



# Refinement Plan Terrebonne

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To: Project Management Team

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Subject: Draft Memorandum #7 – Identification of Preferred, Cost-Constrained Alternative (Task 6.1)

This memorandum summarizes the project team’s recommended, preferred cost constrained alternative for the Terrebonne Refinement Plan. It includes a summary of the public engagements and feedback received during the development and publication of draft Technical Memorandum #6, additional refinements to the couplet and five lane alternatives, further evaluation of the alternatives and recommendations for additional highway transition elements and enhancements to the local circulation system.

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The outcome of this memorandum is the project team’s recommended preferred, cost constrained system alternative for Terrebonne including the highway corridor alignment, intersection improvements, and transition elements. The Advisory Committee will make a recommendation to the Project Management Team (PMT) regarding the preferred alternative, and the PMT will then consider the Advisory Committee’s recommendation and public feedback from the January 9<sup>th</sup> Open House and make a final recommendation to the Deschutes County Board of Commissioner and Oregon Transportation Commission. These two decision bodies will then consider the adoption of the Terrebonne Refinement Plan into the Deschutes County Transportation System Plan and the Oregon Highway Plan, respectively.

## PROMISING ALTERNATIVES EVALUATION

Technical Memorandum #6: *Alternatives Development and Analysis* evaluated two corridor alignment and five intersection alternatives. A brief summary of the evaluated alternatives is provided below:

### ▪ Corridor Alignment

- Couplet (A-4A)– Creating two, one-way roads on US 97 through Terrebonne where the southbound lanes would be located on the existing US 97 alignment and the northbound lanes would be located on 11<sup>th</sup> Street. 11<sup>th</sup> Street would be upgraded to highway standards.
- Five-Lane (A-5A)– Redeveloping the existing alignment of US 97 to accommodate two northbound through lanes, two southbound through lanes, and a center turn lane.

### ▪ Intersection

- Northbound Left Fly-under (I-6A2) with Couplet – Allows free flow movement for southbound and northbound through traffic while providing a grade separated undercrossing for northbound left turns. Vehicles desiring to make a westbound left-turn movement would be required to turn right onto US 97 and make a U-turn at Central Avenue.
- Northbound Left Fly-under (I-6A2) with Five Lane – The fly under would be converted into a two-lane continuation of 11<sup>th</sup> Street to/from Lower Bridge Way. To facilitate the northbound left-turn movements at Lower Bridge Way, an off-ramp from northbound US 97 would be developed between Central Avenue and the 11<sup>th</sup> Street/F Avenue intersection. This intersection would be converted to a roundabout to accommodate the high left-turn demand movement and to facilitate traffic desiring to travel from Lower Bridge Way to northbound US 97 via the off-ramp.
- Restricted Crossing U-Turn (I-5B)– A restricted crossing U-turn (RCUT) eliminates through and left turn movements from the side streets and provides U-turn maneuvers for these movements past the intersection. The northbound U-turn would be facilitated at a new location north of Lower Bridgeway and the southbound U-turn would occur at Central Avenue.
- Free flow Couplet with B Avenue One-Way Westbound (SI-1B)– A couplet on the existing US 97 and 11<sup>th</sup> Street alignments with restricted eastbound movements at US 97/B Avenue and westbound only movements west of 11<sup>th</sup> Street/Smith Rock Way.

- Traffic Signal with Five-Lane Section (SI-7A)– Build out US 97 to a Five-Lane cross section with a traffic signal located at B Avenue. Maintain the existing north/south stop control at 11<sup>th</sup> Street/Smith Rock Way.

The R-CUT was found to be operationally fatally flawed and therefore removed from further consideration as a viable solution. The outcome from Tech Memo #6 was two primary system alternatives which brought the corridor and intersection alternatives into cohesive solutions as follows:

- Couplet on the existing US 97 and 11<sup>th</sup> Street alignments with restricted eastbound movements at US 97/B Avenue and a northbound left fly-under at Lower Bridge Way. See *Figure 1*.
- Five-Lane section on the existing US 97 alignment with a traffic signal at B Avenue, northbound left fly-under at Lower Bridge Way, and roundabout at the US 97 northbound off ramp-F Avenue/11<sup>th</sup> Street intersection. See *Figure 2*.

Cost estimates have continued to be refined through the alternatives process. The cost estimates for both system alternatives are shown in Table 1. The cost estimates show an overall cost of each alternative and a breakdown of the northern and southern improvements (defined as improvements north and south of Central Avenue). This cost estimate includes right-of-way, reconstruction, excavation, earthwork, stormwater, sewer, landscaping, and sidewalks. *A detailed cost estimate is provided in Appendix A.*

**Table 1. Alternative Cost Estimate (as of December 20, 2018)**

Alternative/Project Element	Cost
<b><i>Couplet</i></b>	
B Avenue Configuration & Improvements South of Central Avenue	\$6.3M
Northbound Fly-under and Improvements North of Central Avenue	\$15.1M
<b>Total</b>	<b>\$21.4M</b>
<b><i>Five-Lane</i></b>	
Traffic Signal & Improvements South of Central Avenue	\$5.4M
Northbound Fly-under and Improvements North of Central Avenue	\$20.5M
<b>Total</b>	<b>\$25.9M</b>

As shown in Table 1, both system alternatives at this point exceed the legislative allocation of \$20M dollars for the total project cost of the refinement plan. However, the Couplet system alternative is 7 percent over the allocation compared to the Five-Lane system alternative that is 23 percent over the allocation.

**Figure 1. Couplet Alignment**

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**Figure 2. Five-Lane Alignment**

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## FEEDBACK PROCESS

Since the Concept Development Workshop in September 2018, there has been two public engagement activities and one Advisory Committee meeting to further solicit input on the corridor, intersection, and transitional elements of the project. A brief summary of each of these engagements are summarized below.

### Neighborhood Alliance Meeting November 7, 2018

Attendance of the project team was requested by the Terrebonne Neighborhood Alliance on behalf of several residents and business owners in Terrebonne on November 7<sup>th</sup>, 2018. The meeting was attended by approximately 30 members of the public. The project team gave a brief overview and current status of the project followed by two public proposals. *These proposals are included in Appendix B.* Several voiced perspectives from the meeting included: maintaining the rural features of Terrebonne, retaining the highway on the existing US 97 alignment, preserving 11<sup>th</sup> Street as a local route, improving pedestrian and bicycle connectivity, and reducing speeds on US 97. *It should be noted that Technical Memorandum #6 was not yet available in draft publication at the time of this meeting.*

### Advisory Committee and Project Management Team

The Advisory Committee met for the third time on December 4<sup>th</sup>, 2018 to discuss the outcomes of Technical Memorandum #6. The project team presented the finding from Technical Memorandum #6, followed by several interactive exercises to solicit feedback and further refine the two system alternatives. The committee members were split into groups of three and tasked with evaluating the alternatives based on the goals, objectives, and evaluation criteria developed for the project (see Table 7 in Technical Memorandum #6). The committee provided numerous suggestions for refining the two system alternatives and offer additional feedback for the project team to consider in the overall evaluation process.

### Business US 97/11<sup>th</sup> Street Neighborhood Meeting December 18, 2018

An additional public meeting was held for business and property owners adjacent to US 97 and 11<sup>th</sup> Street. The meeting was also open to the general public. Approximately 78 people participated in the meeting. Similar to the advisory committee meeting, a brief presentation was given by the project team, followed by several workshop exercises to solicit more feedback on the corridor, intersection, and transitional elements. It should be noted that updated cost estimates, potential refinements addressing the previously raised issues by the Advisory Committee during or after the December 4<sup>th</sup>, meeting and newly developed local street enhancements and traffic calming treatments were introduced to the community during this meeting for review and feedback.

The public appeared to be in favor of potential refinements that were presented at the meeting (the alternative refinements are addressed further in this memorandum). The east-west connectivity continues to be a concern in both alternatives. Additionally, an enhanced pedestrian crossing at US 97/B Avenue is identified as a key concern.

Table 2 shows a summary of the evaluation matrices filled out by the public during the meeting. Based on the feedback, the Couplet scored higher than the Five-Lane section in every category.

