2

Alternatives

Section 2.1 of this chapter introduces the range of design options, or alternatives, developed for the Project. Developing a reasonable range of alternatives to address the Project Purpose and Need is an essential part of the NEPA process. **Section 2.2** of this chapter chronicles the screening process used to develop an initial list of alternatives and to eliminate those determined to be unreasonable. **Section 2.3** describes the reasonable alternatives which passed the screening process and are fully analyzed in the FSEIS and identifies the Preferred Alternative. **Section 2.4** describes other project elements including the temporary bicycle and pedestrian detour, and the proposed temporary contractor construction access.

While the 2007 FEIS included an analysis of alternatives related to the GSB, its scope encompassed a much larger transportation project involving the GSB, the adjacent Little Bay Bridges (LBBs), and multiple interchanges and local roads over a 3.5-mile portion of the Spaulding Turnpike. The initial alternatives described in the 2007 FEIS focused on identifying and evaluating potential highway improvements and traffic mitigation measures to improve safety, relieve congestion, reduce travel time and accommodate projected increases in traffic demand. As described in Chapter 1, the 2007 FEIS included an analysis of alternatives related to the GSB, referred to as the Bridge Segment alternatives. General descriptions of each of the build alternatives evaluated for the Bridge Segment is included in Section 2.4.8.4 of the 2007 FEIS, and the discussion in the following paragraphs summarizes the alternatives addressed in this previous NEPA documentation.

In summary, 14 conceptual bridge alternatives were developed during production of the DEIS. During the preliminary screening of alternatives, it was determined that only two main bridge alternatives warranted consideration in the 2007 FEIS:

- Widen/rehabilitate the Little Bay Bridges and rehabilitate the General Sullivan Bridge
- Widen/rehabilitate the Little Bay Bridges and remove the General Sullivan Bridge

As discussed in Section 2.5.4 of the 2007 FEIS, the two bridge alternatives that were carried forward and evaluated were similar in that each involved the proposed rehabilitation and westerly widening of the LBBs from the current four-lanes to eight-lanes. The difference between them was the disposition of the GSB. One alternative included the retention and rehabilitation of the GSB, while the other alternative included the demolition and removal of the GSB, with the addition of a multi-use path on the expanded LBB to accommodate bicycles and pedestrians.

Section 2.7.1 of the 2007 FEIS summarized the rationale behind selecting the rehabilitation of the GSB. The rationale included recognition of the bridge's historic and recreational importance, and the position of agencies and the public to preserve the GSB. Section 2.7.1 also described the extent of the proposed work that would be required to rehabilitate the GSB, including the complete replacement of the deck and supporting structural system, other miscellaneous repairs to the structural steel to arrest future corrosion, cleaning and painting the entire structure, and repairing the substructure.

The alternative that proposed removal of the GSB had lower initial costs and lower long-term maintenance costs, but the alternative that proposed to retain the GSB had a high degree of community support and would not have adversely impacted the historic structure. As stated in the 2008 ROD, "*...after consideration of the landmark status of the GSB and its historic and recreational significance to the area, and that more members of the public have voiced support for the bridge's rehabilitation than for its removal, the Bridge Rehabilitation and Widening option which retains the GSB was identified as part of the Selected Alternative.*"

However, inspections and engineering studies of the current GSB condition were completed from 2009 to 2016 to prepare for the final design of the rehabilitation project. A Type Span and Location (TSL) Study was completed in 2017. These studies indicated that the GSB was more deteriorated than originally understood at the time of the 2007 FEIS. It became clear that the rehabilitation would have very high costs, would carry high risks, and would have a limited life span compared to other options.

As a result of these studies, FHWA concurred with NHDOT's recommendation that further evaluation of rehabilitation and other alternatives was warranted, but determined that a SEIS would be necessary to re-evaluate any changes to the rehabilitation of the GSB, as such changes have the potential to result in significant environmental impacts that were not previously evaluated in the original EIS.

2.1 Preliminary Alternatives

For this FSEIS, the alternatives development process considered almost two dozen preliminary alternatives and design options, several of which came from the *2016-2017 Type, Span, and Location Study*. In 2018, the project team developed additional alternatives after further consultation with the public and FHWA. Each preliminary alternative was developed using roadway and multi-use path design guidelines based on American Association of State Highway

and Transportation Officials (AASHTO) standards for lane and shoulder widths for pedestrians, bicycles, and vehicles.[15]

For roadways such as the Spaulding Turnpike, 12-foot lanes and 12-foot shoulders represent the recommended or "desirable" shoulder width, and 10-foot shoulders represent the "minimum" shoulder width.[16] For multi-use paths, a 12-foot path with 2-foot shoulders (*i.e.,* 16 feet total) represent the recommended or "desirable" multi-use path width, and a 10-foot multi-use path with 1-foot shoulders (*i.e.,*12 feet total) represents the "minimum" multi-use path width.[17] **Table 2.1-1** summarizes the minimum and desirable design widths used in developing the preliminary alternatives. **Figure 2.1-1** provides a visual for the two multi-use path options.

Table 2.1-1 General Sullivan Bridge SEIS – Roadway and Multi-Use Path Width Criteria

Travel Corridor	Minimum Design Width (feet)	Desirable Design Width (feet)
Roadway Lane	12	12
Roadway Shoulder	10	12
Multi-Use Path Lane	10	12
Multi-Use Path Shoulder	1	2

The preliminary alternative designs included both a minimum 12-foot total width and 16-foot total width multi-use path. A 16-foot deck (*i.e.,* 12-foot path with 2-foot shoulders on each side) is structurally desirable over a 12-foot deck for preliminary alternatives. The following range of preliminary alternatives were developed for the Project.[18]

Alternative 1: Rehabilitation of General Sullivan Bridge

Alternative 1 is to rehabilitate the GSB's substructure and truss superstructure and replace the GSB bridge deck. The deck and floor system would be replaced with an 18.3-foot-wide (out-to-out), which matches the deck width of the newly constructed approach bridge on the Dover side. This deck would provide approximately 16 feet rail-to-rail- to accommodate a multiuse path approximately 13.7 feet wide bounded by 1-foot-wide shoulders and pedestrian rails.[19]

Alternative 2: Superstructure Replacement – Truss Alternative

Alternative 2 is to replace the GSB superstructure while retaining the existing substructure. The new superstructure would be a truss with a similar aesthetic appearance to the existing GSB truss. The new GSB superstructure would have an approximately 18.3-foot-wide deck (out-to-out). This deck would provide approximately 16 feet rail-to-rail to accommodate a multi-use path approximately 12 feet wide bounded by 2-foot shoulders and pedestrian rails. There would be no changes to the LBB.

Alternative 3: Partial Rehabilitation of the General Sullivan Bridge

Alternative 3 is to replace the GSB approach spans (spans 1, 2, 3, 7, 8, and 9), and rehabilitate the through-truss main spans (spans 4, 5, and 6). Under this alternative, the through-truss main spans would be rehabilitated and remain in place; the substructure would be retained. Like Alternatives 1 and 2, the GSB superstructure would have an approximately 18.3-foot-wide deck (out-to-out). This deck would provide approximately 16 feet rail-to-rail to accommodate a multiuse path approximately 12 feet wide bounded by 2-foot-wide shoulders and pedestrian rails. There would be no changes to the LBB.

Alternative 4: Complete Replacement

Alternative 4 is to replace the GSB superstructure and substructure, including piers. Under this alternative, both the bridge superstructure and substructure would be replaced with a new substructure and either a steel or concrete superstructure. The new bridge would not have a truss and would not be visually consistent with the existing GSB. The new bridge would be constructed on concrete piers supporting an approximately 18.3-foot-wide deck (out-to-out). This deck would provide approximately 16 feet rail-to-rail to accommodate a multiuse path approximately 12 feet wide bounded by 2-foot-wide shoulders and pedestrian rails. There would be no changes to the LBB.

