RESILIENT EAST HADDAM

FINAL REPORT
CIRCA PHASE III - RESILIENT CONNECTICUT

JUNE 2025

CIRCA
Connecticut Institute for Resilience and Climate Adaptation

KLEINFELDER
Bright People. Right Solutions.

RESILIENT EAST HADDAM

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Sponsored by a grant from the Connecticut Institute for Resilience and Climate Adaptation (CIRCA).
CIRCA is a partnership between the University of Connecticut and the State of Connecticut Department of Energy and Environmental Protection.
More information can be found at: www.circa.uconn.edu

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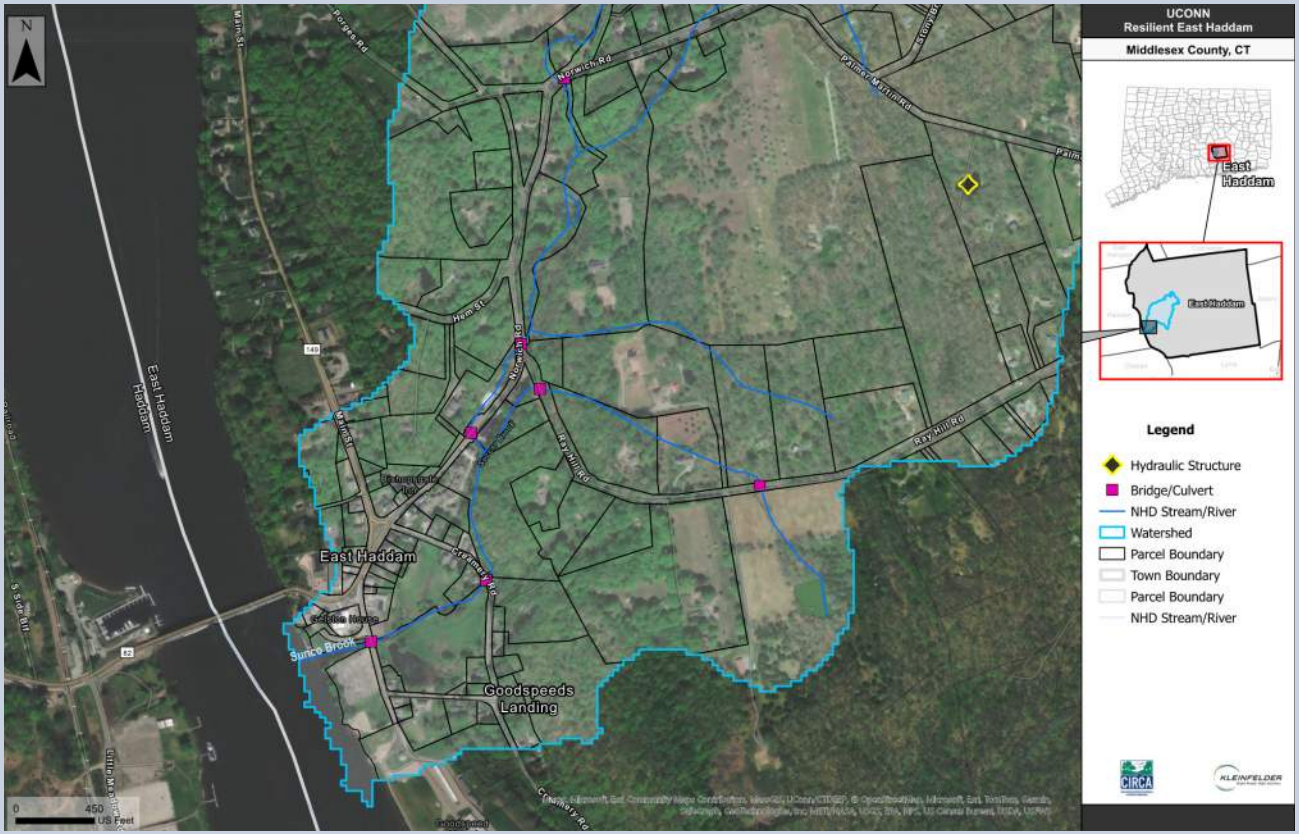
Overview

The focus area of this study is located along the lower reach of Succor Brook in the Town of East Haddam, near its confluence with the Connecticut River. In the study area, Succor Brook flows alongside Norwich Road, Creamery Road, and Lumber Yard Road. At the edge of the study area is the Goodspeed Opera House, a musical theatre landmark and a key cultural asset drawing 80,000-100,000 visitors to the region annually.

Aside from the Opera House itself, other buildings owned by the Goodspeed Foundation are within the focus area including the Natalie and Ashton Tenney Rehearsal Studio, the Scherer Library of Musical Theatre, and a housing development for actors in residence known as the Artists Village. Many other residences and businesses are located in the focus area, and the area overlaps with the East Haddam Historic District.

Also, the study considered flood risks to a municipal wastewater treatment plant (WWTP) and a sewage pump station located along the Connecticut River. This infrastructure treats an average of 55,000 gallons of wastewater per day and serves numerous buildings in the Town.



Succor Brook watershed near its confluence with the Connecticut River

RESILIENT EAST HADDAM

SUMMARY

Existing and Future Flooding Conditions

Succor Brook has overtopped its banks during several recent storm events, notably in 2018, 2021, and 2024. During these storms, flooding impacted the Tenney Rehearsal Studio and the building across the street, a former manufacturing building which houses the Library of Musical Theatre and a costume factory. Other Goodspeed-owned buildings, particularly those in the Artists Village close to Succor Brook, have experienced damage due to flooding. Past floods have also inundated Norwich Road (CT Route 82) and damaged private homes on Creamery Road.

Kleinfelder performed hydrologic and hydraulic modeling to analyze current and future conditions that make the study area more susceptible to flooding. The modeling effort identified key areas for implementation of flood mitigation efforts. With stronger storms anticipated by mid-century, the analysis showed that the community will experience increased damage to key assets and irreplaceable historic structures due to flooding if no mitigation steps are taken. In conjunction with CIRCA, Kleinfelder projected future flood conditions in the Connecticut River to assess potential vulnerabilities to the WWTP and pump station.

Norwich Road along Succor Brook


Flooding at Artists Village

Adaptation Options

Using the results of the current and future conditions analysis, Kleinfelder developed conceptual adaptation options that may assist with reducing flood vulnerability in the study area. When evaluating alternatives, Kleinfelder incorporated stakeholder feedback and focused on potential projects that were realistic and implementable.

The benefits and challenges to implementation of these adaptations are presented in this report.

The planning and conceptual design efforts focused on the following objectives:

1. Identify interventions (such as floodplain creation, flood protection measures, structure elevation, etc.) to reduce risks to Goodspeed facilities, other residences and businesses near Succor Brook, and the Town's WWTP and Pump Station.
2. Identify new locations for Goodspeed rehearsal and administrative buildings that could be pursued using funds identified in this study.
3. Account for stakeholder feedback in the development of flood mitigation measures.

Through ongoing monthly meetings with the project team, as well as four Citizen and Technical Advisory Committee (CTAC) meetings and two public workshops, stakeholder input was gathered to help inform the conceptual design priorities and alternatives that were developed for the Final Report.

Fast moving water over Trouble Pond Dam, upstream of the Tenney Rehearsal Studio

RESILIENT EAST HADDAM SUMMARY

Kleinfelder developed a Benefit-Cost Analysis (BCA) focusing on understanding options for alternatives and phasing, cost estimates, and funding opportunities.

A range of strategies was developed to address flooding within the study area in East Haddam.

Flood Mitigation Alternatives

Alternative 1:

- Remove the obsolete mill building at 21 Norwich Road that currently houses the Tenney Rehearsal Studio and the box culvert carrying Succor Brook beneath the Rehearsal Studio
- Construct a new, more natural Succor Brook channel in the footprint of the Rehearsal Studio
- Relocate the rehearsal space to a new building in a different location. One possible location is 24 Lumber Yard Road, the former Carriage House/Williams Chevrolet property, which is currently owned by the Goodspeed Foundation and is used for parking. However, other locations may be considered for this purpose.
- Elevate existing buildings at 59 and 62 Creamery Road (not required if flood mitigation measures in other alternatives are also implemented)

Alternative 2:
includes Alternative 1, plus:

- Replace the existing box culvert carrying Creamery Road over Succor Brook with a new, wider bridge that spans the bankfull width of Succor Brook
- Re-construct the bank on the right-hand side of the Brook upstream of the Creamery Road crossing to expand capacity and replicate natural wetland and floodplain function to the extent practicable

Alternative 3:
includes Alternatives 1 and 2, plus:

- Construct a floodwall and earthen berm structure on the right bank of Succor Brook between Norwich Road and Creamery Road
- Construct a bypass culvert to provide additional flow capacity at the southernmost crossing of Norwich Road over Succor Brook, where presently there is a sharp bend in the Brook's alignment
- Protect or elevate individual buildings along Succor Brook

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A fourth flood mitigation alternative was considered which includes Alternative 3, but instead of constructing a bypass culvert at Norwich Road, the alternative includes construction of a dam to increase flood storage at the unnamed pond downstream of Daniels Road. The alternative was predicted to improve flood conditions in the study area, however, obtaining local, state, and federal permits for new dam construction is likely to be much more difficult than the anticipated permit process required to construct the other alternatives. Additionally, the operation, maintenance and inspection costs required for a dam is likely to be much greater than the other alternatives. Therefore, this alternative was not advanced beyond the adaptation strategy modeling stage of this analysis.

Separate from the Succor Brook interventions, Kleinfelder has also developed a set of interventions at the WWTP to mitigate risk to the facility based on projected future flood elevations along the Connecticut River.

- Construct an impermeable concrete barrier along the perimeter of the East Haddam Wastewater Treatment Plant buildings and dry floodproof the buildings to at least the future Connecticut River 100-year flood elevation
- Raise electrical and control equipment at the pump station above the projected future Connecticut River 100-year flood elevation

WWTP Process Building

Summary

Kleinfelder recommends that the Town of East Haddam implement Alternative 2 at a minimum, in addition to implementing the adaptations for the WWTP and pump station as shown in the Preferred Conceptual Design section of this report.

With the guidance of the information contained in the Resilient East Haddam final report, Kleinfelder recommends the Town of East Haddam coordinate with the Goodspeed Foundation and determine whether to further Alternative 2, or the expanded design highlighted in Alternative 3. After weighing the trade-offs and selecting an alternative, the Town should seek and secure funding. Upon receipt of funding, Kleinfelder recommends that the Town undertake additional existing conditions investigations to refine the conceptual designs presented in this report, further develop the costs and implementation steps, and advance the project through design development, construction documentation, and implementation.

Implementation & Action Plan

1. Confirm project approach with stakeholders from the Goodspeed Foundation and the East Haddam community.
2. Reach out to private property owners on Creamery Road within the projected 100-year Succor Brook floodplain.
3. Document a plan for relocation of the current Tenney Rehearsal Studio space to a new facility and Town acquisition of the current Rehearsal Studio building.
4. Seek and secure funding to move to the next phase of project design.
5. Conduct additional survey and geotechnical investigations.
6. Update the flood model to reach a site-specific level of detail and confirm the sizing of flood mitigation project elements.
7. Undertake schematic design, complete the permitting process, and refine costs and implementation steps.
8. Advance the project through final engineering design and construction documentation.
9. Execute a procurement process to qualify and select a contractor to perform project construction.

RESILIENT EAST HADDAM

BACKGROUND

East Haddam comprises 56.6 square miles of rolling countryside east of the Connecticut River. The study focus area includes approximately one-half of a mile of Succor Brook upstream of the Connecticut River, located within the East Haddam Historic District and consists of a mix of residential and business land use.

With a population just over 9,100, the historic town has a strong history associated with the Goodspeed Opera House, which opened to theatergoers in October 1877 and is in operation today just shy of 150 years later. The opera house building originally served as a store, office, steamship docking point, and a venue for live performances. The building was restored and reopened in 1963 and has hosted numerous productions that have won more than a dozen Tony awards.

Beyond the opera house and its historical significance, the project area in East Haddam also encompasses residential properties along Norwich Road and Creamery Road and the wastewater treatment plant, which is critical utility infrastructure for the community.

Goodspeed Opera House

Norman Boardman House

RESILIENT EAST HADDAM

BACKGROUND

Resilient East Haddam is one of 14 projects initiated to date under Phase III of the Resilient Connecticut program developed by the Connecticut Institute for Resilience and Climate Adaptation (CIRCA).

The partnership between CIRCA and its pilot project communities was designed to address an array of climate-related vulnerabilities, provide the communities with actionable plans, and establish a roadmap for other Connecticut communities facing similar natural hazards.

CIRCA initiated Resilient Connecticut in Fairfield and New Haven counties in 2018 – 2023, and expanded to New London, Middlesex, Hartford, and Tolland counties in 2021 – 2024.

Resilient Connecticut 2.0 Phase II

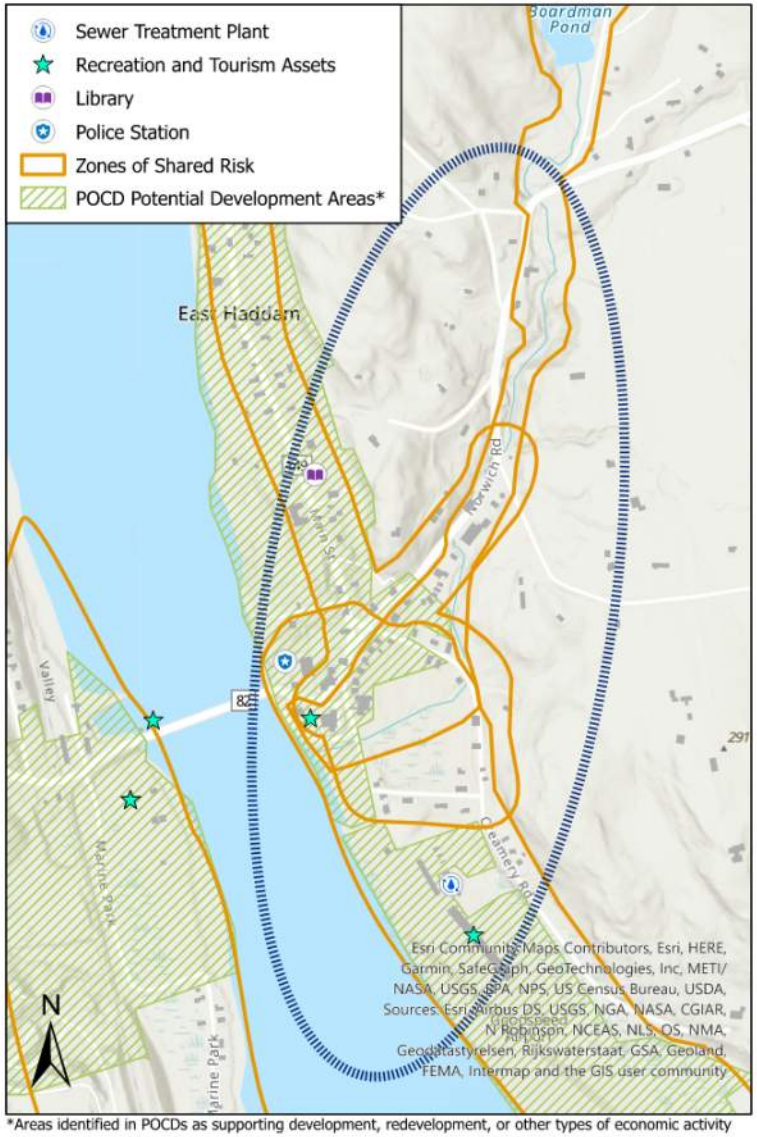
Regional Adaptation/Resilience Opportunity Areas

Name: Goodspeed / Succor Brook
Location: East Haddam

Consideration	Characteristics of Area
Flood Vulnerability	● ● ● ○ ○
Heat Vulnerability	● ● ○ ○ ○
Social Vulnerability	● ○ ○ ○ ○

East Haddam residents have identified flooding from Succor Brook as a persistent concern for the center of town. This brook periodically overtops its banks, and past flash floods have impacted structures associated with the Goodspeed Opera House, including the actor housing, library of musical theater, and rehearsal studio. The Goodspeed is a regional asset that brings 80,000 - 100,000 visitors to East Haddam every year. Additional community assets in this area include the town's police department, sewer treatment plant, and public library, the latter of which can be used as a cooling center when needed.

Goodspeed Opera House Goodspeed Airport East Haddam Police Department	Rathbun Free Memorial Library East Haddam Sewer Treatment Plant



*Areas identified in POCDs as supporting development, redevelopment, or other types of economic activity

BACKGROUND

In Phase II, Resilient Connecticut assessed regional risk and vulnerability across the RiverCOG, SECOG, and CRCOG regions of Connecticut, and identified the Goodspeed/Succor Brook area of East Haddam as an area that commonly floods.

Phase III (Current Phase)

- The goals of Phase III are to support development of a statewide resilience project pipeline and increase coordination across municipal, regional, and state planning efforts.
- Phase III solicits planning level studies to further evaluate and develop strategies to address vulnerabilities in each of the selected communities.
- East Haddam was selected as one of CIRCA's Phase III pilot projects based on several regional assets that are critical to the economy of the area and that have experienced significant flooding in the past.

Data Review

This study builds upon past efforts made at the local and regional level to predict flood impacts in the study area. Previous reports that were reviewed include:

- Connecticut Physical Climate Science Assessment Report (PCSAR)
- Sea Level Rise in Connecticut Final Report
- RiverCOG Flood Susceptibility Mapping
- Effective FEMA Flood Insurance Rate Map and Flood Insurance Study covering East Haddam
- Preliminary HEC-RAS modeling of Succor Brook carried out by CIRCA
- CIRCA Climate Change Vulnerability Index (CCVI) viewer

The effective FEMA Flood Insurance Rate Map (FIRM) covering Succor Brook shows that the Brook was only studied in detail up to a point just downstream of the Creamery Road bridge. Upstream of this point, approximate methods were used to delineate Special Flood Hazard Areas near Succor Brook. The approximate flood zones are not detailed enough to show flood risks in the areas upstream of Creamery Road and are inconsistent with actual flood events experienced by the Town. Also, the FEMA mapping does not reflect anticipated future flood conditions due to climate change.

Succor Brook Watershed Modeling

The Succor Brook watershed contains steep forested upland areas and a relatively flat middle area near the developments at the Town Street/ Norwich Road/Mount Parnassus Road intersection. The Brook passes through multiple abandoned dams, some breached and some partially extant, which were formerly used to power a variety of historical manufacturing operations. Near the project focus area at Norwich Road, Creamery Road, and Lumber Yard Road, the Brook's slope becomes relatively flat as it flows into the Connecticut River.

