Section 2
Bridge Rehabilitation Concepts

2.1 Functional and Operational Demands

The City initiated the Study in an effort to identify and develop preliminary solution alternatives that will support public use of this historic and vital transportation link for future generations of drivers, riders, bicyclists, and pedestrians. The *Baseline Conditions Summary* document identifies the current and forecast demand for the Latah Bridge for vehicular traffic, bicycle and pedestrian traffic, transit, and freight. These demands are summarized in the following text.

2.1.1 Vehicular Traffic

Vehicular traffic currently operates on one travel lane in each direction on the Latah Bridge. Traffic forecasts from the SRTC's 2008 and 2030 regional model suggest that, by 2030, traffic on this segment of the Sunset Boulevard corridor will be reaching capacity. One lane in each direction will result in congestion as traffic is bottlenecked in this location. **As such, two lanes in each direction are recommended for long-term bridge rehabilitation alternatives.**

2.1.2 Bicycle and Pedestrian Traffic

The City of Spokane Master Bike Plan (2009) identifies the West Sunset Boulevard corridor to ultimately have marked, shared travel lanes—meaning that bicyclists would share vehicular travel lanes, and that signs and/or pavement markings would notify drivers that lanes are to be shared. **The City recommended that bike lanes also be considered for any bridge rehabilitation alternative that involves widening the bridge. The rehabilitated bridge must accommodate pedestrians by including minimum standard width sidewalks or multi-use paths.**

2.1.3 Transit

The Spokane Transit Authority (STA) currently uses the West Sunset Boulevard corridor. Bus service, consisting of two fixed-routes, connects downtown Spokane with the City of Airway Heights and Spokane International Airport. STA is planning for long-term growth and transit demand in Airway Heights. High performance transit is planned to run buses every 10 minutes during peaks and every 15 minutes off peak. STA may deploy articulated (60-foot) coaches on the corridor. Beyond STA's long-term planning horizon, a time may come when cost/benefit for light rail transit (LRT) is favorable. **Short- and long-term bridge rehabilitation concepts must accommodate transit and meet current standards for carrying applicable loads. Long-term bridge rehabilitation concepts should consider capacity for accommodating LRT at an indeterminate time in the future.**

2.1.4 Freight

West Sunset Boulevard is classified by the City as a designated principal arterial and a required route for single-unit vehicles of more than 10,000 gross weight, semi-tractor trailers, and trucks with trailers used in intercity or interstate hauling. Approximately 5 percent of the traffic on West Sunset Boulevard is considered to be heavy vehicles (Types 4 to 13 as classified by the Federal Highway Administration). **The rehabilitated Latah Bridge must accommodate freight mobility and meet current standards for carrying applicable loads.**

2.1.5 Bridge Sections Considered

Bridge roadway section concepts were developed that accommodate the short- and long-term demands for the Latah Bridge in a combination of ways. Short-term concepts were developed that maintain the existing curb-to-curb width on the bridge. Long-term concepts were developed that widen the bridge deck to accommodate the future demands for multiple modes of traffic. City minimum standards for principal arterials (City of Spokane, 2007) were used to determine minimum standards for lane widths, bicycle facility widths, and minimum curb-to-curb widths. Tri-Met standards (Tri-Met, 2010) were applied as a practical guideline for developing concepts to accommodate potential future LRT infrastructure.

Exhibit 2-1 illustrates seventeen bridge section concepts that were developed for initial consideration.

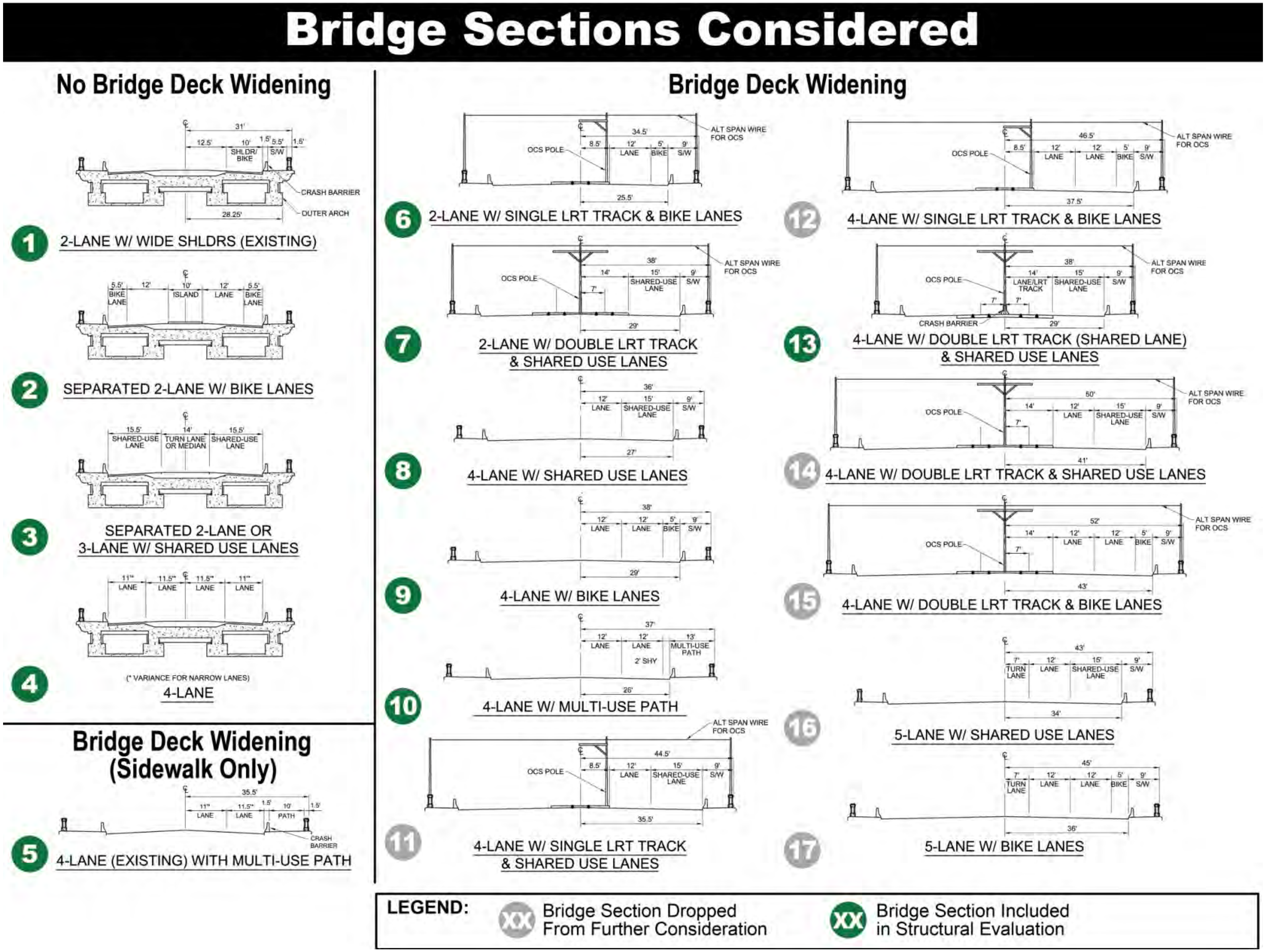
Bridge Sections 1 to 4 illustrate options for how vehicular and non-motorized modes of traffic may use the existing 45-foot curb-to-curb width and existing sidewalk width on the bridge. **Bridge Section 5** accommodates four lanes of vehicular traffic within the existing 45-foot curb-to-curb width, but allows for widening of the bridge deck to include 10-foot-wide multi-use pathways for accommodating non-motorized traffic. **Bridge Sections 6 to 17** allow for widening of the bridge deck as needed to accommodate vehicular, non-motorized, and LRT. Two-lane, four-lane, and five-lane options are illustrated, along with feasible configurations for bike/pedestrian facilities and single- and double-track LRT.

In reviewing bridge sections that consider widening the bridge deck, it became clear that a number of deck configurations accommodated all of the modal demands for a long-term bridge rehabilitation with a nominal 7 feet of bridge deck widening (each side). Specifically, **Bridge Sections 8, 9, 10 and 13** provide four travel lanes and options accommodating bicycle and pedestrian needs. With the same amount of deck widening, **Bridge Section 13** also provides for possible future addition of dual-track LRT. LRT vehicles would be required to share the inside lanes with vehicular traffic on the bridge.

2.1.6 Bridge Sections Evaluated

For the purposes of developing structural rehabilitation concepts, five alternatives for structural rehabilitation of the bridge were selected. Each structural alternative corresponds to a different level of performance as measured by the expected life of the bridge and as measured by the multimodal traffic demand that the bridge can accommodate. Structural analysis of the five alternatives will serve to provide significant flexibility to the City by providing rehabilitation solutions that accommodate a variety of ways to satisfy multimodal transportation demand for all of the **green-numbered** bridge sections (**Bridge Sections 1 to 10 and 13**) shown in Exhibit 2-1.

EXHIBIT 2-1. ***Bridge Sections Considered***



In all alternatives, the structural capacity of the bridge to carry its self weight and traffic meets current design standards. Exhibit 2-2 illustrates the traffic sections provided by each alternative. The five alternatives are as follows:

- Alternative A—20-Year Design Life (no bridge widening—Sections 1 to 4)
- Alternative B—20-Year Design Life with Expanded Sidewalks (bridge widening—Section 5)
- Alternative C—Long-Term Design Life (no bridge widening—Sections 1 to 4)
- Alternative D—Long-Term Design Life with Four Lanes and Bike Lanes (bridge widening—Sections 6 to 10)
- Alternative E—Long-Term Design Life with Four Lanes and Future LRT (bridge widening—Section 13)

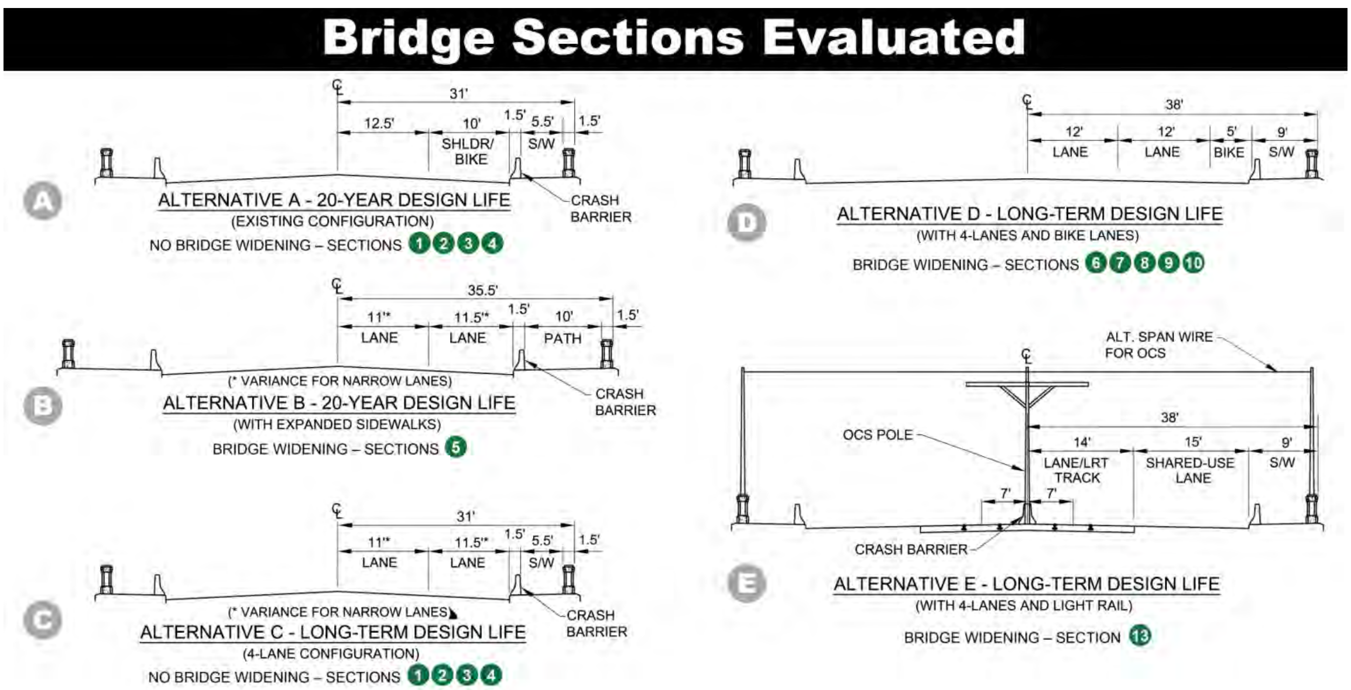
Alternatives A and B consider a 20-year design life and little to no function or capacity change to the bridge.

Alternative C considers a long-term design life, while not changing the function or capacity of the bridge.

Alternatives D and E consider a long-term design life and widen the bridge to allow an increase in the function and capacity of the bridge. Additional vehicular traffic and additional non-vehicular traffic is accommodated.

Appendix C contains concept-level rehabilitation drawings of the five alternatives.

EXHIBIT 2-2. *Bridge Sections Evaluated*



2.2 Structural Considerations

In order to develop rehabilitation concept alternatives that are physically feasible, the following key considerations must be addressed:

- **Bridge Strength.** The rehabilitated bridge must meet current standards for supporting gravity loads.
- **Bridge Durability.** The expected life of the rehabilitated bridge.
- **Bridge Widening.** The rehabilitated bridge must accommodate widening to support functional demands.

2.2.1 Bridge Strength

The existing bridge does not meet current standards for supporting gravity loads. This is due to original design details that are insufficient when evaluated under modern bridge design standards. It is also due to deterioration of certain bridge components. Specific deficiencies were detailed in the report *Baseline Conditions Summary* document.

In general the arches, piers, and spandrel columns and walls have sufficient strength in their current conditions. Interior floor beams over the arches are adequate, as are the interior stringers at the piers and the approach spans. Longitudinal stringers at the outside edges of the piers are deficient, as are the transverse floor beams at the outside edges of the bridge. The original bridge rail is deteriorated to the point that the capacity is impaired.