Alternative 5: Reconfigure Southbound Little Bay Bridge

Alternative 5 is to reconfigure the LBB roadway lanes and shoulders to accommodate a new multi-use path on the existing bridge deck without modifying the existing west bridge fascia,[20] thereby maintaining the existing width of the LBB. Under this alternative, the four roadway lanes would remain 12 feet wide, and the roadway shoulders would be reduced from the desirable 12-foot width to the minimum 10-foot width. A 2-foot-wide concrete barrier would separate the roadway shoulders from a new multi-use path. Without modifying the west fascia of the LBB, the multi-use path would only be 2 feet wide in total with no shoulders and a pedestrian rail, which does not provide an adequate facility. Under this alternative, the GSB superstructure and substructure would be demolished.

[15] A "multi-use" (or "shared use") path is defined by the American Association of State Highway and Transportation Officials as a bikeway physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way.

[16] American Association of State Highway and Transportation Officials. 2011. *A Policy on Geometric Design of Highways and Streets, 6th edition*. Chapter 8, Sections 2.4 and 4.2.

[17] American Association of State Highway and Transportation Officials. 2012. *Guide for the Development of Bicycle Facilities*, *4th edition*. Chapter 5, Sections 2.1 and 2.10.

[18] The list of preliminary alternatives is not consecutive due to the removal of Alternative 8. Alternative 8 was originally developed as a rehabilitation alternative. Upon review of the alternative, it was determined to be substantially identical to Alternative 1. For this reason, Alternative 8 was discarded from the list of preliminary alternatives before being fully developed. The numbering was retained for consistency with other materials developed for the Project.

[19] NH House Bill 2018 (2018 legislative session) adopted the state's 10-year transportation improvement plan for 2019-2028 with provisions that limit funding for the rehabilitation of GSB while allowing its replacement. While this remains the legislative direction, it does not preempt the responsibility of NHDOT to review alternatives under NEPA.

[20] A bridge "fascia" is defined as an outside, covering member designed as an architectural effect rather than to provide strength and rigidity although its function may involve both. A fascia girder is an exposed outermost girder of a span sometimes treated architecturally or otherwise to provide an attractive appearance.

Alternative 6: Southbound Little Bay Bridge - Widened Deck on Pier Extension

Alternative 6 is to widen the southbound LBB to accommodate a new multiuse path. This alternative requires constructing a pier extension, supported by the existing GSB piers, to carry the widened LBB superstructure. The southbound LBB bridge deck would be extended approximately 17.67 feet, including two new girder lines, which are supported by the pier extension. Under Alternative 6, the four travel lanes and shoulders would all remain the desirable 12-foot width. A 2-foot-wide concrete barrier would separate the roadway shoulders from a new multiuse path. The multiuse path would be 16-feet wide in total, consisting of the desirable 12-foot-wide multi-use path with 2-foot-wide shoulders on each side and a pedestrian rail. The new multi-use path would not be in the form of a truss, and therefore would not be visually consistent with the existing GSB. Under this alternative, the GSB superstructure would be demolished. The GSB Piers 2 through 8 would be left in place, but GSB Pier 1 would be removed and replaced with a new drilled shaft pier to support the reconfigured approach span.

Alternative 7: Southbound Little Bay Bridge - Independent Deck on Pier Extension

Alternative 7 is to construct a new separate multiuse path with an approximately 18.3-foot-wide deck (out-to-out) adjacent to the LBB, but not connected to the LBB bridge deck. Similar to Alternative 6, a pier extension would be constructed from the LBB superstructure, which would be supported by the existing GSB piers. On the pier extension, a new multiuse path deck would be constructed, approximately 7.5 feet from the LBB. The LBB superstructure would not be modified. The multiuse path would be 16 feet wide, consisting of the desirable 12-foot-wide multiuse path with 2-foot-wide shoulders on each side, and a pedestrian rail. The new superstructure would not be in the form of a truss, and therefore would not be visually consistent with the existing GSB. Under this alternative, the GSB superstructure would be demolished. The GSB Piers 2 through 8 would be left in place, but GSB Pier 1 would be removed and replaced with a new drilled shaft pier to support the reconfigured approach span.

Alternative 9: Superstructure Replacement – Girder Option

Alternative 9 is to completely replace the GSB superstructure with a steel girder system with a structural steel frame extending from the bottom of the girders to the top of the existing GSB piers. The new superstructure would not be in the form of a truss, and therefore would not be visually consistent with the existing GSB. This alternative would have an approximately 18.3-foot wide deck (out-to-out), a 16-foot-wide multiuse path, consisting of the desirable 12-foot-wide multiuse path with 2-foot-wide shoulders on each side, and a pedestrian rail. Under Alternative 9, the GSB superstructure would be demolished; however, this alternative would reuse the existing piers without requiring significant modifications.

[21] Costs were developed for both a 12-foot and 16-foot wide multi-use path, for each of the alternatives. Because the cost difference between the 12-foot path and a 16-foot path is very small (typically 1% depending on the alternative), the project engineers recommended a 16-foot wide path since it is safer.

2.2 Screening Criteria and Results

A process called screening was used to eliminate preliminary alternatives that did not score well when compared to other alternatives. **Figure 2.2-1** provides a visual representation of the screening process. The screening criteria included:

- **Purpose and Need:** Alternative meets the project Purpose and Need - To provide bicycle and pedestrian access between Dover and Newington. This criterion also considers how well the alternative meets the project Purpose and Need.
- **Feasibility:** Alternative is reasonable and practicable from a technical standpoint. Alternative can be implemented using existing techniques and materials, within a reasonable duration, and without excessive impacts on the environment or the transportation network.
- **Cost:** Alternative has construction and life cycle costs that are not excessive in comparison with other reasonable alternatives.[21, 22]
- **Safety - User Safety:** Alternative provides a safe and efficient crossing for vehicular and non-motorized travel across the span, minimizing deviations from the design standards for roadways and bridges.
- **Safety – Inspection and Emergency Access:** Alternative provides safe means for inspection, maintenance, and emergency vehicle access.
- **Transportation Capacity:** Alternative maintains or improves existing vehicle capacity across the LBB, with no decrease in the number or width of travel lanes or shoulders.
- **Cultural Resource Impacts:** Alternative preserves some or all of the GSB.

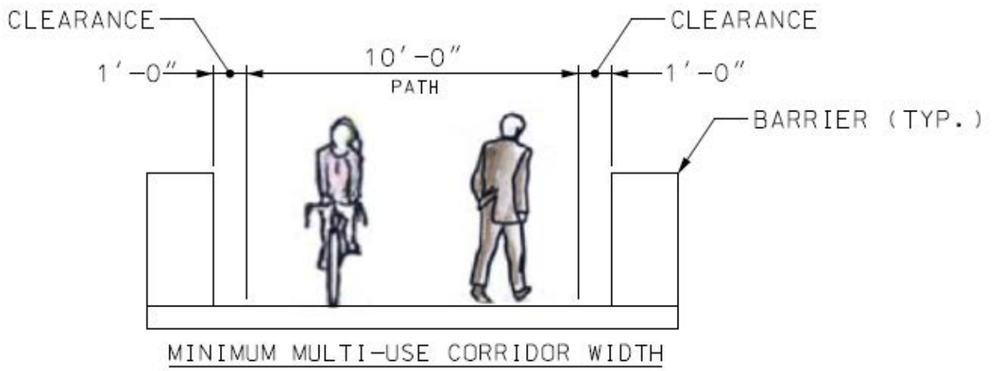
A screening matrix was developed to review the preliminary alternatives based on how well they met the screening criteria (**Table 2.2-1**). The screening criteria eliminated three of the preliminary alternatives from further analysis in the FSEIS, as shown in the screening matrix and described in the following text.

Applying the screening criteria to the preliminary alternatives resulted in the elimination of certain alternatives from further consideration:

- **Alternative 2:** Alternative 2 would completely replace the GSB superstructure, similar to Alternatives 6, 7 and 9. The notable differences among these four alternatives are cost and design. While Alternative 2 would be a truss design with a similar aesthetic appearance to the existing GSB truss, it would have an initial capital cost of $37.75 million, amounting to $8.25 million to $9.75 million more than Alternatives 6, 7 and 9. For these reasons, Alternative 2 would not provide the most cost-effective option for a superstructure replacement and was eliminated during the screening process.