Kleinfelder developed a hydrologic model of the approximately 3.5-square-mile Succor Brook watershed to predict current and future flood flows in Succor Brook. The model considered topography of the watershed from the CT Environmental Conditions Online database, soil data from the USDA, and land cover and rainfall depth data sourced from NOAA. Generally, runoff contributing to riverine flooding increases as natural land is developed and replaced with impervious surfaces such as buildings, roads, and parking lots. Steep terrain with poorly draining soils also tends to generate greater amounts of runoff during storm events.

Flood events are typically characterized by their Annual Exceedance Probability (AEP), which is the probability of the event being equaled or exceeded in a given year. Key events modeled in this analysis were the 10%, 2%, 1%, and 0.2% AEP events, commonly referred to as the 10-year, 50-year, 100-year, and 500-year floods. The watershed model allowed a comparison of predicted flood flows in Succor Brook from the present-day to the future.

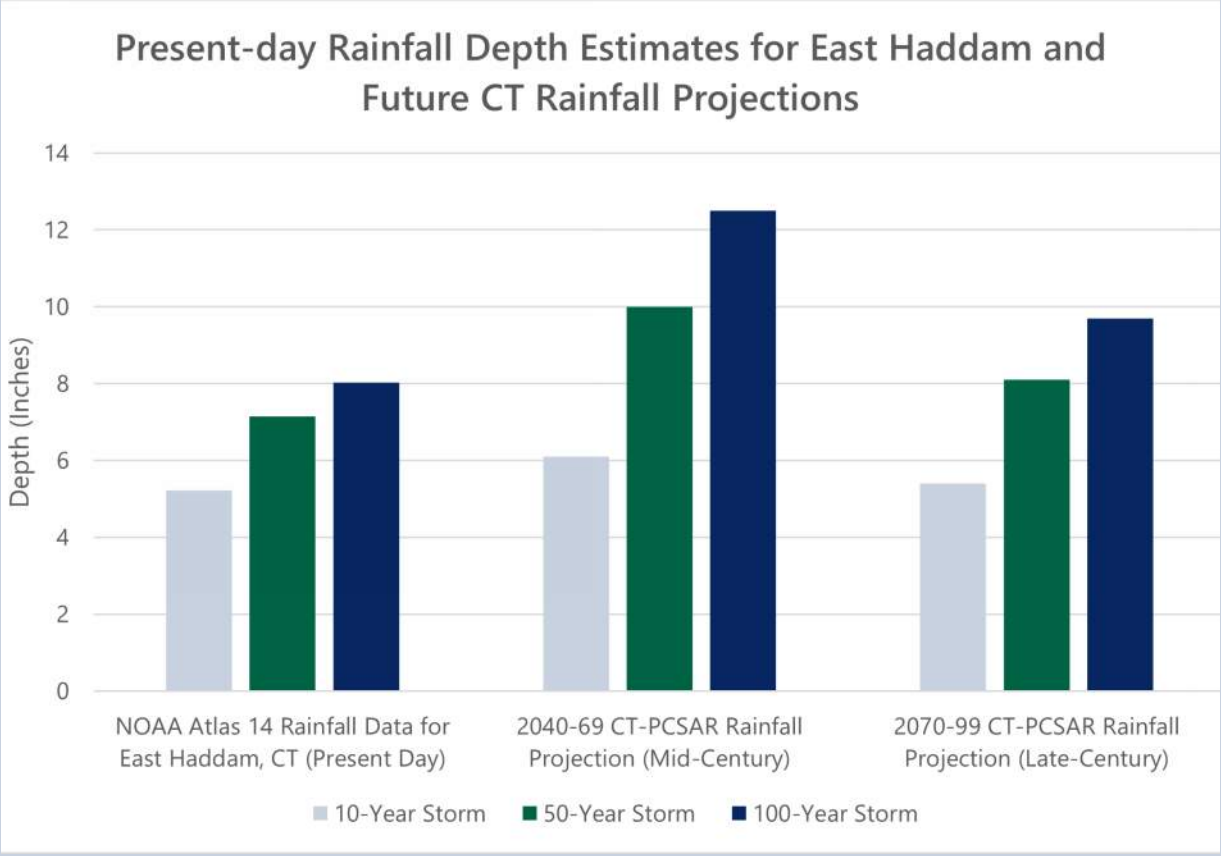
Hydrologic Study Area Overview

Future Rainfall Predictions

As a result of continuing climate change, dangerous storms and severe heat events are expected to become more frequent, and sea level rise is anticipated to continue. In response to this, the University of Connecticut through CIRCA has sought to predict future extreme weather conditions to inform resiliency planning efforts in the State.

In August 2019, CIRCA published the Physical Climate Science Assessment Report (PCSAR) study reporting observed trends and projections of future temperatures and precipitation in the State. According to the results of the study, precipitation depths during storm events of the same AEP would increase from the present day to mid-century (a time horizon between 2040 and 2069).

Kleinfelder used the PCSAR mid-century future precipitation depths as inputs to its Succor Brook watershed model to predict future peak flow magnitudes in Succor Brook. The PCSAR study included predictions for the 10%, 2%, and 1% AEP rainfall depths.



Succor Brook Flood Modeling

To assess current and future flood conditions in the study area, Kleinfelder developed a hydraulic model of the lower reach of Succor Brook. The model accounted for topography and land surface roughness data, in addition to a survey of key elevations of bridges, spillways, and culverts. Record plan information obtained from the Town of East Haddam and CTDOT was also used to inform the model. Photos of previous flood events combined with rainfall records obtained from NOAA were used to calibrate the model.

During past floods, the box culvert carrying Succor Brook under the Tenney Rehearsal Studio has become clogged with large debris carried by the Brook, such as logs and tree branches. Debris clogging has contributed to flooding even during smaller storm events, such as the January 2024 flood, during which rainfall approximately equal to the 2-year 12-hour storm was recorded. Additionally, the culvert is aligned at an offset from the spillway of Trouble Pond Dam immediately upstream of the culvert. This arrangement is hydraulically inefficient during high-flow events, as shown in photos and videos of past floods.

Debris next to rehearsal studio after January 2024 flood

Debris piled up during flooding along Succor Brook

Flood Modeling Results (Present-Day and Projected Mid-Century)

Based on the hydraulic model, the box culvert carrying Succor Brook under the Rehearsal Studio becomes overwhelmed during storm events and results in flooding on Norwich Road. This has occurred even during small events such as the January 2024 flood. When this occurs, floodwaters flow in a southwesterly direction downhill along Norwich Road past the Rehearsal Studio. Most of the water on Norwich Road is prevented from re-entering the channel due to the grading of the roadway surface with respect to the Brook and obstructions such as curbing, sidewalks, and the solid barrier walls of the Norwich Road bridge over Succor Brook south of the Rehearsal Studio.

South of the bridge, water collects at a low point on Norwich Road and spills over the sidewalk and retaining wall separating Norwich Road from the front lawn of the Artists Village, resulting in a flood flow path that cuts through the Artists Village property and runs to the southwest, crossing through the 66 Creamery Road property and over Creamery Road itself. The existing Creamery Road bridge over Succor Brook was also shown to impede flow in during storm events, contributing to flooding on Creamery Road.

As shown in **Figure 1 through Figure 3**, the model predicts that multiple structures in the study area are vulnerable to flooding during present-day Succor Brook floods. In larger storms, the floodplain widens marginally, but inundation depths and velocities increase more significantly. Erosive, high-velocity flood flows have caused property and structure damage on the Artists Village property.

The impacts of flooding along Succor Brook are expected to increase in severity towards mid-century as large rainfall events become more common, as shown in Figures 1 through 3. For example, the Norwich Road bridge crossing Succor Brook near Ray Hill Road is anticipated to overtop in a 50-year storm by mid-century, however, the model predicts that the bridge will pass the present-day 100-year event without overtopping. Also, in the present-day 10-year storm, the Lumber Yard Road bridge is anticipated to be passable, but in the mid-century 10-year storm, the bridge is overtopped. Flood depths and velocities throughout the study area are expected to increase because of larger future storms. Additional mapping and discussion is provided in the Existing and Future Conditions Technical Memorandum in **Appendix B**.

Figure 1. Present and Mid-Century 100-year Floodplain

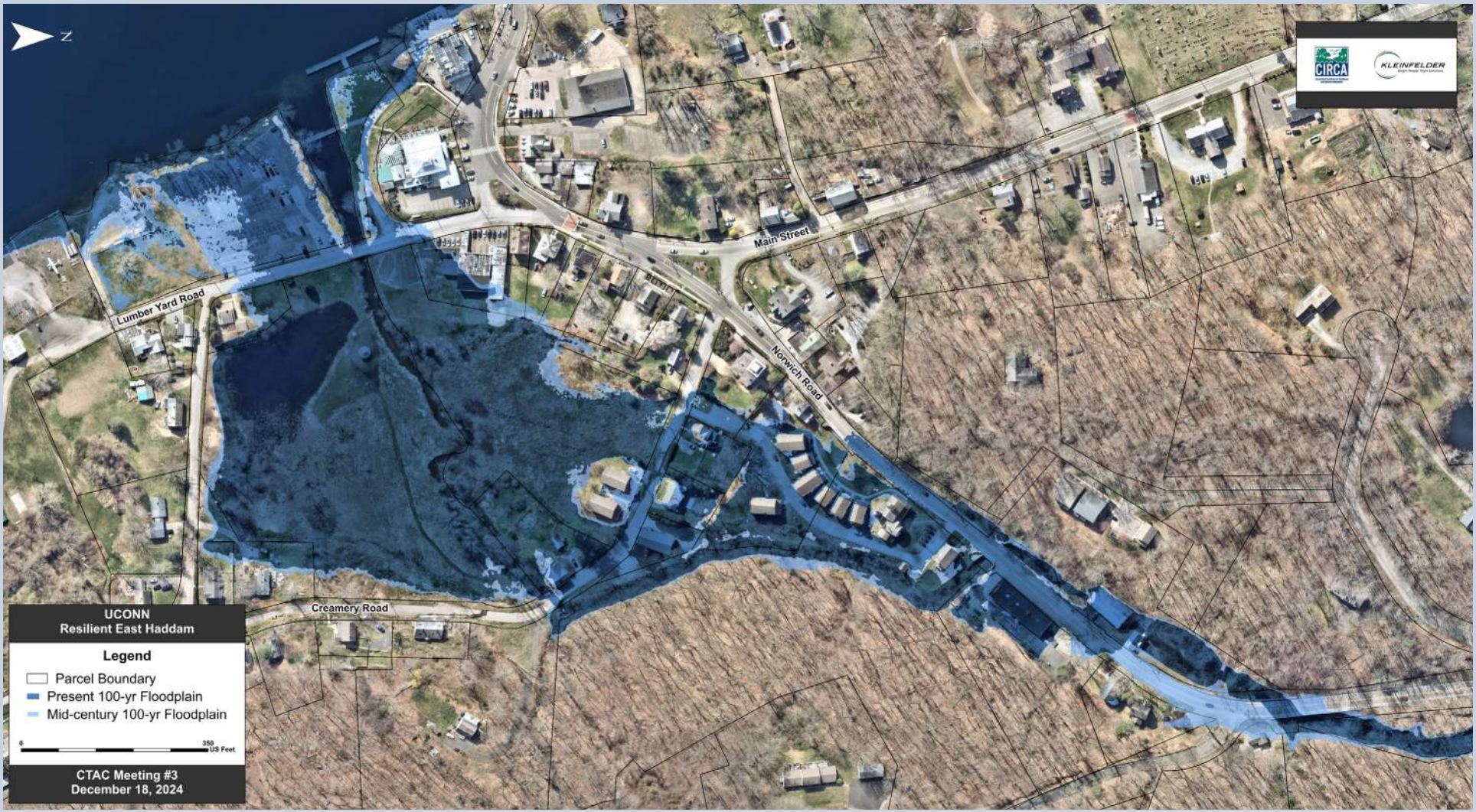


Figure 2. Existing Conditions - Velocity

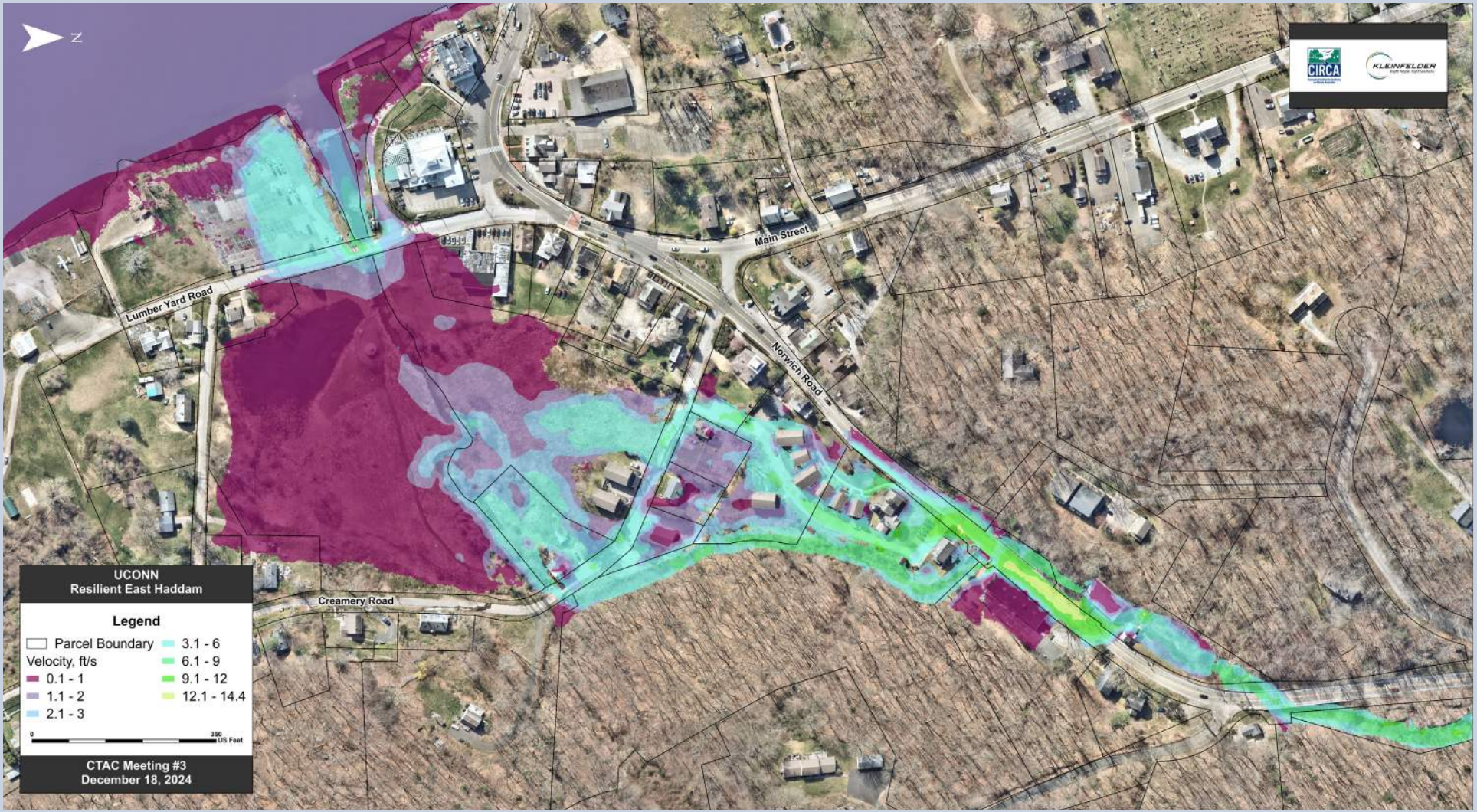
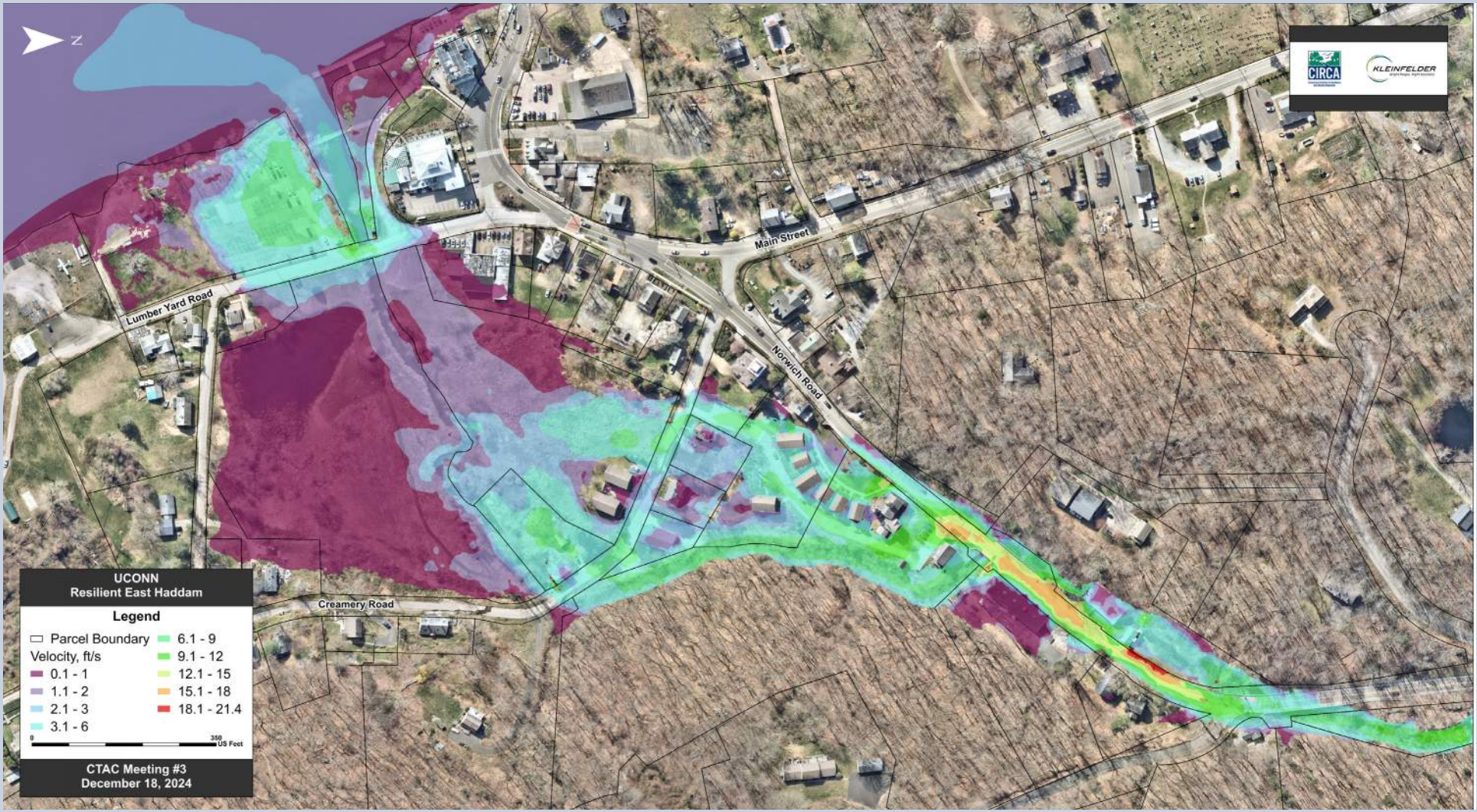


Figure 3. Future Conditions - Velocity



Flood Vulnerability - Wastewater Treatment Plant & Pump Station

Kleinfelder also evaluated the vulnerability of the East Haddam Wastewater Treatment Plant (WWTP) located on the property of a small airport and the wastewater pump station located on Connecticut River Dock Road, behind the Gelston House. The WWTP is located outside of the Succor Brook watershed. Although the pump station is within the present-day Succor Brook floodplain, it is elevated above the projected present and future Succor Brook water surface elevations (WSEs). Therefore, the Connecticut River is the main source of flood risk to both the WWTP and the pump station. The WWTP and pump station are both within the mapped FEMA Zone AE (100-year floodplain) associated with the Connecticut River.