Each alternative includes work necessary to meet current design standards for modern gravity design loads. Design loads and structural requirements are as defined in the *AASHTO LRFD Bridge Design Specifications*, 5th Edition. Improvements to seismic resistance are not included.

Rehabilitation Alternatives A, B, and C retain the existing spandrel columns and walls, floor beams, and deck over the arches. These elements are strengthened by removing the existing asphalt concrete overlay and installing new reinforced concrete overlay. The reinforced concrete overlay will be structurally composite with the original deck, and floor beams—adding depth to the structural members and allowing the addition of reinforcement at the tops of the floor beams.

Certain floor beams over the arches and transverse beams under the approaches are deteriorated. Where required, these elements will be strengthened by removing and replacing deteriorated concrete and installing external steel reinforcement. By completing these repairs and strengthening before installation of the proposed concrete overlay, the added external reinforcement will participate in resisting the bending caused by the new overlay and any live loads.

The tops of the piers are severely deteriorated, particularly near the curb lines. Each alternative includes removing the entire pier top and replacing the deck and stringers. When this concept is advanced into detailed design, consideration may be given to retaining portions of the pier caps.

Alternatives D and E replace the entire superstructure above the arches in addition to the tops of the piers and the approach spans. In these cases, the replacement components will be designed to current standards.

2.2.2 Bridge Durability

A significant consideration in any rehabilitation project is the expected life of the structure after rehabilitation. This study considers two different design life objectives. The first is a relatively short life, defined as 20 years beyond the rehabilitation. After 20 years, major rehabilitation or replacement of the structure may be required.

The second design life objective is a long-term life, defined as 40 to 50 years beyond the rehabilitation with only routine maintenance. After 40 years the structure life may be extended with reasonable repair and rehabilitation effort, and replacement need not be contemplated. Reasonable repair and rehabilitation may include additional corrosion mitigation, structural repair, and other work up to the scale of the work identified in this study.

Any discussion of design life of structures requires consideration of the meaning of "design life." The end of the usable design life is not normally marked by a clearly defined event. Rather, the end of the design life is a period during which maintenance efforts become excessive, utility of the structure is limited because of load restrictions or geometric restrictions, and the combined maintenance and road user cost exceeds the cost of a major rehabilitation or replacement. Many structures are kept in service beyond their nominal service life though diligent maintenance and through acceptance of a reduced level of service.

20-Year Design Life

Alternatives A and B target a relatively short service life. For these, the arches and the piers are not treated because the current capacity is sufficient and the rate of deterioration indicates that the capacity will remain adequate for the target service life. After 20 years of continued deterioration, however, significant repairs to the arches may be required.

Corrosion mitigation is required in order to maintain the floor system components (spandrel columns and arches, stringers, floor beams, and deck) for the 20-year target design life. This is due to both the rate of deterioration of these elements, particularly near the deck joints, and to the sensitivity of the strength of these elements to deterioration. In addition, repair processes tend to accelerate corrosion-induced deterioration.

In these components passive cathodic protection will be used in conjunction with repairs to control corrosion and extend the life of the elements. This passive cathodic protection consists of zinc anodes embedded into the concrete in repair areas.

Long-Term Design Life

Alternatives C, D, and E target a long-term design life. In Alternative C the existing floor system is retained and strengthened. Passive cathodic protection will be used to extend the service life of the floor system components. This is identical to the methods used to provide a 20-year design life. Minor adjustments to the anode sizes and quantities will be implemented to provide a design life of 40 years. After the 40-year anode life, additional corrosion mitigation may be required.

For Alternatives D and E, in which the existing floor system is replaced, the replacement structure will be designed and detailed to provide a service life comparable to new bridges.

For each long-term service life alternative, the arches and portions of the piers will be treated with electrochemical chloride extraction (ECE) to halt the corrosion process. This technology migrates chlorides away from the embedded reinforcement and changes the alkalinity of the concrete in the vicinity of the reinforcement. The combination of chloride removal and re-alkalization makes the process effective in halting corrosion whether the source of the corrosion is chloride contamination or carbonation of the concrete. The effects of the ECE are expected to last 30 to 40 years.

ECE is a non-invasive procedure, and leaves no lasting mark on the structure. This is important in avoiding changes to the historic fabric of the bridge. In addition, because the process is non-invasive and does not change the fundamental characteristics of reinforced concrete it can be repeated when and if the corrosion process resumes.

In each alternative, the deck drainage system will be reconstructed and many of the deck joints will be eliminated. This will reduce the exposure of the bridge to water and de-icing salts, which will prolong the life of the bridge components.

Exhibit 2-3 illustrates how the durability of the bridge may be extended with implementation of a long-term rehabilitation program and the types of maintenance that may be required over time.

EXHIBIT 2-3. *Comparison of Short- and Long-Term Rehabilitation Scenarios*

Example Maintenance and Repair or Rehabilitation Activities*		T=0	20 years	30 years	40 years	50+ years
Short-Term Rehabilitation	**Short Term Rehabilitation Project** *- Strengthen/repair/limited corrosion protection for:* • *Deck and floor beams* • *Spandrels*	✓				
	Bridge Inspections *(every 2 years)*	✓				
	Deck Repairs *(yearly)*					
	Joint replacement *(25-year intervals)*					
	Deck overlay *(25-year intervals)*					
	Major Rehabilitation or Replacement		✓			
Long-Term Rehabilitation	**Long Term Rehabilitation Project** *- Strengthen/repair/corrosion protection for:* • *Deck and floor beams* • *Spandrels* • *Piers and arch ribs* *- Or complete deck/spandrel replacement (widening)* *- Active corrosion protection for piers and arch ribs*	✓				
	Bridge Inspections *(every 2 years)*	✓	✓	✓	✓	✓
	Deck repairs *(yearly)*	✓	✓	✓	✓	✓
	Joint replacement *(25-year intervals)*			✓		
	Deck overlay *(25-year intervals)*			✓		
	Replace cathodic protection *(35-year intervals)*				✓	
	Rehabilitation Project					✓

* For illustrative and comparative purposes only. Actual maintenance and repair regime may vary from the example shown.

2.2.3 Bridge Widening

Three alternatives (B, D, and E) result in a wider bridge deck. In Alternative B the widening is limited to an expansion of the sidewalks. In Alternatives D and E the sidewalks are widened and the curb to curb width is increased in order to provide more space for vehicles, bicycles, pedestrians and future LRT.

Specific deck geometrics were developed to accommodate future traffic patterns. The *Baseline Conditions Summary* document addresses the traffic patterns and traffic volumes expected for different planning assumptions, and develops the criteria to support appropriate bridge widths.

Alternative B retains the original superstructure, and expands the sidewalks from 5.5 feet to 10 feet clear at each side of the bridge for a total widening of 9.0 feet. This is accomplished by removing the existing deck overhang and sidewalk and casting a new deck overhang and sidewalk as shown in Exhibits A-6 through A-9 in Appendix A. The overlap of the new sidewalk onto the existing bridge deck provides a convenient and reliable means of connecting the new deck to the existing structure.

Alternatives D and E widen the curb-to-curb traffic area of the bridge to provide for standard width traffic lanes and bicycle facilities. The sidewalks are also widened from 5.5 feet to 6 feet clear. The total increase in the width of the bridge is 14 feet for both alternatives. Exhibits C-14 through C-21 in Appendix C illustrate these alternatives. The traffic barrier for these alternatives extends beyond the existing spandrel system to the extent that cantilevering decks beyond the existing can be problematic. Replacement of the entire deck framing system is selected as the most reasonable approach. With extensive removal of the deck and deck framing, it is reasonable to remove the existing spandrel columns and spandrel walls. These components will be replaced with elements that effectively support the new deck framing.

The spandrel walls, spandrel columns, and the floor beams at the spandrel columns will be cast-in-place concrete. Forms for these components will be supported from the existing arches.

The deck system, including the floor beams between the spandrel columns, will be a composite system consisting of precast slab panels with a reinforced concrete topping. The precast deck panels will include the floor beams and the decorative features at the edge of the deck. The reinforced concrete deck ties the precast elements together into a smooth and continuous system. Advantages to the precast system include minimizing the falsework required for construction, which speeds construction and saves money. Much of the construction work is then done at ground level, which enhances safety of construction. Precasting at ground level also permits closer construction tolerances, which improves the quality of construction.

In all widening alternatives the decorative brackets and railing will be reconstructed. This helps to mitigate the effect of removing the original shapes from the bridge. The decorative railing will be precast and attached to the bridge deck.

2.3 Bridge Structural Rehabilitation Concepts

Appendix C contains detailed concept-level drawings of the five alternatives.

2.3.1 Alternative A

This alternative repairs the structure to provide structural capacity for dead and live loads, and includes sufficient corrosion mitigation to preserve the bridge for approximately 20 years before significant repair or rehabilitation is required. The geometric configuration of the bridge will remain unchanged. Exhibit 2-4 illustrates repair elements to the bridge superstructure. Exhibits C-2 through C-5 in Appendix C depict the work items included in this alternative.

As part of the rehabilitation, the bridge deck profile will be lowered approximately 4 inches. This change in profile must be addressed in the roadway approaching the bridge.

A key element in this alternative is replacement of the existing asphalt concrete overlay with a reinforced concrete overlay. This overlay extends under the existing concrete traffic barrier and replaces a portion of the existing sidewalk. This overlay reinforces and strengthens the entire floor beam and stringer sections over the arches and at the approaches. With this overlay in place, the bridge deck system meets structural capacity criteria. The overlay is continuous from pier to pier, eliminating deck joints that leaked and exposed the bridge structure to water and de-icing salts.

Construction of the overlay requires no formwork or falsework. The existing bridge deck remains in place and becomes a working surface and a bottom form for the overlay.

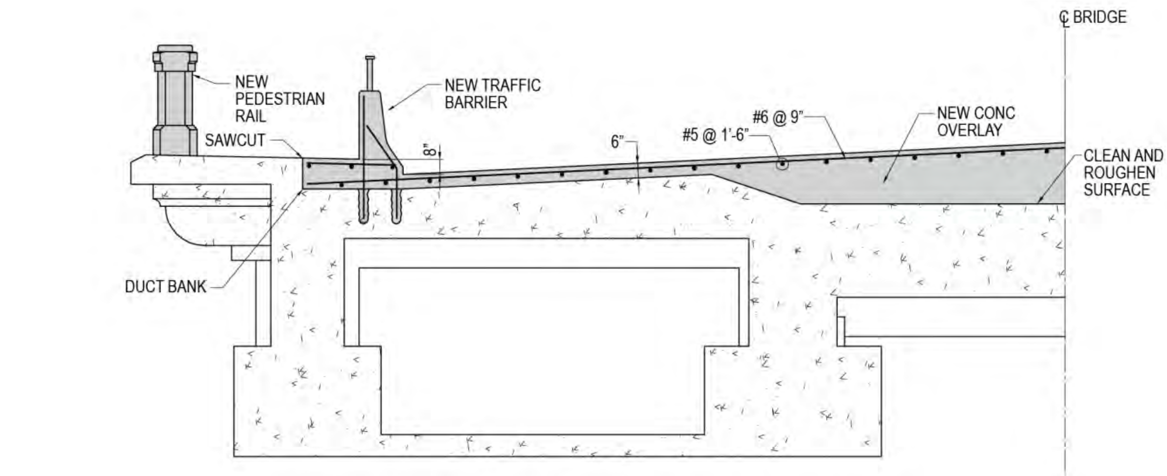
The deck and stringers at the pier tops is severely deteriorated, particularly at the stringers and deck slabs at the curb line. These stringers and the adjacent deck slabs will be replaced. The alternative as defined includes removal and replacement of the entire pier cap; during design of this rehabilitation consideration should be given to retaining the six stringers closest to the centerline of the bridge.

The existing decorative rail will be removed and replaced in kind. The highly detailed rail may be precast and attached to the existing bridge deck.

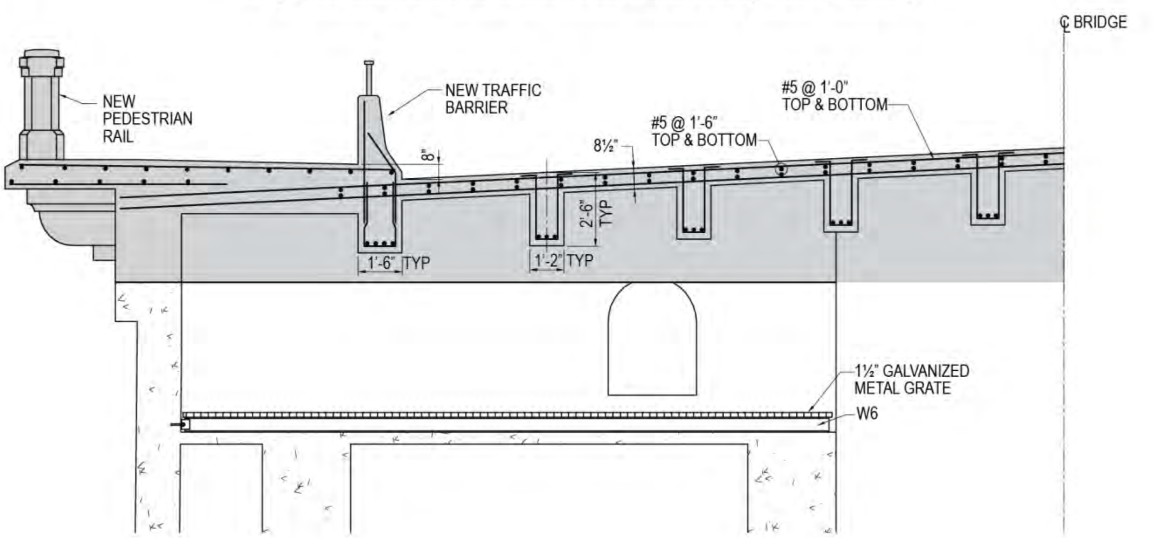
Some deterioration of the transverse floor beams has been observed, primarily at the joints in the deck. Loose and delaminated concrete will be removed, the reinforcing steel cleaned, and the concrete replaced with troweled or pneumatically applied concrete. Passive cathodic protection anodes will be embedded in the patch concrete to control corrosion at the repairs. Where existing reinforcement in the beam repair areas is significantly degraded, the beams may be strengthened by adding steel plates.