[22] Additional information on the cost estimates for each alternative is provided in **Appendix C**.

Figure 2.1-1



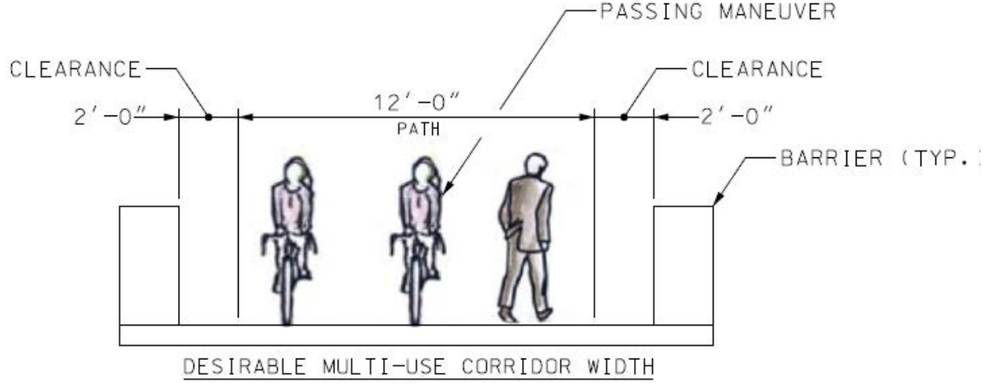


Figure 2.2-1

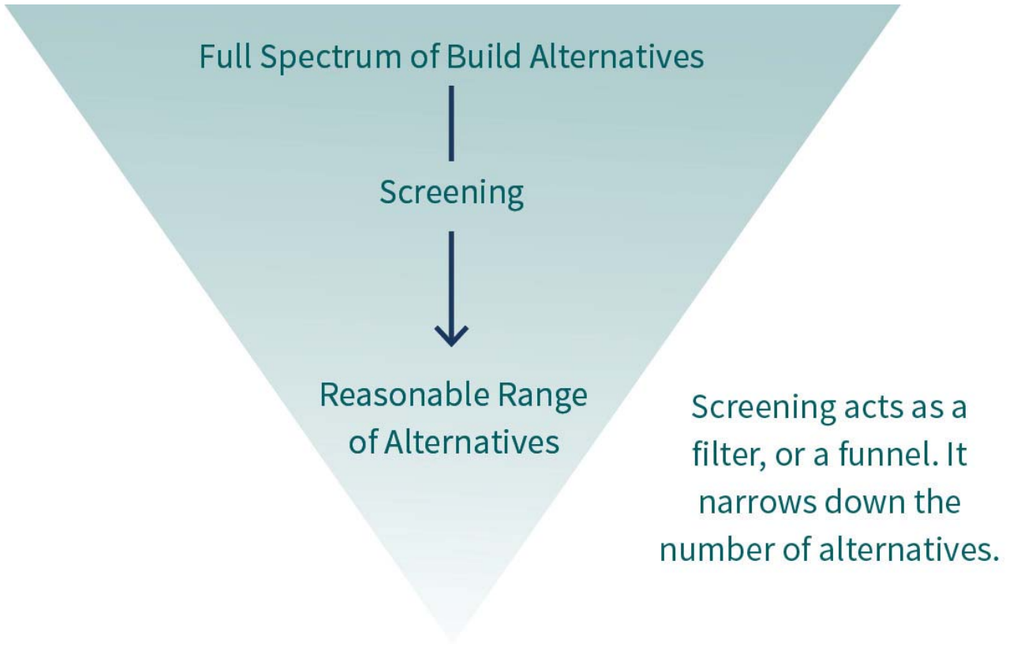


Table 2.2-1 Alternatives Analysis Screening Matrix

Alternative[1]	Screening Criteria								Advanced to Detailed Study in SEIS?
	Purpose and Need[2]	Feasibility[3]	Estimated Costs[4]		Safety - User Safety[5]	Safety - Inspection and Emergency Access[6]	Transportation Capacity[7]	Cultural Resource Impacts[8]	
			Initial Capital Cost, 2018 Dollars	Life Cycle Cost, 2018 Dollars					
No-Action	○	○	$8,000,000[9]	-	○	○	●	●	Y
Alternative 1: Rehabilitation of the General Sullivan Bridge	●	◐	$43,000,000	$74,000,000	●	●	●	●	Y
Alternative 2: Superstructure Replacement - Truss Alternative[10]	●	●	$37,750,000	-	●	●	●	◐	N
Alternative 3: Partial Rehabilitation	●	●	$42,250,000	$61,750,000	●	●	●	◐	Y
Alternative 4: Complete Replacement[10]	●	●	$31,750,000	-	●	●	●	○	N
Alternative 5: Reconfigure Southbound Little Bay Bridge[11]	○	●	-	-	○	○	◐	●	N
Alternative 6: Southbound Little Bay Bridge - Widened Deck on Pier Extension	●	●	$28,000,000	$31,250,000	◐	●	●	◐	Y
Alternative 7: Southbound Little Bay Bridge - Independent Deck on Pier Extension	●	●	$29,500,000	$32,250,000	●	●	●	◐	Y
Alternative 9: Superstructure Replacement - Girder Option	●	●	$28,500,000	$31,250,000	●	●	●	◐	Y

Notes:

○ - Does not perform well in comparison with other preliminary alternatives ◐ - Performs adequately in comparison with other preliminary alternatives ● - Performance exceeds other preliminary alternatives

1 – The list of preliminary alternatives is not consecutive due to the removal of Alternative 8. Alternative 8 was originally developed as a rehabilitation alternative. Upon review of the alternative, it was determined to be identical to Alternative 1. For this reason, Alternative 8 was not included in this table. The numbering was retained for consistency with other materials developed for the Project.
2 – Alternative meets the project Purpose and Need: *To provide bicycle and pedestrian access between Dover and Newington.* This criterion also considers how well the alternative meets the project Purpose and Need.
3 – Alternative is reasonable and practicable from a technical standpoint. Alternative can be implemented using existing techniques and materials, within a reasonable duration, and without excessive impacts on the environment or the transportation network.
4 – Alternative has construction and life cycle costs that are not excessive in comparison with other preliminary alternatives.
5 – Alternative provides a safe and efficient crossing for vehicular and non-motorized travel across the span, minimizing deviations from the design standards for roadways and bridges and the AASHTO design standards for bicycle and pedestrian facilities.
6 – Alternative provides safe means for inspection, maintenance, and emergency vehicle access.
7 – Alternative maintains or improves existing vehicle capacity across the Little Bay Bridge, with no decrease in travel lanes.
8 – Alternative preserves some or all of the GSB.
9 – Under the terms of the existing USCG Bridge Permit for the GSB and LBB, the GSB must be removed if it no longer serves a transportation purpose. The estimated cost to remove all parts of the GSB is $8,000,000.
10 – Life Cycle Cost estimates for Alternatives 2 and 4 were not completed since these alternatives were eliminated early in in the screening due to issues related to their relatively high initial capital costs, combined with concerns related to feasibility and cultural resource impacts.
11 – Alternative 5 was eliminated from consideration prior to development of the cost estimates because it fails to meet the project Purpose and Need.

- **Alternative 4:** Alternative 4 would completely replace the GSB superstructure and stone masonry piers. Compared to all other preliminary alternatives, Alternative 4 is the only alternative that would not preserve any portion of the GSB, which is why this alternative received the lowest score under the cultural resource impacts criterion. Furthermore, this alternative would require greater impacts on the Little Bay aquatic environment. For these reasons, Alternative 4 was eliminated during the screening process.
- **Alternative 5:** Under Alternative 5, the multiuse path would only be 2 feet wide in total with no shoulders. A 2-foot-wide multi-use path would not provide an adequate facility and would be unsafe (for both the public and emergency or inspection services). For these reasons, Alternative 5 would not meet the Purpose and Need or provide a safe multi-use path and was eliminated during the screening process.

