4 Alternatives Evaluation

As described in Chapter 3, eight different long-term alternatives were defined to meet the study goals and objectives. The long-term alternatives advanced into an alternatives analysis process based on the evaluation criteria developed at the beginning of the study and discussed in Chapter 1. The long-term alternatives include seven different build alternatives, as well as a No Build Alternative that includes the repair of the existing bridge. As summarized in Chapter 3, the build alternatives have a variety of horizontal clearances and include one of three different bridge types.

This chapter provides a summary of the alternatives evaluation process and more detailed analysis of each long-term alternative. The summary section includes an evaluation matrix that compares all of the long-term alternatives. The following sections provide the detailed analysis of each alternative, including the results of the evaluation and identification of additional impacts assessment that would likely be needed. The detailed analysis sections also includes a discussion of the mitigation that may be required for any project that would be moved forward into the project development process.

The end of the chapter includes more detailed analysis of the short- and medium-term alternatives introduced in Chapter 3. These nearer term alternatives are focused on intersection, bicycle/pedestrian, and ITS/signage improvements that could be made prior to, in conjunction with, or following the completion of one of the long-term alternatives.

4.1 SUMMARY OF LONG-TERM ALTERNATIVES EVALUATION

At the onset of the study process, a set of evaluation criteria were established to help analyze the long-term alternatives that were developed. The evaluation criteria are comprehensive and address the following topics: bridge operations, transportation impacts, safety, economic development, environment, community, and alternative feasibility.

Table 4.1 and 4.2 provides a summary of the evaluation of the long-term alternatives. The first four alternatives (Alternatives 1, 1T, 2, and 2W) are included in Table 4.1 and the remaining alternatives (Alternatives 3, 3W, 3D, and No Build) are provided in Table 4.2.

Each evaluation criteria is listed along with a summary of the evaluation for each alternative. In addition to the quantitative or qualitative information provided, the table includes an indication, or rating, to the significance of the impact or benefit in a graphical manner. The following is the legend for a rating system utilized:

● = Minor Negative Impact or Most Positive Benefit

◒ = Moderate Impact or Minor/Moderate Positive Benefit

○ = Significant Negative Impact or Least Positive Benefit

Table 4.1. Summary of Alternatives Evaluation (Alternatives 1, 1T, 2, and 2W)

Evaluation Category	Evaluation Criteria	Alternative 1: Vertical Lift Bridge (Rating)	Alternative 1T: Tall Vertical Lift Bridge (Rating)	Alternative 2: Double-leaf Bascule (Rating)	Alternative 2W: Wide Double-leaf Bascule (Rating)
Bridge Operations					
Bridge opening times	Minutes per bridge closure (shortest)	7.5 minutes ◒	7.5 minutes ◒	7.5 minutes ◒	7.5 minutes ◒
Vertical clearances	Feet of vertical clearance (height for vessels)	110-135 feet ○	150 feet ○	Unlimited ●	Unlimited ●
Horizontal clearances	Feet of horizontal clearance (width for vessels)	270 feet ●	270 feet ●	150 feet ◒	220 feet ◒
Estimated number of daily bridge openings	Number per day	11 to 20 ◒	11 to 20 ◒	11 to 20 ◒	11 to 20 ◒
Long-term reliability risk	Long-term reliability risk	Medium Risk ◒	Medium Risk ◒	Medium Risk ◒	Medium Risk ◒
Transportation Impacts & Mobility					
Operational functionality	Corridor intersections level of service (LOS)	No Change ◒	No Change ◒	No Change ◒	No Change ◒
Operational functionality	Corridor volume to capacity ratios	No Change ◒	No Change ◒	No Change ◒	No Change ◒
Operational functionality	Change in 50th and 95th percentile queues	No Change ◒	No Change ◒	No Change ◒	No Change ◒
Travel time	Average roadway travel time along corridor	No Change ◒	No Change ◒	No Change ◒	No Change ◒
Travel time	Average roadway delay (regional)	No Change ◒	No Change ◒	No Change ◒	No Change ◒
Travel time	Average roadway delay (Route 6)	No Change ◒	No Change ◒	No Change ◒	No Change ◒
Travel time	Average transit service delay	N/A	N/A	N/A	N/A
Travel time	Average vessel delay	Reduces/Eliminates Delay ◒	Reduces/Eliminates Delay ◒	Reduces/Eliminates Delay ◒	Reduces/Eliminates Delay ◒
Pedestrian and bicycle mobility and connectivity	Compliance with ADA requirements	Compliant ◒	Compliant ◒	Compliant ◒	Compliant ◒
Pedestrian and bicycle mobility and connectivity	Bicycle/pedestrian delay	No Change ◒	No Change ◒	No Change ◒	No Change ◒
Pedestrian and bicycle mobility and connectivity	Provision of bicycle facilities	Provided (wider shoulders) ●	Provided (wider shoulders) ●	Provided (wider shoulders) ●	Provided (wider shoulders) ●
Pedestrian and bicycle mobility and connectivity	Provision of pedestrian facilities	Provided (sidewalks) ◒	Provided (sidewalks) ◒	Provided (sidewalks) ◒	Provided (sidewalks) ◒

Evaluation Category	Evaluation Criteria	Alternative 1: Vertical Lift Bridge (Rating)	Alternative 1T: Tall Vertical Lift Bridge (Rating)	Alternative 2: Double-leaf Bascule (Rating)	Alternative 2W: Wide Double-leaf Bascule (Rating)
Safety					
Vehicular safety	Conformance with AASHTO and MassDOT standards	Conforms ◒	Conforms ◒	Conforms ◒	Conforms ◒
Vehicular safety	Delay to emergency vehicle access	No Change ◒	No Change ◒	No Change ◒	No Change ◒
Pedestrian and bicycle safety	Impact to high volume bicycle and pedestrian locations	N/A	N/A	N/A	N/A
Marine safety	Impact to safe navigation	Greatly Improved ●	Greatly Improved ●	Moderately Improved ◒	Moderately Improved ◒
Marine safety	Delay to emergency marine access	Improved ●	Improved ●	Improved ●	Improved ●
Environment					
Environmental impacts	Impact to coastal resources (square feet)	Potential Minor Impacts ◒	Potential Minor Impacts ◒	Potential Minor/Moderate Impacts ◒	Potential Minor/Moderate Impacts ◒
Environmental impacts	Impact to wetland resources (square feet)	Potential Minor Impacts ◒	Potential Minor Impacts ◒	Potential Minor/ Moderate Impacts ◒	Potential Minor/ Moderate Impacts ◒
Environmental impacts	Impact to natural resources	Potential Minor Impacts ◒	Potential Minor Impacts ◒	Potential Minor Impacts ◒	Potential Minor Impacts ◒
Environmental impacts	Impact to air quality and greenhouse gases from idling vehicles	Limited Impacts ◒	Limited Impacts ◒	Limited Impacts ◒	Limited Impacts ◒
Land Use & Economic Development					
Business impact from bridge	Number of businesses impacted	None ●	None ●	None ●	None ●
Business impact from bridge	Value of businesses impacted	N/A	N/A	N/A	N/A
Business impact from bridge	Number of jobs lost from businesses impacted	N/A	N/A	N/A	N/A
Economic benefits from bridge	Shipper cost savings	$480,000 ◒	$480,000 ◒	$480,000 ◒	$480,000 ◒
Community					
Community impacts	Impact to protected and recreational open space	No Impact ●	No Impact ●	No Impact ●	No Impact ●

Evaluation Category	Evaluation Criteria	Alternative 1: Vertical Lift Bridge (Rating)	Alternative 1T: Tall Vertical Lift Bridge (Rating)	Alternative 2: Double-leaf Bascule (Rating)	Alternative 2W: Wide Double-leaf Bascule (Rating)
Community impacts	Impact to historical/archeological resources	Limited Impact ◒	Limited Impact ◒	Limited Impact ◒	Limited Impact ◒
Community impacts	Impact to cultural resources	Replacement of historic bridge ○	Replacement of historic bridge ○	Replacement of historic bridge ○	Replacement of historic bridge ○
Community impacts	Impact to business access	No Impact ●	No Impact ●	No Impact ●	No Impact ●
Community impacts	Impact to environmental justice populations	Limited Impact ◒	Limited Impact ◒	Limited Impact ◒	Limited Impact ◒
Visual impacts	Visual impacts	Some Impact ○	Some Impact ○	No Impact ●	No Impact ●
Alternative Feasibility					
Cost	Capital costs	$90-$120 Million ○	$100-$130 Million ○	$85-$100 Million ◒	$130-$160 Million ○
Cost	Annual operating and maintenance costs	$490,000 ◒	$490,000 ◒	$490,000 ◒	$490,000 ●
Construction phase impacts	Construction duration	33 months ○	33 months ○	37 months ○	37 months ○
Construction phase impacts	Impacts to vehicular traffic	2 week road closure ●	2 week road closure ●	24 month road closure ○	24 month road closure ○
Construction phase impacts	Impacts to Marine traffic	1 weekend marine closure ●	1 weekend marine closure ●	3 weekend marine closure ○	3 weekend marine closure ○
Construction phase impacts	Direct impact to abutting land owners/businesses	No Direct Impacts ◒	No Direct Impacts ◒	No Direct Impacts ◒	No Direct Impacts ◒
Construction phase impacts	Indirect impacts to abutting land owners/businesses	Significant access impacts ○	Significant access impacts ○	Significant access impacts ○	Significant access impacts ○
Right-of-way impacts	Permanent and temporary right-of-way impacts	None anticipated ●	None anticipated ●	None anticipated ●	None anticipated ●

Table 4.2. Summary of Alternatives Evaluation (Alternatives 3, 3W, 3D, and No Build)

Evaluation Category	Evaluation Criteria	Alternative 3: Single-leaf Rolling Bascule (Rating)	Alternative 3W: Wide Double-leaf Rolling Bascule (Rating)	Alternative 3D: Double-leaf Dutch Bascule (Rating)	No Build: Repair Existing Swing Bridge (Rating)
Bridge Operations					
Bridge opening times	Minutes per bridge closure (shortest)	7.5 minutes ◒	7.5 minutes ◒	7.5 minutes ◒	7.5 minutes ◒
Vertical clearances	Feet of vertical clearance (height for (vessels)	Unlimited ●	Unlimited ●	Unlimited ●	Unlimited ●
Horizontal clearances	Feet of horizontal clearance (width for vessels)	150 feet ◒	220 feet ●	200 feet ●	95 feet ○
Estimated number of daily bridge openings	Number per day	11 to 20 ◒	11 to 20 ◒	11 to 20 ◒	11 to 20 ◒
Long-term reliability risk	Long-term reliability risk	High Risk ○	Medium Risk ○	TBD	Medium Risk ◒
Transportation Impacts & Mobility					
Operational functionality	Corridor intersections level of service (LOS)	No Change ◒	No Change ◒	No Change ◒	1 intersection below LOS D
Operational functionality	Corridor volume to capacity ratios	No Change ◒	No Change ◒	No Change ◒	Corridor V/C ratios acceptable
Operational functionality	Change in 50th and 95th percentile queues	No Change ◒	No Change ◒	No Change ◒	N/A
Travel time	Average roadway travel time along corridor	No Change ◒	No Change ◒	No Change ◒	6.5 to 9 minutes without bridge delay
Travel time	Average roadway delay (regional)	No Change ◒	No Change ◒	No Change ◒	N/A
Travel time	Average roadway delay (Route 6)	No Change ◒	No Change ◒	No Change ◒	3 to 4.5 minutes plus bridge delay
Travel time	Average transit service delay	N/A	N/A	N/A	N/A
Travel time	Average vessel delay	Reduces/Eliminates Delay ◒	Reduces/Eliminates Delay ◒	Reduces/Eliminates Delay ◒	25% of large cargo vessels delayed 1 day
Pedestrian and bicycle mobility and connectivity	Compliance with ADA requirements	Compliant ◒	Compliant ◒	Compliant ◒	Compliant
Pedestrian and bicycle mobility and connectivity	Bicycle/pedestrian delay	No Change ◒	No Change ◒	No Change ◒	Delay due to bridge opening
Pedestrian and bicycle mobility and connectivity	Provision of bicycle facilities	Provided (wider shoulders) ●	Provided (wider shoulders) ●	Provided (wider shoulders) ●	Roadway shoulders on bridge less than 2 feet

Evaluation Category	Evaluation Criteria	Alternative 3: Single-leaf Rolling Bascule (Rating)	Alternative 3W: Wide Double-leaf Rolling Bascule (Rating)	Alternative 3D: Double-leaf Dutch Bascule (Rating)	No Build: Repair Existing Swing Bridge (Rating)
Pedestrian and bicycle mobility and connectivity	Provision of pedestrian facilities	Provided (sidewalks) ◒	Provided (sidewalks) ◒	Provided (sidewalks) ◒	Sidewalks currently exist on bridge
Safety					
Vehicular safety	Conformance with AASHTO and MassDOT standards	Conforms ◒	Conforms ◒	Conforms ◒	Conforms ◒
Vehicular safety	Delay to emergency vehicle access	No Change ◒	No Change ◒	No Change ◒	Need for bridge opening causes delay
Pedestrian and bicycle safety	Impact to high volume bicycle and pedestrian locations	N/A	N/A	N/A	No high volume locations
Marine safety	Impact to safe navigation	Moderately Improved ◒	Greatly Improved ●	Greatly Improved ●	N/A
Marine safety	Delay to emergency marine access	Improved ●	Improved ●	Improved ●	N/A
Environment					
Environmental impacts	Impact to coastal resources (square feet)	Potential Minor Impacts ◒	Potential Minor Impacts ◒	Potential Minor Impacts ◒	N/A
Environmental impacts	Impact to wetland resources (square feet)	Potential Minor Impacts ◒	Potential Minor Impacts ◒	Potential Minor Impacts ◒	N/A
Environmental impacts	Impact to natural resources	Potential Minor Impacts ◒	Potential Minor Impacts ◒	Potential Minor Impacts ◒	N/A
Environmental impacts	Impact to air quality and greenhouse gases from idling vehicles	Limited Impacts ◒	Limited Impacts ◒	Limited Impacts ◒	N/A
Land Use & Economic Development					
Business impact from bridge	Number of businesses impacted	None ●	None ●	None ●	N/A
Business impact from bridge	Value of businesses impacted	N/A	N/A	N/A	N/A
Business impact from bridge	Number of jobs lost from businesses impacted	N/A	N/A	N/A	N/A
Economic benefits from bridge	Shipper cost savings	$480,000 ◒	$480,000 ◒	$480,000 ◒	N/A
Community					
Community impacts	Impact to protected and recreational open space	No Impact ●	No Impact ●	No Impact ●	N/A

Evaluation Category	Evaluation Criteria	Alternative 3: Single-leaf Rolling Bascule (Rating)	Alternative 3W: Wide Double-leaf Rolling Bascule (Rating)	Alternative 3D: Double-leaf Dutch Bascule (Rating)	No Build: Repair Existing Swing Bridge (Rating)
Community impacts	Impact to historical/archeological resources	Limited Impact ◒	Limited Impact ◒	Limited Impact ◒	N/A
Community impacts	Impact to cultural resources	Replacement of historic bridge ○	Replacement of historic bridge ○	Replacement of historic bridge ○	N/A
Community impacts	Impact to business access	No Impact ●	No Impact ●	No Impact ●	N/A
Community impacts	Impact to environmental justice populations	Limited Impact ◒	Limited Impact ◒	Limited Impact ◒	N/A
Visual impacts	Visual impacts	Limited Impact ◒	Limited Impact ◒	Limited Impact ◒	N/A
Alternative Feasibility					
Cost	Capital costs	$50-$70 Million ●	$90-$110 Million ◒	$100-$125 Million ◒	$45 Million ●
Cost	Annual operating and maintenance costs	$408,000 ●	$490,000 ◒	$490,000 ◒	$416,000 ●
Construction phase impacts	Construction duration	26 months ◒	26 months ◒	26 months ◒	18 months ●
Construction phase impacts	Impacts to vehicular traffic	3 month road closure ◒	3 month road closure ◒	3 month road closure ◒	2 week road closure ●
Construction phase impacts	Impacts to Marine traffic	1 weekend marine closure ●	1 weekend marine closure ●	1 weekend marine closure ●	2 weekend marine closure ◒
Construction phase impacts	Direct Impact to abutting land owners/businesses	No Direct Impacts ◒	No Direct Impacts ◒	No Direct Impacts ◒	No Direct Impacts ◒
Construction phase impacts	Indirect impacts to abutting land owners/businesses	Moderate access impacts ◒	Moderate access impacts ◒	Moderate access impacts ◒	Minor-Moderate access impacts ●
Right-of-way impacts	Permanent and temporary right-of-way impacts	None anticipated ●	None anticipated ●	None anticipated ●	N/A

4.2 NO BUILD ALTERNATIVE: REPAIR SWING BRIDGE

This section provides an evaluation of the No Build Alternative, the long-term alternative that includes the continued maintenance of the existing middle bridge. This alternative includes the rehabilitation of the swing span superstructure in the same configuration as it exists today.

The No Build Alternative was evaluated against the evaluation criteria established at the onset of the study. The evaluation criteria are specific measures of effectiveness used to assess benefits and impacts of each long-term alternative. The No Build Alternative is used as a base line for comparison to the other build alternatives described later in this chapter.

The existing bridge structure was constructed between 1896 and 1903 and has undergone a number of repairs and rehabilitations over the last century. The bridge most recently a complete rehabilitation in 1994 and a program of major repairs began in 1999. Although the bridge structure has been rehabilitated and repaired over the years, much of the original superstructure elements remain. As shown in Figure 4.1, the superstructure for this bridge is the swinging portion of the bridge made of steel truss sections and the connected roadway deck.

Figure 4.1. Existing Middle Bridge Swing Span Opening for Marine Traffic

The superstructure of the middle bridge's swing span consists of two main load-bearing trusses (north and south) connected with bracing at both the top and bottom connecting to the bridge cords. A truss bridge has four beams called chords. The two beams on the bottom, the lower chords, run parallel for the length of the bridge. The upper chords run parallel for less than the full length of the bridge. On the middle bridge, the north and south trusses are identical and evenly spaced from the center of the bridge. The two trusses support a floor system that consists of floor beams, stringers, and a grid deck.

In 2010, MassDOT hired Hardesty & Hanover, LLP (H&H) to perform an inspection of the movable segment of the bridge. The inspection was required to investigate cracks in the bottom chord that were documented in an inspection field report from the previous year.

The inspection and resulting report documented that the bridge's truss bottom and top chords are original members. The visual inspection of bridge conditions and results of a fatigue analysis indicated that the bottom chord is at the end of its fatigue life. The inspection results indicate that the span has undergone a significant number of fatigue cycles. As discussed in Chapter 2, it is estimated that the bridge opens and closes at least 4,000 times per year. The report concluded that the bottom chord has exceeded the expected lifetime.

The bottom chord is a critical structural component of the swing span and the repair of this one component would present significant challenges. The 2010 report's recommendation was to take some short-term actions to prolong the life of the structure while decisions on longer-term solutions were made. Bridge inspectors noted that even if the short-term repair were made, critical decisions on long-term solutions (i.e., a new bridge or a truss replacement option), would need to be made by 2016.

Since the original identification of cracks in the bottom chord was made in 2009, the following improvement/repair activities have taken place:

- Bottom chord fatigue cracking repairs (2009);
- Hydraulic system upgrade (2009);
- Hydraulic lift jack bearing plate repairs (2011);
- Electrical system upgrade (2012);
- Floorbreak repairs (2012); and
- End floor beam to bottom chord connection repairs (2014).

It has been assumed that due to a combination of the age of the structure, the condition of the chords, and the complications with a truss rehabilitation option, that a full replacement of the superstructure will be required within the next fifteen years.

4.2.1 Bridge Operations

Under the No Build Alternative, the bridge operations would be the same as they are today. With a new truss superstructure, the operating time for each bridge movement and the daily number of bridge openings would not change. The horizontal and vertical clearance when the bridge is closed will also remain the same.

MINUTES PER BRIDGE CLOSURE

The opening sequence of the bridge in all of the long-term alternatives, including the No Build Alternative, would continue to follow the AASHTO recommendation that requires approximately four minutes to open and an additional four minutes to close. The average time to open and close the bridge will continue to vary based on the marine traffic transit time and the time required to clear pedestrians and vehicles from the movable span before it can open to marine traffic. The minutes per bridge closure in the No Build Alternative is the same as the current condition.

FEET OF VERTICAL CLEARANCE (OPEN & CLOSED)

No changes will occur in the No Build Alternative to increase the existing six feet of vertical clearance above mean high water (MHW) it is in the closed position. The bridge would continue to create no vertical clearance restrictions when the bridge is open to marine traffic.

FEET OF HORIZONTAL CLEARANCE

No changes will occur in the No Build Alternative to increase the 94- and 95-foot horizontal navigational channel widths. The bridge will continue to result in horizontal clearance restrictions when the bridge is open to marine traffic.

NUMBER OF DAILY BRIDGE OPENINGS

As shown in Table 4.3, the bridge operates on a fixed schedule during the daylight hours and on demand at all other times. This schedule and number of daily openings (11-20 per day) are expected to stay the same. Vessels that transit the bridge are not anticipated to experience any change in delay. The number of daily bridge openings is anticipated to stay the same.

Table 4.3. Bridge Operation Schedule

Early AM	AM	PM	Late PM
On Demand	6:00	12:15	On Demand
-	7:00	1:15	-
-	8:00	2:15	-
-	9:00	3:15	-
-	10:00	4:15	-
-	11:15	5:15	-
-	-	6:15	-

LONG-TERM RELIABILITY RISK

Since each moveable bridge includes a complex interaction of mechanical, electrical, and structural components, there is an inherent risk in a moveable bridge that one of these systems will not operate as designed on any particular day and result in the inability for the bridge to open or close. Some moveable bridge types are at greater risk of inoperability than others due to the nature of their design and the conditions and environment that they operate within. As inoperability of a bridge for a period of time results in community and economic impacts, the risk associated with bridge reliability in the long-term was assessed. This included a general assessment of existing bridges of the type and size under consideration in conditions similar to that of New Bedford Harbor and their ability to remain reliable throughout the life span of the bridge. As noted, all moveable bridges are complex and have some long-term reliability risk. The span width and length of a replacement swing bridge (the No Build Alternative) when operating in the marine costal environment of New Bedford Harbor is estimated to have a medium level of risk. It is likely that even with regular maintenance, the bridge would experience some periods of unanticipated inoperability similar to any moveable bridge in the same location.

4.2.2 Transportation Impacts & Mobility Analysis

The evaluation and assessment of mobility along the corridor between County Street in New Bedford and Adams Street in Fairhaven is an important component of this study. Currently, mobility along the corridor is most significantly impacted by the hourly opening of the New Bedford-Fairhaven Bridge. When the bridge is open, meaning it is closed to vehicular traffic, vehicles need to wait between 12.5 to 22.5 minutes while the bridge swings open, marine traffic transits through the bridge, and then the bridge closes. Typical vehicle queues resulting from the bridge openings range from 1,300 feet to 2,000 feet for eastbound traffic and 1,300 to 1,600 feet for westbound traffic.

As detailed in Chapter 2, a corridor capacity analysis was conducted for the 2014 Existing Condition as well as for a future year (2035) without the consideration of any of the proposed long-term alternatives (2035 No Build Condition). It is not anticipated that any of the long-term alternatives will result in the improvement or degradation of traffic along the corridor. Therefore, the 2035 No Build Condition presented in Chapter 2 and the future traffic condition of each long-term alternative (2035 Build Condition) would be the same. For the purposes of clarity, this will be referred to as the 2035 Condition throughout this chapter.

The analysis of traffic conditions was conducted using Synchro software and application of the *Highway Capacity Manual* based methodology to determine the future performance metrics such as volume-to-capacity ratio, delay, and level of service (LOS). As described in this section, none of the long-term alternatives, including the No Build Alternative, will change vehicular traffic along the corridor. Each of the long-term alternatives will result in the same number of bridge openings and the bridge will on average be open for the same duration. Additional information regarding the 2035 Condition is included in Chapter 2.

CORRIDOR INTERSECTION LEVEL OF SERVICE

Using the 2035 conditions analysis, the LOS was identified for each of the corridor intersections between County Street in New Bedford and Adams Street in Fairhaven. Table 4.4 summarizes the anticipated delay and LOS of each intersection in 2035. The only intersection along the Route 6 Corridor that currently experiences significant delay and an unacceptable LOS is the

Kempton Street/Mill Street and Purchase Street intersection (known locally as the "Octopus Intersection").

Table 4.4. Intersection Delay and LOS Summary, 2035 Condition

Intersection Name	AM Intersection Delay (seconds)	AM Intersection LOS	PM Intersection Delay (seconds)	PM Intersection LOS
Mill Street and Cottage Street	19.2	B	17.0	B
Kempton Street and Cottage Street	34.7	C	14.0	B
Mill Street and County Street	22.6	C	49.6	D
Kempton St and County Street	17.5	B	17.5	B
Kempton Street/Mill Street and Purchase Street ("Octopus Intersection")	87.7	F	112.5	F
Huttleston Avenue & Middle Street	9.8	A	11.6	B
Huttleston Avenue & Main Street	26.3	C	28.6	C
Huttleston Avenue & Adams Street	39.1	D	18.1	B

CORRIDOR VOLUME TO CAPACITY RATIOS/QUEUE LENGTHS

The volume/capacity (v/c) ratio represents the sufficiency of an intersection to accommodate the vehicle demand. A v/c ratio less than 0.85 generally indicates that adequate capacity is available and vehicles are not expected to experience significant queues and delays. As the v/c ratio approaches 1.0, traffic flow may become unstable, and delay and queuing conditions may occur. As shown in Table 4.5, although some ratios are greater than 0.85, none of the intersections are at or above 1.0, indicating that there is sufficient capacity in the corridor intersections to accommodate the future demand.

Table 4.5. Corridor Intersection Volume/Capacity Ratios, 2035 Condition

Intersection Name	AM Intersection V/C Ratio	PM Intersection V/C Ratio
Mill Street & Cottage Street	0.43	0.51
Kempton Street & Cottage Street	0.90	0.63
Mill Street & County Street	0.77	0.92
Kempton Street & County Street	0.69	0.76
Kempton Street/Mill Street & Purchase Street ("Octopus Intersection")	0.72	0.89
Huttleston Avenue & Middle Street	0.47	0.54
Huttleston Avenue & Main Street	0.65	0.66
Huttleston Avenue & Adams Street	0.82	0.64

Table 4.6 presents the queue lengths that would be experienced at each intersection along the Route 6 Corridor in the 2035 No Build Condition. As noted, these queue lengths are the same for the 2035 Build Condition.

Table 4.6. Corridor Intersection 50th and 95th Percentile Queue Lengths, 2035

Intersection Name	Link Name	Movement	AM 50th percentile queue (feet)	AM 95th percentile queue (feet)	PM 50th percentile queue (feet)	PM 95th percentile queue (feet)
Mill Street & Cottage Street	Mill Street	Westbound	122	161	114	179
Mill Street & Cottage Street	Cottage Street	Northbound	54	55	26	48
Mill Street & Cottage Street	Cottage Street	Southbound	49	80	38	85
Kempton Street & Cottage Street	Kempton Street	Eastbound Left	3	8	8	12
Kempton Street & Cottage Street	Kempton Street	Eastbound Through	207	240	128	156
Kempton Street & Cottage Street	Kempton Street	Eastbound Right	0	5	0	0
Kempton Street & Cottage Street	Cottage Street	Northbound	127	150	54	127
Kempton Street & Cottage Street	Cottage Street	Southbound	162	169	64	122
Mill Street & County Street	Mill Street	Westbound	147	195	155	225
Mill Street & County Street	County Street	Northbound Left	8	14	23	23
Mill Street & County Street	County Street	Northbound Through	49	67	175	203
Mill Street & County Street	County Street	Southbound	254	441	278	457
Kempton Street & County Street	Kempton Street	Eastbound Left	24	38	24	44
Kempton Street & County Street	Kempton Street	Eastbound	100	109	84	119
Kempton Street & County Street	County Street	Northbound	135	234	145	283
Kempton Street & County Street	County Street	Southbound	79	162	196	209
Kempton Street/Mill Street & Purchase Street	Kempton Street	Eastbound Left	245	404	378	580
Kempton Street/Mill Street & Purchase Street	Kempton Street	Eastbound	211	228	212	300
Kempton Street/Mill Street & Purchase Street	Mill Street	Westbound Left	374	525	365	574

Intersection Name	Link Name	Movement	AM 50th percentile queue (feet)	AM 95th percentile queue (feet)	PM 50th percentile queue (feet)	PM 95th percentile queue (feet)
Kempton Street/Mill Street & Purchase Street	Mill Street	Westbound Through	405	482	366	536
Kempton Street/Mill Street & Purchase Street	Mill Street	Westbound Right	119	183	96	129
Kempton Street/Mill Street & Purchase Street	Purchase Street	Northbound Left	102	156	209	262
Kempton Street/Mill Street & Purchase Street	Purchase Street	Northbound Through	145	168	260	328
Kempton Street/Mill Street & Purchase Street	Purchase Street	Northbound Right	0	32	40	104
Kempton Street/Mill Street & Purchase Street	Purchase Street	Southbound	281	360	491	626
Huttleston Avenue & Middle Street	Huttleston Ave	Eastbound	61	86	131	170
Huttleston Avenue & Middle Street	Huttleston Ave	Westbound	58	56	64	78
Huttleston Avenue & Middle Street	Middle Street	Northbound	62	109	84	131
Huttleston Avenue & Main Street	Huttleston Ave	Eastbound Left	43	56	93	136
Huttleston Avenue & Main Street	Huttleston Ave	Eastbound	87	61	81	68
Huttleston Avenue & Main Street	Huttleston Ave	Westbound Left	11	35	20	45
Huttleston Avenue & Main Street	Huttleston Ave	Westbound	165	149	167	146
Huttleston Avenue & Main Street	Main Street	Northbound	86	92	137	198
Huttleston Avenue & Main Street	Main Street	Southbound	132	142	156	279
Huttleston Avenue & Adams Street	Huttleston Ave	Eastbound	156	183	40	60
Huttleston Avenue & Adams Street	Huttleston Ave	Westbound	108	162	123	202
Huttleston Avenue & Adams Street	Adams Street	Northbound	106	191	96	151
Huttleston Avenue & Adams Street	Adams Street	Southbound	118	125	118	146

AVERAGE ROADWAY TRAVEL TIME/DELAY

Using the intersection capacity analysis prepared for the 2035 No Build Condition, the travel time along the Route 6 Corridor was prepared to better assess the future conditions when the bridge is open to vehicular traffic. These travel times were compared with the travel times experienced during the 2014 Existing Condition. This comparison in travel times between the 2014 Existing Condition and the 2035 No Build Condition is provided in Table 4.7.

Table 4.7. Route 6 Corridor Travel Times between Cottage Street and Adams Street

Direction	2014 Existing AM Peak Hour	2014 Existing PM Peak Hour	2035 Estimated AM Peak Hour	2035 Estimated PM Peak Hour
Eastbound	6.9 minutes	6.4 minutes	7.2 minutes	6.5 minutes
Westbound	8.2 minutes	6.9 minutes	8.9 minutes	7.5 minutes

As noted in Table 4.7, the travel times along the corridor are generally expected to increase over the 20-year period. This increased travel time in the 2035 No Build Condition, which is generally between seven and eight percent, or 30 to 35 seconds, longer than the 2014 Existing Condition. Some of these travel time increases may be offset by signal system improvements discussed in the short- and medium-term improvements analysis section later in this chapter.

The total travel delay times for eastbound and westbound traffic along the corridor that is due to intersection signal delay is included in Table 4.8. These intersection delay times can be contrasted with the average delay of 12.5 minutes that occurs once per hour when the bridge opens for vessel traffic.

Table 4.8. Route 6 Corridor Delay Due to Intersection Signals

Direction	2014 Existing AM Peak Hour	2014 Existing PM Peak Hour	2035 Estimated AM Peak Hour	2035 Estimated PM Peak Hour
Eastbound	3.0 minutes	2.6 minutes	3.4 minutes	2.6 minutes
Westbound	4.4 minutes	3.1 minutes	5.0 minutes	3.6 minutes

BICYCLE & PEDESTRIAN MOBILITY/CONNECTIVITY

The width of the existing swing span allows for five-foot-wide sidewalks on both the north and south sides and the roadway shoulders less than two feet in width. The rest of the corridor has a slightly wider right-of-way (ROW), but it is still not wide enough to accommodate five-foot-wide bike lanes. Consequently, bicyclists and pedestrians both use the sidewalks along the bridge corridor segment.

Most pedestrian/bicycle use of the bridge occurs on the southern sidewalk since this sidewalk directly connects to the New Bedford downtown and waterfront. A new pedestrian ramp was completed in 2014 as part of a new roadway ramp from northbound Route 18 to eastbound Route 6. Between the New Bedford and Fairhaven shorelines, pedestrian and bicycle connectivity is difficult due to a lack of secure crossings, ramps, and gaps in the sidewalk network.

Because of these access challenges and safety concerns, pedestrian and bicyclist use of the bridge is currently limited. During the peak hour counts conducted for the study, only one pedestrian was observed to walk the entire length of the bridge between New Bedford and Fairhaven. During the warmer months, it is understood that pedestrian and bicycle use is more frequent and increases during non-peak auto hours.

The No Build Alternative does not provide additional bridge width to support the addition of a continuous five-foot-wide bike lane along the corridor. The five-foot-wide sidewalk will remain on each side. A roadway restriping is planned for completion in 2015 to narrow the traffic lanes from 12 to 11-feet-wide, which will allow for slightly wider shoulders along the entire bridge corridor. However, it will not be sufficient to permit a dedicated bike lane along the swing span.

4.2.3 Safety

Improving roadway, pedestrian, bicycle, and marine safety, reducing conflicts between transportation modes, and increasing emergency vehicle access are important considerations for evaluating the long-term alternatives. As described in this section, the replacement of the superstructure would not result in any changes from the existing conditions with regard to conformance to AASHTO and MassDOT standards, delay to emergency vehicle or marine access, or impact to high volume bicycle and pedestrian locations. The concerns related to safe vessel navigation through the bridge would remain as a concern and a significant constraint to New Bedford Harbor.

CONFORMANCE WITH AASHTO AND MASSDOT STANDARDS

For a bridge and approach roadway to be safe for vehicular traffic, it must be geometrically adequate. This consideration takes into account the number of lanes, lane and shoulder widths, approach roadway widths, horizontal clearances to roadside obstacles, stopping sight distances, vertical clearances and more. The standards for these criteria are identified in the AASHTO *Policy on Geometric Design of Highways and Streets* and the MassDOT *Project Development and Design Guidebook* (2006). The No Build Alternative would not result in any changes from the existing condition with regard to conformance to AASHTO and MassDOT standards.

DELAY TO EMERGENCY VEHICLE ACCESS

Both New Bedford and Fairhaven provide fire and emergency services to their respective municipalities. In case of bridge closure, Pope's Island can receive service from Fairhaven via the East Bridge. St. Luke's Hospital in New Bedford is the only facility in the two municipalities that provides emergency services. Bridge closures can affect Emergency Medical Services (EMS) access to the hospital from Fairhaven. The impact of access or delay for emergency vehicles will not change from the current condition with the proposed project.

IMPACT TO HIGH VOLUME BICYCLE AND PEDESTRIAN LOCATIONS

A sidewalk runs along the entire length of the north and south sides of the Route 6 Corridor between MacArthur Drive in New Bedford and Middle Street in Fairhaven. When the current roadway construction is completed in 2015, the roadway shoulders will be widened by reducing the vehicular travel lane width. The existing swing span cross section and width will remain the same under the No Build Alternative. Consequently, five-foot-wide dedicated bike lanes cannot be provided and bicyclists will continue to use the sidewalks. However, since high pedestrian or bicycle volumes are not seen on the bridge and are not anticipated in the future, it is anticipated that there will be an impact to high volume bicycle or pedestrian locations.

IMPACT TO SAFE NAVIGATION

Due to the existing navigational width of the channels at the existing bridge, safe vessel navigation through the bridge is a serious concern and a significant constraint to the North Harbor. Concerns for safe navigation have resulted in vessel limitations, which have resulted in delays and additional costs for commercial vessels.

Navigation through the bridges 94- and 95-foot-wide channels is the primary concern for large commercial vessels. These vessels generally employ harbor tugs for ship assist when maneuvering through the harbor and the bridge. Even with the tugs, limitations are still in place for transiting through the bridge. These include wind speed, visibility, and daylight.

- Wind speed is the primary concern that limits vessels ability to pass through the bridge. In all cases, if the wind exceeds 25 knots, no large vessel will transit the bridge. If the vessel is over 400 feet in length, this may be reduced to as little as 12 knots given the direction and based on the pilot's discretion.
- No vessel will transit through the bridge if the visibility is less than one nautical mile. Although large vessels do not enter the harbor though the hurricane barrier if visibility is limited, changes in visibility can occur rapidly in the harbor due to fog or heavy precipitation.
- Vessels greater than 500 feet in length or over 80 feet in width transit through the bridge and hurricane barrier in daylight only.

When transiting the current bridge, there is limited room for larger vessels to maneuver, especially north of the bridge between Fish Island and Pope's Island. Vessels approach slowly and then increase speed as they enter the bridge opening to ensure that they can exercise better control of the vessel through the passage. The limited maneuvering space on either side of the bridge is complicated by the fact that typically ships approach the bridge on an angle due to slow approach speeds. This angle further reduces any free space between the vessel and the bridge as the vessel is moving through. The swing span's central pivot point, associated piers, and fendering system are located approximately in the center of the federal deep-water channel. This makes the bridge, in the perspective of the pilots, the most vulnerable navigation safety area in the harbor.

When larger ships head northbound through the bridge, limited space is available for stopping or maneuvering once they pass the bridge. Generally, two tugs are employed; one at the bow and one at the stern, but only one can assist once the vessel is in the bridge opening due to the width of the channel. The forward tug goes through the bridge first and can come back alongside once the bow clears. Proceeding northbound, once the vessel passes through the bridge and enters the basin, it must slow and stop before being maneuvered into a berth.

Generally, vessels do not require tugs on transiting southbound. When departing southbound, the vessel leaves the berth and turns in the basin in a manner that allows it to line up with the west channel that is used most of the time. Once lined up, it transits the opening and maintains its alignment with the federal deep-water channel.

The No Build Alternative will not result in any improvements to safe navigation through the bridge. The channel widths and limited maneuverable space in the North Harbor will not change because of the project and the bridge will continue to be a significant constraint to New Bedford Harbor.

DELAY TO EMERGENCY MARINE ACCESS

Currently, the swing span impedes emergency vessel access in cases where there is an emergency in the North Harbor. Both New Bedford and Fairhaven dock their emergency vessels south of the bridge. The bridge must open to allow municipal police, fire and rescue, harbormaster, or other emergency response vessels to transit the bridge. With the exception of one fireboat, the emergency vessels need at least 14 feet of clearance to allow passage without requiring the bridge to open. The No Build Alternative will not increase the vertical clearance from six feet and the bridge will need to open for all emergency vessels. The potential delay for emergency marine response will remain.

4.2.4 Environment

Since the No Build Alternative will not involve a substantial amount of in-water construction, the potential for impacts to the natural environment are limited. It is anticipated that the project would not result in any adverse effects as compared to the current condition. The following sections provide a screening-level assessment, therefore additional and more in-depth analyses of resource impacts would be required, per the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA), as the designs for the bridge progress.

IMPACT TO COASTAL RESOURCES

Coastal Zone Impacts

The New Bedford-Fairhaven Bridge is located within the designated coastal zone of the Commonwealth of Massachusetts. While no impacts are anticipated to the coastal zone, the project may be subject to a federal consistency review to ensure that the proposed project would be consistent with the enforceable policies of the federally approved coastal management program of the Commonwealth.

Floodplains

The current bridge is located within the 100-year floodplain. Flooding and construction within the 100-year floodplain is under the jurisdiction of the Massachusetts Office of Coastal Zone Management (CZM). Since the No Build Alternative does not require substantial in-water construction or construction on the approaches, it is anticipated that potential impacts to floodplains would be minimal. However, coordination with CZM may be needed in future phases of the project to fully identify the extent of potential impacts to the 100-year floodplains and the applicability of coastal hazard policies.

