RESILIENT BRANFORD

FINAL REPORT

CIRCA
Connecticut Institute for Resilience and Climate Adaptation

FUSS & O'NEILL

AUGUST 2023

RESILIENT BRANFORD CONTENTS

The purpose of this project is to evaluate the feasibility of four flood mitigation alternatives to protect the Meadow Street neighborhood in Branford, Connecticut. Flooding of this neighborhood occurs when the Branford River, a tidally-influenced estuary, overtops its banks during coastal storm events. An Amtrak railroad underpass, locally referred to as the Cattle Crossing, is the entry point for floodwaters from the river into the neighborhood. Analysis completed for this project demonstrates that the neighborhood will become more vulnerable to flooding in the future due to the impacts of climate change.

The feasibility analysis of four flood mitigation alternatives are documented in this report. The alternatives include, Alternative 1: Flood Gate with Floodwall; Alternative 2: Flood Gate-Only; Alternative 3: Close the Cattle Crossing; and Alternative 4: Do Nothing. The benefits, considerations and barriers to implementation of all four alternatives were presented to the Town of Branford Engineering Department as well as the First Selectman and to the public in two public engagement meetings. The Town anticipates perusing Alternative 2: Flood Gate-Only. This alterative is cost effective, has a minimal impact on private property and will not permanently impact the flow of traffic to the neighborhood.

PROJECT TEAM

CIRCA

John Truscinski – Director of Resilience Planning

David Murphy – Director of Resilience Engineering

Town of Branford

John Hoefferle – Town Engineer

Jennifer Acquino – Assistant Town Engineer

Kevin Ortiz – Civil Design Engineer

Consultant Team

Fuss & O'Neill, Inc.

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PROJECT DESCRIPTION

The Meadow Street neighborhood is located in the Town of Branford along the Branford River (Figure 1). Flooding of this neighborhood occurs when the Branford River, a tidally-influenced estuary, overtops its banks during coastal storm events. It is anticipated that the Meadow Street Neighborhood will become more vulnerable to frequent flooding as climate change occurs.

Flood models completed as part of this project indicate that the Amtrak railroad underpass, locally referred to as the Cattle Crossing, is the entry point for floodwaters from the river into the neighborhood. The Amtrak railroad embankment provides some flood protection to the neighborhood, despite likely not being constructed for this purpose. The railroad embankment was most likely built to support the railroad tracks and not to act as a levee against floodwaters.

Many residents of the Town of Branford are familiar with the flooding that occurs on Meadow Street and noted during public meetings how they avoid the area during and after large storm events. Business in the neighborhood are impacted by the damaged caused by flooding as well as the lack of costumers and access to their properties.

The goal of this project is to develop implementable adaptation strategies to mitigate the impacts of flooding from the Branford River. This report evaluates the feasibility and potential next steps for each of the flood mitigation alternatives proposed by this project.

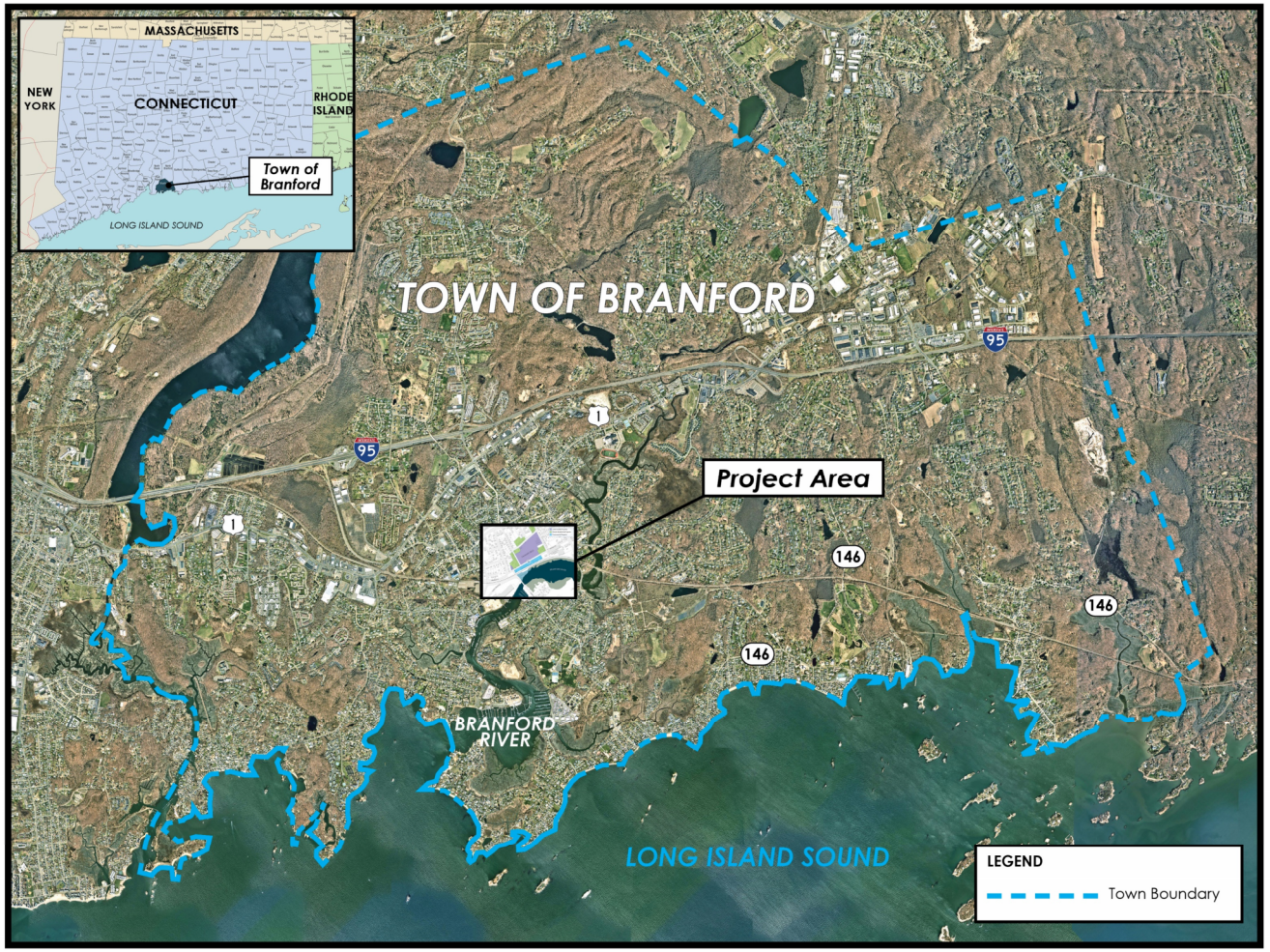

FIGURE 1: LOCUS MAP

RESILIENT BRANFORD

THE MEADOW STREET NEIGHBORHOOD

Along with residential homes and businesses, several municipal assets are located within the Meadow Street neighborhood. The Branford senior center, recreational facilities and municipal offices are part of the recently renovated Community House. A sewer pump station is located on Meadow Street, across from the Cattle Crossing.

The section of Meadow Street that is adjacent to Hammer Field is in a low point compared to the surrounding neighborhoods. The lowest point along Meadow Street is at elevation 2.62 feet (NAVD88). According to data available though National Oceanic and Atmospheric Administration (NOAA), the Mean Higher High Water (MHHW) elevation of the Branford River is 2.97 feet (NAVD88).

Due to the relatively low elevation of Meadow Street, the outfall pipe that discharges stormwater from this area is protected by a valve. The valve automatically closes during high-tide to prevent river water from causing backflow in the stormwater system. Stormwater that collects at the Cattle Crossing is discharged to the river using a pump. Figure 2 shows an overview of the assets within the Meadow Street neighborhood as well as the location of stormwater and sewer infrastructure.

The FEMA Flood Insurance Rate Map (FIRM) indicates that the 100-year floodwater elevation is 12 feet (NAVD88). This is referred to by FEMA as the Base Flood Elevation (BFE) (see dashed line in Figure 2). Most of the Meadow Street and Hammer Field neighborhood are in the FEMA 100-year floodplain meaning this area may be more vulnerable to flooding compared to other neighborhoods in Branford. The FEMA FIRM maps are based on current conditions and do not include climate change projections such as sea level rise. Therefore, FEMA FIRM maps do not accurately display future flood risk due to climate change.

FIGURE 2: OVERVIEW OF PROJECT AREA ASSETS

BRANFORD RIVER FLOOD MODELING

The term annual exceedance probability (AEP) refers to the probability of a rain event being equaled or exceeded in any given year. A storm event with a 10% AEP is often referred to as the 10-year storm event. Similarly, the 50-year storm event has a 2% AEP and the 100-year storm event has a 1% AEP. The 10-year, 50-year and 100-year storm events were modeled as part of this analysis.

Existing Conditions Modeling:

The Connecticut Institute for Resilience & Climate Adaptation (CIRCA) conducted a coastal flood and storm surge analysis of the Branford River. The model relied on historic tropical storm and hurricane data to estimate the depth and extent of floodwaters for three "current climate" (i.e., existing conditions) storm scenarios. The model predictions were verified using data from Superstorm Sandy (see Figure 3).

Future Conditions Modeling:

To assess future conditions due to climate change, CIRCA used a projected sea level rise (SLR) for the year 2050 of 20 inches. This SLR prediction represents a planning level threshold comparable to the NOAA projections. To understand how future climate conditions would impact flooding, 20 inches of SLR was applied to the existing conditions model to represent the climate conditions for the year 2050.

Figures depicting the floodwater depth, in the Meadow Street neighborhood, for existing and future storm scenarios are provided in the following pages.

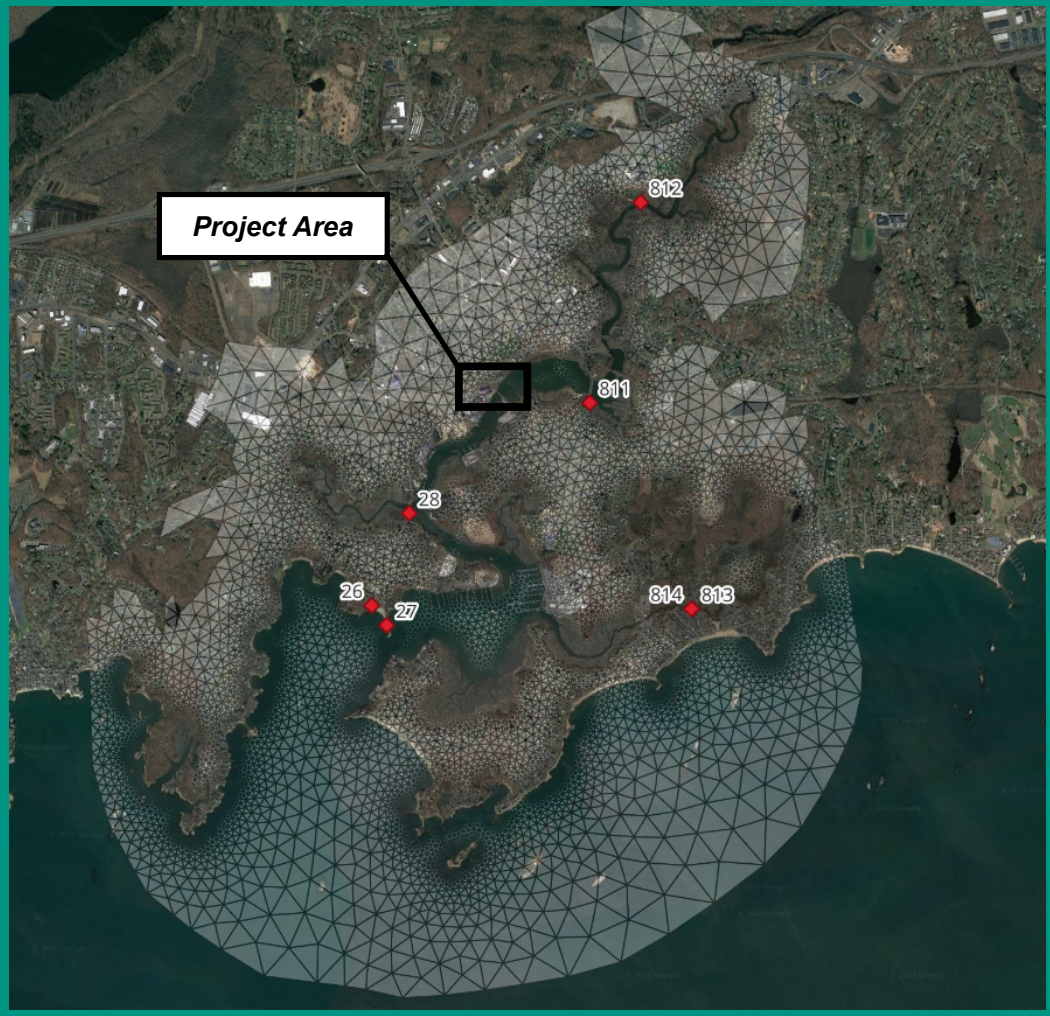

FIGURE 3. A visual representation of the Branford River flood modeling area. Red diamonds indicate the USGS high water mark (HWM) surveys from Superstorm Sandy.

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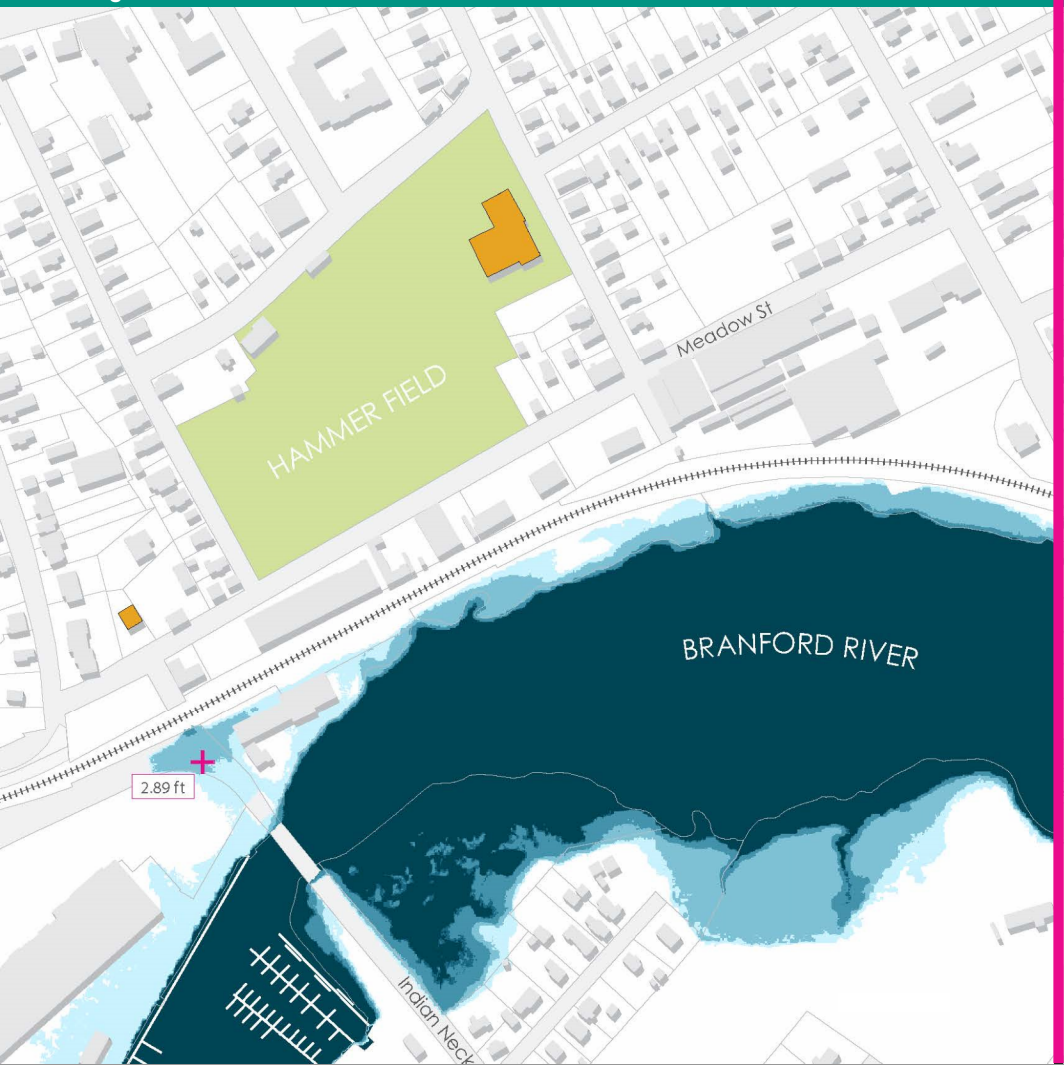
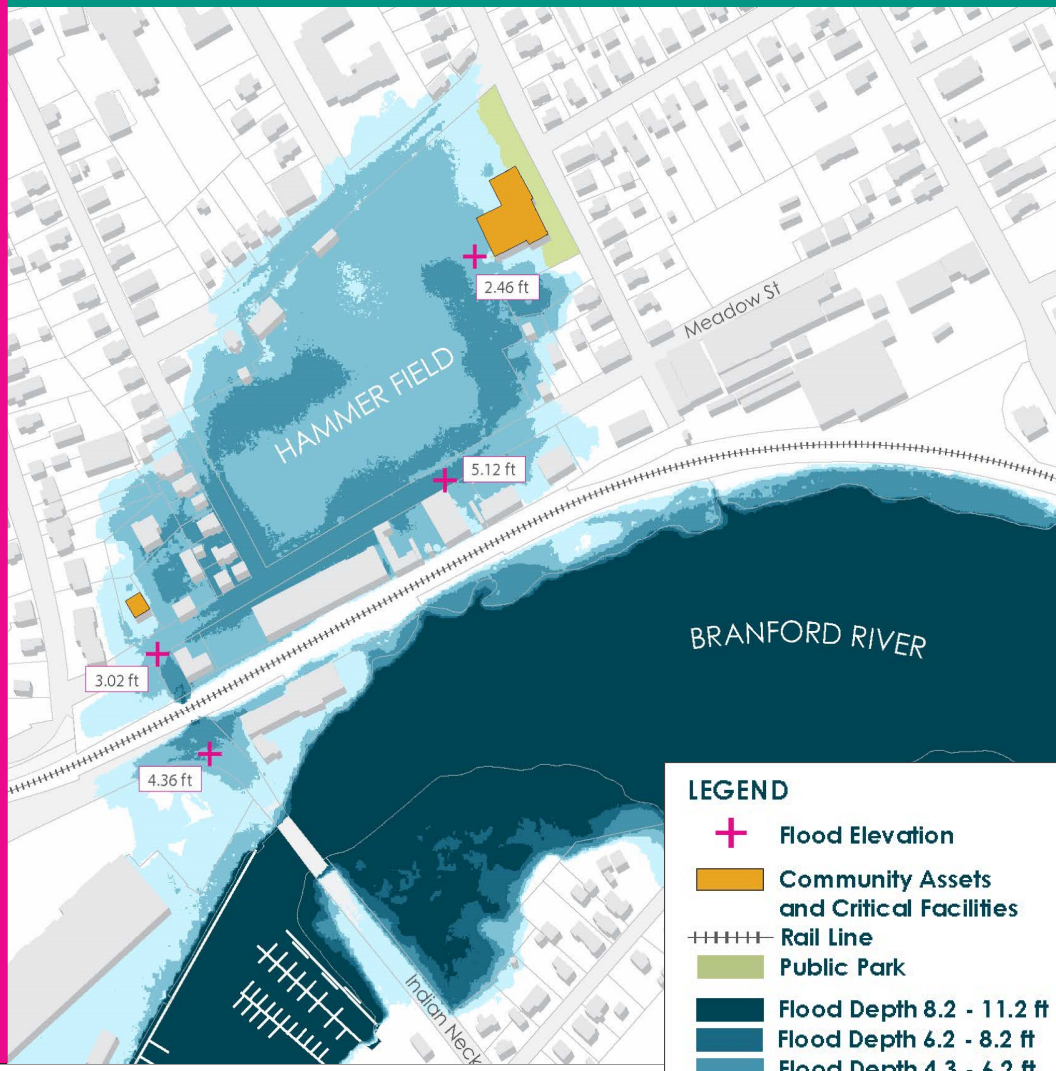
EXTENT OF FLOODING 10-YEAR STORM (PRESENT DAY)

Coastal storm flooding is limited to the area south of the train tracks and makes the Cattle Crossing inaccessible.



EXTENT OF FLOODING 10-YEAR STORM (2050)

Coastal storm flooding will impact up to 35 residential, business and municipal structures as well as result in multiple road closures.



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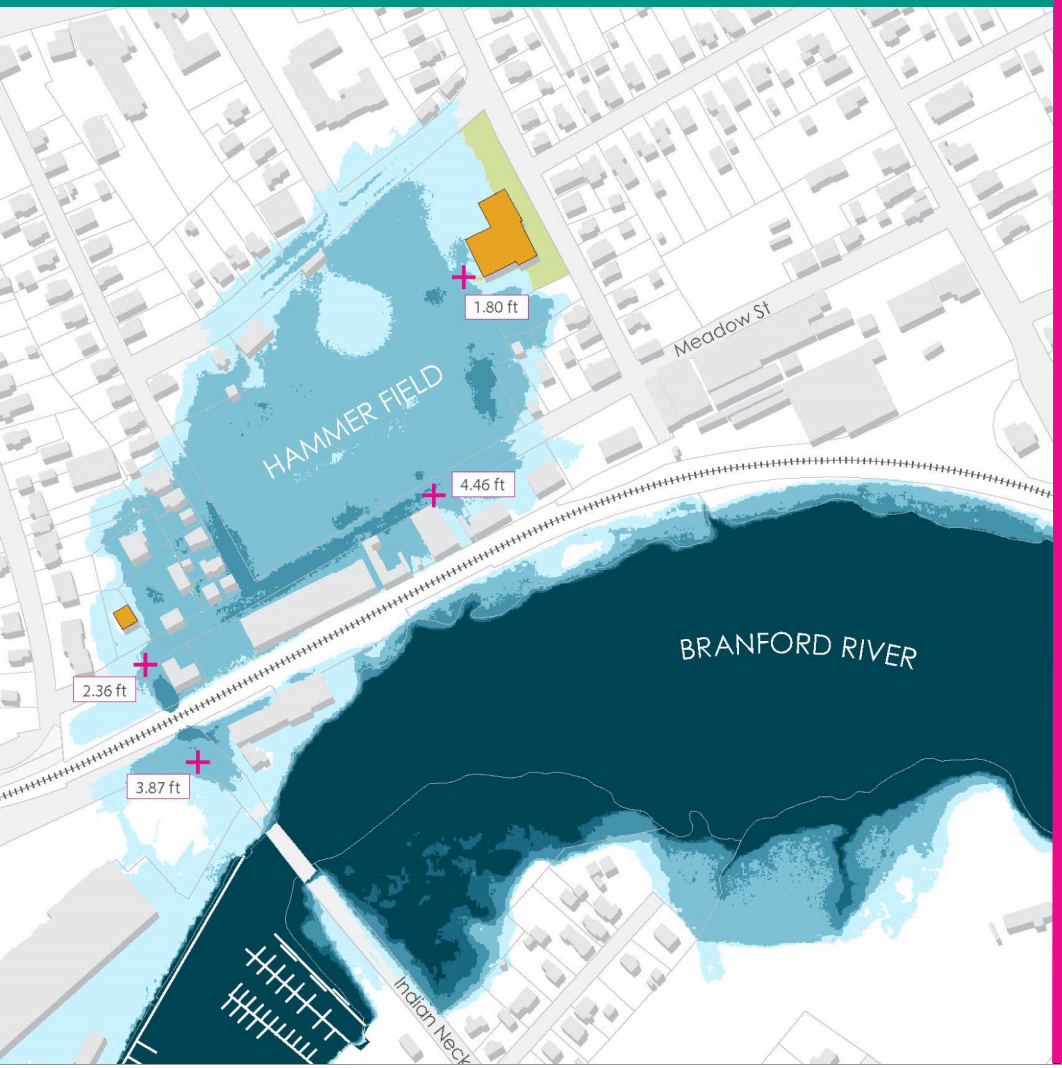
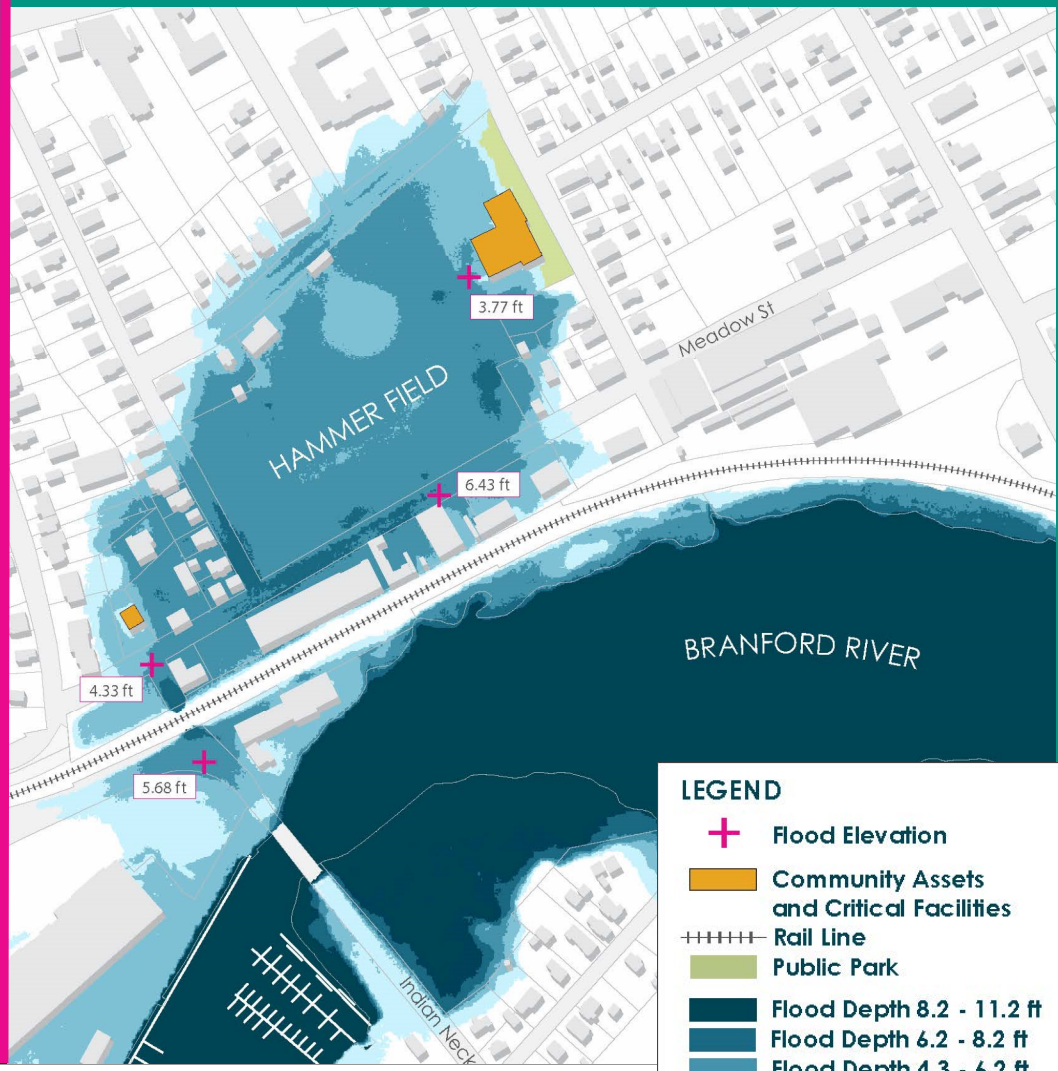
EXTENT OF FLOODING 50-YEAR STORM (PRESENT DAY)

Flooding along Meadow Street could reach a depth up to 4 feet during the 2% AEP coastal storm event.



EXTENT OF FLOODING 50-YEAR STORM (2050)

Under projected future conditions for a coastal storm event with the same AEP, an additional 2 feet of floodwater is anticipated.



LEGEND

- Flood Elevation
- Community Assets and Critical Facilities
- Rail Line
- Public Park
- Flood Depth 8.2 - 11.2 ft
- Flood Depth 6.2 - 8.2 ft
- Flood Depth 4.3 - 6.2 ft
- Flood Depth 2.3 - 4.3 ft
- Flood Depth 0.0 - 2.3 ft

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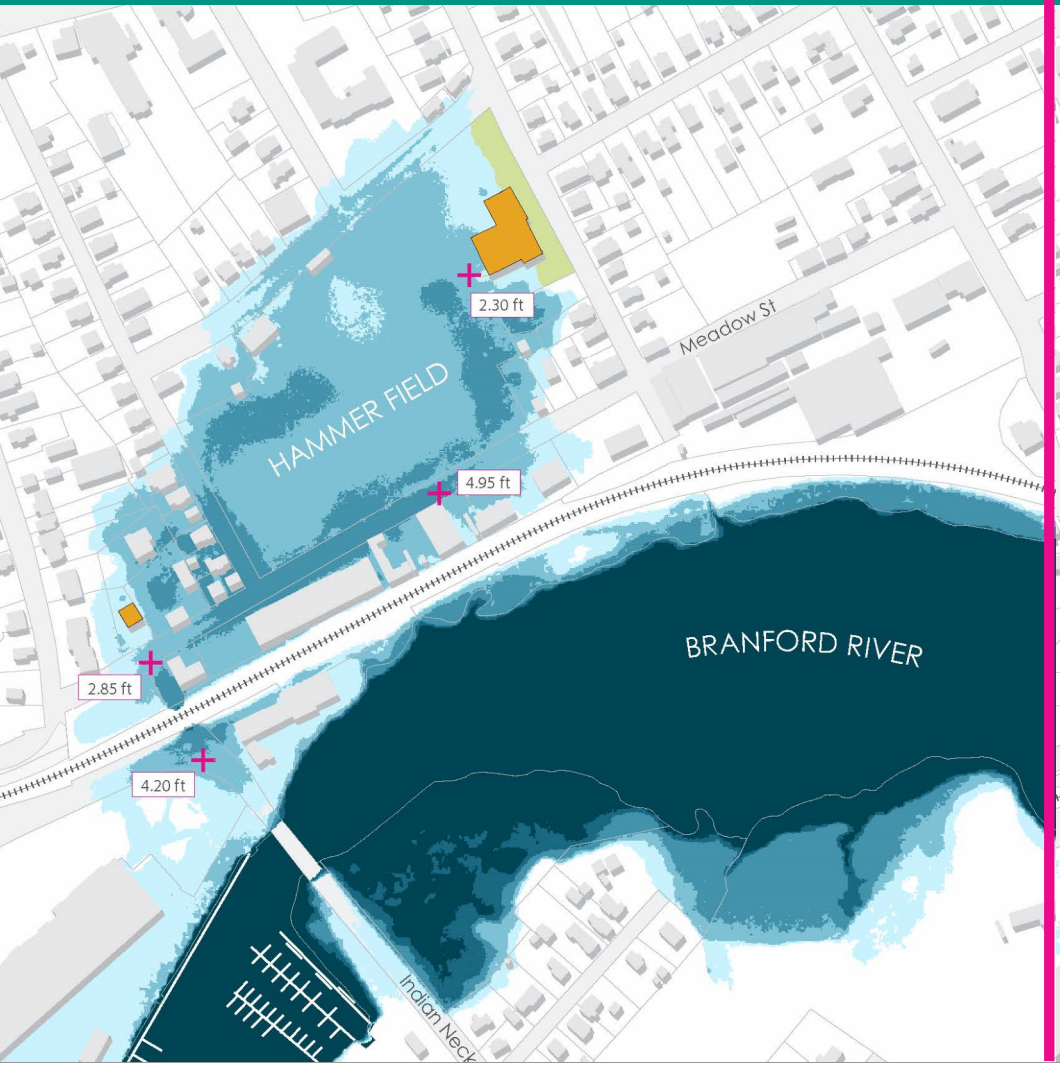
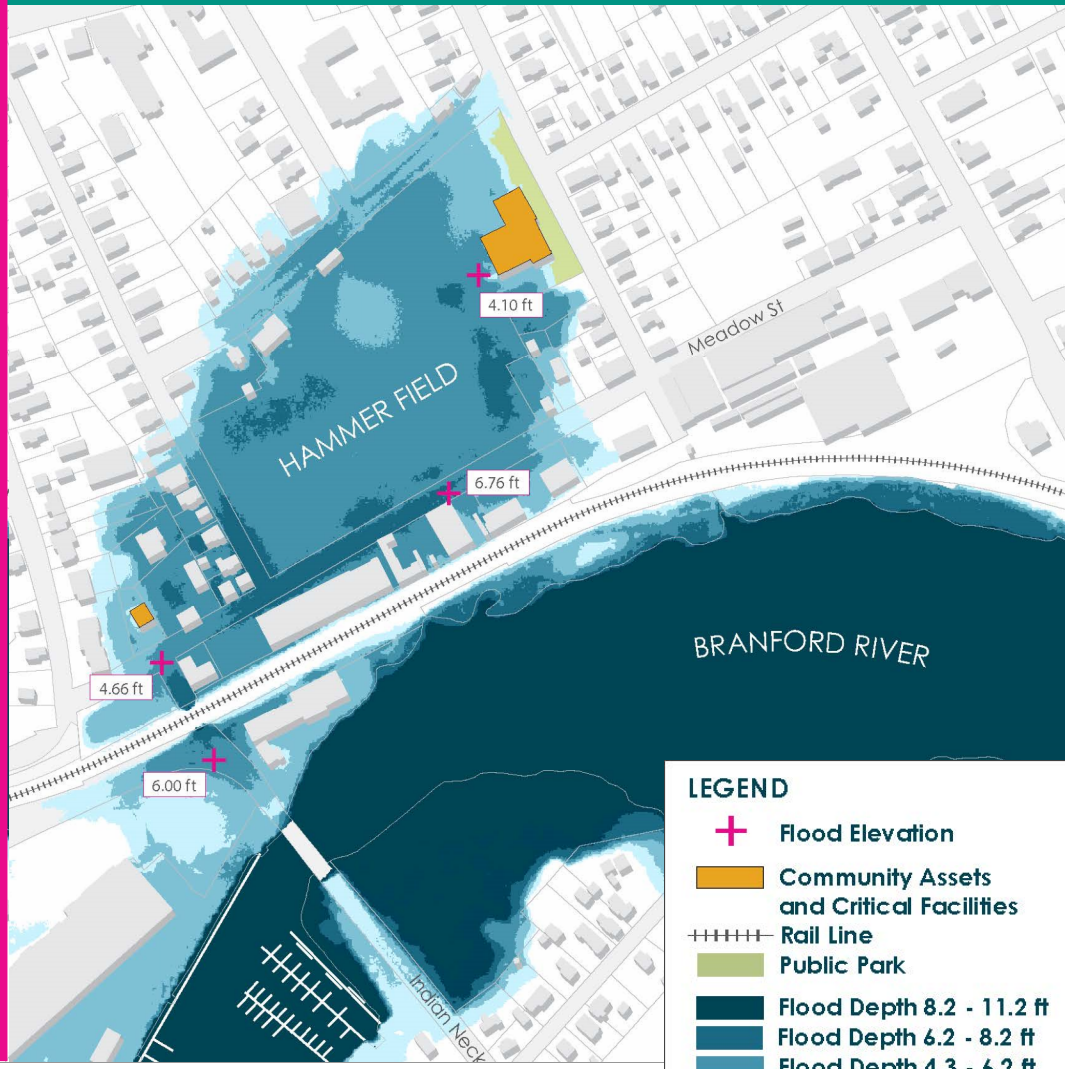
EXTENT OF FLOODING 100-YEAR STORM (PRESENT DAY)

The 1% AEP storm event does not overtop the railroad embankment under current existing conditions.



EXTENT OF FLOODING 100-YEAR STORM (2050)

Stopping floodwater before it enters the Cattle Crossing could protect the Meadow Street neighborhood from coastal flooding. Under the 2050 SLR scenario, the 1% AEP doesn't overtop the railroad embankment.



LEGEND

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FLOOD MODELING RESULTS

Modeling completed for this project indicates that the water surface elevations for floods less intense than the 100-year storm (1% AEP) will not overtop the Amtrak embankment. However, there is insufficient information to know whether the embankment would be stable during a flood.