2.3 Reasonable Alternatives

The screening process narrowed down the preliminary alternatives from eight to five; the five preliminary alternatives that passed screening are referred to as reasonable alternatives.[23] See **Appendix D** for a set of drawings depicting temporary construction access impact plans for each reasonable alternative. These five reasonable alternatives include:

- Alternative 1: Rehabilitation of the General Sullivan Bridge
- Alternative 3: Partial Rehabilitation of the General Sullivan Bridge
- Alternative 6: Southbound Little Bay Bridge - Widened Deck on Pier Extension
- Alternative 7: Southbound Little Bay Bridge - Independent Deck on Pier Extension
- Alternative 9: Superstructure Replacement - Girder Option

This section provides an in-depth description and comparison of the reasonable alternatives, and also discusses the No-Action Alternative. The FSEIS includes an assessment of the No-Action Alternative to serve as a baseline by which to evaluate impacts of the five reasonable alternatives.

No-Action Alternative

Under the No-Action Alternative, non-motorized transportation across the Little Bay would be permanently eliminated. Although the temporary detour (opened for public access in August 2019) provides uninterrupted pedestrian and bicycle access, this temporary detour requires temporary use of one lane of the northbound LBB, which limits the transportation capacity of the highway for motorized vehicles. The temporary detour would need to be removed to allow the expanded LBB to accommodate vehicular traffic volumes as intended and designed (see also **Section 2.4**, *Other Project Elements*). For these reasons, the No-Action Alternative would not meet the Purpose and Need of the Project.

Normal maintenance, monitoring, or inspections that would occur under this alternative would not be adequate to correct the existing state of significant deterioration of the GSB. The No-Action Alternative would not correct the situation that causes the GSB to be considered structurally deficient and deteriorated. Over time, the structural deterioration would lead to serious and unacceptable safety hazards including hazards to navigation. Additionally, under the terms of the existing permit for the GSB and expanded LBB issued by the USCG, the GSB would eventually need to be removed.[24]

Alternative 1: Rehabilitation of the General Sullivan Bridge

Under Alternative 1, the GSB would be rehabilitated and the bridge deck would be replaced. The substructure and truss superstructure would be repaired and rehabilitated to support loading requirements. Predominant work under this alternative would involve removal and replacement of the existing floor system, removal and replacement in-kind of upper and lower lateral braces, replacement in-kind of several sway braces, rehabilitation of the Newington abutment, steel truss repair work, repointing the existing stone masonry piers, cleaning and painting existing structural steel and installing a pedestrian bridge railing. **Figure 2.3-1** depicts the conceptual design for Alternative 1, and more detailed plans are provided in **Appendix B**.

However, the GSB is deteriorated and structurally deficient to a point where a substantial number of structural elements would need to be replaced or extensively repaired. The initial capital cost for this extensive rehabilitation work is estimated to be $43 million. Additionally, extraordinary maintenance would be required to preserve the rehabilitated bridge, including extensive routine paint system touch-up and sealing, overcoating, and multiple full repainting cycles, in addition to rehabilitation to members which continue to deteriorate. Therefore, the total life cycle costs for this alternative, when considered over a 75-year design life, rises to $74 million. These life cycle costs are almost two and a half times the estimated life cycle costs of Alternative 9 over the same period ($31.25 million). As such, Alternative 1 was not identified as the Preferred Alternative.

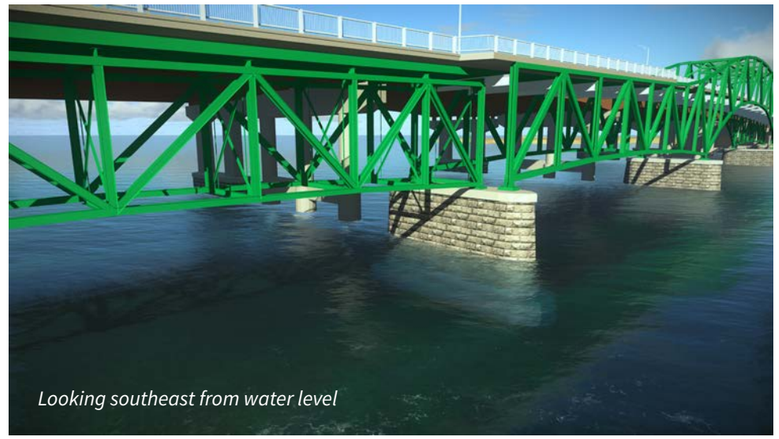
Alternative 3: Partial Rehabilitation of the General Sullivan Bridge

Under Alternative 3, the GSB approach spans from both Dover (Spans 1, 2, and 3) and Newington (Spans 7, 8, and 9) would be replaced, but the through-truss main spans (Spans 4, 5, and 6) would be rehabilitated and remain in place. Additionally, all the substructure units would be retained, and the existing stone masonry piers would be repointed. The resulting GSB superstructure would have an 18.3-foot-wide deck (out-to-out); this deck would provide a multiuse path approximately 16 feet wide. As with Alternative 1, the recently constructed 2010 approach span at the Dover end of the bridge would not require substantial modifications as part of this alternative, as the alignment of the existing GSB would be maintained. Work under this alternative would involve rehabilitation of the Newington abutment. There would be no changes to the LBB under this alternative. **Figure 2.3-2** depicts the conceptual design for Alternative 3, and more detailed plans are provided in **Appendix B**.

[23] The range of reasonable alternatives are not numbered consecutively due to the elimination of preliminary alternatives during the screening process. The numbering was retained for consistency with other materials developed for the Project.

[24] On November 30, 2006, Gary Kassof of the USCG sent a letter to Marc G. Laurin, NHDOT Senior Environmental Manager, regarding the Draft Environmental Impact Statement for the Newington-Dover, 11238 project. The USCG advised NHDOT that the GSB should be removed as it no longer served a transportation purpose, and that a clear and reasonable rationale must be presented for retaining or rebuilding the structure. The letter also stipulated that the bridge permit application to be submitted for construction of the new LBB must address the need to retain or rebuild the GSB and, if the old bridge is to be removed, should include complete removal of all parts not utilized in the new structure.

Looking southeast from Dover to Newington



Looking southeast from water level

Looking south from deck

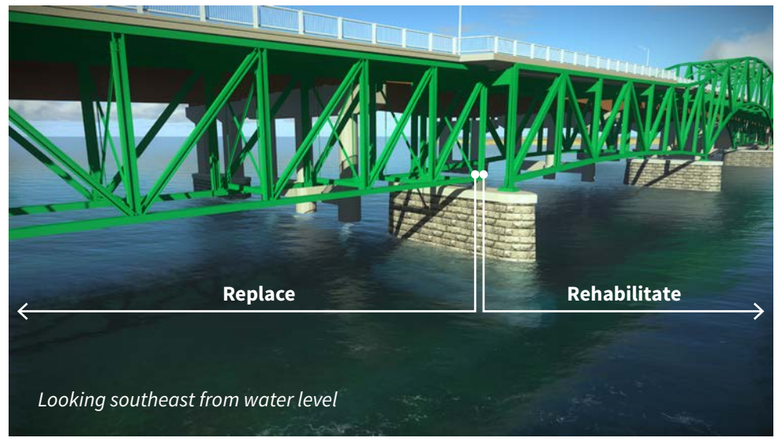
Newington-Dover 11238S | Newington and Dover, NH

General Sullivan Bridge Supplemental EIS

U.S. Department of Transportation
Federal Highway Administration

New Hampshire DOT Department of Transportation

Alternative 1: Rehabilitation of the General Sullivan Bridge Conceptual Design Renderings



Newington-Dover 11238S | Newington and Dover, NH

General Sullivan Bridge Supplemental EIS

Alternative 3: Partial Rehabilitation Conceptual Design Renderings

U.S. Department of Transportation
Federal Highway Administration

New Hampshire DOT Department of Transportation

This alternative was determined to fully meet the Project's Purpose and Need, providing access and connectivity between Newington and Dover, across Little Bay, for non-motorized use.