Additional work includes reconstruction of the deck drain system, to prevent water from splashing on the concrete bridge. A concrete platform just below the deck surface at the piers will be topped with a metal grate in order to maintain safe access for bridge inspectors.

EXHIBIT 2-4. ***Typical Repair Sections – Alternative A***



Typical Deck Section (Repair)



Typical Pier Section (Repair)

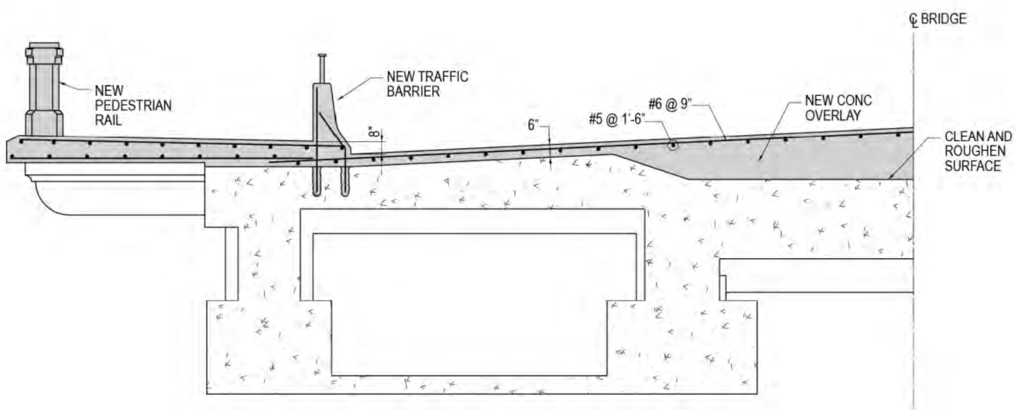
2.3.2 Alternative B

This alternative repairs the structure to provide structural capacity for dead and live loads, and includes sufficient corrosion mitigation to preserve the bridge for approximately 20 years before significant repair or rehabilitation is required. The geometric configuration of the traffic portion of the bridge will remain unchanged, but the sidewalks will be widened from 5.5 feet clear to 10 feet clear. Exhibit 2-5 illustrates repair elements to the bridge superstructure. Exhibits C-6 through C-9 in Appendix C depict the work items included in this alternative.

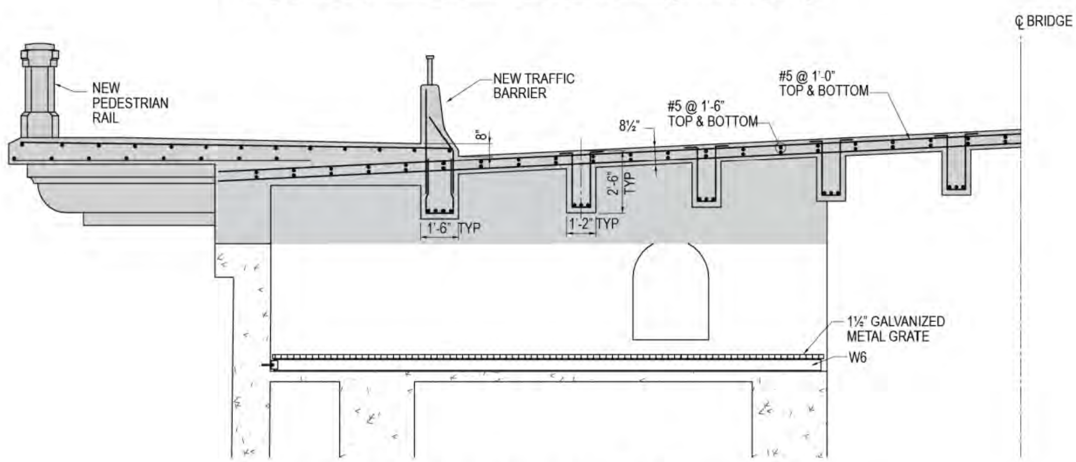
All restoration of the bridge will be the same as defined for Alternative 1, including installation of a concrete overlay, replacement of the slab and stringers at the pier tops, and repair and corrosion mitigation at the bridge deck system.

This alternative includes removal of the entire sidewalk and the deck from the face of the spandrel walls to the tip of the deck overhang. This section of the deck will be replaced and extended 4.5 feet beyond the original edge of deck.

EXHIBIT 2-5. ***Typical Repair Sections – Alternative B***



Typical Deck Section (Repair)



Typical Pier Section (Repair)

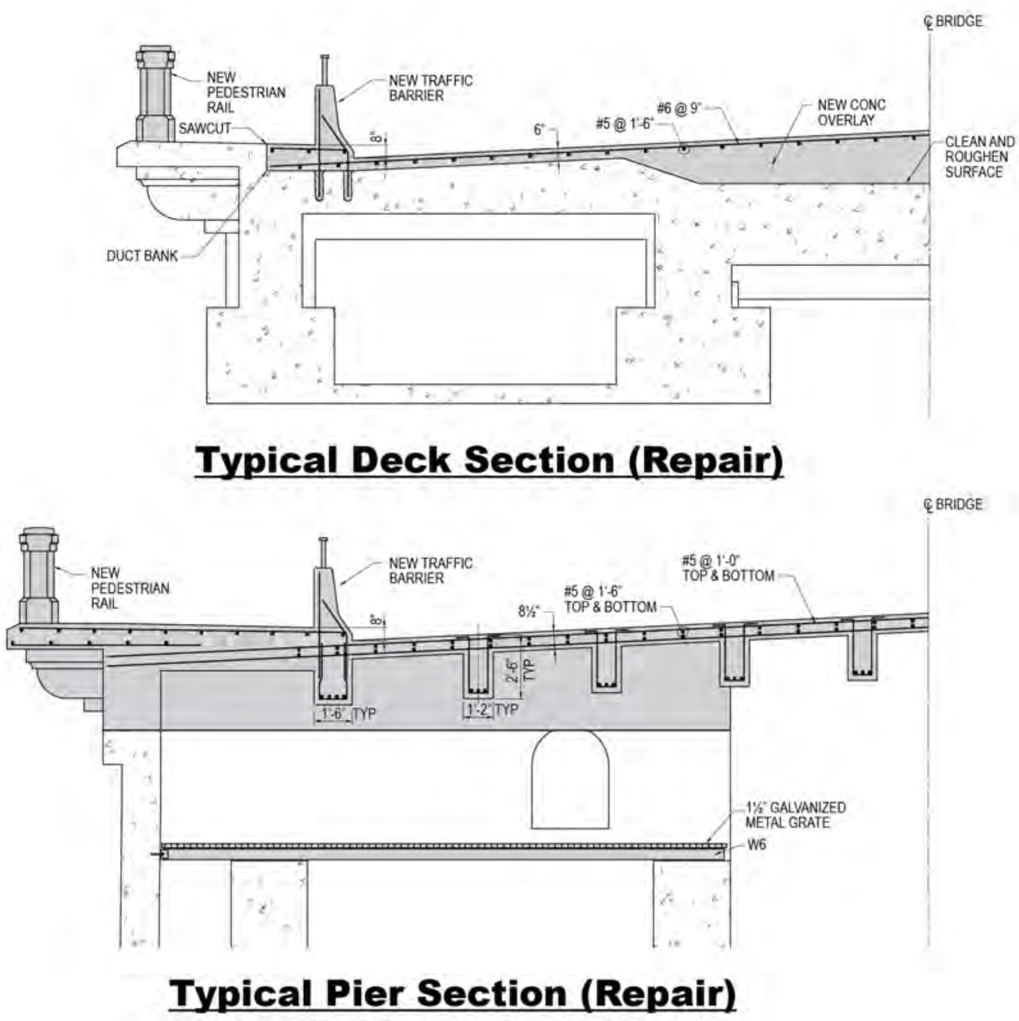
2.3.3 Alternative C

This alternative repairs the structure to provide structural capacity for dead and live loads, and includes sufficient corrosion mitigation to preserve the bridge for an extended time before significant repair or rehabilitation is required. The geometric configuration of the bridge will remain unchanged. Exhibit 2-6 illustrates repair elements to the bridge superstructure. Exhibits C-10 through C-13 in Appendix C depict the work items included in this alternative.

Work items include all items in Alternative A. The size and quantity of the passive anodes in the deck framing repairs may be modified to increase the life of the corrosion mitigation.

Work in addition to the repairs and strengthening of Alternative A consists of performing ECE on the exterior arches and the faces of the piers above the arch springlines. ECE requires identification of any reinforcing steel or tie wires that is exposed at the surface of the concrete. Exposed steel must be coated to isolate it from the anode system. After completion of the ECE, all anodes and steel isolation materials will be removed from the structure.

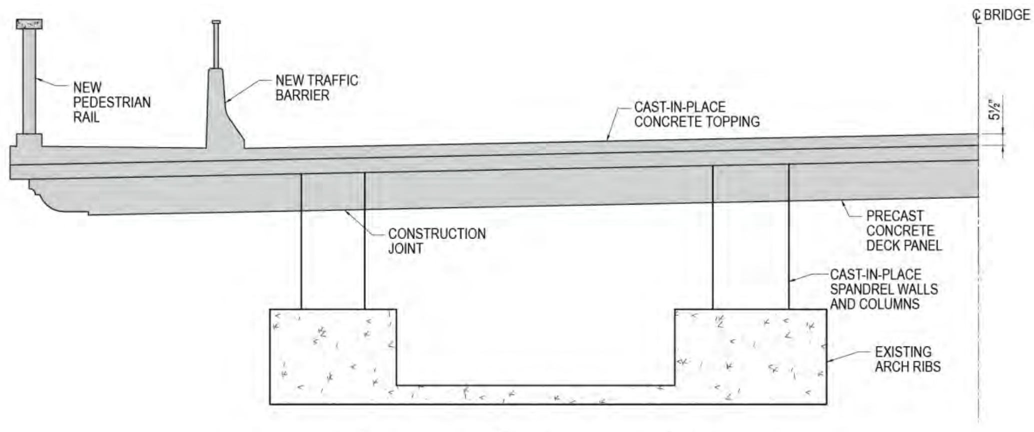
EXHIBIT 2-6. *Typical Repair Sections – Alternative C*

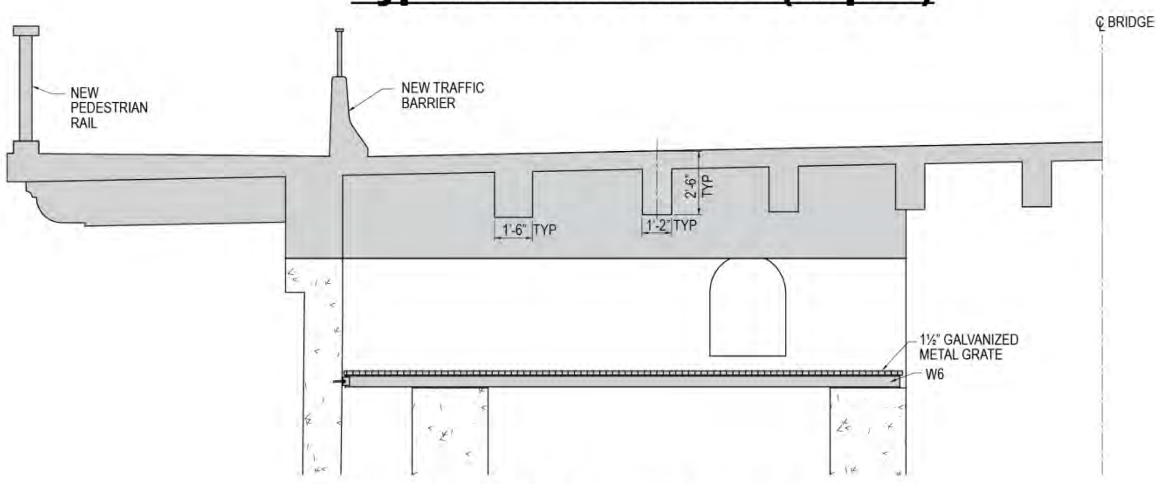


2.3.4 Alternative D

This alternative widens the superstructure to provide 58 feet curb to curb. This curb to curb distance provides four 12-foot-wide lanes and 5-foot bicycle lanes. The width of the sidewalks is increased by half a foot. Exhibit 2-7 illustrates repair elements to the bridge superstructure. Exhibits C-14 through C-17 in Appendix C depict the configuration of this alternative.

EXHIBIT 2-7. ***Typical Repair Sections – Alternative D***





The entire deck, deck framing, and spandrel columns and walls are removed. The spandrel walls and spandrel columns are cast in place, and a precast deck panel system is anchored to the spandrels. This precast system replicates the original floor beam system, but without the need to construct falsework and form the deck in place. A reinforced concrete deck is cast over the precast to tie the deck together and to produce a smooth riding surface.

The top of the pier caps are removed and replaced, just as described for the other alternatives. Consideration may be given during detailed design to retaining the center portion of the pier caps.

A concrete traffic barrier is cast between the traffic and the sidewalk. A new concrete pedestrian rail matching the configuration of the original rail is precast and attached to the bridge deck.

The existing deck drainage system will be replaced. The original concept of deck drains and concealing the drain pipes inside the piers will be retained.

Existing utilities on the bridge must be accommodated during construction. These utilities include critical communications infrastructure (twelve 4-inch conduits) that must be maintained for use during construction, as well as two 12-inch water mains.

