South Stage Road
Extension Plan

Technical Memorandum

August 30, 2024 Project# 27003.014

To: Marc Butorac, PE, PTOE, PMP

From: Mikal Mitchell, PE, HDR

RE: Technical Memorandum #5.2.2.3B: Structure and Constructability Analysis

INTRODUCTION

This technical memorandum (TM) documents the structural and constructability considerations for conceptual bridge layouts for the Recommended Overpass and Underpass Alternatives with compatible Interchanges. This includes The South Stage Extension Plan evaluates overcrossing and interchange alternatives along I-5 between the Phoenix (Exit 24) and South Medford (Exit 27) interchanges, as shown in Figure 1. This project is part of the adopted City of Medford Transportation System Plan (TSP) (Projects 537A and 537B).

The contracted work for this project is based on desktop information and is at a planning level. Therefore, the information and analysis in this TM are preliminary concept and planning-level information that will require additional engineering analysis and confirmation through more detailed data collection and design prior to implementation. This planning document may be adopted in a subsequent environmental review process in accordance with 23 USC 168, Integration of Planning and Environmental Review, and 23 CFR 450, Planning Assistance and Standards.

Figure 1. Study Area

O-2 ALTERNATIVE

As seen in the plan and profile in Attachment A, provided by Kittelson & Associates, Inc., the modified alignment of O-2 continues to East South Stage Road, makes a slight bend to cross the Bear Creek Floodway in an approximately perpendicular fashion, crosses I-5 at an approximately 35 degree skew, then curves to the south around the existing Pacific Power & Light (PPL) substation. The vertical profile of the alternative increases from the existing elevation of East South Stage Road west of Samike Drive to gain the elevation needed to cross over I-5 with the appropriate vertical clearance. It then transitions down and meets the existing grade near the existing PPL substation.

To address hydraulic and no-rise requirements as reasonably as possible at this early planning-level phase, it is assumed that a bridge structure is needed where the existing ground would be inundated by the 100-year flood elevation. Based on the profile shown, this places the beginning of the bridge at approximately Station (Sta.) 9+00. The bridge would then continue until it crosses I-5 and is able to touch down on a ridge that parallels I-5 at approximately Sta. 25+00. The profile grade is significantly higher than the existing ground from approximately Sta. 25+00 to Sta. 32+00 and there is a wetland identified in this stretch of the alignment. It is assumed that the alignment will be supported by Mechanically Stabilized Earth (MSE) walls

ranging from approximately 5 to 30 feet high on each side through this stretch to limit the impacts of fill in the wetlands.

One conceivable span layout for this bridge would be to break it into three units with span lengths as sketched on the attached plan and profile. Unit 1 would consist of three spans (90'-115'-90'). The shorter spans in this unit would allow for shallower structure depths, providing the most hydraulic freeboard where the profile is closest to the 100-year flood elevation.

Unit 2 would consist of five spans (140'-170'-170'-170'-140'). These longer span lengths would help to limit the number of bents in the Bear Creek Floodway. The bridge spans would be well above the 100-year flood elevation in this unit, so increased structure depths for these longer span lengths are not a concern. A realigned Bear Creek Greenway trail would likely pass under the initial spans of this unit, and adequate vertical clearance appears to be available.

Finally, Unit 3 would consist of four spans (120'-150'-150'-85') that would cross over I-5. The slightly thinner structure depths needed for these span lengths would keep the profile grade low while still providing the necessary vertical clearance to I-5. This is only one conceivable span layout for the bridge. A complete bridge type, size, and location (TS&L) alternatives analysis considering refined alignments, different structure types, and a more complete understanding of the project constraints will be necessary in a future phase of work to establish the final bridge layout. The curvature of the alignment in some locations and the exact bridge extents may have an impact on the structure type selected at that time.

If this alternative is to be compatible with an interchange (Alternative I-2) in the future, some revisions to the overcrossing profile and structural layout are likely necessary. It appears the most likely interchange layout would involve southbound ramps on bridges on the west side of I-5, tying into the South Stage Road bridge. The northbound on-ramp would most likely cross under the South Stage Road bridge on the east side of I-5. With this type of Parclo A interchange layout, the South Stage Road profile would need to be adjusted to provide a relatively level intersection of the southbound ramps and South Stage Road. This may require the South Stage Road bridge to touch down further to the west or require increased grades on South Stage Road. The span layout at the intersection would require revisions to accommodate the roadway alignments at each leg of the intersection. On the east side of I-5, the span layout may need to be revised to accommodate the northbound on-ramp crossing under the bridge. Numerous other elements would need to be considered in the design of an overcrossing bridge that is forward-compatible to accommodate future ramp bridges and a ramp terminal intersection. As an example, the initial overcrossing bridge would need to be designed for any future signal support structures that need to be mounted on the bridge. This is just one example of the many considerations that would be required.

