Memorandum 1.10

To: Lisa Cornutt and Anna Henson, ODOT Region 3

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

From: Andrew Fortner, OBEC and Zachary Horowitz, Kittelson & Associates

Date: January 5, 2017

Subject: Task 1.10 Existing Structure Maintenance Deficiencies and No-Build Maintenance Costs of Existing Structure

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.

Executive Summary

This memorandum summarizes the Viaduct's existing structure maintenance deficiencies and documents the conceptual level "No-Build" maintenance costs of the existing structure over the 2040 and 2050 horizon years. This more in-depth understanding of deficiencies and no-build costs were based on interviews with incident responders and ODOT maintenance staff.

The Viaduct incident response meeting highlighted a number of key concerns that ODOT and Oregon State Police (OSP) staff have regarding ongoing maintenance, safety, and traffic operations on and near the Viaduct. The key takeaway is that the current design of the Viaduct makes it more challenging for ODOT and OSP staff to address incidents on and near the Viaduct. Details from the last four years of the OSP incident log, particularly safety and operations concerns identified by ODOT and OSP staff, and strategies that could improve conditions on the Viaduct in the near-term are described in this memorandum.

The Viaduct maintenance meeting identified the annual and non-recurring maintenance and logistical concerns that ODOT staff have regarding upkeep of the Viaduct. Logistically, the narrowness of the inside and outside roadway shoulders is the key issue for the safety and ease of people working on the structure. In regards to annual maintenance, the existing drainage system poses the largest issue and is time and resource intensive to maintain. Non-annual maintenance work such as deck refinishing and bridge joint replacement will need to occur within the planning horizon timeline, at substantial cost. Details about maintenance issues, costs, and repair schedules are provided later in this memorandum, and **Appendix A** and **Appendix B** contain further detail.

Interview Summary

OBEC and Kittelson & Associates conducted two interview meetings on October 24, 2016. The first meeting focused on incident response and operational safety. Representatives from the Oregon State Police and ODOT Region 3 and District 8, Incident Response, and Traffic attended the meeting.

The second meeting focused on cost, access, and safety aspects of ongoing Viaduct maintenance. Representatives from ODOT Region 3 and District 8 and ODOT Region 3 Bridge Maintenance attended the meeting.

This memorandum summarizes the outcomes and primary concerns voiced during the meetings.

Incident Response Meeting

The incident response and operational safety meeting identified a number of concerns related to ongoing maintenance, safety, and traffic operation on the Viaduct. Impacts to traffic operations on and near the Viaduct include:

- Southbound off-ramp queues at the south Medford Interchange spill back into the right through lane on I-5 regularly during the weekday morning peak hour.
  - This creates a safety hazard for southbound vehicles
  - Can impact southbound traffic flow on the Viaduct
- Crashes
  - May require closing upstream on-ramps to prevent additional traffic from entering I-5
  - Crashes located on the Viaduct can be difficult and unsafe for incident responders and OSP to remove
  - Emergency responders may park on opposite side to more easily access the crash site, but this leads to lane closures in both directions of travel
  - High water events due to blocked drainage inlets can create conditions that can cause crashes
- Stalls and traffic slowdowns
  - Stalls are more common events than crashes
  - Stalls can cause traffic backups and it can be difficult for tow trucks, ODOT, and emergency responders to access the area and remove vehicles from the Viaduct to restore traffic flow. An example showing how ODOT incident responders “push” a vehicle off the Viaduct can be seen in **Figure 1** on the following page.
  - Unauthorized persons walking along or crossing the Viaduct can create slow traffic conditions.

Figure 1: ODOT Incident Responders "Pushing" a Stalled Vehicle Off the Viaduct

Summary of Annual Incidents

The OSP and ODOT provided incident report summaries for the Viaduct during a four-year period from January 2013 to October 2016. The data identifies approximately 625 reported incidents that occurred between Exit 27 (the South Medford interchange) and Exit 30 (the North Medford Interchange), which includes approximately 431 reported incidents that occurred near or on the Viaduct. The incident report data is not available for just the section of I-5 that contains the Viaduct; it is only available for the segment between Exit 27 and Exit 30. **Table 1** on the following page summarizes the reported incidents by year and type.