Alternative 3 would have an initial capital cost of $42.25 million and a 75-year life cycle cost of $61.75 million, nearly double the cost of other alternatives (Alternative 9, Alternative 6, and Alternative 7). Given the additional construction, maintenance, and operational costs of an extraordinary magnitude, Alternative 3 was not identified as the Preferred Alternative.

Alternative 6: Southbound Little Bay Bridge – Widened Deck on Pier Extension

Under Alternative 6, the deck of the southbound LBB would be widened approximately 17.5 feet to the west to accommodate a new multi-use path on the LBB. To accomplish this widening, the GSB superstructure would be removed, since the GSB is approximately 15 feet from the LBB.

This alternative would preserve the existing highway lane and shoulder widths on the LBB to avoid compromising the transportation capacity of the recently-expanded LBB while accommodating an AASHTO-compliant 16-foot-wide path. This alternative would extend each of the eight LBB pier caps which would be supported on 24.5-foot pier extensions with new columns connecting down to seven of the eight existing GSB piers. The LBB bridge deck would be extended approximately 17.5 feet, including two new girder lines, which are supported by the pier extensions. Under this alternative, the four travel lanes and shoulders of the LBB would all remain at the AASHTO-recommended 12-foot width. A 2-foot-wide concrete barrier would separate the roadway shoulders from a new multi-use path. The multi-use path would be 16 feet wide in total, consisting of the AASHTO-desirable 12-foot-wide multi-use path with desirable 2-foot wide shoulders on each side and a steel pedestrian rail. Under this alternative, the GSB superstructure would be demolished and the seven repointed GSB existing stone masonry piers would be left in place to support the pier extensions.

The existing curved approach span on the Dover end of the bridge would need to be replaced as part of this alternative, along with the northernmost existing pier (GSB Pier 1). The existing approach span and mechanically-stabilized earth approach, constructed in 2010, consists of curved steel girders with a concrete deck supported on mono-shaft pier foundations, connecting the multi-use path from Dover Point Road to the existing GSB. The replacement of this approach span is required under this alternative as the location of the multi-use path is shifted to the east away from its current alignment to become adjacent to the existing LBB. Connecting to the LBB from the end of the existing GSB approach span is not viable as the gradient required to meet the elevation of the LBB from this location would be greater than the 5 percent maximum gradient, without including landings every 30 feet, as required by the Americans with Disabilities Act (ADA) guidelines for accessibility. This alternative would require the construction of a new mechanically-stabilized earth approach with accompanying curved steel girder approach span, supported on two new mono-shaft foundations requiring one new approach span pier be constructed in Little Bay. At the Newington approach, the existing abutment would be removed in its entirety and replaced, due to changes in geometry and bridge type. **Figure 2.3-3** depicts the conceptual design for Alternative 6, and more detailed plans are provided in **Appendix B**.

This alternative was determined to fully meet the Project's Purpose and Need. The cost of Alternative 6 is estimated to be $28 million and the life cycle costs are estimated to be $31.25 million, similar to Alternative 9.

Under Alternative 6, the multi-use path would be immediately adjacent to the LBB deck. The multi-use path would comply with ADA guidelines for accessibility and would incorporate adequate safety rails. Chain link fencing would be installed on top of a 2-foot-wide concrete barrier; this would provide a measure of safety but would not shield users of the path from noise and wind generated by vehicles passing at highway speeds on the LBB. The lack of separation between vehicular traffic and recreational and non-motorized travelers, and the associated noise, wind, and perception of risk is a substantial disadvantage of this alternative which has viewed unfavorably by the public. While the deflection limits are expected to be within the limits allowable by the design code, the live load deflection induced at mid-span of each span, due to passing trucks, could produce objectionable vibration detectible by users of the multi-use path. This vibration could be detectible due to the length of the spans and the constant high-speed traffic over the bridge. This alternative would therefore perform poorly with respect to user safety and experience relative to other alternatives.

Alternative 6 suffers from a disadvantage in that the new path would be located directly adjacent to high-speed vehicle traffic, thus adversely affecting safety and user experience. This alternative was viewed unfavorably by the public during informational meetings, who expressed concerns that this alternative would put users at risk of potential accidents as well as decreased air and noise quality from adjacent vehicles.

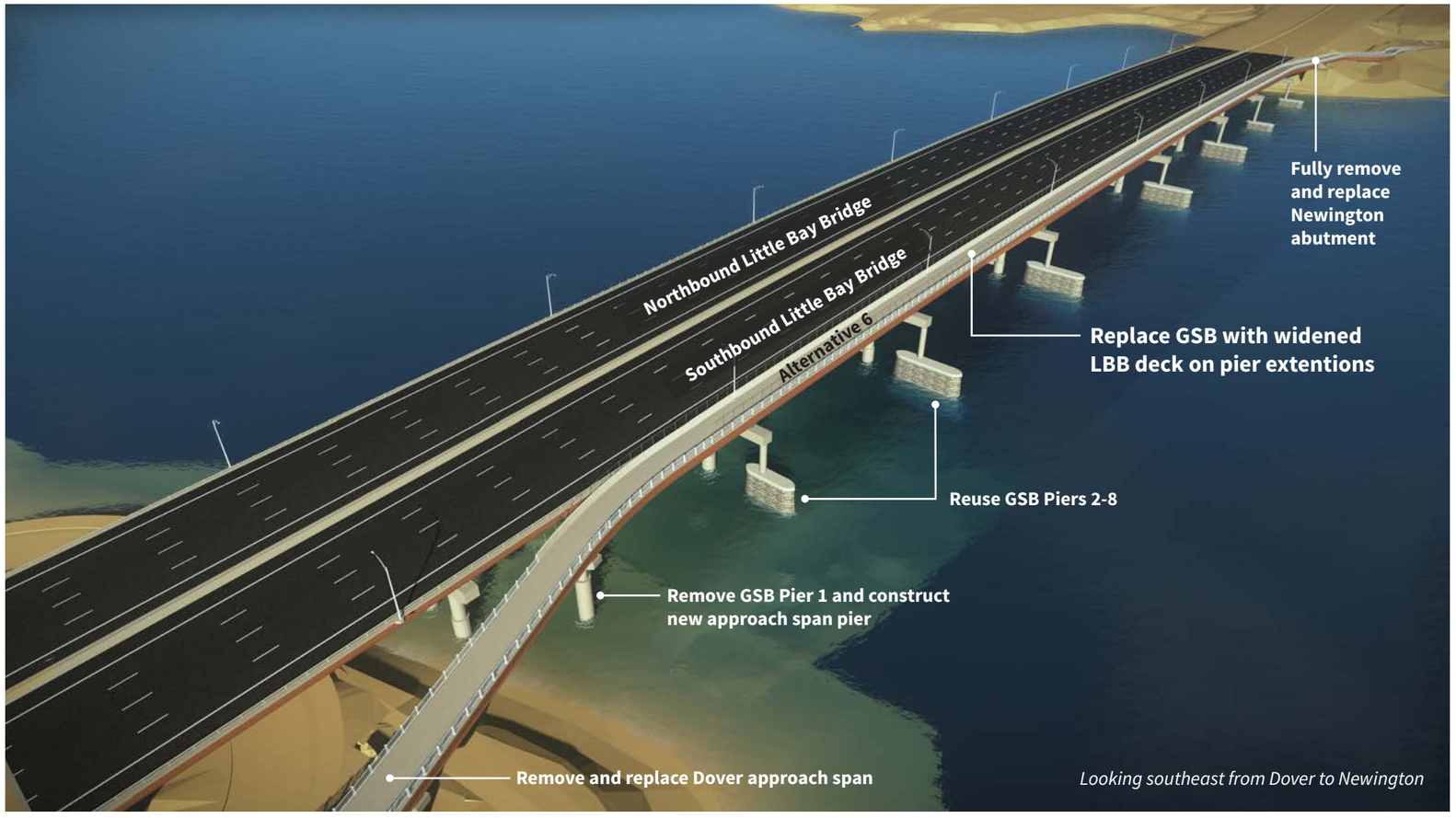
Additionally, construction activities during the erection of the deck extensions has the potential to adversely affect traffic operations for the duration of construction. Alternative 6 would require temporary impacts for construction access and would require reconstruction of the approach span from Hilton Park, including relocation of an existing pier in Little Bay. This work would have permanent impacts to intertidal habitat.