Hazardous and Contaminated Materials

New Bedford-Fairhaven Harbor has been designated as a Superfund Site and is currently undergoing an extensive clean-up effort by the U.S. Environmental Protection Agency (EPA). Since the No Build Alternative would not require a substantial amount of in-water construction work, this alternative has limited potential to result in impacts from the existing contaminated harbor sediments. However, as any designs for the bridge progress, coordination would be undertaken with the EPA and the MassDEP to determine the amount of disturbance anticipated during construction, options for mitigation and minimization, and for the appropriate disposal of the contaminated sediments, as needed.

IMPACT TO WETLAND RESOURCES

A small area of rocky intertidal wetlands is located on the western shore of Pope's Island. Temporary disturbance resulting from the construction of the No Build Alternative may potentially affect this wetland type. Additional field verification of this wetland type, as well as consultation with the U.S. Army Corps of Engineers (USACE) and MassDEP, would be needed in future phases of this project to determine the extent of this resource.

Since the project does not require substantial in-water construction, the No Build Alternative has limited potential to impact water quality from the disturbance and removal of contaminated sediments from New Bedford Harbor during construction. However, coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination.

Proper erosion and sedimentation controls, as well as stormwater pollution prevention best management practices (BMPs), would be implemented during the construction phase to prevent or avoid any potential impacts to the wetlands and aquatic species known to reside within them. Examples of BMPs include silt fencing, biotubes, and regulated construction entrances. Consultation with USACE and MassDEP regarding avoidance and minimization of potential impacts as well as permitting requirements should be undertaken during any future phases of this project.

As project development progresses, special consideration should be given to the location of construction staging areas on Pope's Island. Coastal bank bluff and sea cliff wetlands form the southern shores of Pope's Island and the placement of construction staging areas within or adjacent to these wetlands should be avoided.

IMPACT TO NATURAL RESOURCES

The No Build Alternative would not result in any impacts to Areas of Critical Environmental Concern (ACEC), prime farmland soils, or aquifers. The No Build Alternative has minimal potential for temporary impacts to water quality, shellfish and fish habitat, and priority habitats because of construction.

Water Quality

The proposed bridge rehabilitation has limited potential to impact water quality since the amount of in-water work is minimal in the No Build Alternative. This alternative does not require disturbance or removal of contaminated sediments from New Bedford-Fairhaven Harbor during construction. However, coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination. Additionally, proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to water quality from construction activities.

Shellfish and Fish Habitat

The No Build Alternative has limited potential to result in any impacts to shellfish and fish habitats. However, since New Bedford Harbor has been designed as a shellfish growing area, coordination may be needed with MassDEP to ensure that construction activities do not disrupt active shellfish spawning grounds. Proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to shellfish and fish habitats from construction activities.

Although the consumption of fish and shellfish caught in the New Bedford Inner Harbor is regulated by the Massachusetts Department of Public Health (MDPH), consultation with the National Oceanographic Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) should be undertaken during future phases of this project to determine the presence of Essential Fish Habitats (EFH) within New Bedford-Fairhaven Harbor.

Priority Habitats

The No Build Alternative will not affect priority plant or animal habitats. However, additional field verification or consultation with the U.S. Fish and Wildlife Service (USFWS) and MassDEP may be required in future phases of the project to verify the presence of state and federally listed plant and animal species and habitats.

IMPACTS TO AIR QUALITY AND GREENHOUSE GASES FROM IDLING VEHICLES

None of the long-term alternatives, including the No Build Alternative, would increase traffic volumes the New Bedford-Fairhaven Bridge as compared to the 2035 No Build Condition described in Chapter 2. The number of bridge openings would remain the same. Consequently, none of the long-build alternatives has the potential to worsen air quality compared to the 2035 No Build Condition. However, in future phases of the project, a formal air quality evaluation (microscale or mesoscale) may be required to determine the proposed project's impacts as compared to the National Ambient Air Quality Standards (NAAQS).

Since the No Build Alternative does not include additional bicycle and pedestrian facilities along the Route 6 Corridor, there is only minimal potential for localized air quality benefits. The No Build Alternative does not include these facilities and the potential to shift some motorists to non-motorized modes and reduce the number of idling cars at bridge openings is lower than the build alternatives that include pedestrian and bicycle facilities.

Potential temporary impacts to air quality would be anticipated from construction activities. BMPs would be implemented during construction to minimize vehicle emissions and manage fugitive dust. Typical air quality mitigation measures implemented during construction could include dust suppression and control methods to minimize fugitive dust on dry and windy days.

IMPACTS FROM NOISE

Since traffic volumes are not anticipated to increase substantially over existing levels, the No Build Alternative is not anticipated to result in noise impacts to nearby noise-sensitive receptors. However, a formal noise assessment in compliance with the Federal Highway Administration (FHWA) would be required in any future phases of this project.

Potential temporary noise impacts would result from construction activities and the operation of construction equipment. BMPs would be implemented during construction to mitigate potential noise impacts (particularly during non-daytime hours).

4.2.5 Land Use & Economic Development

The No Build Alternative would maintain the existing constraints being experienced in New Bedford Harbor related cargo delay and business development in the North Harbor.

NUMBER/VALUE OF BUSINESSES AND JOBS PERMANENTLY IMPACTED

In the No Build Alternative, the existing swing span will be rehabilitated and no additional ROW acquisition will be required. The operation of the bridge will not change and would not functionally affect the operation of area businesses. The No Build Alternative would not result in the reduction of the number of jobs. With the absence of physical ROW changes and business operational impacts, no business or related property impacts or acquisition is anticipated due to physical or functional impacts.

SHIPPER COST SAVINGS

Since the No Build Alternative maintains the existing swing span and the existing constraints will remain, no shipper cost savings are anticipated. The same number of ships would experience delays transiting through the bridge and no cost savings would be achieved.

4.2.6 Community

The impacts to community resources, such as open space, recreational areas, or historic/cultural resources, were evaluated for the No Build Alternative. Additionally, access to businesses along the corridor and impacts to Environmental (EJ) populations, and visual impacts were also evaluated.

IMPACT TO PROTECTED AND RECREATIONAL OPEN SPACE

The No Build Alternative would not result in any impacts to protected and/or recreational open space. However, an evaluation of publicly owned parklands, per Section 4(f) of the Department of Transportation Act of 1966, may be required for any future phases of this project.

As the project development phase continues and the designs for the bridge progresses, special consideration should be given to the location of construction staging areas. Marine Park on Pope's Island is owned and operated by the City of New Bedford and occupies the southern half of the island, but should not be used for construction staging.

IMPACT TO CULTURAL/HISTORIC/ARCHAEOLOGICAL RESOURCES

Under the No Build Alternative, the superstructure of the middle bridge's swing span of the National Register-eligible New Bedford-Fairhaven Bridge would be replaced. The loss of the original superstructure could diminish the integrity of this historic property.

The replacement of the bridge superstructure should not result in indirect visual effects to historic properties that lie within the larger study area. A portion of the through truss of the existing swing span is visible as a component of the urban/industrial landscape from both the Schooner Ernestina, located on the New Bedford waterfront, and buildings that lie along the eastern edge of the New Bedford Historic District (see Figure 2.11). Both the Schooner Ernestina and the New Bedford Historic District are National Historic Landmarks. The No Build Alternative would not alter the visual setting of the New Bedford Historic District and the Schooner Ernestina.

Although the No Build Alternative maintains the existing bridge, the replacement of a large amount of original structural members could result in impacts that would require consultation with the Massachusetts Historical Commission (MHC), the State Historic Preservation Office (SHPO). Once the preferred alternative has been selected, FHWA will need to initiate consultation with the MHC in accordance with Section 106 of the National Historic Preservation Act. Consultation should also be undertaken with the New Bedford and Fairhaven Historical Commissions. Through this consultation, additional historic properties that may be eligible for, but are not yet listed in, the National Register of Historic Places will be identified. The potential for effects to archeological resources will also be determined. FHWA, working together with the MHC, will seek ways to avoid, minimize, or mitigate adverse effects beyond the Historic American Engineering Record (HAER) documentation that has already been completed. In addition to consultation under Section 106, the preparation of a programmatic

4(f) evaluation, in compliance with the U.S. Department of Transportation Act of 1966, will be required.

IMPACT TO BUSINESS ACCESS

The parcels surrounding the approaches to the middle bridge include the following businesses:

- Bridge Shoppes shopping center;
- Captain Leroy's marina;
- Maritime Terminals facility;
- AGM Marine Contractors, Inc.; and
- Tucker Roy Marin Towing and Salvage.

The No Build Alternative does not include any modifications to the bridge approaches and utilizes the existing footprint. The horizontal alignment of the road and access to abutting properties will remain the same.

IMPACT TO ENVIRONMENTAL JUSTICE POPULATIONS

The locations of Environmental Justice (EJ) populations were identified in Chapter 2. Some EJ populations reside in neighborhoods that abut or are adjacent to the New Bedford-Fairhaven Bridge. Residential clusters of EJ populations reside at the western edge of the local study area in New Bedford and EJ populations (low-income) also reside throughout the local study area within Fairhaven. Consequently, an evaluation of the potential for disproportionately high and adverse human health or environmental effects of the project alternatives on minority populations and low-income populations, per *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, would be required in future phases of the project to comply with NEPA and MEPA.

The greatest potential for impacts to EJ populations would occur during construction. Under the No Build Alternative, the construction phase would be approximately 18 months. The bridge would be closed to vehicular, bicycle, and pedestrian traffic for two weeks. No transit service currently operates across the bridge. The No Build Alternative also has the potential to result in other temporary construction impacts to the EJ populations located in close proximity to the proposed bridge. Potential impacts could include noise, glare, fumes, and dust from construction equipment as well as changes in traffic patterns and access to businesses due to the movement of construction vehicles. Potential construction period impacts would be mitigated with BMPs for construction activities including those used to minimize dust, noise, maintenance, and protection of traffic plans, and limiting the hours of construction. Further analyses under NEPA and MEPA would be required to determine if construction-related impacts would be disproportionately higher on low-income and minority populations.

The No Build Alternative, along with all of the long-term build alternatives, has the same proportion of impacts to EJ populations compared to non-EJ populations.

VISUAL IMPACTS

Under the No Build Alternative, the existing superstructure will be rebuilt to match the existing bridge. Both swing spans will be approximately 55 feet above the roadway surface and 70 feet above MHW. Consequently, this alternative will not result in any visual impacts.

4.2.7 Alternative Feasibility

The identification of the costs, construction phase impacts, and permanent ROW impacts provides a critical way to evaluate the feasibility of an alternative. This section describes the capital costs, operating and maintenance costs, the construction methodology, a description of impacts to marine and vehicular traffic during construction, and permanent impacts to adjoining properties or businesses that result from the No Build Alternative.

CAPITAL COST

The estimated cost for the No Build Alternative is $45 million. This capital cost would include bridge design and permitting, removal of the existing swing truss structure, and replacement with a newly constructed structure. Limits of construction would be generally limited to the 289-foot length of the existing swing span.

It is assumed that dredging and disturbance of the harbor sediments would not be required as part of the project and no changes to the fendering system would be provided. A more detailed cost estimate would be developed as additional information regarding subsurface conditions, bridge specifications, and design details are developed through the project development process.

OPERATING AND MAINTENANCE COSTS

Upon completion of construction, the No Build Alternative will require both routine maintenance and daily operating costs. Table 4.9 provides the estimated annual costs required to operate and maintain the bridge, which is the second lowest of all of the long-term alternatives. The No Build Alternative has only one mechanical element, which lowers the costs for electricity and lubrication compared to the double-leaf long-term alternatives.

Table 4.9. No Build Alternative: Annual Operating and Maintenance Costs

Operating Costs	Type	Annual Cost (2015$)
Operating Cost	Electricity utility	$ 50,000
Operating Cost	Stand by generator	$ 2,600
Operating Cost	Bridge operators	$300,000
Routine Maintenance	Monthly bridge lubrication	$ 14,400
Routine Maintenance	Replace lamps	$ 1,500
Routine Maintenance	Replace gate arms	$ 7,000
Routine Maintenance	Miscellaneous minor repairs	$ 20,000
Routine Maintenance	Guard rail repairs	$ 20,000
	TOTAL	$ 415,500

In addition to the annual operating and maintenance costs identified above, the newly replaced swing bridge will require major repairs to be conducted on a regular basis to maintain the bridge in a state of good repair and ensure its ongoing utility. The schedule of major repairs included in Table 4.10 is an estimate of repairs that is typical for new swing bridges in similar environments. Over a 50-year span, it should be anticipated that approximately $10.4 million worth of repairs (in 2015 dollars) will be required.

Table 4.10. No Build Alternative: Schedule of Major Repairs

Year	Work Performed	Cost (2015$)
5	Superstructure strengthening/miscellaneous repairs	$2,500,000
10	Fender repairs	$ 250,000
25	Fender repair Control House repairs	$1,250,000 $ 100,000
30	Deck repairs	$ 250,000
35	Minor mechanical repairs Electrical Control repaired Substructure repairs	$ 1,000,000 $ 1,500,000 $3,000,000
40	Fender repairs	$ 250,000
45	Deck repairs	$ 250,000
	TOTAL	$10,350,000

CONSTRUCTION PHASE TRANSPORTATION IMPACTS

The construction phase for the No Build Alternative is 18 months, which is shorter than all of the build alternatives by at least eight months. This alternative would allow for keeping two lanes open for most of the time to vehicular traffic. A two-week long roadway closure would be required in the 12th month of construction. One of the two existing navigational channels would be open for most of the construction duration. Two navigational closures would be required during a two separate long-weekends, which would occur in the 12th month of construction.

CONSTRUCTION PHASE IMPACTS TO ABUTTING LAND OWNERS/BUSINESSES

The construction phase of each long-term alternative has the potential impact to area businesses and property owners due to the change in access during that period. The construction phase of the No Build Alternative is 18 months. While at least two vehicular lanes would be open for most of the construction period, this alternative requires a two-week roadway closure and two marine closures over long weekends that would result in some impacts to area businesses. Compared to the build alternatives, the No Build Alternative's shorter construction duration and ability to maintain at least two vehicular lanes for most of the construction period would limit any significant business impacts.

4.3 ALTERNATIVE 1: VERTICAL LIFT BRIDGE

This section provides an evaluation of Alternative 1: Vertical Lift Bridge consistent with the evaluation criteria established at the initiation of the study. The evaluation criteria are specific measures of effectiveness used to assess benefits and impacts of each alternative.

Alternative 1 is a vertical lift bridge that provides 270 feet of navigational clearance and up to 135 feet of air draft. As shown in Figures 4.2 and 4.3, this alternative has two towers that are used to house the mechanical equipment used to raise and lower the bridge structure. Figures 4.2 and 4.3 provide simulated renderings of what Alternative 1 would look like if standing at Captain Leroy's marina on Pope's Island. Figure 4.2 shows the bridge in the closed position (open for vehicular traffic). Figure 4.3 shows the bridge in the open position (closed for vehicular traffic).

Figure 4.2. Alternative 1: Vertical Lift Bridge in Closed Position

Figure 4.3. Alternative 1: Rendering of Vertical Lift Bridge in Open Position

4.3.1 Bridge Operations

While the number and duration of bridge openings remains the same in Alternative as the current condition and the No Build Alternative, this alternative offers increased vertical clearance in the closed position and horizontal navigational clearance almost three times as wide as the current condition.

MINUTES PER BRIDGE CLOSURE

The opening sequence of the bridge in all of the long-term alternatives, including Alternative 1, would continue to follow the AASHTO recommendation that requires approximately four minutes to open and an additional four minutes to close. The average time to open and close the bridge will continue to vary based on the marine traffic transit time and the time required to clear pedestrians and vehicles from the movable span before it can open to marine traffic. The minutes per bridge closure in Alternative 1 is the same as the current condition.

For this alternative, it is possible that the moveable section of the bridge may not be lifted to the full height each time the bridge is opened. A policy could be established to allow the bridge operator to have the discretion to open the bridge to only the height needed to allow the vessels queued to go through the opening. Although this has the potential to sAvenue60 to 90 seconds (which represents about five percent on an average bridge opening), it would only occur when the bridge operator is confident that no tall vessels are planning to transit the bridge at that time.

FEET OF VERTICAL CLEARANCE (OPEN & CLOSED)

The Alternative 1 bridge would be designed to have a vertical clearance of 14 feet above MHW in the closed position and between 110 to 135 feet above MHW in the open position. Although 110 feet of vertical clearance is anticipated to be sufficient for the vessel types that currently come into the North Harbor, there may be cases where additional vertical clearance is necessary. Since 135 feet of vertical clearance has been the standard for most bridges on the East Coast that cross over waterways with major commercial vessel traffic, for this analysis, it is assumed that this would be the vertical clearance for Alternative 1. The No Build Alternative and the bascule alternatives provide unlimited air draft for vessels.

FEET OF HORIZONTAL CLEARANCE

The Alternative 1 bridge would include approximately 270 feet of horizontal navigational clearance. The bridge would be aligned so that the new pier towers are approximately in the same location as the east and west abutments of the existing swing span.

NUMBER OF DAILY BRIDGE OPENINGS

As described in the No Build Alternative, the bridge currently operates on a fixed schedule each day. For all of the long-term alternatives, including Alternative 1, the schedule and number of daily bridge openings are expected to stay the same.

LONG-TERM RELIABILITY RISK

Since each moveable bridge includes a complex interaction of mechanical, electrical, and structural components, there is an inherent risk in a moveable bridge that one of these systems will not operate as designed on any particular day and result in the inability for the bridge to open or close. Some moveable bridge types are at greater risk of inoperability than others due to the nature of their design and the conditions and environment that they operate within. As inoperability of a bridge for a period of time results in community and economic impacts, the risk associated with bridge reliability in the long-term was assessed. This included a general assessment of existing bridges of the type and size under consideration in conditions similar to that of New Bedford Harbor and their ability to remain reliable throughout the life span of the bridge. As noted, all moveable bridges are complex and have some long-term reliability risk. The span width and length of a new vertical lift bridge (Alternative 1) when operating in the marine costal environment of New Bedford Harbor is estimated to have a medium level of risk. It is likely that even with regular maintenance, the bridge would experience some periods of unanticipated inoperability similar to any moveable bridge in the same location.

4.3.2 Transportation Impacts/Mobility Analysis

The evaluation and assessment of mobility along the corridor between County Street in New Bedford and Adams Street in Fairhaven is an important component of this study. Like of the long-term alternatives, Alternative 1 will not change vehicular traffic along the corridor. Unlike the No Build Alternative, Alternative 1 will provide additional pedestrian and bicycle facilities.

CORRIDOR INTERSECTION LOS, V/C RATIO, QUEUE LENGTHS & ROADWAY TRAVEL TIME/DELAY

As noted in the No Build Alternative analysis, none of the long-term alternatives, including Alternative 1, will change result in changes to vehicular traffic along the corridor as compared to the 2035 No Build Condition described in Chapter 2. Each of the long-term alternatives being considered will result in the same number of bridge openings and the bridge will, on average, be open for the same duration. Therefore, the mobility analysis described previously in Section 4.2.2 related to the No Build Alternative is consistent with the results of intersection LOS, volume to capacity ratio, queue lengths, and travel time and delay analysis for Alternative 1.

BICYCLE & PEDESTRIAN MOBILITY/CONNECTIVITY

The width of the existing swing span allows for five-foot-wide sidewalks on both the north and south sides and the roadway shoulders less than two feet in width. The rest of the corridor has a slightly wider right-of-way (ROW), but it is still not wide enough to accommodate five-foot-wide bike lanes. Consequently, bicyclists and pedestrians both use the sidewalks along the bridge corridor segment.

Most pedestrian/bicycle use of the bridge occurs on the southern sidewalk since this sidewalk directly connects to the New Bedford downtown and waterfront. A new pedestrian ramp was completed in 2014 as part of a new roadway ramp from northbound Route 18 to eastbound Route 6. Between the New Bedford and Fairhaven shorelines, pedestrian and bicycle connectivity is difficult due to a lack of secure crossings, ramps, and gaps in the sidewalk network.

Because of these access challenges and safety concerns, pedestrian and bicyclist use of the bridge is currently limited. During the peak hour counts conducted for the study, only one pedestrian was observed to walk the entire length of the bridge between New Bedford and Fairhaven. During the warmer months, it is understood that pedestrian and bicycle use is more frequent and increases during non-peak auto hours.

Like all of the build alternatives, Alternative 1 allows for a wider bridge with a 64-foot-wide ROW. This bridge width allows for the construction of four 11-foot-wide vehicular travel lanes, two five-foot-wide bike lanes, and two five-foot-wide sidewalks. However, while Alternative 1 provides improved facilities compared to the No Build Alternative, the delay for bicyclists and pedestrians will not change as it is controlled by the frequency and duration of bridge openings, which will not change from the current condition.

4.3.3 Safety

Improving roadway, pedestrian, bicycle, and marine safety, reducing conflicts between transportation modes, and increasing emergency vehicle access are important considerations for evaluating the long-term alternatives. This section provides an overview of the key safety concerns that will be addressed by Alternative 1.

CONFORMANCE WITH AASHTO AND MASSDOT STANDARDS

For a bridge and approach roadway to be safe for vehicular traffic, it must be geometrically adequate. This consideration takes into account the number of lanes, lane and shoulder widths, approach roadway widths, horizontal clearances to roadside obstacles, stopping sight distances, vertical clearances and more. The standards for these criteria are identified in the AASHTO *Policy on Geometric Design of Highways and Streets* and the MassDOT *Project Development and Design Guidebook* (2006). Alternative 1 will conform to these standards with no known variance required.

DELAY TO EMERGENCY VEHICLE ACCESS

Both New Bedford and Fairhaven provide fire and emergency services to their respective municipalities. In case of bridge closure, Pope's Island can receive service from Fairhaven via the East Bridge. St. Luke's Hospital in New Bedford is the only facility in the two municipalities that provides emergency services. Bridge closures can affect Emergency Medical Services (EMS) access to the hospital from Fairhaven. Alternative 1 will not affect the level of access or potential for delay of emergency vehicles compared to the No Build Alternative.

IMPACT TO HIGH VOLUME BICYCLE AND PEDESTRIAN LOCATIONS

A sidewalk runs along the entire length of the north and south sides of the Route 6 Corridor between MacArthur Drive in New Bedford and Middle Street in Fairhaven. When the current roadway construction is completed in 2015, the roadway shoulders will be widened by reducing the vehicular travel lane width. In Alternative 1, the new bridge cross section will include both widened roadway shoulders and sidewalks. However, even though Alternative 1 provides additional pedestrian and bicycle facilities, high pedestrian or bicycle volumes are not seen on the bridge and are not anticipated in the future. Alternative 1 will have no impact to high volume bicycle or pedestrian locations.

IMPACT TO SAFE NAVIGATION

Due to the existing navigational width of the channels at the existing bridge, safe vessel navigation through the bridge is a serious concern and a significant constraint to the North Harbor. Concerns for safe navigation have resulted in vessel limitations, which have resulted in delays and additional costs for commercial vessels.

Navigation through the bridges 94- and 95-foot-wide channels is the primary concern for large commercial vessels. These vessels generally employ harbor tugs for ship assist when maneuvering through the harbor and the bridge. Even with the tugs, limitations are still in place for transiting through the bridge. These include wind speed, visibility, and daylight.

- Wind speed is the primary concern that limits vessels ability to pass through the bridge. In all cases, if the wind exceeds 25 knots, no large vessel will transit the bridge. If the vessel is over 400 feet in length, this may be reduced to as little as 12 knots given the direction and based on the pilot's discretion.
- No vessel will transit through the bridge if the visibility is less than one nautical mile. Although large vessels do not enter the harbor though the hurricane barrier if visibility is limited, changes in visibility can occur rapidly in the harbor due to fog or heavy precipitation.
- Vessels greater than 500 feet in length or over 80 feet in width transit through the bridge and hurricane barrier in daylight only.

When transiting the current bridge, there is limited room for larger vessels to maneuver, especially north of the bridge between Fish Island and Pope's Island. Vessels approach slowly and then increase speed as they enter the bridge opening to ensure that they can exercise better control of the vessel through the passage. The limited maneuvering space on either side of the bridge is complicated by the fact that typically ships approach the bridge on an angle due to slow approach speeds. This angle further reduces any free space between the vessel and the bridge as the vessel is moving through. The swing span's central pivot point, associated piers, and fendering system are located approximately in the center of the federal deep-water channel. This makes the bridge, in the perspective of the pilots, the most vulnerable navigation safety area in the harbor.

When larger ships head northbound through the bridge, limited space is available for stopping or maneuvering once they pass the bridge. Generally, two tugs are employed; one at the bow and one at the stern, but only one can assist once the vessel is in the bridge opening due to the width of the channel. The forward tug goes through the bridge first and can come back alongside once the bow clears. Proceeding northbound, once the vessel passes through the bridge and enters the basin, it must slow and stop before being maneuvered into a berth.

Generally, vessels do not require tugs on transiting southbound. When departing southbound, the vessel leaves the berth and turns in the basin in a manner that allows it to line up with the west channel that is used most of the time. Once lined up, it transits the opening and maintains its alignment with the federal deep-water channel.

While the No Build Alternative does not provide any change from the existing condition, Alternative 1 will result in significant improvements to safe navigation through the bridge. The 270 feet of horizontal clearance would mitigate many of the safe navigation concerns, most notably the wind restriction, which has a significant impact on vessel delay. The wider clearance would allow for full tug assistance throughout the bridge transit and would also minimize the impact of the limited maneuverable space in the North Harbor, which will not change as a result of the project.

DELAY TO EMERGENCY MARINE ACCESS

Currently, the swing span impedes emergency vessel access in cases where there is an emergency in the North Harbor since the bridge must open to allow municipal police, fire and rescue, harbormaster, or other emergency response vessels to transit the bridge.
The design of Alternative 1 allows for a vertical clearance of 14 feet in the down (closed) position. This is sufficient clearance for all but the largest emergency response vessels to fit under the bridge without the need to wait for a bridge opening. This would eliminate most of the delay to emergency response currently experienced due to the bridge.

4.3.4 Environment

The following section presents the potential for impacts to the natural environment from Alternative 1. Compared to the No Build Alternative, Alternative 1 has more potential to impact coastal, wetland, and natural resources due to the required in-water construction. The following sections provide a screening-level assessment, therefore additional and more in-depth analyses of resource impacts would be required, per the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA), as the designs for the bridge progress.

IMPACT TO COASTAL RESOURCES

Coastal Zone Impacts

The New Bedford-Fairhaven Bridge is located within the designated coastal zone of the Commonwealth of Massachusetts; therefore, this project may be subject to a federal consistency review to ensure that the proposed project would be consistent with the enforceable policies of the federally approved coastal management program of the Commonwealth.

The construction required to raise the elevation of the approach on Fish Island under Alternative 1 has the potential to affect Chapter 91 Tidelands located on the eastern side of the island. A Chapter 91 Waterways authorization from the Massachusetts Department of Environmental Protection (MassDEP) may be required for the construction of new bridge structure and retaining walls between the sidewalk and properties on Fish Island.

Within its policy documents, the Massachusetts Office of Coastal Zone Management (CZM) strongly encourages early coordination with the agency to determine the appropriate level of coastal review that would be required for projects. Coordination with CZM should be undertaken during any future NEPA and MEPA phases of the project.

Floodplains

The proposed bridge would be located within the 100-year floodplain. Alternative 1 would require the construction of permanent foundations for the towers to be constructed within the water, potentially affecting the 100-year floodplain and flood levels within this area. As the design for the bridge progresses, there is the opportunity to limit the size of the foundations, thereby minimizing impacts. Flooding and construction within the 100-year floodplain is under the jurisdiction of CZM; therefore, coordination with CZM would be needed in future phases of the project to determine the extent of potential impacts to the 100-year floodplain and the applicability of coastal hazard policies to this project.

Hazardous and Contaminated Materials

New Bedford-Fairhaven Harbor has been designated as a Superfund Site and is currently undergoing an extensive clean-up effort by the EPA. Alternative 1 would require a substantial amount of in-water construction work. As part of the construction, contaminated soil/sediment from New Bedford-Fairhaven Harbor would need to be removed so that new foundations for the bridge towers could be constructed. In-water soil/sediment disturbance would also be expected from the removal of the existing swing span center pier structure. Therefore, Alternative 1 has the potential to result in impacts from the existing contaminated harbor sediments.

As any designs for the bridge progress, coordination would be undertaken with the EPA and the MassDEP to determine the amount of disturbance anticipated during construction, options for mitigation and minimization, and for the appropriate disposal of the contaminated sediments.

IMPACT TO WETLAND RESOURCES

A small area of rocky intertidal wetlands is located on the western shore of Pope's Island. Temporary disturbance resulting from the construction of Alternative 1 may potentially affect this wetland type. Additional field verification of this wetland type, as well as consultation with the USACE and MassDEP, would be needed in future phases of this project to determine the extent of this resource.

Potential impacts to water quality may occur from the disturbance and removal of contaminated sediments from New Bedford-Fairhaven Harbor during construction. Coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination.

Proper erosion and sedimentation controls, as well as stormwater pollution prevention best management practices (BMPs), would be implemented during the construction phase to prevent or avoid any potential impacts to the wetlands and aquatic species known to reside within them. Examples of BMPs include silt fencing, biotubes, and regulated construction entrances. Consultation with USACE and MassDEP regarding avoidance and minimization of potential impacts as well as permitting requirements should be undertaken during any future phases of this project.

As project development progresses, special consideration should be given to the location of construction staging areas on Pope's Island. Coastal bank bluff and sea cliff wetlands form the southern shores of Pope's Island and the placement of construction staging areas within or adjacent to these wetlands should be avoided.

IMPACT TO NATURAL RESOURCES

Alternative 1 would not result in any impacts to Areas of Critical Environmental Concern (ACEC), prime farmland soils, or aquifers. Alternative 1 has the potential for temporary impacts to water quality, shellfish and fish habitat, and priority habitats as a result of construction.

Water Quality

Potential temporary impacts may be anticipated to water quality from the construction of the proposed bridge. Potential impacts to water quality from the in-water soil/sediment disturbance from the removal of the existing swing span center pier structure would be the same as the other build alternatives, but greater than the No Build Alternative.

Coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination. Additionally, proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to water quality from construction activities.

Shellfish and Fish Habitat

Alternative 1 has the potential to result in temporary impacts to shellfish and fish habitats from the construction of the proposed bridge. Since New Bedford Harbor has been designed as a shellfish growing area, coordination may be needed with MassDEP to ensure that construction activities do not disrupt active shellfish spawning grounds. Proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to shellfish and fish habitats from construction activities.

Although the consumption of fish and shellfish caught in the New Bedford Inner Harbor is regulated by the Massachusetts Department of Public Health (MDPH), consultation with the National Oceanographic Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) should be undertaken during future phases of this project to determine the presence of Essential Fish Habitats (EFH) within New Bedford-Fairhaven Harbor.

Priority Habitats

Alternative 1 is not anticipated to impact priority plant or animal habitats. However, additional field verification and/or consultation with the U.S. Fish and Wildlife Service (USFWS) and MassDEP may be required in future phases of the project to verify the presence of state and federally listed plant and animal species and habitats.

IMPACTS TO AIR QUALITY AND GREENHOUSE GASES FROM IDLING VEHICLES

None of the long-term alternatives, including the No Build Alternative, would increase traffic volumes on the corridor as compared to the 2035 No Build Condition described in Chapter 2. The number of bridge openings would remain the same. Consequently, none of the long-term build alternatives has the potential to worsen air quality compared to the 2035 No Build

Condition. In future phases of the project, a formal air quality evaluation (microscale or mesoscale) would be required to determine the proposed project's impacts as compared to the National Ambient Air Quality Standards (NAAQS).

In Alternative 1, the addition of bicycle and pedestrian facilities along the Route 6 Corridor, including along a new movable span, may have the potential for localized air quality benefits. The addition of these facilities has the potential to shift some motorists to non-motorized modes, potentially reducing the number of idling cars at bridge openings.

Potential temporary impacts to air quality would be anticipated from construction activities. BMPs would be implemented during construction to minimize vehicle emissions and manage fugitive dust. Typical air quality mitigation measures implemented during construction could include dust suppression and control methods to minimize fugitive dust on dry and windy days.

IMPACTS FROM NOISE

Since traffic volumes are not anticipated to increase substantially over existing levels, Alternative 1 is not anticipated to result in noise impacts to nearby noise-sensitive receptors. However, a formal noise assessment in compliance with the FHWA would be required in any future phases of this project.

Potential temporary noise impacts would result from construction activities and the operation of construction equipment. BMPs would be implemented during construction to mitigate potential noise impacts (particularly during non-daytime hours).

4.3.5 Land Use and Economic Development

The following section provides analysis regarding the impacts on businesses, including property acquisition to accommodate bridge construction. Additionally, potential economic benefits of Alternative 1, such as shipper cost savings, are evaluated.

NUMBER/VALUE OF BUSINESSES & JOBS PERMANENTLY IMPACTED

The design of the Alternative 1 bridge utilizes primarily the same footprint as the existing swing span and will not require the acquisition of any additional property or ROW. Furthermore, the operation of the new moveable span will not vary dramatically in a way that would functionally affect the operation of area businesses and would not result in the reduction of the number of jobs. With absence of physical ROW changes and business operational impacts, no business or related property impacts or acquisition is anticipated due to physical or functional impacts.

SHIPPER COST SAVINGS

A variety of both landside and maritime benefits were considered to assess the economic benefits of the long-term build alternatives, including Alternative 1. While some may be quantified, others are more difficult to count and therefore the analysis considered both quantitative and qualitative benefits.

As a first step in the assessment, the potential benefits that could be generated by a new bridge were inventoried. In similar projects, automobile and truck benefits are often included, such as reduced travel time, vehicle operating cost savings, and emissions reduction, among others. On the marine side, moveable bridge improvements can affect shipper costs, travel time, and similar factors.

A thorough review of potential benefits indicated few differences between the 2035 No Build Condition and Alternative 1 in terms of quantifiable benefits. This is due to the relatively small variation between the proposed alternatives and the existing condition in most aspects of transportation. The lack of impact to existing and future traffic conditions results in no benefits from reduced travel time, vehicle operating cost savings, and emissions reduction. However, the change in horizontal clearance for vessels between the existing bridge and Alternative 1 is a significant change. The existing bridge provides a maximum horizontal clearance of 95 feet, while the horizontal clearance for Alternative 1 is 270 feet. While there is a limitation on vertical clearance with Alternative 1, this does not pose an issue for any of the vessels that currently call upon the area inside the bridge.

This analysis only considers the benefits directly related to the bridge, an approach consistent with USDOT benefit-cost analysis guidance. While there is potential for additional economic development at the North Terminal and in the North Harbor, the chosen bridge alternative is only one component of that potential growth. As a result, it would be disingenuous to attribute that economic development potential *exclusively* to the new bridge. Additionally, when looking for the true differences between bridge alternatives, it is important to examine only the benefits associated directly with the bridge.

Landside Benefits

Traditional benefits associated with bridge improvements include both landside and maritime components. In the case of the proposed alternatives, no landside impacts were found. Each of the alternatives maintains the same bridge opening duration and creates no difference in general vehicular, bicycle, or pedestrian traffic operations. In other words, an automobile driver who uses the bridge today would discern no improvement in travel time, or achieve any other transportation related benefits, with a new bridge. Similarly, pedestrian and bicycle traffic would observe no change in their travel time.

It is important to note that the duration and methods for construction may cause various delay or diversion impacts during the construction period. However, no impact was quantified as the transportation analysis showed no discernable diversion patterns that could be analyzed. The construction phase impacts will include a limited road closure while the bridge is being installed along with lane closures for the duration of the construction. It is anticipated that during bridge closures, detours and notifications by area ITS systems will be provided to minimize impacts to drivers. While the impacts cannot easily be quantified, it should be noted that the longer closures will have a greater potential for detrimental impacts to local businesses and diversion costs for roadway users.

Since it was determined that the bridge improvement would have minimal or no impact on long-term landside traffic and pedestrian patterns, no landside benefits were quantified or included in the benefits analysis.

Maritime Benefits

A series of interviews were held with maritime users to determine how the current bridge affects their operations and to identify the ways in which a new bridge could positively affect them. As discussed in Chapter 2, wind and its impact on the navigability through the bridge opening is a critical issue facing maritime users. For this analysis, maritime benefits are primarily due to a reduction in shipper costs associated with delays within New Bedford Harbor. Changes in the use of tugs with Alternative 1 were also considered as a potential benefit. Discussions with maritime experts indicated the tugs used are "ship assist" tugs that primarily aid with alignment to the berth. Accordingly, they will still be required for all large cargo vessels that berth in the North Harbor regardless of the selected alternative and no change to tug costs will occur for larger vessels.

The greatest difference between the No Build Alternative, which retains the existing clearance, and the build alternatives is the horizontal navigational clearance. The No Build Alternative maintains the 95 feet of horizontal navigational clearance, which creates issues for the large vessels that enter the North Harbor. When there are high winds, these vessels cannot transit the bridge until the wind speeds are lower, as there is not enough clearance to pass safely through in high wind conditions.

With Alternative 1, the horizontal navigational width would be 270 feet. This width would remove the need for larger vessels to remain moored south of the bridge should high winds prevail. In the past year, three of the 12 vessels were delayed for one day during their trip to New Bedford due to the existing bridge constraint. It is understood that each day of delay costs the shipper $40,000. Under existing conditions, approximately 25 percent of vessels are delayed for a full day, costing shippers a total of $120,000 per year. With Alternative 1, no ships would experience delay, which results in an average savings of $120,000 per year in shipper costs. Assuming that users of the harbor factor into their overall decision-making the potential cost of delay, the widening of the horizontal clearance would reduce the general cost of using the harbor.

Historically, up to 30 vessels have called upon the port in a single year. This is considered a reasonable upper limit, based on interviews conducted with key maritime users. Assuming that the bridge improvement induces vessel calls to meet this historic high, benefits associated with a reduction in delay time would be generated. These new vessels, however, are not currently using the Port of New Bedford. Rather, they are a projection of potential. As a result, and consistent with economic consumer surplus theory, the benefit they receive would be half of the benefit to existing users.

The change from 12 to 30 trips represents a portion of all potential vessels that did not use the Port of New Bedford under the existing conditions, but that would be "attracted" to New Bedford because the risk of delay and associated costs are mitigated with the wider horizontal clearance. The benefits to these additional vessels are estimated using the "rule of one-half," indicating the change in consumer surplus associated with the removal of the risk of delay. In a future year with 30 total vessels, this would result in a benefit of $20,000 per vessel for the 18 additional vessels, or a total of $360,000.

Summary of Benefits

Table 4.11 summarizes the average annual benefits associated with Alternative 1 as compared to the current conditions that would be maintained under the No Build Alternative. As discussed above, no landside benefits were identified or quantified. Additionally, there would be no change in the number of tugs that would be required, so the total costs would remain the same. The benefits generated by any of the new bridge alternatives is estimated to be $480,000 with delay costs representing $120,000 and savings to new cargo vessels $360,000.

Table 4.11. Average Single-Year Benefits of Bridge Replacement Alternatives

Benefit Category	Annual Savings (2015$)
Landside Transportation Savings	$0
Delay Cost Savings	$120,000
Savings to New Cargo Vessels	$360,000
Change in Tug Costs	$0
Total Benefits	$480,000

4.3.6 Community

The impacts to community resources, such as open space, recreational areas, or historic or cultural resources were also evaluated for Alternative 1. Additionally, access to businesses along the corridor and impacts to Environmental Justice (EJ) populations were evaluated. The study team also considered the visual impacts of a new bridge structure.

IMPACT TO PROTECTED AND RECREATIONAL OPEN SPACE

Alternative 1 would not result in any impacts to protected and/or recreational open space. An evaluation of publicly owned parklands, per Section 4(f) of the Department of Transportation Act of 1966, would be required for any future phases of this project.

As the project development phase continues and the designs for the bridge progresses, special consideration should be given to the location of construction staging areas. Marine Park on Pope's Island is owned and operated by the City of New Bedford and occupies the southern half of the island, but should not be used for construction staging.

IMPACT TO CULTURAL/HISTORIC/ARCHEOLOGICAL RESOURCES

Under Alternative 1, the middle bridge's swing span of the National Register-eligible New Bedford-Fairhaven Bridge would be replaced with a new vertical lift bridge. The loss of the swing span would diminish the integrity of this historic property.

In addition to direct effects to the New Bedford-Fairhaven Bridge, there is the potential for indirect visual effects to historic properties that lie within the larger study area. A portion of the through truss of the existing swing span is visible as a component of the urban/industrial landscape from both the Schooner Ernestina, located on the New Bedford waterfront, and buildings that lie along the eastern edge of the New Bedford Historic District (see Figure 2.11). Both the Schooner Ernestina and the New Bedford Historic District are National Historic Landmarks. The towers of the lift bridge would extend 108 feet above the top of the existing truss. As such, they would be visible as prominent features in the distant skyline from both of these historic properties. While the replacement of the swing span with a vertical lift bridge would alter the visual setting of the New Bedford Historic District and the Schooner Ernestina, it is not anticipated that this would adversely affect these resources given both the distance between the properties and the bridge, and the visual complexity of the viewshed.

Regardless of which long-term alternative is selected, FHWA will need to initiate consultation with the MHC in accordance with Section 106 of the National Historic Preservation Act. Consultation should also be undertaken with the New Bedford and Fairhaven Historical Commissions. Through this consultation, additional historic properties that may be eligible for, but are not yet listed in, the National Register of Historic Places will be identified. The potential for effects to archeological resources will also be determined. FHWA, working together with the MHC, will seek ways to avoid, minimize, or mitigate adverse effects beyond the HAER documentation that has already been completed. In addition to consultation under Section 106, the preparation of a programmatic 4(f) evaluation, in compliance with the U.S. Department of Transportation Act of 1966, will be required.

IMPACT TO BUSINESS ACCESS

The parcels surrounding the approaches to the middle bridge include the following businesses:

- Bridge Shoppes shopping center;
- Captain Leroy's marina;
- Maritime Terminals facility;
- AGM Marine Contractors, Inc.; and
- Tucker Roy Marin Towing and Salvage.

The design of Alternative 1 utilizes primarily the same footprint as the existing swing span. The one modification outside the existing bridge footprint will be the grade (slope) along the western approach needed to allow for the greater vertical clearance of the bridge. This will result in approximately 100 feet of the roadway being raised from one to eight feet, which will be designed without changing the horizontal alignment of the road and will not alter the access to either of the abutting properties. This limited impact to the approaches will not result in any physical changes or impacts to business access.

IMPACT TO ENVIRONMENTAL JUSTICE POPULATIONS

The locations of Environmental Justice (EJ) populations were identified in Chapter 2. Some EJ populations reside in neighborhoods that abut or are adjacent to the New Bedford-Fairhaven

Bridge. Residential clusters of EJ populations reside at the western edge of the local study area in New Bedford and EJ populations (low-income) also reside throughout the local study area within Fairhaven. Consequently, an evaluation of the potential for disproportionately high and adverse human health or environmental effects of the project alternatives on minority populations and low-income populations, per *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, would be required in future phases of the project to comply with NEPA and MEPA.

Bicycle and pedestrian improvements in Alternative 1 have the potential to substantially improve the ability of EJ populations, who may not own or have access to automobiles, to get across the bridge to access employment or other key destinations. The greatest potential for impacts to EJ populations would occur during construction. Under Alternative 1, the construction phase would be approximately three years long. The bridge would be closed to vehicular, bicycle, and pedestrian traffic for two to four weeks. No transit service currently operates across the bridge.

Alternative 1 also has the potential to result in other temporary construction impacts to the EJ populations located in close proximity to the proposed bridge. Potential impacts could include noise, glare, fumes, and dust from construction equipment as well as changes in traffic patterns and access to businesses due to the movement of construction vehicles. Potential construction period impacts would be mitigated with BMPs for construction activities including those used to minimize dust, noise, maintenance, and protection of traffic plans, and limiting the hours of construction. Further analyses under NEPA and MEPA would be required to determine if construction-related impacts would be disproportionately higher on low-income and minority populations.

Alternative 1, along with all of the long-term build alternatives, has the same proportion of impacts to EJ populations compared to non-EJ populations.

VISUAL IMPACTS

The visual impacts from Alternative 1 will be more significant than most of the bridge alternatives. The towers of the vertical lift bridge would be 150 feet above the bridge deck or 170 feet above MHW. When the bridge is in the open (up) position, the span would be raised approximately 100-125 feet above the roadway surface. For comparison, the top of the truss of the existing bridge is 70 feet above MHW.

These towers would be a prominent feature in the skyline of the harbor. However, due to the terrain in the area and the viewshed of the harbor, while the towers would be visible from many locations due to their height, they would only be visible over the tops of other structures. The towers would only appear visibly imposing from the bridge approaches, from vessels in the harbor or at the harbor's edge. Figures 4.2 and Figure 4.3 provides simulated renderings of what the bridge would look like if standing at Captain Leroy's on Pope's Island.

4.3.7 Alternative Feasibility

The identification of the costs, construction phase impacts, and permanent ROW impacts provide a critical way to evaluate the feasibility of an alternative. This section describes the capital costs, operating and maintenance costs, the construction methodology, a description of impacts to marine and vehicular traffic during construction, and permanent impacts to adjoining properties or businesses.

CAPITAL COSTS

The estimated cost for Alternative 1 is between $90 and $120 million. This capital cost would include the bridge design and permitting, removal and demolition of the existing swing span and construction of the new bridge span. Limits of construction would be generally limited to the 289-foot length of the existing swing span with modifications to the approach spans limited to raising the approaches to provide the necessary under bridge clearances. It is estimated that this work would all be done utilizing the existing piers and newly reconstructed pier caps. In addition, some limited work would be required approximately 100 feet west of the moveable span on the New Bedford approach roadway on Fish Island to change the grade of the roadway.

It is assumed that dredging and disturbance of the harbor sediments would be limited to construction of the tower structures and fendering system, and removal of the existing swing span's center pier structure. A more detailed cost estimate would be developed as additional information regarding subsurface conditions, bridge specifications, and design details are developed through the project development process.

OPERATING AND MAINTENANCE COSTS

Upon completion of construction, Alternative 1 would require both routine maintenance and daily operating costs. Table 4.12 provides the estimated annual costs required to operate and maintain the bridge, which are the same as the other double-leaf alternatives that have two mechanical units to operate and maintain.

Table 4.12. Alternative 1 Annual Operating and Maintenance Costs

Operating Costs	Type	Annual Cost (2015$)
Operating Cost	Electricity utility	$ 100,000
Operating Cost	Stand by generator	$ 2,600
Operating Cost	Bridge operators	$300,000
Routine Maintenance	Monthly bridge lubrication	$ 27,600
Routine Maintenance	Replace lamps	$ 1,500
Routine Maintenance	Replace gate arms	$ 18,000
Routine Maintenance	Miscellaneous minor repairs	$ 20,000
Routine Maintenance	Guard rail repairs	$ 20,000
	TOTAL	$ 489,700

In addition to the annual operating and maintenance costs identified above, Alternative 1 will require major repairs to be conducted on a regular basis to maintain the bridge in a state of good repair and ensure its ongoing utility. The schedule of major repairs included in Table 4.13 is an estimate of repairs that is typical for vertical lift bridges in similar environments. Over a 50-year span, it should be anticipated that approximately $15.5 million worth of repairs (in 2015 dollars) will be required.

Table 4.13. Alternative 1 Schedule of Major Repairs

Year	Work Performed	Cost (2015$)
10	Fender repairs	$ 250,000
15	Minor Structural repairs	$ 1,500,000
	Deck repairs	$ 250,000
25	Electrical control repairs	$ 700,000
	Minor Structural repairs	$ 1,250,000
	Fender repair	$ 250,000
	Control House repairs	$ 100,000
30	Deck repairs	$ 250,000
35	Replace traffic gates	$ 500,000
	Electrical system rehabilitation	$ 2,000,000
	Structural rehabilitation	$ 4,000,000
	Substructure repairs	$1,000,000
40	Fender repairs	$ 250,000
	Machinery rehabilitation	$3,000,000
45	Deck repairs	$ 250,000
	TOTAL	$15,550,000

CONSTRUCTION PHASE TRANSPORTATION IMPACTS

The construction phase of this project would be approximately three years long, or 33 to 36 months. This alternative would allow for keeping two or three lanes open for most of the time to vehicular traffic. Both of the existing navigational channels would be open for most of the construction duration. The first two years of construction would be focused on construction of the towers and fabrication (off-site) of the bridge span. One navigational closure would be required during a single long weekend, which would occur in month 28 of construction. During this weekend outage, the existing swing span would be removed while the new lift bridge span would be put into place. During this same month, the roadway would need to be closed for two to four weeks.

CONTRUCTION PHASE IMPACTS TO ABUTTING LAND OWNERS/BUSINESSES

The construction phase of each long-term alternative has the potential to impact area businesses due to the change in access during that period. The construction phase of Alternative 1 would be approximately three years long, or 33 to 36 months. While at least two or three vehicular lanes would be open for most of the construction period, Alternative 1 requires a two to four-week long roadway closure and one marine closure over a long weekend that would result in some impacts to area businesses. Due to the longer construction duration, the Alternative 1 impacts would be greater than the No Build Alternative, but would be less than some of the other build alternatives that require lengthy roadway closures.

4.4 ALTERNATIVE 1T: TALL VERTICAL LIFT BRIDGE

This section provides an evaluation of Alternative 1T: Tall Vertical Lift Bridge consistent with the evaluation criteria established at the initiation of the study. The evaluation criteria are specific measures of effectiveness used to assess benefits and impacts of each alternative.

During the review of impacts of the preliminary set of long-term alternatives, the study team developed Alternative 1T to address the potential vertical clearance needs of changing uses in the North Harbor. Compared to Alternative 1 that provides 135 feet of vertical clearance in the open position, Alternative 1T provides 150 feet of vertical clearance. Both Alternative 1 and Alternative 1T provide 270 feet of navigational clearance. Due to the similarity, Figures 4.2 and 4.3 can be used for visual reference of Alternative 1T.

4.4.1 Bridge Operations

MINUTES PER BRIDGE CLOSURE

The opening sequence of the bridge in all of the long-term alternatives, including Alternative 1T, would continue to follow the AASHTO recommendation that requires approximately four minutes to open and an additional four minutes to close. The average time to open and close the bridge will continue to vary based on the marine traffic transit time and the time required to clear pedestrians and vehicles from the movable span before it can open to marine traffic. The minutes per bridge closure in Alternative 1 is the same as the current condition.

For this alternative, it is possible that the moveable section of the bridge may not be lifted to the full height each time the bridge is opened. A policy could be established to allow the bridge operator to have the discretion to open the bridge to only the height needed to allow the vessels queued to go through the opening. Although this has the potential to sAvenue60 to 90 seconds (which represents about five percent on an average bridge opening), it would only occur when the bridge operator is confident that no tall vessels are planning to transit the bridge at that time.

FEET OF VERTICAL CLEARANCE (OPEN & CLOSED)

The Alternative 1T bridge would be designed to have a vertical clearance of 14 feet above MHW in the closed position and 150 feet above MHW in the open position. Alternative IT provides additional vertical clearance above the 110-135 feet provided by Alternative 1. The No Build Alternative and the bascule alternatives provide unlimited air draft for vessels.

FEET OF HORIZONTAL CLEARANCE

The Alternative 1T bridge would include approximately 270 feet of horizontal navigational clearance. The bridge would be aligned so that the new pier towers are approximately in the same location as the east and west abutments of the existing swing span.

NUMBER OF DAILY BRIDGE OPENINGS

As described in the No Build Alternative, the bridge currently operates on a fixed schedule each day. For all of the long-term alternatives, including Alternative 1T, the schedule and number of daily bridge openings are expected to stay the same.

LONG-TERM RELIABILITY RISK

Since each moveable bridge includes a complex interaction of mechanical, electrical and structural components, there is an inherent risk in a moveable bridge that one of these systems will not operate as designed on any particular day and result in the inability for the bridge to open or close. Some moveable bridge types are at greater risk of inoperability than others due to the nature of their design and the conditions and environment that they operate within. As inoperability of a bridge for a period of time results in community and economic impacts, the risk associated with bridge reliability in the long-term was assessed. This included a general assessment of existing bridges of the type and size under consideration in conditions similar to that of New Bedford Harbor and their ability to remain reliable throughout the life span of the bridge. As noted, all moveable bridges are complex and have some long-term reliability risk. The span width and length of a new vertical lift bridge (Alternative 1T) when operating in the marine costal environment of New Bedford Harbor is estimated to have a medium level of risk. It is likely that even with regular maintenance, the bridge would experience some periods of unanticipated inoperability similar to any moveable bridge in the same location.

4.4.2 Transportation Impacts/Mobility Analysis

The evaluation and assessment of mobility along the corridor between County Street in New Bedford and Adams Street in Fairhaven is an important component of this study. Like of the long-term alternatives, Alternative 1T will not change vehicular traffic along the corridor. Unlike the No Build Alternative, Alternative 1T will provide additional pedestrian and bicycle facilities.

CORRIDOR INTERSECTION LOS, V/C RATIO, QUEUE LENGTHS & ROADWAY TRAVEL TIME/DELAY

As noted in the No Build Alternative analysis, none of the long-term alternatives, including Alternative 1T, will change result in changes to vehicular traffic along the corridor as compared to the 2035 No Build Condition described in Chapter 2. Each of the long-term alternatives being considered will result in the same number of bridge openings and the bridge will, on average, be open for the same duration. Therefore, the mobility analysis described previously in Section 4.2.2 related to the No Build Alternative is consistent with the results of intersection LOS, volume to capacity ratio, queue lengths, and travel time and delay analysis for Alternative 1T.

BICYCLE & PEDESTRIAN MOBILITY/CONNECTIVITY

The width of the existing swing span allows for five-foot-wide sidewalks on both the north and south sides and the roadway shoulders less than two feet in width. The rest of the corridor has a slightly wider right-of-way (ROW), but it is still not wide enough to accommodate five-foot-wide bike lanes. Consequently, bicyclists and pedestrians both use the sidewalks along the bridge corridor segment.

Most pedestrian/bicycle use of the bridge occurs on the southern sidewalk since this sidewalk directly connects to the New Bedford downtown and waterfront. A new pedestrian ramp was completed in 2014 as part of a new roadway ramp from northbound Route 18 to eastbound Route 6. Between the New Bedford and Fairhaven shorelines, pedestrian and bicycle connectivity is difficult due to a lack of secure crossings, ramps, and gaps in the sidewalk network.

Because of these access challenges and safety concerns, pedestrian and bicyclist use of the bridge is currently limited. During the peak hour counts conducted for the study, only one pedestrian was observed to walk the entire length of the bridge between New Bedford and Fairhaven. During the warmer months, it is understood that pedestrian and bicycle use is more frequent and increases during non-peak auto hours.

Like all of the build alternatives, Alternative 1T allows for a wider bridge with a 64-foot-wide ROW. This bridge width allows for the construction of four 11-foot-wide vehicular travel lanes, two five-foot-wide bike lanes, and two five-foot-wide sidewalks. However, while Alternative 1T provides improved facilities compared to the No Build Alternative, the delay for bicyclists and pedestrians will not change as it is controlled by the frequency and duration of bridge openings, which will not change from the current condition.

4.4.3 Safety

Improving roadway, pedestrian, bicycle, and marine safety, reducing conflicts between transportation modes, and increasing emergency vehicle access are important considerations for evaluating the long-term alternatives. This section provides an overview of the key safety concerns that will be addressed by Alternative 1T.

CONFORMANCE WITH AASHTO AND MASSDOT STANDARDS

For a bridge and approach roadway to be safe for vehicular traffic, it must be geometrically adequate. This consideration takes into account the number of lanes, lane and shoulder widths, approach roadway widths, horizontal clearances to roadside obstacles, stopping sight distances, vertical clearances and more. The standards for these criteria are identified in the AASHTO *Policy on Geometric Design of Highways and Streets* and the MassDOT *Project Development and Design Guidebook* (2006). Alternative 1T will conform to these standards with no known variance required.

DELAY TO EMERGENCY VEHICLE ACCESS

Both New Bedford and Fairhaven provide fire and emergency services to their respective municipalities. In case of bridge closure, Pope's Island can receive service from Fairhaven via the East Bridge. St. Luke's Hospital in New Bedford is the only facility in the two municipalities that provides emergency services. Bridge closures can affect Emergency Medical Services (EMS) access to the hospital from Fairhaven. Alternative 1T will not affect the level of access or potential for delay of emergency vehicles compared to the No Build Alternative.

IMPACT TO HIGH VOLUME BICYCLE AND PEDESTRIAN LOCATIONS

A sidewalk runs along the entire length of the north and south sides of the Route 6 Corridor between MacArthur Drive in New Bedford and Middle Street in Fairhaven. When the current roadway construction is completed in 2015, the roadway shoulders will be widened by reducing the vehicular travel lane width. In Alternative 1T, the new bridge cross section will include both widened roadway shoulders and sidewalks. However, even though Alternative 1T provides additional pedestrian and bicycle facilities, high pedestrian or bicycle volumes are not seen on the bridge and are not anticipated in the future. Alternative 1T will have no impact to high volume bicycle or pedestrian locations.

IMPACT TO SAFE NAVIGATION

Due to the existing navigational width of the channels at the existing bridge, safe vessel navigation through the bridge is a serious concern and a significant constraint to the North Harbor. Concerns for safe navigation have resulted in vessel limitations, which have resulted in delays and additional costs for commercial vessels.

Navigation through the bridges 94- and 95-foot-wide channels is the primary concern for large commercial vessels. These vessels generally employ harbor tugs for ship assist when maneuvering through the harbor and the bridge. Even with the tugs, limitations are still in place for transiting through the bridge. These include wind speed, visibility, and daylight.

- Wind speed is the primary concern that limits vessels ability to pass through the bridge. In all cases, if the wind exceeds 25 knots, no large vessel will transit the bridge. If the vessel is over 400 feet in length, this may be reduced to as little as 12 knots given the direction and based on the pilot's discretion.
- No vessel will transit through the bridge if the visibility is less than one nautical mile. Although large vessels don't enter the harbor though the hurricane barrier if visibility is limited, changes in visibility can occur rapidly in the harbor due to fog or heavy precipitation.
- Vessels greater than 500 feet in length or over 80 feet in width transit through the bridge and hurricane barrier in daylight only.

When transiting the current bridge, there is limited room for larger vessels to maneuver, especially north of the bridge between Fish Island and Pope's Island. Vessels approach slowly and then increase speed as they enter the bridge opening to ensure that they can exercise better

control of the vessel through the passage. The limited maneuvering space on either side of the bridge is complicated by the fact that typically ships approach the bridge on an angle due to slow approach speeds. This angle further reduces any free space between the vessel and the bridge as the vessel is moving through. The swing span's central pivot point, associated piers, and fendering system are located approximately in the center of the federal deep-water channel. This makes the bridge, in the perspective of the pilots, the most vulnerable navigation safety area in the harbor.

When larger ships head northbound through the bridge, limited space is available for stopping or maneuvering once they pass the bridge. Generally, two tugs are employed; one at the bow and one at the stern, but only one can assist once the vessel is in the bridge opening due to the width of the channel. The forward tug goes through the bridge first and can come back alongside once the bow clears. Proceeding northbound, once the vessel passes through the bridge and enters the basin, it must slow and stop before being maneuvered into a berth.

Generally, vessels do not require tugs on transiting southbound. When departing southbound, the vessel leaves the berth and turns in the basin in a manner that allows it to line up with the west channel that is used most of the time. Once lined up, it transits the opening and maintains its alignment with the federal deep-water channel.

While the No Build Alternative does not provide any change from the existing condition, Alternative 1T will result in significant improvements to safe navigation through the bridge. The 270 feet of horizontal clearance would mitigate many of the safe navigation concerns, most notably the wind restriction, which has a significant impact on vessel delay. The wider clearance would allow for full tug assistance throughout the bridge transit and would also minimize the impact of the limited maneuverable space in the North Harbor, which will not change as a result of the project.

DELAY TO EMERGENCY MARINE ACCESS

Currently, the swing span impedes emergency vessel access in cases where there is an emergency in the North Harbor since the bridge must open to allow municipal police, fire and rescue, harbormaster, or other emergency response vessels to transit the bridge.
The design of Alternative 1T allows for a vertical clearance of 14 feet in the down (closed) position. This is sufficient clearance for all but the largest emergency response vessels to fit under the bridge without the need to wait for a bridge opening. This would eliminate most of the delay to emergency response currently experienced due to the bridge.

4.4.4 Environment

The following section presents the potential for impacts to the natural environment from Alternative 1T. Compared to the No Build Alternative, Alternative 1T has more potential to impact coastal, wetland, and natural resources due to the required in-water construction. The following sections provide a screening-level assessment, therefore additional and more in-depth analyses of resource impacts would be required, per the National Environmental Policy Act

(NEPA) and the Massachusetts Environmental Policy Act (MEPA), as the designs for the bridge progress.

IMPACT TO COASTAL RESOURCES

Coastal Zone Impacts

The New Bedford-Fairhaven Bridge is located within the designated coastal zone of the Commonwealth of Massachusetts; therefore, this project may be subject to a federal consistency review to ensure that the proposed project would be consistent with the enforceable policies of the federally approved coastal management program of the Commonwealth.

The construction required to raise the elevation of the approach on Fish Island under Alternative 1T has the potential to affect Chapter 91 Tidelands located on the eastern side of the island. A Chapter 91 Waterways authorization from the Massachusetts Department of Environmental Protection (MassDEP) may be required for the construction of new bridge structure and retaining walls between the sidewalk and properties on Fish Island.

Within its policy documents, the Massachusetts Office of Coastal Zone Management (CZM) strongly encourages early coordination with the agency to determine the appropriate level of coastal review that would be required for projects. Coordination with CZM should be undertaken during any future NEPA and MEPA phases of the project.

Floodplains

The proposed bridge would be located within the 100-year floodplain. Alternative 1T would require the construction of permanent foundations for the towers to be constructed within the water, potentially affecting the 100-year floodplain and flood levels within this area. As the design for the bridge progresses, there is the opportunity to limit the size of the foundations, thereby minimizing impacts. Flooding and construction within the 100-year floodplain is under the jurisdiction of CZM; therefore, coordination with CZM would be needed in future phases of the project to determine the extent of potential impacts to the 100-year floodplain and the applicability of coastal hazard policies to this project.

Hazardous and Contaminated Materials

New Bedford-Fairhaven Harbor has been designated as a Superfund Site and is currently undergoing an extensive clean-up effort by the EPA. Alternative 1T would require a substantial amount of in-water construction work. As part of the construction, contaminated soil/sediment from New Bedford Harbor would need to be removed so that new foundations for the bridge towers could be constructed. In-water soil/sediment disturbance would also be expected from the removal of the existing swing span center pier structure. Therefore, Alternative 1 has the potential to result in impacts from the existing contaminated harbor sediments.

As any designs for the bridge progress, coordination would be undertaken with the EPA and the MassDEP to determine the amount of disturbance anticipated during construction, options for mitigation and minimization, and for the appropriate disposal of the contaminated sediments.

IMPACT TO WETLAND RESOURCES

A small area of rocky intertidal wetlands is located on the western shore of Pope's Island. Temporary disturbance resulting from the construction of Alternative 1T may potentially affect this wetland type. Additional field verification of this wetland type, as well as consultation with the USACE and MassDEP, would be needed in future phases of this project to determine the extent of this resource.

Potential impacts to water quality may occur from the disturbance and removal of contaminated sediments from New Bedford-Fairhaven Harbor during construction. Coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination.

Proper erosion and sedimentation controls, as well as stormwater pollution prevention best management practices (BMPs), would be implemented during the construction phase to prevent or avoid any potential impacts to the wetlands and aquatic species known to reside within them. Examples of BMPs include silt fencing, biotubes, and regulated construction entrances. Consultation with USACE and MassDEP regarding avoidance and minimization of potential impacts as well as permitting requirements should be undertaken during any future phases of this project.

As project development progresses, special consideration should be given to the location of construction staging areas on Pope's Island. Coastal bank bluff and sea cliff wetlands form the southern shores of Pope's Island and the placement of construction staging areas within or adjacent to these wetlands should be avoided.

IMPACT TO NATURAL RESOURCES

Alternative 1T would not result in any impacts to Areas of Critical Environmental Concern (ACEC), prime farmland soils, or aquifers. Alternative 1T has the potential for temporary impacts to water quality, shellfish and fish habitat, and priority habitats as a result of construction.

Water Quality

Potential temporary impacts may be anticipated to water quality from the construction of Alternative 1T. Potential impacts to water quality may occur from the disturbance and removal of contaminated sediments from New Bedford-Fairhaven Harbor during construction. Coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination. Additionally, proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to water quality from construction activities.

Shellfish and Fish Habitat

Alternative 1T has the potential to result in temporary impacts to shellfish and fish habitats from the construction of the proposed bridge. Since New Bedford Harbor has been designed as a shellfish growing area, coordination may be needed with MassDEP to ensure that construction activities do not disrupt active shellfish spawning grounds. Proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to shellfish and fish habitats from construction activities.

Although the consumption of fish and shellfish caught in the New Bedford Inner Harbor is regulated by the Massachusetts Department of Public Health (MDPH), consultation with the National Oceanographic Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) should be undertaken during future phases of this project to determine the presence of Essential Fish Habitats (EFH) within New Bedford-Fairhaven Harbor.

Priority Habitats

Alternative 1T is not anticipated to impact priority plant or animal habitats. However, additional field verification and/or consultation with the U.S. Fish and Wildlife Service (USFWS) and MassDEP may be required in future phases of the project to verify the presence of state and federally listed plant and animal species and habitats.

IMPACTS TO AIR QUALITY AND GREENHOUSE GASES FROM IDLING VEHICLES

None of the long-term alternatives, including the No Build Alternative, would increase traffic volumes on the corridor as compared to the 2035 No Build Condition described in Chapter 2. The number of bridge openings would remain the same. Consequently, none of the long-build alternatives has the potential to worsen air quality compared to the 2035 No Build Condition. In future phases of the project, a formal air quality evaluation (microscale or mesoscale) would be required to determine the proposed project's impacts as compared to the National Ambient Air Quality Standards (NAAQS).

In Alternative 1T, the addition of bicycle and pedestrian facilities along the Route 6 Corridor, including along a new movable span, may have the potential for localized air quality benefits. The addition of these facilities has the potential to shift some motorists to non-motorized modes, potentially reducing the number of idling cars at bridge openings.

Potential temporary impacts to air quality would be anticipated from construction activities. BMPs would be implemented during construction to minimize vehicle emissions and manage fugitive dust. Typical air quality mitigation measures implemented during construction could include dust suppression and control methods to minimize fugitive dust on dry and windy days.

IMPACTS FROM NOISE

Since traffic volumes are not anticipated to increase substantially over existing levels, Alternative 1T is not anticipated to result in noise impacts to nearby noise-sensitive receptors.

However, a formal noise assessment in compliance with the FHWA would be required in any future phases of this project.

Potential temporary noise impacts would result from construction activities and the operation of construction equipment. BMPs would be implemented during construction to mitigate potential noise impacts (particularly during non-daytime hours).

4.4.5 Land Use and Economic Development

The following section provides analysis regarding the impacts on businesses, including property acquisition to accommodate bridge construction. Additionally, potential economic benefits of Alternative 1T, such as shipper cost savings, are evaluated.

NUMBER/VALUE OF BUSINESSES PERMANENTLY IMPACTED

The design of the Alternative 1T bridge utilizes primarily the same footprint as the existing swing span and will not require the acquisition of any additional property or ROW. Furthermore, the operation of the new moveable span will not vary dramatically in a way that would functionally affect the operation of area businesses and would not result in the reduction of the number of jobs. With absence of physical ROW changes and business operational impacts, no business or related property impacts or acquisition is anticipated due to physical or functional impacts.

SHIPPER COST SAVINGS

A variety of both landside and maritime benefits were considered to assess the economic benefits of the long-term build alternatives, including Alternative 1T. While some may be quantified, others are more difficult to count and therefore the analysis considered both quantitative and qualitative benefits.

As a first step in the assessment, the potential benefits that could be generated by a new bridge were inventoried. In similar projects, automobile and truck benefits are often included, such as reduced travel time, vehicle operating cost savings, and emissions reduction, among others. On the marine side, moveable bridge improvements can affect shipper costs, travel time, and similar factors.

A thorough review of potential benefits indicated few differences between the 2035 No Build Condition and Alternative 1T in terms of quantifiable benefits. This is due to the relatively small variation between the proposed alternatives and the existing condition in most aspects of transportation. The lack of impact to existing and future traffic conditions results in no benefits from reduced travel time, vehicle operating cost savings, and emissions reduction. However, the change in horizontal clearance for vessels between the existing bridge and Alternative 1T is a significant change. The existing bridge provides a maximum horizontal clearance of 95 feet, while the horizontal clearance for Alternative 1T is 270 feet. While there is a limitation on vertical clearance with Alternative 1, this does not pose an issue for any of the vessels that currently call upon the area inside the bridge.

This analysis only considers the benefits directly related to the bridge, an approach consistent with USDOT benefit-cost analysis guidance. While there is potential for additional economic development at the North Terminal and in the North Harbor, the chosen bridge alternative is only one component of that potential growth. As a result, it would be disingenuous to attribute that economic development potential *exclusively* to the new bridge. Additionally, when looking for the true differences between bridge alternatives, it is important to examine only the benefits associated directly with the bridge.

Landside Benefits

Traditional benefits associated with bridge improvements include both landside and maritime components. In the case of the proposed alternatives, no landside impacts were found. Each of the alternatives maintains the same bridge opening duration and creates no difference in general vehicular, bicycle, or pedestrian traffic operations. In other words, an automobile driver who uses the bridge today would discern no improvement in travel time, or achieve any other transportation related benefits, with a new bridge. Similarly, pedestrian and bicycle traffic would observe no change in their travel time.

It is important to note that the duration and methods for construction may cause various delay or diversion impacts during the construction period. However, no impact was quantified as the transportation analysis showed no discernable diversion patterns that could be analyzed. The construction phase impacts will include a limited road closure while the bridge is being installed along with lane closures for the duration of the construction. It is anticipated that during bridge closures, detours and notifications by area ITS systems will be provided to minimize impacts to drivers. While the impacts cannot easily be quantified, it should be noted that the longer closures will have a greater potential for detrimental impacts to local businesses and diversion costs for roadway users.

Since it was determined that the bridge improvement would have minimal or no impact on long-term landside traffic and pedestrian patterns, no landside benefits were quantified or included in the benefits analysis.

Maritime Benefits

A series of interviews were held with maritime users to determine how the current bridge affects their operations and to identify the ways in which a new bridge could positively affect them. As discussed in Chapter 2, wind and its impact on the navigability through the bridge opening is a critical issue facing maritime users. For this analysis, maritime benefits are primarily due to a reduction in shipper costs associated with delays within New Bedford Harbor. Changes in the use of tugs with Alternative 1T were also considered as a potential benefit. Discussions with maritime experts indicated the tugs used are “ship assist” tugs that primarily aid with alignment to the berth. Accordingly, they will still be required for all large cargo vessels that berth in the North Harbor regardless of the selected alternative and no change to tug costs will occur for larger vessels.

The greatest difference between the No Build Alternative, which retains the existing clearance, and the build alternatives is the horizontal navigational clearance. The No Build Alternative maintains the 95 feet of horizontal navigational clearance, which creates issues for the large vessels that enter the North Harbor. When there are high winds, these vessels cannot transit the bridge until the wind speeds are lower, as there is not enough clearance to pass safely through in high wind conditions.

With Alternative 1T, the horizontal navigational width would be 270 feet. This width would remove the need for larger vessels to remain moored south of the bridge should high winds prevail. In the past year, three of the 12 vessels were delayed for one day during their trip to New Bedford due to the existing bridge constraint. It is understood that each day of delay costs the shipper $40,000. Under existing conditions, approximately 25 percent of vessels are delayed for a full day, costing shippers a total of $120,000 per year. With Alternative 1, no ships would experience delay, which results in an average savings of $120,000 per year in shipper costs. Assuming that users of the harbor factor into their overall decision-making the potential cost of delay, the widening of the horizontal clearance would reduce the general cost of using the harbor.

Historically, up to 30 vessels have called upon the port in a single year. This is considered a reasonable upper limit, based on interviews conducted with key maritime users. Assuming that the bridge improvement induces vessel calls to meet this historic high, benefits associated with a reduction in delay time would be generated. These new vessels, however, are not currently using the Port of New Bedford. Rather, they are a projection of potential. As a result, and consistent with economic consumer surplus theory, the benefit they receive would be half of the benefit to existing users.

The change from 12 to 30 trips represents a portion of all potential vessels that did not use the Port of New Bedford under the existing conditions, but that would be "attracted" to New Bedford because the risk of delay and associated costs are mitigated with the wider horizontal clearance. The benefits to these additional vessels are estimated using the "rule of one-half," indicating the change in consumer surplus associated with the removal of the risk of delay. In a future year with 30 total vessels, this would result in a benefit of $20,000 per vessel for the 18 additional vessels, or a total of $360,000.

Summary of Benefits

Table 4.14 summarizes the average annual benefits associated with Alternative 1T as compared to the current conditions that would be maintained under the No Build Alternative. As discussed above, no landside benefits were identified or quantified. Additionally, there would be no change in the number of tugs that would be required, so the total costs would remain the same. The benefits generated by any of the new bridge alternatives is estimated to be $480,000 with delay costs representing $120,000 and savings to new cargo vessels $360,000.

Table 4.14. Average Single-Year Benefits of Bridge Replacement Alternatives

Benefit Category	Annual Savings (2015$)
Landside Transportation Savings	$0
Delay Cost Savings	$120,000
Savings to New Cargo Vessels	$360,000
Change in Tug Costs	$0
Total Benefits	$480,000

4.4.6 Community

The impacts to community resources, such as open space, recreational areas, or historic or cultural resources were also evaluated for Alternative 1T. Additionally, access to businesses along the corridor and impacts to Environmental Justice (EJ) populations were evaluated. The study team also considered the visual impacts of a new bridge structure.

IMPACT TO PROTECTED AND RECREATIONAL OPEN SPACE

Alternative 1T would not result in any impacts to protected and/or recreational open space. An evaluation of publicly owned parklands, per Section 4(f) of the Department of Transportation Act of 1966, would be required for any future phases of this project.

As the project development phase continues and the designs for the bridge progresses, special consideration should be given to the location of construction staging areas. Marine Park on Pope's Island is owned and operated by the City of New Bedford and occupies the southern half of the island, but should not be used for construction staging.

IMPACT TO CULTURAL/HISTORIC/ARCHEOLOGICAL RESOURCES

Under Alternative 1T, the middle bridge's swing span of the National Register-eligible New Bedford-Fairhaven Bridge would be replaced with a new vertical lift bridge. The loss of the swing span would diminish the integrity of this historic property.

In addition to direct effects to the New Bedford-Fairhaven Bridge, there is the potential for indirect visual effects to historic properties that lie within the larger study area. A portion of the through truss of the existing swing span is visible as a component of the urban/industrial landscape from both the Schooner Ernestina, located on the New Bedford waterfront, and buildings that lie along the eastern edge of the New Bedford Historic District (see Figure 2.11). Both the Schooner Ernestina and the New Bedford Historic District are National Historic Landmarks. The towers of the lift bridge would extend 108 feet above the top of the existing truss. As such, they would be visible as prominent features in the distant skyline from both of these historic properties. While the replacement of the swing span with a vertical lift bridge would alter the visual setting of the New Bedford Historic District and the Schooner Ernestina, it is not anticipated that this would adversely affect these resources given both the distance between the properties and the bridge, and the visual complexity of the viewshed.

Once the preferred long-term alternative has been selected, FHWA will need to initiate consultation with the MHC in accordance with Section 106 of the National Historic Preservation Act. Consultation should also be undertaken with the New Bedford and Fairhaven Historical Commissions. Through this consultation, additional historic properties that may be eligible for, but are not yet listed in, the National Register of Historic Places will be identified. The potential for effects to archeological resources will also be determined. FHWA, working together with the MHC, will seek ways to avoid, minimize, or mitigate adverse effects beyond the HAER documentation that has already been completed. In addition to consultation under Section 106, the preparation of a programmatic 4(f) evaluation, in compliance with the U.S. Department of Transportation Act of 1966, will be required.

IMPACT TO BUSINESS ACCESS

The parcels surrounding the approaches to the middle bridge include the following businesses:

- Bridge Shoppes shopping center;
- Captain Leroy's marina;
- Maritime Terminals facility;
- AGM Marine Contractors, Inc.; and
- Tucker Roy Marin Towing and Salvage.

The design of Alternative 1T utilizes primarily the same footprint as the existing swing span. The one modification outside the existing bridge footprint will be the grade (slope) along the western approach needed to allow for the greater vertical clearance of the bridge. This will result in approximately 100 feet of the roadway being raised from one to eight feet, which will be designed without changing the horizontal alignment of the road and will not alter the access to either of the abutting properties. This limited impact to the approaches will not result in any physical changes or impacts to business access.

IMPACT TO ENVIRONMENTAL JUSTICE POPULATIONS

The locations of Environmental Justice (EJ) populations were identified in Chapter 2. Some EJ populations reside in neighborhoods that abut or are adjacent to the New Bedford-Fairhaven Bridge. Residential clusters of EJ populations reside at the western edge of the local study area in New Bedford and EJ populations (low-income) also reside throughout the local study area within Fairhaven. Consequently, an evaluation of the potential for disproportionately high and adverse human health or environmental effects of the project alternatives on minority populations and low-income populations, per *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, would be required in future phases of the project to comply with NEPA and MEPA.

Bicycle and pedestrian improvements in Alternative 1T have the potential to substantially improve the ability of EJ populations, who may not own or have access to automobiles, to get across the bridge to access employment or other key destinations. The greatest potential for impacts to EJ populations would occur during construction. Under Alternative 1T, the construction phase would be approximately three years long. The bridge would be closed to vehicular, bicycle, and pedestrian traffic for two to four weeks. No transit service currently operates across the bridge.

Alternative 1T also has the potential to result in other temporary construction impacts to the EJ populations located in close proximity to the proposed bridge. Potential impacts could include noise, glare, fumes, and dust from construction equipment as well as changes in traffic patterns and access to businesses due to the movement of construction vehicles. Potential construction period impacts would be mitigated with BMPs for construction activities including those used to minimize dust, noise, maintenance, and protection of traffic plans, and limiting the hours of construction. Further analyses under NEPA and MEPA would be required to determine if construction-related impacts would be disproportionately higher on low-income and minority populations.

Alternative 1T, along with all of the long-term build alternatives, has the same proportion of impacts to EJ populations compared to non-EJ populations.

VISUAL IMPACTS

The visual impacts from Alternative 1T would be the most significant of all the build alternatives. The towers of the vertical lift bridge would be 200 feet above the bridge deck, or 180 feet above MHW. When the bridge is in the open (up) position, the span would be lifted approximately 140 feet above the level of the approach spans. For comparison, the top of the truss of the existing bridge is 70 feet above MHW.

These towers would be a prominent feature in the skyline of the harbor. However, due to the terrain in the area and the viewshed of the harbor, while the towers would be visible from many locations due to their height, they would only be visible over the tops of other structures. The towers would only appear visibly imposing from the bridge approaches, from vessels in the harbor or at the harbor's edge. Figure 4.1 and Figure 4.2 provides simulated renderings of what the bridge would look like if standing at Captain Leroy's on Pope's Island.

4.4.7 Alternative Feasibility

The identification of the costs, construction phase impacts, and permanent ROW impacts provide a critical way to evaluate the feasibility of an alternative. This section describes the capital costs, operating and maintenance costs, the construction methodology, a description of impacts to marine and vehicular traffic during construction, and permanent impacts to adjoining properties or businesses.

CAPITAL COST

The estimated cost for Alternative 1T is between $100 and $130 million. This capital cost would include the bridge design and permitting, removal and demolition of the existing swing span and construction of the new bridge. Limits of construction would be generally limited to the 289-foot length of the existing swing span with modifications to the approach spans limited to raising the approaches to provide the necessary under bridge clearances. It is estimated that this work would all be done utilizing the existing piers and newly reconstructed pier caps. It is assumed that dredging and disturbance of the harbor sediments would be limited to construction of the tower structures and fendering system and removal of the existing swing span center pier structure. A more detailed cost estimate would be developed as additional information regarding subsurface conditions, bridge specifications, and design details are developed through the project development process.

OPERATING AND MAINTENANCE COSTS

Upon completion of construction, Alternative 1T will require both routine maintenance and daily operating costs. Table 4.15 provides the estimated annual costs required to operate and maintain the bridge, which are the same as the other double-leaf alternatives that have two mechanical units to operate and maintain.

Table 4.15. Alternative 1T Annual Operating and Maintenance Costs

Operating Costs	Type	Annual Cost (2015 $)
Operating Cost	Electricity utility	$ 100,000
Operating Cost	Stand by generator	$ 2,600
Operating Cost	Bridge operators	$300,000
Routine Maintenance	Monthly bridge lubrication	$ 27,600
Routine Maintenance	Replace lamps	$ 1,500
Routine Maintenance	Replace gate arms	$ 18,000
Routine Maintenance	Miscellaneous minor repairs	$ 20,000
Routine Maintenance	Guard rail repairs	$ 20,000
	TOTAL	$ 489,700

In addition to the annual operating and maintenance costs identified above, Alternative 1T will require major repairs to be conducted on a regular basis to maintain the bridge in a state of good repair and ensure its ongoing utility. The schedule of major repairs included in Table 4.16 is an estimate of repairs that is typical for vertical lift bridges in similar environments. Over a 50-year span, it should be anticipated that approximately $15.5 million worth of repairs (in 2015 dollars) will be required.

Table 4.16. Alternative 1T Schedule of Major Repairs

Year	Work Performed	Cost (2015$)
10	Fender repairs	$ 250,000
15	Minor Structural repairs Deck repairs	$ 1,500,000 $ 250,000
25	Electrical control repairs Minor Structural repairs Fender repair Control House repairs	$ 700,000 $ 1,250,000 $ 250,000 $ 100,000
30	Deck repairs	$ 250,000
35	Replace traffic gates Electrical system rehabilitation Structural rehabilitation Substructure repairs	$ 500,000 $ 2,000,000 $ 4,000,000 $1,000,000
40	Fender repairs Machinery rehabilitation	$ 250,000 $3,000,000
45	Deck repairs	$ 250,000
	TOTAL	$15,550,000

CONSTRUCTION PHASE TRANSPORTATION IMPACTS

The construction phase of Alternative 1T would be approximately three years long, or 33 to 36 months. This alternative would allow two or three lanes to remain open for most of the time to vehicular traffic. Both of the existing navigational channels would be open for most of the construction duration. The first two years of construction would be focused on construction of the towers and fabrication (off-site) of the bridge span. One navigational closure would be required during a single long weekend, which would occur in month 28 of construction. During this weekend outage, the existing swing span would be removed while the new lift bridge span would be put into place. During this same month, the roadway would need to be closed for two to four weeks.

CONTRUCTION PHASE IMPACTS TO ABUTTING LAND OWNERS/BUSINESSES

The construction phase of each long-term alternative has the potential to impact area businesses due to the change in access during that period. During the three-year-long construction phase of Alternative 1T, at least two or three vehicular lanes would remain open. Alternative 1T requires a two to four-week long roadway closure and one marine closure over a long weekend that would result in some impacts to area businesses. Due to the longer construction duration, the Alternative 1T impacts would be greater than the No Build Alternative, but would be less than some of the other build alternatives that require lengthy roadway closures.

4.5 ALTERNATIVE 2: DOUBLE-LEAF BASCULE BRIDGE

This section provides an evaluation of Alternative 2: Double-leaf Bascule Bridge consistent with the evaluation criteria established at the initiation of the study. The evaluation criteria are specific measures of effectiveness used to assess benefits and impacts of each alternative.

Alternative 2 is a double-leaf bascule bridge (standard) that provides 150 feet of navigational clearance and unlimited air draft. The counterweights and mechanical equipment that is necessary to open the bridge are located in the bascule piers below the bridge deck. Figures 4.4 and 4.5 provide simulated renderings for what Alternative 2 would look like if standing at Captain Leroy's marina on Pope's Island. Figure 4.4 shows the bridge in the closed position (open for vehicular traffic). Figure 4.5 shows the bridge in the open position (closed for vehicular traffic).

Figure 4.4. Alternative 2: Double-leaf Bascule Bridge in Closed Position

Figure 4.5. Alternative 2: Double-leaf Bascule Bridge in Open Position

4.5.1 Bridge Operations

MINUTES PER BRIDGE CLOSURE

The opening sequence of the bridge in all of the long-term alternatives, including Alternative 2, would continue to follow the AASHTO recommendation that requires approximately four minutes to open and an additional four minutes to close. The average time to open and close the bridge will continue to vary based on the marine traffic transit time and the time required to clear pedestrians and vehicles from the movable span before it can open to marine traffic. The minutes per bridge closure in Alternative 2 is the same as the current condition.

FEET OF VERTICAL CLEARANCE (OPEN & CLOSED)

The Alternative 2 bridge would be designed to have a vertical clearance of 14 feet above MHW when the bridge is in the closed position. The bridge would create no vertical clearance restrictions when the bridge is open to marine traffic.

FEET OF HORIZONTAL CLEARANCE

The Alternative 2 bridge would include approximately 150 feet of navigational clearance. The bridge would be aligned so that the eastern bridge abutment is in approximately the same location as the existing eastern abutment, with the western abutment about 150 feet to the west, or in the location of the existing west channel.

NUMBER OF DAILY BRIDGE OPENINGS

As described in the No Build Alternative, the bridge currently operates on a fixed schedule each day. For all of the long-term alternatives, including Alternative 2, the schedule and number of daily bridge openings are expected to stay the same.

LONG-TERM RELIABILITY RISK

Since each moveable bridge includes a complex interaction of mechanical, electrical and structural components, there is an inherent risk in a moveable bridge that one of these systems will not operate as designed on any particular day and result in the inability for the bridge to open or close. Some moveable bridge types are at greater risk of inoperability than others due to the nature of their design and the conditions and environment that they operate within. As inoperability of a bridge for a period of time results in community and economic impacts, the risk associated with bridge reliability in the long-term was assessed. This included a general assessment of existing bridges of the type and size under consideration in conditions similar to that of New Bedford Harbor and their ability to remain reliable throughout the life span of the bridge. As noted, all moveable bridges are complex and have some long-term reliability risk. The span width and length of a new bascule bridge (Alternative 2) when operating in the marine costal environment of New Bedford Harbor is estimated to have a medium level of risk. It is likely that even with regular maintenance, the bridge would experience some periods of unanticipated inoperability similar to any moveable bridge in the same location.

4.5.2 Transportation Impacts & Mobility Analysis

The evaluation and assessment of mobility along the corridor between County Street in New Bedford and Adams Street in Fairhaven is an important component of this study. Like of the long-term alternatives, Alternative 2 will not change vehicular traffic along the corridor. Unlike the No Build Alternative, Alternative 2 will provide additional pedestrian and bicycle facilities.

CORRIDOR INTERSECTION LOS, V/C RATIO, QUEUE LENGTHS & ROADWAY TRAVEL TIME/DELAY

As noted in the No Build Alternative analysis, none of the long-term alternatives, including Alternative 2, will result in changes to vehicular traffic along the corridor as compared to the 2035 No Build Condition described in Chapter 2. Each of the long-term alternatives being considered will result in the same number of bridge openings and the bridge will, on average, be open for the same duration. Therefore, the mobility analysis described previously in Section 4.2.2 related to the No Build Alternative is consistent with the results of intersection LOS, volume to capacity ratio, queue lengths, and travel time and delay analysis for Alternative 2.

BICYCLE & PEDESTRIAN MOBILITY/CONNECTIVITY

The width of the existing swing span allows for five-foot-wide sidewalks on both the north and south sides and the roadway shoulders less than two feet in width. The rest of the corridor has a slightly wider right-of-way (ROW), but it is still not wide enough to accommodate five-foot-wide bike lanes. Consequently, bicyclists and pedestrians both use the sidewalks along the bridge corridor segment.

Most pedestrian/bicycle use of the bridge occurs on the southern sidewalk since this sidewalk directly connects to the New Bedford downtown and waterfront. A new pedestrian ramp was completed in 2014 as part of a new roadway ramp from northbound Route 18 to eastbound Route 6. Between the New Bedford and Fairhaven shorelines, pedestrian and bicycle connectivity is difficult due to a lack of secure crossings, ramps, and gaps in the sidewalk network.

Because of these access challenges and safety concerns, pedestrian and bicyclist use of the bridge is currently limited. During the peak hour counts conducted for the study, only one pedestrian was observed to walk the entire length of the bridge between New Bedford and Fairhaven. During the warmer months, it is understood that pedestrian and bicycle use is more frequent and increases during non-peak auto hours.

Like all of the build alternatives, Alternative 2 allows for a wider bridge with a 64-foot-wide ROW. This bridge width allows for the construction of four 11-foot-wide vehicular travel lanes, two five-foot-wide bike lanes, and two five-foot-wide sidewalks. However, while Alternative 2 provides improved facilities compared to the No Build Alternative, the delay for bicyclists and pedestrians will not change as it is controlled by the frequency and duration of bridge openings, which will not change from the current condition.

4.5.3 Safety

Improving roadway, pedestrian, bicycle, and marine safety, reducing conflicts between transportation modes, and increasing emergency vehicle access are important considerations for evaluating the long-term alternatives. This section provides an overview of the key safety concerns that will be addressed by Alternative 2.

CONFORMANCE WITH AASHTO AND MASSDOT STANDARDS

For a bridge and approach roadway to be safe for vehicular traffic, it must be geometrically adequate. This consideration takes into account the number of lanes, lane and shoulder widths, approach roadway widths, horizontal clearances to roadside obstacles, stopping sight distances, vertical clearances and more. The standards for these criteria are identified in the AASHTO *Policy on Geometric Design of Highways and Streets* and the MassDOT *Project Development and Design Guidebook* (2006). Alternative 2 will conform to these standards with no known variance required.

DELAY TO EMERGENCY VEHICLE ACCESS

Both New Bedford and Fairhaven provide fire and emergency services to their respective municipalities. In case of bridge closure, Pope's Island can receive service from Fairhaven via the East Bridge. St. Luke's Hospital in New Bedford is the only facility in the two municipalities that provides emergency services. Bridge closures can affect Emergency Medical Services (EMS) access to the hospital from Fairhaven. Alternative 2 will not affect the level of access or potential for delay of emergency vehicles compared to the No Build Alternative.

IMPACT TO HIGH VOLUME BICYCLE AND PEDESTRIAN LOCATIONS

A sidewalk runs along the entire length of the north and south sides of the Route 6 Corridor between MacArthur Drive in New Bedford and Middle Street in Fairhaven. When the current roadway construction is completed in 2015, the roadway shoulders will be widened by reducing the vehicular travel lane width. In Alternative 2, the new bridge cross section will include both widened roadway shoulders and sidewalks. However, even though Alternative 2 provides additional pedestrian and bicycle facilities, high pedestrian or bicycle volumes are not seen on the bridge and are not anticipated in the future. Alternative 2 will have no impact to high volume bicycle or pedestrian locations.

IMPACT TO SAFE NAVIGATION

Due to the existing navigational width of the channels at the existing bridge, safe vessel navigation through the bridge is a serious concern and a significant constraint to the North Harbor. Concerns for safe navigation have resulted in vessel limitations, which have resulted in delays and additional costs for commercial vessels.

Navigation through the bridges 94- and 95-foot-wide channels is the primary concern for large commercial vessels. These vessels generally employ harbor tugs for ship assist when maneuvering through the harbor and the bridge. Even with the tugs, limitations are still in place for transiting through the bridge. These include wind speed, visibility, and daylight.

- Wind speed is the primary concern that limits vessels ability to pass through the bridge. In all cases, if the wind exceeds 25 knots, no large vessel will transit the bridge. If the vessel is over 400 feet in length, this may be reduced to as little as 12 knots given the direction and based on the pilot's discretion.
- No vessel will transit through the bridge if the visibility is less than one nautical mile. Although large vessels don't enter the harbor though the hurricane barrier if visibility is limited, changes in visibility can occur rapidly in the harbor due to fog or heavy precipitation.
- Vessels greater than 500 feet in length or over 80 feet in width transit through the bridge and hurricane barrier in daylight only.

When transiting the current bridge, there is limited room for larger vessels to maneuver, especially north of the bridge between Fish Island and Pope's Island. Vessels approach slowly and then increase speed as they enter the bridge opening to ensure that they can exercise better

control of the vessel through the passage. The limited maneuvering space on either side of the bridge is complicated by the fact that typically ships approach the bridge on an angle due to slow approach speeds. This angle further reduces any free space between the vessel and the bridge as the vessel is moving through. The swing span's central pivot point, associated piers, and fendering system are located approximately in the center of the federal deep-water channel. This makes the bridge, in the perspective of the pilots, the most vulnerable navigation safety area in the harbor.

When larger ships head northbound through the bridge, limited space is available for stopping or maneuvering once they pass the bridge. Generally, two tugs are employed; one at the bow and one at the stern, but only one can assist once the vessel is in the bridge opening due to the width of the channel. The forward tug goes through the bridge first and can come back alongside once the bow clears. Proceeding northbound, once the vessel passes through the bridge and enters the basin, it must slow and stop before being maneuvered into a berth.

Generally, vessels do not require tugs on transiting southbound. When departing southbound, the vessel leaves the berth and turns in the basin in a manner that allows it to line up with the west channel that is used most of the time. Once lined up, it transits the opening and maintains its alignment with the federal deep-water channel.

While the No Build Alternative does not provide any change from the existing condition, Alternative 2 will result in improvements to safe navigation through the bridge. Operations of the large vessels transiting though the Alternative 2 bridge would not change dramatically from the No Build Condition due to limitations caused by visibility and daylight.

The 150-foot-wide clearance is considered the minimum acceptable width for safe navigation into the North Harbor. As noted two tugs are typically employed for large vessels; one at the bow and one at the stern, with only one able to assist once the vessel is in the bridge opening. This will remain the same for the Alternative 2 bridge. Additionally, the limited maneuvering space on either side of the bridge is complicated by the fact that typically ships approach the bridge on an angle due to slow approach speeds. This angle further reduces any free space between the vessel and the bridge as the vessel is moving through. With a 150-foot-wide navigational clearance the width would still be anticipated to be a concern for the larger ships.

To mitigate this concern, an enhanced fendering system is suggested for construction as part of the bridge. This would include "transit fenders where part of the maneuver involves laying the vessel alongside the fenders and moving forward along the fendering structure as you approach and pass through the bridge opening. This is similar to the system in the Panama Canal and is used effectively to assist in navigation.

DELAY TO EMERGENCY MARINE ACCESS

Currently, the swing span impedes emergency vessel access in cases where there is an emergency in the North Harbor since the bridge must open to allow municipal police, fire and rescue, harbormaster, or other emergency response vessels to transit the bridge.

The design of Alternative 2 allows for a vertical clearance of 14 feet in the down (closed) position. This is sufficient clearance for all but the largest emergency response vessels to fit under the bridge without the need to wait for a bridge opening. This would eliminate most of the delay to emergency response currently experienced due to the bridge.

4.5.4 Environment

The following section presents the potential for impacts to the natural environment from Alternative 2. Compared to the No Build Alternative, Alternative 2 has more potential to impact coastal, wetland, and natural resources due to the required in-water construction. The following sections provide a screening-level assessment, therefore additional and more in-depth analyses of resource impacts would be required, per the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA), as the designs for the bridge progress.

IMPACT TO COASTAL RESOURCES

Coastal Zone Impacts

The New Bedford-Fairhaven Bridge is located within the designated coastal zone of the Commonwealth of Massachusetts; therefore, this project may be subject to a federal consistency review to ensure that the proposed project would be consistent with the enforceable policies of the federally approved coastal management program of the Commonwealth.

The construction required to raise the elevation of the approach on Fish Island under Alternative 2 has the potential to affect Chapter 91 Tidelands located on the eastern side of the island. A Chapter 91 Waterways authorization from the Massachusetts Department of Environmental Protection (MassDEP) may be required for the construction of new bridge structure.

Within its policy documents, the Massachusetts Office of Coastal Zone Management (CZM) strongly encourages early coordination with the agency to determine the appropriate level of coastal review that would be required for projects. Coordination with CZM should be undertaken during any future NEPA and MEPA phases of the project.

Floodplains

The proposed bridge would be located within the 100-year floodplain. Alternative 2 would require the construction of permanent foundations for the bascule piers to be constructed within the water, potentially affecting the 100-year floodplain and flood levels within this area. As the design for the bridge progresses, there is the opportunity to limit the size of the foundations, thereby minimizing impacts. Flooding and construction within the 100-year floodplain is under the jurisdiction of CZM. Therefore, coordination with CZM would be needed in future phases of the project to determine the extent of potential impacts to the 100-year floodplain and the applicability of coastal hazard policies to this project.

Hazardous and Contaminated Materials

New Bedford Harbor has been designated as a Superfund Site and is currently undergoing an extensive clean-up effort by the EPA. Alternative 2 would require a substantial amount of in-water construction work. As part of the construction, contaminated soil/sediment from New Bedford Harbor would need to be removed so that new bascule piers could be constructed. These structures would be at least 24 feet by 64 feet and would require a significant amount of soil disturbance below the water line. In-water soil/sediment disturbance would also be expected from the removal of the existing swing span center pier structure. Therefore, Alternative 2 has the potential to result in impacts from the existing contaminated harbor sediments, greater than those potential impacts anticipated for most of the other long-term alternatives.

As any designs for the bridge progress, coordination would be undertaken with the EPA and the MassDEP to determine the amount of disturbance anticipated during construction, options for mitigation and minimization, and for the appropriate disposal of the contaminated sediments.

IMPACT TO WETLAND RESOURCES

A small area of rocky intertidal wetlands is located on the western shore of Pope's Island. Temporary disturbance resulting from the construction of Alternative 2 may potentially affect this wetland type. Additional field verification of this wetland type, as well as consultation with the USACE and MassDEP, would be needed in future phases of this project to determine the extent of this resource.

Potential impacts to water quality may occur from the disturbance and removal of contaminated sediments from New Bedford-Fairhaven Harbor during construction. Coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination.

Proper erosion and sedimentation controls, as well as stormwater pollution prevention best management practices (BMPs), would be implemented during the construction phase to prevent or avoid any potential impacts to the wetlands and aquatic species known to reside within them. Examples of BMPs include silt fencing, biotubes, and regulated construction entrances. Consultation with USACE and MassDEP regarding avoidance and minimization of potential impacts as well as permitting requirements should be undertaken during any future phases of this project.

As project development progresses, special consideration should be given to the location of construction staging areas on Pope's Island. Coastal bank bluff and sea cliff wetlands form the southern shores of Pope's Island and the placement of construction staging areas within or adjacent to these wetlands should be avoided.

IMPACT TO NATURAL RESOURCES

Alternative 2 would not result in any impacts to Areas of Critical Environmental Concern (ACEC), prime farmland soils, or aquifers. Alternative 2 has the potential for greater impacts to water quality, shellfish and fish habitat, and priority habitats than the No Build Alternative.

Water Quality

Alternative 2 would require a substantial amount of in-water construction work. As part of the construction, contaminated soil/sediment from New Bedford Harbor would need to be removed so that new bascule piers could be constructed. These structures would be at least 24 feet by 64 feet and would require a significant amount of soil disturbance below the water line. Therefore, the potential for impacts to water quality from Alternative 2 would be greater than the No Build Alternative and most of the build alternatives. Additionally, potential impacts from the in-water soil/sediment disturbance from the removal of the existing swing span center pier structure would be the same as the other build alternatives, but greater than the No Build Alternative. Similar to the other long-term alternatives, coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination. Additionally, proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to water quality from construction activities.

Shellfish and Fish Habitat

Due to the substantial in-water construction that would be required, the construction of Alternative 2 would have the potential to result in greater temporary impacts to shellfish and fish habitats than the No Build Alternative. Similar to the other long-term alternatives, coordination may be needed with MassDEP to ensure that construction activities do not disrupt active shellfish spawning grounds. Proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to shellfish and fish habitats from construction activities.

Although the consumption of fish and shellfish caught in the New Bedford Inner Harbor is regulated by the Massachusetts Department of Public Health (MDPH), consultation with the National Oceanographic Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) should be undertaken during future phases of this project to determine the presence of Essential Fish Habitats (EFH) within New Bedford-Fairhaven Harbor.

Priority Habitats

Alternative 2 is not anticipated to impact priority plant or animal habitats. However, additional field verification and/or consultation with the U.S. Fish and Wildlife Service (USFWS) and MassDEP may be required in future phases of the project to verify the presence of state and federally listed plant and animal species and habitats.

IMPACTS TO AIR QUALITY AND GREENHOUSE GASES FROM IDLING VEHICLES

None of the long-term alternatives, including the No Build Alternative, would increase traffic volumes on the corridor as compared to the 2035 No Build Condition described in Chapter 2. The number of bridge openings would remain the same. Consequently, none of the long-build alternatives has the potential to worsen air quality compared to the 2035 No Build Condition. In future phases of the project, a formal air quality evaluation (microscale or mesoscale) would be required to determine the proposed project's impacts as compared to the National Ambient Air Quality Standards (NAAQS).

In Alternative 2, the addition of bicycle and pedestrian facilities along the Route 6 Corridor, including along a new movable span, may have the potential for localized air quality benefits. The addition of these facilities has the potential to shift some motorists to non-motorized modes, potentially reducing the number of idling cars at bridge openings.

Potential temporary impacts to air quality would be anticipated from construction activities. BMPs would be implemented during construction to minimize vehicle emissions and manage fugitive dust. Typical air quality mitigation measures implemented during construction could include dust suppression and control methods to minimize fugitive dust on dry and windy days.

IMPACTS FROM NOISE

Since traffic volumes are not anticipated to increase substantially over existing levels, Alternative 2 is not anticipated to result in noise impacts to nearby noise-sensitive receptors. However, a formal noise assessment in compliance with the FHWA would be required in any future phases of this project.

Potential temporary noise impacts would result from construction activities and the operation of construction equipment. BMPs would be implemented during construction to mitigate potential noise impacts (particularly during non-daytime hours).

4.5.5 Land Use & Economic Development

The following section provides analysis regarding the impacts on businesses, including property acquisition to accommodate bridge construction. Additionally, potential economic benefits of Alternative 2, such as shipper cost savings, are evaluated.

NUMBER/VALUE OF BUSINESSES & JOBS PERMANENTLY IMPACTED

The design of the Alternative 2 bridge utilizes primarily the same footprint as the existing swing span and will not require the acquisition of any additional property or ROW. Furthermore, the operation of the new moveable span will not vary dramatically in a way that would functionally affect the operation of area businesses and would not result in the reduction of the number of jobs. With absence of physical ROW changes and business operational impacts, no business or related property impacts or acquisition is anticipated due to physical or functional impacts.

SHIPPER COST SAVINGS

A variety of both landside and maritime benefits were considered to assess the economic benefits of the long-term build alternatives, including Alternative 2. While some may be quantified, others are more difficult to count and therefore the analysis considered both quantitative and qualitative benefits.

As a first step in the assessment, the potential benefits that could be generated by a new bridge were inventoried. In similar projects, automobile and truck benefits are often included, such as reduced travel time, vehicle operating cost savings, and emissions reduction, among others. On the marine side, moveable bridge improvements can affect shipper costs, travel time, and similar factors.

A thorough review of potential benefits indicated few differences between the 2035 No Build Condition and Alternative 2 in terms of quantifiable benefits. This is due to the relatively small variation between the proposed alternatives and the existing condition in most aspects of transportation. The lack of impact to existing and future traffic conditions results in no benefits from reduced travel time, vehicle operating cost savings, and emissions reduction. However, the change in horizontal clearance for vessels between the existing bridge and Alternative 2 is a significant change. The existing bridge provides a maximum horizontal clearance of 95 feet, while the horizontal clearance for Alternative 2 is 150 feet. Alternative 2 has no limitations on the vertical clearance of vessels.

This analysis only considers the benefits directly related to the bridge, an approach consistent with USDOT benefit-cost analysis guidance. While there is potential for additional economic development at the North Terminal and in the North Harbor, the chosen bridge alternative is only one component of that potential growth. As a result, it would be disingenuous to attribute that economic development potential *exclusively* to the new bridge. Additionally, when looking for the true differences between bridge alternatives, it is important to examine only the benefits associated directly with the bridge.

Landside Benefits

Traditional benefits associated with bridge improvements include both landside and maritime components. In the case of the proposed alternatives, no landside impacts were found. Each of the alternatives maintains the same bridge opening duration and creates no difference in general vehicular, bicycle, or pedestrian traffic operations. In other words, an automobile driver who uses the bridge today would discern no improvement in travel time, or achieve any other transportation related benefits, with a new bridge. Similarly, pedestrian and bicycle traffic would observe no change in their travel time.

It is important to note that the duration and methods for construction may cause various delay or diversion impacts during the construction period. However, no impact was quantified as the transportation analysis showed no discernable diversion patterns that could be analyzed. The construction phase impacts will include a limited road closure while the bridge is being installed along with lane closures for the duration of the construction. It is anticipated that during bridge closures, detours and notifications by area ITS systems will be provided to minimize impacts to drivers. While the impacts cannot easily be quantified, it should be noted that the longer closures will have a greater potential for detrimental impacts to local businesses and diversion costs for roadway users.

Since it was determined that the bridge improvement would have minimal or no impact on long-term landside traffic and pedestrian patterns, no landside benefits were quantified or included in the benefits analysis.

Maritime Benefits

A series of interviews were held with maritime users to determine how the current bridge affects their operations and to identify the ways in which a new bridge could positively affect them. As discussed in Chapter 2, wind and its impact on the navigability through the bridge opening is a critical issue facing maritime users. For this analysis, maritime benefits are primarily due to a reduction in shipper costs associated with delays within New Bedford Harbor. Changes in the use of tugs with Alternative 2 were also considered as a potential benefit. Discussions with maritime experts indicated the tugs used are “ship assist” tugs that primarily aid with alignment to the berth. Accordingly, they will still be required for all large cargo vessels that berth in the North Harbor regardless of the selected alternative and no change to tug costs will occur for larger vessels.

The greatest difference between the No Build Alternative, which retains the existing clearance, and the build alternatives is the horizontal navigational clearance. The No Build Alternative maintains the 95 feet of horizontal navigational clearance, which creates issues for the large vessels that enter the North Harbor. When there are high winds, these vessels cannot transit the bridge until the wind speeds are lower, as there is not enough clearance to pass safely through in high wind conditions.

With Alternative 2, the horizontal navigational width would be 150 feet. This width would remove the need for larger vessels to remain moored south of the bridge should high winds prevail. In the past year, three of the 12 vessels were delayed for one day during their trip to New Bedford due to the existing bridge constraint. It is understood that each day of delay costs the shipper $40,000. Under existing conditions, approximately 25 percent of vessels are delayed for a full day, costing shippers a total of $120,000 per year. With Alternative 2, no ships would experience delay, which results in an average savings of $120,000 per year in shipper costs. Assuming that users of the harbor factor into their overall decision-making the potential cost of delay, the widening of the horizontal clearance would reduce the general cost of using the harbor.

Historically, up to 30 vessels have called upon the port in a single year. This is considered a reasonable upper limit, based on interviews conducted with key maritime users. Assuming that the bridge improvement induces vessel calls to meet this historic high, benefits associated with a reduction in delay time would be generated. These new vessels, however, are not currently using the Port of New Bedford. Rather, they are a projection of potential. As a result, and consistent with economic consumer surplus theory, the benefit they receive would be half of the benefit to existing users.

The change from 12 to 30 trips represents a portion of all potential vessels that did not use the Port of New Bedford under the existing conditions, but that would be “attracted” to New Bedford because the risk of delay and associated costs are mitigated with the wider horizontal clearance. The benefits to these additional vessels are estimated using the “rule of one-half,” indicating the change in consumer surplus associated with the removal of the risk of delay. In a future year with 30 total vessels, this would result in a benefit of $20,000 per vessel for the 18 additional vessels, or a total of $360,000.

Summary of Benefits

Table 4.17 summarizes the average annual benefits associated with Alternative 2 as compared to the current conditions that would be maintained under the No Build Alternative. As discussed above, no landside benefits were identified or quantified. Additionally, there would be no change in the number of tugs that would be required, so the total costs would remain the same. The benefits generated by any of the new bridge alternatives is estimated to be $480,000 with delay costs representing $120,000 and savings to new cargo vessels $360,000.

Table 4.17. Average Single-Year Benefits of Bridge Replacement Alternatives

Benefit Category	Annual Savings (2015$)
Landside Transportation Savings	$0
Delay Cost Savings	$120,000
Savings to New Cargo Vessels	$360,000
Change in Tug Costs	$0
Total Benefits	$480,000

4.5.6 Community

The impacts to community resources, such as open space, recreational areas, or historic or cultural resources were also evaluated for Alternative 2. Additionally, access to businesses along the corridor and impacts to Environmental Justice (EJ) populations were evaluated. The study team also considered the visual impacts of a new bridge structure.

IMPACT TO PROTECTED AND RECREATIONAL OPEN SPACE

Alternative 2 would not result in any impacts to protected and/or recreational open space. An evaluation of publicly owned parklands, per Section 4(f) of the Department of Transportation Act of 1966, would be required for any future phases of this project.

As the project development phase continues and the designs for the bridge progresses, special consideration should be given to the location of construction staging areas. Marine Park on Pope's Island is owned and operated by the City of New Bedford and occupies the southern half of the island, but should not be used for construction staging.

IMPACT TO CULTURAL/HISTORIC/ARCHEOLOGICAL RESOURCES

Under Alternative 2, the middle bridge's swing span of the National Register-eligible New Bedford-Fairhaven Bridge would be replaced with a new double-leaf bascule bridge. The loss of the swing span would diminish the integrity of this historic property.

In addition to direct effects to the New Bedford-Fairhaven Bridge, there is the potential for indirect visual effects to historic properties that lie within the larger study area. A portion of the through truss of the existing swing span is visible as a component of the urban/industrial landscape from both the Schooner Ernestina, located on the New Bedford waterfront, and buildings that lie along the eastern edge of the New Bedford Historic District (see Figure 2.11). Both the Schooner Ernestina and the New Bedford Historic District are National Historic Landmarks. Due to the lack of a truss and thus the lower profile of the bridge, it is unlikely that the new bridge would be visible when in the closed position. It would be visible from the New Bedford Historic District and the Schooner Ernestina when in the open (up) position, as the top of the bridge would extend approximately 28 feet higher than the top of the existing truss when measured from the water. While the replacement of the swing span through truss with a double-leaf bascule span would alter the visual setting of these two historic properties, it is not anticipated that this would adversely affect these resources given both the distance between the properties and the bridge, and the visual complexity of the viewshed.

Regardless of which long-term alternative is selected, FHWA will need to initiate consultation with the MHC in accordance with Section 106 of the National Historic Preservation Act. Consultation should also be undertaken with the New Bedford and Fairhaven Historical Commissions. Through this consultation, additional historic properties that may be eligible for, but are not yet listed in, the National Register of Historic Places will be identified. The potential for effects to archeological resources will also be determined. FHWA, working together with the MHC, will seek ways to avoid, minimize, or mitigate adverse effects beyond the HAER documentation that has already been completed. In addition to consultation under Section 106, the preparation of a programmatic 4(f) evaluation, in compliance with the U.S. Department of Transportation Act of 1966, will be required.

IMPACT TO BUSINESS ACCESS

The parcels surrounding the approaches to the middle bridge include the following businesses:

- Bridge Shoppes shopping center;
- Captain Leroy's marina;
- Maritime Terminals facility;
- AGM Marine Contractors, Inc.; and
- Tucker Roy Marin Towing and Salvage.

Alternative 2 does not include any modifications to the bridge approaches and utilizes the existing footprint. The horizontal alignment of the road and access to abutting properties will remain the same.

IMPACT TO ENVIRONMENTAL JUSTICE POPULATIONS

The locations of Environmental Justice (EJ) populations were identified in Chapter 2. Some EJ populations reside in neighborhoods that abut or are adjacent to the New Bedford-Fairhaven Bridge. Residential clusters of EJ populations reside at the western edge of the local study area in New Bedford and EJ populations (low-income) also reside throughout the local study area within Fairhaven. Consequently, an evaluation of the potential for disproportionately high and adverse human health or environmental effects of the project alternatives on minority populations and low-income populations, per *Executive Order 12898, Federal Actions to Address*

Environmental Justice in Minority Populations and Low-Income Populations, would be required in future phases of the project to comply with NEPA and MEPA.
Bicycle and pedestrian improvements in Alternative 2 have the potential to substantially improve the ability of EJ populations, who may not own or have access to automobiles, to get across the bridge to access employment or other key destinations. The greatest potential for impacts to EJ populations would occur during construction. Under Alternative 2, the construction phase would be approximately three years long. The bridge would be closed to vehicular, bicycle, and pedestrian traffic for two years. No transit service currently operates across the bridge.

Alternative 2 also has the potential to result in other temporary construction impacts to the EJ populations located in close proximity to the proposed bridge. Potential impacts could include noise, glare, fumes, and dust from construction equipment as well as changes in traffic patterns and access to businesses due to the movement of construction vehicles. Potential construction period impacts would be mitigated with BMPs for construction activities including those used to minimize dust, noise, maintenance, and protection of traffic plans, and limiting the hours of construction. Further analyses under NEPA and MEPA would be required to determine if construction-related impacts would be disproportionately higher on low-income and minority populations.

Alternative 2, along with all of the long-term build alternatives, has the same proportion of impacts to EJ populations compared to non-EJ populations.

VISUAL IMPACTS

The visual impacts from Alternative 2 would be limited. When the bridge is in the down position, it would look similar to the fixed spans of the east and west bridges. However, when the bridge is in the up (or open) position the bridge leafs would extend approximately 75 feet above the roadway surface, or 95 feet above MHW. This is approximately 25 feet higher than the top of the existing truss. Although the bridge would be visible from a greater distance while in the up position, the topography and the significant development that surrounds the harbor would shield the view of the bridge from most locations. Figures 4.4 and 4.5 provide simulated renderings of what the bridge would look like if standing at Captain Leroy's on Pope's Island.

4.5.7 Alternative Feasibility

The identification of the costs, construction phase impacts, and permanent ROW impacts provide a critical way to evaluate the feasibility of an alternative. This section describes the capital costs, operating and maintenance costs, the construction methodology, a description of impacts to marine and vehicular traffic during construction, and permanent impacts to adjoining properties or businesses.

CAPITAL COST

The estimated cost for Alternative 2 is between $85 and $100 million. This capital cost would include the bridge design and permitting, removal and demolition of the existing swing span and construction of the new bridge. The limits of construction would be generally limited to the 289-foot length of the existing swing span with modifications to the approach spans limited to raising the approaches to provide the necessary under bridge clearances. It is estimated that this work would all be done utilizing the existing piers and newly reconstructed pier caps. It is assumed that dredging and disturbance of the harbor sediments would be limited to construction of the tower structures and fendering system and removal of the existing swing bridge center pier structure. A more detailed cost estimate would be developed as additional information regarding subsurface conditions, bridge specifications, and design details are developed through the project development process.

OPERATING AND MAINTENANCE COSTS

Upon completion of construction, Alternative 2 will require both routine maintenance and daily operating costs. Table 4.18 provides the estimated annual costs required to operate and maintain the bridge, which are the same as the other double-leaf alternatives that have two mechanical units to operate and maintain.

Table 4.18. Alternative 2 Annual Operating and Maintenance Costs

Operating Costs	Type	Annual Cost (2015 $)
Operating Cost	Electricity utility	$ 100,000
Operating Cost	Stand by generator	$ 2,600
Operating Cost	Bridge operators	$300,000
Routine Maintenance	Monthly bridge lubrication	$ 27,600
Routine Maintenance	Replace lamps	$ 1,500
Routine Maintenance	Replace gate arms	$ 18,000
Routine Maintenance	Miscellaneous minor repairs	$ 20,000
Routine Maintenance	Guard rail repairs	$ 20,000
	TOTAL	$ 489,700

In addition to the annual operating and maintenance costs identified above, Alternative 2 will require major repairs to be conducted on a regular basis to maintain the bridge in a state of good repair and ensure its on-going utility. The schedule of major repairs included in Table 4.19 is an estimate of repairs that is typical for bascule bridges in similar environments. Over a 50-year span, it should be anticipated that approximately $14.6 million worth of repairs (in 2015 dollars) will be required.

Table 4.19. Alternative 2 Schedule of Major Repairs

Year	Work Performed	Cost (2015$)
10	Fender repairs	$250,000
15	Minor structural repairs	$1,250,000
20	Deck repairs	$250,000
25	Electrical control repairs	$700,000
	Minor structural repairs	1,250,000
	Fender repair	$250,000
	Control house repairs	$100,000
30	Deck repairs	$250,000
35	Replace traffic gates	$300,000
	Electrical system rehabilitation	$2,000,000
	Structrural rehabilitation	$3,500,000
	Substructure repairs	$1,000,000
40	Fender repairs	$250,000
	Machinery rehabilitation	$3,000,000
45	Deck repairs	$250,000
	TOTAL	$14,600,000

CONSTRUCTION PHASE TRANSPORTATION IMPACTS

The construction phase of Alternative 2 would be over three years, or approximately 37 months. This alternative would consist of closing the bridge to vehicular traffic for approximately two years during that period, requiring traffic to direct to the Coggeshall Street or I-95 bridges approximately one mile to the north. One of the two existing navigational channels would be open for most of the construction duration. However, navigational closures would be required during three long-weekends with one during the first year of construction (month 10), and two long weekends during the third year of construction (month 32 and 33).

CONTRUCTION PHASE IMPACTS TO ABUTTING LAND OWNERS/BUSINESSES

The construction phase of each long-term alternative has the potential to impact area businesses due to the change in access during that period, however, like the other bascule (standard) bridge (Alternative 2W), the impacts for this alternative are much greater due to the lengthy roadway closure required. The construction phase of Alternative 2 would be over three years and would require the closure of all traffic lanes for approximately two years. Since most of the work would occur within the existing ROW or within the channels, direct impacts to area businesses are not anticipated.

The extended three-year construction duration and associated two-year roadway closure would likely affect certain businesses on Pope's Island and Fish Island that rely heavily on pass-by traffic or easy access. Businesses that would most likely be impacted by the extended construction include:

- Fathoms Restaurant;
- Bob's Sea and Ski Outdoor Sports;

- Worley Beds Factory Outlet;
- Dunkin' Donuts; and
- Fairhaven Hardware.

Since the construction impacts are considered indirect, caused by a change in access versus a direct impact to business operations, the extent of the impact would depend specifically on each business's market and customer base.

4.6 ALTERNATIVE 2W: WIDE DOUBLE-LEAF BASCULE BRIDGE

This section provides an evaluation of Alternative 2W: Wide Double-leaf Bascule Bridge consistent with the evaluation criteria established at the initiation of the study. The evaluation criteria are specific measures of effectiveness used to assess benefits and impacts of each alternative.

During the review of impacts of the preliminary set of long-term alternatives, the study team developed Alternative 2W to address the potential navigational clearance needs of changing uses in the North Harbor. Compared to Alternative 2 that provides 150 feet of horizontal clearance, Alternative 2W provides 200 feet of navigational clearance. Both Alternative 2 and Alternative 2W provide unlimited air draft. Due to the similarity, Figures 4.4 and 4.5 can be used for visual reference of Alternative 2W.

4.6.1 Bridge Operations

MINUTES PER BRIDGE CLOSURE

The opening sequence of the bridge in all of the long-term alternatives, including Alternative 2, would continue to follow the AASHTO recommendation that requires approximately four minutes to open and an additional four minutes to close. The average time to open and close the bridge will continue to vary based on the marine traffic transit time and the time required to clear pedestrians and vehicles from the movable span before it can open to marine traffic. The minutes per bridge closure in Alternative 2 is the same as the current condition.

FEET OF VERTICAL CLEARANCE (OPEN & CLOSED)

The Alternative 2 bridge would be designed to have a vertical clearance of 14 feet above MHW when the bridge is in the closed position. The bridge would create no vertical clearance restrictions when the bridge is open to marine traffic.

FEET OF HORIZONTAL CLEARANCE

The Alternative 2W bridge would include approximately 220 feet of navigational clearance. The bridge would be aligned so that the eastern bridge abutment is in approximately the same location as the existing eastern abutment, with the western abutment about 150 feet to the west, or in the location of the existing west channel.

NUMBER OF DAILY BRIDGE OPENINGS

As described in the No Build Alternative, the bridge currently operates on a fixed schedule each day. For all of the long-term alternatives, including Alternative 2, the schedule and number of daily bridge openings are expected to stay the same.

LONG-TERM RELIABILITY RISK

Since each moveable bridge includes a complex interaction of mechanical, electrical and structural components, there is an inherent risk in a moveable bridge that one of these systems will not operate as designed on any particular day and result in the inability for the bridge to open or close. Some moveable bridge types are at greater risk of inoperability than others due to the nature of their design and the conditions and environment that they operate within. As inoperability of a bridge for a period of time results in community and economic impacts, the risk associated with bridge reliability in the long-term was assessed. This included a general assessment of existing bridges of the type and size under consideration in conditions similar to that of New Bedford Harbor and their ability to remain reliable throughout the life span of the bridge. As noted, all moveable bridges are complex and have some long-term reliability risk. The span width and length of a new bascule bridge (Alternative 2W) when operating in the marine costal environment of New Bedford Harbor is estimated to have a medium level of risk. It is likely that even with regular maintenance, the bridge would experience some periods of unanticipated inoperability similar to any moveable bridge in the same location.

4.6.2 Transportation Impacts & Mobility Analysis

The evaluation and assessment of mobility along the corridor between County Street in New Bedford and Adams Street in Fairhaven is an important component of this study. Like of the long-term alternatives, Alternative 2W will not change vehicular traffic along the corridor. Unlike the No Build Alternative, Alternative 2W will provide additional pedestrian and bicycle facilities.

CORRIDOR INTERSECTION LOS, V/C RATIO, QUEUE LENGTHS & ROADWAY TRAVEL TIME/DELAY

As noted in the No Build Alternative analysis, none of the long-term alternatives, including Alternative 2W, will change result in changes to vehicular traffic along the corridor as compared to the 2035 No Build Condition described in Chapter 2. Each of the long-term alternatives being considered will result in the same number of bridge openings and the bridge will, on average, be open for the same duration. Therefore, the mobility analysis described previously in Section 4.2.2 related to the No Build Alternative is consistent with the results of intersection LOS, volume to capacity ratio, queue lengths, and travel time and delay analysis for Alternative 2W.

BICYCLE & PEDESTRIAN MOBILITY/CONNECTIVITY

The width of the existing swing span allows for five-foot-wide sidewalks on both the north and south sides and the roadway shoulders less than two feet in width. The rest of the corridor has a slightly wider ROW, but it is still not wide enough to accommodate five-foot-wide bike lanes. Consequently, bicyclists and pedestrians both use the sidewalks along the bridge corridor segment.

Most pedestrian/bicycle use of the bridge occurs on the southern sidewalk since this sidewalk directly connects to the New Bedford downtown and waterfront. A new pedestrian ramp was completed in 2014 as part of a new roadway ramp from northbound Route 18 to eastbound Route 6. Between the New Bedford and Fairhaven shorelines, pedestrian and bicycle connectivity is difficult due to a lack of secure crossings, ramps, and gaps in the sidewalk network.

Because of these access challenges and safety concerns, pedestrian and bicyclist use of the bridge is currently limited. During the peak hour counts conducted for the study, only one pedestrian was observed to walk the entire length of the bridge between New Bedford and Fairhaven. During the warmer months, it is understood that pedestrian and bicycle use is more frequent and increases during non-peak auto hours.

Like all of the build alternatives, Alternative 2W allows for a wider bridge with a 64-foot-wide ROW. This bridge width allows for the construction of four 11-foot-wide vehicular travel lanes, two five-foot-wide bike lanes, and two five-foot-wide sidewalks. However, while Alternative 2 provides improved facilities compared to the No Build Alternative, the delay for bicyclists and pedestrians will not change as it is controlled by the frequency and duration of bridge openings, which will not change from the current condition.

4.6.3 Safety

Improving roadway, pedestrian, bicycle, and marine safety, reducing conflicts between transportation modes, and increasing emergency vehicle access are important considerations for evaluating the long-term alternatives. This section provides an overview of the key safety concerns that will be addressed by Alternative 2W.

CONFORMANCE WITH AASHTO AND MASSDOT STANDARDS

For a bridge and approach roadway to be safe for vehicular traffic, it must be geometrically adequate. This consideration takes into account the number of lanes, lane and shoulder widths, approach roadway widths, horizontal clearances to roadside obstacles, stopping sight distances, vertical clearances and more. The standards for these criteria are identified in the AASHTO *Policy on Geometric Design of Highways and Streets* and the MassDOT *Project Development and Design Guidebook* (2006). Alternative 2 will conform to these standards with no known variance required.

DELAY TO EMERGENCY VEHICLE ACCESS

Both New Bedford and Fairhaven provide fire and emergency services to their respective municipalities. In case of bridge closure, Pope's Island can receive service from Fairhaven via the East Bridge. St. Luke's Hospital in New Bedford is the only facility in the two municipalities that provides emergency services. Bridge closures can affect Emergency Medical Services (EMS) access to the hospital from Fairhaven. Alternative 2W will not affect the level of access or potential for delay of emergency vehicles compared to the No Build Alternative.

IMPACT TO HIGH VOLUME BICYCLE AND PEDESTRIAN LOCATIONS

A sidewalk runs along the entire length of the north and south sides of the Route 6 Corridor between MacArthur Drive in New Bedford and Middle Street in Fairhaven. When the current roadway construction is completed in 2015, the roadway shoulders will be widened by reducing the vehicular travel lane width. In Alternative 2W, the new bridge cross section will include both widened roadway shoulders and sidewalks. However, even though Alternative 2W provides additional pedestrian and bicycle facilities, high pedestrian or bicycle volumes are not seen on the bridge and are not anticipated in the future. Alternative 2W will have no impact to high volume bicycle or pedestrian locations.

IMPACT TO SAFE NAVIGATION

Due to the existing navigational width of the channels at the existing bridge, safe vessel navigation through the bridge is a serious concern and a significant constraint to the North Harbor. Concerns for safe navigation have resulted in vessel limitations, which have resulted in delays and additional costs for commercial vessels.

Navigation through the bridges 94- and 95-foot-wide channels is the primary concern for large commercial vessels. These vessels generally employ harbor tugs for ship assist when maneuvering through the harbor and the bridge. Even with the tugs, limitations are still in place for transiting through the bridge. These include wind speed, visibility, and daylight.

- Wind speed is the primary concern that limits vessels ability to pass through the bridge. In all cases, if the wind exceeds 25 knots, no large vessel will transit the bridge. If the vessel is over 400 feet in length, this may be reduced to as little as 12 knots given the direction and based on the pilot's discretion.
- No vessel will transit through the bridge if the visibility is less than one nautical mile. Although large vessels don't enter the harbor though the hurricane barrier if visibility is limited, changes in visibility can occur rapidly in the harbor due to fog or heavy precipitation.
- Vessels greater than 500 feet in length or over 80 feet in width transit through the bridge and hurricane barrier in daylight only.

When transiting the current bridge, there is limited room for larger vessels to maneuver, especially north of the bridge between Fish Island and Pope's Island. Vessels approach slowly and then increase speed as they enter the bridge opening to ensure that they can exercise better

control of the vessel through the passage. The limited maneuvering space on either side of the bridge is complicated by the fact that typically ships approach the bridge on an angle due to slow approach speeds. This angle further reduces any free space between the vessel and the bridge as the vessel is moving through. The swing span's central pivot point, associated piers, and fendering system are located approximately in the center of the federal deep-water channel. This makes the bridge, in the perspective of the pilots, the most vulnerable navigation safety area in the harbor.

When larger ships head northbound through the bridge, limited space is available for stopping or maneuvering once they pass the bridge. Generally, two tugs are employed; one at the bow and one at the stern, but only one can assist once the vessel is in the bridge opening due to the width of the channel. The forward tug goes through the bridge first and can come back alongside once the bow clears. Proceeding northbound, once the vessel passes through the bridge and enters the basin, it must slow and stop before being maneuvered into a berth.

Generally, vessels do not require tugs on transiting southbound. When departing southbound, the vessel leaves the berth and turns in the basin in a manner that allows it to line up with the west channel that is used most of the time. Once lined up, it transits the opening and maintains its alignment with the federal deep-water channel.

While the No Build Alternative does not provide any change from the existing condition, Alternative 2W will result in significant improvements to safe navigation through the bridge. The 220 feet of horizontal clearance would mitigate many of the safe navigation concerns, most notably the wind restriction, which has a significant impact on vessel delay. The wider clearance would allow for full tug assistance throughout the bridge transit and would also minimize the impact of the limited maneuverable space in the North Harbor, which will not change as a result of the project.

DELAY TO EMERGENCY MARINE ACCESS

Currently, the swing span impedes emergency vessel access in cases where there is an emergency in the North Harbor since the bridge must open to allow municipal police, fire and rescue, harbormaster, or other emergency response vessels to transit the bridge.
The design of Alternative 2W allows for a vertical clearance of 14 feet in the down (closed) position. This is sufficient clearance for all but the largest emergency response vessels to fit under the bridge without the need to wait for a bridge opening. This would eliminate most of the delay to emergency response currently experienced due to the bridge.

4.6.4 Environment

The following section presents the potential for impacts to the natural environment from Alternative 2W. Compared to the No Build Alternative, Alternative 2W has more potential to impact coastal, wetland, and natural resources due to the required in-water construction. The following sections provide a screening-level assessment, therefore additional and more in-depth analyses of resource impacts would be required, per the National Environmental Policy Act

(NEPA) and the Massachusetts Environmental Policy Act (MEPA), as the designs for the bridge progress.

IMPACT TO COASTAL RESOURCES

Coastal Zone Impacts

The New Bedford-Fairhaven Bridge is located within the designated coastal zone of the Commonwealth of Massachusetts; therefore, this project may be subject to a federal consistency review to ensure that the proposed project would be consistent with the enforceable policies of the federally approved coastal management program of the Commonwealth.

The construction required to raise the elevation of the approach on Fish Island under Alternative 2W has the potential to affect Chapter 91 Tidelands located on the eastern side of the island. A Chapter 91 Waterways authorization from the Massachusetts Department of Environmental Protection (MassDEP) may be required for the construction of new bridge structure.

Within its policy documents, the Massachusetts Office of Coastal Zone Management (CZM) strongly encourages early coordination with the agency to determine the appropriate level of coastal review that would be required for projects. Coordination with CZM should be undertaken during any future NEPA and MEPA phases of the project.

Floodplains

The proposed bridge would be located within the 100-year floodplain. Alternative 2W would require the construction of permanent foundations for the bascule piers to be constructed within the water, potentially affecting the 100-year floodplain and flood levels within this area. As the design for the bridge progresses, there is the opportunity to limit the size of the foundations, thereby minimizing impacts. Flooding and construction within the 100-year floodplain is under the jurisdiction of CZM; therefore, coordination with CZM would be needed in future phases of the project to determine the extent of potential impacts to the 100-year floodplain and the applicability of coastal hazard policies to this project.

Hazardous and Contaminated Materials

New Bedford Harbor has been designated as a Superfund Site and is currently undergoing an extensive clean-up effort by the EPA. Alternative 2W would require a substantial amount of in-water construction work. As part of the construction, contaminated soil/sediment from New Bedford Harbor would need to be removed so that new bascule piers could be constructed. These structures would be at least 24 feet by 64 feet and would require a significant amount of soil disturbance below the water line. In-water soil/sediment disturbance would also be expected from the removal of the existing swing span center pier structure. Therefore, Alternative 2 has the potential to result in impacts from the existing contaminated harbor sediments, greater than those potential impacts anticipated for most of the other long-term alternatives.

As any designs for the bridge progress, coordination would be undertaken with the EPA and the MassDEP to determine the amount of disturbance anticipated during construction, options for mitigation and minimization, and for the appropriate disposal of the contaminated sediments.

IMPACT TO WETLAND RESOURCES

A small area of rocky intertidal wetlands is located on the western shore of Pope's Island. Temporary disturbance resulting from the construction of Alternative 2W may potentially affect this wetland type. Additional field verification of this wetland type, as well as consultation with the USACE and MassDEP, would be needed in future phases of this project to determine the extent of this resource.

Potential impacts to water quality may occur from the disturbance and removal of contaminated sediments from New Bedford-Fairhaven Harbor during construction. Coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination.

Proper erosion and sedimentation controls, as well as stormwater pollution prevention best management practices (BMPs), would be implemented during the construction phase to prevent or avoid any potential impacts to the wetlands and aquatic species known to reside within them. Examples of BMPs include silt fencing, biotubes, and regulated construction entrances. Consultation with USACE and MassDEP regarding avoidance and minimization of potential impacts as well as permitting requirements should be undertaken during any future phases of this project.

As project development progresses, special consideration should be given to the location of construction staging areas on Pope's Island. Coastal bank bluff and sea cliff wetlands form the southern shores of Pope's Island and the placement of construction staging areas within or adjacent to these wetlands should be avoided.

IMPACT TO NATURAL RESOURCES

Alternative 2W would not result in any impacts to Areas of Critical Environmental Concern (ACEC), prime farmland soils, or aquifers. Alternative 2W has the potential for greater impacts to water quality, shellfish and fish habitat, and priority habitats than the No Build Alternative.

Water Quality

Alternative 2W would require a substantial amount of in-water construction work. As part of the construction, contaminated soil/sediment from New Bedford-Fairhaven Harbor would need to be removed so that new bascule piers could be constructed. These structures would be at least 24 feet by 64 feet and would require a significant amount of soil disturbance below the water line. Therefore, the potential for impacts to water quality from Alternative 2W would be greater than the No Build Alternative and most of the build alternatives. Potential impacts from the in-water soil/sediment disturbance from the removal of the existing swing span center pier structure would be the same as the other build alternatives, but greater than the No Build Alternative.

Similar to the other long-term alternatives, coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination. Additionally, proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to water quality from construction activities.

Shellfish and Fish Habitat

Due to the substantial in-water construction that would be required, the construction of Alternative 2W would have the potential to result in greater temporary impacts to shellfish and fish habitats than the No Build Alternative. Similar to the other long-term alternatives, coordination may be needed with MassDEP to ensure that construction activities do not disrupt active shellfish spawning grounds. Proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to shellfish and fish habitats from construction activities.

Although the consumption of fish and shellfish caught in the New Bedford Inner Harbor is regulated by the Massachusetts Department of Public Health (MDPH), consultation with the National Oceanographic Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) should be undertaken during future phases of this project to determine the presence of Essential Fish Habitats (EFH) within New Bedford-Fairhaven Harbor.

Priority Habitats

Alternative 2 is not anticipated to impact priority plant or animal habitats. However, additional field verification and/or consultation with the U.S. Fish and Wildlife Service (USFWS) and MassDEP may be required in future phases of the project to verify the presence of state and federally listed plant and animal species and habitats.

IMPACTS TO AIR QUALITY AND GREENHOUSE GASES FROM IDLING VEHICLES

None of the long-term alternatives, including the No Build Alternative, would increase traffic volumes on the corridor as compared to the 2035 No Build Condition described in Chapter 2. The number of bridge openings would remain the same. Consequently, none of the long-build alternatives has the potential to worsen air quality compared to the 2035 No Build Condition. In future phases of the project, a formal air quality evaluation (microscale or mesoscale) would be required to determine the proposed project's impacts as compared to the National Ambient Air Quality Standards (NAAQS).

In Alternative 2W, the addition of bicycle and pedestrian facilities along the Route 6 Corridor, including along a new movable span, may have the potential for localized air quality benefits. The addition of these facilities has the potential to shift some motorists to non-motorized modes, potentially reducing the number of idling cars at bridge openings.

Potential temporary impacts to air quality would be anticipated from construction activities. BMPs would be implemented during construction to minimize vehicle emissions and manage fugitive dust. Typical air quality mitigation measures implemented during construction could include dust suppression and control methods to minimize fugitive dust on dry and windy days.

IMPACTS FROM NOISE

Since traffic volumes are not anticipated to increase substantially over existing levels, Alternative 2W is not anticipated to result in noise impacts to nearby noise-sensitive receptors. However, a formal noise assessment in compliance with the FHWA would be required in any future phases of this project.

Potential temporary noise impacts would result from construction activities and the operation of construction equipment. BMPs would be implemented during construction to mitigate potential noise impacts (particularly during non-daytime hours).

4.6.5 Land Use & Economic Development

The following section provides analysis regarding the impacts on businesses, including property acquisition to accommodate bridge construction. Additionally, potential economic benefits of Alternative 2W, such as shipper cost savings, are evaluated.

NUMBER/VALUE OF BUSINESSES & JOBS PERMANENTLY IMPACTED

The design of the Alternative 2W bridge utilizes primarily the same footprint as the existing swing span and will not require the acquisition of any additional property or ROW. Furthermore, the operation of the new moveable span will not vary dramatically in a way that would functionally affect the operation of area businesses and would not result in the reduction of the number of jobs. With absence of physical ROW changes and business operational impacts, no business or related property impacts or acquisition is anticipated due to physical or functional impacts.

SHIPPER COST SAVINGS

A variety of both landside and maritime benefits were considered to assess the economic benefits of the long-term build alternatives, including Alternative 2W. While some may be quantified, others are more difficult to count and therefore the analysis considered both quantitative and qualitative benefits.

As a first step in the assessment, the potential benefits that could be generated by a new bridge were inventoried. In similar projects, automobile and truck benefits are often included, such as reduced travel time, vehicle operating cost savings, and emissions reduction, among others. On the marine side, moveable bridge improvements can affect shipper costs, travel time, and similar factors.

A thorough review of potential benefits indicated few differences between the 2035 No Build Condition and Alternative 2W in terms of quantifiable benefits. This is due to the relatively small variation between the proposed alternatives and the existing condition in most aspects of transportation. The lack of impact to existing and future traffic conditions results in no benefits from reduced travel time, vehicle operating cost savings, and emissions reduction. However, the change in horizontal clearance for vessels between the existing bridge and Alternative 2W is a significant change. The existing bridge provides a maximum horizontal clearance of 95 feet, while the horizontal clearance for Alternative 2W is 220 feet. Alternative 2W has no limitations on the vertical clearance of vessels.

This analysis only considers the benefits directly related to the bridge, an approach consistent with USDOT benefit-cost analysis guidance. While there is potential for additional economic development at the North Terminal and in the North Harbor, the chosen bridge alternative is only one component of that potential growth. As a result, it would be disingenuous to attribute that economic development potential *exclusively* to the new bridge. Additionally, when looking for the true differences between bridge alternatives, it is important to examine only the benefits associated directly with the bridge.

Landside Benefits

Traditional benefits associated with bridge improvements include both landside and maritime components. In the case of the proposed alternatives, no landside impacts were found. Each of the alternatives maintains the same bridge opening duration and creates no difference in general vehicular, bicycle, or pedestrian traffic operations. In other words, an automobile driver who uses the bridge today would discern no improvement in travel time, or achieve any other transportation related benefits, with a new bridge. Similarly, pedestrian and bicycle traffic would observe no change in their travel time.

It is important to note that the duration and methods for construction may cause various delay or diversion impacts during the construction period. However, no impact was quantified as the transportation analysis showed no discernable diversion patterns that could be analyzed. The construction phase impacts will include a limited road closure while the bridge is being installed along with lane closures for the duration of the construction. It is anticipated that during bridge closures, detours and notifications by area ITS systems will be provided to minimize impacts to drivers. While the impacts cannot easily be quantified, it should be noted that the longer closures will have a greater potential for detrimental impacts to local businesses and diversion costs for roadway users.

Since it was determined that the bridge improvement would have minimal or no impact on long-term landside traffic and pedestrian patterns, no landside benefits were quantified or included in the benefits analysis.

Maritime Benefits

A series of interviews were held with maritime users to determine how the current bridge affects their operations and to identify the ways in which a new bridge could positively affect them. As discussed in Chapter 2, wind and its impact on the navigability through the bridge opening is a critical issue facing maritime users. For this analysis, maritime benefits are primarily due to a reduction in shipper costs associated with delays within New Bedford Harbor. Changes in the use of tugs with Alternative 2W were also considered as a potential benefit. Discussions with maritime experts indicated the tugs used are "ship assist" tugs that primarily aid with alignment to the berth. Accordingly, they will still be required for all large cargo vessels that berth in the North Harbor regardless of the selected alternative and no change to tug costs will occur for larger vessels.

The greatest difference between the No Build Alternative, which retains the existing clearance, and the build alternatives is the horizontal navigational clearance. The No Build Alternative maintains the 95 feet of horizontal navigational clearance, which creates issues for the large vessels that enter the North Harbor. When there are high winds, these vessels cannot transit the bridge until the wind speeds are lower, as there is not enough clearance to pass safely through in high wind conditions.

With Alternative 2W, the horizontal navigational width would be 220 feet. This width would remove the need for larger vessels to remain moored south of the bridge should high winds prevail. In the past year, three of the 12 vessels were delayed for one day during their trip to New Bedford due to the existing bridge constraint. It is understood that each day of delay costs the shipper $40,000. Under existing conditions, approximately 25 percent of vessels are delayed for a full day, costing shippers a total of $120,000 per year. With Alternative 2W, no ships would experience delay, which results in an average savings of $120,000 per year in shipper costs. Assuming that users of the harbor factor into their overall decision-making the potential cost of delay, the wider horizontal clearance would reduce the general cost of using the harbor.

Historically, up to 30 vessels have called upon the port in a single year. This is considered a reasonable upper limit, based on interviews conducted with key maritime users. Assuming that the bridge improvement induces vessel calls to meet this historic high, benefits associated with a reduction in delay time would be generated. These new vessels, however, are not currently using the Port of New Bedford. Rather, they are a projection of potential. As a result, and consistent with economic consumer surplus theory, the benefit they receive would be half of the benefit to existing users.

The change from 12 to 30 trips represents a portion of all potential vessels that did not use the Port of New Bedford under the existing conditions, but that would be "attracted" to New Bedford because the risk of delay and associated costs are mitigated with the wider horizontal clearance. The benefits to these additional vessels are estimated using the "rule of one-half," indicating the change in consumer surplus associated with the removal of the risk of delay. In a future year with 30 total vessels, this would result in a benefit of $20,000 per vessel for the 18 additional vessels, or a total of $360,000.

Summary of Benefits

Table 4.20 summarizes the average annual benefits associated with Alternative 2W as compared to the current conditions that would be maintained under the No Build Alternative. As discussed above, no landside benefits were identified or quantified. Additionally, there would be no change in the number of tugs that would be required, so the total costs would remain the same. The benefits generated by any of the new bridge alternatives is estimated to be $480,000 with delay costs representing $120,000 and savings to new cargo vessels $360,000.

Table 4.20. Average Single-Year Benefits of Bridge Replacement Alternatives

Benefit Category	Annual Savings (2015$)
Landside Transportation Savings	$0
Delay Cost Savings	$120,000
Savings to New Cargo Vessels	$360,000
Change in Tug Costs	$0
Total Benefits	$480,000

4.6.6 Community

The impacts to community resources, such as open space, recreational areas, or historic or cultural resources were also evaluated for Alternative 2W. Additionally, access to businesses along the corridor and impacts to Environmental Justice (EJ) populations were evaluated. The study team also considered the visual impacts of a new bridge structure.

IMPACT TO PROTECTED AND RECREATIONAL OPEN SPACE

Alternative 2W would not result in any impacts to protected and/or recreational open space. An evaluation of publicly owned parklands, per Section 4(f) of the Department of Transportation Act of 1966, would be required for any future phases of this project.

As the project development phase continues and the designs for the bridge progresses, special consideration should be given to the location of construction staging areas. Marine Park on Pope's Island is owned and operated by the City of New Bedford and occupies the southern half of the island, but should not be used for construction staging.

IMPACT TO CULTURAL/HISTORIC/ARCHEOLOGICAL RESOURCES

Under Alternative 2W, the middle bridge's swing span of the National Register-eligible New Bedford-Fairhaven Bridge would be replaced with a new double-leaf bascule bridge. The loss of the swing span would diminish the integrity of this historic property.

In addition to direct effects to the New Bedford-Fairhaven Bridge, there is the potential for indirect visual effects to historic properties that lie within the larger study area. A portion of the through truss of the existing swing span is visible as a component of the urban/industrial landscape from both the Schooner Ernestina, located on the New Bedford waterfront, and buildings that lie along the eastern edge of the New Bedford Historic District (see Figure 2.11). Both the Schooner Ernestina and the New Bedford Historic District are National Historic Landmarks. Due to the lack of a truss and thus the lower profile of the bridge, it is unlikely that the new bridge would be visible when in the closed position. It would be visible from the New Bedford Historic District and the Schooner Ernestina when in the open (up) position, as the top of the bridge would extend approximately 63 feet higher than the top of the existing truss when measured from the water. While the replacement of the swing span through truss with a double-leaf bascule span would alter the visual setting of these two historic properties, it is not anticipated that this would adversely affect these resources given both the distance between the properties and the bridge, and the visual complexity of the viewshed.

Regardless of which long-term alternative is selected, FHWA will need to initiate consultation with the MHC in accordance with Section 106 of the National Historic Preservation Act. Consultation should also be undertaken with the New Bedford and Fairhaven Historical Commissions. Through this consultation, additional historic properties that may be eligible for, but are not yet listed in, the National Register of Historic Places will be identified. The potential for effects to archeological resources will also be determined. FHWA, working together with the MHC, will seek ways to avoid, minimize, or mitigate adverse effects beyond the HAER documentation that has already been completed. In addition to consultation under Section 106, the preparation of a programmatic 4(f) evaluation, in compliance with the U.S. Department of Transportation Act of 1966, will be required.

IMPACT TO BUSINESS ACCESS

The parcels surrounding the approaches to the middle bridge include the following businesses:

- Bridge Shoppes shopping center;
- Captain Leroy's marina;
- Maritime Terminals facility;
- AGM Marine Contractors, Inc.; and
- Tucker Roy Marin Towing and Salvage.

Alternative 2W does not include any modifications to the bridge approaches and utilizes the existing footprint. The horizontal alignment of the road and access to abutting properties will remain the same.

IMPACT TO ENVIRONMENTAL JUSTICE POPULATIONS

The locations of Environmental Justice (EJ) populations were identified in Chapter 2. Some EJ populations reside in neighborhoods that abut or are adjacent to the New Bedford-Fairhaven Bridge. Residential clusters of EJ populations reside at the western edge of the local study area in New Bedford and EJ populations (low-income) also reside throughout the local study area within Fairhaven. Consequently, an evaluation of the potential for disproportionately high and adverse human health or environmental effects of the project alternatives on minority populations and low-income populations, per *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, would be required in future phases of the project to comply with NEPA and MEPA.

Bicycle and pedestrian improvements in Alternative 2W have the potential to substantially improve the ability of EJ populations, who may not own or have access to automobiles, to get across the bridge to access employment or other key destinations. The greatest potential for impacts to EJ populations would occur during construction. Under Alternative 2W, the construction phase would be approximately three years long. The bridge would be closed to vehicular, bicycle, and pedestrian traffic for two years. No transit service currently operates across the bridge.

Alternative 2W also has the potential to result in other temporary construction impacts to the EJ populations located in close proximity to the proposed bridge. Potential impacts could include noise, glare, fumes, and dust from construction equipment as well as changes in traffic patterns and access to businesses due to the movement of construction vehicles. Potential construction period impacts would be mitigated with BMPs for construction activities including those used to minimize dust, noise, maintenance, and protection of traffic plans, and limiting the hours of construction. Further analyses under NEPA and MEPA would be required to determine if construction-related impacts would be disproportionately higher on low-income and minority populations.
Alternative 2W, along with all of the long-term build alternatives, has the same proportion of impacts to EJ populations compared to non-EJ populations.

VISUAL IMPACTS

The visual impacts from Alternative 2 would be limited. When the bridge is in the down position, it would look similar to the fixed spans of the east and west bridges. However, when the bridge is in the up (or open) position the bridge leafs would extend approximately 110 feet above the roadway surface or 130 feet above MHW. This is approximately 40 feet higher than the top of the existing truss. Although the bridge would be visible from a greater distance while in the up position, the topography and the significant development that surrounds the harbor would shield the view of the bridge from most locations. Figures 4.4 and 4.5 provide simulated renderings of what the bridge would look like if standing at Captain Leroy's on Pope's Island

4.6.7 Alternative Feasibility

The identification of the costs, construction phase impacts, and permanent ROW impacts provide a critical way to evaluate the feasibility of an alternative. This section describes the capital costs, operating and maintenance costs, the construction methodology, a description of impacts to marine and vehicular traffic during construction, and permanent impacts to adjoining properties or businesses.

CAPITAL COST

The estimated cost for Alternative 2W is between $130 and $160 million. This capital cost would include the bridge design and permitting, removal and demolition of the existing swing span and construction of the new bridge. The limits of construction would be generally limited to the 289-foot length of the existing swing span with modifications to the approach spans limited to raising the approaches to provide the necessary under bridge clearances. It is estimated that this work would all be done utilizing the existing piers and newly reconstructed pier caps. It is assumed that dredging and disturbance of the harbor sediments would be limited to construction of the tower structures and fendering system and removal of the existing swing span center pier structure. A more detailed cost estimate would be developed as additional information regarding subsurface conditions, bridge specifications, and design details are developed through the project development process.

OPERATING AND MAINTENANCE COSTS

Upon completion of construction, Alternative 2W will require both routine maintenance and daily operating costs. Table 4.21 provides the estimated annual costs required to operate and maintain the bridge, which are the same as the other double-leaf alternatives that have two mechanical units to operate and maintain.

Table 4.21. Alternative 2W Annual Operating and Maintenance Costs

Operating Costs	Type	Annual Cost (2015$)
Operating Cost	Electricity utility	$ 100,000
Operating Cost	Stand by generator	$ 2,600
Operating Cost	Bridge operators	$300,000
Routine Maintenance	Monthly bridge lubrication	$ 27,600
Routine Maintenance	Replace lamps	$ 1,500
Routine Maintenance	Replace gate arms	$ 18,000
Routine Maintenance	Miscellaneous minor repairs	$ 20,000
Routine Maintenance	Guard rail repairs	$ 20,000
	TOTAL	$ 489,700

In addition, the annual operating and maintenance costs identified above, Alternative 2W will require major repairs to be conducted on a regular basis to maintain the bridge in a state of good repair and ensure its on-going utility. The schedule of major repairs included in Table 4.22 is an estimate of repairs that is typical for bascule bridges in similar environments. Over a 50-year span, it should be anticipated that approximately $14.6 million worth of repairs (in 2015 dollars) will be required.

CONSTRUCTION PHASE TRANSPORTATION IMPACTS

The construction phase of Alternative 2W would be over three years, or approximately 37 months. This alternative would consist of closing the bridge to vehicular traffic for approximately two years during that period, requiring traffic to direct to the Coggeshall Street or I-95 bridges approximately one mile to the north. One of the two existing navigational channels would be open for most of the construction duration. However, navigational closures would be required during three long-weekends with one during the first year of construction (month 10), and two long weekends during the third year of construction (month 32 and 33).

Table 4.22. Alternative 2W Schedule of Major Repairs

Year	Work Performed	Cost (2015$)
10	Fender repairs	$ 250,000
15	Minor Structural repairs Deck repairs	$ 1,250,000 $ 250,000
25	Electrical control repairs Minor structural repairs Fender repair Control house repairs	$ 700,000 $ 1,250,000 $ 250,000 $ 100,000
30	Deck repairs	$ 250,000
35	Replace traffic gates Electrical system rehabilitation Structural rehabilitation Substructure repairs	$ 300,000 $ 2,000,000 $ 3,500,000 $1,000,000
40	Fender repairs Machinery rehabilitation	$ 250,000 $3,000,000
45	Deck repairs	$ 250,000
	TOTAL	$14,600,000

CONTRUCTION PHASE IMPACTS TO ABUTTING LAND OWNERS/BUSINESSES

The construction phase of each long-term alternative has the potential to impact area businesses due to the change in access during that period, however, like Alternative 2, the impacts for this alternative are much greater due to the lengthy roadway closure required. The construction phase of Alternative 2W would be over three years and would require the closure of all traffic lanes for approximately two years. Since most of the work would occur within the existing ROW or within the channels, direct impacts to area businesses are not anticipated.

The extended three-year construction duration and associated two-year roadway closure would likely affect certain businesses on Pope's Island and Fish Island that rely heavily on pass-by traffic or easy access. Businesses that would most likely be impacted by the extended construction include:

- Fathoms Restaurant;
- Bob's Sea and Ski Outdoor Sports;
- Worley Beds Factory Outlet;
- Dunkin' Donuts; and
- Fairhaven Hardware.

Since the construction impacts are considered indirect, caused by a change in access versus a direct impact to business operations, the extent of the impact would depend specifically on each business's market and customer base.

4.7 ALTERNATIVE 3: SINGLE-LEAF ROLLING BASCULE BRIDGE

This section provides an evaluation of Alternative 3: Single-leaf Rolling Bascule Bridge consistent with the evaluation criteria established at the initiation of the study. The evaluation criteria are specific measures of effectiveness used to assess benefits and impacts of each alternative.

Alternative 3 is a single-leaf rolling bascule bridge that provides 150 feet of navigational clearance and unlimited air draft. The bridge profile includes a truss structure, similar to the existing bridge structure, located above the roadway. In addition, a counterweight would be located above the truss structure. Figures 4.6 and 4.7 provide simulated renderings for what Alternative 2 would look like if standing at Captain Leroy's marina on Pope's Island. Figure 4.6 shows the bridge in the closed position (open for vehicular traffic). Figure 4.7 shows the bridge in the open position (closed for vehicular traffic).

Figure 4.6. Alternative 3: Single-leaf Rolling Bascule Bridge in Closed Position

Figure 4.7. Alternative 3: Single-leaf Rolling Bascule Bridge in Open Position

4.7.1 Bridge Operations

MINUTES PER BRIDGE CLOSURE

The opening sequence of the bridge in all of the long-term alternatives, including Alternative 3, would continue to follow the AASHTO recommendation that requires approximately four minutes to open and an additional four minutes to close. The average time to open and close the bridge will continue to vary based on the marine traffic transit time and the time required to clear pedestrians and vehicles from the movable span before it can open to marine traffic. The minutes per bridge closure in Alternative 3 is the same as the current condition.

FEET OF VERTICAL CLEARANCE

The Alternative 3 bridge would be designed to have a vertical clearance of 14 feet above MHW when the bridge is in the closed position. The bridge would create no vertical clearance restrictions when the bridge is open to marine traffic.

FEET OF HORIZONTAL CLEARANCE (OPEN & CLOSED)

The Alternative 3 bridge would include approximately 150 feet of navigational clearance. The bridge would be aligned so that the eastern bridge abutment is in approximately the same location as the existing eastern abutment, with the western abutment about 150 feet to the west, which is in the location of the existing west channel.

NUMBER OF DAILY BRIDGE OPENINGS

As described in the No Build Alternative, the bridge currently operates on a fixed schedule each day. For all of the long-term alternatives, including Alternative 3, the schedule and number of daily bridge openings are expected to stay the same.

LONG-TERM RELIABILITY RISK

Since each moveable bridge includes a complex interaction of mechanical, electrical and structural components, there is an inherent risk in a moveable bridge that one of these systems will not operate as designed on any particular day and result in the inability for the bridge to open or close. Some moveable bridge types are at greater risk of inoperability than others due to the nature of their design and the conditions and environment that they operate within. As inoperability of a bridge for a period of time results in community and economic impacts, the risk associated with bridge reliability in the long-term was assessed. This included a general assessment of existing bridges of the type and size under consideration in conditions similar to that of New Bedford Harbor and their ability to remain reliable throughout the life span of the bridge. As noted, all moveable bridges are complex and have some long-term reliability risk. It was estimated that a rolling bascule bridge with the span width and length of the New Bedford-Fairhaven Bridge when operating in the marine costal environment of New Bedford Harbor would have a high level of risk. Roadway bridges of similar size and type have had structural and corrosion issues that have created reliability issues and have caused the bridges to be shut down periodically. It is likely that even with regular maintenance, corrosion issues would regularly affect the operability of such a long and wide structure.

4.7.2 Transportation Impacts & Mobility Analysis

The evaluation and assessment of mobility along the corridor between County Street in New Bedford and Adams Street in Fairhaven is an important component of this study. Like of the long-term alternatives, Alternative 3 will not change vehicular traffic along the corridor. Unlike the No Build Alternative, Alternative 3 will provide additional pedestrian and bicycle facilities.

CORRIDOR INTERSECTION LOS, V/C RATIO, QUEUE LENGTHS & ROADWAY TRAVEL TIME/DELAY

As noted in the No Build Alternative analysis, none of the long-term alternatives, including Alternative 3, will change result in changes to vehicular traffic along the corridor as compared to the 2035 No Build Condition described in Chapter 2. Each of the long-term alternatives being considered will result in the same number of bridge openings and the bridge will, on average, be open for the same duration. Therefore, the mobility analysis described previously in Section

4.2.2 related to the No Build Alternative is consistent with the results of intersection LOS, volume to capacity ratio, queue lengths, and travel time and delay analysis for Alternative 3.

BICYCLE & PEDESTRIAN MOBILITY/CONNECTIVITY

The width of the existing swing span allows for five-foot-wide sidewalks on both the north and south sides and the roadway shoulders less than two feet in width. The rest of the corridor has a slightly wider right-of-way (ROW), but it is still not wide enough to accommodate five-foot-wide bike lanes. Consequently, bicyclists and pedestrians both use the sidewalks along the bridge corridor segment.

Most pedestrian/bicycle use of the bridge occurs on the southern sidewalk since this sidewalk directly connects to the New Bedford downtown and waterfront. A new pedestrian ramp was completed in 2014 as part of a new roadway ramp from northbound Route 18 to eastbound Route 6. Between the New Bedford and Fairhaven shorelines, pedestrian and bicycle connectivity is difficult due to a lack of secure crossings, ramps, and gaps in the sidewalk network.

Because of these access challenges and safety concerns, pedestrian and bicyclist use of the bridge is currently limited. During the peak hour counts conducted for the study, only one pedestrian was observed to walk the entire length of the bridge between New Bedford and Fairhaven. During the warmer months, it is understood that pedestrian and bicycle use is more frequent and increases during non-peak auto hours.

Like all of the build alternatives, Alternative 3 allows for a wider bridge with a 64-foot-wide ROW. This bridge width allows for the construction of four 11-foot-wide vehicular travel lanes, two five-foot-wide bike lanes, and two five-foot-wide sidewalks. However, while Alternative 3 provides improved facilities compared to the No Build Alternative, the delay for bicyclists and pedestrians will not change as it is controlled by the frequency and duration of bridge openings, which will not change from the current condition.

4.7.3 Safety

Improving roadway, pedestrian, bicycle, and marine safety, reducing conflicts between transportation modes, and increasing emergency vehicle access are important considerations for evaluating the long-term alternatives. This section provides an overview of the key safety concerns that will be addressed by Alternative 3.

CONFORMANCE WITH AASHTO AND MASSDOT STANDARDS

For a bridge and approach roadway to be safe for vehicular traffic, it must be geometrically adequate. This consideration takes into account the number of lanes, lane and shoulder widths, approach roadway widths, horizontal clearances to roadside obstacles, stopping sight distances, vertical clearances and more. The standards for these criteria are identified in the AASHTO *Policy on Geometric Design of Highways and Streets* and the MassDOT *Project Development and Design*

Guidebook (2006). Alternative 3 will conform to these standards with no known variance required.

DELAY TO EMERGENCY VEHICLE ACCESS

Both New Bedford and Fairhaven provide fire and emergency services to their respective municipalities. In case of bridge closure, Pope's Island can receive service from Fairhaven via the East Bridge. St. Luke's Hospital in New Bedford is the only facility in the two municipalities that provides emergency services. Bridge closures can affect Emergency Medical Services (EMS) access to the hospital from Fairhaven. Alternative 3 will not affect the level of access or potential for delay of emergency vehicles compared to the No Build Alternative.

IMPACT TO HIGH VOLUME BICYCLE AND PEDESTRIAN LOCATIONS

A sidewalk runs along the entire length of the north and south sides of the Route 6 Corridor between MacArthur Drive in New Bedford and Middle Street in Fairhaven. When the current roadway construction is completed in 2015, the roadway shoulders will be widened by reducing the vehicular travel lane width. In Alternative 3, the new bridge cross section will include both widened roadway shoulders and sidewalks. However, even though Alternative 3 provides additional pedestrian and bicycle facilities, high pedestrian or bicycle volumes are not seen on the bridge and are not anticipated in the future. Alternative 3 will have no impact to high volume bicycle or pedestrian locations.

IMPACT TO SAFE NAVIGATION

Due to the existing navigational width of the channels at the existing bridge, safe vessel navigation through the bridge is a serious concern and a significant constraint to the North Harbor. Concerns for safe navigation have resulted in vessel limitations, which have resulted in delays and additional costs for commercial vessels.

Navigation through the bridges 94- and 95-foot-wide channels is the primary concern for large commercial vessels. These vessels generally employ harbor tugs for ship assist when maneuvering through the harbor and the bridge. Even with the tugs, limitations are still in place for transiting through the bridge. These include wind speed, visibility, and daylight.

- Wind speed is the primary concern that limits vessels ability to pass through the bridge. In all cases, if the wind exceeds 25 knots, no large vessel will transit the bridge. If the vessel is over 400 feet in length, this may be reduced to as little as 12 knots given the direction and based on the pilot's discretion.
- No vessel will transit through the bridge if the visibility is less than one nautical mile. Although large vessels don't enter the harbor though the hurricane barrier if visibility is limited, changes in visibility can occur rapidly in the harbor due to fog or heavy precipitation.
- Vessels greater than 500 feet in length or over 80 feet in width transit through the bridge and hurricane barrier in daylight only.

When transiting the current bridge, there is limited room for larger vessels to maneuver, especially north of the bridge between Fish Island and Pope's Island. Vessels approach slowly and then increase speed as they enter the bridge opening to ensure that they can exercise better control of the vessel through the passage. The limited maneuvering space on either side of the bridge is complicated by the fact that typically ships approach the bridge on an angle due to slow approach speeds. This angle further reduces any free space between the vessel and the bridge as the vessel is moving through. The swing span's central pivot point, associated piers, and fendering system are located approximately in the center of the federal deep-water channel. This makes the bridge, in the perspective of the pilots, the most vulnerable navigation safety area in the harbor.

When larger ships head northbound through the bridge, limited space is available for stopping or maneuvering once they pass the bridge. Generally, two tugs are employed; one at the bow and one at the stern, but only one can assist once the vessel is in the bridge opening due to the width of the channel. The forward tug goes through the bridge first and can come back alongside once the bow clears. Proceeding northbound, once the vessel passes through the bridge and enters the basin, it must slow and stop before being maneuvered into a berth.

Generally, vessels do not require tugs on transiting southbound. When departing southbound, the vessel leaves the berth and turns in the basin in a manner that allows it to line up with the west channel that is used most of the time. Once lined up, it transits the opening and maintains its alignment with the federal deep-water channel.

While the No Build Alternative does not provide any change from the existing condition, Alternative 3 will result in improvements to safe navigation through the bridge. Operations of the large vessels transiting though the Alternative 3 bridge would not change dramatically from the No Build Condition due to limitations caused by visibility and daylight.

The 150-foot-wide clearance is considered the minimum acceptable width for safe navigation into the North Harbor. As noted two tugs are typically employed for large vessels; one at the bow and one at the stern, with only one able to assist once the vessel is in the bridge opening. This will remain the same for the Alternative 3 bridge. Additionally, the limited maneuvering space on either side of the bridge is complicated by the fact that typically ships approach the bridge on an angle due to slow approach speeds. This angle further reduces any free space between the vessel and the bridge as the vessel is moving through. With a 150-foot-wide navigational clearance the width would still be anticipated to be a concern for the larger ships.

To mitigate this concern, an enhanced fendering system is suggested for construction as part of the bridge. This would include "transit fenders where part of the maneuver involves laying the vessel alongside the fenders and moving forward along the fendering structure as you approach and pass through the bridge opening. This is similar to the system in the Panama Canal and is used effectively to assist in navigation.

DELAY TO EMERGENCY MARINE ACCESS

Currently, the swing span impedes emergency vessel access in cases where there is an emergency in the North Harbor since the bridge must open to allow municipal police, fire and rescue, harbormaster, or other emergency response vessels to transit the bridge.
The design of Alternative 3 allows for a vertical clearance of 14 feet in the down (closed) position. This is sufficient clearance for all but the largest emergency response vessels to fit under the bridge without the need to wait for a bridge opening. This would eliminate most of the delay to emergency response currently experienced due to the bridge.

4.7.4 Environment

The following section presents the potential for impacts to the natural environment from Alternative 3. Compared to the No Build Alternative, Alternative 3 has more potential to impact coastal, wetland, and natural resources due to the required in-water construction. The following sections provide a screening-level assessment, therefore additional and more in-depth analyses of resource impacts would be required, per the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA), as the designs for the bridge progress.

IMPACT TO COASTAL RESOURCES

Coastal Zone Impacts

The New Bedford-Fairhaven Bridge is located within the designated coastal zone of the Commonwealth of Massachusetts; therefore, this project may be subject to a federal consistency review to ensure that the proposed project would be consistent with the enforceable policies of the federally approved coastal management program of the Commonwealth.

The construction required to raise the elevation of the approach on Fish Island under Alternative 3 has the potential to affect Chapter 91 Tidelands located on the eastern side of the island. A Chapter 91 Waterways authorization from the Massachusetts Department of Environmental Protection (MassDEP) may be required for the construction of new bridge structure.

Within its policy documents, the Massachusetts Office of Coastal Zone Management (CZM) strongly encourages early coordination with the agency to determine the appropriate level of coastal review that would be required for projects. Coordination with CZM should be undertaken during any future NEPA and MEPA phases of the project.

Floodplains

The proposed bridge would be located within the 100-year floodplain. Alternative 3 would require limited in-water construction work as the new bridge would be constructed on piles instead of on piers. This has limited potential to affect the 100-year floodplain and flood levels within this area. Flooding and construction within the 100-year floodplain is under the jurisdiction of CZM. Therefore, coordination with CZM would be needed in future phases of the project to determine the extent of potential impacts to the 100-year floodplain and the applicability of coastal hazard policies to this project.

Hazardous and Contaminated Materials

New Bedford Harbor has been designated as a Superfund Site and is currently undergoing an extensive clean-up effort by the EPA. Alternative 3 would require limited in-water construction work as the new bridge would be constructed on piles instead of on piers. Because of this, Alternative 3 requires less disturbance to the harbor floor and significantly less soil and sediment disturbance than the vertical lift and bascule (standard) build alternatives. However, all of the build alternatives have greater impacts than the No Build Alternative due to the in-water soil/sediment disturbance that would be expected from the removal of the existing swing span center pier structure.

As any designs for the bridge progress, coordination would be undertaken with the EPA and the MassDEP to determine the amount of disturbance anticipated during construction, options for mitigation and minimization, and for the appropriate disposal of the contaminated sediments.

IMPACT TO WETLAND RESOURCES

A small area of rocky intertidal wetlands is located on the western shore of Pope's Island. Temporary disturbance resulting from the construction of Alternative 3 may potentially affect this wetland type. Additional field verification of this wetland type, as well as consultation with the USACE and MassDEP, would be needed in future phases of this project to determine the extent of this resource.

Potential impacts to water quality may occur from the disturbance and removal of contaminated sediments from New Bedford-Fairhaven Harbor during construction. Coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination.

Proper erosion and sedimentation controls, as well as stormwater pollution prevention best management practices (BMPs), would be implemented during the construction phase to prevent or avoid any potential impacts to the wetlands and aquatic species known to reside within them. Examples of BMPs include silt fencing, biotubes, and regulated construction entrances. Consultation with USACE and MassDEP regarding avoidance and minimization of potential impacts as well as permitting requirements should be undertaken during any future phases of this project.

As project development progresses, special consideration should be given to the location of construction staging areas on Pope's Island. Coastal bank bluff and sea cliff wetlands form the southern shores of Pope's Island and the placement of construction staging areas within or adjacent to these wetlands should be avoided.

IMPACT TO NATURAL RESOURCES

Alternative 3 would not result in any impacts to Areas of Critical Environmental Concern (ACEC), prime farmland soils, or aquifers. Alternative 3 has the potential for temporary impacts to water quality, shellfish and fish habitat, and priority habitats as a result of construction.

Water Quality

Alternative 3 requires less in-water construction work than the vertical lift and bascule (standard). However, the potential impacts to water quality would greater than the No Build Alternative due to the in-water soil/sediment disturbance that would be expected from the removal of the existing swing span center pier structure.

Coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination. Additionally, proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to water quality from construction activities.

Shellfish and Fish Habitat

Alternative 3 has the potential to result in temporary impacts to shellfish and fish habitats from the construction of the proposed bridge. Since New Bedford Harbor has been designed as a shellfish growing area, coordination may be needed with MassDEP to ensure that construction activities do not disrupt active shellfish spawning grounds. Proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to shellfish and fish habitats from construction activities.

Although the consumption of fish and shellfish caught in the New Bedford Inner Harbor is regulated by the Massachusetts Department of Public Health (MDPH), consultation with the National Oceanographic Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) should be undertaken during future phases of this project to determine the presence of Essential Fish Habitats (EFH) within New Bedford-Fairhaven Harbor.

Priority Habitats

Alternative 3 is not anticipated to impact priority plant or animal habitats. However, additional field verification and/or consultation with the U.S. Fish and Wildlife Service (USFWS) and MassDEP may be required in future phases of the project to verify the presence of state and federally listed plant and animal species and habitats.

IMPACTS TO AIR QUALITY AND GREENHOUSE GASES FROM IDLING VEHICLES

None of the long-term alternatives, including the No Build Alternative, would increase traffic volumes on the corridor as compared to the 2035 No Build Condition described in Chapter 2. The number of bridge openings would remain the same. Consequently, none of the long-build alternatives has the potential to worsen air quality compared to the 2035 No Build Condition. In future phases of the project, a formal air quality evaluation (microscale or mesoscale) would be required to determine the proposed project's impacts as compared to the National Ambient Air Quality Standards (NAAQS).

In Alternative 3, the addition of bicycle and pedestrian facilities along the Route 6 Corridor, including along a new movable span, may have the potential for localized air quality benefits.

The addition of these facilities has the potential to shift some motorists to non-motorized modes, potentially reducing the number of idling cars at bridge openings.

Potential temporary impacts to air quality would be anticipated from construction activities. BMPs would be implemented during construction to minimize vehicle emissions and manage fugitive dust. Typical air quality mitigation measures implemented during construction could include dust suppression and control methods to minimize fugitive dust on dry and windy days.

IMPACTS FROM NOISE

Since traffic volumes are not anticipated to increase substantially over existing levels, Alternative 3 is not anticipated to result in noise impacts to nearby noise-sensitive receptors. However, a formal noise assessment in compliance with the FHWA would be required in any future phases of this project.

Potential temporary noise impacts would result from construction activities and the operation of construction equipment. BMPs would be implemented during construction to mitigate potential noise impacts (particularly during non-daytime hours).

4.7.5 Land Use & Economic Development

NUMBER/VALUE OF BUSINESSES PERMANENTLY IMPACTED

The design of the Alternative 3 bridge utilizes primarily the same footprint as the existing swing span and will not require the acquisition of any additional property or ROW. Furthermore, the operation of the new moveable span will not vary dramatically in a way that would functionally affect the operation of area businesses and would not result in the reduction of the number of jobs. With absence of physical ROW changes and business operational impacts, no business or related property impacts or acquisition is anticipated due to physical or functional impacts.

SHIPPER COST SAVINGS

A variety of both landside and maritime benefits were considered to assess the economic benefits of the long-term build alternatives, including Alternative 3. While some may be quantified, others are more difficult to count and therefore the analysis considered both quantitative and qualitative benefits.

As a first step in the assessment, the potential benefits that could be generated by a new bridge were inventoried. In similar projects, automobile and truck benefits are often included, such as reduced travel time, vehicle operating cost savings, and emissions reduction, among others. On the marine side, moveable bridge improvements can affect shipper costs, travel time, and similar factors.

A thorough review of potential benefits indicated few differences between the 2035 No Build Condition and Alternative 3 in terms of quantifiable benefits. This is due to the relatively small variation between the proposed alternatives and the existing condition in most aspects of transportation. The lack of impact to existing and future traffic conditions results in no benefits from reduced travel time, vehicle operating cost savings, and emissions reduction. However, the change in horizontal clearance for vessels between the existing bridge and Alternative 3 is a significant change. The existing bridge provides a maximum horizontal clearance of 95 feet, while the horizontal clearance for Alternative 3 is 150 feet. Alternative 3 has no limitations on the vertical clearance of vessels.

This analysis only considers the benefits directly related to the bridge, an approach consistent with USDOT benefit-cost analysis guidance. While there is potential for additional economic development at the North Terminal and in the North Harbor, the chosen bridge alternative is only one component of that potential growth. As a result, it would be disingenuous to attribute that economic development potential *exclusively* to the new bridge. Additionally, when looking for the true differences between bridge alternatives, it is important to examine only the benefits associated directly with the bridge.

Landside Benefits

Traditional benefits associated with bridge improvements include both landside and maritime components. In the case of the proposed alternatives, no landside impacts were found. Each of the alternatives maintains the same bridge opening duration and creates no difference in general vehicular, bicycle, or pedestrian traffic operations. In other words, an automobile driver who uses the bridge today would discern no improvement in travel time, or achieve any other transportation related benefits, with a new bridge. Similarly, pedestrian and bicycle traffic would observe no change in their travel time.

It is important to note that the duration and methods for construction may cause various delay or diversion impacts during the construction period. However, no impact was quantified as the transportation analysis showed no discernable diversion patterns that could be analyzed. The construction phase impacts will include a limited road closure while the bridge is being installed along with lane closures for the duration of the construction. It is anticipated that during bridge closures, detours and notifications by area ITS systems will be provided to minimize impacts to drivers. While the impacts cannot easily be quantified, it should be noted that the longer closures will have a greater potential for detrimental impacts to local businesses and diversion costs for roadway users.

Since it was determined that the bridge improvement would have minimal or no impact on long-term landside traffic and pedestrian patterns, no landside benefits were quantified or included in the benefits analysis.

Maritime Benefits

A series of interviews were held with maritime users to determine how the current bridge affects their operations and to identify the ways in which a new bridge could positively affect them. As discussed in Chapter 2, wind and its impact on the navigability through the bridge opening is a critical issue facing maritime users. For this analysis, maritime benefits are primarily due to a reduction in shipper costs associated with delays within New Bedford Harbor. Changes in the use of tugs with Alternative 3 were also considered as a potential benefit. Discussions with maritime experts indicated the tugs used are “ship assist” tugs that primarily aid with alignment to the berth. Accordingly, they will still be required for all large cargo vessels that berth in the North Harbor regardless of the selected alternative and no change to tug costs will occur for larger vessels.

The greatest difference between the No Build Alternative, which retains the existing clearance, and the build alternatives is the horizontal navigational clearance. The No Build Alternative maintains the 95 feet of horizontal navigational clearance, which creates issues for the large vessels that enter the North Harbor. When there are high winds, these vessels cannot transit the bridge until the wind speeds are lower, as there is not enough clearance to pass safely through in high wind conditions.

With Alternative 3, the horizontal navigational width would be 150 feet. This width would remove the need for larger vessels to remain moored south of the bridge should high winds prevail. In the past year, three of the 12 vessels were delayed for one day during their trip to New Bedford due to the existing bridge constraint. It is understood that each day of delay costs the shipper $40,000. Under existing conditions, approximately 25 percent of vessels are delayed for a full day, costing shippers a total of $120,000 per year. With Alternative 3, no ships would experience delay, which results in an average savings of $120,000 per year in shipper costs. Assuming that users of the harbor factor into their overall decision-making the potential cost of delay, the widening of the horizontal clearance would reduce the general cost of using the harbor.

Historically, up to 30 vessels have called upon the port in a single year. This is considered a reasonable upper limit, based on interviews conducted with key maritime users. Assuming that the bridge improvement induces vessel calls to meet this historic high, benefits associated with a reduction in delay time would be generated. These new vessels, however, are not currently using the Port of New Bedford. Rather, they are a projection of potential. As a result, and consistent with economic consumer surplus theory, the benefit they receive would be half of the benefit to existing users.

The change from 12 to 30 trips represents a portion of all potential vessels that did not use the Port of New Bedford under the existing conditions, but that would be "attracted" to New Bedford because the risk of delay and associated costs are mitigated with the wider horizontal clearance. The benefits to these additional vessels are estimated using the "rule of one-half," indicating the change in consumer surplus associated with the removal of the risk of delay. In a future year with 30 total vessels, this would result in a benefit of $20,000 per vessel for the 18 additional vessels, or a total of $360,000.

Summary of Benefits

Table 4.23 summarizes the average annual benefits associated with Alternative 3 as compared to the current conditions that would be maintained under the No Build Alternative. As discussed above, no landside benefits were identified or quantified. Additionally, there would be no change in the number of tugs that would be required, so the total costs would remain the same. The benefits generated by any of the new bridge alternatives is estimated to be $480,000 with delay costs representing $120,000 and savings to new cargo vessels $360,000.

Table 4.23. Average Single-Year Benefits of Bridge Replacement Alternatives

Benefit Category	Annual Savings (2015$)
Landside Transportation Savings	$0
Delay Cost Savings	$120,000
Savings to New Cargo Vessels	$360,000
Change in Tug Costs	$0
Total Benefits	$480,000

4.7.6 Community

The impacts to community resources, such as open space, recreational areas, or historic or cultural resources were also evaluated for Alternative 3. Additionally, access to businesses along the corridor and impacts to Environmental Justice (EJ) populations were evaluated. The study team also considered the visual impacts of a new bridge structure.

IMPACT TO PROTECTED AND RECREATIONAL OPEN SPACE

Alternative 3 would not result in any impacts to protected and/or recreational open space. An evaluation of publicly owned parklands, per Section 4(f) of the Department of Transportation Act of 1966, would be required for any future phases of this project.

As the project development phase continues and the designs for the bridge progresses, special consideration should be given to the location of construction staging areas. Marine Park on Pope's Island is owned and operated by the City of New Bedford and occupies the southern half of the island, but should not be used for construction staging.

IMPACT TO CULTURAL/HISTORIC/ARCHEOLOGICAL RESOURCES

Under Alternative 3, the middle bridge's swing span of the National Register-eligible New Bedford-Fairhaven Bridge would be replaced with a single-leaf rolling bascule. The loss of the center span would diminish the integrity of this historic property.

In addition to direct effects to the New Bedford-Fairhaven Bridge, there is the potential for indirect visual effects to historic properties that lie within the larger study area. A portion of the through truss of the existing swing span is visible as a component of the urban/industrial landscape from both the Schooner Ernestina, located on the New Bedford waterfront, and buildings that lie along the eastern edge of the New Bedford Historic District (see Figure 2.11). Both the Schooner Ernestina and the New Bedford Historic District are National Historic Landmarks. In the closed position, the truss and counter-weight would be approximately eight feet higher than the height of the existing truss, when measured from the water. They would also be somewhat similar in massing when viewed from the New Bedford Historic District and the Schooner Ernestina. When open, the bridge would rise 103 feet above the top of the existing truss and would appear as a prominent visual feature on the skyline. While the replacement of the swing truss with a single-leaf bascule span would alter the visual setting of these two historic properties, it is not anticipated that this would adversely affect these resources given both the distance between the properties and the bridge, and the visual complexity of the viewshed.

Regardless of which long-term alternative is selected, FHWA will need to initiate consultation with the MHC in accordance with Section 106 of the National Historic Preservation Act. Consultation should also be undertaken with the New Bedford and Fairhaven Historical Commissions. Through this consultation, additional historic properties that may be eligible for, but are not yet listed in, the National Register of Historic Places will be identified. The potential for effects to archeological resources will also be determined. FHWA, working together with the MHC, will seek ways to avoid, minimize, or mitigate adverse effects beyond the HAER documentation that has already been completed. In addition to consultation under Section 106, the preparation of a programmatic 4(f) evaluation, in compliance with the U.S. Department of Transportation Act of 1966, will be required.

IMPACT TO BUSINESS ACCESS

The parcels surrounding the approaches to the middle bridge include the following businesses:

- Bridge Shoppes shopping center;
- Captain Leroy's marina;
- Maritime Terminals facility;
- AGM Marine Contractors, Inc.; and
- Tucker Roy Marin Towing and Salvage.

Alternative 3 does not include any modifications to the bridge approaches and utilizes the existing footprint. The horizontal alignment of the road and access to abutting properties will remain the same.

IMPACT TO ENVIRONMENTAL JUSTICE POPULATIONS

The locations of Environmental Justice (EJ) populations were identified in Chapter 2. Some EJ populations reside in neighborhoods that abut or are adjacent to the New Bedford-Fairhaven Bridge. Residential clusters of EJ populations reside at the western edge of the local study area in New Bedford and EJ populations (low-income) also reside throughout the local study area within Fairhaven. Consequently, an evaluation of the potential for disproportionately high and adverse human health or environmental effects of the project alternatives on minority populations and low-income populations, per *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, would be required in future phases of the project to comply with NEPA and MEPA.

Bicycle and pedestrian improvements in Alternative 3 have the potential to substantially improve the ability of EJ populations, who may not own or have access to automobiles, to get across the bridge to access employment or other key destinations. The greatest potential for impacts to EJ populations would occur during construction. Under Alternative 3, the construction phase would be approximately two years long. The bridge would be closed to vehicular, bicycle, and pedestrian traffic for three months. No transit service currently operates across the bridge.

Alternative 3 also has the potential to result in other temporary construction impacts to the EJ populations located in close proximity to the proposed bridge. Potential impacts could include noise, glare, fumes, and dust from construction equipment as well as changes in traffic patterns and access to businesses due to the movement of construction vehicles. Potential construction period impacts would be mitigated with BMPs for construction activities including those used to minimize dust, noise, maintenance, and protection of traffic plans, and limiting the hours of construction. Further analyses under NEPA and MEPA would be required to determine if construction-related impacts would be disproportionately higher on low-income and minority populations.

Alternative 3, along with all of the long-term build alternatives, has the same proportion of impacts to EJ populations compared to non-EJ populations.

VISUAL IMPACTS

The visual impacts from Alternative 3 would be limited. When the bridge is in the down position, it would look have a similar visual impact as the existing swing bridge as both are truss structures. The Alternative 3 bridge truss is the same height as the existing bridge (55 feet above the roadway surface), but since the roadway deck is elevated in this alternative, the top of the Alternative 3 truss is approximately 75 feet above MHW. The top of the existing truss is approximately 70 feet above MHW. When the bridge is in the up (or open) position, the bridge leaf would extend approximately 170 feet high above the roadway surface or 190 feet above the water line. This is approximately 100 feet above the top of the existing truss.

Although the bridge would be visible from a greater distance while in the up position, the topography and the significant development that surrounds the harbor would shield the view of all but the top of the bridge deck in the up position from most locations. Figure 4.6 and Figure 4.7 provides simulated renderings of what the bridge would look like if standing at Captain Leroy's on Pope's Island.

4.7.7 Alternative Feasibility

CAPITAL COST

The estimated cost for Alternative 3 is between $50 and $70 million. This capital cost would include the bridge design and permitting, removal and demolition of the existing swing bridge and construction of the new bridge. Limits of construction would be generally limited to the 289-foot length of the existing swing span with modifications to the approach spans limited to raising the approaches to provide the necessary under bridge clearances. It is estimated that this work would all be done utilizing the existing piers and newly reconstructed pier caps.

It is assumed that dredging and disturbance of the harbor sediments would be limited to construction of the tower structures and fendering system and removal of the existing swing span center pier structure. A more detailed cost estimate would be developed as additional information regarding subsurface conditions, bridge specifications, and design details are developed through the project development process.

OPERATING AND MAINTENANCE COSTS

Upon completion of construction, Alternative 3 will require both routine maintenance and daily operating costs. Table 4.24 provides the estimated annual costs required to operate and maintain the bridge, which are approximately $80,000 less than double-leaf alternatives that have high costs associated with electrical and lubrication costs to operate two mechanical units. Like the No Build Alternative, Alternative 3 requires just a single mechanical unit to operate the moveable span.

Table 4.24. Alternative 3 Annual Operating and Maintenance Costs

Operating Costs	Type	Annual Cost (2015$)
Operating Cost	Electricity utility	$ 50,000
Operating Cost	Stand by generator	$ 2,600
Operating Cost	Bridge operators	$300,000
Routine Maintenance	Monthly bridge lubrication	$ 14,400
Routine Maintenance	Replace lamps	$ 1,500
Routine Maintenance	Replace gate arms	$ 7,000
Routine Maintenance	Miscellaneous minor repairs	$ 12,000
Routine Maintenance	Guard rail repairs	$ 20,000
	TOTAL	$ 407,500

In addition to the annual operating and maintenance costs identified above, Alternative 3 would require major repairs to be conducted on a regular basis to maintain the bridge in a state of good repair and ensure its ongoing utility. The schedule of major repairs included in Table 4.25 is an estimate of repairs that is typical for rolling bascule bridges in similar environments. Over a 50-year span, it should be anticipated that approximately $9.5 million worth of repairs (in 2015 dollars) will be required.

Table 4.25. Alternative 3 Schedule of Major Repairs

Year	Work Performed	Cost (2015$)
10	Fender repairs	$ 250,000
15	Minor Structural repairs Deck repairs	$ 500,000 $ 250,000
25	Electrical control repairs Minor Structural repairs Fender repair Control House repairs	$ 500,000 $ 750,000 $ 250,000 $ 100,000
30	Deck repairs	$ 250,000
35	Replace traffic gates Electrical system rehabilitation Structural rehabilitation Substructure repairs	$ 200,000 $ 1,500,000 $ 2,000,000 $1,000,000
40	Fender repairs Machinery rehabilitation	$ 250,000 $1,500,000
45	Deck repairs	$ 250,000
	TOTAL	$9,550,000

CONSTRUCTION PHASE TRANSPORTATION IMPACTS

The construction phase of Alternative 3 would be a little over two years, or approximately 26-28 months. This alternative would allow two lanes of the roadway to remain open for most of the time to vehicular traffic. A full roadway shutdown would be required for approximately three months to allow to modification of the bridge approaches and to bring in the new bridge leaf. One of the two existing navigational channels would be open for most of the construction duration. However, one navigational closure would be required during a single long-weekend, which would occur in month 21 of construction. The new 150-foot-wide channel would then be open during the following month.

CONTRUCTION PHASE IMPACTS TO ABUTTING LAND OWNERS/BUSINESSES

The construction phase of each long-term alternative has the potential to impact area businesses due to the change in access during that period. During the two-year-long construction phase of Alternative 3, two vehicular lanes would remain open. Alternative 3 requires the roadway to be closed completely for a three-month period to allow for the removal of the existing swing span and the installation of the new rolling span. This road closure would likely result in some impacts to area businesses. Due to the longer construction duration and three-month roadway closure, the Alternative 3 impacts would be greater than the No Build Alternative, but would be less than some of the other build alternatives that require even longer roadway closures.

4.8 ALTERNATIVE 3W: WIDE DOUBLE-LEAF ROLLING BASCULE BRIDGE

This section provides an evaluation of Alternative 3W: Wide Double-leaf Rolling Bascule Bridge consistent with the evaluation criteria established at the initiation of the study. The evaluation criteria are specific measures of effectiveness used to assess benefits and impacts of each alternative.

During the review of impacts of the preliminary set of long-term alternatives, the study team developed Alternative 3W to address the potential navigational needs of changing uses in the North Harbor. Compared to Alternative 3 that has a single-leaf and provides 150 feet of navigational clearance, Alternative 3W is a wider double-leaf rolling bascule with a navigational width of 220 feet. Although Alternative 3 has only a single leaf, Figures 4.6 and 4.7 can be used for visual reference of Alternative 3W.

4.8.1 Bridge Operations

MINUTES PER BRIDGE CLOSURE

The opening sequence of the bridge in all of the long-term alternatives, including Alternative 3W, would continue to follow the AASHTO recommendation that requires approximately four minutes to open and an additional four minutes to close. The average time to open and close the bridge will continue to vary based on the marine traffic transit time and the time required to clear pedestrians and vehicles from the movable span before it can open to marine traffic. The minutes per bridge closure in Alternative 3W is the same as the current condition.

FEET OF VERTICAL CLEARANCE

The Alternative 3W bridge would be designed to have a vertical clearance of 14 feet above MHW when the bridge is in the closed position. The bridge would create no vertical clearance restrictions when the bridge is open to marine traffic.

FEET OF HORIZONTAL CLEARANCE (OPEN & CLOSED)

The Alternative 3W bridge would include approximately 220 feet of navigational clearance. The bridge would be aligned so that the eastern bridge abutment is in approximately the same location as the existing eastern abutment. The western abutment is located 220 feet to the west. The opening width is the maximum that could be established without affecting the bridge approach on Fish Island.

NUMBER OF DAILY BRIDGE OPENINGS

As described in the No Build Alternative, the bridge currently operates on a fixed schedule each day. For all of the long-term alternatives, including Alternative 3W, the schedule and number of daily bridge openings are expected to stay the same.

LONG-TERM RELIABILITY RISK

Since each moveable bridge includes a complex interaction of mechanical, electrical and structural components, there is an inherent risk in a moveable bridge that one of these systems will not operate as designed on any particular day and result in the inability for the bridge to open or close. Some moveable bridge types are at greater risk of inoperability than others due to the nature of their design and the conditions and environment that they operate within. As inoperability of a bridge for a period of time results in community and economic impacts, the risk associated with bridge reliability in the long-term was assessed. This included a general assessment of existing bridges of the type and size under consideration in conditions similar to that of New Bedford Harbor and their ability to remain reliable throughout the life span of the bridge. As noted, all moveable bridges are complex and have some long-term reliability risk. It was estimated that a rolling bascule bridge with the span width and length of the New Bedford-Fairhaven Bridge when operating in the marine costal environment of New Bedford Harbor would have a high level of risk. Roadway bridges of similar size and type have had structural and corrosion issues that have created reliability issues and have caused the bridges to be shut down periodically. It is likely that even with regular maintenance, corrosion issues would regularly affect the operability of such a long and wide structure.

4.8.2 Transportation Impacts & Mobility Analysis

The evaluation and assessment of mobility along the corridor between County Street in New Bedford and Adams Street in Fairhaven is an important component of this study. Like of the long-term alternatives, Alternative 3W will not change vehicular traffic along the corridor. Unlike the No Build Alternative, Alternative 3W will provide additional pedestrian and bicycle facilities.

CORRIDOR INTERSECTION LOS, V/C RATIO, QUEUE LENGTHS & ROADWAY TRAVEL TIME/DELAY

As noted in the No Build Alternative analysis, none of the long-term alternatives, including Alternative 3W, will change result in changes to vehicular traffic along the corridor as compared to the 2035 No Build Condition described in Chapter 2. Each of the long-term alternatives being considered will result in the same number of bridge openings and the bridge will, on average, be open for the same duration. Therefore, the mobility analysis described previously in Section 4.2.2 related to the No Build Alternative is consistent with the results of intersection LOS, volume to capacity ratio, queue lengths, and travel time and delay analysis for Alternative 3W.

BICYCLE & PEDESTRIAN MOBILITY/CONNECTIVITY

The width of the existing swing span allows for five-foot-wide sidewalks on both the north and south sides and the roadway shoulders less than two feet in width. The rest of the corridor has a slightly wider ROW, but it is still not wide enough to accommodate five-foot-wide bike lanes. Consequently, bicyclists and pedestrians both use the sidewalks along the bridge corridor segment.

Most pedestrian/bicycle use of the bridge occurs on the southern sidewalk since this sidewalk directly connects to the New Bedford downtown and waterfront. A new pedestrian ramp was completed in 2014 as part of a new roadway ramp from northbound Route 18 to eastbound Route 6. Between the New Bedford and Fairhaven shorelines, pedestrian and bicycle connectivity is difficult due to a lack of secure crossings, ramps, and gaps in the sidewalk network.

Because of these access challenges and safety concerns, pedestrian and bicyclist use of the bridge is currently limited. During the peak hour counts conducted for the study, only one pedestrian was observed to walk the entire length of the bridge between New Bedford and Fairhaven. During the warmer months, it is understood that pedestrian and bicycle use is more frequent and increases during non-peak auto hours.

Like all of the build alternatives, Alternative 3W allows for a wider bridge with a 64-foot-wide ROW. This bridge width allows for the construction of four 11-foot-wide vehicular travel lanes, two five-foot-wide bike lanes, and two five-foot-wide sidewalks. However, while Alternative 3W provides improved facilities compared to the No Build Alternative, the delay for bicyclists and pedestrians will not change as it is controlled by the frequency and duration of bridge openings, which will not change from the current condition.

4.8.3 Safety

Improving roadway, pedestrian, bicycle, and marine safety, reducing conflicts between transportation modes, and increasing emergency vehicle access are important considerations for evaluating the long-term alternatives. This section provides an overview of the key safety concerns that will be addressed by Alternative 3W.

CONFORMANCE WITH AASHTO AND MASSDOT STANDARDS

For a bridge and approach roadway to be safe for vehicular traffic, it must be geometrically adequate. This consideration takes into account the number of lanes, lane and shoulder widths, approach roadway widths, horizontal clearances to roadside obstacles, stopping sight distances, vertical clearances and more. The standards for these criteria are identified in the AASHTO *Policy on Geometric Design of Highways and Streets* and the MassDOT *Project Development and Design Guidebook* (2006). Alternative 3W will conform to these standards with no known variance required.

DELAY TO EMERGENCY VEHICLE ACCESS

Both New Bedford and Fairhaven provide fire and emergency services to their respective municipalities. In case of bridge closure, Pope's Island can receive service from Fairhaven via the east bridge. St. Luke's Hospital in New Bedford is the only facility in the two municipalities that provides emergency services. Bridge closures can affect Emergency Medical Services (EMS) access to the hospital from Fairhaven. Alternative 3W will not affect the level of access or potential for delay of emergency vehicles compared to the No Build Alternative.

IMPACT TO HIGH VOLUME BICYCLE AND PEDESTRIAN LOCATIONS

A sidewalk runs along the entire length of the north and south sides of the Route 6 Corridor between MacArthur Drive in New Bedford and Middle Street in Fairhaven. When the current roadway construction is completed in 2015, the roadway shoulders will be widened by reducing the vehicular travel lane width. In Alternative 3W, the new bridge cross section will include both widened roadway shoulders and sidewalks. However, even though Alternative 3W provides additional pedestrian and bicycle facilities, high pedestrian or bicycle volumes are not seen on the bridge and are not anticipated in the future. Alternative 3W will have no impact to high volume bicycle or pedestrian locations.

IMPACT TO SAFE NAVIGATION

Due to the existing navigational width of the channels at the existing bridge, safe vessel navigation through the bridge is a serious concern and a significant constraint to the North Harbor. Concerns for safe navigation have resulted in vessel limitations, which have resulted in delays and additional costs for commercial vessels.

Navigation through the bridges 94- and 95-foot-wide channels is the primary concern for large commercial vessels. These vessels generally employ harbor tugs for ship assist when maneuvering through the harbor and the bridge. Even with the tugs, limitations are still in place for transiting through the bridge. These include wind speed, visibility, and daylight.

- Wind speed is the primary concern that limits vessels ability to pass through the bridge. In all cases, if the wind exceeds 25 knots, no large vessel will transit the bridge. If the vessel is over 400 feet in length, this may be reduced to as little as 12 knots given the direction and based on the pilot's discretion.
- No vessel will transit through the bridge if the visibility is less than one nautical mile. Although large vessels don't enter the harbor though the hurricane barrier if visibility is limited, changes in visibility can occur rapidly in the harbor due to fog or heavy precipitation.
- Vessels greater than 500 feet in length or over 80 feet in width transit through the bridge and hurricane barrier in daylight only.

When transiting the current bridge, there is limited room for larger vessels to maneuver, especially north of the bridge between Fish Island and Pope's Island. Vessels approach slowly and then increase speed as they enter the bridge opening to ensure that they can exercise better control of the vessel through the passage. The limited maneuvering space on either side of the bridge is complicated by the fact that typically ships approach the bridge on an angle due to slow approach speeds. This angle further reduces any free space between the vessel and the bridge as the vessel is moving through. The swing span's central pivot point, associated piers, and fendering system are located approximately in the center of the federal deep-water channel. This makes the bridge, in the perspective of the pilots, the most vulnerable navigation safety area in the harbor.

When larger ships head northbound through the bridge, limited space is available for stopping or maneuvering once they pass the bridge. Generally, two tugs are employed; one at the bow and one at the stern, but only one can assist once the vessel is in the bridge opening due to the width of the channel. The forward tug goes through the bridge first and can come back alongside once the bow clears. Proceeding northbound, once the vessel passes through the bridge and enters the basin, it must slow and stop before being maneuvered into a berth.

Generally, vessels do not require tugs on transiting southbound. When departing southbound, the vessel leaves the berth and turns in the basin in a manner that allows it to line up with the west channel that is used most of the time. Once lined up, it transits the opening and maintains its alignment with the federal deep-water channel.

While the No Build Alternative does not provide any change from the existing condition, Alternative 3W will result in significant improvements to safe navigation through the bridge. The 220 feet of horizontal clearance would mitigate many of the safe navigation concerns, most notably the wind restriction, which has a significant impact on vessel delay. The wider clearance would allow for full tug assistance throughout the bridge transit and would also minimize the impact of the limited maneuverable space in the North Harbor, which will not change as a result of the project.

4.8.4 Environment

The following section presents the potential for impacts to the natural environment from Alternative 3W. Compared to the No Build Alternative, Alternative 3W has more potential to impact coastal, wetland, and natural resources due to the required in-water construction. The following sections provide a screening-level assessment, therefore additional and more in-depth analyses of resource impacts would be required, per the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA), as the designs for the bridge progress.

IMPACT TO COASTAL RESOURCES

Coastal Zone Impacts

The New Bedford-Fairhaven Bridge is located within the designated coastal zone of the Commonwealth of Massachusetts; therefore, this project may be subject to a federal consistency review to ensure that the proposed project would be consistent with the enforceable policies of the federally approved coastal management program of the Commonwealth.

The construction required to raise the elevation of the approach on Fish Island under Alternative 3W has the potential to affect Chapter 91 Tidelands located on the eastern side of the island. A Chapter 91 Waterways authorization from the Massachusetts Department of Environmental Protection (MassDEP) may be required for the construction of new bridge structure.

Within its policy documents, the Massachusetts Office of Coastal Zone Management (CZM) strongly encourages early coordination with the agency to determine the appropriate level of coastal review that would be required for projects. Coordination with CZM should be undertaken during any future NEPA and MEPA phases of the project.

Floodplains

The proposed bridge would be located within the 100-year floodplain. Alternative 3W would require limited in-water construction work as the new bridge would be constructed on piles instead of on piers. This has limited potential to affect the 100-year floodplain and flood levels within this area. Flooding and construction within the 100-year floodplain is under the jurisdiction of CZM. Therefore, coordination with CZM would be needed in future phases of the project to determine the extent of potential impacts to the 100-year floodplain and the applicability of coastal hazard policies to this project.

Hazardous and Contaminated Materials

New Bedford Harbor has been designated as a Superfund Site and is currently undergoing an extensive clean-up effort by the EPA. Alternative 3W would require limited in-water construction work as the new bridge would be constructed on piles instead of on piers. Because of this, Alternative 3W requires less disturbance to the harbor floor and significantly less soil and sediment disturbance than the vertical lift and bascule (standard) build alternatives. However, all of the build alternatives have greater impacts than the No Build Alternative due to the in-water soil/sediment disturbance that would be expected from the removal of the existing swing span center pier structure.

As any designs for the bridge progress, coordination would be undertaken with the EPA and the MassDEP to determine the amount of disturbance anticipated during construction, options for mitigation and minimization, and for the appropriate disposal of the contaminated sediments.

IMPACT TO WETLAND RESOURCES

A small area of rocky intertidal wetlands is located on the western shore of Pope's Island. Temporary disturbance resulting from the construction of Alternative 3W may potentially affect this wetland type. Additional field verification of this wetland type, as well as consultation with the USACE and MassDEP, would be needed in future phases of this project to determine the extent of this resource.

Potential impacts to water quality may occur from the disturbance and removal of contaminated sediments from New Bedford-Fairhaven Harbor during construction. Coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination.

Proper erosion and sedimentation controls, as well as stormwater pollution prevention best management practices (BMPs), would be implemented during the construction phase to prevent or avoid any potential impacts to the wetlands and aquatic species known to reside within them. Examples of BMPs include silt fencing, biotubes, and regulated construction entrances. Consultation with USACE and MassDEP regarding avoidance and minimization of potential impacts as well as permitting requirements should be undertaken during any future phases of this project.

