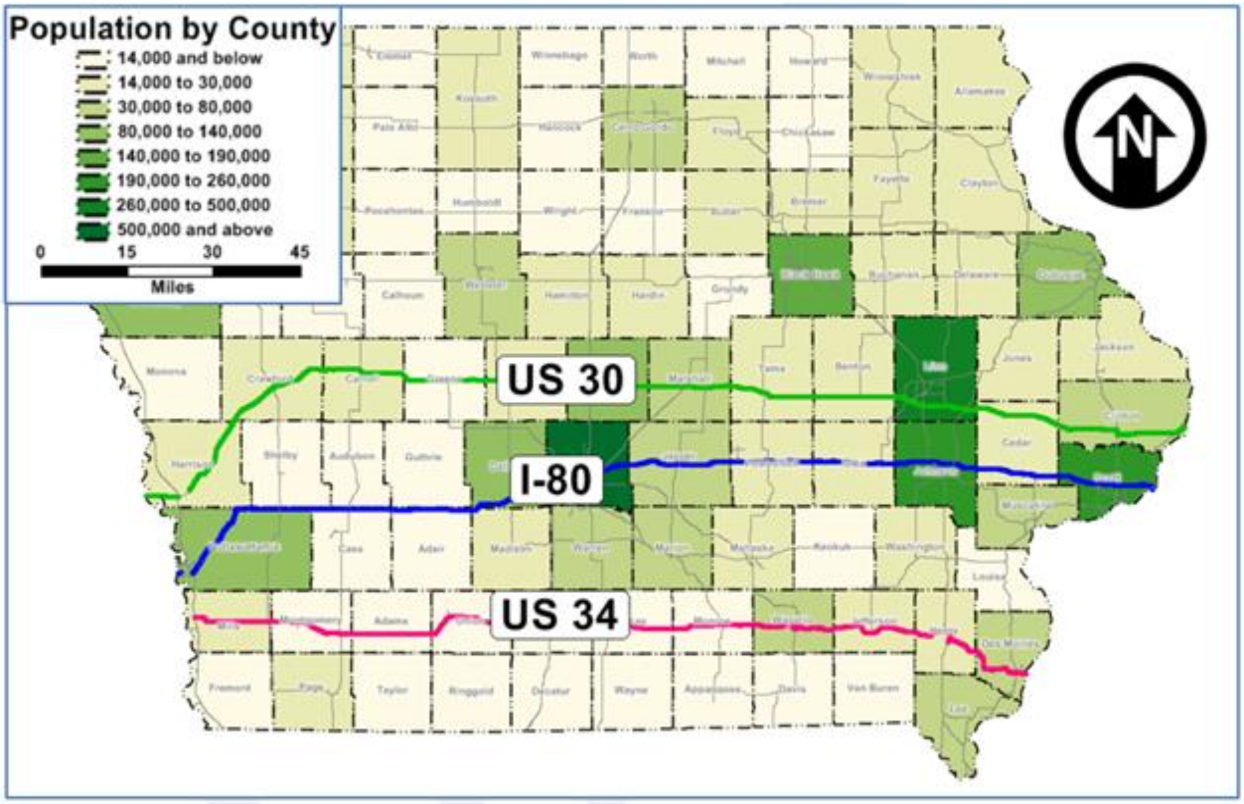
Scenario 3: If investments were made to 4-lane US 34 in lieu of 6-laning Interstate 80, how much traffic diverts from I-80 to US 34 and how much of Interstate maintains a good level of service?

Scenario 4: If I-80 and US 30 were improved to 6-lanes and 4-lanes respectively, how would these improvements impact level of service for both routes from the forecasted traffic numbers?

Scenario 5: If I-80 and US 34 were improved to 6-lanes and 4-lanes respectively, how would these improvements impact level of service for both routes from the forecasted traffic numbers?

The above scenarios were modeled through the Iowa Travel Analysis Model iTRAM by the Iowa DOT's Office of Systems Planning to develop a comparative analysis of various capacity improvements. [(3)] Analysis delineated the data between the east and west side of the state and used I-35 as the natural break point.

It is important to note the forecasted population differences between the east and west half play a signification role in the results. The east side of the state always has more VMT on the three corridors due to higher population densities. Figure 2 below provides the 2040 forecasted population by county and provides a good picture of future population differences across the state. The darker the color the higher the population. Note that the forecasted population shown in the Figure 2 does not account for improvements on any of the corridors.



Source: Office of Systems Planning

Figure 2. Population by county (YEAR 2040)

The primary focus of this discussion will evaluate the impact that capacity improvements have on the utilization, and how that influences Level of Service and the percent change in delay. Again, capacity improvements along US 30 and 34 translate to a 4-lane free flow 65 mph conditions across the state and six-lane reconstruction on I-80 in the rural areas. Utilization was evaluated as daily VMT (vehicle miles traveled) over the corridor in a day.

The below metrics were evaluated in the five scenarios:

- Level of Service as percentage of the route that is classified as:
  - Good
  - Fair
  - Poor

- VMT Vehicle Miles Traveled (Daily)
- Percent Change in Delay (per vehicle)

Level of Service (LOS)

One metric that will be evaluated in this portion of the tech memo is the future Level of Service (LOS). Level of service is the measure used to represent the quality of traffic flow on a segment of a road. LOS is measured on a scale from A-F, with LOS A representing the best operating conditions from the driver's perspective and LOS F being the worst. Operating conditions on a freeway are desirable when drivers are able to maneuver freely within traffic streams without impeding their speed. [(4)] This freedom to maneuver is shown in Figure 3 which shows LOS measures for a basic freeway (Interstates are freeways) segment. A brief description taken from the Highway Capacity Manual for each level of service is summarized below. [(4)] Typically LOS is measured during peak hour volumes, but for the purpose of this memo is based on daily volumes as this is a corridor wide evaluation.

LOS A – Vehicles are almost completely unimpeded in their ability to maneuver and free flow speeds (FFS) are maintained.