To compare the potential impacts of various alternatives during this planning-level phase, it can be helpful to understand the footprint of the permanent foundation at each bent. Since a

foundation type has not been selected at this time, it is assumed that a pile group foundation type would be used, which would have the largest foundation footprint. For bents supporting shorter tributary span lengths (approximately 100 feet), the foundation footprint area can be assumed to be the width of the bridge by approximately 15 feet, therefore each support for shorter tributary span lengths is assumed to be 80 feet x 15 feet. For bents supporting longer tributary span lengths (approximately 170 feet), the foundation footprint area can be assumed to be the width of the bridge by approximately 30 feet, therefore each support for longer tributary span lengths is assumed to be 80 feet x 15 feet. The approximate foundation footprint for bents that support tributary span lengths would vary linearly.

Constructability Assessment

Based on the conceptualized layout at this stage, there do not appear to be any significant constructability concerns for this alternative. The structure is elevated significantly above existing ground between Bear Creek and I-5, resulting in relatively tall columns and likely the use of larger cranes to place girders, but these are not outside the realm of typical bridge construction. Traffic staging on I-5 will need to be addressed during bridge construction, but there seems to be adequate space to shift traffic as needed. Temporary work access, including a temporary work trestle paralleling the proposed bridge with fingers along each bent, will likely be necessary at Bear Creek. If this alternative is designed to be forward-compatible with a future interchange, there do not appear to be any significant constructability concerns. During construction of the ramp bridge connections to the overcrossing bridge, traffic staging on the overcrossing bridge and closure of the overcrossing bridge periodically may be needed.

O-4 ALTERNATIVE

As seen in the attached plan and profile, provided by Kittelson & Associates, the horizontal modified alignment of O-4 is the same as O-2. The difference is that the profile of O-4 increases relatively slightly from the existing elevation of East South Stage Road east of Samike Drive to gain the elevation needed to cross the Bear Creek Floodplain with the necessary freeboard but stays low enough to pass below I-5. The I-5 vertical profile in both directions will have to be raised in this area to allow South Stage Road to pass below. On the east side of I-5, the South Stage profile for this alternative is significantly lower than the existing grade, likely requiring very tall cut retaining walls.

To address hydraulic and no-rise requirements as reasonably as possible at this early planning-level phase, it is assumed that a bridge structure carrying South Stage Road is needed where the existing ground will be inundated by the 100-year flood elevation. Based on the profile, this places the beginning of the bridge at approximately Sta. 9+00 and the end of the bridge at approximately Sta. 21+00. One foot of freeboard to the 100-year flood elevation is assumed in

the development of the profile at this phase. If drift or debris from the stream is a concern in future phases, the profile may need to be raised to allow 3 feet of freeboard.

One conceivable span layout for this bridge would be two units with span lengths as sketched on the attached plan and profile. Unit 1 would consist of four spans (110'-140'-140'-110'). The shorter spans in this unit would allow for shallower structure depths, providing the most hydraulic freeboard where the profile is closest to the 100-year flood elevation. A realigned Bear Creek Greenway would likely pass under the spans. To provide the necessary vertical clearance, the profile may need to be raised slightly, or span lengths and structure depths may need refining in future phases.

Unit 2 would consist of five spans (120'-150'-150'-150'-120'). These longer span lengths would help limit the number of bents in the Bear Creek Floodway without being too long, which would increase the structure depth and raise the profiles of South Stage Road and I-5 unnecessarily. A complete bridge TS&L alternatives analysis considering refined alignments, different structure types, and a more complete understanding of the project constraints will be necessary in a future phase of work to establish the bridge layout. The curvature of the alignment in some locations and the exact bridge extents may have an impact on the structure type selected at that time.

If this alternative is to be forward-compatible with an interchange in the future, some revisions to the structural layout are likely necessary. It appears the most likely interchange layout would involve southbound ramps on bridges on the west side of I-5, tying into the South Stage Road bridge. The northbound on-ramp would most likely cross over South Stage Road on the east side of I-5. The span layout of the South Stage Road bridge at the intersection would require a revision to accommodate the roadway alignments at each leg of the intersection. On the east side of I-5, an additional bridge carrying the northbound on-ramp over South Stage Road would be necessary. Similar to O-2, numerous other elements would need to be considered in the design of a South Stage Road bridge that would have future intersecting ramp bridges.

To compare the potential impacts of various alternatives during this planning-level phase, it can be helpful to understand the footprint of the permanent foundation at each bent. Since a foundation type has not been selected at this time, it is assumed that a pile group foundation type may be used, which would have the largest foundation footprint. For bents supporting shorter tributary span lengths (approximately 110 feet), the foundation footprint area can be assumed to be the width of the bridge by approximately 15 feet. For bents supporting longer tributary span lengths (approximately 150 feet), the foundation footprint area can be assumed to be the width of the bridge by approximately 30 feet. The approximate foundation footprint for bents that support tributary span lengths would vary linearly.

New bridges carrying I-5 over South Stage Road would also be required. It is assumed that these bridges will be single-span bridges with approximate span lengths of 110 feet. These span

lengths will likely require a combination of cut and fill walls paralleling South Stage Road in front of the I-5 bridge abutments.

Significant cut retaining walls in the range of 30 to 50 feet tall may be required east of I-5 for this alternative. This range of retaining wall heights is beyond typical retaining wall heights and would require an in-depth study and input from geotechnical engineers to identify wall types and layouts that may need to include tiered wall systems.

Constructability Assessment

Based on the conceptualized layout at this stage, the most significant constructability concern for this alternative is the very tall cut retaining walls. Construction of these walls will be challenging and a more in-depth study would be necessary to confirm a constructable solution can be achieved. Traffic staging on I-5 will need to be addressed during construction of the increased profile and bridges on I-5. Given the bridge construction, this will likely be more challenging than simply shifting traffic around and will likely require staged construction of the new bridges. Temporary work access, including a temporary work trestle paralleling the proposed South Stage bridge with fingers along each bent, will likely be necessary at Bear Creek. If this alternative is designed to be compatible with a future interchange, there do not appear to be any significant constructability concerns. During construction of the ramp bridge connections to the South Stage Road bridge, traffic staging on the South Stage Road bridge and closure of the bridge may be needed at times. For the construction of the additional northbound on-ramp bridge over South Stage Road, periodic traffic staging on I-5 may be needed along with traffic staging and closure of South Stage Road.

