I-5 Medford Viaduct
Early Anchoring Activity Overview

January 28, 2016
City Council Work Session

I-5 MEDFORD VIADUCT PLANNING & ENVIRONMENTAL STUDY

Agenda

- Work Session Objective
- Project Overview
- Public Involvement Overview
- Early Anchoring Activity Findings
- Key Findings
- Next Steps

Work Session Objectives

- Understanding of the existing and future Viaduct performance and needs
- Presentation of key findings

Project Team Overview

KAI: Kittelson & Associates, Inc.
JLA: JLA Public Involvement, Inc. [DBE]
LSA: Leon Skiles & Associates, Inc.
MBG: Mason, Bruce & Girard, Inc.
NC3D: Newlands & Company, Inc.
OBEC: OBEC Consulting Engineers
URS: URS Corporation
SOTE: Southern Oregon Transportation Engineering [DBE]

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VISUAL SIMULATION
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STRUCTURAL & ROADWAY ANALYSIS / FEASIBILITY
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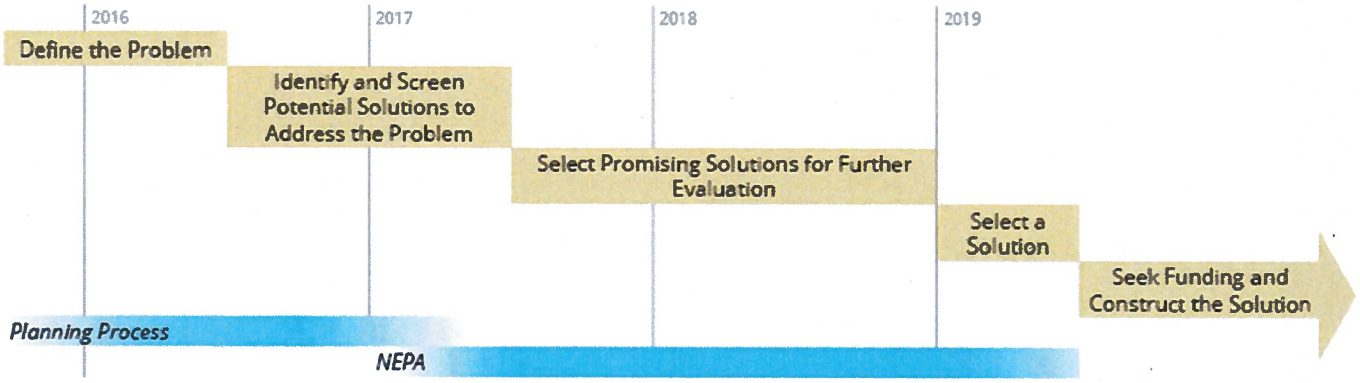
Jaime Jordan, PE (OBEC)
Peter Pagter, PE, SE (OBEC)

Project Description

The **I-5 Medford Viaduct Planning and Environmental Study** will look at the safety, operational, and structural needs of Interstate-5 in the City of Medford between the North and South Medford interchanges, which includes the 3,200-foot viaduct that was built in 1962 and crosses Bear Creek and several local streets."

Preliminary Project Schedule

Preliminary Project Schedule



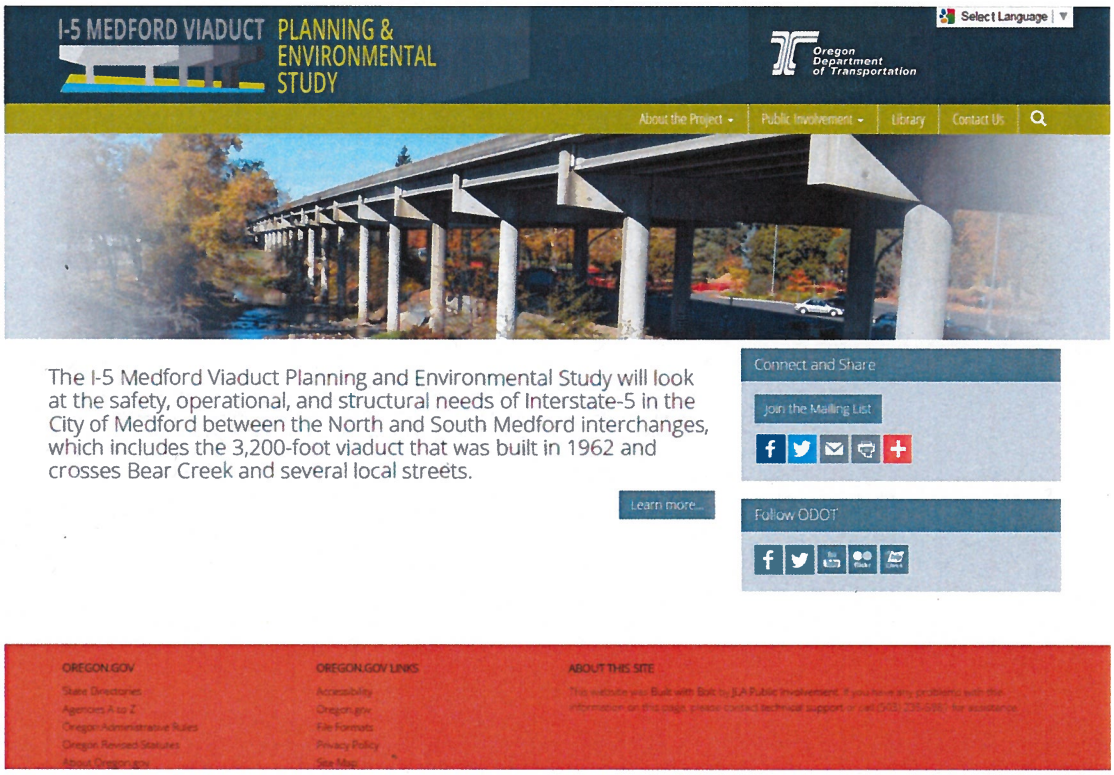
Initial Stakeholder Interviews

- Groups Interviewed:
  - Emergency Services (3)
  - City of Medford (5)
  - Impacted Neighbors (1)
  - Freight Interest (1)
  - Environmental & Natural Resources Interest (1)
  - Chamber Interests (3)
  - Multi-Modal Interests (2)
  - Rogue Valley ACT (2)
  - Environmental Justice and Title VI (2)
  - Jackson County (1)
  - RVCOG / RVMPO (2)

Stakeholder Interviews- Key Themes

- Seismic vulnerability
- Emergency access or a safe harbor
- Aesthetics and safety upgrades
- Relocation of the Viaduct would be economically harmful and controversial
- Tunneling viaduct is a popular idea
- Environmental concerns
- Need more than just Medford stakeholders involved in process
- Better local north/south routes

MedfordViaduct.org



Early Anchoring Activity Memos

Memorandums developed to analyze how the Viaduct performs operationally and seismically now and in the future

- **Tech Memo 1.1 – Travel Time Reliability**
- **Tech Memo 1.2 – Travel Forecasting**
- **Tech Memo 1.3 – Origin-Destination Analysis**
- **Tech Memo 1.4 – Safety Analysis**
- **Tech Memo 1.5 – Bridge Costs and Options**

