

Greenwood Avenue under Railroad

PREPARED FOR: City of Bend, OR
COPY TO: File
PREPARED BY: John Hinman
DATE: August 8, 2016
PROJECT NUMBER: 665109

Greenwood Avenue passes under two parallel two-span steel railroad bridges and a pair of more modern two-span prestressed precast highway bridges carrying Bend Parkway. Greenwood Avenue is a four-lane street with sidewalks on each side. Sidewalks under the railroad bridge are approximately four feet in width; the sidewalks under the Bend Parkway bridge are approximately 8 feet wide. All sidewalks are elevated above the street, and separated from the street by a chain-link fence. The existing bridge abutments constrain widening of the sidewalks away from the center of Greenwood Ave.

Project Purpose

The purpose of a project at the Greenwood Avenue Bridge is to improve pedestrian and bicyclist safety under the railroad and parkway bridges. The capacity and safety may be increased by adding width to sidewalks on each side of Greenwood Ave and by adding bike lanes.

Alternatives Considered

Alternative 1 – Widen Sidewalks Away from the Center of Greenwood Ave.

This alternative consists of leaving the configuration of Greenwood Avenue as it is, and widening the sidewalks under the railroad bridge to match the width of the sidewalks under the Bend parkway.

This alternative requires removing the existing railroad bridge and constructing a new bridge. The existing retaining wall supporting the sidewalks would remain in place, and the profile of the sidewalks would remain as is.

Replacing the railroad bridge involves removing a structure that may be eligible for the National Register of Historic Places because it is more than 50 years old, it uses relatively unusual details, and it is in comparatively original condition. Use of Federal funds for a project that has an adverse effect on a National Register-eligible bridge requires several steps, including investigation of the existing structure and the likely effects on the structure, and demonstration that no feasible alternatives will avoid or reduce adverse effects.

Replacing the railroad bridge will be quite expensive. Both the main line track bridge and the siding track bridge will require temporary bridges, called shoo-fly bridges, and relocation of a substantial amount of existing track. Railroad flagmen are required, controlling train movements and limiting access to the site by the bridge contractor.

The combination of effects on the potentially historic railroad structure and the cost of replacing a railroad bridge greatly increase the time required and the cost required to widen the sidewalks away from the centerline of Greenwood Avenue. These costs are likely to be prohibitive, as just the shoo-fly alone could be in excess of \$1 million.

Alternative 2 – Widen Sidewalks toward the Center of Greenwood Ave.

This alternative consists of reducing Greenwood Ave. from four lanes to two through lanes with a Greenwood Avenue “Road Diet” between approximately NW 2nd Street and NW Harrison Street. This provides the opportunity to provide 6-foot buffered bike lanes on Greenwood Avenue and widen the sidewalks to 8 feet under the existing railroad bridge. A minimum of 20 feet clear between the faces of the barriers must be provided for emergency access along Greenwood Avenue.

The widening would include new retaining walls at the inside edge of the new sidewalks. The existing fences, sidewalks slabs, and the top one to two feet of the existing retaining walls would be removed. Fill between the new and existing retaining walls would be placed, and a new sidewalk slab and fence installed. Modifications to the existing abutment wall transitions may be included to improve sight lines and to remove potential blind spots along the sidewalks.

Pavement, signing, and striping on Greenwood Avenue would be restored. Proposed striping includes a 6-foot buffered bicycle lane between the vehicular lanes and the sidewalk retaining walls.

Traffic restrictions would be required while construction is in progress.

