# User Delay Costs Due to Work Zone Operations Near Echo Junction

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## Disclaimer

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| | |
|---|---|
| AADT | Annual Average Daily Traffic |
| ABC | Accelerated Bridge Construction |
| ADT | Average Daily Traffic |
| DB | Design Build |
| RUC | Road User Cost |
| STIP | State Transportation Improvement Plan |
| TB | Traditional Build |
| UDOT | Utah Department of Transportation |
| UTL | Utah Traffic Lab |
| VOT | Value of Time |
| VHT | Vehicle Hours Traveled |

# EXECUTIVE SUMMARY

With the increasing number of road rehabilitation projects across the United States, the need to reduce user costs due to congestion is more important than ever. The Utah Department of Transportation (UDOT) has proposed replacing two I-80 bridges over Echo Dam Road and Weber River in Summit County. The proposed project includes removal of the existing structures and approaches, followed by construction of the new bridges. The proposed structures will be designed and built to allow for future bridge deck replacement while maintaining two-way traffic. The method of bridge replacement will be Accelerated Bridge Construction (ABC). This study evaluates the impact of proposed replacement on the travelers in Summit County. The purpose of this research is to provide UDOT an estimation of possible delay costs due to congested traffic resulting from the proposed work zone scenarios. The VISSIM micro-simulation tool is used to build and calibrate the models. Hourly traffic volumes, provided by UDOT, are added as vehicle inputs into the model. Two work zone scenarios were developed by UDOT: Echo and Weber River. In each scenario, one direction of traffic is closed at a time, while the opposite direction remains open for traffic. For the closed-direction, ramps are used as detours. Both these scenarios are simulated and user delay costs are measured separately. Results for both the Echo and the Weber River scenarios show that the average daily user delay cost is lowest on Mondays and Tuesdays. This suggests that UDOT can complete the proposed ABC work on these days, to ensure minimum traffic disruption to travelers. The future work consists of estimating user delay costs caused by the replacement of the bridge on 2300 East on I-80. Similar analysis is required to determine the day of the week that would have minimum daily user cost.

# 1. INTRODUCTION

The Utah Traffic Lab (UTL) completed several research projects for the Utah Department of Transportation (UDOT) to evaluate the impact of highway construction on road users. All these studies dealt with the impact of various construction scenarios on travelers. The impacts have been measured as hours of delay, percentage of congested roads, and money values. Road User Costs (RUCs) in the work zone include added vehicle operating costs and delay costs to highway users resulting from construction, maintenance, or rehabilitation activity. The RUCs are a function of the timing, duration, frequency, scope, and characteristics of the work zone, as well as the volume and operating characteristics of the traffic affected. In addition, the dollar cost rates assigned to vehicle operations and delays affect the RUCs (*1*).

The first UTL study evaluates various construction alternatives for reconstruction of I-15 in Salt Lake County, Utah. Three scenarios are compared. The three scenarios are Design Build (DB), Traditional Build (TB), and No Build (NB). The DB method, also known as Fast Track (FT), is used for the reconstruction and is shown to be the best scenario, in terms of user delays. The second study is a compilation of several State Transportation Improvement Plan (STIP) projects. The research analyzes the STIP projects for FT and TB contracting methods to identify the impacts of each method on road users. The scope of this study is limited to analyzing five selected STIP projects within Salt Lake County and modeling various build scenarios using transportation planning tools. In general, the FT method is shown to be the best at minimizing RUCs. In the third study, several different work zone scenarios are developed and modeled in VISUM simulation software. Traffic assignments are run in each scenario for five diurnal periods.

The subject in this report is one of the several Accelerated Bridge Construction (ABC) projects that will be investigated by UTL for UDOT. The work zone scenarios proposed by UDOT are analyzed and the best scenario was selected based on the total user costs.