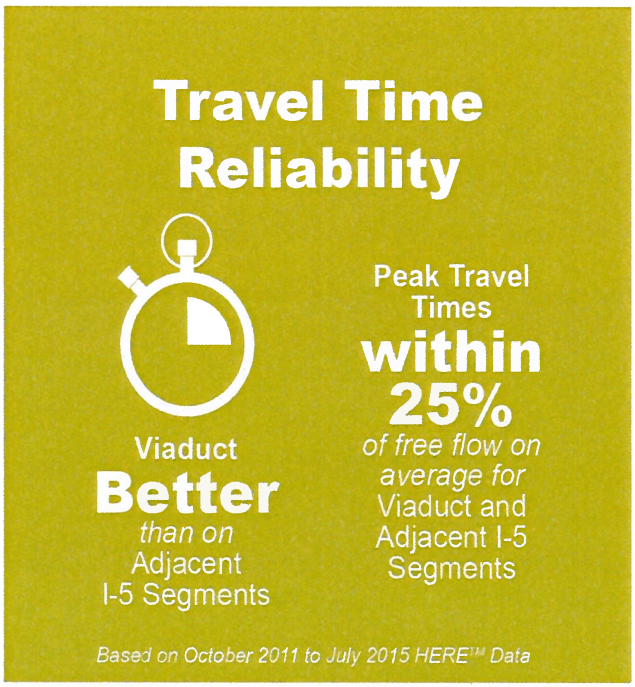
Tech Memo 1.1–Travel Time Reliability

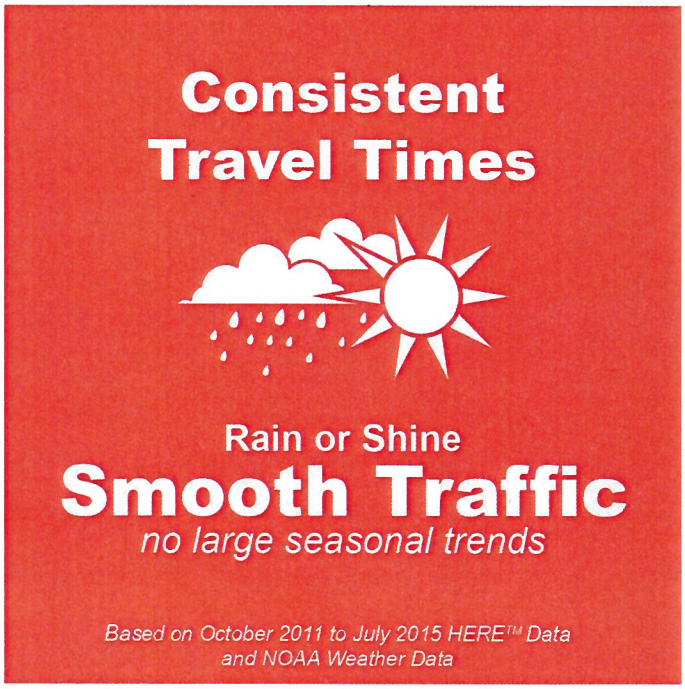
Objective: Determine the level of "reliability" or consistency of travel within the study area

Data:

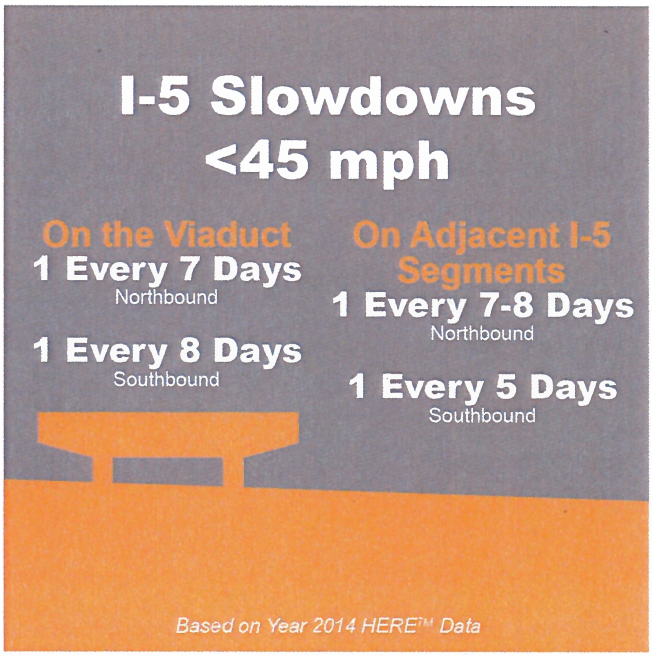
Here™ travel time and speed "probe" from October 2011 to July 2015 was analyzed.

