STATE OF NEW HAMPSHIRE

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SUBJECT: New Castle-Rye 16127
Bridge 066/071
NH 1B over Little Harbor

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THRU: Mark Richardson. P.E.
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DRAFT ENGINEERING REPORT

I. INTRODUCTION

The goal of this project is to address the condition and functionality of the existing bridge carrying Wentworth Road/NH 1B over Little Harbor between the Towns of Rye and New Castle, which has become functionally obsolete and structurally deficient due to the bridge's geometry and poor structural condition. The current two lane bridge is a six-span structure consisting of five steel stringer approach spans and a single-leaf bascule-lift span. Initial correspondence with the United States Coast Guard (USCG) has indicated that Little Harbor is likely considered a Navigable Channel and under the jurisdiction of the USCG. Little Harbor does carry marine traffic which requires the structure to lift, but there is very little of this traffic; according to the bridge's lift logs, the structure has been lifted nine times for vessesls since March of 2010, six times for bouy maintenance by the USCG and three times for private vessels. During this same period, the structure has been lifted twenty-four times for bridge maintenance and inspection and for bridge operator training. Lifts for marine traffic require four-hour notice to the New Hampshire Department of Transportation (NHDOT) Transportation Maintenance Center (TMC), and personnel travel from the NHDOT Bridge

Maintenance Office at 10 Ranger Way in Portsmouth, NH to the bridge to operate the lift.

This report will assess four potential roadway alignment and profile alternatives to accommodate required vehicular, bicycle and pedestrian traffic over Little Harbor and marine traffic on Little Harbor. Investigation of the requirements and limitations of bridge rehabilitation or replacement will also be detailed in this report. Rehabilitation and multiple replacement options will be considered for this structure, and will be developed in the future Type, Size & Location Study (TS&L) based upon requirements and considerations described herein. Replacement options will include replacement on and off the current alignment, on and off the current profile, as well as replacement with both movable and fixed span structures.

II. EXISTING CONDITIONS

A. NH 1B (Wentworth Road)

1. Functional Class: Urban Minor Arterial
2. Type: Class I
3. Roadway – Two 11 ft travel lanes, 1 ft shoulders (5 ft at north end), 4 ft sidewalk, Up to 1.5:1 stone fill side slopes, Constructed in 1942 (North Approach Reconstructed in 1999)
4. Alignment – Bridge is on a 700 ft tangent between reverse curves, Minimum Horizontal Curve: 1000 ft radius
5. Profile – Maximum Grade = 4.0% (1.0% on Bridge)
   Minimum Vertical curves:
   - Sag K = 35 (meets 25 mph design speed)
   - Crest K = 49 (meets 40 mph design speed)
6. Posted Speed: 25 mph
7. Design Vehicle: WB-62
8. Bridge #066/071

Curb-to-curb width = 24 ft.

Length = 249 ft-7½ in (Bascule-Lift Span = 33’-9”)

Built: 1941

Rehabilitation: 1974

Posted: 15 Tons

III. PROBLEMS AND SOLUTIONS

Problem: The existing 1 ft +/- shoulders across the bridge are of insufficient width for bicycle use.

Solution: The desired typical section (4 ft-11 ft-11 ft-4 ft) will provide adequate width for bicycles along both sides of the roadway.

Problem: The existing sidewalk is narrow (4 ft min.) and is on the opposite side of NH 1B from the remaining sidewalk in New Castle which necessitates pedestrians to cross the roadway prior to the bridge.

Solution: The desired typical section provides a 5 ft wide sidewalk which has been relocated to the eastern side of the roadway which will eliminate the requirement for pedestrians to cross the roadway.

Problem: Stormwater treatment is not provided within the existing project area.

Solution: The proposed drainage design and analysis will review the feasibility of constructing a Best Management Practices (BMP) to provide stormwater treatment. A potential BMP may include a grass treatment swale at the southwest quadrant of the bridge.

Problem: The existing bridge is narrow (24 ft. curb-to-curb), and is in poor structural condition. It has been classified as "structurally deficient" by the Bureau of Bridge Design, and is on the State's "Red List".

Solution: Rehabilitate or replace the existing structure to remove it from the red list and accommodate a desirable HL-93 loading for two-way traffic. The extent of required repairs will be determined by structural analysis during the TS&L.

Problem: The existing bascule span is opened infrequently, and requires a four-hour advance notice to the NHDOT Transportation Maintenance Center, and an operator to drive from the NHDOT Bridge Maintenance Office at 10 Ranger Way, Portsmouth, NH in order to operate the bascule.

Solution: Install a system allowing for remote control of the bascule span from the NHDOT Bridge Maintenance Office.

Problem: The existing bridge deck is an open grid deck. This deck is noisy when vehicles pass over it, and is also a hazard to bicyclists.

Solution: Replace the grid deck with a solid surface deck.

Problem: The existing operating system does not meet current code requirements of the American Association of State Highway Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) code requirements. The bridge has no interlocks and does not have any fail safes in place. The bridge also does not have an auxiliary system to operate the bridge in the event of a failure.