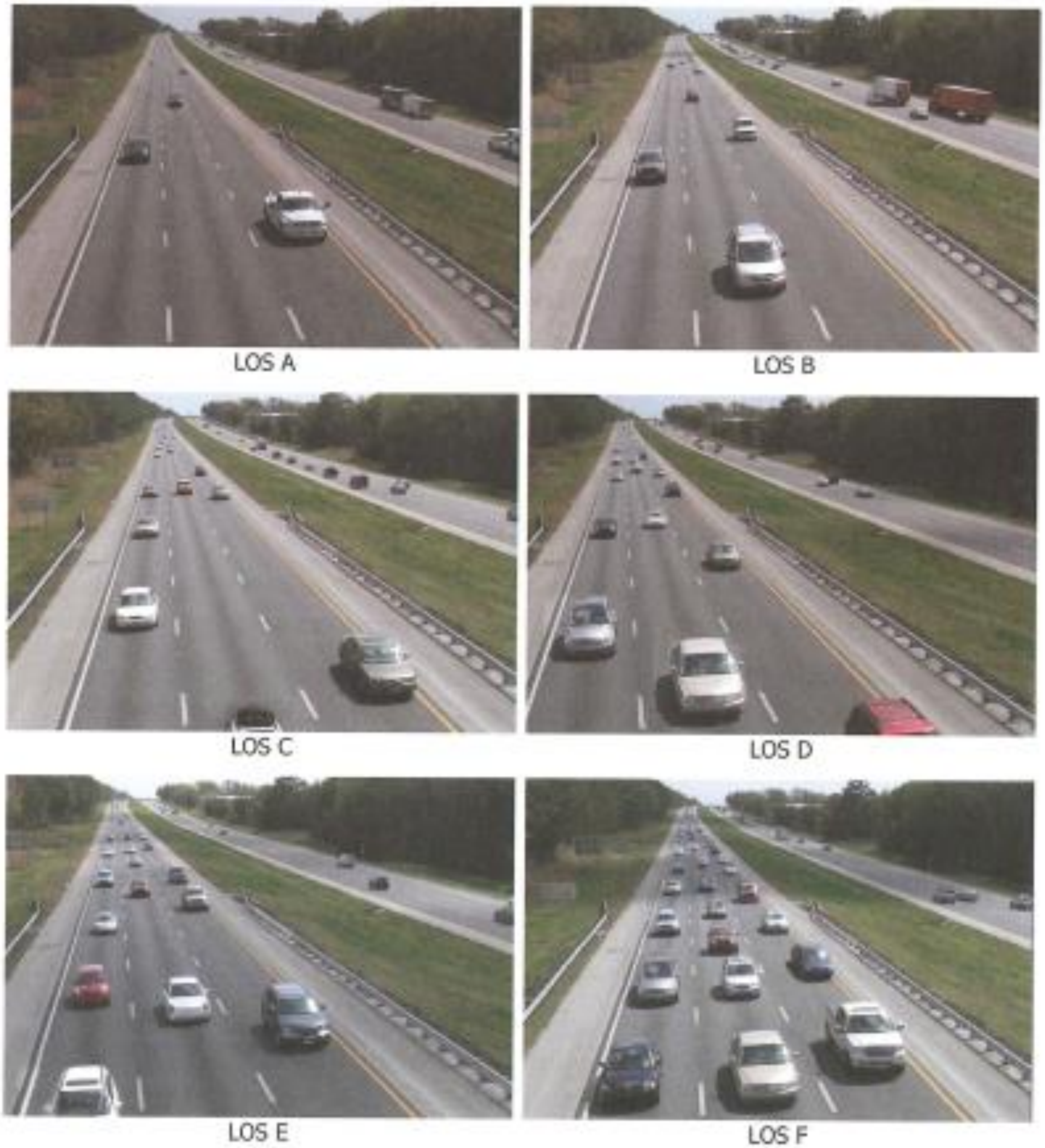
LOS B - The ability to maneuver is slightly restricted and FFS are close be being maintained.

LOS C - The ability to maneuver is noticeable restricted with flow being near FFS.

LOS D – The ability to maneuver is seriously impacted and FFS begins to decline

LOS E – The ability to maneuver is almost nonexistent.

LOS F – Unstable flows. The number of vehicles arriving at the point exceed the number of vehicles that can move through it. An example of this would be bottlenecks.



Source: *TRB. Highway Capacity Manual. HCM 2010. Transportation Research Board, National Research Council, Washington, DC, 2010*

Figure 3. LOS

For the purpose of this tech memo the LOS will be classified as shown in Table 7:

Table 7. LOS CLASSIFICATIONS

Classification	LOS
Good	A to B
Fair	C
Poor	D to F

Vehicle Miles Traveled (VMT) and Delay

The other two metrics that will be discussed are the future percent change in daily delay per vehicle and future percent change in daily vehicle miles traveled (VMT). Daily delay is defined as the additional time needed to travel over the Free Flow Speed Travel Time, as summed for the corridor in question. An example of this would be the difference in seconds traveled if you traveled any of the corridors in the build or no-build scenario and compare that time to the Free Flow Speed Time. Daily VMT can be described as the total miles traveled on the study corridor during a day. This percent change to daily VMT will be reviewed for impacts to the percent change in daily delay.

6. TRAFFIC ANALYSIS RESULTS

The (iTRAM) results for percent change in LOS, VMT, and Delay are summarized for the five scenarios in Figures 4 through 6 and Table 8. The percentages represent the amount of each route, as a percent of route miles, that are operating at that LOS. A brief narrative will be provided summarizing the results of each scenario. It is important to note that increases in vehicle miles traveled on one route may actually improve the delay of the other routes due to the potential of traffic being pulled away from the less attractive route.