As sea level rise continues, flooding that occurs at the Cattle Crossing will likely intensify. For example, the model predicts that the number of structures that would be impacted during a current 100-year storm event (1% AEP) will be consistent with the number of structures impacted during a 10-year storm event (10% AEP) in 2050.

Based on this modeling, preventing flood waters from entering the Cattle Crossing could provide protection for up to the 100-year storm event.

STORM EVENT	NUMBER OF STRUCTURES IMPACTED (NORTH OF TRAIN TRACKS)	
	Current Climate	Future Climate (2050)
10-year	0	34
50-year	29	40
100-year	35	42

ALTERNATIVES ANALYSIS

In addition to the modeling completed by CIRCA, the FEMA Flood FIRM indicates that the 100-year floodwater elevation is 12 feet (NAVD88). The Amtrak embankment is currently at elevation 12 (NAVD88), as shown in Figure 5, with the lowest elevation of the road under the Cattle Crossing at 0.52 feet (NAVD88). The mean higher high water of the Branford River is elevation 2.97 feet (NAVD88). Therefore, by preventing flood waters from entering the Cattle Crossing up to the height of the current Amtrak embankment, the Meadow Street neighborhood could be protected up to the FEMA 100-year floodwater elevation.

Four alternatives were evaluated to address flooding at the Cattle Crossing:

1. Flood Gate with Floodwall
2. Flood Gate-Only
3. Close the Cattle Crossing
4. Do Nothing

Benefits and considerations of each alternative are discussed in the following sections.

FIGURE 4: OVERVIEW OF PROJECT AREA WITH FEMA 100-YEAR FLOODPLAIN

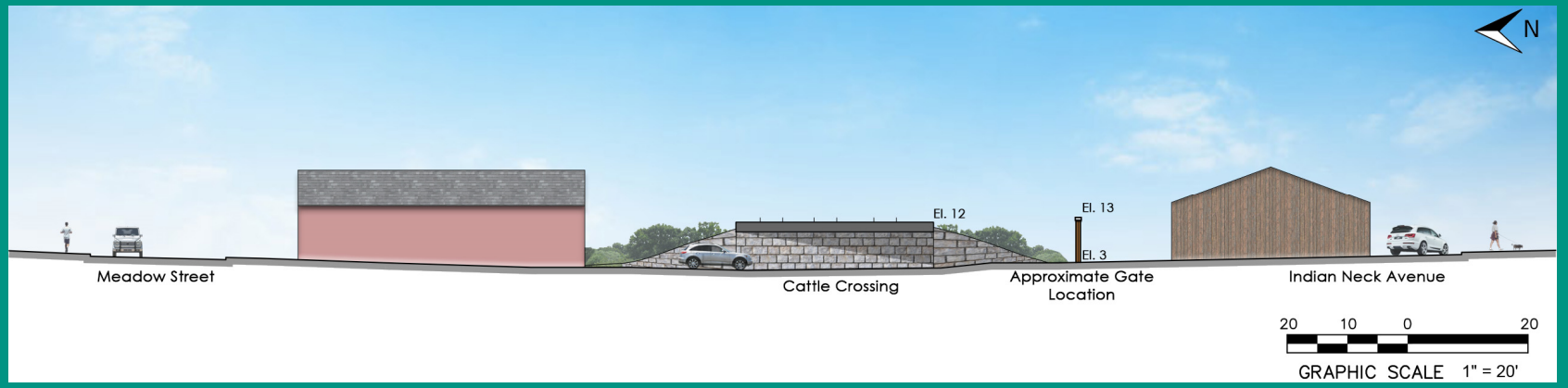

FIGURE 5: CROSS SECTION OF CATTLE CROSSING WITH PROPOSED FLOODWALL

ALTERNATIVE 1: FLOOD GATE WITH FLOODWALL

Alternative 1 consists of installing a flood gate at the Cattle Crossing and floodwall between the Amtrak embankment and the Branford River. The floodwall would connect to the gate and run parallel to the Amtrak embankment.

The proposed flood gate would be a manually-operated swing gate. This gate type was chosen by the Town after discussions of different gate options. This gate type was chosen based on cost, aesthetics, maintenance, and public safety.

The height of the flood gate and floodwall would be elevation 13 (NAVD88) or greater, which is dictated by FEMA flood protection design standards plus any other requirements in place at the time such as the Federal Flood Risk Management Standard (FFRMS) or CT DEEP requirements. The floodwall would be approximately one foot higher than the current Amtrak embankment. The tallest above ground portion of the floodwall is approximately 10 feet high and located at the Cattle Crossing.

A significant benefit of this Alterative is the potential for properties within the Meadow Street neighborhood to be removed from the FEMA 100-year Floodplain as well as the potential for construction to qualify for FEMA funding if it is designed to FEMA standards. The floodwall would need to be built in conjunction with the flood gate for the neighborhood to be removed from the floodplain. Because the Amtrak embankment is not recognized by FEMA as a flood control structure, the regulated 100-year floodplain extends beyond the Amtrak embankment into the Meadow Street neighborhood.

A flood gate and sheet pile floodwall is depicted in Figure 7. Sheet pile is often fitted with a concrete cap to protect the top of the wall from damage as well as provide additional structural reinforcement. Although the floodwall would be a major visual impact, there are options to use the floodwall to improve the overall aesthetics of the neighborhood.

FIGURE 6: EXISTING CONDITIONS

FIGURE 7: PROPOSED CONDITIONS

ALTERNATIVE 1 CONTINUED: FLOOD GATE WITH FLOODWALL

The proposed floodwall would be approximately 1,500-feet long and begin just east of Maple Street (Figure 8). The portion of the floodwall between Maple Street and the Cattle Crossing flood gate is municipal property. As the floodwall extends northeast, it enters on private property behind the warehouse at 46 Indian Neck Avenue and then enters Amtrak right-of-way. At the floodwall's eastern terminus, it ties into the Amtrak embankment. As the space between the Amtrak ROW and building face is limited, the floodwall will likely have to be built on the Amtrak embankment slope to accommodate the necessary space for construction as well as future maintenance of the building.

The flood gate would be manually operated by the Town of Branford Department of Public Works (DPW) and allow for traffic through the Cattle Crossing when there is no risk of flooding. When a storm event is anticipated, a Town employee would swing the gate doors, and lock them into the closed position – temporarily blocking traffic. (See Figure 11 for more detail about how traffic would be temporarily rerouted.)

ALTERNATIVE SUMMARY

- FEMA Fundable: Yes
- Approximate Construction Cost: $4,900,000 to $10,300,000

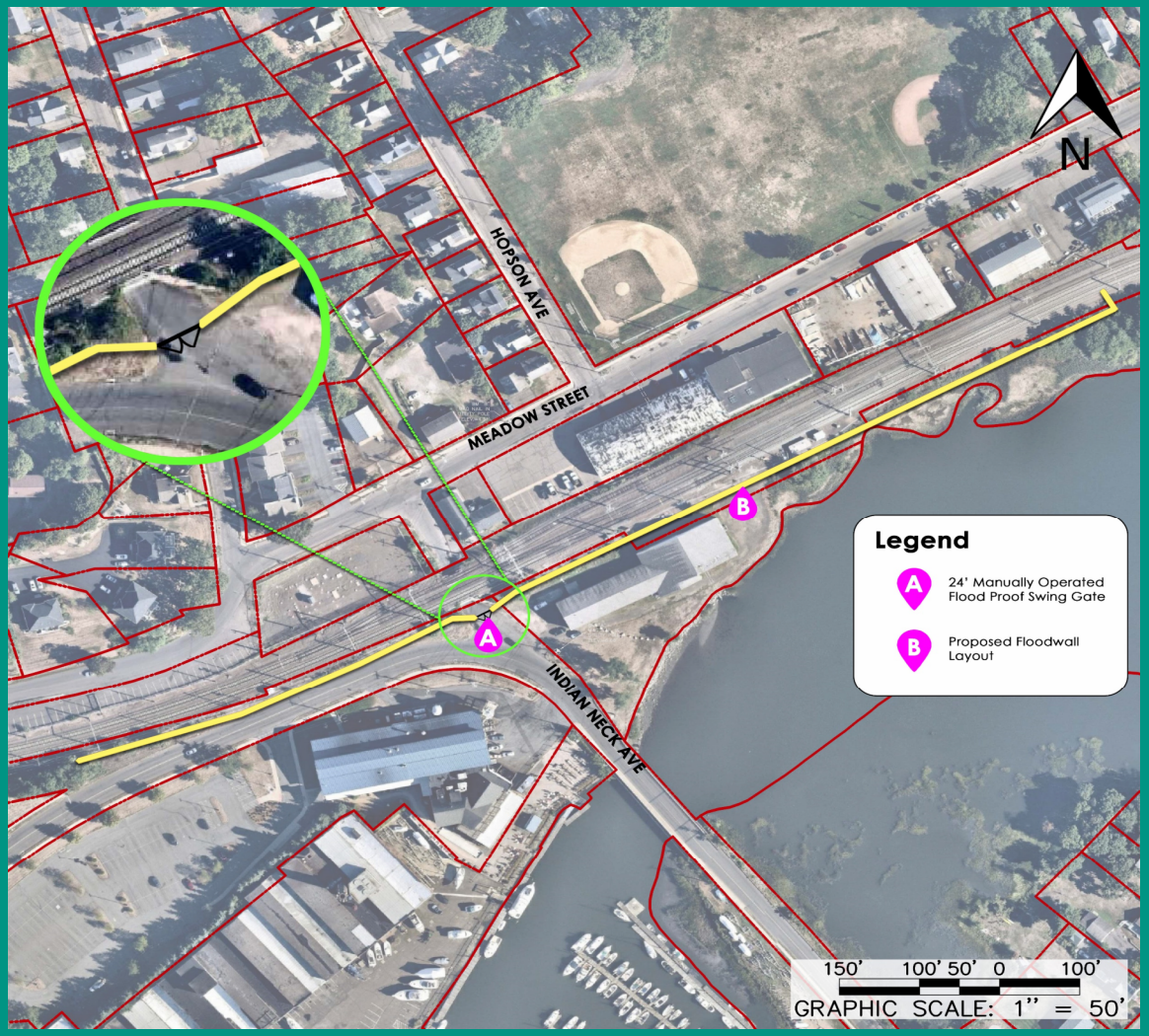

FIGURE 8: ALTERNATIVE 1 LAYOUT

ALTERNATIVE 2: FLOOD GATE-ONLY

Alternative 2 consists of installing a flood gate with berms that tie into the existing Amtrak embankment. The flood gate would be the same flood gate type proposed in Alternative 1, a manually-operated swing gate.

By installing the gate without the entire length of floodwall, Meadow Street would not be protected if floodwaters breached the Amtrak embankment.

Because FEMA does not recognize the Amtrak embankment as a flood protection measure, this Alternative is not eligible for FEMA funding and will not impact the extent of the current 100-year floodplain. However, the floodwall from Alternative 1 could eventually be tied into the flood gate.

The location of the flood gate is proposed at the intersection of Indian Neck Avenue and the Cattle Crossing, as seen in Figure 9. Both Alternatives 1 and 2 include improvements to the intersection as well as regrading the intersection to allow for the gate doors to swing unobstructed.

ALTERNATIVE SUMMARY

- FEMA Fundable: No
- Approximate Construction Cost: $800,000 to $ 1,700,000

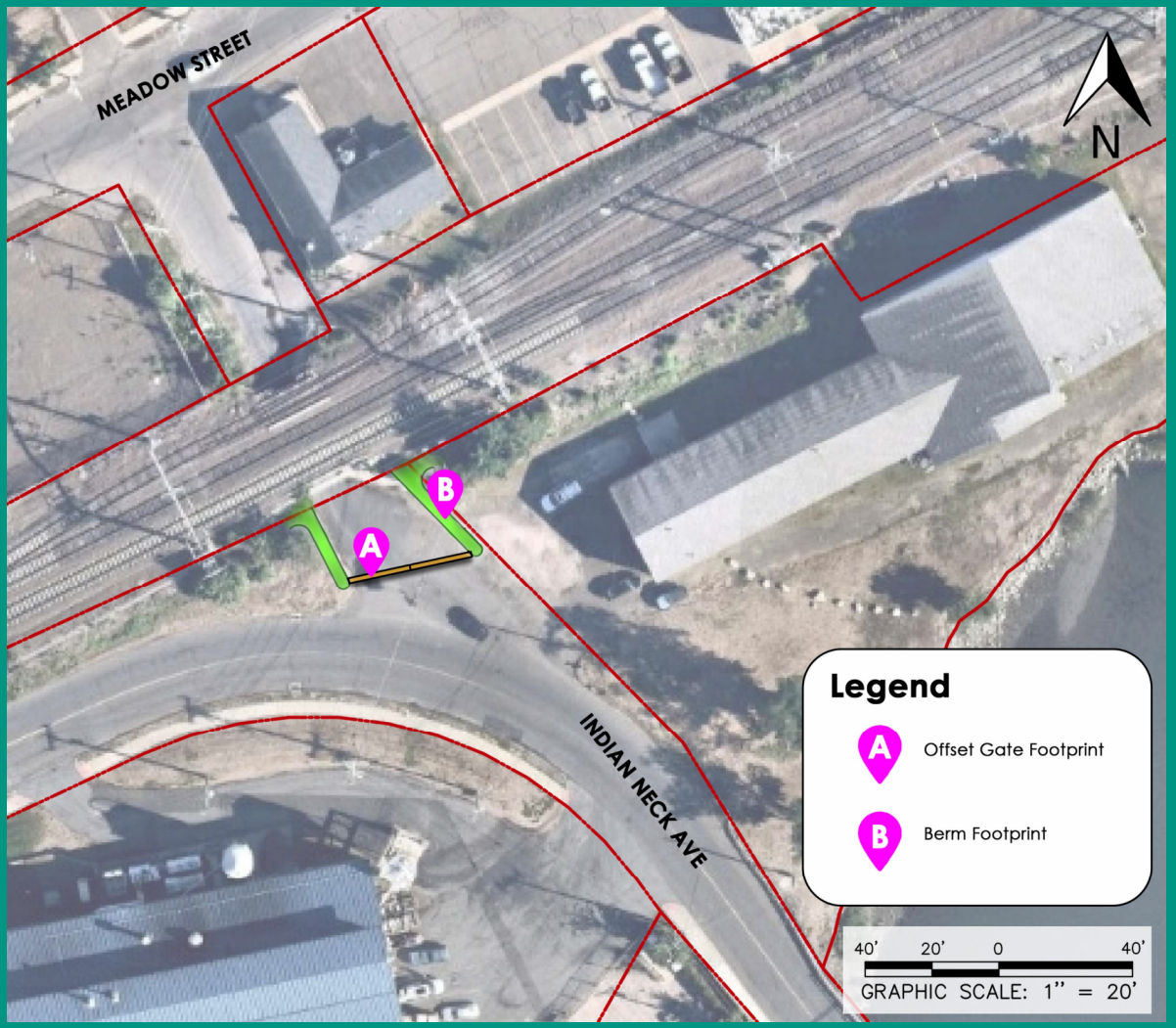

FIGURE 9: GATE-ONLY LAYOUT

ALTERNATIVE 3: CLOSE THE CATTLE CROSSING

The Cattle Crossing would be closed with earthen, structural fill and the slopes vegetated to match the existing embankment, as depicted in Figure 10. Traffic crossing under the railroad would be permanently rerouted to the Maple Street overpass. Cars routinely use the Cattle Crossing, and it is an important part of the Town's bike path network, there are considerable impacts of this Alternative to the community.

Closing access to the Cattle Crossing was previously proposed as an Alternative during public outreach in 2016. At that time, it was reported that the public was generally against this Alternative. However, during recent public engagement events in 2023, some members of the public inquired about this as an option, even though this Alternative was not presented.

Filling in the Cattle Crossing involves filling over the existing stormwater and sewer utilities that currently span underneath the Cattle Crossing, shown in Figure 2. This may cause maintenance costs of the utilities to increase. The costs listed below do not include utility coordination.

This Alternative would not remove the upland structures from the regulated 100-year Floodplain.

ALTERNATIVE SUMMARY

- FEMA Fundable: No
- Approximate Construction Cost: $300,000 to $600,000

FIGURE 10: CLOSING THE CATTLE CROSSING

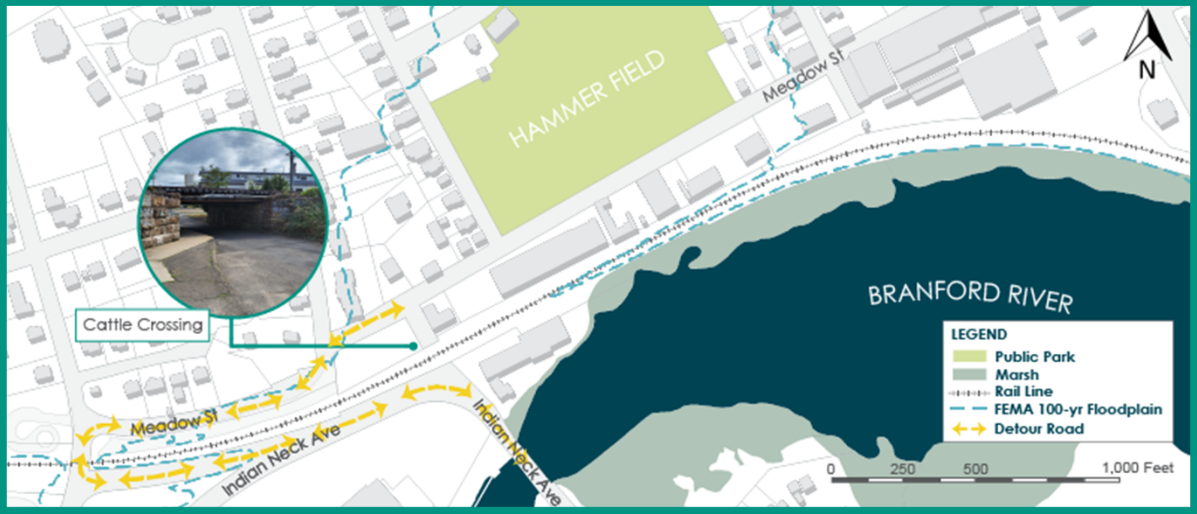

FIGURE 11: DETOUR ROUTE IF CATTLE CROSSING WAS CLOSED

ALTERNATIVE 4: DO NOTHING (MAINTAIN EXISTING CONDITIONS)

Alternative 4 is the "do nothing" option, where no mitigation actions are installed, and the Cattle Crossing remains as is. Although this option has no initial cost, the repetitive cost of flood damages to the Meadow Street neighborhood (i.e., the cost of inaction) should be considered. Flood modeling of the Branford River, completed by CIRCA, which accounts for 20 inches of sea level rise due to climate change, demonstrates that the risk of flooding will increase as climate change continues. By 2050, the flood extent generated by a 10-year storm event will impact as many neighborhood structures as the current 100-year storm event.

ALTERNATIVE SUMMARY

- FEMA Fundable: Not Applicable
- Approximate Initial Construction Cost: $0
- Approx. Damages: $30 million (Projected over a 50 year period. See Benefit-cost Analysis section for details.)

FIGURE 12: FLOODING DURING RECENT STORM EVENT (PHOTOS TAKEN BY CIRCA STAFF, DECEMBER 2022)

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ALTERNATIVES COMPARISON AND SUMMARY

OPTIONS	CONSTRUCTION COST RANGES (-30% to +50%) (based on 2023 dollars)	ADVANTAGES	DISADVANTAGES
Flood Gate With Floodwall	$4,900,000 to $10,300,000	• Eligible for FEMA funding. • Eligible for FEMA Letter of Map Revision (LOMR) that could remove upland structures from regulated floodplain.	• Requires Amtrak coordination. • Most expensive project to implement even with grant funding that would require a 25% match. • Major visual impact to neighborhood. • Requires installation on private property and in Amtrak right-of-way. Wall will need to be adequately set back from building at 46 Indian Neck Avenue which would require building the wall on the ROW slope. • Requires human operation to be deployed.
Flood Gate-Only	$800,000 to $1,700,000	• Relatively low cost (~$1 million). • Option to retrofit with floodwall later.	• Requires Amtrak coordination. • Likely not eligible for FEMA funding. • Requires human operation to be deployed. • Would not allow for upland structures to be removed from regulated floodplain.
Closing The Cattle Crossing	$300,000 to $600,000	• No human operation required.	• Requires Amtrak coordination. • Will complicate access to utilities. (Cost does not account for utility relocation, if necessary.) • Would not allow for upland structures to be removed from regulated floodplain. • Likely not eligible for FEMA funding. • Traffic would be redirected to Maple Street.
Do Nothing	Construction Cost: $0	• No construction cost.	• High annualized cost of damages from flooding (houses, small businesses, roads, etc.). • Due to anticipated impacts of climate change, flooding risk will worsen over time.

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BENEFIT-COST ANALYSIS

A Benefit Cost Analysis (BCA) is a project evaluation tool developed by FEMA to compare the benefits and costs of any project intended to reduce the future risk or associated hazards of flooding. A BCA was only completed for Alternative 1 because it is the only alternative eligible for FEMA funding. The BCA assumes both the flood gate and floodwall are constructed.

A BCA yields a Benefit Cost Ratio (BCR). A BCR is the dollar amount of benefits divided by the dollar amount of costs. For a project to be considered cost effective, and therefore eligible to receive FEMA funding, the BCR must be greater or equal to 1.0. The BCR achieved for Alternative 1 was 4.09.

The BCA documented in this report is calculated based on a conceptual approach to flood mitigation. Although further flood modeling and concept development is necessary to finalize the BCA, the preliminary analysis demonstrates that the anticipated flood protection benefits are sufficient to justify the planning-level costs.

The FEMA BCA Calculator Toolkit (Version 6.0) was used to determine the project costs for this project. The toolkit accounts for project costs based on three categories: Initial Project Costs, Annual Maintenance, and Design Life.

$$\frac{Benefits}{Costs} = BCR$$

$$BCR = 4.09 \; for \; Alternative \; 1$$

PROJECT COSTS	PROJECT SPECIFIC VALUE	DEFINITION	DESCRIPTION
INITIAL PROJECT COSTS	$7,000,000	• The cost to build the project.	• Material costs (manually-operated flood gate, floodwall (assumed sheet pile), stone armor, etc.) • Construction costs (installing the flood gate, driving the sheet pile, etc.) • General construction costs (engineering, legal, administrative costs, etc.)
ANNUAL MAINTENANCE	$20,000	• The cost to maintain the project.	• Mowing around the floodwall. • Graffiti removal. • Maintaining erosion control stone armor. • Standard flood gate maintenance services.
DESIGN LIFE	50 YEARS	• How long the project is designed to be effective for.	• The BCA calculator uses the Annual Maintenance cost and the Design Life to determine how much the project will cost over the design life of the project in addition to the Initial Project Cost.

Select	Project Title	County, State	Benefits (B)	Costs (C)	BCR (B/C)
☑	Brandford Gate	New Haven, CT	$ 29,773,229	$ 7,276,015	4.09
TOTAL (SELECTED)			$ 29,773,229	$ 7,276,015	4.09
TOTAL			$ 29,773,229	$ 7,276,015	4.09

FIGURE 13: SCREENSHOT FROM BCA CALCULATOR

PROJECT BENEFITS: PROTECTED BUILDINGS

The flood protection benefits for this project's BCA are based on the still water elevation (SWEL) of current flooding, as modeled by CIRCA, for the 10-year, 50-year, and 100-year coastal storm events. The after mitigation SWEL was input to the calculator as the ground surface elevation at each property as no flooding is anticipated after the Alternative is constructed.

There are 21 buildings (6 non-residential, 15 residential) that will be protected by this project, as highlighted in Figure 14. The BCA accounts for property damage by comparing the depth of flooding to the lowest floor elevation of the buildings impacted by floodwater. The cost calculation parameters, accounted for in the BCA, include the building size, use category, standard occupancy and first finished floor area.

Although 21 properties were evaluated and will be protected against flooding, only the five properties that provided the highest cost benefits were included in the BCR calculation. Data for these buildings was input into the BCA calculator from publicly available records. The Community House and sewer pump station were not included in the BCA because they are already equipped with flood mitigation measures.

The properties accounted for in the BCR include the four commercial properties along Meadow Street and one residential property. The cost benefit of protecting these five properties provides a BCR of 4.09, well above the 1.0 threshold. The total benefits total $29,773,229 and costs total $7,276,015.

FIGURE 14: STRUCTURES POTENTIALLY PROTECTED FROM THE PRESENT DAY 100-YEAR STORM FLOODWATERS WITH THE CONSTRUCTION OF A FLOODWALL AND FLOOD GATE

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BARRIERS TO IMPLEMENTATION

The following section provides an evaluation of the three primary barriers to implementing the three proposed flood control alternatives.

Potential barriers to implementation were identified through collaboration with the following stakeholders:

Town of Branford (Engineering Department)

Amtrak (Department of Third-Party Development)

Connecticut Department of Energy & Environmental Projection (DEEP)

Feedback received from residents at two Public Engagement Workshops

The primary barriers to implementation that are evaluated in this report include:

Project Funding

Coordination with Property Owners (Including coordination with both Amtrak and private property owners)

Public Opinion & Political Will

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BARRIERS TO IMPLEMENTATION – FUNDING

The most significant barrier to implementation is funding. This project will require between $600,000 and $10.3 million, depending on the alternative selected by the Town. In 2019, the Town allocated a $1 million surplus from its general fund to seed a new Coastal Resiliency Reserve Fund. Money from the Coastal Resiliency Reserve Fund is available for allocation to this project and could be used as match for a state or federal grant. There are several state and federal funding options available to the Town based on the alternative chosen. This report focuses on those offered by FEMA and CTDEEP as they could fund projects that rely on structural controls (i.e., a floodwall or gate). The funding options for each alternative are summarized in the following table.

Alterative 1. Flood Gate with Floodwall

Due to the large implementation cost, the Flood Gate with Floodwall Alternative is unlikely to be fully funded with state or local funds. **However, this Alternative is the only alternative eligible for federal funding through FEMA.**

While a FEMA grant could substantially reduce project costs for a floodwall, the Town would still need to provide a 25% match for the grant. For a $7,000,000 floodwall project, that would require a $1,750,000 match provided by a non-federal source which would typically be funded by a municipality but state funding would also qualify. **This match would still be more expensive than funding 100% of the Flood Gate-Only Alternative.**

Coordination with FEMA is not a critical barrier to implementing a floodwall or flood gate; however, should the Town wish to provide additional benefits to the neighborhood by revising the designated 1% AEP food zone, through a Letter of Map Revision (LOMR) to remove the area behind the floodwall from the floodplain map, or receive FEMA funding. The Floodwall and Flood Gate must be designed to meet FEMA design standards.

Alternative 2. Flood Gate-Only

Municipal or State-funding is likely the best option for this Alternative due to the project's scale and direct local impact. The CTDEEP Climate Resilience Fund is currently the best state funding option for the Town. This funding source has two tracks. Track 1 is typically allocated for Project Planning which has already been completed for this project. Track 2 funding is for Project Development which includes engineering design, studies and analysis, and is the best option for funding the next phase of this Alternative. This grant currently does not apply to implementation (i.e., construction). Construction would have to be funded by the Town based on today's funding programs.

The CTDEEP Climate Resilience Fund requires that 40% of its resources be directed where vulnerable populations reside as defined in CGS Sec. 16-243y, This would not make the Town ineligible for the grant; however, it would make the funding more competitive.

This Alternative would not be eligible for FEMA funding due to the railroad embankment not being part of a certified FEMA approved flood control system. It is unlikely that Amtrak would allow the embankment to be certified as part of a FEMA approved flood control system because of the increased maintenance burden of a levee.

Alterative 3. Fill in the Cattle Crossing

In terms of funding, this Alternative is similar to the Flood Gate-Only Alternative. The CTDEEP Climate Resilience Fund Track 2 would be an appropriate funding option. This Alternative would not be eligible for FEMA funding because the railroad embankment still would not be part of a certified FEMA approved flood control system.

However, due to the relatively low construction cost of this Alternative, the Town's Coastal Resiliency Reserve Fund has the potential to cover the costs of this Alternative pending no unforeseen major costs associated with addressing the existing utilities. That run through the cattle crossing.

RESILIENT BRANFORD

BARRIERS TO IMPLEMENTATION – FUNDING

FUNDING PROGRAM	GENERAL INFORMATION	ALTERATIVE 1. FLOOD GATE WITH FLOODWALL	ALTERATIVE 2. FLOOD GATE-ONLY	ALTERNATIVE 3. CLOSE THE CATTLE CROSSING
FEMA BRIC	• Annual grant program, typically opens in September. • $2.133 billion available for projects in 2022, will fund projects up to $50 million in size. • Projects will require 25% non-federal match. • Competitive nation-wide grant program. • Requires Benefit Cost Ratio (BCR) to be greater or equal than 1.0. • Improvements must comply with FEMA standards. Only the Flood Gate with Floodwall Alternative would be eligible.	✓		
FEMA HAZARD MITIGATION GRANT PROGRAM	• Grant rounds are funded with a presidential major disaster declaration • $3.46 Billion funded with Covid Disaster. • Projects will require 25% non-federal match. • Competitive nation-wide grant program. • BCR must be greater or equal than 1.0. • Improvements must comply with FEMA standards. Only the Flood Gate with Floodwall Alternative would be eligible.	✓		
CTDEEP CLIMATE RESILIENCE FUND	• 2022 was first year of grant program which funded two tracks of projects. Tier 1 – Project Planning: Concept design, alternatives analysis, cost-benefit analysis, alternatives cost estimates, etc. (Tasks under this tier have already been completed in the current phase of this project). Tier 2 – Project Development: Engineering design, studies, and analysis, construction documents preparation, construction bid support, permitting, construction costs • **Program currently does not fund construction. Can only be used to advance design and permitting.** • Awarded $8.8 million in projects from the first grant round. • Minimum of 40% funding directed where vulnerable populations reside which will make securing this funding more competitive for Branford to secure.	✓	✓	✓

BARRIERS TO IMPLEMENTATION – COORDINATION WITH PROPERTY OWNERS

Each of the alternatives will require some work within the Amtrak right-of-way. Each of the three alternatives were submitted to Amtrak as part of their Form, Fit and Function Review. Amtrak has provided comments and indicated that filling in the cattle crossing is their preferred alternative, there were no barriers identified at this time that would prevent any of the alternatives being approved. Each of the alternatives will have to demonstrate adequate clearance to overhead wires and catenary structures, or grounded. A copy of their review comments is attached.

Future Amtrak Review and Approvals

All three alternatives will require Amtrak review and approval. For both design and construction phases, Amtrak will require an agreement and compensation to participate in the project. During the design phase, Amtrak will review engineering at 30, 60, 90, and 100% complete and issue a *Letter of No Exception* at the completion of their review as a sign-off of their approval of the design. Reviews at each stage take a minimum of 30 working days to complete.

Alterative 1. Flood Gate with Floodwall

This alternative will require the most coordination with property owners as its footprint extends along the length of the Amtrak ROW. Amtrak's Form, Fit and Function Review did not identify any critical barriers that would prevent implementation of this alternative. However, given the scale of work that this alternative proposes within the Amtrak ROW, this alternative has the greatest potential to impact Amtrak infrastructure.

This project will also include work within the privately-owned property at 46 Indian Neck Road where the wall would be located between the Amtrak line and an existing building. The wall would need to be set back from the existing building in order to allow for construction and maintenance. This alternative would require that the Town secures an easement on this private property which could be a barrier-to-implementation.

Alternative 2. Flood Gate-Only

This Alternative requires less Amtrak coordination compared to Alternative 1 given the reduced scale of work in the ROW but will still require Amtrak design and construction agreements. This alternative does include construction of berms on the Amtrak ROW.

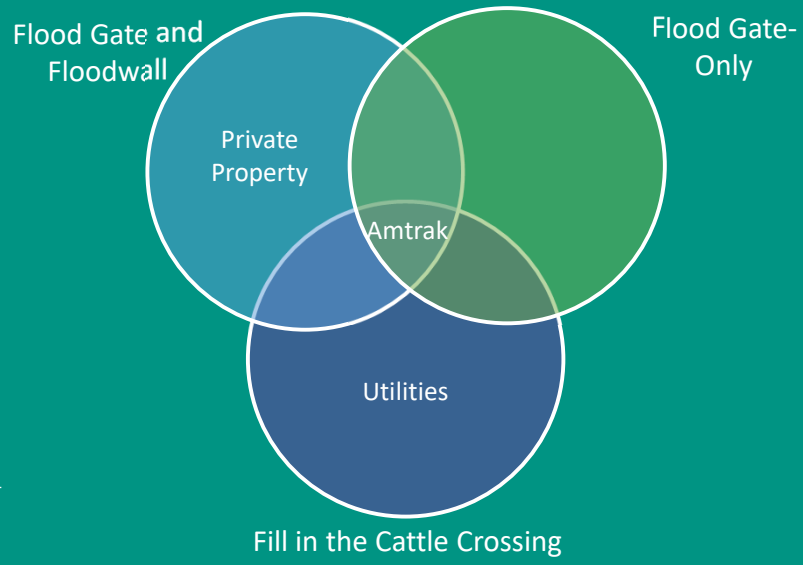
Amtrak's Form, Fit & Function review comments did not state any critical barriers to implementation for this Alternative.

While no work is proposed on the property of 46 Indian Neck Avenue, the property owner should be directly engaged during the design phase to determine the best location of the flood gate that would not impact their existing use of the property.

Alterative 3. Fill in the Cattle Crossing

This Alternative would require access to the Amtrak right-of-way and therefore still require Amtrak design and construction agreements, However, this was Amtrak's preferred alternative as it had the least above ground improvements that could be a conflict and could eliminate an existing bridge crossing.

This alternative would result in burying the existing sewer utilities into the embankment which could complicate future maintenance of the sewers. Further coordination will be required to develop a plan to allow future access of the sewer. That could be accomplished by sleeving the sewer under the embankment,.



OVERVIEW OF COORDINATION REQUIRED FOR EACH ALTERNATIVE

BARRIERS TO IMPLEMENTATION – PUBLIC OPINION & POLITICAL WILL

Collaboration with the Town of Branford, to engage the public, Town staff and political leaders, was an important part of this project and should continue though permitting and final design.

This project included two public engagement events. The first was an in-person public meeting at the Community House (March 1, 2023) where the flood modeling results and alternatives were presented and the public provided feedback and asked questions. The second was at a Jazz on the Green event on June 29, 2023 where a booth was set up to reach out to people that would not normally attend a formal public meeting. During that event, people could approach the project boards to provide their feedback. Fuss & O'Neill staff also walked through the crowd to pass out project flyers and directly engage people before the concert started.

During both of these events, people were largely supportive of the need to do something to reduce flooding risk at the Meadow Street project area. In general, people preferred the Flood Gate-Only alternative as it would be the most cost effective and could substantially reduce flood risk. A summary of the results of these meetings is provided on the following table and as Attachment C to this report.

The Town Engineering Department was engaged during several meetings and a site visit during this project in order to leverage their knowledge of the Town's infrastructure as well as help to define an alternative that best meets the Town's needs. This included a final workshop with the Engineering Department and the First Selectman on April 25, 2023 where the preferred alternative was selected based on the engineering analysis and public input to that date.

Future phases of this project will require continued engagement of the public, political leadership and Town staff in order to create the buy-in that this project will require to secure funding as well as Town staff commitment to operate this recommended alternative. Future design phases should include an appropriate amount of public and was brought up for discussion by a member of the public.

The following table summarizes the feedback that was received throughout the course of this project.

