



**Truro Public Forum Meeting
Mill Pond Alternatives Review
&
DPW Facility Cost Analysis Update
Wednesday, March 8, 2023, at 5:00pm
Community Center 7 Standish Way and Remote**

*A quorum of the following boards and committees may be present:
Select Board, Conservation Commission, Planning Board*

PUBLIC FORUM

<https://meet.goto.com/608983549>

1-866-899-4679, Access Code: 608-983-549

This will be a hybrid meeting, and in person meeting, citizens can also view the meeting on Channel 18 in Truro and on the web on the "Truro TV Channel 18" button under "Helpful Links" on the homepage of the Town of Truro website. Click on the green "Watch" button in the upper right of the page. **To provide comment during the meeting you may join the meeting from a computer, tablet, or smartphone by entering the follow URL into your web browser:** <https://meet.goto.com/608983549> Please note that there may be a slight delay (15-30 seconds) between the meeting and the live stream (and television broadcast).

MEETING PROTOCOL

Questions and comments will commence after presentations are finished. Prior to taking questions, the meeting facilitator will ask for the names and voting status (whether or not you are a voter) and will ask individuals to comment in the order in which their name was received and the facilitator will alternate between remote and in-person participants as much as possible. Remote participants should keep their microphones muted until they are called on. Comments and questions must be kept to three minutes. Each agenda topic will be allotted approximately an hour and a half. Individuals who call in will be asked to identify themselves to help us manage multiple callers effectively. The facilitator will unmute callers periodically to ask for the names of individuals who wish to speak and then callers will be muted until their name is called. Individuals who are participating remotely and want ask questions please enter your name into the chat box to be identified by the facilitator.

5:00 PM

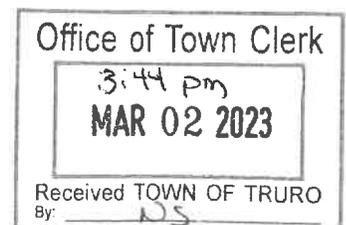
1. Presentation: Mill Pond Alternative

- A. Presenter Jarrod J. Cabral, Public Works Director
- B. Presenter Chief Jamie Calise
- C. Presenter Chief Tim Collins
- D. Presenter Mitch Buck, Woods Hole Group & Nils Wiberg, Fuss & O'Neill
- E. Public Questions and Comments

6:30 PM (Approximately)

2. Presentation: DPW Facility Cost Analysis Update

- A. Presenter Jarrod J. Cabral, Public Works Director
- B. Presenter Jeff Alberti, Weston & Sampson
- C. Public Questions and Comments



What is the Mill Pond Salt Marsh Restoration Project all about?

The culvert at Mill Pond Road is currently damaged and undersized resulting in restricted tidal flow to and from Pamet Harbor/Cape Cod Bay. The purpose of this project is to replace or remove the inadequate culvert with a larger one or consider an alternative design such as a breach.

Let's Break It Down

A 36-inch corrugated pipe conveys drainage from Mill Pond to the Pamet River. In 1991 a large storm event completely breached the roadway and former railroad embankment. The existing 36-inch pipe was installed after the 1991 storm as a temporary measure, with the intent to subsequently install a larger timber bridge as a permanent structure behind it. The bridge was never constructed, and the 36-inch pipe remains today.

Why is this problematic?

The roadway embankment covering the culvert is subject to wave and roadway runoff erosion. This results in a narrowing of the roadway shoulders over the culvert requiring regular repair and replenishment of stone armor scour protection. Additionally, the embankment slopes behind the guardrails exhibit signs of erosion and steepening, providing inadequate lateral support to the guardrail system and roadway embankment.

Stormwater runoff north of the culvert generally flows along the roadway's curb at the edge of the pavement with a leaching catch basin on the southbound (west) lane that provides partial drainage. The majority of roadway runoff discharges from the lowest point immediately north of the culvert and into Mill Pond.

What's the point of this project?

To replace the undersized culvert that restricts tidal flow to/from Mill Pond with a larger structure or channel breach alternative that will allow increased flushing to restore degraded salt marsh resources, provide water quality improvements, and improve the drainage system runoff during various flow conditions.

What are the current options on the table?

There are five options under consideration. Each option will provide improved tidal volumes and ranges to support the restoration of salt marsh areas within Mill Pond and improve post-storm drainage conditions such as allowing the impounded water to drain more quickly versus the existing conditions.

1. Install a 10.5-foot-wide x 8-foot-high culvert with the option to raise the road by two feet. Town Cost Share: \$605,000. Cost Estimate: \$2.42 million. Funding Source: USDA 75%.

2. Install an 8-foot-wide x 8.5-foot-high culvert with the option to raise the road by two feet. Town Cost Share: \$550,000. Cost Estimate: \$2.2 million. Funding Source: USDA 75%.

3. Create a 65-foot-wide breach with a 15-foot-open channel at bottom. Eliminates roadway but allows for recreational possibilities. Town Cost Share: \$275,000. Cost Estimate: \$1.1 million. Town Funding Source: USDA 75%.

4. Create a 95-foot-wide breach with a 10-foot-open channel at bottom. Eliminates roadway but allows for other recreational possibilities. Town Cost Share: \$370,000. Cost Estimate: \$1.48 million. USDA 75%.

5. Raising the road. Size: N/A. Town Cost Share: Difficult to permit as would need to be wider on each side. Cost Estimate: \$1.6 - \$1.8 million. Funding Source: Unsure of Availability.

Note: The cost estimates carry a high dollar contingency based on the current market price and anticipation construction date of approximately three years from now. The town would be a funding source for raising the road unless there is another outside funding source found.

After a complete review of the alternatives the Select Board will decide which alternative to moving forward with:

1. The board could decide to do nothing, and the town could continue to provide maintenance above mean high water and continue to protect the roadway/culvert area from undermining for as long as possible.
2. Another option would be to install a new larger culvert to improve tidal flushing and water quality and elevate the road at a later date to mitigate against future sea level rise.
3. Install a new culvert and raise the road two feet from its present location to mitigate against future sea level rise.
4. Breach and eliminate the roadway and replace it with recreational uses.

Why these alternatives?

Alternatives would allow increased inundation into Mill Pond during coastal storm events. Potential impacts to the Depot Road embankment, adjacent properties, and potential protection/mitigation measures would need to be evaluated in a future design phase. Public access accommodations including vehicle parking, pedestrian access and provisions for potential emergency response would need to be evaluated in a future design phase. There also does not appear to be any properties or dwellings significantly impacted by the alternatives compared to existing conditions. The additional flooded areas tend to be low-lying areas along the face of the coastal bank.



TOWN OF TRURO

P.O. Box 2030, Truro, MA 02666

Tel: 508-349-7004, Fax: 508-349-5505

Department of Public Works

Mill Pond Q&A

March 2023

1. What alternatives have been modeled and show the greatest environmental restoration?

8'x 8' culvert

8'x 10' culvert

95' wide opening with 10' wide channel breach

65' wide opening with 15' bottom wide channel breach

2. What environmental considerations have the town's consultants included in their analysis?

Using the model that the Woods Hole Group developed for Massachusetts we can understand specific and far-reaching flood scenarios for Mill Pond. The state flood risk model looks at both current and future storm risks with sea level rise for the entire Massachusetts coastline, and this includes the 100-year storm event and larger storm events both with and without sea level rise.

3. As part of the final design for all alternatives would mitigation measures be incorporated into the final design to address impacts to the Depot Road embankment and adjacent properties to protect those areas from coastal storm events?

The Depot Road embankment and adjacent properties overlooking Mill Pond will require the embankment to be armored with stone, coir rolls and plantings as needed. Drainage structures will also need to be added to contain stormwater runoff in the Depot Road embankment, and a traffic study for Depot Road will be conducted to determine the best traffic calming measures for Depot Road. Additionally, if the breach is selected, the redesign of the Old County Road and Depot Road intersection will be done to accommodate trailered boats traveling on Old County Road.

4. As we did with Eagle Neck Creek as part of final design will accommodations be made to direct abutters to address safe/accessible access to their personal property if the breach alternative is chosen?

Yes. Chief Collins has recommended to widen the access to 20 Mill Pond Road to accommodate emergency vehicles. The properties of 31 and 40 Mill Pond Road will also be able to access their driveway as they do today. Chief Calise and Chief Collins submitted memos which can be found on the DPW website: [Mill Pond Salt Marsh Restoration Project](#).

5. What is the lifespan of a new culvert?

70 to 100 years with proper maintenance.

6. Is Town Meeting action required to permanently close a road?

No.

7. Have any traffic studies been completed around Depot Road?

Yes. Please visit the DPW website for a complete listing of town traffic counts and studies: [Mill Pond Salt Marsh Restoration Project](#).

8. What are the environmental benefits the larger breach offers?

Based on the modeling results, all alternatives present very similar environmental benefits. The larger breach is not expected to provide significantly more benefits to salt marsh and intertidal habitat than a culvert option since tidal ranges and elevations will be very similar. The large breach would create new saltmarsh platform where there is roadway now which would be more beneficial in creating additional area of shellfish habitat. Without high vehicle use and by removing the asphalt and associated drainage structures this would be a net reduction in pollutant loading into the salt marsh and estuary.