ECE will be performed on the exterior arches and the faces of the piers above the arch springlines. ECE requires identification of any reinforcing steel or tie wires that is exposed at the surface of the concrete. Exposed steel must be coated to isolate it from the anode system. After completion of the ECE, all anodes and steel isolation materials will be removed from the structure.

2.3.5 Alternative E

This alternative widens the superstructure to provide 58 feet curb to curb. This curb to curb distance provides two 14-foot-wide lanes that include provision for future LRT, and two 15-foot shared use lanes. The LRT tracks are flush with the surface of the bridge deck, so that the lanes can be shared by motor vehicles and LRT vehicles. The width of the sidewalks is increased by half a foot. Exhibit 2-8 illustrates repair elements to the bridge superstructure. Exhibits C-18 through C-21 in Appendix C depict the configuration of this alternative.

The entire deck, deck framing, and spandrel columns and walls are removed. The spandrel walls and spandrel columns are cast in place, and a precast deck panel system is anchored to the spandrels. This precast system replicates the original floor beam system, but without the need to construct falsework and form the deck in place. A reinforced concrete deck is cast over the precast to tie the deck together and to produce a smooth riding surface.

The top of the pier caps are removed and replaced, just as described for the other alternatives. Consideration may be given during detailed design to retaining the center portion of the pier caps.

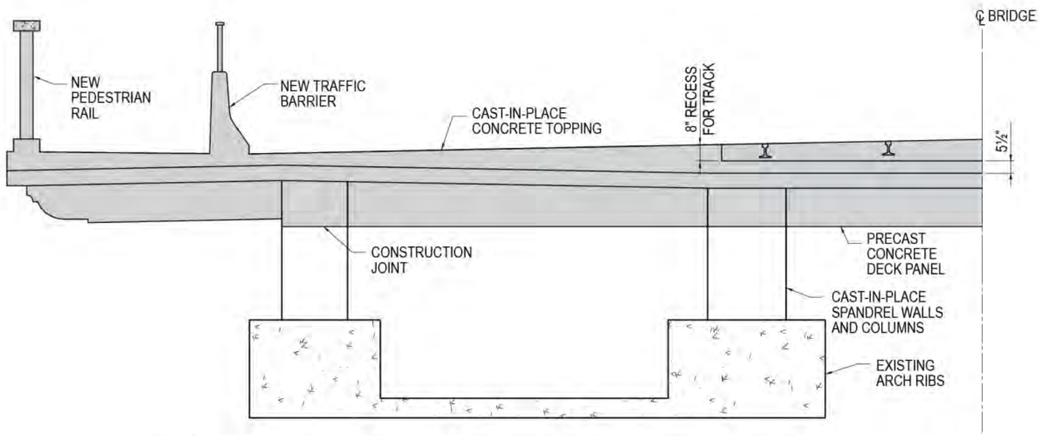
A concrete traffic barrier is cast between the traffic and the sidewalk. A new concrete pedestrian rail matching the configuration of the original rail is precast and attached to the bridge deck.

The existing deck drainage system will be replaced. The original concept of deck drains and concealing the drain pipes inside the piers will be retained.

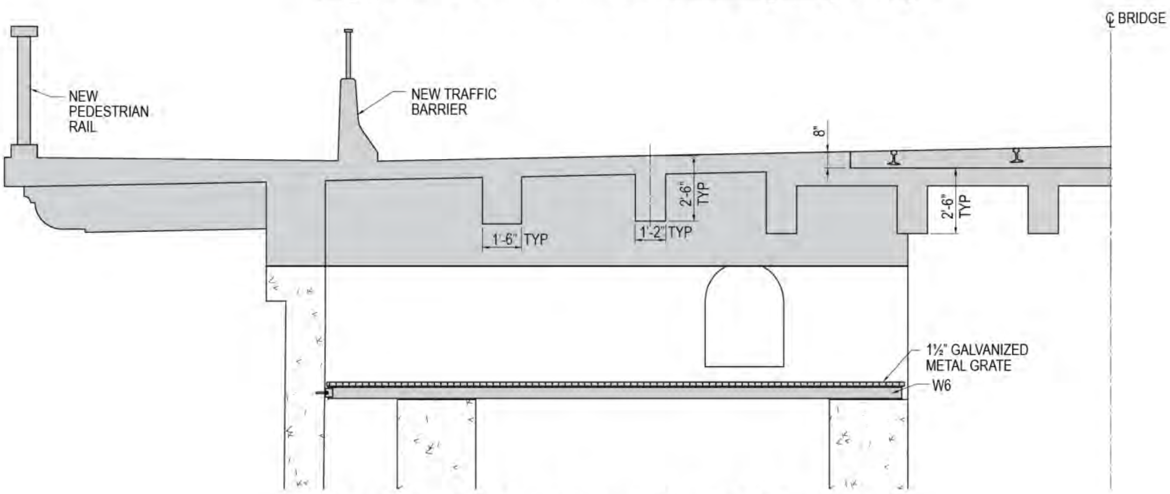
Existing utilities on the bridge must be accommodated during construction. Existing utilities on the bridge must be accommodated during construction. These utilities include critical communications infrastructure (12, 4-inch conduits) that must be maintained for use during construction, as well as two 12-inch water mains.

ECE will be performed on the exterior arches and the faces of the piers above the arch springlines. ECE requires identification of any reinforcing steel or tie wires that is exposed at the surface of the concrete. Exposed steel must be coated to isolate it from the anode system. After completion of the ECE, all anodes and steel isolation materials will be removed from the structure.

EXHIBIT 2-8. ***Typical Repair Sections – Alternative E***



Typical Deck Section (Repair)



Typical Pier Section (Repair)

2.4 Construction Costs

Concept-level construction cost estimates have been developed for each alternative. These estimates are intended to facilitate comparisons of alternatives, and for use in project programming.

These estimates are Class 4 estimates, as defined by the American Society of Cost Engineers. As such, the expected accuracy is on the order of 3 to 12 times the accuracy of an estimate based on completed plans and estimates. In other words, the +/- range of accuracy of a Class 4 estimate is 3 to 12 times greater than for an estimate based on completed plans and specifications.

Detailed cost estimates are presented in Appendix D. Exhibit 2-9 illustrates construction cost estimates, rounded to the nearest $100,000, along with associated accuracy ranges.

EXHIBIT 2-9. *Concept-Level Construction Cost Summary*

Alternative	Construction Cost ($)	Range of Accuracy ($)
Alternative A—20-Year Design Life	15.4 million	13 to 20 million
Alternative B—20-Year Design Life with Expanded Sidewalks	16.8 million	13.5 to 22 million
Alternative C—Long-Term Design Life	22.4 million	18 to 29 million
Alternative D—Long-Term Design Life with Four Lanes and Bike Lanes	27.2 million	22 to 35 million
Alternative E—Long-Term Design Life with Four Lanes and Future LRT	27.2 million	22 to 35 million

2.5 Life Cycle Cost Analysis

An evaluation of the costs of the rehabilitation alternatives over time are presented in the Technical Memorandum *Latah Creek Bridge – Bridge Life Cycle Cost Analysis*, April 2012. This life cycle cost analysis is included in Appendix E. For this evaluation the present worth of the construction alternatives, including the effect of future costs for maintenance and repair, are estimated and compared to determine which alternative is most cost-effective.

Life cycle costs are estimated for a common time period. For convenience, this time period is taken to be 20 years, which is the life of the shortest alternative. A residual value is assigned to those alternatives (C, D and E) with lives extending beyond 20 years in order to account for the difference in effective life of the various alternatives. For the 20-year design life alternatives (A and B), the residual value of the structure at the end of 20 years is taken to be nil. Demolition costs will be included in the construction of a replacement structure.

The life cycle cost analysis evaluates the cost of the alternatives, but does not address the differences in value among Alternatives A, B, and C, and Alternatives C and D. Alternatives C and D provide additional traffic capacity.

In the life cycle cost analysis, the five alternatives are condensed into three separate concepts. Alternatives A and B are considered essentially the same, and so Alternative B is not considered in the life cycle cost analysis. Costs for Alternatives D and E are virtually identical, and so are combined in the life cycle cost analysis.

Exhibit 2-10 shows the alternatives, the capital construction costs, and the relative life cycle costs for the alternatives.

EXHIBIT 2-10. *Capital and Life-Cycle Costs*

Alternative	Capital Construction Cost ($)	Present Value Life Cycle Cost ($)
Alternatives A and B—20-Year Design Life	15.4 million	15.5 million
Alternative C—Long-Term Design Life	22.4 million	13.2 million
Alternative D and E—Long-Term Design Life with Four Lanes and Multi-modal	27.2 million	15.3 million

Life cycle cost analysis is dependent on assumptions about future performance and future costs, including the effective cost of money and the timing and cost of future expenditures. The assumptions are evaluated by conducting a sensitivity analysis in which key analysis variables are modified. In the event that changes in assumptions do not change the order of ranking of the alternatives, confidence in the analysis is good. If changes in the assumptions result in changes in the ranking of the alternatives the likelihood of changes must be considered when programming actions based on the life cycle costs.

The base analysis indicates that the long-term design life is more cost-effective than the short-term design life. This conclusion holds up when considering potential changes in the cost of money over time—whether the cost of money increases or decreases. However, if the current rehabilitation allows the life of the existing bridge to be extended from the assumed 20 years to 30 years, then the short-term design life becomes somewhat more economical.

Extending the life of the bridge under Alternatives A and B contains inherently more risk, as the potential for unplanned bridge closure increases as the structure ages. The cost of this risk is not included in the life cycle cost comparisons, but the risk should be considered when selecting an alternative to carry forward.

In all cases the life cycle cost of Alternatives D and E is greater than the life cycle cost of Alternative C. This is the result of the increased first cost of Alternatives D and E, combined with very similar future costs of these three alternatives. If, however, the future costs of ECE for Alternatives C, D, and E can be deferred from Year 35 to Year 50, the difference in life cycle costs of these alternatives is reduced.

2.6 Construction Duration

Estimates of the time to construct each alternative have been prepared from a contractor's perspective to aid in evaluating the impact of the construction on the local transportation system. Time to construct also has an impact on the total cost to construct.

Construction schedules presume that the bridge will be totally closed during construction. Staging to maintain traffic on the bridge, which would have a tremendous effect on the construction schedule, will not be required.

The schedule presumes also that environmental and permit requirements will not unduly restrict working hours or working seasons. The contractor will be able to work whenever weather permits. For purposes of estimating project duration, a winter shut-down is defined for November through February.

As with the construction cost estimates, the schedules are concept-level only. Workable construction sequences and durations for major activities have been developed in order to determine total working time required to complete the construction. Actual sequencing and methods may vary from those assumed herein, but the overall project durations presented are expected to be accurate to the quarter-year.

Construction schedules are presented in Appendix F. Exhibit 2-11 summarizes total construction durations, including the effects of winter shut-downs.

EXHIBIT 2-11. *Construction Duration*

Alternative	Construction Duration (months)
Alternative A – 20-Year Design Life	17
Alternative B – 20-Year Design Life with Expanded Sidewalks	19
Alternative C – Long-Term Design Life	18
Alternative D – Long-Term Design Life with Four Lanes and Bike Lanes	20
Alternative E – Long-Term Design Life with Four Lanes and Future LRT	20

Section 3

Environmental Considerations

3.1 Introduction and Purpose

Baseline environmental issues related to the existing Latah Bridge were identified and summarized in the *Baseline Conditions Summary* document. This section summarizes a preliminary evaluation and comparison of these environmental issues for each of the Latah Bridge rehabilitation alternatives. Detailed analysis of potential environmental impacts of the preferred rehabilitation option that will be selected at some future date would be conducted under the National Environmental Policy Act (NEPA) and under the State Environmental Policy Act (SEPA). The alternatives evaluated in this study are:

- Alternative A—20 Year Design Life
- Alternative B—20 Year Design Life with Expanded Sidewalks
- Alternative C—Long-Term Design Life
- Alternative D—Long-Term Design Life with Four Lanes and Bike Lanes
- Alternative E—Long-Term Design Life with Four Lanes and Future LRT

These alternatives were chosen to evaluate a range of structural and functional improvements to the bridge for the short-term (20 years) and for the long term (40 to 50 years). The alternatives evaluated include bridge improvements within the existing footprint of the bridge, widening the bridge for multi-use pathways, and further widening the bridge for standard traffic lane, bicycle facilities and provisions for future LRT.

3.2 Key Environmental Issues/Considerations

Exhibit 3-1 summarizes the environmental elements that are evaluated for projects in accordance with FHWA's list in T6640.8A and the primary issues of concern related to each element for a bridge rehabilitation project.