FIGURE 15: PHOTO FROM THE MARCH 1, 2023 PUBLIC MEETING AT THE COMMUNITY HOUSE

FIGURE 16: PHOTO FROM THE JUNE 29, 2023 PUBLIC ENGAGEMENT MEETING AT THE BRANFORD JAZZ ON THE GREEN

BARRIERS TO IMPLEMENTATION – PUBLIC OPINION & POLITICAL WILL

STAKEHOLDER	DATE	FEEDBACK
PUBLIC ENGAGEMENT: THE COMMUNITY HOUSE	March 1, 2023	• The cost of each Alternative was a major point of discussion. Due to the discussion of the cost, Closing the Cattle Crossing emerged as an option that should be addressed in the feasibility analysis • Some did not consider the aesthetics of the Flood Gate and Floodwall Alternative an issue due to the current view being an overgrown Amtrak embankment. • Several ideas on ways to make the floodwall more aesthetically pleasing and community based, like a mural or incorporating vertical plantings, were discussed. • Participants generally preferred the flood gate without the floodwall due to its cost-effectiveness and limited visual impact.
VIRTUAL MEETING WITH ENGINEERING DEPARTMENT & FIRST SELECTMAN	April 25, 2023	• The criteria matrix and weightings were reviewed with the Town staff which confirmed that the Flood Gate-Only alternative best fits the Town's criteria. • The Flood Gate-Only Alternative was selected as the preferred alternative as it best fits the Town's criteria, is the most cost-effective and still allows a sheet pile wall to be added to the gate at a later time.
PUBLIC ENGAGEMENT: JAZZ ON THE GREEN	June 29, 2023	• The majority of participants requested the Cattle Crossing remain open. Several concerns were raised about the impacts that rerouting traffic could have on the neighborhood. • Many supported the Flood Gate-Only Alternative and were amenable to installing a floodwall at a later time. • Overall, feedback was positive for the Flood Gate-Only Alterative.

RECOMMENDED PLAN – FLOOD GATE-ONLY ALTERNATIVE

This table compares all four alternatives based on criteria the Town identified as important. The criteria are weighted on a scale of 1 to 3 based on the importance of the criteria to the Town with 1 being the least important and 3 the most important. Each criteria was comparatively rated for each alternative with 3 being a "positive" rating and 1 being a "negative" rating. The alternative with the highest overall score is the preferred alternative for the Town. **Based on the criteria rating, it was determined that Alternative 2: Flood Gate-Only best fit the Town's criteria and was selected for future phases.**

WEIGHTED COMPARATIVE ANALYSIS MATRIX

ALTERNATIVE	MATRIX CRITERIA					OVERALL SCORE[7]
	Capital Cost[1]	Impact to Amtrak/Private Property[2]	Access Impacts[3]	Effective Flood Control[4]	Implementation Time Frame[5]	
Criteria Weighting[6]	3	1	2	3	2	
1. Flood Gate with Floodwall	2	1	3	3	1	**2.2**
2. Flood Gate-Only	3	2	3	2	2	**2.5**
3. Closing the Cattle Crossing	3	2	1	2	2	**2.1**
4. Do Nothing	1	3	3	1	3	**1.9**

Notes:

1. Based on long term cost effectiveness (benefits of the project divided by the cost of the project).
2. Amount of coordination with stakeholders required to build the project (i.e., Amtrak, utilities, private property owners, etc.). Including procuring easements for operation and maintenance.
3. Access impacts include car and pedestrian travel access through the Cattle Crossing as well as access to existing utilities (i.e., sewer and drainage).
4. Confidence that mitigation action will act as designed. For example, it is unknown how well the Amtrak embankment will continue to act as a flood control measure. The Amtrak embankment could fail under certain storm conditions. This criteria also considers the ability to apply for a FEMA LOMR.
5. How quickly project will be constructed.
6. Each of the matrix criteria are weighted based on their priority to the Town of Branford and feedback from project stakeholders.

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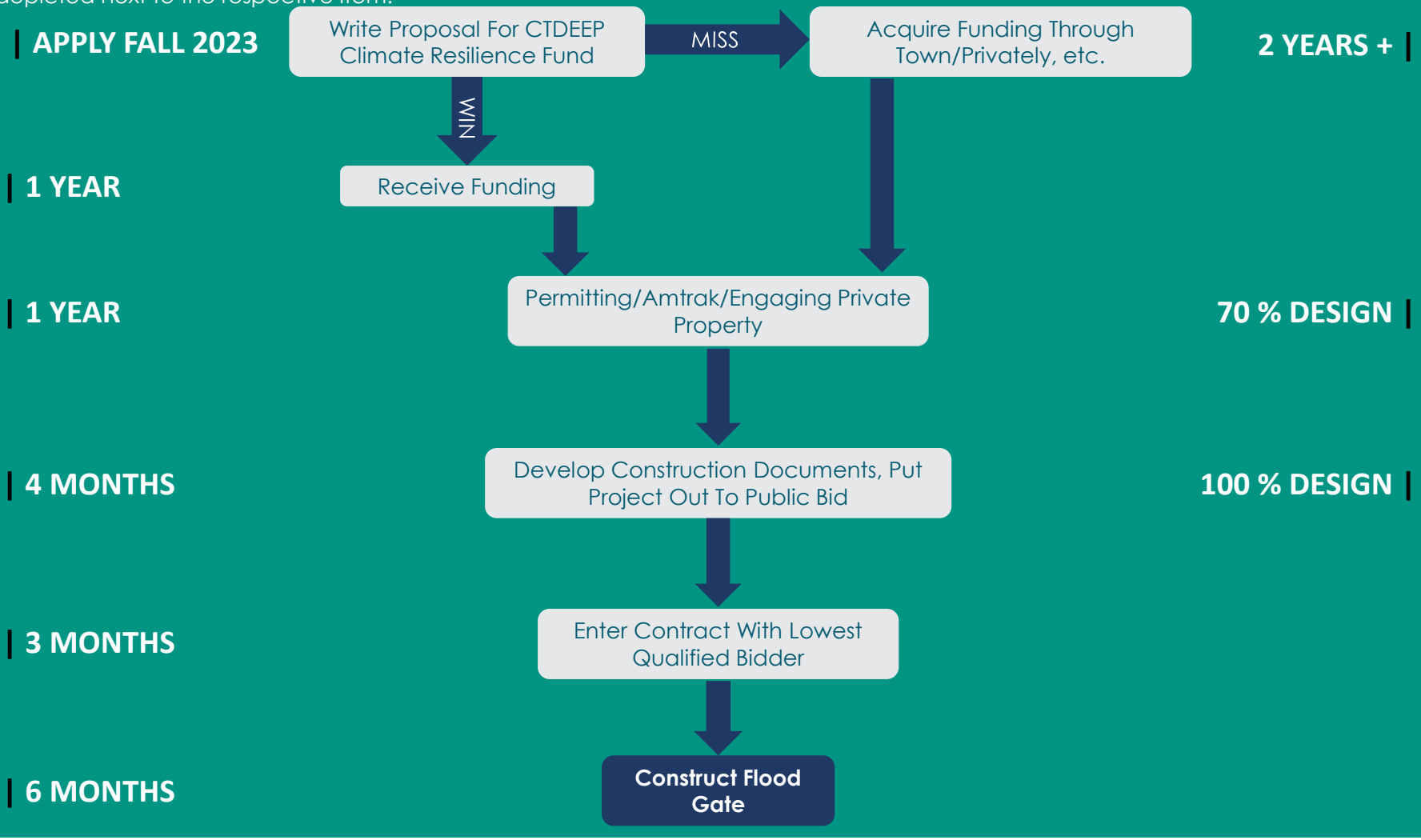
NEXT STEPS – ALTERNATIVE 2: FLOOD GATE-ONLY

This flow chart is an example of proposed next steps for implementation of the preferred Alternative 2: Flood Gate-Only. The time frame for each segment is depicted next to the respective item.



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ATTACHMENT A

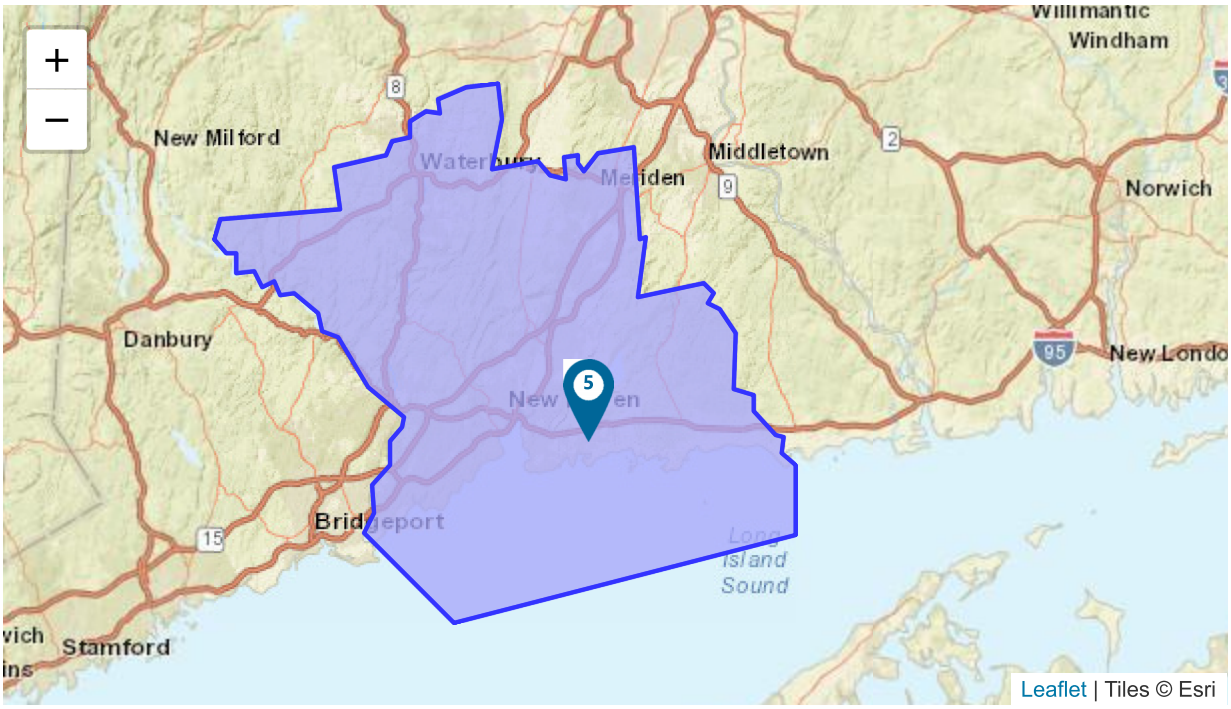
BENEFIT-COST ANALYSIS (BCA) DOCUMENTATION

Benefit-Cost Calculator

V.6.0 (Build 20230324.2039 | Release Notes)

Benefit-Cost Analysis

Project Name: Brandford Gate



				Using 7% Discount Rate			Using 3% Discount Rate (For FY22 BRIC and FMA only)		
Map Marker ▲	Mitigation Title	Property Type	Hazard	Benefits (B)	Costs (C)	BCR (B/C)	Benefits (B)	Costs (C)	BCR (B/C)
1	Other @ 95 Meadow St, Branford, Connecticut, 06405		Coastal A Flood	$ 775,382	$ 7,276,015	0.11	$ 1,445,602	$ 7,514,595	0.19
2	Other @ 143 Meadow St, Branford, Connecticut, 06405		Coastal A Flood	$ 8,509,978	$ 0	0.00	$ 15,865,788	$ 0	0.00
3	Other @ 149 Meadow St, Branford, Connecticut, 06405		Coastal A Flood	$ 2,729,860	$ 0	0.00	$ 5,089,481	$ 0	0.00
4	Other @ 4 Hopson Ave, Branford, Connecticut, 06405		Coastal A Flood	$ 2,293,485	$ 0	0.00	$ 4,275,915	$ 0	0.00
5	Other @ 111 Meadow St, Branford, Connecticut, 06405		Coastal A Flood	$ 15,464,524	$ 0	0.00	$ 28,831,670	$ 0	0.00
TOTAL (SELECTED)				**$ 29,773,229**	**$ 7,276,015**	**4.09**	**$ 55,508,456**	**$ 7,514,595**	**7.39**
TOTAL				**$ 29,773,229**	**$ 7,276,015**	**4.09**	**$ 55,508,456**	**$ 7,514,595**	**7.39**

Property Configuration

Property Title:	Other @ 95 Meadow St, Branford, Connecticut, 06405
Property Location:	06405, New Haven, Connecticut
Property Coordinates:	41.275723004376374, -72.81304898337137
Hazard Type:	Coastal A Flood
Mitigation Action Type:	Other
Property Type:	Non-Residential Building
Analysis Method Type:	Modeled Damages

Cost Estimation

Other @ 95 Meadow St, Branford, Connecticut, 06405

Project Useful Life (years):	50
Project Cost:	$7,000,000
Number of Maintenance Years:	50 Use Default:Yes
Annual Maintenance Cost:	$20,000

Comments

-

Project Useful Life:

Based on the FEMA Reference Guide for a flood wall. The floodwall was assumed to be a steel sheetpile wall with riprap for cost purposes.

-

Mitigation Project Cost:

This project entails a flood wall with a flood gate. The top of the flood wall would be elevation 13 (the FEMA BFE + 1 foot). The flood wall would tie into the Elevation 13 on both sides provide protection to all the structures behind the floodwall. This cost is the entire construction costs of the flood gate and flood wall. The total project cost was included in the first property only. An outline of the flood wall can be seen in the figure named "Flood Wall Plan".

-

Annual Maintenance Cost:

This includes maintenance of the floodwall such as mowing, graffiti removal, riprap replacement etc. The total annual maintenance cost was included in the first property only.

Hazard Probabilities Parameters - Flood
Other @ 95 Meadow St, Branford, Connecticut, 06405

Lowest Floor Elevation of the Property (ft):	7.6
Ground Surface Elevation (ft):	4.6
Base Flood Elevation (ft):	12
Additional Projected Sea Level Rise above BFE (ft):	0
Use Default Recurrence Intervals:	Use Default:Yes

Comments

-

Lowest Floor Elevation:
The lowest floor elevation was estimated using LiDAR and google earth street view. A screenshot of the LiDAR and the google earth street view can be seen in the pdf named "First Floor Elevations".

-

Ground Surface Elevation:
The ground surface elevation was estimated using LiDAR. This can be seen in the pdf named "First Floor Elevations".

-

Base Flood Elevation:
The base flood elevation was determined through the FEMA FIRM map which can be seen in the pdf labeled "FEMA FIRM Map".

Stillwater Elevation
Other @ 95 Meadow St, Branford, Connecticut, 06405

BEFORE MITIGATION

Recurrence Interval (years)	Stillwater Elevation (ft)
10	6.66
50	7.45
100	7.95
500	8.78

AFTER MITIGATION

Recurrence Interval (years)	Stillwater Elevation (ft)
10	4.6
50	4.6
100	4.6
500	4.6

Building Information
Other @ 95 Meadow St, Branford, Connecticut, 06405

Building is elevated on an open foundation:	**No**
Obstruction below the lowest horizontal structural member:	**No**
Non-Residential Occupancy Type:	COM1: Commercial - Retail Trade
Building is outside hundred-year flood area:	No
Building Type:	Non-Fast Food
Building Is Engineered:	**No**
NFIP:	**No**

Comments

-

Elevated Foundation:

This was determined from google street view. See the file named "First Floor Elevations".

-

Structure Type:

This is a sit-down restaurant named the Eel Pot.

Standard Benefits - Building
Other @ 95 Meadow St, Branford, Connecticut, 06405

Depth Damage Curve:	Non-Fast Food (Default) Use Default:Yes
Building Size (sq.ft):	2,568
Building Replacement Value ($/sq.ft):	$100 Use Default:Yes
Demolition Threshold (%):	50.00% Use Default:Yes
Expected Annual Losses due to Building Damages before Mitigation:	$36,897
Expected Annual Losses due to Building Damages after Mitigation:	$0
Expected Annual Benefits - Building:	$36,897

Comments

-

Damage Curve:

This is a sit-down restaurant named the Eel Pot.

-

First Floor Area:

This value was taken via the property card. See the folder labeled "Property Cards".

-

Building Size:

This value was taken via the property card. See the folder labeled "Property Cards".

Depth Damage Curve - Building

Other @ 95 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION				AFTER MITIGATION			
Flood Depth (ft)	Percent (%)	Damage Value ($)	NFIP ($)	ICC Fees ($)	Percent (%)	Damage Value ($)	NFIP ($)	ICC Fees ($)
-2	0.3	720	0	0	0.3	720	0	0
-1	0.3	720	0	0	0.3	720	0	0
0	1.9	4,560	0	0	1.9	4,560	0	0
1	19.4	46,560	0	0	19.4	46,560	0	0
2	32.4	77,760	0	0	32.4	77,760	0	0
3	41	98,400	0	0	41	98,400	0	0
4	49.6	119,040	0	0	49.6	119,040	0	0
5	56.3	240,000	0	0	56.3	240,000	0	0
6	63.9	240,000	0	0	63.9	240,000	0	0
7	67.2	240,000	0	0	67.2	240,000	0	0
8	71.3	240,000	0	0	71.3	240,000	0	0
9	72.7	240,000	0	0	72.7	240,000	0	0
10	73.5	240,000	0	0	73.5	240,000	0	0
11	73.5	240,000	0	0	73.5	240,000	0	0
12	73.5	240,000	0	0	73.5	240,000	0	0
13	73.5	240,000	0	0	73.5	240,000	0	0
14	73.5	240,000	0	0	73.5	240,000	0	0
15	73.5	240,000	0	0	73.5	240,000	0	0
16	73.5	240,000	0	0	73.5	240,000	0	0

Standard Benefits - Contents

Other @ 95 Meadow St, Branford, Connecticut, 06405

Contents Value in Dollars:	$0 Use Default:Yes
Expected Annual Losses due to Content Damages before Mitigation:	$11,757
Expected Annual Losses due to Content Damages after Mitigation:	$0
Expected Annual Benefits - Content:	$11,757

Depth Damage Curve - Contents

Other @ 95 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Percent (%)	Damage Value ($)	Percent (%)	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	28	17,472	28	17,472
2	49	30,576	49	30,576
3	57	35,568	57	35,568
4	72	44,928	72	44,928
5	80	49,920	80	49,920
6	85	53,040	85	53,040
7	93	58,032	93	58,032
8	93	58,032	93	58,032
9	94	58,656	94	58,656
10	94	58,656	94	58,656
11	94	58,656	94	58,656
12	94	58,656	94	58,656
13	94	58,656	94	58,656
14	94	58,656	94	58,656
15	94	58,656	94	58,656
16	94	58,656	94	58,656

Standard Benefits - Displacement

Other @ 95 Meadow St, Branford, Connecticut, 06405

Monthly Displacement Cost ($/sq.ft/month):	1.16 Use Default:Yes
One-Time Displacement Cost ($/sq.ft):	1.09 Use Default:Yes
Expected Annual Losses due to Displacement Damages before mitigation:	$7,530
Expected Annual Losses due to Displacement Damages after Mitigation:	$0
Expected Annual Losses - Displacement:	$7,530

Depth Damage Curve - Displacement

Other @ 95 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Days	Damage Value ($)	Days	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	45	6,977.92	45	6,977.92
2	90	13,955.84	90	13,955.84
3	135	20,933.77	135	20,933.77
4	180	36,725.91	180	36,725.91
5	225	45,907.39	225	45,907.39
6	270	55,088.87	270	55,088.87
7	315	64,270.35	315	64,270.35
8	360	91,080.27	360	91,080.27
9	405	102,465.31	405	102,465.31
10	450	113,850.34	450	113,850.34
11	450	113,850.34	450	113,850.34
12	450	44,071.10	450	44,071.10
13	450	44,071.10	450	44,071.10
14	450	44,071.10	450	44,071.10
15	450	44,071.10	450	44,071.10
16	450	44,071.10	450	44,071.10

Standard Benefits - Loss of Function/Loss of Income

Other @ 95 Meadow St, Branford, Connecticut, 06405

Annual Operating Budget:	$0
Loss of Function/Loss of Income Per Day:	$0
Expected Annual Losses due to Loss of Function/Loss of Income before mitigation:	$0
Expected Annual Losses due to Loss of Function/Loss of Income after mitigation:	$0
Expected Annual Benefits - Expected Annual Benefits - Loss of Function/Loss of Income:	$0

Depth Damage Curve - Loss of Function/Loss of Income

Other @ 95 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Days	Damage Value ($)	Days	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	45	0	45	0
2	90	0	90	0
3	135	0	135	0
4	180	0	180	0
5	225	0	225	0
6	270	0	270	0
7	315	0	315	0
8	360	0	360	0
9	405	0	405	0
10	450	0	450	0
11	450	0	450	0
12	450	0	450	0
13	450	0	450	0
14	450	0	450	0
15	450	0	450	0
16	450	0	450	0

Standard Benefits - Volunteer Costs

Other @ 95 Meadow St, Branford, Connecticut, 06405

Number of Volunteers (volunteers/event):	0
Number of Days of Lodging:	0
Expected Annual Volunteer Benefits:	$0

Standard Benefits - Ecosystem Services

Other @ 95 Meadow St, Branford, Connecticut, 06405

Total Project Area (acres):	0
Percentage of Urban Green Open Space:	0.00%
Percentage of Rural Green Open Space:	0.00%
Percentage of Riparian:	0.00%
Percentage of Coastal Wetlands:	0.00%
Percentage of Inland Wetlands:	0.00%
Percentage of Forests:	0.00%
Percentage of Coral Reefs:	0.00%
Percentage of Shellfish Reefs:	0.00%
Percentage of Beaches and Dunes:	0.00%
Expected Annual Ecosystem Services Benefits:	$0

Benefits-Costs Summary

Other @ 95 Meadow St, Branford, Connecticut, 06405

Total Standard Mitigation Benefits:	$775,382
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$775,382
Total Mitigation Project Cost:	$7,138,007
Benefit Cost Ratio - Standard:	0.11
Benefit Cost Ratio - Standard + Social:	0.11

Property Configuration

Property Title:	Other @ 143 Meadow St, Branford, Connecticut, 06405
Property Location:	06405, New Haven, Connecticut
Property Coordinates:	41.27609915601677, -72.81230584700191
Hazard Type:	Coastal A Flood
Mitigation Action Type:	Other
Property Type:	Non-Residential Building
Analysis Method Type:	Modeled Damages

Cost Estimation

Other @ 143 Meadow St, Branford, Connecticut, 06405

Project Useful Life (years):	50
Project Cost:	$0
Number of Maintenance Years:	50 Use Default:Yes
Annual Maintenance Cost:	$0

Comments

-

:

Based on the FEMA Reference Guide for a flood wall. The floodwall was assumed to be a steel sheetpile wall with riprap for cost purposes.

-

:

This project entails a flood wall with a flood gate. The top of the flood wall would be elevation 13 (the FEMA BFE + 1 foot). The flood wall would tie into the Elevation 13 on both sides provide protection to all the structures behind the floodwall. This cost is the entire construction costs of the flood gate and flood wall. The total project cost was included in the first property only, this is why this value is zero. An outline of the flood wall can be seen in the figure named "Flood Wall Plan".

-

Annual Maintenance Cost:

This includes maintenance of the floodwall such as mowing, graffiti removal, riprap replacement etc. The total annual maintenance cost was included in the first property only, this is why this value is zero.

Hazard Probabilities Parameters - Flood

Other @ 143 Meadow St, Branford, Connecticut, 06405

Lowest Floor Elevation of the Property (ft):	4
Ground Surface Elevation (ft):	4
Base Flood Elevation (ft):	12
Additional Projected Sea Level Rise above BFE (ft):	0
Use Default Recurrence Intervals:	Use Default:Yes

Comments

- :

The lowest floor elevation was estimated using LiDAR and google earth street view. A screenshot of the LiDAR and the google earth street view can be seen in the pdf named "First Floor Elevations".

- :

The ground surface elevation was estimated using LiDAR. This can be seen in the pdf named "First Floor Elevations".

- :

The base flood elevation was determined through the FEMA FIRM map which can be seen in the pdf labeled "FEMA FIRM Map".

Stillwater Elevation

Other @ 143 Meadow St, Branford, Connecticut, 06405

BEFORE MITIGATION

Recurrence Interval (years)	Stillwater Elevation (ft)
10	6.66
50	7.45
100	7.95
500	8.78

AFTER MITIGATION

Recurrence Interval (years)	Stillwater Elevation (ft)
10	4
50	4
100	4
500	4

Building Information

Other @ 143 Meadow St, Branford, Connecticut, 06405

Building is elevated on an open foundation:	**No**
Obstruction below the lowest horizontal structural member:	**No**
Non-Residential Occupancy Type:	COM4: Commercial - Professional/Technical/Business Services
Building is outside hundred-year flood area:	No
Building Type:	Warehouse-Non-Refrig
Building Is Engineered:	**No**
NFIP:	**No**

Comments

- :

This was determined from google street view. See the file named "First Floor Elevations".

- :

This is a turf/landscaping company.

Standard Benefits - Building

Other @ 143 Meadow St, Branford, Connecticut, 06405

Depth Damage Curve:	Warehouse, Non-Refrig (Default) Use Default:Yes
Building Size (sq.ft):	9,008
Building Replacement Value ($/sq.ft):	$100 Use Default:Yes
Demolition Threshold (%):	50.00% Use Default:Yes
Expected Annual Losses due to Building Damages before Mitigation:	$296,710
Expected Annual Losses due to Building Damages after Mitigation:	$0
Expected Annual Benefits - Building:	$296,710

Comments

-

:

This is a turf/landscaping company.

-

:

This value was taken via the property card. See the folder labeled "Property Cards".

-

Building Size:

This value was taken via the property card. See the folder labeled "Property Cards".

Depth Damage Curve - Building

Other @ 143 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION				AFTER MITIGATION			
Flood Depth (ft)	Percent (%)	Damage Value ($)	NFIP ($)	ICC Fees ($)	Percent (%)	Damage Value ($)	NFIP ($)	ICC Fees ($)
-2	0.5	3,744	0	0	0.5	3,744	0	0
-1	0.5	3,744	0	0	0.5	3,744	0	0
0	1.1	8,236.80	0	0	1.1	8,236.80	0	0
1	11.8	88,358.40	0	0	11.8	88,358.40	0	0
2	19.9	149,011.19	0	0	19.9	149,011.19	0	0
3	25.4	190,195.19	0	0	25.4	190,195.19	0	0
4	31.4	235,123.19	0	0	31.4	235,123.19	0	0
5	34.2	256,089.60	0	0	34.2	256,089.60	0	0
6	39	292,032	0	0	39	292,032	0	0
7	41.8	312,998.39	0	0	41.8	312,998.39	0	0
8	45.7	342,201.60	0	0	45.7	342,201.60	0	0
9	50.4	748,800	0	0	50.4	748,800	0	0
10	51.7	748,800	0	0	51.7	748,800	0	0
11	51.7	748,800	0	0	51.7	748,800	0	0
12	51.7	748,800	0	0	51.7	748,800	0	0
13	51.7	748,800	0	0	51.7	748,800	0	0
14	51.7	748,800	0	0	51.7	748,800	0	0
15	51.7	748,800	0	0	51.7	748,800	0	0
16	51.7	748,800	0	0	51.7	748,800	0	0

Standard Benefits - Contents

Other @ 143 Meadow St, Branford, Connecticut, 06405

Contents Value in Dollars:	$0 Use Default:Yes
Expected Annual Losses due to Content Damages before Mitigation:	$190,149
Expected Annual Losses due to Content Damages after Mitigation:	$0
Expected Annual Benefits - Content:	$190,149

Depth Damage Curve - Contents

Other @ 143 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Percent (%)	Damage Value ($)	Percent (%)	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	21	73,906.56	21	73,906.56
2	34	119,658.24	34	119,658.24
3	47	165,409.92	47	165,409.92
4	57	200,603.52	57	200,603.52
5	66	232,277.76	66	232,277.76
6	74	260,432.64	74	260,432.64
7	81	285,068.16	81	285,068.16
8	88	309,703.68	88	309,703.68
9	92	323,781.12	92	323,781.12
10	94	330,819.84	94	330,819.84
11	94	330,819.84	94	330,819.84
12	94	330,819.84	94	330,819.84
13	94	330,819.84	94	330,819.84
14	94	330,819.84	94	330,819.84
15	94	330,819.84	94	330,819.84
16	94	330,819.84	94	330,819.84

Standard Benefits - Displacement

Other @ 143 Meadow St, Branford, Connecticut, 06405

Monthly Displacement Cost ($/sq.ft/month):	1.36 Use Default:Yes
One-Time Displacement Cost ($/sq.ft):	0.95 Use Default:Yes
Expected Annual Losses due to Displacement Damages before mitigation:	$129,773
Expected Annual Losses due to Displacement Damages after Mitigation:	$0
Expected Annual Losses - Displacement:	$129,773

Depth Damage Curve - Displacement

Other @ 143 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Days	Damage Value ($)	Days	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	45	24,166.11	45	24,166.11
2	90	48,332.23	90	48,332.23
3	135	72,498.35	135	72,498.35
4	180	126,872.12	180	126,872.12
5	225	158,590.15	225	158,590.15
6	270	190,308.19	270	190,308.19
7	315	222,026.22	315	222,026.22
8	360	302,076.49	360	302,076.49
9	405	339,836.05	405	339,836.05
10	450	377,595.61	450	377,595.61
11	450	377,595.61	450	377,595.61
12	450	181,245.89	450	181,245.89
13	450	181,245.89	450	181,245.89
14	450	181,245.89	450	181,245.89
15	450	181,245.89	450	181,245.89
16	450	181,245.89	450	181,245.89

Standard Benefits - Loss of Function/Loss of Income

Other @ 143 Meadow St, Branford, Connecticut, 06405

Annual Operating Budget:	$0
Loss of Function/Loss of Income Per Day:	$0
Expected Annual Losses due to Loss of Function/Loss of Income before mitigation:	$0
Expected Annual Losses due to Loss of Function/Loss of Income after mitigation:	$0
Expected Annual Benefits - Expected Annual Benefits - Loss of Function/Loss of Income:	$0

Depth Damage Curve - Loss of Function/Loss of Income

Other @ 143 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Days	Damage Value ($)	Days	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	45	0	45	0
2	90	0	90	0
3	135	0	135	0
4	180	0	180	0
5	225	0	225	0
6	270	0	270	0
7	315	0	315	0
8	360	0	360	0
9	405	0	405	0
10	450	0	450	0
11	450	0	450	0
12	450	0	450	0
13	450	0	450	0
14	450	0	450	0
15	450	0	450	0
16	450	0	450	0

Standard Benefits - Volunteer Costs

Other @ 143 Meadow St, Branford, Connecticut, 06405

Number of Volunteers (volunteers/event):	0
Number of Days of Lodging:	0
Expected Annual Volunteer Benefits:	$0

Standard Benefits - Ecosystem Services

Other @ 143 Meadow St, Branford, Connecticut, 06405

Total Project Area (acres):	0
Percentage of Urban Green Open Space:	0.00%
Percentage of Rural Green Open Space:	0.00%
Percentage of Riparian:	0.00%
Percentage of Coastal Wetlands:	0.00%
Percentage of Inland Wetlands:	0.00%
Percentage of Forests:	0.00%
Percentage of Coral Reefs:	0.00%
Percentage of Shellfish Reefs:	0.00%
Percentage of Beaches and Dunes:	0.00%
Expected Annual Ecosystem Services Benefits:	$0

Benefits-Costs Summary

Other @ 143 Meadow St, Branford, Connecticut, 06405

Total Standard Mitigation Benefits:	$8,509,978
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$8,509,978
Total Mitigation Project Cost:	$0
Benefit Cost Ratio - Standard:	0
Benefit Cost Ratio - Standard + Social:	0

Property Configuration

Property Title:	Other @ 149 Meadow St, Branford, Connecticut, 06405
Property Location:	06405, New Haven, Connecticut
Property Coordinates:	41.276580012066546, -72.81102701686837
Hazard Type:	Coastal A Flood
Mitigation Action Type:	Other
Property Type:	Non-Residential Building
Analysis Method Type:	Modeled Damages

Cost Estimation
Other @ 149 Meadow St, Branford, Connecticut, 06405

Project Useful Life (years):	50
Project Cost:	$0
Number of Maintenance Years:	50 Use Default:Yes
Annual Maintenance Cost:	$0

Comments

-

:

Based on the FEMA Reference Guide for a flood wall. The floodwall was assumed to be a steel sheetpile wall with riprap for cost purposes.

-

:

This project entails a flood wall with a flood gate. The top of the flood wall would be elevation 13 (the FEMA BFE + 1 foot). The flood wall would tie into the Elevation 13 on both sides provide protection to all the structures behind the floodwall. This cost is the entire construction costs of the flood gate and flood wall. The total project cost was included in the first property only, this is why this value is zero. An outline of the flood wall can be seen in the figure named "Flood Wall Plan".

-

Annual Maintenance Cost:

This includes maintenance of the floodwall such as mowing, graffiti removal, riprap replacement etc. The total annual maintenance cost was included in the first property only, this is why this value is zero.

Hazard Probabilities Parameters - Flood

Other @ 149 Meadow St, Branford, Connecticut, 06405

Lowest Floor Elevation of the Property (ft):	6
Ground Surface Elevation (ft):	6
Base Flood Elevation (ft):	12
Additional Projected Sea Level Rise above BFE (ft):	0
Use Default Recurrence Intervals:	Use Default:Yes

Comments

- :

The lowest floor elevation was estimated using LiDAR and google earth street view. A screenshot of the LiDAR and the google earth street view can be seen in the pdf named "First Floor Elevations".

- :

The ground surface elevation was estimated using LiDAR. This can be seen in the pdf named "First Floor Elevations".

- :

The base flood elevation was determined through the FEMA FIRM map which can be seen in the pdf labeled "FEMA FIRM Map".

Stillwater Elevation

Other @ 149 Meadow St, Branford, Connecticut, 06405

BEFORE MITIGATION

Recurrence Interval (years)	Stillwater Elevation (ft)
10	6.66
50	7.45
100	7.95
500	8.78

AFTER MITIGATION

Recurrence Interval (years)	Stillwater Elevation (ft)
10	6
50	6
100	6
500	6

Building Information

Other @ 149 Meadow St, Branford, Connecticut, 06405

Building is elevated on an open foundation:	**No**
Obstruction below the lowest horizontal structural member:	**No**
Non-Residential Occupancy Type:	COM4: Commercial - Professional/Technical/Business Services
Building is outside hundred-year flood area:	No
Building Type:	Warehouse-Non-Refrig
Building Is Engineered:	**No**
NFIP:	**No**

Comments

- :

This was determined from google street view. See the file named "First Floor Elevations".

- :

This is a contracting company.

Standard Benefits - Building

Other @ 149 Meadow St, Branford, Connecticut, 06405

Depth Damage Curve:	Warehouse, Non-Refrig (Default) Use Default:Yes
Building Size (sq.ft):	6,161
Building Replacement Value ($/sq.ft):	$100 Use Default:Yes
Demolition Threshold (%):	50.00% Use Default:Yes
Expected Annual Losses due to Building Damages before Mitigation:	$121,220
Expected Annual Losses due to Building Damages after Mitigation:	$0
Expected Annual Benefits - Building:	$121,220

Comments

- :

This is a contracting company.

- :

This value was taken via the property card. See the folder labeled "Property Cards".

- :

This value was taken via the property card. See the folder labeled "Property Cards".