Solution: The bridge rehabilitation or replacement alternative shall have a new control system that meets current AASHTO LRFD requirements. In addition the operating controls should be consistent with other new control systems on NHDOT Movable

Bridges. Alternatives will be considered for a redundant power source during the TS&L Study.

Problem: The existing bridge operating machinery does not meet current AASHTO LRFD code requirements. Two sets of spring set motor and machinery brakes are required.

Solution: The bridge rehabilitation or replacement alternative shall have two sets of spring set motor and machinery brakes in accordance with AASHTO LRFD requirements. Alternatives primary and auxiliary drive systems will be considered during the TS&L Study.

IV. DESIGN RECOMMENDATIONS AND CONSIDERATIONS

A. Design Speed: NH 1B - 30 mph (5 mph over posted speed limit)

Design Vehicle: WB-62

B. Alternatives:

Four roadway alternatives were evaluated for the engineering report:

Alternative 1 – Existing Horizontal Alignment / Existing Profile

This alternative will match the geometry of the existing roadway's horizontal and vertical profile, and will facilitate a bridge rehabilitation in the existing location and at the existing grade. Minor improvements are proposed for the roadway typical section which include 2 ft paved shoulders and a 5 ft sidewalk. This alternative limits the impacts to the existing steep side slopes and has the smallest new footprint. It does not, however, provide sufficient bike shoulders and does not align the bridge sidewalk with the sidewalk approaching the bridge from the north. The sag curve on the southern approach to the bridge will not meet the requirements of the desired design speed of 30 mph. This alternative will require a full-bridge closure with an offsite detour for rehabilitation of the substructure and bascule span. One.way alternating traffic may be allowed during rehabilitation of the approach spans superstructure. The feasibility of this will be determined during the TS&L.

Alternative 2 – Existing Horizontal Alignment / Raised Profile

This alternative will match the geometry of the existing roadway's horizontal alignment, but the vertical profile will be increased by approx. 6 ft-3 in. The increased profile grade will allow for a bridge replacement with a fixed span. The large change in elevation results in less than desirable vertical geometry south of the bridge in order to limit impacts to land parcels on either side of

the roadway. This will result in significant driveway tie-ins and could potentially reduce driveway sight distance. This alternative will require significant lengths of new retaining walls (up to 13' tall) in each quadrant of the bridge to avoid impacts to Little Harbor and could impact the Amurcork tree located at Sta. 103+25 LT. This alternative will also require a full-bridge closure with an offsite detour for the bridge replacement.

Alternative 3 – Shifted Horizontal Alignment

This alternative will mimic the existing roadway's vertical profile; however, it will shift the horizontal tangent over the bridge approx. 6 ft-9 in to the west. This horizontal shift will not only allow for wider shoulders and relocation of the sidewalk, but it will keep the majority of the impacts on the western side of the roadway. These impacts will require the extension of the existing retaining wall on the northwest quadrant to avoid impacts to the harbor. This alternative will also require full-bridge closure with an offsite detour for bridge replacement.

Alternative 4 – Offline Horizontal Alignment (Phased Construction)

HDR and Hoyle, Tanner reviewed six options for the offline horizontal alignment alternative, which would allow for bridge replacement while keeping the bridge open to traffic. These options ranged from phased demolition/phased bridge construction with one-way alternating traffic to full demolition/full offline bridge construction with two-way traffic operation at all times. Options considered either a temporary fixed span for construction staging, or lift spans with additional lift members to account for the staged construction. Based on bridge construction and demolition operations, permanent impacts, proposed roadway geometry, pedestrian and bike accommodation, and vehicle accommodation, each option was reviewed and ranked. The design team chose to present the option which offsets the existing horizontal alignment 17 ft-5 in to the west. This option is Alternative 4, and will allow for two-way traffic operations during the first phase of construction and one-way alternating traffic with temporary traffic signal during the second phase of construction. The new bridge tangent will be tied into the existing horizontal alignment with curve radii that mimic the existing condition. The design team envisions the new lift span being supported by three lifting members at each span end, allowing for half the lift span to be constructed and to be operational. Although a profile was not prepared for this alternative, it is expected to require the greatest impacts to the harbor, the Amurcork tree, and adjacent stonewalls. It should be noted that all six options for the offline alignment alternative would have significant impacts to the harbor and stonewalls. This alternative will also have the longest construction duration due to the construction staging required.

C. Superelevation:

NH 1B (Wentworth Rd) - $e_{max} = 0.04$
Superelevation calculations are attached.

Superelevation for all of the roadway alternatives will mimic the existing condition and will allow the horizontal curvature to meet the requirements of the desired design speed of 30 mph. The 1450 ft radius right hand curve on the south approach to the bridge will require a 2.4% cross slope. The 1000 ft radius left hand curve on the north approach to the bridge will require a 2.6% cross slope.