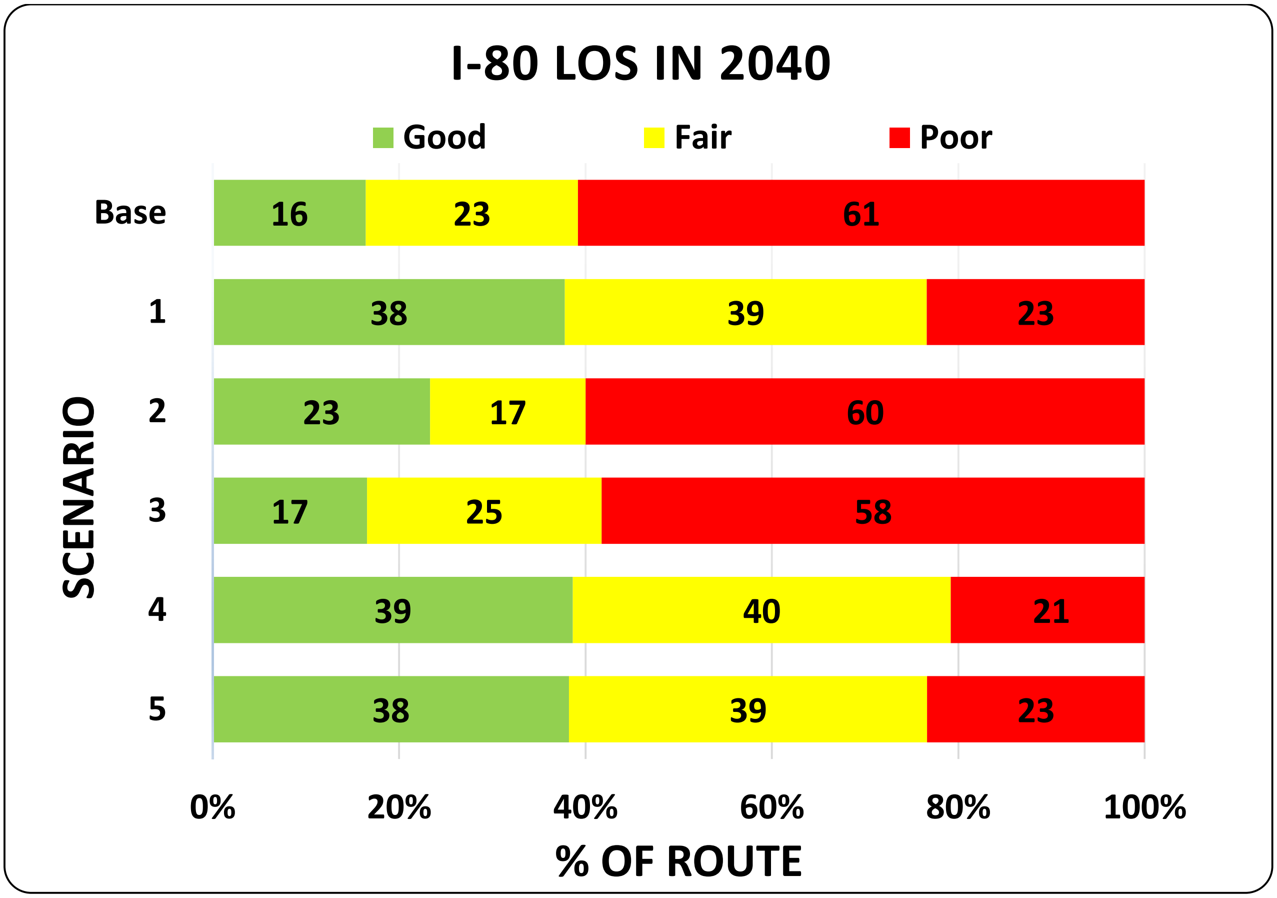


Figure 4. I-80 LOS in 2040

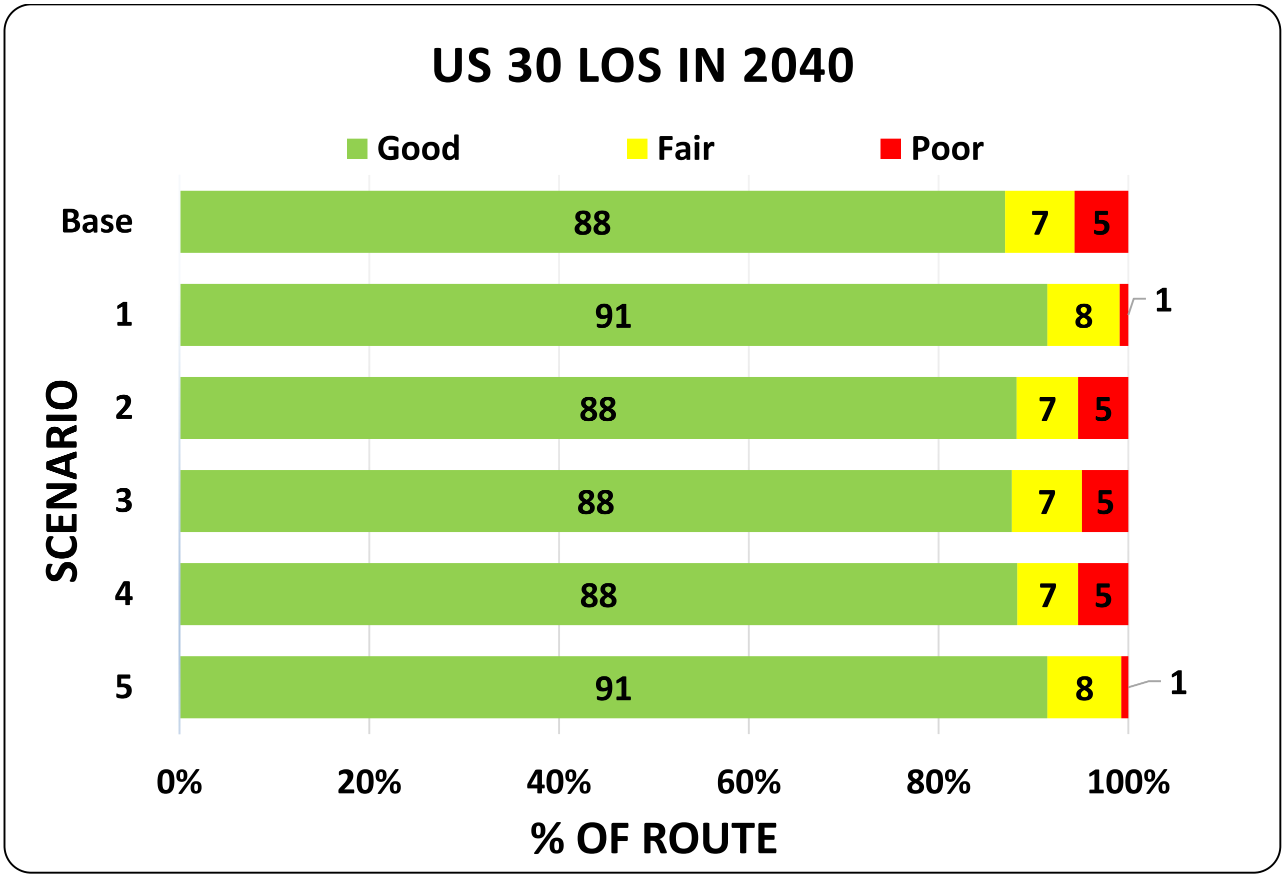


Figure 5. US 30 LOS in 2040

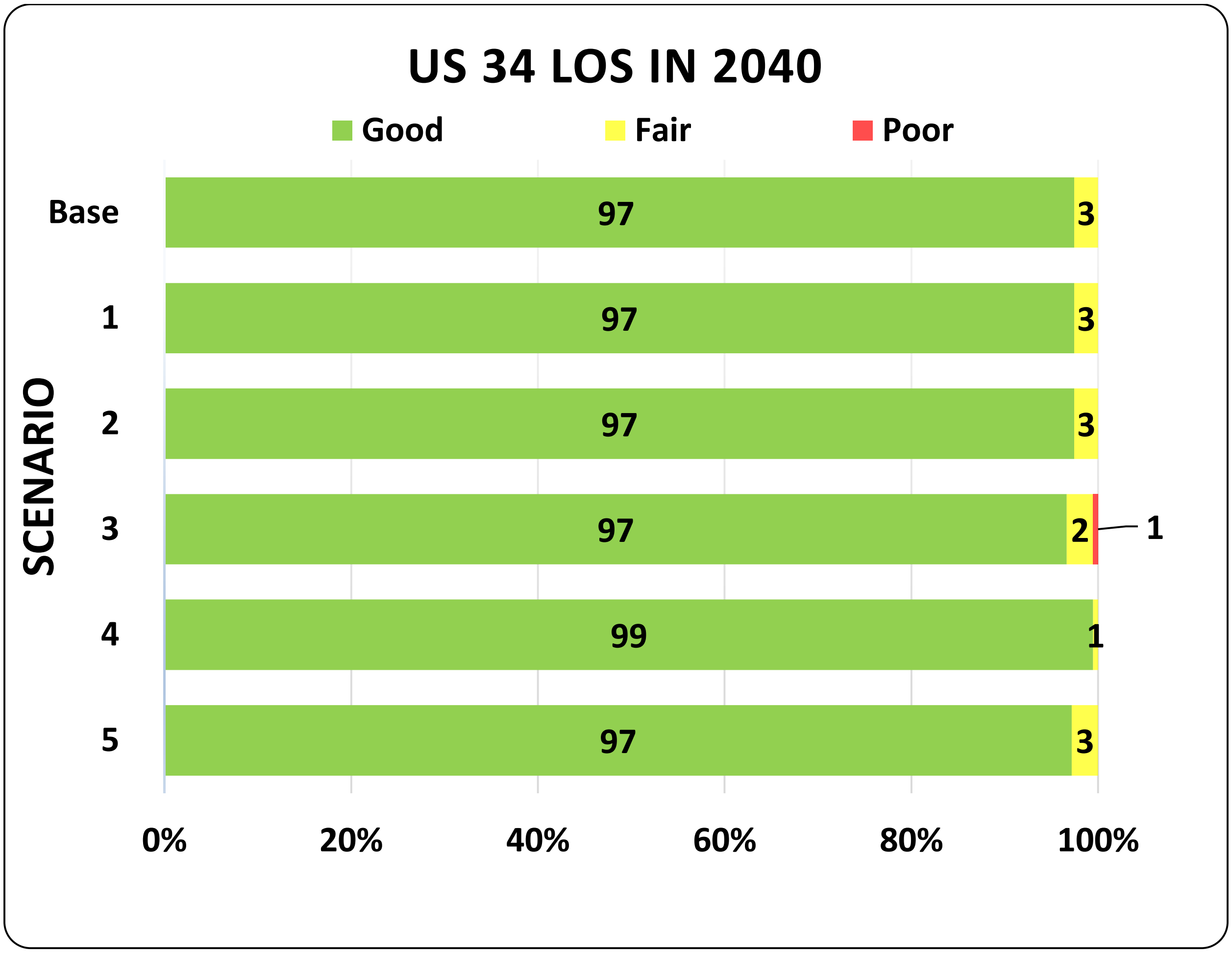


Figure 6. US 34 LOS in 2040

Table 8. PROJECTED PERCENT CHANGE IN VMT AND DELAY IN 2040

Scenario	Route	Description	East of I-35		West of I-35		All Corridors
			% Change VMT	% Change Delay (Per Vehicle)	% Change VMT	% Change Delay (Per Vehicle)	% Change Total Delay
1	80	6 Lanes	8.36	-28.67	1.68	-25.28	-25.07
	30	No Build	-24.25	-17.24	-2.21	-8.27	
	34	No Build	-0.34	-0.41	0.04	-15.84	
2	80	No Build	-1.18	-2.69	-2.48	-1.75	-4.62
	30	4 Lanes	30.80	-36.96	42.14	-29.40	
	34	No Build	-0.11	-0.55	-0.04	-0.44	
3	80	No Build	-4.69	0.99	-0.69	-16.67	-6.25
	30	No Build	-1.24	2.22	0.04	-0.24	
	34	4 Lanes	36.07	-11.22	34.32	-57.00	
4	80	6 Lanes	2.81	-30.98	-0.17	-25.91	-28.49
	30	4 Lanes	24.92	-37.45	38.85	-29.31	
	34	No Build	-0.40	-0.99	-0.16	-17.40	
5	80	6 Lanes	8.16	-28.70	0.29	-23.74	-25.13
	30	No Build	-24.55	-19.32	-1.54	-1.23	
	34	4 Lanes	32.33	-13.09	32.40	-59.62	

Scenario 1

Question: If investments were made to 6-lane I-80 and nothing was done to either US 30 or US 34, would projected traffic demand show a need to four-lane US 30 or US 34 to maintain an acceptable level of service on those routes?