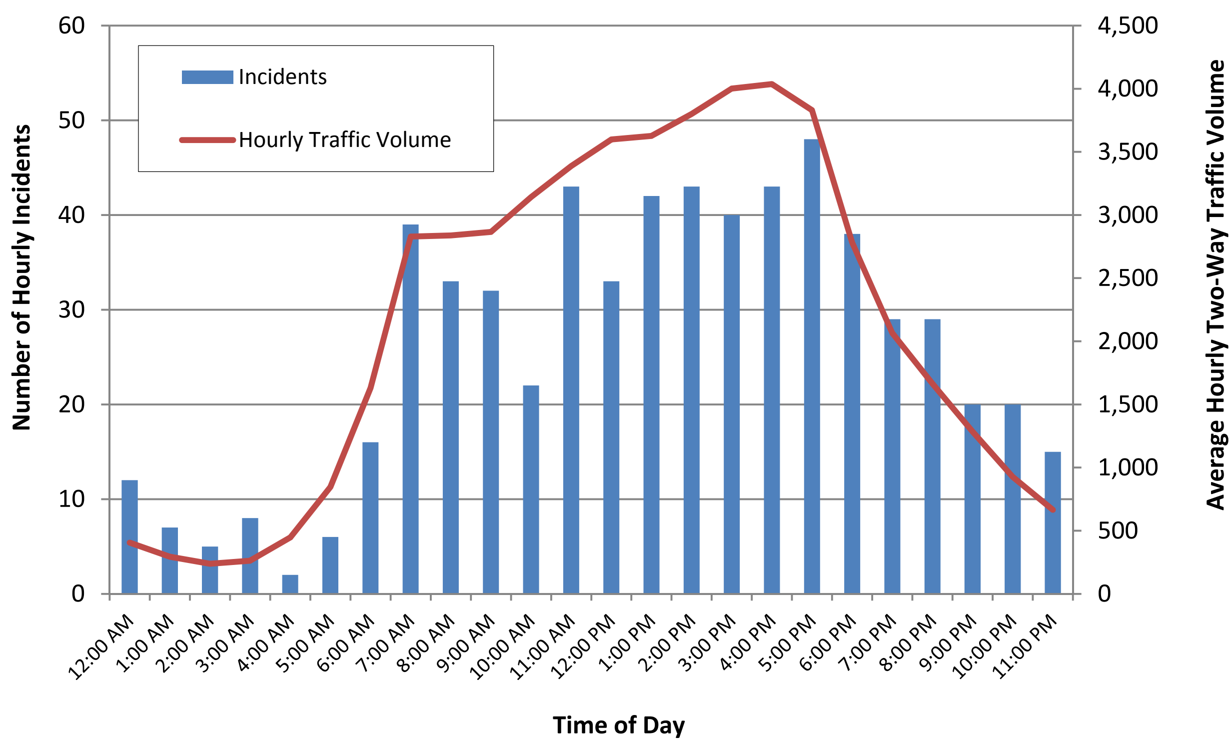
On-road hazards (persons, vehicles or items) represent a plurality (approximately 47 percent to 65 percent) of all reported incidents, depending on the year. While there are some incidents "types" (e.g. suspicious activity) that are not necessarily related to changes in traffic volumes, the number of reported incidents by hour is roughly proportional to the average traffic volume on the Viaduct as shown in **Figure 2** on the following page. This relationship is important because it links the impact that incidents may have on traffic operations and safety on and near the Viaduct. The majority (55 percent) of reported incidents occurred on southbound I-5.