D. Typical Section:

Road	Type	Typical	T.W.* Pavement	Shoulder* Pavement	Structural* Section
NH 1B Alt 1-Exist Horiz./Exist Vert.	Class I	5 SW-2S-11L-11L-2S	4.5 in	4.5 in	8 in Gravel 8 in Cr. Gravel 8 in Sand
NH 1B Alt 2-Exist Horiz./Raised Vert. Alt 3-Shifted Horiz. Alt 4-Offline Horiz.	Class I	4S-11L-11L-4S-5SW	4.5 in	4.5 in	8 in Gravel 8 in Cr. Gravel 8 in Sand

L = Thru Lane, S = Shoulder, SW = Sidewalk
* See Item 3, below

1. The proposed side slopes vary from 4:1 to 1.5:1. Slopes 2:1 or steeper have been assumed to require Class B stone fill which matches the existing banks.
2. Alternatives 2 and 3 are shown to require retaining walls which are assumed to match the existing wall on the north east quadrant. A 4 ft panel, similar to existing, has been provided between the face of curb/back of sidewalk and the face of wall. A fence for pedestrians will also be required at the top of the retaining wall unless the pedestrian railings on the bridge are extended.
3. A review of the structural section has not been requested from Materials and Research at this point. Pavement and structural box materials shown are based on NHDOT's 11 ft-4 in typical and have been used for estimating purposes only.

E. Bridge:

1. The existing bridge is currently 24 ft wide curb to curb. The rehabilitated or replaced bridge section will have two 11 ft travel lanes. Alternative 1 provides two 2 ft shoulders and Alternatives 2, 3 and 4

provide two 4 ft shoulders. The final selection will be determined as part of the TS&L Study. The sidewalk will be widened to 5 ft and depending on the Alternative selected, may be moved from the westerly side to the easterly side of the structure, to better align with approach sidewalks.

2. Alternatives 1 and 3 will be investigated with potential for bridge rehabilitation or replacement. Alternatives 2 and 4 will be investigated for bridge replacement only.

3. The existing structure has a level cross sectional slope, and a 1% grade increasing upstation.

    a. The rehabilitated bridge will maintain the 1.0% grade of the structure. A closed deck system will be investigated for feasibility. Should a closed deck system be determined as feasible, the deck will be crowned to allow for drainage.

    b. Replacement Alternatives 1, 3 and 4 will maintain existing grade as much as practical. Raising the profile may be required, depending upon requirements of the USCG and on the required hydraulic opening.

4. The replaced bridge section will be investigated for the Alternatives.

    a. Alternatives 1 and 3 will investigate accelerated construction techniques to minimize closure time of the structure. The replacement options investigated will include a movable span. It is anticipated that these Alternatives will provide the shortest construction period.

    b. Alternative 2 will investigate a fixed structure for replacement with accelerated construction techniques. After discussion with USCG personnel and after review of the lift logs provided by NHDOT, the design team determined that a fixed structure would require no less than an increase of 6 ft of the roadway profile at the main channel. This increase is based on the required underclearance of 18’-0” required for Coast Guard vessels that may require entry into Little Harbor in emergency situations. Based on a preliminary review, the design team found that this Alternative will have significant impacts on abutters. It should be noted that if a fixed option were pursued further, the USCG could require increases to the profile elevations that are significantly greater than the 6 ft increase reviewed by the design team.

    c. Alternative 4 will maintain at least one lane of traffic for the majority of construction, with short closures of the bridge

during construction of the new movable span. The construction duration for an off-alignment option will be considerably longer than on-alignment replacement. The retaining walls required for this Alternative will also impose the most significant environmental impacts on the Harbor and will require a property taking in the northwest quadrant.

5. The feasibility of staged construction for bridge rehabilitation was reviewed. Staged construction, allowing for one lane of traffic during construction is only feasible during deck replacement and rehabilitation of the approach superstructure, with one 10 ft lane open during this time. The structure would not be open to traffic during the rehabilitation of the bascule span. Dependent upon the approach taken to rehabilitating the piers, the structure may not be open to traffic during rehabilitation of the piers. Staged construction for bridge rehabilitation will be further investigated after conceptual rehabilitation details are developed in the TS&L Study.

6. The bridge structure and its components in all Rehabilitation and Replacement alternatives will be designed in accordance with the AASHTO LRFD Bridge Design Specifications, 6th Edition with 2012 Interim Revision, with the AASHTO LRFD Movable Highway Bridge Design Specifications, 2nd Edition with 2012 Interim Revisions and with the AASHTO Guide Specifications for LRFD Seismic Bridge Design, 2nd Edition, with 2012 Interim Revisions.

7. The 2011 Load Rating performed by Hoyle, Tanner & Associates and HDR Engineering Inc, indicates that the approach superstructure does not have sufficient capacity for HS20 Loading requirements. Ratings for the bascule span indicate that two floorbeams do not currently have capacity for HS20 Loading, and others are slightly above statutory. All approach stringers and likely all bascule span floorbeams will require reinforcement to sustain HL-93 loads, the statutory live load requirement of AASHTO. Bascule girders will require analysis for current statutory loads during the TS&L Study.