Answer: Expanding I-80 to six lanes improves the LOS and delay along this corridor, while also providing some improvements to the LOS and delay on US 30. The improvements to LOS and delay on US 30 are likely due to traffic being diverted from these routes to I-80 as shown in the reduction of VMT on US 30. The LOS on US 34 does not change, while delay is reduced. US 30 has 91 percent and US 34 has 97 percent of the route operating at a good LOS. They are operating at this condition regardless if any improvements are made along those corridors. Therefore, the need to improve US 30 or US 34 does not seem to be warranted as both routes have a good level of service for over 90 percent of either route.

Scenario 2

Question: If investments were made to 4-lane US 30 in lieu of 6-laning Interstate 80, how much traffic diverts from I-80 to US 30 and how much of Interstate maintains an good level of service?

Answer: Expanding US 30 to four-lanes decreases delay on I-80 by up to 2.7 percent east of I-35 and 1.8 percent west of I-35 as some traffic is diverted to US 30. Even with this diversion of traffic, LOS does not change significantly from the no-build scenario as there is only a 1 percent decrease in poor LOS for I-80. The only time LOS improves on US 30 is when the other corridors are improved. This is reflected in the percentage decrease of poor LOS along US 30 in scenarios one and five. Although there is up to 2.5 percent of VMT diverted from I-80, it only leaves 23 percent of I-80 operating at a good level of service .

Scenario 3

Question: If investments were made to 4-lane US 34 in lieu of 6-laning Interstate 80, how much traffic diverts from I-80 to US 34 and how much of Interstate maintains a good level of service?

Answer: Improving US 34 to four-lanes decreases delay on that corridor and worsens the LOS very slightly on US 34 as now one percent is operating as poor LOS. This could be due to the amount of traffic being added to US 34 as there are significant percentage increases in VMT along US 34. Although there is roughly 1.2% of VMT diverted from I-80, it only leaves 17 percent of I-80 operating at a good LOS.

Scenario 4

Question: If I-80 and US 30 were improved to 6-lanes and 4-lanes respectively, how would these improvements impact level of service for both routes from the forecasted traffic numbers?

Answer: Improving I-80 to six lanes and US 30 to four-lanes provides similar impacts to the LOS along I-80 as scenario 1 (only improving I-80). In regards to total delay, this scenario provides the greatest percentage in reduction at 28.49%. US 30 has 88 percent operating at a LOS of good, while I-80 has 39 percent of the route operating at a good LOS. LOS on U.S 30 did not change from the no-build scenario, while there is a 23 percent increase in the amount of I-80 operating at a good LOS from the no-build scenario.

Scenario 5

Question: If I-80 and US 34 were improved to 6-lanes and 4-lanes respectively, how would these improvements impact level of service for both routes from the forecasted traffic numbers?

Answer: Improving I-80 to six lanes and US 34 to four-lanes provides similar reduction in total delay as scenario 1 (improving only I-80). Both routes see an increase in VMT and nothing seems to be diverted from either route. US 34 has 97 percent operating at a good LOS while 38 percent of I-80 is operating at a good condition. Improvements cannot be seen to the LOS on US 34 from the no-build scenario, while there is a 22 percent increase in the amount of I-80 operating at a good LOS from the no-build scenario.

Traffic Analysis Summary

The greatest benefit to users might be described where the largest amount of travelers would gain the most positive impacts from the investment. Improved LOS, decreased delay, and increased capacity are the primary metrics that were evaluated to help with this discussion. The traffic analysis results provide a good picture of what the impacts are from capacity improvements for each scenario, and which scenario would provide the biggest overall positive impact to travelers.

The biggest overall impact to delay can be seen when the corridors are being evaluated as a whole in each of the five scenarios. Table 8 provides the total percent change in delay in yellow as the three corridors are considered together. The biggest percentage decrease in total delay is when both I-80 and US 30 had capacity improvements. Improving only US 30 had the least amount of impact to a total decrease in delay as shown in scenario 2. If only one corridor was improved, it appears that improving I-80 would get roughly five times the decrease in total delay when compared to US 30 and roughly four times when compared to US 34.

With all of the scenarios, US 30 has a minimum of 88 percent and US 34 has a minimum of 97 percent operating at good LOS, regardless if any capacity improvements are done to those routes. I-80 on the other hand has a significantly lower percentage of the route operating at a good LOS, around 20 percent, if nothing is done for capacity improvements. This in turn means that approximately 80 percent of I-80 is operating at fair to poor LOS while only twelve percent and three percent of US 30 and US 34 operate at fair to poor LOS.

In regards to how improving I-80 impacts the two other corridors, the data shows expansion of I-80 to six lanes increases the amount of US 30 operating at a good condition from 88 percent to 91 percent, whereas there is no change in LOS on US 34. Improving only the parallel non-interstate routes does not seem to have a signification positive impact to the operations on I-80, as there is a one to seven percent increase in the amount of I-80 operating at a good level of service as shown in scenarios two and three.

It is important to keep in mind that although there may be bigger percentage changes in LOS and delay on the west side of the state, a greater amount of travelers would be impacted on the east side of the state due to higher population densities.

7. COST VS UTILIZATION

Using the 2040 forecasted daily vehicle miles traveled (VMT) that were generated through iTRAM and the 2016 estimated construction costs above, a comparison of cost vs utilization can be accomplished. The purpose of this evaluation is to compare how much influence capacity improvements would have on the amount of usage for the three corridors.