## 1.1 Project Description

UDOT proposes replacing two bridge structures near Echo Dam Road on I-80 and Weber River in Summit County, Utah. The proposed work includes removal of the existing spans and approaches and replacing them with new structures. The proposed structures are to have a minimum width and minimum length sufficient to accommodate the specified requirements (*3*). The structures will be designed and constructed to allow for future bridge deck replacement, while maintaining two-way traffic. The method of bridge replacement will be Accelerated Bridge Construction (ABC). Maintenance of traffic during construction is a critical component of the work. This study evaluates the impacts of proposed replacement on the travelers in the Summit area. This research will provide UDOT an estimation of possible delay costs due to congested traffic resulting from the proposed work zone scenarios.

## 1.2 Research Objective

The goal of this report is to provide UDOT with probable user delay costs resulting from the replacement of the two bridges near Echo interchange. The objective of this project is to evaluate scenarios of work zone closures so that UDOT can specify requirements for MOT plans in request for proposal. In other words, based on the results, UDOT will be able to specify the impact of lane closures and other actions that should be taken to keep traffic moving during construction. VISSIM micro-simulation tool is used to estimate the increased delays while construction is ongoing.

The report is organized as follows: Research methodology is described in Section 2 followed by the analysis results and discussion in Section 3. Section 4 consists of the conclusions drawn from the study.

# 2. RESEARCH METHODOLOGY

The methodology followed in this research follows:

- Build simulation model in VISSIM micro-simulation analysis platform.
- Obtain the hourly traffic volumes collected by UDOT.
- Data calibration and Validation.
- Run assignments for No Build scenario and find total Vehicle Hour Traveled (VHT).
- Assign work zone operations separately for both Echo and Weber River scenarios.
- Run simulations for both Echo and Weber River scenarios separately and find total VHT.
- Find the increased VHT and multiply it with separate VOT for cars and trucks.
- Find daily user delay costs for Monday, Tuesday, Saturday, and Sunday for July and August 2008.

Figure 2.1 shows a flow diagram of the general plan used to calculate traffic delay costs.

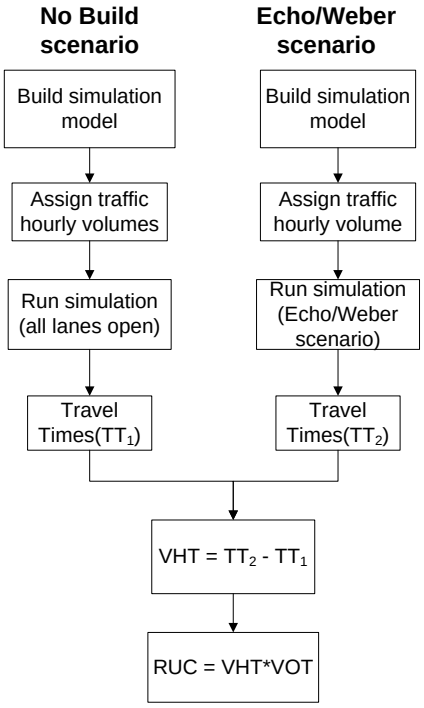


**Figure 2.1** Flow Diagram of Work Methodology

The I-80 echo interchange network was constructed using VISSIM micro-simulation tool. Figure 2.2 shows the same.

