Missisquoi Bay Causeway
Scoping Report

Vermont Agency of Transportation

Policy, Planning, and Intermodal Development Division

One National Life Drive

Montpelier, VT 05633-5001

802-828-2784

www.vtrans.vermont.gov

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EXECUTIVE SUMMARY

This report evaluates alternatives to remove the causeway at the southern end of Lake Champlain's Missisquoi Bay. The study was requested by the Vermont Legislature in Act 40 of 2015. The causeway, and drawbridge that once spanned its opening, formerly carried VT Route 78 across the mouth of the Bay. The drawbridge was removed but most of the causeway was left in place following the construction of a new shore-to-shore bridge in 2007. There is approximately $4.12 million remaining in the federal earmark that was used to fund the Missisquoi Bay bridge project. The $4.12 million earmark must be matched with 20% non-federal funds. While the Missisquoi Bay bridge project is complete, VTrans must decide whether or not the funds remaining from the earmark should be used to remove more of the causeway or be repurposed for investment in other transportation system programming. This report informs that decision. VTrans is seeking public input on this draft and will document comments in a final report.

The purpose of this project is to help improve water quality in the Missisquoi Bay without causing an unacceptable increase to the phosphorus concertation in the Northeast Arm of Lake Champlain (see Figure 1), and without causing an unacceptable impact to the spiny softshell turtles, a state designated threatened species that depend on the causeway and surrounding lake for habitat.

Four alternatives are evaluated including (1) leave the causeway in place, (2) remove a portion of the eastern arm of the causeway, (3) remove all of the eastern arm of the causeway and (4) complete removal of the eastern and western arms of the causeway.

The selection of a preferred alternative is constrained by the available funding of $4.12 million and the need for action must consider the following points:

- Phosphorus concentrations exceed the Vermont water quality standards in most areas of Lake Champlain today and have been since the 1980s. The current phosphorous concentration in the Missisquoi Bay and the Northeast Arm exceed the water quality standards. Phosphorus sources in Missisquoi Bay and their relative contributions include streambank erosion (35%), and stormwater runoff from cropland (29%), forest (16%), developed land (9%) and backroads (5%). The 6% balance is from farmstead, pastureland and wastewater facilities.
- Many residents believe that removal of the causeway will significantly improve water quality in the Missisquoi Bay by restoring a more effective flushing of phosphorus to the south where it can mix with waters in the Northeast Arm.
- Removal of the eastern and western arms of the causeway has been estimated to reduce bay-wide average phosphorus concentrations and sedimentation in Missisquoi Bay by about 1 %. Any changes in currents or phosphorus levels would be limited to the vicinity of the causeway (within about two miles), and would be matched by corresponding phosphorus increases south of the causeway in the Northeast Arm.
- The potential effect of the causeway on phosphorus concentration were evaluated extensively as part of the scoping and permitting process for the Missisquoi Bay bridge project. The science and methodology were peer reviewed and vetted through a public

process led by the US-Canada International Joint Committee (IJC) and found to be sound. However, local public sentiment remained strongly in favor of causeway removal as a water quality mitigation measure. In recognition of this local sediment, the IJC recommended removing the causeway because it was an obstacle to cooperative efforts to address water quality. The local sentiment is also supported by the 2015-2023 Northwest Regional Plan which includes a policy to remove the causeway as a strategy to improve water quality.

- The Missisquoi Bay causeway provides habitat for the spiny softshell turtle which is included on the state's list of endangered and threatened species. The turtles use a narrow band of the causeway at waterline for a basking area during the fall, and use the lake bottom north and south of the causeway opening for winter hibernation.
- The monitoring program conducted as part of the bridge project found that spiny softshell turtles continue to use the causeway and bridge area for basking and winter hibernating. The monitoring report also notes that longer term impacts due to permanent habitat changes resulting from the bridge project and partial causeway removal are uncertain. Therefore, removal of any additional sections of the causeway must proceed with caution and include appropriate monitoring and mitigation.

VTrans, after consulting with the Vermont Agency of Natural Resources, recommends Alternative 2 - Partial Removal of the Eastern Arm of the causeway. This alternative would remove approximately 330 feet of the causeway, the maximum possible given permitting and funding constraints. Alternative 2 satisfies the purpose and need to improve water quality in the Missisquoi Bay without causing a significant increase of phosphorus in the Northeast Arm and while minimizing impacts to the spiny softshell turtles. Partial removal is a step towards satisfying the policy in the Northwest Regional Plan and recommendation of the IJC, both of which call for causeway removal. It is the only removal alternative that can be implemented for an estimated cost ($2.4 million) that does not exceed the remaining funds from the Missisquoi Bay Bridge earmark ($4.1 million). This cost estimate includes engineering, permitting, construction and turtle and water quality monitoring. Results from monitoring impacts to the spiny softshell turtle and water quality would be permit conditions for this alternative and would also inform a future assessment about removing additional sections of the causeway.

Alternative 1 - Leave the Causeway in Place would allow the earmarked funds to be redirected to other federally eligible transportation projects. However, Alternative 1 is not recommended because it has a neutral effect on water quality and is not supported by the Northwest Regional Plan.

The other two causeway removal alternatives are not permittable at this time, would take decades to implement and their estimated costs exceed available funding. Removal of the entire eastern arm (Alternative 3) would have to be implemented in four phases that could extend over thirty years and have an estimated cost of $8.9 million. The cost to remove the entire eastern and western arms (Alternative 4) would also take more than thirty years, and could cost in excess of $13.5 million. Alternative 4 could only be implemented if the spiny softshell turtles were relocated, which is not included in the cost estimate. Successful relocation is extremely unlikely and the cost and timeline associated with such an effort would be significant.

1.0 INTRODUCTION

This scoping report evaluates alternatives to remove the former VT Route 78 causeway at the southern end of Lake Champlain's Missisquoi Bay. The study was requested by the Vermont Legislature in Act 40 of 2015.[1] The causeway, and drawbridge that once spanned its opening, formerly carried VT Route 78 across the mouth of the Bay. The drawbridge was removed but most of the causeway was left in place following the construction of a new shore-to-shore bridge in 2007. There is approximately $4.12 million left in the federal earmark that was used to fund the Missisquoi Bay bridge project. The $4.12 million earmark must be matched with 20% non-federal funds. While the Missisquoi Bay bridge project is complete, VTrans must decide whether or not the funds remaining from the earmark should be used to remove more of the causeway or be repurposed for investment in other transportation system programming. This report informs that decision. VTrans is seeking public input on this draft and will document comments in a final report.

Section 2.0 provides background information on the causeway and why it was left in place following the bridge project. The decision to leave most of the causeway in place considered complex and competing issues related to its potential effect on the Bay's water quality and its use as wildlife habitat for the spiny softshell turtle, a threatened species. A summary of each issue is provided because they continue to be determining factors on the desirability, feasibility, and cost effectiveness of removing some or all of the causeway.

Section 3.0 describes the project's purpose and need based on the findings from Section 2.0.

Section 4.0 evaluates four alternatives including (1) leave the causeway in place, (2) remove a portion of the eastern arm of the causeway, (3) remove all of the eastern arm of the causeway and (4) complete removal of the eastern and western arms of the causeway. Order of magnitude cost estimates, potential resource impacts and permitting requirements are identified for each alternative. Advantages and disadvantages are summarized.

Section 5.0 summarizes findings and presents the VTrans recommended alternative.

The information presented in this report is based on a review of various permits issued for the Missisquoi Bay Bridge Project, the spiny softshell turtle Monitoring Report and consultation with VTrans and Agency of Natural Resource staff that were involved with the bridge project or are subject matter experts.

2.0 BACKGROUND AND CONTEXT

2.1 Causeway History and General Characteristics

The Missisquoi Bay Causeway extends on an east-west alignment across the southern end of Lake Champlain's Missisquoi Bay. The causeway and the old Missisquoi Bay Bridge were

[1] No. 40. 2015. An act relating to the State's Transportation Program and miscellaneous changes to laws related to transportation., Sec. 22. State Highway Bridge program

constructed circa 1938 to carry VT Route 78 across the mouth of the Bay. VT 78 provides an east-west connection between I-89 and US 7 in Swanton, VT and US 2 in Alburgh, VT which further extends into New York State via the Rouses Point Bridge. VT 78 is on the National Highway System (NHS) and connects Interstate 87 in New York State and Interstate 89 in Vermont (Figure 1).

Figure 1: Regional Location

The old drawbridge spanned an opening of approximately 500 feet between the eastern and western arms of the causeway. The old opening was divided into three channels by concrete bridge piers. A new multi-span bridge, with much shorter causeways at its approaches from each shoreline was constructed over three years and opened to traffic in 2007. The new bridge is located approximately 60 feet on-center to the south of the causeway and old bridge. After the completion of the new bridge, the causeway no longer served a transportation purpose. The drawbridge was removed, and the waterway opening was increased from approximately 500 feet to 830 feet. The larger opening was created by removing 330 feet of the eastern arm of the causeway. An aerial view of the existing causeway, new bridge and surrounding area is shown in Figure 2.

The eastern arm of the causeway is open to the public for recreational purposes and is served by a parking lot and boat launch at the Larry Greene Fishing Access that is maintained and operated

by the Vermont Department of Fish & Wildlife. As required in the Endangered and Threatened Species Taking Permit for the bridge project, the western arm of the causeway is closed to the public to protect its use as a basking area for the spiny softshell turtle, which are discussed further in Section 2.4 of the report. The top of both arms of the causeway is approximately 28 feet wide and is approximately 20 feet above the lake bottom at the terminal end of the eastern arm. The causeway is approximately 100 feet wide at the lake bottom. The causeway extends an unknown distance below the bottom of the lake. The top surface of the causeway is predominantly asphalt over a gravel roadway base. The structure of the causeway consists of larger sized rock and rip rap mined from a nearby quarry when the causeway was constructed in 1938. Attachment A includes sheets from the bridge construction plans that show the section of the eastern arm that was removed.