9. Will any of the alternatives promote sediment travel upstream towards Pamet Harbor that would result in a negative impact on shellfish or the established mooring field and harbor?

A significant amount of sand has already migrated upstream into Mill Pond with prior culvert repairs/replacements. Some additional sand may be deposited upstream in Mill Pond and is likely a benefit to the intertidal and shellfish habitat. Some fine material may be scoured, mobilized, and moved out of Mill Pond and downstream into Pamet Harbor, however, the amount is likely minimal and could be deposited in the saltmarsh platform, which could act to nourish the salt marsh. I do not believe that there will be a large plume generated that will cause water quality or turbidity issues in Pamet Harbor. The fine material in the pond is cohesive and unlikely to be mobilized by additional tidal flow. Additionally, the modeling for all the alternatives does not show Mill Pond completely emptying out at low tide.

10. If we do not raise Mill Pond Road and just install the culvert, when does the road overtop?

The road would overtop in present day with a 10-year storm event, and more frequently with 2' of sea level rise in 2070.

13. If the town raises the road two feet and installs the culvert when would the road overtop?

Raising the road two feet today will provide protection against the 100-year storm event in present day. In 2070, raising the road two feet will only provide protection from a 10-year storm event.

14. What other options does the town have besides permanent roadway closure, and installing a breach?

- Do nothing and continue to provide maintenance above mean high water and continue to protect the roadway and culvert area from undermining – for as long as possible.
- Install a new culvert and raise the road at a later date.
- Install a new culvert and raise the road two feet.

15. Have the public safety officials weighed in on emergency access to Pamet Harbor?

Yes. Both public safety officials, Chief Collins, and Chief Calise, have submitted written opinions and are posted on the DPW website: [Mill Pond Salt Marsh Restoration Project](#).

16. What effect does permanent roadway closure have on the water quality around Mill Pond?

The breach option will provide a reduction in stormwater runoff from the paved surface which will translate as a reduction in pathogens, organic nutrients, hydrocarbons, and heavy metals.

17. What impact does continue vehicle travel have over Mill Pond Road regarding water quality?

Mill Pond Road water quality is controlled by tidal exchange with Pamet Harbor. Both the culvert and breach alternatives restore full tidal exchange and flushing to Mill Pond. Mill Pond water quality is impaired by the undersized culvert under the road that reduces tidal flushing in poor mixing, sedimentation, and nutrient retention. Roadway removal and its associated stormwater drainage will reduce the pollutant loading into the salt marsh and estuary.

18. Which committees and/or boards should have oversight or interest in this project?

- The Board of Health for water quality concerns, location of septic systems and well locations.
- The Conservation Commission has jurisdiction over the project due to the close proximity to a wetland.
- The Climate Action Committee is charged with assessing the town's vulnerabilities to the consequences climate change.
- The Shellfish Committee's interest would be the impact of the tidal flushing on shellfish propagation.
- The Harbor Commission concerns would be emergency access/egress to Pamet Harbor and traffic increases on Depot Road.

19. What is the cost of obtaining easements?

Any parcel that is permanently physically impacted by construction would require a permanent easement for maintenance. Any parcel temporarily impacted by construction would also require a temporary easement for construction purposes only. Historically, easements have been funded by operational funds through town manager approval.

20. The roads listed on the table shown on the Cape Cod Commission's Low-Lying Roads Study (click here to view) are only the roads that scored the highest in terms of both their flooding vulnerability and criticality score. Why was Mill Pond identified as a vulnerable road but had a low criticality score?

- Low volume rural road.
- Road doesn't support an Environmental Justice Community (it now does)
- No critical facilities present (Pamet Harbor is one but linked to Depot Road)
- Does not support emergency critical facilities.
- Does not support physical businesses.
- There are alternative routes for access for property owners, through traffic, and emergency vehicles.

Mill Pond Road did not make the top priority list because it is not considered a high-priority asset. This sort of analysis does not consider people's emotional feelings toward the road. But as a reminder, the basis for this project is a culvert replacement project to enhance estuarine habitat & storm drainage and that road closure was an enhancement of one set of replacement alternatives (breach).

21. Will Mill Pond Road remain open to the public for vehicular travel?

Yes. Apart from the pedestrian bridge to be installed, Mill Pond Road will remain open to the public for vehicular travel.

22. Will the town continue to maintain Mill Pond Road for vehicular travel?

Yes. The town will continue to maintain Mill Pond Road for vehicular travel, apart from the pedestrian bridge to be installed. The town will maintain the pedestrian bridge for recreational use. The road will not be abandoned or permanently closed.

23. Is the town abandoning Mill Pond Road?

No. The town is not abandoning any portion of Mill Pond Road.

24. Is the town discontinuing Mill Pond Road?

No. The town is not discontinuing any portion of Mill Pond Road.

25. Is Town Meeting approval required for the construction of the pedestrian bridge or for the exclusion of vehicles from the bridge?

No. Town Meeting approval is not required.

26. Why not a bridge?

The culvert alternatives serve the same purpose and offer very similar environmental benefits as a causeway or a traditional bridge. Funding for something larger than the proposed culverts would need to be funded by the taxpayers as grant funding would not be easily awarded for this scenario. The Select Board will need to consider which low-lying roads identified in previous studies are essential low-lying roads and worthy of taxpayer investment.

Mill Pond Alternatives

Objective: Restore tidal flow to Mill Pond by replacing the undersized, damaged culvert.

Benefits: Restore degraded salt marshes, Water quality improvements, improved drainage/runoff

Option	Size	Comments	Cost Estimate	Funding source
Large Culvert 1	10.5 x 8'	Town cost share is \$605,000.	\$2.42 million	USDA 75%
Small Culvert 2	8 x 8.5'	Like Eagle Neck Creek Town cost share is \$550,000.	\$2.2 million	USDA 75%
Smaller Breach 1	65' breach with 15' channel at bottom	Town cost share is \$275,000.	\$1.1 million	USDA 75%
Larger Breach 2	95' breach with 10' channel at bottom	Sides stepped down ("benches") Town cost share is \$370,000.	\$1.48 million	USDA 75%
Raising of road	NA	Difficult to permit as would need to be wider on each side	\$1.6 – 1.8 million	Unsure of availability

Note: The cost estimates carry a high dollar contingency based on the current market price and anticipated construction date of approximately three years from now. The Town would be the funding source for raising the road unless there is another outside funding source found.

***Contact Information:
Jarrod Cabral
Department of Public Works Director
(508) 214-0400
jcabral@truro-ma.gov***



Scott Horsley
Water Resources Consultant
65 Little River Road • Cotuit, MA 02635 • 508-364-7818

February 1, 2023

Jarrold J. Cabral
Director
Department of Public Works
Truro MA 02666

RE: Mill Pond Salt Marsh Restoration Project

Dear Jarrod:

At your request I have reviewed the technical documents associated with the proposed Mill Pond Salt Marsh Restoration Project. These include "Mill Pond Salt Marsh Restoration Alternatives", prepared by Fuss & ONeill dated June, 2022 and the "Mill Pond Restoration Conceptual Design Report Truro, Massachusetts", prepared by the Woods Hole Group dated June 22, 2022.

I concur with the recommended alternative (breach channel with a 95-foot top). In my opinion this is the best long-term solution and will provide the best water quality and ecological restoration results. With climate change and sea level rise in mind this solution will also provide the most resilience to these changing conditions. The removal of the road and its associated stormwater drainage will be a net reduction in pollutant loading to the salt marsh and estuary.

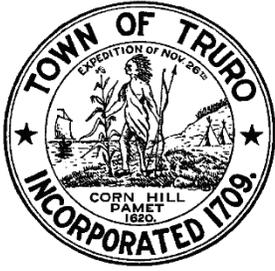
The project is based upon hydrologic modeling completed by the Woods Hole Group. I have over twenty years of experience working with this firm and highly respect their professional work in these types of projects.

Best wishes for the project moving forward. Please call me directly with any questions that you might have.

Sincerely,

A handwritten signature in black ink, appearing to read "S. Horsley", with a stylized flourish at the end.

Scott W. Horsley
Water Resources Consultant



TOWN OF TRURO

24 Town Hall Road
P.O. Box 2030, Truro, MA 02666
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Department of Public Works Director Jarrod Cabral Re: Recommendation to the Select Board

March 2023 – To permanently close the road and install a 95-foot breach with a 10-foot-wide inner channel for the following environmental considerations.

Using the model developed by the Woods Hole Group, we can understand specific and far-reaching flood scenarios for Mill Pond. The state's flood risk model considers both current and future storm risks with sea level rise for the entire coastline and includes the 100-year storm (and larger storm events) both with and without sea level rise. As part of the Mill Pond alternative analysis, several sea level rise scenarios were applied to each alternative and further analyzed.

Today Mill Pond Road is vulnerable to overtopping from 10-year storm events. This means – regardless of which alternative is chosen the roadway will be overtopped unless the road is raised two feet. Elevating the road will provide protection against the 100-year storm event in the present day.

In 2070, the best-case scenario is raising the road by two feet would only provide protection from a 10-year storm event very similar to the vulnerabilities we see today. Additionally, closing the roadway will positively impact the environment and provide the best ecological and water quality results. In addition to the increased flushing, it would eliminate direct stormwater discharges from impervious surfaces, reducing existing pollutant loading. If the roadway was permanently closed, recreational benefits could be applied to the area. This could include installing a small pedestrian bridge to accommodate walkers and bikers; providing drop-off kayak areas; fishing and potentially shell fishing as the water quality improves over time, and more.

This recommendation directly ties into three Select Board Goals and Objectives.

Goal C: Protect and restore our fragile environment.

Goal D: Use long-term strategic planning to guarantee our community's future health and well-being.

Goal E: Proactively engage and involve town residents and property/business owners.

Objective 5: The Select Board will support and encourage projects that protect and restore our coastal community, and Mill Pond is listed as one of those projects.

Lastly, over the last budget cycles, the Town Manager directed staff to include the Climate Action Committee and the Energy Committee in the capital planning process to get their feedback and answer questions as we work our way through the annual capital project budget cycle.

This work directive from the Town Manager is also related to Objective 10: The Select Board will support and collaborate with the Climate Action Committee and the Energy Committee on creating a climate action plan. This recommendation was made with climate change and sea level rise in mind and will also provide the best water quality and restoration results.



TRURO POLICE



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JAMIE M. CALISE
CHIEF OF POLICE

CRAIG DANZIGER
DEPUTY CHIEF OF POLICE

To: Jarrod Cabral, DPW Director
From: Jamie Calise, Chief of Police
Date: July 5, 2022
Re: Mill Pond Rd. Culvert Project

Thanks for your presentation with respect to the Mill Pond Rd. culvert project

Given the specifics of the project that you provided, inclusive of the maps that depicted the project's local impact, I do not foresee any public safety concerns with the proposed plan.

Each of the properties that abut this area are accessible from either Depot Rd., the proposed remaining portion of Mill Pond Rd., or Old County Rd. The only minimal impact that I can envision is that a call to any section of Depot Rd. (west of Old County) would require the use of Old County Rd. if the responding officer was south of Mill Pond Rd. at the time of the call.

Thanks again for this useful information.

Sincerely,

/s/ Jamie M. Calise

Jamie M. Calise
Chief of Police



TRURO FIRE RESCUE
344 ROUTE SIX, P.O. BOX 2013
TRURO, MASSACHUSETTS 02666

Timothy J Collins
Fire Chief

Telephone (508) 487-7548
Facsimile (508) 487-6708

To: Jarod Cabral DPW director
From: Tim Collins Truro Fire Chief
Date: 8 February 2023
RE: Mill Pond Project

Given the specifics of the Mill Pond Rd project, I do not foresee any public safety concerns other than the road that goes to number 20 Mill Pond Road parcel number 054-001-000 on Town of Turo assessors GIS. All other properties that abut the affected area can be accessed by either Old County Rd or Depot rd.

Number 20 Mill Pond Rd access from Old County Road would have to be addressed. The access to the driveway would have to be moved a minimum of 35ft to the SW of the current entrance, measured from the current post with the house number. This change would allow easier access for the turning radius of our Fire Engines. The 20 Mill Pond Rd driveway has a corner at approximate position 41.986748 -70.070554 and as seen on the map where the driveway crosses from 22 Mill Pond parcel 050-221-000 and 20 Mill Pond rd.

This corner is not conducive to the turning radius of our vehicles, there is a telephone pole, fence, and trees that make the radius too tight for our access. The whole driveway does not meet town bylaw 1-9-13 for Public Safety Clearing which should be addressed as the road is too narrow with the trees and not 14 ft clearance. It is our opinion that the closing of Mill Pond Rd with the modifications to the entrance to 20 Mill Pond Rd would not cause a delay in our access to the property, aside from the access issues as described above.

Sincerely,

Timothy J Collins
Fire Chief

Mill Pond Culvert Replacement Alternatives

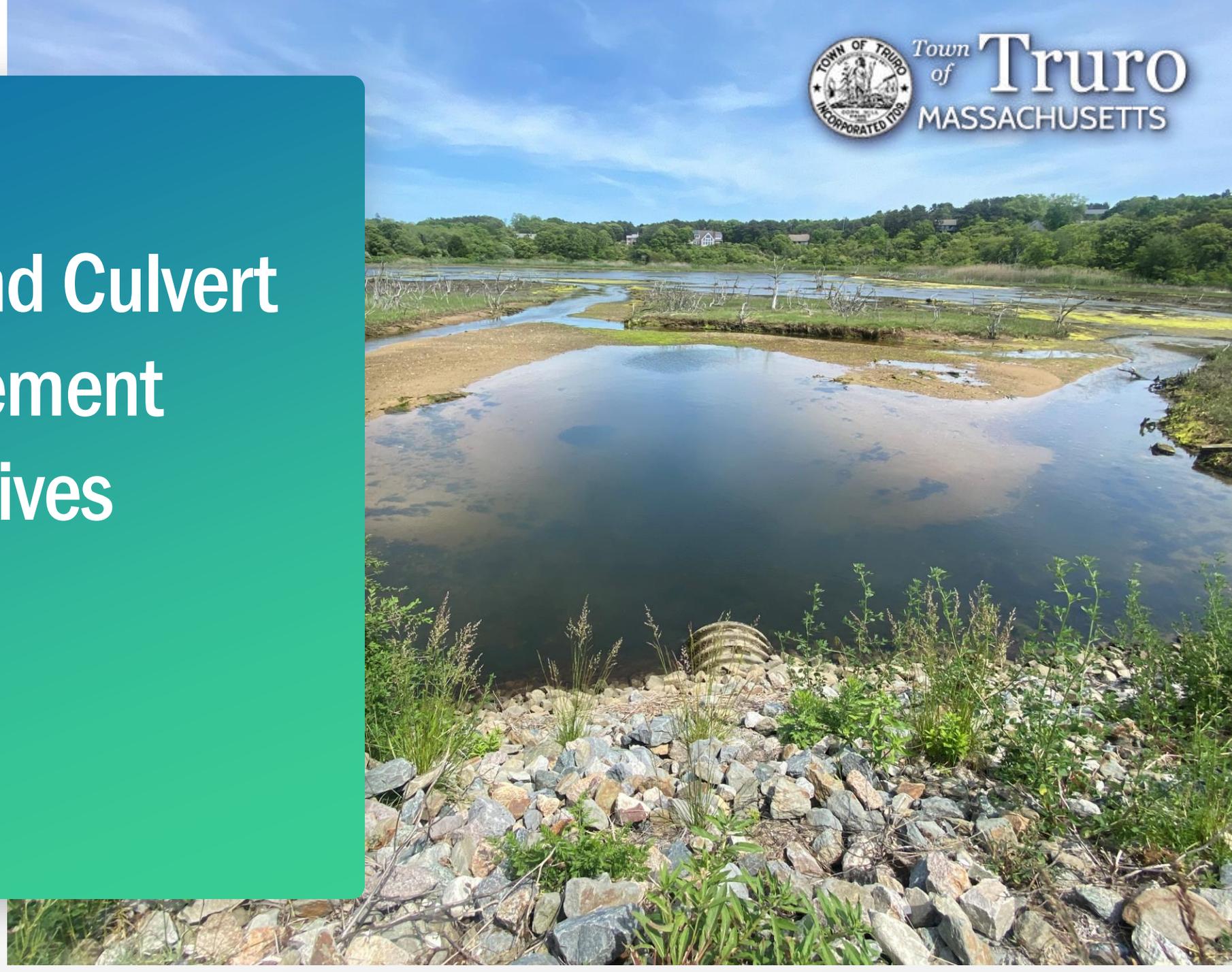
Mitchell Buck, P.E.

The Woods Hole Group, Inc.

Nils Wiberg, P.E., C.F.M.

Fuss & O'Neill

Date: March 8, 2023



Pamet River Basin Overview

1. Pamet River (Study Phase)

Undersized culvert & tide gate under Truro Center Rd
Undersized ~400 ft long culvert under Route 6

2. Mill Pond (Concepts Developed)

Undersized culvert under Mill Pond Road

3. Little Pamet River (Study Phase)

Failing culvert with tidal control & undersized culvert

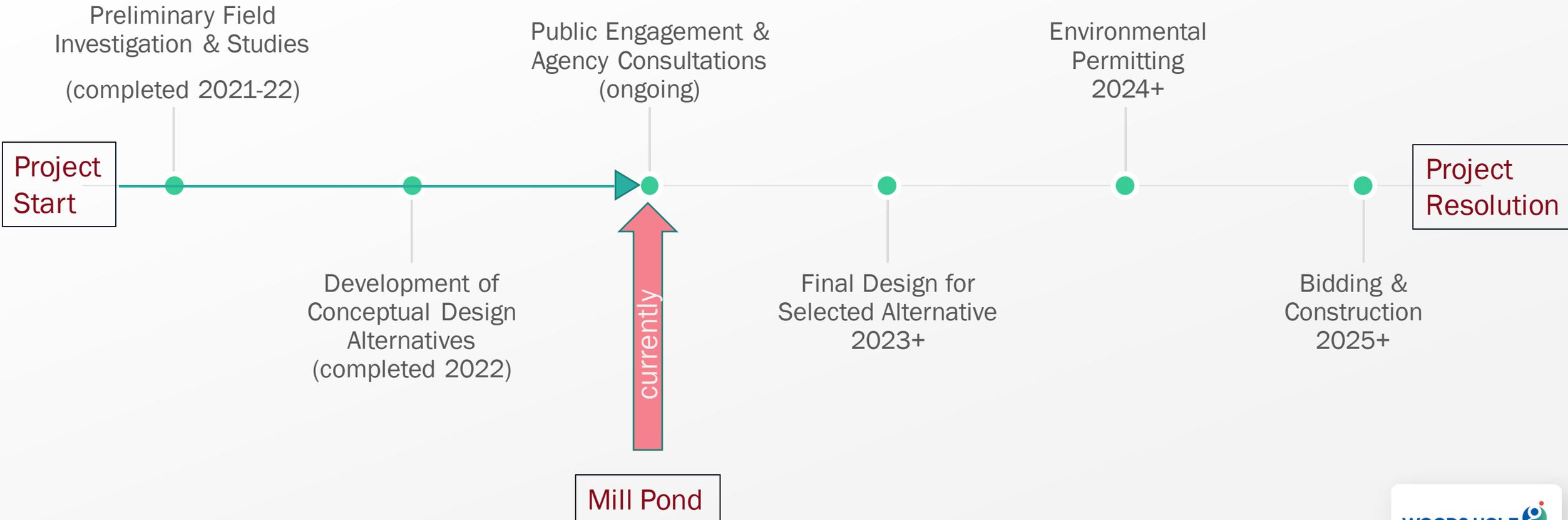
4. Eagle Neck Creek (Constructed)

Undersized culvert replaced and railroad berm breach enlargement.

OVERALL GOAL: Restore tides, habitat, and storm drainage while improving future coastal resiliency and minimizing abutter impacts.



Mill Pond Project Schedule & Progress



Mill Pond Site Overview

Cape Cod Bay



Mill Pond Background

- ❑ Former gristmill site with a 12-inch culvert under road.
- ❑ 1991 No-Name storm breached the roadway and a larger 36-in culvert was installed as an emergency measure and has been in place ever since. It has required frequent repairs and maintenance.
- ❑ Pond outlet channel hydraulically restricted by undersized culvert and an island/shoal that acts as a weir (dashed yellow oval).



Mill Pond

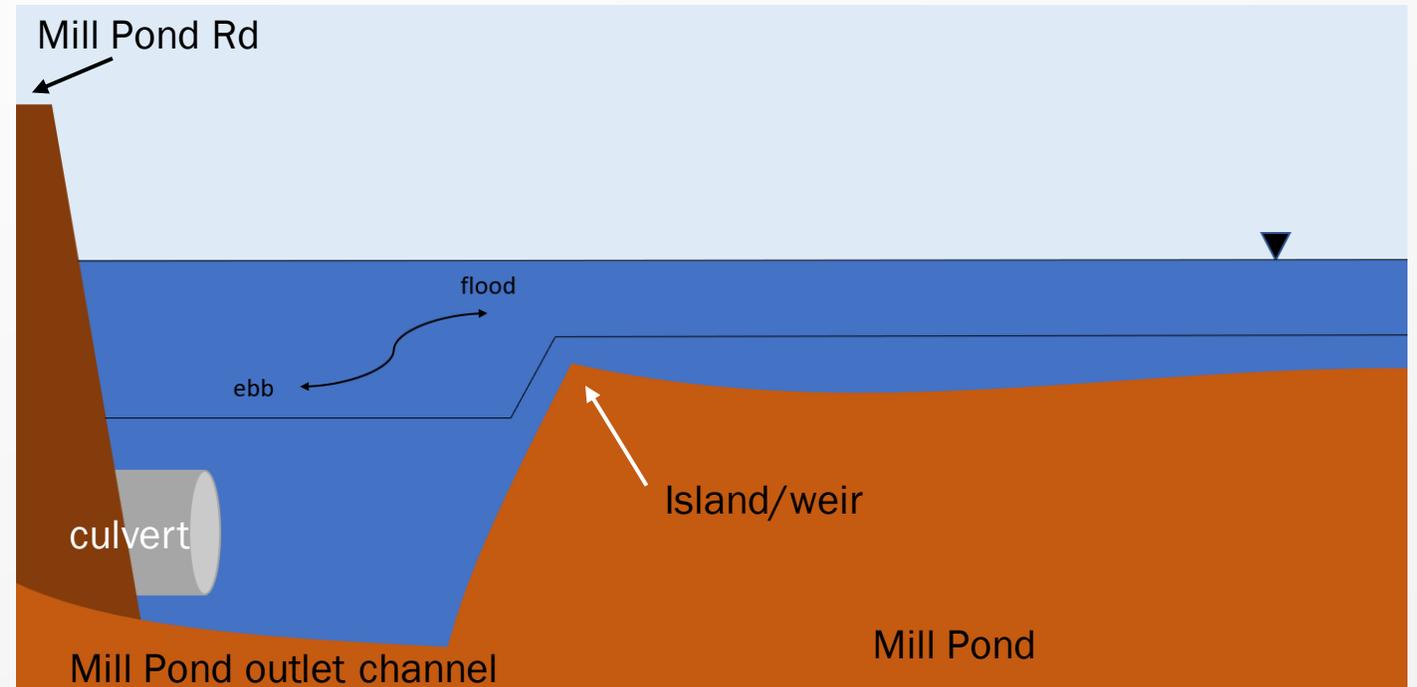


Mill Pond

Road

Cross-section Sketch of the Mill Pond Bottom, Outlet Channel, & Culvert

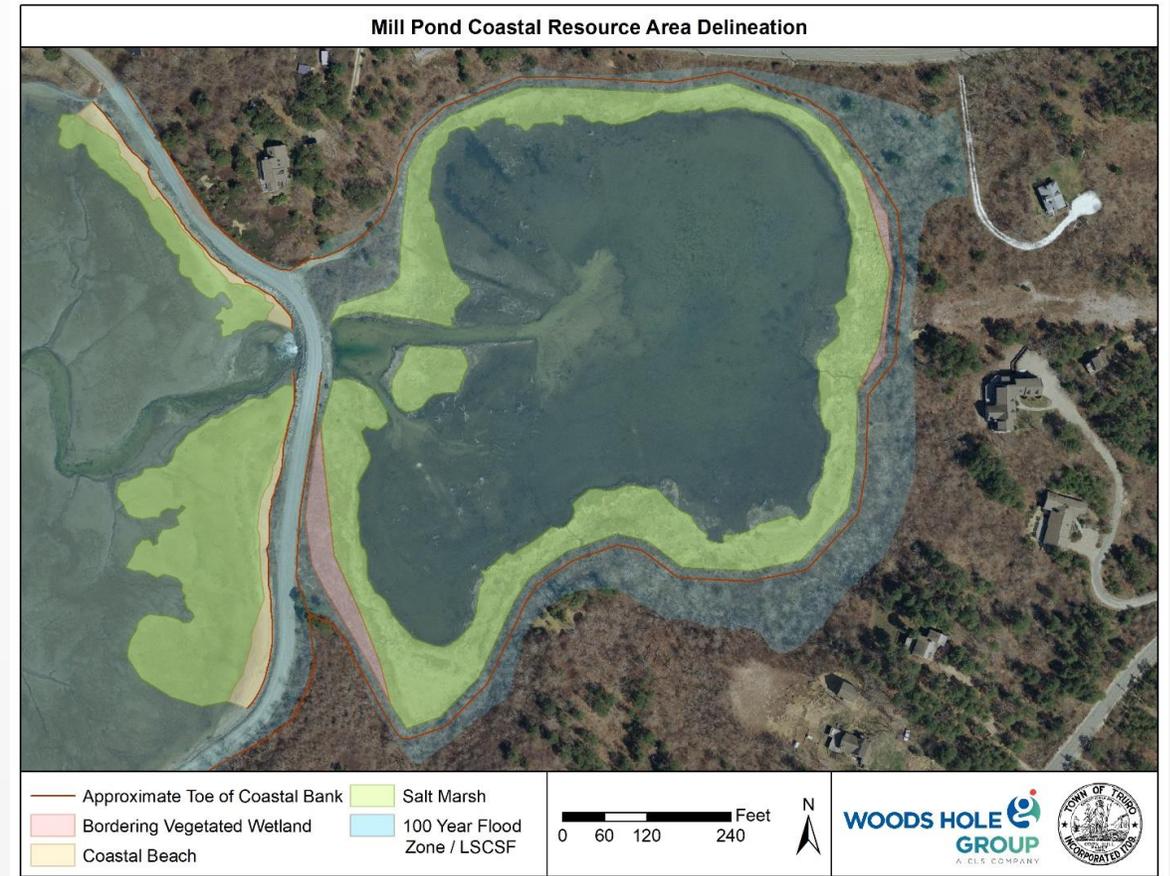
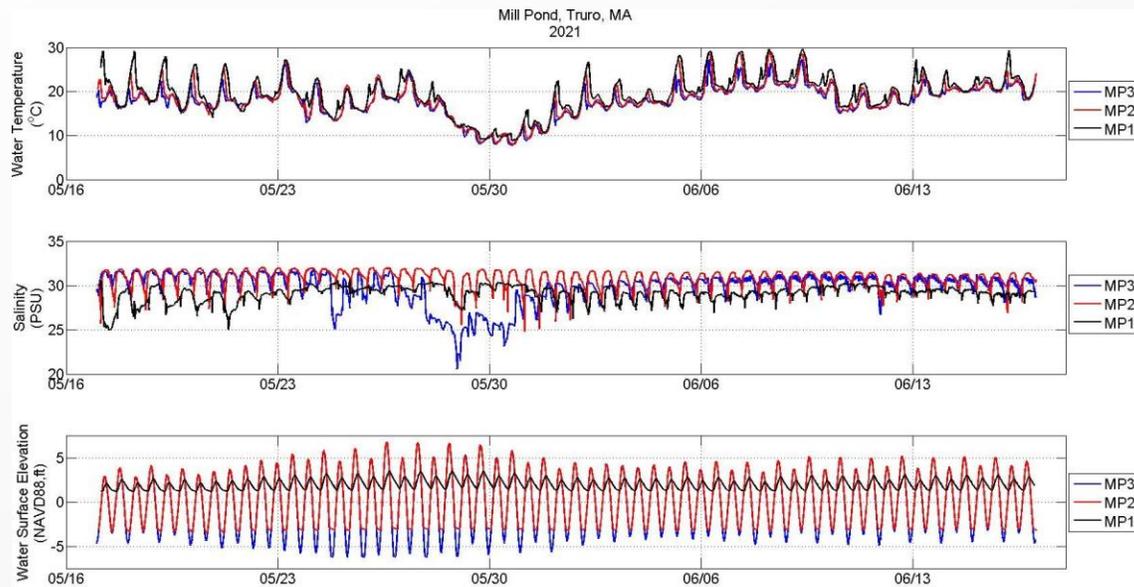
- ❖ Sketch of the Mill Pond system cross section including the pond, weir, culvert, and embankment.
- ❖ The culvert invert (bottom of inside pipe inlet) is at a lower elevation than the pond bed. However, the pond does not completely drain due to:
 - ❖ The undersized culvert under Mill Pond Rd limiting drainage, and
 - ❖ The shoal/island that causes a weir effect at the head of outlet channel



2021 Mill Pond Field Investigation

Field Investigation

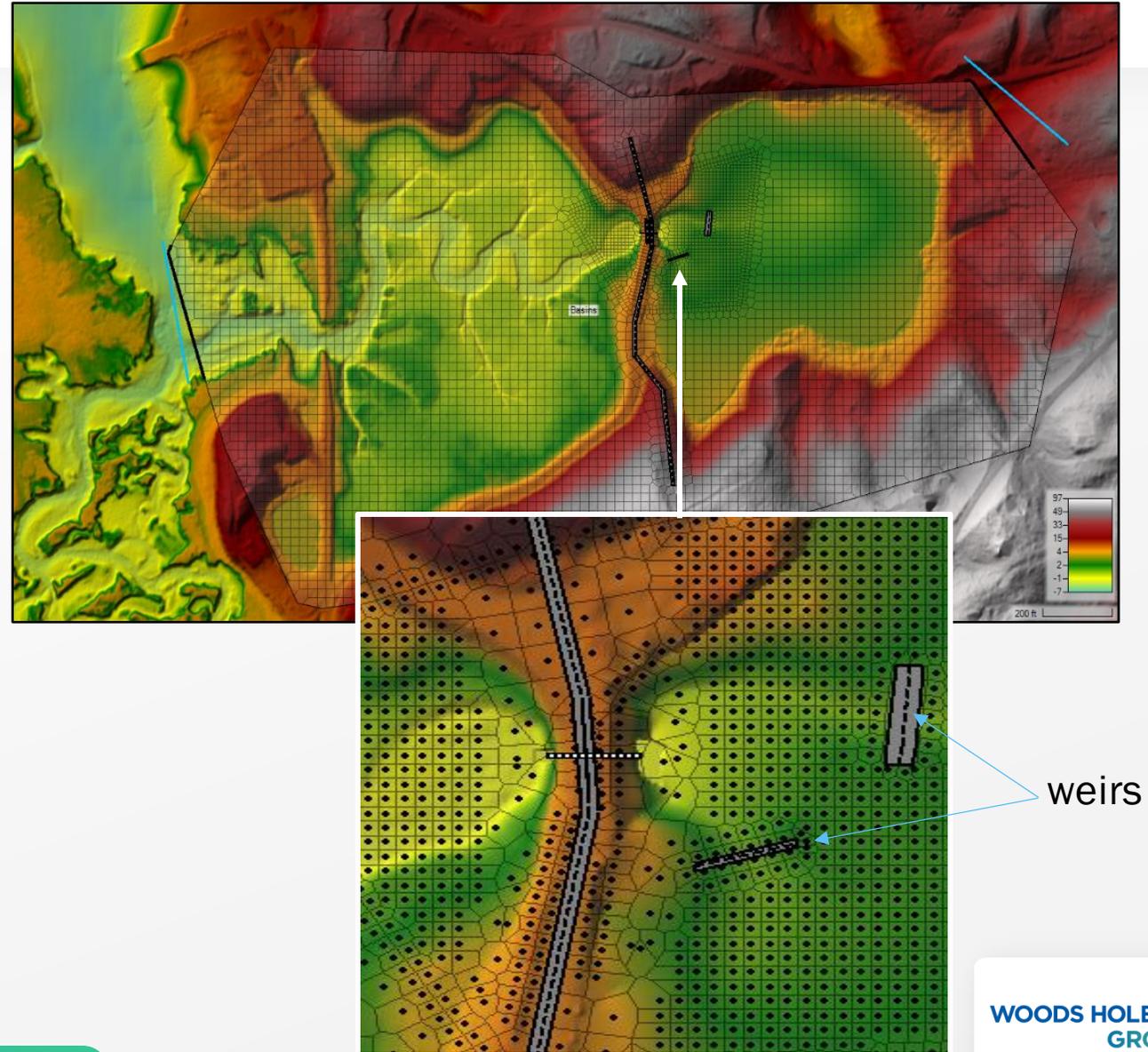
- ❖ Topographic & bathymetric survey
- ❖ Wetland delineation
- ❖ Tide and salinity measurements; ~2ft tidal dampening
- ❖ Geotechnical borings at Mill Pond Rd



2022 Mill Pond Alternatives Modeling

Hydrodynamic Modeling

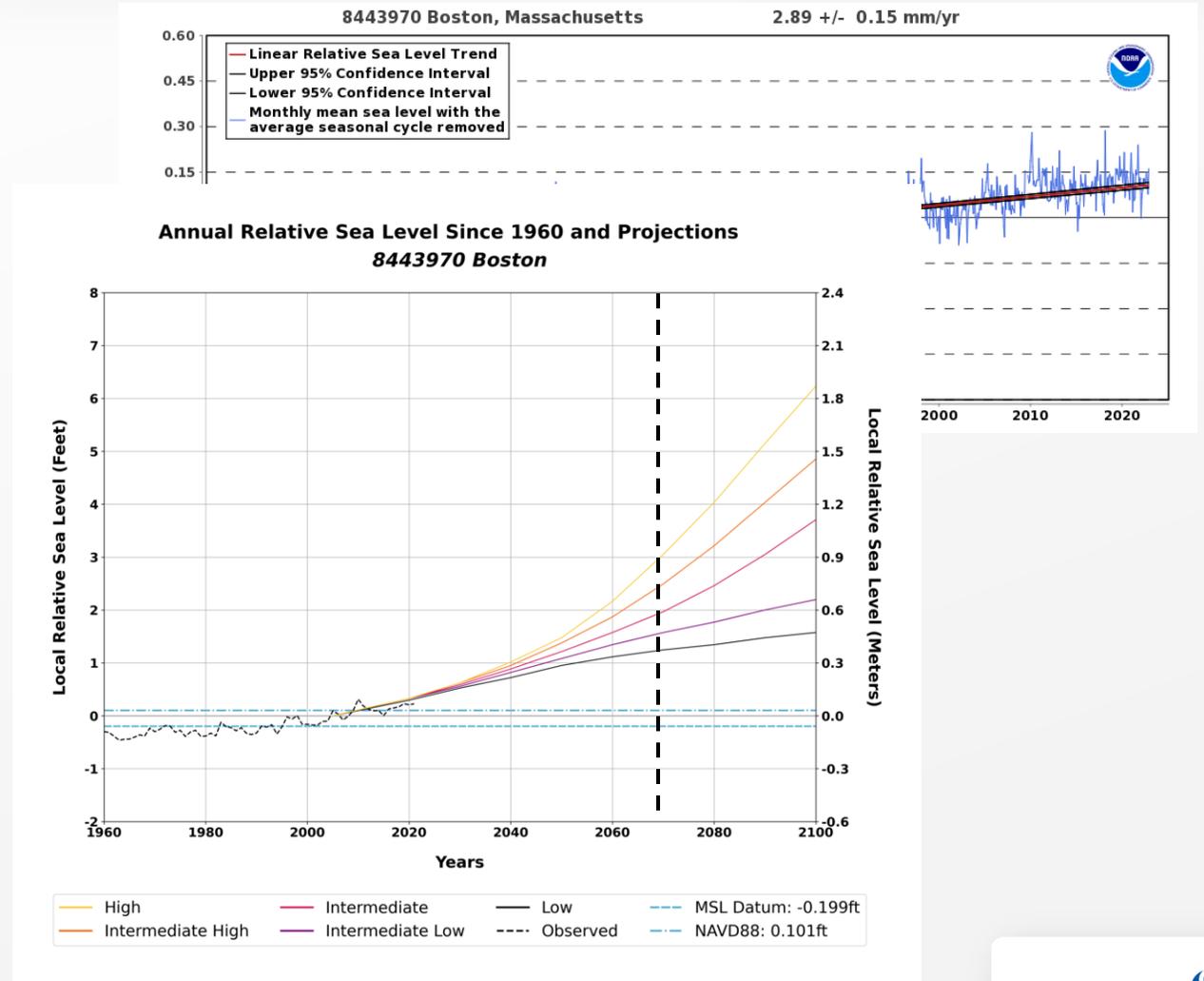
- ❖ Developed a HEC-RAS2D hydrodynamic model for the Mill Pond system including the middle basin and Pamet Harbor.
- ❖ Simulated Existing Conditions for normal tides
 - ❖ Required adding 2 weirs to account for shoals/island that attenuate drainage
- ❖ Develop return period storm scenarios based on MC-FRM storms.
- ❖ Simulate future sea level rise scenarios for normal tides and storms.
- ❖ Alternatives development: Conducted a culvert sizing analysis using a hydraulic-hydrologic hypsometric model.
- ❖ Developed refined alternatives to simulate & evaluate with HEC-RAS2D.



Historic & Future Sea Level Rise

Sea level rise based on Boston NOAA Water Level Station # 8443970 that has been in operation since the 1921.

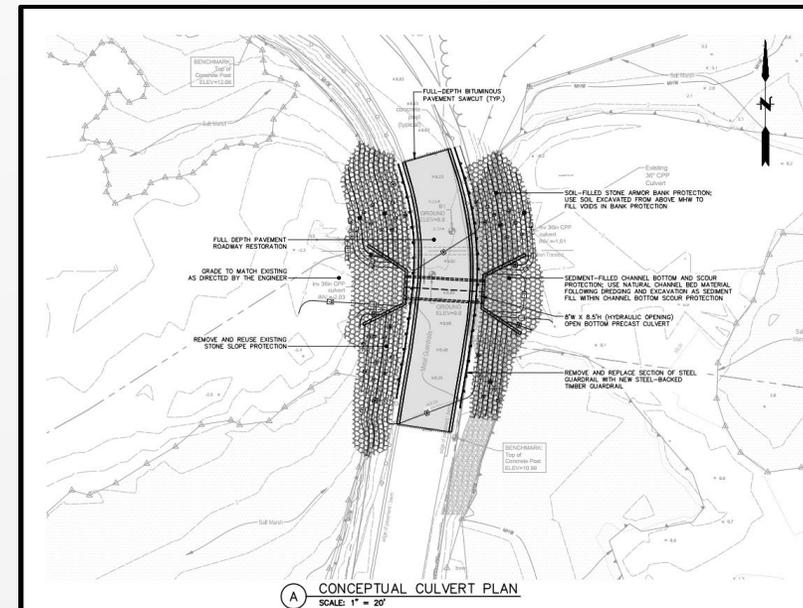
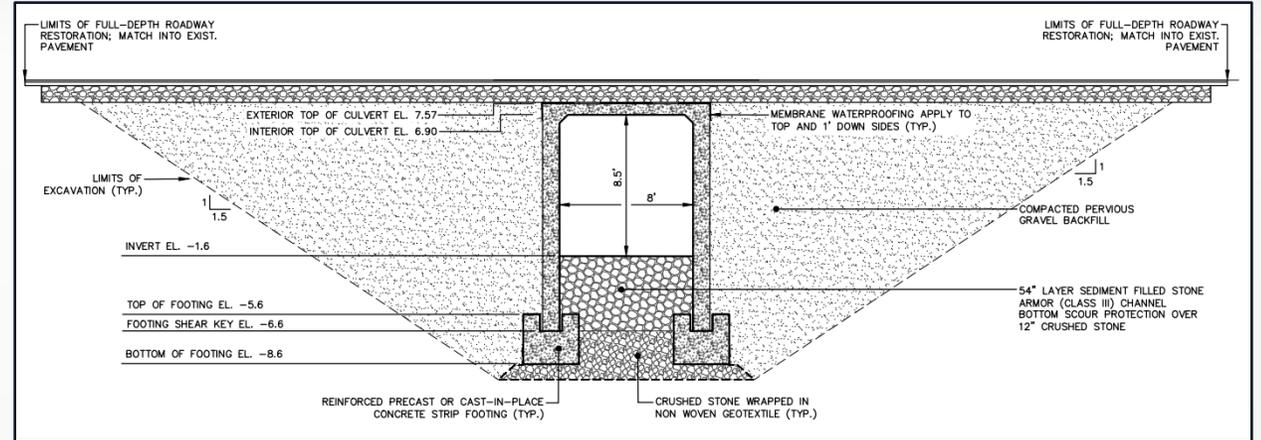
- ❖ Historic sea levels have risen 289 mm (11.4 inches) over the last century.
- ❖ Since recent rates of sea level rise are outpacing historical rates, NOAA has developed different projections (forecasts) of sea level rise ranging from low to medium to high.
- ❖ The NOAA medium-projection of sea level rise was used for this analysis, which is approximately 2-feet in 2070 (approximately 50-year timeline); in line with the projections used for Eagle Neck Creek.
- ❖ Recent Massachusetts State guidance for sea level rise in this area is closer to 4.2 feet, which exceeds the NOAA high-projection.



Alternative Concept 1: 8Wx8.5H Box Culvert

Conceptual Level Design

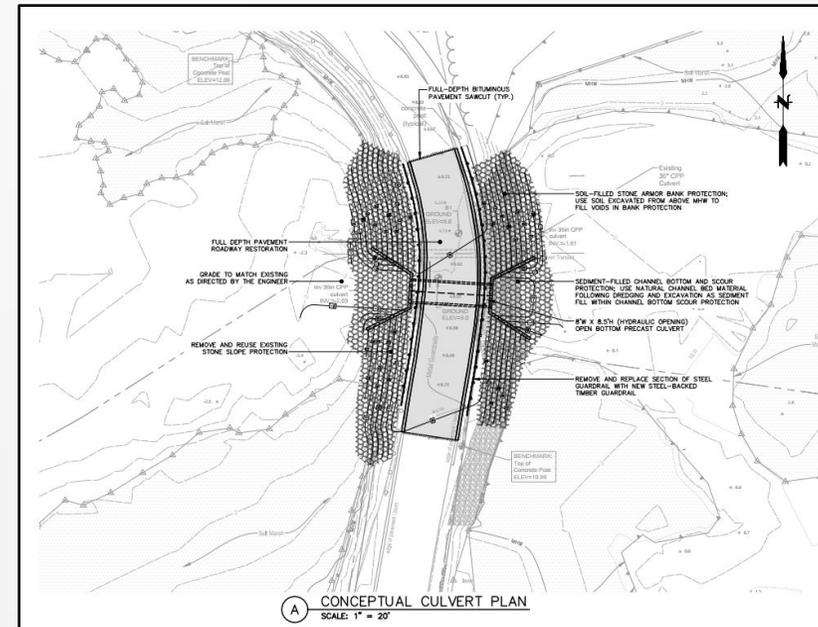
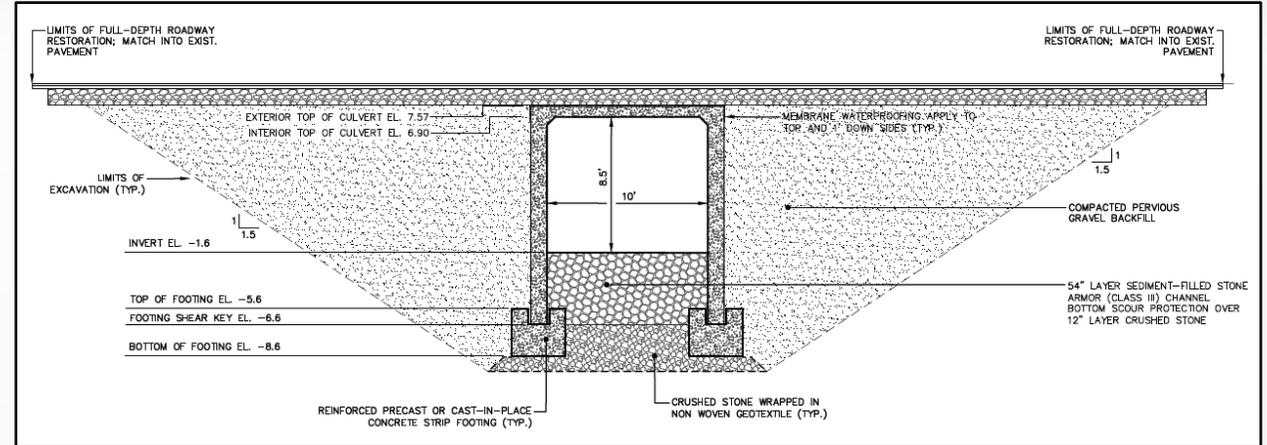
- ❖ Maintains the road and installs a 8-foot-wide by 8.5-foot-high box culvert.
- ❖ Hydrodynamic modeling using HEC-RAS 2D
- ❖ Foundation design
- ❖ Scour mitigation design
- ❖ Embankment armoring
- ❖ 8-ft wide culvert is effectively a small bridge and very similar to the replacement culvert at Eagle Neck Creek.



Alternative Concept 2: 10Wx8.5H Box Culvert

Conceptual Level Design

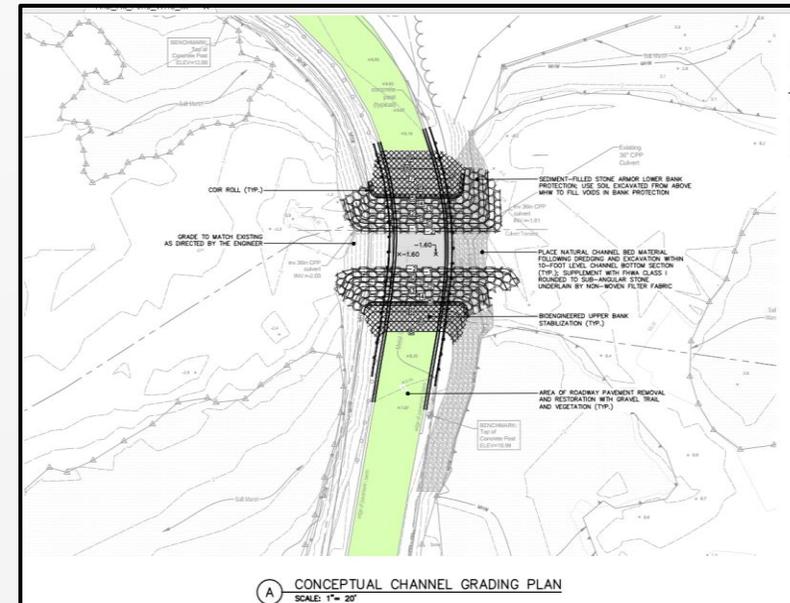
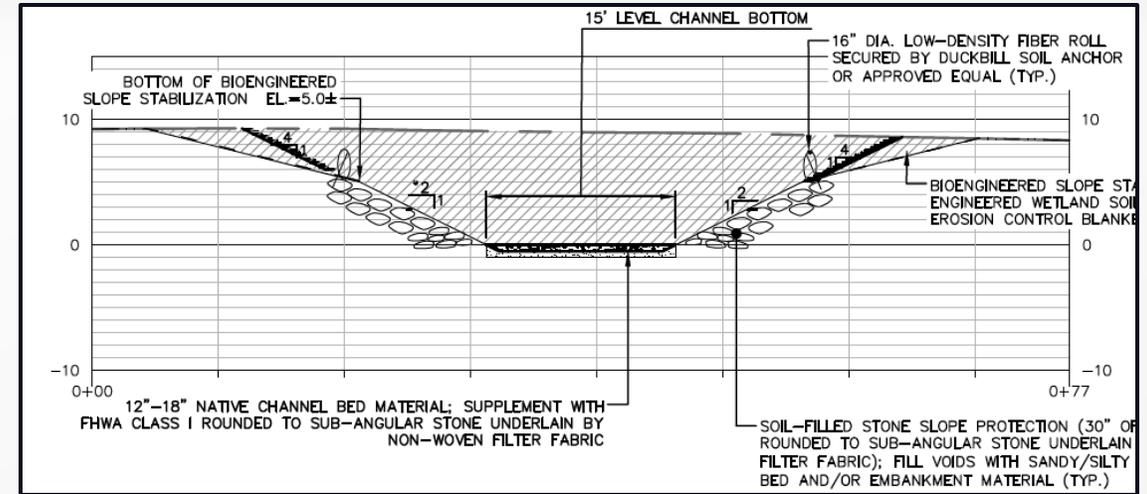
- ❖ Maintains the road and installs a 10-foot-wide by 8.5-foot-high box culvert.
- ❖ Hydrodynamic modeling using HEC-RAS 2D
- ❖ Foundation design
- ❖ Scour mitigation design
- ❖ Embankment armoring
- ❖ 10-ft wide culvert is effectively a small bridge and very similar to the replacement culvert at Eagle Neck Creek.



Alternative Concept 3: Open Channel (breach)

Conceptual Level Design

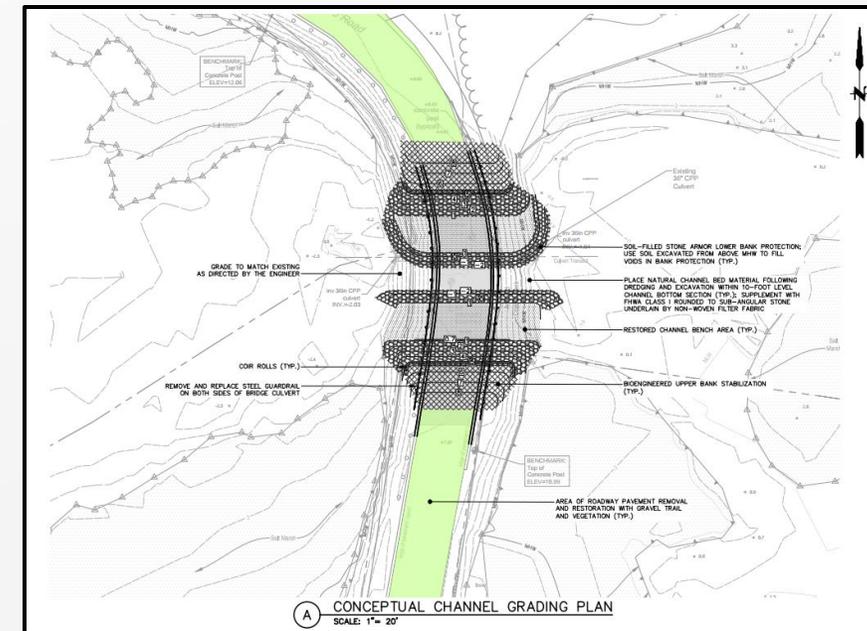
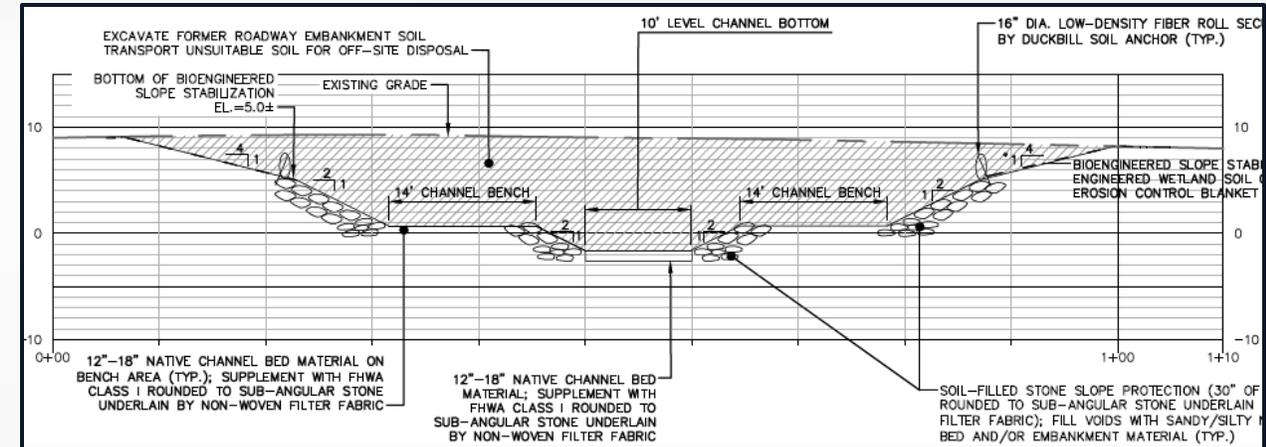
- ❖ Open channel (breach) with 15-foot bottom width & 65-foot top width
- ❖ Road is discontinued to improve coastal resiliency planning for future sea level rise.
- ❖ Hydrodynamic Modeling Alternatives - HEC-RAS 2D
- ❖ Foundation Design
- ❖ Scour Mitigation
- ❖ Embankment armoring & restoration plantings
- ❖ Possible creation of a recreation area with a pedestrian bridge.



Alternative Concept 4: Open Channel (breach) & Saltmarsh Benches

Conceptual Level Design

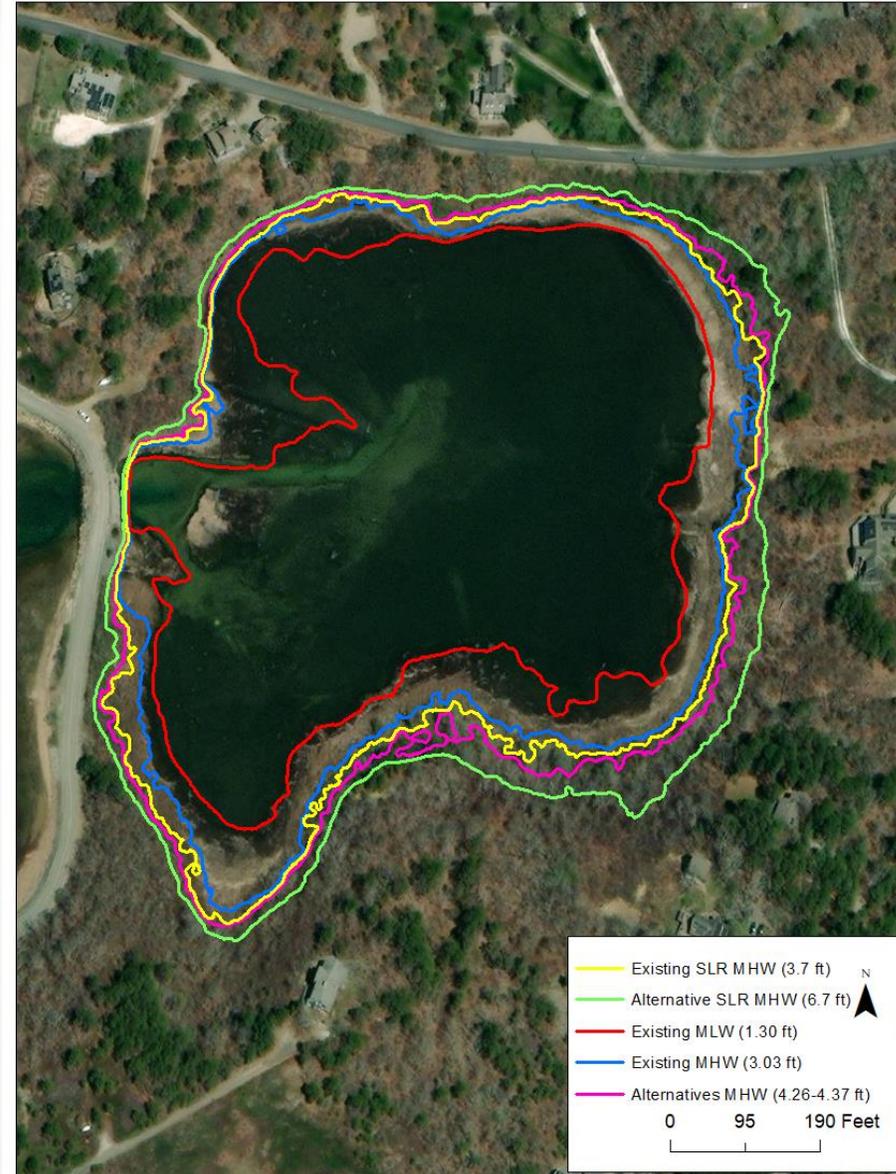
- ❖ Open channel (breach) with 10-foot bottom width & 95-foot top width and salt marsh benches
- ❖ Road is discontinued to improve coastal resiliency planning for future sea level rise.
- ❖ Hydrodynamic Modeling Alternatives – HEC-RAS 2D
- ❖ Foundation Design
- ❖ Scour Mitigation
- ❖ Embankment armoring
- ❖ Salt Marsh restoration plantings on benches
 - ❖ New habitat (salt marsh) creation in the former roadway
- ❖ Possible creation of a recreation area with a pedestrian bridge.



Conceptual Alternatives Performance Modeling Results

- The four Alternatives produced similar results with similar MHW and MLW extents; therefore, there are similar expectations for tidal restoration.
- Modeling indicated that the weir contributes to preventing the pond from fully draining.
- It is possible that natural channel morphology may evolve over time to allow for further drainage of the pond with a larger opening.

	Existing	Existing	Alt 1.	Alt. 2	Alt. 3	Alt. 4
	Present Day	2ft SLR in 2070	8'Wx8.5' H Culvert	10'Wx8.5' H Culvert	65' top / 15' Bottom	95' top / 10' Bottom
Total area of Inundation at MHW (acres)	9.9	11.9	13.3	13.4	13.4	13.4
Area of Change at MHW (acres)	0	2.0	3.4	3.5	3.5	3.5



Alternatives Comparison & Evaluation

- A decision analysis matrix was prepared to help rank each alternatives to aid the decision process for the Town (top table):
 - Criteria included: environmental impacts, property impacts, ecology, emergency response, recreation, construction cost & duration, O&M, & resiliency.
 - Alternative 4 the large open channel (breach) was the highest ranked alternative.
 - Culvert alternatives are more expensive than the open channel breach alternatives because of the structural elements, materials, and labor/construction costs.
 - Open channel (breach) alternatives have greater habitat value and plan for future resiliency.
- The MA DER Blue Carbon Calculator was used to estimate potential project restoration benefits in terms of emissions reductions (bottom table).
 - Restored marshes sequester carbon & reduce CH4 emissions.
 - The reduction in Greenhouse Gases (GHG) is equivalent to 589 gallons of gas saved in a year, which is cumulative over future years.

Alt. #	Alternative	Order of Magnitude Opinion of Cost*	Unweighted Evaluation Matrix Score	Weighted Evaluation Matrix Score
1	8'Wx8.5'H Culvert	\$2.20M	2.67	2.66
2	10'Wx8.5'H Culvert	\$2.42M	2.67	2.69
3	65' Breach /15' Bottom	\$1.13M	3.78	3.80
4	95' Breach /10' Bottom	\$1.48M	3.67	3.74

*Order-of-magnitude opinions of probable construction costs that do not include final design, permitting, outreach, monitoring, etc.

Cumulative Emissions/Reductions	Years Post Project					
	1	10	20	30	40	50
CO2-C (tons CO2-C)	-1	-14	-28	-43	-57	-71
GHG (tons CO2e)	-5	-52	-104	-156	-208	-261
GHG (gallons of gas equivalent)	-589	-5,888	-11,777	-17,665	-23,554	-29,442

Other Alternatives/Considerations

Raising the road to keep pace with sea level rise:

- Roadway would need to be raised at least 2-feet over a ~1,600 foot length to provided necessarily resiliency.
- Roadway embankment would expand by 6-feet on either side that would pose significant regulatory implications for wetlands. Therefore, a vertical concrete wall would be needed to reduce wetland impacts.
- The additional cost to raise the roadway by 2-ft in conjunction with culvert replacement is approximately \$1.6-1.8M, which would not be covered by current or other available grant programs.
- Mill Pond Road was evaluated under the Low-Lying Rod Study but ranked low. While the road was identified as being vulnerable, it had a low criticality score since alternative routes are available and it does not support any businesses, community or emergency services (among other factors).

Bridge or Causeway over an open channel (breach)?

- A bridge over an open channel does not provide any additional benefits over the large box culvert since
 - The box culverts restore full tidal range already
 - Provides sufficient headspace for small watercraft.
- Adds significant cost that would not be eligible for available grant funding sources.
- Would require the bridge to be redesigned/reconstructed in the future if the roadway is raised.

Summary

- ❖ Town is holding this meeting to engage the public and receive feedback regarding the conceptual alternatives.
- ❖ Four alternatives have been developed including a two box culverts that maintains Mill Pond Road and two open channels (breaches) where the roadway is removed.
- ❖ All four alternatives provides a similar level of tidal restoration.
 - ❖ Alternative 4 creates additional salt marsh habitat with potential additional water quality benefits.
- ❖ Open Channel (breach) alternatives rank higher than box culverts in decision matrix due to less cost, less impacts, and increased ecological benefits.
- ❖ Additional engineering studies and design will be needed once a preferred alternative has been selected.
- ❖ Engage Agencies and develop the Environmental Permitting Path for selected alternative. Permitting path will likely require 6 different permits and take 18 months. This will provide further opportunity for public comment.
- ❖ Working to secure additional grant funding to advance the project.
- ❖ More project information available at:
 - ❖ <https://www.truro-ma.gov/public-works/pages/mill-pond-salt-marsh-restoration-project>
 - ❖ <https://www.engagetruro.org/mill-pond-salt-marsh-restoration-project>

Thanks to Project Partners:

