



WEST DAVIS
CORRIDOR

Technical Memorandum 19: Traffic Performance and Engineering Design of Shepard Lane and Gloves Lane Area Alternatives

in support of the
Environmental Impact Statement

West Davis Corridor Project

January 2017 Note – The information in Technical Memorandum 19 that was released in April 2013 has been updated with a more detailed analysis. The detailed analysis of the Shepard Lane and Glover Lane alternatives is included in TM – 28, West Davis Corridor Interstate Access Change Request which was provided to FHWA in December 2016.

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1.0 Introduction

The purpose of this technical memorandum is to compare and evaluate interchange options for the West Davis Corridor (WDC) southern terminals. The southern system-to-system connection of the WDC to Interstate 15 (I-15) and Legacy Parkway is a critical component of the overall transportation network.

The Federal Highway Administration (FHWA) has the responsibility to ensure safe and efficient operations of the national interstate system, as the Utah Department of Transportation (UDOT) likewise has its responsibility for the state and regional highway system. As lead federal and state agencies, it is imperative that these agencies conduct a comprehensive analysis of the southern WDC interchange to ensure a sound decision-making process during the Environmental Impact Statement (EIS) process.

This memorandum compares a proposed WDC interchange option that connects to I-15 near Shepard Lane (north of the existing I-15/Legacy Parkway interchange) and a proposed interchange option that connects in the Grovers Lane area (south of the existing Grovers Lane overpass). See the figures at the end of this memorandum.

These terminals include system interchanges for each alternative. WDC traffic modeling results are also included to the point where these unique options join and begin to run along a common alignment. Engineering design of mainline WDC segments beyond the limits of the interchanges are considered to meet the standards of both UDOT and the American Association of State Highway and Transportation Officials (AASHTO).

This memorandum is not intended to describe the environmental impacts of the WDC highway segments of these different options.

2.0 Shepard Lane and Grovers Lane Options Recommended for Comparison

The objective of the proposed interchanges is to allow traffic to move to and from the proposed WDC to and from I-15 and Legacy Parkway. The Shepard Lane option and the Grovers Lane option are compared side by side for certain features, such as traffic performance, roadway operation, geometric design, and other miscellaneous factors. A description of each criterion is included in Appendix A.

2.1 Shepard Lane Option

The Shepard Lane option provides a collector-distributor (CD) road in both the northbound and southbound directions. Connections for traffic movements between I-15, Legacy Parkway, and the WDC are full system connections. Local connections to and from Shepard Lane and Park Lane are also provided. Existing railroad tracks are shifted to the west to allow for necessary ramps in the southbound direction.

2.2 Gloves Lane Option

The Gloves Lane option provides system connections between I-15 and the WDC, and all movements between Legacy Parkway and WDC. Because a local connection is not required near Gloves Lane to meet the purpose of the project, a local service interchange is not part of this interchange design.

3.0 Option Comparison

In order to compare and evaluate the design options developed, this evaluation is organized into Part 1, Part 2, and Part 3. Part 1 comparisons include traffic performance. Part 2 comparisons include operations and roadway geometric design. Part 3 comparisons include other additional factors.

Each option is evaluated for each category as presented in the following tables. Within each category, one of two scenarios is presented:

1. The options are considered “Comparable.” This means that, when compared to each other, one option does not have a significant advantage over the other in terms of that specific criterion.
2. An “Advantage” is assigned to one of the options. This means that, when compared to each other, one of the options is determined to have an advantage in terms of that specific criterion only. When an “Advantage” is assigned to an option, it does not mean that the other option does not meet standards or is considered to be unacceptable. The “Advantage” is meant only as a relative comparison to the other option.

Note that both the Shepard Lane and Gloves Lane options would meet the minimum UDOT and AASHTO geometric standards and would operate at an acceptable level of service (LOS D or better) in 2040.

It is also important to note that some criteria do not necessarily have an established UDOT or AASHTO standard. In these cases, engineering judgment is applied as the alternatives are compared to each other, and a determination is made about whether the alternatives are “Comparable” or whether one has an “Advantage.”

To ensure a comprehensive and objective analysis, the WDC team hired another engineering firm to independently review the interchanges for the items examined in this technical memorandum. The results presented in this memorandum are based on the consensus evaluation of the WDC team engineers and the independent review firm.

Comparison categories are not presented in any particular order (that is, categories listed first are not considered more important). A summary of each comparison criterion is presented in Appendix A. The abbreviation “MOI” refers to the UDOT *Roadway Design Manual of Instruction* (August 2011 update). The abbreviation “GB” refers to the 2011 version of the AASHTO publication *A Policy on Geometric Design of Highways and Streets*, or “Green Book.” The Green Book is considered the industry standard for roadway design and has been adopted by UDOT as its official standard.



3.1 Part 1 Option Comparison – Traffic Performance

Part 1 compares the projected traffic performance of each option. Traffic performance is defined as an option's ability to handle projected traffic demands. Traffic performance is very important to an option's viability. A system interchange that accommodates projected traffic demands is needed to meet the purpose of the project. An option recommended for advancement in the project's EIS must meet minimum traffic performance requirements (defined as level of service LOS D or better).

Part 1 does not necessarily consider how well an option is designed or the task of drivers in the interchange but rather considers the traffic performance based on traffic modeling results. Acceptable traffic performance minimizes congestion and delay, which in turn can improve safety. Modeled traffic data was produced using the Vissim program using inputs generated by the Cube traffic model and traffic counts. Table 1 includes a comparison of these performance categories for each option and also specific outputs from the Vissim program.

Both the AM peak and PM peak hours were modeled for each category in Table 1. All numeric values in Table 1 are the simple average of these AM and PM peak results.

Table 1. Part 1 Comparison – Traffic Performance

Comparison Category	Shepard Lane Alternative	Glovers Lane Alternative	Evaluation
Average Network Speed The average predicted speed of vehicles traveling through the analysis area. Higher speeds reflect better operation.	64.4 mph	66.4 mph	Comparable
Travel Time – Northbound Traffic to I-15 The time it takes for traffic to move from point to point: <ul style="list-style-type: none">• I-15 through traffic (from a point near Parrish Lane on the south to a point near Burton Lane on the north)• Legacy Parkway to I-15 (from a point near Parrish Lane on the south to a point near Burton Lane on the north)	780 seconds (combined total)	777 seconds (combined total)	Comparable
Travel Time – Southbound Traffic to I-15 The time it takes for traffic to move from point to point: <ul style="list-style-type: none">• I-15 through traffic (from a point near Burton Lane on the north to a point near Parrish Lane on the south)• WDC to I-15 (from a point near the Central Davis Sewer Treatment Plant to a point on I-15 south of Glovers Lane)	746 seconds (combined total)	715 seconds (combined total)	Comparable
Travel Time to West Davis Corridor The time it takes for traffic to move from point to point: <ul style="list-style-type: none">• I-15 to WDC (from a point on I-15 south of Glovers Lane to a point near the Central Davis Sewer Treatment Plant)• Legacy Parkway to WDC (from a point near Parrish Lane on the south to a point near the Central Davis Sewer Treatment Plant)	823 seconds (combined total)	747 seconds (combined total)	Advantage – Glovers



Table 1. Part 1 Comparison – Traffic Performance

Comparison Category	Shepard Lane Alternative	Glovers Lane Alternative	Evaluation
Travel Time to Legacy Parkway The time it takes for traffic to move from point to point: <ul style="list-style-type: none"> • I-15 to Legacy Parkway (from a point near Burton Lane on the north to a point near Parrish Lane on the south) • Legacy Parkway to WDC (from a point near Parrish Lane on the south to a point near the Central Davis Sewer Plant) 	838 seconds (combined total)	741 seconds (combined total)	Advantage – Glovers
Total Network Delay This is the total delay of vehicles in the study area. Less delay reflects better operation.	115.0 hours	83.4 hours	Advantage – Glovers
Total Travel Time This measures all travel time for all maneuvers from and to common points through the interchange area. This involves all vehicle routes in the model, including those specifically analyzed above, and others such as U.S. Highway 89 (US 89) and local interchanges. This compares overall traffic operation of the options.	2,036.4 hours	1988.4 hours	Comparable
Operates Near Capacity This category evaluates how close the interchange operates near its maximum capacity. A complex system interchange that regularly operates near capacity is more susceptible to failure due to small variations in traffic, minor incidents, or weather. This is also an important consideration from the standpoint of a making long-term infrastructure investment.	Operates within 5–10% of maximum capacity	Operates within 10–20% of maximum capacity	Advantage – Glovers