Depth Damage Curve - Building

Other @ 149 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION				AFTER MITIGATION			
Flood Depth (ft)	Percent (%)	Damage Value ($)	NFIP ($)	ICC Fees ($)	Percent (%)	Damage Value ($)	NFIP ($)	ICC Fees ($)
-2	0.5	2,440	0	0	0.5	2,440	0	0
-1	0.5	2,440	0	0	0.5	2,440	0	0
0	1.1	5,368	0	0	1.1	5,368	0	0
1	11.8	57,584	0	0	11.8	57,584	0	0
2	19.9	97,112	0	0	19.9	97,112	0	0
3	25.4	123,952	0	0	25.4	123,952	0	0
4	31.4	153,232	0	0	31.4	153,232	0	0
5	34.2	166,896	0	0	34.2	166,896	0	0
6	39	190,320	0	0	39	190,320	0	0
7	41.8	203,984	0	0	41.8	203,984	0	0
8	45.7	223,016	0	0	45.7	223,016	0	0
9	50.4	488,000	0	0	50.4	488,000	0	0
10	51.7	488,000	0	0	51.7	488,000	0	0
11	51.7	488,000	0	0	51.7	488,000	0	0
12	51.7	488,000	0	0	51.7	488,000	0	0
13	51.7	488,000	0	0	51.7	488,000	0	0
14	51.7	488,000	0	0	51.7	488,000	0	0
15	51.7	488,000	0	0	51.7	488,000	0	0
16	51.7	488,000	0	0	51.7	488,000	0	0

Standard Benefits - Contents

Other @ 149 Meadow St, Branford, Connecticut, 06405

Contents Value in Dollars:	$0 Use Default:Yes
Expected Annual Losses due to Content Damages before Mitigation:	$76,586
Expected Annual Losses due to Content Damages after Mitigation:	$0
Expected Annual Benefits - Content:	$76,586

Depth Damage Curve - Contents

Other @ 149 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Percent (%)	Damage Value ($)	Percent (%)	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	21	48,165.6	21	48,165.6
2	34	77,982.4	34	77,982.4
3	47	107,799.2	47	107,799.2
4	57	130,735.2	57	130,735.2
5	66	151,377.6	66	151,377.6
6	74	169,726.4	74	169,726.4
7	81	185,781.6	81	185,781.6
8	88	201,836.8	88	201,836.8
9	92	211,011.2	92	211,011.2
10	94	215,598.4	94	215,598.4
11	94	215,598.4	94	215,598.4
12	94	215,598.4	94	215,598.4
13	94	215,598.4	94	215,598.4
14	94	215,598.4	94	215,598.4
15	94	215,598.4	94	215,598.4
16	94	215,598.4	94	215,598.4

Standard Benefits - Displacement

Other @ 149 Meadow St, Branford, Connecticut, 06405

Monthly Displacement Cost ($/sq.ft/month):	0	Use Default: *No*
One-Time Displacement Cost ($/sq.ft):	0	Use Default: *No*
Expected Annual Losses due to Displacement Damages before mitigation:	$0	
Expected Annual Losses due to Displacement Damages after Mitigation:	$0	
Expected Annual Losses - Displacement:	$0	

Depth Damage Curve - Displacement

Other @ 149 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Days	Damage Value ($)	Days	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	45	0	45	0
2	90	0	90	0
3	135	0	135	0
4	180	0	180	0
5	225	0	225	0
6	270	0	270	0
7	315	0	315	0
8	360	0	360	0
9	405	0	405	0
10	450	0	450	0
11	450	0	450	0
12	450	0	450	0
13	450	0	450	0
14	450	0	450	0
15	450	0	450	0
16	450	0	450	0

Standard Benefits - Loss of Function/Loss of Income

Other @ 149 Meadow St, Branford, Connecticut, 06405

Annual Operating Budget:	$0
Loss of Function/Loss of Income Per Day:	$0
Expected Annual Losses due to Loss of Function/Loss of Income before mitigation:	$0
Expected Annual Losses due to Loss of Function/Loss of Income after mitigation:	$0
Expected Annual Benefits - Expected Annual Benefits - Loss of Function/Loss of Income:	$0

Depth Damage Curve - Loss of Function/Loss of Income

Other @ 149 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Days	Damage Value ($)	Days	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	45	0	45	0
2	90	0	90	0
3	135	0	135	0
4	180	0	180	0
5	225	0	225	0
6	270	0	270	0
7	315	0	315	0
8	360	0	360	0
9	405	0	405	0
10	450	0	450	0
11	450	0	450	0
12	450	0	450	0
13	450	0	450	0
14	450	0	450	0
15	450	0	450	0
16	450	0	450	0

Standard Benefits - Volunteer Costs

Other @ 149 Meadow St, Branford, Connecticut, 06405

Number of Volunteers (volunteers/event):	0
Number of Days of Lodging:	0
Expected Annual Volunteer Benefits:	$0

Standard Benefits - Ecosystem Services

Other @ 149 Meadow St, Branford, Connecticut, 06405

Total Project Area (acres):	0
Percentage of Urban Green Open Space:	0.00%
Percentage of Rural Green Open Space:	0.00%
Percentage of Riparian:	0.00%
Percentage of Coastal Wetlands:	0.00%
Percentage of Inland Wetlands:	0.00%
Percentage of Forests:	0.00%
Percentage of Coral Reefs:	0.00%
Percentage of Shellfish Reefs:	0.00%
Percentage of Beaches and Dunes:	0.00%
Expected Annual Ecosystem Services Benefits:	$0

Benefits-Costs Summary

Other @ 149 Meadow St, Branford, Connecticut, 06405

Total Standard Mitigation Benefits:	$2,729,860
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$2,729,860
Total Mitigation Project Cost:	$0
Benefit Cost Ratio - Standard:	0
Benefit Cost Ratio - Standard + Social:	0

Property Configuration

Property Title:	Other @ 4 Hopson Ave, Branford, Connecticut, 06405
Property Location:	06405, New Haven, Connecticut
Property Coordinates:	41.276228014042715, -72.81284798533322
Hazard Type:	Coastal A Flood
Mitigation Action Type:	Other
Property Type:	Residential Building
Analysis Method Type:	Modeled Damages

Cost Estimation

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

Project Useful Life (years):	50
Project Cost:	$0
Number of Maintenance Years:	50 Use Default:Yes
Annual Maintenance Cost:	$0

Comments

-

Project Useful Life:

Based on the FEMA Reference Guide for a flood wall. The floodwall was assumed to be a steel sheetpile wall with riprap for cost purposes.

-

:

This project entails a flood wall with a flood gate. The top of the flood wall would be elevation 13 (the FEMA BFE + 1 foot). The flood wall would tie into the Elevation 13 on both sides provide protection to all the structures behind the floodwall. This cost is the entire construction costs of the flood gate and flood wall. The total project cost was included in the first property only, this is why this value is zero. An outline of the flood wall can be seen in the figure named "Flood Wall Plan".

-

:

This includes maintenance of the floodwall such as mowing, graffiti removal, riprap replacement etc. The total annual maintenance cost was included in the first property only, this is why this value is zero.

Hazard Probabilities Parameters - Flood

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

Lowest Floor Elevation of the Property (ft):	5.35
Ground Surface Elevation (ft):	4.35
Base Flood Elevation (ft):	12
Additional Projected Sea Level Rise above BFE (ft):	0
Use Default Recurrence Intervals:	Use Default:Yes

Comments

- :

The lowest floor elevation was estimated using LiDAR and google earth street view. A screenshot of the LiDAR and the google earth street view can be seen in the pdf named "First Floor Elevations".

- :

The ground surface elevation was estimated using LiDAR. This can be seen in the pdf named "First Floor Elevations".

- :

The base flood elevation was determined through the FEMA FIRM map which can be seen in the pdf labeled "FEMA FIRM Map".

Stillwater Elevation

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

BEFORE MITIGATION

Recurrence Interval (years)	Stillwater Elevation (ft)
10	6.66
50	7.45
100	7.95
500	8.78

AFTER MITIGATION

Recurrence Interval (years)	Stillwater Elevation (ft)
10	4.35
50	4.35
100	4.35
500	4.35

Building Information

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

Building is elevated on an open foundation:	**No**
Obstruction below the lowest horizontal structural member:	**No**
Building Type:	One Story
Foundation Type:	Slab
Building Has Basement:	**No**
NFIP:	**No**

Comments

- :

This was determined from google street view. See the file named "First Floor Elevations".

- :

This was determined from the property card. See the folder labeled "Property Cards".

- :

This was determined from the property card. See the folder labeled "Property Cards".

Standard Benefits - Building

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

Depth Damage Curve:	Expert Panel - SLAB Use Default:Yes
Building Size (sq.ft):	1,008
Building Replacement Value ($/sq.ft):	$100 Use Default:Yes
Demolition Threshold (%):	50.00% Use Default:Yes
Expected Annual Losses due to Building Damages before Mitigation:	$114,310
Expected Annual Losses due to Building Damages after Mitigation:	$0
Expected Annual Benefits - Building:	$114,310

Comments

-

:

This was determined from the property card. See the folder labeled "Property Cards".

-

Building Size:

This value was taken via the property card. See the folder labeled "Property Cards".

Depth Damage Curve - Building

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

	BEFORE MITIGATION				AFTER MITIGATION			
Flood Depth (ft)	Percent (%)	Damage Value ($)	NFIP ($)	ICC Fees ($)	Percent (%)	Damage Value ($)	NFIP ($)	ICC Fees ($)
-2	0	0	0	0	0	0	0	0
-1	0	0	0	0	0	0	0	0
0	12	12,096	0	0	12	12,096	0	0
1	25	25,200	0	0	25	25,200	0	0
2	50	100,800	0	0	50	100,800	0	0
3	75	100,800	0	0	75	100,800	0	0
4	100	100,800	0	0	100	100,800	0	0
5	100	100,800	0	0	100	100,800	0	0
6	100	100,800	0	0	100	100,800	0	0
7	100	100,800	0	0	100	100,800	0	0
8	100	100,800	0	0	100	100,800	0	0
9	100	100,800	0	0	100	100,800	0	0
10	100	100,800	0	0	100	100,800	0	0
11	100	100,800	0	0	100	100,800	0	0
12	100	100,800	0	0	100	100,800	0	0
13	100	100,800	0	0	100	100,800	0	0
14	100	100,800	0	0	100	100,800	0	0
15	100	100,800	0	0	100	100,800	0	0
16	100	100,800	0	0	100	100,800	0	0

Standard Benefits - Contents

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

Contents Value in Dollars:	$0 Use Default:Yes
Utilities Elevated:	**No**
Expected Annual Losses due to Content Damages before Mitigation:	$51,876
Expected Annual Losses due to Content Damages after Mitigation:	$0
Expected Annual Benefits - Content:	$51,876

Depth Damage Curve - Contents

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Percent (%)	Damage Value ($)	Percent (%)	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	10	5,040	10	5,040
1	30	15,120	30	15,120
2	45	22,680	45	22,680
3	75	37,800	75	37,800
4	100	50,400	100	50,400
5	100	50,400	100	50,400
6	100	50,400	100	50,400
7	100	50,400	100	50,400
8	100	50,400	100	50,400
9	100	50,400	100	50,400
10	100	50,400	100	50,400
11	100	50,400	100	50,400
12	100	50,400	100	50,400
13	100	50,400	100	50,400
14	100	50,400	100	50,400
15	100	50,400	100	50,400
16	100	50,400	100	50,400

Standard Benefits - Displacement

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

Lodging Per Diem:	$114 Use Default:Yes
Meals Per Diem:	$69 Use Default:Yes
Population Affected:	0
Total Residential Displacement Cost:	$0
Expected Annual Losses due to Displacement Damages before mitigation:	$0
Expected Annual Losses due to Displacement Damages after Mitigation:	$0
Expected Annual Losses - Displacement:	$0

Depth Damage Curve - Displacement

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Days	Damage Value ($)	Days	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	120	0	120	0
2	360	0	360	0
3	540	0	540	0
4	720	0	720	0
5	720	0	720	0
6	720	0	720	0
7	720	0	720	0
8	720	0	720	0
9	720	0	720	0
10	720	0	720	0
11	720	0	720	0
12	720	0	720	0
13	720	0	720	0
14	720	0	720	0
15	720	0	720	0
16	720	0	720	0

Additional Benefits - Street Maintenance

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

Total Annual Street Maintenance Budget:	$0
Total Number of Street Miles Maintained:	0
Street Miles that will not require future maintenance:	0
Expected Annual Benefits - Street Maintenance:	$0

Standard Benefits - Volunteer Costs

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

Number of Volunteers (volunteers/event):	0
Number of Days of Lodging:	0
Expected Annual Volunteer Benefits:	$0

Standard Benefits - Ecosystem Services

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

Total Project Area (acres):	0
Percentage of Urban Green Open Space:	0.00%
Percentage of Rural Green Open Space:	0.00%
Percentage of Riparian:	0.00%
Percentage of Coastal Wetlands:	0.00%
Percentage of Inland Wetlands:	0.00%
Percentage of Forests:	0.00%
Percentage of Coral Reefs:	0.00%
Percentage of Shellfish Reefs:	0.00%
Percentage of Beaches and Dunes:	0.00%
Expected Annual Ecosystem Services Benefits:	$0

Additional Benefits - Social

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

Number of Workers:	0
Expected Annual Social Benefits:	$0

Benefits-Costs Summary

Other @ 4 Hopson Ave, Branford, Connecticut, 06405

Total Standard Mitigation Benefits:	$2,293,485
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$2,293,485
Total Mitigation Project Cost:	$0
Benefit Cost Ratio - Standard:	0
Benefit Cost Ratio - Standard + Social:	0

Property Configuration

Property Title:	Other @ 111 Meadow St, Branford, Connecticut, 06405
Property Location:	06405, New Haven, Connecticut
Property Coordinates:	41.27614000405936, -72.81202898957396
Hazard Type:	Coastal A Flood
Mitigation Action Type:	Other
Property Type:	Non-Residential Building
Analysis Method Type:	Modeled Damages

Cost Estimation

Other @ 111 Meadow St, Branford, Connecticut, 06405

Project Useful Life (years):	50
Project Cost:	$0
Number of Maintenance Years:	50 Use Default:Yes
Annual Maintenance Cost:	$0

Comments

- :

Based on the FEMA Reference Guide for a flood wall. The floodwall was assumed to be a steel sheetpile wall with riprap for cost purposes.

- :

This project entails a flood wall with a flood gate. The top of the flood wall would be elevation 13 (the FEMA BFE + 1 foot). The flood wall would tie into the Elevation 13 on both sides provide protection to all the structures behind the floodwall. This cost is the entire construction costs of the flood gate and flood wall. The total project cost was included in the first property only, this is why this value is zero. An outline of the flood wall can be seen in the figure named "Flood Wall Plan".

- :

This includes maintenance of the floodwall such as mowing, graffiti removal, riprap replacement etc. The total annual maintenance cost was included in the first property only, this is why this value is zero.

Hazard Probabilities Parameters - Flood

Other @ 111 Meadow St, Branford, Connecticut, 06405

Lowest Floor Elevation of the Property (ft):	4
Ground Surface Elevation (ft):	4
Base Flood Elevation (ft):	12
Additional Projected Sea Level Rise above BFE (ft):	0
Use Default Recurrence Intervals:	Use Default:Yes

Comments

- :

The lowest floor elevation was estimated using LiDAR and google earth street view. A screenshot of the LiDAR and the google earth street view can be seen in the pdf named "First Floor Elevations".

- :

The ground surface elevation was estimated using LiDAR. This can be seen in the pdf named "First Floor Elevations".

- :

The base flood elevation was determined through the FEMA FIRM map which can be seen in the pdf labeled "FEMA FIRM Map".

Stillwater Elevation

Other @ 111 Meadow St, Branford, Connecticut, 06405

BEFORE MITIGATION

Recurrence Interval (years)	Stillwater Elevation (ft)
10	6.66
50	7.45
100	7.95
500	8.78

AFTER MITIGATION

Recurrence Interval (years)	Stillwater Elevation (ft)
10	4
50	4
100	4
500	4

Building Information

Other @ 111 Meadow St, Branford, Connecticut, 06405

Building is elevated on an open foundation:	**No**
Obstruction below the lowest horizontal structural member:	**No**
Non-Residential Occupancy Type:	COM4: Commercial - Professional/Technical/Business Services
Building is outside hundred-year flood area:	No
Building Type:	Service Station
Building Is Engineered:	**No**
NFIP:	**No**

Comments

- :

This was determined from google street view. See the file named "First Floor Elevations".

- :

This is a car repair/service center.

Standard Benefits - Building

Other @ 111 Meadow St, Branford, Connecticut, 06405

Depth Damage Curve:	Service Station (Default) Use Default:Yes
Building Size (sq.ft):	11,765
Building Replacement Value ($/sq.ft):	$100 Use Default:Yes
Demolition Threshold (%):	50.00% Use Default:Yes
Expected Annual Losses due to Building Damages before Mitigation:	$445,422
Expected Annual Losses due to Building Damages after Mitigation:	$0
Expected Annual Benefits - Building:	$445,422

Comments

-

Damage Curve:

This is a car repair/service center.

-

First Floor Area:

This value was taken via the property card. See the folder labeled "Property Cards".

-

Building Size:

This value was taken via the property card. See the folder labeled "Property Cards".

Depth Damage Curve - Building

Other @ 111 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION				AFTER MITIGATION			
Flood Depth (ft)	Percent (%)	Damage Value ($)	NFIP ($)	ICC Fees ($)	Percent (%)	Damage Value ($)	NFIP ($)	ICC Fees ($)
-2	0.5	5,882.5	0	0	0.5	5,882.5	0	0
-1	0.5	5,882.5	0	0	0.5	5,882.5	0	0
0	1.2	14,118	0	0	1.2	14,118	0	0
1	11.1	130,591.5	0	0	11.1	130,591.5	0	0
2	18.1	212,946.50	0	0	18.1	212,946.50	0	0
3	23.5	276,477.5	0	0	23.5	276,477.5	0	0
4	29.5	347,067.5	0	0	29.5	347,067.5	0	0
5	31.9	375,303.5	0	0	31.9	375,303.5	0	0
6	36.8	432,951.99	0	0	36.8	432,951.99	0	0
7	40.9	481,188.5	0	0	40.9	481,188.5	0	0
8	45.1	530,601.5	0	0	45.1	530,601.5	0	0
9	48.3	568,249.5	0	0	48.3	568,249.5	0	0
10	49.7	584,720.5	0	0	49.7	584,720.5	0	0
11	49.7	584,720.5	0	0	49.7	584,720.5	0	0
12	49.7	584,720.5	0	0	49.7	584,720.5	0	0
13	49.7	584,720.5	0	0	49.7	584,720.5	0	0
14	49.7	584,720.5	0	0	49.7	584,720.5	0	0
15	49.7	584,720.5	0	0	49.7	584,720.5	0	0
16	49.7	584,720.5	0	0	49.7	584,720.5	0	0

Standard Benefits - Contents

Other @ 111 Meadow St, Branford, Connecticut, 06405

Contents Value in Dollars:	$0 Use Default:Yes
Expected Annual Losses due to Content Damages before Mitigation:	$505,644
Expected Annual Losses due to Content Damages after Mitigation:	$0
Expected Annual Benefits - Content:	$505,644

Depth Damage Curve - Contents

Other @ 111 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Percent (%)	Damage Value ($)	Percent (%)	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	16	156,239.2	16	156,239.2
2	29	283,183.55	29	283,183.55
3	41	400,362.95	41	400,362.95
4	58	566,367.1	58	566,367.1
5	63	615,191.85	63	615,191.85
6	71	693,311.45	71	693,311.45
7	79	771,431.05	79	771,431.05
8	84	820,255.8	84	820,255.8
9	87	849,550.65	87	849,550.65
10	87	849,550.65	87	849,550.65
11	87	849,550.65	87	849,550.65
12	87	849,550.65	87	849,550.65
13	87	849,550.65	87	849,550.65
14	87	849,550.65	87	849,550.65
15	87	849,550.65	87	849,550.65
16	87	849,550.65	87	849,550.65

Standard Benefits - Displacement

Other @ 111 Meadow St, Branford, Connecticut, 06405

Monthly Displacement Cost ($/sq.ft/month):	1.36 Use Default:Yes
One-Time Displacement Cost ($/sq.ft):	0.95 Use Default:Yes
Expected Annual Losses due to Displacement Damages before mitigation:	$169,491
Expected Annual Losses due to Displacement Damages after Mitigation:	$0
Expected Annual Losses - Displacement:	$169,491

Depth Damage Curve - Displacement

Other @ 111 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Days	Damage Value ($)	Days	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	45	31,562.43	45	31,562.43
2	90	63,124.86	90	63,124.86
3	135	94,687.29	135	94,687.29
4	180	165,702.77	180	165,702.77
5	225	207,128.46	225	207,128.46
6	270	248,554.15	270	248,554.15
7	315	289,979.85	315	289,979.85
8	360	394,530.41	360	394,530.41
9	405	443,846.71	405	443,846.71
10	450	493,163.01	450	493,163.01
11	450	493,163.01	450	493,163.01
12	450	236,718.24	450	236,718.24
13	450	236,718.24	450	236,718.24
14	450	236,718.24	450	236,718.24
15	450	236,718.24	450	236,718.24
16	450	236,718.24	450	236,718.24

Standard Benefits - Loss of Function/Loss of Income

Other @ 111 Meadow St, Branford, Connecticut, 06405

Annual Operating Budget:	$0
Loss of Function/Loss of Income Per Day:	$0
Expected Annual Losses due to Loss of Function/Loss of Income before mitigation:	$0
Expected Annual Losses due to Loss of Function/Loss of Income after mitigation:	$0
Expected Annual Benefits - Expected Annual Benefits - Loss of Function/Loss of Income:	$0

Depth Damage Curve - Loss of Function/Loss of Income

Other @ 111 Meadow St, Branford, Connecticut, 06405

	BEFORE MITIGATION		AFTER MITIGATION	
Flood Depth (ft)	Days	Damage Value ($)	Days	Damage Value ($)
-2	0	0	0	0
-1	0	0	0	0
0	0	0	0	0
1	45	0	45	0
2	90	0	90	0
3	135	0	135	0
4	180	0	180	0
5	225	0	225	0
6	270	0	270	0
7	315	0	315	0
8	360	0	360	0
9	405	0	405	0
10	450	0	450	0
11	450	0	450	0
12	450	0	450	0
13	450	0	450	0
14	450	0	450	0
15	450	0	450	0
16	450	0	450	0

Standard Benefits - Volunteer Costs

Other @ 111 Meadow St, Branford, Connecticut, 06405

Number of Volunteers (volunteers/event):	0
Number of Days of Lodging:	0
Expected Annual Volunteer Benefits:	$0

Standard Benefits - Ecosystem Services

Other @ 111 Meadow St, Branford, Connecticut, 06405

Total Project Area (acres):	0
Percentage of Urban Green Open Space:	0.00%
Percentage of Rural Green Open Space:	0.00%
Percentage of Riparian:	0.00%
Percentage of Coastal Wetlands:	0.00%
Percentage of Inland Wetlands:	0.00%
Percentage of Forests:	0.00%
Percentage of Coral Reefs:	0.00%
Percentage of Shellfish Reefs:	0.00%
Percentage of Beaches and Dunes:	0.00%
Expected Annual Ecosystem Services Benefits:	$0

Benefits-Costs Summary

Other @ 111 Meadow St, Branford, Connecticut, 06405

Total Standard Mitigation Benefits:	$15,464,524
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$15,464,524
Total Mitigation Project Cost:	$0
Benefit Cost Ratio - Standard:	0
Benefit Cost Ratio - Standard + Social:	0

RESILIENT
BRANFORD

ATTACHMENT B

AMTRAK FORM, FIT AND FUNCTION REVIEW COMMENTS

NATIONAL RAILROAD PASSENGER CORPORATION
Engineering Department, 30th Street Station, 4th Floor South Tower, Box 64
2955 Market Street, Philadelphia, PA 19104

July 26, 2023

Celicia Boyden, EIT, MS
Water Resources Engineer
Fuss & O'Neill, Inc.
317 Iron Horse Way Suite 204
Providence, RI 02908

Subject: Branford, CT, Indian Neck Road Amtrak AB Line MP 81.44, Amtrak Form, Fit, Function Review of the proposed Meadow Street Neighborhood Flood Mitigation Project

Dear Mr. Kuljis:

Attached are Amtrak's Design Review Comments regarding the subject white paper as provided in your email dated May 31, 2023. Please provide a revised PDF of the submittal and an itemized response that addresses our comments in the attached Amtrak Design Review Comments – Resolution Form.

If you have any questions concerning this matter, please contact Candace Hager, Third Party Development Lead at candace.cervino@amtrak.com.

Sincerely,

Candace Hager

on behalf of

Michael Kolonauski
Senior Manager Engineering Services

Attachments

Amtrak Design Review Comments - Resolution Form

Project Name	**Branford River Flood Mitigation**		**Date**
Location/Milepost:	**Indian Neck Rd MP 81.44**		
Deliverable Type/Name:	**LOT 1 - Preliminary Review**	**Submitted for Review by 3rd Party**	**6/14/23**
Submitted by:	**CDOT**	**Review Complete (Amtrak Response Date)**	**7/26/23**

ID	Section	Sheet No.	Comment Made by:	Amtrak Comments	3rd Party Response	Status?
1	Attachments	General	STR	From a structural standpoint Alternative 3 closing Cattle Pass would be a great way to eliminate a bridge structure and assoociated maintenance. As for wall tie in points more details are needed and utimately Structures will defer to the Track Group for their assessment of the Alternatives presented.		NEW
2	Attachments	General	TRK	System Track prefers Alternative 3, eliminating the underpass and installing a continuous embankment of structural fill.		NEW
3	Attachments	General	PLN	Closing the bridge or adding just a flood gate is preferred by Planning since it would have less impact on the RR than the floodwall if the railroad is adjusted in the future.		NEW
4	Attachments	General	CON	EP3014 and EP2031 track monitoring (depending on the alternative selected) should be incorporated into any future design plans. See attached.		NEW
5	Attachments	General	ET	Any proposed work within 25 feet of the centerline of track requires Amtrak RWP Protection. This will require onsite personnel.		NEW
6	Attachments	General	ET	Any work to be performed within 15 feet of the overhead wires must be done under the protection of an Amtrak Class "A" employee. This will require onsite personnel.		NEW
7	Attachments	Page 17-19, 21, 23	ET	What would the distance of the flood gates be for alternative 2 to the nearest catenary structure? Depending on the distance the gates would have to be bonded into the railroad grounding system.		NEW
8	Attachments	Page 18	ET	Be mindful of distance to OCS poles. OCS poles should not be disturbed and foundations must remain intact with no impact to structural integrity. If alternative 2 were to be chosen, all OCS structures but remain protected during construction. If there will be any impacts to OCS structures, a qualified ET consultant must be retained.		NEW
9	Attachments	Page 21	ET	While the flood wall that spans the length of Amtrak ROW would not directly impact ET, Amtrak's future ability to maintain asssets should be considered. Ample space should be maintained in order to potentially perform work in the area as well as the ability to efficiently move material into staging sites. This wall shown in alternative 2 may hinder that since it spans such an expansive length of the ROW and with the north end of the wall having a concrete cut off. Amtrak must have proper access to the ROW.		NEW
10	Attachments	Page 16	ET	Flood gate option 1 provides the least amount of ET impact given its clearances to structures and overhead wires. It also provides the best option for Amtrak to maintain assets and move material in and out of the ROW.		NEW
11	Attachments	General	ET	During the construction phases of the chosen alternative, if a crane lift is used, a separate lift plan will need to be included that shows clearances to any overhead wires.		NEW
12	Attachments	General	ET	Defer to track department about tie in locations. From an ET perspective, locations should avoid directly tying into locations where structures and foundations are located.		NEW
13	Attachments	General	ET	This location is situated within an Amtrak interlocking so underground cables may be present. A field survey/markout will need to be conducted to confirm no conflicts with the proposed wall/gate.		NEW
14	Attachments	General	ET	Question 3 references distance from Amtrak overhead wires. Please clarify what wires this distance is in relation to. Is this the catenary lines over the tracks, or the outermost feeder wire? The 25ft offset should be from the OCS pole line due to the presence of live switches and taps.		NEW
15	Attachments	General	ET	For design budgeting defer to Amtrak's 3rd party development group. For construction the town may need to budget for any required railroad protection costs.		NEW

Key to Comments:
PLN = Planning
ET = Electric Traction
CON = Construction
TRK = Track
STR = Structures

1. GENERAL

1.1. Introduction and Purpose

Track monitoring is a method of ensuring the integrity of track geometry during construction work that could affect track stability, called Roadbed Disturbing Work. This includes any earth disturbing construction activity either under the track (called underground crossing work) or within 50 feet of the centerline of the nearest track effecting the theoretical railroad embankment line as shown on Figure 1 (called parallel work).

Examples of the types of projects in which track monitoring is required:

- Underground pipe crossings by jacking or horizontal directional drilling.
- Local work, such as for foundation excavation or ground dewatering.
- Excavation that is parallel to the track, such as construction of ditch or utility trench.
- Pile driving adjacent to the track, such as construction of an access road.

The purpose of track monitoring is to record railroad track geometry data before, during, and after the completion of construction. The collected geometry data is compared to determine if the track has been adversely affected by construction. If the track has been adversely affected, the data can be used to alert Amtrak personnel to take appropriate action and reestablish pre-construction conditions.

1.2. Related Documents

Amtrak Structures EP 3005 – Pipleline Occupancy

Amtrak Structures EP 3005, Spec. 02082A - Additional Requirements for Horizontal Directional Drilling (HDD) / Directional Boring

Amtrak Track Department Frac-Out Contingency Plan (FCP) (included in Structures EP 3005, Spec. 02082A)

Amtrak Structures EP 3014, Spec. 02261 - Requirements for Temporary Sheeting and Shoring to Support Amtrak Tracks

Amtrak Land Surveying Standards and Procedures Manual, Version 2.0

1.3. Responsibilities

Contractor responsibilities:

- Using proven surveying methods and materials to establish Remote Monitoring Points (RMPs) for collection of track data.
- Gathering and recording track data before construction starts.

- Gather, recording, and report track geometry data at pre-determined time intervals during construction.
- Comparing pre-construction and during-construction data to determine if differential movement has occurred.
- Report track monitoring data and comparison to Amtrak Construction Project Manager, Assistant Division Engineer of Track, and System Track Contracting Office Technical Representative (COTR).
- Pay for any repairs required if track movement meets or exceeds 3/8-inch in any direction or creates conditions exceeding track geometry maintenance limits as defined in the MW1000 for the class of track concerned.

Amtrak responsibilities:

- Amtrak will identify and provide contact information for the following: System Track COTR for track monitoring, the Assistant Division Engineer of Track responsible for maintenance, and the Construction Project Manager.
- Prior to construction Amtrak will review/approve the submitted Track Monitoring Plan.
- Schedule Track Inspector to cover the anticipated duration of roadbed disturbing work.
- Monitor track movement and prescribe repairs, restrictions, or removal tracks from service to ensure the safety of train operations.

2. METHODS & MATERIALS

2.1. Surveying Requirements

Surveyor in charge of performing track monitoring must be, or be working under the direct supervision of, a professional land surveyor duly registered in the state. Contractor Surveyors must have working knowledge of Amtrak Survey Specification and have current Contractor Orientation Training credentials.

Datum and accuracy will be in accordance with Amtrak Land Surveying Standards and Procedures Manual, Version 2.0:

Datums – NAD 83 with appropriate UTM Zone - NAVD 88
All coordinates in US survey feet.
Horizontal and vertical accuracy 0.01-feet (1/8-inch) for all reports.

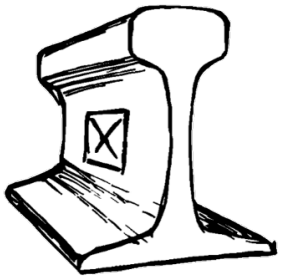
Control must be verified before and during construction with frequency sufficiency to ensure continued accuracy.

2.2. Equipment Requirements

Monitoring shall be performed by a total station instrument having a minimum angular accuracy of 1-second and an electronic distance measurement accuracy of 1.0mm + 2ppm.

Total station will locate Remote Monitoring Points (RMPs) located on the track to be monitored. Points should be either commercially available calibrated reflective targets or small prisms. All targets shall be mounted a uniform elevation below top of rail.

- Reflective targets shall be less than 3-inches square and affixed by adhesive to the web of the rail (as shown). Common types are shown in figure 1 but are not exclusive. Minimum angle of 30º from instrument to target face is allowed. Therefore, multiple target types may be used to aid in visibility from the instrument. During application the rail should be spot cleaned and dried to allow good adhesion.
- Small precise prisms shall remain at least 1-inch below the top of rail. They are typically on a bracket clamped to the base of the rail and must not interfere with track components.



3. MONITORING POINT LOCATIONS

3.1. General Instructions

Benchmarks to be occupied including foresights and back sights, shall be outside of the ZOI for the roadbed disturbing work.

RMPs will be installed as pairs, with one target on each rail of the track to be monitored. The pairs shall be set perpendicular to the direction of the rails to allow for measurement of cross-level.

Pairs of RMPs will be spaced along the rails at 15.5-foot intervals. In locations of special track work (i.e.- turnouts, crossings, and miter rails) the System Track COTR will determine an alternate arrangement.

3.2. Underground Crossing Work

This method for RMPs is applicable for underground work that enters Zone 3 shown on Figure 2 and/or crosses under the tracks.

Determine the Zone of Influence for the underground crossing work at the elevation of the bottom of railroad tie. Calculate by taking the diameter or width of the underground work, extending to the ground surface at the soil angle of repose. Soil angle of repose should be taken from soil borings performed at the crossing location that cover the depth from track level to the depth of underground work. If soil boring data is not available or does not satisfy the System Track COTR, use 20º as a conservative soil angle of repose. See Figure 2 for an example.

In each direction starting from the intersection of the centerlines of underground work and track, place RMPs every 15.5-feet until the monitoring point pairs are outside the Zone of Influence. Continue the RMPs for five pairs outside of the ZOI for a tie-in with undisturbed track. Refer to Figure 3 for an example.

3.3. Work Parallel to Track

This method for placing RMPs is applicable for underground work that enters either Zone 2 or Zone 3 from figure 2, that does not cross under the tracks.

Determine the Zone of Influence for the underground crossing work at the elevation of the bottom of railroad tie. Calculate by taking the lowest elevation limits of the underground work, extending to the ground surface at the soil angle of repose. Soil angle of repose should be taken from soil borings performed at the crossing location that cover the depth from track level to the depth of underground work. If soil boring data is not available or does not satisfy the System Track COTR, use 20º as a conservative soil angle of repose. See Figure 4 for an example.

Any place the ZOI intersects Zone 2 from Figure 1 requires monitoring for the track directly perpendicular to the intersection of ZOI and Zone 2. In each direction, place RMPs every 15.5-feet until the RMP pairs are outside the Zone of Influence. Continue the RMPs for five pairs outside of the ZOI for a tie-in with undisturbed track. See Figure 5 for an example.

4. PRECONSTRUCTION ACTIVITIES

4.1. Track Monitoring Plan Submittal

Track Monitoring Plan shall be submitted a minimum of 4-weeks prior to commencement of roadbed disturbing work. The System Track COTR will review and provide comments or approval. As a minimum, the package must include the following:

- Information on the registration and experience of the field surveyor in charge performing the track monitoring.
- Design specifications of the total station instrument to be used, including angular accuracy and distance measurement accuracy.
- Design specifications of the prisms or targets to be used. Include information on adhesives, if used.
- Plan views, cross sections, profile views, or diagrams showing the roadbed disturbing work and the relation to the Zones shown in Figure 1. Include soil boring logs and laboratory data related to the project site.
- Detailed plan showing control locations in relationship to the tracks, roadbed disturbing work, and zone of influence. Include details on methods and frequency of control verification.
- Detailed Track Monitoring Plan view showing the location of all RMP locations, control points to be occupied during monitoring, the ground disturbing work and the ZOI. Each RMP must be numbered, with the hundredth being the track number, even numbered points on right rail, odd numbered points on left rail in the direction of increasing milepost. See Figure 6 for an Example Track Monitoring Plan.

4.2. Contractor Safety Training

All contractors that work on Amtrak owned or leased property are required to complete Amtrak's Contractor Orientation Training available at: www.amtrakcontractor.com

Contractor identification badges must be worn / displayed on the outermost garment, above the waist, always while on Amtrak owned or leased property.

5. CONSTRUCTION

5.1. Track Inspector

Amtrak person having current qualifications in MW1000 and Physical Characteristics for the area work is being performed. Can inspect track and repair, restrict, or remove track form service if necessary.

Must be on-site when the leading end of work enters Zone 2 as shown on Figure 1 or as directed by the System Track COTR. Shall remain on-site until the completion of roadbed disturbing work, including reaming and pullback operations of horizontal directional drilling as defined by EP3005 Spec. 02082.

Will be provided at the sole cost of the project.

Will restrict or remove track form service if necessary, based on the MW1000 standards of track geometry for the class of track(s) involved. The Track Inspector has the authority to halt construction at any time should construction activities jeopardize the safe movement of trains over the work area.

5.2. Monitoring Procedures

Initial baseline reading of all monitoring points shall be recorded within ten (10) to five (5) days prior to construction. During the initial baseline readings, the offset from top of rail to the target shall be recorded for use in Track Monitoring Reports.

During construction, track monitoring shall start when the leading end of work enters Zone 2 as shown on Figure 2 or as directed by the System Track COTR. All RPMs shall be measured and recorded each time monitoring occurs.