WWTP Control Building

The WWTP consists of two pre-engineered wood-frame buildings, known as the Process and Control Buildings, constructed on elevated concrete foundations. An emergency generator is located on an elevated platform outside the Process Building. The generator is fueled by propane stored in two tanks anchored to a concrete slab behind the WWTP buildings.

WWTP Control Building Interior

The pump station consists of a concrete wetwell containing two submersible pumps, with a fiberglass enclosure containing pump controls. An emergency generator is mounted atop the wetwell and other exterior mounted control panels above the top of the wetwell slab. Both the WWTP floor and the top slab of the pump station were designed to an elevation of 12± ft above the North American Vertical Datum of 1988 (NAVD88), which was formerly one foot above the 100-year floodplain elevation of the Connecticut River in effect during the mid-1990s. However, since that time, FEMA revised its study of the Connecticut River and raised the 100-year flood elevation to 12.2 ft above NAVD88. Although the WWTP has not experienced a severe flood since it opened, its present vulnerability to the Connecticut River 100-year flood is greater than originally intended.

CURRENT & FUTURE CONDITIONS ANALYSIS

With changes in rainfall patterns driven by climate change, the Connecticut River 100-year flood elevation is anticipated to increase even higher by mid-century. Downstream of East Haddam, the Connecticut River empties into Long Island Sound, and East Haddam's location along the Connecticut River places it at a point near the influence of coastal storms. As a result of future sea level rise, the boundary of coastal storm influence may move upstream along the Connecticut River beyond the WWTP and pump station site. Kleinfelder and CIRCA determined that applying an increase of 20 inches to the present Connecticut River flood elevations was appropriate for analyzing future flood risk to these facilities. This projected increase is based on a planning level threshold for anticipated sea level rise by the year 2050 developed by CIRCA. Refer to the Current and Future Conditions Technical Memorandum in **Appendix B** for additional information.

WWTP Process Building Interior

If a 100-year flood were to occur along the Connecticut River in the present-day, approximately 0.2 feet of water would enter the WWTP buildings. This poses a risk of damage to objects stored on the floor and equipment mounted near the level of the floor. One of the WWTP buildings, the Process Building, has reactor tanks used for wastewater treatment that are covered by open metal grating. Floodwaters would be susceptible to entering the tanks via these openings, potentially disrupting the treatment process. In a 2050 100-year flood, there is the potential for 1.9 feet of floodwater to enter the building. This would pose significant risk to the wood-frame structure of the WWTP buildings above their elevated concrete foundation resulting from hydrostatic and hydrodynamic flood forces. Water within the building would reach a level that would inundate the fine screening and ultraviolet disinfection units and all other materials and equipment at an elevation equal to or below 13.9 ft above NAVD88.

The lowest-mounted control panels at the pump station would be threatened by a present-day 100-year flood of the Connecticut River. However, in a future 100-year flood, the control panels inside of the fiberglass enclosure as well as the emergency generator would be inundated.

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PUBLIC ENGAGEMENT

Public workshops were conducted to engage the community in the planning process, soliciting feedback to hear the concerns and needs, which assisted the planning team in establishing the priorities for concepts.

The first workshop, held in October 2024, introduced the project and presented the present-day and future flood conditions. The Project Team also solicited feedback on community needs and priorities related to the project area.

The second workshop, held in February 2025, showcased adaptation alternatives to mitigate climate risks in the project area. The Project Team presented conceptual plans from various perspectives in the study area and described the differences between alternatives in addressing the flooding along Succor Brook.

A Citizen and Technical Advisory Committee (CTAC) was created in coordination with the Town of East Haddam and CIRCA that reflects a broad cross section of community stakeholders with expertise in the project area. CTAC meetings were held throughout the duration of the Phase II project to provide local, lived experience and feedback for flood adaptation options.

CTAC Meeting #1 - April 25, 2024

- Goal: Introduce Resilient CT Phase II project to CTAC. Evaluate and discuss existing and future climate conditions analysis and impact of flooding.

CTAC Meeting #2 - October 7, 2024

- Goal: Establish and review priorities and discuss trade-offs and compromises.

CTAC Meeting #3 - December 18, 2024

- Goal: Present and engage in discussion of adaptation option alternatives for priority areas.

CTAC Meeting # 4 - March 6, 2025

- Goal: Present and review preliminary draft report and steps to complete the project.

A Stakeholder Engagement Summary is provided in **Appendix A.**

First Resilient East Haddam Public Workshop

ADAPTATION OPTIONS

Succor Brook Adaptation Strategies

From the hydraulic model results, Kleinfelder developed adaptation strategies that, when implemented, can reduce the magnitude of flood damage in the study area. The model facilitated testing multiple combinations of flood control interventions. Kleinfelder focused on developing mitigation strategies that were actionable and permittable.

Kleinfelder evaluated four mitigation alternatives to reduce flood impacts in the study area, discussed in the following sections.

1. Alternative 1: Remove Rehearsal Studio
2. Alternative 2: Remove Rehearsal Studio + Widen Creamery Road Bridge
3. Alternative 3: Remove Rehearsal Studio + Widen Creamery Road Bridge + Raise Artists Village Driveway + Construct Berm/Floodwall Structure + Construct Norwich Road Bypass Culvert
4. Alternative 4: Remove Rehearsal Studio + Widen Creamery Road Bridge + Construct Dam at Daniels Road Pond + Raise Driveway and Construct Berm/Floodwall

ALTERNATIVE 1

Alternative 1: Remove Rehearsal Studio

Alternative 1 consists of constructing a new natural channel in the footprint of the existing Tenney Rehearsal Studio and box culvert at 21 Norwich Road. The concrete channels upstream and downstream of the Studio would also be removed. Because the existing culvert floods even in small storms, removal of the Studio is a top priority for flood mitigation, and this action is carried forward in each remaining alternative.

Implementing this alternative would require the Goodspeed Foundation to secure alternative rehearsal space. The alternative space would need to be within walking distance of the Artists Village per stipulations of actors' union contracts. One option for a relocated rehearsal space would be at a new building on the former Carriage House/Williams Chevrolet property at 24 Lumber Yard Road, which is currently owned by the Goodspeed Foundation and used for parking. However, other locations that comply with actor contract requirements may be considered for a relocated studio.

From the hydraulic model, this alternative is anticipated to alleviate flooding on Norwich Road in storms up to the present-day 50-year storm. In the present-day 100-year storm, floodwaters are projected to overtop the southernmost Norwich Road bridge over Succor Brook. Flooding on Creamery Road is anticipated to persist under this alternative due to the constraint caused by the existing Creamery Road box culvert.

As a result of removing the Rehearsal Studio, residential and commercial buildings at 59 and 62 Creamery Road respectively are predicted to experience slightly higher floodwater elevations during certain flood events. The maximum water surface elevation increase at these sites is predicted to be on the order of 0.5 feet, however, modeling at a site-specific level would be required to confirm these impacts. This would occur because reducing or eliminating the flood flow path via Norwich Road, the front of the Artists Village property, and across the side yard of 66 Creamery Road would cause more flow to reach the main Succor Brook channel upstream of Creamery Road, increasing impacts downstream of Norwich Road at locations very close to the Brook. The two impacted buildings could be elevated to mitigate risks posed by the increase in water surface elevation, however, incorporating elevation of these structures in this alternative is unlikely to be viable. The historic nature of the two structures may preclude their elevation or make elevating them prohibitively expensive. The cost of elevating these structures was assumed equal to their replacement value according to the East Haddam Assessor's database, adjusted to 2024 dollars.

Therefore, Kleinfelder does not recommend implementation of Alternative 1 alone without additional measures that prevent the need for elevating these structures.

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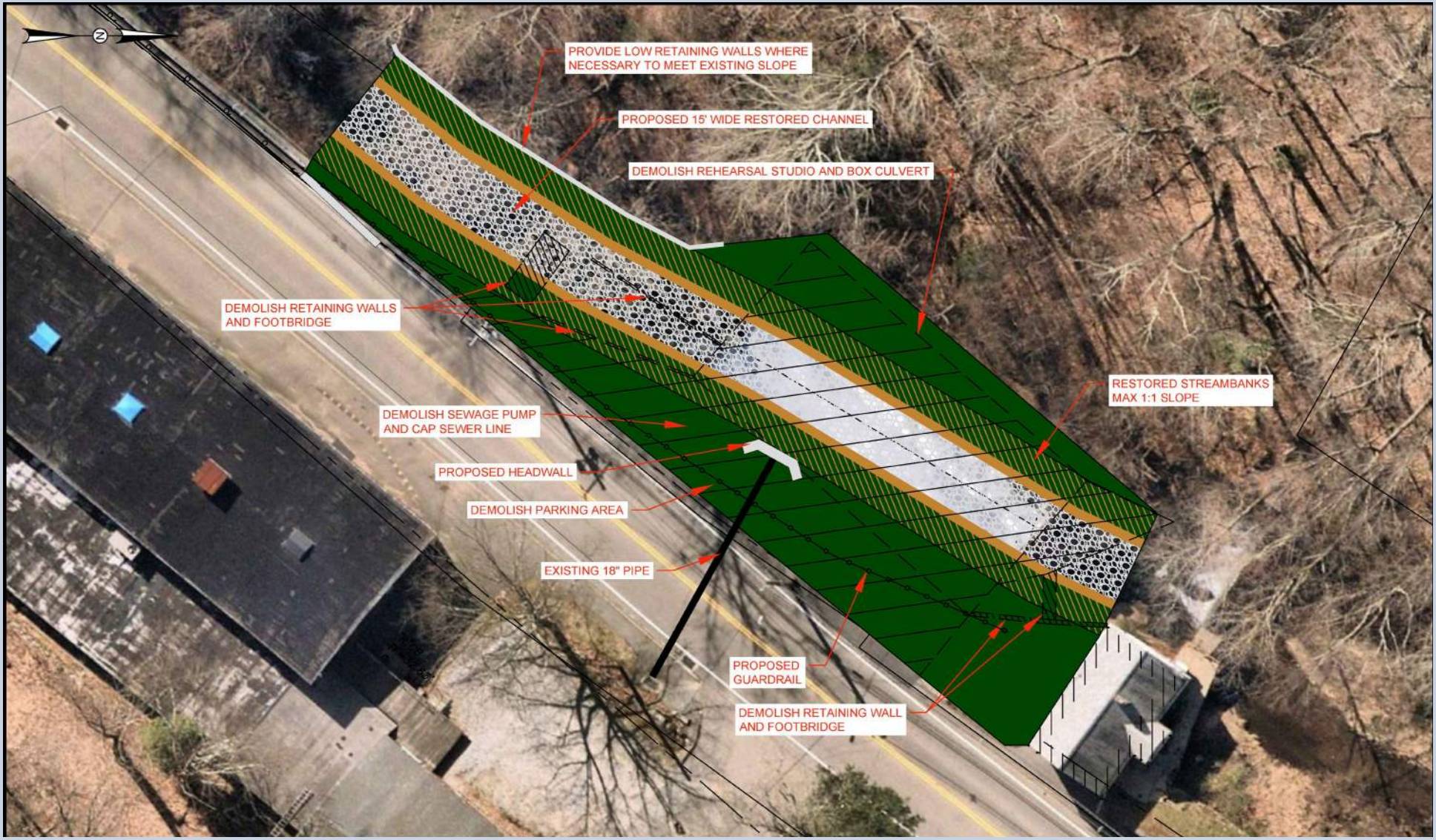
ALTERNATIVE 1



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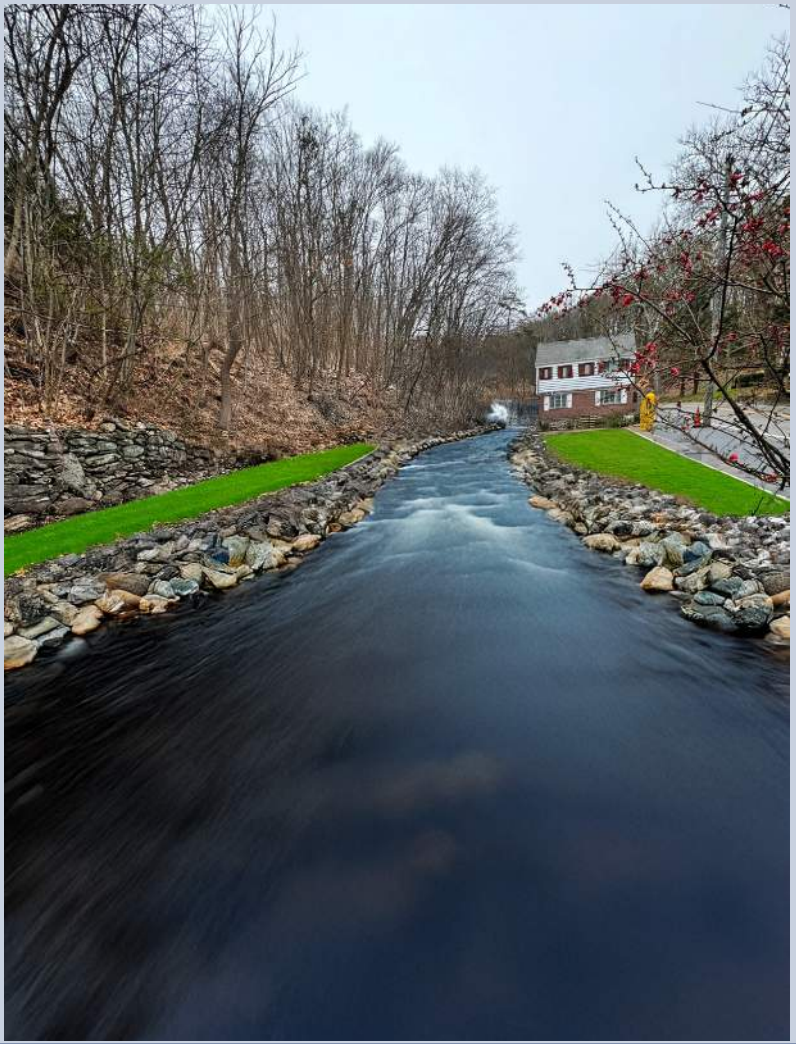
ALTERNATIVE 1

Restored Stream with Rehearsal Space Removed

Before

After



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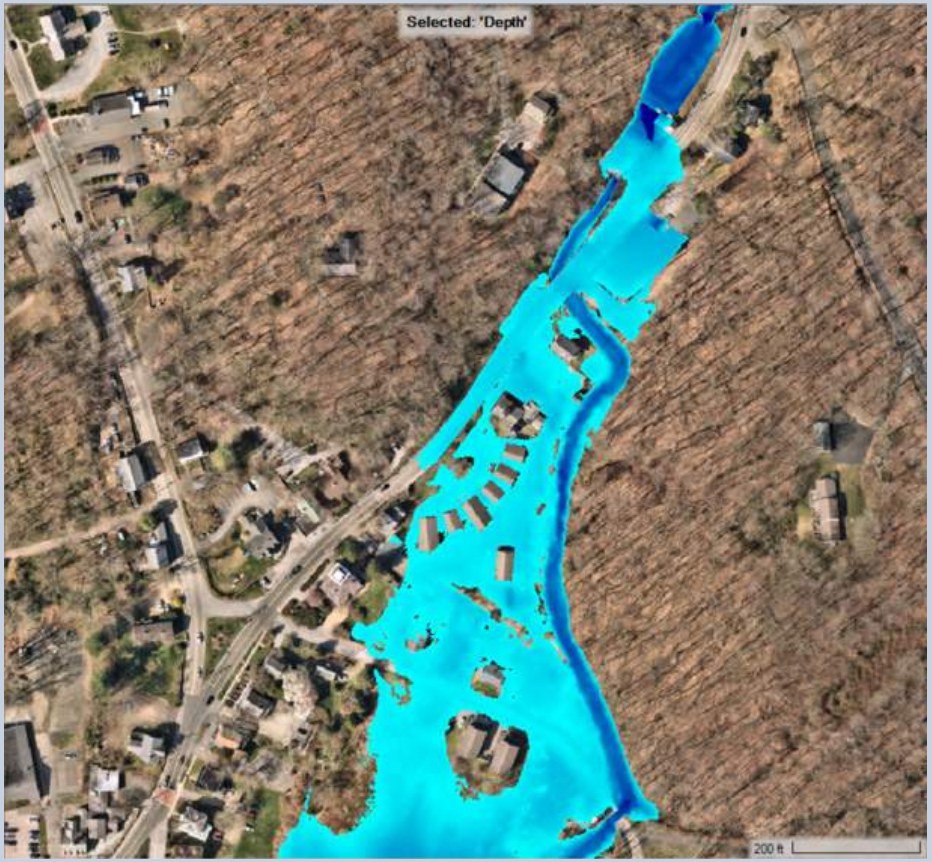
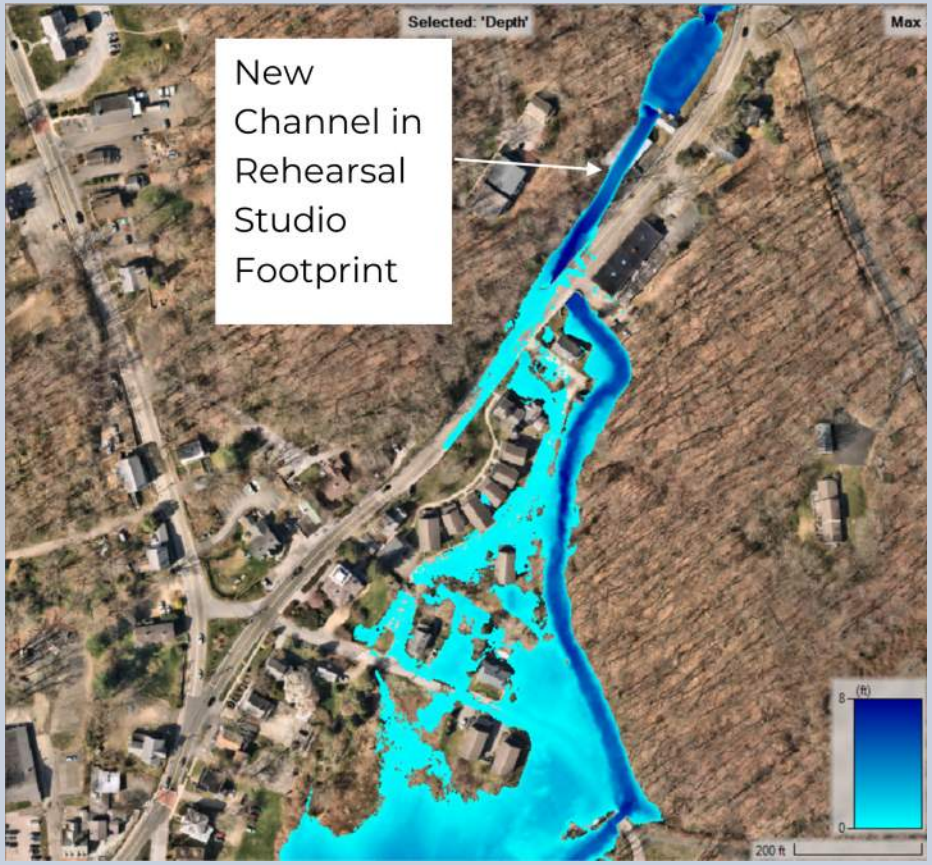
ALTERNATIVE 1

Present-day 100-year flood, no build condition



Present-day 100-year flood, with mitigation



ALTERNATIVE 2

Alternative 2: Remove Rehearsal Studio + Widen Creamery Road Bridge

Alternative 2 includes Alternative 1, plus replacement of the existing box culvert carrying Creamery Road over Succor Brook with a new, wider bridge that spans the bankfull width of the Brook. Also, this alternative includes an expanded bank on the right-hand side of the Brook upstream of the Creamery Road crossing.