8. The 2011 In-Depth Inspection performed by Hoyle, Tanner & Associates and HDR Engineering Inc. indicates that several piles are buckled above the waterline, and that the pier caps have sustained significant section loss. This report coded the substructure in Serious Condition, as described by the National Bridge Inspection Standards (NBIS) Coding Guide. The 2008 Underwater Inspection Report indicates that there is significant section loss in the piles adjacent to the riverbed, and are in Poor Condition, as described by the NBIS Coding Guide. The substructure will require analysis during the TS&L Study.

It is likely that caps and piles in all piers will require retrofit if the structure is rehabilitated.

9. If rehabilitated, the structure will maintain its current span arrangement with a 249 ft-7½ in overall length, with two approach spans on the southerly side of the bascule span (42 ft-7½ in and 39 ft-5 in) and three approach spans on the northerly side of the bascule span (40 ft-1 in, 43 ft-2 in and 42 ft-7¼ in). The bascule will have a closed span length of 33 ft-9 in, with support pile rows spaced at 4 ft on each end of the span.

10. If replaced, the structure will have one approach span on the southerly side of the proposed movable span (60 ft) and two approach spans on the northerly side of the movable span (60 ft, 60 ft). The movable span will have a span length of approximately 70 ft.

11. For replacement options, steel stringer and precast, prestressed concrete superstructure options will be investigated for approach superstructures during the TS&L Study.

12. For replacement options, different movable bridge options will be investigated for the movable span during the TS&L Study.

13. Replacement options will utilize drilled shaft foundations for the approach piers, and the hollow concrete piers for support at the movable span.

14. It is anticipated that for all rehabilitation and replacement options, remote control capabilities will be implemented for the movable span, so that the bridge can be lifted remotely, with controls being located at the NHDOT Bridge Maintenance Office at 10 Ranger Way, Portsmouth, NH.

F. Guardrail:

The existing guardrail on the project is a mix of steel and wood post w-beam with sub-standard flared and buried end sections. As a goal of the project is to provide additional shoulder width while limiting slope impacts, the proposed guardrail panel will be reduced to 1 ft or 1 ft-6 in in some areas. To provide the required post stability, the project proposes to use the Department's 31 in Midwest Guardrail System (MGS) with 9' steel posts, as needed. New 25 ft Energy Absorbing Guide Rail Terminals (EAGRT) are also envisioned. Other guardrail systems will be investigated during the Slope and Drain Submission at the direction of NHDOT. The limits of proposed guardrail are expected to be similar to the existing condition for all alternatives.

G. Design Exceptions:

25 mph sag vertical curve, K= 35 – Alternative 1 (30 mph standard, K= 37 minimum)

H. Drainage and Stormwater Treatment:

The existing stormwater on the south side of the bridge sheet flows off the pavement and down the embankment between Sta. 103+00 and 105+00. Runoff from the northbound lane from Sta. 100+00 to 103+00 RT is conveyed along the gravel shoulder and discharged to Little Harbor by a rip-rapped sluice way at Sta. 102+50. Runoff from the southbound lane from Sta. 100+00 to 103+00 LT sheet flows off the pavement and across the adjacent parcel.

Stormwater that falls on the existing bridge (Sta. 105+00 to 107+50) is discharged directly through the bridge into the channel via the slots in the steel decking.

The existing stormwater on the north side of the bridge is collected in two closed drainage systems. Runoff from Sta. 107+50 to 110+15 is conveyed at the granite curb to catch basins on either side of the roadway just prior to the existing bridge joint. A Corrugated Metal Pipe (CMP) slope drain outlets both structures to the harbor on the east side of the roadway. Runoff from Sta. 110+15 to 111+50 is similarly conveyed along the curb line to structures at Sta. 110+15. This stormwater is then piped against the grade to a catch basin at Sta. 112+25 LT. From this point, the runoff is piped 100 lf to the west through a 24" RCP where it outlets into an approx. 150 lf rip-rapped channel that discharges into a wetland adjacent to the harbor.

The proposed stormwater design on the northern approach to the bridge is expected to mimic the existing condition. The catch basins just north of the bridge joint may need to be relocated further to the north if a bridge approach slab is required, but this system is still expected to discharge on the embankment along the east side of the roadway. The catch basins at Sta. 110+15 will need to be relocated to match the revised curb line.

The proposed stormwater design on the southern approach to the bridge will likely vary depending on which alternative is selected. In Alternative 1, runoff from the northbound lane will be able to mimic the existing condition. For Alternatives 2, 3, & 4, the vertical granite curbing for the proposed sidewalk will prevent runoff from the northbound lane from sheet flowing off the roadway and a new closed system may be required to discharge stormwater. Depending on the limits of the proposed vertical granite curbing/sidewalk,

runoff from the southbound lane from Sta. 102+50 to 105+00 LT will no longer be able to sheet flow off the pavement and a closed system may be required for all alternatives. Runoff from Sta. 100+00 to 102+50 LT will be able to sheet flow onto the adjacent parcel under each alternative as it does in the existing condition.