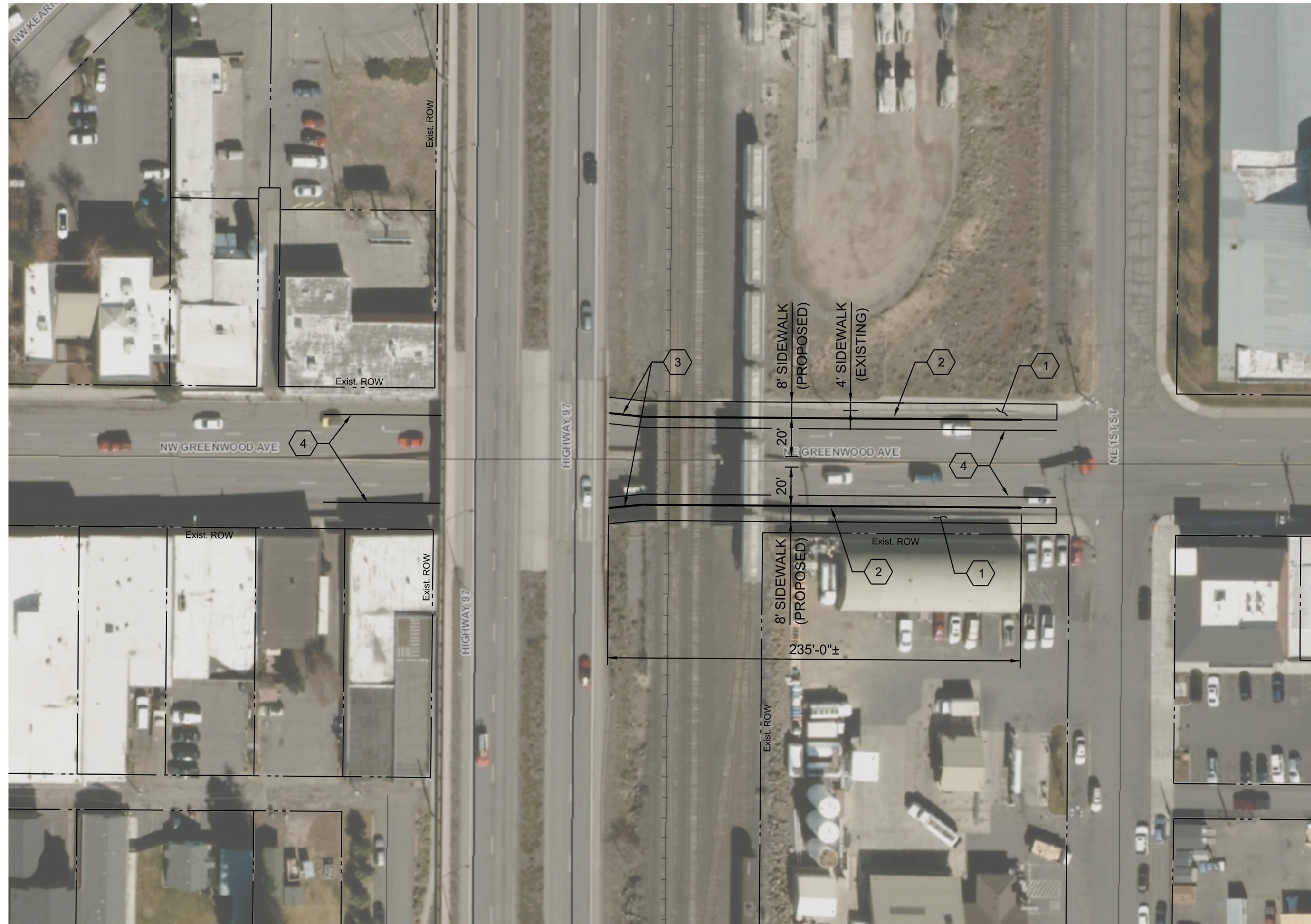
Cost of this alternative is approximately \$829,000, including design, construction, and construction engineering and inspection.

Recommendation

The recommendation is to pursue widening the Greenwood Avenue “Road Diet” concept that allows sidewalks towards the center of Greenwood Avenue. This includes reducing Greenwood to two lanes, and striping bicycle lanes between the sidewalk and the vehicular lanes.

Basis of Costs

Cost estimates included are Class 5 estimates as defined by ASTM E2516, *Standard Classification for Cost Estimate Classification System*. Class 5 estimates can be expected to have an accuracy range of approximately +100% to -50%.



KEY NOTES:

- 1 REMOVE EXISTING 4' WIDE SIDEWALK AND CONSTRUCT 8' WIDE SIDEWALK.
- 2 CONSTRUCT NEW RETAINING WALL.
- 3 TRANSITION WALL TO EXISTING.
- 4 STRIPE 6' WIDE BIKE LANE.

PLAN
1"=60'-0"

**GREENWOOD AVE,
UNDER BNSF**

Hawthorne Avenue Bridge

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The BNSF Railroad and the Bend Parkway cut through the City of Bend, limiting east-west movement of vehicles, bicycles, and pedestrians to a series of existing undercrossings. Many of these undercrossings have either substandard bicycle/pedestrian facilities or none at all.