Table 1: Summary of Incidents between Exit 27 and Exit 30

Incident Type	2013	2014	2015	2016*
Hazard on road (person, vehicle or item)	99	108	87	70
Disabled motorist	22	11	11	10
Citizen-initiated driving complaint	12	12	9	13
Crash	10	5	6	7
Request to check on the welfare of a person	4	5	8	11
Suspicious activity	3	2	5	4
Other	18	22	18	33
Total	**168**	**165**	**144**	**148**

* Partial year (January – October 2016)

Figure 2: Reported Incidents and Average Hourly Two-Way Traffic Volume



Bridge Maintenance Meeting

Logistical Issues

In general, the narrow roadway cross section makes any maintenance performed on the bridge difficult and dangerous for crews. Nearly all the work performed on the bridge deck must occur at night to minimize traffic delays because the activities require a lane closure. Workers are located near traffic and have no escape route from their work area should the need arise due to an errant vehicle or other hazard. Obtaining access to the underside of the bridge is difficult given the current and planned development near and under the bridge.

During the meeting, ODOT maintenance and district staff universally agreed that the construction of pullouts would not substantially increase safety or improve maintenance functions or have the benefits of a continuous 12' outside shoulder in each direction of travel. Staff was concerned that pullouts would encourage motorists to use them in non-emergency situations thereby decreasing their availability for maintenance and emergency response use. Furthermore, pullouts may not be conveniently located near where work needs to be performed.

Regular Maintenance Issues

The most commonly raised maintenance issue was poor drainage on the bridge. The drainage system clogs on a regular basis and does not have enough capacity for the runoff that must be evacuated from the roadway. This results in water backing up and pooling on the Viaduct, forcing traffic to slow. As traffic slows unexpectedly, distracted or unprepared drivers are more likely to cause a crash. Maintenance crews indicate that the drains should be fully cleaned four times per year. In practice, cleaning only occurs three times per year, as it requires multiple lane closures and is very time- and resource-intensive. Additional drainage maintenance is performed as needed. Routine sweeping is also required to prevent clogs between cleaning cycles. Replacing or retrofitting the existing system would require the installation of stormwater filtering and detention facilities, as the current drain system feeds directly into Bear Creek. ODOT stated that the current agreement with the City of Medford identifies ODOT as the party responsible for the bridge runoff and the City responsible for the parking lot runoff.

An additional concern raised by attendees was the difficulty in removing debris or other items (obstructions) that fall off vehicles as they travel across the bridge. A rolling slow-down is typically required to remove the obstruction. This requires coordination between agencies to get the required measures for removal in place. This process leaves the hazard on the roadway for a longer period of time, increasing the risk of a crash.

Members of the community have expressed concern about the quantity of pigeon droppings under the bridge that they must wheel through along the Bear Creek Greenway Trail and roadway undercrossing. Current efforts to deter pigeon roosting by using spikes and other means have been ineffective. ODOT and the United States Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) are exploring other options.

Repairs and Non-Annual Maintenance

Multiple deferred and non-annual maintenance needs were expressed during the meeting. The deck is in need of repair and a structural overlay will be needed within the planning horizon. The structural overlay work would likely consist of removing and replacing the existing microsilica concrete overlay and repairing any delaminated areas as needed. Multi-layer polymer concrete overlays (MPCOs) would be applied on a regular basis to protect the structural overlay.

Bridge joints are regular maintenance items that typically require replacement or repairs every 10 years. A project to repair the joints and install an MPCO is scheduled for 2018. During the interview, ODOT indicated that there are a number of pier caps that have soft concrete with areas of excessive spalling, particularly near the joints. This issue must be remedied during the planning horizon.

The eight steel spans in the bridge require additional maintenance related to the paint system and fatigue-prone weld details. The paint system is nearing the end of its lifespan and the eight spans will require repainting during the planning horizon. Approximately 65 percent of the paint is currently in Fair (CS2) condition based on the most recent inspection report.

Poor detailing dating back to the original design has led to cracking in the welds at the stiffener connections. A project to repair the connections that currently show significant signs of distress (cracks greater than 5/8" in length) or connections that are easily retrofitted to relieve stress concentrations, has recently been completed. However, this leaves approximately 50 percent of the connections untouched, and they would likely require attention in the future.

Conceptual Cost Estimating for No-Build Maintenance

A conceptual cost estimate was created for maintaining the bridge in its current state using two planning windows: from the year 2020 to 2040 and from the year 2020 to 2050. Cost data is based on current ODOT bid item prices for repair work, and is presented in year 2016 dollars. No adjustments for inflation have been made at this time. Assumptions about the frequencies used to produce the maintenance cost estimate are presented in **Appendix A** and a full line item breakdown is shown in **Appendix B**.

Maintenance Costs

A summary of the long term maintenance cost estimate, presented in 2016 dollars, is shown in **Table 2** on the following page. The estimates do not include traffic control and other costs associated with the logistical issues presented earlier of performing work on the Medford Viaduct. These are captured in the 40 percent contingency applied to the totals for non-annual maintenance items that would be competitively bid. An additional contingency of 15 percent each for both preliminary and construction engineering has been added. A breakdown of total costs is presented in **Table 2** on the following page.

Table 2: Summary of No-Build Long Term Maintenance Costs

	2040 Horizon	2050 Horizon
Regular Maintenance Items	$1,960,000	$2,940,000
Deferred and Non-Annual Maintenance	$22,090,000	$25,370,000
TOTAL	**$24,050,000**	**$28,310,000**

Potential Near-Term Operational Improvements

There are a number of potential operational strategies and infrastructure improvements on and near the Viaduct that would improve safety for maintenance and incident response activities without retrofitting or rebuilding the entire structure. The potential improvements listed below for ODOT's consideration are based on the interviews conducted, the operational and safety analyses that were conducted as part of anchoring memoranda 1.1 through 1.4, and the project team's current assessment. The potential improvements are described below:

- **South Medford Interchange Southbound Off-Ramp Queuing Mitigation** – Weekday AM peak hour queues regularly spill back into the off-ramp deceleration area which can increase the likelihood of rear-end collisions and impact vehicle speeds on the Viaduct. A near-term transportation demand management (TDM) and/or operations study could identify implementable near-term TDM or operations/geometric improvements to alleviate queue spillbacks.
- **Lighting Installation** – Lighting along the Viaduct would enhance the overall safety of travelers, incident responders, and maintenance workers given that all scheduled maintenance activities occur at night due to traffic volumes on I-5.
- **Variable Message Signs (VMS)/Variable Speed Limits (VSL)** – VMS and VSL (shown in **Figure 3** on the following page) implementation between and at the north and south Medford interchanges would provide safety and traffic management benefits by addressing the safety issues identified by emergency responders and maintenance workers.
- **Ramp Metering** – Ramp metering implementation at the north Medford interchange would provide safety and traffic management benefits by addressing the safety issues identified by emergency responders and maintenance workers. The south Medford interchange may not have enough room for ramp metering.
- **Additional Incident Response Vehicles** – Increasing the number of ODOT Region 3's incident response vehicles (which is currently one vehicle) could improve response times along the Viaduct and throughout the region.

One additional solution that was discussed during the meeting was the construction of pullouts on either side of the Viaduct. After reviewing the option, attendees felt that pullouts would not provide a comprehensive solution to the existing maintenance, safety, and operational issues.

Figure 3. Potential Variable Speed Limit Implementation

Appendix A: Maintenance Cost Estimation Assumption Narrative

Costs for all maintenance items are based on recent ODOT bridge cost data and information obtained from the meetings. ODOT maintenance section was also consulted for costs related to current projects on the Medford Viaduct. Quantities were estimated based on the bridge inspection report and plans, as necessary.