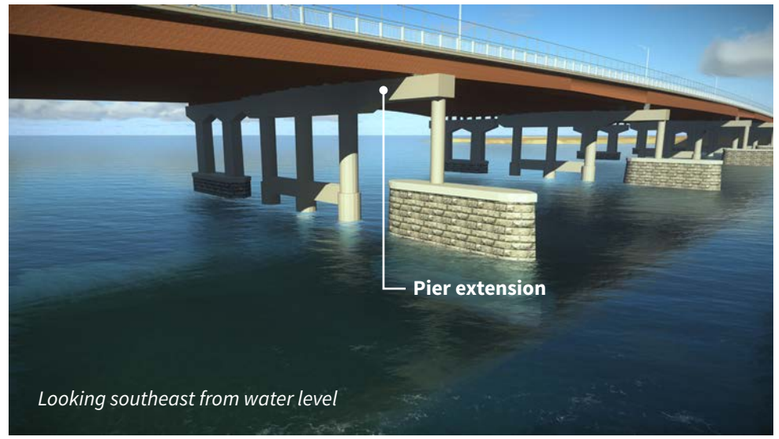
Alternative 6 was determined to be reasonable. However, it is not the Preferred Alternative due to its disadvantages with respect to user safety and experience, as well as its environmental and construction-phase impacts.

Alternative 7: Southbound Little Bay Bridge – Independent Deck on Pier Extension

Alternative 7 is similar to Alternative 6 but would construct a new, separate multi- use path adjacent to the existing southbound LBB superstructure rather than extend the LBB deck. This alternative would require the demolition and removal of the GSB superstructure. Like Alternative 6, pier cap extensions would be constructed 24.5 feet from the LBB superstructure, which would be supported on new columns connecting down to the existing GSB piers. A new multiuse path deck would be constructed approximately 7.5 feet from the existing southbound LBB superstructure. Under this alternative, the southbound LBB superstructure would not be modified, and would thereby maintain the current 12-foot-wide travel lanes and shoulders. The multi-use path would be 16-feet wide (rail-to-rail), consisting of the desirable 12-foot-wide multi-use path with desirable 2-foot-wide shoulders on each side, and a steel pedestrian rail.

Under this alternative, the GSB superstructure would be demolished, and seven of the eight existing GSB stone masonry piers would be repointed and left in place for support of the pier extensions. Also, like Alternative 6, the recently constructed 2010 GSB approach span on the Dover end of the bridge would need to be replaced, including removal of GSB Pier 1 and construction of a new pier in Little Bay to support a new approach span.





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Alternative 6:
Southbound Little Bay Bridge—
Widened Deck on Pier Extension
Conceptual Design Renderings

At the Newington approach, the existing abutment would be removed in its entirety and replaced, due to changes in geometry and bridge type. **Figure 2.3-4** depicts the conceptual design for Alternative 7, and more detailed plans are provided in **Appendix B**.

Alternative 7 was determined to fully meet the Project's Purpose and Need. In comparison to the other alternatives, Alternative 7 has an estimated initial capital cost of $29.5 million and a life cycle cost of $32.25 million, slightly more than Alternative 6 and Alternative 9, but substantially less than Alternatives 1 and 3.

Like other alternatives, Alternative 7 would provide a 16-foot-wide multiuse path, and this path would be designed to comply with the ADA rules for accessibility and would incorporate adequate safety rails. As with the reasonable alternatives, these design characteristics provide adequate user safety and access for emergency and inspection vehicles. It would locate the new path relatively close to high-speed vehicle traffic (about 7.5 feet), thereby compromising its ability to fully support the Purpose and Need relative to the Preferred Alternative (22.5 feet from the LBB). Because Alternative 7 would preserve the existing width of the southbound LBB, it would not impact the existing transportation capacity of the LBB.

The proposed separation from the high-speed traffic on the LBB (7.5 feet) is a substantial reduction relative to the existing condition, and while greater than Alternative 6, is still a concern to the public. And, like Alternative 6, construction of the pier cap extensions could temporarily impact traffic operations during the construction phase. Alternative 7 would require temporary impacts for construction access and would require reconstruction of the approach span from Hilton Park, including removal of an existing pier. This work would have permanent impacts to intertidal habitat. Additionally, the initial capital costs and life cycle costs of Alternative 7 are slightly higher than Alternative 9.

Alternative 7 was determined to be reasonable. However, it is not the Preferred Alternative because of its disadvantages with respect to user safety and experience, its additional environmental and construction-phase impacts, and its slightly higher costs.

Alternative 9: Superstructure Replacement – Girder Option

Alternative 9 has several advantages over other alternatives. Under Alternative 9, the GSB superstructure would be replaced with a steel girder superstructure with a structural steel frame extending from the bottom of the girders to the top of the existing GSB piers. Two design options for the steel frame are under consideration – one in the form of a "V" longitudinally (the "V-Frame" option), and a second curved "Super Haunch" option. This alternative follows the existing GSB alignment, thereby allowing the reuse of the existing repointed GSB stone masonry piers without requiring significant modifications. **Figure 2.3-5** depicts the conceptual design for Alternative 9, and more detailed plans are provided in **Appendix B**.

Alternative 9 would fully meet the Project's Purpose and Need of providing access and connectivity between Newington and Dover, across Little Bay, for non- motorized use, and it would perform well in comparison to the other alternatives when factors such as feasibility, cost, safety, and preservation of the transportation capacity of the LBB.

Engineering analysis determined that Alternative 9 would be reasonable and practical from a technical standpoint. It could be implemented using conventional construction techniques and materials, within a reasonable time frame, and without excessive impacts on the environment or to the transportation network.