No provisions are currently available for crossing at Hawthorne Avenue. 0.3 miles north of Hawthorne Avenue, the Greenwood Avenue undercrossing has only 4-foot-wide sidewalks, constrained between guardrail and the bridge abutments. The next undercrossing is NE Olney Avenue, 0.47 miles north of Hawthorne. NE Olney has bicycle lanes and narrow sidewalks.

0.27 miles south of Hawthorne Avenue, the Franklin Avenue undercrossing has narrow (5-foot-wide) and short (7-foot-tall) pedestrian tunnels and no bike lanes. The next undercrossing is Cascade Lakes Scenic Byway, 0.44 miles south of Hawthorne Avenue. Cascade Lakes Scenic byway has both sidewalks and bicycle lanes.

Project Purpose

The purpose of a project at Hawthorne Avenue Bridge is improvement of pedestrian and bicyclist safety by providing pedestrian and bicycle access across the BNSF Railroad and the Bend Parkway.

Alternatives Considered

Alternative 1 – Construct a Pedestrian Tunnel

This alternative consists of constructing a pedestrian underpass under both the BNSF right of way and the Bend Parkway. This tunnel would be approximately 200 to 210 feet long, portal to portal. Extensive ramps would be required to transition from existing ground to the tunnel invert.

Pedestrian tunnels are not viewed favorably in the United States. They are frequently isolated from view, which contributes to a perception that users may not be safe. The width of the tunnel can range from 10 feet to 14 feet, not including shy distance from the main path to the edges. Considering the length of the tunnel, a wider passageway would be desirable. The tunnel would have a clear height of 10 feet. The roof of the tunnel would be at least a few feet below the grade of the Bend Parkway and railroad.

Undercrossings at railroads are much more expensive than overcrossings, due to the need to construct shoofly structures and to rebuild tracks. Even without railroad involvement, excavation and construction of tunnels costs more than do bridge structures.

Underground structures require more maintenance than do overcrossings. Lighting, cleaning, security, drainage and dewatering, and ventilation are required. All of these elements add to construction costs and require on-going maintenance and operations costs.

Access to the tunnels would involve ramps with switchbacks get from the existing ground to the tunnel portals. Ramps must comply with the Americans with Disabilities Act (ADA). The ADA requires ramps to be constructed with 30-ft horizontal runs separated by horizontal landings that are at least 5 feet long. Each run can rise no more than 2.5 feet. Over multiple runs, this is an average slope of approximately 7%. To descend 18 feet below grade would require horizontal runs of ramps totaling at least 275 feet at each end.

Vacant lots are available to construct stairs and ramps. The lot on the west side is only about 0.10 acres, making it difficult to fit the necessary ramps into the available space. The lot on the east side is much larger, providing more options for layout of the ramps.

Tunnels can be extremely expensive per square foot of plan area. In addition, the involvement of the railroad increases engineering, agency review, and construction time and costs. However, the ramps leading to the portals would be less expensive per square foot than the tunnel. Cost of this alternative is over \$10,000,000, including design, construction, rail road involvement, and construction engineering and inspection.

Alternative 2 – Construct a Pedestrian Overcrossing

This alternative consists of constructing an overcrossing, or bridge, to provide for bicycle and pedestrian traffic. A combination of ramps and stairs would be provided for access to the bridge deck. Screens and barriers would be provided to protect the railroad and the Bend Parkway from objects thrown by pedestrians.

The overall length of the overcrossing would be approximately 200 to 210 feet. A minimum width of 12 feet clear is recommended, and a width of 14 to 16 feet is preferred. The bottom of the structure would be a minimum of 17'-6" feet above the Bend Parkway, and 23'-6" above the railroad tracks. A pier would be constructed between the Bend Parkway and the railroad. Additional piers would occur at each end of the main crossing and as needed to support the ramps.

As with the tunnel, ADA mandates the use of ramps to meet accessibility requirements. Ramps adjacent to the Bend Parkway must total approximately 275 feet in length in order to provide clearance over the street. Ramps adjacent to the railroad must total approximately 345 feet in order to provide clearance over the tracks. This normally requires switchback ramps and would require acquisition of the adjacent lots same as for the tunnel alternative.

Given the length of ramps and switchbacks required, some of the ramps will have to be only 10 feet wide, especially over the west lot. ADA does allow the ramps to be less wide than the main bridge. The plan view shows a possible scheme where the overcrossing is longer than needed for crossing the parkway and railroad. The additional length allows the ramps to occupy as much of the lot at the west end as possible.