Adding a wider Creamery Road bridge and bank expansion to the Rehearsal Studio relocation in Alternative 1 is projected to eliminate the increased flood impacts at 59 and 62 Creamery Road that are anticipated if only the Rehearsal Studio is removed. As a result, Alternative 2 is predicted to reduce water surface elevations on Creamery Road as well as within the Artists Village when compared to the no-build condition, although some flooding would persist in these areas during larger floods, particularly in events equal to or greater in strength than the present-day 50-year flood.

Additionally, the present Creamery Road culvert is a four-sided precast concrete structure, and replacing the crossing with a new bridge presents an opportunity to restore the natural channel in this area. The conceptual replacement bridge would be approximately 24 feet wide, roughly double the width of the existing crossing. Reconstructing the right-side bank of the Brook, which currently is formed by a stone armor edge, could provide new wetland habitat and replicate natural wetland and floodplain function. Modeling of this alternative included a conceptual re-constructed bank extending approximately 300 feet upstream of the Creamery Road bridge. The channel was widened by approximately 10 feet. Sizing of the bridge and expanded bank would be verified in a future design phase should the Town opt to pursue this alternative.

Compared to Alternative 3, this alternative would have significantly less impact to existing trees and vegetation. A portion of the 62 Creamery Road property may require a permanent easement to accommodate the expanded bank, and minor impacts to existing trees and vegetation would occur. Protection of the residence at 59 Creamery Road from disturbance due to the bridge replacement would be required as part of the construction process.

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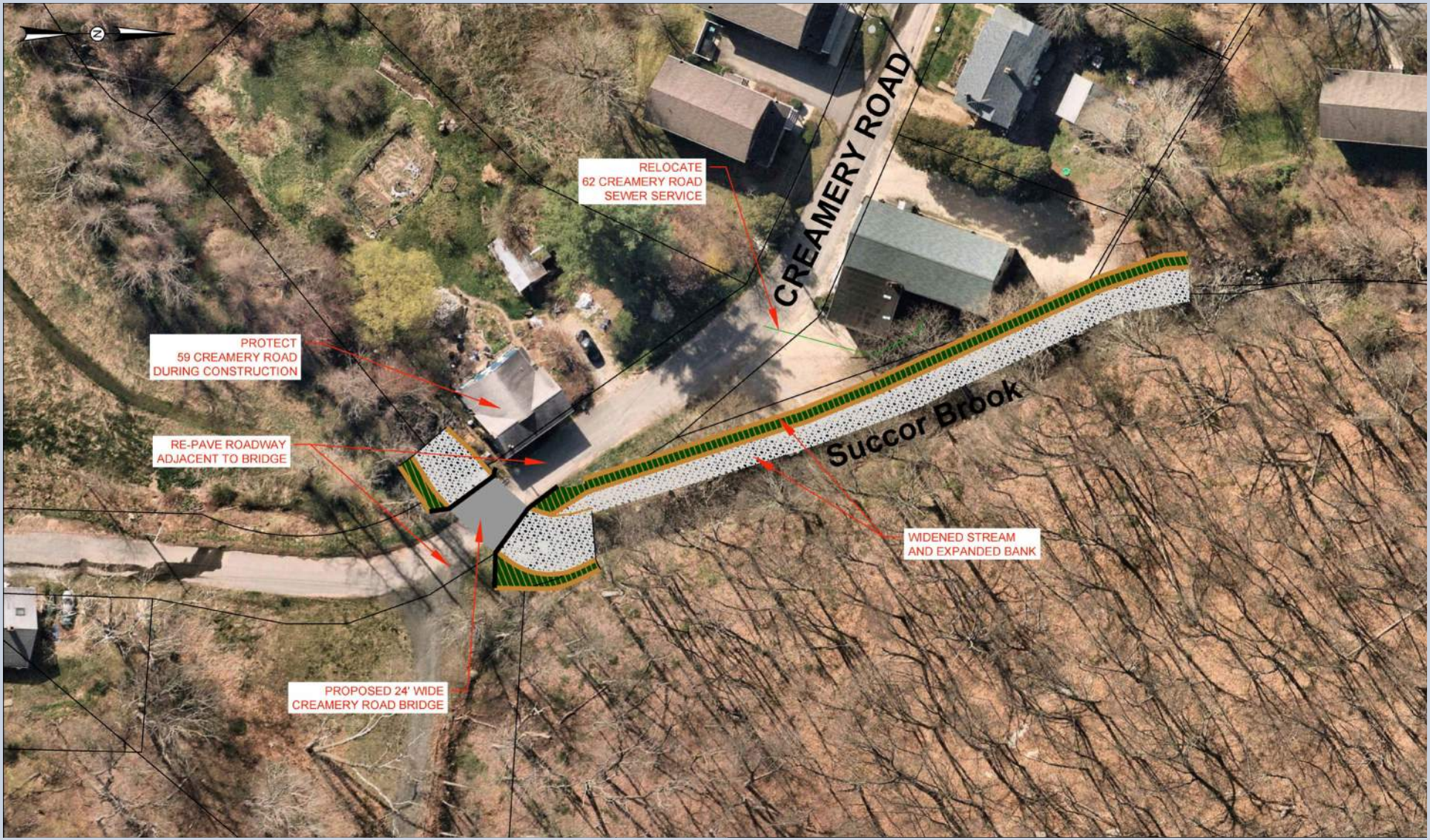
ALTERNATIVE 2



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ALTERNATIVE 2

Widened Creamery Road Crossing

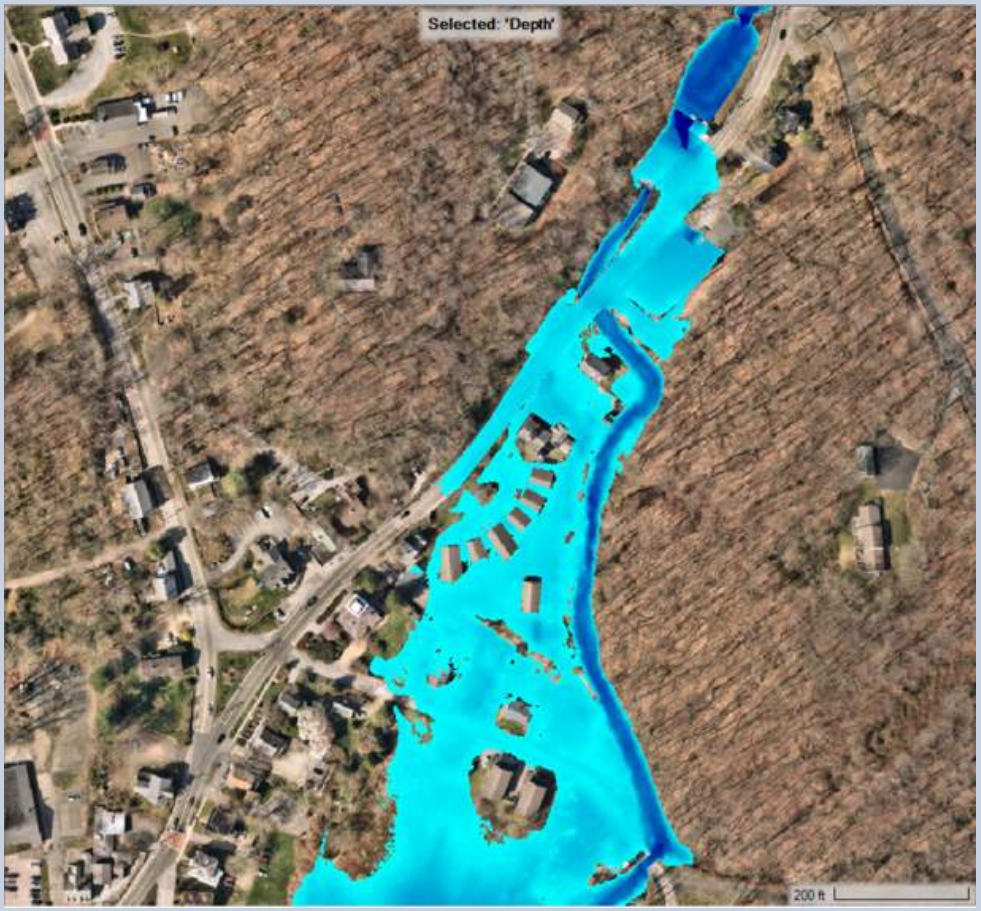
Before

After

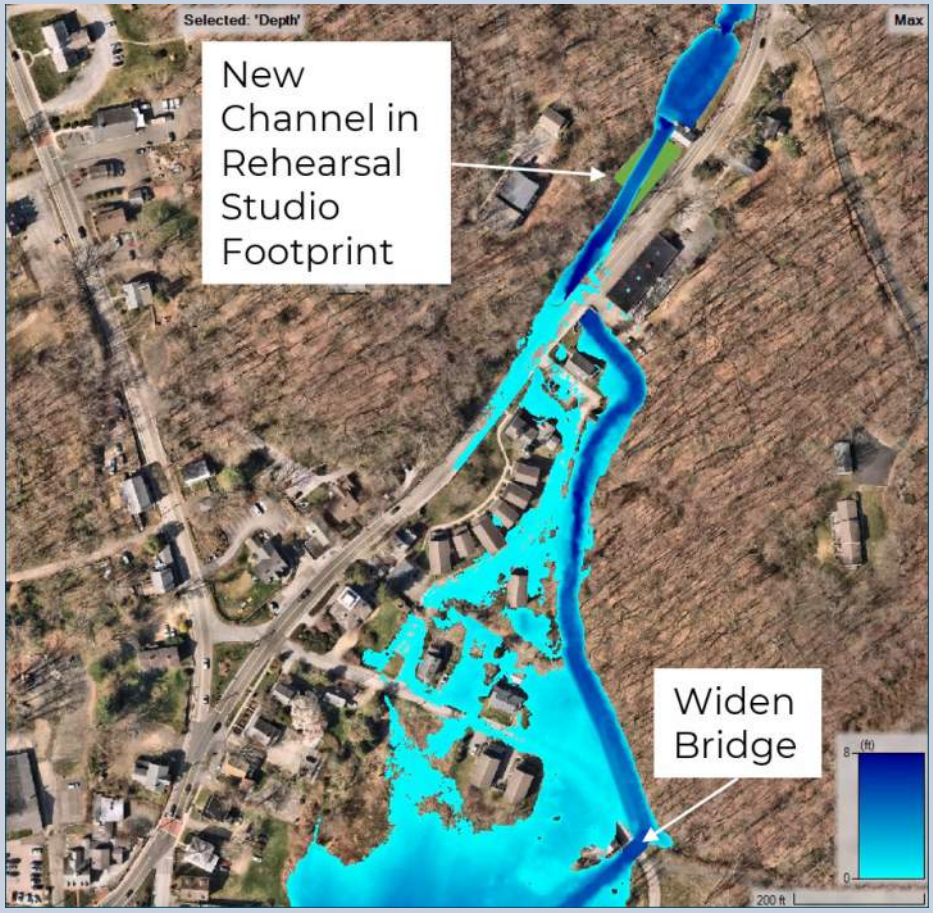
RESILIENT EAST HADDAM

ALTERNATIVE 2

Present-day 100-year flood, no build condition



Present-day 100-year flood, with mitigation



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ALTERNATIVE 3

Alternative 3: Remove Rehearsal Studio + Widen Creamery Road Bridge + Raise Artists Village Driveway + Construct Berm/Floodwall Structure + Construct Norwich Road Bypass Culvert

Alternative 3 consists of the improvements in Alternatives 1 and 2, plus additional infrastructure to protect properties on Creamery Road and Norwich Road from the 100-year flood. To achieve this level of protection, Alternative 3 includes construction of a floodwall and earthen berm structure on the right bank of Succor Brook between Norwich Road and Creamery Road. The northern end of the earthen berm would tie into a raised and re-located driveway accessing the Artists Village property on Norwich Road. In the conceptual design, the floodwall would extend from the Creamery Road bridge upstream along the right bank of Succor Brook. The floodwall would transition to an earthen berm near the southeastern corner of the Artists Village property, where more room is available to construct a berm. The conceptual maximum height of the floodwall is 6 feet near Creamery Road, tapering to 4 feet along the earthen berm segment. The purpose of the floodwall and raised driveway would be to prevent flood flows from reaching over the banks of Succor Brook and damaging properties near the Brook.

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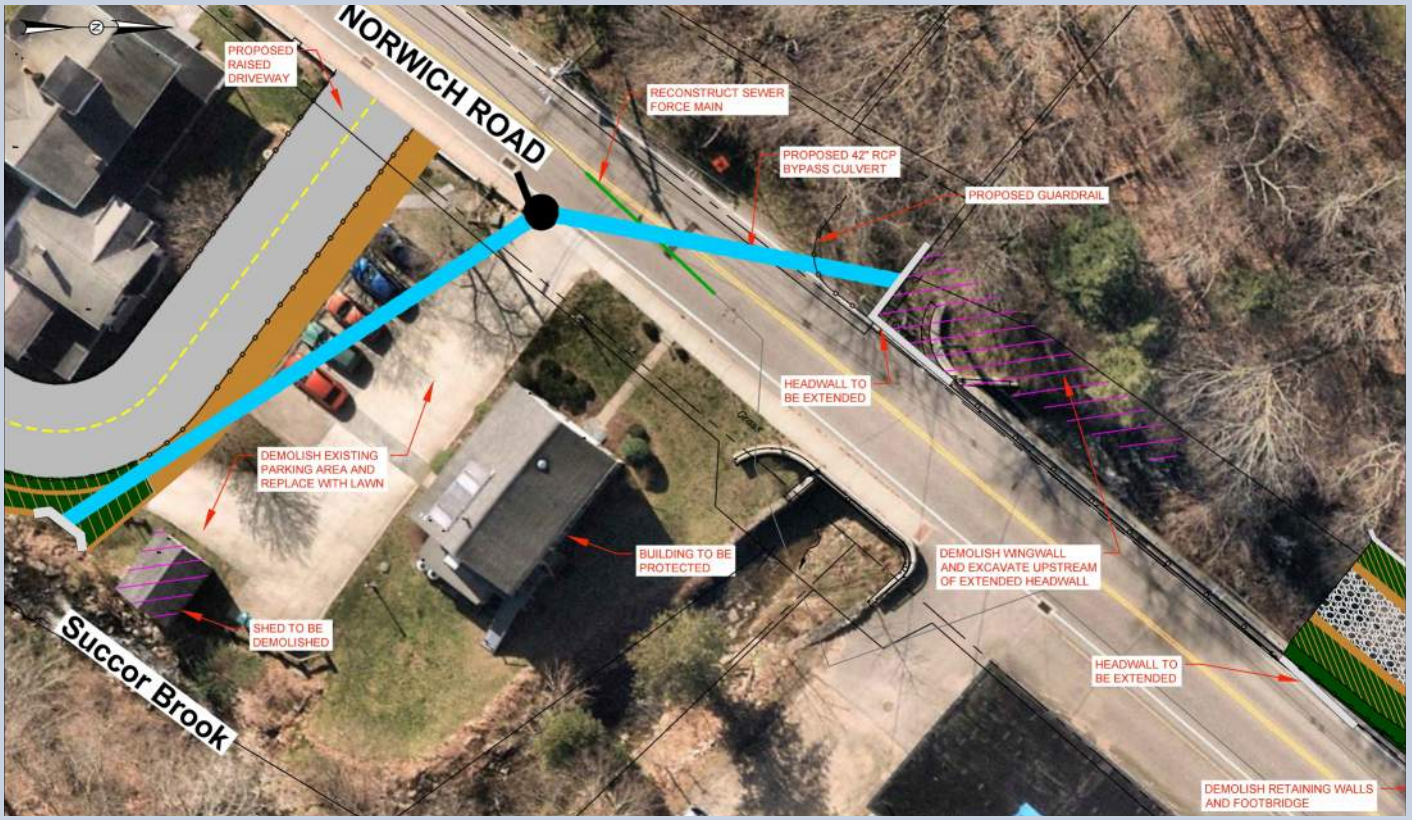
ALTERNATIVE 3

In addition, the alternative proposes a bypass culvert beneath Norwich Road with a conceptual diameter of 42 inches. By providing a bypass culvert and a raised headwall at the southernmost Norwich Road bridge, the bridge is predicted to pass the present-day 100-year flood without overtopping.

This infrastructure would also provide protection in these areas during projected future floods. In the future 100-year event, the raised driveway would reduce the velocity of floodwaters before they reach buildings compared to the no-build condition, limiting structure damage and reducing erosion in the study area.



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ALTERNATIVE 3

Example Flood Wall

Example Earthen Berm Floodwall

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ALTERNATIVE 3

Example Raised Driveway at Norwich Road

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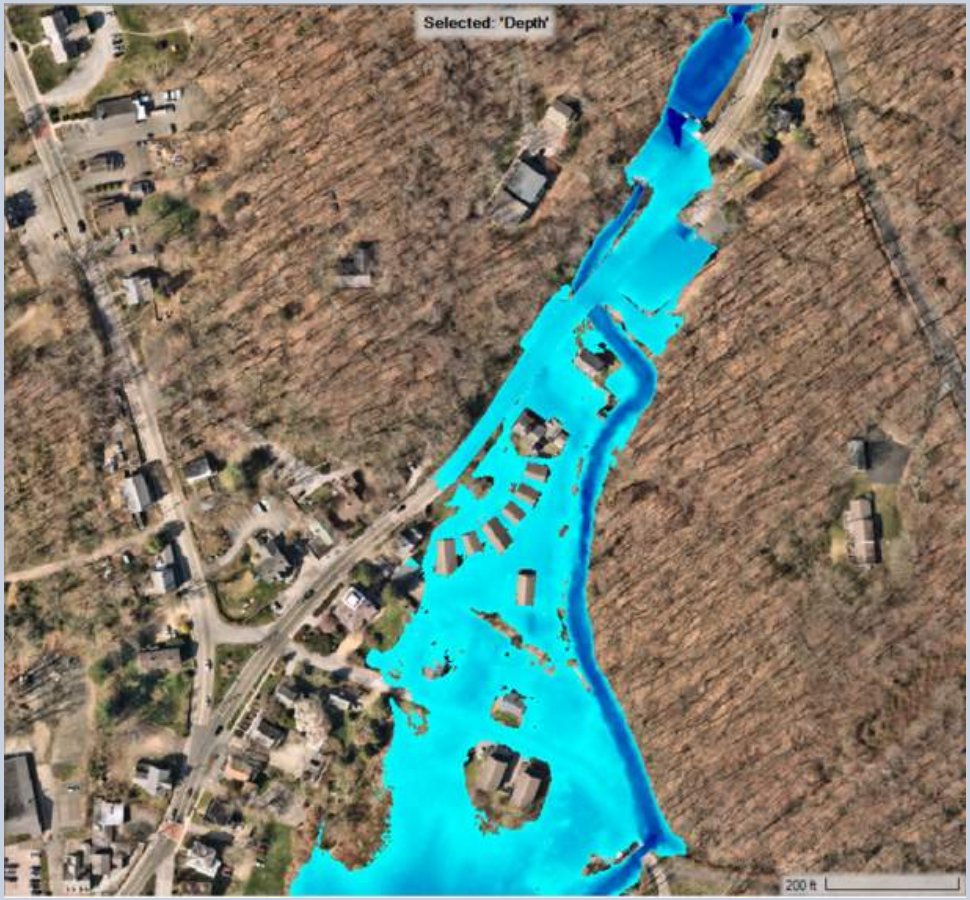
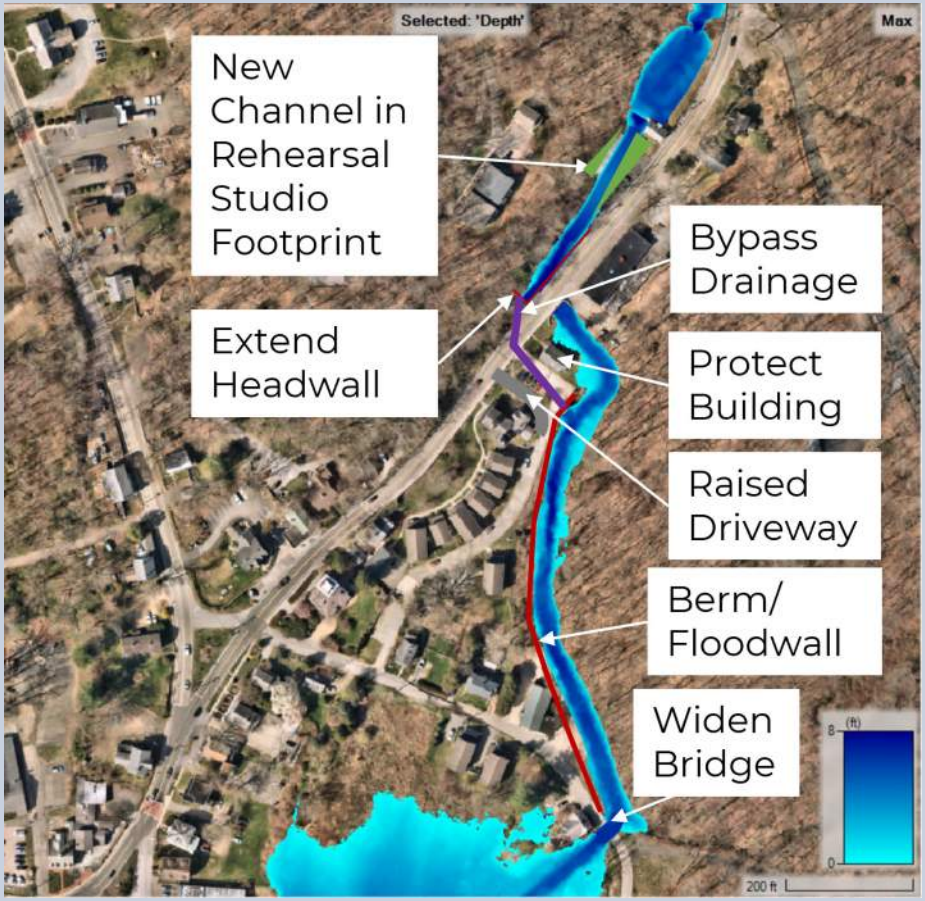
ALTERNATIVE 3

Present-day 100-year flood, no build condition



Present-day 100-year flood, with mitigation



ALTERNATIVE 4

Alternative 4: Remove Rehearsal Studio + Widen Creamery Road Bridge + Construct Dam at Daniels Road Pond + Raise Driveway and Construct Berm/Floodwall

Alternative 4 consists of Alternative 3, plus construction of a dam at the outlet of the pond on the downstream end of Daniels Road. The bypass culvert proposed under Alternative 3 would not be required under this alternative. Kleinfelder reviewed several potential flood storage sites in the Succor Brook watershed, including the former Boardman Pond dam, another former dam downstream of the Boardman Pond dam, and a low-lying area upstream of Boardman Road. Kleinfelder estimated that the available storage volume at the Daniels Road pond would be most likely option to decrease flood flows in the lower Succor Brook study area.

The outlet of the pond is currently the location of a beaver dam, which has partially breached in the past according to reports from abutters. Constructing an engineered dam at this location with a low-level outlet would maximize flood storage, though the potential storage volume is limited by the elevation of Daniels Road.

Kleinfelder reviewed a constructed dam alternative, conceptually sized with a 200-foot spillway and a 36-inch diameter low-flow culvert. The spillway elevation was adjusted such that the maximum elevation in the pond during the present-day 100-year flood was 1 foot below the elevation of Daniels Road. Because bathymetric data for the pond was not available, Kleinfelder estimated the amount of storage by extrapolation of Lidar topography obtained from the CT Environmental Conditions Online database. The estimated storage volume below the crest elevation used for the analysis was approximately 135 acre-feet. With this conceptual dam in place along with the removed Rehearsal Studio and widened Creamery Road bridge, overtopping of Norwich Road in the present-day 100-year flood is predicted to be eliminated without requiring construction of the bypass culvert proposed in Alternative 3. Compared to Alternative 2, the extents and depths of flooding in each event would be reduced further in this alternative.

There are several challenges to implementing this alternative. Because a dam impedes natural stream flow, provisions for aquatic organism passage (e.g. a fish ladder) would likely be required. Extensive environmental permitting for a new dam would be required at the local, state, and federal levels. The Town would need to acquire or obtain a permanent easement for the dam site and an access road to the dam. Dams require a high level of maintenance and inspection, and the Town would take on additional liability related to ensuring the continued safety of the dam.

Due to these challenges, Alternative 4 was not advanced to the Cost Estimate and BCA phase of this study.

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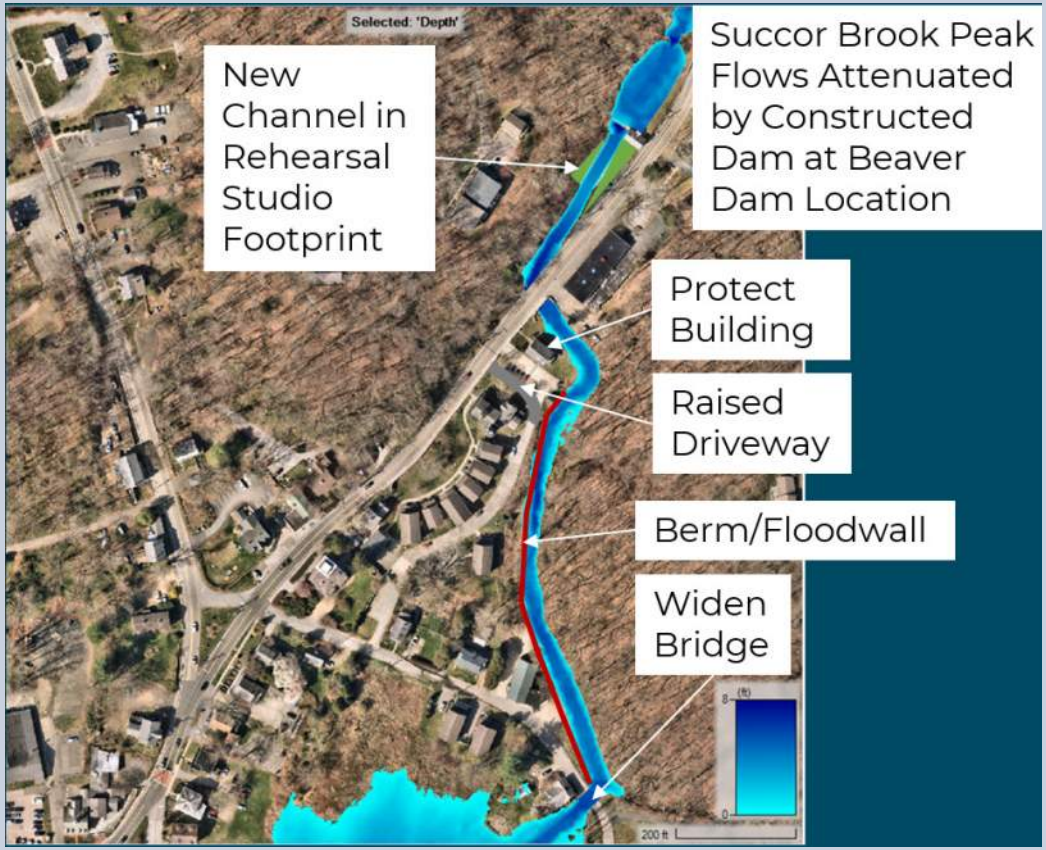
ALTERNATIVE 4

Present-day 100 year flood, no build condition

Present-day 100-year flood, with mitigation



ADDITIONAL ADAPTATION STRATEGIES FOR SUCCOR BROOK

Individual Building Floodproofing:

In Alternatives 1 and 2, although conditions are predicted to improve relative to the no-build condition, flooding is anticipated to continue to occur at certain properties along Creamery Road. Additionally, with the Alternative 3 improvements in place, flooding is projected to occur in the study area under mid-century 100-year floods. Damage would be reduced in Alternative 3 compared to the no-build condition since the raised driveway would slow down flood flows from Succor Brook before they reach buildings. Fully mitigating the modeled 100-year mid-century storm in the study area would require intensive measures that are unlikely to be economically and/or environmentally feasible, such as re-sizing both Norwich Road bridges over Succor Brook and potentially dredging or widening longer reaches of the Brook. Given this, an additional recommended action is to conduct direct outreach to property owners in the area impacted by the mid-century 100-year flood based on the chosen alternative. A professional should visit the affected homes and businesses to discuss potential flood mitigation measures, assess interest or feasibility for implementing site-specific flood resilience improvements and provide information on available resources or funding programs.

Pumping out a flooded area next to a building

Trouble Pond Dam

Kleinfelder found that if Trouble Pond Dam were to be lowered or removed, the impacts on flooding would be negligible given that the Rehearsal Studio culvert (and the Norwich Road bridge downstream of the Studio) controls flooding on Norwich Road in present-day storms. In large mid-century storms, the Norwich Road bridge near Ray Hill Road is projected to overtop, sending floodwaters downhill on Norwich Road towards the low point in front of the Artists Village. Based on field observations, the dam is currently providing little flood storage due to sediment accumulation on the upstream side of the spillway.

ADDITIONAL ADAPTATION STRATEGIES FOR SUCCOR BROOK

Even if sediment behind the dam were to be removed, the dam would not provide enough flood storage to improve conditions in the study area. Since significant stream restoration would be required as part of the Rehearsal Studio removal, Kleinfelder recommends that removal of the Trouble Pond Dam be considered in conjunction with efforts to remove the studio.

Dam removal was not evaluated as a flood mitigation alternative in this study because of the lack of impact to flooding related to the dam. Further study and field investigations would be required to estimate costs related to removal of the dam, including sediment removal and stream restoration in the footprint of the dam and upstream.

Lumber Yard Road

Kleinfelder found that although the Lumber Yard Road crossing overtops in storms larger than the present-day 10-year storm, replacing the crossing with a wider structure did not significantly change flooding conditions in the flood-prone areas of Norwich Road and Creamery Road. However, the current box culvert at Lumber Yard Road has abutments that extend into the bankfull width of the brook, and replacement of the culvert with a wider structure would provide an opportunity to improve aquatic organism habitat connectivity between Succor Brook and the Connecticut River. In addition, there are potential construction cost savings that could be achieved if the Lumber Yard Road bridge were replaced at the same time as the Creamery Road bridge.

Because of the potential to increase conveyance capacity and improve overall riverine habitat connectivity along Succor Brook, Kleinfelder recommends that future studies to replace the Creamery Road bridge also consider replacement of the Lumber Yard Road culvert.

Lumber Yard Road crossing

ADAPTATION STRATEGIES FOR WWTP & PUMP STATION

Separate from the Succor Brook interventions, Kleinfelder has also developed a set of interventions at the WWTP to mitigate risk to the facility based on projected future flood elevations along the Connecticut River.

Floodproofing Guidelines

Kleinfelder reviewed the floodproofing guidelines listed below to put the current and future 100-year Connecticut River flood elevations into context:

- Technical Report #16 (TR-16), Guides for the Design of Wastewater Treatment Works, developed by the New England Interstate Water Pollution Control Commission (NEIWPCC), issued 2011 and revised 2016
- American Society of Civil Engineers (ASCE) 24-14, Flood Resistant Design and Construction (Currently adopted as a reference standard by the International Code Council), issued 2015
- ASCE 24-24, Flood Resistant Design and Construction (Latest ASCE Guidance, not yet adopted by the International Code Council), issued 2025
- Floodplain Building Elevation Standards for Critical Facilities and Activities, developed by CIRCA, issued 2022

The Floodplain Building Elevation Standards for Critical Facilities and Activities CIRCA guidance document states that according to CT DEEP, wastewater treatment facility and collection system projects funded through the state Clean Water Fund (CWF) are required to meet the NEIWPCC TR-16 floodproofing standards. The East Haddam WWTP buildings and pump station are likely to qualify as containing critical activities as defined by CT DEEP's Municipal Wastewater Section and therefore the NEIWPCC TR-16 floodproofing guidance for critical equipment elevation would apply.

Recommendations

To ensure upgrades to the facility meet CWF funding requirements and to protect the WWTP and pump station against the projected future 100-year Connecticut River flood, Kleinfelder recommends the following interventions for the two facilities:

- Construct an impermeable concrete barrier along the perimeter of both East Haddam Wastewater Treatment Plant buildings and dry floodproof the buildings to a minimum elevation of 15.2 feet above NAVD88
- Raise the backup generator at the WWTP to 15.2 feet above NAVD88
- Raise electrical/control equipment and the backup generator at the pump station to 15.2 feet above NAVD88

By dry floodproofing the WWTP Process and Control buildings with perimeter barriers, the existing wastewater treatment equipment within the building can remain in place. A concrete wall would extend around the perimeter of each building, with a top elevation of 15.2 feet. The wall would be approximately 3.2 feet tall and could have an exterior aesthetic treatment such as a concrete masonry unit veneer wall to reduce visual impact.

ADAPTATION STRATEGIES FOR WWTP & PUMP STATION

The concrete wall would be designed to resist the forces of moving floodwaters. The emergency backup generator, currently mounted on a concrete pad at the same level as the building floor elevation, should also be elevated to 15.2 feet. Vent and louver openings would be raised above elevation 15.2 if necessary. Heights of the WWTP buildings would not increase significantly, if at all.

A floodproofing retrofit would need to accommodate access to the interiors of the WWTP buildings. If the existing door thresholds were raised to match the dry floodproofing elevation, additional stairways outside and inside of the buildings would be required for access over the barrier. The Control Building has an exterior ramp that would need to be extended for it to reach the barrier elevation, and an interior ramp or lift would need to be provided to complete the accessible pathway to the inside of the building. Due to a lack of space inside of the buildings to provide stairs and/or ramps, it is recommended that WWTP building doors be retrofitted with flood barriers integrated with the floodproofed walls. This would maintain access to the building at the existing finish floor level.

There are two main categories of flood barriers: passive and active.

- Active barriers require human intervention to deploy in advance of a flood event, while passive barriers deploy automatically without human intervention. Although a relatively long warning period would precede a flood on the Connecticut River, there is still a chance that if a flood is predicted, floodwaters may inundate the area surrounding the WWTP before a trained individual can access the site and deploy the barriers.
- Passive flood barriers are best suited for staff entryways where frequent access is expected, while active barriers left in place are more suitable for doors where only occasional access is needed. Vendors such as Floodbreak and Flood Control International manufacture custom passive flood barriers that deploy automatically using the force of rising floodwaters without the need for electricity. The barriers are available in vertical lift configurations that save space, as well as horizontal lifting configurations that would be easier to install as a retrofit but require more space.

Both WWTP buildings have sets of double doors which could be used for loading large objects or equipment into the buildings. These doors could be retrofitted with removable stop logs that are left in place except for occasions when access through them is needed.