EXHIBIT 3-1. *Environmental Elements Reviewed Under NEPA/SEPA*

Environmental Element	Potential Topics of Concern for Bridge Rehabilitation Projects
Earth	Soil type, unstable soils, erosion, impervious surfaces, filling, grading
Air	Air emissions (dust, automobile, odors)
Water	Surface water (streams, water bodies, shorelines, filling and excavation, surface water withdrawals or diversions, 100-year floodplain) Groundwater (withdrawal, discharge to groundwater, critical aquifer recharge area (CARA), aquifer sensitive area [ASA]) Water runoff (runoff, stormwater, waste materials entering ground or surface waters)
Wildlife	Plants, animals, threatened and endangered species, habitat, wetlands, water body modification, migration route

EXHIBIT 3-1. *Environmental Elements Reviewed Under NEPA/SEPA*

Environmental Element	Potential Topics of Concern for Bridge Rehabilitation Projects
Energy and natural resources	Energy (electric, natural gas, oil, solar), natural resources (gas, oil, minerals), conservation
Environmental health	Exposure to toxic chemicals, risk of fire and explosion, spills, and hazardous waste sites. Also includes noise.
Land use and shoreline use/housing	Land use, zoning, comprehensive plan, shorelines, critical areas, displacement of people, housing, farmlands, coastal barriers and coastal zone impacts, and construction impacts
Visual impacts	Structure height, views, aesthetics, light and glare
Recreation	Displacement or impairment of recreational opportunities, wild and scenic rivers
Cultural resources	Historic and cultural places, archaeological sites
Transportation	Access, public transit, parking, vehicular trips and peak, impacts to existing infrastructure, considerations relating to pedestrians and bicyclists, local short-term uses vs. long-term productivity
Public Services	Fire protection, police protection, health care, schools, other
Energy and natural resources	Electrical, natural gas, water, refuse, telephone, and/or sanitary sewer service, septic system, irreversible and irretrievable commitment of resources
Environmental justice	Minority and low-income populations, relocation
Social and economic	Adverse or beneficial changes to the existing socioeconomic conditions, joint development

Of these elements, the primary potential environmental issues identified in the Latah Bridge Rehabilitation Study are related to the following:

- **Water.** Potential impacts to Latah Creek during bridge construction and stormwater management during bridge operations
- **Land use.** Construction work and bridge improvements would be within a protected shorelines area and a public park (High Bridge Park) is partially within the project footprint. Right-of-way (ROW) acquisition that might be required for improvements to bridge approaches would change land use from existing conditions.
- **Recreation**. Because High Bridge Park lies underneath the bridge and is within the project area, and because of the historic properties in the project vicinity,

Photo from Latah Bridge deck, looking north. Environmental context includes Latah Creek and High Bridge Park below the structure.

compliance with Section 4(f) of the Department of Transportation Act is anticipated, especially if federal funding is acquired. A Section 4(f) evaluation would require consultation with the City of Spokane Parks & Recreation Department. The goals of the evaluation and consultation would be to determine whether any constructive use of 4(f) properties would occur and to (1) avoid or minimize temporary use of the park for project purposes during bridge rehabilitation, (2) maintain public access to and use of the park safely during rehabilitation, and (3) avoid permanent impacts to the park.

- **Cultural resources.** Latah Bridge is a historic bridge that was listed in the National Register of Historic Places (NRHP) on July 16, 1982, which makes it also listed in the Washington Heritage Register (WHR). The bridge was documented as part of an inventory of bridges, trestles and aqueducts in the state of Washington, and then listed in the NRHP as part of "Bridges and Tunnels in Washington State." The bridge was documented in 1979 on a Historic American Engineering Record form.

  Two historic districts near the Latah Bridge have been listed in the NRHP and the WHR: Browne's Addition Historic District and Ninth Avenue Historic District. In addition to evaluation of effects on the bridge itself, consideration must also be given to effects of the project on the historic districts. These effects could be direct, indirect, or proximity-related and could include changes to the districts' viewsheds, noise effects, and effects related to project construction.

  Seven archaeological sites have been documented within a 0.5-mile search radius. One of these sites is an Indian campsite located near Latah Bridge. Therefore, a high potential exists for intact subsurface cultural deposits within the project area.

Photo from High Bridge Park, looking northeast. Latah Bridge's aesthetics and history are environmental considerations.

- **Aesthetics/lighting and glare.** Latah Bridge has pleasing aesthetic characteristics, with prominent arches supporting the bridge and an aesthetically pleasing balustrade (bridge railing) that lines each side of the bridge. Roadway illumination is provided on the bridge, although a consistent lighting level is not provided and the original light fixtures have been replaced with modern cobrahead fixtures. The architectural and historic elements of the bridge should be preserved in compliance with Section 106 of the National Historic Preservation Act of 1966 (as amended). This is primarily a concern for alternatives that widen the existing bridge, because widening could change the appearance and historic architectural elements of the bridge.

- **Wildlife.** Bats are known to use the bridge for roosting and peregrine falcons have been known to use the bridge for nesting in the past

- **Transportation.** Temporary impacts to traffic and other transportation modes (pedestrians, bicyclists, and transit) would occur during construction because it is anticipated that the bridge would be closed to the public for up to 2 years.

On the basis of the evaluation of topics of concern for each NEPA/SEPA environmental element listed in Exhibit 3-1, all of the action alternatives are similar in that, with appropriate mitigation, they would have only minor impacts on the following environmental elements:

- **Earth.** All alternatives are at the same location as the existing bridge and thus have similar geologic and soil conditions. Alternatives C, D, and E require access to the piers, and access to and shoring for the abutments, which would increase potential risk for erosion. However, it is assumed that best management practices would be employed to control and minimize erosion to the extent that there would be no significant differences among the alternatives.
- **Air.** All alternatives may require a hot-spot analysis at Sunset Boulevard and Government Way, depending on the project impacts to the intersection operations. The results of this analysis should be similar for all alternatives because the traffic conditions are the same, ultimately restoring four lanes of traffic to the bridge roadway segment.
- **Environmental health** (includes noise and hazardous materials):
  - **Noise.** All alternatives are anticipated to generate similar noise levels. A noise analysis may be required to evaluate noise impacts to High Bridge Park, the historic districts or to the surrounding community during construction and operations. However, because anticipated noise generated from the rehabilitated bridge should not be any greater than it would have been when the existing bridge was open to four lanes of traffic, the impacts are expected to be low for all alternatives.
  - **Hazardous materials.** Nearby properties would be evaluated for past chemical or hazardous material uses to assess the potential for encountering soil or groundwater contaminants during construction. Because the alternatives are all within the same project footprint, this potential should be the same for all of them.
- **Energy and natural resources.** The alternatives that widen the bridge would generate more demolition material for disposal and consume more natural resources (concrete, steel, etc.) than those that would retain the existing bridge width. The additional disposal and consumption of materials required for widening the bridge would be evaluated quantitatively but is anticipated to be a relatively small increment.
- **Transportation.** All alternatives satisfy the purpose and need related to transportation, which is to rehabilitate the existing Latah Bridge so that it structurally accommodates required gravity loads for planned and forecast multimodal transportation demands. It is assumed that all alternatives would close the bridge during construction, which would produce the same temporary impact for all alternatives. A traffic management plan will be developed to manage detour traffic and operations throughout the temporary closure.
- **Public services and utilities.** No public schools, hospitals, or fire stations are located within or near the project area, and the project is not expected to require additional utility services. Therefore, public services and utilities would not be affected by any alternative. Because alternative emergency routes would remain available to public service providers, temporary bridge closure during rehabilitation should not adversely affect response times for emergency services under any alternative, but this should be confirmed. In any case, the response times would be the same for all alternatives.
- **Environmental justice.** Environmental justice evaluates impacts to minority and low-income populations resulting from the project to determine if a disproportionate impact is occurring to those populations. It is anticipated that environmental justice outcomes will be the same for all alternatives because with the bridge remaining at the same location, the populations potentially affected remain the same. Based on the 2000 Census, the Census Tract and Block Group where the project is located have a lower minority

concentration than the larger geographic area of Spokane. Also, less than 1 percent of the households were at poverty level (U.S. Census, American Fact Finder). However, if ROW acquisition is necessary for the bridge rehabilitation project, an evaluation may be needed to determine if properties proposed for acquisition are predominately minority and/or low income properties.

- **Social and economic elements.** The Latah Bridge serves as a non-freeway link between the main city metropolis and the residential, commercial, and industrial areas that lie west of Latah Creek. It also provides an alternative route to I-90 from the city center to Spokane Falls Community College, Northern Quest Casino, Fairchild Air Force Base, Spokane Interstate Airport, and the West Plains. All of the action alternatives would temporarily affect socioeconomic conditions while the bridge is closed during construction, and all would provide comparable socioeconomic benefits after the bridge is reopened. The NEPA/SEPA analysis will document these effects. Alternative E may provide an incremental socioeconomic benefit due to the provisions to accommodate future LRT.

3.3 Environmental Comparison of Bridge Rehabilitation Alternatives

On the basis of a preliminary review of existing conditions, Exhibit 3-2 presents a summary comparison of those environmental elements that have notable comparative differences among the alternatives: water, wildlife (bats, peregrine falcons, and fish), land use, architectural aesthetics, cultural resources, and recreation. These comparative differences are summarized in the following text.

3.3.1 Comparative Differences of Environmental Elements

Water Resources

The potential for short-term degradation of water quality during construction and shoreline impacts are higher with Alternatives C, D, and E because they require access to bridge piers via the Latah Valley floor. All alternatives would require netting or a method to collect falling debris from deck construction work. All alternatives would address improvements to the existing bridge stormwater collection system and would provide treatment. Such stormwater system improvements may be located in Latah Valley where collected bridge stormwater is currently released from the bridge piers.

Wildlife Protection

Wildlife protection includes protection of species and also of wildlife habitats that include wetlands. No federally listed endangered or threatened plant or animal species is documented as resident in the project area. Wildlife protection implemented for the bridge rehabilitation project would be focused on fish, bats and peregrine falcons, which are listed on the Washington State Department of Fish and Wildlife's *Priority Habitats and Species List.* Each is summarized as follows:

- **Fish.** The potential for harm to fish in Latah Creek would be higher with Alternatives C, D, and E because they require access to bridge piers in the Latah Valley.
- **Bats.** Townsend's big-eared bats are known to roost in the initial, enclosed bridge spans on both ends of the bridge. Roosting sites would not be impacted construction for Alternatives A, B, and C. Bat roosting sites will be temporarily lost during the construction of Alternatives D and E because the bridge superstructure that serves as a roosting site would be removed and replaced.

EXHIBIT 3-2. *Comparison of Key Environmental Elements*

Environmental Element	Alternative A (20-year design life; 62 feet wide, configuration remains the same)	Alternative B (20-year design life; 71 feet wide, has expanded sidewalks)	Alternative C (Long-term design life; 62 feet wide)	Alternative D (Long-term design life; 76 feet wide with four lanes and bike lanes)	Alternative E (Long-term design life; 76 feet wide with four lanes and future LRT)
Primary distinguishing features of alternatives	▪ Avoids need for access via and/or bridge work in Latah Valley (except for stormwater facilities). ▪ Bridge width remains the same at 62 feet wide overall. ▪ Improvements only on deck.	▪ Avoids need for access via and/or bridge work in Latah Valley (except for stormwater facilities). ▪ Bridge is widened 9 feet to 71 feet overall. ▪ Improvements only on deck.	▪ Contractor access to bridge piers/arches required in Latah Valley for ECE and minor repairs. ▪ Bridge width remains the same ▪ Improvements only on deck except for ECE.	▪ Contractor access to bridge piers/arches required in Latah Valley for ECE and minor repairs. ▪ Bridge is widened 14 feet to 76 feet overall. ▪ Requires removal of small arches and spandrels and ECE performed.	▪ Contractor access to bridge piers/arches required in Latah Valley for ECE and minor repairs. ▪ Bridge is widened 14 feet to 76 feet overall. ▪ Requires removal of small arches and spandrels and ECE performed.
Water resources (water quality protection)	▪ Less potential risk to impact water resources and permitting (shorelines, hydraulic project approval [HPA], floodplain, Section 404 and Section 401, channel migration zone) because avoids access via and/or work in valley floor. ▪ Less potential risk related to stormwater facilities because all stormwater generated will be at bridge deck level. ▪ Stormwater generated during operations will be the same as existing conditions. ▪ Bridge stormwater system improvements would include work in Latah Valley floor where stormwater is currently released from the piers.	▪ Less potential risk to impact water resources and permitting (shorelines, HPA, floodplain, Section 404 and Section 401, channel migration zone) because avoids access via and/or work in valley floor. ▪ Least potential risk related to stormwater facilities because all stormwater generated will be at bridge deck level. ▪ More stormwater collected during operations because of wider bridge. ▪ Bridge stormwater system improvements would include work in Latah Valley floor where stormwater is currently released from the piers.	▪ Higher potential risk to impact water resources because of access to and work in valley floor (access to the piers/arches). ▪ More potential risk of stormwater impacts during construction because of access via the Latah Valley floor. ▪ Stormwater generated during operations will be the same as existing conditions. ▪ Bridge stormwater system improvements would include work in Latah Valley floor where stormwater is currently released from the piers.	▪ Higher potential risk to impact water resources because of access via and work in valley floor (access to the piers/arches, and access to and shoring for the abutments). ▪ More potential risk of stormwater impacts during construction because of access via and/or work in Latah Valley floor. ▪ More stormwater collected during operations because of wider bridge. ▪ Bridge stormwater system improvements would include work in Latah Valley floor where stormwater is currently released from the piers.	▪ Higher potential risk to impact water resources because of access via and work in valley floor (access to the piers/arches, and access to and shoring for the abutments). ▪ More potential risk of stormwater impacts during construction because of access via and/or work in Latah Valley floor. ▪ More stormwater collected during operations because of wider bridge. ▪ Bridge stormwater system improvements would include work in Latah Valley floor where stormwater is currently released from the piers.