Table 9 provides the 2016 estimated costs of capacity improvements and total forecasted daily VMT. The total daily VMT in Table 9 reflects the highest VMT for any of the five scenarios. For example, US 30 has the highest forecasted VMT for scenario 2 and that number is reflected as 4.9 million in the Table. Note that the data in Table 9 reflects 2040 VMT numbers and the cost reflects 2016 prices.

Table 9. 2040 VMT COMPARED TO IMPROVEMENT COST

Scenario	Route	Total Daily VMT	Total Estimated Cost ($ Millions)
1	I-80	14,000,000	3,400
2	US 30	4,900,000	1,500
3	US 34	1,700,000	1,500

The data reflects the following:

- Future VMT on I-80 is 8.0 times greater than US 34
- Future VMT on I-80 is 2.8 times greater than US 30
- The cost of improving US 30 and US 34 is the same.
- The cost of improving I-80 is 2.3 times greater than either US 30 and US 34

8. ECONOMIC IMPACTS

This portion of the tech memo is to explore of the cost of congestion as it relates to the amount of delay. This is important because delays on the system translate into economic costs from lost time, increased vehicle costs and increase chance of collision. Congestion can be simply described as when traffic demand approaches or exceeds the available capacity of the system.(5) Again, delay can be described as the additional time needed to travel over the Free Flow Speed Travel Time of the corridor in question.

As traffic volumes continue to increase, the need to address the operational capacity of the system is also increasing. Congestion is becoming a nationwide problem and Iowa is not immune to this concern. According to TRIP, a national transportation research group, it is estimated that congestion costs Iowa motorists $380 million annually in lost time and wasted fuel. (6) Although figures vary from source to source, it is consistent with the message that the costs of congestion are real and on the rise.

The amount of forecasted total daily delay is reflected in Table 10 and the numbers were generated from the iTRAM model of the five scenarios.

Table 10. DAILY DELAY FORECAST FOR 2040

Scenario	Route	Description	East of I-35 Daily Delay (Hours)	West of I-35 Daily Delay (Hours)	Total Daily Delay (Hours)
Base	80	No Build	40,910	10,845	51,755
	30	No Build	3,672	232	3,904
	34	No Build	33	17	50
1	80	6 Lanes	30,942	8,222	39,164
	30	No Build	2,320	210	2,530
	34	No Build	33	14	47
2	80	No Build	39,418	10,408	49,826
	30	4 Lanes	3,015	243	3,258
	34	No Build	33	17	50
3	80	No Build	39,265	8,984	48,249
	30	No Build	3,694	231	3,925
	34	6 Lanes	41	10	51
4	80	6 Lanes	28,687	8,016	36,703
	30	4 Lanes	2,850	238	3,088
	34	No Build	33	14	47
5	80	6 Lanes	30,882	8,295	39,177
	30	No Build	2,255	227	2,482
	34	4 Lanes	39	9	48

The results in Table 10 reflect the following bullet points:

- The east side of the state has significantly more delay than the west side
- I-80 no build has more than 10 times the delay when compared to US 30 no build
- US 34 has the least amount of delay and there is minimal difference between the build and no build scenario

Now that the cost and delay for each scenario is defined, an analysis of what customers get out of the cost of investment can be looked at. The cost effectiveness analysis of the scenarios can be described as a way to measure the effectiveness of the investment (relative costs to the decreased daily delay). Table 11 provides an overview of how cost effective each scenario is in regards to decreasing the delay on Iowa's roadway system. The base condition does not account for any improvements being done on the corridors after what is currently planned the 2017-2021 five-year highway program. The Cost/Decreased Delay is calculated by the cost of the scenario divided by the amount of reduced delay from the no-build to the build scenario.

The lower this number is, the more cost effective the improvement strategy is, which is demonstrating to be scenario 1.

Table 11. FUTURE DELAY 2040 VS COST (COST EFFECTIVENESS)

Scenario	Description	Cost ($Millions)	All Corridors Total Daily Delay (hours)	Cost / Decreased Daily Delay ($/Hr)
Base	No Build	NA	55,709	NA
1	6-Lane I-80	3,400	41,741	240,000.00
2	4-Lane US 30	1,500	53,134	580,000.00
3	4-Lane US 34	1,500	52,225	430,000.00
4	6-Lane I-80 & 4-Lane US 30	4,900	39,838	300,000.00
5	6-Lane I-80 & 4-Lane US 34	4,900	41,707	350,000.00

Table 12 provides a summary of the information from Table 10 with the high and low ranges of delay for the three corridors. This information may provide a snapshot on where we may need to investigate and prioritize capacity improvements when looking at delay. Addressing delay on the system is important for Iowa's future economic health as there is a need to have an efficient, safe, and reliable network for freight. [7] When comparing the numbers, it is clear that I-80 has the most forecasted delay with US 34 having the least amount.

As congestion does have negative economic impacts, the additional fuel consumption from delays due to idling or frequent burst of acceleration may also play an adverse role in the environment due to increased vehicle emissions. [8]

Table 12. RANGE OF DELAY FORECASTED FOR 2040

Route	East of I-35		West of I-35	
	Low (Daily Hours)	High (Daily Hours)	Low (Daily Hours)	High (Daily Hours)
I-80	29,000	39,000	8,000	10,000
US 30	2,300	3,700	210	240
US 34	30	40	10	20

9. AFFORDABILITY

Typical yearly funding for the Highway Program is forecasted to be roughly $700 Million dollars per year over the next five fiscal years. [9] This is money programmed for investments on the primary highway system to be available for highway right-of-way and construction. This section of the memo is to evaluate how much time it would take to improve US 30 or US 34 to expressways across the state for three funding scenarios. Included in the evaluation is a quick look at how much investment and time is needed to expand I-80 to six-lanes

It is currently uncertain how much funding could be targeted for improvements, but three yearly funding scenarios were considered within this analysis. Figure 7 provides the number of years it would take to four-lane the remaining segments of US 30 or US 34. Since the cost estimate for improving US 30 and US 34 is essentially the same, the time it would take to improve them to expressways is also the same. As for I-80, it takes larger amounts of yearly funding to improve this route in a reasonable amount of time due to the higher cost.