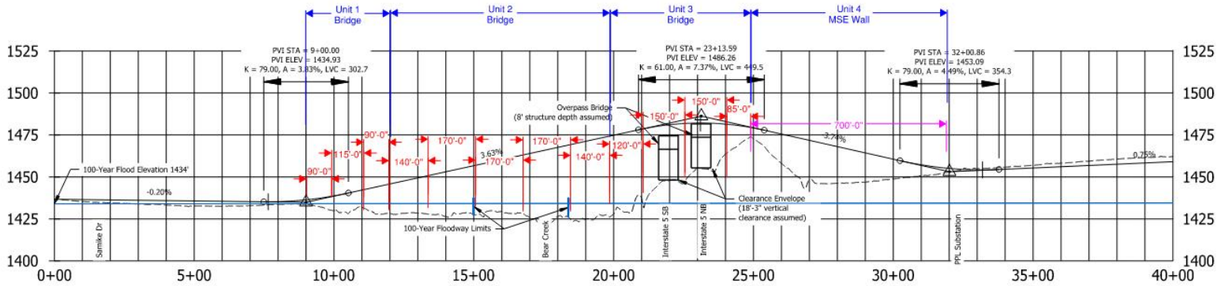
SUMMARY OF FINDINGS

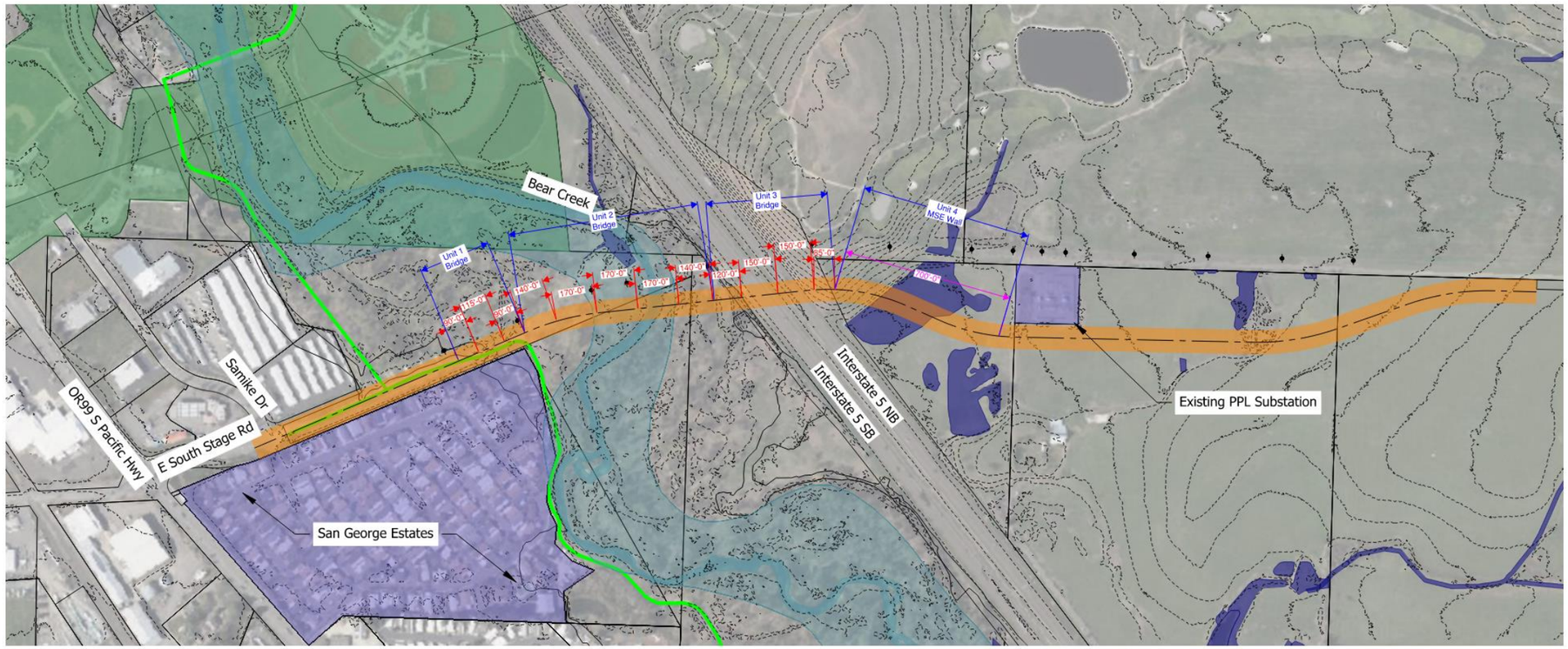
Based on this preliminary, concept-level, planning information analysis, the modified Phase 1 O-2 (overpass) alternative and the forward-compatible Phase 2 I-2 (overpass) alternative appear feasible from a structural and constructability perspective. The modified O-4 (underpass) and the I-4 (underpass) alternatives are likely feasible from a structural and constructability perspective, but further study of the tall cut retaining walls would be needed to confirm this. These findings are based purely on a desktop exercise and require further evaluation and modification through the environmental and design phases.

Attachment A. Horizontal and Vertical Alignment Geometry of the Recommended Overpass and Underpass Alternatives with Compatible Interchanges

Overpass (Underpass) Alternatives

South Stage Southerly Realignment: Modified Alternative O-2





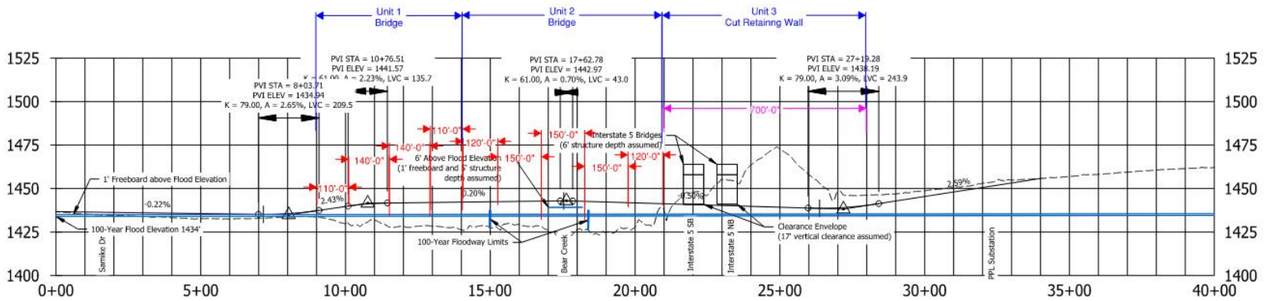
South Stage Road
Extension Plan

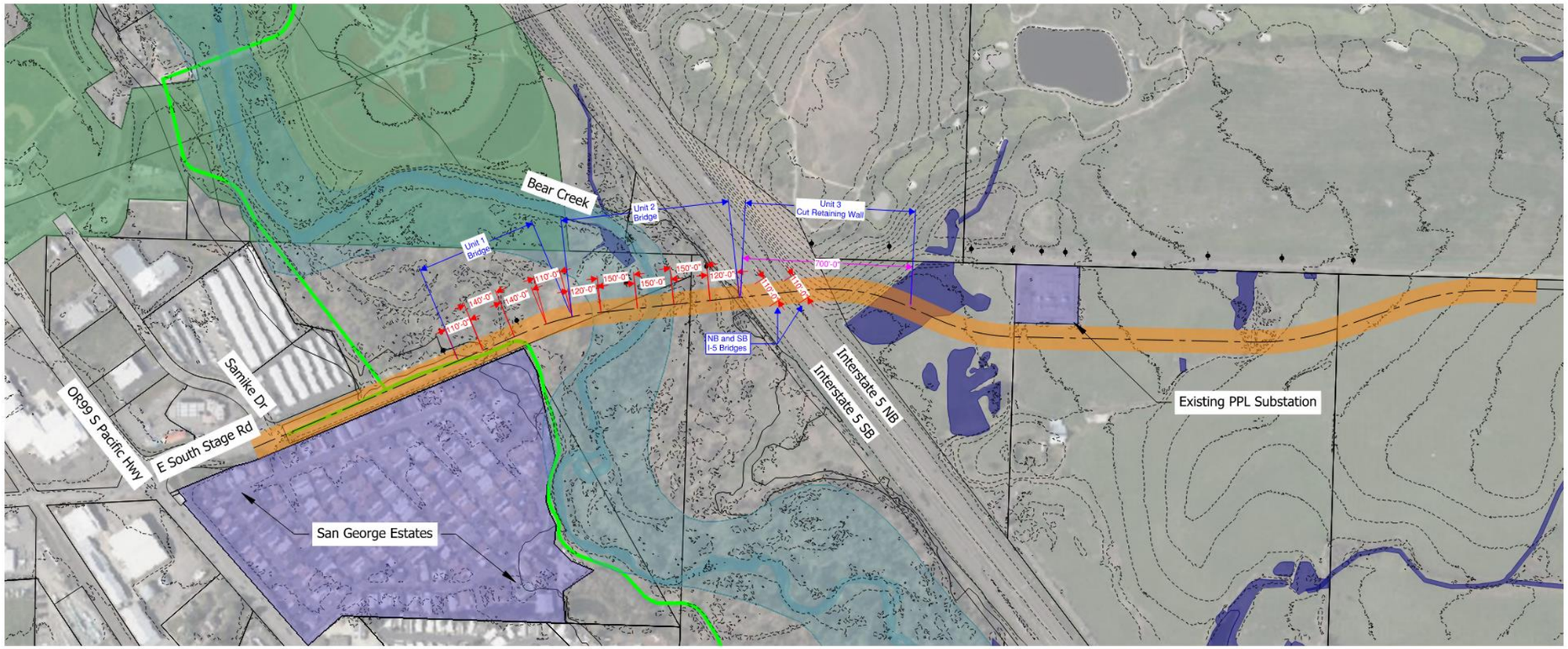
Legend
- Bear Creek
- 100-Year Floodway
- Wetlands
- Parks
- Bear Creek Greenway
- Utility Pole

0 400 800 Feet

O-2 Modified Southerly Alignment

South Stage Underpass: Modified Alternative O-4





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O-4 Modified Southerly Alignment