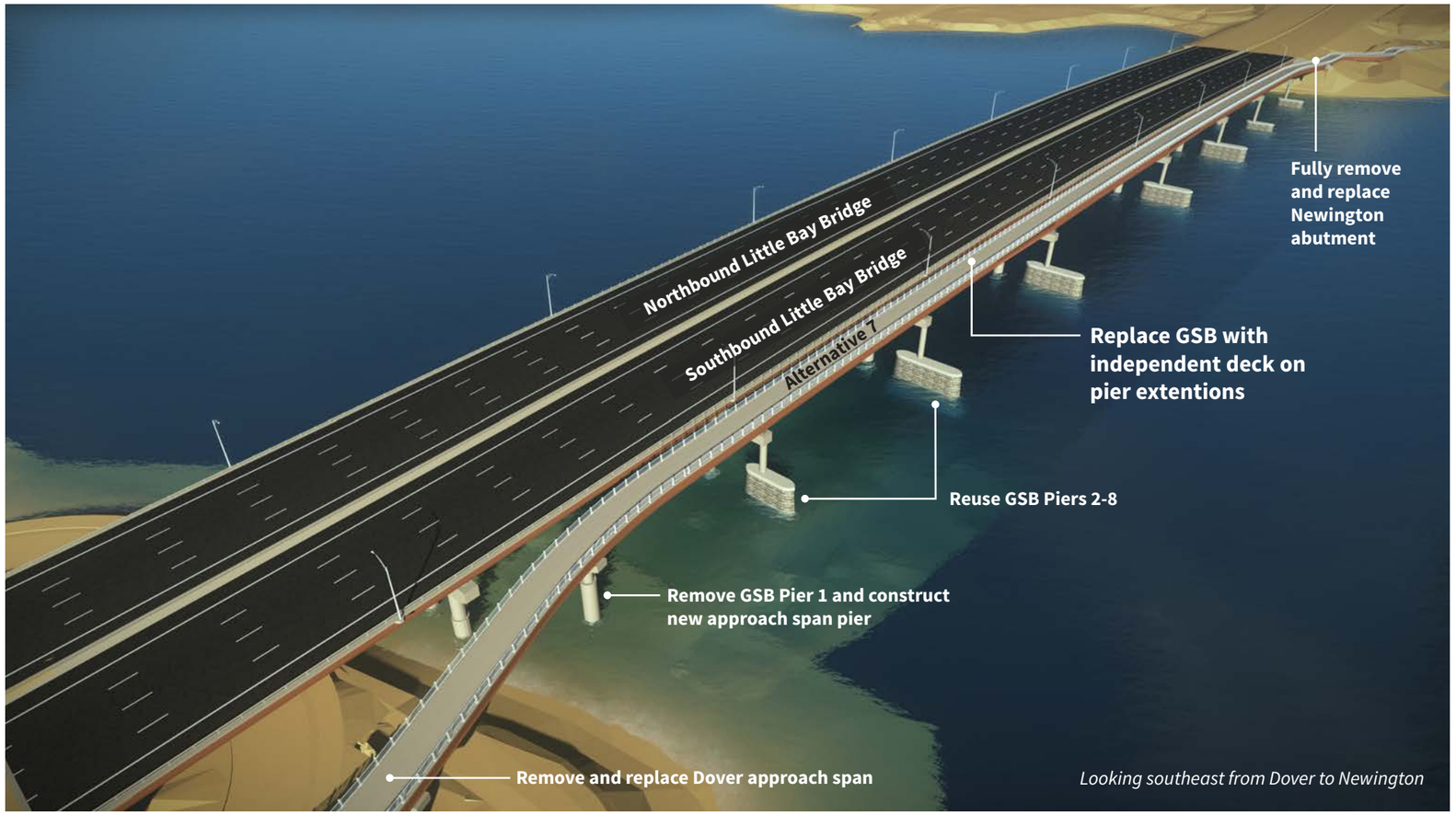
Alternative 9 would have an estimated initial capital cost of $28.5 million and a life cycle cost of $31.25 million. In comparison to the other alternatives, Alternative 9 would cost slightly more than Alternative 6 but is otherwise the least expensive reasonable alternative.

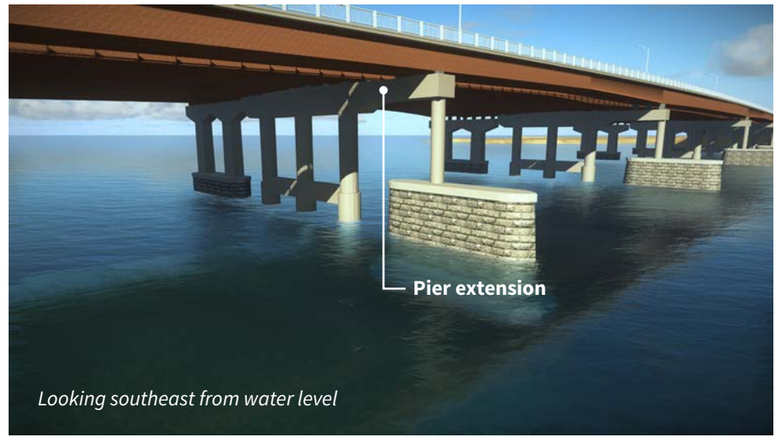
This alternative would have a 16-foot-wide multiuse path, would comply with the ADA guidelines for accessibility and would have a steel pedestrian rail along both sides of the new bridge deck. The new path would be 22.5 feet from the LBB, approximately 7.4 feet further from the LBB than the existing GSB (at 15.1 feet). These characteristics contribute to the high performance of the design with respect to user safety, emergency access, and inspection safety. The new superstructure would not be in the form of a truss, and therefore would not be visually consistent with the existing GSB. There would be no changes to the southbound LBB which would preserve the existing transportation capacity of the LBB.

The recently constructed 2010 approach span at the Dover end of the bridge would not require substantial modifications as part of this alternative, as the alignment of the existing GSB would be maintained. The existing Newington abutment would be rehabilitated or removed in its entirety and replaced. The overall footprint should be smaller than the existing abutment due to the proposed reduced deck width. Alternative 9 would require temporary impacts for construction access. It would avoid the need to reconstruct the approach span from Hilton Park which would minimize intertidal habitat impacts.

Preferred Alternative

For the reasons discussed above, the Preferred Alternative for the Project has been determined to be Alternative 9: Superstructure Replacement - Girder Option, which involves the complete removal and replacement of the GSB superstructure. Under Alternative 9, the GSB superstructure would be replaced with a steel girder system with a structural steel frame extending from the bottom of the girders to the top of the existing GSB piers. Alternative 9 would preserve the existing piers without requiring significant modifications.





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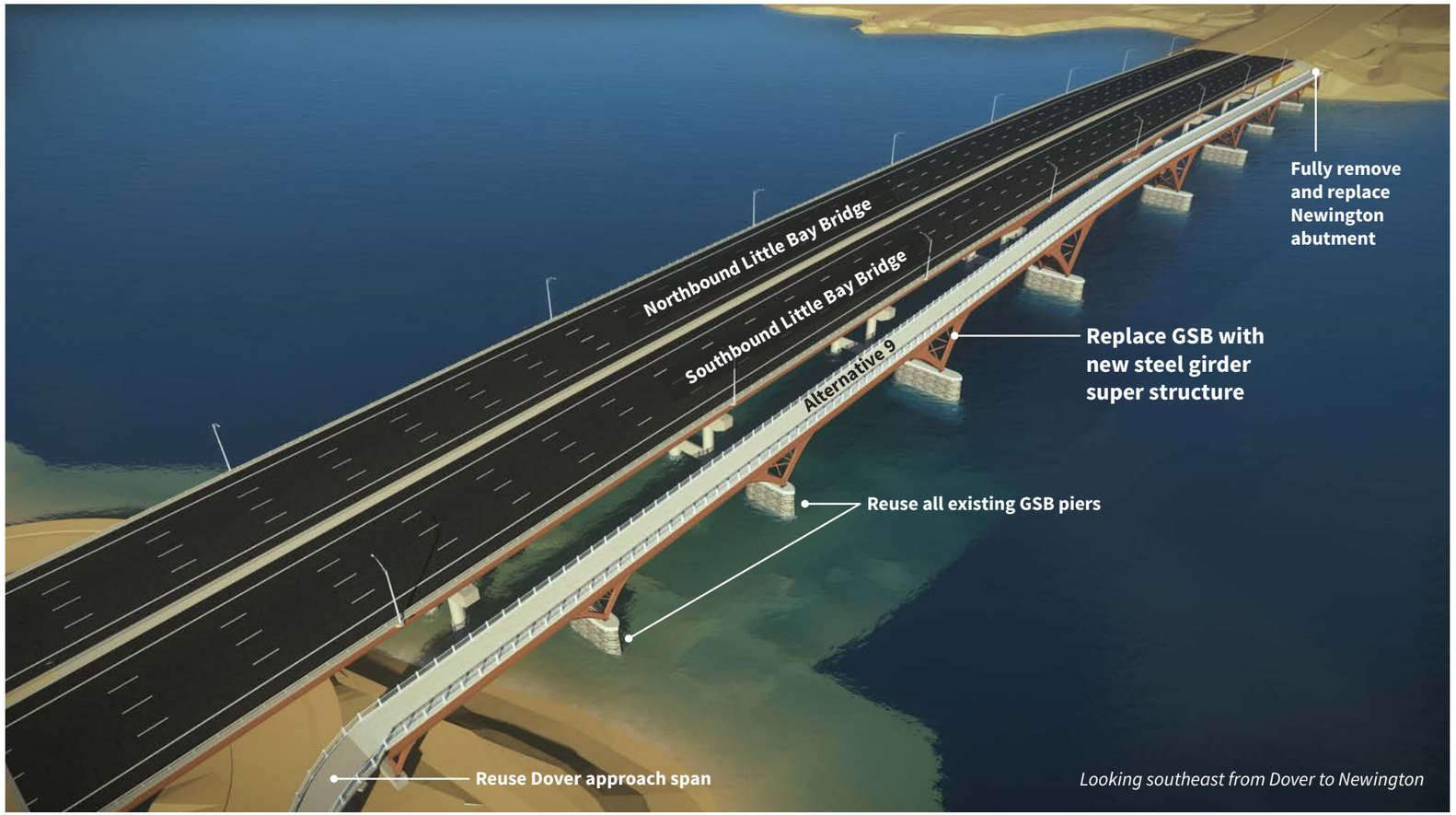
Alternative 7:
Southbound Little Bay Bridge—
Independent Deck on Pier Extension
Conceptual Design Renderings



"V-Frame" design option shown. "Super Haunch" similar.