The assumptions below were considered when performing this analysis on US 30 and US 34:

- A 4 percent per year increase in the costs of construction due to inflation.
- Funding for these improvements would remain somewhat unchanged. The revenue being generated for highway projects will remain fairly consistent, unless other funding sources can be established.
- Only one of the corridors is being funded at any one time.
- Construction/Funding begins in the year 2022.

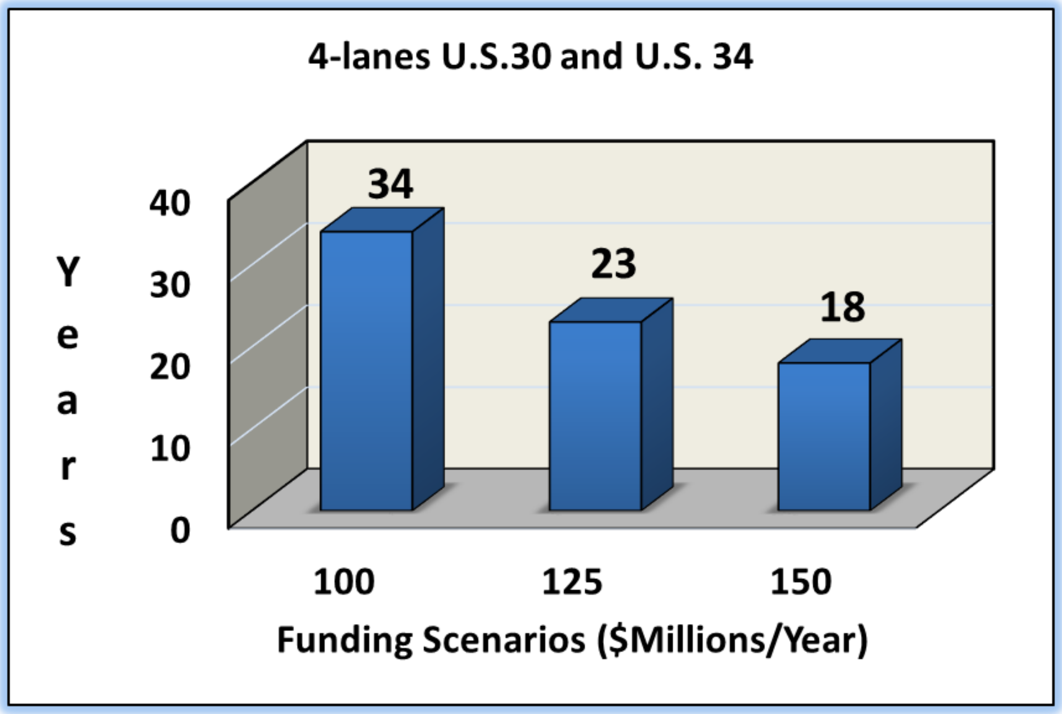


Figure 7: Years to Complete 4-lanes of US 30 or US 34 (Begin construction 2022)

The three funding scenarios examined consume a significant portion of the available funds that are allocated for Iowa's infrastructure needs. As there is a continuous need to invest in Iowa's transportation system, it should be done in the most cost effective manner.

If it was desired to invest in I-80 and another corridor at once, it would take an investment of $325-$350 million per year for twenty years to complete both routes. This time period assumes that an investment of $200 million per year was allocated to six-lane I-80. This means that if I-80 was improved simultaneously with either U.S 30 or U.S 34 and was to be completed in twenty years, it would take about half of available program dollars on an annual basis.

10. ENVIRONMENTAL IMPACTS

Inclusive of a significant monetary commitment to making capacity improvements, an assessment of what the potential environmental impacts would also need to be reviewed. There would likely be impacts to resources when improving our infrastructure. The list below is not all inclusive, but highlights some of the personal and environmental resources that could be impacted by these capacity improvements.

- Residential Homes
- Businesses
- Historic Properties
- Farmland
- Floodplains
- Waters of the US
- Threatened and Endangered Species

Constructing a four-lane expressway on U.S 30 and US 34 would likely have more significant impacts to environmental resources when compared to six-laning I-80. This estimation is based off of the amount of right-of-way (ROW) that would need to be acquired. Converting an existing two-lane facility to four-lanes and constructing a new-four lane facility to bypass communities would likely need more newly acquired ROW than expanding I-80. The more ROW that would be required, increases the likelihood of impacting the resources in the State of Iowa.

Table 13 provides the rough estimation on how many acres/mile of new ROW that would be needed for different improvement strategies. The reason 4-laning on new alignment, which are the bypasses, requires significantly more acres/mile to be acquired is due to the roadway being built in areas that are undeveloped, such as farmland. When building on undeveloped land, the entire ROW would need to be purchased, which is not the case when expanding existing corridors. When improving existing corridors, some of the right-of-way could likely be used for expansion. It is estimated that there will be a need to acquire more than twice the amount of land to develop US 30 and U.S 34 than Interstate I-80.

Table 13. ROW IMPACT COMPARISON

Description	Units
6-laning I-80	10 Acres/Mile
4-laning (Convert 2 to 4 lanes)	23 Acres/Mile
4-laning (New alignment)	40 Acres/Mile
Diamond Interchanges	38 Acres/Interchange

In addition to the potential environmental impacts to bypassing towns and cities, there are also possible socioeconomic impacts that would need to be evaluated. According to the Project Development Process Manual's bypass guidance, each community is unique and would have to be evaluated individually to determine if bypassing a community could have negative impacts. (10)

11. TRAVELER CONSIDERATIONS

Although mobility is one of the primary reasons a traveler would use a particular roadway, it is not the solitary reason. This might also be true for freight, where many facilities along I-80 are designed towards convenience for the trucking industry. These amenities may play a role into why travelers could still choose the interstate over parallel off alignment corridors, regardless if capacity improvements are made to them.