As the proposed project is expected to increase the impervious surface area by providing wider shoulders and potentially a solid deck bridge, the feasibility of providing stormwater treatment will need to be reviewed. Due to the steep slopes on either side of the roadway, there is little room for stormwater Best Management Practices (BMP's) on the northern approach. Runoff increases on this approach are expected to be minor, however, as it will be limited to the increased shoulder width. Catch basins with deep sumps could be provided to help remove solids. Although there are still tight conditions on the southern approach to the bridge, the southwest quadrant where the original bridge abutment was located may provide an opportunity for a BMP. Along this section between Sta. 102+50 to 104+00 LT, the right of way increases from 40 ft to 60 ft and the terrain is relatively level. This area may allow the opportunity to construct a grass swale, which will likely not meet all the Alteration of Terrain (AoT) regulations, but could provide some level of treatment. The feasibility of a stormwater BMP in this location should be investigated once a preferred alternative is selected. The chosen BMP will need to avoid impacts to the existing stone walls and the adjacent Amurcork tree.

I. Environmental:

See the Environmental Study for a full description of all known environmental resources, impacts, and commitments.

1. Harbors – The existing bridge crosses Little Harbor. The construction for replacement or rehabilitation of bridge piers will cause impacts to the harbor under all Alternatives. Replacement options call for the construction of new piers in the water way and rehabilitation options will require existing piers be reinforced, which will require work in water. Additionally, Alternatives 2 and 4 will impose further impacts to the harbor, as retaining walls will be required. These walls are expected to impact the harbor on the western side of the bridge for Alternative 4, and in the northeast and northwest quadrants of the bridge for Alternative 2. Alternative 3 will also require retaining walls, but the required walls are anticipated to be significantly smaller than Alternatives 2 and 4, and modification of existing retaining walls may be sufficient for Alternative 3.

2. Tidal Wetlands – There are three delineated tidal wetland areas adjacent to the project limits. Two of the areas are located at the northeast and southeast quadrants of the existing structure, one of which, the southeast quadrant, is mitigation for previous construction of the marina, at the southeast corner. The third is located in the northwest quadrant of the structure, approximately 100 ft from the existing edge of roadway. Wetland impacts will be avoided and minimized to the extent practicable during design. It is not anticipated that the footprint of the final condition will result in direct impacts, as all rehabilitation and replacement options will be on-alignment or located just to the north of the existing structure. The exact project impact areas have not been determined at this stage of project design, however it is likely that work will occur within the 100 ft tidal buffer zone and/or the 250 ft Shoreland Water Quality Protection Act (SWQPA) buffer zone. If work will take place within these areas, the applicable permits will be secured prior to start of construction work. Existing wetlands will be considered during the design of construction and access and staging areas, and BMPs will be closely followed and monitored in order to protect wetlands and other local resources. If needed, mitigation will be provided to offset any unavoidable wetland impacts that may occur as a result of project activities.

3. Historic Resources – The bridge is eligible for the National Register of Historic Places under Criterion C ("embody distinctive characteristics") as a rare example of a bascule bridge in the State of New Hampshire. As the older of only two remaining examples of this bridge type, the bridge embodies "the distinctive characteristics" of its type and method of construction. It is also eligible under Criterion A ("associated with events that have made a significant contribution to the broad patterns of our history"), inasmuch as its construction is associated with improvements to the Portsmouth Harbor Defense Area undertaken during World War II.

4. Archeological Resources – An archaeological area of potential effect (APE) has been established for the project area, an area of approximately 150 ft in and extending approximately 600 ft from each end of the bridge, along Wentworth Road. Hand corings within the right-of-way have not indicated any potential archeological resources within this area. Stone abutments from the previous bridge alignments have been identified at the north and south ends of the bridge. The abutment at the north extends to approximately Sta. 110+13 on both the west and east sides of the roadway. The abutment at the south is located in the southwest quadrant, and extends from the end of the bridge south, to approximately Sta 103+00. It is possible that SHPO will consider these abutments to be archaeological resources. Significant impacts to these abutments are anticipated for Alternative 4, and significant impacts to the abutment at the north approach are anticipated for Alternative 2. Since staging areas will not be determined until completion of the design, archeological impacts due to

any staging areas or other activity outside the right-of-way will be determined at time of selection.

5. Endangered Species

    a. The National Oceanic and Atmospheric Administration (NOAA) identified several federally listed threatened or endangered species of fish that may occur within the Piscataqua River including: the Gulf of Maine Distinct Population Segment (DPS) of Atlantic sturgeon (Acipenser oxyrhynchus) (Threatened), the New York Bight DPS of Atlantic sturgeon (Endangered), the Gulf of Maine DPS of Atlantic sturgeon (Endangered), the Carolina DPS of Atlantic sturgeon (Endangered), the South Atlantic DPS of Atlantic sturgeon (Endangered), and the Shortnose sturgeon (Acipenser brevirostrum) (Endangered).
    b. No known potentially critical wildlife habitat was found within the project area. Two species were identified as occurring outside the project area: Marsh Elder, located approximately 370 ft northeast of the project area and the bald eagle, located approximately 0.35 miles outside the project area.