Figure 2: Causeway Site

2.2 Federal Earmarks Related to the Missisquoi Bay Bridge and Causeway

An earmark for the new Missisquoi Bay Bridge was provided in the 2005 federal funding and authorization bill referred to as SAFETEA-LU[1], and was modified in the SAFETEA-LU Technical Corrections Act of 2008. The original 2005 earmark set aside $18,000,000 for the replacement of the Missisquoi Bay Bridge. It also set aside $32,000,000 for nine other state-maintained bridges

[1] Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users

in Vermont (Figure 3). The 2008 SAFETEA-LU Corrections Act modified the earmark language to allow the $18,000,000 for the replacement of the Missisquoi Bay Bridge and the removal of the Missisquoi Bay causeway and also added the following special conditions:

- Requires VTrans to certify "…to the Federal Highway Administration the final determination of the agency regarding the removal of the Missisquoi Bay causeway."
- Allows VTrans to use any unobligated or unexpended funds remaining from the Missisquoi Bay Bridge earmark for replacement and reconstruction of the nine other State-maintained bridges identified in the 2005 earmark after VTrans makes a determination regarding removal of the causeway.

As of March 2016, there was approximately $4.12 million of unobligated and unexpended federal funds remaining from the Missisquoi Bay Bridge earmark. The special conditions added to the earmark language in 2008 require that any funds not used to replace the Missisquoi Bay Bridge or to remove the causeway may only be spent on the other nine state-maintained bridges. However, as indicated in (Figure 3), all of these other bridges are either complete or nearly complete and do not require any additional funds.

The latest and recently passed 2015 federal transportation reauthorization law (FAST Act), now allows any unobligated earmark funds to be utilized for other transportation projects within 50 miles from the location of the project for which the earmark funds were originally intended. The redirected earmark funds must be used for a transportation project that is eligible for federal funding. Once a state elects to repurpose funds, it will have until the end of FY 2019 to obligate the funds. Earmark funds that are not repurposed will be lost.

Figure 3: Other Vermont Bridges Funded by Earmarks 2005 SAFETEA-LU Earmark

Municipality	Bridge	Set Aside	Status
Reading	BR#1-VT 44	$2.1 M	Complete and accepted May 2008
Huntington	BR#42-East St	$2.5 M	Complete and accepted Sep 2008
Tunbridge	BR#4-VT 110	$4.5 M	Complete and accepted Sep 2008
Bethel	BR#31-VT 12 (Church St)	$3.9 M	Complete and accepted Oct 2008
Springfield	BR#64-VT 11 (Main St)	$1.0 M	Complete and accepted Sep 2010
Stockbridge	BR#30-VT 100	$3.0 M	Complete and accepted Oct 2010
Cornwall	BR#9-VT 125	$4.0 M	Complete and accepted Nov 2011
Bristol	BR#8-VT 116	$6.0 M	Substantially complete June 2015
Rutland City	BR#2-River St	$5.0 M	Under construction. Anticipated Completion 2017 Construction Season
Total		$32.0 M	

2.3 Water Quality

Phosphorus concentrations exceed the Vermont water quality standards in most areas of the Lake today and have been since the 1980s. The current phosphorous concentration in the Missisquoi Bay is about twice as high as the water quality standards for that segment of the lake (0.025 micrograms/liter) and is on an increasing trend line (Figure 4). South of the causeway, phosphorous concentration in the Northeast Arm of Lake Champlain also consistently exceed the water quality standards for that segment of the lake (0.014 micrograms/liter) and continues to increase (Figure 5). Based on modeling conducted by the EPA, agricultural land, developed land and streambank erosion are the major sources of phosphorus for all segments of the Lake. Phosphorus sources in Missisquoi Bay and their relative contributions include streambank erosion (35%), and stormwater runoff from cropland (29%), forest (16%), developed land (9%) and backroads (5%). The 6% balance is from farmstead, pastureland and wastewater facilities[1].

Figure 4: Missisquoi Bay Phosphorus Concentrations[2]

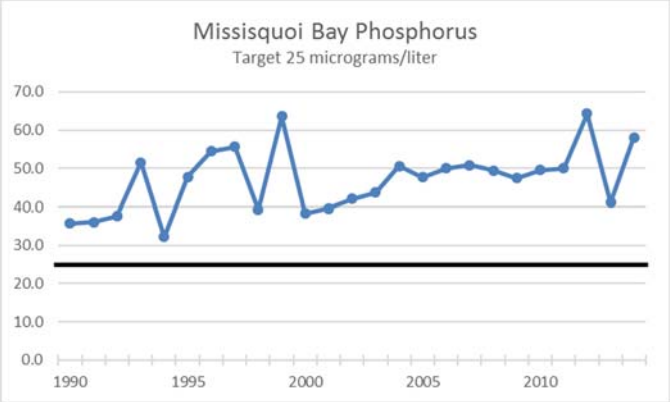
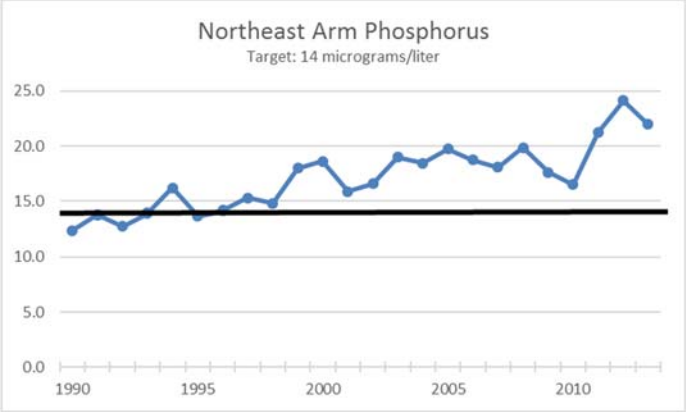


Figure 5: Northeast Arm Phosphorus Concentrations[4]



[1] "Lake Champlain Phosphorus TMDL Phase 1Implementation Plan"; Forwarded by the State of Vermont for the U.S. Environmental Protection Agency; Draft August 2015; Figure 3, Page 17

[2] "Phosphorus TMDLs for Vermont Segments of Lake Champlain", U.S. Environmental Protection Agency; Region 1, New England; Boston, MA; August 14, 2015; Figure 5, Page 15.

Poor water quality in the Missisquoi Bay has been a driving factor in the public's desire to remove the causeway. Many residents believe that removal of the causeway will significantly improve water quality in the Missisquoi Bay by restoring a more effective flushing of phosphorus to the south where it can mix with waters in the Northeast Arm. Therefore, there was a need to evaluate whether or not causeway removal would be an effective strategy to improve water quality in Missisquoi Bay without causing an unacceptable increase to the phosphorus in the Northeast Arm.

VTrans recognized the need to repair or replace the old Missisquoi Bay Bridge more or less coincident with the public's increasing desire to remove the causeway as a means to improve water quality in the Bay. The early bridge alternatives included rehabilitating or reconstructing the old drawbridge which would leave the causeway intact, and constructing a new shore-to-shore bridge on a new alignment. A new shore-to-shore bridge would have eliminated the need for the causeway from a transportation perspective and created the possibility that it could be removed. Therefore, there was a need for VTrans to evaluate the water quality benefits of causeway removal.

To help advise the Vermont Agency of Transportation and inform the general public, the ANR Water Quality Division conducted a phosphorus mass balance modeling analysis of Missisquoi Bay which simulated the enhanced mixing effects of causeway removal. An initial report was prepared in 1993 and refined and updated in 1994.

The results of the 1993-1994 Water Quality Division modeling study[1,2] suggested that removal of the causeway would produce an 8% reduction in average total phosphorus concentrations in Missisquoi Bay, and a 9% increase in phosphorus concentrations in the Northeast Arm. Based on information provided by engineering consultants to the Vermont Agency of Transportation, the estimated additional project cost of removing the causeway and building a shore-to-shore bridge was $21 million[3], relative to the cost of the simpler design alternative under consideration at the time which would have kept the highway on the existing causeway. Because the water quality benefits to Missisquoi Bay would be offset by adverse impacts on the Northeast Arm with no net phosphorus removal benefit to Lake Champlain as a whole, and because of the poor cost/benefit ratio, the report concluded that causeway removal was not justified by water quality considerations.

Presentation of the findings of the Water Quality Division study generated a strong negative public reaction in which a desire for an additional study was expressed. The Agency of Transportation agreed to fund a second analysis that would address public desire for a study that (1) was conducted by a scientific consultant independent of state government, (2) developed a true hydrodynamic model that directly simulated changes in water currents in the

[1] Vermont Agency of Natural Resources. 1993. Vermont Route 78 Swanton-Alburg Bridge Project water quality assessment. The effects of a wider bridge opening on water quality in Missisquoi Bay and the Northeast Arm of Lake Champlain. Waterbury, VT.

[2] Vermont Agency of Natural Resources. 1994. Vermont Route 78 Swanton-Alburg Bridge Project water quality assessment. Update. Waterbury, VT.

[3] It should be noted that later in the design process, the Agency of Transportation determined that construction of a new shore-to-shore bridge was the preferred alternative due to geotechnical reasons independent of water quality considerations. This decision removed the major cost of building a new bridge from the with vs. without causeway cost comparison.

bay in response to causeway removal, and (3) modeled sedimentation changes in the bay as well as phosphorus concentrations.

The scientific studies were conducted by Applied Science Associates, Inc. (ASA) and were overseen by the ANR in consultation with an international Project Advisory Committee composed of federal, provincial, and state water quality and engineering experts, as well as local elected officials and other citizens. The work involved field data collection and modeling analyses to simulate the impacts of causeway removal. In two reports released in 1997, ASA concluded that removal of the causeway would reduce bay-wide average phosphorus concentrations and sedimentation in Missisquoi Bay by about 1 %. Any changes in currents or phosphorus levels would be limited to the vicinity of the causeway (within about two miles), and would be matched by corresponding phosphorus increases south of the causeway in the Northeast Arm portion of Lake Champlain. After reviewing these reports, the Agency of Natural Resources and the Project Advisory Committee found that the conclusions were valid and should be used as part of the public decision regarding causeway removal.

In spite of these findings, local public sentiment remained strong in favor of causeway removal as a water quality mitigation measure. In response, the U.S. and Canadian federal governments requested in 2004 that the International Joint Commission (IJC)[1] investigate the matter and consider whether the causeway's continued existence was consistent with the Boundary Waters Treaty between the two countries.

The IJC established an International Missisquoi Bay Task Force to advise them, and the Task Force oversaw a scientific peer review of the ASA modeling studies. The peer review was conducted by eight scientists from various federal, state, and provincial environmental management agencies. After considering the results of the scientific peer review, the Task Force reported to the IJC that the hydrodynamic modeling studies were scientifically sound and very likely to be correct, and that the IJC should rely on these findings. The Task Force concluded that neither the existing causeway nor its removal would affect flows or pollution in either the U.S. or Canada beyond very small amounts in areas in the near vicinity of the causeway.