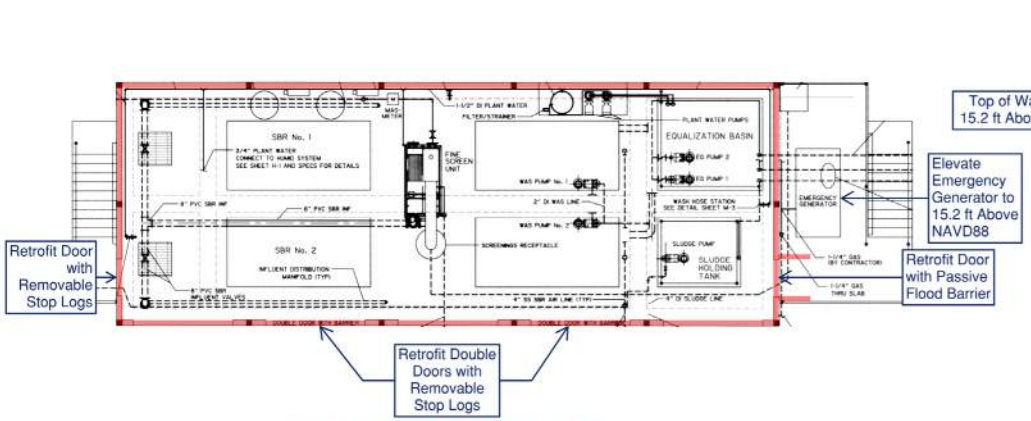
Additional structural engineering and architectural studies would be required to develop this concept into a constructible design, including but not limited to consideration of measures to ensure the buildings can resist buoyant forces resulting from flooding up to elevation 15.2.

ADAPTATION STRATEGIES FOR WWTP & PUMP STATION

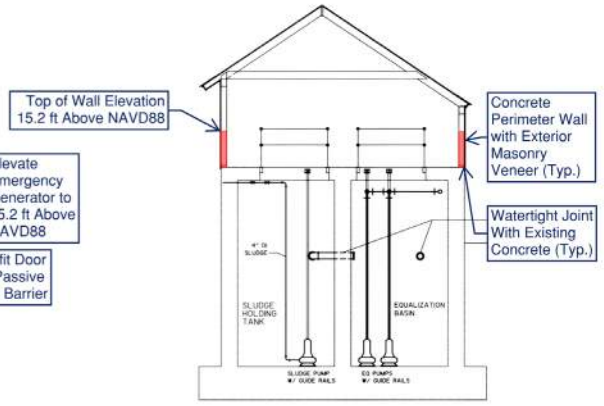
Description	Floodproofing Standard	Elevation (ft above NAVD88)
ASCE 24-24 Floodproofing Standard for Class 3 Buildings (including WWTPs)	750-year Flood Elevation (estimated using a calculation based on FEMA 100-year and 500-year flood elevations)	17.0
Effective FEMA Connecticut River 500-year Flood Elevation	--	16.0
NEIWPCC TR-16 Protection of Critical Equipment Elevation	FEMA Base Flood Elevation + 3 Feet	15.2
NEIWPCC TR-16 Protection of Non-Critical Equipment Elevation	FEMA Base Flood Elevation + 2 Feet	14.2
2050 100-year Connecticut River Projected Flood Elevation	FEMA Base Flood Elevation + 20 inches (1.7 feet)	13.9
ASCE 24-14 Floodproofing Standard for Class 3 buildings (including WWTPs)	FEMA Base Flood Elevation + 1 Foot	13.2
Effective FEMA Connecticut River 100-year Flood Elevation (Base Flood Elevation)	--	12.2
Existing East Haddam WWTP Finish Floor and Top of Pump Station Concrete Slab Elevation	--	12.0

ADAPTATION STRATEGIES FOR WWTP & PUMP STATION

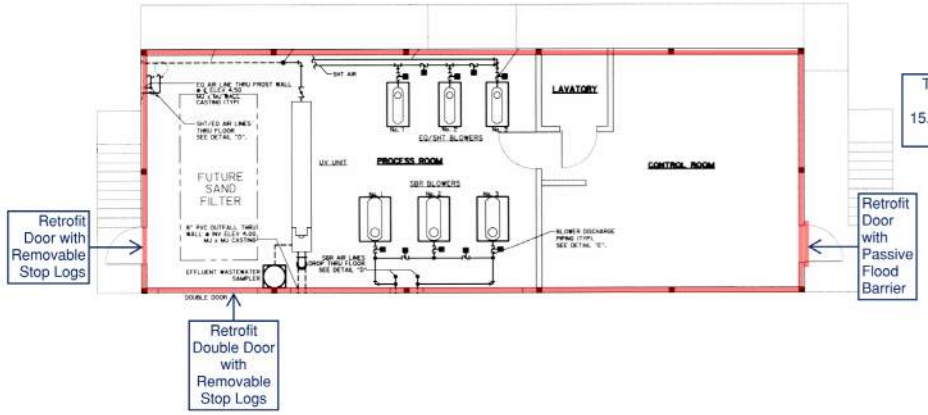
East Haddam Wastewater Treatment Plant Adaptation Plan



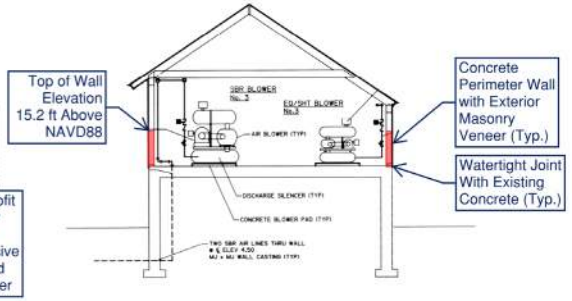
WWTP Process Building - Plan



WWTP Process Building - Section



WWTP Control Building - Plan



WWTP Control Building - Section

RESILIENT EAST HADDAM

ALTERNATIVE COMPARISON

ALTERNATIVES	CONCEPTUAL-LEVEL OPINION OF CONSTRUCTION COST (2024 DOLLARS)	ASSUMPTIONS	BENEFITS	CHALLENGES
1. Remove Rehearsal Studio	$1,870,000 + $563,000 for elevation of 59 and 62 Creamery Road	- Goodspeed donates the Studio land to the Town or provides the Town with a permanent easement - Goodspeed constructs a new rehearsal space on land they already own	- Restores segment of natural stream in existing studio footprint - Reduces flooding at Norwich Road properties - Eliminates Norwich Road overtopping in storms up to the present-day 50-year event - Cost effective over the long run	- Increases flood risk to buildings at 59 Creamery Road and 62 Creamery road (if no other interventions are built) - Requires Goodspeed to arrange alternative rehearsal space during construction meeting terms of actors' contracts, or delay removal of existing Studio until new space is complete

RESILIENT EAST HADDAM

ALTERNATIVE COMPARISON

ALTERNATIVES	CONCEPTUAL-LEVEL OPINION OF CONSTRUCTION COST (2024 DOLLARS)	ASSUMPTIONS	BENEFITS	CHALLENGES
2. Remove Rehearsal Studio + Widen Creamery Road Bridge	$3,420,000	Alternative 1 assumptions plus: - Town can aquire land on 62 Creamery Road for bank expansion at little to no cost	Alternative 1 advantages plus: - Improve flood conditions at all buildings in study area compared to no-build condition due to reduction in bottleneck effect at Creamery Road crossing - Replacement Creamery Road bridge can span the bankfull width of Succor Brook and have a natural stream bottom, improving aquatic species passage - Adds new wetland habitat upstream of crossing	- Requires acquisition of a portion of 62 Creamery Road along the Brook for bank widening

ALTERNATIVE COMPARISON

ALTERNATIVES	CONCEPTUAL-LEVEL OPINION OF CONSTRUCTION COST (2024 DOLLARS)	ASSUMPTIONS	BENEFITS	CHALLENGES
3. Remove Rehearsal Studio + Widen Creamery Road Crossing + Raise Driveway and Construct Berm/Floodwall + Bypass culvert at Norwich Road Bridge	$6,710,000	Alternative 2 assumptions plus: - Town can acquire land or permanent easement to construct earthen berm on Artists Village property at little to no cost	Alternatve 2 advantages plus: - Norwich Road bypass culvert eliminates over-topping of Norwich Road in the present-day 100-year flood - Berm and floodwall eliminates flooding on Creamery Road in the present-day 100-year flood - Raise driveway and berm will protect buildings from high-velocity flows during projected mid-century storm events	- Not eligible for FEMA funding since BCR is less than 1.0 - More difficult option to permit than Options 1 and 2 due to extensive con-struction near riverbank and historic commission approval to remove shed and construct raised driveway close to 12A Norwich Road - Requires annual maintenance by the Town to ensure structural integrity of floodwall and berm - Requires tree/vegetation removal along the right bank of Succor Brook - Requires reconstruction of a portion of sewer force main in Norwich Road to accommodate bypass culvert

RESILIENT EAST HADDAM

ALTERNATIVE COMPARISON

ALTERNATIVES	CONCEPTUAL-LEVEL OPINION OF CONSTRUCTION COST (2024 DOLLARS)	ASSUMPTIONS	BENEFITS	CHALLENGES
4. Remove Rehearsal Studio + Widen Creamery Road Crossing + Construct Dam at Daniels Pond + Raise Driveway and Construct + Construct Berm/Floodwall	Not computed	Alternative 3 assumptions plus: - Land acquisition at the dam site and construction of an access road to the dam site is achievable - 135 +/- acre-feet of storage is feasible at Daniels Road pond below the crest of the dam	Alternative 3 advantage plus: - Watershed storage reduces peak flood flow rates in all curent and future storm events - Eliminates overtopping of Norwich Road in the present-day 100-year flood without requiring bypass culvert	Alternative 3 disadvantages plus: - Most difficult to permit of all alternatives due to loss of aquatic organism passage at dam outlet - Most intensive maintenance requirements of all alternatives to ensure continued safe operation of dam

BENEFIT-COST ANALYSIS

Kleinfelder performed a Benefit-Cost Analysis (BCA) of the adaptation options. In general, a BCA is an economic analysis that compares the benefits of a risk mitigation project with its costs of implementation to estimate its overall cost effectiveness. The result of a BCA is a benefit-cost ratio (BCR), which is the dollar amount of total benefits from the project divided by the total costs.

To carry out the analysis, Kleinfelder used version 6.0 of the FEMA BCA toolkit, a spreadsheet program developed by FEMA that calculates BCRs for a project based on the type of mitigation project, the anticipated benefits, and the initial and ongoing project costs. Project benefits are calculated in the form of avoided damages to structures and their contents, as well as avoided flood-related ancillary costs such as temporary relocation, volunteer labor, and social costs. Projects that achieve a BCR of greater than or equal to 1 are considered by FEMA to be cost effective and eligible for FEMA grant funding.

For this analysis, the standard FEMA discount rate of 7.0% was chosen to reflect the time value of money. FEMA BCA guidance prior to June 2025 recommended using a discount rate of 3.1%. BCA results using both discount rates are presented in this section. Benefits were counted as avoided structural and contents damage achieved from implementing flood mitigation alternatives. Costs were computed as the initial project cost and annual maintenance cost over the design life of the project. Alternatives 1, 2, and 3 were evaluated. Initial project costs include land survey, engineering, and administrative costs, as well as materials and labor necessary to construct the improvements. Maintenance costs for Alternatives 1 and 2 were taken as 5% of the cost of retaining walls and a headwall required to tie in an existing drainage pipe to the new channel in the Rehearsal Studio footprint. For Alternative 3, additional maintenance costs were taken as 5% of the cost of the vertical structural floodwall. For Alternative 1, the costs of elevating 59 and 62 Creamery Road were included in the BCA and were assumed to be equal to the replacement cost of each building. Building replacement values were obtained from the East Haddam Assessor's Database.

The benefits and costs documented in this report are preliminary as they are based on the conceptual Succor Brook flood mitigations developed as part of this analysis. Additional design development to refine costs and floodplain modeling to reflect a more detailed design would be required to finalize the BCA presented in this section.

RESILIENT EAST HADDAM

BENEFIT-COST ANALYSIS

	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
Initial Project Costs	$1,870,000 + $563,000 for elevation of 59 and 62 Creamery Road	$3,420,000	$6,710,000
Annual Maintenance	$4,500 (restored channel)	$4,500 (restored channel) (no additional maintenance cost was assumed for the replacement crossing)	$4,500 (restored channel) $39,000 (berm and floodwall) (Maintenance costs for the bypass culvert were assumed to be covered under the Town's maintenance of drainage infrastructure, no additional cost was assumed
Design Life (based on FEMA BCA Toolkit guidance for type of project)	100 years (Rehearsal Studio)	50 years (Creamery Road bridge) 100 years (Rehearsal Studio)	35 years (berm, floodwall, and bypass culvert) 50 years (Creamery Road Bridge) 100 years (Rehearsal Studio)
Benefit/Cost Ratio (BCR) with Discount Rate = 3.1%	2.16	1.48	0.70
Benefit/Cost Ratio (BCR) with Discount Rate = 7.0%	1.11	0.75	0.37

RESILIENT EAST HADDAM

PROJECT FUNDING

The following table lists funding opportunities (both grants and loans) applicable to flood mitigation alternatives 1-3 and the WWTP/Pump Station. Note that only certain portions of the recommended alternatives may qualify for funding under these programs, and additional funding may need to be obtained from the Town or private landowners.

Funding Program	General Information	Alt. 1	Alt. 2	Alt. 3	WWTP & Pump Station
CT DEEP Resilience Fund	- Program funds construction and planning and design of climate resilience projects	✓	✓	✓	✓
CT DEEP Resilience Loan Program (planned, not yet implemented)	- Authorized by CT legislature in 2024; terms of the program are TBD - Program is intended to provide low-interest loans to municipalities and private entities for resiliency projects	TBD	TBD	TBD	TBD
Long Island Sound Futures Fund	- Funds resilience, water quality, and fish passage projects in the Long Island Sound Study Area (each alternative is within this area) - Requires minimum non-federal match of 50% of the requested funding amount	✓	✓	✓	
Federal Highway Administration (FHWA) National Culvert Removal, Replacement, & Restoration Grants (Culvert Aquatic Organism Passage Program)	- Funds replacement of culverts and weirs that pose barriers to anadromous fish (does not include dam removal) - Requires 20% non-federal matching funds	✓	✓	✓	

RESILIENT EAST HADDAM

PROJECT FUNDING

Funding Program	General Information	Alt. 1	Alt. 2	Alt. 3	WWTP & Pump Station
US Fish & Wildlife Service (USFWS) National Fish Passage Program	- Funds projects which remove in-stream barriers and restore climate resilient aquatic connectivity to benefit Federal trust resources - Requirement to work with FWS Fish and Aquatic Conservation Program in project development - No cost-sharing requirement but applications including cost-sharing score higher - Non-profit organizations in addition to municipal/county/ state governments are eligible to apply	✓	✓	✓	
EPA / CT DEEP Clean Water Act Section 319 Nonpoint Source Grant Program	- Funds projects that address nutrients, bacteria, and sediment including habitat improvements and dam re-moval, in addition to other projects to improve stormwater runoff management - Requires 40% non-federal match	✓	✓	✓	
FEMA Hazard Mitigation Grant Program (HMGP)	- Available after a Presidential Major Disaster declaration - Includes funding for projects protecting buildings from flooding and drainage improvement projects - Requires 25% non-federal match - BCR must be greater than or equal to 1	✓			
FEMA Flood Mitigation Assistance (FMA) Swift Current Program	- Available after a Presidential Major Disaster declaration - Requires 25% non-federal match - BCR must be greater than or equal to 1 - Funds are only available to property owners with a current flood insurance policy under the National Flood Insurance Program (NFIP) and a history of repetitive losses or substantial flood damage	✓			

RESILIENT EAST HADDAM

PROJECT FUNDING

Funding Program	General Information	Alt. 1	Alt. 2	Alt. 3	WWTP & Pump Station
Connecticut Communities Challenge Grant	- Categories of projects funded include mobility improvements, essential infrastructure, and major hub redevelopment including brownfields remediation - Requires 50% private and/or local funding match	✓	✓	✓	
Connecticut Clean Water Fund Program	- Funds wastewater infrastructure improvements projects, including resiliency/climate change adaptation projects				✓

RESILIENT EAST HADDAM

PREFERRED CONCEPTUAL DESIGN

Kleinfelder recommends that the Town of East Haddam implement Alternative 2 at a minimum, in addition to implementing the adaptations for the WWTP and pump station.

With the guidance of the information contained in the Resilient East Haddam final report, Kleinfelder recommends the Town of East Haddam coordinate with the Goodspeed Foundation and determine whether to further Alternative 2, or the expanded design highlighted in Alternative 3. After weighing the trade-offs and selecting an alternative, the Town should seek and secure funding.

Upon receipt of funding, Kleinfelder recommends that the Town undertake additional existing conditions investigations to refine the conceptual designs presented in this report, reach out to property owners in the mid-century 100-year floodplain to review floodproofing options, further develop the costs and implementation steps, and advance the project through design development, construction documentation, and implementation.

East Haddam Swing Bridge Painting in Town Hall

APPENDIX A

STAKEHOLDER ENGAGEMENT SUMMARY

CTAC MEETING #1

Community and Technical Advisory Committee (CTAC) Meeting #1
Thursday, April 25, 2024, 3-4 PM
Virtual Meeting

Meeting Goals
Present an overview of the program and project goals. Discuss potential trade-offs and compromises to mitigate flooding in lower Succor Brook.

Attendees

CTAC Members
- Margot Burns, Senior Environmental Planner - RiverCOG
- David Byrd, General Manager - Goodspeed Opera
- Bob Casner, Chair - East Haddam Economic Development Commission
- Cameron Hendry, East Haddam Redevelopment Agency
- John Olin, East Haddam Conservation Commission

CIRCA
- John Truscinski, Director of Resilience Planning
- Nicole Govert, Project Lead Community Resilience Planner
- Mary Buchanan, Community Resilience Planner

Kleinfelder
- Neil Kulikauskas, Project Manager/Principal
- Kyle Johnson, Assistant Project Manager, Resiliency Specialist
- Dan Pasquale, Project Engineer, Modeling
- Lizzy Norris, Project Engineer, Design
- Kate Riley, Principal, Community Engagement Manager

CTAC MEETING #1

Agenda

1. Introductions
2. CIRCA Overview
3. “Resilient East Haddam” Project
4. Stakeholder Engagement
5. Information Sharing/Open Discussion/Q&A

Meeting Summary

Kleinfelder and CIRCA teams provided an overview of the CIRCA Resilient CT Program and the Resilient East Haddam project goals. Kleinfelder presented the scope of the study and the project study limits. The team discussed challenges and limitations associated with this type of study. Kleinfelder presented the project schedule including the planned future stakeholder engagement activities including CTAC Meetings and Public Workshops.