EXHIBIT 3-2. *Comparison of Key Environmental Elements*

Environmental Element	Alternative A (20-year design life; 62 feet wide, configuration remains the same)	Alternative B (20-year design life; 71 feet wide, has expanded sidewalks)	Alternative C (Long-term design life; 62 feet wide)	Alternative D (Long-term design life; 76 feet wide with four lanes and bike lanes)	Alternative E (Long-term design life; 76 feet wide with four lanes and future LRT)
Wildlife ***Bats***	▪ Minimized risk to bat roosting during construction. Roost area less disturbed than Alternatives D and E.	▪ Minimized risk to bat roosting during construction. Roost area less disturbed than Alternatives D and E.	▪ Minimized risk to bat roosting during construction. Roost area less disturbed than Alternatives D and E.	▪ Higher risk for potential impact to bats because the bat roosting area in approach spans are demolished and replaced during construction.	▪ Higher risk for potential impact to bats because the bat roosting area in approach spans are demolished and replaced during construction.
Falcons	▪ Lower risk for potential impact to falcons because of shorter construction schedule.	▪ Lower risk for potential impact to falcons because of shorter construction schedule.	▪ Moderate risk for potential impact to falcons because construction schedule is longer than 20-year life alternatives (Alternatives A and B), but not as long as the long term alternatives that include widening (Alternatives D and E).	▪ Higher risk for potential impact to falcons because of longer construction schedule.	▪ Higher risk for potential impact to falcons because of longer construction schedule.
Wetlands (field surveys have not been done to confirm absence)	▪ Less potential risk for wetlands disturbance because bridge work is only at deck level.	▪ Less potential risk for wetlands disturbance because bridge work is only at deck level	▪ Higher potential risk for wetlands disturbance because of access via Latah Valley floor.	▪ Higher potential risk for wetlands disturbance because of access via and/or work in Latah Valley floor.	▪ Higher potential risk for wetlands disturbance because of access via and/or work in Latah Valley floor.
Land use (shorelines, ROW)	▪ Less potential risk for land use permitting requirements because bridge work is only at deck level. ▪ ROW needs are anticipated to be less than Alternatives B, D and E because the bridge width remains the same (but approach improvements may require ROW acquisition).	▪ Less potential risk for land use permitting requirements because bridge work is only at deck level. ▪ ROW needs are more than Alternative A but less than Alternatives D and E because the bridge will be widened but not as much as for Alternatives D and E.	▪ Higher potential risk for land use permitting requirements because of access via and/or work in Latah Valley floor. ▪ ROW needs are anticipated to be the same as Alternative A because the bridge width remains the same (approach improvements may require ROW acquisition).	▪ Higher potential risk for land use permitting requirements because of access via and/or work in Latah Valley floor. ▪ ROW needs are anticipated to be the highest because the bridge is widened the most.	▪ Higher potential risk for land use permitting requirements because of access via and/or work in Latah Valley floor ▪ ROW needs are anticipated to be the highest because the bridge is widened the most.

EXHIBIT 3-2. *Comparison of Key Environmental Elements*

Environmental Element	Alternative A (20-year design life; 62 feet wide, configuration remains the same)	Alternative B (20-year design life; 71 feet wide, has expanded sidewalks)	Alternative C (Long-term design life; 62 feet wide)	Alternative D (Long-term design life; 76 feet wide with four lanes and bike lanes)	Alternative E (Long-term design life; 76 feet wide with four lanes and future LRT)
Historic bridge architectural aesthetics	▪ Potential for no adverse effect because there is no change in bridge appearance. ▪ Arches are not redone (not removed and restored). ▪ Balustrades would be removed, replicated, and replaced.	▪ Potential for no adverse effect from widened bridge because widening is only 9 feet overall ▪ Will have some visual effect and may cause some shadow. ▪ Due to size and scale of the bridge and distance from which it is generally viewed, the visual change will be minor and difficult to discern. ▪ Balustrades would be removed, replicated, and replaced ▪ Arches are not redone (not removed and restored).	▪ Potential for no adverse effect because there is no change in bridge appearance. ▪ Arches are not redone (not removed and restored). ▪ Balustrades would be removed, replicated, and replaced.	▪ Potential for adverse effect which would require a Memorandum of Agreement ▪ More visual effect than Alternative B because of wider bridge. ▪ Balustrades would be removed, replicated, and replaced ▪ The small arches and spandrels would be removed and replaced. ▪ Need further evaluation (simulations would help show if the brackets and/or the top of the arches would be obscured, and if any shadows would be created).	▪ Potential for adverse effect which would require a Memorandum of Agreement ▪ More visual effect than Alternative B because of wider bridge. ▪ Balustrades would be removed, replicated, and replaced. ▪ The small arches and spandrels would be removed and replaced. ▪ Need further evaluation (simulations would help show if the brackets and/or the top of the arches would be obscured, and if any shadows would be created).
Cultural Resources	▪ Less potential risk for archeological findings because ground disturbance only at bridge deck level. ▪ Lower risk for potential impacts to potential Traditional Cultural Property (TCP).	▪ Less potential risk for archeological findings because ground disturbance only at bridge deck level. ▪ Lower risk for potential impacts to potential TCP.	▪ Higher potential risk for archeological findings. Ground disturbance in Latah Valley (access to the piers/arches and potential stormwater facilities). ▪ Higher risk for potential impact to TCP —need Tribal consultations.	▪ Higher potential risk for archeological findings. Ground disturbance in Latah Valley (access to the piers/arches, approach spans, access to and excavation/shoring for the abutments and potential stormwater facilities). ▪ Higher risk for potential impact to TCP—need Tribal consultations.	▪ Higher potential risk for archeological findings. Ground disturbance in Latah Valley (access to the piers/arches, approach spans, access to and excavation/shoring for the abutments and potential stormwater facilities). ▪ Higher risk for potential impact to TCP —need Tribal consultations.

EXHIBIT 3-2. *Comparison of Key Environmental Elements*

Environmental Element	Alternative A (20-year design life; 62 feet wide, configuration remains the same)	Alternative B (20-year design life; 71 feet wide, has expanded sidewalks)	Alternative C (Long-term design life; 62 feet wide)	Alternative D (Long-term design life; 76 feet wide with four lanes and bike lanes)	Alternative E (Long-term design life; 76 feet wide with four lanes and future LRT)
Recreation	▪ Least risk for potential impact to recreation at High Bridge Park because all work is done at deck level (however, need to prevent falling debris).	▪ Least risk for potential impact to recreation at High Bridge Park because all work is done at deck level (however, need to prevent falling debris).	▪ Higher risk for potential impact to recreational activities at High Bridge Park because of access via Latah Valley floor (in park lands). Park activities and use may continue but may need to be diverted around work area.	▪ Higher risk for potential impact to recreational activities at High Bridge Park because of access via Latah Valley floor (in park lands). Park activities and use may continue but may need to be diverted around work area.	▪ Higher risk for potential impact to recreational activities at High Bridge Park because of access via Latah Valley floor (in park lands). Park activities and use may continue but may need to be diverted around work area.

- **Peregrine falcons.** Peregrine falcons are not known to be currently nesting on the bridge but have nested on the bridge historically. Any nest could be removed or disturbed under any alternative, but more so with Alternatives D and E because of the removal of the spandrels and small arches that are directly above the large arches, where the falcons have nested in the past.
- **Wetlands.** No wetlands are listed on the National Wetlands Inventory (USFWS, 2012) in the project area and none are shown on the City Map website (City of Spokane, 2011a). Because the project area includes Latah Creek, however, jurisdictional wetlands are likely present. A field survey to identify the presence of wetlands has not yet been conducted; this would be done prior to construction of the selected alternative. If wetlands are present in the project area, potential impacts are more likely to result from the alternatives that require access to piers, arches, approach spans and construction of stormwater facilities within the Latah Valley floor.

Land Use

Land use and zoning are not anticipated to change as a result of any of the Latah Bridge rehabilitation alternatives. However, all alternatives would require shoreline permitting under the Shoreline Management Act, which regulates land use within the jurisdictional area of 200 feet from the ordinary high water mark of Latah Creek. Alternatives C, D, and E may have more permit requirements because access to bridge piers and construction required in the Latah Valley floor could temporarily affect factors such as erosion and water quality to a greater degree than the other alternatives where construction would be primarily on the bridge deck.

Potential ROW acquisition needs for Alternatives A and C are anticipated to be the same and less than for those alternatives that would widen the bridge (Alternatives B, D, and E). The wider the bridge, the more ROW may be needed, particularly on the east side, which may have to be reconfigured to transition traffic more easily on and off the bridge to the Sunset Road arterial and the intersection with Inland Empire Way.

Aesthetics, Lighting/Glare

Those alternatives that would widen the bridge would have a potential to affect bridge aesthetics. The widening could cause shadows or may obscure architectural features that are below the widened bridge deck; the wider the bridge, the greater the change. Therefore, because Alternatives A and C don’t change the appearance of the bridge, there would be no effect to bridge aesthetics. Alternative B may affect aesthetics due to the widened bridge deck. Alternatives D and E may affect the bridge aesthetics to a greater degree, due to the additional widening. Because the bridge’s mass and scale is so large, and because the bridge is usually viewed from a distance, changes resulting from a widened bridge deck may not be readily noticeable. Aesthetics will be part of the evaluation of effects to the historic districts that are near the bridge. Effects related to lighting and glare are expected to be similar for all alternatives.

Historic Bridge Architectural Elements

As an NRHP-listed historic property, any alternatives that would widen the bridge would fall under National Historic Preservation Act regulations. Design decisions that impact character defining features of the bridge (balustrades, spandrels, arches) will need to consider options that would preserve the original appearance of these elements. Alternatives A and C would likely be determined to not affect the historic integrity of the bridge. Alternatives B, D, and E that widen the bridge have greater potential to affect the historic integrity.

Cultural Resources

The potential for cultural resources impacts are greatest with Alternatives C, D, and E because of the construction work and access required in the Latah Creek Valley floor, but excavations are expected to be limited to the abutments and for potential stormwater facilities, and will be relatively shallow and confined. Alternatives D and E would have some potential for discovery of archeological findings because of ground disturbance where the bridge deck would be widened at the approaches. Alternatives A and B have the least potential for cultural resources impacts but as with all of the alternatives, the anticipated improvements to the current stormwater system may require shallow excavation in the valley floor and cultural deposits may be encountered where land is disturbed. All alternatives cross Latah Valley, and this valley may be within a TCP that may need special consideration based on Tribal concerns.

Recreation [Section 4(f)]

The potential for recreation impacts is greater with Alternatives C, D, and E because of the construction work and access required in the Latah Creek Valley floor within High Bridge Park. All alternatives under a NEPA environmental review would require a Section 4(f) evaluation to identify how impacts on recreational properties could be avoided, minimized, or otherwise mitigated. Travel or public use under the bridge may have to be detoured or temporarily closed to maintain public safety during bridge construction.

In addition to effects to recreational property, Section 4(f) applies if a historic bridge or highway is used by the project. A "use" is defined as an action that will impair the historic integrity of the bridge either by rehabilitation or demolition. Rehabilitation that does not impair the historic integrity of the bridge, determined in consultation with the Department of Archeology and Historic Preservation (DAHP), is not subject to Section 4(f) (FHWA1). For Alternatives A and C that would likely result in a Section 106 finding of No Adverse Effect because the bridge is not widened Section 4(f) would not apply for the use of the bridge. Alternative B may possibly have the same determination as A and C because the bridge is widened, but only by 9 feet (4.5 feet on each side of the bridge), which may not impair the historic integrity of the bridge.

Section 4(f) allows a “Programmatic Section 4(f) Evaluation and Approval for FHWA Projects that Necessitate the Use of Historic Bridges” for those bridges that must be rehabilitated or replaced in order to assure public safety, and for which there is no feasible and prudent alternative that maintains the historic integrity of the bridge. Use of the Programmatic process requires agreement among the FHWA, the SHPO, and the Advisory Council on Historic Preservation pursuant to Section 106 of the NHPA (FHWA2). For Alternatives D, and E, where there could be a Section 106 finding of Adverse Effect, the Programmatic could likely be used to demonstrate that there are no feasible and prudent alternatives to the proposed use of the historic bridge.

3.3.2 Analysis Conclusion

While none of the alternatives result in significant environmental impacts, Alternative A has the least potential for impacts as compared to the other rehabilitation alternatives. Alternative B has less impact potential than Alternatives C, D, and E because construction is confined to the bridge deck. Alternative C has less impact than Alternatives D and E because Alternative C does not have the additional impacts that come with widening the bridge. All alternatives would be required to avoid, minimize or otherwise mitigate adverse impacts consistent with regulatory requirements and best practices.

3.4 Agency Recommendations for Future Project Phases

Several meetings with local environmental agency staff occurred during this study to obtain input on their environmental concerns and obtain their recommendations for future consideration. These recommendations may be considered for project planning. No City commitments have been made at this phase of the project. Meeting notes are provided in Appendix A, and recommendations are summarized as follows:

- **Washington State Department of Fish and Wildlife (WDFW).** A meeting was held on April 13, 2012, with the City of Spokane, CH2M HILL and WDFW representative in attendance. The following suggestions/recommendations were provided by the WDFW representative:
  - Conduct an ongoing study of bats on the bridge to understand their habits, where they roost, when they are using the bridge, and other survival needs Note: City staff responded that the bridge could be made available to WDFW staff, researchers or graduate students to study the bats currently on the bridge.
  - Determine if an alternative site for hibernacula could be established nearby that would provide an alternative location for bats during bridge construction Note: This would take an understanding of what is needed to successfully support or build hibernacula, and identification of potential nearby sites that meets criteria yet to be determined.
  - Obtain information from other bridge projects in the Pacific Northwest and the United States to determine what was done to protect bats and their habitats on bridges during bridge construction or rehabilitation.
  - Provide WDFW with the opportunity to comment on any future habitat management plan, particularly as it relates to bats and peregrine falcons. Note: Falcons have not been observed on the bridge for years, but there was a time when nesting occurred on the large arches.
- **Spokane City/County Historic Preservation Office (Spokane HPO).** A meeting was held on April 13, 2012, with City of Spokane, CH2M HILL, and Spokane HPO representative in attendance. The following comments/recommendations were provided by the Spokane HPO representative:
  - The important architectural elements of the Latah Bridge are the arches, balustrade, and overlook areas on the deck. If an architectural change is made, the visual change would need to be evaluated from several different vantage points to determine its significance. A change to the character-defining features of the bridge may be considered a significant impact.
  - The regulations allow replacement of historic architectural features under certain conditions when the structure has deteriorated and is no longer as strong or as safe as it needs to be to meet regulatory standards and public safety.
  - The Spokane HPO will need to evaluate the visual impact of the alternative selected in the future. For those alternatives that change the bridge dimensions and features (such as widening), it is recommended that before and after simulations of how the wider bridge will look up close and at a distance would be useful for this evaluation. Simulations would also be important for obtaining input from the public on the aesthetic affect to the historic bridge.
  - The Spokane HPO will want to see examples of other bridges that have been widened to compare to the bridge proposal, and to see results of the evaluations conducted on those historic bridges where their appearances were altered.
  - The Monroe Street Bridge was considered a successful rehabilitation project of a historic bridge, and the Spokane HPO representative suggested that similar mitigation be included in the Latah Bridge rehabilitation project, including closing the bridge at the end of construction for a public party and installing interpretive signs designed with assistance from the Spokane HPO. Kristen said, “in some cases architectural elements look similar to the original, but are not exactly the same as the original. Compromises can be made when it makes sense to do so.”
  - Existing lights on the Latah Bridge do not have an old, historical look to them, but new lights could be chosen that would give that appearance. Historic photos should be reviewed when considering the final

lighting on the rehabilitated Latah Bridge. Sources to research include the Northwest Museum of Arts and Culture, Spokesman-Review, and websites highlighting historic photos.