Since many of these amenities are already in place along I-80, large investments would likely not be needed to accommodate traveler's needs. Below are some conveniences that Interstate 80 presently has that could potentially impact a customer's decision to utilize Interstate 80 over US 30 and US 34.

Rest Areas – Provides a safe place for place to rest and access to a variety of services which are located approximately every 60 miles. (11)

Alternative Service Locations (ASLs) - These are additional locations to the rest area that provides similar rest area services that are provided to the traveling public. (11)

Truck Stops – Include many services inclusive of parking and providing a place to rest. There are significantly more of these along the Interstate than on state highways.

Truck Parking – Inadequate supply of trucking spaces can result in safety concerns due to driver fatigue and parking in undesignated locations such as exit ramps. In addition, there are regulations in place that limit the hours a truck driver can drive to help with driver fatigue. This may also play role in the demand for truck parking. (12) There are already investments made for truck parking at various locations along I-80. (13)

Dynamic Message Boards – There are significantly more message boards to communicate with travelers about delays, road conditions, etc. This provides more real time information to users so decisions can be made on travel.

Travel Time and Distance – As I-80 is a major freight corridor, travel time and miles traveled for freight moving through the state would be less on I-80 vs US 30 or US 34. This is also true for travelers passing through the state. This assumes travelers are entering and exiting the State of Iowa via I-80.

Safety – The Interstate System is the safest road system in the country when measured by "fatality rate" (fatalities per 100 million vehicle miles traveled) than those in other functional classes according the Federal Highway Administration. (14) Additionally, at grade intersections are not permitted on the interstate system as would US 30 and US 34. This limitation results in fewer conflict points and a reduced potential for crashes. (15)

As the Iowa DOT's Project Development Process Manual states, different classification of routes provide different types of connectivity. (10) In this case Interstate (I-80) and US Highways (US 30 and US 34) provide vary different types of connectivity. Interstate travelers tend to be traveling over longer distances while someone traveling on a state highway would likely be travelling from one community to another. This connectivity difference could contribute to why the amount of traffic diverted from I-80 to the other corridors is relatively small, regardless of the type of improvements are made to other corridors.

12. SUMMARY

This section of the tech memo is to provide the reader with a quick synopsis of the above analysis and is intended to help with the discussion on where Iowa might prioritize infrastructure investments.

As there is a limited amount of funding, there needs to be a review on where customers get the most benefit from the investment. If I-80 was improved simultaneously with either US 30 or US 34, and was to be completed in twenty years, it would take about half of available program dollars on an annual basis. Knowing this limitation, a review of where we may get the most out of the investment is an important part to the conversation.

Table 14 provides a summary of the five scenarios and how each improvement strategy impacts future daily delay, future level of service on I-80, and which one is the most cost effective when addressing delay. The data indicates that a greater amount of users could be delayed if investments were not made on I-80. This is shown in scenarios 2 and 3, which are the only scenarios where I-80 is left as 4-lanes in the rural areas. When looking at the five improvement scenarios the below bullet points can be derived from scenarios 2 and 3:

- These two improvement scenarios have the largest amount of total daily delay
- These two scenarios have the largest percentage of I-80 operating at a LOS of D or worse (roughly 60%)
- These two scenarios have the least amount of improvements to total daily delay
- These two scenarios have the highest cost for every hour of reduced delay (least cost effective)

Table 14. FUTURE OPERATIONS SUMMARY (2040)

Scenario	Description	Cost ($Millions)	All Corridors Total Daily Delay (Hours)	All Corridors % Change in Total Delay	% I-80 LOS D - F	Cost / Decreased Daily Delay ($/Hr)
Base	No build on any routes	0	55,709	NA	61	NA
1	6-Lane I-80	3,400	41,741	-25.07	23	$ 240,000.00
2	4-Lane U.S 30	1,500	53,134	-4.62	60	$ 580,000.00
3	4-Lane U.S 34	1,500	52,225	-6.25	58	$ 430,000.00
4	6-Lane I-80 & 4-Lane US 30	4,900	39,838	-28.49	21	$ 300,000.00
5	6-Lane I-80 & 4-Lane US 34	4,900	41,707	-25.13	23	$ 350,000.00

In regards to the worst case condition for level of service on parallel corridors, US 34 showed 1 percent and US 30 showed 5 percent of the route operating at poor conditions. This holds true even if these routes were not expanded to a four-lane expressways across the state.

As for I-80, future traffic projects that almost 60 percent of that route would be operating at a poor level of service if it remained 4-lanes, and since this route has the highest amount of vehicle miles traveled, this delay would affect the most drivers. The data reflected that there was little improvement to the operations of I-80 if other parallel corridors were improved, as it did not divert enough traffic from I-80.

Traffic forecasts indicate that traffic volumes on the Interstate will continue to increase and will necessitate the need for additional capacity. Investing in capacity expansion will be required to keep up with the traffic demand and maintain a desirable level of service along that corridor. Inversely, traffic volumes are not predicted to increase to such a rate as to negatively impact the level of service on US 30 and US 34 to an unacceptable level.

The data demonstrates that the cost of improving I-80 would be 2.3 times the cost of investing in US 30 or US 34. Although I-80 would need more investment in time and funding, the data showed that improving I-80 would likely have a proportionally bigger impact to the utilization. Additionally, investing in I-80 (scenario 1) provides the most cost effective way to reduce future delay on the system at $240,000/Hr. of reduced daily delay.

Finally, it appears that the environmental footprint of improving US 30 and US 34 to 4-lanes would be greater than expanding I-80 to 6-lanes. It is likely that there will be a need to acquire more right-of-way to 4-lane these corridors across the state. Adding a lane in each direction on I-80 would have a much less need for acquiring new ROW than converting 2-lanes to a four-lane section and constructing a new 4-lane roadway in undeveloped properties.

13. RECOMMENDATION

The above analysis supports that users may get the most benefit out of investing in Interstate 80 over parallel off alignment corridors, but further analysis of US 30 and US 34 may be appropriate to evaluate specific areas that may need capacity improvements.

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