Cost of this alternative is approximately \$5,000,000, including design, construction, rail road involvement, and construction engineering and inspection. This assumes that the square footage of the ramps would require structures comparable to the main spans (i.e., similar unit cost).

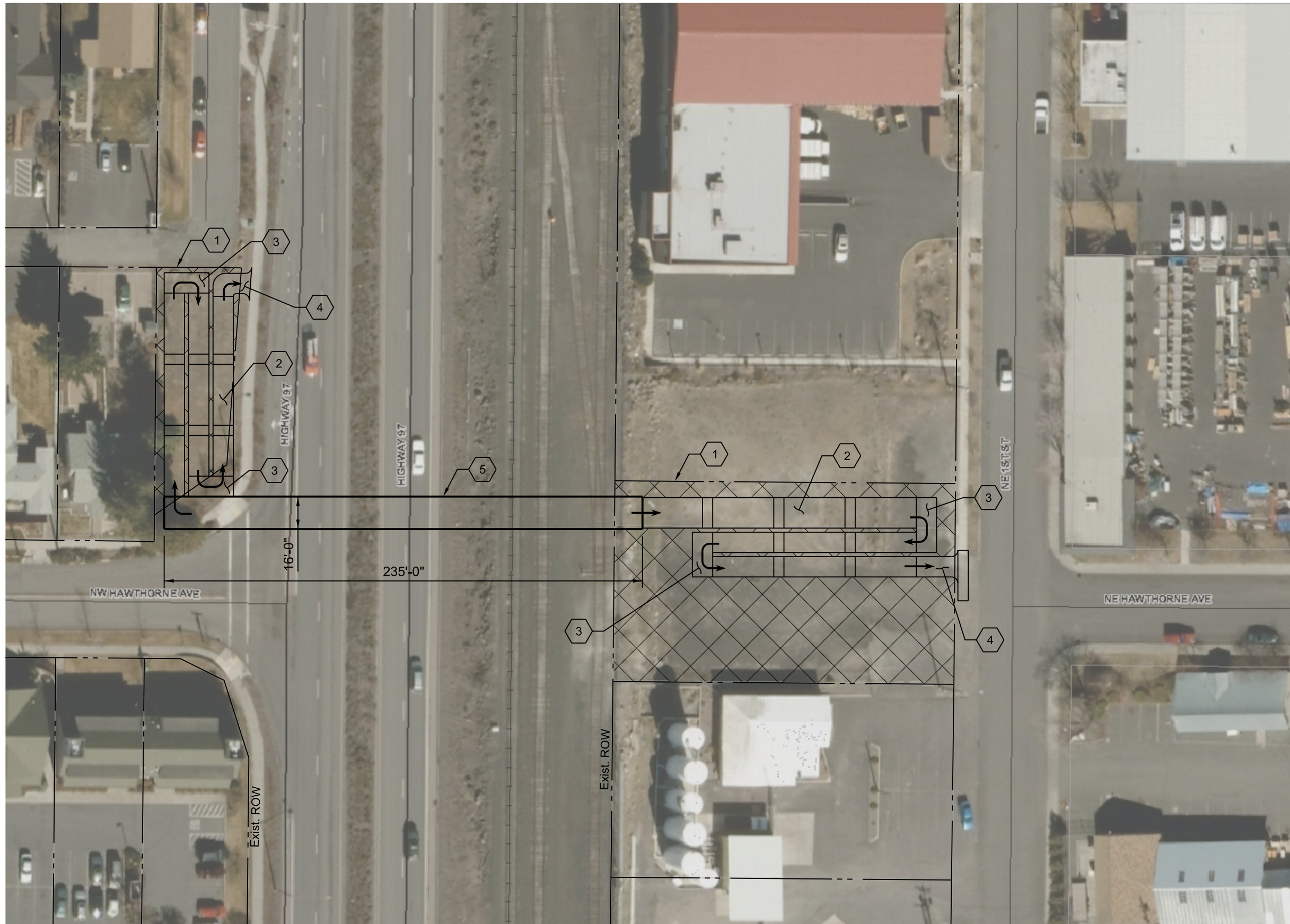
Recommendation

An overcrossing structure will be less costly to build and to operate than an undercrossing, and will be more likely to be used than an undercrossing. In the event that a pedestrian facility is proposed for the Hawthorne location, an overcrossing is the recommended approach.