- **Spokane Tribe of Indians.** A meeting was held on April 18, 2012, with the City of Spokane, CH2M HILL and Spokane Tribe representatives in attendance. The following comments/recommendations were provided by the Spokane Tribe representatives:
  - Because all ground disturbance activities have potential for disturbing archeological deposits of importance and known archeological deposits exist in the vicinity of the project, a cultural resource survey and report should address the potential for both historic and Tribal findings. Potential ground disturbance activities include improvements to the existing stormwater control system, widening the bridge deck and abutments, road approach improvements (which could result in additional excavation should contaminated soils be encountered from a known adjacent underground storage tank site that has been removed or from unknown contaminated sites), and future park trail improvements. Trail improvements would likely not be part of the bridge project unless it became a mitigation measure to compensate for potential recreational parkland impacts to High Bridge Park.
  - It would be desirable to have a TCP study conducted sometime in the future that would encompass a regional review of lands including those near High Bridge Park, Centennial Trail, Kendall Yards, Council Circle, and the City's Controlled Stormwater Overflow project. It was mentioned at that meeting that any cultural resources analysis for the Latah Bridge Rehabilitation project, including ethnicity and historical use, would likely be limited to only the bridge project area because funding for projects typically do not extend beyond project boundaries.
  - The most important thing that this future project could do is to include signage on the bridge, and, if trails are involved, signage along trails that would describe nearby archeological findings, the historic use of the property, and Tribal history and life in early times. Also, it was mentioned that the history and naming of "Hangman Creek" should be explained on a sign—including why that name was changed to Latah Creek, so that the earlier name and history are not erased from memory.
  - If a trail under the bridge is incorporated into the future project, care should be given to avoid a historic campsite that lies under the bridge. This trail would likely be on the valley's hillside and above the campsite, but locating above the known archeological site may still result in new findings during trail construction.
  - A burial site is located south of Latah Bridge and I-90 Bridge, above the Latah Creek Valley floor. It is recognized that the project is not near this burial site, but it serves as a reminder that these types of sacred findings are possible within the project area.
  - An Inadvertent Discovery Plan needs to be prepared before ground is disturbed or construction starts so that procedures are in place should any archeological discoveries be made.
  - Should any Tribal resources be found (burials, campsites, or other archeological findings), these resources need to be placed in the care of the Spokane Tribe of Indians.

Section 4

Recommendations and Implementation Strategies

4.1 Recommendations

This study has identified five feasible alternatives for rehabilitating the Latah Bridge. These five alternatives represent both short- and long-term solutions for extending the life of this historic structure and accommodating vital multimodal transportation needs. Further, the alternatives provide substantial flexibility to the City in terms of how the bridge deck may ultimately be configured to handle future multimodal needs over time.

It is beneficial to narrow down these alternatives such that the City may proceed confidently with securing funding for final design, environmental documentation, right-of-way (as needed), and construction of the rehabilitation project.

4.1.1 Preferred Bridge Rehabilitation Alternative

Narrowing down these alternatives is accomplished by: (1) determining if it is best for the City to pursue short- or long-term rehabilitation solutions, and (2) considering whether the bridge should be widened to meet future functional needs. This study considers two different bridge design life objectives. Alternatives A and B consider a relatively short design life—defined as 20 years beyond the rehabilitation. After the 20 years, major rehabilitation or replacement of the structure may be required. Alternatives C, D, and E are designed with the objective of a long-term life, defined as 40 to 50 years beyond the rehabilitation with primarily routine maintenance. After the 40 years the structure life can be extended with reasonable repair and rehabilitation effort, and replacement need not be contemplated. Evaluating short- vs. long-term scenarios is based on review of key criteria, including bridge functional requirements, operational risks, impacts to environment, and cost.

Upon reviewing these criteria, it is recommended that the City pursue rehabilitation solutions that are designed with long-term design life for the Latah Bridge, and include bridge widening to meet anticipated transportation needs.

The analysis of the criteria in the following text substantiates this recommendation.

Bridge Functional Requirements

The Latah Bridge currently provides capacity sufficient to meet today's traffic operations, freight transit, and pedestrian/bicycle needs. This study suggests that, in 18 years (by 2030), an additional lane will be required in each direction on the bridge to maintain acceptable traffic operations. Further, this study suggests that fixed route transit trips will steadily increase along this corridor, and that long-term rehabilitation solutions should consider loading requirements such that light rail transit is an option for the West Sunset Boulevard corridor. City bicycle and pedestrian plans demonstrate the importance of the Latah Bridge and Sunset Boulevard corridor to our community.

Long-term rehabilitation alternatives (D and E) provide adequate deck width on the bridge to meet these critical functional requirements. Long-term rehabilitation alternative C does not widen the bridge deck, and does not provide the City flexibility to meet forecast transportation needs.

Operational Risk

Extending the life of the bridge under short-term design life alternatives (A and B) contains inherently more risk, as the potential for unplanned bridge closure increases as the structure ages.

Implementation of long-term alternatives (C, D, and E) provide for rehabilitation and strengthening of the bridge elements that currently require it, and further provide for corrosion mitigation to preserve key bridge elements that are at risk for causing future operational issues.

Impacts to the Environment

Long design life alternatives (C, D, and E) involve more extensive demolition and replacement of bridge superstructure elements and corrosion protection throughout the bridge structure, and accordingly have the potential for impacting the environment to a greater degree than the short-term options. This study has identified possible greater impacts to water, wildlife, shorelines, historic bridge architecture, archeology, and recreation. It should be noted that these impacts are primarily focused on short-duration impacts during the rehabilitation construction period. With the possible exception of bridge architecture, long-term impacts to the environment do not differ substantially amongst the bridge alternatives.

Stakeholder and public outreach efforts throughout this study have solicited comments with regard to the rehabilitation concepts. People generally support the long-term approach to rehabilitating the Latah Bridge, primarily due to the appreciation of the longevity and architecture of the existing structure, coupled with the ability to accommodate the future's multi-modal transportation needs with a widened rehabilitated structure.

Cost

Although the capital costs for long-term design life alternatives (C, D, and E) are greater than for the short-term design life alternatives (A and B), the life cycle cost analysis indicates that the long-term design life alternatives are more cost-effective than the short-term alternatives. These results indicate that the greater capital cost required by the long-term life alternatives is balanced by the reduced long-term maintenance costs for these options. Short-term alternatives defer long-term rehabilitation capital costs to the future when costs may be higher, and increase risk that further bridge deterioration will result in additional rehabilitation measures. While Alternative C has a lower life cycle cost than Alternatives D and E,

From a cost strategy standpoint, it is important to recognize the typical timeline required to obtain grant funding for major capital projects such as this.

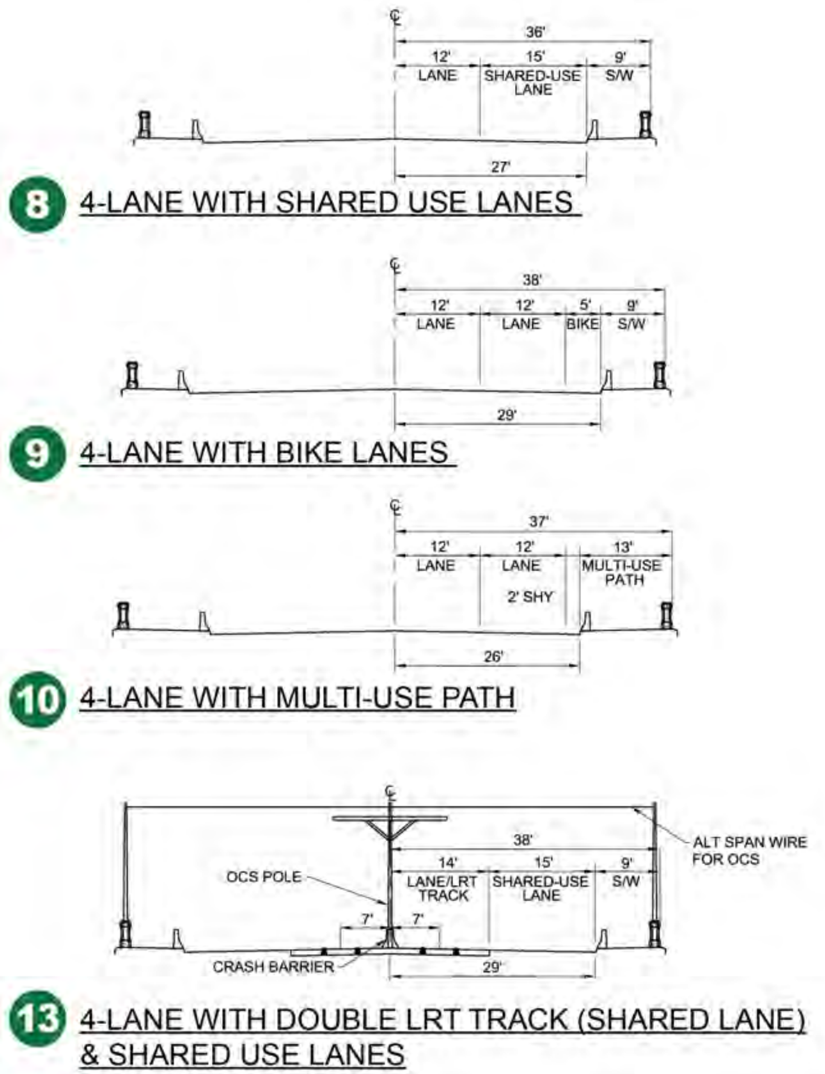
Grant funding for this significant of a project will likely need to be obtained from a number of different sources over time. Further, once the grant funding is secured, there is a lengthy timeline to develop final design, complete environmental documentation and permitting, obtain right-of-way (as needed), and construct the rehabilitation project. It has been the City's experience with recent major projects that this overall timeline can take between 8 and 15 years to fully implement the project. From this perspective, it is imperative that the long-term life alternatives are pursued. By the time that the implementation timeline has been accomplished, the bridge may be functionally obsolete (four lanes needed), and/or additional deterioration of the bridge may require more extensive rehabilitation than is currently recommended.

Summary

It is recommended that the City adopt long-term bridge rehabilitation Alternatives D or E that provide bridge deck widening sufficient to accommodate planned and forecast vehicles, pedestrians, bicyclists, transit, and freight demands with adequate lane widths and facilities that meet current standards.

Alternatives D and E have comparable capital costs and environmental impacts and differ primarily by how they accommodate future multi-modal transportation needs. By simply identifying that the City wishes to pursue these long-term life alternatives, the City has all of the key data needed to pursue funding to advance a rehabilitation project, and maintains flexibility to defer the decision on specific deck and lane configuration to the final design phase. Exhibit 4-1 illustrates the configurations that are available for future consideration, upon implementation of Alternatives D or E.

EXHIBIT 4-1. *Flexibility for Possible Deck Configurations*



4.1.2 Recommendations for Environmental and Permitting Activities

This section provides recommendations for NEPA/SEPA environmental evaluations and for permitting activities.

NEPA/SEPA Summary and Recommendations

Implementation of either Alternative D or E should be feasible provided that project planning considers avoidance, minimization, and other mitigation of impacts if necessary. Environmental elements with the highest potential for environmental impact have been identified and include water quality, wildlife, land use, architectural aesthetics, recreation, and cultural resources. Other environmental elements would be addressed in the future NEPA/SEPA environmental approval process, but they should not be critical to the approval of the project. The preliminary findings and suggested supporting documentation for NEPA/SEPA approvals and agency coordination, as identified in this report, are recommended to be considered for future project planning (Exhibit 4-2 and the associated “bullet” list). Those approvals that require a lengthy period of time to complete (for example, cultural resources, wildlife protection, Section 404, and recreational resources under Section 4(f)) are recommended to begin as soon as possible during project execution.

Exhibit 4-2 presents the environmental reports that are anticipated to meet compliance with regulatory requirements for the NEPA/SEPA evaluation process. Jurisdictional agencies that administer these regulations are also listed.

EXHIBIT 4-2. *Approvals and Reports Required for NEPA/SEPA**

Regulatory Compliance	Reports	Agencies
Clean Water Act	Construction Methodology Report and Wetlands Inventory	United States Army Corps of Engineers and Washington State Department of Ecology
Endangered Species Act Section 7	Biological Assessment	United States Fish and Wildlife Service
Department of Transportation Act Section 4(f)	Section 4(f) Evaluation and Park Mitigation Plan	Washington State Department of Transportation, Washington Department of Archeology and Historic Preservation, Federal Highway Administration, and Spokane City Parks Department
National Historic Preservation Act Section 106	Cultural Resources Report	Washington State Department of Archaeology and Historic Preservation, interested federally recognized Tribes, Spokane Historic Preservation Officer
Hazardous Materials	Hazardous Materials Report, Bridge Asbestos Testing Report	Washington State Department of Ecology and Washington State Department of Transportation
Clean Air Act	Hot Spot Analysis	Spokane Regional Transportation Council and Spokane Regional Clean Air Agency
Critical Areas Ordinance (geologic hazards)	Geotechnical Report	Washington State Department of Transportation

*This list may not be all inclusive of approvals that would be required for the future Latah Bridge Rehabilitation project.

As summarized in Exhibit 4-2, environmental elements subject to regulation will require the following supporting documentation:

- **Water Quality.** A construction methodology report which explains how construction would be conducted in a manner to minimize or avoid release of sediments into Latah Creek, and addresses the potential for erosion and spills during bridge construction.
- **Wildlife and Wetlands.** A biological assessment (BA) addressing the protection of fish and fish habitat in Latah Creek. A habitat management plan (HMP) may be required for protection of Townsend's big-eared bats and peregrine falcons. Because the project area includes Latah Creek, jurisdictional wetlands are likely present. A wetlands field survey and inventory will be required to confirm the presence or absence of wetlands within the project area. If wetlands are present, a Wetlands Delineation and Mitigation Plan will be prepared and followed.
- **Recreation.** A Section 4(f) evaluation which explains the existing functions, features, and attributes of High Bridge Park; how they would be temporarily or permanently affected by the project; and what would be done to avoid, minimize or otherwise mitigate impacts so that the public could continue to use High Bridge Park during construction to the same extent as before construction. The Section 4(f) evaluation and park mitigation plan would have to be agreed to and signed by the City Parks Department.

- **Cultural Resources.** An Area of Potential Effects (APE) must be prepared and submitted to appropriate agencies and Tribes for comment. Field surveys would be followed by a cultural resources report in compliance with Section 106 of the National Historic Preservation Act. The Cultural Resources Report would address historic, Tribal, and archeological issues related to the project. This report and its findings would require agreement and approval from WSDOT, DAHP, Spokane Historic Preservation Office (HPO), and relevant Tribes.

  Furthermore, the cultural resources report must conclude that there is a finding of No Adverse Effect to the bridge under Section 106, and this finding must receive concurrence from the DAHP in order for the bridge to not be subject to Section 4(f), in compliance with the "Programmatic Section 4(f) Evaluation and Approval for FHWA Projects that Necessitate the Use of Historic Bridges."

- **Other Reports.** Other brief reports may be necessary for hazardous materials, asbestos testing, air quality hot spot analyses, and geotechnical investigations.

Permitting Summary and Recommendations

Implementation of Alternatives D and E may be rigorous to permit because they may require access to bridge piers and arches and subsurface construction of stormwater facilities work in Latah Creek Valley and both widen the bridge, changing the appearance of an National Register of Historic Places NRHP-listed structure.

The preliminary findings and suggested supporting documentation for permitting approvals, as identified in this report, are recommended to be considered for future project planning (Exhibit 4-3 and associated "bullet" list). The greatest permit challenges would be related to the following:

- Sections 401 and 404 because of the water quality protection measures
- Floodplain Development Permit to accommodate possible access to bridge piers and arches within the floodplain
- Shorelines permit to accommodate construction of stormwater facilities within the Latah Creek Valley floor in addition to the bridge deck work and road approaches

Those permit approvals that require a lengthy period of time to complete (for example, Sections 401 and 404, Floodplain Development, and Shorelines) are recommended to begin as soon as possible after the NEPA/SEPA environmental review processes have concluded.

EXHIBIT 4-3. *Environmental Permits Required**

Permit or Approval*	Agencies
Hydraulic Project Approval (HPA)	Washington State Department of Fish & Wildlife
SEPA Environmental Checklist Approval	City of Spokane
Shorelines Permit	City of Spokane
Floodplain Development Permit and Critical Areas Ordinance Compliance	City of Spokane
Habitat Management Plan	City of Spokane
Section 401 Water Quality Certification	Washington State Department of Ecology
Section 404 Wetlands/Fill Permit	United States Army Corps of Engineers
NPDES General Construction Permit for Stormwater	Washington State Department of Ecology
Notice of Construction (air emissions)	Spokane Regional Clean Air Agency

*This permit list may not be all inclusive of all environmental permits and approvals required for the future Latah Bridge Rehabilitation project.

The permits listed in Exhibit 4-3 would require the following supporting documentation:

- **All Water Resources Permits [including a shorelines permit, floodplain development permit, Section 401 Water Quality Certification, and Section 404 (wetlands/fills) permit)].** All water resources permits would require the preparation of a Joint Aquatic Resources Permit Application, which would include the construction methodology and project figures showing the temporary construction activities and the permanent features anticipated as a result of the project that would be located within the Latah Creek shorelands, floodplain, and channel migration zone, and below the ordinary high water mark of Latah Creek.
- **Hydraulic Project Approval.** The purpose of an HPA is to protect fish and aquatic habitat. An HPA is required for any work within or over the ordinary high water mark, which includes work on the bridge deck. The bridge rehabilitation construction is anticipated to occur year-round. Because no construction is anticipated within the lands or waters below the ordinary high water mark of Latah Creek, a fish mitigation plan for work occurring in the creek and outside of the approved fish construction work window should not be necessary. WDFW would want to review and comment on any proposed Habitat Management Plan, particularly as it relates to bats and peregrine falcons (Karin Divens, 2012).
- **Floodplain Development Permit.** Because the entire bridge is located within the shorelines buffer area, all work on the bridge (including work within Latah Creek Valley or work above the valley) would require a shorelines permit. A shorelines permit would require a hydraulic analysis evaluating the potential for a rise in the Latah Creek elevation resulting from construction activities and from the rehabilitated bridge, particularly with regard to any potential adverse effect on flood frequency and extent.
- **NPDES General Construction Permit for Stormwater.** The NPDES Stormwater permit would require a stormwater pollution prevention plan (SWPPP); a temporary erosion sediment control (TESC) plan; a site drainage plan; and a spill prevention, control and countermeasure (SPCC) plan.
- **Notice of Construction (NOC) for air emissions.** A NOC may require calculation of anticipated air emissions from demolition and construction activities.

4.1.3 Companion Projects

Implementation of long-term rehabilitation alternatives for the Latah Bridge has direct impacts to the West Sunset Boulevard corridor. Improving the bridge capacity from two to four travel lanes, and setting the stage for possible future light rail transit all have direct geometric impacts on the roadway corridor immediately to the east and west of the bridge itself. A limited review of geometric considerations for implementation of the long-term bridge rehabilitation options was conducted as part of this Study. This analysis is documented in a technical memorandum, provided in Appendix G.

Widening of the Latah Bridge to accommodate four lanes of traffic (Alternative D) provides for a straightforward transition to the existing five-lane road configuration for Sunset Boulevard immediately west of the bridge. Directly east of the Latah Bridge, an existing underpass at Inland Empire Way creates a bottleneck because only one vehicle lane is provided in each direction. Further, existing horizontal geometry at this location is not favorable for 35-mph design speeds. As such, significant reconfiguration of the underpass at Inland Empire Way may need to be considered. Exhibit 4-4 (at the end of this section) illustrates in plan and section views how Sunset Boulevard and the Inland Empire Way underpass may be reconfigured to accommodate four lanes of traffic, bike lanes, and sidewalks on Sunset Boulevard near the Latah Bridge.

Introducing the option for future light rail transit on the Latah Bridge (Alternative E) and the Sunset Boulevard corridor will require substantial improvements to the corridor as the light rail infrastructure is implemented. While LRT is not currently planned, and if implemented, would likely be implemented by others, it is worthwhile for the City to understand how decisions for rehabilitating the Latah Bridge and approaches on Sunset Boulevard may impact the ability to implement LRT in the future.

West of the Latah Bridge, the existing five-lane roadway would need to be widened to allow for dual light rail tracks to occupy the center of the roadway. East of the Latah Bridge, the underpass at Inland Empire Way will likely need significant reconfiguration to allow LRT to continue at grade in the center of Sunset Boulevard. The underpass down to Inland Empire Way would need to be relocated outside of the Sunset Boulevard corridor to eliminate conflicts for potential LRT operations. Exhibit 4-5 (at the end of this section) illustrates in plan and section views how Sunset Boulevard and the Inland Empire Way underpass may be reconfigured to accommodate four lanes of traffic, dual-track light rail that shares the inside travel lanes, shared-use bike lanes, and sidewalks on Sunset Boulevard near the Latah Bridge.

In order to better understand potential impacts of selecting specific Latah Bridge deck configurations to the adjacent Sunset Boulevard corridor, and in particular the Inland Empire Way underpass, it is recommended that the City further study these scenarios and potential impacts and prior to the selection of a preferred deck configuration alternative. Further, the City may wish to consider whether it is beneficial or not to include potential geometric improvements to the Inland Empire Way underpass as part of the Latah Bridge Rehabilitation Project, or as a separate capital project.

4.2 Implementation Strategies

The following strategies are provided to guide the City in future phases of implementation of the Latah Bridge Rehabilitation Study. In particular, the next phase of the project would include Final Design and Environmental Documentation/Permitting. Guidance provided includes an outline of key final design scoping elements, and environmental documentation and permitting considerations.

4.2.1 Order of Work

Implementing long term rehabilitation Alternative D or E involves a number of work items that may be addressed in a single capital improvement project, or may be approached in a number of other ways to achieve the long term result. Recognizing that it will likely take a minimum of 5 to 10 years for the City to be able to implement a single capital project of this size and scope, it may be beneficial to break the work up in to smaller projects. For example, the ECE corrosion mitigation work in the arches and piers may be completed as an initial, stand-alone project before the other project elements are done. Performing the corrosion mitigation early has the benefit of reducing the amount of corrosion damage repair that may be needed.

Should routine inspections uncover rapidly deteriorating conditions in bridge deck or beam elements, these may need to be addressed prior to a complete deck replacement project.

4.2.2 Final Design Scoping Elements

Exhibit 4-6 summarizes the anticipated final design scope elements for the next phase of the Latah Bridge Rehabilitation Project and illustrates known issues and/or considerations associated with the elements.

EXHIBIT 4-6. *Final Design Scoping Elements*

Design Scope Element	Summary of Anticipated Work	Known Issues/Considerations
Survey and mapping	Design quality topographic survey and mapping should be accomplished to support final design.	• Limits of survey will correspond to the selected bridge rehabilitation alternative, and incorporate approach roadways to limits as needed to accomplish the work, including contractor staging areas, proposed rights-of-way, and temporary construction easements. • Laser mapping of the bridge structure itself may be beneficial for final design and modeling purposes.
Geotechnical investigations	Design will include: • Review of existing geotechnical data to understand if additional investigations and recommendations are needed for: o Stormwater facilities o Roadway cut/fill slopes o Pavement design (PCCP and HMA)	• Shallow rock is evident throughout project area and may be encountered during excavations, trenching.
Demolition	Design will include: • Existing pavements, curbs, sidewalks, and landscaping. • Latah Bridge superstructure elements	• Bridge demolition will accommodate required safety and environmental measures to limit impacts to park access and Latah Creek below the bridge.
Site preparation and grading	Design will include: • Approach roadway embankments	▪ Shallow rock is evident throughout project area and may be encountered during excavations, trenching.
Storm drainage	Design will include: • Minimal net new pollution generating impervious surfaces • Collection and conveyance from bridge structure • Water quality and control facilities • Construction stormwater control BMPs and SWPPP	• Underground sewer lines are located below the bridge structure, and may need to be located for design of stormwater facilities. • Shallow rock is evident throughout project area and may be encountered during excavations, trenching.
Roadways	Design will include: • New bridge approaches, approach slabs • Possible minor realignment of W. Sunset Boulevard approaches, as required.	• Preferred deck configuration for Latah Bridge may have impacts to W. Sunset Boulevard geometrics immediately east and west of the bridge, and require minor to significant approach roadway work. Extent of these impacts to be determined.
Utilities	Design will include: • Temporary relocation of communications infrastructure on bridge • Removal and/or replacement of City water facilities on Latah Bridge	• Communications infrastructure on the bridge is critical, and temporary disruptions to service must be minimized/avoided. Close coordination with CenturyLink is required. • Coordination with City Water and Wastewater Department for relocation/replacement of water facilities on bridge, and for location of sewer facilities under bridge. • Shallow rock is evident throughout project area and may be encountered during excavations, trenching.

EXHIBIT 4-6. *Final Design Scoping Elements*

Design Scope Element	Summary of Anticipated Work	Known Issues/Considerations
Bridge rehabilitation	Design will include: • Structural inspections, analysis and testing. • Detailed structural rehabilitation plans and specifications • Corrosion mitigation plans and specifications • Structural repair details and specifications	• Depending on rate of deterioration of the structure and timing for final design, additional detailed bridge inspections, analysis, and testing may be required prior to initiating final design.
Roadway lighting	Design will include: • Replacement of roadway lighting system	• Pedestrian-level lighting should be considered.
Landscaping	Design will include: • Restoration of areas disturbed during construction, including approaches, pier access routes, and construction staging areas.	• Drought tolerant/indigenous plantings
Environmental documentation and permitting	Scope will include: • SEPA Checklist preparation and coordination • NEPA Documentation	• See Section 4.1.2 for detailed Environmental Documentation and Permitting considerations.
Bid/award phase and construction management	Scope will include: • Pre-Bid and Pre-Construction Conferences • Addenda • Bid Opening and Review • Resident Engineering and Administration • Final Inspection, Closeout and Reporting	

Section 5 Works Cited and References Consulted

In addition to specific references found in the *Baseline Conditions Summary* document, include:

Abrahamson, Randy. 2012. Spokane Tribe of Indians. Conversation at Tribal coordination meeting on April 18, 2012.

CH2M HILL. 2012. *Latah Bridge Rehabilitation Study, Volume 1, Baseline Conditions Summary.* City of Spokane

Divens, Karin. 2012. Washington State Department of Fish and Wildlife Biologist. Conversation at agency coordination meeting on April 13, 2012.

Franco, Brea. 2012. Spokane Tribe of Indians. Conversation at Tribal coordination meeting on April 18, 2012.

Griffin, Kristen. 2012. Spokane/ Spokane County Historical Preservation Office. Conversation at agency coordination meeting on April 13, 2012.

United States Department of Transportation, Federal Highways Administration*.* 2012. *Environmental Review Toolkit, FHWA Technical Advisory T6640.8A* http://environment.fhwa.dot.gov/projdev/impta6640.asp

United States Department of Transportation, Federal Highways Administration. 2012. *Programmatic Section 4(f) Evaluation and Approval for FHWA Projects that Necessitate the Use of Historic Bridges.* http://www.environment.fhwa.dot.gov/projdev/4fbridge.asp