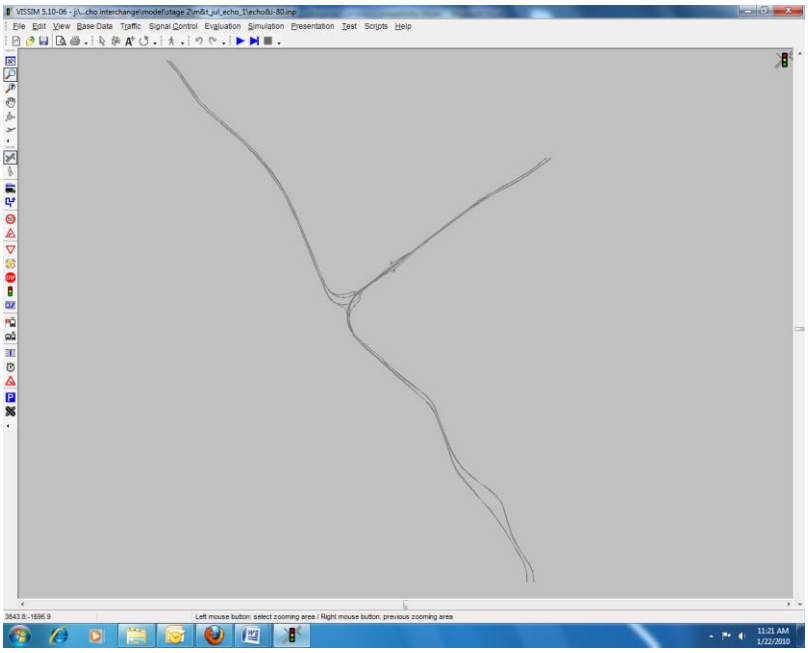

**Figure 2.2** VISSIM Model of the I-80 Echo Interchange

## 2.1 Developing Reconstruction Closure Scenarios

UDOT engineers wanted several factors taken into account when developing scenarios for the reconstruction. A major concern is road user delays during the construction. Therefore, priority should be given to those days of the week that produce the least congestion and efficiently use available detour routes. From the traffic data provided by UDOT, it was observed that the AADT values are minimum during Mondays, Tuesdays, and weekends. The average of AADTs for Monday and Tuesday are used to represent the typical weekday traffic. From the seasonal variation of traffic demand, it was observed that the traffic was lowest in the months of July and August 2008. Therefore, analysis is done for these months to minimize impact on travelers.

The I-80 Echo corridor network model is built in VISSIM, and AADTs are used to generate the traffic. Two work zone scenarios were developed by UDOT for this project: Echo and Weber River. In both of these scenarios, one direction of traffic is closed at a time and the other direction open to traffic. Each scenario is simulated in VISSIM, and user delay costs were measured separately for each scenario.

# 3. RESULTS

Table 3.1 summarizes the average daily user delay costs for both Echo and Weber River scenarios. Delay costs are separately calculated for typical weekday (Monday and Tuesday) average, Saturday, and Sunday to distinguish the impacts on both weekday and weekends.

**Table 3.1** Average Daily User Delay Costs for Echo and Weber Scenario

| Echo Scenario Costs | | | Web River Scenario Costs | | |
|---|---|---|---|---|---|
| | **July** | **August** | | **July** | **August** |
| Mon&Tue Average | $4,798 | $4,587 | Mon&Tue Average | $4,481 | $4,301 |
| Saturday | $5,889 | $5,868 | Saturday | $5,579 | $5,544 |
| Sunday | $5,595 | $5,660 | Sunday | $4,949 | $5,041 |

The results for the Echo scenario show that average daily user costs would be more for weekends compared to Mondays and Tuesdays averaged for both July and August 2008. The Weber scenario shows the highest user delay cost on Saturdays, followed by Sundays. It is lowest for the Monday and Tuesday average. Since construction should be done on those days with minimum traffic, UDOT should select Mondays and Tuesdays for construction activities to minimize user delay costs and traffic disruption to the travelers in that area. Figure 3.2 and Figure 3.3 are the graphical representations of the above table.