CTAC MEETING #2

Community and Technical Advisory Committee (CTAC) Meeting #2
Wednesday, August 21, 2024, 11AM - 1PM
Virtual Meeting

Meeting Goals
Present preliminary modeling of existing and future flood conditions in lower Succor Brook. Discuss potential adaptation strategies to mitigate flooding and discuss potential trade-offs and compromises of each adaptation strategy.

Attendees

CTAC Members
- Margot Burns, Senior Environmental Planner - RiverCOG
- Donna Lynn Hilton - Goodspeed Opera
- Ed Blaschik – Goodspeed Opera
- Bob Casner, Chair - East Haddam Economic Development Commission
- Rachel Colonni, Chatham Health District
- Todd Gelston, Community Member
- Cameron Hendry, East Haddam Redevelopment Agency
- John Olin, East Haddam Conservation Commission
- Michele Velez, Director of Public Works
- James Ventres, East Haddam Land Use Office
- Jeff Wolter, Chairman - Goodspeed Opera

CIRCA
- John Truscinski, Director of Resilience Planning
- Mary Buchanan, Community Resilience Planner

CTAC MEETING #2

Kleinfelder
- Neil Kulikauskas, Project Manager/Principal
- Kyle Johnson, Assistant Project Manager, Resiliency Specialist
- Dan Pasquale, Project Engineer, Modeling
- Lizzy Norris, Project Engineer, Design
- Kate Riley, Principal, Community Engagement Manager

Agenda
1. Re-Introductions – New members!
2. Review of "Resilient East Haddam" Project
3. What's Happened Since Last Meeting
4. Review Priorities and Flood Mitigation Strategies
5. Discussion on Trade Offs and Compromises
6. Q&A

Meeting Summary
Kleinfelder re-presented a summary of the project goals and project overview including, project limits, scope of study, challenges and limitations, and project schedule. Kleinfelder presented the progress since last meeting that included a summary of the hydrologic and hydraulic modeling results and public outreach activities. A discussion was held on priorities and potential adaptation strategies including a discussion on potential trade-offs and compromises. The team also discussed the feasibility and effectiveness of potentially utilizing storage within the upper watershed to mitigate flooding in lower Succor Brook.

CTAC MEETING #3

Community and Technical Advisory Committee (CTAC) Meeting #3
Wednesday, December 18, 2024, 3:00-4:30 PM

Meeting Goals
Present preliminary adaptation options and effectiveness to mitigate flooding. Discuss trade-offs and compromises of each adaptation strategy.

Attendees

CTAC Members
- Margot Burns, Senior Environmental Planner - RiverCOG
- Donna Lynn Hilton - Goodspeed Opera
- Ed Blaschik – Goodspeed Opera
- Bob Casner, Chair - East Haddam Economic Development Commission
- Rachel Colonni, Chatham Health District
- Todd Gelston, Community Member
- Cameron Hendry, East Haddam Redevelopment Agency
- John Olin, East Haddam Conservation Commission
- Michele Velez, Director of Public Works
- James Ventres, East Haddam Land Use Office
- Jeff Wolter, Chairman - Goodspeed Opera

CIRCA
- John Truscinski, Director of Resilience Planning
- Mary Buchanan, Community Resilience Planner
- Nicole Govert, Project Lead Community Resilience Planner

CTAC MEETING #3

Kleinfelder
- Neil Kulikauskas, Project Manager/Principal
- Kyle Johnson, Assistant Project Manager, Resiliency Specialist
- Dan Pasquale, Project Engineer, Modeling
- Lizzy Norris, Project Engineer, Design
- Kate Riley, Principal, Community Engagement Manager

Agenda
1. Welcome
2. Review of Scope and Schedule
3. What's Happened Since Last Meeting
4. Presentation of Adaptation Options
5. Discussion of Adaptation Options
6. Open Discussion (Q&A)

Meeting Summary
The team discussed the progress of the project, focusing on the current and future conditions analysis, adaptation strategy development, and the potential solutions to mitigate flood risk along Succor Brook. They also explored the feasibility of removing a dam in the current setup and the potential relocation of the rehearsal studio, considering various alternatives. The importance of forward thinking, considering the changing climate, and aligning with state and federal climate resilience programs was emphasized throughout the meeting.

CTAC MEETING #4

Community and Technical Advisory Committee (CTAC) Meeting #4
Thursday, March 6, 2025, 12-1 PM

Meeting Goals
Present preliminary adaptation options and effectiveness to mitigate flooding. Discuss trade-offs and compromises of each adaptation strategy.

Attendees

CTAC Members
- Margot Burns, Senior Environmental Planner - RiverCOG
- Donna Lynn Hilton - Goodspeed Opera
- Ed Blaschik – Goodspeed Opera
- Bob Casner, Chair - East Haddam Economic Development Commission
- Rachel Colonni, Chatham Health District
- Todd Gelston, Community Member
- Cameron Hendry, East Haddam Redevelopment Agency
- John Olin, East Haddam Conservation Commission
- Michele Velez, Director of Public Works
- James Ventres, East Haddam Land Use Office
- Jeff Wolter, Chairman - Goodspeed Opera

CIRCA
- John Truscinski, Director of Resilience Planning
- Mary Buchanan, Community Resilience Planner
- Nicole Govert, Project Lead Community Resilience Planner

CTAC MEETING #4

Kleinfelder
- Neil Kulikauskas, Project Manager/Principal
- Dan Pasquale, Project Engineer, Modeling
- Lizzy Norris, Project Engineer, Design
- Kate Riley, Principal, Community Engagement Manager

Agenda
1. Welcome
2. Review of Scope and Schedule
3. What's Happened Since Last Meeting
4. Review Adaptation Options
5. Benefit Cost Analysis
6. Open Discussion (Q&A)

Meeting Summary
Kleinfelder re-presented the project scope and schedule. Kleinfelder presented the progress since last meeting that included a summary of Public Meeting #2, development of recommended adaptation strategies, and a summary of preliminary costs. A discussion was held on the recommended adaptation projects and cost development. The team also discussed the preliminary approach to benefit cost analysis and how that would affect the priority potential funding for the recommended adaptation projects.

RESILIENT EAST HADDAM

PUBLIC WORKSHOP #1

Public Workshop #1
Thursday, October 24, 2024, 6:30-8:30 PM
East Haddam Municipal Office Complex

Meeting Goals
Present an overview of the program and project goals. Present preliminary modeling of existing and future flood conditions in lower Succor Brook. Discuss potential adaptation strategies to mitigate flooding and discuss potential trade-offs and compromises of each adaptation strategy.

Attendees

CIRCA
- John Truscinski, Director of Resilience Planning
- Mary Buchanan, Community Resilience Planner
- Nicole Govert, Project Lead Community Resilience Planner

Kleinfelder
- Neil Kulikauskas, Project Manager/Principal
- Dan Pasquale, Project Engineer, Modeling
- Lizzy Norris, Project Engineer, Design
- Kate Riley, Principal, Community Engagement Manager

Public
- See sign-in sheet

RESILIENT EAST HADDAM

PUBLIC WORKSHOP #1

Agenda

1. Introductions
2. CIRCA Overview
3. “Resilient East Haddam” Project
4. Existing and Future Conditions
5. Information Sharing/Open Discussion/Q&A

Meeting Summary

Kleinfelder introduced the project team. CIRCA provided an overview of the Resilient CT Program. Kleinfelder provided an overview of the Resilient East Haddam project including project goals, project overview, scope of study, challenges and limitations, and schedule. Kleinfelder presented modeling results showing existing and future flooding conditions in lower Succor Brook. A discussion was held on the potential adaptation options, challenges and limitations, and other public input items (see discussion items below). Kleinfelder summarized next steps in the project.

Public Discussion

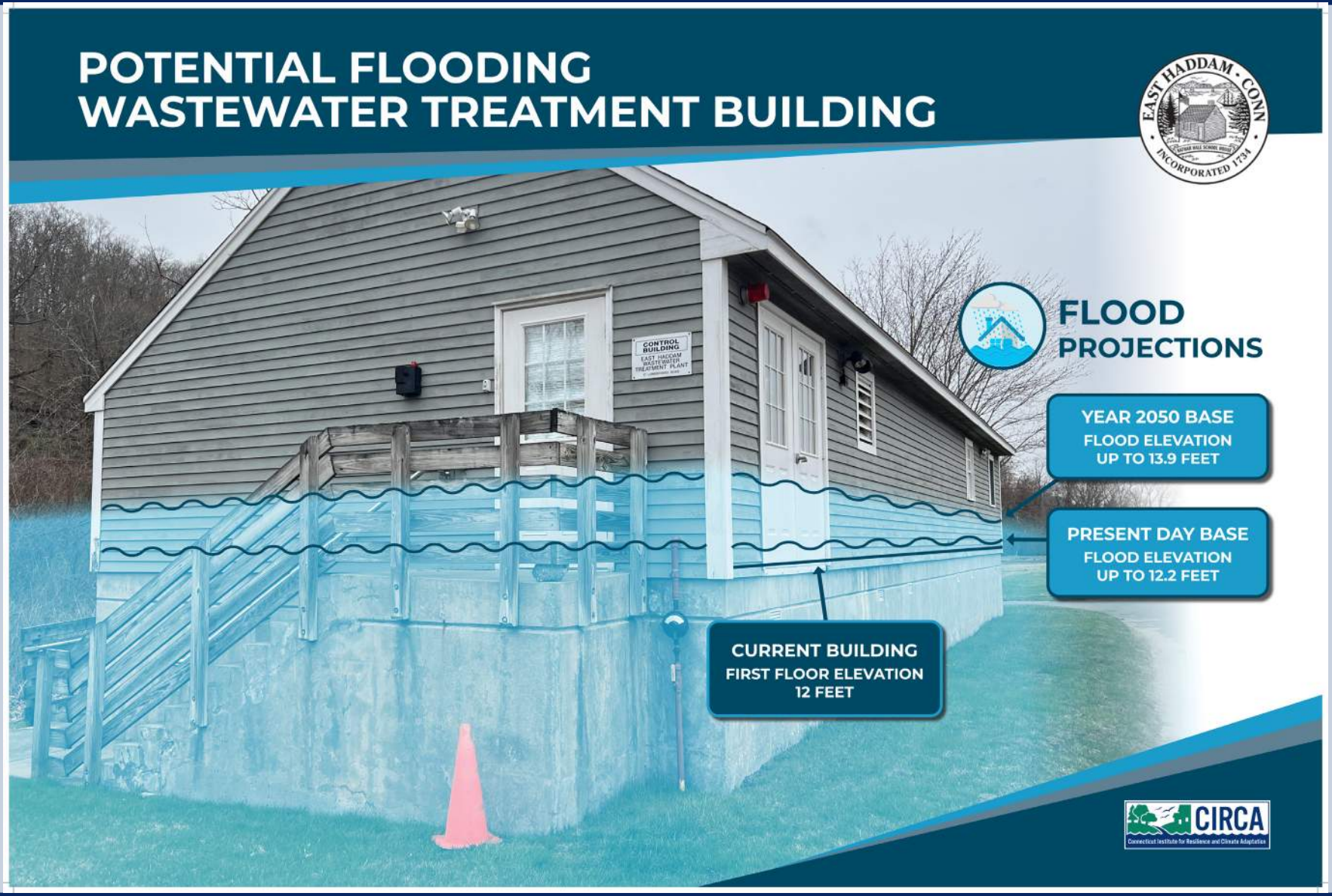
- What are the yellow outlines on the mapping? ***Property lines of Goodspeed***
- Where does effluent from treatment plant go? ***Connecticut River***
- What is peak flow?
- Where is the rain fall measured? ***NOAA lets you pick a point and bases it on this. This is based on East Haddam. Also using statewide averages.***
- Did this calibration data include 1982 storm? ***Where there was 4 feet of water at high flow.***
- Using the artist village image- add 4 feet of water.
- Can you correlate this image to a point on the chart? Height of the water and speed of the water? A***nnual rainfall in CT is 50-55” Rainfall is measured in depth of inches. Over 24 hours.***
- Another question on the velocity of the flow, in addition to the depth. ***Point out that the brook is L-shaped. Water wants to go straight.***
- Beaver Dam – uncertainty around impacts from a breach? ***A high-level analysis showed that it would be approxi-***

mately same as the 100-year storm.

- Beaver Dam may be a positive thing. If we had no dam, we'd have all that water run down the hill. Dam slows it down. What is the ratio of volume of water held behind the beaver dam, versus total water shed. ***Flows are from the whole watershed. Consider the dam construction. Not a breach of a manmade dam, with a beaver dam, you have sticks that pile up, jam up. They slow the water down. A beaver dam break is not as catastrophic as a manmade dam breach. We understand where it fits in, looks like a 100-year storm, and incorporate that understanding.***
- How confident are you in the modeling 10-year, 100-year?
- Will adaptations only be within the project limits, or will there be some proposed further up in the watershed?
- Why was study area limited the way it was. Why didn't it include the Beaver Dam? ***We are able to asses including the dam. The solutions may lie upstream.***
- Looks like you're concerned with Goodspeed. Why are all the pics of Goodspeed? Why do they have all the property as a non-profit? This seems like a plan to protect Goodspeed.
- ***The study includes assessment of the beaver dam. Study limits are for the damage. 3M gallons in the pond.***
- ***The reason we focused on this area is because it's had the most amount of damage.***
- Why not build a manmade dam instead of relying on the beaver dam? ***They will just build downstream.***
- Why isn't trouble pond included? ***It is part of the model and the survey.***
- Beaver dam - the January storm, John Olin photographed the beaver dam. Very concerned at that time. Dam is overtopped and water is pouring out from all levels of the dam. Area around was flooded, thinking it could go any moment.

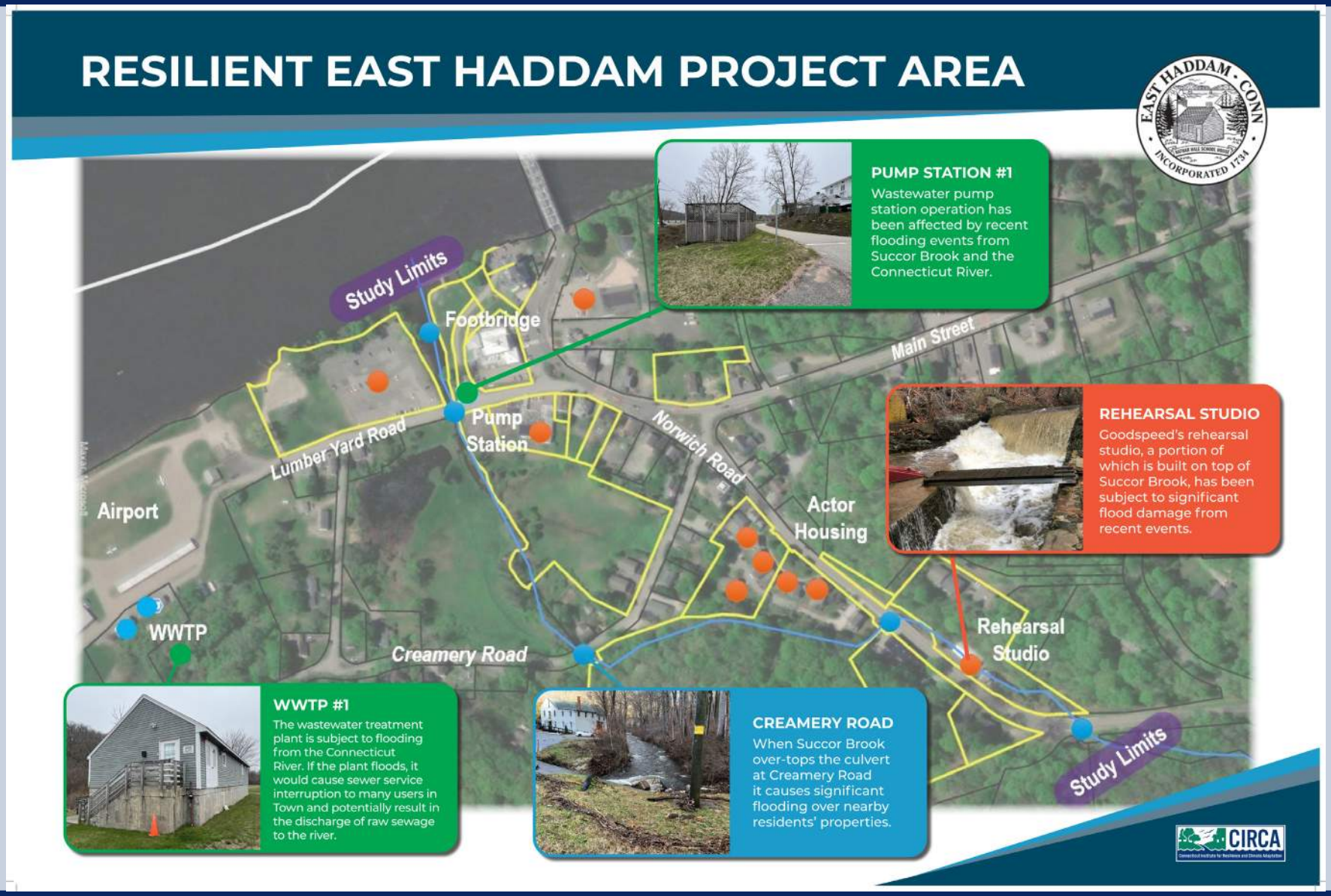
First Resilient East Haddam Public Workshop

- Trouble pond was a settling pond. Captures erosion, lets erosion settle out, clean water flow out.
- 66 Creamery Road - Water comes fast and furious. Would this be different if Goodspeed didn't build the actor housing. Why didn't they look into it. It funnels the water down. What was a field is now a concrete driveway that creates a funnel for the water. Flows we are seeing coming from the storms are from the whole watershed. Don't forget about the residents on Creamery Road.
- ***Present FEMA study of Succor Brook stops downstream of Creamery Road. Requested info from FEMA, but they didn't have data that fully extended past the lower brook.***
- The Boardman reservoir broke and brought the reservoir. Since the breach, these weather events have a greater impact on the village. No attenuation, no control, no storage. Move up the watershed to consider alternatives.
- ***Boardman Pond had no flood control. Storage capacity was dead.***
- Inaccessible gorge, still stuff hanging across trouble pond. Diseased trees. Who's responsible for clearing debris?
- Were culverts appropriately sized? The newer ones on Norwich Road? ***We don't know what they were designed to, typically 25 or 50-year. State uses that data.***
- Potential adaptations. How do they fit with grant applications, especially when they want nature-based solutions? Degree and depth of flooding here are beyond what nature-based solutions. ***There are other federal grants available. They want you using climate date with forward-thinking data. Adaptations will require use of forward-looking data. Other actions that reduce impact.***
- Beavers – most people see them as a nuisance. Beavers see us as a nuisance. We have exterminated them and it has changed the hydrology. We have disturbed the system from its natural state.
- Cost-benefit analysis. Need to look hard at the costs of maintenance of these solutions. Trouble pond was maintained daily. Commit to maintaining.
- Study zone makes sense, but solution zone may be wider.
- Our priorities are to make this village a vibrant community where we can bring businesses that can thrive. May be change of properties, relocation.