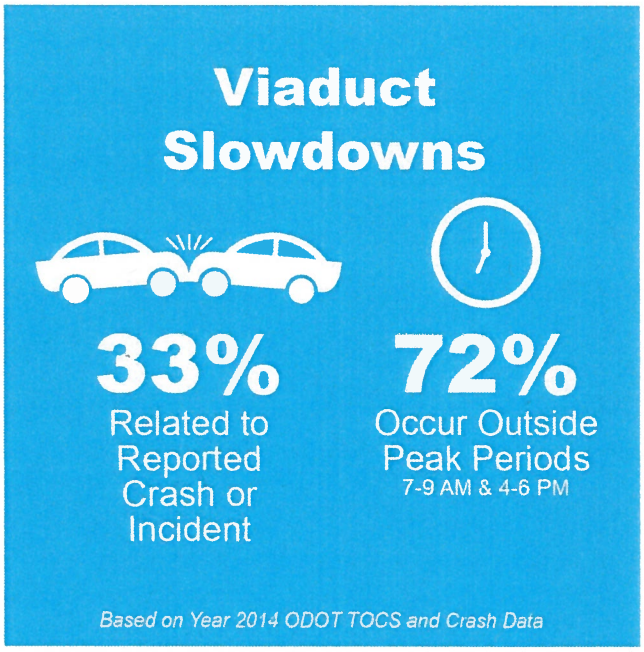
Tech Memo 1.1 – Travel Time Reliability





Tech Memo 1.1 – Travel Time Reliability

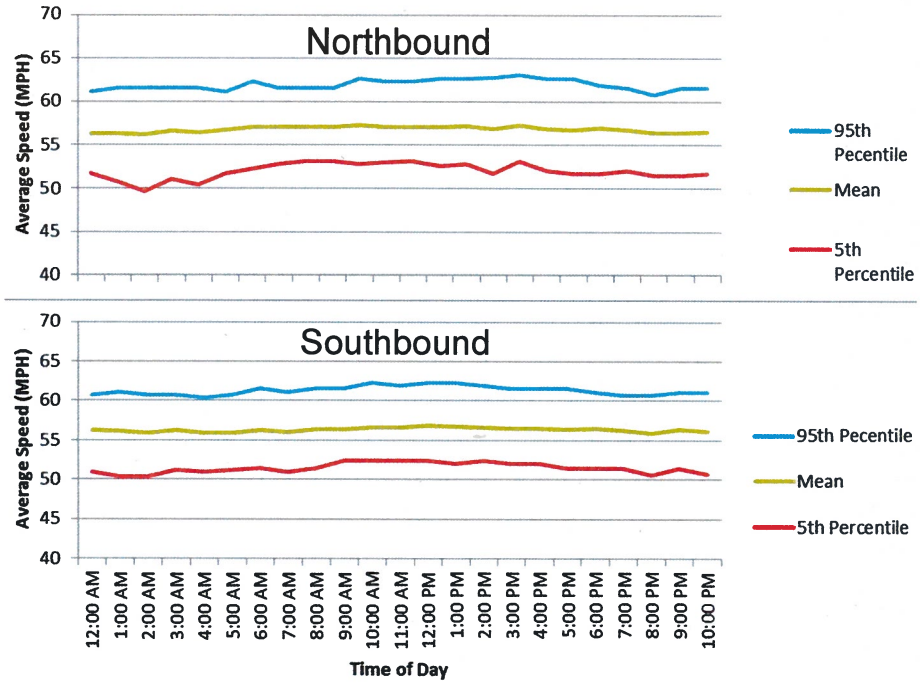




Tech Memo 1.1 – Travel Time Reliability

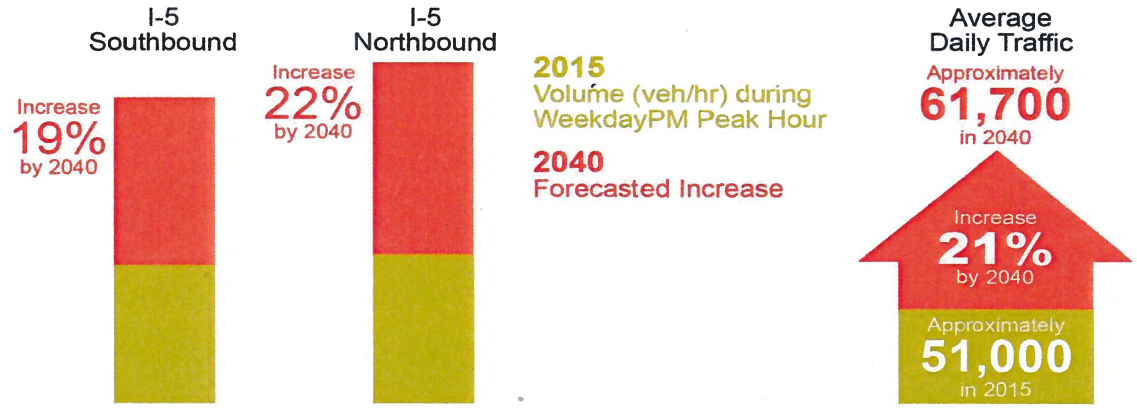
Time of Day variations of average speeds show only **small variations**.

For both northbound and southbound traffic on the viaduct segment, at **no time of day** was the 5th percentile speed **less than 49 MPH.**

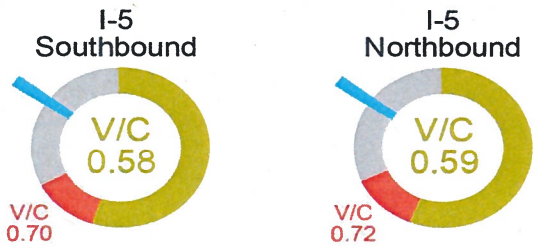


Tech Memo 1.2 – Travel Forecasting

Travel Demand Forecasting Results



Medford Viaduct Operational Results



2015
V/C Ratio during Weekday PM Peak Hour

2040
Forecasted V/C Ratio Increase during Weekday PM Peak Hour

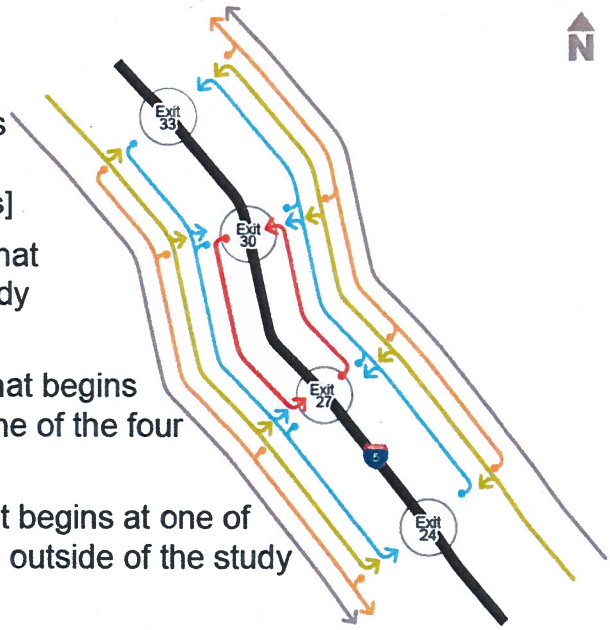
Meets Oregon Highway Plan (OHP)
Mobility Target V/C Ratio of 0.85 or less

Tech Memo 1.3 – O-D Analysis

Objective: Determine the percentage of "local" trips using the Viaduct

FIGURE 1

Trip Types Within Study Area

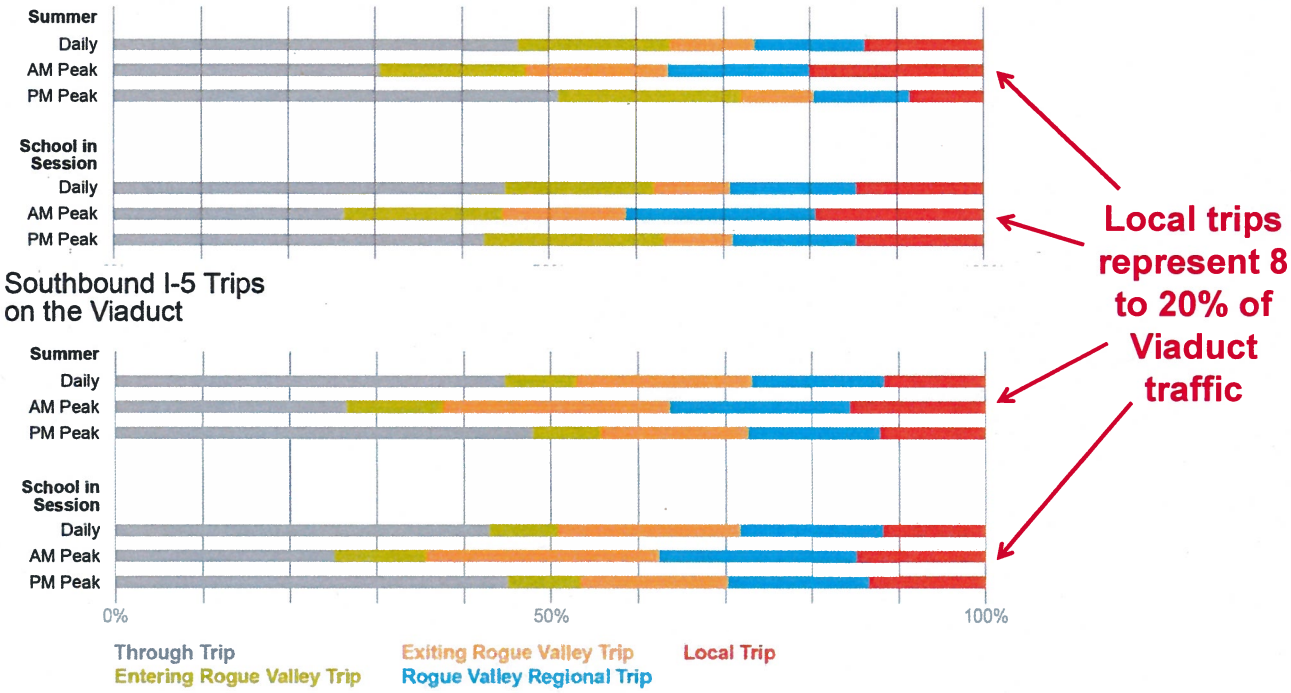


- **Local Trip:** A trip that starts and ends at the North and South Medford interchanges (or vice versa)[3.1 miles]
- **Rogue Valley Regional Trip:** A trip that starts and ends at one of the four study interchanges, but is not a Local Trip.
- **Entering Rogue Valley Trip:** A trip that begins outside the study area and ends at one of the four study interchanges.
- **Exiting Rogue Valley Trip:** A trip that begins at one of the four study interchanges and ends outside of the study area.
- **Through Trip:** An I-5 trip that does not use any of the four study area interchanges.