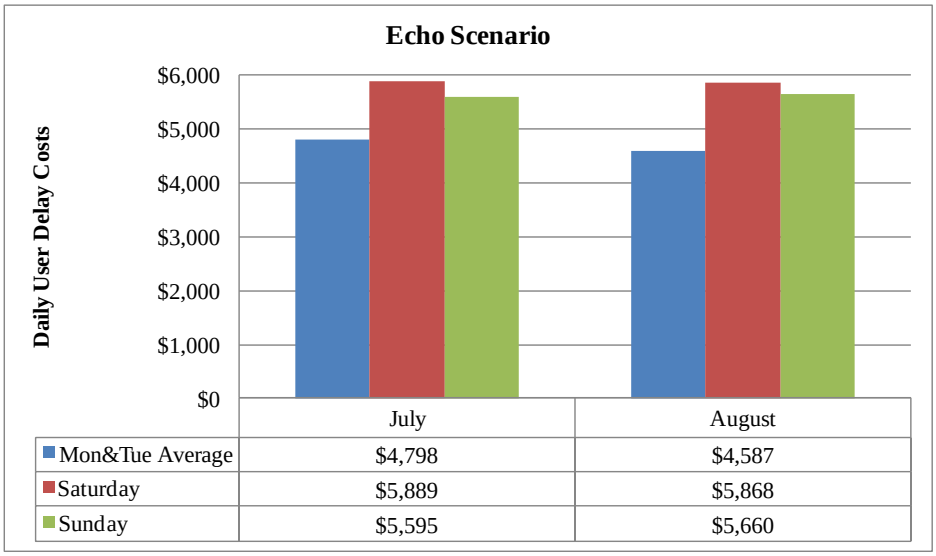


**Figure 3.2** Results for Echo Scenario

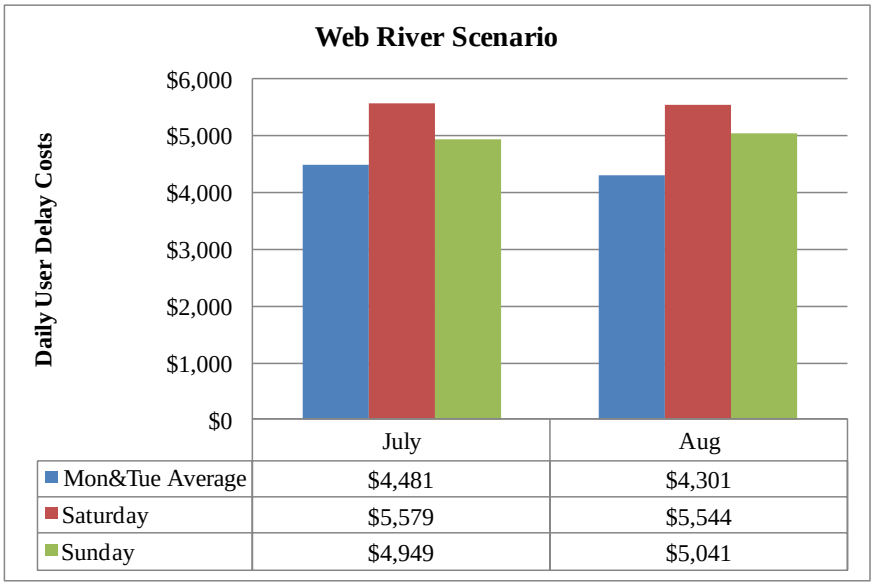


**Figure 3.3** Results for Weber Scenario

# 4. CONCLUSIONS

UDOT will replace two bridge structures near Echo Dam Road on I-80 and Weber River in Summit County, Utah. The proposed work includes removing the existing spans and approaches and replacing them with new structures. The goal of the study is to evaluate the impact of replacing the two bridges on the travelers in Summit area. This research will provide UDOT an estimation of possible delay costs due to traffic disruption resulting from the proposed work zone scenarios near the Echo interchange. VISSIM micro-simulation tool is used to build and calibrate the models. Hourly traffic volumes provided by UDOT are added as vehicle inputs into the model.

In both the Echo and the Weber River scenarios, a single direction of traffic is closed at a time and the other direction is open for traffic. Both these scenarios are simulated and user delay costs are measured separately for each scenario. Results for both the Echo and the Weber River scenarios show that the average daily user delay cost is lower on Mondays and Tuesdays. This suggests that UDOT should perform construction work on those days to ensure minimum traffic disruption to the travelers in that area.

# 5. FUTURE WORK

The following work needs to be completed as follows:

1. Estimate the user delay cost caused by the replacement of the bridge on 2300 East on I-80. The work will include removing the existing structures and approaches and replacing them with new structures.
2. Determine the day of the week that has minimum user delay cost, so construction work can be performed with minimum traffic disruption.
3. Build, calibrate, and validate a VISSIM model of the 2300 East bridge on I-80 affected area.
4. Add hourly traffic volume provided by UDOT.
5. Develop work zone scenarios upon consultation with UDOT engineers.
6. Model scenarios.
7. Run assignment and estimate travel time delays.
8. Calculate the average daily user cost.

# 6. REFERENCES


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