Monitoring shall be performed at the beginning and end of every work shift, a minimum of twice daily (12-hour intervals). If track geometry meets or exceeds 0.03-feet (3/8-inch) of movement in any direction, monitoring must be performed every 4-hours until roadbed disturbing work is complete.

After roadbed disturbing work is complete, measurements will continue once a day until movement less than 0.01-feet (1/8-inch) has been observed for 5 consecutive days. Field conditions may warrant additional RMPs or extending the duration of post-construction monitoring as directed by the Track Inspector or System Track COTR.

5.3. Communication

Track Monitoring Report shall be produced immediately after each monitoring event. Measurements shown will be based on top-of-rail elevations based on the offset measured during initial setup. This will include total displacement of each RMP and cross level between RMP pairs.

Track Monitoring Reports must be signed and sealed by the surveyor in charge and cross-signed by the Track Inspector during work requiring their presence on-site. See Figure 6.7 for a sample Track Monitoring Report. The quickness of reporting track conditions is paramount to the safety of Amtrak operations.

An online sharing platform, such as Microsoft SharePoint Excel or Google Drive Sheets, must be set up and utilized by the contractor to immediately host the track monitoring data. A read-only link must be made available to the System Track COTR for distribution to Amtrak personnel as necessary. This real-time access will allow Amtrak's engineers to track movement and plan corrective action, if required.

5.4. Remediation Procedures for Track Movement

- As a reminder: any person MW1000 qualified can restrict or remove a track from service based on track geometry conditions. Any person can stop the work and trains should construction activities jeopardize the safe movement of trains over the work area.

All work on track surface and alignment will be performed solely by Amtrak forces.

If track is measured to have met or exceeds the track geometry maintenance limits as defined in the MW1000 for the class of track concerned or moves 0.03-feet (3/8-inch) displacement from baseline in any direction, then all work shall cease immediately. The following two items must be undertaken:

- The Track Inspector must immediately inspect the track geometry and take any corrective action that may be required per MW1000.

- The contractor must immediately and continuously attempt to notify the Amtrak Construction Project Manager, Assistant Division Engineer of Track, and System Track COTR of the deviations and confirm that corrective action is being taken on-site.

It is assumed that subsidence will continue, and corrective actions should be taken before track geometry exceeds the safety limits set forth in MW1000.

Any repairs made to correct track geometry beyond the threshold, will be made at the sole cost of the contractor.

5.5. Construction Re-Start

Work may not resume until the track inspector has inspected all tracks within the limits of disturbance and completed any appropriate action to repair, restrict, or remove the tracks from service. In addition, one of the following requirements must be met:

- If no further subsidence is expected, the Construction Manager must inspect the site and have taken corrective action to ensure continued construction actives will not cause further subsidence, to the satisfaction of the System Track COTR.

- If further subsidence is expected, the Construction Manager, Assistant Division Engineer, and System Track COTR should agree on how to best protect train operations. Any further actions required to ensure the safe passage of trains, such as increased frequency of track monitoring, shall be undertaken at the sole expense of the contractor.

6. FIGURES AND EXAMPLES

Figure 1, Zones of Influence under track (from Structures EP 3014)

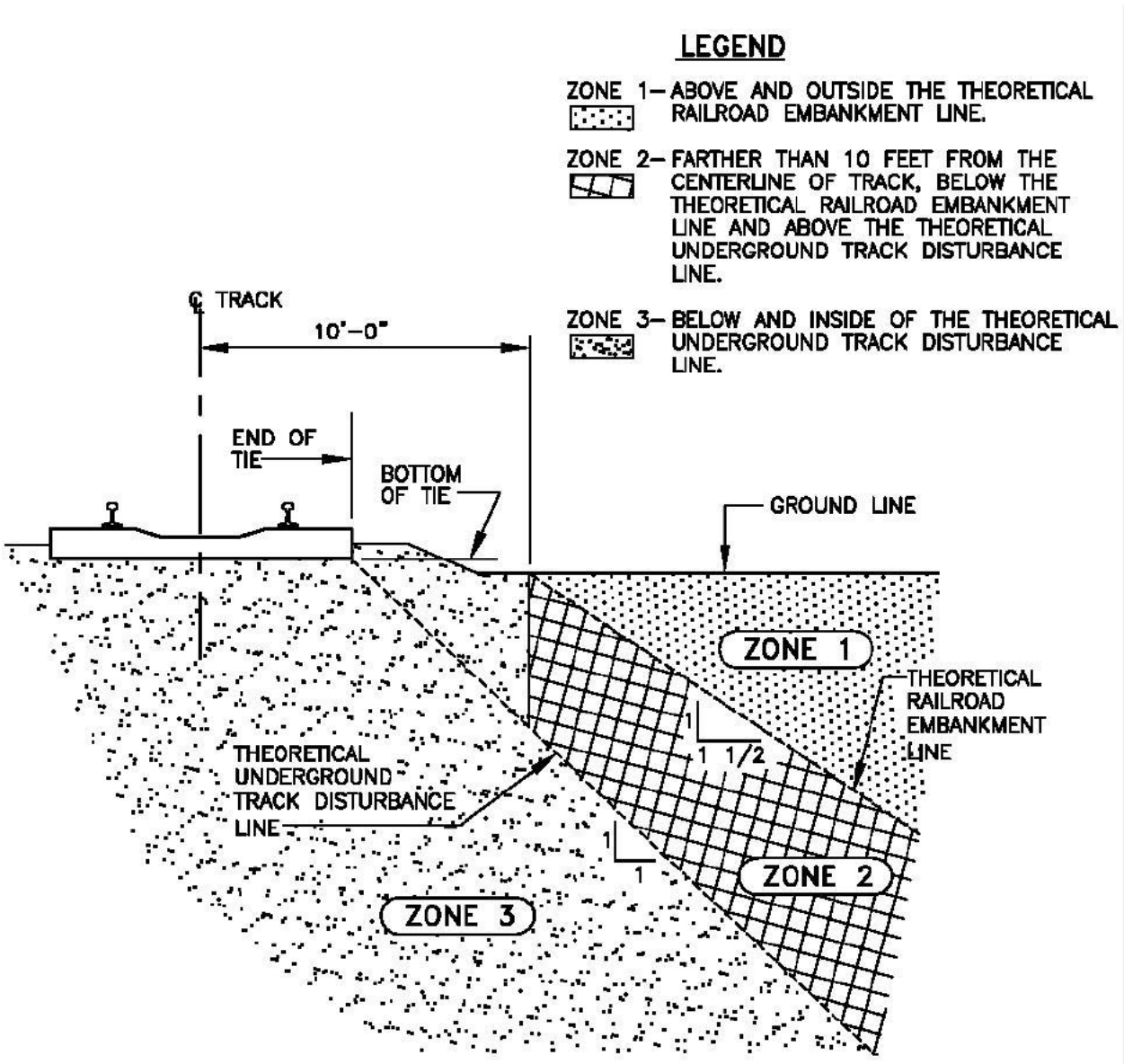


Figure 2, Section View of Underground Crossing

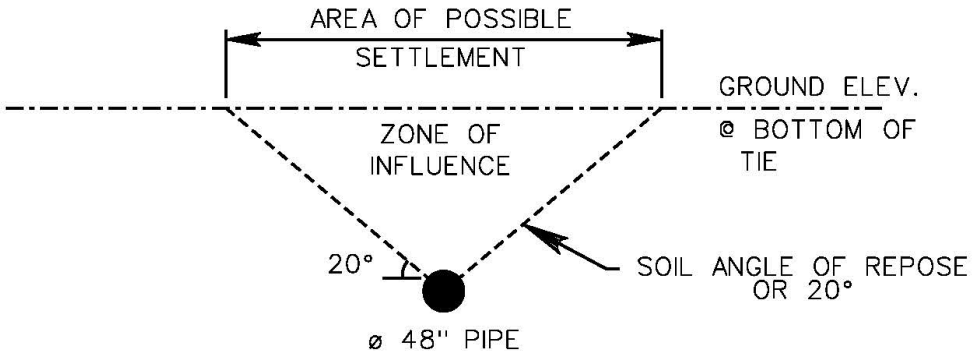
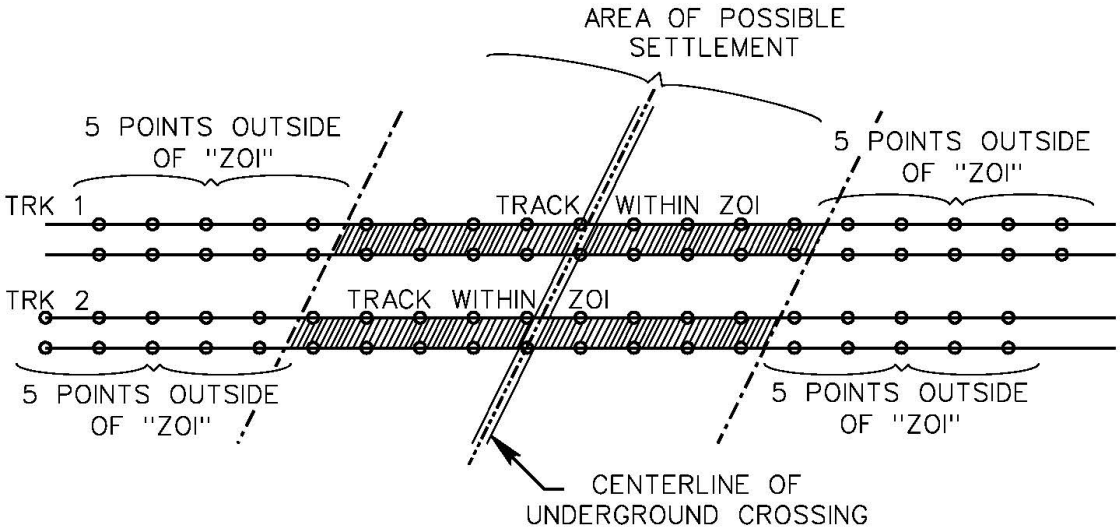


Figure 3, Plan View of Underground Crossing



TRACK MONITORING POINTS
SPACED 15.5 FEET ON BOTH RAILS

Figure 4, Section View of Parallel Work

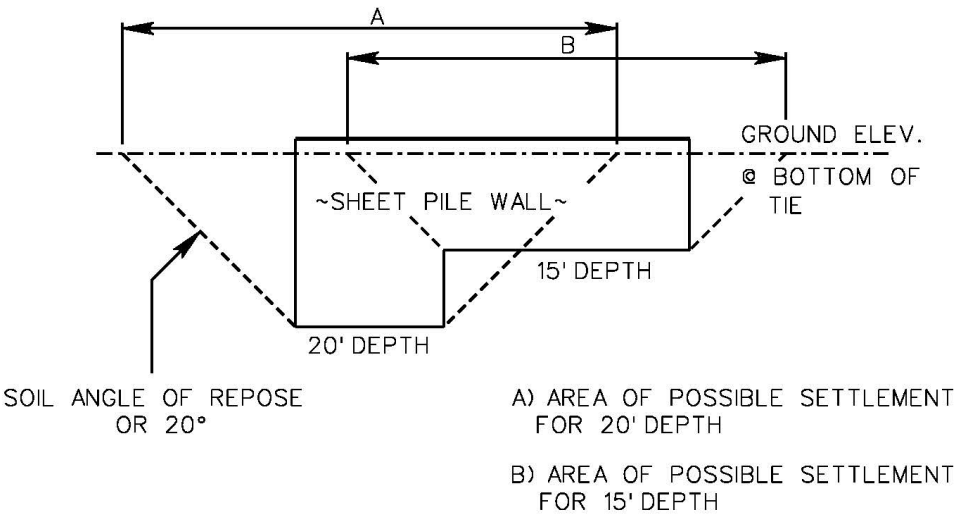


Figure 5, Plan View of Parallel Work

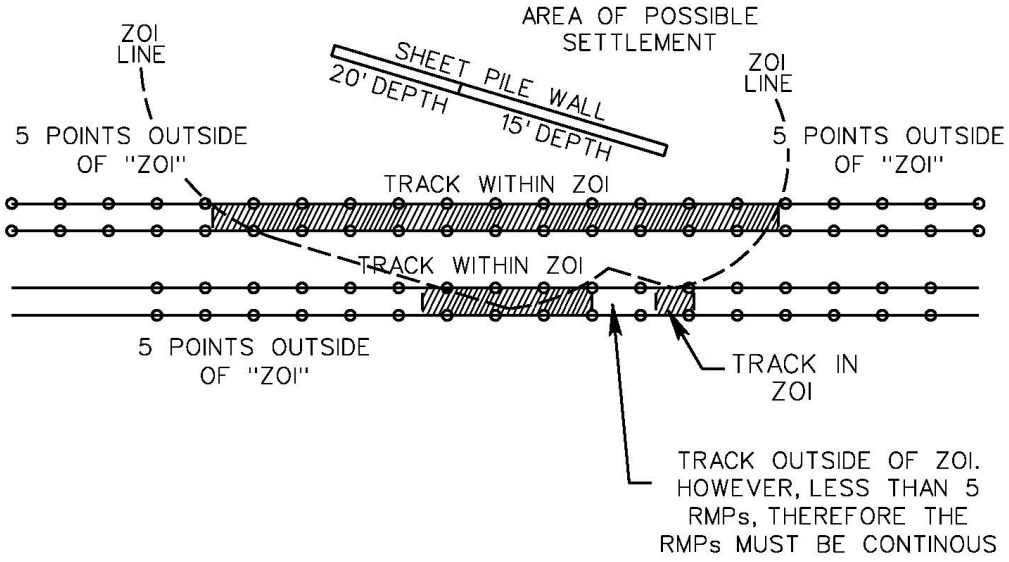


Figure 6, Example Track Monitoring Plan

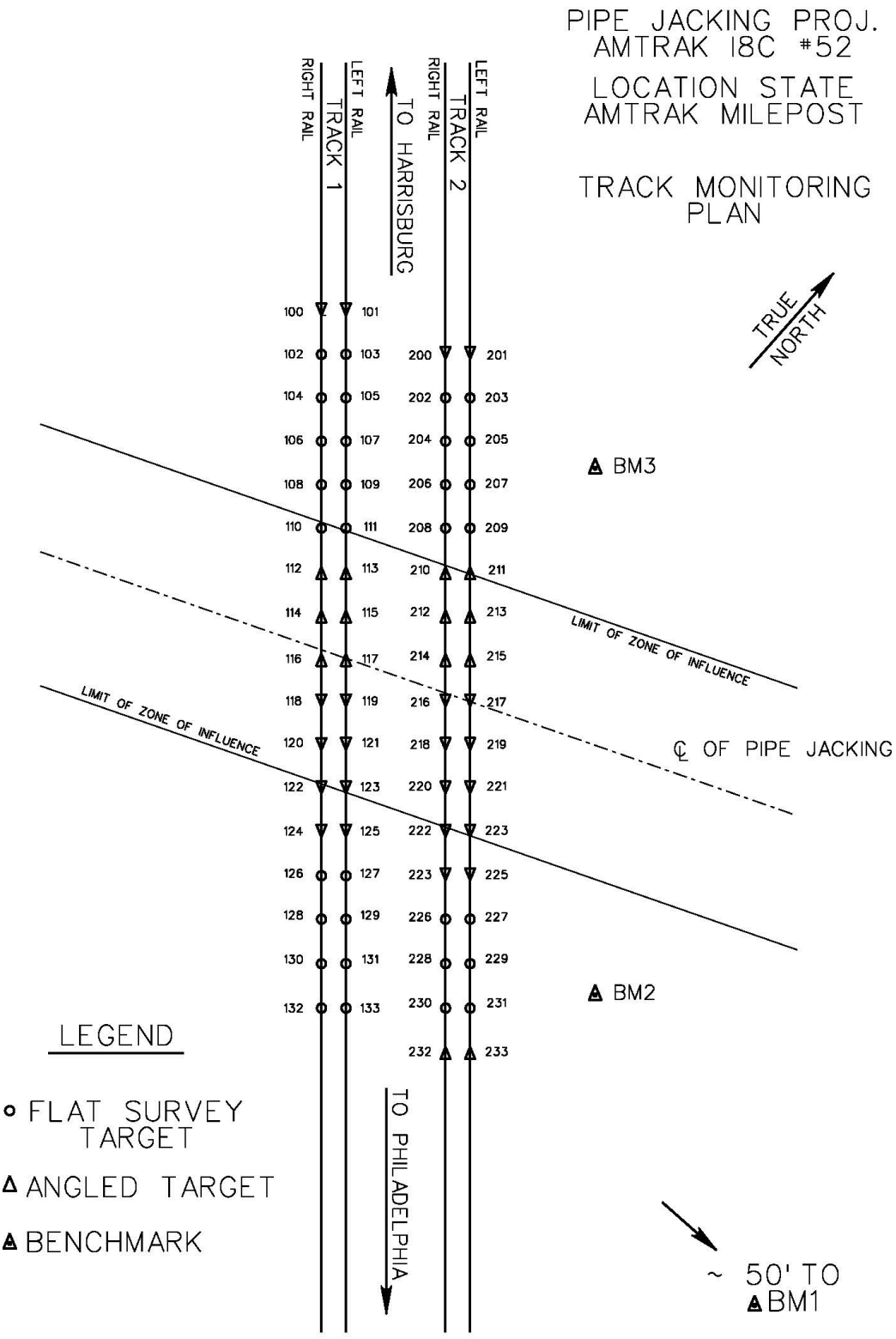


Figure 7, Example Track Monitoring Report

Monitoring Location: _____

Date & Time: _____

Underground Work Complete: _____ft

Track Number for this Sheet: _____

Right Rail				Left Rail				Cross Level (inches)
RPM	Top of Rail Movement (inches) (displacement from baseline)			RPM	Top of Rail Movement (inches) (displacement from baseline)			
	North	East	Elev		North	East	Elev	
100				101				
102				103				
104				105				
106				107				
108				109				
110				111				
112				113				
114				115				
116				117				
118				119				
120				121				
122				123				

Land Surveyor signature: _____ Seal:

Track Inspector signature: _____

Track Inspector SAP number: _____

Figure 8, Example Zone of Influence (Subsidence) Calculation

Scenario

Pipe jacking, perpendicular under tracks. 48-inch diameter pipe, 11-feet from top of rail elevation to top of pipe. No soil boring data given, assume Angle of Repose = 20°.

Calculations

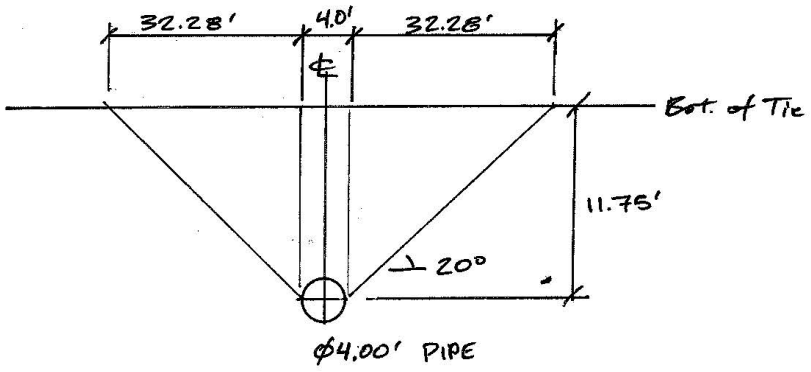
Pipe Work	⌀ 48-inch = 4.00 ft
Top of rail to bottom of tie	1.25 ft (typical)
Bottom of tie to center of pipe	depth top rail to top pipe – typical track depth + 1/2 Work
	11.00 ft – 1.25 ft + 2.00 ft = 7.75 ft
Half width of ZOI	[depth * tan (angle of repose)] + 1/2 Work
	[(11.75 ft) tan (90º - 20º)] + 2.00 ft = 34.28 ft

Convert ZOI to stations 34.28 ft / 15.5 ft = 2.216 -(round)-> 2 stations

Determine total RMP pairs on each track

Center station (1) + Stations in ZOI, each direction (2 + 2) + Five tie-in stations (5 + 5) = Total

Total pairs of RMPs = 15 (centered on crossing)



SCOPE AND NATURE

This practice provides procedures for Contractors to follow, when working on Amtrak Right-of-Way, adjacent to Amtrak tracks, to assure the protection of trains and maintenance of scheduled railroad operations.

SPECIAL REFERENCE

Note: This information was included under former Engineering Practice 1305.

Contractors shall comply with procedures detailed in the following specifications, when applicable:

Section	Title	Revision No.	Revision Date
01141A	Safety and Protection of Railroad Traffic and Property	4	10/01/12
01142A	Submission Documentation Required for Amtrak Review and Approval of Plans for Bridge Erection, Demolition and Other Crane/ Hoisting Operations over Railroad Right-of-Way	1	12/15/05
01520A	Requirements for Temporary Protection Shields for Demolition and Construction of Overhead Bridges and Other Structures	1	08/07/01
02261A	Requirements for Temporary Sheeting and Shoring to Support Amtrak Tracks	3	06/20/08

SPECIAL MATERIALS

Not Applicable

PROCEDURE

1. The Contractor shall conform to the applicable specifications.

2. Amtrak I&C shall assure that agencies and other third parties proposing construction on or adjacent to Amtrak Right-of-Way conform to Amtrak requirements detailed herein.

3. Amtrak Design and Construction shall review the Contractor’s proposed design and construction procedures for conformance with specifications, with sound engineering design practice and with the procedures detailed in the applicable Engineering Practice documents.

4. Amtrak Construction shall monitor the activities of the Contractor on-site to assure compliance/ adherence to approved procedures throughout the construction period.

REPORTING

As detailed in the specifications.

RESPONSIBILITY

Amtrak I&C Staff	Comply with Procedure
Director Project Initiation & Development	Assure Compliance
Amtrak Design Staff	Comply with Procedure
Director Structures Design	Assure Compliance
Amtrak Construction Staff	Comply with Procedure
Deputy Chief Engineer Construction	Assure compliance

SECTION 01141A – SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY

PART 1 - GENERAL

1.1 SCOPE

A. This specification describes the safety procedures and protection provisions for Contractors and Permittees entering and working upon railroad property.

B. Use of this specification is as required by Amtrak, as described in Amtrak Engineering Practice EP3014.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 DEFINITIONS

A. CHIEF ENGINEER: Amtrak Chief Engineer

B. RAILROAD: National Railroad Passenger Corporation (Amtrak), and/or the duly authorized representative

C. ENGINEERING PRACTICE: Amtrak Engineering Practices establish a system of uniform practices, notices and instructions for the Amtrak Engineering Department, providing current, permanent and temporary, departmental procedures and policies.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PRE-ENTRY MEETING

A. Before entry of Permittee and/or Contractors onto Railroad's property, a pre-entry meeting shall be held at which time Permittee and/or Contractors shall submit for written approval of the Chief Engineer, plans, computations and a detailed description of proposed methods for accomplishing the work, including methods for protecting Railroad's traffic. Any such written approval shall not relieve Permittee and/or Contractor of their complete responsibility for the adequacy and safety of their operations.

3.2 RULES, REGULATIONS AND REQUIREMENTS

A. Railroad traffic shall be maintained at all times with safety and continuity, and Permittee and/or Contractors shall conduct their operations in compliance with all rules, regulations, and requirements of Railroad (including these Specifications) with respect to any work performed on, over, under, within or adjacent to Railroad's property. Permittee and/or Contractors shall be responsible for acquainting themselves with such rules, regulations and requirements. Any violation of Railroads safety rules, regulations, or requirements shall be grounds for the immediate suspension of the Permittee and/or Contractor work, and the re-training of all personnel, at the Permittee's expense.

3.3 MAINTENANCE OF SAFE CONDITIONS

A. If tracks or other property of Railroad are endangered during the work, Permittee and/or Contractor shall immediately take such steps as may be directed by Railroad to restore safe conditions, and upon failure of Permittee and/or Contractor to immediately carry out such direction, Railroad may take whatever steps are reasonably necessary to restore safe conditions. All costs and expenses of restoring safe conditions, and of repairing any damage to Railroad's trains, tracks, right-of-way or other property caused by the operations of Permittee and/or Contractors, shall be paid by Permittee.

3.4 PROTECTION IN GENERAL

A. Permittee and/or Contractors shall consult with the Chief Engineer to determine the type and extent of protection required to insure safety and continuity of railroad traffic. Any Inspectors, Track Foremen, Track Watchmen, Flagman, Signalmen, Electric Traction Linemen, or other employees deemed necessary by Railroad, at its sole discretion, for protective services shall be obtained from Railroad by Permittee and/or Contractors. The cost of same shall be paid directly to Railroad by Permittee. The provision of such employees by Railroad, and any other precautionary measures taken by Railroad, shall not relieve Permittee and/or Contractors from their complete responsibility for the adequacy and safety of their operations.

3.5 PROTECTION FOR WORK NEAR ELECTRIFIED TRACK OR WIRE

A. Whenever work is performed in the vicinity of electrified tracks and/or high voltage wires, particular care must be exercised, and Railroad's requirements regarding clearance to be maintained between equipment and tracks and/or energized wires, and otherwise regarding work in the vicinity of electrified tracks, must be strictly observed. No employees or equipment will be permitted to work near overhead wires, except when protected by a Class A employee of Railroad. **Permittee and/or Contractors must supply an adequate length of grounding cable (4/0 copper with approved clamps) for each piece of equipment working near or adjacent to any overhead wire**.

3.6 FOULING OF TRACK OR WIRE

A. No work will be permitted within twenty-five (25) feet of the centerline of track or the energized wire or have potential of getting within twenty-five (25) feet of track wire without the

approval of the Chief Engineer's representative. Permittee and/or Contractors shall conduct their work so that no part of any equipment or material shall foul an active track or overhead wire without the written permission of the Chief Engineer's representative. When Permittee and/or Contractors desire to foul an active track, they must provide the Chief Engineer's representative with their site-specific work plan a minimum of twenty-one (21) working days in advance, so that, if approved, arrangements may be made for proper protection of Railroad. Any equipment shall be considered to be fouling a track or overhead wire when located (a) within fifteen (15) feet from the centerline of the track or within fifteen (15) feet from the wire, or (b) in such a position that failure of same, with or without a load, would bring it within fifteen (15) feet from the centerline of the track or within fifteen (15) feet from the wire and requires the presence of the proper Railroad protection personnel.

B. If acceptable to the Chief Engineer's representative, a safety barrier (approved temporary fence or barricade) may be installed at fifteen (15) feet from centerline of track or overhead wire to afford the Permittee and/or Contractor with a work area that is not considered fouling. Nevertheless, protection personnel may be required at the discretion of the Chief Engineer's representative.

3.7 TRACK OUTAGES

A. Permittee and/or Contractors shall verify the time and schedule of track outages from Railroad before scheduling any of their work on, over, under, within, or adjacent to Railroad's right-of-way. Railroad does not guarantee the availability of any track outage at any particular time. Permittee and/or Contractors shall schedule all work to be performed in such a manner as not to interfere with Railroad operations. Permittee and/or Contractors shall use all necessary care and precaution to avoid accidents, delay or interference with Railroad's trains or other property.

3.8 DEMOLITION

A. During any demolition, the Contractor must provide horizontal and vertical shields, designed by a Professional Engineer registered in the state in which the work takes place. These shields shall be designed in accordance with the Railroad's specifications and approved by the Railroad, so as to prevent any debris from falling onto the Railroad's right-of-way or other property. A grounded temporary vertical protective barrier must be provided if an existing vertical protective barrier is removed during demolition. In addition, if any openings are left in an existing bridge deck, a protective fence must be erected at both ends of the bridge to prohibit unauthorized persons from entering onto the bridge.

B. Ballasted track structure shall be kept free of all construction and demolition debris. Geo-textiles or canvas shall be placed over the track ties and ballast to keep the ballast clean.

3.9 EQUIPMENT CONDITION

A. All equipment to be used in the vicinity of operating tracks shall be in "certified" first-class condition so as to prevent failures that might cause delay to trains or damage to Railroad's property. No equipment shall be placed or put into operation near or adjacent to operating tracks without first obtaining permission from the Chief Engineer's representative. **Under no**

circumstances shall any equipment or materials be placed or stored within twenty-five (25) feet from the centerline of an outside track, except as approved by the Site Specific Safety Work Plan. To insure compliance with this requirement, Permittee and/or Contractors **must establish a twenty-five (25) foot foul line prior to the start of work** by either driving stakes, taping off or erecting a temporary fence, or providing an alternate method as approved by the Chief Engineer's representative. Permittee and/or Contractors will be issued warning stickers which must be placed in the operating cabs of all equipment as a constant reminder of the twenty-five (25) foot clearance envelope.

3.10 STORAGE OF MATERIALS AND EQUIPMENT

A. No material or equipment shall be stored on Railroad's property without first having obtained permission from the Chief Engineer. Any such storage will be on the condition that Railroad will not be liable for loss of or damage to such materials or equipment from any cause.

B. If permission is granted for the storage of compressed gas cylinders on Railroad property, they shall be stored a minimum of 25 feet from the nearest track in an approved lockable enclosure. The enclosure shall be locked when the Permittee and/or Contractor is not on the project site.

3.11 CONDITION OF RAILROAD'S PROPERTY

A. Permittee and/or Contractors shall keep Railroad's property clear of all refuse and debris from its operations. Upon completion of the work, Permittee and/or Contractors shall remove from Railroad's property all machinery, equipment, surplus materials, falsework, rubbish, temporary structures, and other property of the Permittee and/or Contractors and shall leave Railroad's property in a condition satisfactory to the Chief Engineer.

3.12 SAFETY TRAINING

A. All individuals, including representatives and employees of Permittee and/or Contractor, before entering onto Railroad's property and before coming within twenty-five (25) feet of the centerline of the track or energized wire must first attend Railroad's Contractor Orientation Computer Based Training Class. The Contractor Orientation Class will be provided electronically at **www.amtrakcontractor.com**. Upon successful completion of the course and test, the individual taking the course will receive a temporary certificate without a photo that is valid for three weeks. The individual must upload a photo of himself/herself that will be embedded in the permanent ID card. The photo ID will be mailed to the individual's home address and must be worn/displayed while on Railroad property. Training is valid for one calendar year. All costs of complying with Railroad's safety training shall be at the sole expense of Permittee and/or Contractor. The Permittee and/or Contractor shall appoint a qualified person as its Safety Representative. The Safety Representative shall continuously ensure that all individuals comply with Railroad's safety requirements. All safety training records must be maintained with the Permittee's and/or Contractor's site specific work plan.

3.13 NO CHARGES TO RAILROAD

A. It is expressly understood that neither these Specifications, nor any document to which they are attached, include any work for which Railroad is to be billed by Permittee and/or Contractors, unless Railroad gives a written request that such work be performed at Railroad's expense.

END OF SECTION 01141A

SECTION 01142A – SUBMISSION DOCUMENTATION REQUIRED FOR AMTRAK REVIEW AND APPROVAL OF PLANS FOR BRIDGE ERECTION, DEMOLITION AND OTHER CRANE/ HOISTING OPERATIONS OVER RAILROAD RIGHT-OF-WAY

PART 1 - GENERAL

1.1 SCOPE

A. Amtrak requires that a site-specific work plan for accomplishing hoisting operations be prepared for every applicable project, and for each type of lift on a project.
   1. The plan shall demonstrate adherence to Amtrak safety rules.
   2. The plan shall demonstrate constructibility.
   3. The plan shall minimize impact to rail operations.
   4. The approved plan will provide the basis for field inspection/ verification of the actual work.

B. Preparation, review and approval of the Crane/ Hoisting site-specific work plan does not relieve the Contractor from meeting other Amtrak requirements for adequate planning and documentation of proposed work procedures within the Right-of-Way of the railroad..

C. Current Amtrak safety rules shall be adhered to in every respect.

D. Use of this specification is as required by Amtrak, as described in Amtrak Engineering Practice EP3014.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 DEFINITIONS

A. CHIEF ENGINEER: Amtrak Vice President, Chief Engineer

B. RAILROAD: National Railroad Passenger Corporation (Amtrak), and/or the duly authorized representative

C. ENGINEERING PRACTICE: Amtrak Engineering Practices establish a system of uniform practices, notices and instructions for the Amtrak Engineering Department, providing current, permanent and temporary, departmental procedures and policies.

1.4 SUBMISSION REQUIREMENTS

A. Unless otherwise directed in the Contract, the Contractor shall submit five sets of plans and calculations to the authorized representative of the Chief Engineer, Structures, whose name and address will be provided at the project pre-construction meeting.

B. Submitted calculations and plans shall be signed and sealed by a Professional Engineer, registered in the State in which the work will be performed.

C. The Contractor shall revise and resubmit plans and calculations as many times as necessary, until a complete and correct site-specific work plan for crane/ hoisting operations has been approved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 THE CONTRACTOR SHALL PROVIDE, AT A MINIMUM, THE FOLLOWING INFORMATION FOR REVIEW AND APPROVAL BY AMTRAK ENGINEERING STRUCTURES:

A. Plan view showing location(s) of cranes, operating radii, with delivery and/or disposal locations shown. Provide all necessary dimensions for locating the elements of the plan.

B. Plans and computations showing the weight of the pick.

C. Crane rating sheets, demonstrating that cranes are adequate for 150% of the calculated pick weight. That is, the cranes shall be capable of picking 150% of the load, while maintaining normal, recommended factors of safety. The adequacy of the crane for the proposed pick shall be determined by using the manufacturer's published crane rating chart and not the maximum crane capacity. Crane and boom nomenclature is to be indicated.

D. Calculations demonstrating that slings, shackles, lifting beams, etc. are adequate for 150% of the calculated pick weight.

E. Location plan showing obstructions, indicating that the proposed swing is possible. "Walking" of load using two cranes will not be permitted. Rather, multiple picks and repositioning of the crane may be permitted to get the load to the needed location for the final pick, if necessary.

F. Data sheet listing types and sizes of slings and other connecting equipment. Include copies of catalog cuts for specialized equipment. Detail attachment methods on the plans.

G. A complete procedure, indicating the order of lifts and any repositioning or re-hitching of the crane or cranes.

H. Temporary support of any components or intermediate stages, as may be required.

I. A time schedule of the various stages, as well as a schedule for the entire lifting process.

END OF SECTION 01142A

SECTION 02261A – REQUIREMENTS FOR TEMPORARY SHEETING AND SHORING TO SUPPORT AMTRAK TRACKS

PART 1 - GENERAL

1.1 SCOPE

A. This engineering practice describes items to be included in the design and construction of temporary sheeting and shoring construction adjacent and proximate to Amtrak tracks.

B. Use of this specification is as required by Amtrak, as described in Amtrak Engineering Practice EP3014.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 DEFINITIONS

A. CHIEF ENGINEER: Amtrak Vice President, Chief Engineer

B. RAILROAD: National Railroad Passenger Corporation (Amtrak), and/or the duly authorized representative

C. ENGINEERING PRACTICE: Amtrak Engineering Practices establish a system of uniform practices, notices and instructions for the Amtrak Engineering Department, providing current, permanent and temporary, departmental procedures and policies.

1.4 SUBMISSION REQUIREMENTS

A. Unless otherwise directed in the Contract, the Contractor shall submit five sets of plans and calculations to the authorized representative of the Chief Engineer, Structures, whose name and address will be provided at the project pre-construction meeting.

B. Submitted calculations and plans shall be signed and sealed by a Professional Engineer, registered in the State in which the work will be performed.

C. The Contractor shall revise and resubmit plans and calculations as many times as necessary, until a complete and correct site-specific work plan for temporary sheeting and shoring has been approved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONTRACTORS INSTALLING TEMPORARY CONSTRUCTION SHEETING AND SHORING TO SUPPORT AMTRAK TRACKS SHALL CONFORM TO THE FOLLOWING:

A. Footings for all piers, columns, walls, or other facilities shall be located and designed so that any temporary sheeting and shoring for support of adjacent track or tracks during construction, will not be closer than toe of ballast slope. The dimension from gage of rail to toe of ballast, along tangent track, is 7'-5"; see dimensions on Track standard plans for curved track dimensions.