The IJC issued its report to the United States and Canadian federal governments in 2005. The IJC accepted the Task Force findings and concluded that the causeway did not affect water levels or flows or cause more than negligible pollution in Missisquoi Bay. The IJC did, however, recommend that the causeway be removed, with two significant conditions, in order to help refocus public attention on necessary phosphorus reductions from the bay's watershed and to remove what they described as "an obstacle to expanding the cooperative efforts by farmers, municipalities, taxpayers and others that will be needed to achieve nutrient reductions." The IJC's recommendation was made with the condition that an amount of money equal to the cost of causeway removal paid for by the State of Vermont be provided by the governments of Canada and Quebec to be spent roughly equally on both sides of the international boundary to (1) reduce phosphorous inputs into the bay and (2) to facilitate the relocation of the habitat for the spiny softshell turtles.

[1] The International Joint Commission (IJC) is established by the Boundary Waters Treaty to hear disputes under certain circumstances when requested by the United State and Canadian governments. If the IJC decides to hear a dispute, it renders a non-binding report. The Boundary Waters Treaty, signed in 1909, provides principles and mechanisms to help resolve disputes concerning water quality and water quantity along the boundary between the United States and Canada.

The IJC recommendation to remove the causeway is conditioned on relocating the habitat for the spiny softshell turtle. The IJC expressed its shared concern with the future of the turtles but was convinced that with appropriate study, planning and action, adequate habitat for the turtles could be found or established.

Subsequent lake monitoring and research has corroborated the 1997 ASA water quality modeling findings:

- After a portion of the causeway was removed in 2007 as part of the construction of the new Missisquoi Bay bridge, the ANR Department of Environmental Conservation examined long-term water quality monitoring data obtained before (1992-2006) and after (2007-2011) the partial causeway removal. No changes in water quality gradients between Missisquoi Bay and the Northeast Arm were found to suggest that no enhanced water mixing between these two areas of Lake Champlain had occurred after partial causeway removal.
- Sediment core studies conducted by researchers at the University of Vermont and published in 2012 in the Journal of Great Lakes Research examined the history of water quality changes in northeastern Lake Champlain. This research found no alteration of the eutrophication rate in Missisquoi Bay following causeway construction in 1937. According to this paper, algal blooms in Missisquoi Bay did not develop until decades later, concurrent with the intensification of regional agriculture in the 1970s.

Local public opinion continues to support causeway removal as a means to improve water quality in Missisquoi Bay. This opinion is articulated in the Northwest Regional Plan which "…support(s) removal of the Missisquoi Bay and Carry Bay causeways" as a policy to support Goal 3 to maintain or improve the quality of lakes, ponds, rivers, streams and groundwater[1]

2.4 Spiny Softshell Turtle

The Missisquoi Bay Causeway provides habitat for the spiny softshell turtle which is included on the state's list of endangered and threatened species. The turtles use a narrow band of the causeway at waterline for a basking area during the fall, and use the lake bottom north and south of the causeway opening for winter hibernation (hibernaculum). The impact on the spiny softshell turtle is a significant consideration when evaluating the feasibility of different causeway removal alternatives. This section describes the requirements of the Endangered and Threatened Species Taking Permit and some of the related characteristics of the spiny softshell turtle to inform the alternatives evaluation in Section 4.0.

Endangered and Threatened Species Taking Permit

Per Vermont's Endangered and Threatened Species Act, a permit is required to justify the taking or possession of an endangered or threatened species. The spiny softshell turtle is listed as a threatened species. The permitting requirements are the same for endangered and threatened species.

[1] Page 85, Plan for the Northwest Region, 2015-2023, Adopted July 29, 2015, Northwest Regional Planning Commission

Prior to 2016, an Endangered and Threatened Species Taking Permit (E&T Permit) could be issued if the Secretary of ANR determined that the taking is being done for scientific purposes; to enhance the propagation of species; to prevent or mitigate economic hardship; for zoological exhibition; for educational purposes, and for special provisions consistent with the federal Endangered Species Act (10 VAS §5408(a)). Act 145 of 2016 modified the Endangered and Threatened Species Act in two ways relative to the causeway. First, it allows the Secretary of ANR to designate by rule critical habitat for endangered and threatened species. Second, it eliminated economic hardship as a basis for a taking and added "incidental taking". The criteria for allowing an incidental taking are: 1) the taking is necessary to conduct an otherwise lawful activity; (2) the taking is attendant or secondary to, and not the purpose of, the lawful activity; (3) the impact of the permitted incidental take is minimized; and (4) the incidental taking will not impair the conservation or recovery of any endangered species or threatened species.

The original E&T Permit application submitted by VTrans was based on the construction of a new shore-to-shore bridge located 60 feet south of the existing road and causeway, removal of the old drawbridge and removal of most of the eastern and western arms of the causeway. Construction of a new bridge and complete removal of the drawbridge and causeway was the preferred alternative recommended in the 1997 Environmental Assessment completed to satisfy NEPA requirements.

Public input was provided during the E&T Permit hearing process by local officials from Vermont and Canada, the Northwest VT Regional Planning Commission, Lake Champlain Committee, Lake Champlain Walleye Association, Audubon Vermont, and the Conservation Law Foundation. As required in state statute, the Endangered Species Committee also provided advice for the Secretary's consideration. Comments were offered in support and in opposition to complete causeway removal.

The Endangered Species Committee advised that the new bridge be placed north of the causeway, rather than south where it may shade the turtle's basking area along the causeway. The Committee also recommended that if the permit allows, removal should be limited to only a portion of the eastern arm. The Endangered Species Committee also advised that any additional removal should not occur until monitoring for a five-year period establishes that the project has not caused unacceptable impacts to the turtle population. Incremental removal at five-year intervals would allow assessment of the impact of the construction and flow dynamics changes to turtle habitat.

An E&T Takings Permit was issued in January 2002. It allowed construction of the new bridge south of the causeway as proposed by VTrans and complete removal of the old drawbridge including its piers and abutments. The permit limited removal of the causeway to 330 feet on the lake end of the eastern arm. The species of concern addressed in the permit were the spiny softshell turtle, and three different types of mussels. The permit includes some conditions related to the mussels. The mussels are not expected to have a significant impact on alternatives to remove more sections of the causeway. However, if state listed mussels are found in a construction zone, there are typically relocation and monitoring conditions in the E&T permit.

The findings and conclusions on which the E&T Permit is based document the impact that causeway removal, and other aspects of the bridge project, would have on the turtle's basking area and hibernacula and justified the taking based on the public benefits of the bridge project.

The impacts are due primarily to removal of the causeway while the benefits are all related to transportation improvements resulting from the new bridge. Conclusion #16 of the E&T Permit describes the nexus between causeway removal and the new bridge:

- The construction of the new bridge and removal of the old bridge are integral parts of one application due to the 404 requirement imposed by the US Army Core of Engineers that fill be removed from Lake Champlain in an amount equal to what is put into the lake (to accommodate the fill required for the new piers and approaches of the new bridge).

The justification for issuing the E&T Permit is based on the consequences described in conclusions number 21-25 which state that failure to approve the Species Taking Permit for the Bridge would:

- Result in an unwarranted privation on the orderly development of the State;
- Impose an economic hardship on the State by continuing the traffic delays caused by the present bridge's narrowness;
- Impose an economic hardship on the State by continuing the public safety expenses caused by the present bridge's narrowness;
- Impose an economic hardship on the State by continuing the unnecessary maintenance expenses caused by the present bridge's age and deteriorating condition; and
- Impose an economic hardship on the State by facilitating the $5,517,600 civil penalty that the United States Coast Guard can levy on VTrans (because the old bridge was restricting navigation).

A new E&T Permit will be required before more sections of the causeway can be removed to justify taking of the spiny softshell turtle. Removal of some or all the remaining causeway would be a stand-alone project that is no longer linked to the bridge project and the benefits it provides. Therefore, the taking must be justified based on conditions specific to the causeway related to the exceptions in Vermont's Endangered and Threatened Species Act described above.

The most relevant of these exceptions are the incidental taking justifications added in 2016 in Act 145 as described above. Additionally, Vermont's Endangered and Threatened Species Act requires that an applicant demonstrate that a proposed activity cannot practicably be designed to avoid the taking and still satisfy the basic project purpose. If the purpose of causeway removal is to improve water quality, particularly to reduce phosphorus, there are a number of alternative approaches available that will not directly impact the turtles.

Other conclusions in the E&T Permit that are important to consider:

- #17 - There are two habitat features associated with the Missisquoi Bay Bridge that are important to the spiny softshell turtles, the basking areas provided by the causeway and the underwater hibernaculum (adjacent to the causeway) provided by the water flow and the causeway.
- #18 - The turtles make limited use of the eastern causeway for basking

- #19 - The change in flow mechanics caused by the removal of the causeway will have an adverse impact on the hibernaculum. The adverse effect will be a result of decreased flow velocity and changes in benthic (lake bottom) erosion. The greater amount of the causeway removed, the greater impact on the hibernaculum.

The permit includes fifteen conditions specific to the spiny softshell turtles. Most of the permit conditions addressed issues related to reducing impacts during construction and monitoring requirements. Results of the monitoring are described in more detail below. the following conditions have the most bearing on alternatives related to removal of additional sections of the causeway:

- Condition 11: This condition originally prohibited any access to the eastern arm of the causeway. It was later eliminated by a permit amendment and full access is allowed. The eastern arm of the causeway is now open to the public for recreational purposes and is served by a parking lot and boat launch at the Larry Greene Fishing Access that is maintained and operated by the Vermont Department of Fish & Wildlife.
- Condition 12: This condition requires that the road surface and guardrails of the existing causeway shall be left in place. This permit condition was recommended by the Endangered Species Committee to help stabilize the causeway after it is no longer used as a roadway. The asphalt road surface has been left in place, although there has still been some damage due to erosion. The guardrails were removed as allowed in a permit amendment.
- Condition 18: Sedimentation and turbidity associated with any project-related activity shall be minimized. During removal of the 330 feet of the eastern arm, VTrans found it challenging to minimize turbidity given the softer soils on the adjacent lake bottom, currents and sometime strong winds. To mitigate this risk, subsequent removal may require supplemental techniques to enhance the effectiveness of the turbidity screens or restrictions in construction activities based on conditions.

Turtle Monitoring

The E&T Permit required post-construction monitoring by specifying that “Any further removal of the causeway should not occur until monitoring for a five-year period establishes that the project has not caused unacceptable impacts to the turtle population”. Monitoring was conducted pre-construction (1996-2003), during construction (May 2004-October 2007), and post construction (2008-2012). The turtle’s basking, hibernation and overall movement patterns were monitored as well as potential changes in water quality and the topography of the lake bottom (bathymetry). The results of this long term monitoring effort are documented in the “Missisquoi Bay Bridge Project – spiny softshell turtle Monitoring 1996-2012 – Final Report” (May 2013, McFarland Johnson for the Vermont Agency of Transportation).

Prior to construction activities, most softshell turtles were observed basking on the south side of the western causeway. After construction was complete, the great majority of softshell turtles were found on the north side of the western arm which is closed to vehicle traffic and pedestrians. The monitoring report notes that the turtles are still finding opportunities to bask

in the bridge project area but the bridge has resulted in less overall suitable basking habitat and less diversity of basking habitat conditions (orientation to sun and wind).

During construction, temporary basking platforms were deployed on the north and south of the causeway and bridge project and were used by many softshell turtles. A permanent basking platform was constructed adjacent to a bridge pier near the causeway opening but few turtles have been observed using it.

Radio telemetry was used to track hibernation locations and overall movement patterns. While the softshell turtles use other areas north and south of the causeway for hibernation, 78% of the tracked turtles hibernated near the bridge area. The percentage dropped during construction through the winter of 2008-2009, but rebounded in the following years. The monitoring report notes that spiny softshell turtles continue to hibernate near the bridge. The report also found that the spiny softshell turtles continue to follow their annual movement patterns in the Lake.

Water quality characteristics that affect habitat for the spiny softshell turtle were monitored from June 2002 to April 2012 including temperature, dissolved oxygen, pH, turbidity, phosphorus and current velocity. Although the data collection was limited, the report states that there is no indication that the bridge project adversely affected the water quality of the spiny softshell habitat.

According to the monitoring report, the softshell turtles prefer soft lake-bottom substrates along the existing channel. Any changes to the channel configuration, water velocity, or substrate characteristics could potentially affect their choice of winter hibernation locations. When 330 feet of the eastern causeway was removed, it was only excavated to the depth of the surrounding lake bottom leaving behind a foundation of rock in the softer substrates. Post construction bathymetry shows the water is much shallower at the footprint of the removed causeway than in the adjacent areas. Leaving in place the causeways foundation may have preserved characteristics of the channel that are important to the turtles' s hibernaculum.

3.0 PROJECT PURPOSE AND NEED

The purpose of this project is to help improve water quality in the Missisquoi Bay without causing an unacceptable increase to the phosphorus concertation in the Northeast Arm and without causing an unacceptable impact to the threatened, spiny softshell turtles that live in the Bay.

The need for action must consider the following points:

- Available funding. There is approximately $4.12 million left in the federal earmark that was used to fund the Missisquoi Bay bridge project. The $4.12 million earmark must be matched with 20% non-federal funds.
- Phosphorus concentrations exceed the Vermont water quality standards in most areas of Lake Champlain today and have been since the 1980s. The current phosphorous concentration in the Missisquoi Bay is about twice as high as the water quality standards for that segment of the lake and is on an increasing trend line.

- Phosphorous concentration in the Northeast Arm of Lake Champlain, which is located south of the causeway, also consistently exceed the phosphorus target for that segment of the Lake and is on an increasing trend line.
- Phosphorus sources in Missisquoi Bay and their relative contributions include streambank erosion (35%), and stormwater runoff from cropland (29%), forest (16%), developed land (9%) and backroads (5%). The 6% balance is from farmstead, pastureland and wastewater facilities.
- Many residents believe that removal of the old VT Route 78 causeway will significantly improve water quality in the Missisquoi Bay by restoring a more effective flushing of phosphorus to the south where it can mix with waters in the Northeast Arm.
- Removal of the eastern and western arms of the causeway has been estimated to reduce bay-wide average phosphorus concentrations and sedimentation in Missisquoi Bay by about 1 %. Any changes in currents or phosphorus levels would be limited to the vicinity of the causeway (within about two miles), and would be matched by corresponding phosphorus increases south of the causeway in the Northeast Arm.
- The science and methodology used to estimate the effect of the causeway on phosphorus concentration were peer reviewed by third party subject matter experts and vetted through a public process led by the US-Canada International Joint Committee and found to be sound. However, local public sentiment remained strongly in favor of causeway removal as a water quality mitigation measure. In recognition of this local sediment, the IJC recommended removing the causeway because it was an obstacle to cooperative efforts to address water quality. The local sentiment is also supported by the 2015-2023 Northwest Regional Plan which includes a policy to remove the causeway as a strategy to improve water quality.
- The Missisquoi Bay causeway provides habitat for the spiny softshell turtle which is included on the state's list of endangered and threatened species. The turtles use a narrow band of the causeway at waterline for a basking area during fall and spring, and use the lake bottom north and south of the causeway opening for winter hibernation (hibernaculum).
- The monitoring program conducted as part of the bridge project found that spiny softshell turtles continue to use the causeway and bridge area for basking and winter hibernating. This finding suggests that removal of additional sections of the eastern arm of the causeway may also have limited impact on the turtles.
- The monitoring report also notes that longer term impacts due to permanent habitat changes resulting from the bridge project and partial causeway removal are uncertain. Therefore, removal of any additional sections of the causeway must proceed with caution and include appropriate monitoring and mitigation.

4.0 ALTERNATIVES ANALYSIS

This section presents an evaluation of four alternatives including (1) leave the causeway in place, (2) remove a portion of the eastern arm of the causeway, (3) remove all of the eastern arm of the causeway, and (4) complete removal of the eastern and western arms of the

causeway. Section 4.1 describe the cost estimate methodology and assumptions and Section 4.2 provides background information on state and federal permitting requirements. Section 4.3 describes the characteristics of each alternative, order of magnitude cost estimates, potential resource impacts, permitting requirements and advantages and disadvantages are summarized. The comparison is summarized in an Alternatives Evaluation Matrix at the end of this section.

4.1 Cost Estimate Approach

Order of magnitude cost estimates have been prepared for each causeway removal alternative and are presented in Attachment B. The demolition and construction activities are based on approximate quantities and unit costs. Unit costs are in current dollars and were determined for the related VTrans pay item's bid history averaged from January 1, 2010 through December 31, 2015. Mobilization and construction engineering costs are based on typical percentages of construction costs and allowances are included for traffic control and measures to mitigate the amount of debris and mud that would be spread on to VT 78 as trucks leave the removal site. The cost for monitoring impacts to the spiny softshell turtles and water quality before and during construction and for five years post construction is included in each removal alternative and is based on the cost of the previous monitoring work. Each removal alternative assumes that turbidity would be managed using floating turbidity screens. The use of sheet piles was investigated as an option to manage turbidity during construction. Steel sheet piles are not recommended because their installation and removal would cause significant turbidity offsetting any benefits during removal of the causeway. If sheet piles are used, total cost estimates for each alternative would double. Each removal alternative assumes that the parking lot for the Larry Greene Fishing Access will need to be repaved and restriped following construction. The costs to prepare an Environmental Assessment or Environmental Impact Statement are based on VTrans experience with similar documentation. As standard practice, the cost estimate includes a thirty percent contingency to account for the level of detail typical of a scoping study.

4.2 Permit Requirements

Because each alternative that involves removal of the causeway would be using federal transportation funds, it must comply with National Environmental Policy Act and would also require the other state and federal permits described below.

National Environmental Policy Act of 1969 (NEPA)

All federal actions, including projects that use federal funding or require a federal permit, must demonstrate compliance with NEPA. For projects that involve more than one federal agency, there is a "lead federal agency" that is charged with implementing NEPA, most commonly the FHWA for VTrans transportation projects. There are three levels of NEPA clearance: a Categorical Exclusion (CE), for projects with minimal environmental impacts; an Environmental Assessment (EA), for projects where the significance of impacts is uncertain; and an Environmental Impact Statement (EIS), where the impacts are expected to be "significant". The federal agency makes the determination of what level of document to prepare. Significance is based on the context and intensity of the impact (see 40 CFR 1508.27). FHWA further considers

factors such as the type, quality and sensitivity of the resource involved; the project location; the duration of the effect; and the project context.

The Missisquoi Bay Bridge project required an Environmental Assessment. Based on previous experience, VTrans expects that an EA would be required for Alternatives 2 and 3 which involve partial or complete removal of the eastern arm of the causeway respectively. Given the known, significant impact of complete removal of the eastern and western arms of the causeway, it is possible that an Environmental Impact Statement would be required for Alternative 4.

Act 250 State Land Use Permit

Vermont's Conservation and Development law, State Land Use and Development Plans (10 VSA 151) (Act 250), is a state-wide land use planning law that regulates large scale developments using ten criteria related to natural resources, cultural resources, and social effects. There is usually a presumption of compliance under certain criteria when other state approvals are acquired (i.e. state wetlands permit, E&T permit, etc). Significant public involvement opportunities exist under this permit process.

An Act 250 permit was issued (LUP # 6G0555) on September 8, 2003 that authorized VTrans to construct the new bridge and remove 330 feet of causeway, drawbridge, existing piers and abutments. The Act 250 permit incorporated the conditions of the Endangered and Threatened Species Taking Permit. Other conditions that were included specific to the causeway are:

- Condition #12: Maintenance of the causeway shall be performed by the Permittee (VTrans)
- Condition #13: A portion of the drawbridge causeway shall remain in place to provide spiny softshell turtle habitat.
- Condition #20: Any new disposal sites or uses for causeway debris shall be reviewed and approved by the Act 250 District Coordinator. The Act 250 permit allowed material removed from the causeway and drawbridge to be disposed of at either the A.G. Anderson Highgate Sand Plant property or the Shelburne Limestone Company's quarries.

Since the Act 250 permit for the bridge incorporates conditions specific to the causeway and its removal, the Act 250 permit would need to be amended for all alternatives. With the exception of the impacts to the spiny softshell turtle, there were no other conditions or findings of fact that raised concerns about removing additional sections of the causeway.

VT 401 Water Quality Certification

The Federal Water Pollution Control Act (33 USC 1251) (also known as the Clean Water Act), includes a provision that "Any applicant for a Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency a certification from the State in which the discharge originates…". The certification ensures that the applicant has complied with the standards listed in the Clean Water Act and with the Vermont Water Quality Standards. The application form includes information about the

proposed project, proposed wetland mitigation (if any), and a demonstration that the project is in compliance with the anti-degradation provisions in the Vermont Water Quality Standards. There would be a public comment period under this permit.

USCOE Individual Permit: Section 404 of the Clean Water Act; Section 10 of the Rivers and Harbors Act of 1899

Section 404 of the Clean Water Act (codified at 33 USC 1344) authorizes the regulation of the discharge of materials into Waters of the Unites States. The program is administered by the Army Corps of Engineers through the Navigation and Navigable Waters regulations 33 CFR 320-338. Lake Champlain would be the waterway in this action.

Section 10 of the River and Harbors Act of 1899 (33 USC 403) regulates dredging and filling in "Navigable Waters". Regulations for administering the law are in 33 CFR 322 and 23 CFR 650. Navigable waters are defined in 33 CFR 329.4 as "those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce." The Army Corps of Engineers (Corps) administers the program.

The application process can be involved. Much of the information needed for this application would be obtained during preparation of other applications. Removal of some or all of the causeway would likely be an Individual Permit as there would be greater than 5,000 sf of impact below ordinary high water (OHW 98.0' elevation, Lake Champlain). As part of the application, there would need to be a demonstration that there will be no more than minimal direct and indirect impacts to the aquatic resource(s) resulting from the project.

Section 9 Coast Guard Bridge Permit

Section 9 of the Rivers and Harbors Act (33 USC 491) prohibits the construction of any bridge, dam, dike or causeway over or in navigable waterways of the U.S. without Congressional approval. The United States Coast Guard (USCG) administers Section 9 and issues Bridge permits over navigable waters. Regulations for administering the law are in Navigable Waterway regulations 33 CFR 114 - 118. The permit is required for any new bridges or causeways, or modifications to existing bridges. Since the alternatives involve only the removal of the causeway, this permit would not be required.

State Wetland Permit

A state wetland permit is required for projects that impact Class One or Two wetlands. There was no impact to wetland resulting from removal of the drawbridge and 330 feet of the eastern causeway that were completed with the bridge project. There are no impacts to wetlands anticipated with removal of additional sections of the causeway.

VT Lake Encroachment Permit

Vermont state law 29 VSA 11 (Management of Lakes and Ponds) requires that a Lake Encroachment Permit be issued for projects that encroach on lakes and ponds that are public waters.

"Encroachment" includes filling or altering of the land under lakes and ponds, as well as the construction of bridges, retaining walls, or docks in or over lakes and ponds "Public waters" are defined as "navigable waters", which means "Lake Champlain, Lake Memphremagog, the Connecticut River, all natural inland lakes within Vermont and all streams, ponds, flowages, and other waters within the territorial limits of Vermont, including the Vermont portion of boundary waters, which are boatable under the laws of this state."

This permit is administered by ANR. Similar information that is required for the USCOE permit is required for this permit. The permit would be required for all causeway removal alternatives. It would include conditions related to managing turbidity during the removal process which could include monitoring requirements and protocols to temporarily halt work. In general, some temporary release of sediment would be tolerated during construction activities if there is a demonstrated overall public benefit to the project.

Each removal alternative assumes that turbidity will be managed using floating turbidity screens. The use of steel sheet piles was investigated as an option to manage turbidity during construction. Steel sheet piles are not recommended because their installation and removal would cause significant turbidity offsetting any benefits during removal of the causeway. If sheet piles are used, total cost estimates for each alternative would double.

Compliance with Section 106 of the National Historic Preservation Act

The National Historic Preservation Act (16 USC 470) provides for the preservation of historic resources. Section 106 of the law requires that federal undertakings (actions involving federal funding, permits or property) must take into account the effect on historic properties. Transportation projects might involve Section 106 because of work on or near historic bridges, historic buildings, historic districts, or areas sensitive for archaeology. VTrans has a programmatic agreement with the VT Division for Historic Preservation to review transportation projects for compliance with Section 106.

Historic and archaeological resources were identified as part of the bridge project. The resources included the draw bridge, the draw bridge operator's house, a tollhouse and wooden barges that were used to construct the causeway. Two prehistoric sites were identified including one large Native American base camp or semi-permanent residential site. Mitigation was provided for impacted sites as part of the bridge project. Additional impacts and mitigation is not anticipated for removal of additional sections of the causeway.

VT Endangered and Threatened Species Taking Permit

Vermont law 10 VSA Chapter 123 (Protection of Endangered Species) prohibits the taking, possessing, or transporting of state-threatened and state-endangered plants and animals. The law is administered by the Wildlife Diversity Program of the Vermont Fish and Wildlife Department (VFWD) through the Vermont Threatened and Endangered Species Rule, which lists the plant and animal species protected by the law.

For the reasons outlined in Section 2.4, an Endangered and Threatened Species Taking Permit will be required for any alternative that involves removal of the causeway.

4.3 Alternatives

Alternative 1: Leave Existing Causeway in Place

No additional sections of the causeway would be removed. The causeway would be maintained as required in the Missisquoi Bay Bridge Act 250 permit. The eastern arm of the causeway would continue to be available for recreational use. The western arm of the causeway would continue to be preserved as a basking area for the spiny softshell turtles, and would remain off limits to pedestrians and vehicles.

This alternative would make it possible to repurpose the unspent portion of federal transportation funds left over from the Missisquoi Bay bridge earmark to fund federally eligible transportation projects within 50 miles of the causeway. As noted above, stormwater runoff from the roadway network contributes 5% of the phosphorus entering the Bay. Therefore, VTrans and ANR considered directing some portion of the earmarked funds for planning and implementation of town highway stormwater improvements to support the efforts of Vermont municipalities in the basin to meet the requirements of the 2015 state water quality law, Act 64. VTrans currently provides funding for local road improvements through the Better Roads, Town Highway Class 2 Roadway and Town Highway Structures grant programs. To help municipalities comply with these new requirements, funding for the Better Roads programs was increased significantly since the passage of Act 64. All of these programs use state only funds for town highway projects because they are more flexible and have less administrative overhead than federally funded efforts (which can be overly burdensome and inefficient for smaller-cost local projects). Given these inefficiencies, addressing local road storm water improvements is not considered an effective use of federal funding in this case.

Advantages

- Allows repurposing of earmark funds for other federally eligible transportation projects.
- Avoids impacting the spiny softshell turtle.
- Maintains recreational access.

Disadvantages

- The causeway requires periodic maintenance.
- Inconsistent with Northwest Regional Plan and unlikely to be supported by local residents.

Alternative 2: Partial Removal of Eastern Arm of the Causeway

Approximately 330 feet of the lakeside end of the eastern arm of the causeway would be removed down to the elevation of the natural lake bed. The long-term turtle monitoring study completed for the bridge project suggests that the turtles were able to adapt following removal of about 330 feet of the eastern causeway. Therefore, this alternative is considered to be feasible from a permitting perspective because its length is equal to the amount of causeway removed with the bridge project.

The new terminal end would be graded at an appropriate slope and covered with four feet of Type IV stone matching the design of the current causeway end. After removal, the eastern arm of the causeway would be approximately 1,400 feet long and the channel opening between the eastern and western arms would increase from approximately 830 feet to 1,160 feet. The existing asphalt surface on the causeway would be left in place and patched as necessary. The eastern arm of the causeway would continue to be available for recreational use. The western arm of the causeway would continue to be preserved as a basking area for the spiny softshell turtles, and would remain off limits to pedestrians and vehicles.

The estimated capital cost for this alternative is $2.4 million. This estimate includes the cost for engineering, permitting, construction and all turtle and water quality monitoring conditions. The engineering and permitting phase would take three to five years. Depending on permit conditions that might impose restrictions on construction activity or other mitigation, the removal might extend over two construction seasons. Post construction monitoring of the spiny softshell turtles would last five years.

To satisfy NEPA requirements, this alternative would require an Environmental Assessment. The project would also require an amendment to the Act 250 permit for the bridge. An Endangered and Threatened Species Taking Permit would be required to justify the potential impacts to the spiny softshell turtle and to certain species of mussels that are also found near the bridge and causeway. The E&T permit might require mitigation measures during construction and would require a monitoring program before construction starts to establish a baseline, during construction and for five years post construction. Other necessary permits are identified in the Evaluation Matrix (Figure 7 on page 25) but are not anticipated to include significant conditions.

As summarized in Section 2.3 above, complete removal of the causeway has been estimated to reduce bay-wide average phosphorus concentrations and sedimentation in Missisquoi Bay by about 1 %. Any changes in currents or phosphorus levels would be limited to the vicinity of the causeway (within about two miles), and would be matched by corresponding phosphorus increases south of the causeway in the Northeast Arm. Based on water quality monitoring data obtained by ANR before (1992-2006) and after (2007-2011) the 330 feet of the eastern arm was removed in 2007, no changes in water quality gradients had occurred between Missisquoi Bay and the Northeast Arm. These data suggest that no enhanced water mixing between these two areas of Lake Champlain had occurred after partial causeway removal. It's reasonable to expect a similar outcome for this alternative, which would remove the same amount of causeway that was removed in 2007. Therefore, this alternative may only marginally address the desire to improve water quality. The effects on water quality should be monitored as part of the project.

Advantages

- Provides limited but positive effect on reducing phosphorus concentrations.
- Expected to have a minimal impact to the spiny softshell turtles because the amount of causeway removed would be similar to the amount removed during the bridge project
- Estimated cost of $2.4 million is less than available federal earmark funds of $4.1 million. The balance of $1.7 million could help address any unforeseen cost increases, which are common in transportation projects.

- Opportunity to study the impact of additional causeway removal on the spiny softshell turtles
- Opportunity to evaluate the effect of additional causeway removal on phosphorus dispersion
- Most of the eastern causeway would remain in-tact and available for recreational use
- Partial removal is a step towards satisfying the Northwest Regional Plan's policy calling for causeway removal because it makes progress towards removing the causeway.

Disadvantages

- Difficult and expensive to manage sediment during the removal process which could result in short-term degradation of water quality.
- The causeway requires periodic maintenance.

Alternative 3: Complete Removal of Eastern Arm of the Causeway

Complete removal of the eastern arm would occur in four phases so that impacts to the spiny softshell turtle could be monitored prior to moving forward with each phase. The potential impacts to the spiny softshell turtle that would result with removal of the rest of the eastern arm of the causeway are potentially significant and uncertain. The findings of the long-term turtle monitoring that occurred before, during and after the bridge project indicate that removal of approximately 330 feet of causeway may not result in an unacceptable impact to the turtle's basking area and hibernaculum. This experience cannot be translated into an understanding of the impacts that might occur if the entire eastern arm is removed at the same time. Removal of the entire eastern arm might for example change conditions in the channel that create the turtle's hibernaculum. This phased approach was recommended by the Endangered Species Committee in comments on the E&T Permit for the bridge project and it is reasonable to assume a similar approach would be required for this alternative.

Approximately 1,350 feet of the eastern causeway would be removed down to the elevation of the natural lake bed to the point where it's lakeside end would align with the approach causeway for the new bridge. The first three phases would remove approximately 330 feet each, and the fourth and final phase would remove the remaining 360 feet. Each phase would provide a terminal end to be graded at an appropriate slope and covered with four feet of Type IV stone matching the design of the current causeway end. Approximately 280 feet of the causeway would be left in place after the fourth phase and could continue to serve as a fishing pier. The existing asphalt surface would be left in place and patched as necessary. The channel opening would increase from 830 feet to 2,180 feet.

The total estimated capital cost for all four phases is $8,900,000. It would take between 30 and 35 years to complete all four phases (Figure 6). This schedule assumes that the duration for the engineering and permitting activity for the first phase would be five years and would include the preparation of plans and the Environmental Assessment for all four phases. The Engineering and Permitting activity for subsequent phases would still be required but would involve less extensive updates. Each phase assumes that construction would occur in one season. Depending on permit conditions that might include restrictions on construction activity or other mitigation,

removal for any one phase could extend over two construction seasons. Post construction monitoring of the spiny softshell turtles would last five years for each phase.

Figure 6: Implementation Schedule for Phased Removal of the Eastern Arm

Removal Phase	Activity	Years
Phase I	Eng & Permitting	5
	Construction	1
	Monitoring	5
Phase II	Eng & Permitting	2
	Construction	1
	Monitoring	5
Phase III	Eng & Permitting	2
	Construction	1
	Monitoring	5
Phase IV	Eng & Permitting	2
	Construction	1
	Monitoring	5
	Total Duration	35

The permitting requirements are similar to Alternative 2. An Environmental Assessment would be required to satisfy NEPA and would need to be updated prior to each phase. Similarly, the Act 250 permit for the bridge project would need to be amended for each phase. Given the length of time between the phases, all other required permits would have to be updated and resubmitted for approval for each phase.

As summarized in Section 2.3 above, complete removal of the eastern and western arms of the causeway has been estimated to reduce bay-wide average phosphorus concentrations and sedimentation in Missisquoi Bay by about 1 %. Any changes in currents or phosphorus levels would be limited to the vicinity of the causeway (within about two miles), and would be matched by corresponding phosphorus increases south of the causeway in the Northeast Arm. It is reasonable to infer that the removal of just the eastern arm as proposed in this alternative would have less of an effect on phosphorus concentrations in Missisquoi Bay and the Northeast Arm.

<u>Advantages</u>

- Provides limited but positive effect on reducing phosphorus concentrations.
- It is possible that a phased approach would be permitted because it allows causeway removal to move forward in a careful manner, with defined check-in points while protecting the habitat of the spiny softshell turtles.
- Opportunity to evaluate the effect of additional causeway removal on phosphorus concentrations.
- Reduces the amount of maintenance required for up-keep of the causeway.
- Partial removal is a step towards satisfying the Northwest Regional Plan's policy calling for causeway removal because it makes progress towards removing the causeway.

Disadvantages

- Requires a sustained commitment and dedication of resources for more than thirty years.
- Cost estimate of $8.9 million exceeds the remaining federal earmarked funds of $4.1 million.
- Difficult and expensive to manage sediment during the removal process which could result in short-term degradation of water quality during each phase.
- Requires re-paving the fishing access parking lot for each phase.
- It is possible that the results of turtle monitoring following any one of the first three phases would find that an unacceptable impact had occurred. Therefore, there are no guarantees that a phased approach could be fully implemented.
- The western arm of the causeway would continue to require periodic maintenance.

Alternative 4: Complete Removal of Eastern and Western Arms of the Causeway

All of the eastern and western arms of the causeway would be removed in phases. The results of the long term spiny softshell turtle monitoring study indicate that post bridge construction the turtles rely much more on the western arm for basking. Therefore, this alternative is not feasible without successful relocation of the spiny softshell turtles. The eastern arm would be removed in four phases as described in Alternative 3. Research and pilot testing of turtle relocation could occur concurrent with the 30-35 years it would take to remove the eastern causeway.

Removal of the western arm could only be pursued if efforts to relocate the turtles are successful. Successful relocation is extremely uncertain and the cost associated with such an effort would be significant. The monitoring work completed for the bridge project demonstrated that the spiny softshell turtles are strong swimmers and already utilize a larger portion of the lake and surrounding area, including the Missisquoi and Pike Rivers. The turtles return to the causeway from as far away as 12 miles. There are other hibernacula within 12 miles of the causeway that receive some use, but the majority of the adult females return to the causeway. There is currently a lack of knowledge about how to implement relocation in an effective manner and research would be necessary before moving forward. Relocation would likely include footprint and lake bottom impacts at any new basking and hibernacula site requiring additional permits and possibly purchase of conservation easements or land to ensure permanent protection.

The causeway would be removed down to the elevation of the natural lake bed and its length would be shortened to the point where the lakeside ends of each arm would align with the approach causeways for the new bridge. Since this alternative assumes that the spiny softshell turtle would be successfully relocated, it also assumes the entire western arm would be removed as the fifth and final phase. Approximately 280 feet of the eastern causeway would be left in place and could continue to serve as a fishing pier. About 290 feet of the western causeway would be left in place. The existing asphalt surface on the causeway would be left in place and patched as necessary. The channel opening would increase from 830 feet to approximately 3,500 feet.

The minimum capital cost estimate for this alternative is $13.5 million and has two important caveats:

- First, this estimate does not include the cost to relocate the spiny softshell turtles which is essential to implementing this alternative. Relocating the turtles would involve research on whether or not relocation is possible, identifying and evaluating potential locations, piloting the relocation, purchasing easements or outright purchase of land that would be protected as the new basking and hibernaculum site for the turtles, final relocation implementation and monitoring. There are too many unknowns related to relocating the turtles to develop a reliable schedule or cost estimate at this point. Given that the cost to simply monitor the turtles was approximately $600,000 for the bridge project, the cost to relocate the turtles, assuming it's feasible in the first place, would be in the millions.
- Second, this cost estimate assumes that the western arm of the causeway would be removed in its entirety following a four phased removal of the eastern arm. If multiple phases are required to remove the western arm, perhaps as an incremental process to relocate the turtles, the cost would increase by approximately $3-$4 million.

As summarized in Section 2.3 above, complete removal of the eastern and western arms of the causeway has been estimated to reduce bay-wide average phosphorus concentrations and sedimentation in Missisquoi Bay by about 1 %. Any changes in currents or phosphorus levels would be limited to the vicinity of the causeway (within about two miles), and would be matched by corresponding phosphorus increases south of the causeway in the Northeast Arm.

<u>Advantages</u>

- Provides limited but positive effect on reducing phosphorus concentrations.
- It is possible a phased removal approach of the eastern arm would be permitted because it allows causeway removal to move forward in a careful manner, with defined check-in points while protecting the habitat of the spiny softshell turtles.
- Opportunity to evaluate the effect of additional causeway removal on phosphorus concentrations.
- Eliminates the need to maintain the eastern and western arms of the causeway.
- Consistent with the policy in the Northwest Regional Plan to remove the causeway.

<u>Disadvantages</u>

- Requires a sustained commitment and dedication of resources for more than thirty years.
- It is possible that the results of turtle monitoring following any one of the four phases to remove the eastern arm would find that an unacceptable impact had occurred. Therefore, there are no guarantees that this alternative could be fully implemented.
- Full implementation of this alternative also depends on relocating the spiny softshell turtles. Successful relocation is extremely unlikely and the cost associated with such an effort would be significant. The timeline is uncertain and if extended would increase

cost. A significant amount of funds could be invested to learn that relocation is not feasible.

- Minimum cost estimate of $13.5 million far exceeds the remaining federal earmarked funds of $4.1 million.
- Difficult and expensive to manage sediment during the removal process which could result in short-term degradation of water quality during each removal phase.

Figure 7: Evaluation Matrix

		Alt 1	***Alt 2***	***Alt 3***	***Alt 4***
		No Action	*Remove Partial East Arm (330 ft)*	*Remove Complete East Arm*	*Remove East and West Arms*
Costs	Capital Cost with Turbidity Screens [5]	$0	$2,400,000	$8,900,000	$13,500,000
	Annual Maintenance Cost	$10,000	$10,000	$8,000	$0
	Implementation Time	Not Applicable	7 Years	30-35 Years	More than 35 Years
Potential Resource Impacts	Agricultural	None	None	None	None
	Historic Structures Sites & Districts	None	None	None	None
	Archeology	None	None	None	Possible
	Floodplain	None	None	None	None
	Fish & Wildlife Lake Bottom Habitat	None	Possible	Possible	Possible
	Endangered & Threated Species	None	Yes	Yes	Yes - Significant
	Public Lands - Section 4(f)	None	Minor	Significant [1]	Significant [1]
	Land & Water Conservation Fund - Section 6(f)	None	None	None	None
	Noise	None	None	None	None
	Wetlands	None	None	None	None
	Right-of-Way	None	None	None	None
	Water Quality During Construction	None	Temporary [2]	Temporary [2]	Temporary [2]
	Water Quality after Completion	None	Limited but Positive	Limited but Positive	Limited but Positive
Other Issues	Transportation Concerns	None	None	None	None
	Community Character	No Change	No Change	Significant [3]	Significant [3]
	Economic Impacts	None	None	None	None
	Conformance to Regional Plan	No	Yes [4]	Yes [4]	Yes [4]
	Navigation	No Change	No Change	No Change	No Change
	Satisfies Purpose & Need	Somewhat	Yes	Yes	Yes
Permit Required	NEPA	No	Environmental Assessment	Environmental Assessment	Possible Environmental Impact Statement
	Act 250	No	Yes	Yes	Yes
	401 Water Quality	No	Yes	Yes	Yes
	COE Permit (Sections 10 & 404)	No	Yes	Yes	Yes
	Coast Guard	No	No	No	No
	State Wetlands Permit	No	No	No	No
	Stormwater Construction Permit	No	No	No	No
	Stormwater Operational Permit	No	No	No	No
	Lakes & Ponds Permit	No	Yes	Yes	Yes
	Endangered & Threatened Species Taking	No	Yes	Yes	Yes
	Compliance with Sec 106 National Historic Preservation Act	No	Yes	Yes	Yes

NOTES

1 Loss of fishing pier Alternatives 3 and 4

2 Difficult to manage turbidity during demolition

3 Loss of fishing pier Alternatives 3 and 4

4 Support the 2015 - 2023 Nortwest Regional Plan because they improve water quality or involve removal of some of all of the Missisquoi Bay causeway, which is a specific policy in the regional plan.

5 Capital costs would double if steel sheet piles are used to manage turbidity during construction

5.0 PREFERRED ALTERNATIVE

VTrans, after consulting with ANR, recommends Alternative 2 - Partial Removal of the Eastern Arm of the Causeway. This alternative would result in removing as much of the causeway as possible given permitting and funding constraints. Alternative 2 satisfies the purpose and need because it has the potential to improve water quality in the Missisquoi Bay without causing a significant increase of phosphorus in the Northeast Arm and it minimizes impacts to the spiny softshell turtles.

Based on the results of the extensive water quality modeling conducted during the evaluation of Missisquoi Bay bridge alternatives, complete removal of the causeway is estimated to have a limited, but positive effect on reducing phosphorus concentrations in Missisquoi Bay. Partial removal would have less of an effect on water quality, but is the only removal alternative that can will minimize impacts to the spiny softshell turtle. This alternative makes progress towards achieving the Northwest Regional Planning Commission's policy supporting causeway removal. Partial removal of the causeway is also consistent with the recommendation of the U.S.-Canada International Joint Commission. The IJC recognized that causeway removal will have a limited effect on water quality, but recommended removal to refocus public attention on necessary phosphorus reductions from the bay's watershed and to remove what they described as "an obstacle to expanding the cooperative efforts by farmers, municipalities, taxpayers and others that will be needed to achieve nutrient reductions." Thus, moving forward with partial removal may shore up local support for the other water quality improvement efforts now underway through implementation of the state's clean water law, Act 64. Results from monitoring impacts to the spiny softshell turtle and water quality to be conducted as part of this alternative would inform a future assessment about removing additional sections of the causeway.

At an estimated cost of $2.4 million, Alternative 2-Partial Removal is the only removal option that can be implemented for an estimated cost that does not exceed the remaining funds from the Missisquoi Bay Bridge earmark of $4.1 million.

Non-Preferred Alternatives

Alternative 1- Leave the Existing Causeway in Place, is not consistent with the Northwest Regional Plan's policy calling for removal of the causeway. Leaving the causeway in place would have no adverse effect on the habitat of the spiny softshell turtle because it maintains current conditions but provides no potential water quality improvement. This alternative would allow the earmarked funds to be used for other federally eligible transportation projects. However, given the administrative overhead associated with federal funds, it would be inefficient to redirect the money to lower-cost local roadway stormwater improvement projects. The unused earmark funds could be directed at any number of other transportation projects but this advantage is not relative to the purpose and need of the project.

The other two causeway removal alternatives are not permittable at this time and their estimated costs exceed available funding. Alternative 3-Phased Removal of the Entire Eastern Arm of the Causeway would arguably have more of an effect on reducing phosphorus concentrations in the Bay than Alternative 2 because it would increase the channel opening to about half a mile. However, in order to ensure the turtle habitat is protected, complete removal of the eastern arm would have to be implemented in four phases that would extend over more

than thirty years. It is possible that this alternative may move forward over the years, depending on the results of turtle and water quality monitoring. The estimated cost of $8.9 million exceeds the $4.1 that is available with the federal earmark, so additional funding would be necessary.

Alternative 4-Complete Removal of the Eastern and Western Arms of the causeway would start with the phased removal of the eastern arm as described in Alternative 3. Therefore, this alternative has the same challenges including implementation over more than thirty years. Additionally, its implementation would require relocation of the spiny softshell turtle. Successful relocation is extremely unlikely and the cost and additional time associated with such an effort would be significant. A significant amount of funds could be invested only to learn that relocation is not feasible. The minimum cost for this alternative is $13.5 million. There are too many unknowns related to relocating the turtles to develop a reliable schedule and cost estimate at this point. However, the cost is likely to be much higher when the cost for relocating the turtles is considered. The estimated minimum cost of $13.5 million exceeds the $4.1 that is available with the federal earmark, so additional funding would be necessary.

REFERENCES

Alburg-Swanton BRF 036-1(1) Environmental Assessment, October 1997.

Endangered and Threatened Species Taking Permit, Permittee: Vermont Agency of Transportation; Listed Species of Concern: Giant floater, Fragile papershell, Pink heelspliiter, and Spiny softshell turtle; Location: Route 78 Bridge and causeway over Lake Champlain connecting the towns of Alburg and Swanton; January 25, 2002; Vermont Department of Fish and Wildlife.

International Missisquoi Bay Task Force, Final Report to the International Joint Commission; October 20, 2004

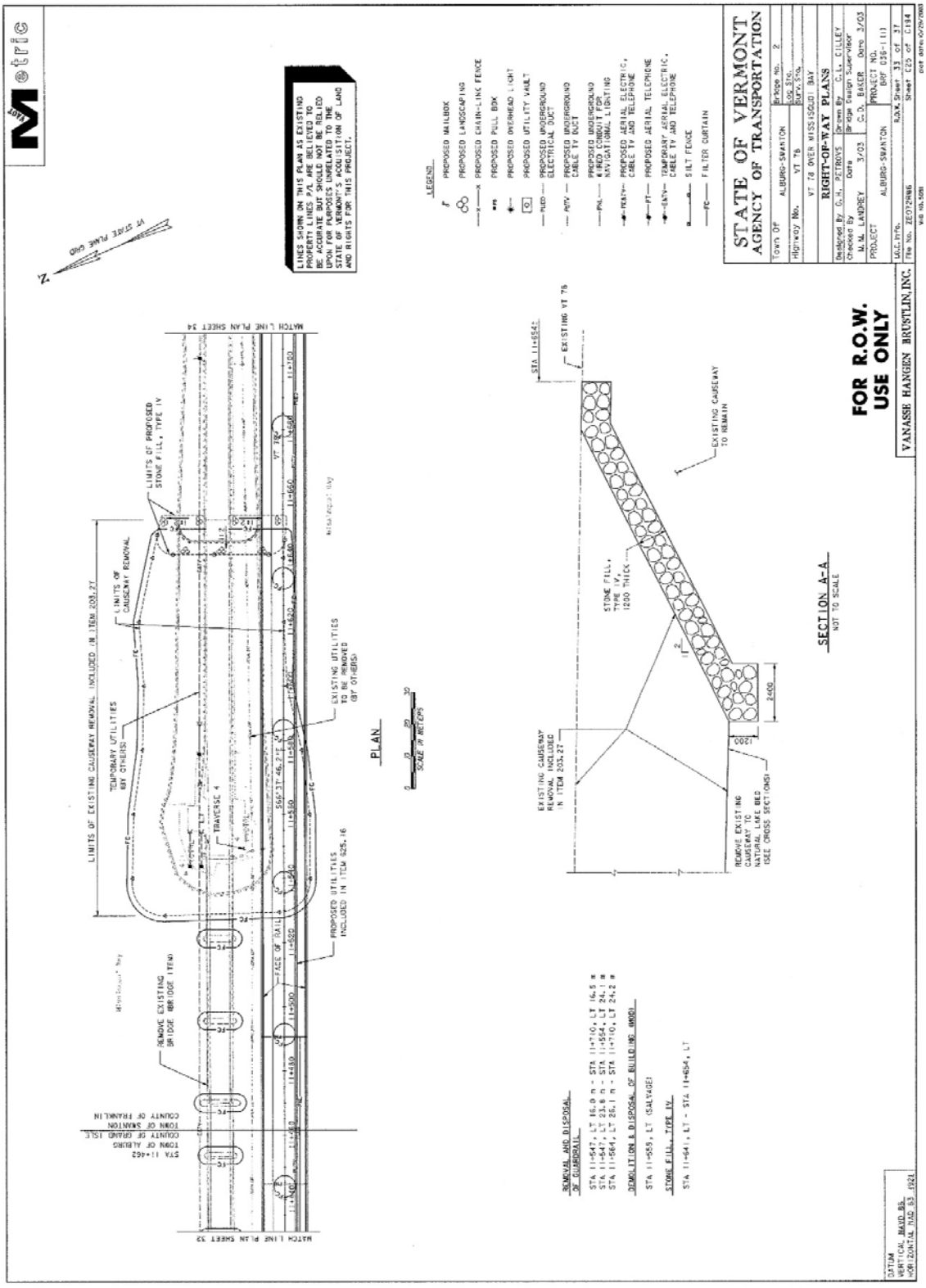
Missisquoi Bay Bridge Act 250 Permit, LUP# 6G0555; September 8, 2003; District #6 Environmental Commission

Missisquoi Bay Bridge Project – Spiny Softshell Turtle Monitoring 1996-2012 – Final Report; May 2013; McFarland Johnson for the Vermont Agency of Transportation

Plan for the Northwest Region, 2015-2023; Adopted July 29, 2015, Northwest Regional Planning Commission

Transboundary Impacts of the Missisquoi Bay Causeway and the Missisquoi Bay Bridge Project, A Report to the Governments of the United States and Canada; February 2005; International Joint Commission Canada and United States

ATTACHMENT A: CAUSEWAY REMOVAL PLANS FROM MISSISQUOI BAY BRIDGE PROJECT



ATTACHMENT B: COST ESTIMATES

Alternative 2: Partial Removal of Eastern Arm					
Partial Removal of Eastern Arm	330	lf			
Item	**Pay Item**	**Quantity**	**Units**	**Unit Cost**	**Sub-Total**
Demolition & Construction Activities					
Unclassified Channel Excavation	203.27	17,000	CY	$25	$417,520
Turbidity Curtains for Sediment Control	649.61	956	SY	$41	$39,178
Remove Pavement on Causeway	203.28	3,960	CY	$33	$132,541
Stabilize & Shape Causeway End, Stone IV Fill	613.13	130	CY	$177	$23,057
Overlay Fishing Access Parking Area	406.25	246	tons	$190	$46,740
Durable 4 Inch White Line (white)	646.401	1,800	lf	$1.60	$2,880
				Sub-Total Construction:	$661,916
General Conditions					
Mobilization	$661,916	8	%		$52,953
Construction Engineering	$661,916	12	%		$79,430
Traffic Control	$40,000	1	LS		$40,000
Tracking Pad, Rinsing Station, street sweeping	$50,000	1	LS		$50,000
				Sub-Total Construction:	$222,383
Engineering and Permits					
Engineering		1	LS	$100,000	$100,000
Endangered & Threatened Species Permit & Monitoring		1	LS	$600,000	$600,000
NEPA Environmental Assessment		1	LS	$200,000	$200,000
Other Permits		1	LS	$50,000	$50,000
				Sub-Total Engineering	$950,000
Summary					
Sub-Total Costs					$1,834,299
Contingency				30%	$550,290
				Total	$2,384,589
				Rounding	$2,400,000

Alternative 3					
Remove Eastern Arm - Phase I	330	lf			
Item	**Pay Item**	**Quantity**	**Units**	**Unit Cost**	**Sub-Total**
Demolition & Construction Activities					
Unclassified Channel Excavation	203.27	16,038	CY	$25	$393,893
Turbidity Curtains for Sediment Control	649.61	956	SY	$41	$39,178
Remove Pavement on Causeway	203.28	3,960	CY	$33	$132,541
Stabilize & Shape Causeway End, Stone IV Fill	613.13	130	CY	$177	$23,010
Overlay Fishing Access Parking Area	406.25	246	tons	$190	$46,740
Durable 4 Inch White Line (white)	646.401	1,800	lf	$1.60	$2,880
			Sub-Total Construction:		$638,242
General Conditions					
Mobilization	$638,242	8	%		$51,059
Construction Engineering	$638,242	12	%		$76,589
Traffic Control	$40,000	1	LS		$40,000
Tracking Pad, Rinsing Station, street sweeping	$50,000	1	LS		$50,000
			Sub-Total Construction:		$217,648
Engineering and Permits					
Engineering		1	LS	$100,000	$200,000
Endangered & Threatened Species Permit & Monitoring		1	LS	$600,000	$600,000
NEPA Environmental Assessment		1	LS	$200,000	$200,000
Other Permits		1	LS	$50,000	$50,000
			Sub-Total Engineering		$1,050,000
Summary					
Sub-Total Costs					$1,905,891
Contingency				30%	$571,767
				Total	$2,477,658
Alternative 3					
Remove Eastern Arm - Phase II	330	lf			
Item	**Pay Item**	**Quantity**	**Units**	**Unit Cost**	**Sub-Total**
Demolition & Construction Activities					
Unclassified Channel Excavation	203.27	16,038	CY	$25	$393,893
Turbidity Curtains for Sediment Control	649.61	956	SY	$41	$39,178
Remove Pavement on Causeway	203.28	3,960	CY	$33	$132,541
Stabilize & Shape Causeway End, Stone IV Fill	613.13	130	CY	$177	$23,010
Overlay Fishing Access Parking Area	406.25	246	tons	$190	$46,740
Durable 4 Inch White Line (white)	646.401	1,800	lf	$1.60	$2,880
			Sub-Total Construction:		$638,242
General Conditions					
Mobilization	$638,242	8	%		$51,059
Construction Engineering	$638,242	12	%		$76,589
Traffic Control	$40,000	1	LS		$40,000
Tracking Pad, Rinsing Station, street sweeping	$50,000	1	LS		$50,000
			Sub-Total Construction:		$217,648
Engineering and Permits					
Engineering		1	LS	$50,000	$50,000
Endangered & Threatened Species Permit & Monitoring		1	LS	$600,000	$600,000
NEPA Environmental Assessment Update		1	LS	$50,000	$50,000
Other Permits		1	LS	$50,000	$50,000
			Sub-Total Engineering		$750,000
Summary					
Sub-Total Costs					$1,605,891
Contingency				30%	$481,767
				Total	$2,087,658

Alternative 3					
Remove Eastern Arm - Phase III	330	lf			
Item	**Pay Item**	**Quantity**	**Units**	**Unit Cost**	**Sub-Total**
Demolition & Construction Activities					
Unclassified Channel Excavation	203.27	16,038	CY	$25	$393,893
Turbidity Curtains for Sediment Control	649.61	956	SY	$41	$39,178
Remove Pavement on Causeway	203.28	3,960	CY	$33	$132,541
Stabilize & Shape Causeway End, Stone IV Fill	613.13	130	CY	$177	$23,010
Overlay Fishing Access Parking Area	406.25	246	tons	$190	$46,740
Durable 4 Inch White Line (white)	646.401	1,800	lf	$1.60	$2,880
			Sub-Total Construction:		$638,242
General Conditions					
Mobilization	$638,242	8	%		$51,059
Construction Engineering	$638,242	12	%		$76,589
Traffic Control	$40,000	1	LS		$40,000
Tracking Pad, Rinsing Station, street sweeping	$50,000	1	LS		$50,000
			Sub-Total Construction:		$217,648
Engineering and Permits					
Engineering		1	LS	$50,000	$50,000
Endangered & Threatened Species Permit & Monitoring		1	LS	$600,000	$600,000
NEPA Environmental Assessment Update		1	LS	$50,000	$50,000
Other Permits		1	LS	$50,000	$50,000
			Sub-Total Engineering		$750,000
Summary					
Sub-Total Costs					$1,605,891
Contingency				30%	$481,767
				Total	$2,087,658
Alternative 3					
Remove Eastern Arm - Phase IV	360	lf			
Item	**Pay Item**	**Quantity**	**Units**	**Unit Cost**	**Sub-Total**
Demolition & Construction Activities					
Unclassified Channel Excavation	203.27	17,496	CY	$25	$429,702
Turbidity Curtains for Sediment Control	649.61	1,022	SY	$41	$41,911
Remove Pavement on Causeway	203.28	4,320	CY	$33	$144,590
Stabilize & Shape Causeway End, Stone IV Fill	613.13	130	CY	$177	$23,010
Overlay Fishing Access Parking Area	406.25	246	tons	$190	$46,740
Durable 4 Inch White Line (white)	646.401	1,800	lf	$1.60	$2,880
			Sub-Total Construction:		$688,833
General Conditions					
Mobilization	$688,833	8	%		$55,107
Construction Engineering	$688,833	12	%		$82,660
Traffic Control	$40,000	1	LS		$40,000
Tracking Pad, Rinsing Station, street sweeping	$50,000	1	LS		$50,000
			Sub-Total Construction:		$227,767
Engineering and Permits					
Engineering		1	LS	$50,000	$50,000
Endnagered & Threatened Species Permit		1	LS	$600,000	$600,000
NEPA Environmental Assessment Update		1	LS	$50,000	$50,000
Other Permits		1	LS	$50,000	$50,000
			Sub-Total Engineering		$750,000
Summary					
Sub-Total Costs					$1,666,600
Contingency				30%	$499,980
				Total	$2,166,580

Alternative 3 Summary Cost Estimate					
Summary	Construction	General Conditions	Engineering & Permits	Contingency	Total
Phase I	$638,242	$217,648	$1,050,000	$571,767	$2,477,658
Phase II	$638,242	$217,648	$750,000	$481,767	$2,087,658
Phase III	$638,242	$217,648	$750,000	$481,767	$2,087,658
Phase IV	$688,833	$227,767	$750,000	$499,980	$2,166,580
Totals	$2,603,560	$880,712	$3,300,000	$2,035,282	$8,819,554
				Rounding	$8,900,000

Alternative 4					
Remove Entire Western Arm - Phase V	1340	lf			
Item	Pay Item	Quantity	Units	Unit Cost	Sub-Total
Demolition & Construction Activities					
Unclassified Channel Excavation	203.27	65,124	CY	$25	$1,599,445
Turbidity Curtains for Sediment Control	649.61	3,200	SY	$41	$131,200
Remove Pavement on Causeway	203.28	16,080	CY	$33	$538,198
Stabilize & Shape Causeway End, Stone IV Fill	613.13	130	CY	$177	$23,010
			Sub-Total Construction:		$2,291,853
General Conditions					
Mobilization	$2,291,853	8	%		$183,348
Construction Engineering	$2,291,853	12	%		$275,022
Traffic Control	$40,000	1	LS		$40,000
Tracking Pad, Rinsing Station, street sweeping	$50,000	1	LS		$50,000
			Sub-Total Construction:		$548,371
Engineering and Permits					
Engineering		1	LS	$50,000	$50,000
Endangered & Threatened Species Permit & Monitoring		1	LS	$600,000	$600,000
NEPA Environmental Assessment Update		1	LS	$50,000	$50,000
Other Permits		1	LS	$50,000	$50,000
			Sub-Total Engineering		$750,000
Summary					
Sub-Total Costs					$3,590,224
Contingency				30%	$1,077,067
				Total	$4,667,291

Alternative 4 Summary Cost Estimate					
Summary	Construction	General Conditions	Engineering & Permits	Contingency	Total
Eastern Arm Phase I	$638,242	$217,648	$1,050,000	$571,767	$2,477,658
Eastern Arm Phase II	$638,242	$217,648	$750,000	$481,767	$2,087,658
Eastern Arm Phase III	$638,242	$217,648	$750,000	$481,767	$2,087,658
Eastern Arm Phase IV	$688,833	$227,767	$750,000	$499,980	$2,166,580
All of Western Arm - Phase V	$2,291,853	$548,371	$750,000	$1,077,067	$4,667,291
Totals	$4,895,413	$1,429,083	$4,050,000	$3,112,349	$13,486,844
				Rounding	$13,500,000