As project development progresses, special consideration should be given to the location of construction staging areas on Pope's Island. Coastal bank bluff and sea cliff wetlands form the southern shores of Pope's Island and the placement of construction staging areas within or adjacent to these wetlands should be avoided.

IMPACT TO NATURAL RESOURCES

Alternative 3W would not result in any impacts to Areas of Critical Environmental Concern (ACEC), prime farmland soils, or aquifers. Alternative 3W has the potential for temporary impacts to water quality, shellfish and fish habitat, and priority habitats as a result of construction.

Water Quality

Alternative 3W requires less in-water construction work than the vertical lift and bascule (standard). However, the potential impacts to water quality would greater than the No Build Alternative due to the in-water soil/sediment disturbance that would be expected from the removal of the existing swing span center pier structure.

Coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination. Additionally, proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to water quality from construction activities.

Shellfish and Fish Habitat

Alternative 3W has the potential to result in temporary impacts to shellfish and fish habitats from the construction of the proposed bridge. Since New Bedford Harbor has been designed as a shellfish growing area, coordination may be needed with MassDEP to ensure that construction activities do not disrupt active shellfish spawning grounds. Proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to shellfish and fish habitats from construction activities.

Although the consumption of fish and shellfish caught in the New Bedford Inner Harbor is regulated by the Massachusetts Department of Public Health (MDPH), consultation with the National Oceanographic Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) should be undertaken during future phases of this project to determine the presence of Essential Fish Habitats (EFH) within New Bedford-Fairhaven Harbor.

Priority Habitats

Alternative 3W is not anticipated to impact priority plant or animal habitats. However, additional field verification and/or consultation with the U.S. Fish and Wildlife Service

(USFWS) and MassDEP may be required in future phases of the project to verify the presence of state and federally listed plant and animal species and habitats.

IMPACTS TO AIR QUALITY AND GREENHOUSE GASES FROM IDLING VEHICLES

None of the long-term alternatives, including the No Build Alternative, would increase traffic volumes on the corridor as compared to the 2035 No Build Condition described in Chapter 2. The number of bridge openings would remain the same. Consequently, none of the long-build alternatives has the potential to worsen air quality compared to the 2035 No Build Condition. In future phases of the project, a formal air quality evaluation (microscale or mesoscale) would be required to determine the proposed project's impacts as compared to the National Ambient Air Quality Standards (NAAQS).

In Alternative 3W, the addition of bicycle and pedestrian facilities along the Route 6 Corridor, including along a new movable span, may have the potential for localized air quality benefits. The addition of these facilities has the potential to shift some motorists to non-motorized modes, potentially reducing the number of idling cars at bridge openings.

Potential temporary impacts to air quality would be anticipated from construction activities. BMPs would be implemented during construction to minimize vehicle emissions and manage fugitive dust. Typical air quality mitigation measures implemented during construction could include dust suppression and control methods to minimize fugitive dust on dry and windy days.

IMPACTS FROM NOISE

Since traffic volumes are not anticipated to increase substantially over existing levels, Alternative 3W is not anticipated to result in noise impacts to nearby noise-sensitive receptors. However, a formal noise assessment in compliance with the FHWA would be required in any future phases of this project.

Potential temporary noise impacts would result from construction activities and the operation of construction equipment. BMPs would be implemented during construction to mitigate potential noise impacts (particularly during non-daytime hours).

4.8.5 Land Use & Economic Development

NUMBER/VALUE OF BUSINESSES PERMANENTLY IMPACTED

The design of the Alternative 3W bridge utilizes primarily the same footprint as the existing swing span and will not require the acquisition of any additional property or ROW. Furthermore, the operation of the new moveable span will not vary dramatically in a way that would functionally affect the operation of area businesses and would not result in the reduction of the number of jobs. With absence of physical ROW changes and business operational impacts, no business or related property impacts or acquisition is anticipated due to physical or functional impacts.

SHIPPER COST SAVINGS

A variety of both landside and maritime benefits were considered to assess the economic benefits of the long-term build alternatives, including Alternative 3W. While some may be quantified, others are more difficult to count and therefore the analysis considered both quantitative and qualitative benefits.

As a first step in the assessment, the potential benefits that could be generated by a new bridge were inventoried. In similar projects, automobile and truck benefits are often included, such as reduced travel time, vehicle operating cost savings, and emissions reduction, among others. On the marine side, moveable bridge improvements can affect shipper costs, travel time, and similar factors.

A thorough review of potential benefits indicated few differences between the 2035 No Build Condition and Alternative 3W in terms of quantifiable benefits. This is due to the relatively small variation between the proposed alternatives and the existing condition in most aspects of transportation. The lack of impact to existing and future traffic conditions results in no benefits from reduced travel time, vehicle operating cost savings, and emissions reduction. However, the change in horizontal clearance for vessels between the existing bridge and Alternative 3W is a significant change. The existing bridge provides a maximum horizontal clearance of 95 feet, while the horizontal clearance for Alternative 3W is 220 feet. Alternative 3W has no limitations on the vertical clearance of vessels.

This analysis only considers the benefits directly related to the bridge, an approach consistent with USDOT benefit-cost analysis guidance. While there is potential for additional economic development at the North Terminal and in the North Harbor, the chosen bridge alternative is only one component of that potential growth. As a result, it would be disingenuous to attribute that economic development potential *exclusively* to the new bridge. Additionally, when looking for the true differences between bridge alternatives, it is important to examine only the benefits associated directly with the bridge.

Landside Benefits

Traditional benefits associated with bridge improvements include both landside and maritime components. In the case of the proposed alternatives, no landside impacts were found. Each of the alternatives maintains the same bridge opening duration and creates no difference in general vehicular, bicycle, or pedestrian traffic operations. In other words, an automobile driver who uses the bridge today would discern no improvement in travel time, or achieve any other transportation related benefits, with a new bridge. Similarly, pedestrian and bicycle traffic would observe no change in their travel time.

It is important to note that the duration and methods for construction may cause various delay or diversion impacts during the construction period. However, no impact was quantified as the transportation analysis showed no discernable diversion patterns that could be analyzed. The construction phase impacts will include a limited road closure while the bridge is being installed along with lane closures for the duration of the construction. It is anticipated that during bridge closures, detours and notifications by area ITS systems will be provided to minimize impacts to drivers. While the impacts cannot easily be quantified, it should be noted that the longer closures will have a greater potential for detrimental impacts to local businesses and diversion costs for roadway users.

Since it was determined that the bridge improvement would have minimal or no impact on long-term landside traffic and pedestrian patterns, no landside benefits were quantified or included in the benefits analysis.

Maritime Benefits

A series of interviews were held with maritime users to determine how the current bridge affects their operations and to identify the ways in which a new bridge could positively affect them. As discussed in Chapter 2, wind and its impact on the navigability through the bridge opening is a critical issue facing maritime users. For this analysis, maritime benefits are primarily due to a reduction in shipper costs associated with delays within New Bedford Harbor. Changes in the use of tugs with Alternative 3W were also considered as a potential benefit. Discussions with maritime experts indicated the tugs used are "ship assist" tugs that primarily aid with alignment to the berth. Accordingly, they will still be required for all large cargo vessels that berth in the North Harbor regardless of the selected alternative and no change to tug costs will occur for larger vessels.

The greatest difference between the No Build Alternative, which retains the existing clearance, and the build alternatives is the horizontal navigational clearance. The No Build Alternative maintains the 95 feet of horizontal navigational clearance, which creates issues for the large vessels that enter the North Harbor. When there are high winds, these vessels cannot transit the bridge until the wind speeds are lower, as there is not enough clearance to pass safely through in high wind conditions.

With Alternative 3W, the horizontal navigational width would be 220 feet. This width would remove the need for larger vessels to remain moored south of the bridge should high winds prevail. In the past year, three of the 12 vessels were delayed for one day during their trip to New Bedford due to the existing bridge constraint. It is understood that each day of delay costs the shipper $40,000. Under existing conditions, approximately 25 percent of vessels are delayed for a full day, costing shippers a total of $120,000 per year. With Alternative 3W, no ships would experience delay, which results in an average savings of $120,000 per year in shipper costs. Assuming that users of the harbor factor into their overall decision-making the potential cost of delay, the widening of the horizontal clearance would reduce the general cost of using the harbor.

Historically, up to 30 vessels have called upon the port in a single year. This is considered a reasonable upper limit, based on interviews conducted with key maritime users. Assuming that the bridge improvement induces vessel calls to meet this historic high, benefits associated with a reduction in delay time would be generated. These new vessels, however, are not currently using the Port of New Bedford. Rather, they are a projection of potential. As a result, and consistent with economic consumer surplus theory, the benefit they receive would be half of the benefit to existing users.

The change from 12 to 30 trips represents a portion of all potential vessels that did not use the Port of New Bedford under the existing conditions, but that would be "attracted" to New Bedford because the risk of delay and associated costs are mitigated with the wider horizontal clearance. The benefits to these additional vessels are estimated using the "rule of one-half," indicating the change in consumer surplus associated with the removal of the risk of delay. In a future year with 30 total vessels, this would result in a benefit of $20,000 per vessel for the 18 additional vessels, or a total of $360,000.

Summary of Benefits

Table 4.26 summarizes the average annual benefits associated with Alternative 3W as compared to the current conditions that would be maintained under the No Build Alternative. As discussed above, no landside benefits were identified or quantified. Additionally, there would be no change in the number of tugs that would be required, so the total costs would remain the same. The benefits generated by any of the new bridge alternatives is estimated to be $480,000 with delay costs representing $120,000 and savings to new cargo vessels $360,000.

Table 4.26. Average Single-Year Benefits of Bridge Replacement Alternatives

Benefit Category	Annual Savings (2015$)
Landside Transportation Savings	$0
Delay Cost Savings	$120,000
Savings to New Cargo Vessels	$360,000
Change in Tug Costs	$0
Total Benefits	$480,000

4.8.6 Community

The impacts to community resources, such as open space, recreational areas, or historic or cultural resources were also evaluated for Alternative 3W. Additionally, access to businesses along the corridor and impacts to Environmental Justice (EJ) populations were evaluated. The study team also considered the visual impacts of a new bridge structure.

IMPACT TO PROTECTED AND RECREATIONAL OPEN SPACE

Alternative 3W would not result in any impacts to protected and/or recreational open space. An evaluation of publicly owned parklands, per Section 4(f) of the Department of Transportation Act of 1966, would be required for any future phases of this project.

As the project development phase continues and the designs for the bridge progresses, special consideration should be given to the location of construction staging areas. Marine Park on Pope's Island is owned and operated by the City of New Bedford and occupies the southern half of the island, but should not be used for construction staging.

IMPACT TO CULTURAL/HISTORIC/ARCHEOLOGICAL RESOURCES

Under Alternative 3W, the middle bridge's swing span of the National Register-eligible New Bedford-Fairhaven Bridge would be replaced with a double-leaf rolling bascule. The loss of the center span would diminish the integrity of this historic property.

In addition to direct effects to the New Bedford-Fairhaven Bridge, there is the potential for indirect visual effects to historic properties that lie within the larger study area. A portion of the through truss of the existing swing span is visible as a component of the urban/industrial landscape from both the Schooner Ernestina, located on the New Bedford waterfront, and buildings that lie along the eastern edge of the New Bedford Historic District (see Figure 2.11). Both the Schooner Ernestina and the New Bedford Historic District are National Historic Landmarks. In the closed position, the two truss structures and counterweights would be approximately eight feet higher than the height of the existing truss, when measured from the water. They would also be somewhat similar in massing when viewed from the New Bedford Historic District and the Schooner Ernestina. When open, the two movable spans would rise 103 feet above the top of the existing truss and would appear as a prominent visual feature on the skyline. While the replacement of the swing truss with a double-leaf bascule span would alter the visual setting of these two historic properties, it is not anticipated that this would adversely affect these resources given both the distance between the properties and the bridge, and the visual complexity of the viewshed.

Regardless of which long-term alternative is selected, FHWA will need to initiate consultation with the MHC in accordance with Section 106 of the National Historic Preservation Act. Consultation should also be undertaken with the New Bedford and Fairhaven Historical Commissions. Through this consultation, additional historic properties that may be eligible for, but are not yet listed in, the National Register of Historic Places will be identified. The potential for effects to archeological resources will also be determined. FHWA, working together with the MHC, will seek ways to avoid, minimize, or mitigate adverse effects beyond the HAER documentation that has already been completed. In addition to consultation under Section 106, the preparation of a programmatic 4(f) evaluation, in compliance with the U.S. Department of Transportation Act of 1966, will be required.

IMPACT TO BUSINESS ACCESS

The parcels surrounding the approaches to the middle bridge include the following businesses:

- Bridge Shoppes shopping center;
- Captain Leroy's marina;
- Maritime Terminals facility;
- AGM Marine Contractors, Inc.; and
- Tucker Roy Marin Towing and Salvage.

Alternative 3W does not include any modifications to the bridge approaches and utilizes the existing footprint. The horizontal alignment of the road and access to abutting properties will remain the same.

IMPACT TO ENVIRONMENTAL JUSTICE POPULATIONS

The locations of Environmental Justice (EJ) populations were identified in Chapter 2. Some EJ populations reside in neighborhoods that abut or are adjacent to the New Bedford-Fairhaven Bridge. Residential clusters of EJ populations reside at the western edge of the local study area in New Bedford and EJ populations (low-income) also reside throughout the local study area within Fairhaven. Consequently, an evaluation of the potential for disproportionately high and adverse human health or environmental effects of the project alternatives on minority populations and low-income populations, per *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, would be required in future phases of the project to comply with NEPA and MEPA.

Bicycle and pedestrian improvements in Alternative 3W have the potential to substantially improve the ability of EJ populations, who may not own or have access to automobiles, to get across the bridge to access employment or other key destinations. The greatest potential for impacts to EJ populations would occur during construction. Under Alternative 3W, the construction phase would be approximately two years long. The bridge would be closed to vehicular, bicycle, and pedestrian traffic for three months. No transit service currently operates across the bridge.

Alternative 3W also has the potential to result in other temporary construction impacts to the EJ populations located in close proximity to the proposed bridge. Potential impacts could include noise, glare, fumes, and dust from construction equipment as well as changes in traffic patterns and access to businesses due to the movement of construction vehicles. Potential construction period impacts would be mitigated with BMPs for construction activities including those used to minimize dust, noise, maintenance, and protection of traffic plans, and limiting the hours of construction. Further analyses under NEPA and MEPA would be required to determine if construction-related impacts would be disproportionately higher on low-income and minority populations.

Alternative 3W, along with all of the long-term build alternatives, has the same proportion of impacts to EJ populations compared to non-EJ populations.

VISUAL IMPACTS

The visual impacts from Alternative 3W would be limited. When the bridge is in the down position, it would look have a similar visual impact as the existing swing bridge as both are truss structures. The Alternative 3W bridge trusses are the same height as the existing bridge (55 feet above the roadway surface), but since the roadway deck is elevated in this alternative, the top of the Alternative 3W truss is approximately 75 feet above MHW. The top of the existing truss is approximately 70 feet above MHW. When the bridge is in the up (or open) position, the bridge leaf would extend approximately 130 feet high above the roadway surface or 150 feet above the water line. This is approximately 60 feet above the top of the existing truss.

Although the bridge would be visible from a greater distance while in the up position, the topography and the significant development that surrounds the harbor would shield the view of all but the top of the bridge deck in the up position from most locations. Although Alternative 3 has a longer single-leaf, Figure 4.6 and Figure 4.7 provides simulated renderings of what a rolling bascule bridge would look like if standing at Captain Leroy's on Pope's Island.

4.8.7 Alternative Feasibility

CAPITAL COST

The estimated cost for Alternative 3W is between $90 and $110 million. This capital cost would include the bridge design and permitting, removal and demolition of the existing swing bridge and construction of the new bridge. Limits of construction would be generally limited to the 289-foot length of the existing swing span with modifications to the approach spans limited to raising the approaches to provide the necessary under bridge clearances. It is estimated that this work would all be done utilizing the existing piers and newly reconstructed pier caps.

It is assumed that dredging and disturbance of the harbor sediments would be limited to construction of the piers and fendering system and removal of the existing swing bridge center pier structure. A more detailed cost estimate would be developed as additional information regarding subsurface conditions, bridge specifications, and design details are developed through the project development process.

OPERATING AND MAINTENANCE COSTS

Upon completion of construction, Alternative 3W will require both routine maintenance and daily operating costs. Table 4.27 provides the estimated annual costs required to operate and maintain the bridge, which are the same as the other double-leaf alternatives that have two mechanical units to operate and maintain.

Table 4.27. Alternative 3W Annual Operating and Maintenance Costs

Operating Costs	Type	Annual Cost (2015$)
Operating Cost	Electricity utility	$ 100,000
Operating Cost	Stand by generator	$ 2,600
Operating Cost	Bridge operators	$300,000
Routine Maintenance	Monthly bridge lubrication	$ 27,600
Routine Maintenance	Replace lamps	$ 1,500
Routine Maintenance	Replace gate arms	$ 18,000
Routine Maintenance	Miscellaneous minor repairs	$ 20,000
Routine Maintenance	Guard rail repairs	$ 20,000
	TOTAL	$ 489,700

In addition to the annual operating and maintenance costs identified above, the Alternative 3W bridge will require major repairs to be conducted on a regular basis to maintain the bridge in a state of good repair and ensure its ongoing utility. The schedule of major repairs included in Table 4.28 is an estimate of repairs that is typical for rolling bascule bridges in similar environments. Over a 50-year span, it should be anticipated that approximately $12.1 million worth of repairs (in 2015 dollars) will be required.

Table 4.28. Alternative 3W Schedule of Major Repairs

Year	Work Performed	Cost (2015$)
10	Fender repairs	$ 250,000
15	Minor Structural repairs Deck repairs	$1,000,000 $ 250,000
25	Electrical control repairs Minor Structural repairs Fender repair Control House repairs	$ 700,000 $ 1,000,000 $ 250,000 $ 100,000
30	Deck repairs	$ 250,000
35	Replace traffic gates Electrical system rehabilitation Structural rehabilitation Substructure repairs	$ 300,000 $ 1,500,000 $ 2,000,000 $1,000,000
40	Fender repairs Machinery rehabilitation	$ 250,000 $3,000,000
45	Deck repairs	$ 250,000
	TOTAL	$12,100,000

CONSTRUCTION PHASE TRANSPORTATION IMPACTS

The construction phase of Alternative 3W would be a little over two years, or approximately 26-28 months. This alternative would allow two lanes of the roadway to remain open for most of the time to vehicular traffic. A full roadway shutdown would be required for approximately three months to allow to modification of the bridge approaches and to bring in the new bridge leaf. One of the two existing navigational channels would be open for most of the construction duration. However, one navigational closure would be required during a single long-weekend, which would occur in month 21 of construction. The new 220-foot-wide channel would then be open during the following month.

CONTRUCTION PHASE IMPACTS TO ABUTTING LAND OWNERS/BUSINESSES

The construction phase of each long-term alternative has the potential to impact area businesses due to the change in access during that period. During the two-year-long construction phase of Alternative 3W, two vehicular lanes would remain open. Alternative 3W requires the roadway to be closed completely for a three-month period to allow for the removal of the existing swing span and the installation of the new rolling span. This road closure would likely result in some impacts to area businesses. Due to the longer construction duration and three-month roadway closure, the Alternative 3W impacts would be greater than the No Build Alternative, but would be less than some of the other build alternatives that require even longer roadway closures.

4.9 ALTERNATIVE 3D: DOUBLE-LEAF DUTCH BASCULE BRIDGE

This section provides an evaluation of Alternative 3D: Double-leaf Dutch Bascule Bridge consistent with the evaluation criteria established at the initiation of the study. The evaluation criteria are specific measures of effectiveness used to assess benefits and impacts of each alternative.

During the review of impacts of the preliminary set of long-term alternatives, the study team developed Alternative 3D to explore the feasibility of a different bridge type than the rolling bascule bridge type. Alternative 3D provides 200 feet of navigational clearance and is a Dutch-style bascule bridge.

4.9.1 Bridge Operations

MINUTES PER BRIDGE CLOSURE

The opening sequence of the bridge in all of the long-term alternatives, including Alternative 3D, would continue to follow the AASHTO recommendation that requires approximately four minutes to open and an additional four minutes to close. The average time to open and close the bridge will continue to vary based on the marine traffic transit time and the time required to clear pedestrians and vehicles from the movable span before it can open to marine traffic. The minutes per bridge closure in Alternative 3D is the same as the current condition.

FEET OF VERTICAL CLEARANCE

The Alternative 3D bridge would be designed to have a vertical clearance of 14 feet above MHW when the bridge is in the closed position. The bridge would create no vertical clearance restrictions when the bridge is open to marine traffic.

FEET OF HORIZONTAL CLEARANCE (OPEN & CLOSED)

The Alternative 3D bridge would include approximately 200 feet of navigational clearance. The bridge would be aligned so that the eastern bridge abutment is in approximately the same location as the existing eastern abutment. The western abutment is located 200 feet to the west. The opening width is the maximum that could be established without affecting the bridge approach on Fish Island.

NUMBER OF DAILY BRIDGE OPENINGS

As described in the No Build Alternative, the bridge currently operates on a fixed schedule each day. For all of the long-term alternatives, including Alternative 3D, the schedule and number of daily bridge openings are expected to stay the same.

LONG-TERM RELIABILITY RISK

Since each moveable bridge includes a complex interaction of mechanical, electrical and structural components, there is an inherent risk in a moveable bridge that one of these systems will not operate as designed on any particular day and result in the inability for the bridge to open or close. Some moveable bridge types are at greater risk of inoperability than others due to the nature of their design and the conditions and environment that they operate within. As inoperability of a bridge for a period of time results in community and economic impacts, the risk associated with bridge reliability in the long-term was assessed. This included a general assessment of existing bridges of the type and size under consideration in conditions similar to that of New Bedford Harbor and their ability to remain reliable throughout the life span of the bridge. As noted, all moveable bridges are complex and have some long-term reliability risk. Since there have no double-leaf Dutch-style bascule bridges built with a similar length and width of the New Bedford-Fairhaven Bridge an assessment of the long-term reliability risk could not be completed. If this alternative proceeds into the preliminary design phase additional analysis will be required to assess the reliability of this bridge type in the costal marine environment with the length and widths identified taking into account the area wind loads while in the up position and the anticipated vehicle loads while in the down position.

4.9.2 Transportation Impacts & Mobility Analysis

The evaluation and assessment of mobility along the corridor between County Street in New Bedford and Adams Street in Fairhaven is an important component of this study. Like of the long-term alternatives, Alternative 3D will not change vehicular traffic along the corridor. Unlike the No Build Alternative, Alternative 3D will provide additional pedestrian and bicycle facilities.

CORRIDOR INTERSECTION LOS, V/C RATIO, QUEUE LENGTHS & ROADWAY TRAVEL TIME/DELAY

As noted in the No Build Alternative analysis, none of the long-term alternatives, including Alternative 3D, will change result in changes to vehicular traffic along the corridor as compared to the 2035 No Build Condition described in Chapter 2. Each of the long-term alternatives being considered will result in the same number of bridge openings and the bridge will, on average, be open for the same duration. Therefore, the mobility analysis described previously in Section 4.2.2 related to the No Build Alternative is consistent with the results of intersection LOS, volume to capacity ratio, queue lengths, and travel time and delay analysis for Alternative 3D.

BICYCLE & PEDESTRIAN MOBILITY/CONNECTIVITY

The width of the existing swing span allows for five-foot-wide sidewalks on both the north and south sides and the roadway shoulders less than two feet in width. The rest of the corridor has a slightly wider ROW, but it is still not wide enough to accommodate five-foot-wide bike lanes. Consequently, bicyclists and pedestrians both use the sidewalks along the bridge corridor segment.

Most pedestrian/bicycle use of the bridge occurs on the southern sidewalk since this sidewalk directly connects to the New Bedford downtown and waterfront. A new pedestrian ramp was completed in 2014 as part of a new roadway ramp from northbound Route 18 to eastbound Route 6. Between the New Bedford and Fairhaven shorelines, pedestrian and bicycle connectivity is difficult due to a lack of secure crossings, ramps, and gaps in the sidewalk network.

Because of these access challenges and safety concerns, pedestrian and bicyclist use of the bridge is currently limited. During the peak hour counts conducted for the study, only one pedestrian was observed to walk the entire length of the bridge between New Bedford and Fairhaven. During the warmer months, it is understood that pedestrian and bicycle use is more frequent and increases during non-peak auto hours.

Like all of the build alternatives, Alternative 3D allows for a wider bridge with a 64-foot-wide ROW. This bridge width allows for the construction of four 11-foot-wide vehicular travel lanes, two five-foot-wide bike lanes, and two five-foot-wide sidewalks. However, while Alternative 3D provides improved facilities compared to the No Build Alternative, the delay for bicyclists and pedestrians will not change as it is controlled by the frequency and duration of bridge openings, which will not change from the current condition.

4.9.3 Safety

Improving roadway, pedestrian, bicycle, and marine safety, reducing conflicts between transportation modes, and increasing emergency vehicle access are important considerations for evaluating the long-term alternatives. This section provides an overview of the key safety concerns that will be addressed by Alternative 3D.

CONFORMANCE WITH AASHTO AND MASSDOT STANDARDS

For a bridge and approach roadway to be safe for vehicular traffic, it must be geometrically adequate. This consideration takes into account the number of lanes, lane and shoulder widths, approach roadway widths, horizontal clearances to roadside obstacles, stopping sight distances, vertical clearances and more. The standards for these criteria are identified in the AASHTO *Policy on Geometric Design of Highways and Streets* and the MassDOT *Project Development and Design Guidebook* (2006). Alternative 3D will conform to these standards with no known variance required.

DELAY TO EMERGENCY VEHICLE ACCESS

Both New Bedford and Fairhaven provide fire and emergency services to their respective municipalities. In case of bridge closure, Pope's Island can receive service from Fairhaven via the east bridge. St. Luke's Hospital in New Bedford is the only facility in the two municipalities that provides emergency services. Bridge closures can affect Emergency Medical Services (EMS) access to the hospital from Fairhaven. Alternative 3D will not affect the level of access or potential for delay of emergency vehicles compared to the No Build Alternative.

IMPACT TO HIGH VOLUME BICYCLE AND PEDESTRIAN LOCATIONS

A sidewalk runs along the entire length of the north and south sides of the Route 6 Corridor between MacArthur Drive in New Bedford and Middle Street in Fairhaven. When the current roadway construction is completed in 2015, the roadway shoulders will be widened by reducing the vehicular travel lane width. In Alternative 3D, the new bridge cross section will include both widened roadway shoulders and sidewalks. However, even though Alternative 3D provides additional pedestrian and bicycle facilities, high pedestrian or bicycle volumes are not seen on the bridge and are not anticipated in the future. Alternative 3D will have no impact to high volume bicycle or pedestrian locations.

IMPACT TO SAFE NAVIGATION

Due to the existing navigational width of the channels at the existing bridge, safe vessel navigation through the bridge is a serious concern and a significant constraint to the North Harbor. Concerns for safe navigation have resulted in vessel limitations, which have resulted in delays and additional costs for commercial vessels.

Navigation through the bridges 94- and 95-foot-wide channels is the primary concern for large commercial vessels. These vessels generally employ harbor tugs for ship assist when maneuvering through the harbor and the bridge. Even with the tugs, limitations are still in place for transiting through the bridge. These include wind speed, visibility, and daylight.

- Wind speed is the primary concern that limits vessels ability to pass through the bridge. In all cases, if the wind exceeds 25 knots, no large vessel will transit the bridge. If the vessel is over 400 feet in length, this may be reduced to as little as 12 knots given the direction and based on the pilot’s discretion.
- No vessel will transit through the bridge if the visibility is less than one nautical mile. Although large vessels don’t enter the harbor though the hurricane barrier if visibility is limited, changes in visibility can occur rapidly in the harbor due to fog or heavy precipitation.
- Vessels greater than 500 feet in length or over 80 feet in width transit through the bridge and hurricane barrier in daylight only.

When transiting the current bridge, there is limited room for larger vessels to maneuver, especially north of the bridge between Fish Island and Pope’s Island. Vessels approach slowly and then increase speed as they enter the bridge opening to ensure that they can exercise better control of the vessel through the passage. The limited maneuvering space on either side of the bridge is complicated by the fact that typically ships approach the bridge on an angle due to slow approach speeds. This angle further reduces any free space between the vessel and the bridge as the vessel is moving through. The swing span’s central pivot point, associated piers, and fendering system are located approximately in the center of the federal deep-water channel. This makes the bridge, in the perspective of the pilots, the most vulnerable navigation safety area in the harbor.

When larger ships head northbound through the bridge, limited space is available for stopping or maneuvering once they pass the bridge. Generally, two tugs are employed; one at the bow and one at the stern, but only one can assist once the vessel is in the bridge opening due to the width of the channel. The forward tug goes through the bridge first and can come back alongside once the bow clears. Proceeding northbound, once the vessel passes through the bridge and enters the basin, it must slow and stop before being maneuvered into a berth.

Generally, vessels do not require tugs on transiting southbound. When departing southbound, the vessel leaves the berth and turns in the basin in a manner that allows it to line up with the west channel that is used most of the time. Once lined up, it transits the opening and maintains its alignment with the federal deep-water channel.

While the No Build Alternative does not provide any change from the existing condition, Alternative 3D will result in significant improvements to safe navigation through the bridge. The 200 feet of horizontal clearance would mitigate many of the safe navigation concerns, most notably the wind restriction, which has a significant impact on vessel delay. The wider clearance would allow for full tug assistance throughout the bridge transit and would also minimize the impact of the limited maneuverable space in the North Harbor, which will not change as a result of the project.

4.9.4 Environment

The following section presents the potential for impacts to the natural environment from Alternative 3D. Compared to the No Build Alternative, Alternative 3D has more potential to impact coastal, wetland, and natural resources due to the required in-water construction. The following sections provide a screening-level assessment, therefore additional and more in-depth analyses of resource impacts would be required, per the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA), as the designs for the bridge progress.

IMPACT TO COASTAL RESOURCES

Coastal Zone Impacts

The New Bedford-Fairhaven Bridge is located within the designated coastal zone of the Commonwealth of Massachusetts; therefore, this project may be subject to a federal consistency review to ensure that the proposed project would be consistent with the enforceable policies of the federally approved coastal management program of the Commonwealth.

The construction required to raise the elevation of the approach on Fish Island under Alternative 3D has the potential to affect Chapter 91 Tidelands located on the eastern side of the island. A Chapter 91 Waterways authorization from the Massachusetts Department of Environmental Protection (MassDEP) may be required for the construction of new bridge structure.

Within its policy documents, the Massachusetts Office of Coastal Zone Management (CZM) strongly encourages early coordination with the agency to determine the appropriate level of coastal review that would be required for projects. Coordination with CZM should be undertaken during any future NEPA and MEPA phases of the project.

Floodplains

The proposed bridge would be located within the 100-year floodplain. Alternative 3D would require limited in-water construction work as the new bridge would be constructed on piles instead of on piers. This has limited potential to affect the 100-year floodplain and flood levels within this area. Flooding and construction within the 100-year floodplain is under the jurisdiction of CZM. Therefore, coordination with CZM would be needed in future phases of the project to determine the extent of potential impacts to the 100-year floodplain and the applicability of coastal hazard policies to this project.

Hazardous and Contaminated Materials

New Bedford Harbor has been designated as a Superfund Site and is currently undergoing an extensive clean-up effort by the EPA. Alternative 3D would require limited in-water construction work as the new bridge would be constructed on piles instead of on piers. Because of this, Alternative 3D requires less disturbance to the harbor floor and significantly less soil and sediment disturbance than the vertical lift and bascule (standard) build alternatives. However, all of the build alternatives have greater impacts than the No Build Alternative due to the in-water soil/sediment disturbance that would be expected from the removal of the existing swing span center pier structure.

As any designs for the bridge progress, coordination would be undertaken with the EPA and the MassDEP to determine the amount of disturbance anticipated during construction, options for mitigation and minimization, and for the appropriate disposal of the contaminated sediments.

IMPACT TO WETLAND RESOURCES

A small area of rocky intertidal wetlands is located on the western shore of Pope's Island. Temporary disturbance resulting from the construction of Alternative 3D may potentially affect this wetland type. Additional field verification of this wetland type, as well as consultation with the USACE and MassDEP, would be needed in future phases of this project to determine the extent of this resource.

Potential impacts to water quality may occur from the disturbance and removal of contaminated sediments from New Bedford-Fairhaven Harbor during construction. Coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination.

Proper erosion and sedimentation controls, as well as stormwater pollution prevention best management practices (BMPs), would be implemented during the construction phase to prevent or avoid any potential impacts to the wetlands and aquatic species known to reside within them. Examples of BMPs include silt fencing, biotubes, and regulated construction entrances. Consultation with USACE and MassDEP regarding avoidance and minimization of potential impacts as well as permitting requirements should be undertaken during any future phases of this project.

As project development progresses, special consideration should be given to the location of construction staging areas on Pope's Island. Coastal bank bluff and sea cliff wetlands form the southern shores of Pope's Island and the placement of construction staging areas within or adjacent to these wetlands should be avoided.

IMPACT TO NATURAL RESOURCES

Alternative 3D would not result in any impacts to Areas of Critical Environmental Concern (ACEC), prime farmland soils, or aquifers. Alternative 3D has the potential for temporary impacts to water quality, shellfish and fish habitat, and priority habitats as a result of construction.

Water Quality

Alternative 3D requires less in-water construction work than the vertical lift and bascule (standard). However, the potential impacts to water quality would greater than the No Build Alternative due to the in-water soil/sediment disturbance that would be expected from the removal of the existing swing span center pier structure.

Coordination with the EPA and MassDEP would be undertaken in later phases of this project to determine the appropriate measures that would be required to minimize and/or mitigate potential impacts from contamination. Additionally, proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to water quality from construction activities.

Shellfish and Fish Habitat

Alternative 3D has the potential to result in temporary impacts to shellfish and fish habitats from the construction of the proposed bridge. Since New Bedford Harbor has been designed as a shellfish growing area, coordination may be needed with MassDEP to ensure that construction activities do not disrupt active shellfish spawning grounds. Proper erosion and sedimentation controls as well as stormwater pollution prevention BMPs would be implemented during the construction phase to prevent or minimize any additional potential impacts to shellfish and fish habitats from construction activities.

Although the consumption of fish and shellfish caught in the New Bedford Inner Harbor is regulated by the Massachusetts Department of Public Health (MDPH), consultation with the National Oceanographic Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) should be undertaken during future phases of this project to determine the presence of Essential Fish Habitats (EFH) within New Bedford-Fairhaven Harbor.

Priority Habitats

Alternative 3D is not anticipated to impact priority plant or animal habitats. However, additional field verification and/or consultation with the U.S. Fish and Wildlife Service

(USFWS) and MassDEP may be required in future phases of the project to verify the presence of state and federally listed plant and animal species and habitats.

IMPACTS TO AIR QUALITY AND GREENHOUSE GASES FROM IDLING VEHICLES

None of the long-term alternatives, including the No Build Alternative, would increase traffic volumes on the corridor as compared to the 2035 No Build Condition described in Chapter 2. The number of bridge openings would remain the same. Consequently, none of the long-build alternatives has the potential to worsen air quality compared to the 2035 No Build Condition. In future phases of the project, a formal air quality evaluation (microscale or mesoscale) would be required to determine the proposed project's impacts as compared to the National Ambient Air Quality Standards (NAAQS).

In Alternative 3D, the addition of bicycle and pedestrian facilities along the Route 6 Corridor, including along a new movable span, may have the potential for localized air quality benefits. The addition of these facilities has the potential to shift some motorists to non-motorized modes, potentially reducing the number of idling cars at bridge openings.

Potential temporary impacts to air quality would be anticipated from construction activities. BMPs would be implemented during construction to minimize vehicle emissions and manage fugitive dust. Typical air quality mitigation measures implemented during construction could include dust suppression and control methods to minimize fugitive dust on dry and windy days.

IMPACTS FROM NOISE

Since traffic volumes are not anticipated to increase substantially over existing levels, Alternative 3D is not anticipated to result in noise impacts to nearby noise-sensitive receptors. However, a formal noise assessment in compliance with the FHWA would be required in any future phases of this project.

Potential temporary noise impacts would result from construction activities and the operation of construction equipment. BMPs would be implemented during construction to mitigate potential noise impacts (particularly during non-daytime hours).

4.9.5 Land Use & Economic Development

NUMBER/VALUE OF BUSINESSES PERMANENTLY IMPACTED

The design of the Alternative 3D bridge utilizes primarily the same footprint as the existing swing span and will not require the acquisition of any additional property or ROW. Furthermore, the operation of the new moveable span will not vary dramatically in a way that would functionally affect the operation of area businesses and would not result in the reduction of the number of jobs. With absence of physical ROW changes and business operational impacts, no business or related property impacts or acquisition is anticipated due to physical or functional impacts.

SHIPPER COST SAVINGS

A variety of both landside and maritime benefits were considered to assess the economic benefits of the long-term build alternatives, including Alternative 3D. While some may be quantified, others are more difficult to count and therefore the analysis considered both quantitative and qualitative benefits.

As a first step in the assessment, the potential benefits that could be generated by a new bridge were inventoried. In similar projects, automobile and truck benefits are often included, such as reduced travel time, vehicle operating cost savings, and emissions reduction, among others. On the marine side, moveable bridge improvements can affect shipper costs, travel time, and similar factors.

A thorough review of potential benefits indicated few differences between the 2035 No Build Condition and Alternative 3D in terms of quantifiable benefits. This is due to the relatively small variation between the proposed alternatives and the existing condition in most aspects of transportation. The lack of impact to existing and future traffic conditions results in no benefits from reduced travel time, vehicle operating cost savings, and emissions reduction. However, the change in horizontal clearance for vessels between the existing bridge and Alternative 3D is a significant change. The existing bridge provides a maximum horizontal clearance of 95 feet, while the horizontal clearance for Alternative 3D is 200 feet. Alternative 3D has no limitations on the vertical clearance of vessels.

This analysis only considers the benefits directly related to the bridge, an approach consistent with USDOT benefit-cost analysis guidance. While there is potential for additional economic development at the North Terminal and in the North Harbor, the chosen bridge alternative is only one component of that potential growth. As a result, it would be disingenuous to attribute that economic development potential *exclusively* to the new bridge. Additionally, when looking for the true differences between bridge alternatives, it is important to examine only the benefits associated directly with the bridge.

Landside Benefits

Traditional benefits associated with bridge improvements include both landside and maritime components. In the case of the proposed alternatives, no landside impacts were found. Each of the alternatives maintains the same bridge opening duration and creates no difference in general vehicular, bicycle, or pedestrian traffic operations. In other words, an automobile driver who uses the bridge today would discern no improvement in travel time, or achieve any other transportation related benefits, with a new bridge. Similarly, pedestrian and bicycle traffic would observe no change in their travel time.

It is important to note that the duration and methods for construction may cause various delay or diversion impacts during the construction period. However, no impact was quantified as the transportation analysis showed no discernable diversion patterns that could be analyzed. The construction phase impacts will include a limited road closure while the bridge is being installed along with lane closures for the duration of the construction. It is anticipated that during bridge closures, detours and notifications by area ITS systems will be provided to minimize impacts to drivers. While the impacts cannot easily be quantified, it should be noted that the longer closures will have a greater potential for detrimental impacts to local businesses and diversion costs for roadway users.

Since it was determined that the bridge improvement would have minimal or no impact on long-term landside traffic and pedestrian patterns, no landside benefits were quantified or included in the benefits analysis.

Maritime Benefits

A series of interviews were held with maritime users to determine how the current bridge affects their operations and to identify the ways in which a new bridge could positively affect them. As discussed in Chapter 2, wind and its impact on the navigability through the bridge opening is a critical issue facing maritime users. For this analysis, maritime benefits are primarily due to a reduction in shipper costs associated with delays within New Bedford Harbor. Changes in the use of tugs with Alternative 3D were also considered as a potential benefit. Discussions with maritime experts indicated the tugs used are "ship assist" tugs that primarily aid with alignment to the berth. Accordingly, they will still be required for all large cargo vessels that berth in the North Harbor regardless of the selected alternative and no change to tug costs will occur for larger vessels.

The greatest difference between the No Build Alternative, which retains the existing clearance, and the build alternatives is the horizontal navigational clearance. The No Build Alternative maintains the 95 feet of horizontal navigational clearance, which creates issues for the large vessels that enter the North Harbor. When there are high winds, these vessels cannot transit the bridge until the wind speeds are lower, as there is not enough clearance to pass safely through in high wind conditions.

With Alternative 3D, the horizontal navigational width would be 200 feet. This width would remove the need for larger vessels to remain moored south of the bridge should high winds prevail. In the past year, three of the 12 vessels were delayed for one day during their trip to New Bedford due to the existing bridge constraint. It is understood that each day of delay costs the shipper $40,000. Under existing conditions, approximately 25 percent of vessels are delayed for a full day, costing shippers a total of $120,000 per year. With Alternative 3D, no ships would experience delay, which results in an average savings of $120,000 per year in shipper costs. Assuming that users of the harbor factor into their overall decision-making the potential cost of delay, the widening of the horizontal clearance would reduce the general cost of using the harbor.

Historically, up to 30 vessels have called upon the port in a single year. This is considered a reasonable upper limit, based on interviews conducted with key maritime users. Assuming that the bridge improvement induces vessel calls to meet this historic high, benefits associated with a reduction in delay time would be generated. These new vessels, however, are not currently using the Port of New Bedford. Rather, they are a projection of potential. As a result, and consistent with economic consumer surplus theory, the benefit they receive would be half of the benefit to existing users.

The change from 12 to 30 trips represents a portion of all potential vessels that did not use the Port of New Bedford under the existing conditions, but that would be "attracted" to New Bedford because the risk of delay and associated costs are mitigated with the wider horizontal clearance. The benefits to these additional vessels are estimated using the "rule of one-half," indicating the change in consumer surplus associated with the removal of the risk of delay. In a future year with 30 total vessels, this would result in a benefit of $20,000 per vessel for the 18 additional vessels, or a total of $360,000.

Summary of Benefits

Table 4.29 summarizes the average annual benefits associated with Alternative 3D as compared to the current conditions that would be maintained under the No Build Alternative. As discussed above, no landside benefits were identified or quantified. Additionally, there would be no change in the number of tugs that would be required, so the total costs would remain the same. The benefits generated by any of the new bridge alternatives is estimated to be $480,000 with delay costs representing $120,000 and savings to new cargo vessels $360,000.

Table 4.29. Average Single-Year Benefits of Bridge Replacement Alternatives

Benefit Category	Annual Savings (2015$)
Landside Transportation Savings	$0
Delay Cost Savings	$120,000
Savings to New Cargo Vessels	$360,000
Change in Tug Costs	$0
Total Benefits	$480,000

4.9.6 Community

The impacts to community resources, such as open space, recreational areas, or historic or cultural resources were also evaluated for Alternative 3D. Additionally, access to businesses along the corridor and impacts to Environmental Justice (EJ) populations were evaluated. The study team also considered the visual impacts of a new bridge structure.

IMPACT TO PROTECTED AND RECREATIONAL OPEN SPACE

Alternative 3D would not result in any impacts to protected and/or recreational open space. An evaluation of publicly owned parklands, per Section 4(f) of the Department of Transportation Act of 1966, would be required for any future phases of this project.

As the project development phase continues and the designs for the bridge progresses, special consideration should be given to the location of construction staging areas. Marine Park on Pope's Island is owned and operated by the City of New Bedford and occupies the southern half of the island, but should not be used for construction staging.

IMPACT TO CULTURAL/HISTORIC/ARCHEOLOGICAL RESOURCES

Under Alternative 3D, the middle bridge's swing span of the National Register-eligible New Bedford-Fairhaven Bridge would be replaced with a double-leaf Dutch-style bascule. The loss of the center span would diminish the integrity of this historic property.

In addition to direct effects to the New Bedford-Fairhaven Bridge, there is the potential for indirect visual effects to historic properties that lie within the larger study area. A portion of the through truss of the existing swing span is visible as a component of the urban/industrial landscape from both the Schooner Ernestina, located on the New Bedford waterfront, and buildings that lie along the eastern edge of the New Bedford Historic District (see Figure 2.11). Both the Schooner Ernestina and the New Bedford Historic District are National Historic Landmarks.

In the closed position, the beam and counterweights would be approximately the 55 feet above the roadway surface, approximately the same height as the existing truss. The massing of Alternative 3D would be reduced, with a tri-pod support structure on each end of the moveable span to support beams and the counterweight that are located above the roadway surface. They would also be somewhat similar in massing when viewed from the New Bedford Historic District and the Schooner Ernestina. When open, the two movable spans would rise 48 feet above the top of the existing truss and would appear as a prominent visual feature on the skyline. While the replacement of the swing truss with a double-leaf Dutch-style span would alter the visual setting of these two historic properties, it is not anticipated that this would adversely affect these resources given both the distance between the properties and the bridge, and the visual complexity of the viewshed.

Regardless of which long-term alternative is selected, FHWA will need to initiate consultation with the MHC in accordance with Section 106 of the National Historic Preservation Act. Consultation should also be undertaken with the New Bedford and Fairhaven Historical Commissions. Through this consultation, additional historic properties that may be eligible for, but are not yet listed in, the National Register of Historic Places will be identified. The potential for effects to archeological resources will also be determined. FHWA, working together with the MHC, will seek ways to avoid, minimize, or mitigate adverse effects beyond the HAER documentation that has already been completed. In addition to consultation under Section 106, the preparation of a programmatic 4(f) evaluation, in compliance with the U.S. Department of Transportation Act of 1966, will be required.

IMPACT TO BUSINESS ACCESS

The parcels surrounding the approaches to the middle bridge include the following businesses:

- Bridge Shoppes shopping center;
- Captain Leroy's marina;
- Maritime Terminals facility;
- AGM Marine Contractors, Inc.; and
- Tucker Roy Marin Towing and Salvage.

Alternative 3D does not include any modifications to the bridge approaches and utilizes the existing footprint. The horizontal alignment of the road and access to abutting properties will remain the same.

IMPACT TO ENVIRONMENTAL JUSTICE POPULATIONS

The locations of Environmental Justice (EJ) populations were identified in Chapter 2. Some EJ populations reside in neighborhoods that abut or are adjacent to the New Bedford-Fairhaven Bridge. Residential clusters of EJ populations reside at the western edge of the local study area in New Bedford and EJ populations (low-income) also reside throughout the local study area within Fairhaven. Consequently, an evaluation of the potential for disproportionately high and adverse human health or environmental effects of the project alternatives on minority populations and low-income populations, per *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, would be required in future phases of the project to comply with NEPA and MEPA.

Bicycle and pedestrian improvements in Alternative 3D have the potential to substantially improve the ability of EJ populations, who may not own or have access to automobiles, to get across the bridge to access employment or other key destinations. The greatest potential for impacts to EJ populations would occur during construction. Under Alternative 3D, the construction phase would be approximately two years long. The bridge would be closed to vehicular, bicycle, and pedestrian traffic for three months. No transit service currently operates across the bridge.

Alternative 3D also has the potential to result in other temporary construction impacts to the EJ populations located in close proximity to the proposed bridge. Potential impacts could include noise, glare, fumes, and dust from construction equipment as well as changes in traffic patterns and access to businesses due to the movement of construction vehicles. Potential construction period impacts would be mitigated with BMPs for construction activities including those used to minimize dust, noise, maintenance, and protection of traffic plans, and limiting the hours of construction. Further analyses under NEPA and MEPA would be required to determine if construction-related impacts would be disproportionately higher on low-income and minority populations.

Alternative 3D, along with all of the long-term build alternatives, has the same proportion of impacts to EJ populations compared to non-EJ populations.

VISUAL IMPACTS

The visual impacts from Alternative 3D would be limited. When the bridge is in the down position, it would look have a similar visual impact as the existing swing bridge as both are approximately 55 feet above the roadway surface. The existing truss structure will be replaced with a beam and counterweight located above the roadway. The counterweight is typically a large concrete block, although it may be possible to include some aesthetic or iconic masking of the block. When the bridge is in the up (or open) position the two bridge leaves would extend approximately 118 feet high above the roadway surface or 138 feet above the water line. This is approximately 48 feet above the top of the existing truss. Although the bridge would be visible from a greater distance while in the up position, the topography and the significant development that surrounds the harbor would shield the view of all but the top of the bridge deck in the up position from most locations.

4.9.7 Alternative Feasibility

CAPITAL COST

The estimated cost for Alternative 3D is between $100 and $125 million. This capital cost would include the bridge design and permitting, removal and demolition of the existing swing bridge and construction of the new bridge. Limits of construction would be generally limited to the 289-foot length of the existing swing span with modifications to the approach spans limited to raising the approaches to provide the necessary under bridge clearances. It is estimated that this work would all be done utilizing the existing piers and newly reconstructed pier caps.

It is assumed that dredging and disturbance of the harbor sediments would be limited to construction of the piers and fendering system and removal of the existing swing bridge center pier structure. A more detailed cost estimate would be developed as additional information regarding subsurface conditions, bridge specifications, and design details are developed through the project development process.

OPERATING AND MAINTENANCE COSTS

Upon completion of construction, Alternative 3D will require both routine maintenance and daily operating costs. Table 4.30 provides the estimated annual costs required to operate and maintain the bridge, which are the same as the other double-leaf alternatives that have two mechanical units to operate and maintain.

Table 4.30. Alternative 3D Annual Operating and Maintenance Costs

Operating Costs	Type	Annual Cost (2015$)
Operating Cost	Electricity utility	$ 100,000
Operating Cost	Stand by generator	$ 2,600
Operating Cost	Bridge operators	$300,000
Routine Maintenance	Monthly bridge lubrication	$ 27,600
Routine Maintenance	Replace lamps	$ 1,500
Routine Maintenance	Replace gate arms	$ 18,000
Routine Maintenance	Miscellaneous minor repairs	$ 20,000
Routine Maintenance	Guard rail repairs	$ 20,000
	TOTAL	$ 489,700

In addition to the annual operating and maintenance costs identified above, the Alternative 3D bridge will require major repairs to be conducted on a regular basis to maintain the bridge in a state of good repair and ensure its on-going utility. The schedule of major repairs included in

Table 4.31 is an estimate of repairs that is typical for rolling bascule bridges in similar environments. Over a 50-year span, it should be anticipated that approximately $12.1 million worth of repairs (in 2015 dollars) will be required.

Table 4.31. Alternative 3D Schedule of Major Repairs

Year	Work Performed	Cost (2015$)
10	Fender repairs	$ 250,000
15	Minor Structural repairs Deck repairs	$1,000,000 $ 250,000
25	Electrical control repairs Minor Structural repairs Fender repair Control House repairs	$ 700,000 $ 1,000,000 $ 250,000 $ 100,000
30	Deck repairs	$ 250,000
35	Replace traffic gates Electrical system rehabilitation Structural rehabilitation Substructure repairs	$ 300,000 $ 1,500,000 $ 2,000,000 $1,000,000
40	Fender repairs Machinery rehabilitation	$ 250,000 $3,000,000
45	Deck repairs	$ 250,000
	TOTAL	$12,100,000

CONSTRUCTION PHASE TRANSPORTATION IMPACTS

The construction phase of Alternative 3D would be a little over two years, or approximately 26-28 months. This alternative would allow two lanes of the roadway to remain open for most of the time to vehicular traffic. A full roadway shutdown would be required for approximately three months to allow to modification of the bridge approaches and to bring in the new bridge leaf. One of the two existing navigational channels would be open for most of the construction duration. However, one navigational closure would be required during a single long-weekend, which would occur in month 21 of construction. The new 200-foot-wide channel would then be open during the following month.

CONTRUCTION PHASE IMPACTS TO ABUTTING LAND OWNERS/BUSINESSES

The construction phase of each long-term alternative has the potential to impact area businesses due to the change in access during that period. During the two-year-long construction phase of Alternative 3D, two vehicular lanes would remain open. Alternative 3D requires the roadway to be closed completely for a three-month period to allow for the removal of the existing swing span and the installation of the new rolling span. This road closure would likely result in some impacts to area businesses. Due to the longer construction duration and three-month roadway closure, the Alternative 3D impacts would be greater than the No Build Alternative, but would be less than some of the other build alternatives that require even longer roadway closures.

4.10 ANALYSIS OF SHORT/MEDIUM-TERM ALTERNATIVES

In addition to the long-term alternatives for the replacement of the New Bedford-Fairhaven Bridge, a number of short-term (less than five years) and medium-term (less than ten years) improvements have been considered and analyzed as part of the study. These improvements fall into three areas: intersection improvements, bicycle-pedestrian improvements and ITS/signage improvements. The following section identifies the potential improvements and discusses the potential impacts, the benefits, and the costs of each.

4.10.1 Intersection Improvements

Based on the findings of 2035 No Build Condition analysis described in Section 2.10, a detailed future conditions analysis was conducted to address the specific capacity issues and constraints that were identified. The goal of this analysis was to identify specific improvements that would optimize the traffic flow along the Route 6 Corridor. For the purpose of this analysis, the Route 6 Corridor includes the segment between Cottage Street in New Bedford and Adams Street in Fairhaven. The focus of the analysis was on the signalized intersections with approaches that currently operate at a mid LOS D or worse.

The following section provides a description of proposed improvements by intersection, an assessment of the resulting improvements to the intersection level of service, and a summary of overall travel time improvements by direction and by peak hour.

PROPOSED SHORT-TERM IMPROVEMENTS

The study team identified a number of signal-related intersection improvements that would not require significant capital costs or ROW acquisitions. As described in this section, signal-timing splits, phasing, coordination offsets, or cycle lengths changes are proposed for each of the nine corridor intersections. Since these changes are relatively quick to implement with minor costs and could provide immediate benefits to operations along the corridor, they are designated as short-term improvements. These improvements are expected to benefit the corridor if long-term closure of the bridge is required for construction.

Table 4.32 summarizes the proposed signal changes for each of the nine intersections along the Route 6 Corridor.

Table 4.32. Description of Proposed Signal Changes

Intersection	Peak Hour	Cycle Length	Timing Splits/Phasing	Coordination Offset
Kempton Street & Cottage Street	AM Peak	Increased from 80 sec to 90 sec	North/south decreased from 34 sec to 27 sec. Westbound increased from 30 sec to 47 sec.	No Change
Mill Street & Cottage Street	AM Peak	Increased from 80 sec to 90 sec	North/south decreased from 33 sec to 27 sec. Westbound increased from 34 sec to 50 sec.	Changed from 2 sec to 10 sec
Mill Street & County Street	PM Peak	Increased from 75 sec to 80 sec	North/south decreased by 3 seconds. Westbound increased from 25 sec to 33 sec.	Changed from 0 sec to 64 sec
Kempton Street & County Street	PM Peak	Increased from 75 sec to 80 sec	North/south increased from 38 sec to 43 sec.	No Change
Route 6 & Pleasant Street (Octopus Intersection)	AM Peak	Decreased from 155 sec to 120 sec	East and west split phase decreased from 30 sec and 35 sec, respectively to a concurrent NEMA phase of 57 sec. North and south split phases of 35 sec each, increased to concurrent NEMA phases of 48 sec and 36 sec, respectively. Northbound has a 12 sec lead-time.	No coordination
Route 6 at Pleasant Street (Octopus Intersection)	PM Peak	Decreased from 155 sec to 120 sec	East and west split phase decreased from 30 sec and 35 sec, respectively to a concurrent NEMA phase of 42 sec. North and south split phases of 35 sec each, increased to concurrent NEMA phases of 57 sec and 42 sec, respectively. Northbound has a 15 sec lead-time.	No coordination
Main Street & Huttleston Avenue	PM Peak	No Change	Eastbound decreased from 52 sec to 43 sec. Westbound decreased from 33 sec to 27 sec. North/south increased from 30 sec to 39 sec.	No Change
Middle Street & Huttleston Avenue	PM Peak	No Change	East/west decreased from 60 sec to 51 sec. Northbound increased from 30 sec to 39 sec.	No Change
Adams Street & Huttleston Avenue	AM Peak	No Change	Southbound lead decreased from 15 sec to 8 sec. North/south increased from 14 sec to 21 sec.	No Change

Note: NEMA stands for National Electrical Manufacturer's Association. NEMA Phasing is typical traffic signal phasing

Kempton Street and Cottage Street

During the AM peak hour, the southbound Cottage Street approach at Kempton Street will change from a LOS C under the 2014 Existing Condition to a LOS E under the 2035 No Build Condition. To improve this condition, an increase in cycle length and timing split modifications are proposed for this intersection. A change in cycle length, timings, and offset at the upstream intersection of Mill Street and Cottage Street will also help the LOS of this intersection. This improved coordination in the north/south direction will result in a better LOS C in the southbound direction in the 2035 Build Condition.

Mill Street and Cottage Street

During both AM and PM peak hours, all approaches at this intersection operate at mid LOS D or better during the 2035 No Build Condition. However, to achieve better traffic coordination in the north/south direction and improve southbound approach at the Kempton Street/Cottage Street intersection, cycle length, timings, and offset changes are proposed. As noted in Table 4.32, the cycle length will be lengthened, timing splits will be adjusted, and offsets will be modified. Due to the proposed improvements, the intersection would continue to operate at the same LOS (LOS B) as in the 2035No Build Condition, during both AM and PM peak hours. However, the average delay is two seconds shorter during the AM peak hour.

Mill Street and County Street

During the PM peak hour, the southbound County Street approach will change from a LOS D under the 2014 Existing Condition to a LOS F under the 2035 No Build Condition. To improve this condition, an increased cycle length, timing split changes, and offsets are proposed. A similar change in cycle length and timings is proposed at the downstream intersection of Kempton Street and County Street. This improves coordination in the north/south direction and thus provides a better LOS D in the southbound direction in the 2035 Build Condition.

Kempton Street and County Street

During both AM and PM peak hours, all approaches at this intersection operate at mid LOS D or better during the 2035 No Build Condition. However, to achieve better traffic coordination in the north/south direction and improve southbound condition at the Mill Street/County Street intersection described above, the cycle length, timings, and offset are proposed to be changed. As noted in Table 4.32, the cycle length will be increased and north/south timing splits will be increased. Due to the proposed improvements, the intersection would continue to operate at the same LOS (LOS B) as in the 2035 No Build Condition, during both AM and PM peak hours. However, the average delay is 1.5 seconds shorter during both peak hours.

Route 6 and Pleasant Street ("Octopus Intersection")

During both AM and PM peak hours, all approaches at this intersection operate at a LOS E or worse and the overall intersection will operate at LOS F under the 2035 No Build Condition. This intersection currently operates with split signal phasing that allows traffic from each approach to go at the same time. An exclusive pedestrian phase is also available. This results in a high cycle length of 155 seconds, which causes inefficient operation and high delays.

The proposed signal timing will combine north and south traffic movements into one concurrent NEMA phase. The same would be true for east and west traffic movements. In addition, the exclusive pedestrian phase would be distributed among the concurrent phases to operate in conjunction with each non-opposing signal phase. This results in a reduced cycle length of 120 seconds, thus optimizing the operations at the intersection as well as reducing the delays on all approaches. The LOS and delays described in Tables 4.33 and 4.34 include these improvements.

As part of the *Pleasant Street-Kempton Street-Mill Street-Sixth Street-Route 6 Intersection Study* (December 2012, the Southeastern Regional Planning and Economic Development District (SRPEDD) recommended a concurrent pedestrian and traffic phasing for this intersection, which supports the choice of pedestrian phasing recommended in this study.

Additionally, SRPEDD looked at closing the Route 18 southbound off-ramp to westbound Route 6 as a second alternative and replacing the “Octopus Intersection” with a roundabout as a third alternative to improve this intersection. For the reasons described below, the alternative with closure of the Route 18 southbound off-ramp was deemed expensive and inappropriate for the minimal benefits achieved. The roundabout was ruled out due to lack of enough ROW.

The closure of the Route 18 southbound off-ramp was tested with the split traffic signal phasing that currently exists. With the exclusive pedestrian phase combined into the phasing, timing adjustments did not achieve a significant benefit.

However, it is expected that the Route 18 off-ramp closure combined with the concurrent NEMA traffic phasing and reduced cycle length (recommended in this study) would further reduce delays and improve safety. However, this option was not tested as part of the current study and would need further investigation.

Main Street and Huttleston Avenue

During the PM peak hour, the northbound approach of this intersection would change from a LOS D under the 2014 Existing Condition to a LOS E under the 2035 No Build Condition. The southbound approach would change from a low LOS E under the 2014 Existing Condition to a high LOS E under the 2035 No Build Condition. To improve this condition, the signal timing changes listed in Table 4.32 are proposed for each approach. This will provide a LOS D in both northbound and southbound directions in the 2035 Build Condition.

Middle Street and Huttleston Avenue

During both AM and PM peak hours, all approaches at this intersection would operate at LOS C or better during the 2035 No Build Condition. However, since this intersection is combined in signal operation with the intersection of Main Street and Huttleston Avenue, signal-timing changes are proposed during PM peak hour. The change in operations at this intersection due to the proposed timing changes will be negligible.

Adams Street and Huttleston Avenue

During the AM peak hour, the northbound approach would change from a LOS C under the 2014 Existing Condition to a LOS F under the 2035 No Build Condition. To improve this condition, the signal timing changes are proposed for two approaches at this intersection. This will provide a mid LOS D in the 2035 Build Condition.

CAPACITY ANALYSIS

A capacity analysis with the proposed improvements described above was conducted using Synchro software. An HCM-based methodology was applied to determine the improved future performance metrics such as volume-to-capacity ratio, delay, and LOS. A comparison of performance metrics for the 2035 No Build Condition and 2035 Build Condition is provided in Table 4.33. A detailed table showing improvements on individual approaches at corridor intersections is provided in Appendix F.

Table 4.33. Intersection Delay and LOS Summary, 2035 No Build vs 2035 Build Conditions

ID #	Intersection Name	2035 No Build Condition AM Int. Delay	2035 No Build Condition AM Int. LOS	2035 No Build Condition PM Int. Delay	2035 No Build Condition PM Int. LOS	2035 Build Condition AM Int. Delay	2035 Build Condition AM Int. LOS	2035 Build Condition PM Int. Delay	2035 Build Condition PM Int. LOS
1	Mill Street & Cottage Street	19.2	B	17.0	B	17.9	B	-	-
2	Kempton Street & Cottage Street	34.7	C	14.0	B	27.9	C	-	-
3	Mill Street & County Street	22.6	C	49.6	D	-	-	29.0	C
4	Kempton St & County St	17.5	B	17.5	B	-	-	16.0	B
5	Kempton St/Mill St & Purchase St	87.7	F	112.5	F	32.8	C	40.5	D
6	Huttleston Avenue & Middle Street	9.8	A	11.6	B	-	-	11.6	B
7	Huttleston Avenue & Main Street	26.3	C	28.6	C	-	-	27.3	C
8	Huttleston Avenue & Adams Street	39.1	D	18.1	B	34.0	D	-	-

TRAVEL TIME IMPROVEMENT

To better assess the conditions along the Corridor with the proposed improvements, the travel time along the corridor between Cottage Street and Adams Street was derived using the capacity analysis for the 2035 No Build Condition and 2035 Build Condition. These travel times are compared with the travel times experienced during the 2014 Existing Condition data collection. A comparison of the 2035 No Build Condition and 2035 Build Condition travel times is provided in Table 4.34.

Table 4.34. Route 6 Corridor Travel Time Between Cottage Street and Adams Street

Direction	2035 No Build AM Peak Hour (min.)	2035 No Build PM Peak Hour (min.)	2035 Build AM Peak Hour (min.)	2035 Build PM Peak Hour (min.)	AM Peak Hour (% change)	PM Peak Hour (% change)
Eastbound	7.2	6.5	6.6	5.9	9%	10%
Westbound	8.9	7.5	6.9	6.3	23%	16%

As noted in the above table, the travel times in the 2035 Build Condition are approximately ten percent better in the eastbound direction compared to the 2035 No Build Conditions. Similarly, travel timesavings in the westbound direction are 23 percent and 16 percent during AM and PM peak hours, respectively. The travel times are anticipated to be better than what is being experienced during the 2014 Existing Condition.

Since these improvements are all limited to signal timing changes, it is anticipated that the cost would be limited to the labor costs to make the changes. Depending upon the procedures used to make the changes, costs for traffic-related improvements would be less than $20,000.

4.10.2 Bicycle/Pedestrian Improvements

Based on the assessment of bicycle and pedestrian conditions along the corridor, three potential improvements have been identified. As shown in Figure 4.8, these improvements include:

- A bicycle and pedestrian path along Route 6 from Pleasant Street to Route 18;
- A pedestrian ramp and staircase to replace staircase on north side of bridge; and
- Completion of sidewalk network along MacArthur Drive, which is the primary pedestrian route from the bridge to the proposed Whale's Tooth Commuter Rail Station.

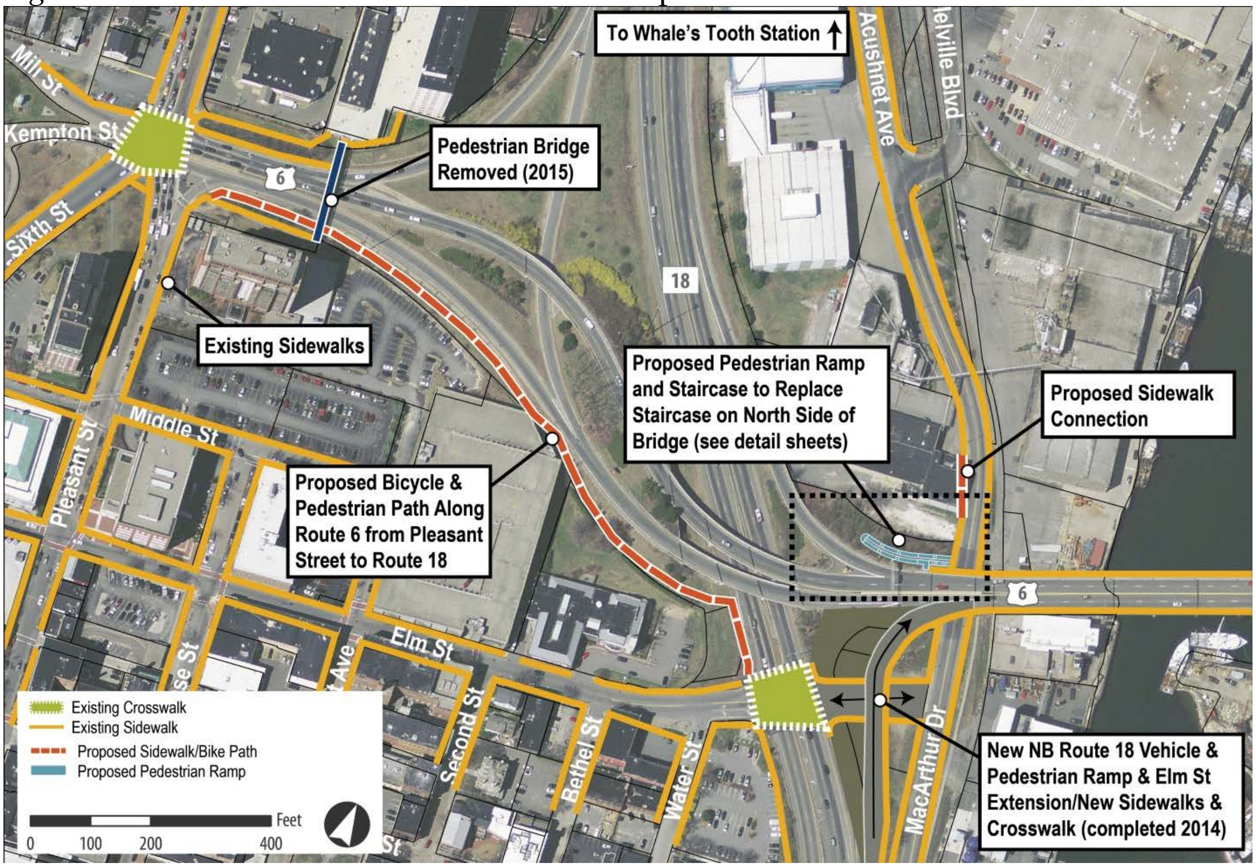
The following is an assessment of costs and impacts for each bicycle or pedestrian improvement.

PROPOSED BICYCLE AND PEDESTRIAN PATH FROM PLEASANT STREET TO ROUTE 18

A pedestrian path that provides a more direct path for pedestrians between the "Octopus Intersection" and the Route 18/Elm Street intersection is proposed for the corridor. The 10- to 12-foot-wide path would be located within on the south side of the existing Route 6 ROW. A four- to six-foot high fence would be installed to provide separation between the eastbound Route 6 travel lanes and ramp and the path.

As described in Chapter 2, the "Octopus Intersection" experiences the highest pedestrian activity along the corridor. During the evening peak hour, 59 pedestrians were counted at Kempton Street/Mill Street and Purchase Street intersection. Providing improved connections between this high pedestrian location and other pedestrian destinations, such as Marine Park on Pope's Island, the future Whale's Tooth Station, and the New Bedford waterfront will improve the pedestrian environment of the area.

Figure 4.8. Route 6 Corridor Bike/Pedestrian Improvements



To connect between these two points, pedestrians have to travel south on Pleasant Street and then east on Elm Street. This route will shorten the walk (or ride) between the two end points by about 400 feet from the current 1,600-foot walk. This would shorten the walk by about 25 percent or two minutes. Although the time and distance savings are not significant, the new route would be much safer as it would avoid the many intersections and driveways along the present route and provide a continuous sidewalk/pathway instead of the existing route along Elm Street, Acushnet Avenue and Pleasant Street. Most notably, pedestrians would avoid crossing the entrances to the Elm Street Garage and the parking lot to the Regency Apartments, which are types of driveways that are particularly unfriendly for pedestrians. The estimated cost for this 0.25-mile long multi-use path is $350,000. To ensure that safety is maintained along the corridor, design of the path will require the appropriate roadway separation, fencing, and lighting. Aside from ensuring that safety is maintained, there are no adverse impacts anticipated from construction of the path.

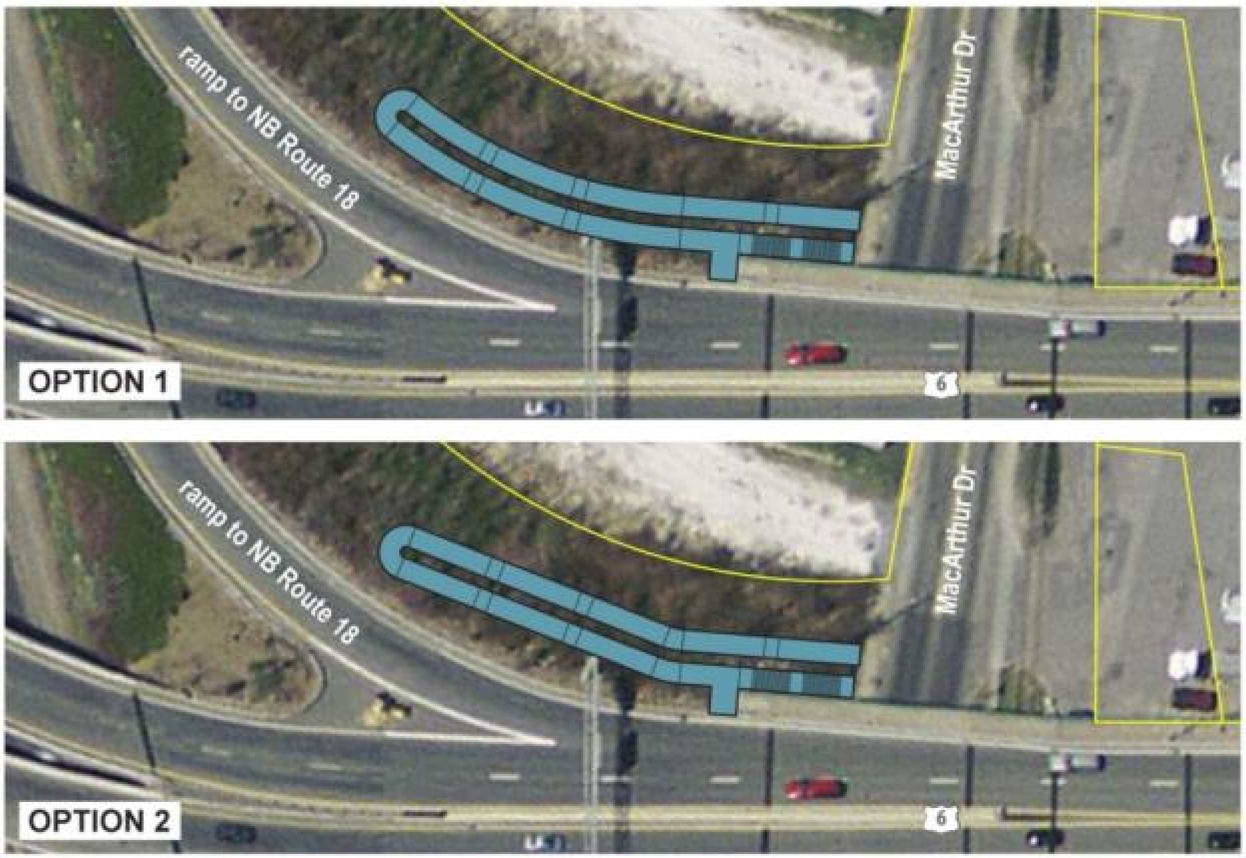
PROPOSED PEDESTRIAN RAMP TO REPLACE STAIRCASE ON NORTH SIDE OF BRIDGE

Upon completion of the ongoing highway work on both Route 6 and Route 18, many of the pedestrian and bicycle facilities will be enhanced and improved. However, the stairs connecting the north side of Route 6 to MacArthur Boulevard are only receiving minor improvements. Reconstructing this connection so that an ADA-compliant ramp system is provided will greatly enhance connectivity in the corridor. This will be especially important upon the completion of the Whale's Tooth Station located further north on Acushnet Avenue, which will be a significant new pedestrian and bicyclist destination in the area.

Due to the significant slope along the edge of the Route 6 ramp, the ramp will require the construction of retaining structures and fencing to ensure stability and safety. The estimated cost for this ramp structure is $450,000. Due to the location of the proposed ramp structure, there are no negative impacts anticipated resulting from construction.

Two different options for the ADA-compliant bicycle/pedestrian ramp are shown in Figure 4.9.

Figure 4.9. Potential Bike/Pedestrian Ramp Options



REPLACEMENT OF SIDEWALK CONNECTION ALONG MACARTHUR DRIVE

As shown in Figure 4.8, a segment of sidewalk is missing along MacArthur Drive just north of Route 6. Limited room exists along MacArthur Drive between the roadway curb line and the adjacent building, located at 255 MacArthur Drive. Currently, there is a beaten path along this segment where pedestrians travel along the grassy area. It is anticipated that with the opening of Whale's Tooth Station, pedestrian activity between the station and downtown New Bedford will increase along MacArthur Drive. It is proposed that a sidewalk be constructed in this important 85-foot long segment to fill the gap in the existing network. By adding this one sidewalk segment, the local pedestrian network will be more complete. The additional sidewalk connection will complement the recent and ongoing improvements to pedestrian facilities that have been made in the area.

Although the estimated construction cost of the sidewalk is limited to $15,000, it is anticipated that funding will be needed for the required additional property rights required for its construction. The pedestrian safety and accessibility benefits of providing this 85 feet of sidewalk are significant for this heavily traveled industrial truck route, with the benefits likely increasing over time with the construction of Whale's Tooth Station.

4.10.3 ITS/Signage Improvements

As previously described, each bridge opening results in vehicular delays between 12.5 to 22.5 minutes. Even though hourly bridge openings are regularly scheduled throughout the day, it has been noted throughout the study that travelers are sometimes unknowingly delayed due to lack of a bridge opening notification. The existing signage, although helpful, does not provide sufficient information regarding the status of a bridge opening to allow for appropriate route selection for many travelers.

Additional signs at locations where travelers can make appropriate detour route selections would benefit travelers. The existing ITS/signage system would result in increased benefits by implementing the following:

- Complete replacement of the existing ITS/sign system associated with the bridge;
- Upgrade of the ITS/sign system to provide additional information regarding travel time to the bridge and bridge status;
- Addition of two signs at the Route 6 and Route 240 intersection to facilitate route diversions along Route 240;
- Addition of a sign on I-195 Westbound to replace signs that were previously removed;
- Addition of a sign on Route 6 at the Adams Street intersection to facilitate route diversions along Adams Street; and
- Addition of a sign that is visible to Middle Street motorists to inform them of bridge closings.

The location of the existing ITS signs and the proposed ITS signs are shown in Figure 4.10.

Figure 4.10. Existing and Proposed ITS Signage Locations

COMPLETE REPLACEMENT OF EXISTING SYSTEM

Complete replacement of the existing ITS/signage system associated with the bridge would benefit travelers by providing a more reliable system. As previously noted the existing system was built with technology that is now outdated and difficult to repair or replace. Replacing the existing system would allow for installation of a variable message system that could be triggered by the bridge operator. Due to the urban context of most of the existing signs, the signs should be limited in size and provide helpful but short messages. These could be similar to the sign shown in Figure 4.11. Design considerations would include the size and location of the sign and the anticipated messages to be included.

Figure 4.11. Roadside ITS/Changeable Signage

To keep the signs small and fit within the context of the area but still provide the necessary information, the signs could be limited to two or three lines and provide information such as:

Next Bridge Closing
Scheduled at 2:15 pm

Bridge Closing
in 5 minutes

Bridge Now Closed
Seek Alt. Route

Bridge Opening
In 5 minutes

This information would benefit area travelers by providing additional information regarding the status of the bridge. The system information would be schedule-based or provided (through a semi-automated system) from the bridge operator. The estimated cost for this type of system is estimated be approximately $750,000 to $1,000,000 and would depend upon the specific sign type and the design for the associated communications system.

EXPAND THE ITS/SIGN SYSTEM

In addition to the signs currently in place, the system could be expanded to provide additional information to travelers at locations where they could make diversion decisions. These system expansion locations are all located in Fairhaven and are shown in Figure 4.10. These additional sign locations would provide information to approaches that currently don't have a bridge warning until the point where it is difficult to make an alternative route selection, or at locations where alternative route selection would be preferred. In locations where the existing changeable message signs are located, during peak hours it was measured that 60 percent of vehicles used a route that did not include the bridge when the signs were indicating the bridge was closed to traffic. At the Huttleston Avenue/Main Street intersection, this range resulted in a 30- to 50-car difference in peak hours. This indicates that travelers are utilizing the information to make route choices. If the system were expanded, the impact of the bridge openings may be reduced through better information regarding travel route options. The estimated cost for the expansion of the system is $400,000.

UPGRADE OF THE ITS/SIGN SYSTEM

The system could be upgraded to include the implementation of the MassDOT "GO Time" System or a similar functionality. In 2012, MassDOT initiated an operational test of a Bluetooth-based real time traveler information system. The system calculates travel time between two or more points along the roadway by using time stamps collected from anonymous wireless devices, and displays these live travel times on roadside portable variable message signs. Based on positive feedback from the initial test, MassDOT proceeded with the development of a statewide expansion. As part of the system rollout, MassDOT is installing travel time signs consistent with *Manual of Uniform Traffic Control Devices*. An example of these signs is shown in Figure 4.12. These signs display the travel time to specific points along the highway. MassDOT currently plans to install this system along I-195.

Figure 4.12. Roadside ITS/Changeable Signage

The changeable signs noted in the section above could be enhanced by an expansion of the “GO Time” system to include the approaches to the bridge. The signs could then include messages similar to the following:

Next Bridge Closing
Scheduled at 2:15 pm
Time to Bridge xx mins

Bridge Closing
in 5 minutes
Time to Bridge xx mins

This information would be relevant for select sign locations , such as those along I-195 or at the Route 6/Route 240 intersection where the distance between the sign would allow for more accurate measurements. Additionally when the bridge is either not open or is in the opening process, the utilization of Bluetooth travel time prediction technology would not provide accurate results.

An important part of the “GO Time” system is that real-time travel data will be made available through an open data strategy to web and smartphone app developers. This open data strategy allows for the development of smartphone apps and further distribution of travel data. Integration of the bridge with the “GO Time” system would allow for more information to be made available.

Assuming the other ITS/changeable signs noted above are already installed the cost to integrate bridge signs into the “GO Time” system is estimated to be approximately $100,000.