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Alternative 9: Superstructure Replacement—Girder Option (Preferred Alternative) Conceptual Design Renderings

2.4 Other Project Elements

Temporary Bicycle and Pedestrian Detour

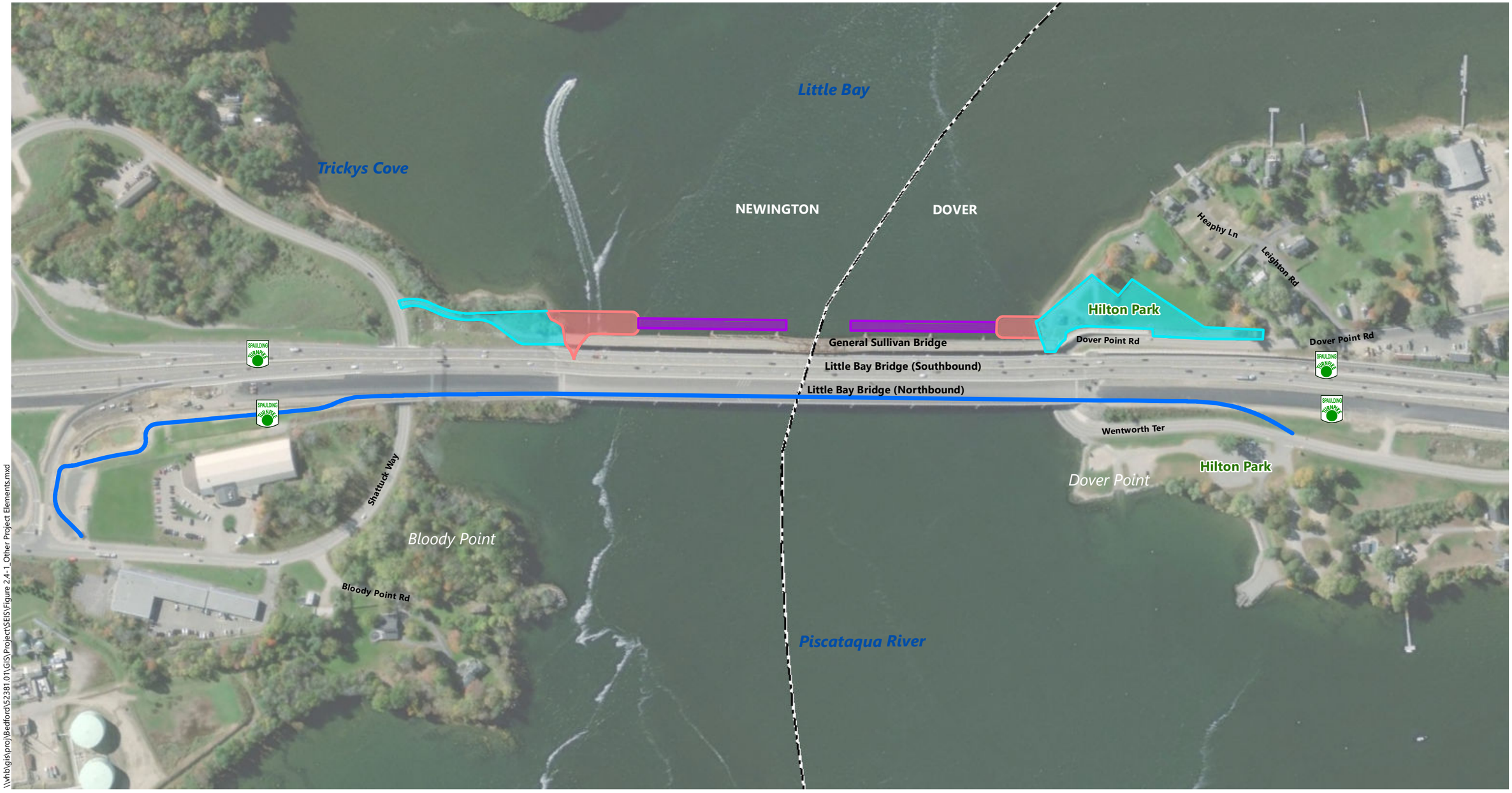
A temporary bicycle and pedestrian detour was constructed on the northbound LBB to provide non-motorized connectivity across Little Bay in part due to the closure of the GSB, opening for public use in August 2019, and will remain in place during construction of the Project (refer to **Figure 2.4-1**). This temporary detour would be part of all Action Alternatives. The detour path is 10 feet wide, with a 48-inch tall, 2-foot-wide concrete barrier and chain link fencing installed to separate path users and vehicular traffic. To meet pedestrian rail requirements, chain link fencing was installed on the existing northbound LBB railing to address the height and rail gap. The temporary bicycle and pedestrian detour approach from Shattuck Way on the Newington side connects to and utilizes the access road already constructed for the water quality treatment Best Management Practice (BMP) basin located adjacent to the Exit 4 northbound on-ramp from Shattuck Way. The temporary detour approach on the Dover side connects to Wentworth Terrace, adjacent to the eastern side of Hilton Park. Because this temporary detour requires temporary use of one lane of the northbound LBB, it would be removed as soon as possible following completion of the Project to allow the expanded LBB to accommodate vehicular traffic volumes as intended and designed.

Temporary Contractor Construction Access

All Action Alternatives would require temporary occupation of upland areas and surface waters in Newington and Dover throughout the duration of construction. Please see **Appendix D** for a set of drawings depicting temporary construction access plans for each reasonable alternative. These areas include:

- **Construction Access, Laydown, and Staging Areas:** During construction, approximately 2.0 acres total (0.5 acre in Newington and 1.5 acres in Dover) would be temporarily occupied and fenced off for construction access, laydown, and staging. Of the area proposed to be used in Dover, approximately 1.1 acres of Hilton Park would not be publicly accessible. This temporary use would require a pavilion to be replaced or relocated to another location in Hilton Park.
- **Causeways and Trestles Construction:** All Action Alternatives would require the use of two temporary causeways and trestles extending from the Newington and Dover sides of the bay. The causeways would be approximately 260 feet long on the Newington side and 130 feet long on the Dover side. The causeways would provide a top width of 30 feet for construction of the approach spans of the bridge. Placement of the trestles beyond the causeways would extend for approximately 450 to 460 feet in Newington and 470 to 480 feet in Dover. The trestles would be supported by pile bents. While the causeways and trestles are in use, the 200-foot navigational channel would be maintained at its existing location. In addition to the temporary causeway on the Dover side of the bridge, Alternatives 6 and 7 would require the use of a drill rig platform for the removal and replacement of GSB Pier 1.

Figure 2.4-1



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0 150 300 600 Feet

Legend

- Town Boundaries
- Temporary Contractor Workspace (Varies by Alternative)
- Temporary Causeway
- Temporary Trestle
- Temporary Bicycle and Pedestrian Detour (Approximate)

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Other Project Elements

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Source: VHB, NH GRANIT