B. USE OF SHEETING: When support of track or tracks is necessary during construction of the above-mentioned facilities, interlocking steel sheeting, adequately braced and designed to carry Cooper E80 live-load plus 50 percent impact allowance is required. Soldier piles and lagging will be permitted for track support ONLY when required penetration of steel sheet piling cannot be obtained, due to site-specific conditions that make steel sheet piling placement impracticable, in the opinion of the authorized, Amtrak design review engineer.
   1. For usual soil conditions and limited excavations, sheeting is required when the near-track excavation extends beneath or nearer to the track than the Theoretical Railroad Embankment Line. The Theoretical Railroad Embankment Line is defined as a line that starts at grade, ten foot from the centerline of the outer track, and extends downward, away from the track, at a slope of 1-1/2 horizontal to one vertical.
   2. For special soil conditions, such as soft organic soils and rock conditions, and for unusual excavation conditions, temporary supports for excavations may be necessary even when the limits fall beyond the Theoretical Railroad Embankment Line, requiring site specific analysis by a professional, geotechnical engineer.
   3. See Sketch SK-1, "Normal Requirements for Sheet Piling Adjacent to Tracks".

C. Exploratory trenches, three feet deep and 15 inches wide in the form of an "H", with outside dimensions matching the proposed outside dimensions of sheeting, shall be hand dug, prior to placing and driving the sheeting, in any area where railroad or utility underground installations are known or suspected. These trenches are for exploratory purposes only, and shall be backfilled and immediately compacted, in layers. This work shall be performed only in the presence of a railroad inspector.

D. Absolute use of track is required while driving sheeting adjacent to running track. Track usage shall be prearranged per standard procedures, through the Amtrak project representative.

E. Cavities adjacent to sheet piling, created by pile driving, shall be filled with sand, and any disturbed ballast shall be restored and tamped immediately.

F. Sheet piling cutoffs
   1. During construction, sheeting shall be cut off at an elevation no higher than the top of tie.
   2. At the completion of construction activities involving the use of sheet piling, sheet piling may be pulled if there will be no adverse impact to the railroad track support bed, as determined by the Amtrak site engineer. This will generally be permitted when both of these conditions are met:
      a. the sheeting face is at least ten feet distant from the centerline of track, and
      b. the bottom of the excavation that the sheeting supported prior to backfilling, does not fall within an assumed influence zone under the tracks. The assumed influence

zone is defined as the area, as seen in cross-sectional view, falling beneath the Theoretical Underground Track Disturbance Line. This line is defined as a line that starts at the end and bottom of the ties, and extends from the track outward and downward at a one-to-one (45-degree) slope.

3. Sheet piling that is to be left in-place, shall be cut off below the ground line
   a. at least eighteen inches below final ground line at the sheeting, and
   b. no higher than 24 inches below the elevation of the bottom of the nearest ties
4. See Sketch SK-1, "Normal Requirements for Sheet Piling Adjacent to Tracks".

G. The excavation adjacent to the track shall be covered, ramped and protected by handrails, barricades and warning lights, as required by applicable safety regulations, and as directed by Amtrak.

H. Final backfilling of excavation shall conform to project specifications.

I. The Contractor shall provide Amtrak with a detailed schedule of proposed construction operations, detailing each step of the proposed temporary construction operations in proximity to Amtrak tracks, so that Amtrak may review and approve the proposed operations, and may properly inspect and monitor operations.

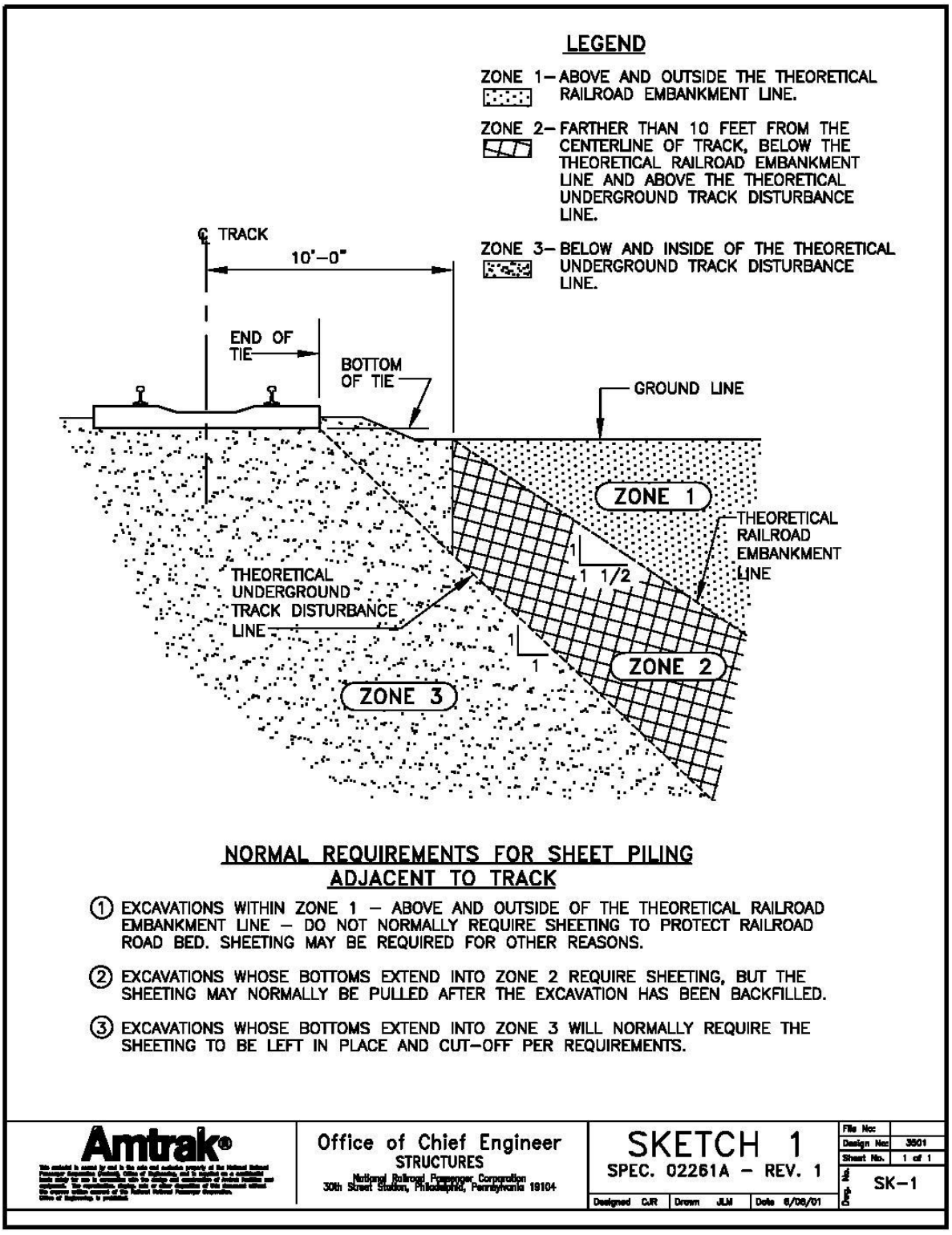
J. Drawings for the proposed temporary sheeting and shoring shall be signed and sealed by a Licensed Professional Engineer. Complete design calculations, clearly referenced to the drawings, and easy to review, shall be provided with submission of drawings.

K. Where site specific conditions impose insurmountable restrictions to the design of temporary construction conforming to the limitations listed above, the design of temporary construction shall be developed in close coordination with Amtrak design review personnel. The Chief Engineer, Structures shall provide final approval of temporary construction that does not conform to the above limitations.
   1. When Amtrak grants approval for sheeting closer than standard minimum clearances, the Contractor shall develop a survey plan, if not already required by the project, for the adjacent tracks, to be conducted prior to, during, and after the temporary sheeting construction operations. If settlement is detected, construction operations shall be suspended until the track has been returned to its initial condition, and stabilized, as determined by the Amtrak project site representative.
   2. The Contractor shall stockpile ten (10) tons of approved ballast at the project site, and maintain that amount in ready reserve, to allow for the possible need to restore track profile.

L. Particular care shall be taken in the planning, design and execution of temporary construction, as relates to railroad slope protection and drainage facilities. Erosion and sediment control best management practices shall be designed and employed, as approved by Amtrak. Any unintended disruption to railroad drainage facilities, caused by the temporary construction, shall be promptly remedied, as directed by the Engineer, solely at the Contractor's cost.

M. The following Information Sketch is attached:

   1. Figure No. SK-1: Normal Requirements for Sheet Piling Adjacent to Track



END OF SECTION 02261A

RESILIENT
BRANFORD

ATTACHMENT C

PUBLIC MEETING NOTES

PUBLIC MEETING NOTES

MARCH 1, 2023 – 6:00 p.m.
Branford Community House
Branford, CT

PROJECT NUMBER: 20191105.A10

PROJECT NAME: CIRCA Resilient Connecticut Phase III - Branford

ATTENDEES:

Name	Organization
David Murphy	CIRCA
John Truscinski	CIRCA
Jennifer Acquino	Town of Branford
Dean Audet	Fuss & O'Neill
Celicia Boyden	Fuss & O'Neill
Rebecca Meyers	Fuss & O'Neill

RE: Public Meeting

SUBMITTED BY: Fuss & O'Neill

ATTACHMENTS:
A – List of Public Meeting Attendees
B – Meeting Presentation
C – Poster Boards

Fuss & O'Neill, the Town of Branford and CIRCA conducted a public meeting to review the finding from the Existing and Future Conditions Analysis and the principal alternatives available to reduce flood risk. This meeting was held on March 1, 2023 at the Joseph Trapasso Community House.

During this meeting, Fuss & O'Neill provided a background on the project location, flood mitigation goals, two mitigation alternatives, and CIRCA flood modeling results. The attached presentation titled "Resilient Meadow Street Public Meeting" was reviewed during the meeting. The attached poster boards were displayed for public feedback as well as discussion with the Engineers and Town. The main discussion topics raised by the public and questions are outlined below.

FILLING IN THE CATTLE CROSSING

- The idea of filling in the "Cattle Crossing" was revisited (question from Rob Mendehlson). In general, the represented public at this meeting had less opposition than what was recorded during the 2016 public outreach.

- Filling in the "Cattle Crossing" would involve redirecting or covering utilities that run under the "Cattle Crossing" and discussion with Amtrak as it is in their right-of-way.

- The Town raised concern about placing fill material over the utilities which would complicate future maintenance and make it difficult to access them.

SHEET PILE WALL

- The sheet pile wall was reviewed as an alternative. Some attendees did not consider the view an issue due to the current views being the overgrown Amtrak embankment and the sheet pile wall will not block the view of the water.

- Ideas for the aesthetics of the sheet pile wall were suggested by members of the public:
    - Paint a mural.
    - Add a (stone or wood) facade.
    - Incorporate vertical plantings for "green wall" effect.

COST

- Concern was raised over the difference in prices of the sheet pile wall, the gate with embankment, and filling in the "Cattle Crossing".
    - The sheet pile wall would be the most expensive option at around $7 million.
    - The gate with the embankment was estimated to be $1-2 million.
    - Filling in the "Cattle Crossing" was estimated to be around $500,000, however, this does not include relocating utilities or other potential complications (i.e., Amtrak coordination, improvements the embankment to account for changes in hydraulic pressures).

- The sheet pile wall would be significantly more expensive than the gate with embankments, the benefits include:
    - Increase flood protection of the Amtrak embankment.

  - Justification for FEMA funding. (even with FEMA funding, the cost to the Town would still be more for the sheet pile wall than the gate with embankments)
  - The ability to apply for a LOMR to remove the neighborhood from the FEMA regulated floodplain.

- There was some preference (from Finance Director) for installing the gate with the embankment and adding the sheet pile wall at a later time.

OTHER ALTERNATIVES

- A hurricane barrier downstream was suggested (by Peter Hentschel). It was discussed that a hurricane barrier is outside the scope of this project.

- Further considerations discussed include:
  - Requires coordination with the Army Corps of Engineers (i.e. would have a long implementation schedule) and may not be permittable.
  - Significant risk that the Town could spend years and money developing a concept and discover that the regulatory barriers make it infeasible (i.e., likely extraordinarily more costly and difficult to fund or permit).

GENERAL NOTES

- The Town suggested a larger canvasing effort to gain additional public feedback, specifically from the Meadow Street neighborhood business owners and residents.

- Further analysis (e.g., costs and public approval) of the option to filling in the "Cattle Crossing" is required.

- Several questions were raised about where the floodwater currently stored along Meadow Street would go if a barrier at the Cattle Crossing was constructed. Because the project is located on a portion of the river that is tidally influenced, the reduced floodwater storage is minuscule compared to the size of the source of flooding (i.e., the ocean), therefore no compensation for the displaced floodwaters is required.

- Based on the discussions that were summarized above in these notes, public consensus has not been reached.

PHOTOS FROM PUBLIC MEETING

FUSS & O'NEILL

Attachment A

List of Public Meeting Attendees

Name	Address	email
Ray Ingraham	34 Indian Neck Ave	Ingraydad@Gmail.com
PETER HENTSCHEL	285 THIMBLE ISLAND RD	PETERH@TECTONPC.COM
Carolyn Sines	20 Linden Shores	cas4Branford@gmail
Frank Twohill	PO Box 794	franktwohill@hotmail.com
Ann Freeman	4 Kenwood Ln	afreeman@comcast.net
Donald Conklin	4 Waverly Rd	donaldconklin@sbcglobal.net
Deborah Conklin	" "	twodc@sbcglobal.net
David Rood	26 Hickory Hill Lane	davidrood107@gmail.com
Tracy Everson	23 Mill Creek Rd	everson5rtm@gmail.com
Tricia Anderson	14 Acorn St	TRICIA60RTM@gmail.com
Robert Mentkowski	4 Prospect Hill Rd	robert.mentkowski@yale.edu

FUSS & O'NEILL

Attachment B

Meeting Presentation

RESILIENT
MEADOW STREET

PROJECT UPDATE

RESILIENT
MEADOW STREET

Project goal is to reduce flood risk in Meadow Street neighborhood above Amtrak embankment

RESILIENT
MEADOW STREET

FEMA flood mapping shows substantial flood risk to neighborhood

41 structures now in FEMA floodplain upland of Amtrak embankment

Does not include future sea level rise, flood risk will worsen

RESILIENT
MEADOW STREET

Existing physical conditions are a challenge

"Cattle Crossing" is primary flood pathway

Meadow Street low point is at elevation 2.62'

Mean Higher High Water at elevation 2.97'

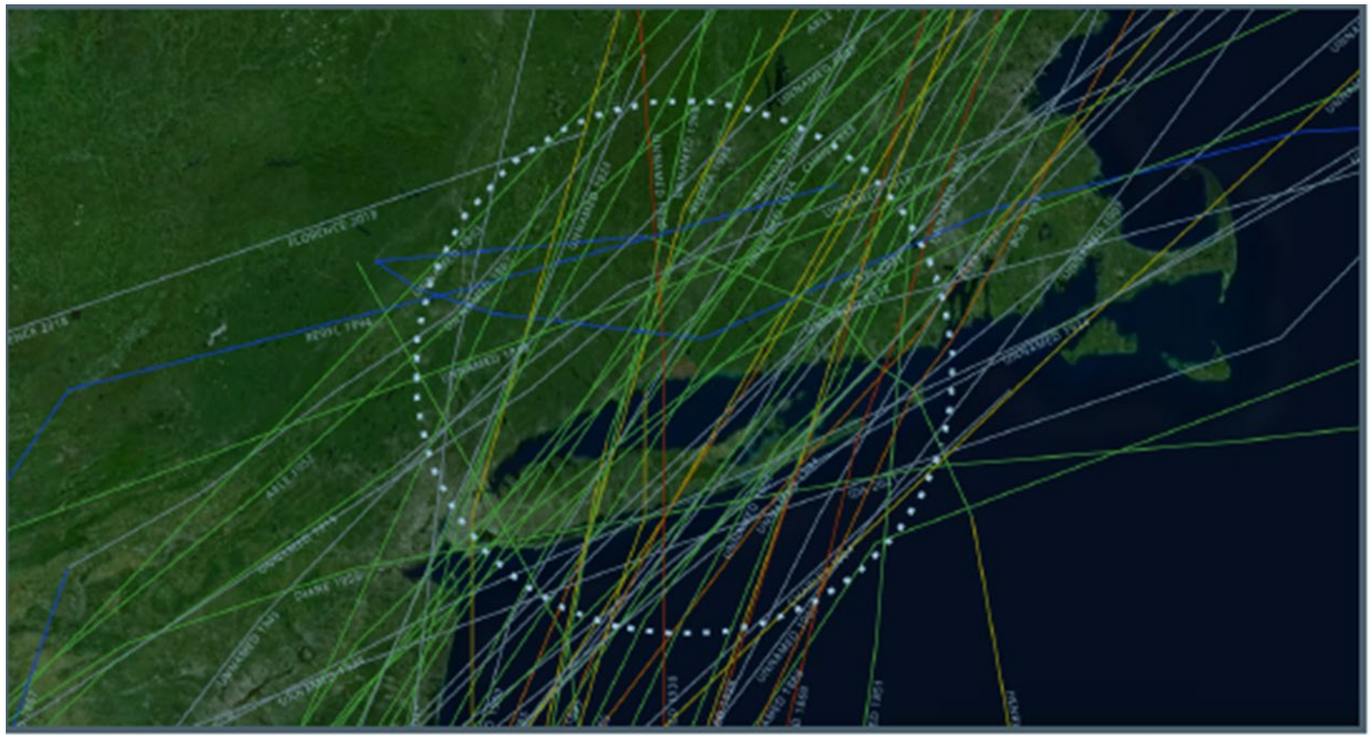


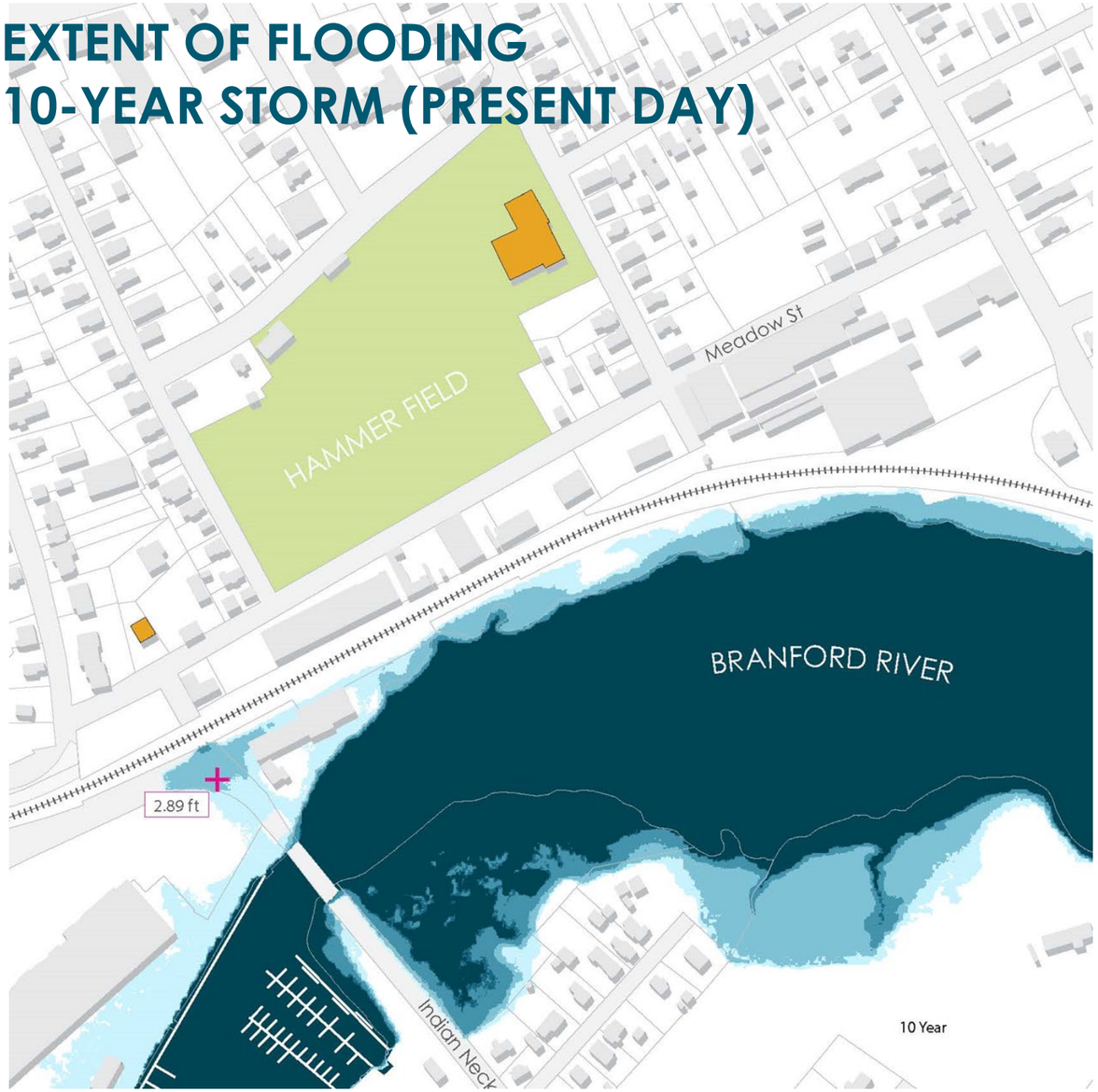
Figure 5: NOAA Storm Tracks for historical tropical storms and hurricanes within 60 miles of Branford.

UCONN Connecticut Institute for Resilience & Climate Adaptation modeled current and future flooding

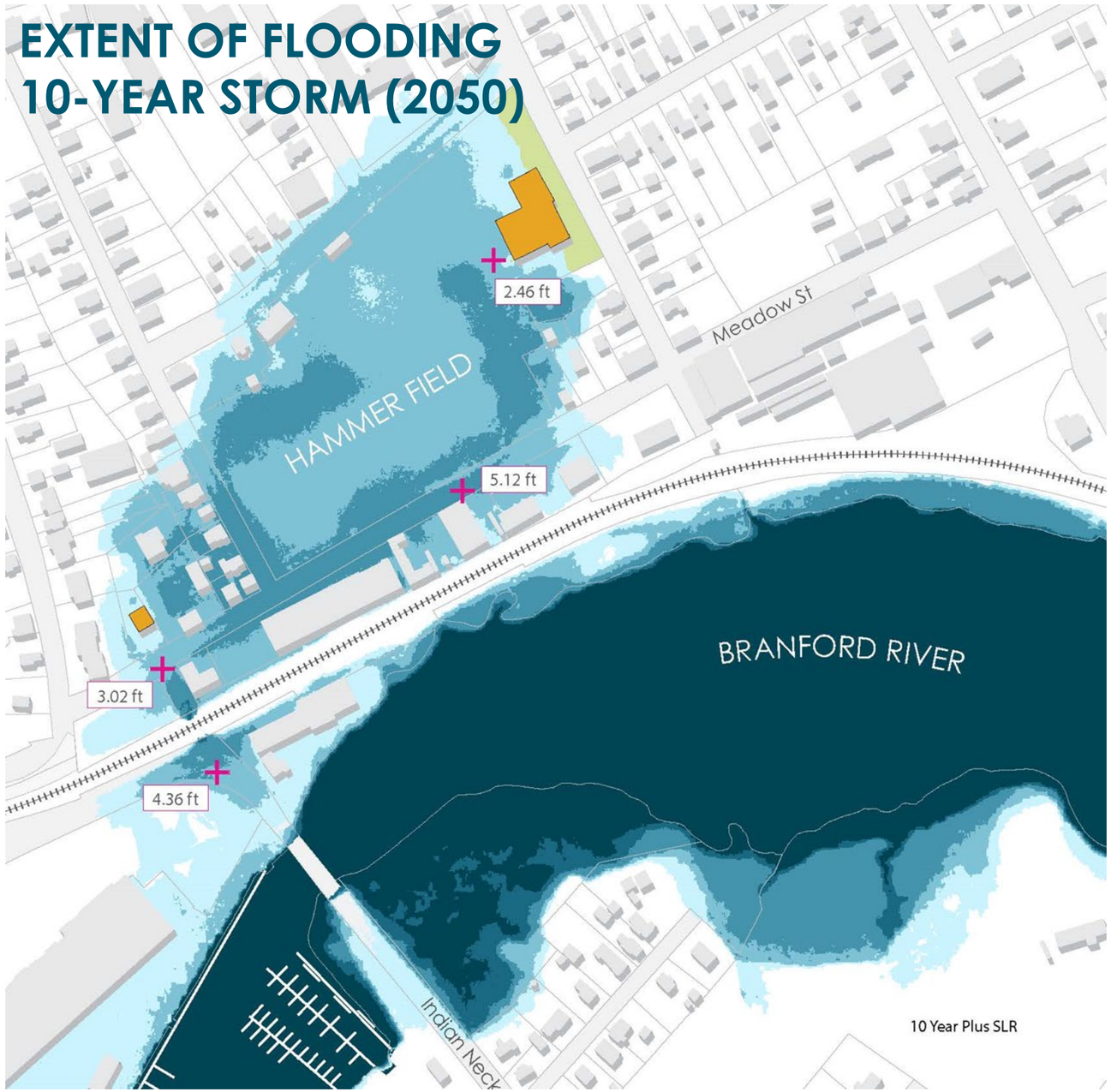
Future modeled conditions include 20-inches of sea level rise by 2050

RESILIENT MEADOW STREET

EXTENT OF FLOODING 10-YEAR STORM (PRESENT DAY)



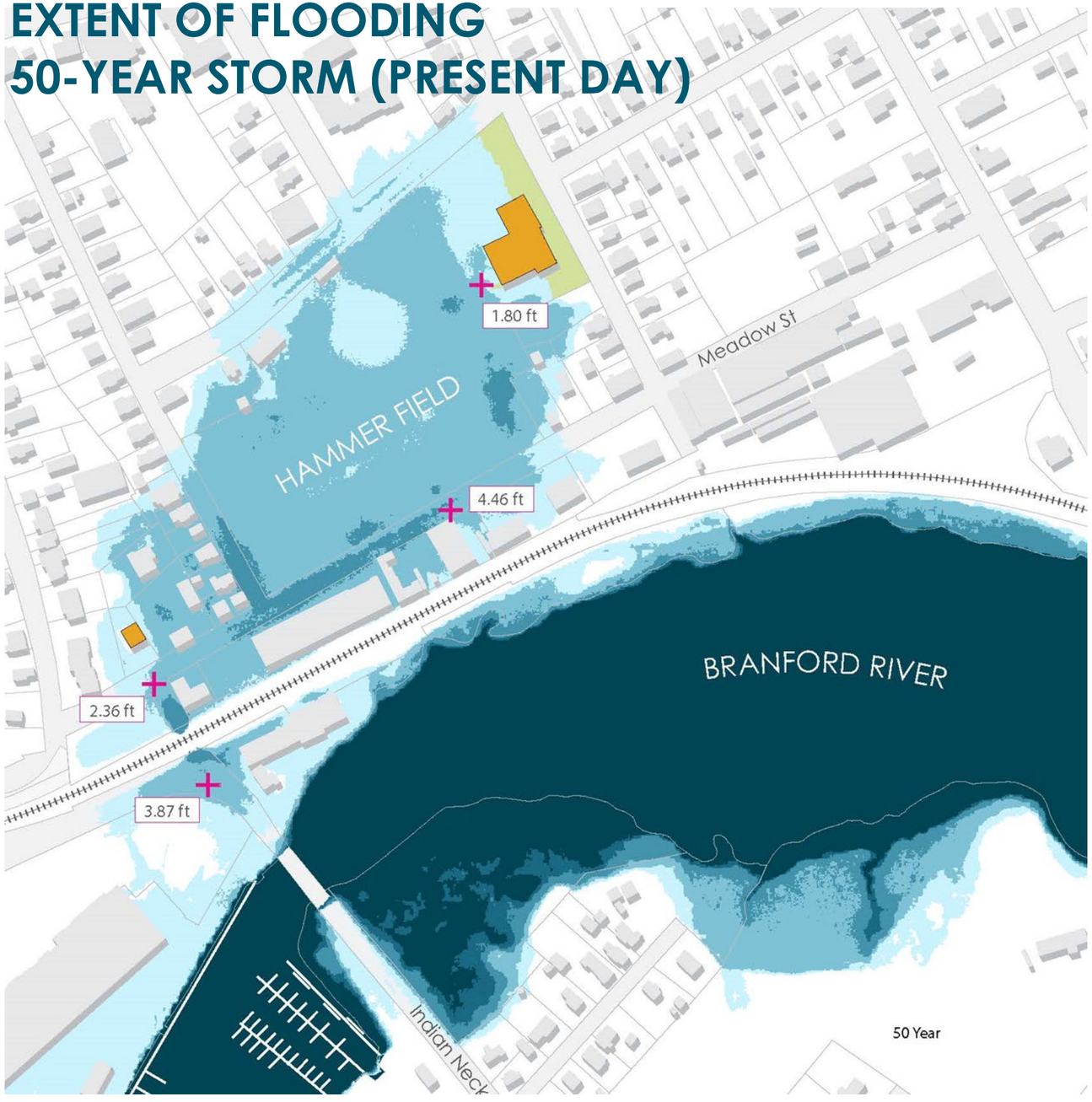
EXTENT OF FLOODING 10-YEAR STORM (2050)



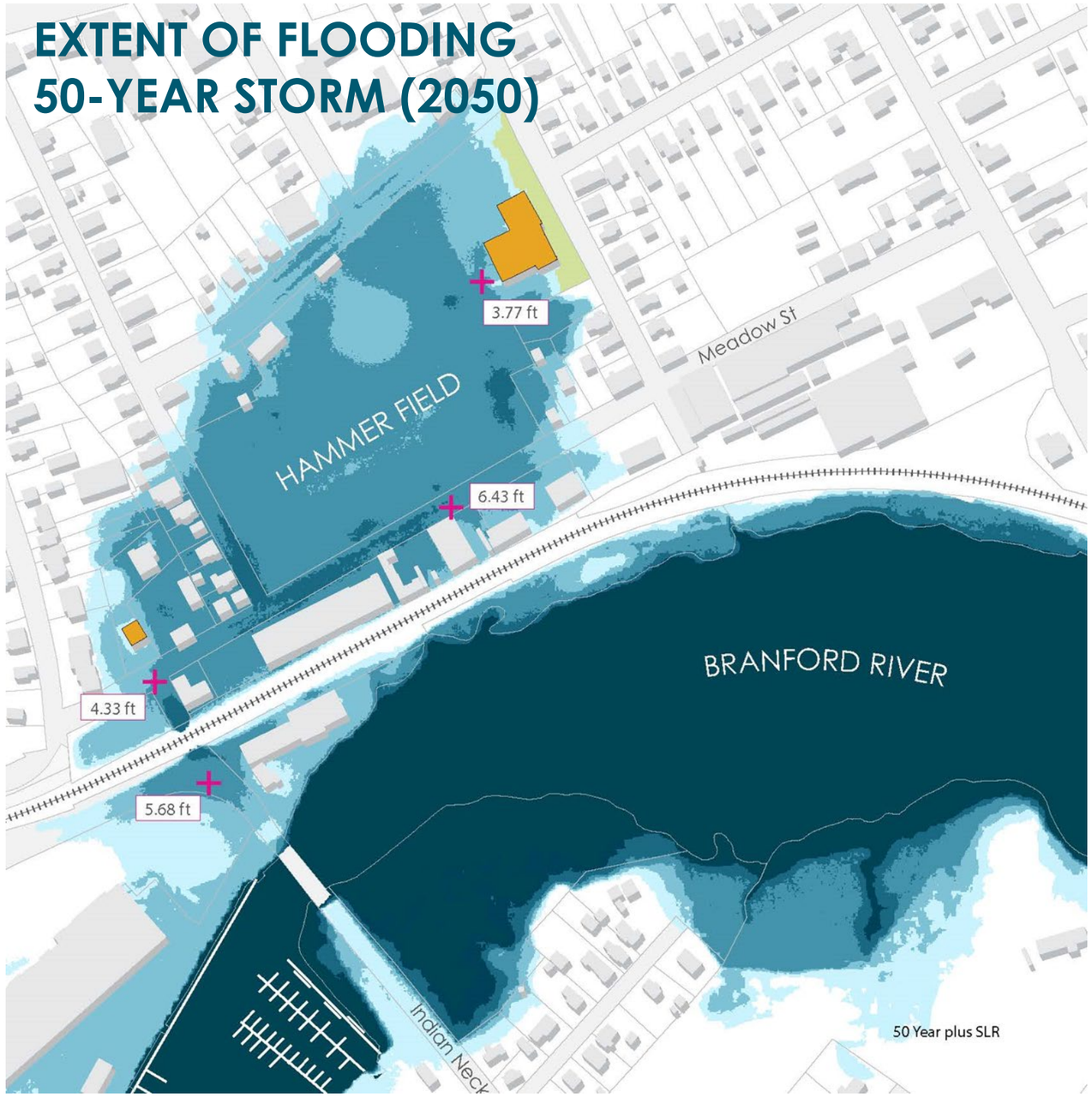
10-YEAR RETURN STORM FLOOD MAPPING

RESILIENT
MEADOW STREET

EXTENT OF FLOODING
50-YEAR STORM (PRESENT DAY)



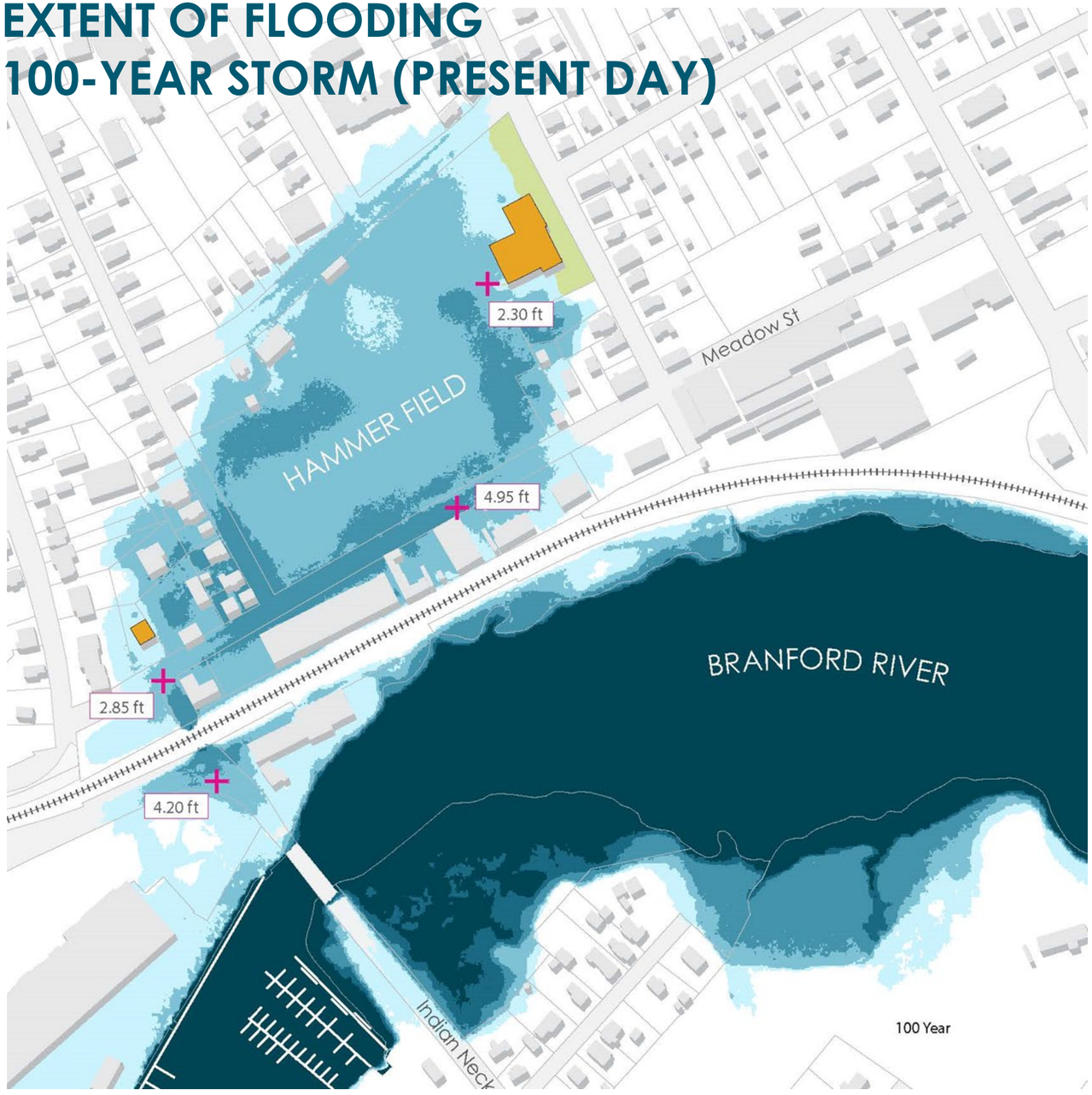
EXTENT OF FLOODING
50-YEAR STORM (2050)