6. Stonewalls – A stonewall has been identified in the north and south ends of the bridge. The stonewall at the north end retains the bridge approach roadway and extends to approximately Sta. 110+13 on both the west and east sides of the roadway. The stonewall at the south end is located in the southwest quadrant, and extends from the end of the bridge south, to approximately Sta 103+00. Significant impacts to all stonewalls are anticipated for Alternative 4, and significant impacts to the retaining walls at the north approach are anticipated for Alternative 2. Alternative 3 may impact the stonewalls in the northwest quadrant. These impacts will be further investigated during the TS&L Study.

7. Contaminated Soils – No contaminated soils are anticipated.

J. Right-of-Way:

Level 2 Right-of-Way abstracting was provided to the design team by the NHDOT on June 28, 2013. Based on this information, the right of way across the causeway varies from about 75 ft wide on the Rye side to about 71 ft wide on the New Castle side. The right-of-way narrows to approximately 50 ft wide on center in the relocated section of NH 1B behind the Wentworth-by-the-Sea Hotel. As previously mentioned, between Sta. 102+50 and 104+00 LT the right-of-way widens to about 100 ft where the abutment from the original bridge is located.

As discussed at multiple project meetings, a goal of the project is to avoid right-of-way impacts. Based on information to day, this seems feasible in all four quadrants for all Alternatives. Right-of-way information in the northwest quadrant is partially based upon the 1874 right-of-way layout. However, additional research will be required during the TS&L Study to confirm that no Alternative impacts adjacent parcels.

K. Maintenance of Traffic:

It is anticipated that due to the impacts required to maintain traffic during bridge construction, a full bridge closure with an offsite detour will be preferred. However, the feasibility of both a bridge closure and phased bridge construction have been reviewed and are discussed below:

1. Full Bridge Closure with Offsite Detour – Alternatives 1, 2, & 3 will require a full closure of the existing bridge with an offsite detour to facilitate construction of the new bridge. The proposed detour (counterclockwise) would require New Castle generated traffic to follow NH 1B north across the island up to the intersection with Marcy Street. At this intersection, traffic would turn left onto New Castle Avenue and proceed to the intersection with South Street. From this point, traffic would turn left onto South Street and would proceed to the signalized intersection with Sagamore Avenue (NH 1A). It is anticipated that traffic bound for I-95 or US 1 would proceed straight thru the intersection on South Street, traffic bound for I-95 or US 1 north would turn right onto Miller Ave and traffic bound for NH1A or points in Rye would turn left onto Sagamore Ave. The detour would continue down Sagamore Ave. to the intersection of Wentworth Rd (NH 1B). Traffic bound for NH 1A would continue straight while vehicles wishing to reach the opposite side of the bridge would complete the detour by turning left. The detour has a length of 5.87 miles and is anticipated to take approx. 14 minutes and 15 seconds to traverse at the posted speed allowing for 60 seconds of delay at the traffic signal.

   The diversion of traffic to the detour route is not expected to cause any of the roadway segments to exceed their capacity. The highest ADT along the detour route is 9,200 vehicles per day (vpd), with an estimated 460 passenger cars per hour per lane (pcphpl) which is well below the 1,700 pcphpl capacity of a two-lane highway (although the urban sections of the roadway may have a lower base capacity). However, the detour is expected to increase delay at the stop controlled and traffic signal controlled intersections.

The City of Portsmouth has jurisdiction over NH1A and NH1B within the city limits. Coordination with the City will be required for detours.

The 3-leg stop controlled intersection of Sagamore Ave. (NH 1A) and Wentworth Rd (NH1B) is expected to see large reductions in traffic volume on the westbound (81%), northbound (22%), and southbound (14%) approaches. This intersection requires westbound traffic on NH 1B to stop while movements on NH 1A have free operation. A small increase in volume is expected for the northbound and southbound through movements, however, this is not expected to create queuing or safety issues as there is a bypass shoulder on Sagamore Ave. and there appears to be adequate sight distance on each approach.

The 3-leg stop controlled intersection of New Castle Ave. and Marcy St. (NH 1B) requires eastbound traffic to stop while movements on NH 1B operate freely. This intersection is expected see a large increase in traffic volume on the northbound (145%) and eastbound (300%) approaches. This intersection was reconstructed in recent years to reduce the skew angle. The resulting tight geometry may make turning movements difficult, especially for large vehicles. Additionally, a double yellow tracking mark from the south to the west approach may cause driver confusion over who has the right of way. Approach control and markings should be reviewed at this intersection if a detour is utilized. The proposed detour route does not direct traffic to the intersection of Marcy St. and South St. due to its complex geometry, which does not favor northbound right turns, and the existence of the highly utilized cut-thru on New Castle Ave. for cars looking to access South Street from NH 1B northbound.