mph = miles per hour

3.2 Part 2 Option Comparison – Operations and Design

Part 2 is a comparison of the operational characteristics of each option as related to its design development. This evaluation takes into account the tasks of the driver and how vehicles interact within the interchange. An interchange with design features that enhance and simplify driver tasks is considered favorable. Straightforward design features that promote good operations can enhance safety, minimize congestion, reduce driver frustration or error, and generally contribute to the long-term benefits of the facility.

Table 2. Part 2 Comparison – Operations and Design

Comparison Category ^a	Shepard Lane Alternative	Glovers Lane Alternative	Evaluation
Distances Available for Lane Changes and Weaving Includes merges, approaches, and weaving where applicable. Greater distances allow safer and easier operation.	Acceptable to good lengths.	Generous merge and approach lengths available and no weaving is required.	Advantage – Glovers
Driver Expectancy It is advantageous when design features conform to normal, prevailing driver expectations (such as exit and entrance ramps being to the right).	SB exit to Park Lane from I-15 is in advance of what might be expected; left exit from SB CD road to Shepard Lane; left entrance from SB Shepard Lane to CD road; left exit to Shepard Lane from WDC; left entrance from Shepard Lane to WDC.	Very good driver expectancy; EB to NB move is left exit but isn't a significantly used move; left entrance of WB ramp from NB I-15 might not be expected, but lane doesn't drop.	Advantage – Glovers
Maximize Design Speed It is advantageous that design speeds throughout the interchange stay as consistent as possible with mainline freeway design speeds.	2 of 3 major flyover ramps = 50 mph; other major ramp = 45 mph.	3 of 4 major ramps = 45 mph; other major ramp = 50 mph; minor ramps 1 = 40 mph, 1 = 45 mph.	Advantage – Shepard
Roadway Geometry This involves general roadway geometry and features that exceed minimum standards or that might meet values that are recommended but not required. This category uses UDOT and AASHTO standards and engineering judgment to evaluate features.	Some geometric features are not ideal, although still acceptable: ramps to/from I-15/WDC are semi-directional; S-curve on SB ramp from Shepard Lane; east-side frontage road shift.	Some geometric features are not ideal, although still acceptable: adds S-curves into east frontage road; might require some mild lane shifts on Legacy Parkway or I-15.	Comparable
Signs Designs that readily allow clear, properly spaced advance signing are advantageous and can also mitigate the complexity of interchanges.	Length of CD road would not allow full spacing of all recommended signs for the major split. Signing can likely be accomplished, but the limited space might require exceptions to spacing standards.	Long approaches allow clear and effective signing.	Advantage – Glovers
Decision Sight Distance Straight and unobstructed sight lines in advance of decision points can help drivers anticipate upcoming features and make maneuvers earlier.	A few areas are deficient but can be mitigated and made acceptable with signing: SB CD road to Shepard Lane exit, SB WDC split, approaching Shepard local (NB and SB), Park Lane to NB CD road.	Long approach lengths, combined with straightforward decision requirements, simplify the matter of decision sight distance. Little if any additional signing to mitigate is anticipated.	Advantage – Glovers

Table 2. Part 2 Comparison – Operations and Design

Comparison Category ^a	Shepard Lane Alternative	Glovers Lane Alternative	Evaluation
System Movement Lane Assignments Designs that place drivers in the correct lane for the most-used movements reduce necessary lane changes and maneuvering.	NB Legacy to WDC requires minimum 1 lane change. SB WDC to Legacy requires minimum 1 lane change. NB I-15 to Shepard Lane requires minimum two lane changes.	All ramps are “single move” with no need for lane assignments. Each exit from a main line is a standard exit ramp except for SB WDC which has reasonable lane assignments that are intuitive for the upcoming splits.	Advantage – Glovers
Weaving Section Weaving is not ideal, but if it cannot be avoided, then it is better to separate weaving from the main freeway facility.	Due to limited distance between Park Lane and Shepard Lane interchanges, weaving is required. Weaving sections are separated from main freeway.	Design does not require any weaving sections.	Advantage – Glovers
Two-Exit vs. Single Exit Interchanges with a single exit from the main freeway facility can help driver decisions and provide simplicity on the main facility.	Single exit both NB and SB.	Single exit NB and SB.	Comparable
System Connection for All Moves Each freeway-to-freeway maneuver can be accomplished on a system ramp or connection (no at-grade intersections).	At-grade moves are required for EB WDC to NB I-15 and from SB I-15 to WB WDC.	All movements are system movements with no local at-grade moves required.	Advantage – Glovers
Situational Complexity General assessment of interchange's ease of operation from the driver's seat, including geometric and maneuvering challenges and mitigations.	Overall, there is a lot going on in a relatively short area, with I-15, US 89, Legacy, and WDC, plus 2 local interchanges converging all within a 2-mile stretch. Some maneuvers are more complex than others, and the design simplifies and mitigates some of the complexity. However, the overall driver demands, combined with a relatively short space and heavy traffic, add complexity. The significant curve along I-15 with many existing structures also contributes to this.	Weaving and lane changes are kept to a minimum, and most entrance and exit movements are simple and conventional. The design is straightforward and is not expected to be significantly more challenging than conventional freeway driving.	Advantage – Glovers

SB = southbound; NB = northbound; EB = eastbound; WB = westbound

^a See Appendix A for further explanation of categories.

3.3 Part 3 Option Comparison – Other Factors

Part 3 compares aspects of an interchange that are not directly related to traffic, design, or the driving experience. Although not directly reflecting an option's functionality or operations, these categories are considered very important in evaluating each option.

Table 3. Part 3 Comparison – Other Factors

Comparison Category ^a	Shepard Lane Alternative	Glovers Lane Alternative	Evaluation
Minimizes Number and Size of Structures More structure means increased long-term maintenance and increased safety concerns due to snow removal and icing.	6 bridge structures totaling approximately 177,000 square feet	6 bridge structures totaling approximately 100,000 square feet	Advantage – Glovers
Provides Independent Bypass Route In the event of a major incident on an existing north-south route (I-15 or Legacy), an independent alternate route becomes essential to allowing regional traffic flow and also provides an emergency route if needed.	WDC access from and to I-15 does not require Legacy. WDC access from and to Legacy does not require I-15. Bypass routes include CD roads separated from mainline, but close parallel proximity curtails independence.	WDC access from and to I-15 does not require Legacy. WDC access from and to Legacy does not require I-15. Provides a much greater distance of truly independent (non-parallel) route throughout Farmington.	Advantage – Glovers
Provides Local Interchange Access at Shepard Lane The Wasatch Front Regional Council's Regional Transportation Plan includes a future project to construct a local service interchange at Shepard Lane and I-15, regardless of any WDC.	Provides this local interchange as part of the WDC.	Interchange is not precluded but would remain as a planned future project.	Advantage – Shepard
Reduces Risk of Impacts to Existing Structures Major impacts to existing structures would add cost and delay to the project or might require design exceptions.	Some risk due to minimal extra space through several existing Legacy/US 89 structures. Also, these structures are very large.	Little risk; the only structures possibly affected are at Glovers Lane. Space is available if needed.	Advantage – Glovers
Provides WDC Access to West Farmington and South Kaysville Convenient access to and from residential and commercial areas of west Farmington and south Kaysville would increase the local benefit of the facility	Convenient access is provided to and from WDC by way of the Park Lane or Shepard Lane interchanges.	Access to west Farmington and south Kaysville would be inconvenient and would require out-of-direction travel.	Advantage – Shepard
Allows Future Expansion of I-15 When traffic exceeds capacity on I-15, an expansion of I-15 might be necessary.	Little flexibility available due to existing Park Lane and US 89 structures.	Little flexibility available due to railroad tracks.	Comparable

^a See Appendix A for further explanation of categories.

4.0 Conclusions

The above analysis demonstrates that, in terms of traffic performance and engineering, the Gloves Lane option has several significant advantages over the Shepard Lane option.

In Part 1, the traffic performance of each option was modeled and compared. The Gloves Lane option performed better than the Shepard Lane option in every measure, having higher speeds, reduced travel times, and significantly less delay. The operations and design analysis in Part 2 indicates that the design of the Gloves Lane option is preferable to that of the Shepard Lane option. The Gloves Lane option has advantages in 8 of the 11 criteria, while the Shepard Lane option has only one advantage. The Gloves Lane interchange features a more straightforward and conventional design, which simplifies the traffic operations and maneuvers. It is very similar to other system interchanges. Finally, when evaluating the other criteria in Part 3, the Gloves Lane option has a slight advantage over the Shepard Lane option. Overall, out of the 25 criteria considered, the Gloves Lane option has advantages in 15 categories, the Shepard Lane option has advantages in 3 categories, and the two are comparable in the 7 other categories.

Based on the evaluation of traffic performance, operations, geometric design, and other factors described above, the Gloves Lane option provides substantial benefits over the Shepard Lane option. The design is more straightforward in terms of geometry and meeting driver expectancy. The interchange features more-efficient traffic flow, improved operations, and reduced delay and congestion, all of which contribute to improved safety. The Gloves Lane option has a clear and substantial advantage over the Shepard Lane option in providing a safe, reliable, and efficient southern system connection and in meeting the purpose of the project.

Appendix A – Further Discussion of Evaluation Categories

Distances Available for Lane Changes and Weaving

This includes lengths for parallel exit lanes, weaving lanes, entrance lane acceleration, gap acceptance, approaches, and so on. These lengths are important in relation to both traffic operation and UDOT and AASHTO standards (GB pp. 10-107 to 10-121). Greater distances and lengths of these lanes are considered favorable.

Driver Expectancy

This refers to how well the design adheres to normal, prevailing driver expectations of roadway features and required maneuvers. This relates to the likelihood of drivers responding to roadway situations in predictable ways, and can reduce errors and enhance safety and operations (GB pp. 2-41 to 2-42). For example, drivers generally expect that entrance and exit ramps will be to the right.

Maximize Design Speed

Higher design speeds through the interchange are desirable. This includes collector-distributor roads and ramps (GB pp. 10-81, 10-89).

Roadway Geometry

This involves general roadway geometry and features that exceed minimum standards or that might meet values that are recommended but not required (UDOT MOI p. 51 and GB pp. 3-111 to 3-112, 3-163 to 3-166). This category uses UDOT and AASHTO standards and engineering judgment to determine a comparison.

Signs

This considers how readily guidance signing can be placed to ensure safe and smooth traffic flow. This is somewhat related to decision sight distance, driver expectancy, and so on.

Designs that readily allow clear, properly spaced advance signing are advantageous and can also mitigate the complexity of interchanges.

Decision Sight Distance

When difficult or unexpected maneuvers are required, a clear sight distance is recommended, especially when there are other elements such as merging, weaving, and so on (GB pp. 3-6 to 3-7). This allows a driver to detect the issue or situation and have the time to select an

appropriate speed and path. Appropriate and adequate signing and traffic control can help mitigate these sight issues.

System Movement Lane Assignments

Lane assignments are considered as the particular lane that vehicles enter when in a multilane weaving section. It is considered favorable when a vehicle enters a weaving section and is already in the lane needed for the desired destination.

Weaving Sections

Weaving sections cause turbulence, can reduce capacity, and can cause unfavorable operations. Ideally, weaving sections are eliminated entirely, but if a weaving section must exist, it is considered favorable to at least separate weaving from the main facility (GB pp. 10-80, 10-81).