**Table 2. Summary of Public Evaluation Matrix**

Goal	Five-Lane Alternative	Couplet Alternative
Community & Livability	1.7	2.1
Mobility	1.6	2.5
Safety & Health	1.2	2.3
Accessibility	1.2	2.4
Financial Responsibility	1.4	2.5
Economic Vitality	1.8	2.1

### Feedback Summary and Potential Refinements

The public, advisory committee, and Project Management Team (PMT) have collectively responded to the couplet and five-lane system alternatives over the past few months through the three public engagement meetings described above. A summary of the primary questions, suggestions, and concerns is provided below:

- Couplet
  - Concerns about increased traffic on 11<sup>th</sup>, losing the local nature and north-south continuity of 11<sup>th</sup>.
  - Concerns about right-of-way impacts near the southern couplet split.
  - Could the U-turn movement be moved further south?
  - Will trucks be able to circulate to businesses under a couplet?
  - Concerns with eastbound bicycle being rerouted due to the one-way nature of B Avenue between US 97 and 11<sup>th</sup> Street
  - General cost and right-of-way impacts compared to the legislative allocation of \$20M.
  - Will businesses lose exposure with one-way roads?
- Five-Lane
  - Concerns regarding the barrier and bisecting effect within the community.

- Concerns about the right-of-way impacts associated with the northbound off-ramp to the 11<sup>th</sup> Street/F Avenue intersection.
- Concerns about the right-of-way impacts and at the B Avenue/US 97 intersection.
- Could the center turn lane be removed north of Central Avenue or replaced by a raised landscape median.
- Could the northbound off-ramp be eliminated, and Crook River Ranch traffic be re-assigned to 11<sup>th</sup> Street to access Lower Bridge Way? What would the volumes be on 11<sup>th</sup> Street without the NB off-ramp?
- Would 11<sup>th</sup> Street need to be reconstructed?
- Could the five-lane concept be modified to a three-lane alternative and widened later?
- General cost and right-of-way impacts compared to the legislative allocation of \$20M.
- Can the signal be placed at US 97/C Avenue instead of US 97/B Avenue?

Figures 3 and 4 give a visual representation of comments and concerns for both the couplet and five-lane alignment, respectively.

**Figure 3 – Couplet Comments**

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**Figure 4 –Five-Lane Comments**

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## ASSESSMENT OF POTENTIAL REFINEMENTS AND OTHER POTENTIAL ALTERNATIVES

This section assesses the comments identified by the feedback sessions and categorizes as *considered for refinement* and *not considered for refinement*.

### Couplet

#### *Considered for Refinement*

- Concerns about right-of-way impacts near the southern couplet split.
  - The existing couplet system alternative shows the maximum right of way impact at the southern extremity of the project including a four-foot landscaping strip and 10-foot sidewalks. The new refined couplet cross-section will reduce the sidewalks to 8 feet in width. In addition, the U-turn will be shifted further south to minimize impacts (see below). ***This refinement will likely have both cost increase and cost reduction outcomes.***
- Could the U-turn movement be moved further south?
  - Updated concept designs show the U-turn farther south allowing direct access to the businesses from the southbound U-turn movement. It also introduces speed reduction geometry. See Figure 5 for more details. ***This refinement will likely have cost increase outcomes.***
    - It should be noted that the southerly U-turn shift does introduce new right-of-way impacts to the property south of 11<sup>th</sup> Street and east of US 97. These impacts and access to the property will be refined further through the design process. Options to shift the improvement west to avoid impacts to properties owners will be explored through additional design phases.
- Concerns with eastbound bicycle being rerouted due to the one-way nature of B Avenue between US 97 and 11<sup>th</sup> Street
  - Updated concept designs introduce a separated cycle track for eastbound bicycle traffic in this one-way westbound segment of B Avenue. This should improve bicycle safety in this segment. See Figure 6 for more details. ***This refinement will likely have cost reduction outcomes.***
- General cost and right-of-way impacts compared to the legislative allocation of \$20M.
  - Updated concept design introduces several cost reducing enhancements including. ***These refinements will likely have cost reduction outcomes.***
    - Reduces sidewalks throughout the project from 10 to 8 feet (see Figure 7).

- The conversion of the southbound off-ramp at Lower Bridge Way from a diamond to parclo B ramp configuration. This significantly reduces right-of-way needs in the northwest quadrant of this intersection and will help reduce driver perception related speeds issues. *See Figure 8 for more details.*
- Reduce US97 lane widths from standard 12 to 11 feet.

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**Figure 5. Couplet Southern U-turn configuration**



**Figure 6. B Avenue Reverse Cycle Track Concept Plan**



**Figure 7. Couplet Cross Section Comparison**



**Figure 8. Couplet North Side Parcel B Plan View**



### ***Not Considered for Refinement***

- Concerns about increased traffic on 11<sup>th</sup> and losing the local nature and north-south continuity of 11<sup>th</sup>.
  - While disruption to the character of Terrebonne is a concern, the couplet would require upgrading 11<sup>th</sup> Street to ODOT standards. To maintain the vitality of 11<sup>th</sup> Street, the cross section would be built to include bike lanes, sidewalks, and landscaping that would emphasize the character of Terrebonne. Speed reduction techniques would be implemented to emphasize the rural community environment.
  - Other alternatives (i.e., 5-lane with or without the NB off-ramp at Lower Bridge Way) also will require 11<sup>th</sup> Street to be either partially or fully rebuilt to carry the forecasted northbound left-turn traffic at Lower Bridge Way and accommodate sidewalks and bicycle lanes according to Deschutes County Standards.
  - The updated couplet cross-section reduces the barrier effect of US 97 through Terrebonne by reducing the pedestrian and bicycle exposure to 32 feet crossing the one-way couplet. This results with a total highway exposure of 64 feet against one-way traffic compared to at least 74 feet of two-way traffic exposure under a five-lane cross-section assuming buffered bike lanes. Pedestrians and bicyclists would still also need to cross 11<sup>th</sup> Avenue under the five-lane system alternatives exposing them to an additional 36 feet of exposure
- Will trucks be able to circulate to businesses under a couplet?
  - The conceptual design was completed with trucks in mind. All turning radii at intersections can accommodate a WB-67 (53-foot tractor trailer). Trucks may be required to circulate using one-way, directional streets to reach their destination.
  - Access to businesses throughout the corridor should be generally enhanced as the number of conflict points at each driveway along both US 97 (existing) and 11<sup>th</sup> Street will be reduced under the couplet configuration.
- Will businesses lose exposure with one-way roads?
  - The majority of businesses on US 97 also have access to both US 97 and 11<sup>th</sup> Street or have cross access from adjacent parking lots. While a small portion of businesses will have reduced exposure to both northbound and southbound traffic, a couplet provides improved quality of access whereas the current congestion can limit the viability of access to businesses. Additionally, a couplet reduces the number of conflict points at driveways along both US 97 and 11<sup>th</sup> Street.

## Five-Lane

### *Considerations for Refinement*

- Could the center turn lane be removed north of Central Avenue or replaced by a raised landscape medium.
  - The turn lane is not necessary north of Central Avenue; however, some form of vehicle separation and speed reduction would provide an enhancement. As such, a raise landscape or concrete island would be recommended. ***This refinement will likely have cost neutral outcome.***
- General cost and right-of-way impacts compared to the legislative allocation of \$20M.
  - Updated concept design introduces several cost reducing enhancements including. ***These refinements will likely have cost reduction outcomes.***
    - The conversion of the southbound off-ramp at Lower Bridge Way from a diamond to parclo B ramp configuration. This significantly reduces right-of-way needs in the northwest quadrant of this intersection and will help reduce driver perception related speeds issues. *See Figure 9 for more details.*
    - Reduces sidewalks throughout the project from 10 to 8 feet and travel lanes from 12 to 11 feet (see Figure 10).

**Figure 9. Five-Lane North Side Parclo B**

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**Figure 10. Five-Lane Recommended Cross Section**



### ***Not Considered for Refinement***

- Could the northbound off-ramp be eliminated, and Crook River Ranch traffic be re-assigned to 11<sup>th</sup> Street to access Lower Bridge Way? What would the volumes be on 11<sup>th</sup> Street without the NB off-ramp?
  - Reroute northbound left turning movements at Lower Bridge Way to use 11<sup>th</sup> Street starting at the US 97/11<sup>th</sup> Street junction. The high demand for northbound vehicles to Crooked River Ranch and Lower Bridge Way would approximately triple the number of vehicles using 11<sup>th</sup> Street.
  - Removing the northbound off-ramp would necessitate rebuilding all 11<sup>th</sup> Street to accommodate the increased traffic volumes.
- Would 11<sup>th</sup> Street need to be reconstructed?
  - The existing condition of 11<sup>th</sup> Street would not be sufficient to accommodate the additional northbound traffic. 11<sup>th</sup> Street would need to be reconstructed from the US 97/11<sup>th</sup> Street intersection on the south end of Terrebonne to the interchange at Lower Bridge Way.
- Concerns regarding the barrier and bisecting effect within the community.
  - In comparison to the couplet, the five-lane section further bisects the community by introducing more conflicts for accessing and crossing US 97 and increasing the total number of lanes and pedestrian/bicycle exposure distances.
- Could the five-lane concept be modified to a three-lane alternative and widen later?
  - As shown in Technical Memorandum #5, a three-lane cross section on US 97 is not sufficient to accommodate the vehicular demand on the corridor. Assuming the reroute of northbound left vehicles at Lower Bridge Way, Figure 11 shows the potential queue associated with a three-lane section and a signal at B Avenue. The peak hour queues would be substantial for US 97 and northbound at 11<sup>th</sup> Street/Smith Rock Way.
  - Given the reroute of traffic to 11<sup>th</sup> Street to access Lower Bridge Way, 11<sup>th</sup> Street would also need to be rebuilt to accommodate traffic to/from Lower Bridge Way. This traffic would approximately triple the current volumes on 11<sup>th</sup> Street.
  - Given the need to improve 11<sup>th</sup> Street, a theoretical initial three-lane scenario would exhaust legislature allocation of funding and additional funds well beyond the current \$25.9 Million estimate would be required for widening US 97 as it would require a second contract and result in basically constructing seven new lanes through Terrebonne (i.e., five on US 97 and two on 11<sup>th</sup> Street).

- Can the signal be placed at US 97/C Avenue instead of US 97/B Avenue?
  - Technical Memorandum #5 identified the future turning movements at US 97/B Avenue and US 97/C Avenue. Given the high side street volumes at B Avenue, local circulation, pedestrian activity, and proximity to the Terrebonne Community School, a signal would be most appropriate at US 97/B Avenue.

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**Figure 11 – 2040 Three-Lane Configuration – 95<sup>th</sup> Percentile Queue**

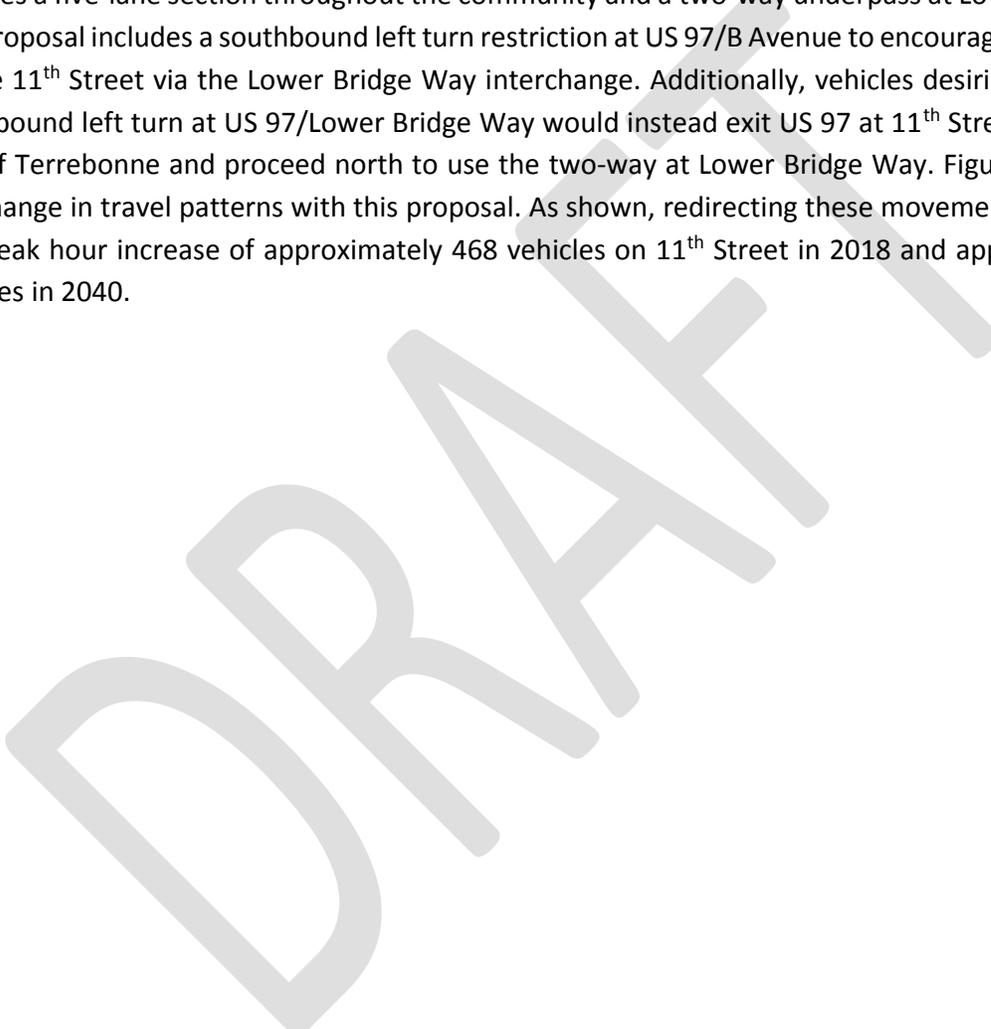
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## Other Potential Alternatives

Three additional alternatives were developed by advisory team members and public participants and presented to the project team for consideration. These potential alternatives are presented below. *Evaluation criteria matrices for these alternatives are provided in Appendix C:*

### ***Five-Lane Section with Diversion***

The Save Terrebonne! Coalition developed a scenario that retains the existing US 97 alignment. This includes a five-lane section throughout the community and a two-way underpass at Lower Bridge Way. The proposal includes a southbound left turn restriction at US 97/B Avenue to encourage these vehicles to use 11<sup>th</sup> Street via the Lower Bridge Way interchange. Additionally, vehicles desiring to perform a northbound left turn at US 97/Lower Bridge Way would instead exit US 97 at 11<sup>th</sup> Street on the south end of Terrebonne and proceed north to use the two-way at Lower Bridge Way. Figure 12 illustrates the change in travel patterns with this proposal. As shown, redirecting these movements would result in a peak hour increase of approximately 468 vehicles on 11<sup>th</sup> Street in 2018 and approximately 896 vehicles in 2040.



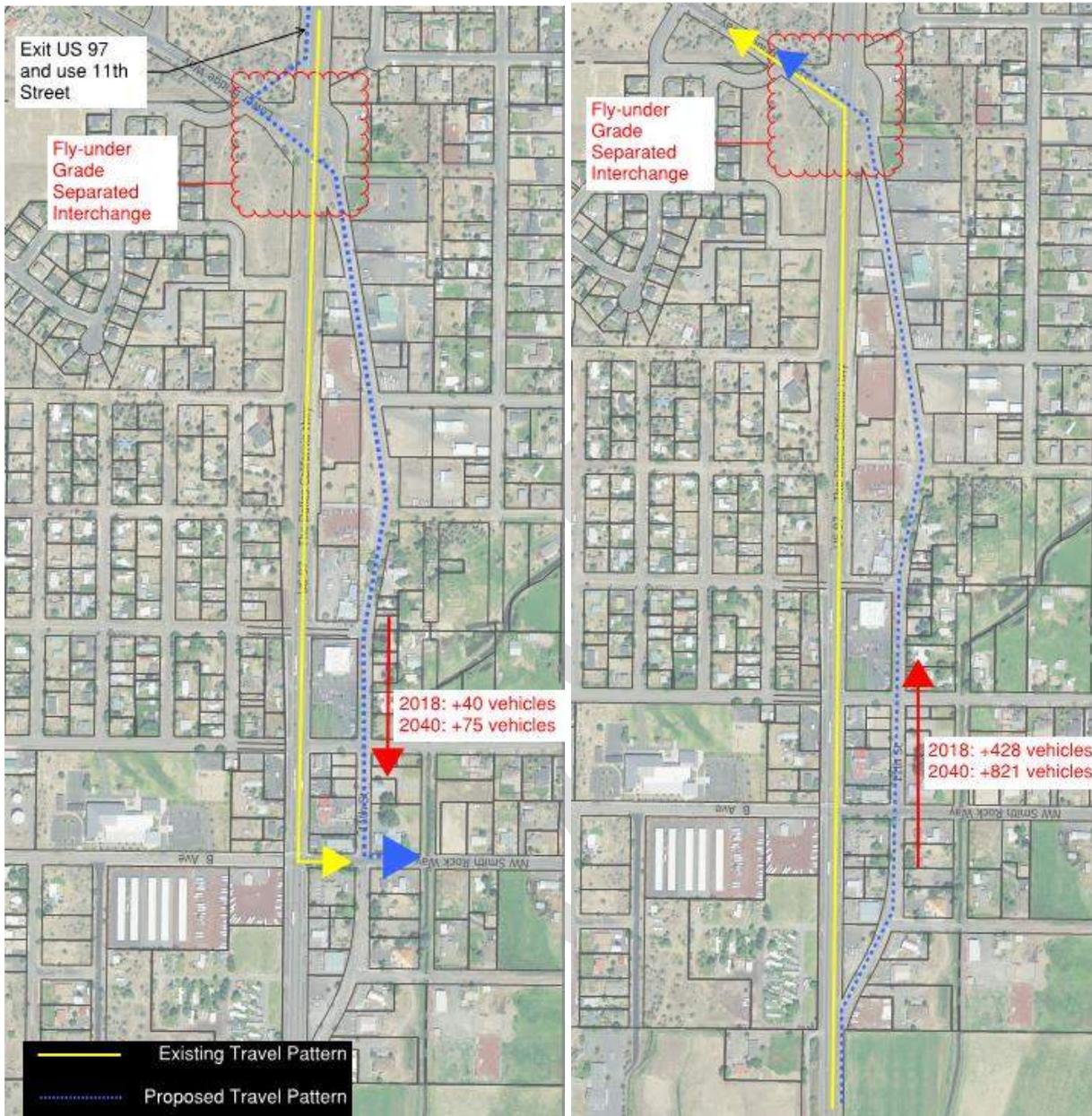


Figure 12. Existing and Proposed Travel Patterns for Southbound left turn movements at B Avenue (left) and Northbound left turning movements at Lower Bridge Way (right)

### *Proposed Alternative Evaluation*

An evaluation criteria matrix for this alternative is provided in Appendix C.1. Based on the evaluation criteria, the alternative includes several fatal flaws including operations, safety and cost. Without intersection improvements at US 97/B Avenue, the intersection would not meet mobility standards (even with southbound left turn restrictions). Maintaining the local, business road characteristics is a high priority for this proposal; however, the addition of through volumes on 11<sup>th</sup> Street from the diversions would substantially increase the traffic on the roadway. Diversions onto 11<sup>th</sup> Street are expected to triple the number of vehicles using 11<sup>th</sup> Street under the existing and five-lane alternative configuration. To accommodate the increase in volumes, 11<sup>th</sup> Street would need to be reconstructed. This would be an additional cost to the alternative. In addition, the ability for motorist to access and/or cross US 97 without signal at B Avenue would be difficult given the number of introduced conflicts (see Alternative Access and Conflict Comparison section for further discussion).

### *Considerations for Refinement*

Several improvements identified in the proposal that have been considered for refinement to the existing couplet and five-lane system alternatives, including:

- Adding curbs, sidewalks, and bike lanes to 11<sup>th</sup> Street,
- Adding crosswalks at Smith Rock Way, A Street, and C Avenue along 11<sup>th</sup> Street,
- Improving streetscape on US 97, and
- Providing a pedestrian improvement at B Avenue.

### ***Three-Lane Section with Add Lanes***

An additional proposal was presented at the Neighborhood Alliance Meeting on November 7<sup>th</sup>, 2018. This proposal maintains US 97 as a three-lane cross section with various add lanes from the minor streets onto the mainline.

### *Proposed Alternative Evaluation*

An evaluation criteria matrix for this alternative is provided in Appendix C.2. An operational analysis was completed to evaluate the mobility resiliency of this alternative. The analysis identified that the alternative does not meet future mobility standards at US 97/B Avenue under the future 2040 scenario and therefore was not included as a promising alternative. The concept layout and operation analysis worksheet were provided in Appendix K of Tech Memo #6.

### *Considerations for Refinement*

Several improvements identified in the proposal that have been considered for refinement to the existing couplet and five-lane system alternatives, including:

- Improving streetscape on US 97, and
- Speed reduction signage prior to entering Terrebonne.

### ***Three-Lane Section with Diversion***

A revised proposal was submitted by an Advisory Committee Member during the Advisory Committee Meeting on December 4<sup>th</sup>. The proposal suggests maintaining a three-lane section on US 97 with a grade separated interchange at Lower Bridge Way. The alternative routes local traffic to the interchange to minimize minor street turning movements onto US 97. The proposed interchange at Lower Bridge Way does not show a viable alternative for northbound left-turn movements to exit US 97 and access 11<sup>th</sup> Street and the two-way underpass. Thus, the alternative would either necessitate diverting all this traffic to 11<sup>th</sup> Street require the rebuilding of 11<sup>th</sup> Street through the community or introducing the northbound off-ramp shown in the five-lane system alternative.

### ***Proposed Alternative Evaluation***

An evaluation criteria matrix for this alternative is provided in Appendix C.3. As shown Technical Memorandum #5: *Future Conditions Analysis*, a three-lane section does not retain the capacity to support the volumes on US 97 in 2040. Similar to the five-lane diversion proposal, redirection to 11<sup>th</sup> Street will increase traffic, likely requiring the reconstruction of the roadway. Further, the reconstruction of 11<sup>th</sup> Street would result in construction costs similar to that of the couplet system alternative without the benefit of a second northbound and southbound lane on US 97. Based on the operations and feasibility of the alternative, it is not recommended to continue for further review.

### ***Considerations for Refinement***

Several improvements identified in the proposal that have been considered for refinement to the existing couplet and five-lane system alternatives, including:

- Installing a Rectangular Rapid Flash Beacon (RRFB) across US 97.

## ALTERNATIVE ACCESS AND CONFLICT COMPARISON

To help further evaluate the accessibility between the Couplet and Five-Lane system alternatives, a vehicular turning movement conflict analysis was performed to compare the merging, diverging, and crossing conflicts within the study corridor. A conflict is defined when two vehicular paths cross one another or diverge or merge together. The crossing conflicts represent the potential for more serious related incidents compared to the diverging and merging conflicts. The ability to access a roadway/driveway or cross a roadway is directly affected by the number of conflict points and the volumes levels of the respective facilities.

To develop the comparison, the total number of conflicts along both US 97 and 11<sup>th</sup> Street between 10<sup>th</sup> Avenue (south) and Lower Bridge Way (north) was determined for existing No-Build conditions and Build conditions under the Couplet and Five-Lane System alternatives. Table 3 provides a comparison of the conflicts at four-legged intersections. Figures 13A-F illustrate the conflicts and conflicts at three-legged intersections. *A conflict analysis spreadsheet is provided in Appendix D.*

**Table 3. Vehicular Conflict Comparison**

Alternative	Merging	Diverging	Crossing	Total Conflicts
Existing	185	185	289	659
Couplet	79	79	105	263
Five-Lane	185	185	343	713
<i>Difference between Five-Lane and Couplet</i>	<i>106</i>	<i>106</i>	<i>238</i>	<i>450</i>

As shown above, the couplet reduces the overall number of conflicts from existing conditions by 60 percent (659 to 263) and has 63 percent less conflicts than the five-lane system alternative. Furthermore, the number of crossing conflicts (those with the potential for more serious related incidents) under the Couplet is reduced by 64 percent compared to existing conditions and 69 percent compared to the five-lane system alternative. The significant reduction of conflicts is illustrated in the turn movement conflict diagrams shown in Figures 13A through 13C. This reduction of conflicts will result in a lower potential for crashes given the one-way nature of the couplet and lead to better overall accessibility for motorists accessing adjacent businesses and crossing US 97.

## ALTERNATIVE REFINEMENTS

As part of this phase of the planning process, the two most promising system alternatives were refined from their initial conceptual alignments based on geometric constraints and feedback from the public, Advisory Committee, and PMT.

### Couplet

The following refinements were made to the couplet design:

- Reduced sidewalk width from 10 to 8 feet and travel lanes from 12 to 11 feet in width (see Figure 6). This update cross-section maintains the curb to curb exposure for pedestrians and bicyclists at 32 feet.
- Converted the southbound off ramp at US 97/Lower Bridge Way from a traditional diamond to a parclo B loop ramp. As part of this modification, a lateral shift was introduced to slow southbound vehicles entering the community.
- Shifted the Southern U-turn and introduced a chicane to slow northbound vehicles entering the community.
- Introduced rectangular rapid flash beacons and marked crossings at the B Avenue-Smith Way crossings of US 97 (existing) and 11<sup>th</sup> Street.
- Introduced an eastbound cycle track for the one-way portion of B Avenue between US 97 (existing) and 11<sup>th</sup> Street.
- Improved access to businesses at the corner of US 97/11<sup>th</sup> Street including the post office.
- Utilize roadway geometry to reduce northbound speed.
- Introduce short, medium, and long-term local street enhancements (See “*Circulation Improvements*” section below). The local street improvement between 11<sup>th</sup> and 13<sup>th</sup> Streets near Lower Bridge Way was included to help with local circulation.

### Five-Lane

The following refinement were made to the five-lane design:

- Reduced sidewalk width from 10 feet to 8 feet and travel lanes from 12 feet to 11 feet(see Figure 10). This updated cross-section also reduced the curb to curb exposure for pedestrians and bicyclists from 78 to 74 feet.
- Converted the southbound offramp at US 97/Lower Bridge Way from a traditional diamond to a parclo B loop ramp. As part of this modification, a lateral shift was introduced to slow southbound vehicles entering the community.

Figures 14 and 15 show the refinements to the couplet and five-lane alignments, respectively.

## Evaluation Criteria Matrix of the Most Promising System Alternatives

Table 4 evaluates the couplet and five-lane alternatives based on a quantitative assessment of the evaluation criteria for the Refinement Plan. The scoring system is as follows:

- The alternatives with the best possible outcome are indicated by a solid circle.
- The alternatives with neutral or marginal improvement outcomes are indicated by a half-filled circle.
- The alternatives with the least favorable outcome are indicated by an open circle.
- The circles were evaluated by the following values: open circle=0, half circle=1, and full circle=3.

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**Figure 14. Refined Couplet**

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**Figure 15. Refined Five-Lane**

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**Table 4. Goals, Objectives, and Evaluation Criteria Comparison of the Refined Most Promising System Alternatives**

Goal	Objective	Evaluation Criteria	Couplet		Five Lane	
			Rating	Comments	Rating	Comments
<p><b>Community &amp; Livability:</b> provide for a high quality of life by balancing US 97 mobility needs with community values and interests.</p>	<ul style="list-style-type: none"> <li>• Increase transportation choices on US 97 by adding or improving bicycle and pedestrian routes, crossing, and connections to transit, including a crossing at US 97 &amp; B Street which serves as a school crossing and scenic bike route crossing.</li> <li>• Link regional and local routes to key attractors on US 97, such as shopping, schools, residential areas, and other community destinations.</li> <li>• Provide a transportation network that accommodates local, commuter, and region traffic, including freight movements along US 97.</li> </ul>	<ul style="list-style-type: none"> <li>• Does the proposed project element serve people that live in, work in, and/or visit Terrebonne?</li> </ul>		<ul style="list-style-type: none"> <li>• It <b>improves accessibility</b> to/from US 97 for businesses and residents by reducing vehicular, pedestrian, and bicycle conflicts (TM #7, Table 3).</li> <li>• Has the potential to partially impact the existing businesses or residences (TM #7, Figure 14).</li> </ul>		<ul style="list-style-type: none"> <li>• <b>Create a larger east-west barrier</b> for vehicles, pedestrian, bicycles to cross or turn to/from US 97 to local businesses and residences (TM #7, Figure 15).</li> <li>• Has the potential to physically impact two businesses and partially impact others (TM #7, Figure 15).</li> </ul>
		<ul style="list-style-type: none"> <li>• Are there any significant barriers to or impacts that would result from the proposed project element, such as the presence of significant natural resources or require acquisition of property contaminated by Haz Mat?</li> </ul>		<ul style="list-style-type: none"> <li>• None identified at this time</li> </ul>		<ul style="list-style-type: none"> <li>• None identified at this time</li> </ul>
		<ul style="list-style-type: none"> <li>• What are the right of way impacts of the proposed project element - # of businesses relocated, #of residential properties impacted, impacts to public facilities, etc.</li> </ul>		<ul style="list-style-type: none"> <li>• Improvements generally stay within existing rights-of-way along the US 97 (existing) and 11<sup>th</sup> Street corridors; however, the following potential right-of-way impacts are note:                             <ul style="list-style-type: none"> <li>○ Parcel south of 11<sup>th</sup> and east of US 97 (TM #7, Figure 14)</li> <li>○ Southeast parcel(s) and northeast parcel at the Smith Rock Way-B Avenue/11<sup>th</sup> Street intersection (TM #7, Figure 14)</li> <li>○ Southwest parcel at the Lower Bridge Way/US 97 intersection (TM #7, Figure 14)</li> </ul> </li> </ul>		<ul style="list-style-type: none"> <li>• Improvements generally stay within existing rights-of-way along the US 97 (existing) and 11<sup>th</sup> Street corridors; however, the following potential right-of-way impacts are note:                             <ul style="list-style-type: none"> <li>○ Southeast parcel(s) at the B Avenue/US 97 intersection (TM #7, Figure 15)</li> <li>○ Southwest parcel(s) at the F Avenue/11<sup>th</sup> Street intersection (TM #7, Figure 15)</li> <li>○ Southwest parcel at the Lower Bridge Way/US 97 intersection (TM #7, Figure 15)</li> </ul> </li> </ul>
<p><b>Mobility:</b> Provide a safe and efficient transportation system for all modes of travel, including local trips, through trips on the highway, emergency services, and freight.</p>	<ul style="list-style-type: none"> <li>• Evaluate all potential US 97 alternatives, such as maintaining the existing US 97 alignment, creating a highway couplet with 11th Street or constructing a bypass east or west of the existing alignment.</li> <li>• Identify and evaluate all potential at-grade and grade separated solutions for the Lower Bridge Way/US 97 intersection in concert with the development of the alternative alignments for US 97.</li> <li>• Maintain the carrying and dimensional capacity for statewide freight movement on US 97.</li> </ul>	<ul style="list-style-type: none"> <li>• Does the proposed project element meet mobility targets on US 97 through 2040?</li> </ul>		<ul style="list-style-type: none"> <li>• <b>All intersections</b> meet mobility standards in 2040 (TM #6, Figure 18).</li> </ul>		<ul style="list-style-type: none"> <li>• All intersections meet mobility standards in 2040 <b>except for the B Avenue/US 97 signalized intersection</b> which is forecasted to operate at a volume to capacity ratio of 0.79 (exceeding the Oregon Highway Plan and Oregon Design Manual mobility standard) (TM #6, Figure 19).</li> <li>• During the weekday PM peak hour in 2040, northbound queues from B Avenue will extend past C Avenue and southbound queues will extend past 11<sup>th</sup> Street (TM #6, App H).</li> </ul>
		<ul style="list-style-type: none"> <li>• Does the proposed project element represent an investment that works toward the long-term solution for the corridor?</li> </ul>		<ul style="list-style-type: none"> <li>• All project elements are forward compatible through 2040 (TM #6, Figure 18).</li> <li>• The couplet allows the opportunity to convert back to two-way streets, if a bypass is eventually developed around Terrebonne (TM #7, Figure 14).</li> <li>• The Lower Bridge Way grade separated interchange is unlikely to be compatible with a future bypass (TM #7, Figure 14).</li> </ul>		<ul style="list-style-type: none"> <li>• The B Avenue/US 97 signalized intersection does not meet mobility standards in 2040 (TM #6, Figure 19).</li> <li>• The Lower Bridge Way grade separated interchange is unlikely to be compatible with a future bypass (TM #7, Figure 15).</li> </ul>

Goal	Objective	Evaluation Criteria	Couplet		Five Lane	
			Rating	Comments	Rating	Comments
		<ul style="list-style-type: none"> <li>Does the proposed project element maintain or enhance the carrying and dimensional capacity for statewide freight movement?</li> </ul>	●	<ul style="list-style-type: none"> <li>The couplet expands the northbound and southbound dimensional capacity from 20 feet (12-foot travel lane and 8-foot shoulder) to 32 feet (6-foot bike lane, 2-foot buffer, two 11-foot travel lanes, 2-foot shy) (TM #7, Figure 7).</li> <li>The couplet increases the carrying capacity by providing a second northbound and southbound travel lane <b>without control devices</b> (TM #7, Figure 14).</li> </ul>	◐	<ul style="list-style-type: none"> <li>The five-lane expands the northbound and southbound dimensional capacity from 20 feet (12-foot travel lane and 8-foot shoulder) to 30 feet (6-foot bike lane, 2-foot buffer, two 11-foot travel lanes) (TM #7, Figure 10).</li> <li>The five-lane increases the carrying capacity by providing a second northbound and southbound travel lane; however, it also introduces a signal at B Avenue which limits capacity and <b>does not allow it to meet mobility standards in 2040</b> (TM #6, Figure 19).</li> </ul>
		<ul style="list-style-type: none"> <li>Does the proposed project element enhance east-west connectivity within the community?</li> </ul>	●	<ul style="list-style-type: none"> <li>The couplet <b>reduces</b> pedestrian and bicycle exposure from 54 feet of two-way conflicts (measured at B Avenue) to 32 feet of one-way conflict (TM #7, Figure 14).</li> <li>The total number of lanes on US 97 (existing) and 11<sup>th</sup> Street are <b>maintained at four and converted to one-way</b> (TM #7, Figure 14).</li> <li>Pedestrian and bicycle safety are further enhanced with the placement of rectangular rapid flash beacons at the B Avenue-Smith Rock Way crossings of the couplet (TM #7, Figure 14).</li> </ul>	◐	<ul style="list-style-type: none"> <li>The five-lane <b>increases</b> the pedestrian and bicycle exposure from 54 feet of two-way conflicts (measured at B Avenue) to 62 feet of two-way conflicts (TM #7, Figure 15).</li> <li>The total number of lanes on US 97 (existing) and 11<sup>th</sup> Street are <b>increased from 4 to 6 lanes of two-way traffic</b> (TM #7, Figure 15).</li> <li>Pedestrian and bicycle safety are further enhanced with the placement of a traffic signal at the B Avenue-Smith Rock Way crossings of the couplet (TM #7, Figure 15).</li> </ul>
<p><b>Safety and Health:</b> enable people to safely and comfortably drive, walk, run or cycle in and through the Community, including along and across US 97, for all types of trips.</p>	<ul style="list-style-type: none"> <li>Address safety, comfort, and security of people driving, walking, and biking along and across US 97.</li> <li>Use transitional and traffic calming techniques to slow traffic to posted speeds.</li> </ul>	<ul style="list-style-type: none"> <li>Does the proposed project element address an area with a crash history or risk factor? Is it expected to improve safety or slow speeds?</li> </ul>	●	<ul style="list-style-type: none"> <li>The grade separated crossing at Lower Bridge Way addresses a crash history location (TM #7, Figure 14).</li> <li>The southern and northern gate chicanes should <b>reduce</b> travel speeds entering the community (TM #7, Figure 14).</li> <li>The narrow cross-section (26 feet curb-to-curb) and urban characteristics (curb, landscaping, buffered bike lane and sidewalks) should help slow speeds (TM #7, Figure 6).</li> </ul>	◐	<ul style="list-style-type: none"> <li>The grade separated crossing at Lower Bridge Way addresses a crash history location (TM #7, Figure 15).</li> <li>The wider five lane section <b>may maintain existing or potentially increase</b> travel speeds entering the community (TM #7, Figure 15).</li> <li>The urban characteristics (curb, landscaping, buffered bike lane and sidewalks) should help slow speeds (TM #7, Figure 10).</li> </ul>
		<ul style="list-style-type: none"> <li>Does the proposed project element reduce the level of stress experienced by pedestrians and/or cyclists?</li> </ul>	●	<ul style="list-style-type: none"> <li>The buffer bike lane and separated sidewalks will reduce the level of stress by pedestrians and/or cyclists traveling parallel to US 97 (TM #7, Figure 6).</li> <li>The reduced pedestrian and bicycle exposure throughout the couplet should <b>improve</b> the east-west crossing experience (TM #7, Figure 7).</li> <li>The installation of rectangular rapid flash beacons at the B Avenue-Smith Rock Way crossings of the couplet should enhance pedestrian and bicycle safety (TM #7, Figure 14).</li> </ul>	◐	<ul style="list-style-type: none"> <li>The buffer bike lane and separated sidewalks will reduce the level of stress by pedestrians and/or cyclists traveling parallel to US 97 (TM #7, Figure 10).</li> <li>The increased pedestrian and bicycle exposure throughout the corridor will <b>reduce</b> the east-west crossing experience (TM #7, Figure 10).</li> <li>The installation of a traffic signal at the B Avenue/US 97 intersection should enhance pedestrian and bicycle safety at that location (TM #7, Figure 15).</li> </ul>

Goal	Objective	Evaluation Criteria	Couplet		Five Lane	
			Rating	Comments	Rating	Comments
<p><b>Accessibility:</b> provide infrastructure that supports accessible transportation options for all users.</p>	<ul style="list-style-type: none"> <li>Address the identified existing and future year 2040 gaps and deficiencies (needs) within the study area.</li> <li>Provide well-designed, visible, safe, and convenient infrastructure and crossings for all users (e.g., agricultural equipment).</li> </ul>	<ul style="list-style-type: none"> <li>Does the proposed project element address existing gap or deficiency in the vehicular, transit, bicycle and/or pedestrian network?</li> </ul>	●	<ul style="list-style-type: none"> <li>The buffer bike lane and separated sidewalks will address many of the existing gaps along the corridor (TM #7, Figure 6).</li> <li>The grade separated crossing at Lower Bridge Way addresses a crash history location and improves vehicular, pedestrian, and bicycle operations (TM #7, Figure 8).</li> <li>The narrow cross-section and northerly and southerly chicanes entering the community <b>should reduce</b> traveling speeds (TM #7, Figure 8).</li> </ul>	●	<ul style="list-style-type: none"> <li>The buffer bike lane and separated sidewalks will address many of the existing gaps along the corridor (TM #7, Figure 10).</li> <li>The grade separated crossing at Lower Bridge Way addresses a crash history location and improves vehicular, pedestrian, and bicycle operations (TM #7, Figure 9).</li> </ul>
<p><b>Financial Responsibility:</b> use resources efficiently and invest in infrastructure that will serve the Community and statewide highway for years to come.</p>	<ul style="list-style-type: none"> <li>Achieve maximum return on the \$20 million allocated for improvements in the Terrebonne community</li> </ul>	<ul style="list-style-type: none"> <li>What is the planning-level cost estimate of the proposed project element?</li> </ul>	◐	<ul style="list-style-type: none"> <li>\$22.5M (TM #7, Table 5)</li> </ul>	○	<ul style="list-style-type: none"> <li>\$25.9M (TM #7, Table 5)</li> </ul>
		<ul style="list-style-type: none"> <li>Can the preferred plan be implemented with the money allocated?</li> </ul>	●	<ul style="list-style-type: none"> <li>Value engineering should allow the couplet concept to be refined to meet the \$20M legislative allocation or stay within 10 percent (currently 13 percent over the allocation) (TM #7, Table 5).</li> </ul>	○	<ul style="list-style-type: none"> <li><b>Not at this time.</b> The current estimate is 30 percent over the \$20M legislative allocation (TM #7, Table 5).</li> </ul>
		<ul style="list-style-type: none"> <li>Does the benefit exceed the cost over a 20-year horizon?</li> </ul>	●	<ul style="list-style-type: none"> <li>The Couplet benefit to cost will exceed 1.0 due to the safety benefits and no control delay (i.e., traffic signals) to US97 traffic.</li> </ul>	◐	<ul style="list-style-type: none"> <li>The Five-Lane benefit to cost will exceed 1.0 due to the safety benefits; however, the introduction of the traffic signal at B Avenue will introduce significant travel delay costs which will reduce the overall benefit of the five-lane compared to the couplet.</li> </ul>
<p><b>Economic Vitality:</b> encourage visitors and investment in the recreational, agricultural, business areas nearby and served by US 97.</p>	<ul style="list-style-type: none"> <li>Provide connections to businesses and natural areas within and near the Terrebonne community.</li> <li>Attract tourist and investment dollars to the greater Terrebonne community</li> </ul>	<ul style="list-style-type: none"> <li>Does the proposed project element address mobility and serviceability for local and regional freight activity?</li> </ul>	◐	<ul style="list-style-type: none"> <li>US 97 <b>meets</b> mobility standards in 2040 without the introduction of any mainline traffic control devices (e.g., a traffic signal) (TM #6, Figure 18).</li> <li>Access conflicts to/from local businesses and residences accessing or crossing the highway are <b>substantially reduced</b> (60%) Furthermore, the more serious related crossing conflicts are <b>decreased</b> by 64% (TM #7, Table 3).</li> <li>Fewer conflict points and the introduction of one-way streets allows for <b>improved</b> accessibility and east-west connectivity at all local street and private driveway approaches to US 97, however, may impact local freight activity on system (TM #7, Table 3).</li> </ul>	○	<ul style="list-style-type: none"> <li>US 97 <b>does not meet</b> mobility standards in 2040 and introduces a mainline traffic control device (i.e., a traffic signal) (TM #6, Figure 19).</li> <li>Access conflicts to/from local businesses and residences accessing or crossing the highway is <b>increased</b> (8%). Furthermore, the more serious related crossing conflicts are <b>increased</b> by 19% (TM #7, Table 3).</li> <li>Increased conflict points <b>reduce</b> accessibility and east-west connectivity at all local streets and private driveway approaches to US 97 except the signalized B Avenue intersection (TM #7, Table 3).</li> </ul>

Goal	Objective	Evaluation Criteria	Couplet		Five Lane	
			Rating	Comments	Rating	Comments
		<ul style="list-style-type: none"> <li>Does the proposed project element support business activity in and around the community (e.g., the Smith Rock State Park)?</li> </ul>	●	<ul style="list-style-type: none"> <li>The couplet provides improved access to the local businesses and expands the amount of highway frontage within the commercially zoned portion of the community (TM #7, Figure 14).</li> <li>Access to/from Smith Rock State Park is improved by reducing the number of conflicts (TM #7, Table 3).</li> <li>Crooked River Ranch and Jefferson County residents are provided with a safer and more efficient access to US 97 and the Terrebonne community with the grade separated interchange (TM #7, Figure 14).</li> </ul>	◐	<ul style="list-style-type: none"> <li>The five-lane alternative <b>increases</b> the conflict points and <b>decreases</b> the ease of access to the local businesses because of the number of lanes that need to be crossed (TM #7, Table 3).</li> <li>Access to/from Smith Rock State Park is improved by the introduction of the traffic signal at B Avenue (TM #7, Figure 15).</li> <li>Crooked River Ranch and Jefferson County residents are provided with a safer and more efficient access to US 97 and the Terrebonne community with the grade separated interchange (TM #7, Figure 15).</li> </ul>
		<ul style="list-style-type: none"> <li>Does the proposed project element improve pedestrian and/or bicycle access to businesses and natural areas in and around the community?</li> </ul>	●	<ul style="list-style-type: none"> <li>The buffered bike lane and separated sidewalks will reduce the level of stress by pedestrians and/or cyclists traveling parallel to US 97 (TM #7, Figure 6).</li> <li>The reduced pedestrian and bicycle exposure throughout the couplet should <b>improve</b> the east-west crossing experience and access to businesses and Smith Rock State Park (TM #7, Figure 6).</li> <li>The installation of rectangular rapid flash beacons at the B Avenue-Smith Rock Way crossings of the couplet should enhance pedestrian and bicycle safety as well as access to the Terrebonne Community School (TM #7, Figure 14).</li> </ul>	◐	<ul style="list-style-type: none"> <li>The buffered bike lane and separated sidewalks will reduce the level of stress by pedestrians and/or cyclists traveling parallel to US 97 (TM #7, Figure 10).</li> <li>The increased pedestrian and bicycle exposure throughout the corridor will <b>reduce</b> the east-west crossing experience and access to businesses (TM #7, Figure 10).</li> <li>The installation of a traffic signal at the B Avenue/US 97 intersection should enhance pedestrian and bicycle safety at that location as well as access to the Terrebonne Community School (TM #7, Figure 15).</li> </ul>
<b>Total Evaluation Results</b>			●	<b>A combined score of 38 out of a possible 48.</b>	◐	<b>A combined score of 16 out of a possible 48.</b>

Scoring – Blank=0, Half=1, Full=3

## Refined Preliminary Cost Estimates

The preliminary cost estimates for the couplet and five-lane alignments have been refined and updated to reflect the changes shown in Figures 14 and 15. In addition to the refinements, changes in costs are reflective of further evaluation of stormwater, right-of-way, and infrastructure requirements. Table 5 shows cost estimates for both the couplet and five-lane alternative. Each alternative is further defined by the segment costs south and north of Central Avenue. These estimates include cost of construction, design engineering, construction engineering, landscaping, and right-of-way. This estimate also includes transitional costs such as speed reduction and pedestrian crossing infrastructure (explained in further detail in the following sections). The estimate does not include local road circulation improvements. *Revised cost estimates as of January 4<sup>th</sup> are provided in Appendix E.*

**Table 5. Alternative Cost Estimate (As of January 4, 2018)**

Project	Cost
<b><i>Couplet</i></b>	
B Avenue Configuration & Improvements South of Central Avenue	\$6.9M
Northbound Fly-under and Improvements North of Central Avenue	\$15.6M
<b>Total</b>	<b>\$22.5M</b>
<b><i>Five-Lane</i></b>	
Traffic Signal & Improvements South of Central Avenue	\$5.4M
Northbound Fly-under and Improvements North of Central Avenue	\$20.5M
<b>Total</b>	<b>\$25.9M</b>

## SELECTED “PREFERRED” ALTERNATIVE

Based on the evaluation presented above and feedback received by the Advisory Committee, PMT, and public, the project team recommends the ***Couplet*** move forward as the preferred, cost constrained system alternative for the Refinement Plan. Maintaining the rural, community character of Terrebonne is a high priority for ODOT and the design team. Therefore, providing transition elements and local circulation routes will be critical components of the Refinement Plan and couplet design.

## TRANSITION ELEMENTS FOR PREFERRED ALTERNATIVE

This section identifies transition needs and potential improvement enhancements under the couplet design.

### Existing Speeds and Proposed Speed Limits

Table 5 in Technical Memorandum #4: *Existing Conditions Analysis* shows existing speed data throughout Terrebonne. The data indicates the 85<sup>th</sup> percentile speeds (speed at which no more than 15% of traffic is exceeding) are higher than the posted speed on US 97 north of Lower Bridge Way and near Central Avenue.

Figure 16 shows the existing and proposed speed zones in the greater Terrebonne Area. To reduce the speeds from an expressway (55 miles per hour) to a rural community, a quarter-mile transition zone is recommended before entering the community. The transition zone will also be enhanced through lateral shifts in traffic through chicane treatments introduced at the north and south gateways. As shown in the figure, reducing the posted speed to 45 miles per hour before the 35 mile per hour speed zone in the community will give drivers an opportunity to react to the changing environment. South of Terrebonne, the current speed transition zone is about 0.25 mile. The transition zone should be extended on the north end of the community as shown in the figure.



**Figure 16. Speed Zones**



## Speed Reduction Treatments

Speed reduction is a high concern for those living in the community and traveling through the community. The following treatments have been considered and recommended as shown below for the preferred couplet system alternative and Terrebonne Refinement Plan:

### *Gateway Treatments*

Gateway signs and treatments provide a visual queue to drivers that the roadway environment is changing from a highway to “urban” area. Figure 17 shows an example of a gateway sign.

#### *Project Team Recommendation:*

Gateway welcome signs should ultimately be placed at the extremities of the community – just north of Lower Bridge Way and just south of 11<sup>th</sup> Street at both the entrances and exits.



**Figure 17. Example Gateway Sign**

### *Speed Feedback Signs*

A speed feedback sign is a treatment designed to provide a message to drivers exceeding a certain speed threshold. A speed feedback sign is currently located north of Terrebonne for southbound vehicles entering the community. Figure 18 shows an example of a speed feedback sign.

#### *Project Team Recommendation:*

A speed feedback sign should be installed just north of the community entry chicane for northbound traffic and the existing southbound speed feedback sign should be placed just north of the bridge structure at Lower Bridge Way.



**Figure 18. Example Speed Feedback Sign**

### **High Visibility Crosswalks**

High visibility crosswalks are enhanced pedestrian crossing treatments for uncontrolled intersections that cross multilane arterials or collectors. The crossing alters drivers of crossing pedestrians by way of high visibility continental pavement markings opposed to the standard, two parallel stripes. Figure 19 shows an example of a continental striping, high visibility crosswalk.



**Figure 19. High Visibility Crosswalk** (source: FHWA)

#### *Project Team Recommendation:*

In conjunction with the recommended Rectangular Rapid Flash Beacons, east-west high visibility cross walks should be installed on the north side of the B Avenue/US 97 southbound and Smith Rock Way/US 97 northbound (11<sup>th</sup> Street) intersections. In addition, high visibility crosswalks should be provided on the north-south crossings at US 97 northbound and southbound intersections at B Avenue, Smith Rock Way, C Avenue, and Central Avenue.

### **Landscaping and Street Furnishings**

Landscaping along the roadway can act as a traffic calming technique that provides a visual message to drivers that the area is a “community space”. It also provides a buffer between the travel way and sidewalk. Landscaping can include trees, bushes, grass, rocks, gravel, or other materials that distinguish a defined buffer area along the roadway. Landscaping may also break up long, interrupted corridors that may be conducive to speeding.

#### *Project Team Recommendation:*

The project should consider appropriate landscaping from Lower Bridge Way to 10<sup>th</sup> Avenue on the couplet.

### **Pavement Treatments**

The reconstruction of US 97 and 11<sup>th</sup> Street will ultimately require pavement upgrades to the roadways. Pavement treatments such as reflective pavement markers, traverse pavement markings, or speed limit pavement legends may bring attention to the changing environment and reduce speeds of through vehicles. Additionally, stop bars on the side streets should be set back to provide sufficient visibility of pedestrians to drivers.

*Project Team Recommendation:*

ODOT should consider the potential for introducing pavement treatments within the quarter-mile transition areas as part of the final design process

## Pedestrian Crossing Evaluation

### *Feedback for Crossing Locations*

Pedestrian crossing treatments and locations were identified by the public during the Concept Development Workshop, and the Advisory Committee during a meeting held December 4<sup>th</sup>. Respondents identified a need for pedestrian crossing improvements at B Avenue, C Avenue, and Central Avenue. The overwhelming majority identified B Avenue as a key pedestrian crossing location for the community. B Avenue is a critical side street that provides direct access to the Terrebonne Community School. C Avenue and Central Avenue were also identified based on key destination centers such as Thriftway.

### *Pedestrian Crossing Analysis*

A pedestrian crossing analysis was completed at US 97/B Avenue and 11<sup>th</sup> Street/B Avenue under the couplet scenario. The National Cooperative Highway Research Program (NCHRP) report 562, released in 2006, provides research for improving pedestrian safety at unsignalized intersections. The couplet alternative does not include traffic signals at B Avenue. Based on the through volumes on US 97 and 11<sup>th</sup> Street, NCHRP 562 identifies that a marked crosswalk is not sufficient as a standalone treatment. Enhanced treatments such as traffic calming, pedestrian signals, or other substantial crossing improvements should be provided to improve crossing safety for pedestrians.

Rectangular Rapid Flash Beacons (RRFBs) are enhanced pedestrian treatments that are a lower cost alternative to traffic signals and Pedestrian Hybrid Beacon (PHB). RRFBs use an irregular flashing pattern (similar to emergency vehicle flashers) that are activated by pedestrians manually pushing a button or automotive pedestrian detection. The RRFB has been proven to increase the yielding behavior of drivers at crosswalks.

ODOT report SPR 721, *Evaluation of Alternative Pedestrian Control Devices*<sup>1</sup>, identifies RRFBs as viable enhanced crossing treatments on ODOT facilities. The study concluded that RRFBs should be considered on roadways where the posted speed is 40mph or less.

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<sup>1</sup> <https://www.oregon.gov/ODOT/Programs/ResearchDocuments/SPR721pedreport.pdf?ga=t>

*Project Team Recommendation:*

Rectangular Rapid Flashing Beacons (RRFBs) should be installed at US 97/B Avenue and 11<sup>th</sup> Street/B Avenue (Smith Rock Way) intersections for the north side east-west crossings to provide enhanced pedestrian crossing treatments. The intersections of US 97/C Avenue and US 97/Central Avenue should be monitored for additional pedestrian treatments. It is not recommended that a marked crosswalk be installed without enhanced treatments.

## Wayfinding

There are several movements in the couplet alternative that may require wayfinding signs for vehicles who are unfamiliar with the turning maneuvers. Wayfinding signs provide additional information in complex environments for drivers, cyclists, and pedestrians. Figure 20 shows an example of a wayfinding sign for a median U-turn.

*Project Team Recommendation:*

U-turn based wayfinding signs and other guide signs should be considered during the final design project. U-turn signs would be useful for drivers at the southbound U-turn at US 97/11<sup>th</sup> Street, the southbound U-turn at US 97/Central Avenue, and northbound at the junction of 11<sup>th</sup> Street/US 97/Lower Bridge Way.



**Figure 20. Example Wayfinding Sign** (source: FHWA Median U-Turn Intersection Information Guide)

## LOCAL CIRCULATION IMPROVEMENTS

To enhance local circulation to the Terrebonne system, alternative connectivity routes were identified throughout the community. These routes provide connections to the grid system in the downtown area to address gaps in the existing infrastructure. Figure 21 identifies roadway connections based on high, medium, and low priority. The priorities were developed based on existing need, functional classification of roadway, alternative needs, and existing connectivity. The following is a list of recommended connections (as shown in Figure 21) categorized by priority:

- **High Priority**
  - **04:** Formalize 9<sup>th</sup> Street from E Avenue to F Avenue
  - **05:** Formalize E Avenue from 7<sup>th</sup> Street to 9<sup>th</sup> Street
  - **08:** A Avenue from 11<sup>th</sup> Street to COID Canal and North-South Connection over the COID Canal from A Avenue to Smith Rock Way<sup>2</sup>
  - **16:** Construct H Avenue from 11<sup>th</sup> Street to 13<sup>th</sup> Street (***Recommended for inclusion in the initial construction phase***)
- **Medium Priority**
  - **01:** Formalize F Avenue from 19<sup>th</sup> Street to US 97 Frontage Road
  - **02:** 4<sup>th</sup> Street connection from Forster Drive north approximately 1,000 feet
  - **03:** Formalization of F Avenue Frontage Road to Barberry Drive
  - **09:** A Avenue Extension from COID Canal to future 16<sup>th</sup> Street Extension
  - **11:** 16<sup>th</sup> Street Extension from C Avenue to A Avenue
  - **12:** 13<sup>th</sup> Street Extension from B Avenue to E Avenue
  - **13:** E Avenue Extension from 11<sup>th</sup> Street to 16<sup>th</sup> Street
- **Low Priority**
  - **06:** 5<sup>th</sup> Street Extension from B Avenue south to Odem Avenue
  - **07:** 6<sup>th</sup> Street Extension from A Avenue to US 97

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<sup>2</sup> Should be the highest priority to provide connectivity east of 11<sup>th</sup> Street for business in southeast Terrebonne

- **10:** 16<sup>th</sup> Street Extension from A Avenue south of Terrebonne
- **14:** G Avenue Extension from 15<sup>th</sup> Street to 16<sup>th</sup> Street
- **15:** H Avenue Extension from 15<sup>th</sup> Street to 16<sup>th</sup> Street

*Project Team Recommendation:*

The local street enhancement should be included in the ultimate refinement plan for adoption into the Deschutes County TSP. The specific timing of these improvements will be driven by redevelopment and new development within the Terrebonne Community and the availability of local, state, and federal funds.



**Figure 21. Local Circulation**



## NEXT STEPS

On January 9<sup>th</sup> the Advisory Committee will meet followed by a public open house. The Advisory Committee will recommend a preferred alternative to the PMT. The PMT will then identify a preferred alternative based on input from the project team, Advisory Committee, and public. The PMT will present a preferred alternative to the Deschutes County Planning Commission and the Oregon Transportation Commission through public hearings for consideration and adoption.



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Appendix A – December  
20<sup>th</sup>, 2018 Cost Estimate

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Appendix B – Public  
Proposals

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Appendix C – Public  
Proposal Evaluation  
Matrices

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Appendix D – Conflict  
Comparison Spreadsheet

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Appendix E – January 4<sup>th</sup>,  
2018 Cost Estimate