The 3-leg stop controlled intersection of South St. and New Castle Ave. is expected to see a large increases in traffic volume on the westbound (300%) and northbound (76%) approaches. This intersection requires westbound traffic on New Castle Ave. to stop while northbound and southbound traffic on South St. operate freely. There is a potential for queuing and safety issues for traffic turning left from New Castle Ave. as sight distance looking to the north up South St. is limited by the proximity of shrubs and buildings.

The 4-leg signal controlled intersection of Sagamore Ave./South St./Miller Ave. (NH 1A) and South St. is expected to see a large increase in traffic volume (76%) on the westbound South St. approach while the eastbound and northbound approaches are expected to see volume reductions of 18% and 13%, respectively. However, a minor increase in northbound right turns and a significant increase in eastbound through movements is anticipated. Southbound NH 1A is

not expected to see a significant change in approach volume. The change in lane utilization and increased traffic is expected to cause a significant increase in delay for this intersection. A dedicated right turn lane and a signal phase (including an overlap) are provided on the northbound approach so the queuing here may not be a large issue. However, as a dedicated left turn lane is not provided on the westbound approach, the increase in eastbound through and westbound through and left turn movements may cause significant queuing and delay on this leg that already experiences heavy volumes. If a detour is utilized, the traffic signal timing should be reviewed at this intersection to determine if timing adjustments could help mitigate traffic impacts.

2. Phased Bridge Construction – Alternative 4 will allow for maintenance of traffic across the bridge during construction by constructing half of the proposed bridge offline.
    a. Phase 1 – The first phase of construction will demolish the sidewalk on the existing bridge to allow for construction of the southbound lane and shoulder of the new bridge. Two-way traffic will be maintained on the existing bridge utilizing the full existing 24 ft curb-to-curb cross section (two-12 ft travel lanes). The current bridge railing between the roadway and sidewalk would serve as the barrier to the work zone. Bicycle accommodation within the travel way would remain unchanged, however, accommodations would no longer be provided for pedestrians without construction of a temporary structure.

    b. Phase 2 – The second phase of construction will shift traffic to the newly constructed southbound lane while the remaining bridge is demolished and the northbound lane, shoulder, and sidewalk of the new bridge are constructed. The new lift span is expected to be comprised of three lift members, with one at the center of the roadway, allowing for the half the lift span to be constructed and operational. A one-way alternating traffic pattern with a temporary 2-phase traffic signal will be required during this phase. The traffic signal is expected to provide a Level of Service C for both approaches and is not expected to result in significant queuing (6 or 7 vehicles). The traveled way will consist of an approximate 13 ft lane that will utilize the future southbound lane and shoulder. A portable concrete barrier will be required along the east side of the new bridge to separate traffic from the work zone. Bicycle accommodations would be diminished as they would now be required to proceed with traffic through the temporary traffic signal. Pedestrian accommodations would not be provided unless a temporary structure is utilized.

L. Utilities:

1. Overhead power utilities and the existing utility poles will be impacted from Sta. 103+00 to Sta. 109+00 due to construction and potential widening of the road.

2. There is a power line carried by the bridge structure, which passes onto the structure at the southwest corner, at the Rye abutment. This power line runs up the utility pole at the northwest corner of the bridge, and is carried overhead off the structure. This line powers the movable span.

3. It is anticipated that auxiliary power could be supplied by a portable generator

4. There are three data cables owned by Fairpoint Communications, one copper and two fiber optic, that cross above the bridge structure. These cables are supported by the utility poles on the southwest and northwest corners of the bridge. These cables are supported by utility poles along both the north and south approaches to the bridge.

5. It is anticipated that for all rehabilitation and replacement options, remote control capabilities will be implemented into the movable span, so that the bridge can be operated remotely, with controls being located at the NHDOT Bridge Maintenance Office at 10 Ranger Way, Portsmouth, NH. Installation of fiber optic cables, for control of the movable span, may be required.

6. There are fiber optic cables owned by Comcast running under Wentworth Road up to Sta. 103+00. It is not anticipated that these cables will be permanently impacted, since they terminate approximately 300 ft south of the bridge site. Off-alignment replacement options may temporarily affect these cables during construction. There are also fiber optic cables running along and under Wentworth Road, and are located approximately 150 ft north of the bridge. Off-alignment replacement options may permanently affect this utility.

7. North of the structure, there are water lines and sewer lines along Wentworth Road, Campbells Lane and Marina Heights. These water lines are more than 450 ft north of the bridge site. No impacts are anticipated.

8. A letter submitted by the Portsmouth Public Works Department indicates that the Rye Water District has utilities in the project area, but no

indication of specific utility locations have been provided. Potential impacts will be investigated during the TS&L Study.

9. There is a catch basin located immediately north of the New Castle Abutment. Permanent impacts to this catch basin are anticipated for all replacement options, and permanent impacts may be required for rehabilitation options, if analysis deems that an approach slab is required to meet modern statutory loading requirements. There are two catch basins approximately 260 ft north of the New Castle abutment which may be permanently impacted by off-alignment options.

10. There is a post with a remote receiver located in the southeast quadrant of the structure, approximately 160 ft north of the structure. This utility is labeled as being owned by the Portsmouth Water Department. There are potential temporary and permanent impacts to this receiver.

11. Additional drainage structures will be required on the bridge if a closed deck system is constructed.

M. Lighting:

There is existing roadway lighting along NH 1B on the southbound and northbound approach located above the bridge traffic signals. Lighting design requirements will be determined during Final Design but as a minimum, existing lighting will be maintained or relocated.

N. Accidents:

Accident data was reviewed by NHDOT's highway safety engineer for a 10 year period from 2003 to 2013. No crashes were reported during this time period for a segment of NH 1B extending 300' along each approach to the bridge.

O. Traffic:

<u>Annual Average Daily Traffic (AADT)</u>

NH 1B (Wentworth Rd) at Rye TL: 4,200 vpd (2010 AADT)

P. Survey:

Survey was performed by NHDOT in 2012. Depending on which alternative is selected, additional survey may be required at the north end of the project to tie in elevations relative to the proposed alignment.

Q. Soils:

A geotechnical investigation for the project area will be conducted during Final Design. Limited boring information is provided on the 1941 design plans of the existing structure. Refer to the 1941 Design Plans for information regarding soils in the project area.

R. Recommendations:

At this time, the design team recommends that Alternative 2 (raised profile) and Alternative 4 (Off-Alignment, Staged Construction) not be selected for Preliminary Design.

Alternative 2 requires retaining walls up to 13 ft tall, and will impose significant impacts on abutters. Retaining walls will be constructed along the property lines of abutters, and significant modifications to grading of adjacent driveways will be required. This Alternative will require significantly more work in the harbor than Alternatives 1 and 3, in order to construct retaining walls on the north approach. Additionally, this Alternative may potentially restrict future waterway travel by limiting the vertical underclearance of the structure.

Alternative 4 will require significant work in the harbor for retaining walls on the west side of the structure. While this Alternative will allow NH 1B/Wentworth Road to remain open to traffic during construction, it will require significantly longer construction duration. This Alternative will also require removal of the Amurcork tree located in the southwest quadrant of the bridge.

While all Alternatives will be further investigated and reviewed as part of the TS&L Study, Alternatives 2 and 4 impose unreasonable environmental impacts and impacts on abutters when compared to Alternatives 1 and 3. Based on investigations performed during production of the Engineering Report, the design team recommends that Alternatives 2 and 4 are not selected for Preliminary Design.

Moving forward, the design team will focus primarily on Alternatives 1 and 3 for potential rehabilitation or replacement, respectively. However, the team will review all Alternatives for the best alignment and structure type. The team will also perform analysis to determine the best means to rehabilitate the structure. After analysis and investigation are completed, the design team will

provide recommendation whether to rehabilitate or replace the structure in the TS&L Study.

S. Earthwork:

Earthwork will be required if bridge replacement is selected. The following are approximate quantities for options recommended in Section R. Approximate quantities are as follows:

Alternative 1:

Common Excavation =	1,700 CY
Embankment-in-Place =	50 CY

Alternative 3:

Common Excavation =	3,630 CY
Embankment-in-Place =	400 CY

T. Estimate:

Based upon Recommendations Described in Section R, order-of-magnitude cost estimates have been developed for recommended Alternatives associated with bridge replacement. Estimates for rehabilitation options and updated estimates for replacement options will be developed after further analysis and investigation is performed in the TS&L Study.

The estimates below were performed for Alternatives 1 and 3 assuming replacement of the existing structure, and for purposes of comparing the roadway alignments under similar bridge options.

Actual construction costs may vary from the costs shown below due to historic, structural and environmental requirements to be determined during the TS&L Study. Utility relocation and Control of Water are not included in this estimate.

a. Alternative 1 (Existing Horizontal Alignment)

Highway Construction	$296,000
Retaining Wall Construction	$24,500
Bridge Construction	$17,360,000
Engineering	$1,395,000
Total	$19,075,000

b. Alternative 3 (Shifted Horizontal Alignment)

Highway Construction	$483,000
Retaining Wall Construction	$280,000
Bridge Construction	$18,000,000

Engineering	$1,395,000
Total	$20,158,000

See cost preliminary estimates for further details.

U. Available Materials:

1. MicroStation detail of the project area
2. Preliminary Roadway Design Base Plans, Profiles, Cross Sections
3. Existing Bridge Plan, Elevation and Sections
4. Conceptual Replacement Bridge Elevation and Sections
5. Preliminary Cost Estimate
6. Public Involvement Plan and Advisory Committee Meeting Minutes
7. Existing Utility Information
8. Superelevation Calculations
9. Horizontal and Vertical Alignment Reports
10. Detour Plan
11. Intersection Photos

Drafted: _____

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File