Two-Exit vs. Single Exit

It is preferable that interchanges have only a single exit as opposed to two different exit points. This can help simplify the driver's decision process and maneuvering requirements. Single exits also can remove weaving from the main facility, can provide a high-speed exit for all traffic, and might help meet driver expectancy (GB pp. 10-81 to 10-82).

System Connection for All Moves

It is considered desirable if all potential moves are able to be completed with a direct or semidirect system connection (that is, the vehicle does not have to traverse through a local road or a traffic signal). These connections provide higher operating speeds, increased capacity, and enhanced operations (GB pp. 10-53 to 10-54).

Situational Complexity

This refers to overall operational characteristics and ease of usage by drivers. It is helpful to drivers to have well-spaced, sequential decision points and traffic movements. Multiple/complex decisions, heavy traffic, complicated designs, and multiple lane changes (especially weaving) combined with high speeds can lead to poor driver performance and accidents. It is preferable if a design avoids the condition of "a lot going on at once" (GB p. 2-44).

Minimize Size and Number of Structures

It is advantageous to minimize structures due to ongoing maintenance costs, snow removal operations, safety issues such as increased tendency to form ice, and visual impacts.

Provides Independent Bypass Route

Serious accidents, major road construction, or other roadway incidents can restrict or temporarily shut down the major facilities of I-15 and Legacy Parkway. Normally, WDC



traffic would have access to and from both of these facilities. In the event of a major incident on I-15 or Legacy Parkway, it is important that access be maintained between whichever facility remains operational and the WDC. This access will help allow regional northbound and southbound traffic to bypass the incident and continue moving. An “independent bypass route” means that access between two facilities is not reliant upon a third facility. See examples below:

- *Northbound*: If a vehicle traveling to the WDC from Legacy Parkway can do so without ever having to enter I-15, this independent access is considered an advantage. It is also an advantage if a vehicle traveling from I-15 to the WDC can do so without ever having to enter Legacy Parkway.
- *Southbound*: If a vehicle traveling from the WDC to Legacy Parkway can do so without ever having to enter I-15, this is considered an advantage. It is also an advantage if a vehicle traveling from the WDC to I-15 can do so without ever having to enter Legacy Parkway.

It is recognized that parallel roadway facilities in close proximity might provide emergency responders and maintenance personnel with a good way to access specific roadway locations. However, facilities in close proximity might not always provide the same benefits to traffic as facilities separated by greater distances. Chemical spills, fires, or even “rubbernecking” (drivers slowing down to view an incident) can increase the risk of traffic congestion on a nearby parallel facility, despite its being separate and accessed independently. Overall, greater physical separation of facilities is considered a further advantage.

If an incident occurs on the WDC, regional traffic would be able to use the existing facilities of I-15 and/or Legacy Parkway. For the WDC traffic immediately affected by such an incident, a discussion is included below under the section titled Provides West Davis Corridor Access to West Farmington and South Kaysville.

Provides Local Interchange Access at Shepard Lane

The Wasatch Front Regional Council’s (WFRC) Regional Transportation Plan lists a project to construct a local interchange at Shepard Lane at some point in the future. This interchange would be constructed separate from the WDC facilities. If the WDC includes this local interchange as part of its system, then the needs of the Regional Transportation Plan will be met at this location.

Reduces Risk of Impacts to Existing Structures

Concepts that minimize the risk of impacts to existing structures are considered more advantageous. Impacts to structures can reduce safety, can increase construction costs, can limit flexibility in project phasing, and might increase maintenance needs.



Provides West Davis Corridor Access to West Farmington and South Kaysville

Local access to the WDC within a reasonable distance to the west Farmington and south Kaysville area is considered advantageous. Convenient access from these residential and commercial areas would increase the direct local benefit of the facility. Furthermore, in the event of a serious accident or major incident on the WDC in this area, lack of local access could cause difficulty rerouting traffic affected by the incident. Limited local access might also create a need for special access points for emergency responders to ensure reasonable response times.

Allows Potential Future Expansion of I-15

Because I-15 is a nationally significant facility, it is desirable to preserve the ability to expand this facility if needed. Concepts that more easily allow for expansion of I-15 are considered advantageous.



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