As each alternative is expensive, further study of pedestrian/bicycle movement is warranted. Improvements of alternative routes, such as the Greenwood Avenue undercrossing, may be more cost effective.

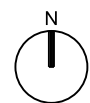
Basis of Costs

Cost estimates included are Class 5 estimates as defined by ASTM E2516, *Standard Classification for Cost Estimate Classification System*. Class 5 estimates can be expected to have an accuracy range of approximately +100% to -50%.



KEY NOTES:

- 1 ACQUIRE RIGHT-OF-WAY.
- 2 INSTALL ACCESS RAMP.
- 3 SWITCH BACK FOR ACCESS RAMP.
- 4 CONNECT SIDEWALK TO ACCESS RAMP.
- 5 INSTALL BICYCLE/PEDESTRIAN OVERPASS.

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 **PLAN**
 1"=50'-0"

HAWTHORNE AVE.

Franklin Avenue Bridge

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The existing Franklin Avenue Bridge carrying the Burlington Northern Railroad is a concrete and steel underpass. As was typical for these structures, the main span over vehicular traffic uses steel girders. Separate concrete pedestrian tunnels behind the primary abutments are monolithic with the abutments.

The existing pedestrian tunnels are approximately 5 feet wide and 7 feet tall. The sidewalks leading to the pedestrian tunnels from the east curve horizontally and vertically, so that there is no direct line of sight into the tunnels from the east until users are at the entrance to the tunnels.

A newer Bend Parkway bridge was built parallel to and west of the railroad bridge; this new structure includes sidewalks along Franklin Avenue. The new sidewalks are wider, are open to view from Franklin Avenue, and align with the pedestrian tunnels under the railroad tracks.

Project Purpose

The purpose of a project at the Franklin Avenue Bridge is to improve pedestrian and bicyclist safety by increasing the vertical and horizontal clearances in the pedestrian tunnels, and by re-aligning the approaches to the pedestrian tunnels from the east so that any occupants of the tunnel can be seen from the roadway.

Alternatives Considered

Alternative 1 – Expand the Pedestrian Tunnels

This alternative consists of replacing the pedestrian tunnels with wider tunnels, and increasing the vertical clearance from 7 feet to 10 feet. The sidewalks approaching from the east would be re-aligned to promote visibility into the tunnel from the east approach.

The construction of the original bridge and tunnels makes it infeasible to widen the pedestrian tunnels or to change the vertical clearance. Rail traffic would be disrupted during construction, and costs for removing the tunnels and constructing new abutments would be very high. Any changes to vertical clearance would require lowering the sidewalk profile, which would affect the nearby highway bridge.

The existing bridge appears to be in fairly original configuration. A Federal nexus, such as use of Federal funds or need for Federal permits or approvals, would require coordination of any modifications with the State Historic Preservation Office (SHPO).

Alternative 2 – Retain the Existing Pedestrian Tunnels and Re-align the East Approach Sidewalks

This alternative consists of removing the existing sidewalks and constructing new sidewalks aligned with the pedestrian tunnels. This would improve visibility into the tunnels, which is likely to increase the perception of personal safety for tunnel users. The existing tunnels would remain as they are.

The location and size of the pedestrian tunnels will make it difficult to see from Franklin Avenue into the tunnels with any approach sidewalk configuration. The benefit of re-aligning the approaches would be limited to visibility into the tunnels from the east approach only.

The east elevation of the bridge appears to be in fairly original configuration, including the original fabric of the ornate concrete rails. A Federal nexus, such as use of Federal funds or need for Federal permits or approvals, would require coordination of any modifications with the SHPO.

Alternative 3 – Improve drainage and lighting

This alternative leaves the existing structure as is, and upgrades existing lighting and sidewalk drainage for the comfort of pedestrians. Screening or fencing could also be installed at the transitions between tunnels to improve sight distance and eliminate blind spots in the tunnel. Such work, if a Federal nexus is present, requires coordination with the SHPO.

Recommendation

Modification of the tunnels themselves is not feasible, due to the high cost of construction and the high cost of affecting the railroad operations. Modification of the east sidewalk approaches to the tunnels will be costly and will have limited beneficial effect on tunnel use. Painting, lighting, screening, and drainage improvements would provide minor safety improvements and improve the user experience.