Tech Memo 1.3 – O-D Analysis

Northbound I-5 Trips on the Viaduct

Local trip: A trip that starts and ends at the North and South Medford interchanges (or vice versa)



Tech Memo 1.4 – Safety Analysis

Objective: What does the crash record tell us about I-5 in the project area?

FIGURE 1

Viaduct crashes were located on the Viaduct.

Interchange Area crashes were located on I-5 in the vicinity of the North Medford and South Medford interchanges and within their merge and diverge influence areas.

Other I-5 Mainline Segment crashes were located on other basic freeway segments in the study area.

84 reported crashes
During the five-year study period (2010 - 2014)

No ODOT 2014 SPIS locations were identified

8 reported crashes were on the Viaduct

53 reported crashes within an Interchange Area

23 reported crashes on Other I-5 Mainline Segments

5-Year Crash Rate for the Viaduct
0.08 Crashes
per million vehicle miles

5-Year Crash Rate for I-5 from MP 26.86 to MP 30.61
0.13 Crashes
per million vehicle miles

COMPARED TO

5-Year Statewide Average for Urban Interstate Facilities
0.55 Crashes
per million vehicle miles

Tech Memo 1.4 – Safety Analysis

Interstate crashes were analyzed based on the reported latitude-longitude location of each crash as provided in the ODOT crash reports.

0 fatalities **55%** injury crashes **45%** property damage only

Viaduct Segment	Other I-5 Mainline Segments	Interchange Areas
3 guard rail crashes *two attributed to high water one to inattention*	11 rear-end crashes	22 rear-end crashes
1 median barrier crash *attributed to excessive speed*	8 object crashes	13 sideswipe crashes
1 bridge rail crash on approach *attributed to speed*	2 sideswipe crashes	13 object crashes
+ 3 rear-end crashes *attributed to an improper lane change, a phantom vehicle, and following too closely*	+ 2 remaining crashes *attributed to head-on and miscellaneous*	+ 5 remaining crashes *attributed to turning, head-on, and miscellaneous*
8 reported crashes	23 reported crashes	53 reported crashes

TABLE 1
Crash Conditions Summary

Location	5-Year Total Crashes	Inclement Weather		Intoxication		Low Lighting	
		Rain	Snow or Ice	Alcohol	Drugs	Dusk or Dawn	Dark
Viaduct	8	3	1	1	0	2	4
Interchange Area	53	9	2	0	0	4	7
Other I-5 Mainline Segments	23	1	2	2	1	0	2

5-Year Crash Rate Comparison

I-5 Milepost 26.86 to 30.61:
0.13 crashes/MVM

Viaduct Segment Only:
0.08 crashes/MVM

Other I-5 mainline Segments:
0.09 crashes/MVM

5-Year Statewide Average for Urban Interstate Segments:
0.55 crashes/MVM

MVM: Million vehicle miles

Tech Memo 1.5 – Estimated Costs

– Improve the existing viaduct structure to meet current seismic standards AND consider potential widening of existing structure.

– Construct a new facility along the existing alignment to meet the current seismic standards AND provide operational and safety improvements for I-5 through Medford.

– Realign I-5 through Medford to eliminate the need for the existing viaduct structure.

RETROFIT

Estimated Costs

- Complies with current ODOT methodologies,
- Expected to withstand a Cascadia Subduction Zone seismic event
- Maintains a 30 year design life.
- Assumed Phase 2 Retrofit elements:
  - Addition of fiber reinforced polymer or steel jackets to columns
  - Crossbeam strengthening
  - Spread footing strengthening or enlargement at all bents
  - Deck replacement and repair and painting of girders.
- Cost estimates based on 2007-2027 Bridge Needs Study and most recent Bridge Inspection Report.
- Estimate from 2007 study escalated to current dollars at 3% per year.
- Widening to accommodate four-lane cross section with shoulders estimated at $500 per square foot.

Estimated Costs

- Literature research, 2014 Oregon Highways Seismic Plus Report, and discussions with ODOT Region 3 and Bridge Section staff
- Maintains a 75-year design life
- Expected to withstand a Cascadia Subduction Zone seismic event
- Costs estimated based on $500 per square foot for replacement structure plus $100 per square foot for removal of existing structure.
- Options include four- or six-lane cross sections.
- Extensive public input would be incorporated into the chosen design.

REROUTE

Estimated Costs

- Assumed a new 13-mile long alignment, likely east of existing I-5, between Blackwell Road interchange (Exit 35) and Fern Valley interchange (Exit 24) with new interchanges at Crater Lake Highway, Table Rock Road, and North Phoenix Road.
- Other potential alignments less feasible due to stream and river crossings, and routing around residential areas, golf courses, the Medford Airport, and farms.
- Cost was estimated based on average cost per mile of other recent ODOT projects.

Preliminary Cost Comparison

Scenario	Conceptual Alternative	Preliminary Order-of-Magnitude Cost Estimate	Design Life
Retrofit	Seismic Retrofit only to Seismic Retrofit and Widening with 4 standard lanes and shoulders	$40,000,000 to $80,000,000	30+ years
Rebuild	New 4-lane bridge on similar alignment	$410,000,000	75+ years
	New 6-lane bridge on similar alignment	$500,000,000	75+ years
Reroute	New 13-mile Realignment	$1,100,000,000	75+ years

Key Findings

- No capacity issues within planning horizon (2040)
- No demonstrated operational safety issues
- Seismic structural deficiencies under a Cascadia Subduction Zone event
- Several substandard design features
- Maintenance & incident management working area deficiencies

Next Steps

- **Develop summary technical memo of early anchoring activities**
- **Develop transportation problem statement brochure and video**

Memorandum 1.6

I-5 MEDFORD VIADUCT PLANNING & ENVIRONMENTAL STUDY

To: Lisa Cornutt and Anna Henson, Oregon Department of Transportation, Region 3

From: Andrew Howe, PE

Date: December 8, 2015

Subject: Task 1.6 Development of Seismic Modeling Approach

The purpose of this memorandum and the other early anchoring activity memorandums in Phase 1A of the project is to inform the Draft Problem Statement and guide further development of the project.

Introduction

The objective of this memorandum is to describe the seismic modeling process that will be utilized to define the Retrofit scenario (i.e., alternative solutions to improve the existing viaduct structure to meet current seismic standards). The modeling will be used to determine what specific improvements would be needed to retrofit the Medford Viaduct to survive a Cascadia Subduction Zone seismic event. This information will then be used to develop cost estimates for the Retrofit scenario and inform the comparison of the scenarios.

This memorandum addresses preparing a three-dimensional seismic model to evaluate the Medford Viaduct for seismic rehabilitation. A clear outline of how the structural modeling will be done is critical because the results from the model will drive the method of retrofit, the cost and ultimately the decision to retrofit or rebuild/reroute the existing facility.

The purpose of the model is to analyze the bridge, determine the seismic deficiencies, and identify retrofit schemes. The American Association of State Highway and Transportation Officials Load and Resistance Factor Design (AASHTO LRFD) Earthquake Resisting System (ERS) and its Earthquake Resisting Elements (EREs) must be identified for the existing bridge and then analyzed to see what vulnerabilities exist. The proposed Retrofit Scenario alternatives can then be added to the model by modifying the EREs to successfully retrofit the existing bridge.

Modeling Approach

Criteria and Methodology

Modeling of the bridge will be done in accordance with the AASHTO Guide Specifications for LRFD Seismic Bridge Design (Guide Spec), the Oregon Bridge Design and Drafting Manual (BDDM), and best standard practices. The finite element modelling will be completed with GT-Strudl or similar structural analysis software. Seismic loadings will be determined using linear response spectra analyses. Since the direction of the ground motions is unknown, seismic loads are applied separately in the longitudinal and transverse directions of the bridge. The resulting loads on the structure are combined to determine the worst-case loads and displacements on the different bridge elements according to the Guide Spec. These analyses are iterative to most accurately capture the stiffnesses of the structure and foundations.

The seismic modeling approach will be based on the assumption that the structure will be retrofitted to resist large seismic motions. The model of the existing structure will be prepared initially to identify seismic deficiencies (base model). This model will then be modified during iterative analysis based on the structural deficiencies observed in the base model. If the existing bridge is to be widened, the future layout of the bridge and the design of these new elements will significantly influence the performance of the bridge and the recommended retrofit solutions. Based on a review of the plans, the following retrofit methods appear likely to be implemented:

- Encase and tie down footings (add top mat reinforcement) so that footing capacity exceeds that of the columns.
- Add ductility to columns with fiber-reinforced polymer (FRP) confinement.
- Thicken and strengthen crossbeams to exceed strength of columns and improve joint detailing.
- Isolate the currently integral Bent 39 superstructure and crossbeam from the columns.
- Widen the bents with additional stronger, stiffer columns and foundations to control deflections.

The 2006 FHWA Seismic Retrofitting Manual for Highway Structures will be used as the basis for proportioning retrofits where the BDDM or Guide Spec does not adequately address the situation.

Frame Layout

This 47-span bridge contains 20 distinct frames. The 20 frames are identified in Appendix A. Each frame is bounded by an abutment or expansion joint at each end. The seismic response of each frame is partially dependent on the adjacent frames; therefore, the structural modeling must consider the effects of frame interaction. However, modeling all 47 spans in a single structural model is not the preferred approach.

Therefore, the 20 individual frames will be modeled in 5 to 10 separate sub-models that successively progress along the bridge. The specific set of frames in each model will be determined in the next phase of work. The following breakdown is just one potential option:

Sub-Model A: Frames 01 to 06
Sub-Model B: Frames 05 to 10
Sub-Model C: Frames 09 to 14
Sub-Model D: Frames 13 to 18
Sub-Model E: Frames 17 to 20

The connection (boundary condition) between frames will potentially be modeled as pinned and free to bound the interaction effects.

Node Layout and Member Connectivity

The superstructure will be modeled as a spline. In order to allow for the future potential of adding the deck and girders to the model as actual elements, the nodes along the spline will be spaced at approximately 8'-6" centers to make the deck plates roughly square. Girders are all simple span, so moments will be released at every bent. The deck is continuous except at joints (see Appendix A) so there will be no axial release between spans except at expansion joints.

The crossbeam node layout will place nodes at 8'-6" centers with additional nodes at the top of columns and structure centerline. This node layout will readily facilitate a more detailed model as noted above.

Columns will have two members per plastic hinge region at the top and bottom of the column and 4 to 6 members between hinges depending upon column height.

Superstructure Boundary Conditions

Cable restrainers with variable slack currently provide the girder to crossbeam connection for axial movement in the longitudinal direction. Spring members approximating the cable stiffnesses will be used to connect the crossbeam to superstructure. The slack in the cable restrainer is approximately equivalent to the expansion joint opening and the cable restrainer spring will be used to model the interaction of the frames after the expansion joints have opened. The transverse direction has shear lugs at every bent with near zero room for movement. The superstructure will be pinned to the crossbeam in the transverse direction. The torsional connection between the superstructure and the crossbeam will be fixed.

	Connection Type by Axis					
	Translation			Rotation		
Bent	X (long.)	Y (trans.)	Z (vert.)	X	Y	Z
Bents 1 and 48	Fixed	Fixed	Fixed	Fixed	Free	Fixed
Bents 2 through 47	Spring*	Fixed	Fixed	Fixed	Free	Spring

* Longitudinal Restrainer Slack Varies by Span and Bent. See Table in Appendix A for Slack Values

Member and Material Properties

The superstructure members will be modeled using gross section properties as significant cracking is not expected to occur.

Crossbeam members will be modeled with the effective sections of the retrofitted crossbeam using assumed dimensions. Initial section properties will be based on a crossbeam sufficient in size to induce plastic hinging in the columns. Gross section properties will be used for an initial

modeling run. The results from this initial analysis will be used to determine where crossbeam cracking is anticipated. Where cracking is anticipated, an effective moment of inertia based on the quantity of reinforcement and axial load on the beam will be used. Section properties, including gross member dimensions and the use of effective section properties, will be refined as the analysis progresses based on analysis results.

The plastic hinge region of the columns will be modeled using the stiffness associated with first yield of the longitudinal reinforcement and assuming that FRP confining reinforcement is added to the column section. Column members outside of the hinges will be modeled in a manner similar to the crossbeam members. The degree of column cracking will vary with direction as the columns will be bent in double curvature in the transverse direction and single curvature in the longitudinal direction. An effective moment of inertia based on the quantity of reinforcement and axial load of the column will be used where analysis indicates column cracking is likely. The bent frame model used in these analyses will be used in pushover analyses with revised moment-curvature behavior in the plastic hinge regions.

Material Properties

Material properties will be assigned based on as-built plan information. Where as-built plans do not specify the necessary information the ODOT Load Rating Manual will be used to assign material properties based on the known year of construction. Consideration will be given to material testing if there appears to be overall project benefits to such an effort.

Foundation Springs and Boundary Conditions

The abutments will be modeled as uncoupled springs. Pile stiffness will be calculated in the L-Pile software using assumed soil properties for the embankment fill. Passive resistance behind the backwall will be included in the abutment spring calculations. Analysis will be performed with both the passive resistance included and excluded from the abutment spring stiffness to adequately bound the superstructure movement both towards and away from the backfill. The addition of transverse passive resistance by retrofitting wingwalls to the abutment will be considered based on structural behavior during analysis. Stiffnesses of the springs will be per the guidance in the BDDM.

Footings will be modeled as uncoupled springs per the guidance in the BDDM. Limited foundation information, including allowable bearing capacity, is available on the plans. This information will be used to develop foundation springs for analysis. Consideration will be given to implementing a limited geotechnical investigation plan to quantify subsurface conditions and most specifically seismic hazards (liquefaction and lateral spread). Sizes of the footings for foundation spring calculations will assume the footing will be strengthened and enlarged during the seismic retrofit. Spring stiffnesses will be iterative, with initial analyses assuming the existing footing sizes in plan remain unchanged and the footing thicknesses will be increased as required to provide for footing strengths sufficient to induce plastic hinging in the columns. The bents with existing sheet pile scour repairs will have their stiffnesses calculated assuming one-

third of the depth of the sheet pile is effective at engaging passive soil resistance against lateral movement.

Loadings

Dead loads will be applied using appropriate distributed and point loads for bridge rails, deck overlay, existing seismic retrofit measures and utilities. Self-weight will be applied internally by the analysis software based on the assigned member and material properties.

Seismic inertial loading will be generated internally by the analysis software. The response spectrum will be estimated based on available subsurface information and guidance in the BDDM.

Summary

Sample calculations for several steps in the modeling phase are provided in Appendix B. These would serve as the basis for the detailed modeling of the bridge. Based on initial analysis results, retrofit methods will be modified and iterated through the model until a complete solution is developed that meets ODOT and AASHTO design criteria.

Memorandum 1.5

I-5 MEDFORD VIADUCT PLANNING & ENVIRONMENTAL STUDY

To: Lisa Cornutt and Anna Henson, Oregon Department of Transportation, Region 3

CC: Marc Butorac, PE, PTOE and Susie Wright, PE, Kittelson & Associates

From: Jeff Bernardo, PE, OBEC

Date: January 15, 2016

Subject: **Estimated Costs for Retrofit, Rebuild and Reroute Scenarios**

The purpose of this memorandum and the other early anchoring activity memorandums in Phase 1A of the project is to inform the Draft Problem Statement and guide further development of the project.

This memorandum is focused on providing programming-level estimated costs for the potential Retrofit, Rebuild, and Reroute scenarios for the Medford Viaduct. Because project alternatives have not yet been defined, each of these scenarios has many variables and unknowns. These conceptual cost estimates have been prepared based on the best information available at this time. These are very preliminary estimates and are intended only for providing context and understanding the order-of-magnitude of differences among the scenarios. The consultant team will develop more precise cost estimates later on, once the transportation problem statement is developed and project alternatives are defined to address the identified problems.

ODOT has previously estimated the cost of retrofitting or rebuilding the Medford Viaduct structure (Bridge Number 08332). The consultant team performed a literature search and talked to Region 3 and Bridge Section staff in the process of preparing this memorandum. For the reroute option, the consultant team made assumptions about a likely realignment length and estimated a cost based on average costs per mile of other recently completed ODOT projects. This memo summarizes the findings of that research.

Summary of Findings

Table 1 summarizes the estimated costs for each conceptual alternative within the three preliminary scenarios.

TABLE 1

Estimated Conceptual Costs by Potential Scenario

Scenario	Conceptual Alternative	Preliminary Order-of-Magnitude Cost Estimate
Retrofit	Rehabilitation and Seismic Retrofit	$40,000,000 to $80,000,000
Rebuild	New 4-lane bridge on similar alignment	$410,000,000
	New 6-lane bridge on similar alignment	$500,000,000
Reroute	New 13-mile Realignment	$1,100,000,000

Retrofit Scenario

Making repairs and performing seismic retrofits to the existing Medford Viaduct structure will be a significant infrastructure investment. At the conclusion of such a project, the structure should be considered to be low maintenance for an extended period of time. The design life for repairs is assumed to be 30 years. The bridge should also be expected to survive the Cascadia Subduction Zone seismic event, meaning seismic retrofit schemes must comply with current ODOT methodologies. The need for additional width will need to be addressed based on separate traffic analyses. Conceptual cost estimates are provided for repairs with and without widening the structure.

A review of the current bridge inspection report indicates that a bridge deck replacement is likely warranted and that repair and painting of the steel girders is warranted. The bridge deck was overlaid in 2003 and is already showing signs of distress. The majority of the surface is cracked with some delamination of the overlay. Portions of the deck show cracking and rust staining, indicating full depth cracking. There is a current STIP project for overlaying the existing deck: Key # 19540 I-5: Medford Viaduct Deck Overlay. Design is scheduled for 2016 and construction is schedule for 2018.

The majority of the steel girders have cracks in the connection between the diaphragm and girder. Nearly all of the paint system is showing signs of distress and should be replaced. Other repairs are also warranted, though these will be incidental to either the deck and girder work or the seismic retrofit work.

A review of the plans indicates that a Phase 2 seismic retrofit of this structure is likely straightforward, though extensive. A Phase 2 seismic retrofit is intended to strengthen the

existing structure in order to bring it up to the current design codes for seismic design. The columns will require the addition of a fiber reinforced polymer (FRP) or steel jacket to improve confinement of the concrete. The crossbeams will require strengthening with additional concrete and steel. The existing concrete spread footings will need to be strengthened and possibly enlarged. These items will need to be addressed at all bents in the bridge. Additionally, Bent 39, which is located near 10th Street, will require seismic isolation of the superstructure and crossbeam or replacement of the crossbeam. A Phase 1 seismic retrofit, provides simple repairs to prevent excessive movements but does not strengthen the bridge. This was previously performed on the Medford Viaduct in 2003 but will need to be modified to accommodate the Phase 2 retrofit.

The consultant team's research found one reference to a repair and seismic retrofit cost estimate prepared in the 2007-2027 Bridge Needs Study. The cost of repair and retrofit was estimated in 2007 dollars to be $28,143,000. This work included painting, scour repairs, deck rehabilitation, seismic retrofit, and a rail retrofit. The current Bridge Inspection Report (dated June 5, 2014) for this structure was retrieved from ODOT's database to evaluate current repair needs for this structure. This 2007 estimate has been escalated at 3% per year to represent 2016 dollars to approximately $40,000,000.

The estimated cost for seismic retrofit and widening is based on the retrofit cost plus the additional deck area added by widening the bridge. Assuming a standard 4-lane freeway cross-section and using $500 per square foot to represent total project cost, the widening cost is estimated at approximately $40,000,000. This brings the total project cost to approximately $80,000,000. The feasibility of traffic control during deck replacement with or without widening the structure has not been investigated in detail at this time; however, the project team is confident that Retrofit based alternatives can be developed which are both constructable and address traffic control criteria . At the alternatives development stage of the project, ODOT mobility requirements and staging duration (delay costs) will be evaluation criteria for each alternative developed within this scenario set as part of the overall constructability analysis.

These projects costs represent a high degree of variability due to several significant complexities that cannot be quantified at this time. More detailed seismic modeling would be necessary to determined specific deficiencies. Once the deficiencies are identified, determining constructible solutions will be challenging due to many on-site constraints such as Bear Creek, Historic Downtown, Hawthorne Park and traffic control.

Rebuild Scenarios

Full replacement of the Medford Viaduct structure is another scenario to be considered. A new structure would have a 75-year design life and should be considered low maintenance for at least the first 30 years following construction. Built to current codes, the replacement bridge would be expected to survive the Cascadia Subduction Zone seismic event and serve as a

Phase 2 lifeline route for recovery efforts in Southern Oregon. US 97 is ODOT's designated Phase 1 lifeline route through Southern Oregon.

The recommended roadway width for a 4-lane structure is 90 feet. In the event that a traffic study indicates a 6-lane structure is warranted, the recommended roadway width is 114 feet. The length of a replacement bridge is anticipated to be 3,300 feet. The structure would be designed to be a more aesthetically pleasing structure than the existing structure and fit in better with its surroundings. Extensive public involvement is expected during project development in order to choose a design that has the approval of the community. Additionally, traffic needs will dictate staged construction of the new structure.

The 2014 Oregon Highways Seismic Plus Report includes an estimated cost to replace the existing bridge. The cost was based on the square-feet of deck area of the proposed structure, which is assumed to be 4-lanes (approximately 90-feet wide). The cost included in this report is $373,810,000 in 2013 dollars. Inflating to 2016, the project estimate is approximately $410,000,000. The additional width for a six-lane option would be approximately 20% more, or roughly $500,000,000.

The estimated cost of constructing a new structure is $500 per square-foot for construction and $100 per square foot for existing bridge removal. The bridge only cost (in 2016 dollars) for replacement of the Medford Viaduct with a 4-lane structure is estimated to be $177,000,000. The estimated bridge only cost of replacement with a 6-lane structure is estimated to be $220,000,000. Comparing this new bridge only cost with the Seismic Plus Report's total project cost, it appears the programmed amount is reasonable at this planning stage of the project.

Similar to the Retrofit Scenario, Rebuild based alternatives can be developed which are both constructable and address traffic control criteria . At the alternatives development stage of the project, ODOT mobility requirements and staging duration (delay costs) will be evaluation criteria for each alternative developed within this scenario set as part of the overall constructability analysis.

Reroute Scenario

Without an identified alignment for the reroute option, the estimated per mile cost is based on several conservative assumptions. The route has been assumed to depart from I-5 at the Blackwell Rd. Interchange at exit 35 and re-connect at the Fern Valley Interchange, exit 24. The alignment would likely be located on the east side of I-5 and could require reconstruction of both existing interchanges at each end and construction of at least three new interchanges at major intersecting roads including Crater Lake Highway, Table Rock Rd. and N. Phoenix Rd. The overall length of the reroute scenario has been assumed to be 13 miles.

Other considerations include crossing the Rogue River, Bear Creek and other streams, navigating through or around several residential areas, golf courses, the Medford Airport and many agricultural farms. The location and extent of retaining walls and other structures are unknown, but are anticipated to be needed. The average cost assumed in this estimate may vary widely depending on the preferred alignment and associated environmental, property and structure costs.

ODOT has not previously prepared a cost estimate for the reroute scenario. Therefore, the estimated cost presented here for the reroute option is based on an average of project costs from several recent highway and freeway projects in Oregon. Projects used for the basis of calculating the average per mile cost include the Sunrise Corridor JTA, Fern Valley Interchange, Willamette River Bridge, OR62 Bypass, and Pioneer Mt. to Eddyville (shown in Table 2). The average costs include all construction, right of way, environmental and engineering fees. The average cost based on these projects is $70 million per mile (see table below for sample projects and costs).

TABLE 2

Estimated Costs by Scenario

Project Name	Project Description	Cost/Mile
Sunrise	New freeway with 3 bridges, 2 ped bridges, and 18 walls.	$60 Million
Willamette River Bridge I-5	Large freeway bridge w/one mile of new roadway	$120 Million
OR62 Bypass	4.5 miles of new highway with 2 bridges and several structures	$30 Million
Fern Valley Interchange	New interchange with 1 mile of new roadway	$70 Million
Pioneer Mt. to Eddyville	5.5 miles of new highway with several structures	$70 Million
Average Cost		$70 Million

Based on $70 million per mile and adding 20% for contingencies, the overall project cost for the 13 mile reroute scenario is estimated at $1.1 Billion. This does not include modifications to local street networks and connections.

Similar to the Retrofit Scenario, Reroute based alternatives can be developed which are both constructable and address traffic control criteria . At the alternatives development stage of the project, ODOT mobility requirements and staging duration (delay costs) will be evaluation criteria for each alternative developed within this scenario set as part of the overall constructability analysis.

Summary

As stated upfront, the purpose of this memorandum is purely to provide context and understanding the order-of-magnitude of differences among the scenarios. Many other factors beyond cost will need to be evaluated once the transportation problem statement is developed. In general, the retrofit alternatives are the most cost-effective scenario for providing a seismically resilient route for Interstate 5 through the Medford area. However, it is estimated that the design life for this option will be limited to 30 years and future repairs will likely be necessary.

The rebuild scenario is substantially more expensive than the retrofit scenario. However, this option will provide a minimum 75-year design life and will limit the need for future maintenance. Full replacement would also support staged construction that would minimize impacts to public traffic during construction.

The reroute scenario is the most expensive and complicated option of the three. This option will provide a long design life and low maintenance similar to the rebuild option, but the impacts of this option will likely be extensive on the Rogue Valley. It would also require substantial modifications to the local street networks within the Medford and Central Point area.

Memorandum 1.7

I-5 MEDFORD VIADUCT PLANNING & ENVIRONMENTAL STUDY

To: Lisa Cornutt and Anna Henson, ODOT Region 3

CC: Marc Butorac, PE, PTOE, and Susie Wright, Kittelson & Associates

From: Seth Gallant, OBEC

Date: January 15, 2016

Subject: **Task 1.7 Project-Specific GIS Data Inventory & Gap Identification Memo**

The purpose of this memorandum and the other early anchoring activity memorandums in Phase 1A of the project is to inform the Draft Problem Statement and guide further development of the project.

Introduction

This memorandum summarizes the anticipated GIS data needs for the I-5 Medford Viaduct project and the expected data sources, identifies the data that the project team has, data that has not yet been obtained, but is readily available, and identifies data that may not be readily available. The primary sources of mapping data will be Jackson County, the City of Medford, and the ODOT GIS Unit. Other sources will include the Rogue Valley Metropolitan Planning Organization, U.S. Bureau of the Census, Pacific Power, and natural resource databases.

Needs, Data Sources, and Data Gaps by Use and Subject

The following table summarizes all of the GIS data that the consultant team anticipates would be needed to complete the I-5 Medford Viaduct project facility plan and NEPA phase.

Table 1: GIS Data Inventory

Item	Source	Status	Comments
Base Mapping			
Streets	Jackson County GIS Website	Acquired Oct. 2015.	
City limits	Jackson County GIS Website	Acquired Oct. 2015.	
Urban growth boundaries	Jackson County GIS Website	Acquired Oct. 2015.	
Rivers/streams	Jackson County GIS Website	Acquired Oct. 2015.	
Topography	Jackson County GIS Website	Acquired Oct. 2015.	

Transportation			
Existing Medford Viaduct footprint	ODOT	Gap	OBEC has some info from previous bridge inspection work. Does not contain coordinate info that matches GIS data. ODOT may have better data.
Roadway functional classification (see Figure 1)	Jackson County GIS Website	Acquired Oct. 2015.	
Identified roadway deficiencies in Jackson County		Gap	Consultant team would need to produce.
Existing sidewalks and bicycle lanes	Jackson County GIS Website	Acquired Oct. 2015.	
Transit lines	Jackson County GIS Website	Acquired Oct. 2015.	
Area projects in the financially constrained RTP		Gap	Consultant team would need to produce.
Other planned and funded transportation improvements		Gap	Consultant team would need to produce.
Medford Airport Runway Protection Zone	City of Medford	Acquired Oct. 2015.	
Land Use and Planning			
Existing land use	Jackson County GIS Website	Acquired Oct. 2015.	Have existing land use for the County from the Jackson County TSP data set. Existing land use in the City of Medford needs to be developed from property codes in tax lot data.
City Zoning (see Figure 2)	Jackson County GIS Website	Acquired Oct. 2015.	
County Zoning	Jackson County GIS Website	Acquired Oct. 2015.	
City Comprehensive Plan Designations	Jackson County GIS Website	Acquired Oct. 2015.	
County Comprehensive Plan Designations	Jackson County GIS Website	Acquired Oct. 2015.	
Urban reserve areas	Jackson County GIS Website	Acquired Oct. 2015.	
Goal 5 resources		Gap	Would need to come from City and County Comp Plans. May not exist as shapefiles. There is a shapefile showing Areas of Special Concern, but it is incomplete and out-of-date per the Jackson County GIS website metadata.
Right-of-Way			
Taxlots/property boundaries (see Figure 2)	Jackson County GIS Website	Acquired Oct. 2015.	
Property ownership	Jackson County GIS Website	Acquired Oct. 2015.	
Building footprints	Jackson County GIS Website	Acquired Oct. 2015.	

Driveway/access information	Jackson County GIS Website	Acquired Oct. 2015.	Shapefile shows locations of driveways. Limited information about them.
Utilities			
Underground utility locations	Jackson County TSP data set, City of Medford, and other individual utility providers	Gap	Have Stormwater and Sewer within City of Medford, Rogue Valley Sewer service lines, gas pipelines (Avista Corp. and Gas Transmission NW) from Jackson County TSP data set. Do not have water service lines. There may be other underground utilities present, such as electrical or communication lines.
Aerial utility locations	from individual utility providers	Gap	Have Pacificorp high voltage transmission lines from Jackson County TSP data set. Would need to obtain other local electrical and communication utility info.
Environmental Justice/Socioeconomics			
Demographic data from U.S. Census Bureau American Community Survey	2010 Census and 2013 ACS	Acquired	By the time demographic data is needed, there will likely be more current ACS data available.
Enumeration district boundaries	2010 Census and 2013 ACS	Acquired	
Community facilities (schools, libraries, hospitals, police stations, fire stations, churches, parks)	Jackson County GIS Website	Acquired Oct. 2015.	
Parks/Recreation/Wildlife Areas			
Existing parks, wildlife areas, and multi-use paths (see Figure 3)	Jackson County GIS Website	Acquired Oct. 2015.	
Proposed/planned parks and wildlife areas		Gap	Consultant team would need to produce.
Planned Trails/Multi-Use Paths	Medford GIS	Acquired Oct. 2015.	
Cultural Resources			
Identified historic and cultural resources, including archaeological resources		Gap	Consultant team would need to produce based on cultural resources inventory/evaluation. Confidential archaeological resource locations would not be mapped.
Potential historic resources		Gap	Consultant team would need to produce based on cultural resources inventory/evaluation.
Historic districts (see Figure 3)	Jackson County GIS Website	Acquired Oct. 2015.	
Water Resources			
Streams (base)	Jackson County GIS Website	Acquired Oct. 2015.	
Streams (detailed)	USGS and BLM hydrography datasets	Gap	Base streams layer from Jackson Co. GIS is adequate as a base layer. For more detailed information on streams, USGS and BLM datasets should be acquired.

Floodplains/floodways (see Figure 4)	Jackson County GIS Website	Acquired Oct. 2015.	
ODOT stream crossing culverts, if available	ODOT	Gap	Have some culvert information from Jackson Co. TSP data set. Does not appear to include locations inside Medford city limits or ODOT facilities.
ODFW fish passage barrier locations	ODFW	Gap	Available from ODFW website: https://nrimp.dfw.state.or.us/nrimp/default.aspx?p=259
Local Wetland Inventory	City of Medford	Acquired Oct. 2015.	
National Wetland Inventory	USFWS	Acquired Oct. 2015.	
Water Quality	ODFW	Gap	Available from ODFW website: https://nrimp.dfw.state.or.us/nrimp/default.aspx?p=259
DEQ 301d listed stream layers	DEQ	Acquired Oct. 2015.	
Natural Systems/Habitats/Threatened and Endangered Species			
Vernal Pool Critical Habitat	Jackson County GIS Website.	Acquired Oct. 2015.	
Conservation opportunity areas	ODFW	Gap	Available from ODFW website: https://nrimp.dfw.state.or.us/nrimp/default.aspx?p=259
Wildlife Habitat areas	ODFW	Gap	Available from ODFW website: https://nrimp.dfw.state.or.us/nrimp/default.aspx?p=259
Wildlife linkages	ODFW	Gap	Available from ODFW website: https://nrimp.dfw.state.or.us/nrimp/default.aspx?p=259
Vegetation Type	Jackson County GIS Website	Acquired Oct. 2015.	
ESA-designated critical habitat	USFWS	Gap	Available from USFWS website: http://www.fws.gov/gis/data/national/index.html
DSL-designated Essential Salmonid Habitat data	USFWS or DSL	Gap	Should be readily available from USFWS or DSL.
ODFW fish distribution data	ODFW	Gap	Available from ODFW website: https://nrimp.dfw.state.or.us/nrimp/default.aspx?p=259
Threatened and Endangered Species in Jackson County	NMFS	Gap	Available from NMFS website: http://www.westcoast.fisheries.noaa.gov/maps_data/maps_and_gis_data.html
	USFWS	Gap	Available from USFWS website: https://ecos.fws.gov/ipac/
Geology			
Soil Types	Jackson County GIS Website	Acquired Oct. 2015.	
Geological features		Gap	Not clear if this is readily available. Consultant team may need to produce based on Geological evaluation.
Geological hazards		Gap	Not clear if this is readily available. Consultant team may need to produce based on Geological evaluation.
HazMat			
DEQ LUST and UST data (see Figure 4)	Jackson County TSP data set	Acquired Oct. 2015.	GIS data should be cross-checked against latest DEQ database to ensure it is up-to-date. Database information is available at DEQ website: http://www.deq.state.or.us/lq/tanks/lust/LustPublicLookup.asp
State Hazardous Waste System ECSI data (see Figure 4)	Jackson County TSP data set	Acquired Oct. 2015	GIS data should be cross-checked against latest DEQ database to ensure it is up-to-date. Database information is available at DEQ website: http://www.deq.state.or.us/lq/ECSI/ecsidownload.htm

Discussion of GIS Data Gaps

The following provides additional discussion of the GIS data that has not been obtained.

Transportation

The footprint of the existing viaduct would be needed for purposes of understanding changes that would result from different proposed project alternatives. The consultant team (OBEC) has some CAD work from previous inspection work on the viaduct structure. It is not in a coordinate system that relates with the GIS data set. Therefore, extensive work would be needed in order to convert it to the appropriate coordinate system. ODOT may have better CAD data for the existing viaduct footprint.

Identified roadway deficiencies, RTP projects, and other planned projects in the project are all readily available information, but GIS shapefiles would need to be created in order to map them.

Land Use and Planning

Goal 5 resources probably do not exist as a single discrete GIS dataset. This information would need to come from the City and County Comprehensive Plans. A fair amount of research may be required in order to determine all of the resources that are included and develop a GIS shapefile showing them. An existing shapefile called Areas of Special Concern appears to show some Goal 5 Resources. However, the metadata description for this shapefile states that it is incomplete and out-of-date.

Utilities

Underground sewer and stormwater lines have been obtained for the City of Medford and for the Rogue Valley Sewer service areas. The Jackson County TSP data includes underground gas pipelines. The consultant team does not have data for underground water service lines. This may need to come from the City's water service provider. There may be other underground utilities present, such as electrical or communication conduits. More research would be needed to determine if other underground utilities are present.

Overhead utility information is limited. The Jackson County TSP data set includes Pacificorp high voltage transmission lines. The consultant team does not have GIS data on other electrical and communication service lines. These may be available from the individual utility providers.

Parks/Recreation/Wildlife Areas

The consultant team has obtained a shapefile for planned trails. Planned parks do not appear to exist as GIS data, but can be created relatively quickly.

Cultural Resources

Project-specific historic and cultural resources would need to be inventoried. Historic resources in the project area would be mapped based on the inventory results. Archaeological resource locations are confidential and would not be included in these maps.

Water Resources and Natural Systems/Habitats/Threatened and Endangered Species

There are several items under Water Resources and Natural Systems/Habitats/Threatened and Endangered Species that are readily available from their respective resources agencies and can be downloaded from their websites. The analysts responsible for evaluation of these disciplines should retrieve their own data, since they will be most familiar with what is needed.

Geology

The consultant team has shapefiles showing soil type, but does not have shapefiles showing geological features and hazards. This would most likely need to be produced as part of a geological analysis.

HazMat

The consultant team has GIS shapefiles for DEQ LUST and UST data and State Hazardous Waste System ECSI from the Jackson County TSP data set. Additional research should be done to cross check this data against the current online databases to confirm that it is up-to-date.