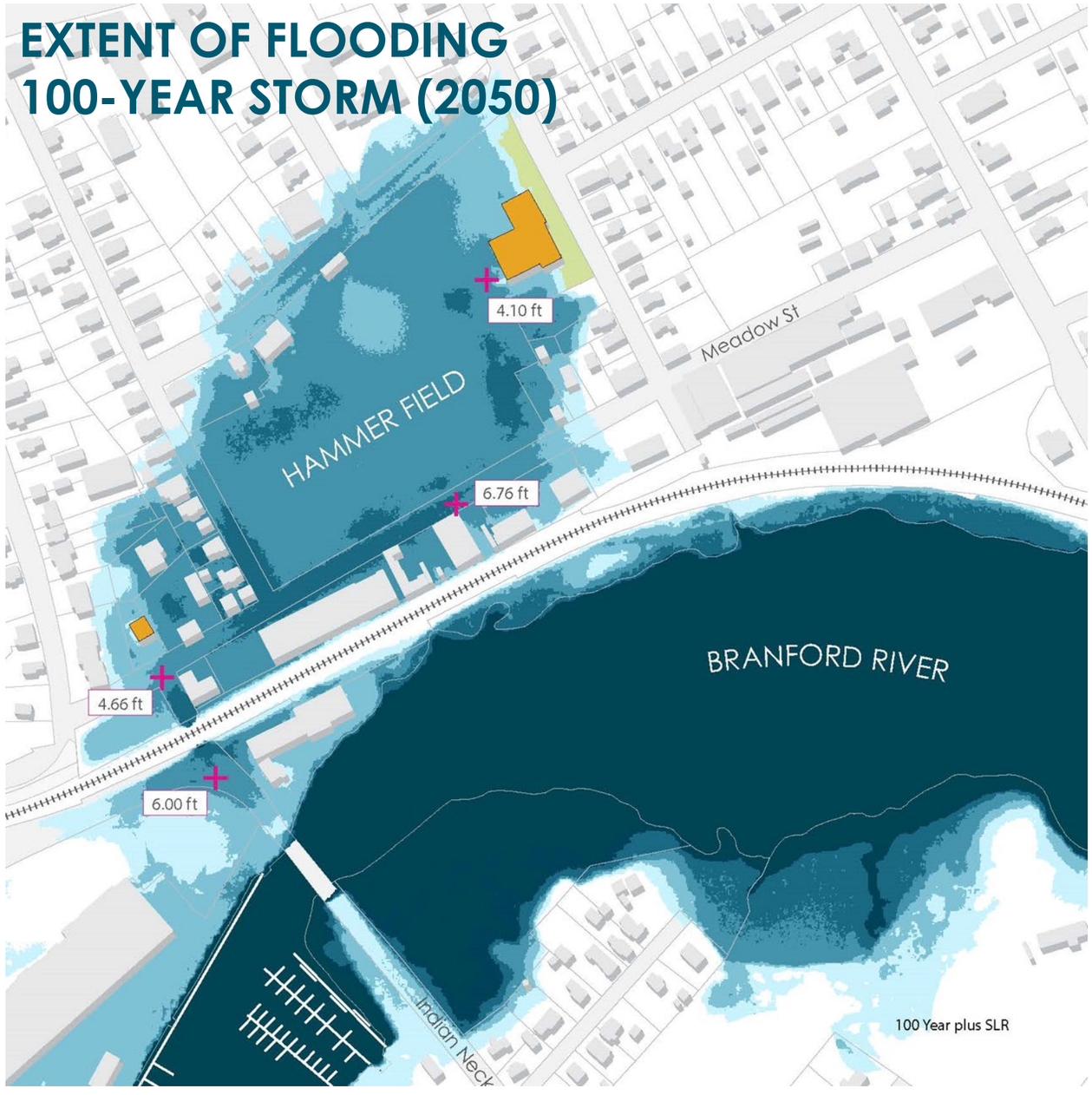
50-YEAR RETURN STORM FLOOD MAPPING

RESILIENT
MEADOW STREET

EXTENT OF FLOODING
100-YEAR STORM (PRESENT DAY)



EXTENT OF FLOODING
100-YEAR STORM (2050)



100-YEAR RETURN STORM FLOOD MAPPING

STORM EVENT	NUMBER OF STRUCTURES IMPACTED (NORTH OF TRAIN TRACKS)	
	Current Climate	Future Climate (2050)
10-year	0	34
50-year	29	40
100-year	35	42

Predicted that today's 100-year frequency flood will be equivalent to projected 10-year frequency flood in 2050

RESILIENT
MEADOW STREET

2016 Public Meeting feedback to keep “Cattle Crossing” open

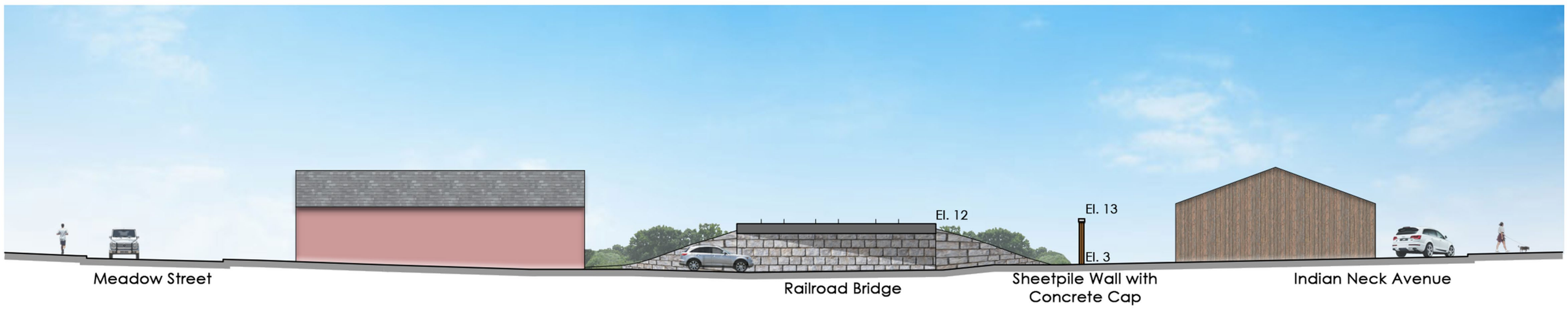
Two Options

1) **Install gate-only** to close “Cattle Crossing” during floods

2) **Install gate and new floodwall** to close “Cattle Crossing" and reinforce Amtrak embankment

RESILIENT
MEADOW STREET

OPTIONS	ADVANTAGES	DISADVANTAGES
Gate-Only	Relatively low cost	Likely not eligible for FEMA funding Requires human operation to be deployed (applies to both)
Gate with Flood Wall	Eligible for FEMA funding Approvable by FEMA to remove upland structures from regulated floodplain	Multi-million dollar project Major visual impact Conflicts with existing building and Amtrak embankment, requires Amtrak approval



RESILIENT
MEADOW STREET

QUESTIONS?

CIRCA
Connecticut Institute for Resilience and Climate Adaptation

FUSS & O'NEILL

Attachment C

Poster Boards

THE MEADOW STREET NEIGHBORHOOD

RESILIENT BRANFORD

Storm Event	Number of Structures Impacted (North of Train Tracks)	
	Current Climate	Future Climate (2050)
10-Year	0	34
50-Year	29	40
100-Year	35	42

THE CATTLE CROSSING

CIRCA Connecticut Institute for Resilience and Climate Adaptation

FUSS & O'NEILL

EXTENT OF FLOODING

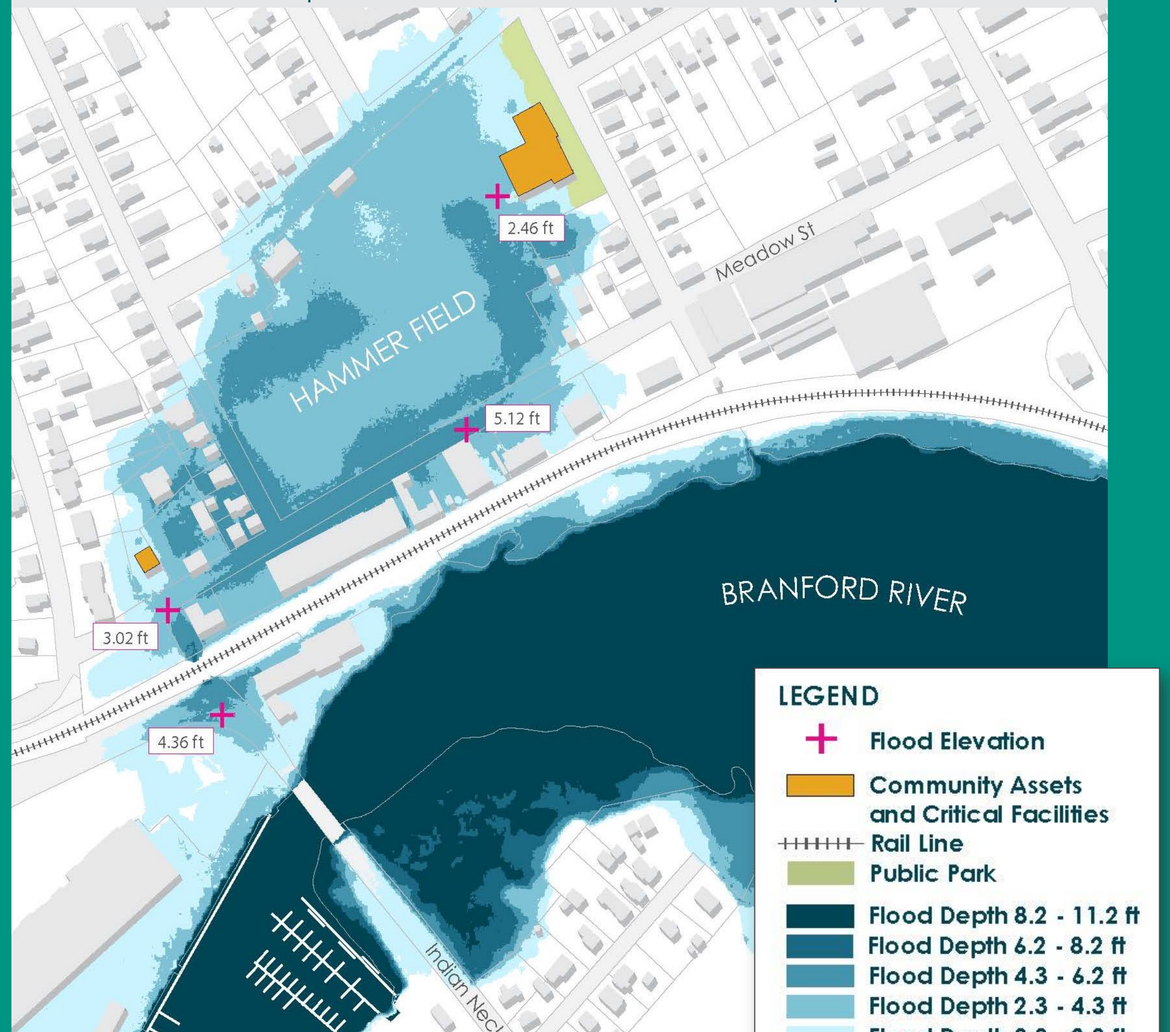
10-YEAR STORM (PRESENT DAY)

Present day, coastal storm flooding is limited to the area south of the train tracks and makes the Cattle Crossing inaccessible.

10-YEAR STORM (2050)

Assumes 20-inches of sea level rise

Future climate, coastal storm flooding will impact up to 35 residential, business and municipal structures as well as result in multiple road closures.

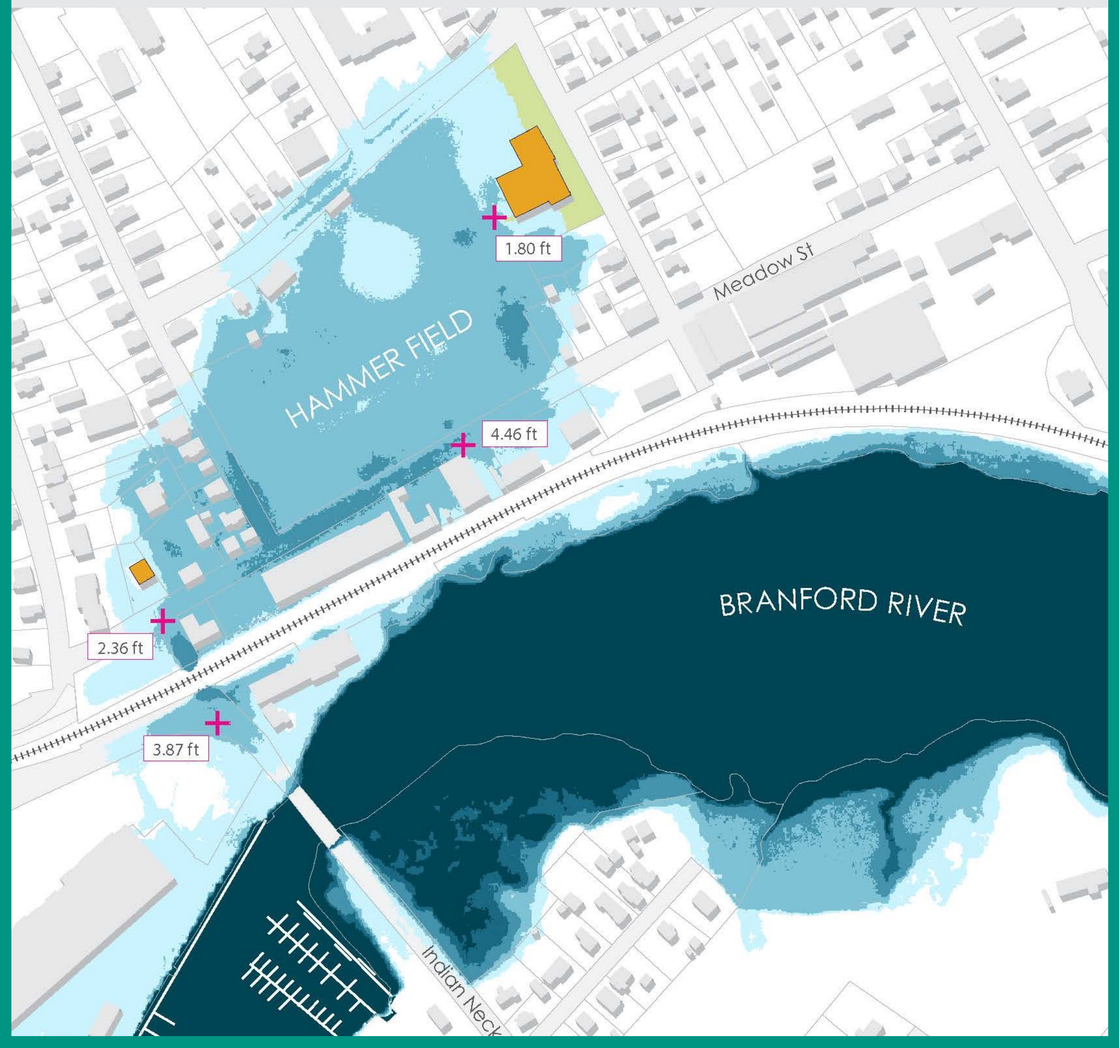


RESILIENT BRANFORD

EXTENT OF FLOODING

50-YEAR STORM (PRESENT DAY)

Flooding along Meadow Street could reach a depth up to 4 feet during the 2% AEP coastal storm event.



50-YEAR STORM (2050)

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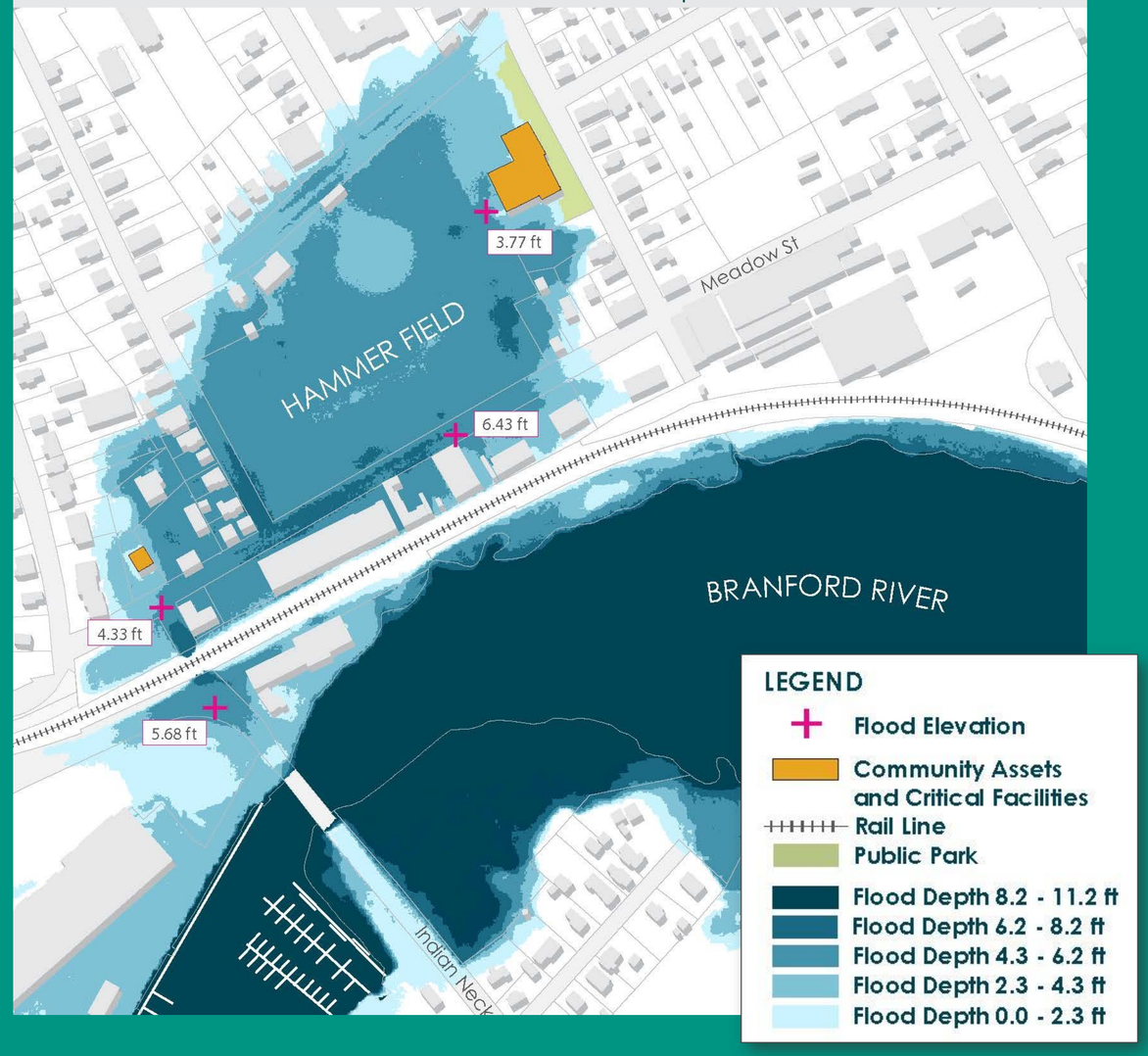
Under projected future conditions for a coastal storm event with the same AEP, an additional 2 feet of floodwater is anticipated.

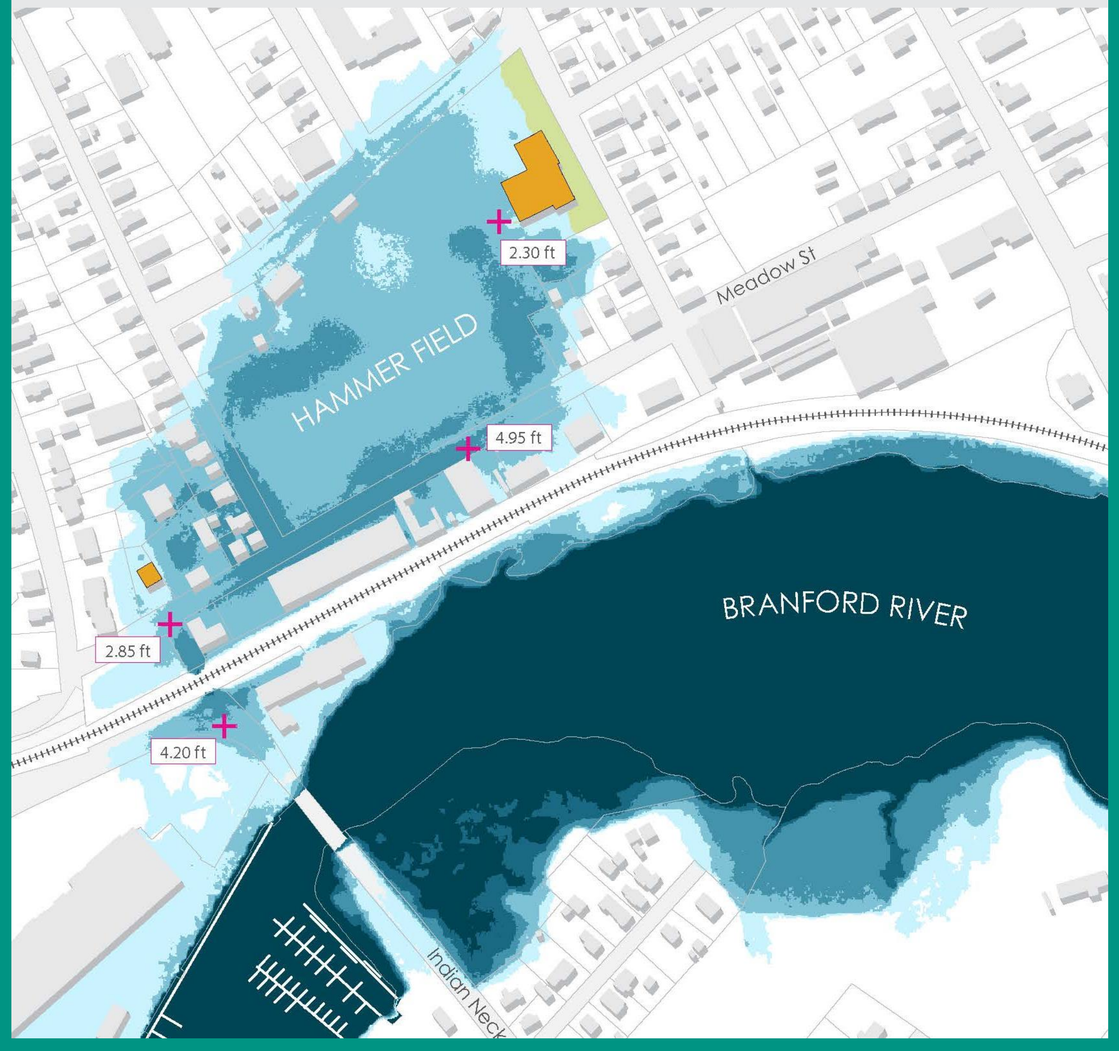


RESILIENT BRANFORD

EXTENT OF FLOODING

100-YEAR STORM (PRESENT DAY)

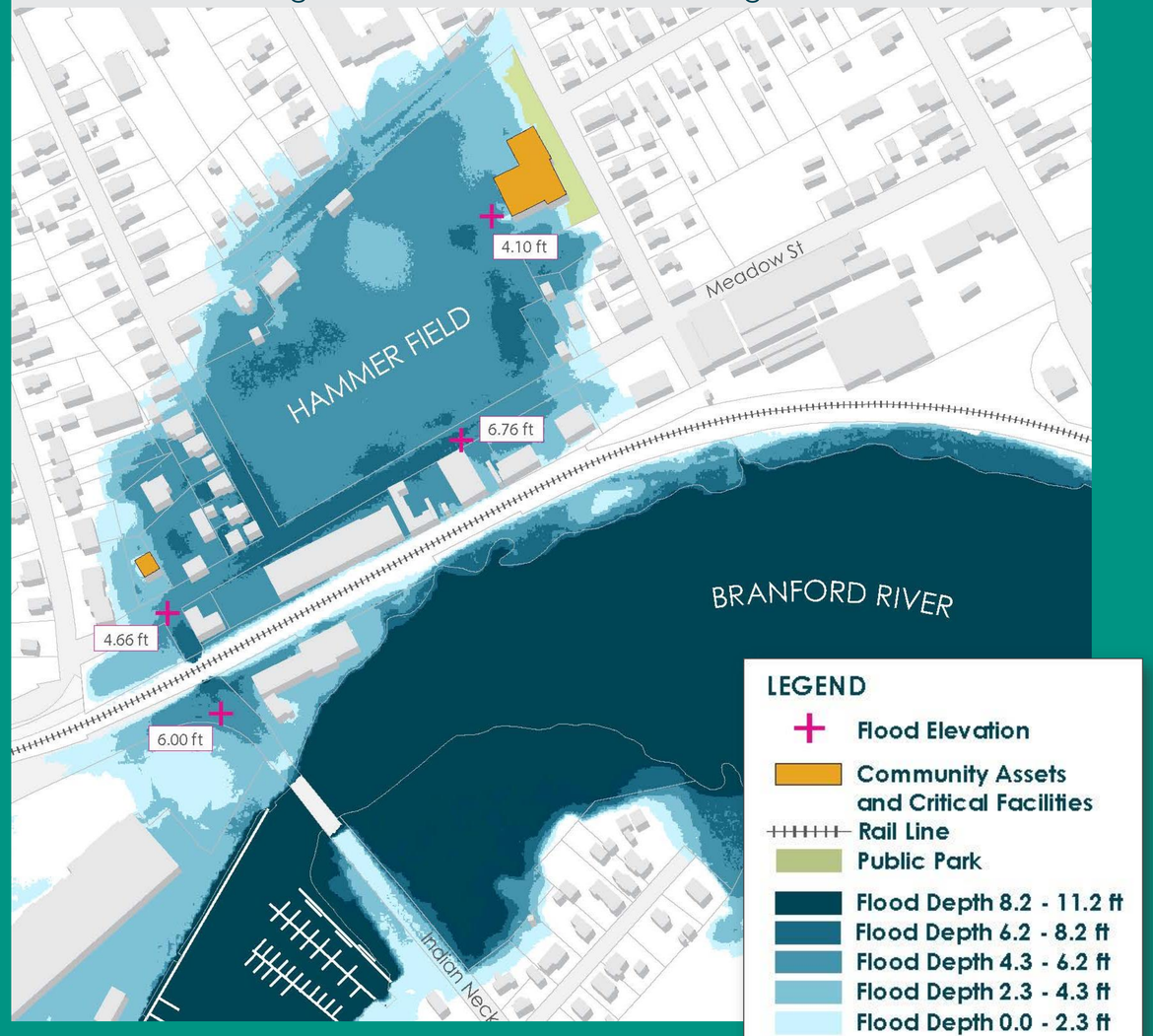
The 1% AEP storm event does not overtop the railroad embankment, even under the future SLR scenario.



100-YEAR STORM (2050)

Assumes 20-inches of sea level rise

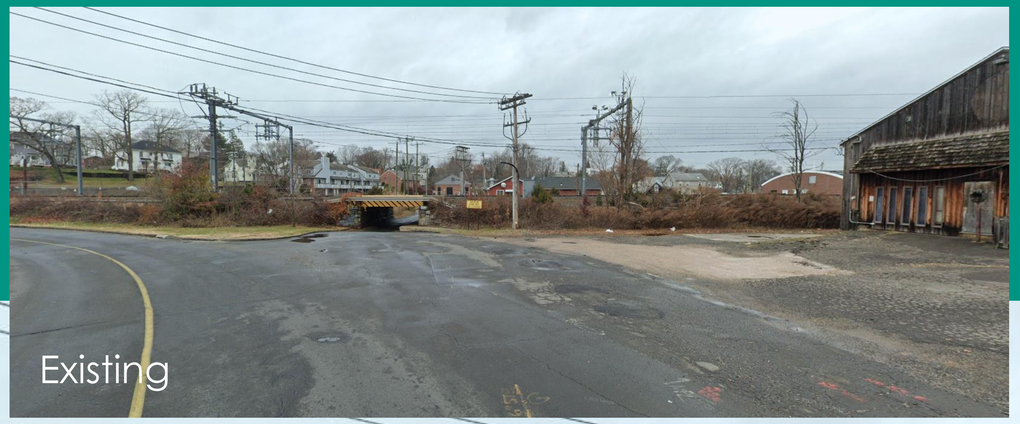
Stopping floodwater before it enters the Cattle Crossing will protect the Meadow Street neighborhood from coastal flooding.



RESILIENT BRANFORD

GATE AND SHEET PILE WALL

RESILIENT BRANFORD



Existing

CIRCA Connecticut Institute for Resilience and Climate Adaptation

FUSS & O'NEILL

GATE AND EMBANKMENT
Sheet Pile Wall Plan

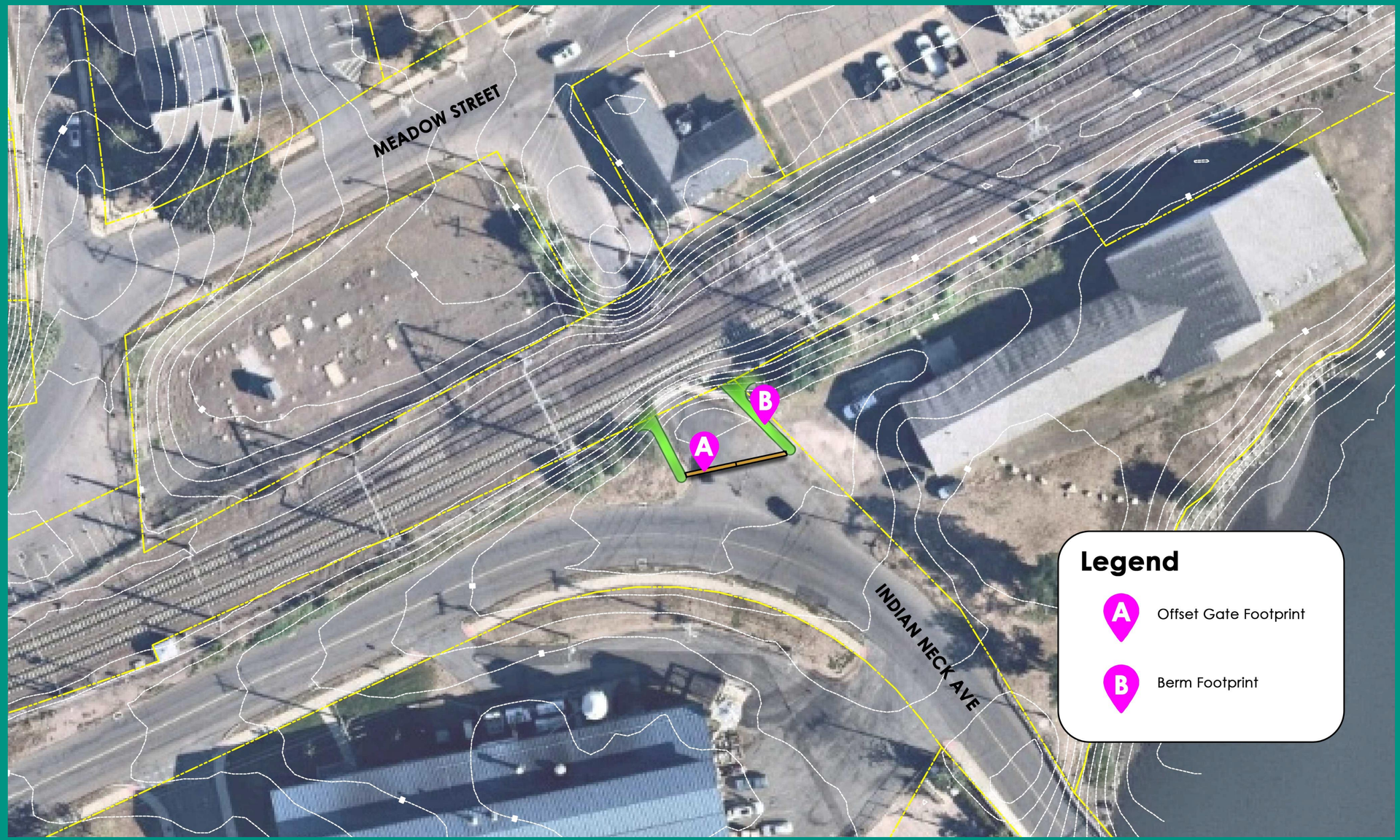
RESILIENT BRANFORD

CIRCA Connecticut Institute for Resilience and Climate Adaptation

FUSS & O'NEILL

GATE AND EMBANKMENT
Berm Plan

RESILIENT BRANFORD



CIRCA Connecticut Institute for Resilience and Climate Adaptation

FUSS & O'NEILL

CROSS-SECTION GATE AND SHEET PILE WALL

RESILIENT BRANFORD

CIRCA Connecticut Institute for Resilience and Climate Adaptation

FUSS & O'NEILL

PUBLIC ENGAGEMENT MEETING NOTES

JUNE 29, 2023 – 5:00 p.m.
Branford Jazz On-the-Green
Branford, CT

PROJECT NUMBER: 20191105.A10

PROJECT NAME: CIRCA Resilient Connecticut Phase III - Branford

ATTENDEES:

Name	Organization
David Murphy	CIRCA
John Hoefferle	Town of Branford
Dean Audet	Fuss & O'Neill
Celicia Boyden	Fuss & O'Neill
Rebecca Meyers	Fuss & O'Neill

RE: Public Engagement – Jazz On-the-Green

SUBMITTED BY: Fuss & O'Neill

ATTACHMENTS:
A – Flyer
B – Poster Boards

For this public engagement opportunity, Fuss & O'Neill set up a tent and poster boards before the weekly Town of Branford Jazz-on-the-Green concert on June 29, 2023. The attached poster boards were displayed for public feedback as well as discussion with the Engineers and Town. The attached flyer titled "Meadow Street Flood Resilience Project Public Engagement" was distributed to passersby and those who came up to the tent to ask questions.

Fuss & O'Neill staff engaged the crowd by distributing flyers to people sitting on the green and had the opportunity to discuss the project with anyone in the crowd who was interested in the project. Fuss & O'Neill provided a background on the project location, flood mitigation goals, two mitigation alternatives, and CIRCA flood modeling results.

The project and alternatives were discussed with approximately 40 members of the public. A summary of the general discussion topics and questions are outlined below.

- Many members of the Public were familiar with the flooding issues that occur on Meadow Street and in Hammer Field during storms and large rain events. Several Town residents mentioned that they avoided the area during and after heavy rainfall.

- Concerns about costs were discussed and how the project would be funded. It was discussed that the Town could receive funding from FEMA only for the flood gate with flood wall alternative, but that other funding opportunities are available for the flood gate only alternative.

- Concerns about how the building adjacent to the Cattle Crossing (4 Indian Neck Ave) would be affected with the flood gate with floodwall alternative were discussed. It was mentioned that discussions with the owner would need to occur but that the goal was to avoid the building as much as possible by going behind the structure.

- Several questions were raised about Amtrak coordination. Fuss & O'Neill outlined that a Form, Fit, and Function review process was underway and Amtrak coordination would be taken into consideration.

- There was a broad range of responses concerning the alternatives from the public including the following:
    - Generally, residents wanted to address the folding in the most cost-effective way, even if that meant filling in the Cattle Crossing.
    - If the Cattle Crossing was to be closed, it was suggested that a traffic study be undertaken to evaluate the impacts to intersections at Maple Street.
    - Constructing the flood gate only was generally well received.
    - Most disliked of the aesthetics of the sheet pile wall, unless necessary to protect against flooding. Several mentioned collaborations with local artists.