Regular Maintenance Issues

Although not included in this maintenance cost estimate, a cost of approximately $500,000 was estimated for replacing the existing drainage system with a design that would clog less frequently and reduce maintenance. This is a high-level planning cost estimate based on current bid data. Factors such as water quality or quantity treatment requirements, changes to bid prices, and custom design details could potentially increase the cost to replace the drainage system. The drainage system requires multiple lane closures in order to clean out, and it should be cleaned four times per year. Based on information provided at the meeting, it costs $10,000 per cleaning, which includes an extra maintenance worker shift, night work and traffic control. Routine sweeping is assumed to cost $3,000 per event six times per year.

Obstruction removal, which requires a rolling slowdown and cannot be predictably scheduled, is also calculated into the cost estimate. Obstruction removal is estimated to occur 12 times per year (once per month) at a cost of $3,000 per occurrence to account for the use of equipment and required coordination between agencies to arrange and implement the slowdown.

Deferred and Non-Annual Maintenance

A structural overlay and a multi-layer polymer concrete overlay (MPCO) sealing overlay are required to maintain the long term performance of the bridge deck. The structural overlay consists of removing and replacing the existing microsilica overlay and repairing any delaminations as needed. For purposes of the estimate, it is assumed that the entire deck area of the bridge will require the structural overlay and that 30 percent of the deck area will require Class 2 surface preparation to repair delaminations. Furthermore, it is assumed that the structural overlay would only be needed once during the planning horizon and that the work would occur at the midpoint of the window (at years 10 and 15 of the year 2040 and year 2050 planning horizons, respectively).

It is assumed that the MPCO sealing overlay will be needed over the entire deck. Based on typical results that ODOT has experienced in other areas of I-5 with similar traffic levels, MPCOs have a lifespan of approximately five to seven years. Based on a seven year lifespan, two MPCOs would be required during the year 2040 planning horizon, and three would be needed during the year 2050 planning horizon.

Maintenance history indicates that the joints having a lifespan of approximately 10 years. This means that joints would need to be repaired or replaced once in the year 2040 planning horizon, and twice in the year 2050 planning horizon. To address maintenance concerns about potential repairs to the pier caps, it is assumed that half of the pier caps will require repair over their entire surface area. Repair to the pier caps is assumed to occur once at the midpoint for each planning horizon.

Additional maintenance required for the steel spans is assumed to occur once at the midpoint for each planning horizon. Based on the values in the most recent bridge inspection report, repainting is assumed to be needed on the entirety of the painted surfaces. Based on a report from Wiss, Janney, Elstner Associates, approximately 50 percent of the stiffeners will not be repaired for poor detailing by the end of the current maintenance effort. It is assumed that the $570,000 recently spent will need to be spent again at the midpoint of the repair window to address the locations that have not yet been repaired.

Relative to the other options under consideration, nearly all of the regular and non-annual maintenance costs will be incurred within the planning horizon under any retrofit option, with or without constructing a bridge widening. However, for the rebuild option, nearly all of the regular and non-annual maintenance costs will be avoided or drastically reduced within the planning horizon.

Appendix B

No-Build Maintenance Costs

Regular Maintenance Items

Item	Planning Horizon 2040	Planning Horizon 2050
Drain Cleanings	$800,000	$1,200,000
Debris Removal	$800,000	$1,200,000
Sweeping	$360,000	$540,000
Subtotal:	**$1,960,000**	**$2,940,000**

Repairs and Non-annual maintenance

Item	Planning Horizon 2040	Planning Horizon 2050
Pier Cap Repair	$760,000	$760,000
Structural Deck Repair	$3,600,000	$3,600,000
MPCO	$2,740,000	$4,110,000
Joint Replacement	$450,000	$900,000
Steel Paint	$4,150,000	$4,150,000
Stiffener Repair	$570,000	$570,000
Subtotal:	**$12,270,000**	**$14,090,000**
10% Mobilization:	$1,230,000	$1,410,000
40% Contingency:	$4,910,000	$5,640,000
30% PE & CE:	$3,680,000	$4,230,000
Subtotal:	**$22,090,000**	**$25,370,000**
GRAND TOTAL:	**$24,050,000**	**$28,310,000**

Note: All costs shown are in 2016 dollars