POTENTIAL FLOODING
WASTEWATER TREATMENT BUILDING
EAST HADDAM · CONN · INCORPORATED 1734
CONTROL BUILDING
EAST HADDAM WASTEWATER TREATMENT PLANT
FLOOD PROJECTIONS
YEAR 2050 BASE FLOOD ELEVATION UP TO 13.9 FEET
PRESENT DAY BASE FLOOD ELEVATION UP TO 12.2 FEET
CURRENT BUILDING FIRST FLOOR ELEVATION 12 FEET
CIRCA
Connecticut Institute for Resilience and Climate Adaptation

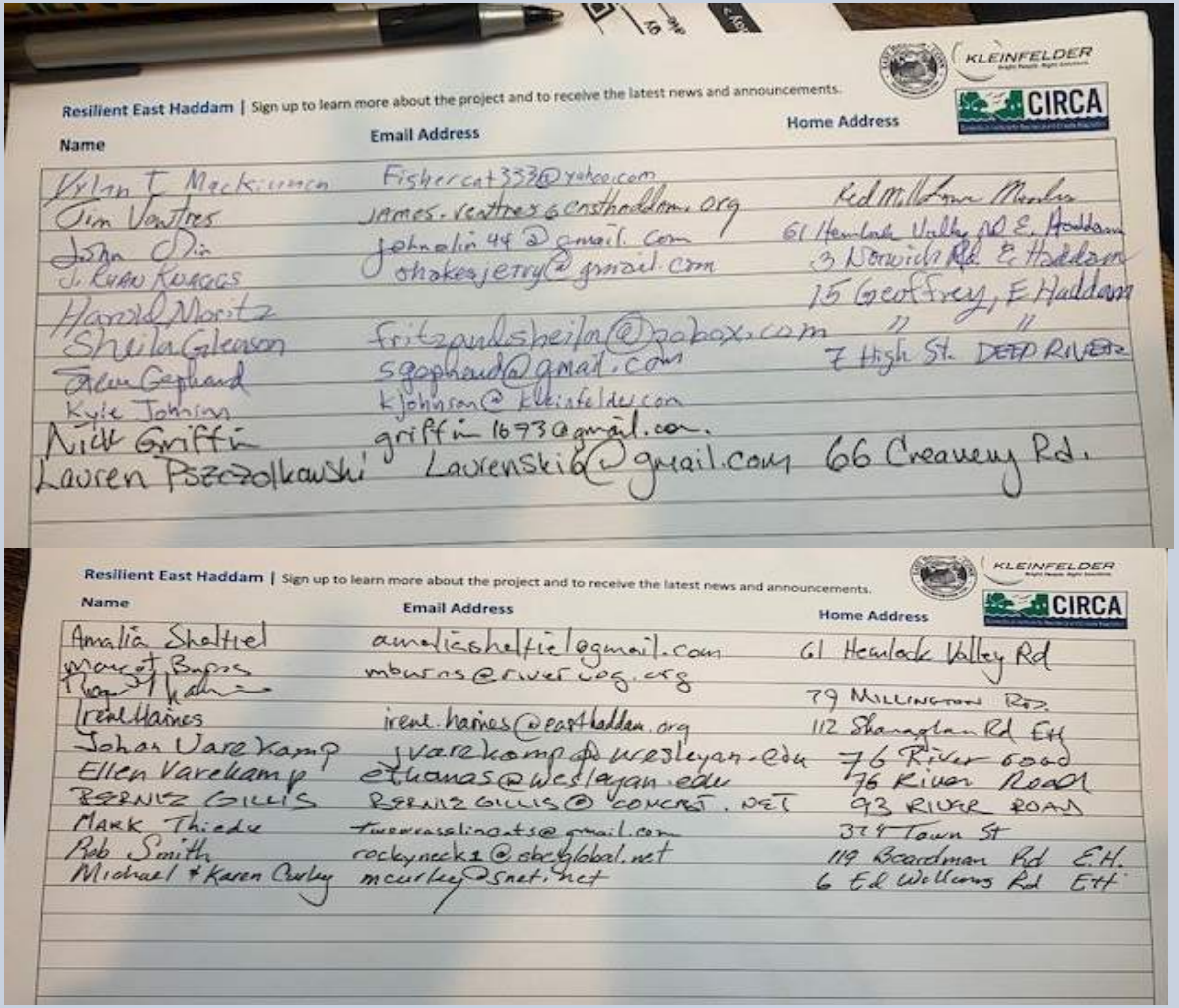
RESILIENT EAST HADDAM

PUBLIC WORKSHOP #1



RESILIENT EAST HADDAM

PUBLIC WORKSHOP #1



Resilient East Haddam | Sign up to learn more about the project and to receive the latest news and announcements.

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J. Ryan Kovacs	ohakeajerry@gmail.com	15 Geoffrey, E Haddam
Harold Moritz		
Sheila Gleason	fritzpaulsheila@yahoo.com	" "
Galen Gephard	sgophaud@gmail.com	7 High St. DEEP RIVER
Kyle Johnson	kjohnson@Elkinfelder.com	
Nick Griffin	griffin1673@gmail.com.	
Lauren Pszczolkowski	Laurenski@gmail.com	66 Creamery Rd.

Resilient East Haddam | Sign up to learn more about the project and to receive the latest news and announcements.

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Michael & Karen Curley	mcurley@snet.net	6 Ed Williams Rd E.H.

RESILIENT EAST HADDAM

PUBLIC WORKSHOP #2

Public Workshop #2
Wednesday, February 5, 2025, 6:30-8:30 PM
East Haddam Municipal Office Complex

Meeting Goals
Present an overview of the program, project goals and progress. Present preliminary adaptation options to mitigate flooding and discuss potential trade-offs and compromises of each adaptation strategy. Solicit public input.

Attendees

CIRCA
- Mary Buchanan, Community Resilience Planner
- Nicole Govert, Project Lead Community Resilience Planner

Kleinfelder
- Neil Kulikauskas, Project Manager/Principal
- Dan Pasquale, Project Engineer, Modeling
- Lizzy Norris, Project Engineer, Design
- Kate Riley, Principal, Community Engagement Manager
- Kyle Johnson, Assistant Project Manager, Resiliency Specialist

Public
- See sign-in sheet

PUBLIC WORKSHOP #2

Agenda

1. Introductions
2. Review of Scope and Schedule
3. What's Happened Since Last Meeting
4. Presentation of Adaptation Options
5. Discussion of Adaptation Options
6. Open Discussion (Q&A)

Meeting Summary

Kleinfelder re-introduced the project team. Kleinfelder provided an overview of the Resilient East Haddam project scope, progress and schedule. Kleinfelder presented a summary of work completed since the previous public meeting including completion of modeling of current and future conditions, CTAC Meeting #3, and the development of adaptation strategies. Kleinfelder presented the various adaptation options along with effectiveness to mitigate flooding. A discussion was held on the potential adaptation options, challenges and limitations, and other public input items (see discussion items below). Kleinfelder summarized next steps in the project.

Public Discussion

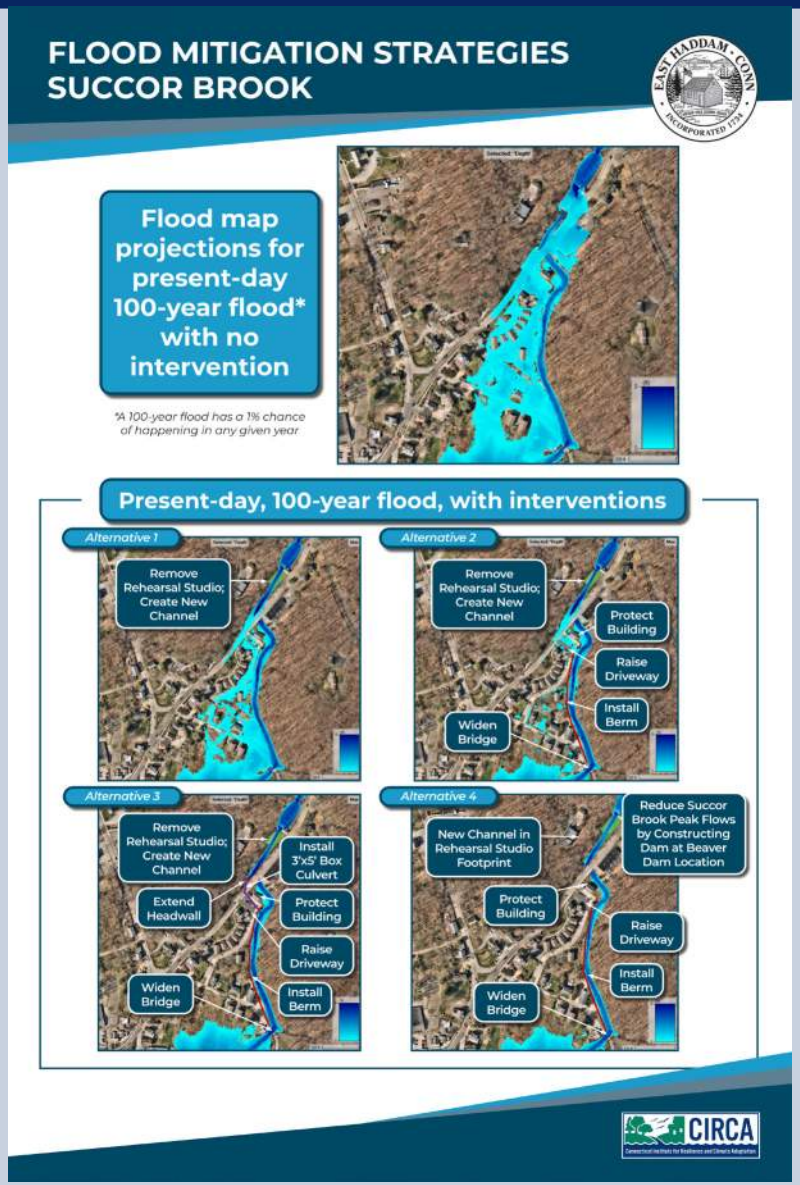
- Why plan to current year 100-year when we are closer to mid-century 100-year? Won't the plans be obsolete? At this point, will we be wasting money? By the time we get to the mid-century we are going to have to invest again. ***Discussion ensued around level of service and cost-benefit analysis.***
- Question about storage and Daniel's Pond- how much storage would be there? How high would the dam be?
- Can Boardman Pond Dam be restored and be a flood control area? ***It was a pond and the town decided to breech that dam. Should be considered a method to restore flood water storage. The rule of thumb is that you need to hold 10% of flood volume to be effective. Even if you used both of those, the old one and the one that was breeches recently, you'd need 4x the storage.***
- Does that take into account dredging the fill in the pond. Topography shows the bottom and that's what we ended up using.
- If you were to consider that Boardman Pond location and not have it full, but it can flow out the bottom? ***We accounted for that. Even so, it wasn't enough for even the 100-year. Could work for smaller storms. It's a design principle that you need 10% or storage to have an impact on the large storm. Smaller storms - yes.***

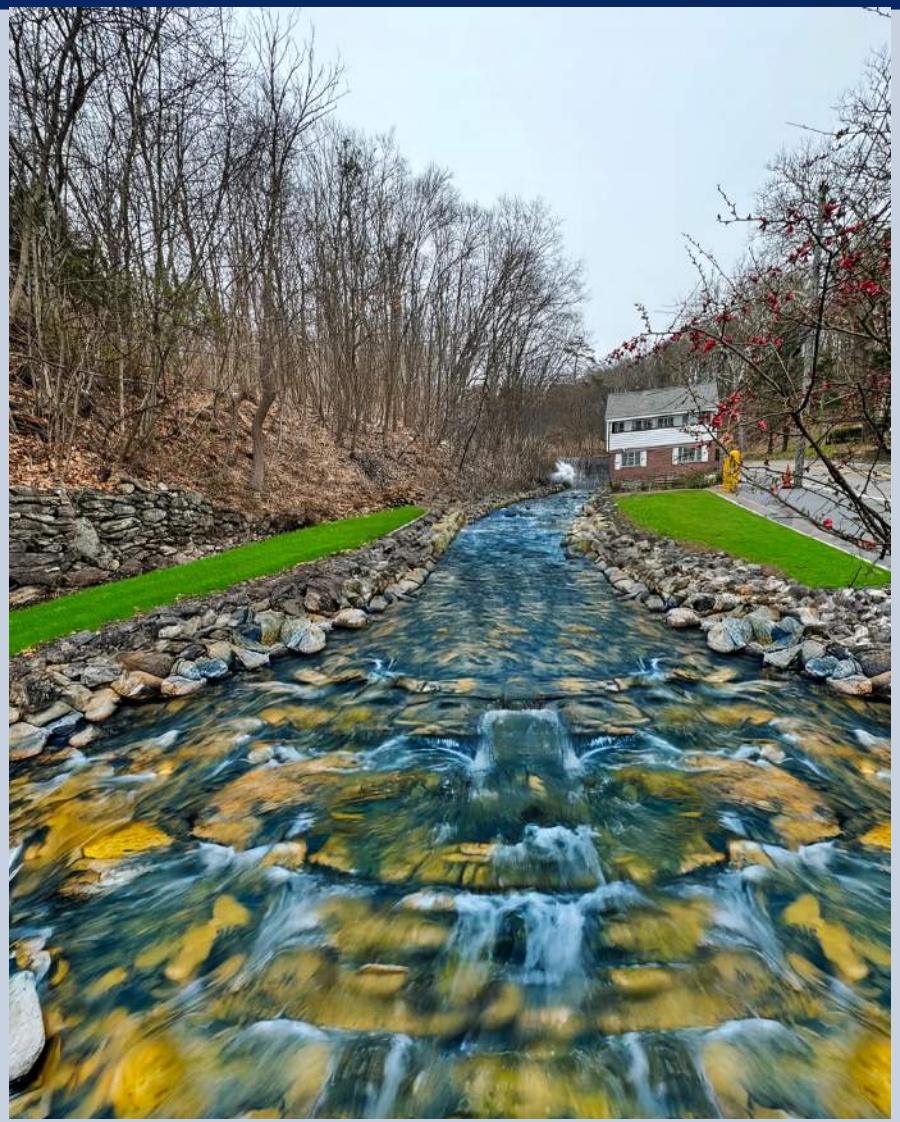
But not the larger storms.

- What if you use both areas? Would that eliminate the need to do all this infrastructure. ***It could reduce the some of the adaptations proposed (remove bypass pipe, lower floodwall, etc.)***
- Do you know of any flood control dams at this minor scale? ***I know many small dams that are in disrepair and in danger of breech.***
- Can we cut a channel to restore the natural flow path that goes behind the brick building? ***We can look at that.***
- Beavers - they can be good. List of guidelines for managing water and protecting habitats. Did you look at this? ***No.***
- Trouble Pond Dam - did you look at removing this? Is it a possibility? Would that aggravate flooding. ***This a problematic dam. If you dredge it out, can you lower the profile. Agreed. We wanted to keep the costs that directly mitigate flooding strategies as cost-effective as possible. From a flooding perspective, it has no impact, but from an overall project perspective, it should likely be removed as part of the overall project.***
- ***John Olin has a letter from the owner to the Two Wrastlin' Cats café. He experienced the breech of the dam. Also refers to 9/2018 storm. 8 inches. Lots of damage. Beaver Dam doesn't have to break to cause the flooding.***
- Have you considered tree loss due to emerald ash borer? Losing a lot of trees.
- Creamery Road - is that on existing flood plain maps? Is it in an existing flood plain? ***Yes, FEMA zone AE, and partially FEMA zone A. 100-year floodplain.***
- The treatment plant flooding comes from CT River? ***Yes.***
- Would you remove the small building adjacent to Trouble Pond dam? ***It's not currently shown as impacted by flooding.***
- What would the flood wall look like?
- What can we do right now? Is there money available now? Can we chip away at this? ***Maintenance of the area - debris, drainage structures. We are going to prioritize the adaptations and cost them out and make a list of what can done first.***
- Does the state have ready money for this? ***FEMA BRIC program. DEEP matching funds.***

Second Resilient East Haddam Public Workshop

PUBLIC WORKSHOP #2



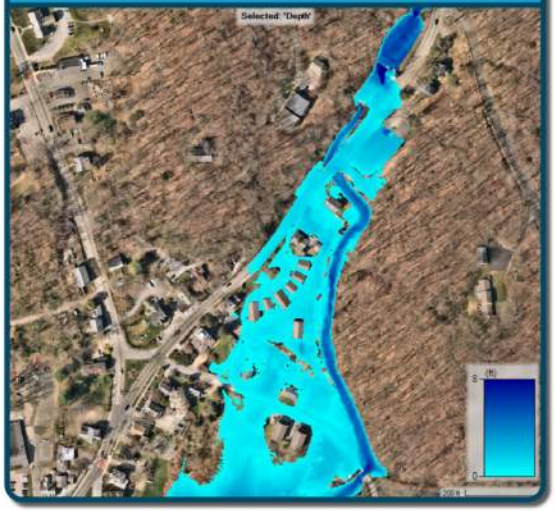


Rendering of a restored Succor Brook stream

FLOOD MITIGATION STRATEGIES
SUCCOR BROOK

FLOOD MAP PROJECTIONS

Present-day 100-year flood* WITH NO INTERVENTION



*A 100-year flood has a 1% chance of happening in any given year

1. Remove Rehearsal Studio; Create New Channel
2. Extend Headwall
3. Install New Drainage Bypass
4. Protect Building
5. Raise Driveway
6. Install Berm
7. Widen Bridge

Present-day, 100-year flood, WITH INTERVENTIONS

FLOOD MITIGATION STRATEGIES
CREAMERY ROAD BRIDGE

EXISTING BRIDGE CONDITIONS

- Replace existing crossing with new 24' wide bridge.
- Restore natural streambed through the bridge crossing.
- Connect end of floodwall to bridge wingwall.

PROPOSED BRIDGE MODIFICATIONS

APPENDIX B

FLOOD MODEL REFERENCE DOCUMENTS

UNDER SEPARATE COVER

APPENDIX C

BENEFIT COST ANALYSIS & ADAPTATION ALTERNATIVE COST ESTIMATE

UNDER SEPARATE COVER