PHOTO FROM PUBLIC ENGAGEMENT MEETING


THE MEADOW STREET NEIGHBORHOOD
FLOOD MITIGATION PROJECT
BRANFORD
OZARK TRAIL
THE MEADOW STREET NEIGHBORHOOD
BRANFORD

Attachment A

Flyer

Meadow Street Flood Resilience Project
Public Engagement

June 29, 2023 | 5:00PM | Branford Jazz-on-the Green | 1019 Main St | Branford, CT

The Meadow Street Neighborhood

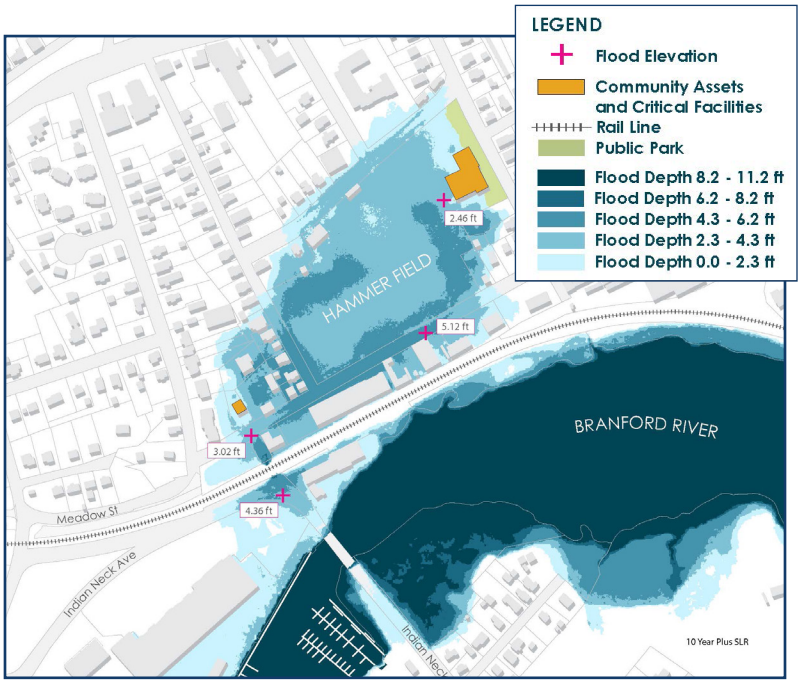
Meadow Street is a low-lying street located between Hammer Field and the Amtrak railroad embankment. This road, Hammer Field and the surrounding neighborhood are exposed to flooding from the Branford River through the "Cattle Crossing" which is an underpass under the Amtrak embankment. The fact that the elevation of the low point on this road is just below Mean High Water (2.66 feet NAVD88) highlights the risk of flooding on the road. This neighborhood is within the FEMA-mapped floodplain and has experienced flooding from past coastal storms.

Rising sea levels are increasing the threats of flooding in this neighborhood. On the Long Island Sound shoreline, up to 20-inches of sea level rise is projected by 2050. The impacts of this additional water could be substantial. For example, a storm with a 10% probability of occurring in 2023 would only flood the underpass, however, a storm with the same probability of flooding in 2050 is projected to flood up to 35 residences, businesses, and municipal structures.

The Town of Branford is working with the Connecticut Institute for Resilience & Climate Adaptation (CIRCA) to develop a plan to reduce flooding risk in the Meadow Street neighborhood. This project is funded through a partnership between Department of Housing and Urban Development (HUD) and Connecticut Department of Housing (CT DOH) through the National Disaster Resilience program, and focuses on increasing the resilience and sustainability of communities along Connecticut's coast and inland waterways.

On June 29, 2023 on the Branford Green, before the Branford Jazz-on-the-Green Concert, the Town and CIRCA will set up a tent and be conducting a workshop for the public to discuss flooding risks in this neighborhood and potential solutions being considered to control those risks.

The "Cattle Crossing" from Indian Neck Road



Projected Extent of Flooding for 10-Year Storm in 2050

Attachment B

Poster Boards

THE MEADOW STREET NEIGHBORHOOD

RESILIENT BRANFORD

Storm Event	Number of Structures Impacted (North of Train Tracks)	
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THE CATTLE CROSSING

CIRCA Connecticut Institute for Resilience and Climate Adaptation

FUSS & O'NEILL

EXTENT OF FLOODING

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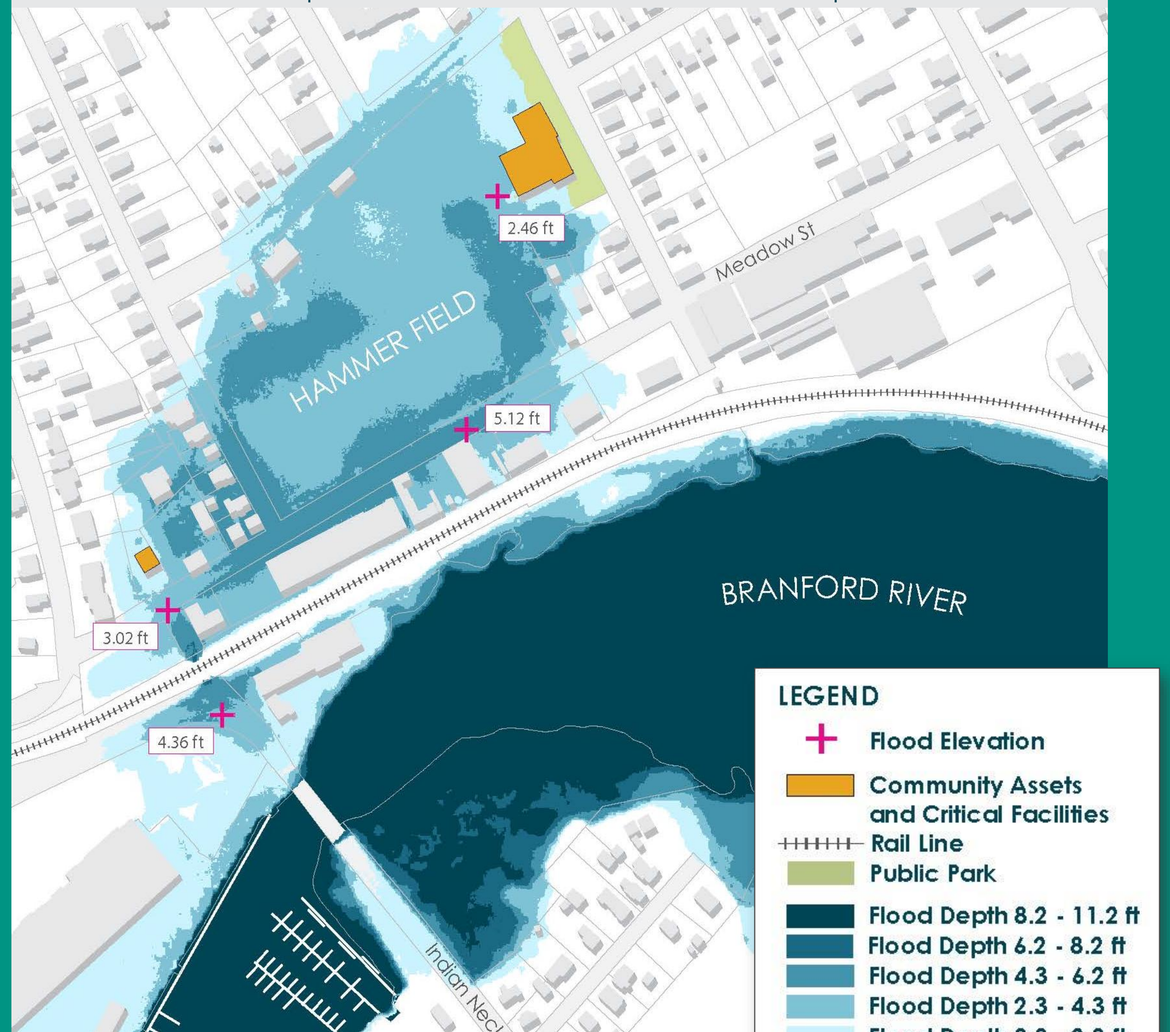

RESILIENT BRANFORD

EXTENT OF FLOODING

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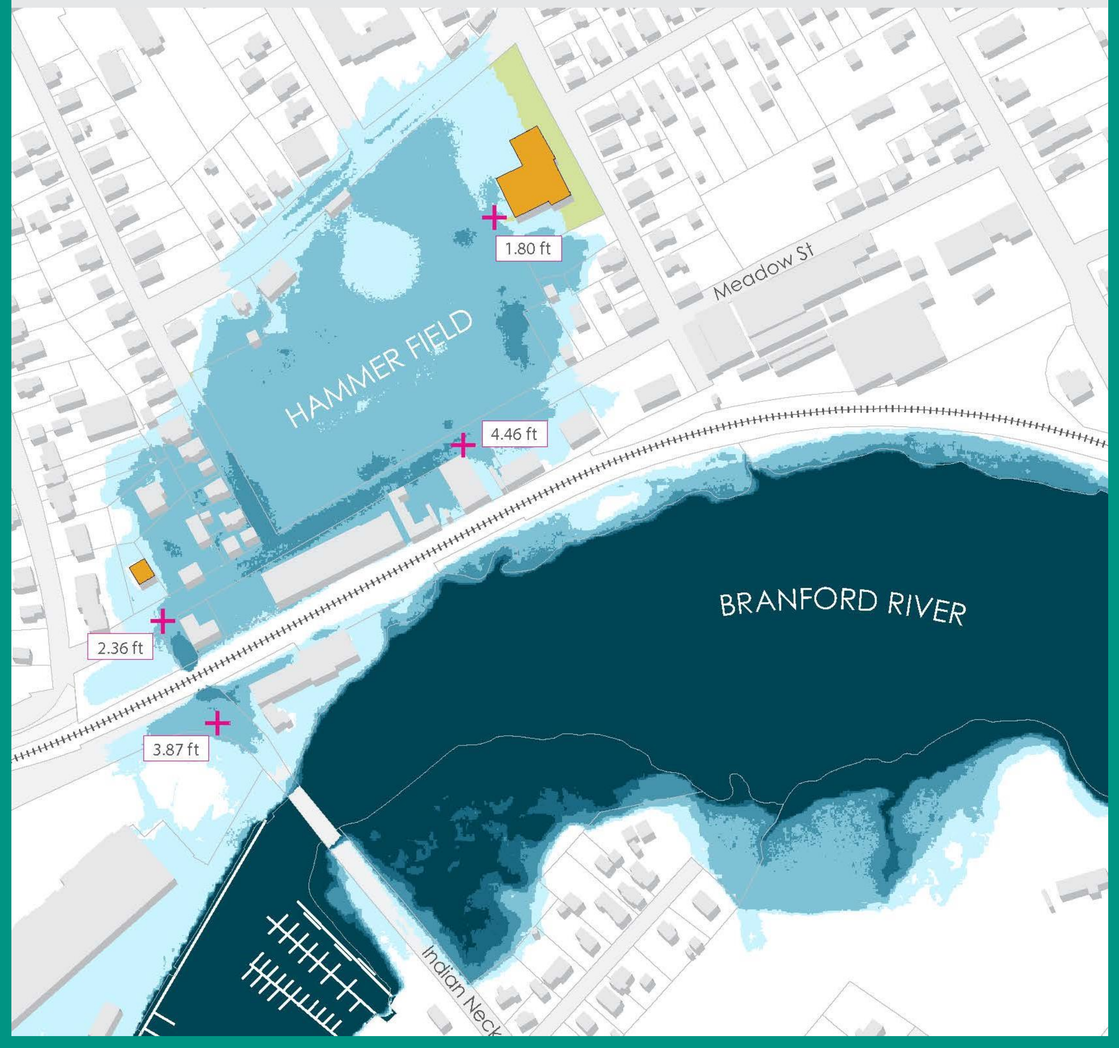
Flooding along Meadow Street could reach a depth up to 4 feet during the 2% AEP coastal storm event.



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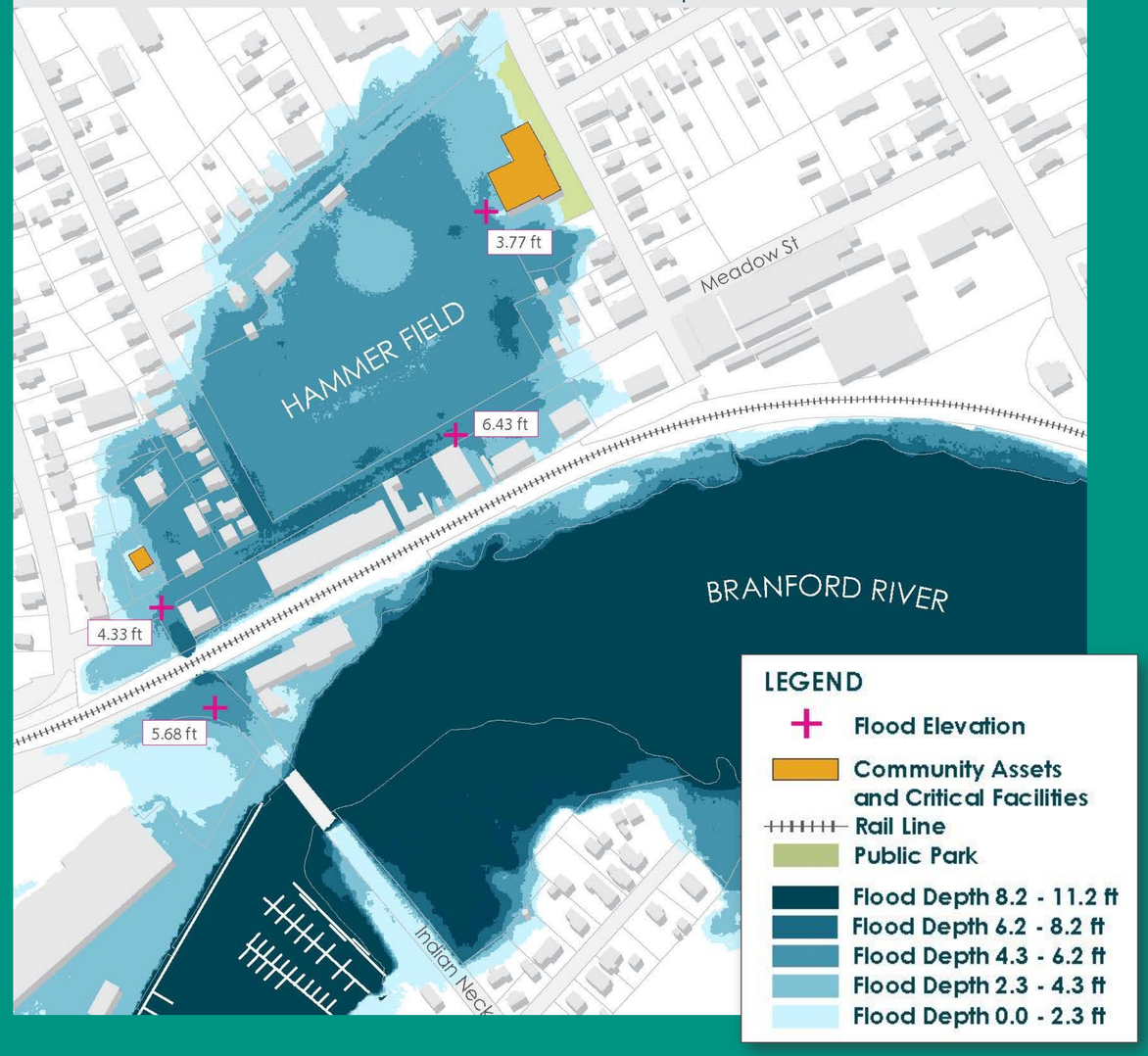

RESILIENT BRANFORD

EXTENT OF FLOODING

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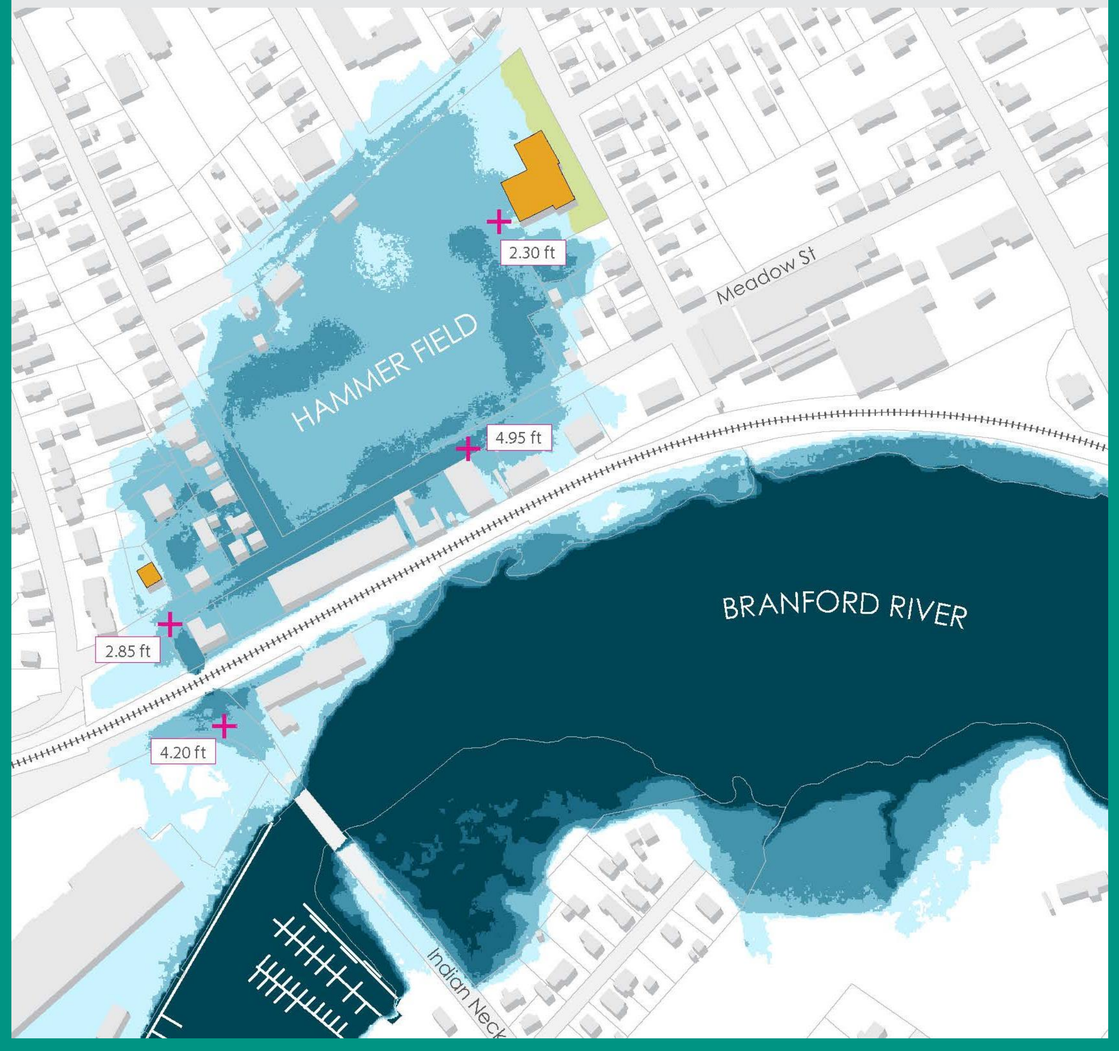

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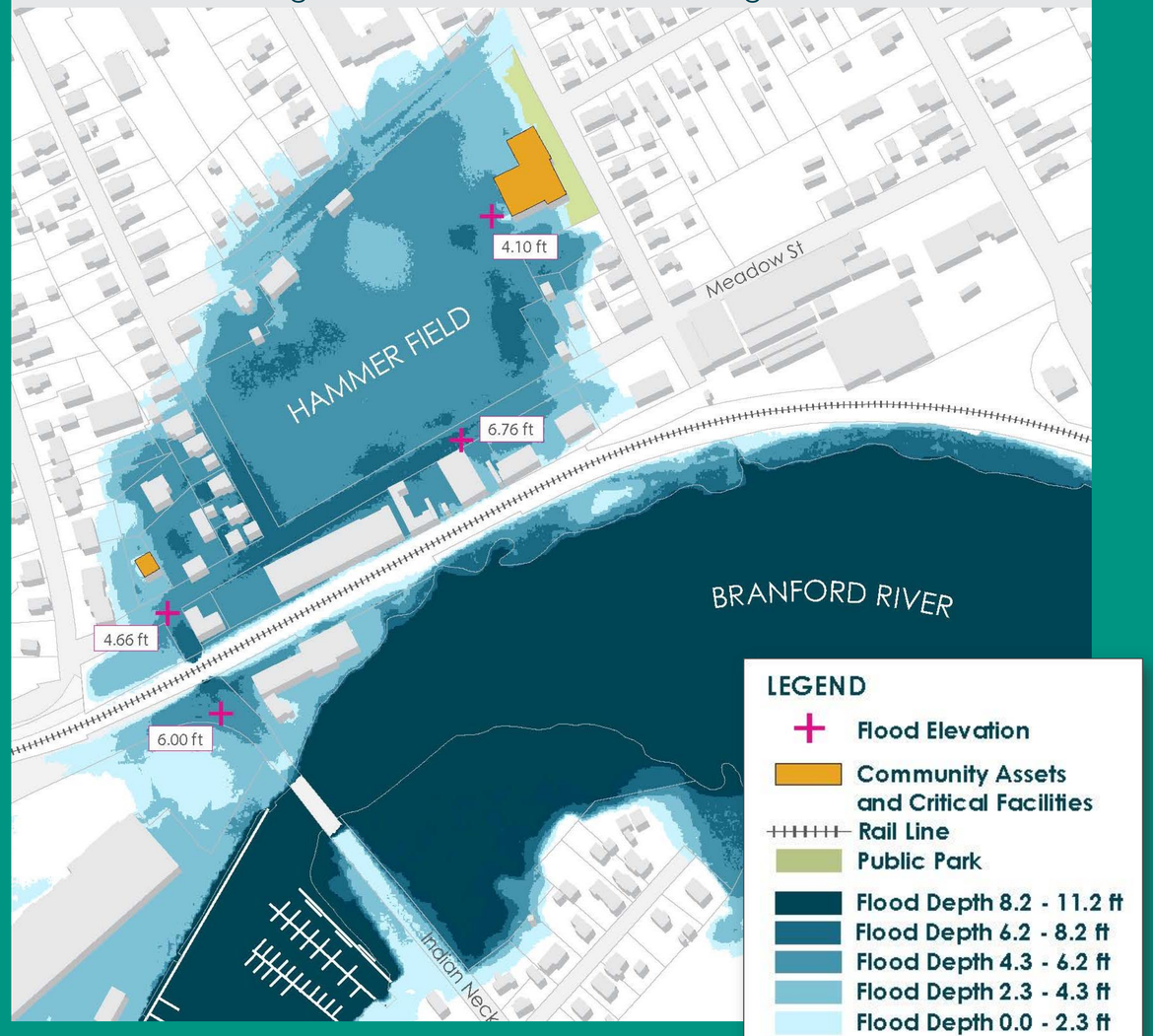
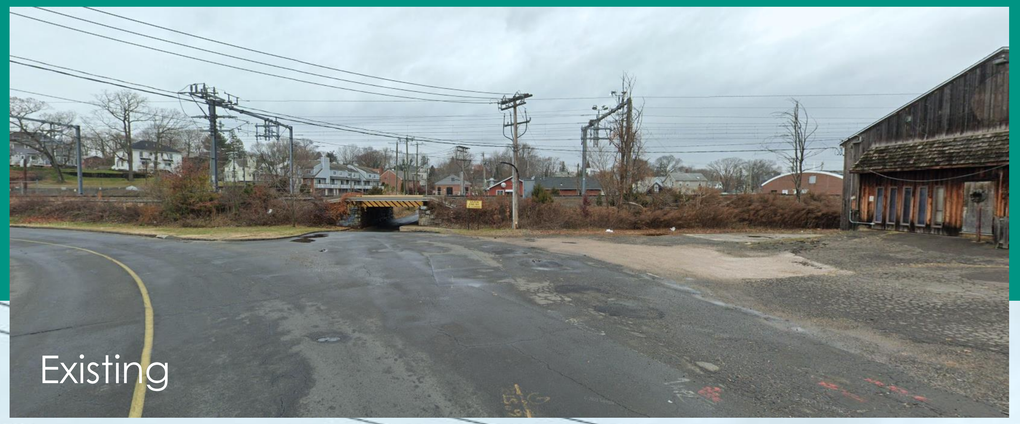


RESILIENT BRANFORD

GATE AND SHEET PILE WALL

RESILIENT BRANFORD



Existing

CIRCA Connecticut Institute for Resilience and Climate Adaptation

FUSS & O'NEILL

GATE AND EMBANKMENT
Sheet Pile Wall Plan

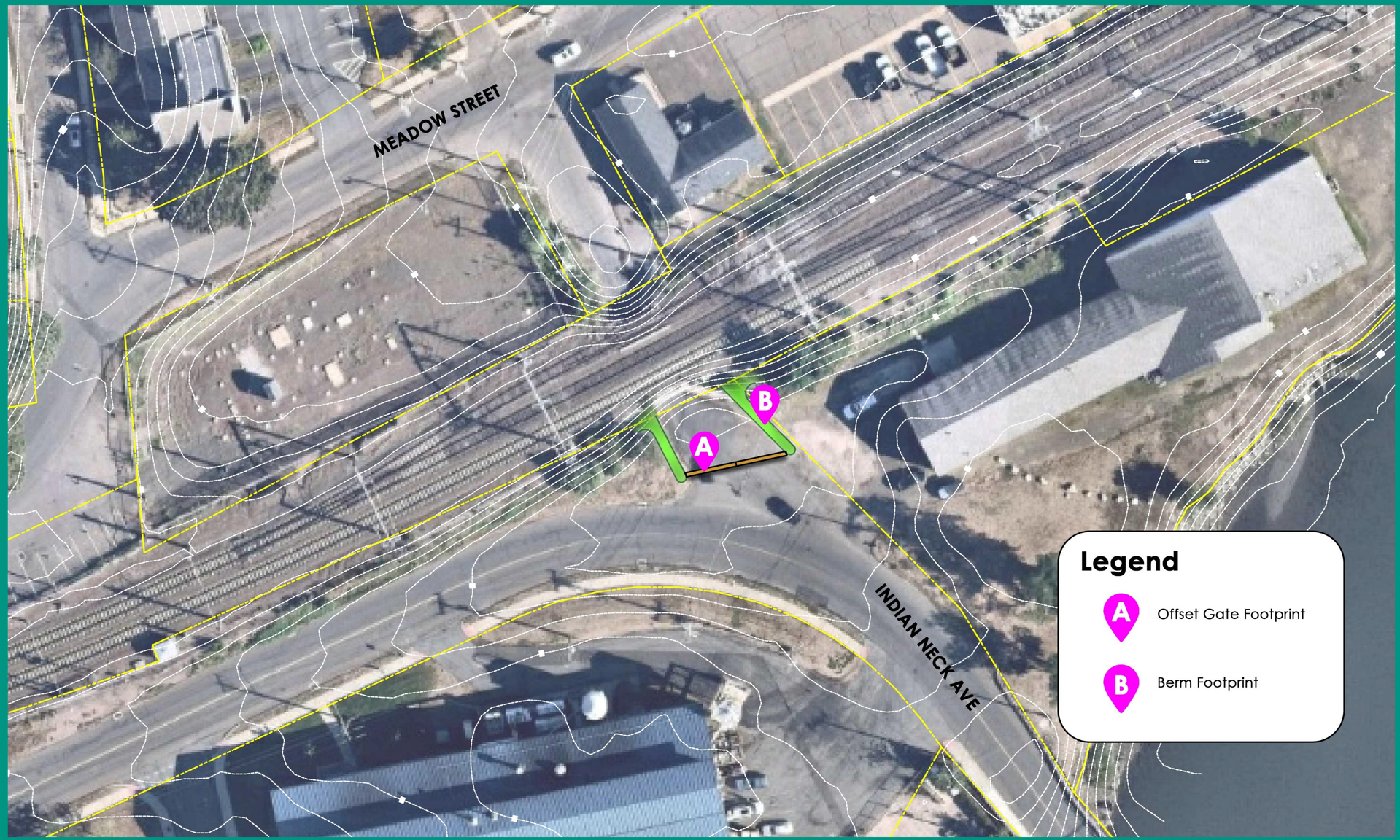
RESILIENT BRANFORD

CIRCA Connecticut Institute for Resilience and Climate Adaptation

FUSS & O'NEILL

GATE AND EMBANKMENT
Berm Plan

RESILIENT BRANFORD



CIRCA Connecticut Institute for Resilience and Climate Adaptation

FUSS & O'NEILL

CROSS-SECTION GATE AND SHEET PILE WALL

RESILIENT BRANFORD

CIRCA Connecticut Institute for Resilience and Climate Adaptation

FUSS & O'NEILL

RESILIENT
BRANFORD

ATTACHMENT D

COST ESTIMATES

ORDER OF MAGNITUDE OPINION OF COST

FUSS & O'NEILL
Disciplines to Deliver

PROJECT:	Resilient Branford - Gate and Sheetpile Wall	SHEET:	1 OF 1
LOCATION:	Branford, CT	DATE PREPARED:	02/02/23
DESCRIPTION:	**Installing a sheetpile wall and swing gate to prevent the flooding of the neighborhood near Meadow Street.**	ESTIMATOR:	RKM
		CHECKED BY:	DA
		PROJECT NO.:	20191105.C10

Since Fuss & O'Neill has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor(s)' methods of determining prices, or over competitive bidding or market conditions, Fuss & O'Neill's opinion of probable Total Project Costs and Construction Cost are made on the basis of Fuss & O'Neill's experience and qualifications and represent Fuss & O'Neill's best judgment as an experienced and qualified professional engineer, familiar with the construction industry; but Fuss & O'Neill cannot and does not guarantee that proposals, bids or actual Total Project or Construction Costs will not vary from opinions of probable cost prepared by Fuss & O'Neill. If prior to the bidding or negotiating Phase the Owner wishes greater assurance as to Total Project or Construction Costs, the Owner shall employ an independent cost estimator.

	ITEM DESCRIPTION	UNITS	NUM. OF UNITS	COST PER UNIT	TOTAL COST
1	**Site Preparation**				
	Mobilization & Demobilization (5%)	LS	1	$235,204.88	$235,205
	Sediment Control (2%)	LS	1	$94,081.95	$94,082
	Insurance and Bonds (5%)	LS	1	$235,204.88	$235,205
	Clearing and Grubbing (2%)	LS	1	$94,081.95	$94,082
	Subtotal				**$658,574**
3	**Site Improvements**				
	Sheetpile Wall	LB	1,248,030	$3.25	$4,056,098
	Swing Gate	LS	1	$600,000.00	$600,000
	Riprap	CY	600	$80.00	$48,000
	Subtotal				**$4,704,098**
4	**General Conditions**				
	Construction Survey Layout & As-Built Mapping	LS	1	$10,000.00	$10,000
	Traffic Control	DAYS	14	$5,000.00	$70,000
	General Conditions	LS	1	$23,000.00	$23,000
	Amtrak and Utility Coordination	LS	1	$250,000.00	$250,000
	Subtotal				**$353,000**
	TOTAL CONSTRUCTION COST				$5,715,671
	ENGINEERING/LEGAL/ADMINISTRATIVE (20%)				$1,143,134
	SUBTOTAL				**$6,860,000**
	TOTAL COST (-30% TO +50% ROUNDED)				**$4,900,000 TO $10,300,000**

Notes:

ORDER OF MAGNITUDE OPINION OF COST

FUSS & O'NEILL
Disciplines to Deliver

PROJECT:	Resilient Branford - Gate and Embankment
LOCATION:	Branford, CT
DESCRIPTION:	**Installing a swing gate to prevent the flooding of the neighborhood near Meadow Street.**

SHEET:	1 OF 1
DATE PREPARED:	02/02/23
ESTIMATOR:	RKM
CHECKED BY:	DA
PROJECT NO.:	20191105.C10

Since Fuss & O'Neill has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor(s)' methods of determining prices, or over competitive bidding or market conditions, Fuss & O'Neill's opinion of probable Total Project Costs and Construction Cost are made on the basis of Fuss & O'Neill's experience and qualifications and represent Fuss & O'Neill's best judgment as an experienced and qualified professional engineer, familiar with the construction industry; but Fuss & O'Neill cannot and does not guarantee that proposals, bids or actual Total Project or Construction Costs will not vary from opinions of probable cost prepared by Fuss & O'Neill. If prior to the bidding or negotiating Phase the Owner wishes greater assurance as to Total Project or Construction Costs, the Owner shall employ an independent cost estimator.

	ITEM DESCRIPTION	UNITS	NUM. OF UNITS	COST PER UNIT	TOTAL COST
1	**Site Preparation**				
	Mobilization & Demobilization (5%)	LS	1	$50,000.00	$50,000
	Sediment Control (5%)	LS	1	$20,000.00	$20,000
	Insurance and Bonds (5%)	LS	1	$50,000.00	$50,000
	Site Prep (2%)	LS	1	$20,000.00	$20,000
	Subtotal				**$140,000**
3	**Site Improvements**				
	Swing Gate	LS	1	$600,000.00	$600,000
	Embankment Fill	CY	510	$97.00	$49,470
	Subtotal				**$649,470**
4	**General Conditions**				
	Construction Survey Layout & As-Built Mapping	LS	1	$10,000.00	$10,000
	Traffic Control	DAYS	14	$1,000.00	$14,000
	General Conditions	LS	1	$23,000.00	$23,000
	Amtrak and Utility Coordination	LS	1	$100,000.00	$100,000
	Subtotal				**$147,000**
	TOTAL CONSTRUCTION COST				$936,470
	ENGINEERING/LEGAL/ADMINISTRATIVE (20%)				$187,294
	SUBTOTAL				**$1,130,000**
	TOTAL COST (-30% TO +50% ROUNDED)				**$800,000 TO $1,700,000**

Notes:

ORDER OF MAGNITUDE OPINION OF COST		FUSS & O'NEILL *Disciplines to Deliver*	SHEET: 1 OF 1
PROJECT:	Resilient Branford - Gate and Embankment		DATE PREPARED: 02/02/23
LOCATION:	Branford, CT		ESTIMATOR: RKM
DESCRIPTION:	**Filling in the Cattle Crossing to prevent the flooding of the neighborhood near Meadow Street.**		CHECKED BY: DA
			PROJECT NO.: 20191105.C10

Since Fuss & O'Neill has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor(s)' methods of determining prices, or over competitive bidding or market conditions, Fuss & O'Neill's opinion of probable Total Project Costs and Construction Cost are made on the basis of Fuss & O'Neill's experience and qualifications and represent Fuss & O'Neill's best judgment as an experienced and qualified professional engineer, familiar with the construction industry; but Fuss & O'Neill cannot and does not guarantee that proposals, bids or actual Total Project or Construction Costs will not vary from opinions of probable cost prepared by Fuss & O'Neill. If prior to the bidding or negotiating Phase the Owner wishes greater assurance as to Total Project or Construction Costs, the Owner shall employ an independent cost estimator.

	ITEM DESCRIPTION	UNITS	NUM. OF UNITS	COST PER UNIT	TOTAL COST
1	**Site Preparation**				
	Mobilization & Demobilization (5%)	LS	1	$50,000.00	$50,000
	Sediment Control (5%)	LS	1	$20,000.00	$20,000
	Insurance and Bonds (5%)	LS	1	$50,000.00	$50,000
	Site Prep (2%)	LS	1	$20,000.00	$20,000
	Subtotal				**$140,000**
3	**Site Improvements**				
	Flowable Fill	CY	430	$100.00	$43,000
	Subtotal				**$43,000**
4	**General Conditions**				
	Construction Survey Layout & As-Built Mapping	LS	1	$10,000.00	$10,000
	Traffic Control	DAYS	14	$1,000.00	$14,000
	General Conditions	LS	1	$23,000.00	$23,000
	Amtrak and Utility Coordination	LS	1	$100,000.00	$100,000
	Subtotal				**$147,000**
	TOTAL CONSTRUCTION COST				$330,000
	ENGINEERING/LEGAL/ADMINISTRATIVE (20%)				$66,000
	SUBTOTAL				**$400,000**
	TOTAL COST (-30% TO +50% ROUNDED)				**$300,000 TO $600,000**

Notes: