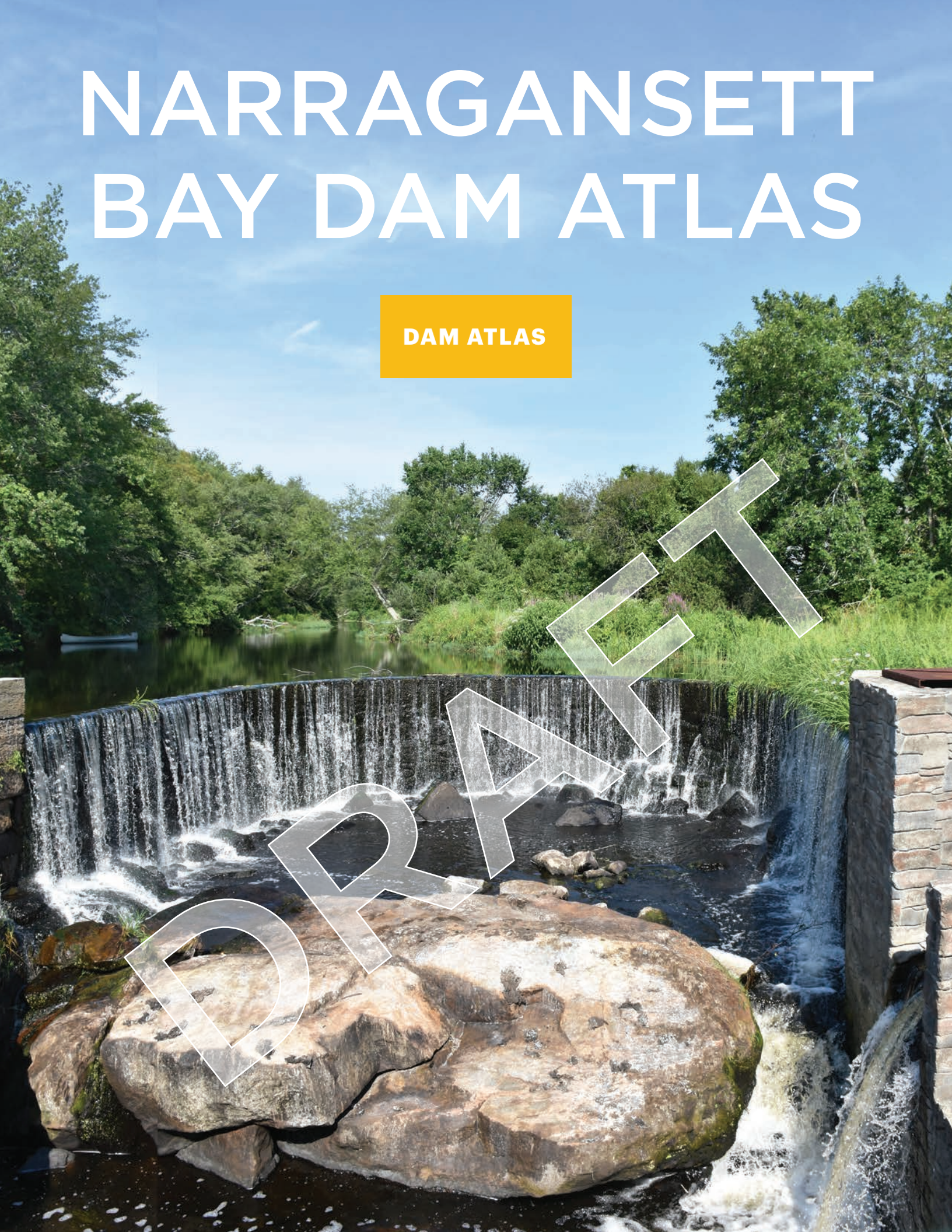


NARRAGANSETT BAY DAM ATLAS

DAM ATLAS

DRAFT



NARRAGANSETT BAY DAM ATLAS

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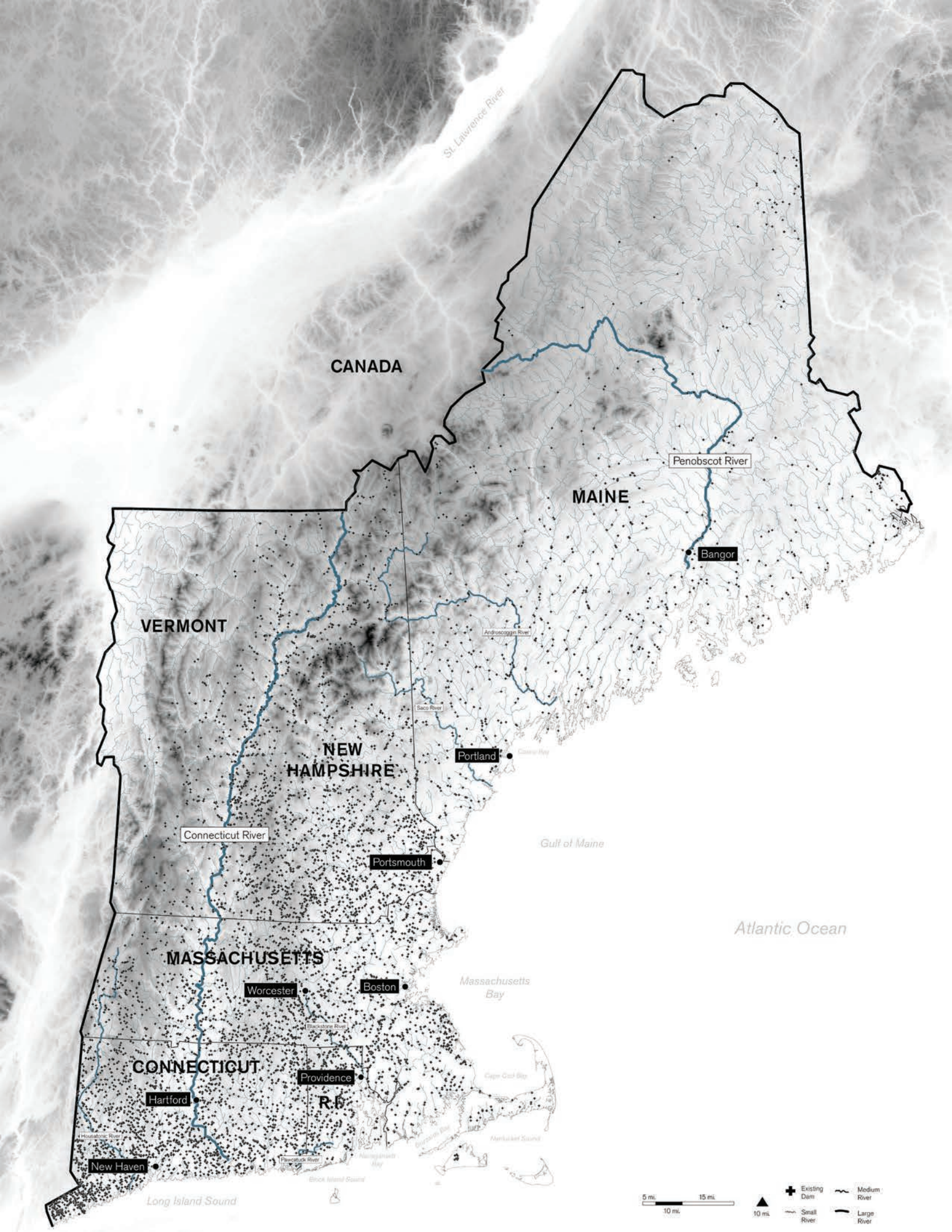
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There are over fourteen thousand dams in New England. The majority are small “legacy dams,” only five to twenty feet tall, built over one hundred years ago to power early colonial grist mills and later industrial textile mills. Dams have shaped complex landscapes; they are a symbol of economic prosperity and cultural identity as well as a potential source of clean energy and recreation. However, many dams within the region no longer serve their original purposes and are coming to the end of their life cycles. In its 2021 Infrastructure Report Card, the American Society of Civil Engineers gave the nation’s dams a ‘D’ grade, indicating the lack of maintenance and poor condition of many of the dams. Aging infrastructure, shifting climate regimes, and large storm events have heightened these concerns, as an increasing number of dams are at risk of breaching and threatening downstream communities. In addition to addressing these safety concerns, future decisions about these dams have the potential to improve habitat connectivity for endangered and threatened migratory fish such as salmon, herring, shad, and eels, and to improve water quality and restore the flow of sediments and nutrients that support critical freshwater and coastal habitats.

While it may make sense to remove legacy dams from an ecological, economic, or safety perspective, some dams and their associated impoundments, have become a significant part of individual and collective sense of place in rural New England communities¹. Dams and impoundments are landmarks within an otherwise unstructured forested landscape; they are places where people grew up fishing with their grandparents, landscapes people drive or walk by every day, and features that have led to higher property values. In some cases, the dams are on the town seal in recognition of the village’s colonial and industrial history. To many, these dams are seen as a symbol of cultural and regional identity.

As many of these dams are coming to the end of their life cycle and will either need to be repaired or removed in the coming decades, communities will need to come together to make decisions about the future of these dams. These decisions are complex and will need to consider ecological, social, safety and

economic trade-offs. In making these decisions, the public and community leaders will benefit from a trusted and unbiased source of information on the ecological and social considerations associated with dams.

This document is intended for both community members as well as practitioners that are working with communities to make a decision about the future of a dam. While there are many great resources and publications for proponents of dam removal², this document proposes a slightly different approach. Rather than advocating solely for removal, the goal of the methods and approach shared in this document is to bring a community into an open conversation to think creatively about the future of a dam. While this may seem counterintuitive if your role is to advocate for dam removal, engaging communities in an open but structured discussion about the future of a dam has the potential to lead to better environmental outcomes and a community that has more ownership, connection and sense of stewardship over their river. In addition, this approach has the potential to address what are often perceived as unequal power dynamics between dam removal proponents and the local community that has lead to projects stalling or failing in the past³.

Our methods bring together design workshops with a method of environmental decision making called Structured Decision Making⁴ with the specific goal of improving the way stakeholders and community members are brought into the decision making process around dams. Structured Decision Making is founded on the idea that good decisions are grounded in an in-depth understanding of both values (what is important) and consequences (what is likely to happen if an alternative is implemented). It is based on the assumption that there are not “right decisions” so aims to help inform and make decisions transparent rather than prescribe a preferred solution.

The document is made up of three main sections- The first part, “*Understanding Dams*” introduces key ecological, social, infrastructural and economic factors that are important to consider for the management of dams at the individual and watershed scale. The second part, “*Case Studies*”, looks at various alternatives for the future of a dam and presents a series of case studies of projects throughout the region. The last section, “*Making Decisions*”, shares methods, ideas and tools for how to engage in conversations about the future of a dam. In addition to this document, these materials, along with an interactive GIS map, are being shared open-source on the website- www.damatlas.org.

The study area for this Dam Atlas encompasses the Narragansett Bay Watershed and the coastal watersheds of Rhode Island. Within this study area, we have mapped and analyzed 1,034 documented dams. Approximately 53% of the dams are within the state of Rhode Island, 44% are in Massachusetts and 3% are in Connecticut. Each dam within the watershed is unique; they vary in size, age, flow, material, and use; they differ in the ecological impact they have

on the watershed; and they each have a distinct relationship to the surrounding communities.

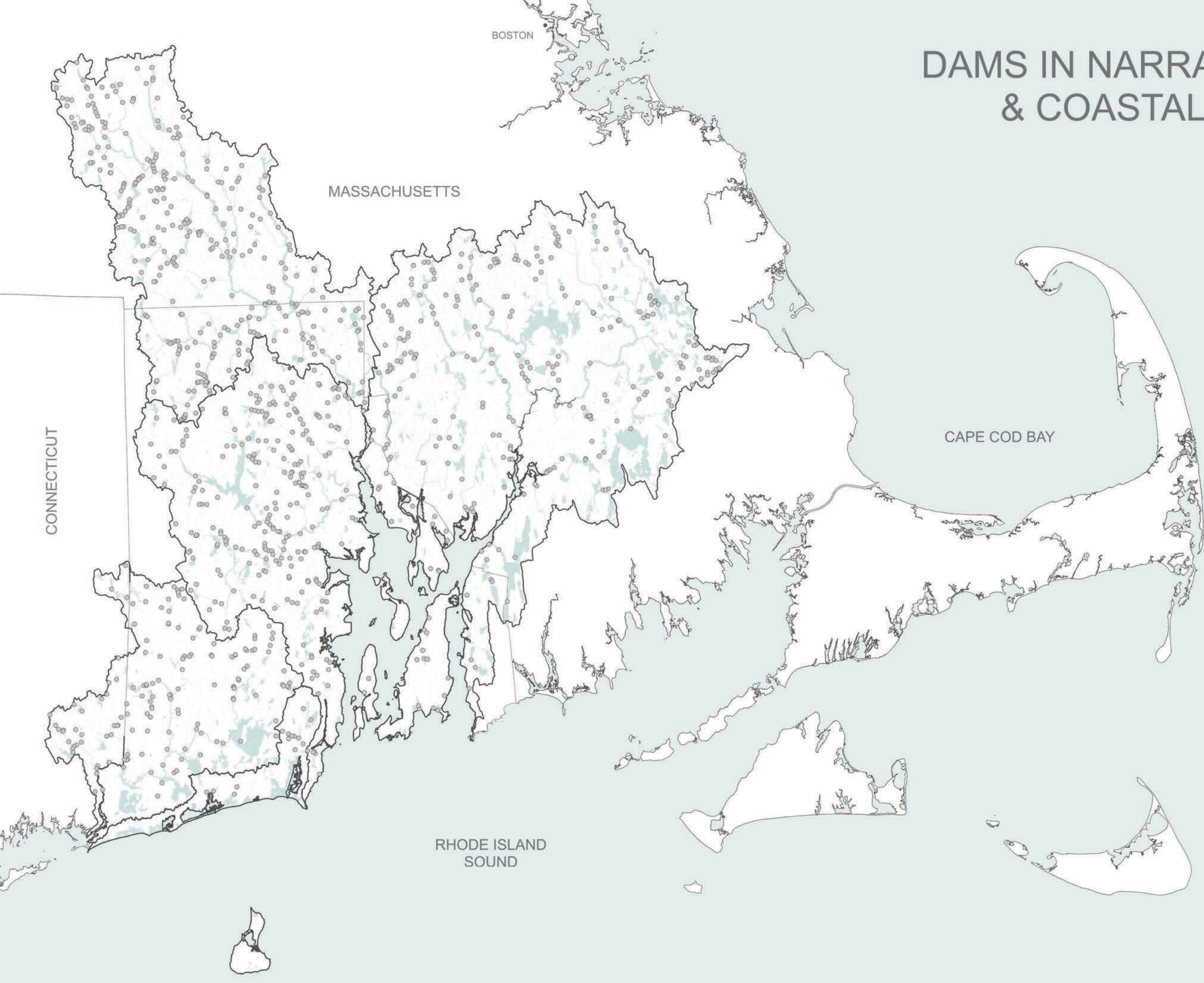
The maps in the document were produced using GIS. State databases provided the locations of dams in the study area in addition to other data about the dams. However, as is apparent in the maps on the following pages, the different state databases have different data available. For example, the ownership of the dam was not available for many of the Rhode Island dams and the age of the dam was not available for many of the Massachusetts dams. One of the goals of this document and the website is to encourage the inventorying and sharing of data about dams. In addition to the dam datasets, we used GIS data available on state and national websites to do additional analysis of the dams. A full report of the methods we used can be found in the journal article, *Guiding Decisions on the Future of Dams: A GIS Database Characterizing Ecological and Social Considerations of Dam Decisions in Southern New England*.

While this Dam Atlas is focused on dams in the Narragansett Bay and coastal watersheds of Rhode Island, the metrics calculated in the GIS analysis can be applied to other watersheds and the decision making tools are not regionally specific. By sharing our methods and the open source decision support toolkit, the aim is to help support practitioners and communities that are looking for ideas, methods, and techniques for having discussions about the future of a dam. We encourage others to use, test, modify, evolve, and share these methods. Ultimately, the goal is that this work can contribute to a “library of approaches” that are openly shared to build knowledge and techniques to support collaborative environmental decision making around dams.

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DAMS IN NARRAGANSETT BAY & COASTAL WATERSHEDS





Breached Saundersville Dam on the Blackstone River. Many dams within the watershed are over 100 years old.

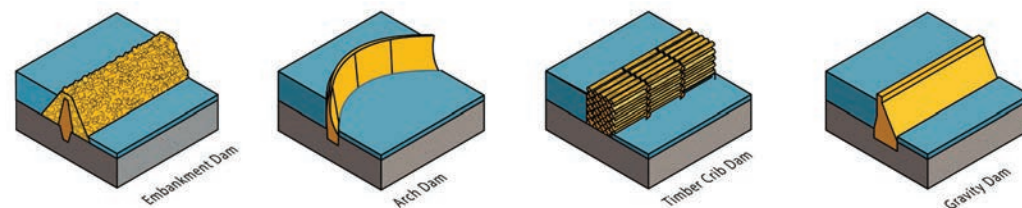
SECTION 01

UNDERSTANDING DAMS

DAM TYPES, USE and OWNERSHIP

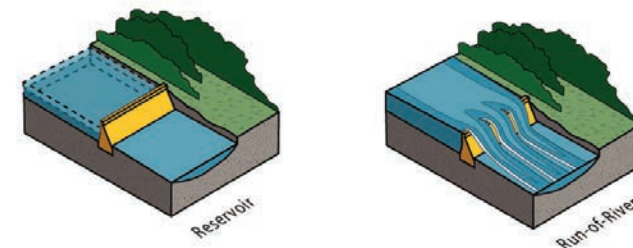
Dam Types

Depending on the size, age, and purpose of a dam, a range of construction materials and methods may have been used in the original construction. Common materials include earth, timber, stone, concrete, and masonry. Embankment dams are typically built from compacted earth ("earthfill") or rock ("rockfill"). Concrete and masonry dams are generally categorized as either gravity or arch dams. Gravity dams rely on the sheer weight of the structure to hold back water, while arch dams are built of thin concrete walls that transfer the force of the impounded water to the abutments on either side of the dam. Some historic dams within the Narragansett Bay and the coastal watersheds of Rhode Island were originally timber crib dams, constructed by cross-stacking heavy timbers like log cabins and filling them with boulders. Many of these timber crib dams were later rebuilt using concrete and stone, or replaced by new dams constructed immediately downstream of the original. Older dams often consist of a combination of materials, reflecting various repairs and modifications made over the years.



Embankment dam, Gravity dam, Arch dam, Timber crib dam

Dams function in various ways depending on their intended purpose. Two common types are run-of-river dams and detention (or storage) dams. The vast majority of dams in the study area are run-of-river dams. These structures have limited water storage capacity, and operators have minimal control over how much water is held back or released. As a result, water levels on either side of a run-of-river dam fluctuate very little; the volume of water flowing over the dam is nearly the same as it would be without the structure. In contrast, detention dams create large impoundments and are equipped with operational controls that allow operators to manage water use—determining how much water is



Run-of-river-dam, Detention or storage dam

diverted, stored, or released downstream. These dams are typically built for specific purposes such as municipal water supply, irrigation, or hydroelectric generation. Flood control dams are a type of detention dam designed to temporarily store large volumes of water during storm events or seasonal flooding.

Dam Ownership

Unlike the large, federally owned dams found in the Western and Southeastern United States, most dams in New England were originally built by private individuals or companies to power mills—and many remain privately owned today. Within the Narragansett Bay and associated coastal watersheds, records from state and national regulatory authorities indicate that 345 dams (34%) are privately owned, 308 dams (30%) are publicly owned, and 377 dams (36%) have unknown private owners and are commonly considered "abandoned." When a property with a dam changes hands, ownership and responsibility for the dam typically transfer to the new owner. While some landowners may value having a dam on their property, it also carries significant liabilities. Dam owners are legally responsible for the safe operation of the structure and may be held liable for any injuries or damages resulting from its failure. They are also responsible for the costs of regular maintenance and repairs, as well as for securing any necessary licenses or completing state-mandated inspections. The 377 dams with unknown ownership present a particular challenge for regulatory authorities. Many of these dams are in disrepair, yet there is no clearly defined responsible party. Because many of these structures are over a century old, ownership records may have been lost or forgotten over time.

Even though the majority of legacy dams are privately owned, dams are undeniably a public issue. They affect the health of rivers—resources held in common by all people—and, if not properly maintained, can pose serious risks to downstream communities. While the dam owner is ultimately responsible for decision-making and for covering associated costs, the expense of repairs or removal can reach hundreds of thousands of dollars, far beyond the financial capacity of most private owners. There are few, if any, other examples in the United States of such widespread infrastructure being privately owned.

D a m U s e

The majority of dams in Narragansett Bay and associated coastal watersheds were originally built for small-scale, localized production of kinetic power. Today, many of these dams are functionally obsolete and no longer serve their original purpose. However, some historic dams have been adapted for other uses, including recreation, small-scale hydroelectric generation, agricultural water supply, and fire protection.

Seventy-six dams within the study area are listed as providing municipal water supply. Two of the largest systems are the Scituate Reservoir, which supplies drinking water to the Providence metropolitan area, and the Assawompset Pond Complex, which provides water to much of southeastern Massachusetts, including the cities of New Bedford and Taunton. As critical infrastructure, these dams and reservoirs must be properly maintained to ensure the continued delivery of essential services.

Within the study area, ten dams—seven in Rhode Island and three in Massachusetts—currently serve as sources of hydropower. Rhode Island’s hydropower systems generate approximately 23,000 megawatt-hours (MWh) annually, while the state consumes around 7,700 gigawatt-hours (GWh) of electricity each year¹. This means that the seven in-state hydropower facilities supply only about 0.3% of Rhode Island’s electricity needs. As interest grows among local utilities and the public in carbon-free, domestic energy sources, some have advocated for repurposing legacy dam infrastructure to support distributed energy generation. However, significant limitations exist. Factors such as river size and flow rate, dam height, regional topography, and current technology all restrict the potential output of hydropower in the region. For example, a proposed hydropower facility on a 20-foot-tall dam on the Pawtuxet River was expected to produce just 0.3 megawatts², whereas a 70-acre solar installation planned for a landfill in East Providence is projected to generate 3.7 megawatts⁴. While emerging technologies may increase the efficiency of small-scale systems⁵—including micro-hydropower (5 to 100 kilowatts) and pico-hydropower (under 5 kilowatts)—seasonal low flows will remain a persistent challenge, limiting the reliability and year-round performance of such systems.

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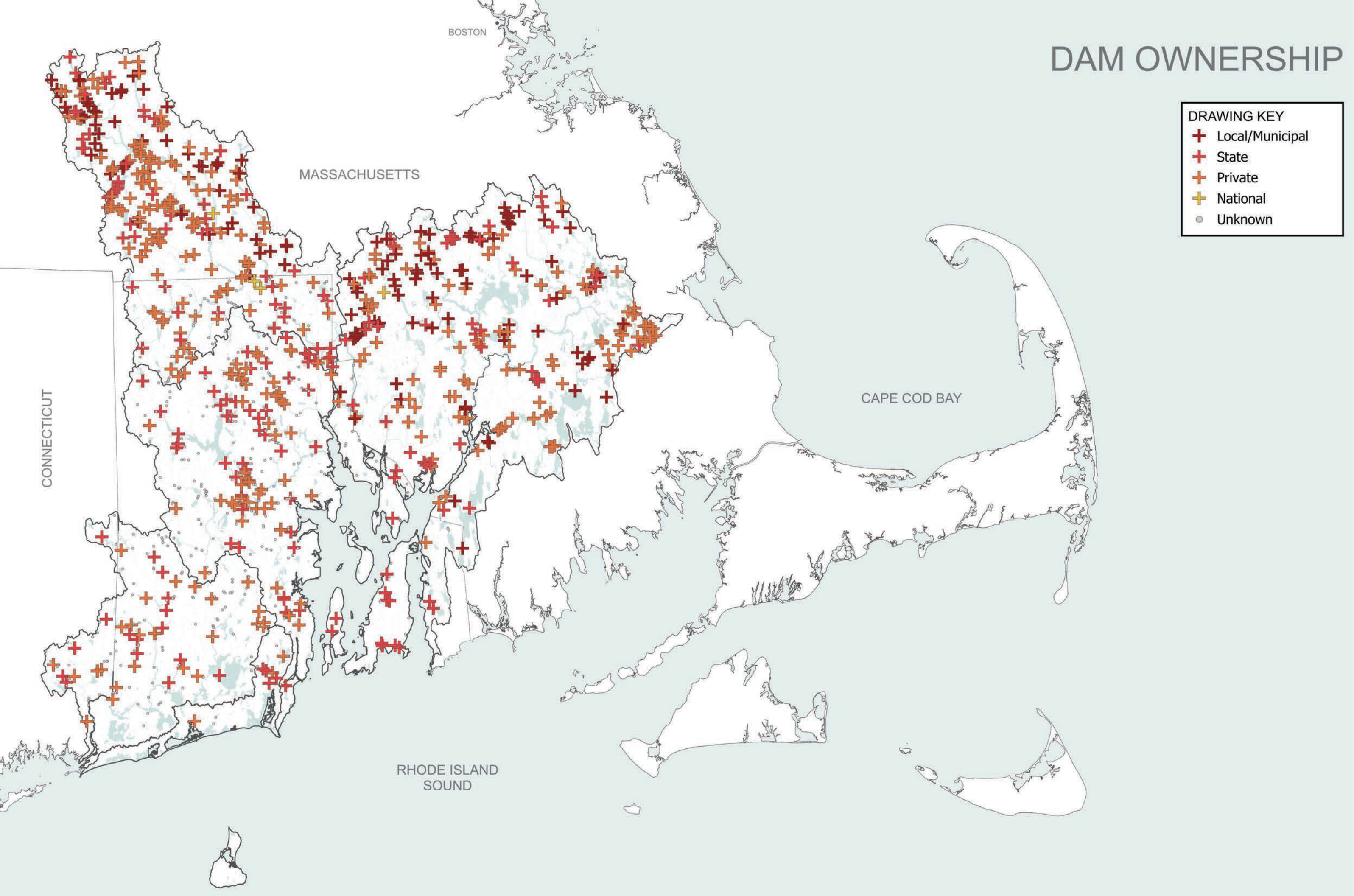
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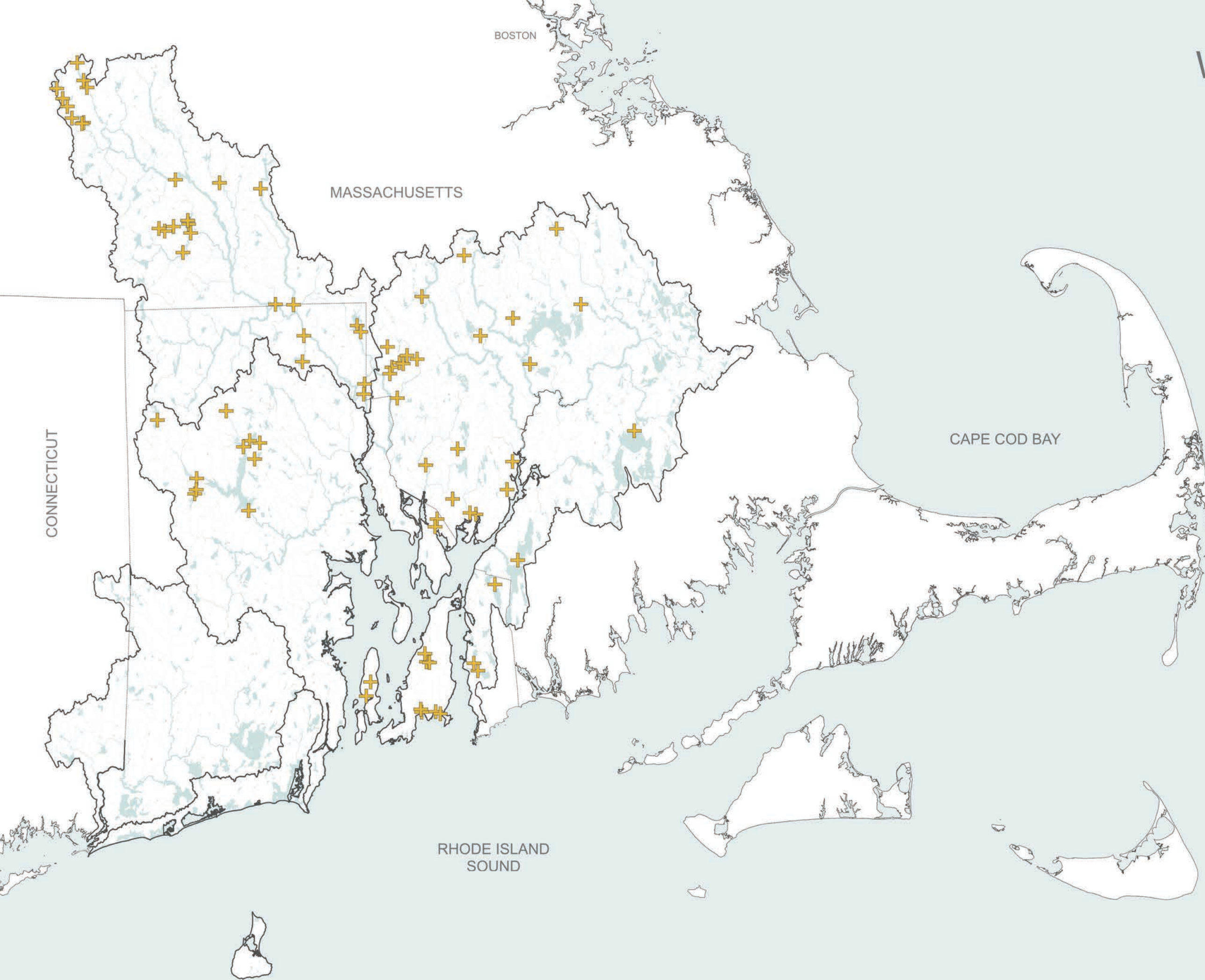
5. See, for example proposals by Turbulent. <https://www.turbulent.be/>

DAM OWNERSHIP



WATER SUPPLY

DRAWING KEY
+ Dams with reservoirs used
for municipal water supply

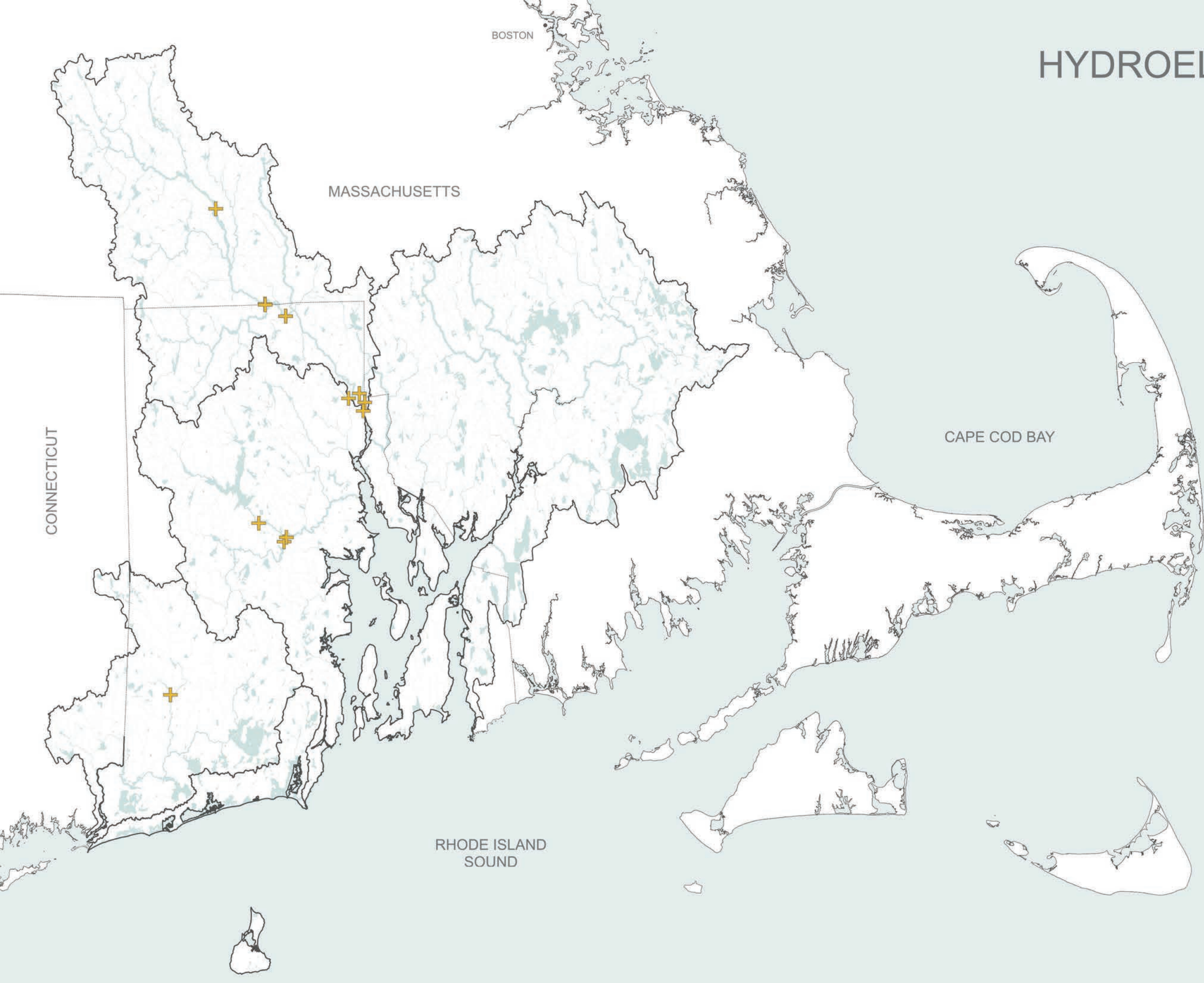


HYDROELECTRIC DAMS

DRAWING KEY

+

Dams used to generate hydroelectric power



HAZARD RISK + CLIMATE CHANGE

The majority of dams within the Narragansett Bay and associated coastal watersheds were built over a century ago and are now approaching the end of their life cycles. Many have not been adequately maintained or repaired, and their failure could result in significant downstream damage¹. State governments classify dams based on the potential impact of a failure on downstream communities, infrastructure, and structures. It is important to note that this hazard classification does not reflect the structural integrity or current condition of the dam itself; rather, it is based solely on the potential consequences if the dam were to fail.

There are 3 hazard rankings commonly used by Federal and State agencies:

- **High Hazard Dam:** A dam whose failure or improper operation would likely result in the loss of human life in downstream communities.
- **Significant Hazard Dam:** A dam whose failure or improper operation would likely not cause loss of life but could lead to major economic losses, disruption of critical infrastructure, or other impacts detrimental to public health, safety, or welfare.
- **Low Hazard Dam:** A dam whose failure or improper operation would likely not result in loss of life and would cause only minimal economic or environmental impacts.

In both Massachusetts and Rhode Island, regulated dams include those classified as significant or high hazard, as well as low hazard dams that are six feet or more in height or have a storage capacity of fifteen acre-feet or more. (An acre-foot is the volume of water that would cover one acre to a depth of one foot.) Dams that are less than six feet in height and have a storage capacity below this threshold are generally unregulated.

With the exception of hydropower dams regulated by the Federal Energy Regulatory Commission (FERC), there is no national standard for dam inspections. In Massachusetts, the Department of Conservation and Recreation's Office of Dam Safety² oversees regulated dams, while in Rhode Island, this responsibility falls to the Department of Environmental Management (RIDEM)³. In both states, high hazard dams must be inspected

by a qualified engineer every two years, and significant hazard dams must be inspected every five years. Inspection requirements for low hazard dams differ by state: in Massachusetts, they must be inspected every ten years, whereas in Rhode Island, inspections are required every five years.

When these dam inspections are conducted, the condition of the embankment, spillway, and low-level outlet(s) are rated as good, fair, poor, or unsafe. Following a visual inspection, a dam inspection report is prepared, identifying specific deficiencies and, if warranted, recommending corrective measures. In Massachusetts, owners of dams with deficiencies that are not addressed are fined, adding to the costs of owning a dam. Based on available hazard data provided by the National Inventory of Dams, there are 151 high hazard potential dams within the study area, of which 62 are classified as being in poor condition and 41 as fair.

In addition to regular inspections, both Massachusetts and Rhode Island require that all high and significant hazard dams have an Emergency Action Plan (EAP) on file. An EAP is a formal document that outlines potential emergency scenarios and establishes pre-planned actions to minimize loss of life and property damage. It includes an analysis of downstream flood risk in the event of dam failure, along with communication protocols to alert local emergency agencies and downstream residents. Within the study area, there are 151 high-hazard and 222 significant-hazard dams. However, only 79 high-hazard dams and 134 significant-hazard dams currently have EAPs in place—just 57% of the total, indicating a significant gap in emergency preparedness.

CLIMATE CHANGE

In addition to concerns about aging infrastructure and inadequate maintenance, the risk of dam failure is increasing due to the growing frequency and intensity of extreme weather events. Many older dams were constructed at a time when severe precipitation and peak river flows were less common, and their design standards did not anticipate today's climate conditions. These dams were also often built when fewer communities and less infrastructure existed in downstream flood zones. As development has expanded, more roads, homes, wastewater treatment plants, and other critical infrastructure are now located downstream of dams, significantly increasing the potential consequences of dam failure.

Climate change has altered many aspects of life in the United States, prompting a reevaluation of long-standing infrastructure, including dams. With the exception of a small number of dams specifically designed for flood control, most dams in the Narragansett Bay region and its associated coastal watersheds do not provide flood mitigation benefits. The risks posed by aging and poorly maintained dams are exacerbated by rising annual precipitation and the increasing frequency of extreme rainfall events. These events can cause flooding upstream of dams and, in the event of failure, lead to sudden and severe flooding downstream.

For example, in March 2010, Rhode Island experienced record-breaking rainfall, with more than 16.34 inches falling in a single month—most of it over just a few days. Several dams in the region failed or came close to failing under the strain of the excess water³. Fortunately, these breaches did not result in fatalities. More recently, in 2023, torrential rains in Central Massachusetts raised alarms about the potential failure of the Barrett Park Pond Dam in Leominster, prompting the Massachusetts Emergency Management Agency to issue an evacuation order for residents in low-lying areas⁴. Similar incidents across the country—including the 2020 failures of the Edenville and Sanford dams in Michigan—have resulted in billions of dollars in damages and the displacement of thousands of residents whose homes were flooded⁵.

Dam failure can be catastrophic, resulting in the loss of life, property, and critical infrastructure. The most common causes of failure include overtopping—when water flows over or around the dam—foundation defects such as slope instability or settlement, and internal erosion due to seepage. Additional contributing factors may include structural failure, cracking, and inadequate maintenance⁶.

Given the age of dams in the region, the increasing frequency of major storm events, and the significant risks dam failure poses to downstream communities, it is essential that municipalities have the resources necessary to conduct regular inspections. While having an Emergency Action Plan (EAP) on file is critical to ensure communities can respond effectively in the event of a failure, it is equally important that states and local governments have access to adequate funding for proactive, preventative measures—such as repairing or removing high and significant hazard dams that are in poor condition.

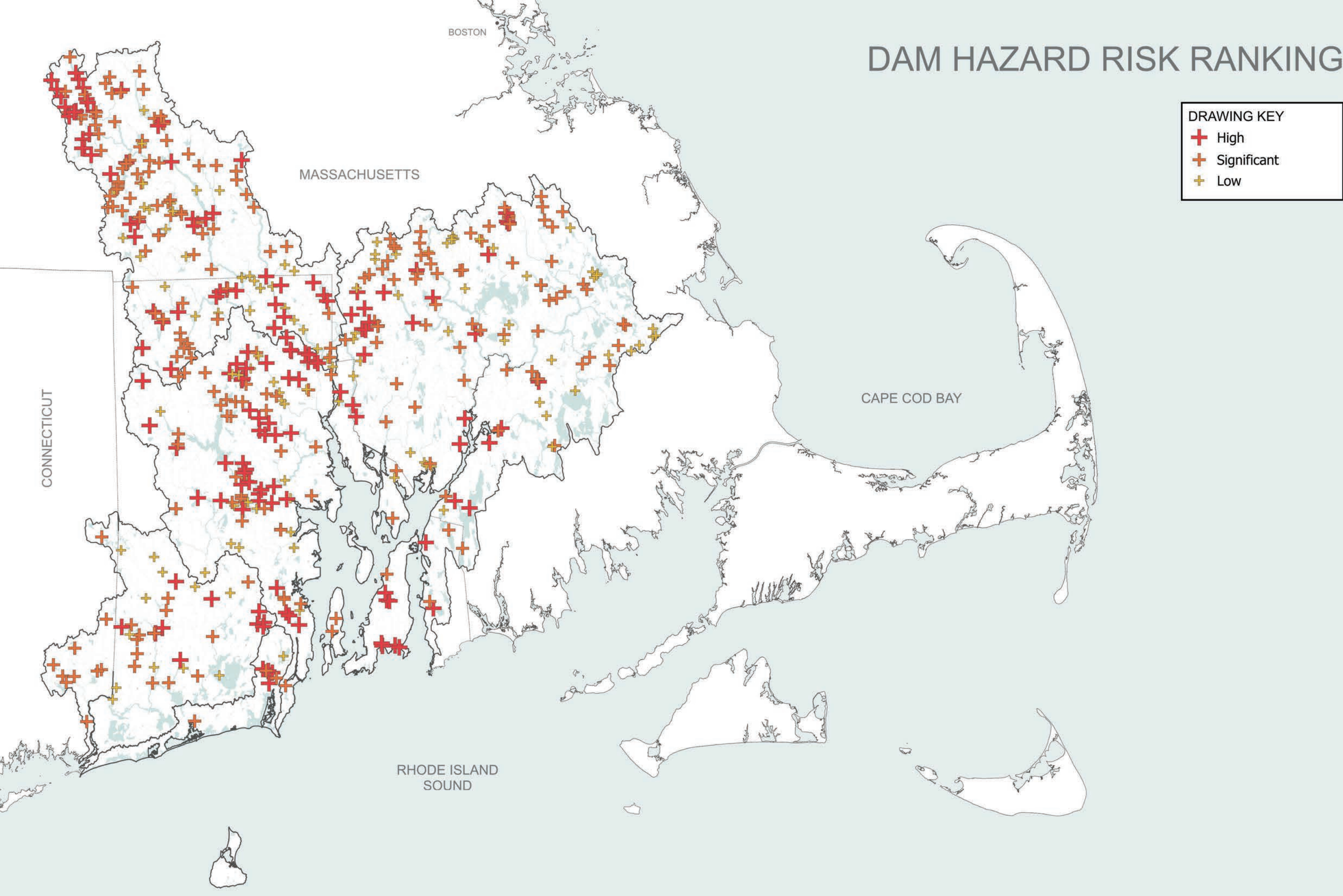


Record Flooding on the Pawtuxet River, March 31, 2010;
Photo Source: National Weather Service Northeast River Forecast Center

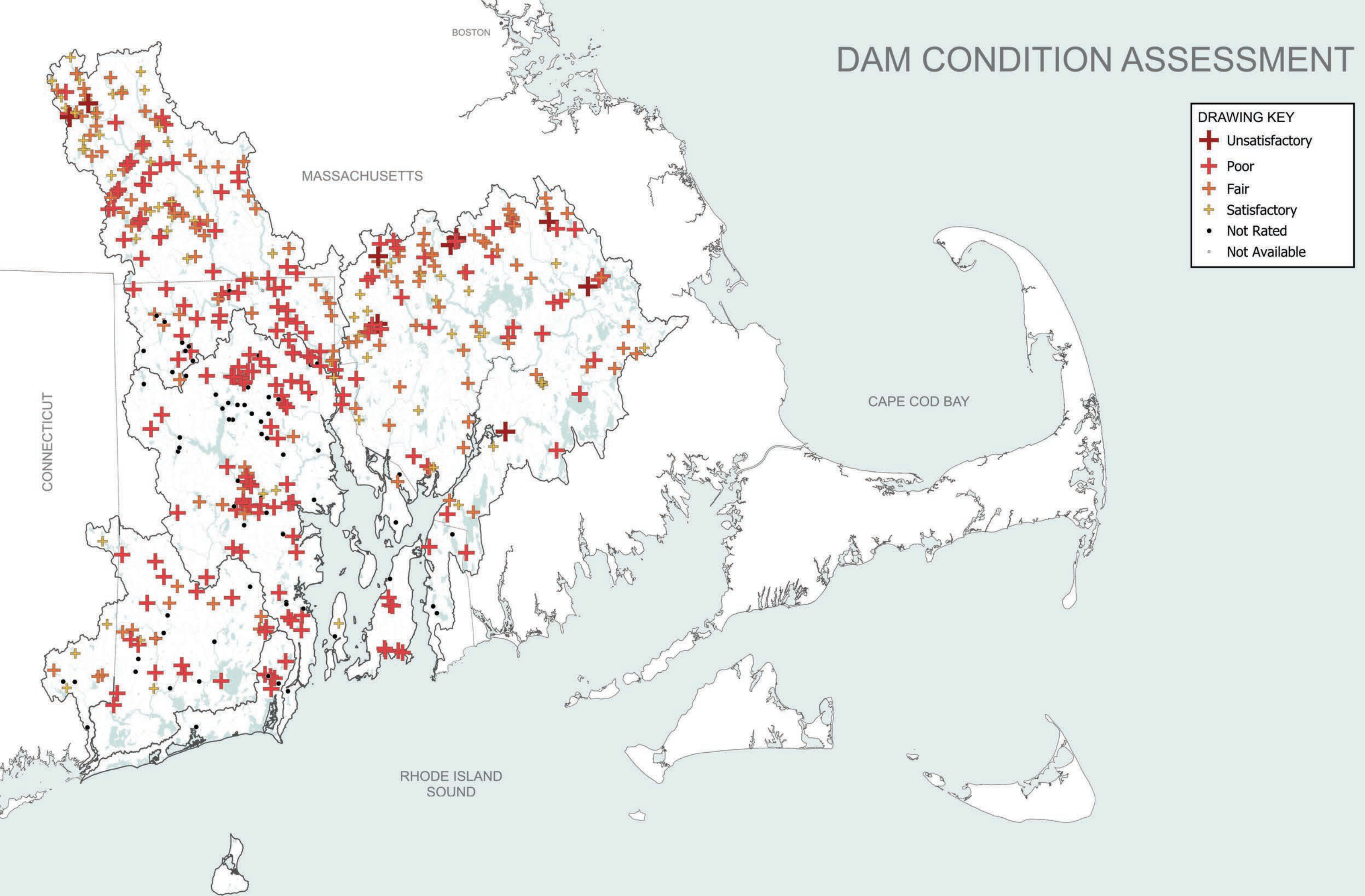
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DAM HAZARD RISK RANKING



DAM CONDITION ASSESSMENT

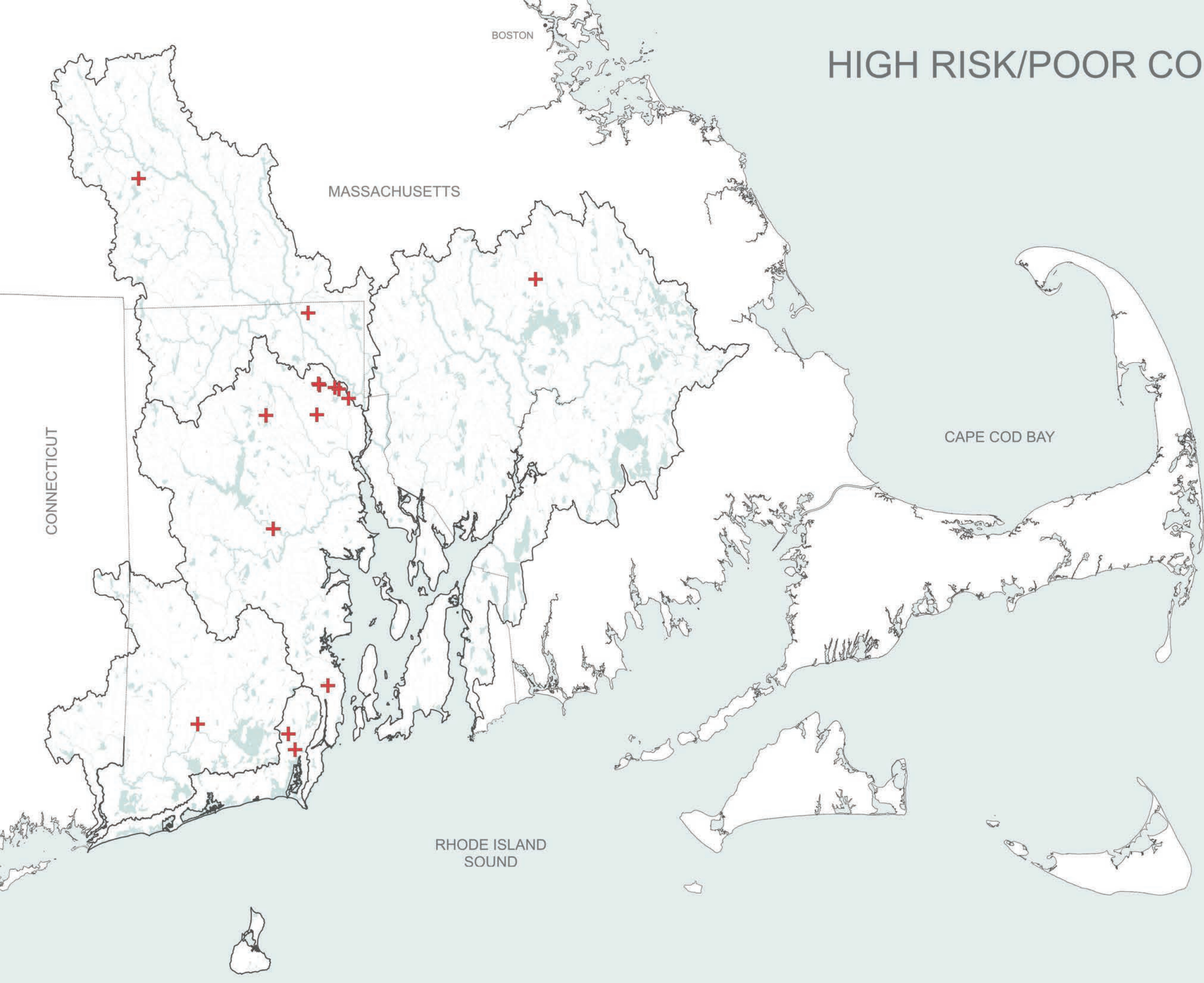


HIGH RISK/POOR CONDITION DAMS

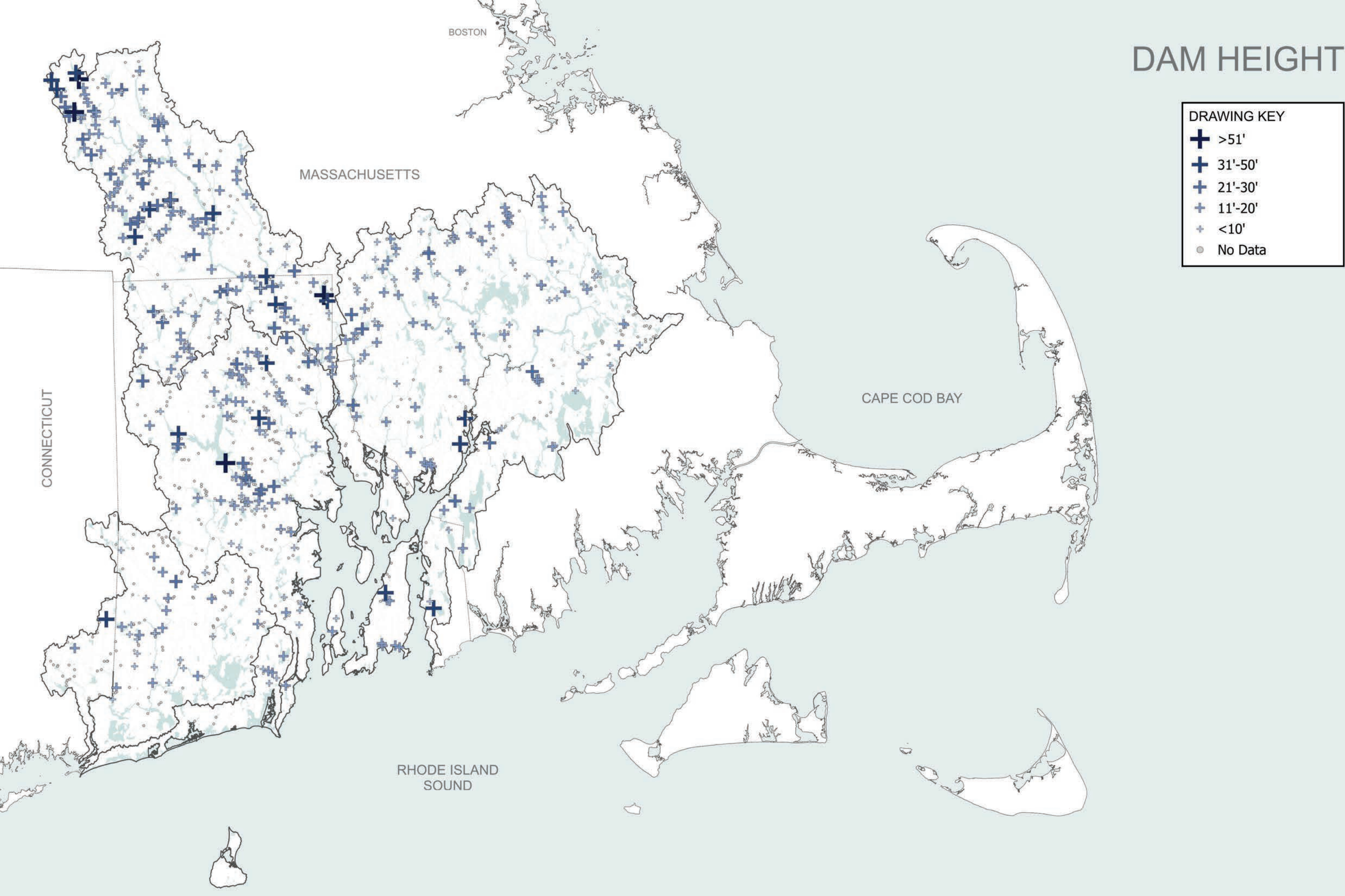
DRAWING KEY

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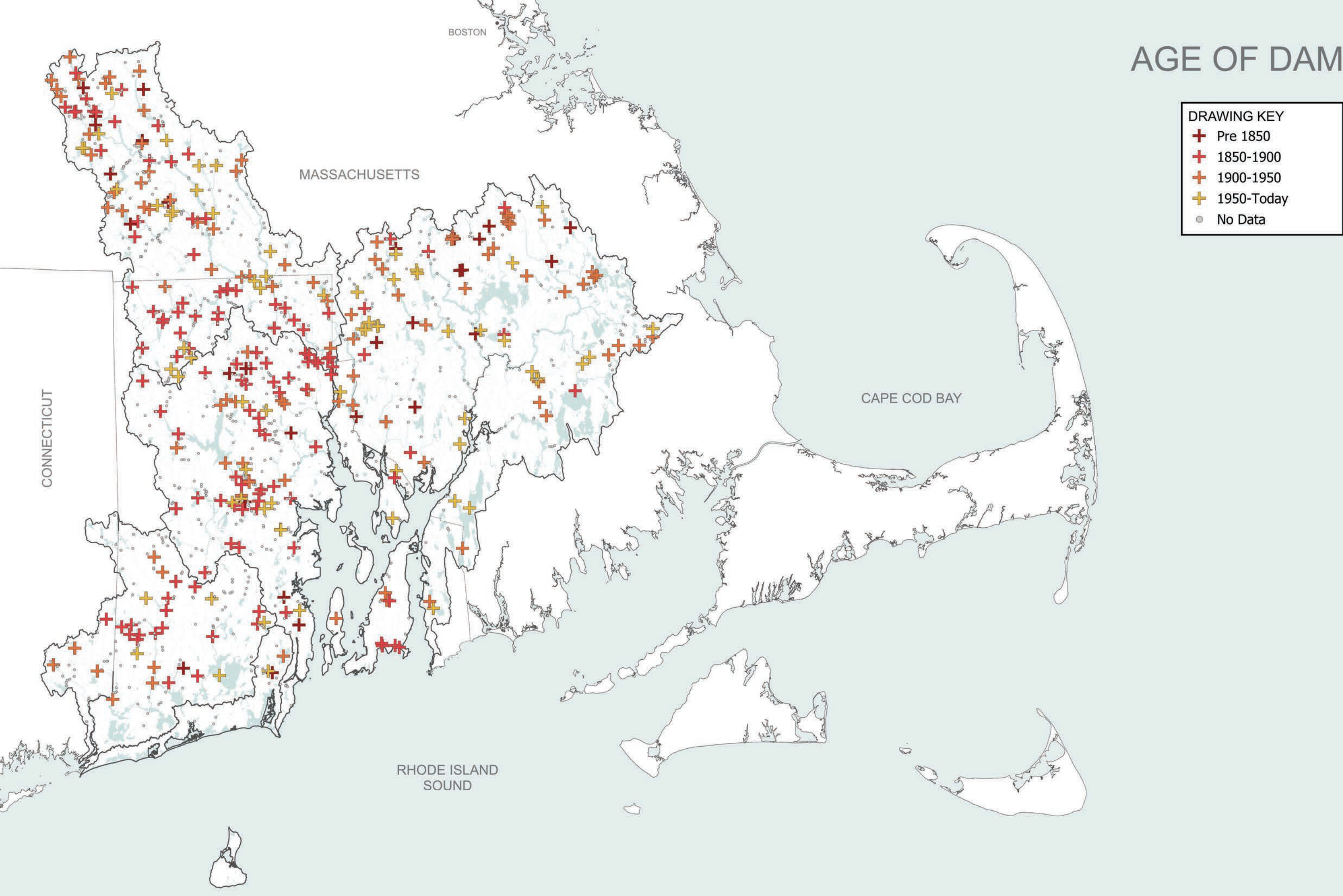
Dams that are both High Risk and in Poor Condition



DAM HEIGHT



AGE OF DAM



INDIGENOUS AND COLONIAL HISTORY

The Narragansett Bay and associated coastal watersheds are the traditional homelands of the Narragansett, Wampanoag, and Nipmuc nations. While discussions about the history of dams and rivers in New England often emphasize colonial and industrial narratives, Indigenous peoples developed deep and enduring relationships with these waterways long before European settlement. For the tribes of the region, rivers were vital for transportation, fishing, and subsistence. More than that, rivers were—and for many, continue to be—regarded as living entities. They remain central to the cultural identity and spiritual life of Indigenous communities throughout the region.



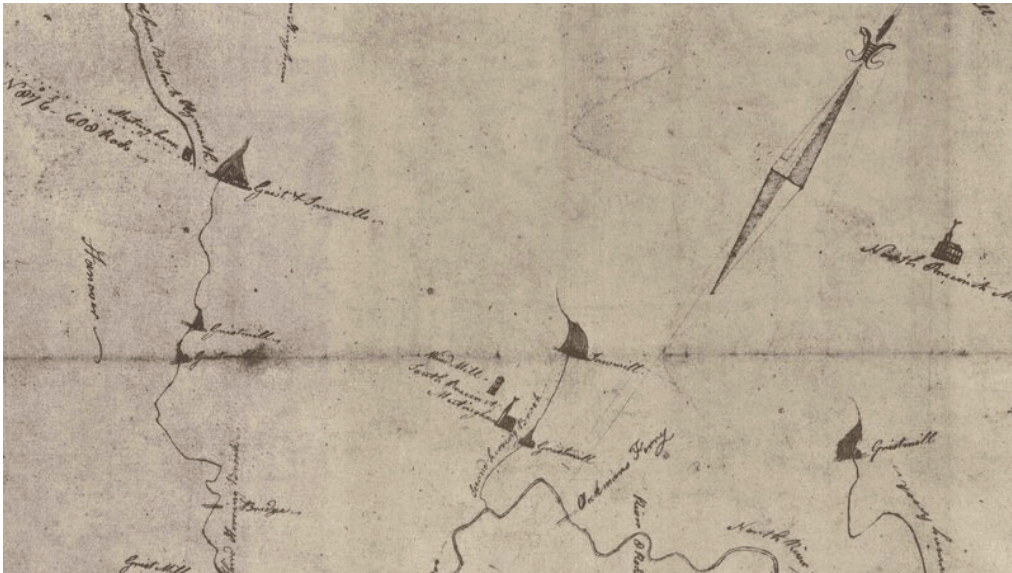
Indigenous Nations of the Narragansett Bay and coastal watersheds

When European colonists first arrived in the region now known as New England, they encountered rivers teeming with migratory fish. Indigenous communities had long depended on the migration of these fish, which typically coincided with early spring when other food sources were scarce. However, shortly after arrival, the colonists started constructing dams to provide power to mills, often blocking fish migration routes in the process. The impact was immediately evident to Indigenous communities, who saw the decline of a vital food source. This loss only deepened over time; by the mid-19th century, many migratory species such as shad, eel, and river herring had become scarce throughout Rhode Island's watersheds. Beyond disrupting traditional food systems, dams also flooded farmland and destroyed burial grounds, ceremonial sites, and other spiritually significant places located along rivers.

Rivers remain a vital part of life for Indigenous communities in the region. For some, dams and the diminished migratory fish runs continue to symbolize the injustices of colonization and its lasting impacts on Indigenous cultures, spiritual relationships, and connections between people and rivers.

COLONIAL HISTORY

The colonial settlement of New England was oriented around the region's rivers. European colonists brought with them the knowledge and technology to harness the energy of fast-moving, rocky rivers to power gristmills and sawmills. Slater Mill Dam, constructed on the Blackstone River in 1793, powered the nation's first successful textile mill and changed the scale and impact of hydropower technology throughout the region. Slater Mill's success inspired other local entrepreneurs, prompting the rapid increase of hydro-powered mill construction and leading to widespread alterations of the landscapes and watersheds. However, with the rise of steam power in the late 19th century, factories were no longer dependent on rivers for energy. This technological shift led to the decline of New England's textile industry and left many dams as post-industrial relics scattered across the region.



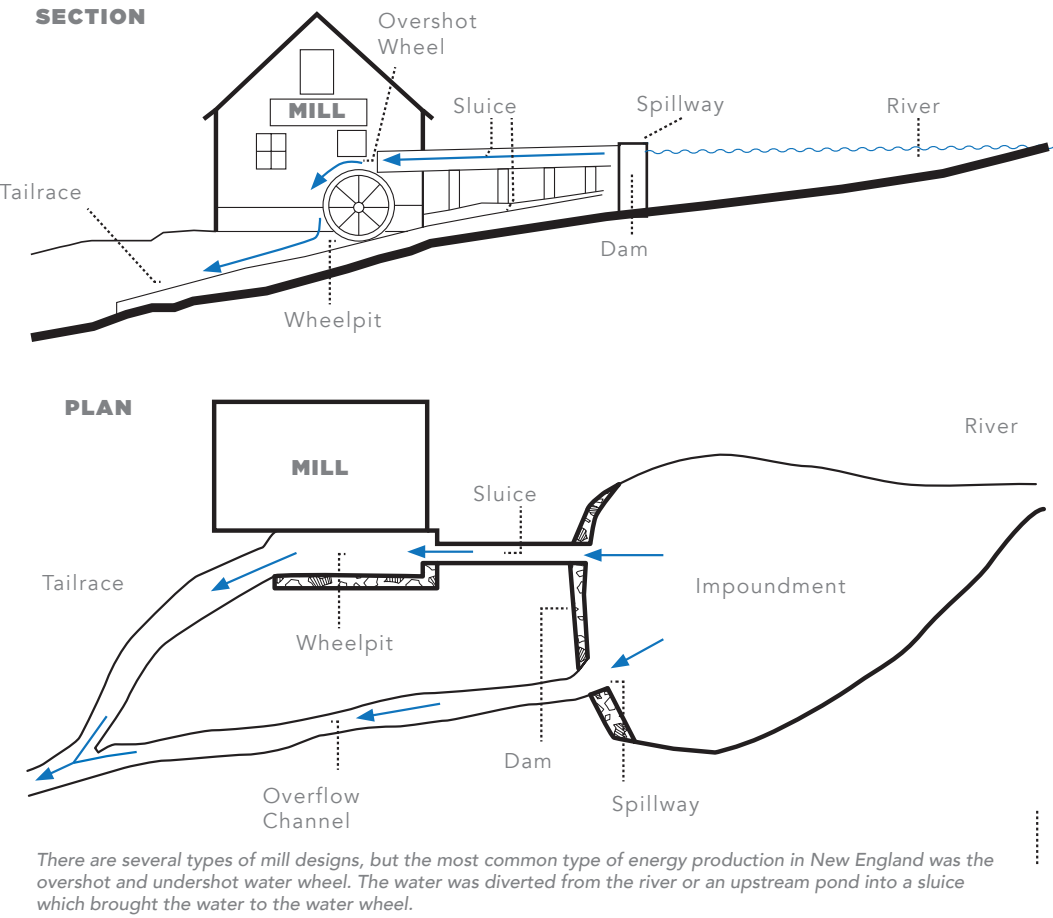
Map of area surrounding Scituate, Massachusetts, circa 1795. Map shows the density of early gristmills on streams.

As thousands of dams across New England near the end of their life cycles, dam owners and communities are faced with critical decisions about the future of this aging infrastructure. These decisions often require balancing ecological restoration and public safety with the desire to preserve local history and the distinctive cultural landscapes of the region¹. Some dams—such as the Slater Mill Dam—are listed on the National Register of Historic Places, a federal designation for properties deemed “significant in American history and worthy of preservation.”² Under Section 106 of the National Historic Preservation Act, federal agencies must engage in a review and consultation process to assess the potential effects of their actions on historic properties. This process includes exploring a range of alternatives to avoid, minimize, or mitigate adverse impacts to historic resources.

Some dams may not be listed on the National Register of Historic Places but still hold deep significance for local communities and contribute to a shared sense of place and history. According to the World Heritage Convention, cultural landscapes are the “combined works of nature and of humans,” reflecting the evolution of human society and settlement over time. In New England, dams—along with associated mill ponds and historic mill structures—form a distinctive cultural landscape. These features tell the story of how the region’s landscapes have been shaped by both natural processes and human activity, revealing the deep and ongoing connections between communities and the places they inhabit.

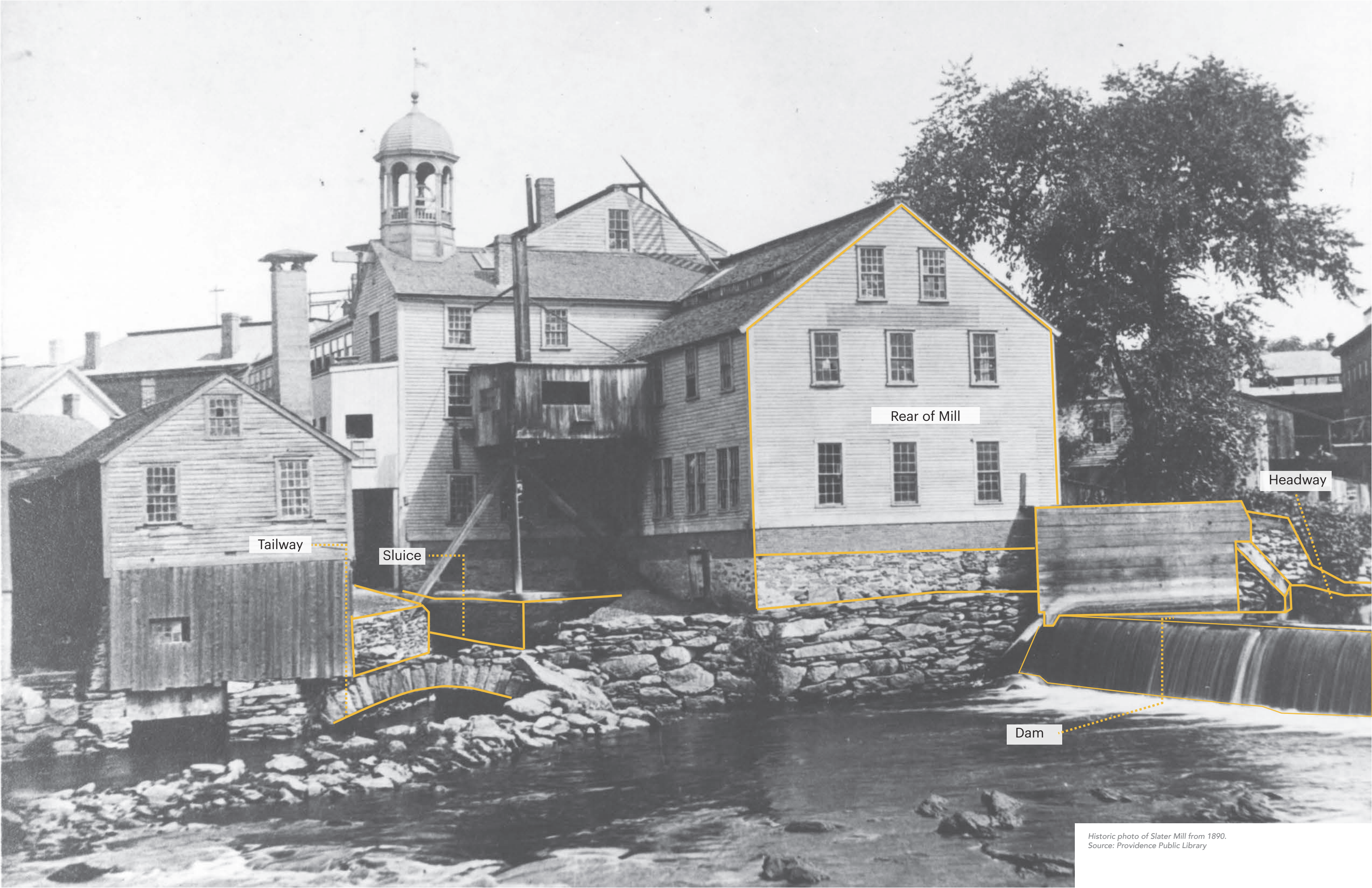
In some cases, the historical significance of a dam may justify its repair and continued maintenance. However, at other sites, there may be opportunities to use design to commemorate the location and layered histories of the dam and river without preserving the physical dam structure itself. When a dam removal is planned, historical archaeologists are often brought in to document the site’s historical context—including the mill, dam, and surrounding features—

at both local and regional scales. These experts typically conduct site visits during the dismantling process, recording observations and photographing structural and design elements. Their findings may be used to create interpretive signage that communicates the site’s historical significance to the public. This documentation and interpretation work is often required as part of a Memorandum of Agreement (MOA) negotiated among the lead federal agency, supporting agencies, State Historic Preservation Officers (SHPOs), Tribal Historic Preservation Officers (THPOs), and other consulting parties. The MOA outlines how the historical value of the site will be recognized, even as the physical structure is removed. - (Refer to the “Case Studies” section to explore some of the alternatives that can be used to mark, interpret, and adapt historic dam structures to help maintain their sense of place, even if the dam structure is removed.)



REFERENCES and ADDITIONAL RESOURCES

1. See, for example, McClain, Serena, Lindloff, Stephanie, Baer, Katherine. Dam Removal and Historic Preservation: Reconciling Dueling Objectives. American Rivers and the National Park Service. 2008.
2. National Park Service. National Register of Historic Places. <https://www.nps.gov/subjects/nationalregister/index.htm>



Rear of Mill

Tailway

Sluice

Headway

Dam

Historic photo of Slater Mill from 1890.
Source: Providence Public Library

DAMS WITHIN HISTORIC DISTRICTS

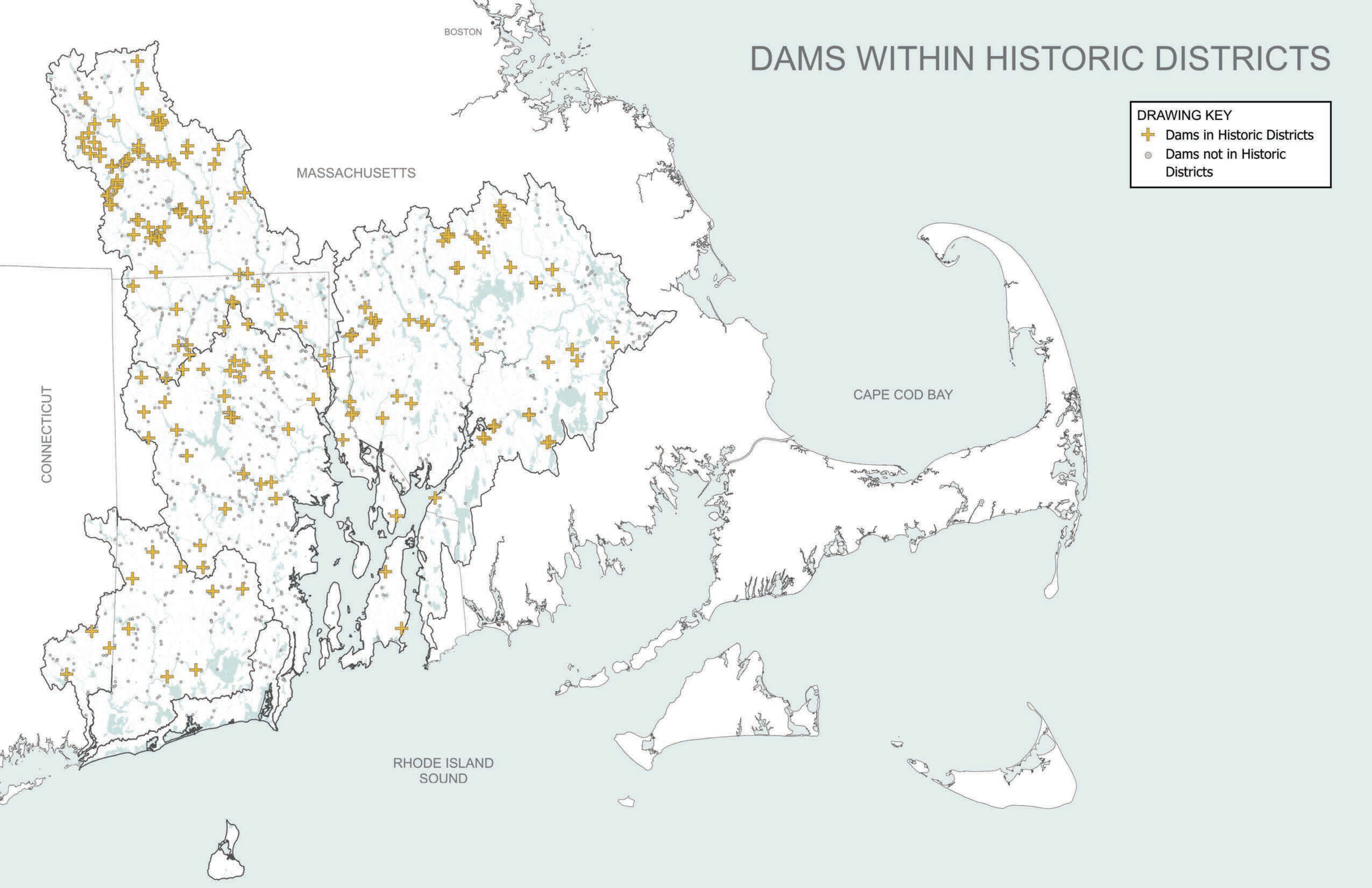
DRAWING KEY

+

Dams in Historic Districts

●

Dams not in Historic Districts



SENSE OF PLACE + RECREATION

Sense of place refers to the emotional connection or attachment individuals feel toward specific places or landscapes. This connection often develops over time through personal experience and can be shaped by a range of factors—including social, cultural, ecological, aesthetic, or historical associations. These qualities contribute to a unique relationship between people and their environments. Because sense of place is rooted in individual experience and perception, it can vary widely: one person may associate a location with positive memories, while another may view the same place negatively. Regardless of the nature of the perception, attachment to place plays a significant role in mental health and well-being. This emotional bond is often deeply intertwined with personal and cultural identity.

Community sentiment toward a dam can vary widely depending on factors such as its location, structure, history, family connections, and local uses of the dam and its resulting impoundment¹. A dam may have served as the foundation of a community—powering a mill for one generation and evolving into a tourist attraction for the next—becoming deeply embedded in local identity, sense of place, and pride. In some cases, community attachment centers more on the impoundment than the dam itself. The impoundment may be a beloved swimming hole, a fishing spot where generations have gathered, or a scenic area central to community life. The dam's aesthetics may also hold value: the view of the waterfall, the sound of rushing water, or the presence of a visual landmark in the forest. At the same time, for some community members, the dam may symbolize the colonial legacy of the region—the disruption of natural river systems and the dispossession of Indigenous lands and lifeways. These multiple and sometimes conflicting perspectives reflect the complexity of community relationships with dams and the landscapes they shape.

Depending on whether a community's attachment is to the dam, the impoundment, or the idea of a free-flowing river, a range of future scenarios may be considered. For example, a nature-like fishway can maintain the impoundment while significantly improving fish passage. If sufficient open space exists around the dam, a bypass channel can be constructed to preserve



Aesthetics of a dam, Horseshoe Falls. Photo by Emily Vogler

the visual presence of the dam while enhancing habitat connectivity and fish migration. Additionally, thoughtful design interventions can help retain a sense of place and aesthetic qualities associated with the dam—even if the structure is removed.²

When a community feels a strong attachment to a privately owned dam, opportunities for public input may be limited. However, if the dam is publicly owned, the opportunity may exist for the local community to contribute to a decision on the future of the dam. The Decision Support Tools available on this website are designed to support these conversations by helping communities identify and articulate which aspects of the dam and surrounding environment are most meaningful to them and to explore a range of alternatives.

RECREATION

One of the primary ways that people currently interact with and develop a connection to the region's rivers is through recreation. Within the Narragansett Bay and associated coastal watersheds, waterways provide an important opportunity for recreation. In addition to the 256 miles of coastline in Narragansett Bay, there are more than 3,000 miles of rivers and streams that support freshwater recreation, including boating, swimming, and fishing.

Flowing River Recreation:

Rivers within the region are a popular recreational destination for paddlers. Whether day trips or overnight trips, canoes or kayaks, smooth water or rapids, paddlers flock to rivers in the warm months of the year. However, the high number of dams in the watershed and the lack of clear signage and buoys create an obstacle for paddlers traveling downstream on a river. Paddlers have to be knowledgeable about the location of dams and portages. In some places, the portage includes challenging and lengthy traverses across roads and/or carrying the boat up steep embankments. There is also a significant risk that paddlers unaware of a dam's location can go over the dam, capsize, and potentially drown. The frequency and unpredictability of dams can prevent paddlers from feeling safe exploring the region's rivers. In addition to paddling, many of the region's free-flowing rivers are also prized for fly-fishing, offering another way people connect to and appreciate local waterways.

Impoundment Recreation:

The flat water behind dams—known as impoundments or reservoirs—offers a different set of recreational opportunities. Many communities use these calm waters for boating, swimming, and fishing. In addition to being ideal for canoes and kayaks, some impoundments are large enough to accommodate motorized boats. Of the 801 impoundments within the watershed, 68 (8.5%) are stocked with freshwater fish, enhancing their appeal to anglers. The calm conditions also make impoundments popular swimming spots for people of all ages. Recreational use of an impoundment varies depending on its size and the level of public access. Some impoundments are equipped with boat ramps, docks, and other amenities, while others—particularly those used for municipal water supply—may have restricted or no public access.

When considering the future of a dam, communities often face a trade-off between prioritizing recreation on free-flowing rivers and maintaining recreational opportunities on the flat water of an impoundment. See the Case Studies section for examples of alternatives that preserve impoundments while improving habitat connectivity and fish passage.

REFERENCES and ADDITIONAL RESOURCES

1. See, for example, McClain, Serena, Lindloff, Stephanie, Baer, Katherine. Dam Removal and Historic Preservation: Reconciling Dueling Objectives. American Rivers and the National Park Service. 2008.

2. See the "Case Studies" chapter to explore some of these alternatives.

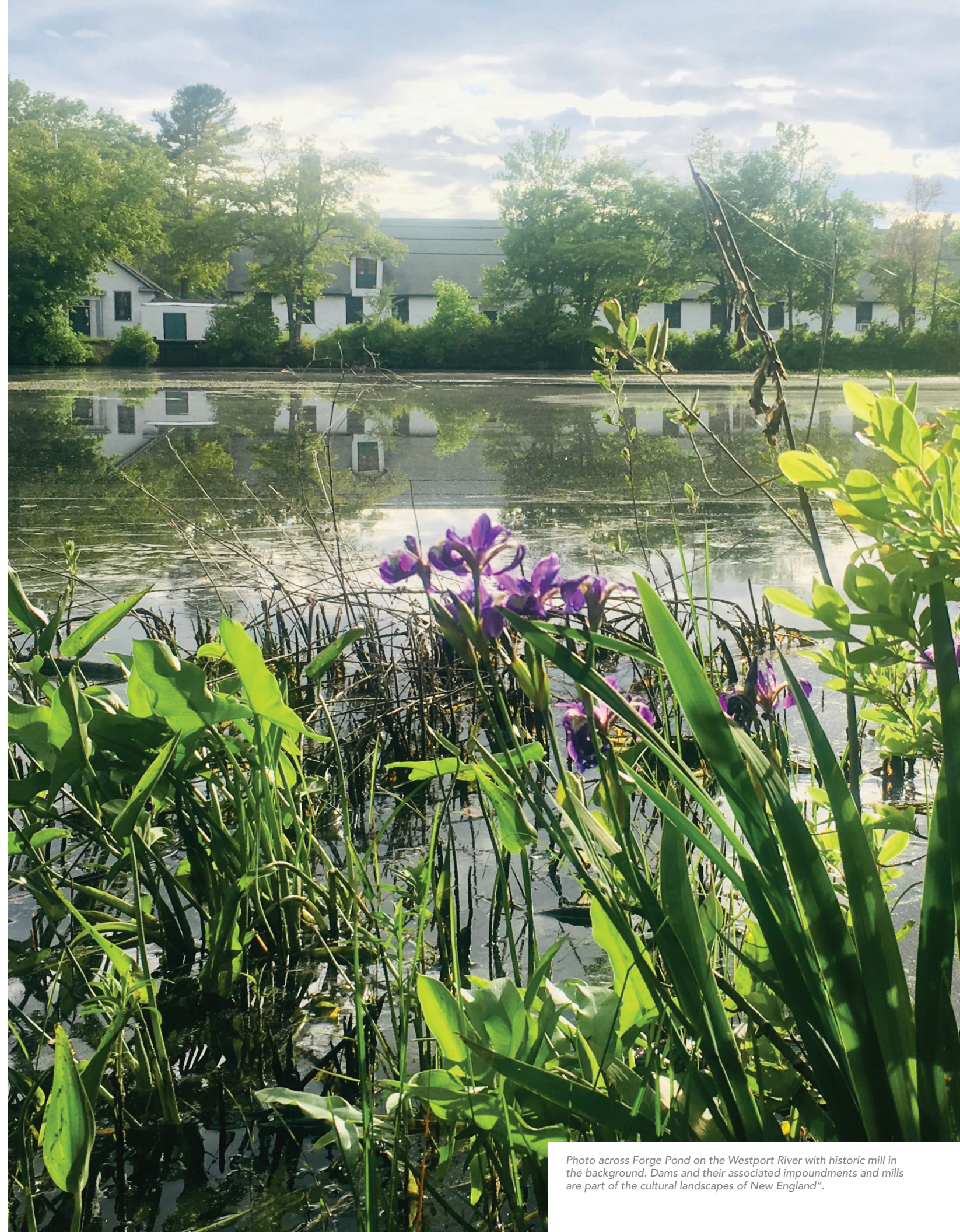
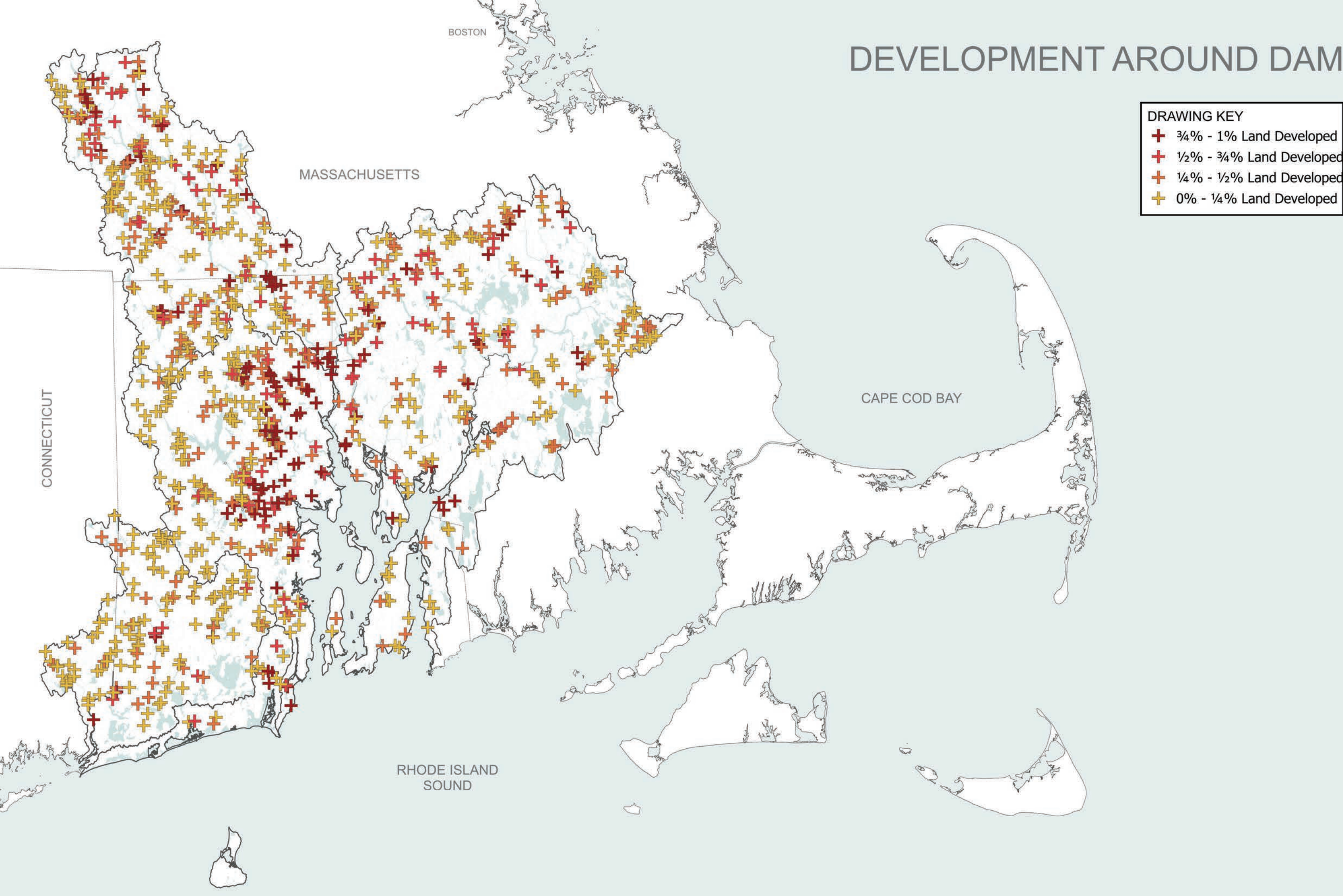
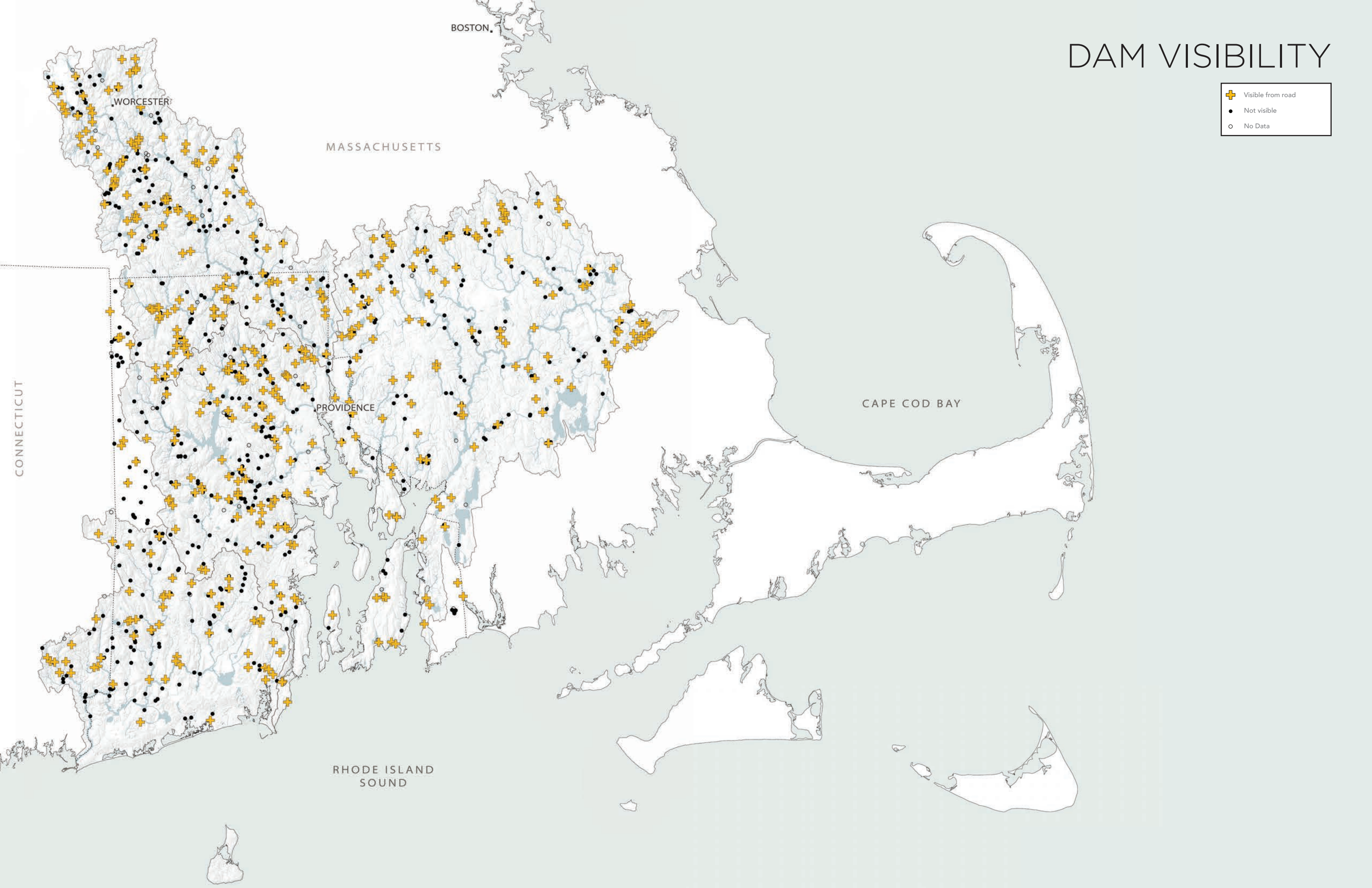


Photo across Forge Pond on the Westport River with historic mill in the background. Dams and their associated impoundments and mills are part of the cultural landscapes of New England.

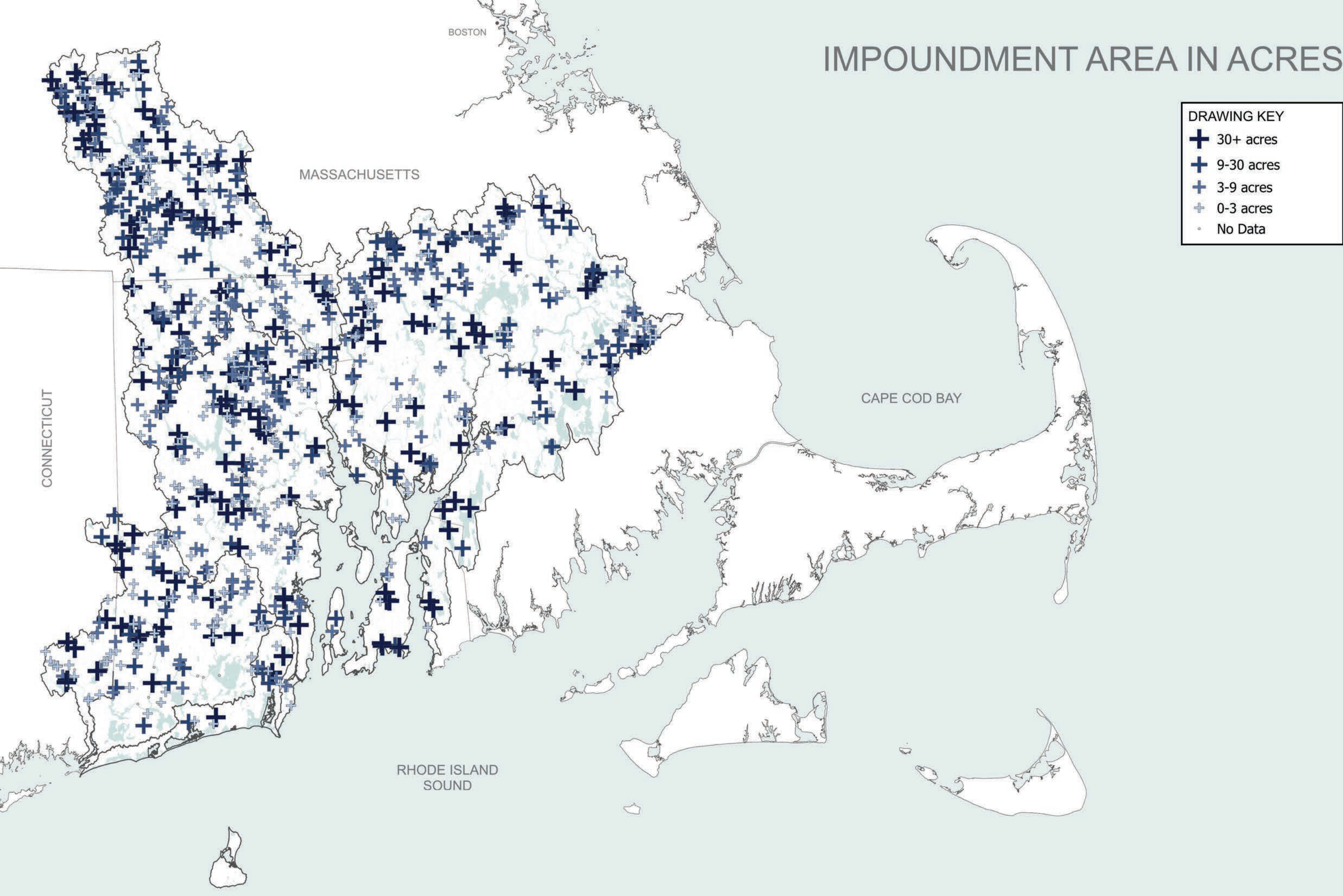
DEVELOPMENT AROUND DAM



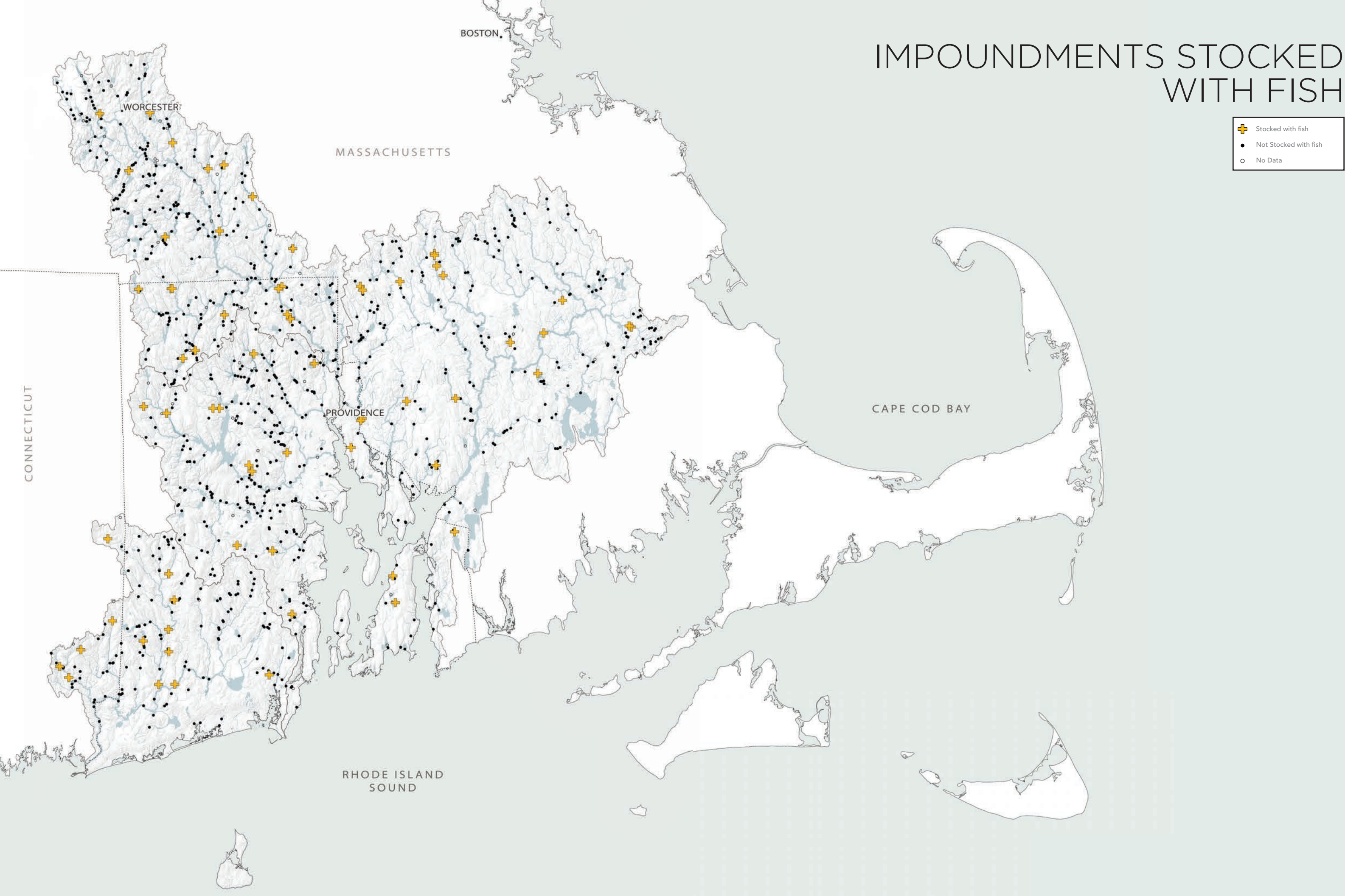
DAM VISIBILITY



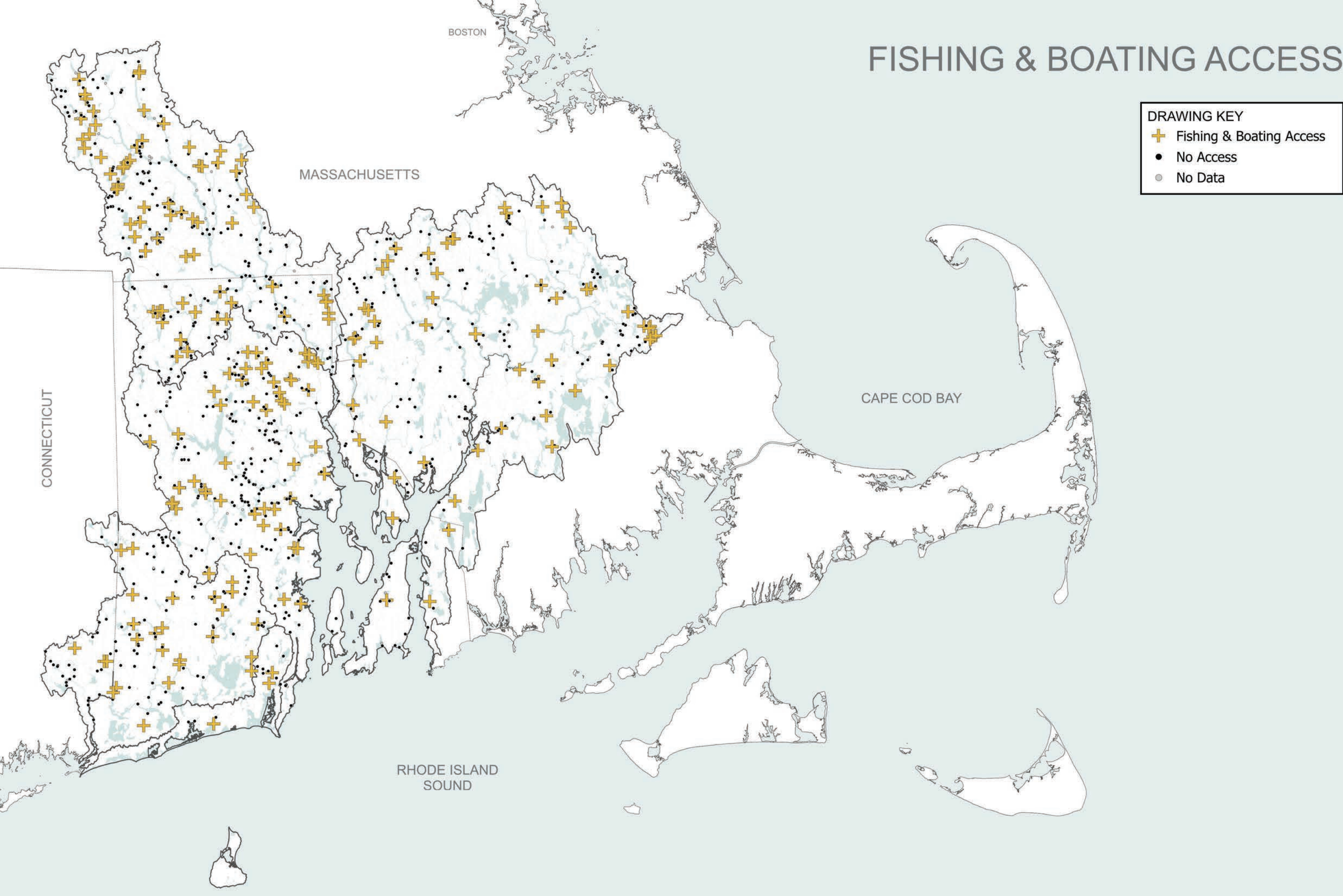
IMPOUNDMENT AREA IN ACRES



IMPOUNDMENTS STOCKED WITH FISH



FISHING & BOATING ACCESS

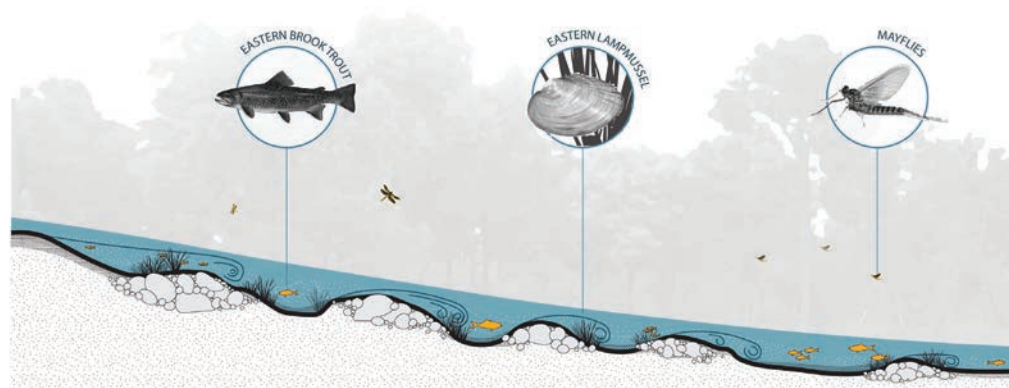


FISH PASSAGE + ECOSYSTEM IMPACTS

River systems are significantly altered by the construction of dams, often with lasting impacts on interspecies relationships and overall habitat connectivity. A river is more than just flowing water—it transports fish, sediment, nutrients, and aquatic organisms from its headwaters (the farthest upstream point) to its mouth (where it discharges into coastal waters), supporting diverse and interconnected ecosystems along its length. Dams interrupt these natural processes by creating barriers that sever upstream and downstream continuity and break the vital connection between rivers and oceans. As a result, multiple ecosystems become fragmented, undermining ecological health and resilience¹.

RIVER FLOW AND ECOSYSTEM DYNAMICS

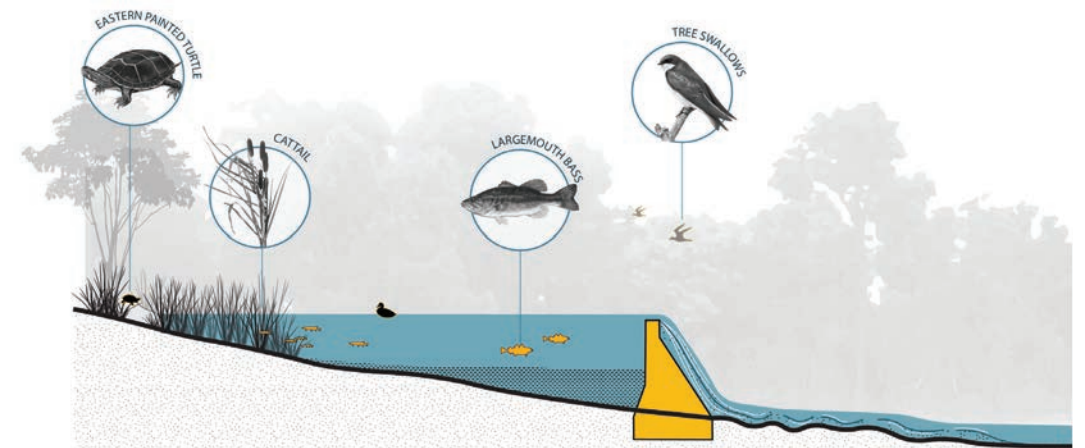
Before European settlement, beaver dams and natural ponds were common features in the smaller streams of the Narragansett Bay watershed. However, the ecological changes brought about by these natural structures were far less extensive than those associated with human-constructed dams. Beaver dams are typically small, porous, and often seasonal or temporary (ephemeral), allowing for continued movement of water and aquatic organisms. In contrast, dams built for industry and power generation were designed to be permanent and impervious, resulting in large-scale and lasting alterations to river flow and ecology throughout the region. These constructed dams transform



Diagrammatic Section of free flowing river

portions of a river ecosystem into a lake ecosystem. While different aquatic and terrestrial species may thrive in each of these habitat types, both rivers and impoundments can provide critical wetland habitat. These wetlands serve a variety of ecological functions: they act as travel corridors; nesting, feeding, and nursery sites; resting and brood-rearing areas; and sources of drinking water and cover for a wide range of wildlife. Additionally, they provide critical seasonal habitat for breeding, migrating, and overwintering bird species².

Free-flowing reaches of rivers and streams transport wood, rocks, and other natural debris downstream, where these materials accumulate to form characteristic riffles (shallow, rocky areas), pools, and meanders. These habitat features provide shelter for prey species and are essential for supporting cold-water fish such as brook trout, fallfish, blacknose dace, and longnose dace. Free-flowing rivers also sustain a diverse community of macroinvertebrates—including mayflies, stoneflies, caddisflies, midges, crane flies, blackflies, dragonflies, damselflies, crayfish, and mollusks—which form the base of the freshwater aquatic food chain and provide critical nutrition for fish and other wildlife. In Rhode Island, Eastern brook trout are listed as a Species of Greatest Conservation Need due to habitat loss, water pollution, climate change, and the presence of dams that disrupt the cold, clear water flows they require.

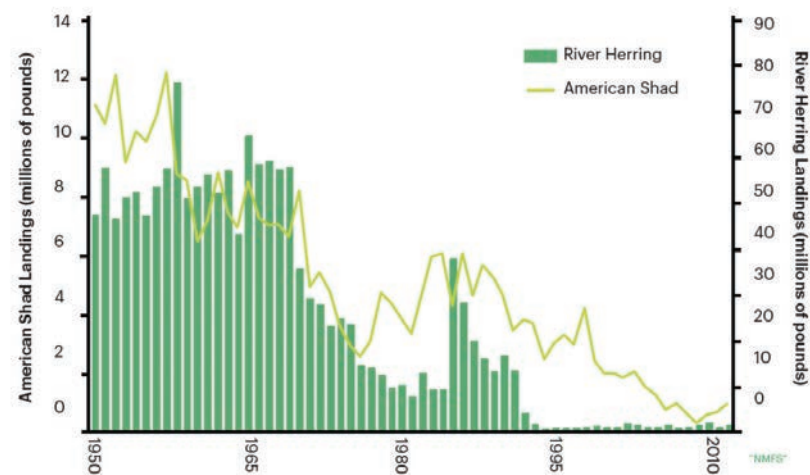


Diagrammatic Section of free flowing river

Similarly, several species of freshwater mussels are considered sensitive species because of degraded water quality and the fragmentation of river habitats.

During high flow events, free-flowing rivers naturally overflow into adjacent floodplains, where water is slowed and dispersed. This process helps mitigate high-velocity flows and reduces the risk of flood damage to downstream human communities. At the same time, significant amounts of sediment are carried downstream and deposited across floodplains, estuaries, marshes, and wetlands, delivering nutrients that support healthy wetland functioning. In contrast, dams can trap sediments and nutrients upstream, disrupting these natural processes. In some cases, the accumulation of nutrients behind a dam can lead to eutrophication and harmful algal blooms, negatively impacting water quality and aquatic life.

When a dam is constructed, the river habitat upstream is transformed into a lake-like environment characterized by warmer temperatures, slower-moving water, and lower levels of dissolved oxygen. These conditions are unsuitable for cold-water species but favorable for warm-water species such as non-native largemouth and small mouth bass, bluegill, and chain pickerel—all commonly found in lake and pond habitats throughout the region. Within these impoundments, wetlands that once lined riverbanks, floodplains, and the former river channel are displaced to the shoreline or survive in shallow zones. These remaining wetlands serve as critical spawning and nursery habitat for various fish species. Additionally, turtles, amphibians, and fish feed on the abundant invertebrates that thrive among aquatic plants. When a dam is removed, areas of the former impoundment transition into floodplain wetlands—an ecologically valuable habitat that supports biodiversity and hydrologic function. In some cases, rare or endangered species may have established themselves in the novel lake ecosystems created by impoundments and additional studies are required to understand the impact of removing or preserving a dam.



National Commercial Landings of Herring and Shad

Alewife

Alosa pseudoharengus



Length: Up to 15"
Weight: 8-10 oz.
Migratory Run: Mid-March to Mid-June
Passage Needs: 5' channel width, 2.25' pool depth, 10' channel length
Spawning Temperature: 57°

The Alewife migrates to freshwater streams where it spawns in large rivers, small streams, and ponds, including barrier beach ponds. Spawning substrates include gravel, sand, detritus, and submerged vegetation with sluggish water flows.

American Shad

Alosa sapidissima



Length: Up to 30"
Weight: 6-12 lbs.
Migratory Run: Early-Mid May
Passage Needs: 20' channel width, 4' pool depth, 30' channel length
Spawning Temperature: 50W°

This keystone species migrates to fresh water when temperature reaches 50°F. Spawns in broad flats of 1-6m deep water. Eggs do best in gravel and rubble substrates. Females lay 650,000 eggs. Juvenile migrate back to ocean in Fall.

American Eel

Anguilla rostrata



Length: Females average 2' to 3'. Males half the size
Weight: 8.9 lbs
Migratory Run: Spring - Summer
Passage Needs: 6' channel width, 2' pool depth, 10' channel length
Spawning Temperature:

Eels are catadromous, meaning they live in freshwater rivers and spawn in the ocean. In October, sexually mature eels swim out of the Bay to the Sargasso Sea in the mid atlantic where they spawn and die. The eel larvae drift in the ocean for 9-12 months and then enter the bay where adults remain in freshwater rivers and streams for the majority of their lives.

Blueback Herring

Alosa aestivalis



Length: Up to 16"
Weight: 8-10 oz.
Migratory Run: Early-Mid May
Passage Needs: 5' channel width, 2' pool depth, 10' channel length
Spawning Temperature: 57°

Blueback herring have similar habitat requirements to the Alewife, but spawn in swiftflowing, deeper stretches of rivers and streams with an associated hard substrate and in slower-flowing tributaries and flooded low-lying areas adjacent to main streams. Spawn 3-4 weeks after Alewife.

Atlantic Salmon

Salmo salar



Length: 28" to 30"
Weight: 8 to 12 lbs
Migratory Run: Late Fall
Passage Needs: 20' channel width, 3.75' pool depth, 40' channel length
Spawning Temperature: 45-50°

Atlantic Salmon lay their eggs in the river bed. Juveniles need clean, well-oxygenated water and cobble sized substrate free of sediment. Historically, Atlantic salmon were present in Narragansett Bay; however, recent attempts to restore salmon to southern New England waters have been unsuccessful.

When a river is dammed, the section downstream no longer receives natural inputs of wood, rocks, sediment, and organic debris that help form critical habitat features such as riffles, pools, and gravel beds. As a result, the river begins to function more like a chute, with simplified, high-velocity flows and reduced habitat diversity. Without access to floodplains or the sediment transport that builds and maintains them, these altered rivers are also more prone to causing damage during large storms.

Dams can further impact ecosystems by fragmenting habitats and isolating populations of fish, freshwater mussels, and other wildlife. This separation can reduce genetic diversity and reproductive success, ultimately leading to population declines. In addition, damming a free-flowing system can facilitate the introduction or spread of non-native species, disrupting predator-prey dynamics and shifting the balance of the aquatic ecosystem. While dams generally have negative effects on habitat connectivity and biodiversity, there are isolated cases where they have acted as barriers that limit the spread of invasive species or aquatic diseases from one population to another⁴.

MIGRATORY FISH PASSAGE

Dams disrupt the migration and spawning cycles of fish that rely on free-flowing waterways during different stages of their life. Anadromous fish—such as salmon, American shad, and river herring—live in the ocean but return to freshwater rivers each spring to spawn. Guided by the Earth’s magnetic field, many of these fish return to the river where they were born. Once near their natal stream, they rely on scent to locate the specific tributary. If unable to reach this location, some will not spawn elsewhere; instead, they continue searching until their energy is exhausted, ultimately dying before reproducing. The American eel is catadromous, meaning it spawns in the ocean—specifically the Sargasso Sea—and its young migrate inland into river networks. There, they feed and mature in freshwater ecosystems for five to ten years or more before returning to the Sargasso Sea to spawn and die. In both cases, dams present a significant barrier to these essential life cycles, contributing to population declines of migratory fish species.

The migration of fish is not only essential for the survival of individual species but also plays a critical role in the health of both river and ocean ecosystems. Anadromous fish like river herring, which spawn in freshwater and mature in the ocean, form a foundational part of the marine food web—supporting species such as tuna, striped bass, sea birds, seals, and whales. When these fish return to their natal rivers, they bring ocean-derived nutrients inland, enriching river ecosystems and feeding birds, mammals, and other wildlife. This nutrient transfer supports a healthy food chain across both terrestrial and aquatic environments. When dams and other barriers disrupt this migratory connection, the ecological consequences are far-reaching. The disconnection between river and ocean systems affects fish, bird, and mammal populations in both habitats, and also undermines recreational and subsistence fishing along the Atlantic coast.

Historically, the river systems and coastal ponds that drain into Narragansett Bay and Block Island Sound supported the migration of millions of river herring, Atlantic salmon, shad, and American eels. However, within a few hundred years of European colonization and the widespread construction of dams, these migratory fish populations had nearly disappeared³. Rhode Island’s once-thriving Atlantic salmon fishery collapsed in 1870, and the river herring fishery was severely depleted by 1930. Today, populations of blueback herring, alewife, and American shad in the northeastern United States are estimated to be less than 1%, 2%, and 3% of their historic levels, respectively.

Given the importance of migratory fish species to the coastal rivers of Narragansett Bay, it is essential to consider a dam’s location within the watershed when assessing its ecological impact. Head-of-tide dams—the first dams encountered by fish as they migrate upstream from the ocean—are particularly critical. If these dams lack effective fish passage, the entire river system becomes inaccessible to migratory species, dramatically reducing available spawning habitat and limiting reproductive success. Dams located on the main stem of a river are also especially disruptive, as they block access to large portions of the upstream watershed. Even when some level of fish passage exists, delays at dams can increase predation risk; migrating fish become vulnerable while congregating or struggling to pass. These disruptions contribute to population declines among migratory species while simultaneously benefiting predator populations, further destabilizing the aquatic ecosystem.

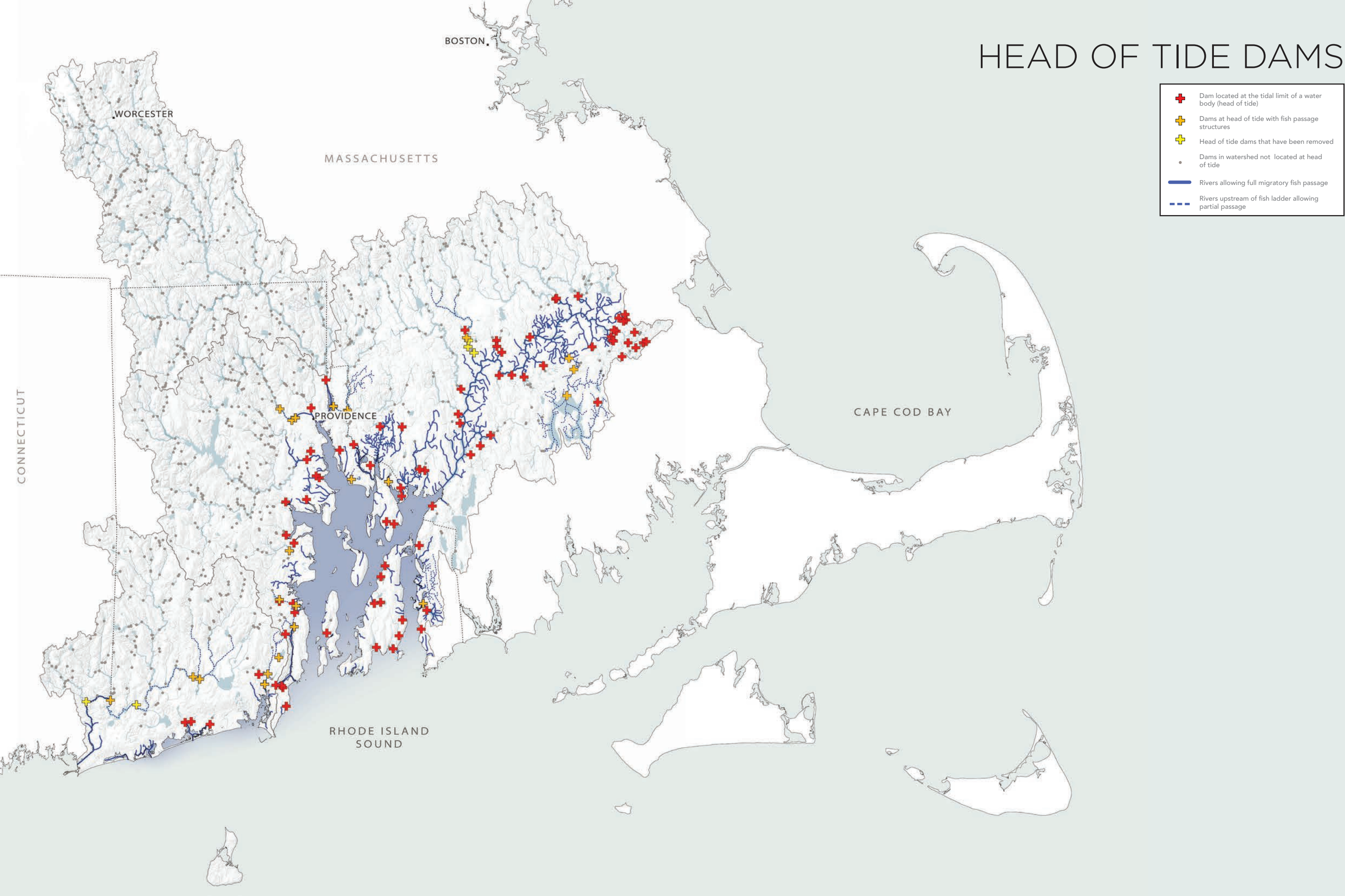
In cases where dams have been removed from rivers in New England, some species of migratory fish have returned quickly—sometimes to waterways where they had not been seen in over a century. In areas where dam removal is not feasible, fishways can offer a viable alternative to improve fish passage. See the Case Studies section for examples of different fishway designs and how they have been implemented. As part of any dam decision-making process, a comprehensive ecological assessment is essential. This assessment should evaluate existing wildlife and wetland habitats and consider how each proposed scenario—whether removal, modification, or repair—would impact the ecological functions and species that depend on the site.

REFERENCES and ADDITIONAL RESOURCES

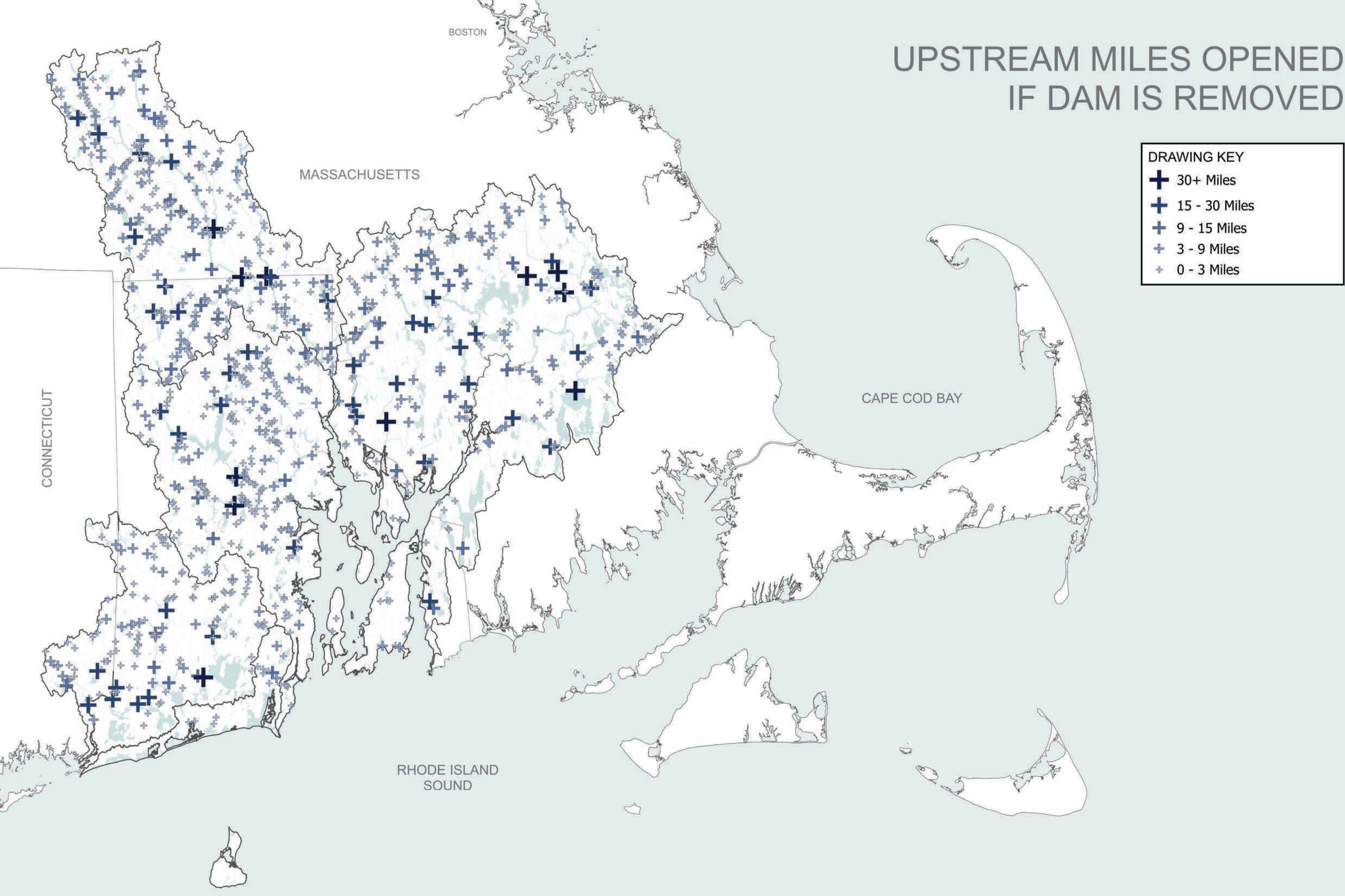
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HEAD OF TIDE DAMS

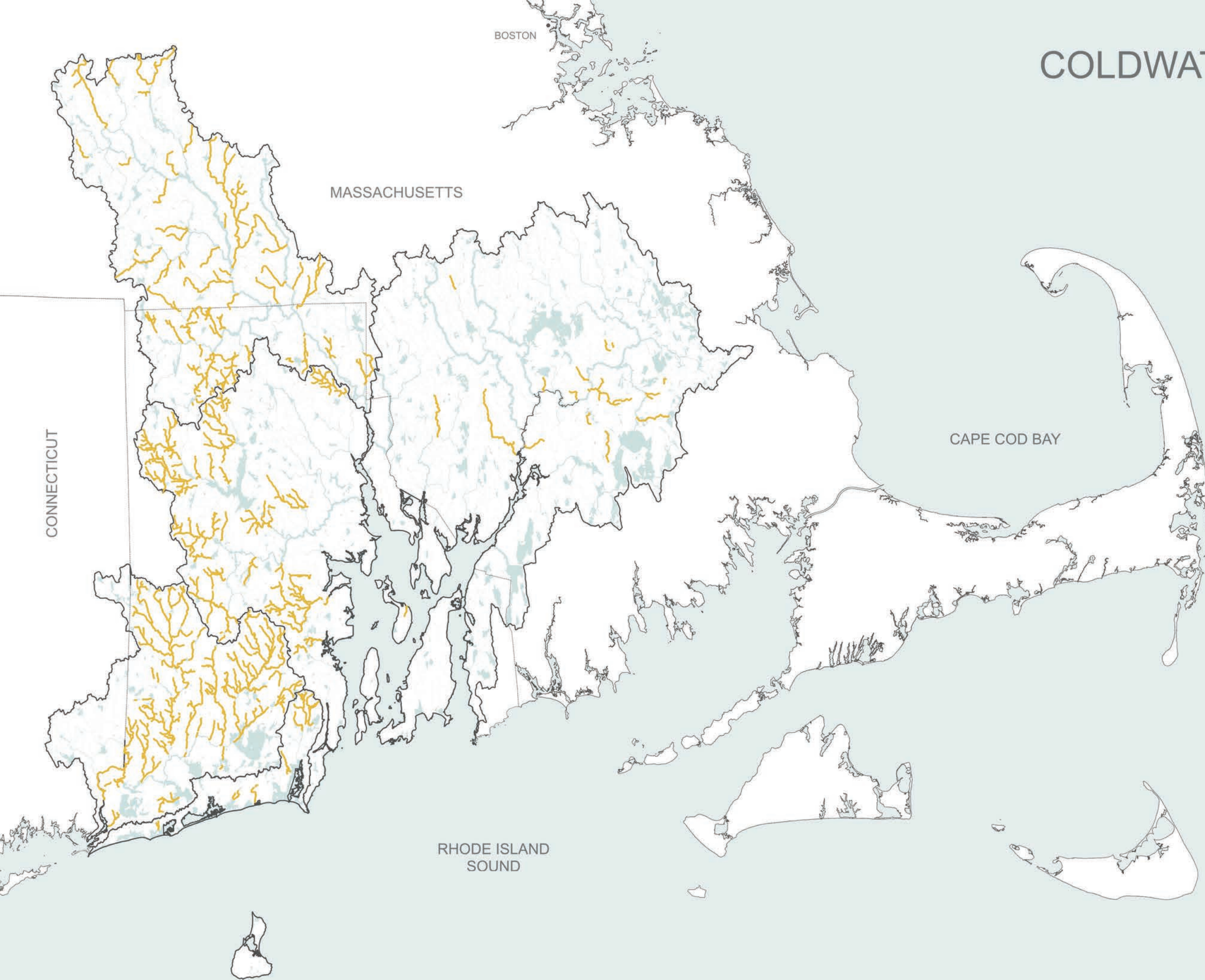


UPSTREAM MILES OPENED IF DAM IS REMOVED



COLDWATER FISHERIES

DRAWING KEY
Rivers and Streams with coldwater
fish habitat



WATER QUALITY + SEDIMENT

Dams alter the natural flow of a river, leading to significant changes in water quality¹. By creating stagnant impoundments with large surface areas, dams increase water temperatures as these surfaces absorb more sunlight. These warmer conditions can become unsuitable for cold-water fish species that once thrived in free-flowing rivers. Elevated temperatures also accelerate evaporation and reduce the water's capacity to hold dissolved oxygen, further stressing aquatic life². Dissolved oxygen levels are also impacted when a dam changes the flow regime from a fast-moving river to a dammed impoundment with still water. While fast-moving water is well aerated, still water is warmed by sun exposure, contributing to decreased oxygen saturation. In large, deep impoundments, the release of cold bottom water can occasionally support an artificial cold-water fishery for trout or herring downstream. However, most impoundments in the study area are shallow, and water is typically released from the warmer surface layer, offering little benefit to downstream cold-water habitats.



Fish Kill due to low oxygen conditions in Narragansett Bay

Excess nutrients—particularly nitrogen and phosphorus—can create harmful conditions in impoundments and downstream coastal waters. Elevated concentrations of these nutrients often stimulate excessive growth of aquatic plants and algae, which deplete oxygen as they decompose. In severe cases, low oxygen levels can lead to large-scale fish kills in lakes, rivers, and bays. Some algal blooms, such as those caused by cyanobacteria (blue-green algae), are of particular concern because they can produce toxins harmful to humans, pets, and wildlife.

Scientists have hypothesized that in some cases, dams—particularly those with impoundments located in headwater tributaries—may actually promote natural nutrient removal or storage processes, potentially improving water quality in downstream estuaries³. Riparian wetlands surrounding impoundments may also help filter excess nutrients before they enter the river system. Ongoing research is exploring whether nutrient retention may represent an unexpected tradeoff when evaluating the ecological impacts of dam removal.

SEDIMENT

Rivers naturally transport sediment downstream; however, when dams are built, much of this sediment becomes trapped and settles in the impoundment behind the dam. Two key concerns related to sediment are accumulation and contamination⁴.

Accumulation:

Unless regularly dredged, sediment will accumulate over time behind a dam. This buildup is typically more significant in watersheds with agricultural and urban land uses, where sediment-laden stormwater flows into rivers. As sediment fills an impoundment, it reduces the waterbody's storage capacity, increasing the risk of flooding during high-flow events and storms. The accumulating sediment also makes the impoundment shallower, warmer, and lower in dissolved oxygen—conditions that are less hospitable to many aquatic species. Sediment buildup can smother habitat for bottom-dwelling organisms and disrupt ecological processes. Downstream, the absence of sediment can cause a river to become sediment starved, leading to channel incision and bank erosion.

Contamination:

Many dams in the Narragansett Bay and associated coastal watersheds date back to the Industrial Revolution. As a result, sediments trapped behind these dams may contain a variety of pollutants, including nutrients, heavy metals, hydrocarbons, and synthetic organic compounds. While dams may temporarily prevent the spread of these contaminants by keeping them contained, they also pose challenges for dam removal. Releasing or disturbing contaminated sediments can have serious environmental and regulatory implications, often requiring costly remediation and careful planning.

Sediment management is a critical consideration when evaluating future scenarios for a dam. It directly influences project design, permitting requirements, and overall cost. Sediment dynamics are highly site-specific and often complex—every dam and watershed presents a unique set of conditions. Whether contaminated or not, accumulated sediment behind a dam can significantly complicate and increase the cost of removal. When a dam is removed, sediment may be released downstream, which can increase turbidity, affect wetland habitats, and potentially release trapped contaminants. However, in many cases, the reach downstream of a dam is considered “sediment starved” due to long-term disruption of natural sediment transport. In such cases, replenishing sediment can actually support ecological restoration and enhance riverine and wetland function. The amount of sediment expected to move downstream after a dam removal should be evaluated in the context of the river’s size, the watershed’s scale, and the system’s typical sediment budget. For large rivers, the sediment released during removal may represent only a small fraction of the annual sediment load—and in some cases, it may be similar to what the system would naturally transport during a major storm event.

If a decision is made to remove a dam, a range of sediment management alternatives should be considered based on site conditions, sediment characteristics, and ecological goals. These may include⁵:

- Sediment removal and offsite disposal – physically dredging sediment and transporting it to a permitted disposal location.
- On-site redistribution and revegetation – spreading sediment across adjacent land areas and stabilizing it with vegetation to prevent further mobility.
- Natural downstream transport – allowing the river to carry sediment downstream where it can be redistributed naturally.
- Capping or in-situ remediation – placing a clean material layer over contaminated sediment to prevent its spread, particularly when sediment is highly polluted.
- Controlled or managed drawdown – gradually lowering water levels, sometimes over multiple years, to allow sediment to settle, stabilize, and revegetate in place.



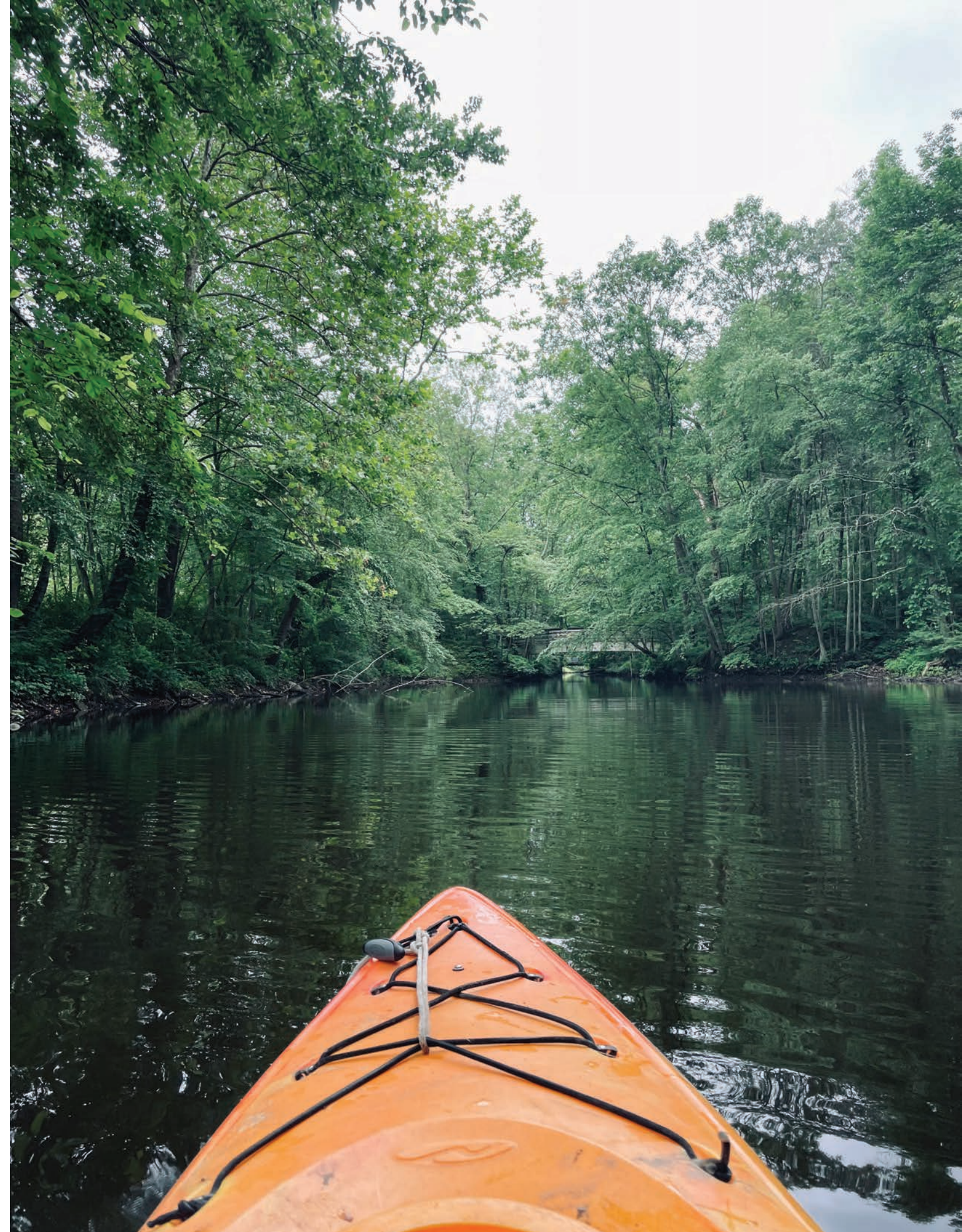
- Targeted removal of isolated contaminants – excavating only the most contaminated areas while leaving cleaner sediment to stabilize or move downstream.
- Hybrid approaches – combining several of the above strategies to balance environmental, regulatory, and cost considerations.

The decision about how to manage sediment begins with a regulatory review that evaluates current and historical upstream land uses, conducts sediment testing for contamination, and uses sediment probing to estimate the total volume of material within the impoundment. This assessment helps determine how much sediment is likely to be mobilized following dam removal. It is important to note that not all sediment within an impoundment will move downstream immediately—or at all. Sediments located in the main river channel are typically the first to mobilize, beginning to move as soon as the dam is breached. In contrast, sediment deposited in the floodplain or along the margins of the impoundment may only be mobilized during large storm events and likely over the course of many years. When managing contaminated sediments, it is also critical to consider contamination levels not just within the impoundment, but in the broader watershed context. In heavily urbanized watersheds, contaminants may be present both upstream and downstream, and the impoundment may not be the sole or even the primary source of pollution.

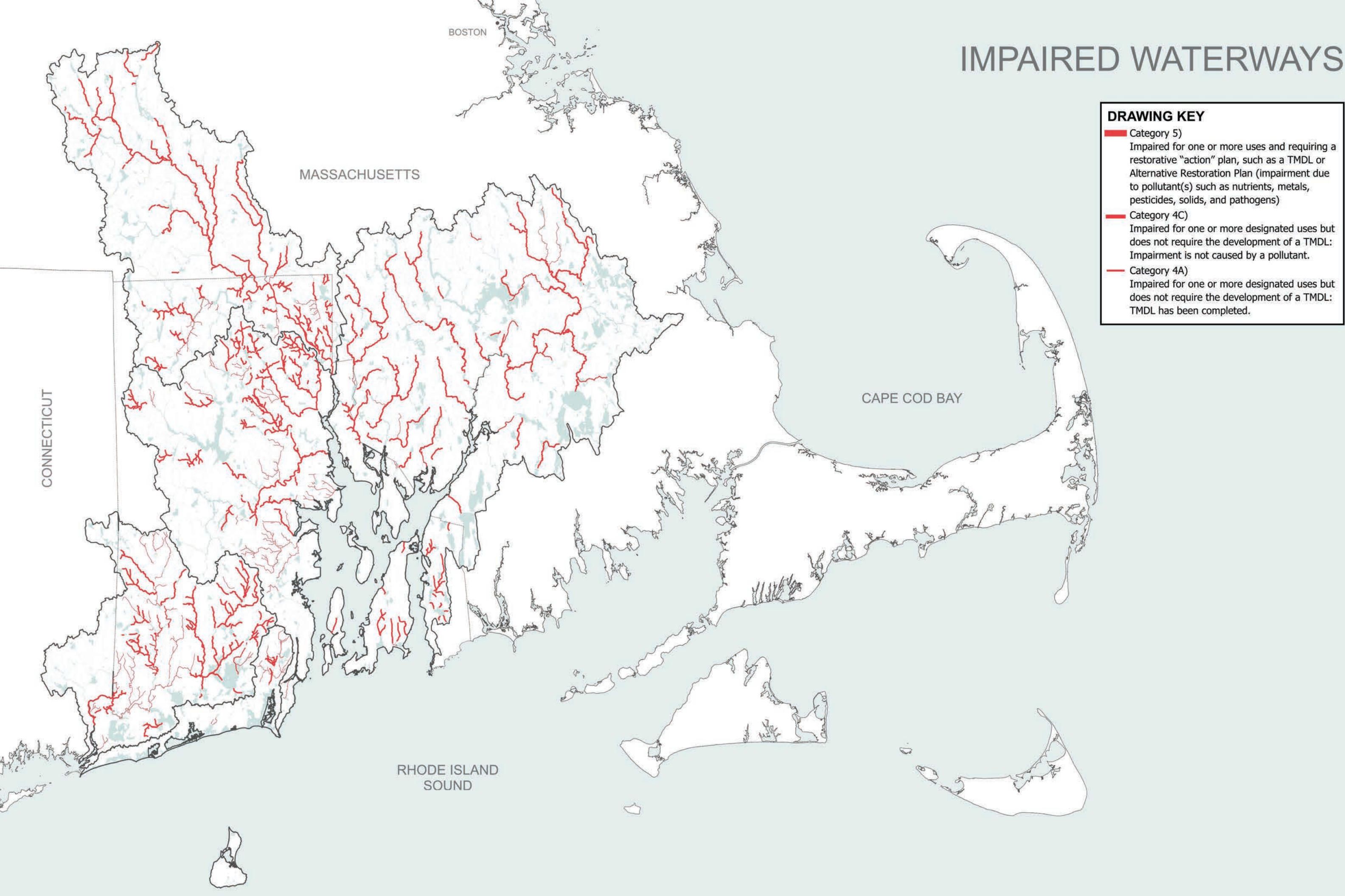
In addition to depriving rivers of sediment, dams can also reduce sediment delivery to downstream coastal ecosystems⁶. Rivers within the Narragansett Bay watershed play a critical role in transporting sediment that nourishes beaches and salt marshes. These coastal systems, particularly salt marshes, are already heavily degraded and under threat—and will face increasing pressure from sea level rise⁷. By trapping sediment upstream, dams limit the supply of sediment that salt marshes rely on to maintain elevation and adapt to rising seas. As a result, dams further reduce the resilience of these vital coastal habitats in the face of climate change.

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IMPAIRED WATERWAYS



COST + FUNDING

Dam removal, repair, or modification can be costly, and because every dam is different, many factors influence the total cost and economic impact of a given decision. When considering future scenarios for a dam, key economic considerations include short-term costs, long-term costs, liability costs, and broader socioeconomic impacts.

In most cases, short-term costs are the primary focus when evaluating alternatives. These may span multiple project phases, including public outreach and feasibility studies; design and permitting; implementation (e.g., dam repair, removal, or modification); and post-removal adaptive management and monitoring. Actual implementation costs will vary depending on the dam's size, location, condition, proximity to infrastructure and utilities, the sediment management strategy, methods for controlling water during construction, and regional economic conditions.

Long-term costs must also be taken into account. While repairing or upgrading a dam may appear less expensive in the short term, it often comes with ongoing costs related to inspection, maintenance, and eventual future repairs. Beyond direct project expenses, it is important to evaluate societal economic impacts. For example, if the impoundment is a valued recreational site or tourist attraction, changes to the dam could affect local revenue. Impacts on nearby property values should also be assessed. Importantly, this evaluation should include consideration of who benefits and who bears the costs—recognizing that economic effects are often distributed unequally within a community.

Finally, dam modification alternatives—such as nature-like fishways, bypass channels, or technical fishways—can be more expensive to construct and maintain than full removal. However, in some cases, these options provide a middle ground that supports fish passage and ecological restoration while maintaining certain valued features of the dam or impoundment. Such compromises may help communities navigate otherwise controversial decisions by balancing trade-offs across multiple priorities.

FUNDING

Dam projects often require a combination of funding sources, including support from state and federal agencies, nonprofit organizations, municipalities, and private foundations. In some cases, full dam removal may have a greater chance of attracting external funding, but each project is unique, and economic considerations must be evaluated alongside ecological, cultural, and social dimensions of the decision.

Available grants and loans are typically tied to the stated purpose of the project. For example, while funding may not be available specifically for fish passage restoration, there could be resources available for broader goals such as watershed restoration, flood mitigation, or coastal and climate resilience—or vice versa. Understanding how a project aligns with funding priorities is essential when developing a financing strategy.

It is also important to note that ongoing costs associated with dam ownership—such as fishway maintenance or required safety inspections—are rarely supported by external funding. Similarly, securing funds for dam repairs can be particularly difficult if the structure is not classified as high or significant hazard, or if it is not in poor or unsafe condition.

SOCIAL AND ECOLOGICAL METRICS

As part of the Narragansett Bay Dam Atlas, we developed a GIS database to assess the ecological and social dimensions of the known dams in the Narragansett Bay watershed. While there have been other studies that characterize and rank the ecological benefits of dam removal, these studies often focus only on the regional scale and rarely consider the social aspects of dams. Such large-scale geographical studies are not always relevant to local communities. In the Narragansett Bay watershed, many rivers do not rank highly at a regional scale even though they are considered important for improving fish passage at the local scale. By omitting information on the social dimensions of dams, these databases overlook what is often the most critical factor in determining the future of a dam: public buy-in.

For this study, we modeled the ecological metrics and ranking system after The Nature Conservancy’s Northeast Aquatic Connectivity study. We used 13 metrics that measure factors relating to river connectivity and watershed quality (Table x). The metrics were then weighted for the potential benefit of removal for either resident or migratory fish. Weights for migratory fish emphasized river connectivity improvements, particularly for the downstream river network. Weights for resident fish emphasized barrier densities, connectivity improvement, and watershed condition. All the dams in the watershed were then ranked from 1 to 1034 with lower values indicating a greater ecological benefit for dam removal or modification.

To better understand and map the social dimensions of a dam, we created a set of social value metrics to estimate the value that the presence of a dam currently provides to the local community. High social value may indicate a stronger community attachment to the dam and/or impoundment, and dams with high social value typically require a more extensive community engagement process to explore options that balance the social and ecological dimensions of the decision. These social value metrics consider the value of dams and their impoundments to history, sense-of-place, recreation, scenery, and property values. In order to distinguish between community attachment to dams and impoundments, we created two separate sets of social value metrics (Table x and x).

ECOLOGICAL METRICS

METRIC	DEFINITION	RATIONALE
Upstream Length	Length of river upstream (ignores dams).	Maximum potential habitat if all upstream dams are removed.
Distance to mouth	Distance to river mouth (ignores dams).	Maximum potential habitat if all down-stream dams are removed.
Downstream barrier count	Number of dams downstream to mouth.	Potential for fully connecting downstream habitat to ocean.
Upstream barrier density	Dams/km upstream.	Average length of upstream network opened up per dam removal.
Downstream barrier density	Dams/km downstream.	Average length of downstream network opened up per dam removal.
Area of lakes/ponds	Area of lakes/ponds in the upstream functional network.	Lakes/ponds provide key habitat for some migratory fish (e.g., river herring).
Upstream functional network length	Length of contiguous upstream riv-er.	Additional functional habitat that would be added given the other existing dams.
Downstream functional network length	Length of contiguous downstream river.	Additional functional habitat that would be added given the other existing dams
Total functional network length	Sum of upstream and downstream networks.	Total habitat that would be connected given the other existing dams.
Absolute Gain	Smaller of the upstream and down-stream functional network lengths .	Gain in functional habitat from barrier removal.
% impervious cover	% impervious cover in the dam watershed.	Associated with increased nutrient and pollutant loads in run-off.
% agricultural cover	% agricultural cover in the dam watershed.	Associated with increased nutrient loads in run-off.
% natural riparian zone	% natural cover within 50 m of up-stream rivers in the dam watershed.	Natural riparian cover helps remove pollutants from run-off.

Ecological metrics for evaluating benefits of dam removal or modification. All metrics are defined based on the dam or its watershed.

SOCIAL METRICS- DAM

METRIC	DEFINITION	RATIONALE	SCORING
Historic status	Is dam in a historic district and is it visible from a road?	May provide legal protection or sentimental value.	If in historic district: +5 if not visible +10 if visible
Year of construction	Year the dam was built.	Older dams may have more sentimental value.	+3 pts if before 1800 +2 pts if 1800-1900 +1 pt (1900-1950)
Trails	Does a hiking/biking trail pass within 50 m?	Dam may provide a scenic destination to hikers/ bikers.	+1 if any trails present
Construction material	Type of material used for the dam construction.	Dam material can affect aesthetic value.	+1 if dam is either masonry or stone
Visibility	Dam visibility from local road segments > 50 m long and < 50 m from the dam.	May provide sense-of-place to a larger number of residents.	+10 if dam is visible
Developmental setting	Percent of land within 100 m of the dam that is developed.	May provide sense-of-place to a larger number of residents.	+2 pts if 25-49%, +4 pts if 50-74%, +6 pts if ≥75%
Neighboring properties	Buildings < 50 m from river centerline and < 1 km up-stream). Omitted if pond is present.	Lowering water level could affect property values and water access.	+10 per building
Hazard class	National Inventory of Dams hazard ranking.	The hazard level posed by a dam can detract from its community attachment.	-2 if medium -5 if high

Social value metrics for evaluating community attachment to the dam. More points are assigned to metrics that we considered associated with greater social attachment.

SOCIAL METRICS- IMPOUNDMENT

METRIC	DEFINITION	RATIONALE	SCORING
Neighboring properties	Buildings < 50 m from pond or river centerline (< 1 km upstream).	Lowering water level could affect property values.	+10 per house
Parks	Is the pond adjacent to a public park? (yes/no)	Impoundment may be a central feature of the park and provide sense-of-place	+20 if present
Hiking/biking	Do biking/hiking trails pass within 50 m? (yes/no)	Pond may provide a scenic destination.	+1 if present
Visibility	Is pond visible from local roads > 50 m long and within 500 m of pond?	May provide broader community with sense-of-place.	+10 if either impoundment is visible
Pond size	Area of impoundment in acres	Larger impoundments may benefit a larger community and provide more recreational opportunities.	+1 if < 1 acre +2 if 1-10 acres +3 if 11-25 acres +4 if 26-100 acres +5 if 101-500 acres +6 if > 500 acres
Road access	Does a local road pass within 10 m?	Provides access to either motorboats or non-motorized boats.	+5 if road present
Motorboat access	Is a boat ramp present?	Provides access to motorized boaters. Lowering of water level may eliminate all opportunity for motorboats.	+5 if boat ramp present
Fishing opportunity	Is the pond stocked with fish?	Pond provides benefit to anglers.	+5 if pond is stocked

Social value metrics for evaluating community attachment to the dam impoundment. More points are assigned to metrics that we considered associated with greater social attachment.

The GIS analysis and assessment of the social and ecological factors provide communities with the ability to compare opportunities and priorities across the watershed and consider where and how to invest financial resources. Dams that rank highly for fish should be prioritized for removal or for modifications that support fish passage. Dams that are high-ranking in ecological value and low-ranking in social value may be especially good candidates for removal. For example, dam removal would likely experience less community resistance if a dam were in the middle of the forest than if it were located off of Main Street. For dams that rank highly for both social and ecological value, the substantial ecological benefits of improving fish passage must be considered alongside a strong likelihood of community attachment. Decision-making about these dams will require a more extensive public process that explores a full range of alternatives that may address social concerns while still providing some ecological benefits, including removal as well as the construction of nature-like fishways, bypass channels, and/or technical fishways.

These metrics and maps provide a new way for us to understand and visualize the ecological and social dimensions of dams in the watershed. By quantifying the social metrics, we do not intend to suggest that these metrics should limit the mitigation options that are considered or prohibit ecological restoration actions for a particular dam. Instead, the social metrics are intended to indicate the need to engage interested communities in exploring fish passage alternatives that have the potential to both provide ecological benefits and preserve social value. Our analysis is also intended for broader-scale guidance, comparisons, and prioritization of projects at the watershed scale. For publicly owned dams, a community engagement process can help build an understanding of the social dimensions of place-based attachment to that specific dam. Identifying and quantifying the social dimensions of dams provides a way for these factors to be discussed and analyzed alongside the ecological dimensions so that they are included in watershed-scale decision-making about priority projects.

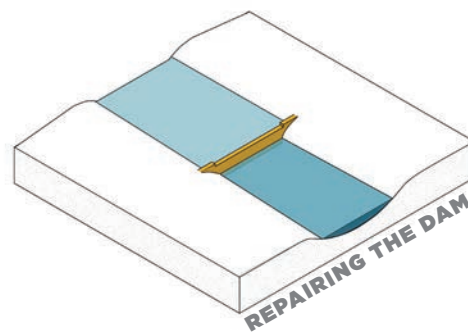
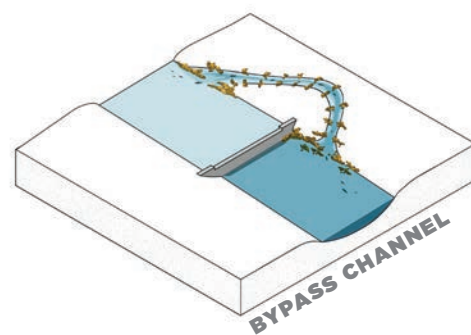
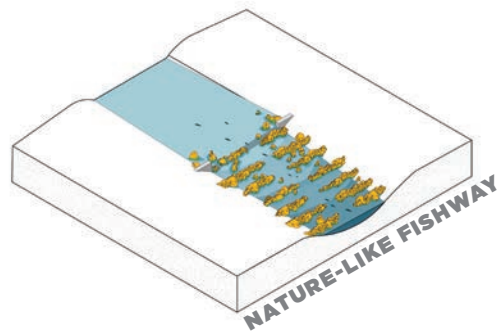
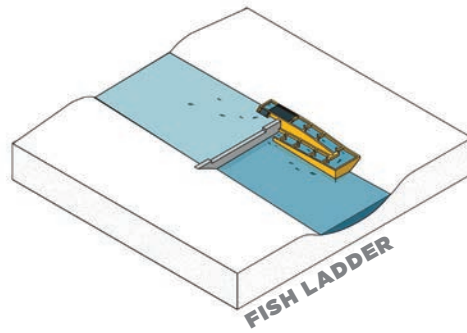
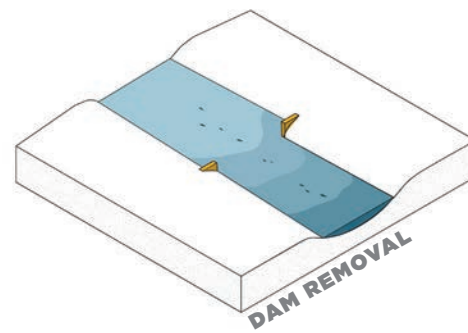
The full results of the analysis can be found in the journal article, “Guiding Decisions on the Future of Dams: A GIS Database Characterizing Ecological and Social Considerations of Dam Decisions in Southern New England”¹. The GIS methods shared in the paper can be replicated in other geographic regions.

REFERENCES and ADDITIONAL RESOURCES

1. Parent, Jason R., Arthur J. Gold, Emily Vogler, and Kelly Addy Lowder. 2024. “Guiding Decisions on the Future of Dams: A GIS Database Characterizing Ecological and Social Considerations of Dam Decisions.” *Journal of Environmental Management* 351 (February): 119683. <https://doi.org/10.1016/j.jenvman.2023.119683>.

SECTION 02

CASE STUDIES



Within the Narragansett Bay and coastal watersheds, there is a need to address aging dams that are in poor condition and in need of repair. Each dam is unique and has different ecological, social, physical and economic factors that need to be considered when exploring solutions. Given that most dams within New England are small and obsolete, there are often a range of alternatives that can achieve multiple objectives. Dam removal is frequently the most cost-effective way to manage aging dams. Removal will restore most natural river functions and ecological connectivity, eliminate future risks of failure, and avoid long term maintenance and repair costs. However, the social, physical and economic aspects of the local community often warrant consideration of alternatives. Conventional fishways or nature-like fishways are often used in combination with either no or partial lowering of the water levels upstream of the dam. Where dams are not removed, repair and long-term maintenance costs and the potential consequences of dam failure to property, infrastructure and livelihoods need to be identified through engineering studies. The future of any particular dam may warrant the exploration of other options that move beyond what is often perceived as just two options of either keeping or removing the dam.

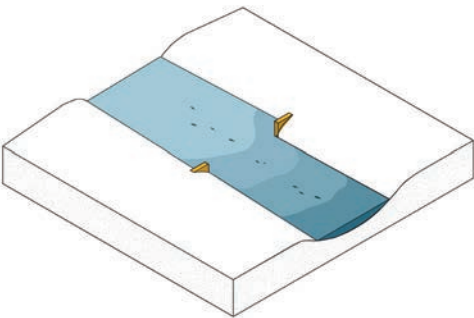
Dams are constructed landscapes that require creative thinking to address the often competing trade-offs of a decision. On the following pages are a description of different strategies that have been used and case studies that describe specific projects where these strategies have been deployed. See the "Decision-Making Tools" section to explore how to engage in conversations about the range of alternatives and to explore how they meet the project objectives.

DAM REMOVAL

Dam removal provides full habitat connectivity and fish passage up and downstream. It eliminates the risk of dam failure and avoids long-term maintenance and repair costs. It represents a “one and done” solution to the many aging dams in the region. Removal also allows canoes and kayaks unobstructed passage downstream without the need for long and sometimes dangerous portages (carrying a boat around the dam).

Dam removal requires careful study and engineering to assure that neighboring infrastructure, such as bridges and roadways are not damaged by changes in the river channel. Studies are also needed to understand the impact of lowering the upstream water elevations on wells, upstream wetlands, recreation and private properties along the impoundment. While dam removal can be expensive up-front, there is no long-term cost or maintenance required once the dam is removed.

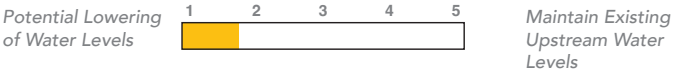
DAM REMOVAL



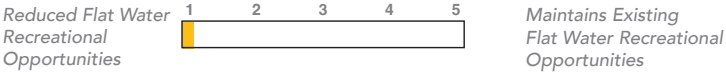
FISH PASSAGE UP AND DOWN STREAM



UPSTREAM WATER LEVELS



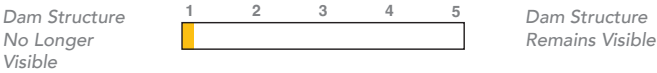
RECREATION ON THE IMPOUNDMENT



RECREATION ON THE RIVER



VISIBILITY OF DAM



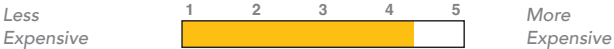
WATER QUALITY



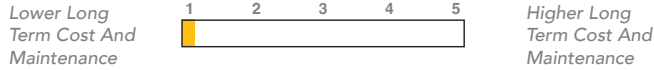
RISK OF DAM FAILURE



UP-FRONT COST



LONG-TERM COST AND MAINTENANCE



PAWTUXET FALLS DAM

PROJECT SUMMARY

In the 19th century, dams constructed along the Pawtuxet River helped to power Rhode Island's textile industry. Years of industrial use, including the release of untreated chemicals from the Ciba-Geigy chemical plant, left the river heavily polluted. Poor water quality led to declines in fish population and river access for the local community. After decades of investments aimed at improving water quality and habitat in the river, the decision was made to remove the Pawtuxet Falls Dam. For hundreds of years, the Pawtuxet Falls Dam blocked migratory fish passage as the first of many dams leading from the Narragansett Bay through the mill towns situated along the river.



LOCATION

Cranston and Warwick, RI

RIVER

Pawtuxet River

YEAR

2011

GOAL

Migratory fish passage

TYPE

Partial removal

COST

Approximately \$1,000,000 including permits, engineering, and project management; construction cost of approx. \$800,000

PROJECT PARTNERS

Pawtuxet River Authority & Watershed Council (PRA); Narragansett Bay Estuary Program; USDA Natural Resources Conservation Service; RIDEM; RICRMC; The Rhode Island Foundation; USEPA; National Oceanic and Atmospheric Administration; US Fish and Wildlife Service; American Rivers; Save The Bay; RI Saltwater Anglers Association; Friends of the Pawtuxet; Pawtuxet Village Association; City of Cranston; City of Warwick; Restore America's Estuaries; RI Rivers Council; RI Corporate Wetlands Partnership; Rhodes-on-the-Pawtuxet; Hunter's Garage 66.

CHALLENGES:

There were multiple hurdles that needed to be overcome before the dam could be removed. Design issues were complicated as stakeholders wished to minimize changes to the river's morphology. However, bedrock in the area was not stable enough to safely navigate river herring upstream and allow for a full dam removal. The water quality and sediment were degraded by more than a century's worth of upstream discharge of human and industrial waste, including the hazardous waste. Furthermore, at the time, it would have been the largest ecological dam removal undertaken in Rhode Island. Lastly, Pawtuxet Falls Dam was in a highly visible historic location and the dam and waterfall were part of the local landscape and sense of place.



SOLUTIONS:

In 2011, a project led by the Pawtuxet River Authority and Narragansett Bay Estuary Program, along with dozens of partners, used excavators to strategically demolish the concrete spillway. Native wetland plantings were installed along the newly exposed river banks to aid habitat restoration goals. Today, anadromous fish populations like river herring and American shad are once again able to travel upstream to spawn.

This project employed a process of ongoing public interaction, including advocacy on the part of a local business owner. Eight public meetings were held over four years, during which time, assessments and design plans were completed. During this process, the design was modified due to the bedrock conditions. The final design

resulted in a portion of the dam staying in place to divert flow and fish in a way that promotes successful upstream migration.

SUCCESSES:

A NOAA representative reflecting on the process asserted that the biggest hurdle was consensus-building. Ultimately, community consensus was reached, and for the first time in three hundred years, this section of the river was able to flow freely into Narragansett Bay, restoring 7.5 miles of spawning habitat above the dam.

LESSONS LEARNED:

For highly visible dams, the public process is very important to build an understanding of the project trade offs and the varying community interests.



Photo during and after removal.

REFERENCES and ADDITIONAL RESOURCES

NBEP presentation: https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1212&context=fishpassage_conference

Cranston Herald Article: <https://cranstononline.com/stories/village-celebrates-dam-removal-opening-pawtuxet-to-migratory-fish,63352>

LOWER SHANNOCK FALLS

PROJECT SUMMARY

Lower Shannock Falls Dam, located on the Upper Pawcatuck River between Charlestown and Richmond, was erected in the early 1800's. This site contains historic significance to both the Narragansett Tribe and Anglo-European communities. The Lower Shannock Falls dam removal was part of a comprehensive project that opened fish passage through seven dams along the Pawcatuck River. The dam was removed in 2010 but modifications were made in 2011 to improve flow conditions.



LOCATION

Charlestown/Richmond, RI

RIVER

Pawcatuck River

YEAR

2010

GOAL

Migratory fish passage

TYPE

Complete removal with Historic Signage and Artifacts

COST

\$843,470 including: Feasibility Assessment (~\$42,300), Design and Permitting (\$187,260), Construction and Oversight (\$588,910), Post-Construction Monitoring (~\$25,000).

PROJECT PARTNERS

Wood Pawcatuck Watershed Association; Trout Unlimited; United States Fish and Wildlife Service; RI Coastal Resources Management Council; RI Department of Environmental Management; National Oceanic and Atmospheric Administration; Save the Bay; Richmond Conservation Commission; Town of Richmond; USDA Natural Resources Conservation Service; American Rivers; and Narragansett Bay Estuary Program.

CHALLENGES:

Initially, the neighboring community was not in favor of the design and construction that was needed for the dam to be removed. Some residents were worried that the diversion of the river during the construction process may have negative ecological impacts. Others were concerned that the site would not reflect its historical significance to both Anglo-Americans and the Narragansett Tribe. Additionally, others were worried that when the dam was removed, the water would be too turbulent to permit recreational use.

SOLUTIONS:

In 2010, the dam was removed and three weirs were installed to ensure that river flows met the migratory needs

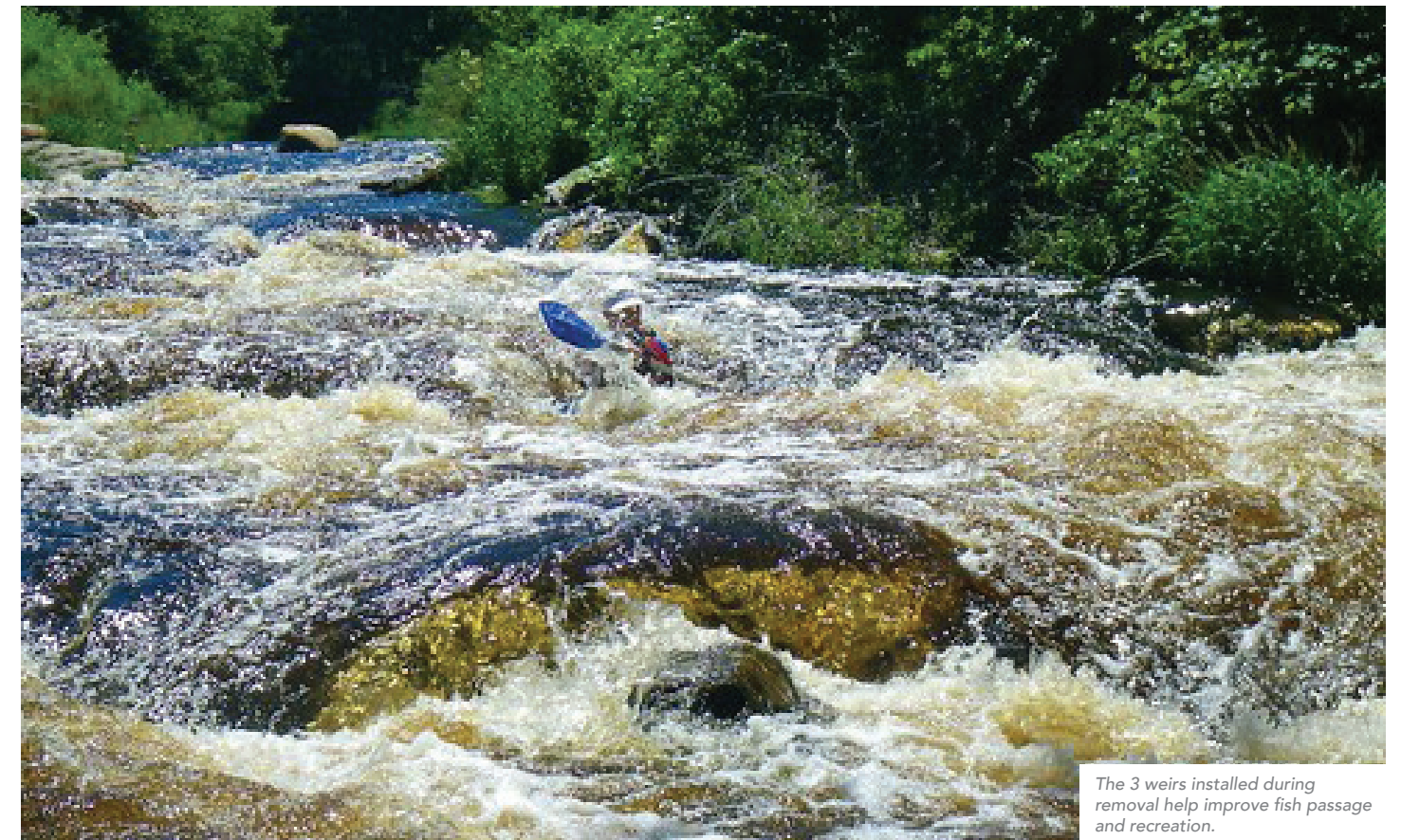
of the fish. The Knowles Mill Public Park was developed by the town of Richmond on the river bank below the falls providing trails as well as fishing and boating access downstream of the former dam. The historic smoke stack from the mill was left in place and interpretive signs were installed in the park to document the historic and cultural importance of the area.

SUCCESSES + LESSONS LEARNED:

Throughout the project, the project team consulted with the local community and the Narragansett Tribe. This collaboration allowed for the historical preservation concerns of the community to be addressed while allowing for the dam to be removed. By creating a

public park surrounding the old dam site, public access to the river was enhanced. The history of the site is communicated through the preservation of ruins as well as signage in the park that displays historic photos.

The project benefited from a team experienced in fishery biology, hydrology/hydraulics, sediment transport, and water management. Completing the weirs in "dry" conditions helped achieve elevations and other design features required for fish passage. Testing river flows during and following construction allowed site-specific modifications that would help fish in their migration up and down the river.



The 3 weirs installed during removal help improve fish passage and recreation.

REFERENCES and ADDITIONAL RESOURCES

NOAA's presentation: "Advancing Anadromous Fish Passage Efficiency Lower Shannock Falls Dam Removal Pawcatuck River, Rhode Island" <https://www.estuaries.org/pdf/2010conference/tuesday16/galleon3/session3/turek.pdf>

WHITE ROCK DAM

PROJECT SUMMARY

For over 200 years, there have been dams at the mouth of the Pawcatuck watershed. In 1938, these historic dams were replaced by the White Rock Dam. It spanned 108 feet across the Pawcatuck River and stood six feet high. The dam blocked most fish passage from the Atlantic Ocean into the Pawcatuck River. Although a raceway was available to migrating fish, it only passed fish under perfect stream conditions; studies showed that only 15 percent of fish were able to battle through the strong currents in the narrow channel. Flooding was another significant concern. Major flooding in 2010 damaged the structure, causing it to become a safety hazard.



add caption to picture on the left. Is this post removal? Looking up or down stream? Is the a per removal photos that can be added to help

LOCATION

Westerly, Rhode Island and Stonington, Connecticut

RIVER

Pawcatuck River

GOAL

Migratory fish passage; Flood abatement; Recreation enhancement

TYPE

Complete Removal

COST

\$794,000

PROJECT PARTNERS

The Nature Conservancy; United States Fish and Wildlife Service; RI Coastal Resources Management Council; RI Department of Environmental Management; National Oceanic and Atmospheric Administration; the Wood-Pawcatuck Watershed Association; and Save the Bay.

CHALLENGES:

White Rock Dam was privately owned and adjacent to three other properties. It spanned across the Connecticut and Rhode Island border. One of the greatest challenges was that the dam was under the jurisdiction of two states.

SOLUTIONS:

The removal of the White Rock Dam required stakeholder and decision-maker integration across both states. The owner of the dam, who would be liable for damages if the dam were to fail, allowed the removal of the dam. There was no significant push back from the owners of the other adjacent properties. Working across state boundaries provided significant permitting challenges, but coordination between government agencies and environmental organizations in both states allowed

the process to move forward. Two separate filings -- an 800-page application in Connecticut and a 650-page application in Rhode Island -- resulted in approval of the dam removal permits.

SUCCESSES:

Removal of the dam eliminated a hazardous structure, which minimized possible flooding downstream while allowing diadromous fish species to regain passage to and from the ocean. The White Rock Dam was the first dam blocking migratory flow from the Narragansett Bay through the Pawcatuck River. The removal of the dam spurred subsequent projects upstream.

LESSONS LEARNED:

Cooperation with other agencies is necessary especially when working across state boundaries: Sally Harold,

from the Connecticut chapter of The Nature Conservancy, stated, "A lot of it means we have twice as much work to do. We have two agencies to work with, but it also means we can double-dip fisheries biologists from both sides, from both agencies, and there's been great cooperation between agencies and other project partners from both sides of the river."



The White Rock Dam was under the jurisdiction of two states which added to the complications of the project.

REFERENCES and ADDITIONAL RESOURCES

FUSS and O'NEILL: <https://www.fando.com/project/white-rock-dam-removal/>

<https://www.ctpublic.org/environment/2015-09-08/dem-begins-white-rock-dam-removal-along-pawcatuck-river>

MILL RIVER DAMS

PROJECT SUMMARY

Mill River, a 4-mile long tributary of the Taunton River, historically provided habitat and spawning grounds for migratory and resident fish, such as river herring, yellow perch, chain pickerel, American eel, and trout. The river was an active fishing location for native peoples for centuries until their forced removal from the area. At that point, colonists constructed a series of dams, which provided water and power to settlers, but cut off major fish runs. As a result of these obstructions and pollution from upstream manufacturing, a Massachusetts state report declared the river “dead” in terms of alewife population in 1921. In 2005, the decaying Mill River Dams were thrust into the national spotlight when Whittenton Dam nearly failed, forcing thousands of local residents to evacuate their homes and costing the city close to \$1.5 million. Failure of the dam was narrowly avoided in this case, but community and regulatory attention turned toward finding solutions as dam failure may have led to major loss of life and property in downtown Taunton.



LOCATION

Mill River, Massachusetts

RIVER

Mill River

YEAR

Hopewell Mills 2012;
Whittenton 2013;
West Britannia 2018

GOAL

Reduce flooding risk,
Migratory fish passage,
Recreation and habitat
enhancement

TYPE

Complete Removal of two
dams; Reconstruction of one
dam

COST

\$1,574,000 (estimated total)
West Britannia Dam removal:
\$354,420
Whittenton Dam removal:
\$650,435
Morey’s Bridge Dam (dam
reconstruction, fish ladder/
eel ramp installation): \$4.3
million (includes cost of bridge
replacement)

PROJECT PARTNERS

The Nature Conservancy,
NOAA, American Rivers, the
Coastal America Foundation,
the National Oceanic and
Atmospheric Administration,
the Massachusetts Division
of Ecological Restoration,
U.S. Fish & Wildlife Service,
the Massachusetts Division of
Marine Fisheries, Southeastern
Regional Planning and
Economic Development
District, Save the Bay,
USDA-Natural Resources
Conservation Service, MA
Department of Mental
Health, MA Department of
Transportation, Mass Audubon,
Taunton River Watershed
Alliance, Corporate Wetlands
Restoration Program, Acuity
Management and other dam
owners.\

CHALLENGES:

Because multiple dams (West Britannia, Whittenton, and Morey’s Bridge) were involved in this project, each had its own set of challenges.

SOLUTIONS:

In response to the near dam failure, risk posed to the surrounding communities, and an effort to reconnect the area to the Wild and Scenic Taunton River, three dams were removed over a series of years(Hopewell Mills in 2012, Whittenton in 2013, West Britannia in 2018). Morey’s Bridge Dam was left in place, but a fish ladder and eel ramp was installed in 2012 as part of a bridge restoration project through the Department of Transportation.

SUCCESSES:

With a release of natural sediment held back by the dams, the river has begun to restore its natural channel, with increased biodiversity, and recreational access from the Narragansett Bay to the headwaters of

the Mill River. The dam removals and reconstruction restored fish passage to 30 miles of habitat in the Taunton Watershed. River herring and sea lamprey have been reported in the area for the first time in 200 years. The project has also improved recreational access and reduced flooding threat to local communities--and has spurred secondary projects like the Weir Village Riverfront Park, which provides a waterfront walkway, boat ramp, and fishing pier.

LESSONS LEARNED:

The near-failure of the Whittendon Dam highlighted the dangers of neglected historic dams. Repairing the Whittenton Dam alone would have cost an estimated \$1.9 million. The cost of removing the dams, restoring the river, and reducing dangerous hazards was far less costly and provided more beneficial outcomes for local residents

and habitats along this stretch of the Mill River.

The Mill River Dams are a good example of the benefit of taking a “river approach” to addressing dams to improve habitat connectivity. Rather than only repairing or removing the failing Whittenton Dam, the team used the crisis as a catalyst to address multiple decaying dams along the Mill River and as a result were able to improve habitat connectivity along 30 miles of the river.



Vegetation growing in along the restored river edge and paddling the river without obstructions.

REFERENCES and ADDITIONAL RESOURCES

Nature Conservancy: <https://www.nature.org/en-us/about-us/where-we-work/united-states/massachusetts/stories-in-massachusetts/mill-river-restoration/>

MASS DER: <https://www.mass.gov/service-details/mill-river-restoration#:~:text=The%20Hopewell%20Mills%20Dam,constructed%20at%20Morey's%20Bridge%20Dam.>

DAM REMOVAL- PRIORITIZING PUBLIC ACCESS

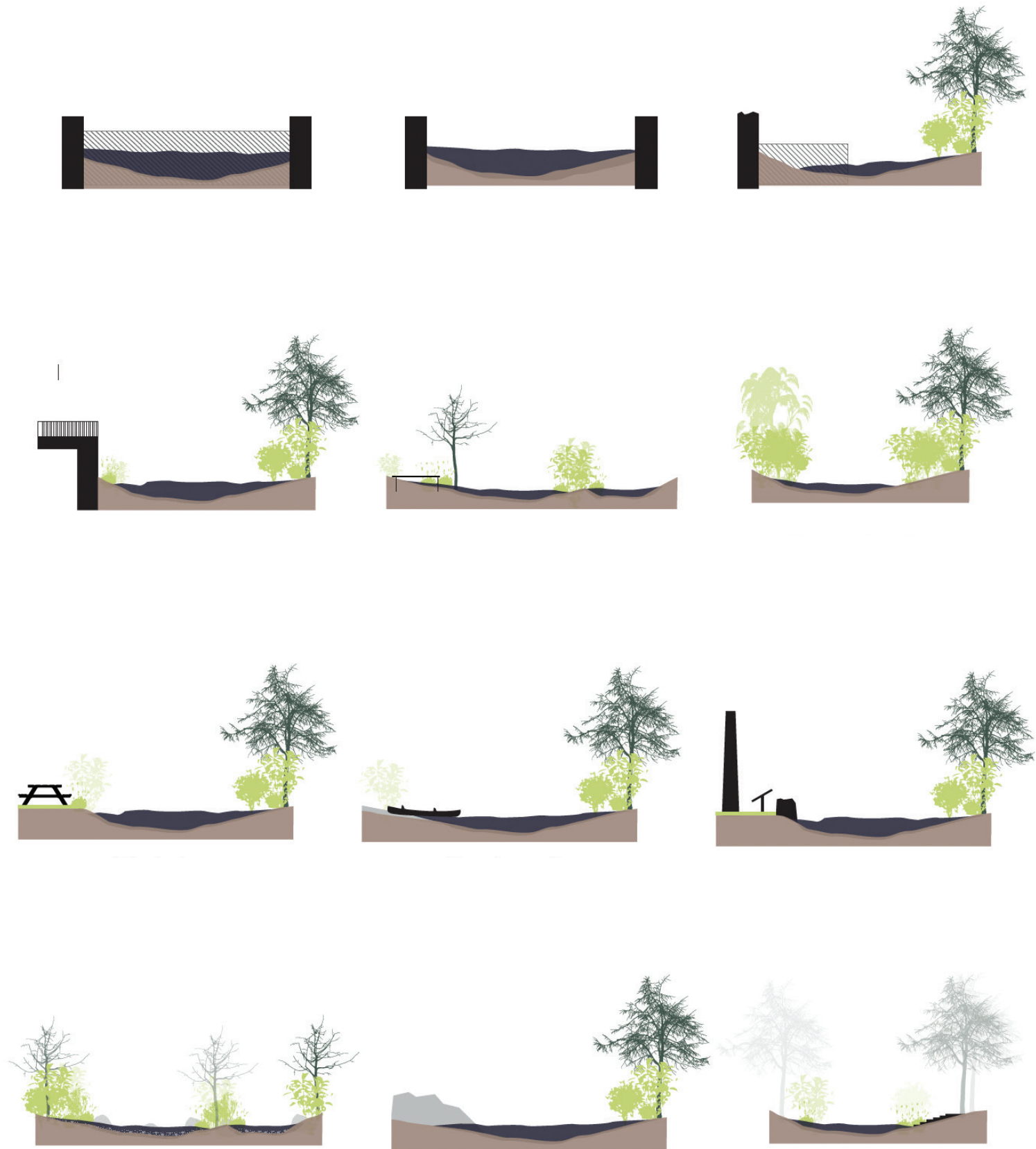
When dams are being considered for removal that are owned by state or local governments, there may be the possibility that removal can provide new public spaces adjacent to the river. These public spaces can provide public access to the river such as new walking trails, boat ramps, or fishing docks and help create or maintain a sense of place even if the landscape is changing. Landscape architects on the project team can work with the community to envision and design the future of public access to the surrounding landscape.

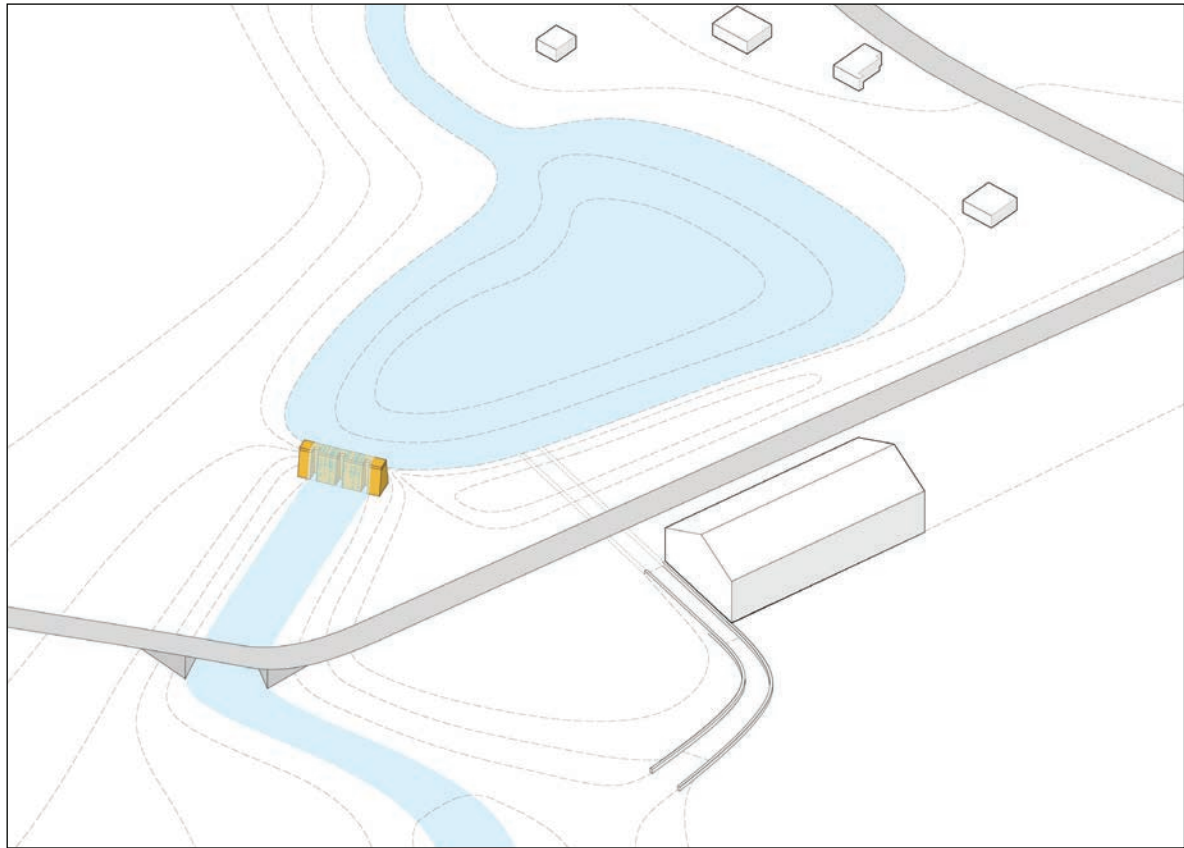
On some sites that are being considered for removal, the dam may be perceived as an important part of the local landscape and cultural history. There are design strategies that can help maintain a sense of place and/or preserve portions of the historic structures while restoring a free-flowing river.

Some examples include:

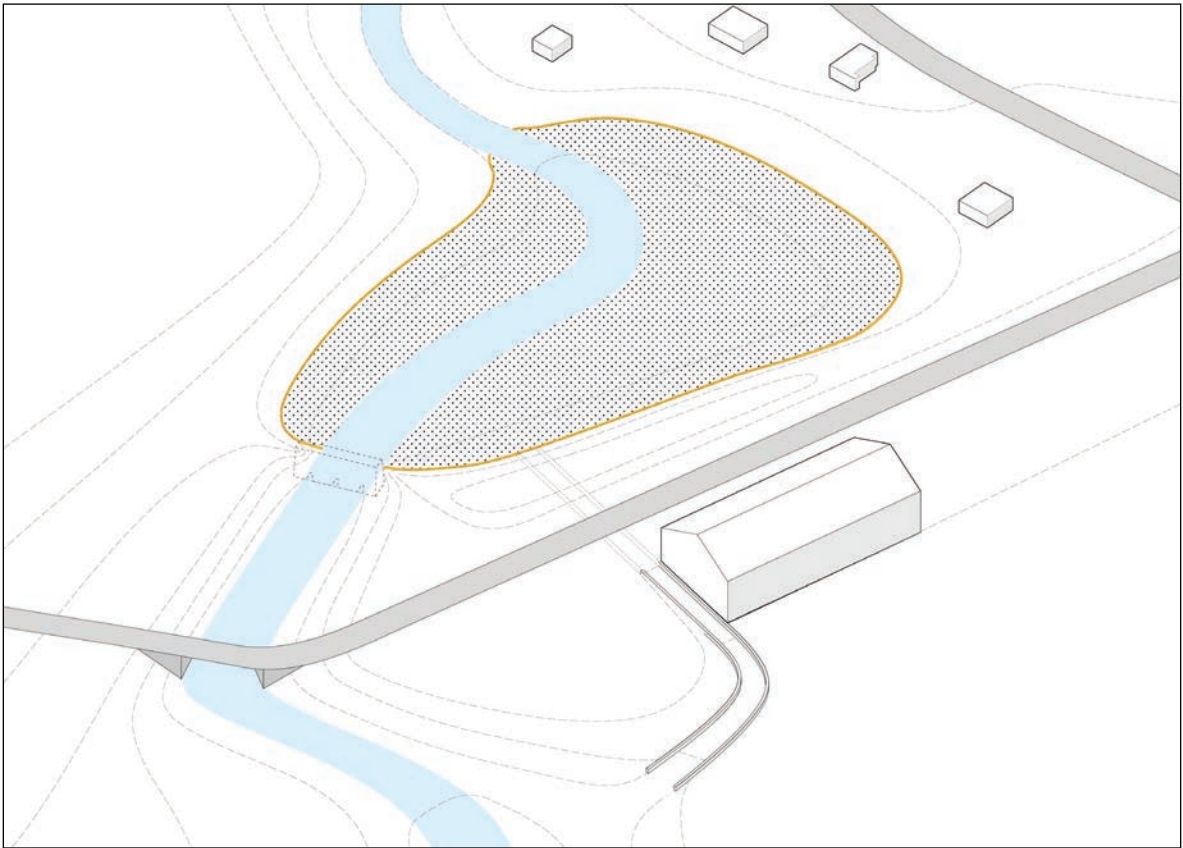
- A portion of the dam structure can be preserved on either side of the river channel to mark the historic location of the dam.
- The location of the dam can be marked with a piece of public art that can tell the history of the dam and site.
- The river can be diverted around the dam, but the structure can be preserved.
- Water features can be added that maintain the acoustic and aesthetics of the waterfall
- The area that was the impoundment can be maintained as a wet meadow to ensure views across the historic impoundment are maintained
- A trail at the historic elevation of the impoundment can be installed to mark its historic location
- Other features can be added that maintain the aesthetics of the dam and public access can be provided in the area surrounding the dam.

On the following pages, speculative ideas for how to design a site post removal are shared through a series of diagrams. In addition, there are a series of case studies where public access was a key aspect of the design.

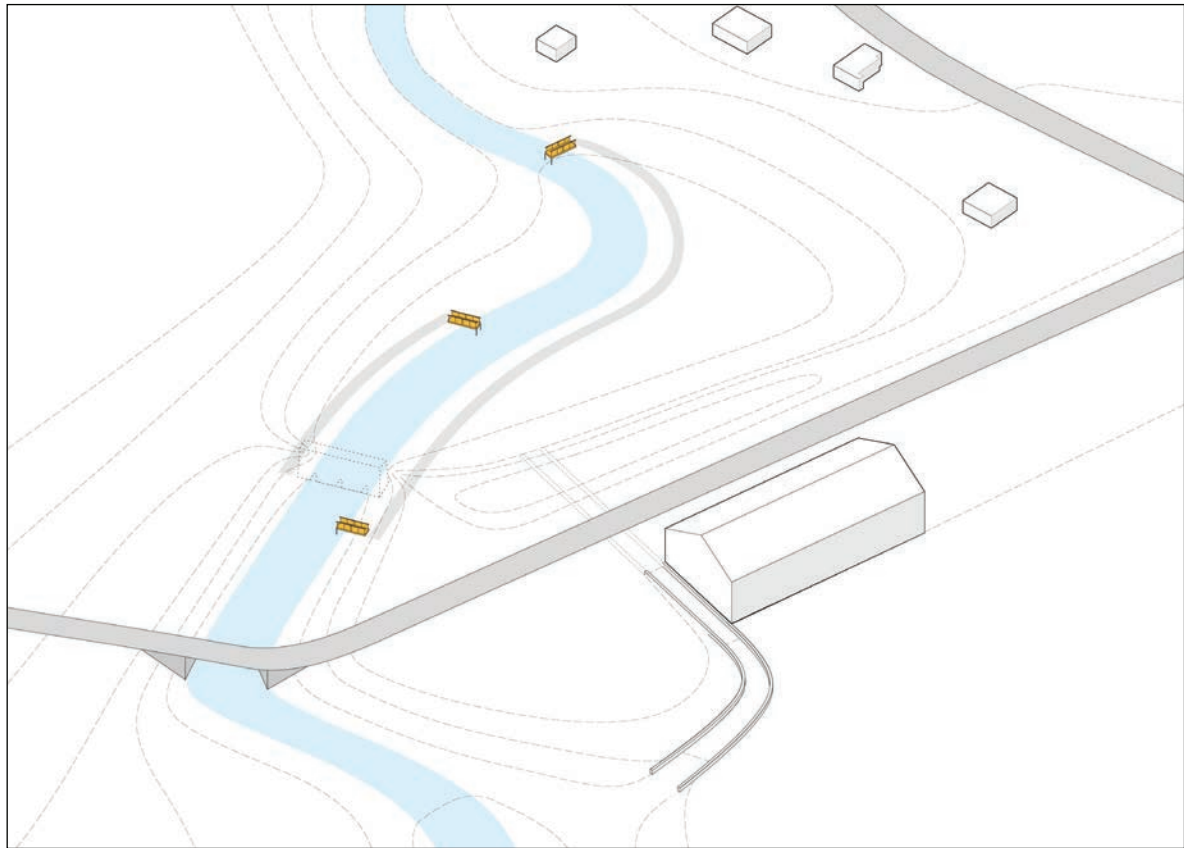




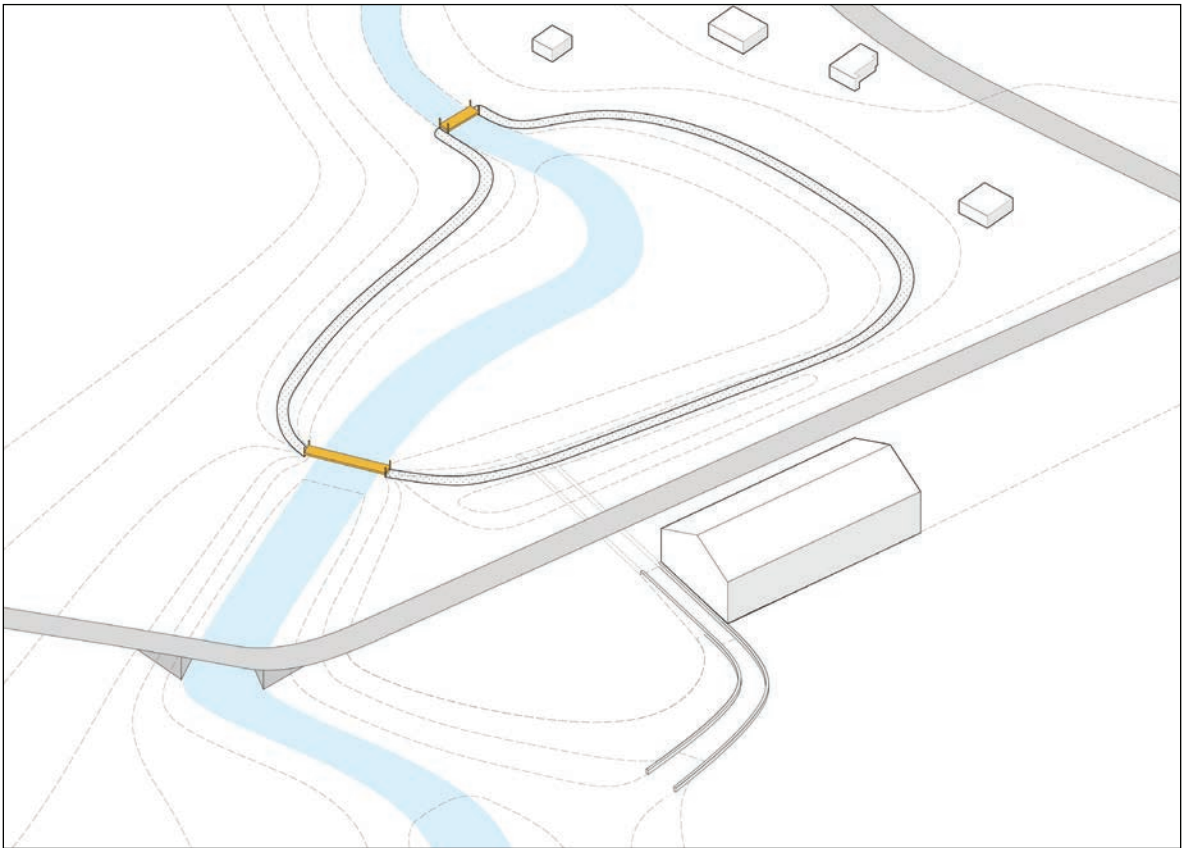
EXISTING CONDITIONS: Diagram of Existing Conditions- Dam and impoundment.



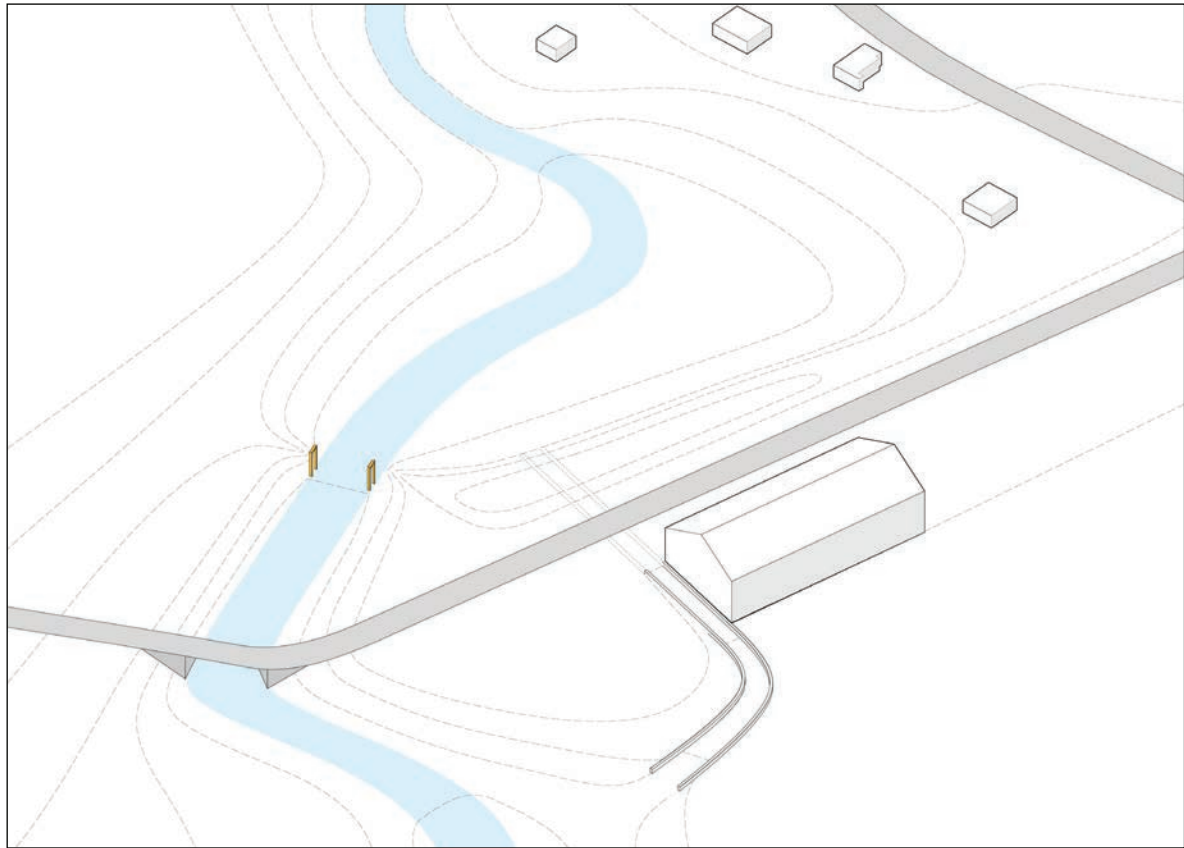
PUBLIC OPEN SPACE: The area that was the impoundment can be a new public space and maintained as a wet meadow to ensure views across the historic impoundment are maintained.



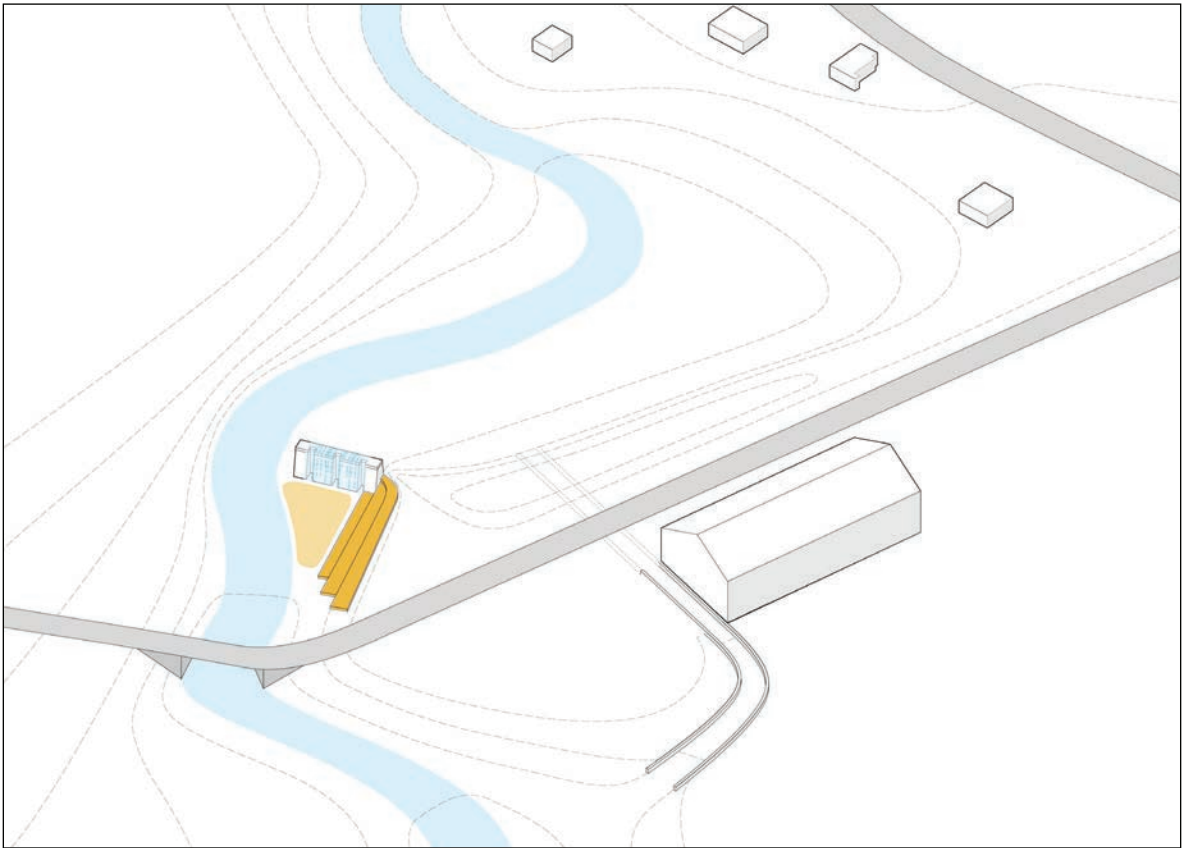
FISHING ACCESS: Fishing docks or rocks can be installed along river to improve fishing access and improve recreation.



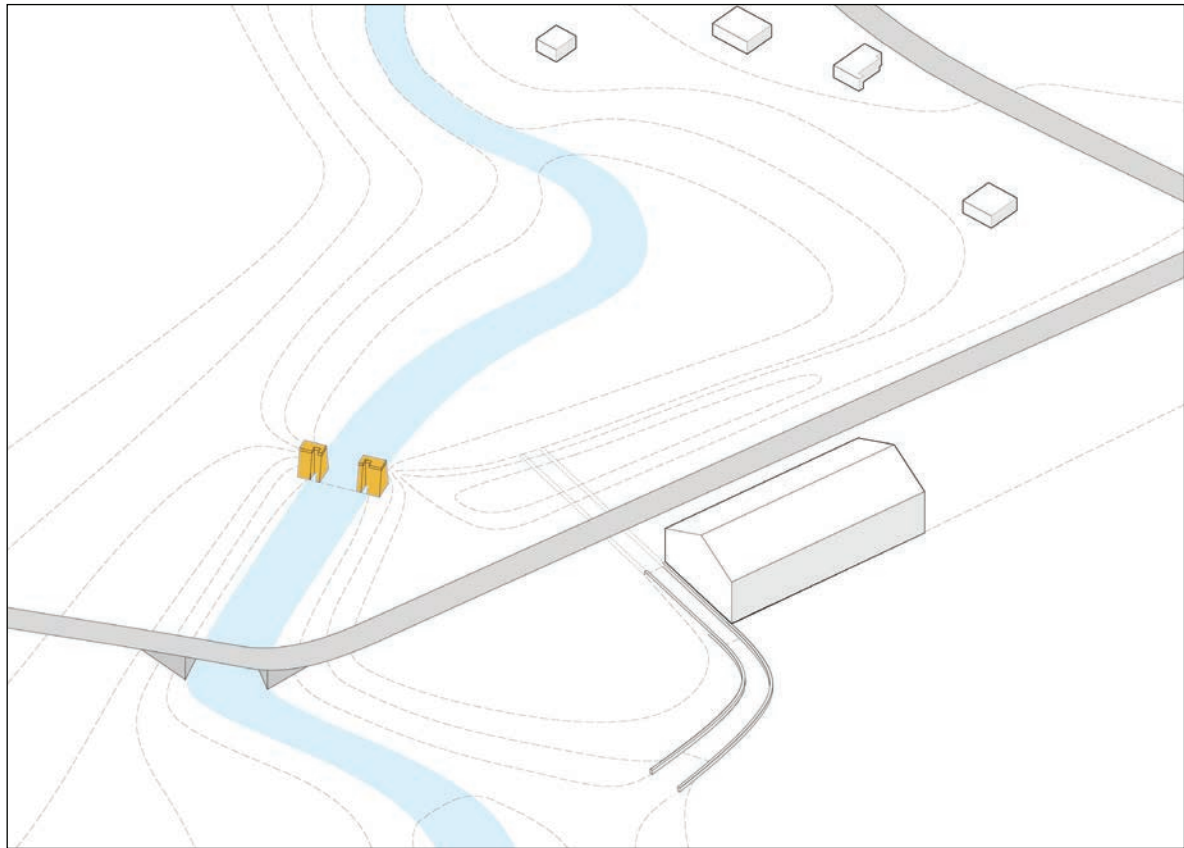
PATHS: Path can mark the location of the historic impoundment or provide trails to access the floodplain.



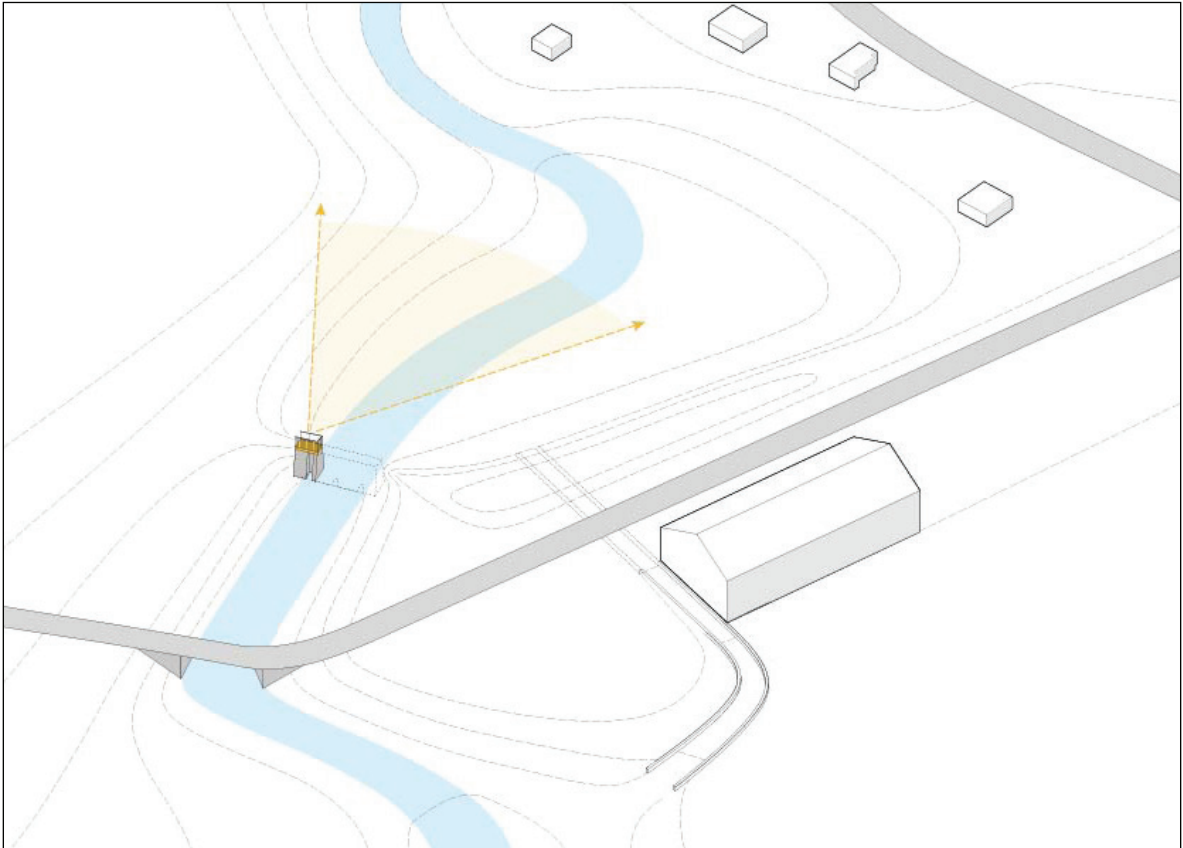
PUBLIC ART: Public Art sculptures can be installed to mark the historic location of the dam.



PUBLIC GATHERING SPACE: River can be diverted around the historic dam. A public gathering space can be constructed adjacent to the historic structure and a water feature installed to maintain the aesthetics of the waterfall.



HISTORIC STRUCTURE: A portion of the dam can remain to mark the historic location and honor the history of the dam.



OVERLOOK: An overlook can be constructed on top of the historic dam structure to provide views of the river.



Rendering showing the possibility of installing public art to mark the location of a removed dam.

KENT DAM AND WATERFALL

PROJECT SUMMARY

Although outside of the Narragansett Bay watershed, the Kent Dam case study is a useful example of a project that provided habitat connectivity, improved water quality, and historic preservation of a dam structure. The Cuyahoga River in Kent, Ohio has been a vital resource for people of the river valley since approximately 9,000 BC--acting as a travel corridor, water supply, and hunting and fishing grounds. The arch-shaped Kent Dam was constructed in 1836 to power various mills in the rapidly-industrializing Kent area. Because it is the oldest masonry dam in Ohio and the second oldest arch-shaped dam attached to a canal lock in the US, it has become an iconic feature of the city. However, after falling into disuse in the early 20th century, it caused dam pool stagnation, obstructed fish passage, and led to other water quality issues. The nation's attention was drawn to the Cuyahoga River in 1970, when industrial and sewage waste caused the river to catch fire. This event, along with others across the country, spurred the adoption of the Clean Water Act, which was passed in 1972 in an effort to "restore the chemical, physical and biological integrity of the nation's waters."



LOCATION
Kent, Ohio

RIVER
Cuyahoga River

YEAR
2005

GOAL
Improved water quality, Historic preservation, Migratory fish passage, Aquatic habitat

TYPE
Partial removal with historic preservation

COST
\$5,013,150

PROJECT PARTNERS
The Ohio EPA; Kent Dam Advisory Committee; The City of Kent.

FUNDING SOURCES
The City of Kent
Ohio EPA WRRSP Grants
Clean Ohio Fund Grant
Ohio Department of Natural Resources Grant
Ohio EPA Section 319 Grant

CHALLENGES:

The stretch of the Cuyahoga River that ran through the defunct Kent Dam was cited for noncompliance with the Clean Water Act by the Ohio EPA for exceeding pollutant concentrations. The EPA informed the City of Kent that they must pursue a modification-removal of the dam or face more stringent permitting limits at the City's Water Reclamation Facility. Because this permitting would be costly to Kent taxpayers and have little benefit to the quality of the river, the City of Kent began the processes of review and public engagement necessary to remove the dam with historic preservation.

SOLUTIONS:

Due to the potential conflict between historical preservationists and environmental advocates, the city created a 19-member Kent Dam Advisory Committee (KDAC). Their goal was to examine feasibility and decision-making pathways by studying factors like applicable laws and regulations, water quality issues, historical significance, and fish migration routes. After several meetings, the KDAC proposed a solution: the removal of a concrete wall that had been placed across the old lock area. This removal would allow water to flow around the arch dam, which would improve water quality and allow fish passage while maintaining the historic arch structure. Tannery Park was constructed surrounding the historic arch dam and a pump circulates water so water continues to flow over the front of the dam.

SUCCESSES:

By removing part of the dam to create a by-pass channel around the arch dam structure, the health of the river was restored without jeopardizing the historical aspect of the dam or interfering with the city's identity. Since the partial removal of the dam, once-stagnant pools that emitted a foul odor are now flowing and allows for migratory fish passage. Dissolved oxygen levels at Kent Dam have improved. Also, the adjacent Tannery Park was expanded to allow increased public access to the historic landmark.

LESSONS LEARNED:

By creating an advisory committee dedicated to research and resolution, the project team was able to reach a solution that met the needs of the environment as well as the citizens of Kent. Because so much national attention was focused on the project,

early involvement spurred the Clean Water Act, strategies of engagement, analysis, and implementation; it even helped to inform similar projects across the country.

The Kent Dam is also a good example of a project that was able to achieve the dual goals of habitat connectivity and historic preservation. By creating a public park at the dam site, the history of the site and sense of place was able to be preserved and possibly enhanced. In addition, by adding a water feature to the arch dam artifact, the aesthetic and acoustic experience of being near a waterfall was preserved.



A water feature was designed and installed to maintain the aesthetics of the water flowing over the dam.

REFERENCES and ADDITIONAL RESOURCES

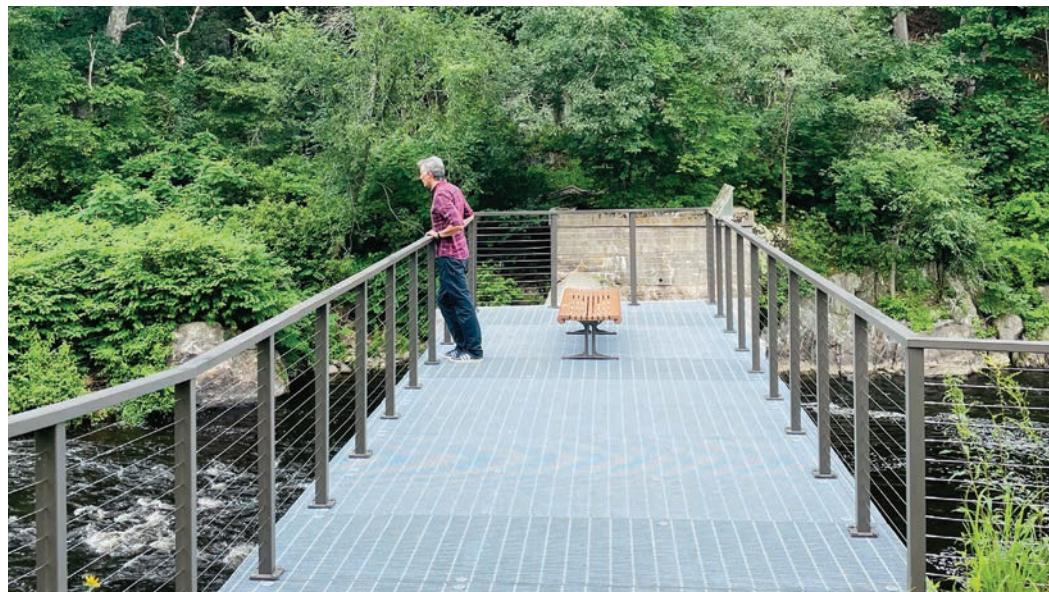
City of Kent: <https://www.kentohio.org/409/Dam-Restoration-Project>

CASE STUDIES - REMOVAL

HEAD TIDE DAM

PROJECT SUMMARY

Although outside of the Narragansett Bay watershed, the High Tide Dam in Alna provides a case study of a partial removal of a dam. The project consisted of the removal of 26 feet of the west side of the dam, the construction of an overlook in its place, construction of a retaining wall at the foundation of an old mill, and the addition of a path to the river. The modification of the Alna dam is the second project in a series of three projects aiming to improve fish passage in the Sheepscot River, improve public safety and access, and honor the history at the individual sites. The first of the three projects, completed in 2018, was the removal of the Coopers Mills Dam in Whitefield upstream of the Head Tide Dam. The third project, at Branch Pond Mill Dam in the town of China, Maine, will stabilize the dam and install a fishway. Together the project aims to improve fish passage on the Sheepscot River which is home to the southernmost genetically unique wild populations of Atlantic salmon remaining as well as 11 other species of migratory species.



LOCATION
Alna, Maine

RIVER
Sheepscot River

YEAR
2019

GOAL
Improve fish passage, enhance public safety and access, and honor the history of individual sites.

TYPE
Partial Removal

COST
\$515,000.

PROJECT PARTNERS
Town of Alna, Atlantic Salmon Federation (ASF), The Nature Conservancy, Midcoast Conservancy, National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service, Maine Department of Marine Resources, Maine Department of Environmental Protection, and the National Fish and Wildlife Foundation.

FUNDING SOURCES
NOAA Community Habitat Restoration Program, US Fish and Wildlife Service, Enbridge Corporation, The Nature Conservancy, Elmina B. Sewall Foundation, Davis Conservation Foundation, Patagonia, Farnsworth Foundation, Trout and Salmon Foundation and others.

CHALLENGES:

The Head Tide Dam was constructed over 250 years ago to power a series of mills in Alna. The Jewett family donated the dam to the town in 1964. One of the main challenges in the project was deciding whether work could proceed due to a covenant in the deed stating the dam could never be destroyed.

SOLUTIONS:

To address the concerns about the legal deed covenant, the decision was made to partially remove the western portion of the dam. The partial dam removal and construction of the overlook platform – which maintained “one contiguous line from shore to shore” – was deemed acceptable by Alna selectmen and legal counsel as complying with the legal deed covenant. In addition, the partial removal maintained a portion of the historic structure as a landmark for the community.

Public access was an important aspect of the redesign of the site. Over the western portion of the river where the dam was removed, an elevated ADA accessible viewing platform was constructed. The viewing platform provided a space for informational signage and a lookout onto the river. By using a grate rather than concrete for the elevated walkway, the project team hoped that it wouldn't deter shad which can be sensitive to passing under concrete. The final design maintained and strengthened recreational opportunities at the site. By maintaining part of the dam, a

swimming hole that has been a popular destination for generations was preserved. In addition, the pedestrian path down to the river provided access to the river and a safe place to put in and take out kayaks and canoes.

SUCCESSES:

The partial removal of the Head Tide Dam is a good example of the ability to think and work creatively to address legal limitations on a project. It also was successful in providing habitat connectivity as well as preserving the historic dam structure that was important to the community.

LESSONS LEARNED:

The partial removal of the Head Tide Dam resulted from a strong team that worked on the project. The restoration team did not go into the community with a preconceived idea of what needed to happen but rather

worked with the community to decide how to improve fish passage and river connectivity.

Just because there are legal challenges or deed restrictions on a dam, doesn't mean that modifications can not be made to a dam. This project highlights the opportunity to think creatively to work through legal challenges and deed restrictions.



View of the steps down to the river and the overlook over the removed portion of the dam.

REFERENCES and ADDITIONAL RESOURCES

<https://atlanticsalmonrestoration.org/projects/magic-on-the-river>

<https://lcnme.com/currentnews/work-starts-at-head-tide-dam-in-alna/>

<https://lcnme.com/currentnews/head-tide-dam-project-a-gift-thats-going-to-outlive-us-all/>

FISH LADDERS

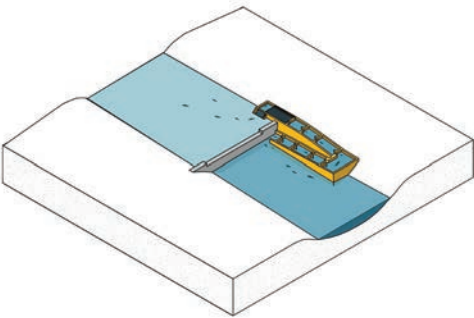
A conventional fishway, commonly nicknamed “fish ladder,” is a structure that is built alongside an existing dam that is intended to provide a corridor for aquatic species to swim up and over the dam barrier, then back down. Conventional fishways may be an option where there is a desire to provide some fish passage without removing the dam. Selecting the most appropriate fishway for a given project will depend upon the slope, budget, flow conditions, and target species.

Those unfamiliar with fish ladders may be surprised at the complexities and challenges that must be overcome for these to function well with a variety of species (e.g., river herring, shad, eels) and life stages (juvenile vs. adult). Fish vary dramatically in their swimming speed, stamina and leaping ability. The slope, turbulence, placement of resting areas and other design features are essential elements. Unfortunately, a “one-size-fits- all” approach with fishways rarely works. In addition, fish seek particular velocities and pathways through a river channel as they move upstream. If the entrance placement and water flow out of a fish ladder does not match preferred conditions, migrating fish will not use the ladder and can mass in huge numbers at the base of a dam – negating the entire fish ladder. The design of fish ladders that will accommodate multiple fish species and life stages is not yet a mature science and many fish ladders require costly alterations after construction.

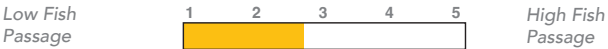
If a dam has received a letter of deficiency, the dam would need to be repaired prior to constructing the fishway. In addition to this upfront cost, this scenario requires long-term maintenance of the dam and the fishway. Conventional fishways vary in cost, aesthetics, and performance depending on the design and dam structure. They are not inexpensive and frequently cost upwards of half a million dollars.

There are 3 general types of conventional fishways found within Narragansett Bay Watershed: Denil fishway, Alaskan steeppass fishway and Weir and Pool fishways.

TECHNICAL FISH LADDERS



FISH PASSAGE UP AND DOWN STREAM



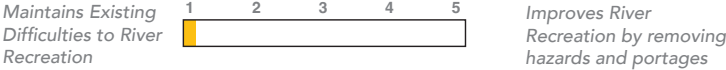
UPSTREAM WATER LEVELS



RECREATION ON THE IMPOUNDMENT



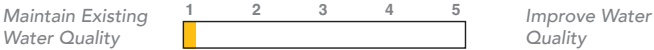
RECREATION ON THE RIVER



VISIBILITY OF DAM



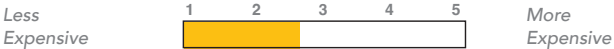
WATER QUALITY



RISK OF DAM FAILURE



UP-FRONT COST



LONG-TERM COST AND MAINTENANCE



HORSESHOE FALLS DAM

PROJECT SUMMARY

Located in Shannock Village on the Upper Pawcatuck River, the Horseshoe Falls Dam was built around 1759. The last working mill burned down in 1856, but the dam remained and repairs were made over the years. Rich in both cultural and historical value and located in a well-populated area, the dam was not a good candidate for complete or even partial removal, as the site is well known and appreciated for its aesthetic value. In 2010, the community and the local stakeholders decided to build a Denil fishway and eel passage structure. The Horseshoe Falls fish ladder installation was part of a comprehensive project that opened fish passage through seven dams along the Pawcatuck River.



LOCATION

Charlestown/Richmond, RI

RIVER

Pawcatuck River

YEAR

2010

GOAL

Migratory fish passage + historic preservation

TYPE

Denil Fishway

COST

\$628,469

PROJECT PARTNERS

Wood Pawcatuck Watershed Association; Kenyon Industries, Inc; Town of Charlestown; Trout Unlimited; United States Fish and Wildlife Service; RI Coastal Resources Management Council; RI Department of Environmental Management; National Oceanic and Atmospheric Administration; Save the Bay; Richmond Conservation Commission; Town of Charlestown; USDA Natural Resources Conservation Service; American Rivers; Fuss and O'Neill; and Narragansett Bay Estuary Program.

CHALLENGES:

Removal of the dam was challenged as the Horseshoe Falls Dam was a local landmark widely appreciated for its scenic beauty. It is the only horseshoe-shaped falls in Rhode Island. Many perceive Horseshoe Falls Dam as an historically significant part of the state's industrial heritage.

SOLUTIONS:

Due to the dam's scenic beauty and historical importance, the restoration project required sustained outreach to ensure all stakeholders were heard and all interests were met. An elaborate state of the art Denil fishway was

designed to allow alewife and eel passage. To ensure the fishway did not look out of place, engineers shaped the exterior of the fishway to match the stones of the original mill foundation on the opposite bank.

SUCCESSES:

This project was able to meet the dual objectives of improving fish passage and the preservation of the historic arch dam structure.

LESSONS LEARNED:

The Horseshoe Falls Dam fishway project demonstrates that there is room for flexibility in discussions

between dam removal and historic preservation. Creative alternatives can achieve project goals like fish passage without compromising the aesthetic of a cherished landmark.



The fishway at Horseshoe falls was designed to match the stonework of the historic mill foundation.

REFERENCES and ADDITIONAL RESOURCES

Wood Pawcatuck Watershed Association's presentation: <http://www.wpwa.org/documents/WPWA%20Horseshoe%20Presentation.pdf>

MANTON MILL POND DAM

PROJECT SUMMARY

The Woonasquatucket River has been designated an “American Heritage River” by the U.S. Environmental Protection Agency (EPA) for its legacy of use for food and energy before and during the Industrial Revolution. Since the 1990’s, the Woonasquatucket River Watershed Council has been working to restore the health of the river and provide access and recreation opportunities for the surrounding community. This work has included the restoration of dams within the river as well as upgrades to a Greenway network that runs adjacent to the river. The fishway installed at Manton Mill Pond Dam is the fifth in a series of dam removal and fish passage projects along the lowest stretch of the Woonasquatucket River.



LOCATION

Providence, Rhode Island

RIVER

Woonasquatucket River

YEAR

2016

GOAL

Migratory fish passage, Public art, Education

TYPE

Denil Fishway

COST

\$492,000

PROJECT PARTNERS

Woonasquatucket River Watershed Council (WRWC), Rhode Island Department of Environmental Management (DEM), Rhode Island Coastal Resources Management Council (CRMC), EA Engineering, U.S. Department of Agriculture (USDA), Preferred Equipment Resource.

CHALLENGES :

The dam is a concrete run-of-river dam. Located downstream of the Centredale Manor Superfund site in North Providence, the Manton Mill dam accumulated toxic sediment (dioxins) from chemical production that took place from the 1940s-1970s. Because these pollutants are persistent, dam removal could pose danger to communities and habitats downstream. Therefore, the decision was made to add a fish ladder rather than remove the dam.

SOLUTIONS :

Before construction of the fishway could begin, areas of toxic, dioxin-impacted sediment were removed from the site. The fishway was designed with S-shaped concrete walls with a series of

pools and weirs that allow for upstream migration.

SUCSESSES :

Completed in 2016, the new fishway was designed to allow up to 40,000 herring to migrate upstream each year. The S-shaped fishway allows other project goals to be met as well; public art pieces were incorporated into its concrete surface and it is an ideal location to observe the spring fish migration. Local schools have begun to use the new fishway as an educational tool--bringing students to the Woonasquatucket to teach them about habitat restoration.

LESSONS LEARNED :

Because dams within New England were typically constructed to support

industrial activities, toxic sediment accumulation behind a dam is a common concern. In order to mitigate the potential impact of dam removal releasing toxic sediments downstream, it is often necessary to keep the dam when contaminated sediments are present.



The S-shape structure provided the elevation change needed between the pond and river below dam.

REFERENCES and ADDITIONAL RESOURCES

Woonasquatucket River Watershed Council: <https://wrwc.org/wp/what-we-do/restoration/fish-passages/>

GILBERT STEWART DAM

PROJECT SUMMARY

Gilbert Stuart Stream is the largest freshwater tributary to the Narrow River, which empties into the Narragansett Bay. For over a century, a small dam located at the historic home of artist Gilbert Stuart has impeded the passage of migratory river herring, who travel up the Narrow River via Gilbert Stuart Stream and into Carrs Pond to spawn. In the 1960's, Rhode Island's Division of Fish and Wildlife installed an Alaskan steeppass fish ladder that allowed thousands of migrating river herring to pass to Carrs Pond.



LOCATION

North Kingstown, RI

RIVER

Gilbert Stuart Stream / Narrow River

YEAR

1960's (fish ladder),
2021 (picket weir)

GOAL

Migratory fish passage

TYPE

Alaskan steeppass fishway

PROJECT PARTNERS

Gilbert Stuart Birthplace & Museum, Rhode Island Division of Fish and Wildlife (1960's fish ladder) The Nature Conservancy, the RI Department of Environmental Management (DEM), Horace and Ella Kimball Foundation, Narragansett Improvement and Preservation Foundation, Rhode Island Saltwater Anglers (picket weir).

CHALLENGES:

Although the 1960's fish ladder allowed herring to pass to Carrs Pond above the dam, a junction that led to a mill race frequently attracted and confused the fish, forcing them to choose the wrong path. If the herring turned into the mill run instead of the fishway, they were prone to becoming trapped and ultimately dying.

SOLUTIONS:

The Gilbert Stuart Museum was able to maintain the character of the historic dam by implementing a barrier that would allow water, but not fish, to pass through the mill run. The blocking structure, known as a picket weir, resembles a picket fence and is aesthetically consistent with the historic character of the surrounding property. This picket weir is a novel alternative to the Department of Environmental Management's practice of using temporary plastic fencing, which can be visually distracting and prone to failure during high flow.

SUCCESSES:

In recent years, between 30,000 and 100,000 herring may be seen migrating up the Gilbert Stuart fish ladder. The Gilbert Stuart Birthplace & Museum hosts an annual spring fair, where visitors are encouraged to watch the herring run from trails and bridges, as well as via an underwater camera stream. The Shady Lea Mill dam, situated above Carrs Pond on the Mattatuxet River, was designated as a "high hazard" and was removed in 2018. This subsequent project opened an additional ½ mile of river to the herring, eels, and trout.



The Alaska steeppass is a prefabricated, modular style of Denil fish ladder.

REFERENCES and ADDITIONAL RESOURCES

Narrow River Preservation Association: <https://narrowriver.org/river-herring/>

OLIVER MILLS (MUTTOCK) DAM

PROJECT SUMMARY

The Nemasket River supports the largest and longest herring run in Massachusetts. The herring make the yearly 40-mile journey from Mount Hope Bay through the Taunton and Nemasket River to the Assawompset Pond Complex to spawn. Members of the Wampanoag Tribe built weirs to catch migrating herring each spring in a village at Muttock (now Oliver Mills area). In 1734, the weirs were replaced by a dam, which was used to power iron works, grist, and saw mills serving the colony of Middleborough until it was abandoned in the 1870s. Throughout this period, the site remained an active fish run, with highly organized yearly efforts to catch and distribute the passing herring, which were cooked and distributed at the nearby community herring house. The Oliver Mills dam is the first of three dams on the Nemasket River between the undammed Wild and Scenic Taunton river and the valuable spawning grounds of the Assawompset Pond Complex.



Pool an weir fishway constructed at Oliver Mills.

LOCATION

Middleborough, MA

RIVER

Nemasket River

YEAR

1982

GOAL

Migratory fish passage

TYPE

Pool and Weir Fishway

COST

Unknown

PROJECT PARTNERS

Massachusetts Division of Marine Fisheries.

CHALLENGES :

The mill and dam remained in a state of abandonment until the 1960's, when Oliver Mill Park was opened surrounding the dam and historic industrial ruins. Herring populations in the Nemasket River declined dramatically during this time, with a mysterious die-off event in 1965. Low water levels and invasive plants exacerbated the issue and prompted proposals to reestablish fish passage on the river.

SOLUTIONS :

The fishways at Oliver Mill were initiated by an effort to restore the ecological and cultural heritage of the Nemasket River. During the 1960's and 1970's the site was partially restored for recreation, fish passage, and to preserve the industrial archeological site. During this time, two stone fish ways were installed. In 1982, the Massachusetts Division of Marine Fisheries built a new stone and concrete notched weir-pool fishway. In 1996 the Middleborough-Lakeville Herring Fishery Commission was created to administer and enforce herring harvest regulations, maintain and enhance herring habitat, and public education on the herring run.

SUCCESSES + LESSONS LEARNED :

The Nemasket River is relatively short (11.2 miles) with only 3 dams between the ocean and the 1,721 acres of prime spawning grounds of the Assawompset Ponds. Taking a whole river approach, fishways have been constructed at all three dams, allowing fish passage into the ponds. In 2013, almost one million

herring were able to pass through the fishway at Oliver Mill to spawn in Assawompset Pond!

The communities of Middleborough and Lakeville have been shaped by the abundance of herring in the Nemasket River. In addition to the ecological value of the annual hearing run, it is also an important social and cultural event. Community support to preserve the yearly fish run helped to spur the restoration of the river and the fish migration. Since 2013, local and state Cultural Councils and the Middleborough Tourism Committee have hosted the Annual Herring Run festival to bring the community together to celebrate the fishrun. These celebrations help to reinforce the relationship between the community and the herring, ensuring the herring remain an important part of the local identity and helping to spur continued

stewardship and involvement in preserving and improving the annual fish runs.

This case study is also an example of how a fishway can be integrated into a public park to achieve multiple objectives. With the creation of the Oliver Mill Park, the project was able to achieve the shared goals of improving fish passage, providing recreation, and preserving history. The fishways are integrated into the design of the park allowing the fishruns to be highly visible. Oliver Mill park provides paths for visitors to see the historic stone mill ruins and bridges that cross the multiple river channels and allow visitors to see the herring run below. In 2000, Oliver Mill Park was listed on the National Register of Historic Places as the Muttock Historic and Archeological District.



The fishway at Oliver Mills is integrated into the design of a public park.

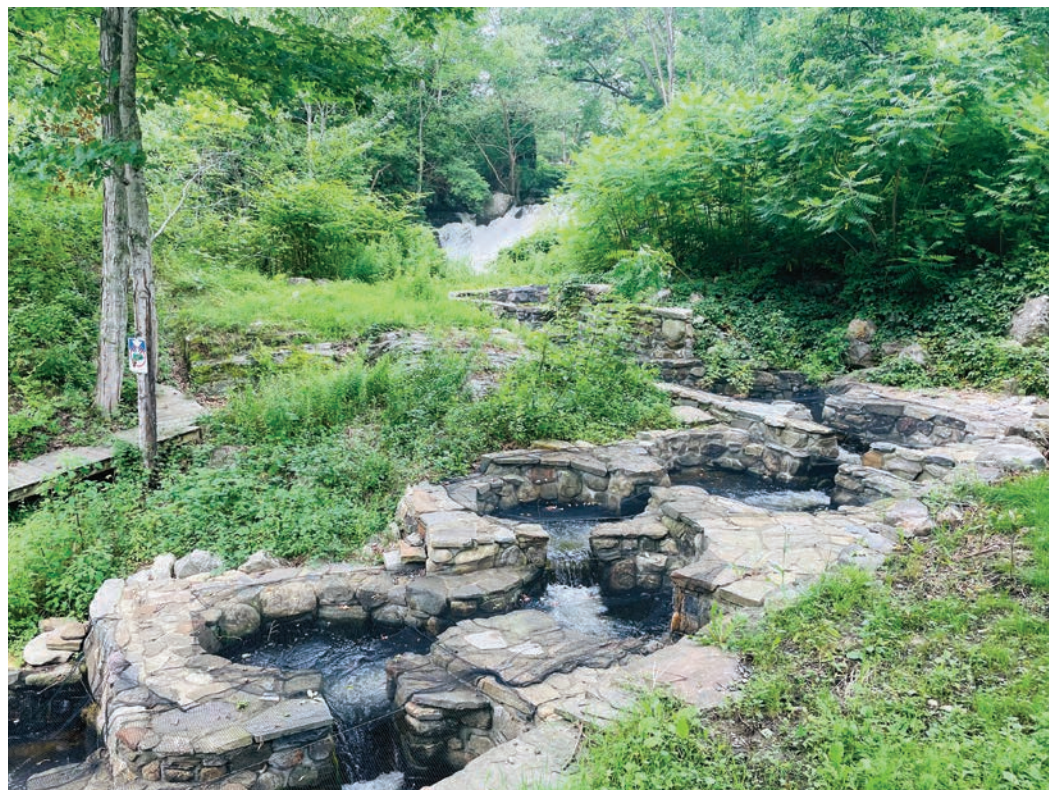
REFERENCES and ADDITIONAL RESOURCES

CASE STUDIES - FISH LADDER

DAMARISCOTTA MILLS

PROJECT SUMMARY

Although outside of the Narragansett Bay watershed, the Damariscotta Mills provides a unique case study of a fish ladder. In Algonquian, the name Damariscotta means “place of an abundance of alewives.” However, in 1729, a double sawmill was constructed at the falls between fresh water Damariscotta lake and the tidal headwaters of the Damariscotta river. The dams blocked the annual alewife migration. In 1741, the legislature called for fish passage at Damariscotta mills, but it wasn’t until 1807 that the towns built the new “stream” to bypass the dam. In 2007, after two centuries of use, a restoration project was initiated by a strong community group working with the Towns of Nobleboro and Newcastle and the Nobleboro Historical Society to restore the deteriorating fish ladders.



LOCATION

Nobleboro, Maine

RIVER

Damariscotta River

YEAR

Originally constructed in 1807 and then restored and rebuilt and restored between 2007-2017

GOAL

Fish passage

TYPE

Pool and Weir Fishway

COST

Restoration cost over \$1,000,000

PROJECT PARTNERS

Towns of Nobleboro and Newcastle, the Nobleboro Historical Society, US Fish and Wildlife Service, Maine Department of Marine Resources, and the involvement of many community members.

CHALLENGES:

The original fish ladder was a series of small pools connected by short passages that raised over 42 feet from the bay to the impoundment. The fish ladder worked well for about 180 years but its stonework and the underlying concrete deteriorated as ice dislodged stones and blocked the path for the fish. By the 1990s, the fish ladder was in very poor condition, and fish count plummeted to less than 200,000.

SOLUTIONS:

With strong community organizing, and fundraising, the reconstruction of the fish ladder began in 2007. The redesign and reconstruction of the fish ladder is similar to that of the original, consisting of a series of 69 ascending pools connected by weirs, or short waterfall passageways that each rise 8-10 inches. The reconstruction took over 10 years and could only take place from November - April to avoid spawning season. In April every year, the construction team had to stop so the ladder could be used for the spring migration. The renovated ladder winds 1,500 feet up the hill and was reconstructed using the original stones and designed to weave around mature trees that shade the pools.

The lower pools are publicly accessible and include a boardwalk and signage. The upper portions snake through residential backyards before reaching the lake.

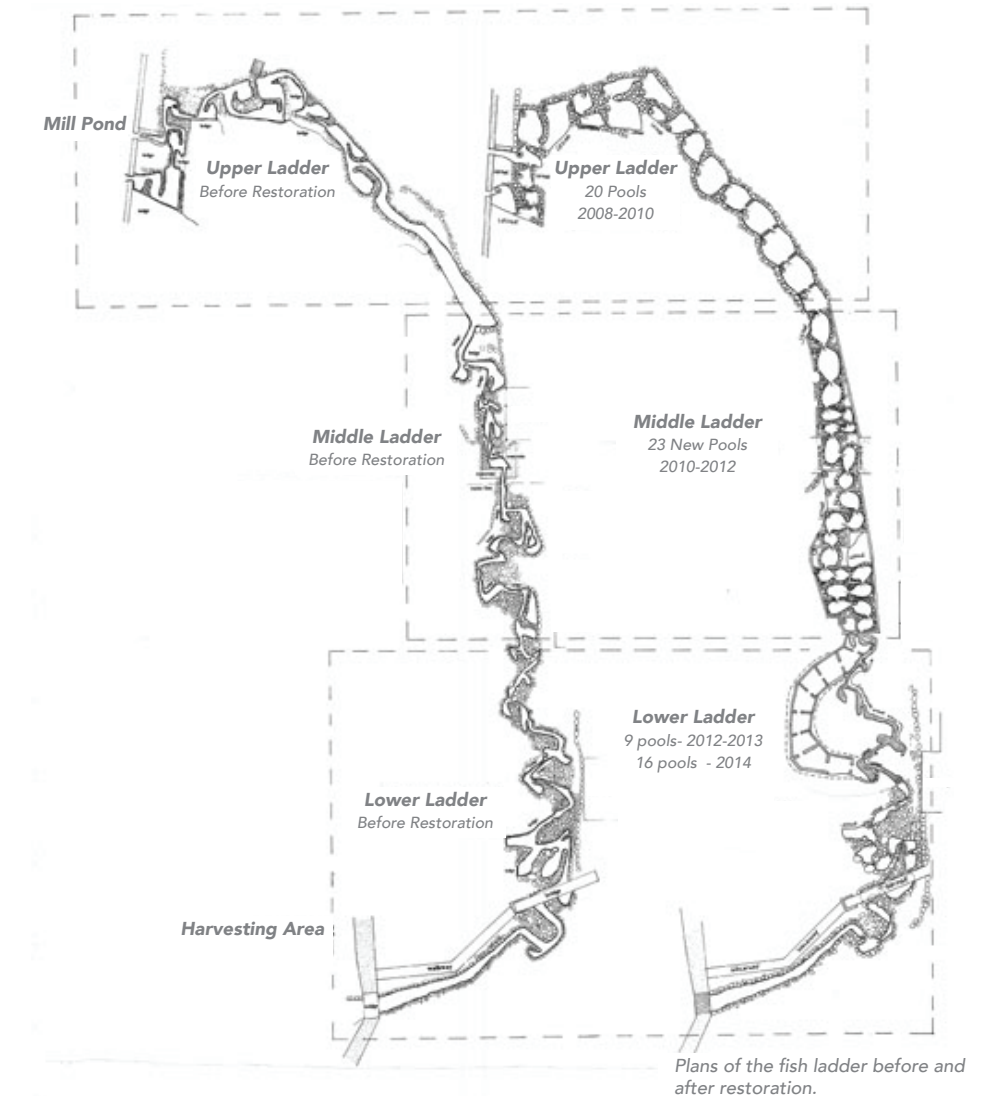
At the lower end of the pools, a set of “dippers” and troughs, allow for the towns to harvest alewife. The harvested

alewives are used primarily as lobster bait however a few bushels are smoked and sold for human consumption. All funds received for harvested alewives are spent to maintain and restore the fish ladder and harvesting area.

SUCCESSES:

Following the restoration, more than one million alewives pass up the fish ladder to spawn each spring making the Damariscotta river one of Maine’s oldest and most productive alewife fisheries.

Community support has been key to the restoration of the fish ladders. An annual Herring festival took place from 2007 until the pandemic and helped raise funds and support for the restoration. Currently the community group is raising funds to replace the boardwalk and foot bridges. Volunteers are present at the Fish Ladder on May weekends to welcome visitors, and sell tee shirts caps and other Fish Ladder. In addition, fundraising takes place at community events such as a silent auctions, an annual “Alewife run” and concerts.



REFERENCES and ADDITIONAL RESOURCES

<https://damariscottamills.org/>

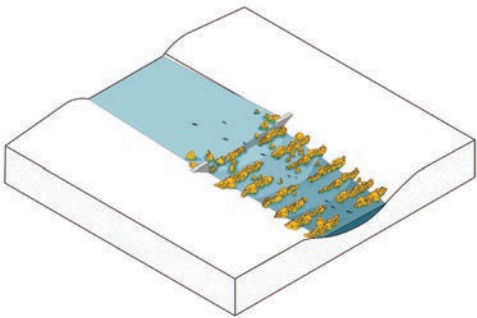
<https://www.atlasobscura.com/articles/fish-ladder-maine-lobster-industry>

NATURE-LIKE FISHWAYS RIVER WIDE

A nature-like fishway resembles a natural river with a series of pools and riffles. It consists of a wide, low-gradient channel that is constructed with rocks and boulders that are gradually terraced to make up the height difference between the below-dam and above-dam elevation. Boulders in the channel create multiple pathways that vary in length and velocity to allow multiple fish species to swim upstream. Because nature-like fishways are wide and gradual channels, they also provide improved fish habitat connectivity up and downstream. Nature-like fishways may be suitable for low height obstructions, where upstream water level control is not essential, and if there is a need or desire to preserve the upstream impoundment due to recreation, well water, contaminants or habitat. Nature-like fishways vary in cost, aesthetics, and performance depending on the design and dam structure

River-Wide Nature Like Fishways - In this scenario, the river downstream of the dam is gradually raised to the elevation of the dam across the whole river channel through a series of rock/pools. Because the fishway spans the whole width of the river channel, the dam is no longer visible. In this scenario, there needs to be sufficient space downstream to build up the channel gradually to the height of the dam. Frequently, the dam is partially lowered to reduce the elevation the downstream channel has to be raised. In addition to full width nature-like fishways, there is an option for partial width fishways that only extend across a portion of the river width.

NATURE-LIKE FISHWAY



FISH PASSAGE UP AND DOWN STREAM



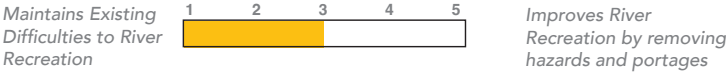
UPSTREAM WATER LEVELS



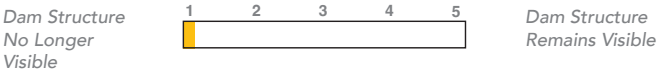
RECREATION ON THE IMPOUNDMENT



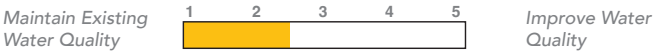
RECREATION ON THE RIVER



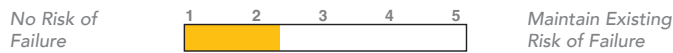
VISIBILITY OF DAM



WATER QUALITY



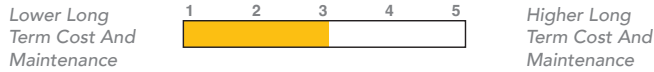
RISK OF DAM FAILURE



UP-FRONT COST



LONG-TERM COST AND MAINTENANCE



KENYON MILL DAM

PROJECT SUMMARY

Located on the Upper Pawcatuck River in Rhode Island, Kenyon Mill was built around 1772. The privately-owned mill houses and Kenyon Industries, a fabric producer housed in the historic mill building, once used the impoundment created by the dam to retain water for possible fire suppression. By 2010, the dam had fallen into disrepair and had a partial breach at the end of its spillway. This work was part of a comprehensive project that opened fish passage through seven dams along the Pawcatuck River.



LOCATION
Richmond, Rhode Island

RIVER
Pawcatuck River

YEAR
2013

GOAL
Migratory fish passage

TYPE
River Wide Nature Like Fishway

COST
\$1,124,322

PROJECT PARTNERS
Wood Pawcatuck Watershed Association; Kenyon Industries, Inc.; Town of Richmond; Trout Unlimited; United States Fish and Wildlife Service; RI Coastal Resources Management Council; RI Department of Environmental Management; National Oceanic and Atmospheric Administration; Save the Bay; Richmond Conservation Commission; USDA Natural Resources Conservation Service; American Rivers; and Narragansett Bay Estuary Program.

CHALLENGES :
The neighboring community did not support full dam removal due to concerns about the impacts of lowered water levels on residential wells upstream. In addition, Kenyon Mills owned the dam and was willing to have it removed, but needed the impoundment for fire suppression.

SOLUTIONS:
Construction crews implemented a partial dam removal and installed a rock ramp, or nature-like fishway spanning the full width of the river channel. The dam height was lowered and a rock ramp was constructed to create the riffles and flow necessary

to sustain fish passage with a gradual incline in elevation.

SUCCESSES:
Creating a nature-like fishway provided fish passage while allowing for the impoundment to remain upstream, providing water for fire suppression and ensuring that the upstream wells would not lose drinking water. In addition, during low flow, the rock ramps provide diverse habitat along the river's edge.



The Kenyon Mills Nature Like Fishway created pockets of wetland habitat between the weirs.

REFERENCES and ADDITIONAL RESOURCES

Wood Pawcatuck Watershed Association's presentation: [http://www.wpwa.org/documents/KenyonPublicPresentation%20\(3\).pdf](http://www.wpwa.org/documents/KenyonPublicPresentation%20(3).pdf)

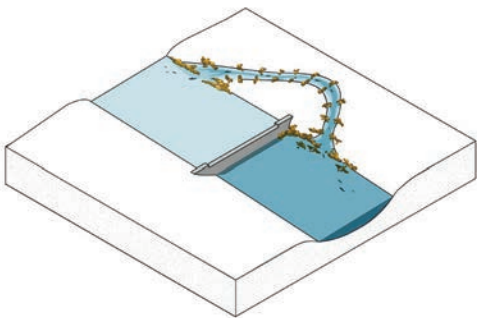
Turek, J., A. Haro, and B. Towler (2016). Federal Interagency Nature-like Fishway Passage Design Guidelines for Atlantic Coast Diadromous Fishes. Interagency Technical Memorandum.

NATURE-LIKE FISHWAYS BYPASS CHANNEL

A nature-like fishway resembles a natural river with a series of pools and riffles. It consists of a wide, low-gradient channel that is constructed with rocks and boulders that are gradually terraced to make up the height difference between the below-dam and above-dam elevation. Boulders in the channel create multiple pathways that vary in length and velocity to allow multiple fish species to swim upstream. Because nature-like fishways are wide and gradual channels, they also provide improved fish habitat connectivity up and downstream. Nature-like fishways may be suitable for low height obstructions, where upstream water level control is not essential, and if there is a need or desire to preserve the upstream impoundment due to recreation, well water, contaminants or habitat. Nature-like fishways vary in cost, aesthetics, and performance depending on the design and dam structure

Bypass Nature-Like Fishways - In this scenario, a new channel is constructed to bypass the dam and connect the river upstream of the dam to the river downstream of the dam. This alternative requires that there is land adjacent to the dam where a channel can be excavated and graded using the rock/pool strategy. It is a good alternative to consider if the dam is a historic structure or there is the desire to protect views of the dam structure itself. If a dam has received a letter of deficiency, the dam would need to be repaired prior to constructing a by-pass channel. In addition to this upfront cost, this alternative requires long-term maintenance.

BYPASS CHANNEL



FISH PASSAGE UP AND DOWN STREAM



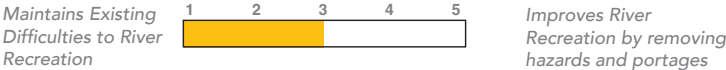
UPSTREAM WATER LEVELS



RECREATION ON THE IMPOUNDMENT



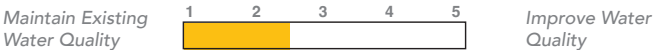
RECREATION ON THE RIVER



VISIBILITY OF DAM



WATER QUALITY



RISK OF DAM FAILURE



UP-FRONT COST



LONG-TERM COST AND MAINTENANCE



HOWLAND DAM BYPASS CHANNEL

PROJECT SUMMARY

Although outside of the Narragansett Bay watershed, the Howland Dam case study is a good example of a nature-like bypass channel. The Penobscot River Restoration Project was a decades-long effort to restore migratory fish passage while maintaining hydropower within Maine's largest watershed. In order to reconnect the Lower Piscataquis River to the Upper Penobscot River, various dams needed to be altered or removed to accommodate passage. In 2012, the Great Works dam was removed at the head of tide, followed by the 2013 removal of the Veazie Dam, and 2014 installation of a fish lift at Milford Dam. The Howland Dam would become the final obstacle in the effort to reconnect the two rivers.



LOCATION

Howland, Maine

RIVER

Piscataquis River

YEAR

2016

GOAL

Migratory fish passage,
Maintain hydropower

TYPE

Bypass- Nature Like Fishway

COST

~\$4.8 million

PROJECT PARTNERS

Penobscot River Restoration Trust, Penobscot Indian Nation, Atlantic Salmon Federation, The Nature Conservancy, American Rivers, Natural Resources Council of Maine, Maine Audubon, Maine Department of Marine Resources, Maine Department of Inland Fisheries and Wildlife, Maine Department of Environmental Protection, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Kleinschmidt, Inter-Fluve.

FUNDING SOURCES

50/50 by government grants and private donations

CHALLENGES:

Because the Howland, Great Works, and Veazie Dams once generated hydroelectric power, production would need to be shifted elsewhere. The river also experienced dramatic variations in flow, necessitating careful monitoring of volume and velocity to prevent flooding.

SOLUTIONS:

The project team ensured that hydroelectric energy production could continue by strategically decommissioning the existing facilities and implementing system upgrades at six other sites. These upgrades resulted in as much hydropower production as before the dam removals. A nature-like bypass channel was designed to

resemble a natural stream, reflecting ideal conditions for migratory species. In order to re-grade the sloped site into a channel, bedrock was blasted and strategically placed throughout the stream bed to create roughness and water perturbation critical to the health of migrating fish.

SUCCESSES:

This project was the first large-scale natural fish passage channel of its kind, allowing for a restored Salmon run up the Penobscot River. Its complex construction accommodates a wide range of flow volumes and velocities. Overall, the Penobscot River Restoration Project restored nearly 2,000 miles of historic river habitat.



REFERENCES and ADDITIONAL RESOURCES

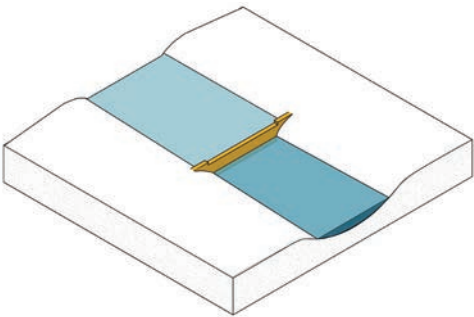
PENOBSCOT RIVER RESTORATION TRUST: <https://www.nrcm.org/wp-content/uploads/2016/06/Howlandbypassfacts.pdf>

REPAIRING THE DAM

For social, economic, and/or environmental reasons, keeping and repairing a dam is sometimes the option selected for a dam and its community. Some reasons a dam may be preserved include: the presence of contaminated sediment behind a dam; the dam is listed on the national registry of historic places; rare or endangered species are found in the upstream impoundment; and there are multiple dams downstream that block fish passage. Depending on the location of the dam within the watershed and the importance of fish passage, repairs to the dam can be combined with other fish passage structures. For example, if a dam is located in the headwaters (upstream) where anadromous fish passage is not a priority and where the cost of providing fish passage is very expensive, the decision may be made to just repair the dam. However, if the dam is located close to where the river meets the ocean and providing fish passage is a priority but removal is not possible, the dam may be repaired and a fish passage structure may be added. If the decision is made to keep a dam, structural deficiencies must be addressed through repairs and future inspection and maintenance needs to be factored into cost estimates.

With dam repair, the structure of the dam would remain and the existing surrounding ecology would be unaffected. However, unless fish passage structures are added, there would be no fish passage or habitat connectivity above this dam. And while this may be one of the least expensive alternatives in the short term, this alternative requires long-term maintenance so cost over time needs to be considered.

REPAIRING THE DAM



FISH PASSAGE UP AND DOWN STREAM



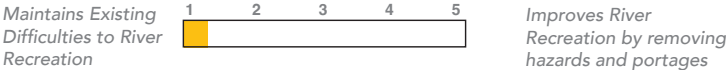
UPSTREAM WATER LEVELS



RECREATION ON THE IMPOUNDMENT



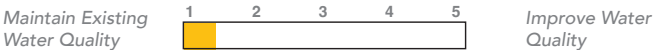
RECREATION ON THE RIVER



VISIBILITY OF DAM



WATER QUALITY



RISK OF DAM FAILURE



UP-FRONT COST



LONG-TERM COST AND MAINTENANCE



SECTION 03

MAKING DECISIONS



There are many reasons a decision may need to be made about the future of a dam. A dam may have received a letter of deficiency and require repair. Community members may wish to restore fish passage to the river. A dam owner may no longer be able to maintain the structure. Or there may be growing concerns about water quality, which can be compromised by the presence of a dam.

Many factors influence how a final decision is made. Depending on the ownership, use, and location of the dam—as well as the nature of the community—each decision-making process will look different. The extent to which a community can participate depends largely on whether the dam is privately or publicly owned. In either case, reaching a decision can take time and almost always requires patience. This is why it is important to consider community priorities before a deadline or crisis forces a decision—whether that is applying for a grant or responding to a storm that threatens the integrity of a dam.

This section of the Dam Atlas presents a method developed by a team of researchers at the Rhode Island School of Design (RISD) in collaboration with colleagues from the National Science Foundation funded Future of Dams project. The approach combines elements of design charrettes with Structured Decision Making (SDM) to support inclusive and transparent decision processes.

The following materials are open source and are made available for public use in the hope of improving how communities are engaged in decisions about dams. Our goal is to strengthen communities' ability to work together to find creative solutions that address the often competing needs of rivers and dams. There are many ways to involve communities in conversations about dams, and this document and website are intended to encourage the sharing of methods. Others are invited to use, test, and adapt these tools—and to share their own methods and experiences in return.

INTRODUCTION TO THE APPROACH

Decisions about aging dams in New England can be contentious. While removing legacy dams may make sense from an ecological, economic, or safety perspective, a 2016 study found that more than 50 dams identified for potential removal in the region had been stalled or delayed due to community opposition¹. In many cases, this resistance is rooted in a perceived threat to a cherished local landscape—a favorite swimming hole, a familiar landmark, an element of the town’s history and identity. In others, disagreement arises from differing views of which version of “nature”—the upland wetlands formed by an impoundment or the free-flowing river and restored aquatic connectivity—should be preserved or prioritized.

Too often, the decision-making process itself has been flawed—driven by what community members perceive as a top-down approach—and has resulted in more divisive discussions about the future of a dam. Researchers have found that when outside “experts” from state agencies or nonprofits play a leading role, community members often feel ignored or excluded from decisions about their own local resources². In some circumstances, local residents have expressed the belief that outside agencies arrived with the intent and resources to remove a dam regardless of community perspectives. These power dynamics have been identified as one of the key factors undermining community-engaged restoration efforts.

Limitations of Current Methods

Town hall-style meetings and public hearings remain the most common form of public engagement around dams. These meetings are intended to share information and provide opportunities for the public to express their views. Sometimes they are run by a trained, neutral facilitator; more often, they are organized and led by local officials, conservation commissions, engineers, or environmental organizations that already favor dam removal.

Depending on the level of local interest or apathy, such meetings can easily be driven by strong voices on either side of the debate. The microphone often is dominated by those most comfortable speaking in public—leaving quieter or

more moderate participants unheard. This dynamic discourages dialogue and can result in discussions that are less balanced, or even misleadingly one-sided.

Stakeholders today have access to a growing number of decision-support tools designed to guide choices about the future of dams. However, most of these tools are intended for town officials, agency staff, or others operating in an “official” capacity rather than for community members. While they can be effective at prioritizing projects based on scientific data and analysis, they often fail to integrate the social values and lived experiences that matter most to local residents—such as history, sense of place, and aesthetic or spiritual relationships to the river.

EXPLORING NEW METHODS

One of the most effective ways to incorporate social and cultural dimensions into a river restoration project is by facilitating direct community participation throughout the planning process. Community-engaged restoration can provide multiple benefits, including:

- Sharing insights into local social, ethical, and political values
- Creating shared opportunities for social learning
- Building broader acceptance, legitimacy, and long-term support for the planning process and its outcomes

Although there is growing consensus on the importance of involving citizens early in restoration planning, there remains little clarity about how this should happen or what form it should take.

Our work draws on landscape architecture, a field increasingly committed to creating meaningful opportunities for public participation in design decisions. By combining methods from Structured Decision Making (SDM) and collaborative design charrettes, we developed an interdisciplinary, workshop-based approach to support more inclusive and creative community engagement around dams.

STRUCTURED DECISION MAKING

Structured Decision Making (SDM) provides a systematic and collaborative framework for making complex environmental decisions—one that incorporates both values and facts³. This approach is grounded in the idea that there are no single “right” decisions. Rather than prescribing an outcome, SDM helps participants make informed, transparent choices through shared understanding. It provides a structure for talking, learning, and reasoning together about the facts and values that shape a decision.

Below is an outline of the key steps in the SDM process. However, in practice, the process is rarely linear. New information or perspectives may emerge at any stage, prompting participants to revisit earlier phases, such as re-framing the problem, refining objectives, or reconsidering alternatives.

The methods described here are adapted from *Structured Decision Making: A Practical Guide to Environmental Management Choices*, an excellent resource for anyone interested in applying this approach to community or environmental projects.

STEPS IN PROCESS	UNDERLYING QUESTION	EXAMPLE in the context of dam decisions
1. Problem Framing	What is the context for (scope and bounds of) the decision?	- Single dam - Whole river approach
2. Determining Objectives	What objectives and performance measures will be used to identify and evaluate the alternatives?	- Improve fish passage - Increase recreational opportunities - Reduce flooding
3. Identifying Alternatives	What are the alternative actions or strategies under consideration?	- Do nothing - Remove dam - Nature-like fishway - Technical fishway
4. Estimating Consequences	What are the expected consequences of these actions or strategies?	50% improved fish passage 80 summer days when the river would be passable by canoe
5. Evaluating Trade-offs	What are the key trade-offs?	Trade-off between fish passage and hydropower
6. Deciding And Taking Actions	Who are the decision makers? How can the decision be implemented in a way that promotes learning over time?	- Citizen science - Ongoing stewardship

TABLE 1: Steps in the Structured Decision Making framework (Modified from Gregory et al. 2012)

DESIGN CHARRETTES

Design charrettes are collaborative workshops commonly used in architecture, landscape architecture, and urban planning to involve community members directly in the design process. Like environmental decision-making, design fields continue to grapple with questions of inclusion and power. Charrettes aim to democratize design by inviting the public to help shape ideas, envision alternatives, and contribute local knowledge⁴.

Designers use a range of visual and graphic tools—maps, renderings, models, diagrams, and plans—to communicate ideas and test possible futures. These tools make abstract decisions more tangible and help participants visualize the physical and ecological consequences of different choices. Before a charrette, facilitators prepare interactive materials and exercises that encourage participation and creative thinking, ensuring that community members are not simply responding to finished proposals but actively contributing to the envisioning of a site.

HYBRID APPROACH

While SDM provides a robust framework for environmental decision-making, it was originally designed for small groups of 5–25 stakeholders—such as representatives from agencies, tribes, NGOs, and utility companies—rather than for large public audiences. Design charrettes, by contrast, offer valuable guidance on how to organize large public meetings and how to use visual tools that help participants understand and discuss alternatives. However, they provide little direction on how to evaluate trade-offs or reach a final decision.

By merging SDM with the participatory methods of design charrettes, the strengths of each address the limitations of the other. By integrating these two frameworks, the approach outlined in this document provides both a clear process for decision-making and practical guidance for engaging the public, enabling communities to work collaboratively toward decisions that reflect both ecological and cultural values.

APPROACH	BENEFITS	LIMITS
STRUCTURED DECISION MAKING	- Clearly defined process for coming to a decision - Transparent, systematic process for evaluating alternatives and trade-offs based on shared objectives and performance measures.	Limited guidance on how to engage the public in decision making
CHARRETTES	- Provide effective models for organizing and facilitating large public workshops - Use of visual tools to help participants understand complexity of dam and to visualize alternatives	Often more open-ended design process without clear guidance on how to evaluate alternatives and make a final decision.

TABLE 2: Benefits and limitations to the Structured Decision Making process and Charrettes that lend themselves to a hybrid approach



REFERENCES and ADDITIONAL RESOURCES

1. Fox, C. A., F. J. Magilligan, and C. S. Sneddon. 2016. "You kill the dam, you are killing a part of me": dam removal and the environmental politics of river restoration. *Geoforum* 70:93–104.
2. Johnson, S. and Graber, B.E. 2002. Enlisting the Social Sciences in Decisions about Dam Removal. *Bioscience* 52 (8), 731–738.

REFERENCES and ADDITIONAL RESOURCES

3. Gregory, R., Failing, L., Harstone, M., Long, G., McDaniels, T.L., & Ohlson, D.W. 2012. *Structured Decision Making: A Practical Guide to Environmental Management Choices*. Wiley-Blackwell, Chichester, U.K.
4. Lennertz, B., Lutzenhiser, A., & Duany, A. (2017). *The Charrette HANDBOOK: The Essential Guide to Design-Based Public Involvement* (2nd ed.). Routledge. <https://doi.org/10.4324/9781351179263>

UNDERLYING PRINCIPLES

These principles are drawn from lessons learned through running workshops and are intended to foster more inclusive, transparent, and collaborative decision-making. Even if the Structured Decision Making (SDM) framework outlined in this document is not used, these principles can still help guide the development of a more effective and equitable process—one that balances technical, ecological, and social considerations.

Respect Local Values and Perspectives

Scientific information can inform decisions, but it cannot be their sole basis. Community preferences are shaped by scientific, moral, and ethical values. Many dam projects have failed when proponents ignored social concerns that mattered most to residents. Successful processes acknowledge and honor local values, ensuring participants feel heard. Value-based objectives may not be quantifiable but should be documented and considered alongside scientific objectives.

Neutral Facilitation and Structured Dialogue

Creating space for dialogue and shared understanding requires neutral facilitation. A third-party facilitator helps balance power dynamics and guides participants through a transparent exploration of alternatives rather than steering toward a single outcome. Small-group discussions allow all voices to be heard, encourage mutual respect, and promote negotiation grounded in listening and learning.

Shift from Positions to Interests

Positions center outcomes—such as “keep” or “remove” the dam—while interests represent the motivations behind them, like safety, habitat, or heritage. Focusing on interests instead of fixed positions fosters collaboration and problem-solving. By framing discussions around shared interests, communities can uncover creative solutions that satisfy multiple objectives rather than reinforcing polarized debate.

Build Shared Objectives

Developing shared objectives is foundational to collaboration. Participants can often agree on common goals even when personal priorities differ. Agreement doesn’t require everyone to hold or value each objective equally—it requires recognizing them as legitimate. Establishing shared objectives builds trust, empathy, and understanding, enabling groups to move from small agreements toward resolving complex, value-driven decisions.

Explore a Range of Alternatives

Smaller dams often offer multiple potential solutions that achieve overlapping objectives. Options such as partial removal or nature-like fishways may cost more but can help broaden conversations beyond what might be perceived as binary options of keeping or removing a dam. Exploring a range of alternatives encourages creative problem-solving and helps participants balance ecological, historical, and aesthetic trade-offs through collaborative negotiation.

Foster Learning through Accessible and Visual Information

An informed public is essential to sound decision-making. Complex technical studies should be translated into clear, accessible language and visuals. Maps, diagrams, and renderings help participants see relationships and trade-offs that numbers alone cannot convey, building shared understanding and supporting inclusive dialogue.

Ensure Transparent Evaluation of Alternatives

The SDM framework enables a transparent comparison of alternatives based on how well each meets the project objectives. Participants may weigh objectives differently, but the decision matrix allows those differences to be seen and discussed openly. Transparency about values and trade-offs supports trust and accountability in the final decision.

WHO SHOULD BE INVOLVED?

Who participates in decision-making about a dam will vary depending on ownership, geography, funding, and the motivation for action. When a dam is owned by a local, state, or federal agency, there is both a greater obligation and increased opportunity for community input. For privately owned dams, the extent of community involvement will depend on the specific context and the owner's willingness to collaborate and to consider community concerns.

We suggest that four key groups participate in this work. Their involvement can inform one another at various stages of the decision-making process:

PROJECT TEAM

The project team consists of the consultants and professionals supporting the decision-making process. This may include engineers conducting hydrology and hydraulics (H&H) studies to assess the effects of dam removal on flow, or feasibility studies exploring design alternatives. Ecologists may analyze the impacts of alternatives on migratory fish and wetland habitats. Landscape architects can study how proposed changes affect the recreational, spatial, and aesthetic landscape, and help the public visualize how access and use might evolve if the dam is removed. The team may also include local environmental planning agencies helping to manage the project. A neutral third-party facilitator is strongly recommended—someone who does not have a stake in the outcome and can remain impartial throughout the process.

STEERING COMMITTEE

The steering committee should include key local stakeholders who represent diverse interests in the project. Members might include representatives from local, state, and federal agencies; local tribes; river advocacy organizations; nonprofits; community organizations; and historical societies. The steering committee should encompass voices able to speak to all the major dimensions of a dam decision. This group works closely with the project team to guide both the process and content, ensuring that multiple perspectives are represented and that the outcomes are grounded in community context.

PUBLIC

When planning outreach, it is helpful to distinguish between two main categories of the public:

- **The broader public**, whose interests in the dam and river may be rooted in recreation, heritage, ecology, spirituality, or civic identity but whose property will not be directly physically or financially impacted by the decision.
- **Directly affected stakeholders**, such as adjacent property owners or business owners whose properties, access, or economic interests may be directly impacted by the decision.

The level of involvement from the general public will vary widely from project to project. Contentious dam decisions—especially those involving highly visible or historically significant structures—often draw greater participation than less controversial ones. However, even well-attended public meetings typically represent only a small segment of the population, often skewed toward those with the time, resources, and confidence to participate—such as older, wealthier, or more formally educated residents.

Recognizing these limitations, the project team should make a concerted effort to reach a broader and more diverse audience. A multi pronged approach might combine structured workshops, like those described in this guide, with more accessible forms of outreach—pop-up events, local business partnerships, collaborations with schools and community groups—to ensure that a wider range of voices and values are represented in discussions about the river's future.

ADJACENT PROPERTY OWNERS

When planning outreach, it is essential to engage directly with property owners and businesses whose land or operations may be financially or physically affected by the decision. These stakeholders have a tangible connection to the dam and its surrounding landscape and are often among the most vocal and influential participants in the process. Building relationships early can prevent misunderstandings, reduce resistance, and cultivate trust.

For directly affected property owners, the project team should prioritize individual or small-group meetings early in the process, well before public workshops or hearings. Early, face-to-face conversations allow for open and transparent discussion about potential impacts, help identify specific concerns or data needs, and can prevent misinformation or mistrust from spreading later.

In past projects, when property owners have felt excluded or caught off guard, frustration has sometimes led to the formation of organized opposition groups. Taking the time to engage adjacent property owners early—listening carefully to their concerns and explaining the process clearly—can reduce conflict and build shared understanding from the outset.

Who Should Attend These Meetings

Meetings with directly affected property owners should be attended by a small team that includes:

- A project lead or facilitator familiar with the goals and process of the project.
- A technical expert (such as an engineer or hydrologist) who can speak clearly about the site conditions, potential changes, and safety concerns.
- A local liaison who understands local context and can help ensure conversations remain respectful and productive. This could be someone from the steering committee or a local municipal representative (such as a conservation agent, planner, or public works staff person).

How to Reach Out

Outreach should begin before public meetings and well before alternatives are finalized. Property owners should hear about the project directly from the team—not through rumors or media. Common approaches include:

- Personal letters or emails introducing the project and offering a meeting. Letters should include clear contact information, a short project overview, and an invitation for one-on-one discussion.
- Phone calls or door-to-door introductions can be effective in smaller communities, especially when conducted by a trusted local figure or project partner.
- In municipalities where property records are public, tax assessor databases or GIS parcel maps can be used to identify and contact owners of adjacent or upstream/downstream properties.

How to Conduct the Meeting

Meetings should be informal, ideally at the property owner's home, dam site, business, or a neutral local location. The purpose is to listen as much as to inform. Key steps include:

- Explaining the purpose of the project and the steps of the process.
- Communicate to the property owner that a range of options, including but not limited to removal, are being considered for the future of the dam
- Provide visual materials such as aerial maps, photos, or diagrams to help ground the discussion in the specific site context.
- Ask open-ended questions: "What concerns do you have about potential changes to the river and dam?" or "What do you value most about this place?"
- Take notes on concerns and values—these can help shape project objectives and communication strategies later in the process.
- If uncertainties exist (for example, about potential changes to water levels or access), acknowledge them honestly and describe how the project team plans to address them through studies or further analysis.

Follow-Up

After each conversation, send a short summary of what was discussed, along with contact information and next steps. Continue to keep these property owners informed throughout the process. Maintaining open communication helps ensure that directly affected residents feel heard and respected—even if they disagree with the final outcome.

WHO IS THE DECISION MAKER?

Ultimately, the decision about the future of a dam—whether to repair, modify, or remove it—rests with the owner of the dam. In New England, dams may be privately owned, municipally owned, owned by state or federal agencies, or by corporations, utilities, or water districts. In some cases the dam owner is unknown. While state and federal permitting agencies have regulatory authority over the environmental and engineering aspects of any proposed action, they do not determine whether a dam should stay or go; rather, they review, approve, or condition proposals put forward by the owner. Understanding who owns the dam and how that ownership structure makes decisions is essential to planning meaningful public engagement.

Publicly Owned Dams

When a dam is publicly owned—by a municipality, water district, or state agency—the final decision about its future is made through established public-governance procedures. Decisions about public infrastructure such as dams generally require both technical evaluation and formal authorization by an elected body, often following public meetings, staff recommendations, and engineering reports. In the case of municipal ownership, the governing body, such as a select board, town council, city council, or board of public works, typically make the formal decision about whether to repair, remove, or modify the structure. Once a decision is made, the municipality carries out the necessary next steps, including securing funding, contracting, and completing required permit filings.

Common practices and constraints:

Governance Body Authority: In many New England municipalities, a select board (in towns) or city council (in cities) has authority over municipal property decisions, including infrastructure. They may vote to authorize a dam project (repair, removal, or modification), allocate funding, or delegate the task to a department (of public works or engineering, for example).

Charter or Bylaw Dependence: The municipal charter, bylaws, or town meeting structure can influence who has authority—some municipalities require town meeting votes (in addition to a select board vote) for large capital projects.

Department and Staff Role: Before the governing vote, the municipal public works, engineering, or conservation departments typically develop or contract out assessments, feasibility studies, cost estimates, and proposals to present to the governing body.

Public Input: Municipal governing bodies often hold public hearings or solicit public comments before approving significant infrastructure changes, especially for controversial or costly projects like dam removal. This may be mandated by local laws or expected by practice. Some past municipal projects have been subject to town meeting votes or appropriations votes to approve removal, modification, or maintenance funding for a dam.

Privately Owned Dams

For privately owned dams, the owner ultimately decides whether to pursue removal, modification, or repair. That decision can only proceed if all required local, state, and federal permits are obtained. These permitting steps create formal opportunities for public input, which can influence the design, conditions, or even the feasibility of the proposed action. In some cases, private dam owners actively seek public involvement. In others, owners may prefer to move forward with their chosen course of action regardless of public concerns or preferences.

Although private owners are not legally required to engage the public in discussions about the dam’s future, there are still several key points in the permitting process where public participation is built into regulatory review. These include public notices, comment periods, and hearings associated with wetlands, water quality, and federal permitting processes, each offering opportunities for community members to voice concerns or provide input that can shape final outcomes. Early, well-documented participation is most effective, particularly during scoping, wetlands hearings, and environmental review windows. See the permitting section later in the document for more information about the permitting process.

Key Public Input Opportunities – Massachusetts

- Massachusetts Wetlands Protection Act (WPA): Local Conservation Commission holds a public hearing on the Notice of Intent (NOI).
- Massachusetts Environmental Policy Act (MEPA): If triggered, public comments are accepted on the Environmental Notification Form (ENF) and/or Environmental Impact Report (EIR).
- 401 Water Quality Certification (Massachusetts Department of Environmental Protection – MassDEP): Requires public notice and a defined comment period.
- Massachusetts Public Waterfront Act (Chapter 91 Waterways): Public notice and, where applicable, a hearing for work in tidelands or Great Ponds.
- United States Army Corps of Engineers (USACE) – Clean Water Act Section 404 / Rivers and Harbors Act Section 10: Public Notice and approximately 30-day comment period for Individual Permits.
- Section 106 of the National Historic Preservation Act (Historic/Cultural Review): Public participation occurs when a federal project may affect historic or cultural properties.

Key Public Input Opportunities – Rhode Island

- Rhode Island Department of Environmental Management (RIDEM) – Freshwater Wetlands: Public notice and comment period.
- Rhode Island Coastal Resources Management Council (CRMC) – Assent: Public notice issued; formal objections can trigger a public hearing before the Council or a subcommittee.

- 401 Water Quality Certification (Rhode Island Department of Environmental Management – RIDEM): Public notice and comment period when required.
- United States Army Corps of Engineers (USACE) – Clean Water Act Section 404 / Rivers and Harbors Act Section 10: Public Notice and approximately 30-day comment period for Individual Permits.
- Dam Safety Program (RIDEM): Constituent reports or public concerns can prompt inspections or enforcement actions relevant to project decisions.

Federally Licensed Hydropower Dams

The Federal Energy Regulatory Commission (FERC) is the federal agency responsible for licensing and overseeing non-federal hydropower projects in the United States. These licenses typically apply to privately owned, utility-owned, or municipally owned dams that generate electricity and are connected to interstate waters or the power grid. FERC’s authority covers the construction, operation, and safety of these hydropower facilities, as well as their environmental performance.

Licenses are generally issued for a term of 30 to 50 years, after which the dam owner must undergo a relicensing process to continue operation. Relicensing provides one of the most comprehensive opportunities to revisit how a hydropower project affects the river ecosystem and surrounding communities. It is a moment when decisions can be made about flow management, fish passage, recreation access, cultural resources, and overall river health.

Key Public Input Moments in FERC Relicensing

The FERC relicensing process includes several formal and informal opportunities for public participation. These occur across multiple stages of the Integrated Licensing Process, as outlined below:

1. Pre-Application Stage:

The process begins when the dam owner files a Notice of Intent and Pre-Application Document (PAD). FERC then holds public scoping meetings and invites written comments to identify key issues and studies needed to evaluate project impacts.

2. Study Plan Development:

The applicant drafts a Study Plan describing how project impacts will be analyzed. Public agencies and stakeholders can comment, propose modifications, or dispute methods before FERC approves the plan.

3. Draft License Application:

Once studies are complete, the Draft License Application is circulated for public and agency review. Feedback at this stage can shape proposed operations and mitigation measures.

4. Environmental Review (NEPA):

FERC releases a Draft Environmental Assessment (EA) or Environmental Impact Statement (EIS) for a formal public comment period (typically 30–45 days), often with public meetings or hearings.

5. Final License and Rehearing:

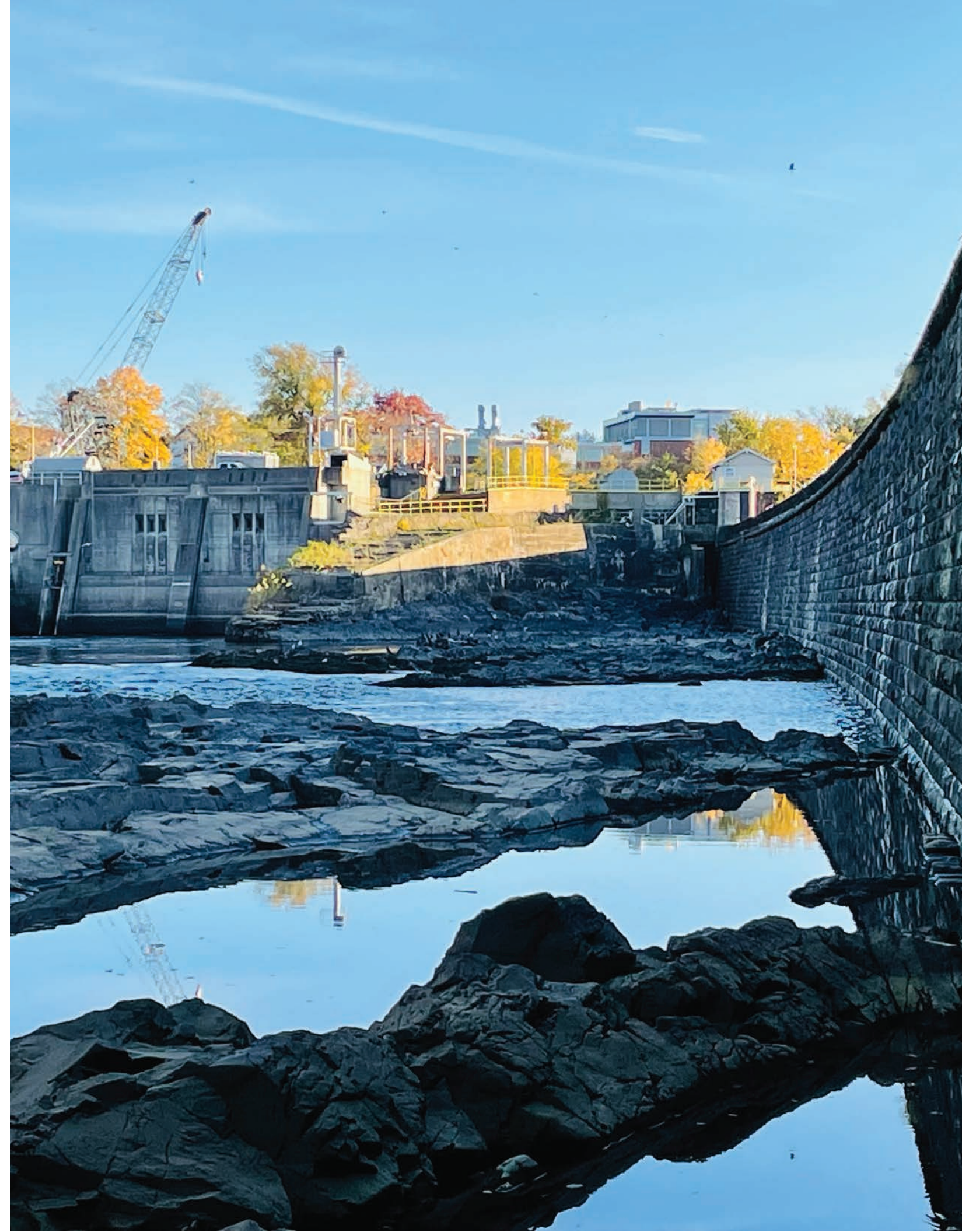
After considering all input, FERC issues a Final License Order. Stakeholders may request a rehearing if they believe key issues were not adequately addressed.

6. Settlement Agreements (Throughout):

At any stage, stakeholders may negotiate settlement agreements outlining restoration, mitigation, or monitoring commitments. FERC may incorporate these agreements into the final license if they serve the public interest.

Summary

Across ownership types, the owner makes the final decision about a dam's future. For publicly owned dams there will be a greater opportunity for public input. For privately owned dams, permitting and licensing processes create structured opportunities for public input and regulatory review—moments when communities can help shape outcomes, add conditions, and improve designs.



HOW TO USE THESE TOOLS

In this section, we share a range of tools designed to support different stages of the decision-making process. Some tools are intended for the project team, others for a steering committee, and others for the general public. Not all tools or steps will apply to every project, and the process will rarely unfold in a perfectly linear way. We offer several possible sequences for how these tools might be used together; however, the exact structure and interaction between the project team, steering committee, and public will vary with each context.

This is a workshop-based approach, which differs from a conventional meeting in both purpose and format. Whereas meetings often focus on sharing updates, making announcements, or obtaining approvals, workshops are designed for collaboration, learning, and problem-solving. Workshops invite participants to engage directly with materials, exchange perspectives, and collectively explore alternatives. They create space for dialogue and reflection—building understanding and trust among participants. Workshops can be structured around specific activities such as identifying objectives, brainstorming alternatives, or evaluating trade-offs, each using tools from this guide to support structured participation and transparent discussion.

For this reason, the toolkit is meant to be flexible. Practitioners and community members are encouraged to take whichever components are most useful and adapt them to their own process. Some may find value in the objective cards to help clarify community values; others may use the decision matrix to evaluate alternatives or employ the visualization methods to communicate potential outcomes. The tools can be used individually or in combination, depending on the scale, timeline, and goals of the project. We encourage practitioners, educators, and community members to share their adaptations, improvements, and lessons learned so that this toolkit can continue to evolve as an open, collaborative resource.



OVERVIEW OF STEPS AND TOOLS

1. PROBLEM FRAMING:

This first step defines the context and scope of the dam decision. It involves clarifying what decision needs to be made, who will be involved, and what the timeline and boundaries are. The goal is to ensure that everyone understands the challenge and what is at stake before moving forward.

1.1	Roll-playing Exercise	Steering Committee + Project Team
1.2	Data Collection	Project Team
1.3	Problem Sketch	Steering Committee
1.4	Paddle The River!	Public + Steering Committee + Project Team

2. DETERMINING OBJECTIVES:

Here, the group identifies what matters and may be impacted by the decision—ecological health, public safety, recreation, cultural heritage, or other priorities. These objectives guide the evaluation of different options and help make sure the process reflects the values and interests of the community.

2.1	Brainstorming Objectives	Steering Committee + Project Team
2.2	Objective Cards	Public
2.3	Developing Performance Measures	Steering Committee + Project Team

3. IDENTIFYING ALTERNATIVES:

This step involves brainstorming a full range of possible actions—from complete removal to repair or modification. The goal is to encourage creative, open-ended, site-specific thinking without locking into any single solution.

3.1	Case Studies	Project Team + Steering Committee
3.2	Brainstorming Alternatives	Public + Steering Committee + Project Team
3.3	Site Visit	Public + Steering Committee + Project Team

4. ESTIMATING CONSEQUENCES:

Each alternative is analyzed for its likely impacts—ecological, social, economic, and safety-related. This might involve engineering or scientific studies, visualizations, and/or expert input to help everyone understand the potential outcomes of each alternative.

4.1	Feasibility Studies	Project Team + Steering Committee
4.2	Visualizing the Alternatives	Project Team
4.3	Filling in the Decision Matrix	Project Team + Steering Committee

5. EVALUATING TRADE-OFFS:

The group compares the alternatives using a decision matrix, weighing how well each option meets the objectives. This step makes the pros and cons visible, supporting transparent, informed discussion and helping the group see where compromises might be possible.

5.1	Decision Matrix	Public + Steering Committee
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6. DECIDING AND TAKING ACTION:

The outcome of the public process is communicated to the decision maker(s) and a final decision is made. This includes documenting the process, securing permits, developing final design and construction documents, and setting up a long-term adaptive management and stewardship plan.

6.1	Final Report	Project Team
6.2	Permitting	Project Team
6.3	Implementation	Project Team
6.4	Stewardship	Public + Steering Committee

SINGLE WORKSHOP

In some cases, it may make sense to combine all steps of the decision-making process into a single meeting. This format works well as an early exploratory workshop when the goal is to identify community interests and determine which alternatives should advance to a feasibility study, or when it is unlikely that participants will attend multiple sessions. Hosting several such workshops—at different times or locations—can also broaden participation.

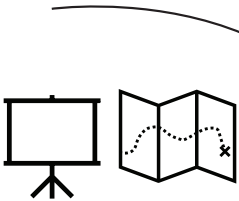
A single exploratory workshop can serve as an early step in a longer public process. Introducing discussion about the future of the dam in this setting helps communities begin to discuss potential changes without immediately triggering resistance to dam removal. The exploratory workshop model can jump-start dialogue, clarify community priorities, and identify which alternatives warrant further study. At this stage, consequence estimates will likely be general, and that is okay—the process helps determine what data will be needed in subsequent feasibility studies. Results from those studies can then inform a second round of workshops with more detailed and quantitative performance measures using the same decision-making framework.

For single-session workshops, the objectives and alternatives are typically determined in advance by the project team and steering committee. However, leaving blank objective cards and empty alternative columns in the matrix can invite participants to share ideas that may have been overlooked. Facilitators might ask, “What’s missing from this list?” to encourage reflection and ensure that all community perspectives are represented.

WORKSHOP PLAN

1. Introduction (Problem Framing)

- Presentation- what is known about the dam.
- Discuss the process and timeline.



2. Discuss Objectives

- Participants select objective cards.
- Participants use the objective cards to share their interests and concerns about the future of the dam.



3. Present Alternatives

- Present case studies and alternatives.
- Explain matrix.



4. Group Discussion of Alternatives

- Discuss case studies and alternatives.
- Brainstorm other alternatives.
- Review Matrix.



5. Evaluate Tradeoffs

- Participants rank alternatives.
 - GREEN = Preferred option
 - YELLOW = Acceptable option
 - RED = Oppose



6. Conclusion

- Report out.
- Closing remarks.

MULTIPLE WORKSHOPS

If a dam is publicly owned, highly visible, or strongly tied to community identity, it will likely require a more extensive public process that provides meaningful opportunities for public involvement. In these cases, the decision-making process should be designed as a series of workshops and check-ins that allow for ongoing exchange between the project team, the steering committee, and the public.

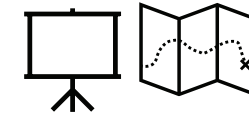
We recommend engaging the public at a minimum of four key points during the process:

- An initial workshop where participants discuss the project scope and provide input on project objectives
- A second workshop where participants provide input on project alternatives
- A third workshop where participants evaluate the alternatives
- A final meeting when the project team or decision makers present the final report and final decision

The process is iterative, with ongoing communication between the project team, steering committee, and public. The team may first refine materials internally, review them with the steering committee for initial feedback, and then share them more broadly with the public for input. This cycle—of refinement, feedback, and revision—may occur several times over the course of one or more years, depending on project complexity, funding, and permitting timelines.

On the following page is an example timeline of how this process might unfold over the course of a couple years. Sample agendas for each workshop are provided in the appendix and editable google doc versions are available on the website- www.thedamatlas.org

FIRST WORKSHOP



DISCUSS PROJECT FRAMING + DETERMINE OBJECTIVES

- Presentation of what is known about the dam.
- Discuss the process and timeline.
- Participants select objective cards and use the cards to share their interests and concerns about the future of the dam.

SECOND WORKSHOP



BRAINSTORM ALTERNATIVES

- Overview of charrette and presentation of case studies.
- Participants select objective cards to introduce themselves.
- Charrette to develop alternatives.

THIRD WORKSHOP



EVALUATE ALTERNATIVES

- Overview of matrix.
- Participants select objective cards to introduce themselves.
- Rank alternatives on the matrix.

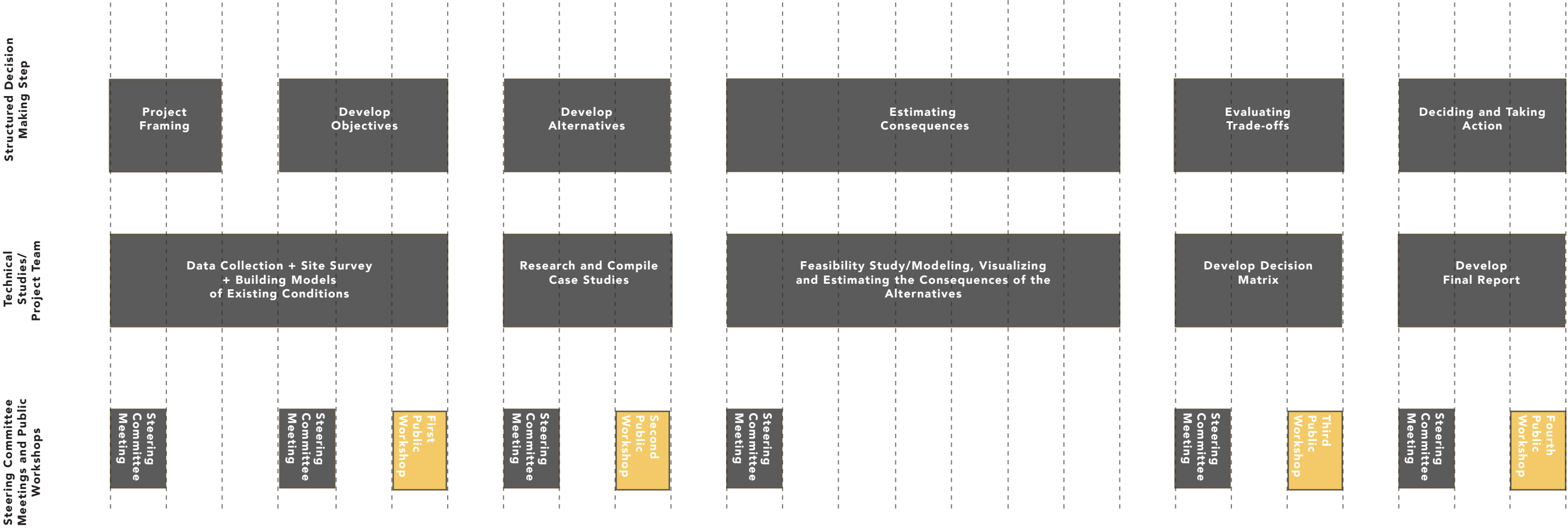
FOURTH WORKSHOP



FINAL REPORT

- Presentation of outcome of public process and the final decision.
- Discuss next steps.
- Discuss opportunities for adaptive management and stewardship.

SAMPLE TIMELINE



Example of Project Timeline

WORKSHOP SETUP

Whether you are hosting a public meeting as part of a single exploratory workshop or as the first in a series, it is important to think carefully about how to create the conditions for a productive and inclusive conversation.

VENUE

Choose a neutral venue that feels accessible and welcoming to all community members. Public spaces such as libraries, gymnasiums, or community centers often provide suitable rooms that can be used free of charge. The neutrality of the space helps reinforce the openness of the process.

SIGN-IN AND PARTICIPANT DISTRIBUTION

As community members arrive, ask them to sign in. This allows for follow-up communication and continuity if multiple meetings are planned.

After sign-in, distribute participants randomly among tables of five to ten people to ensure a mix of perspectives at each table. Randomization helps prevent clustering of participants who already share similar viewpoints. To achieve this, assign each attendee a color or number at registration that corresponds to a designated table.

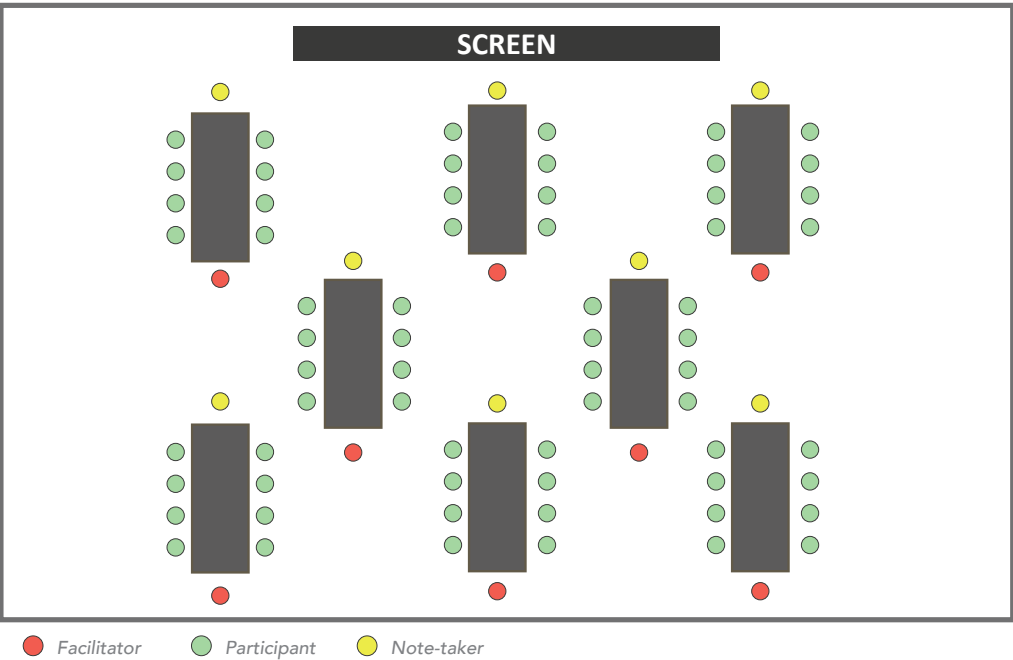
GROUP TABLES

Breakout tables are essential because dialogue is at the heart of community-engaged decision-making. Small-group discussions allow participants to listen to different perspectives, ask questions, and engage in civil exchange with fellow community members. Facilitated discussions ensure that everyone has the opportunity to participate, build understanding of others’ viewpoints, and open the space for negotiation and collaboration.

ROLES

Each table should have a facilitator and a note-taker.

- The facilitator guides the discussion, introduces decision-making tools, and helps keep the conversation focused and inclusive.
- The note-taker records comments and key points so they can be included in meeting summaries, reviewed by the project team, and factored into the decision-making process. Because not everyone will hear all comments, detailed note-taking is essential to ensure that ideas raised in small groups are captured and represented in subsequent discussions.



POP-UP EVENTS

In addition to more formal workshops, pop-up events can be a useful tool in community engagement around dams. Pop-up events—sometimes called pop-up offices or mobile engagement booths—are temporary, informal spaces set up in public locations where community members naturally gather, such as downtown sidewalks, libraries, grocery stores, festivals, parks, or farmers’ markets. Designed to be approachable and visible, pop-ups invite residents to stop by casually, ask questions, and share thoughts without the formality or time commitment of a public meeting.

Pop-ups bring the conversation about river and dam projects to the community, rather than expecting the community to come to a meeting. They can take the form of a staffed table, small tent, or even a vacant storefront transformed into a short-term information hub. By meeting people where they are, pop-ups lower barriers to participation and help reach a broader cross-section of the public—including residents who might not normally attend a workshop or hearing.

WHY POP-UPS?

Pop-ups can be especially valuable for projects involving dams, where decisions are often complex, technical, and emotionally charged. By creating an informal space for dialogue, they:

Lower barriers to engagement. People can stop by for a brief conversation without needing to attend a scheduled meeting. This encourages participation from a wider demographic, including younger residents, parents, and those with limited availability.

Increase visibility and awareness. Pop-ups are highly visible and serve as a public reminder that a decision-making process is underway. For example, the Ipswich River Watershed Association (IRWA) opened a downtown pop-up office ahead of a town vote on dam removal to increase visibility and invite informal, drop-in conversations about the future of the river.

Encourage informal feedback and social learning. Visitors can ask questions, look at visual materials, and share local knowledge or concerns in a relaxed setting. This helps project teams understand public perceptions and refine messaging before formal workshops.

Build trust and transparency. Having project representatives available in person demonstrates accessibility and openness. It helps humanize technical processes and allows residents to see that their perspectives are being heard.

PRACTICAL TIPS FOR ORGANIZING POP-UPS

Choose visible, accessible locations. such as libraries, town greens, community events, or local markets. Schedule times when foot traffic is highest.

Design engaging displays. Use large maps, before-and-after renderings, and simple diagrams. Avoid jargon and keep text concise.

Make it interactive. Provide sticky notes, comment cards, or tablets for participants to record their priorities, memories, or concerns. Consider displaying objective cards and asking people to fill out the decision matrix.

Staff with care. Make sure the pop-up is staffed with a project representative who can explain the technical aspects of the project and be there to listen, answer questions, and document input.

Promote and document. Announce events through town newsletters, local news, and social media. Take notes or photos to record common questions and themes. Share a short summary afterward so participants can see how their input is being used.

Pop-ups work best when integrated with other engagement strategies, forming part of a multilayered process that builds awareness, dialogue, and trust over time.

A photograph of a river with a stone bridge and a building in the background. The river is in the foreground, with a small waterfall or dam. The bridge is made of stone and has several arches. In the background, there is a large, multi-story building with a red roof and white walls. The sky is blue with some clouds.

1

PROBLEM FRAMING

One of the first steps in any decision-making process is to define the problem, clarify the decision context, and establish the project's scope. This typically occurs early with the project team and steering committee to ensure a shared understanding of what the process will address.

Key questions to clarify include:

- What is the decision to be made?
- Should the focus be on a single dam, a river reach, or the entire watershed?
- Who are the final decision-makers, and how will public input be incorporated?
- How does this decision relate to others in the region?
- What is the timeline?

Determining the appropriate spatial scale of a project is a critical early step that shapes both analysis and engagement. Focusing on a single dam may be appropriate when the structure presents immediate safety concerns, clear ecological opportunities, or strong community interest. However, rivers rarely function as isolated systems—decisions about one dam often affect and are influenced by conditions upstream and downstream. Taking a reach-scale or whole-river perspective can help reveal cumulative impacts, interdependencies among structures, and broader opportunities for restoration, access, and recreation. In some cases, beginning with one dam can serve as a pilot that informs or catalyzes future projects within the same watershed.

At this stage, it is also critical to identify who the ultimate decision-makers are and how public input will be incorporated into the final decision. Clarifying this early helps manage expectations, ensures transparency, and avoids confusion later in the process. It also enables the project team to design engagement strategies that align with how and when decisions will actually be made. By making the decision pathway explicit from the start, participants can better understand how their voices contribute to the outcome and where influence is most meaningful along the way.

1.1

MAKING DECISION - PROBLEM FRAMING

ROLE PLAYING EXERCISE

WHO:
Project Team and Steering Committee

TIME:
2 hours

PURPOSE:
Roll playing can be a valuable way for people to understand issues from another persons perspective.

MATERIALS:
Printed character cards
Printed objective cards
Printed alternative cards
Printed matrix
Green red and yellow dots

OVERVIEW

Given that many dam decisions unfold over multiple years, it is important to take time at the beginning of the process for members of the steering committee to get to know one another. It is also valuable to create opportunities for participants to consider the decision from other members’ perspectives.

Role playing provides a forum for engaging participants in a hypothetical yet realistic decision-making scenario. By assuming roles different from their own, participants gain insight into other stakeholders’ perspectives, interests, and constraints.

We developed a role-playing scenario to help members of the steering committee better understand one another’s viewpoints and priorities, while also introducing them to the decision-support tools that will later be used in public meetings.

In a typical exercise, participants are assigned stakeholder roles—such as dam owner, fisheries biologist, local historian, business owner, or resident living downstream—and are presented with a fictional but realistic dam decision case. Working in small groups, they review background materials, articulate their stakeholder’s objectives, and discuss trade-offs using a simplified decision matrix. The session usually lasts two hours and concludes with a group reflection on insights gained, how perspectives shifted, and how the process might inform real-world collaboration.

PROBLEM FRAMING			DETERMINING OBJECTIVES			IDENTIFYING ALTERNATIVES			ESTIMATING CONSEQUENCES			EVALUATING TRADE-OFFS			DECIDING AND TAKING ACTION		
Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public

HOW TO PLAY

Randomly assign five to ten participants and a facilitator to each table. Each participant receives a character card describing their role.

1:OVERVIEW + AGENDA

Main Organizer: Read the scenario aloud and review the workshop agenda with participants.

2: GROUP INTRODUCTIONS + OBJECTIVE CARDS

Facilitators: Place the objective cards in a row at the center of each table.

Ask participants to select five cards that represent their assigned character’s interests and concerns about the dam, and to rank them from highest to lowest priority—from left to right

If participants feel their interests are not represented, encourage them to write a new objective on a blank card.

Next, ask participants to use the cards to introduce themselves and share their interests and concerns about the dam with the group.

3: CASE STUDIES + ALTERNATIVES + MATRIX

Main Organizer: Present several case studies that illustrate the alternatives being considered for the dam.

4: GROUP DISCUSSION OF ALTERNATIVES

Facilitators: Place the printed case studies in the middle of each table.

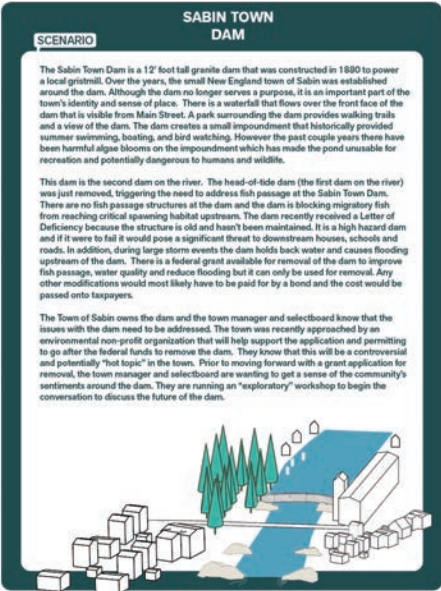
Ask participants which aspects of the case studies seem relevant to the Sabin Town Dam and encourage them to reference specific case study sheets when they speak.

Invite participants to suggest additional alternatives that should be added to the list under consideration.

Pause for questions and ensure that all participants understand the range of alternatives being discussed.

5: EVALUATING ALTERNATIVES + RANKING MATRIX

Facilitators : Hand out a matrix to each participant and place stacks of green, yellow, and red dots in the center of the table.



REFERENCES and ADDITIONAL RESOURCES

Song, Cuihong, Natallia Leuchanka Diessner, Catherine M. Ashcraft, and Weiwei Mo. 2021. “Can Science-Informed, Consensus-Based Stakeholder Negotiations Achieve Optimal Dam Decision Outcomes?” Environmental Development 37 (March): 100602. <https://doi.org/10.1016/j.envdev.2020.100602>.

Rumore, D., Schenk, T., & Susskind, L. (2016). Role-play simulations for climate change adaptation education and engagement. Nature Climate Change, 6(8), 745–750. <https://doi.org/10.1038/nclimate3084>

Ask participants to review the alternatives, then use the matrix to rank each option according to their level of support:

- GREEN = Preferred option** – “This is a great solution.”
- YELLOW = Acceptable option** – “Not the best, but I could support it.”
- RED = Opposed** – “I cannot support this option.”

All participants must use one green and one yellow sticker.

Go around the circle and have participants share their rankings and explain their reasoning.

As participants present, compile the results on the facilitator’s master copy of the matrix.

6: REPORT OUT and DISCUSSION

Facilitators: Share your group’s final rankings and offer a brief reflection on the process.

Main Organizer: Open a full-group discussion by asking:

- What was your experience participating in the role-playing exercise?
- What perspectives or challenges did you notice?
- How might this exercise help prepare you for future discussions about the dam?

DATA COLLECTION

WHO:
Project Team with support of Steering Committee

TIME:
May take weeks or months to gather all the relevant data and make it into a clear presentation.

PURPOSE:
Compile everything that is know about the dam

MATERIALS:
Historic documents, studies, planning documents, town records, etc.

OVERVIEW

One of the initial steps for the project team is to collect and synthesize all available existing data on the dam, the river, and the surrounding landscape. These could include archival records of existing maps and plans, past dam inspection reports, FEMA flood mapping, aerial photos, historic maps and photographs, fisheries data, planning department reports, and utilities mapping. The initial reconnaissance phase is intended to determine the overall breadth of the project and the likely project challenges. The materials are best compiled into a presentation, document, and/or website that can be shared with the public and steering committee and kept for future reference.

DAM AND LAND OWNERSHIP:

Determine the date of construction and history of repairs and modifications of the dam through research and consultation with a civil engineer, expert consultants, and historical engineering drawings. Determine the dam owner and, if necessary, a point of contact for the dam owner. It may also be helpful to do a preliminary assessment of land ownership for the area around the impoundment and the dam structure.

DAM USES:

Determine if the dam and impoundment are currently serving any purpose that will necessitate replacement of the use. Many dams no longer serve the purpose for which they were designed, but many do provide important functions. Dams that provide water supply, hydropower, flood control, or road, rail, or other utility crossings may have more complex trade-offs than those structures that do not provide any services. In some cases, these purposes can be replaced by other means.

INFRASTRUCTURE:

Identify any potential infrastructure that could be impacted by dam removal. For example, if bridges cross any portion of the impoundment or cross the river downstream of the dam, an assessment of potential erosion will need to be made during the feasibility study. In some places, water and sewer pipes or telecommunication cables are routed through dams or impoundments, and alternatives for protecting or moving them will need to be assessed. Some dams are attached to mill buildings or retaining walls, requiring a stability assessment during the feasibility phase.

RARE SPECIES:

Determine if the dam, impoundment, and/or adjacent land are located in priority or estimated habitats for state or federally listed species. If these habitats are present, projects can only proceed through close consultation with state and federal biologists.

SEDIMENT QUALITY:

Preliminarily assess the potential for contaminants trapped behind the dam by considering current and past upstream land uses. Was there industrial activity upstream? Was there also industrial activity downstream that would lead to contaminants along the whole river corridor? Are there known contaminates in the area? Information on water and sediment quality in the river may also be available from past environmental studies. If studies are insufficient to determine potential contamination, a sediment sample may be needed. Sediment screening standards are available from state agencies.

COMMUNITY CONCERNS:

Preliminarily assess potential community interests and concerns. Is the impoundment currently used for recreation? Is there an opportunity for the construction of a park or canoe access following dam removal? Is the dam structure considered a historic resource for the site, neighborhood, or town?

SAFETY:

Preliminarily assess any safety concerns related to the dam. Review any past dam inspections and Emergency Action Plans. Is there currently any flooding in the area surrounding the dam? Are there communities that live downstream of the dam that could be impacted by a potential breach?

FUNDING POSSIBILITIES:

Determine potential “hooks” for funding possibilities. Foundations and agencies that provide grants for river restoration and dam removal have different interests. Some provide funds for projects that help anadromous fish, such as herring or salmon, or for sport fish, such as trout. Others will provide funds for climate resilience or public safety.

SITE SURVEY:

Contract a professional site survey. The site survey will create a scaled topographic base map showing existing conditions and will provide information necessary to assess engineering conditions and deficiencies, hydraulics, and sediment management. In order to completely survey the site, the surveying team must get in the water! The survey should include:

- 1 Topographic plans and cross-section drawings of the river and adjacent land upstream and downstream of the dam, including cultural infrastructure (buildings, roadways, utilities) as well as geographic features in and around the impoundment.
2. A survey of the deepest part of the stream downstream, upstream, and through the impoundment.
3. A survey of the impoundment bottom and the depth of soft sediment throughout the impoundment (bathymetry and depth to refusal).
4. A delineation and survey of the resource areas that will be affected as required in the Wetlands Protection Act and Army Corps of Engineers regulations.

PROBLEM FRAMING			DETERMINING OBJECTIVES			IDENTIFYING ALTERNATIVES			ESTIMATING CONSEQUENCES			EVALUATING TRADE-OFFS			DECIDING AND TAKING ACTION		
Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public

REFERENCES and ADDITIONAL RESOURCES

Executive Office of Energy and Environmental Affairs (2007). *DAM REMOVAL in MASSACHUSETTS: A Basic Guide for Project Proponents*.

Historical Topographic Maps available here: <https://www.usgs.gov/faqs/how-do-i-find-download-or-order-topographic-maps>

PROBLEM SKETCH

WHO:
Project Team and Steering Committee

TIME:
2-3 hours

PURPOSE:
Build understanding of key elements of the decision and get group familiar with SDM process.

MATERIALS:
Printed blank decision matrix and/or a chalkboard or flip chart and writing materials.

OVERVIEW

During the early stages of problem framing, it can be helpful to conduct a brief problem sketch with the project team. The problem sketch walks quickly through the first steps of the Structured Decision-Making (SDM) process: framing the decision, identifying preliminary objectives, and outlining a range of possible alternatives. This exercise helps participants understand the SDM framework, build a shared understanding of key decision elements, and clarify what studies or data may be needed to evaluate the alternatives.

As part of this exercise, the group can begin drafting a preliminary consequence table that links objectives, performance measures, and alternatives. Developing this table early provides insight into potential information gaps, trade-offs, and uncertainties, helping the team determine what additional expertise, studies, or consultation may be needed to fully evaluate the alternatives.

It is important to remember that SDM—and the creation of a consequence table—is an iterative process. The goal of this early problem sketch is simply to better understand the decision and to test potential objectives and alternatives. The consequence table will evolve as the public becomes engaged and the decision context becomes clearer; objectives or alternatives may be added or removed, and their descriptions refined as the process moves forward.

PRE-WORKSHOP PREPARATION

Ensure that the room is equipped with a large chalkboard, whiteboard, projector, or another surface where the consequence table can be drawn. It should be clearly visible to the entire group as it is being filled in. You may also wish to print a draft consequence table for each participant so they can take notes and brainstorm individually during the discussion.

SETTING UP THE EXERCISE

Begin by asking participants what matters most to them regarding the issue or decision at hand. This question helps the project team identify and articulate preliminary objectives, which can then be added to the consequence table.

Encourage brainstorming and discussion, but avoid letting the group become overly focused on wording at this stage. The goal is to capture the main trade-offs and relationships among objectives and alternatives—not to finalize language or structure.

Once the group has completed the problem sketch consequence table, review it together. Ask:

“If this table were filled in, would it summarize the essential information needed to make a decision?”

This reflection helps assess whether the group has defined a clear and complete framework for moving forward.

SKETCH Consequence Table

	Performance Measure	SCENARIO 1	SCENARIO 2	SCENARIO 3
OBJECTIVE 1				
OBJECTIVE 2				
OBJECTIVE 3				
OBJECTIVE 4				
OBJECTIVE 5				
OBJECTIVE 6				
OBJECTIVE 7				
OBJECTIVE 8				
OBJECTIVE 9				
OBJECTIVE 10				

REFERENCES and ADDITIONAL RESOURCES

Gregory, R., Failing, L., Harstone, M., Long, G., McDaniels, T.L., & Ohlson, D.W. 2012. *Structured Decision Making: A Practical Guide to Environmental Management Choices*. Wiley-Blackwell, Chichester, U.K.

See exercises:
2.1 for guidance on brainstorming objectives
2.3 for guidance on brainstorming performance measures
3.2 for guidance on brainstorming alternatives.



PADDLE THE RIVER!

WHO:
Project Team, Steering Committee and General Public

TIME:
3-5 hours

PURPOSE:
Familiarize the Project Team, Steering Committee and public with the river and the dam site

MATERIALS:
Canoes/kayaks, maps, life jackets, insurance, water, snacks

OVERVIEW

Early in the process, it is helpful to get the steering committee, project team, and community members out on the river. When discussions take place only in meetings, it can be easy to lose sight of the river’s physical realities. Getting out on boats and exploring the river—both upstream and downstream of the dam—helps everyone gain a clearer understanding of the dam within its context and of the key issues affecting the river.

Being on the water is one of the best ways to get to know a river. Participants can observe wildlife and vegetation, experience recreational opportunities firsthand, and better appreciate the river’s ecological, cultural, and aesthetic significance. Direct experience also helps participants connect emotionally to the landscape, which can foster more thoughtful and grounded discussions later in the process.

If getting on the water is not feasible due to limited access, rapids, river scale, or accessibility challenges, consider at least organizing a site visit or walk along the riverbank. Even a short visit can help participants visualize the setting and understand how the river functions in relation to surrounding land uses. See Section 3.3 for more information about site visits.

PREPARATION

Determine a route that is reasonable given the group’s time, experience, and comfort level. Ideally, begin upstream of the dam or series of dams under discussion and paddle downstream. Canoes are ideal for this activity, as they allow an experienced paddler to steer from the back while accommodating one or two less experienced participants in the front.

Take all necessary safety precautions to ensure the group’s well-being, or partner with a local kayak or canoe outfitter that can assist with logistics and safety support. All participants must wear life jackets at all times.

DAY OF PADDLE

Before getting on the water, use an aerial or topographic map to orient the group to the area they will explore. Bring the maps along on the trip and, depending on the route length, pause periodically to reference them. This helps participants connect what they observe in the landscape to the mapped features and gain spatial understanding of the river system.

Ideally, include someone on the paddle who can speak to the ecological conditions that are observed along the route—such as plant and animal species, invasive species, and flow dynamics.

From the water, participants can observe upstream properties that may be affected by dam removal, note existing recreational uses of impoundments, and experience firsthand what it means to portage a dam.

Be sure to document the trip with photos or short videos to share with participants who were unable to attend.



REFERENCES and ADDITIONAL RESOURCES

To access topographic maps: <https://www.usgs.gov/faqs/how-do-i-find-download-or-order-topographic-maps>
For information on insurance contact the American Canoe Association Insurance: <https://americancanoe.org/insurance/for-event-organizers/>

PROBLEM FRAMING			DETERMINING OBJECTIVES			IDENTIFYING ALTERNATIVES			ESTIMATING CONSEQUENCES			EVALUATING TRADE-OFFS			DECIDING AND TAKING ACTION		
Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public



2

DETERMINING OBJECTIVES

Project objectives represent the social, ecological, and economic attributes that are important to both the public and decision-makers. These objectives are used to evaluate and understand the consequences of the alternatives. The wording of each objective typically includes the thing that matters and a verb that indicates the desired direction of change. Clearly defining objectives helps translate important values into concrete terms relevant to the specific decision and can help participants shift their focus from positions to interests.

Example of possible objectives in dam decision-making include:

- Increase fish populations
- Maintain views of the historic dam structure
- Minimize negative impacts on hydropower production
- Reduce costs

Agreeing on objectives does not require that everyone assign the same level of importance to each one, or even that they personally hold that value. It only requires that participants recognize these as legitimate objectives—things that someone within the decision context cares about. This act of building shared objectives serves as both a practical and relational foundation. It allows participants to see the full range of community values represented and fosters empathy and curiosity toward perspectives different from their own. Research in both negotiation theory and Structured Decision-Making suggests that when groups can reach agreement on small, concrete matters—such as how to frame objectives—they build the trust and mutual understanding necessary to work through more complex and value-laden decisions.

After an initial list of project objectives are developed, performance measures will need to be assigned to the objectives. Performance measures are specific metrics linked to each objective that help compare and report how well each alternative performs. While scientific and economic metrics (e.g., water temperature, cost) may be easier to quantify, social and cultural considerations—such as sense of place or aesthetics—are equally important and should not be excluded simply because they are difficult to measure.

BRAINSTORMING OBJECTIVES

WHO:
Project Team and Steering Committee

TIME:
1-2 hours

PURPOSE:
Clarify project objectives

MATERIALS:
Paper for individual steering committee members + flip chart or blackboard for taking notes.

OVERVIEW

Good objectives help decision-makers focus on what matters most and what information will be needed to evaluate the alternatives. The process of developing objectives also helps participants identify shared values and build common ground early in the decision-making process.

- During this activity, the goal is to create a list of objectives that:
- Capture all the things that matter when evaluating proposed alternatives
 - Are concise and easily understandable
 - Are influenced or impacted by the alternatives under consideration
 - Are independent from one another

It is also important to begin distinguishing between means and ends objectives..

Fundamental objectives (ends) represent the outcomes you ultimately want to achieve.

Means objectives describe the actions or steps that help achieve those ends.

To move from means to ends, ask the question: “Why is that important?”

Just because an objective is difficult to measure does not mean it should be excluded. At this point, all factors that might influence the evaluation of alternatives should be included. Determining how to measure or account for them will come in a later stage of the process.



PROBLEM FRAMING	DETERMINING OBJECTIVES	IDENTIFYING ALTERNATIVES	ESTIMATING CONSEQUENCES	EVALUATING TRADE-OFFS	DECIDING AND TAKING ACTION
Project Team	Project Team	Project Team	Project Team	Project Team	Project Team
Steering Committee	Steering Committee	Steering Committee	Steering Committee	Steering Committee	Steering Committee
General Public	General Public	General Public	General Public	General Public	General Public

BRAINSTORMING

- Begin by asking participants the following questions (write them on a flip chart or project them on a slide):
- What are we trying to achieve by making this decision?
 - What specific issues or concerns would you like to see addressed?
 - What specific issues or concerns might others want to see addressed through this process?

Ask members of the steering committee to take 5–10 minutes to write down their own ideas independently before sharing them with the group. If participants are strongly attached to supporting or opposing a particular solution, ask them to list what they see as positive or negative about that solution. This helps uncover the underlying values behind their positions.

SHARING

Once everyone has completed their lists, begin structuring the issues and concerns into a clear set of objectives. Ask participants to share their notes. Depending on the group size, it may be most efficient to have each person share three to four objectives in a first round, then invite additional ideas afterward.

As participants share, record the objectives on a flip chart or whiteboard so they are visible to everyone. Consider organizing them into broad categories such as ecological, social and cultural, infrastructural, or economic.

FUNDAMENTAL OBJECTIVES

The goal at this stage is to identify the fundamental objectives from the means objectives. One effective way to do this is by asking: “Why is that important?” A fundamental objective is one for which the answer to that question is simply, “because it is.”

As participants share objectives, ask clarifying questions to help reveal the underlying purpose and meaning. It may also be useful to sketch a means–ends network to show how various objectives relate to one another. If participants mention process or strategic objectives, list these separately but adjacent to the fundamental objectives so their relationships can be understood and revisited later in the process.

HIERARCHICIZING

Once the group has agreed on a set of fundamental objectives, begin to organize them into an objective hierarchy that identifies subcomponents or sub-objectives. This structure will help clarify how broader goals relate to more specific outcomes. For Example:

Ecological Objectives: Increase fish passage, improve water quality

Social/Cultural Objectives: Maintain views of historic structures, enhance recreation access

Economic Objectives: Minimize costs, sustain hydropower generation

TESTING

Once an initial list of project objectives has been developed, it is important to test whether they are useful and sufficient for evaluating the alternatives. Creating another iteration of the consequence table is a valuable way to do this.

As a group, review the sketch consequence table and imagine it filled in with data. Ask:

- Does this list capture the issues that are most important?
- Is anything missing?
- Would these objectives allow us to fairly evaluate all alternatives?

This review helps ensure that the objectives are comprehensive, balanced, and measurable before the process moves forward.

REFERENCES and ADDITIONAL RESOURCES

Gregory, R., Failing, L., Harstone, M., Long, G., McDaniels, T.L., & Ohlson, D.W. 2012. Structured Decision Making: A Practical Guide to Environmental Management Choices. Wiley-Blackwell, Chichester, U.K.

OBJECTIVE CARDS

WHO:
General Public

TIME:
1 hour

PURPOSE:
Clarify project objectives and help people focus on interests not positions.

MATERIALS:
Objective cards

OVERVIEW

The deck of Objective Cards consists of 6” x 4” physical cards. On one side, each card lists a project objective; on the other, it includes a diagram and brief explanatory text that illustrate or expand on the issue.

Many people come to a public meeting about a dam with a clear position—for example, “keep the dam” or “remove the dam.” One of the primary goals of using Objective Cards is to help shift the conversation from positions to interests—for instance, from “remove the dam” to “improve fish passage,” or from “keep the dam” to “preserve the town’s history.” This shift is essential, because while positions lock participants into advocating for a single alternative, many of their underlying interests can often be achieved through multiple options.

Using the Objective Cards early in the public process helps participants begin from a place of common ground. For example, many may agree that maintaining a healthy river system is important. Such early agreement allows the group to discuss and evaluate options collectively, focusing on shared goals rather than opposing positions.

This process enables the public to define what matters most and identify what should be assessed in comparing alternatives. Conducting this activity in a public setting ensures that both ecological and social considerations are recognized and incorporated into the decision-making process. Ultimately, one of the goals of using Objective Cards is to actively involve the public in determining the project objectives themselves.

By providing a shared language and format, the cards allow people to negotiate meaning and connect scientific, technical, and cultural dimensions of dam decisions. This process helps participants articulate what matters most and identify what should be evaluated when comparing alternatives.

GOAL OF THE EXERCISE

- 1. Provide participants with a structured way to introduce themselves that encourages dialogue.
- 2. Help participants clarify the issues and values they feel most strongly about.
- 3. Invite participants to select five cards to broaden the discussion beyond a single issue or position.
- 4. Encourage a shift from positions to interests
- 5. Reinforce that both scientific facts and social values are being considered in discussions about the dam’s future.

PRE-WORKSHOP PREPARATION

Begin by identifying the key objectives for the project through discussions with the steering committee and by reviewing existing studies, local histories, and records of community

involvement. Ensure that the objective cards represent the full range of ecological, social, and economic considerations.

Once you have identified these key objectives, select and print the most relevant cards from the Objective Card deck. Be sure to include a supply of blank cards so that participants can contribute additional objectives or concerns during the session.

SETTING UP THE EXERCISE

After an introductory presentation outlining the decision context and goals of the workshop, place the Objective Cards face down in a row in the center of each table.

Ask participants to select five cards that best represent their interests and concerns about the dam. They should then arrange the cards in ranked

order—from highest to lowest priority, left to right—and use them as prompts to introduce themselves and share their perspectives with the group.

Facilitators can help guide conversation by asking follow-up questions, such as:

- “Why is this issue important to you?”
- “How might this objective be affected by different alternatives?”

If printing a full set of cards for each participant is not feasible, ask participants to record their top five objectives on paper instead. When it is their turn, they can select the corresponding cards from the table and return them afterward.

Continue until everyone at the table has had a chance to share. This activity helps participants remain focused during introductions, recognize shared priorities, and begin developing a collective understanding of what matters most.



REFERENCES and ADDITIONAL RESOURCES

PROBLEM FRAMING			DETERMINING OBJECTIVES			IDENTIFYING ALTERNATIVES			ESTIMATING CONSEQUENCES			EVALUATING TRADE-OFFS			DECIDING AND TAKING ACTION		
Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public



MAKING DECISION - DETERMINING OBJECTIVES

DEVELOPING PERFORMANCE MEASURES

WHO:
Steering Committee

TIME:
2 hours

PURPOSE:
Clarify performance measures

MATERIALS:
Paper for individual steering committee members + flip chart or blackboard for taking notes.

OVERVIEW

Once an initial draft of objectives has been developed, the next step is to identify performance measures that can be used to compare how different alternatives affect those objectives. The goal is to select measures that highlight meaningful differences in the impacts of management alternatives across social, ecological, and economic dimensions. Identifying performance measures often reveals the need for additional data collection or modeling. If it is not feasible to collect the required data or build models within the project’s time, budget, or staffing constraints, alternative measures such as constructed scales and relative impacts will need to be identified.

Effective performance measures should be:

- **Unambiguous** – Clearly linked to the fundamental objective being evaluated.
- **Direct** – Directly related to the consequence or outcome of interest.
- **Comprehensive** – Cover the full range of possible outcomes.
- **Operational** – Supported by data that are available or can be feasibly collected.
- **Understandable** – Easily interpreted and communicated to both technical and non-technical audiences.

Types of Attributes

- **Natural Attributes:** Natural criteria directly measure the attribute itself—such as dollars for financial impacts or hectares for habitat area. Use natural criteria whenever possible; they provide the most direct and transparent basis for comparison.
- **Constructed Attributes:** Constructed scales are developed specifically for the decision context, often using relative or sliding scales (e.g., 1–5 or low–medium–high). They are useful for assessing complex or qualitative factors but can be ambiguous and open to interpretation. Use them carefully and explain their basis clearly.
- **Proxy Attributes:** A proxy is a measurable attribute strongly correlated with the objective but not directly measuring it—for example, habitat area as a proxy for species welfare. Use proxies only when natural or constructed attributes are unavailable, and make their limitations explicit, as they can obscure uncertainty or value judgments.

PROBLEM FRAMING	DETERMINING OBJECTIVES	IDENTIFYING ALTERNATIVES	ESTIMATING CONSEQUENCES	EVALUATING TRADE-OFFS	DECIDING AND TAKING ACTION
Project Team Steering Committee General Public	Project Team Steering Committee General Public	Project Team Steering Committee General Public	Project Team Steering Committee General Public	Project Team Steering Committee General Public	Project Team Steering Committee General Public

SETTING UP THE EXERCISE

Display the draft list of objectives so the entire group can see them clearly. This can be done using a flip chart, projector, blackboard or screanshare. Make sure there is enough space below each objective to record notes about potential performance measures.

BRAINSTORMING

Go through the objectives one by one, asking the steering committee:

“What specific information would you need in order to evaluate the impact of these alternatives?”

As committee members respond, record all proposed ideas for each objective on the board or flip chart.

Before moving on to the next objective, ask participants to consider the possible data sources or models that could be used:

“For each of these possible performance measures, what are potential sources of information for estimating this measure?”

Encourage discussion to evaluate and select the most useful performance measures for each objective. In some cases, time or funding constraints may prevent the use of the most ideal measure. Adjustments can be made later if it becomes clear that certain data or models are unavailable.

As with all aspects of the Structured Decision Making (SDM) process, identifying and refining performance measures is iterative—expect to revisit and improve these choices as new information becomes available and understanding deepens.

REFERENCES and ADDITIONAL RESOURCES

Gregory, R., Failing, L., Harstone, M., Long, G., McDaniels, T.L., & Ohlson, D.W. 2012. Structured Decision Making: A Practical Guide to Environmental Management Choices. Wiley-Blackwell, Chichester, U.K.

A photograph of a river with a small dam or weir, surrounded by lush green trees. The water is flowing over the dam, creating a small waterfall. The trees are dense and green, with some yellowing leaves visible. The sky is overcast.

3

IDENTIFYING ALTERNATIVES

Within the Narragansett Bay and Rhode Island coastal watersheds, many aging dams are in poor condition, in need of repair, and no longer serve a purpose. Each dam is unique, with distinct ecological, social, physical, and economic factors that must be considered when exploring alternatives. Because most dams in New England are relatively small, there is often a range of feasible alternatives that can achieve multiple objectives.

Dam removal is frequently the most cost-effective approach to managing aging dams. It restores natural river functions and ecological connectivity, eliminates the risk of structural failure, and avoids long-term maintenance and repair costs. However, the social, cultural, and economic dimensions of local communities often warrant exploring additional options.

In some cases, conventional or nature-like fishways may be used in combination with partial dam removal. In others, historic canal infrastructure can be repurposed for fish passage structures. And sometimes full river connectivity can be restored while preserving all or a portion of the historic dam or spillway.

This diversity of potential outcomes underscores the need for a transparent, structured decision-making process—one that integrates technical studies with community values to support balanced, informed, and durable solutions for rivers and the communities that depend on them.

CASE STUDIES

WHO:
Steering Committee and/
or General Public

TIME:
1 hour

PURPOSE:
Review case studies of
other similar projects to
help understand possible
alternatives

MATERIALS:
Case Study Cards

OVERVIEW

Each dam is unique, and its ecological, social, physical, and economic context must be carefully considered when exploring future scenarios. Unlike large dams—where few options exist beyond removal—small dams often present a wider range of feasible alternatives. While dam removal may be the most effective means of restoring river functions and ecological connectivity, the social, physical, and economic dimensions of a community may justify exploring additional options.

While typical design charrettes are open-ended and generative, dam-related planning processes benefit from a structured exploration of known alternatives—such as dam removal, partial removal, nature-like fishways, or rehabilitation—while still leaving space for creative, site-specific solutions that may emerge from the community.

Case studies are an effective way for both the steering committee and the general public to learn how other communities have addressed aging dam infrastructure. They familiarize participants with common alternatives and provide a shared foundation for discussion about possible solutions for the project at hand. Seeing examples of completed projects—such as photographs of restored river reaches—can help participants visualize future conditions and reduce uncertainty or fear of change. Case studies also help illustrate the types of technical, financial, and regulatory support needed to advance projects and highlight potential funding opportunities and constraints relevant to local decision-making.

PRE-WORKSHOP PREPARATION

Meeting organizers should select case studies that match the scale, type, and context of the dam being discussed. This resource includes downloadable PDFs of sample case studies, as well as editable Microsoft Word and Google Doc templates for creating new ones.

Prior to the workshop, print enough copies so that each table has at least one of each case study. If you plan to run multiple workshops, consider printing on card stock for durability and reuse.

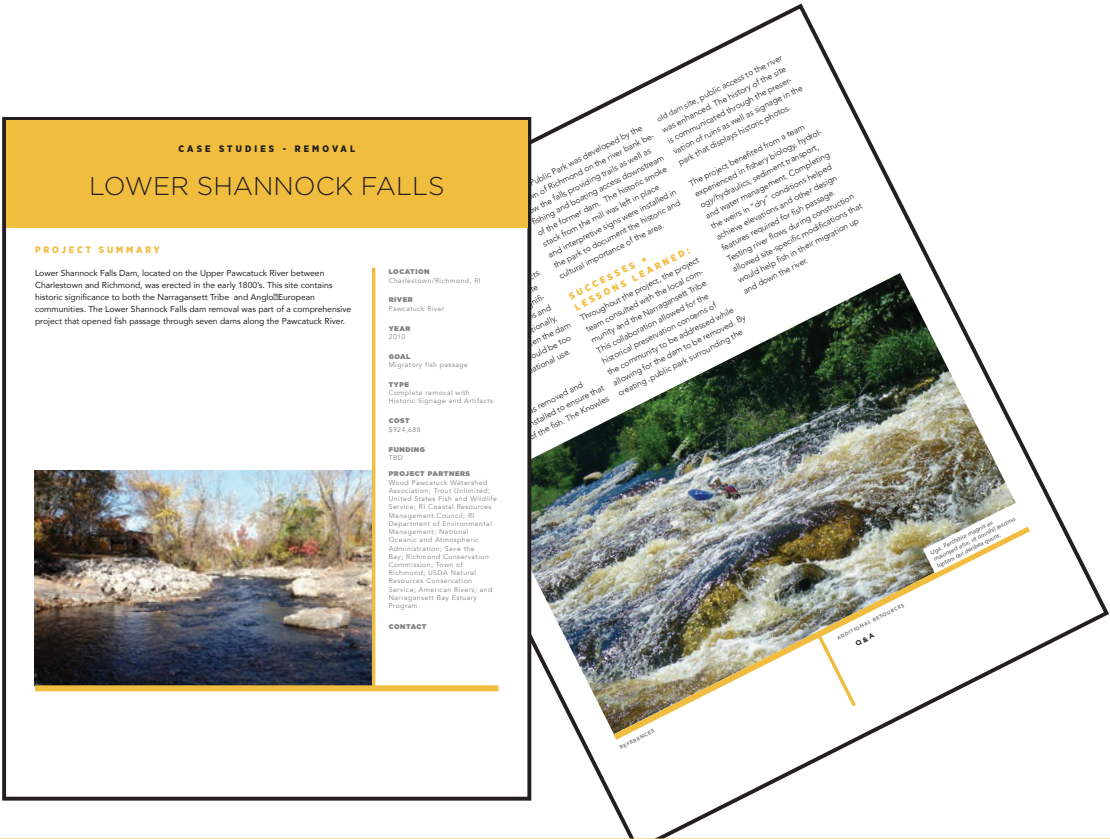
THE EXERCISE

During the presentation, the facilitator should introduce the case studies, highlighting key project details and outcomes. Using before-and-after photographs is especially effective for helping participants visualize the impact of different alternatives.

After the presentation, distribute the printed case studies to each table and ask participants to review them together.

Once everyone has had time to read and discuss, invite the group to reflect on the following questions:

- Are there any questions about the case studies?
- What aspects of each case study seem most relevant to the decision at hand?
- Given what we learned from these examples, what alternatives might be appropriate to consider for this project?



REFERENCES and ADDITIONAL RESOURCES

PROBLEM FRAMING			DETERMINING OBJECTIVES			IDENTIFYING ALTERNATIVES			ESTIMATING CONSEQUENCES			EVALUATING TRADE-OFFS			DECIDING AND TAKING ACTION		
Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public

BRAINSTORMING ALTERNATIVES

WHO:
Steering Committee

TIME:
2-5 Hours

PURPOSE:
Brainstorm alternatives

MATERIALS:
Aerial and topographic survey printed at the same scale, photographs, trace paper, architectural or engineer scale, pens, pencils, markers

OVERVIEW

Community sentiment around a dam often varies depending on its location, structure, history, and use. If a dam is in the middle of the woods and is no longer serving a purpose, removal may be the best and only alternative worth pursuing. However, if there is community attachment to the dammed landscape, a range of alternatives may need to be considered. The nature of local attachment—whether to the dam itself or to the impoundment—can shape which future scenarios are most acceptable. For instance, a nature-like fishway can maintain the impoundment while significantly improving fish passage, though the dam structure may no longer be visible. Where space allows, a bypass channel can preserve the visual presence of the dam while enhancing fish passage and habitat connectivity. Even when a dam is removed, thoughtful design can help retain the site’s sense of place and aesthetic character. A growing number of case studies illustrate these types of hybrid and adaptive solutions and can be shared with communities to help them visualize alternatives and understand how different approaches balance ecological restoration with cultural and social values.

This exercise engages the steering committee and general public in brainstorming creative alternatives for the river in a charrette style workshop. While dam modification alternatives may be more costly, require long-term maintenance, and not be as effective for improving river connectivity, exploring a full range of options allows discussions to move beyond the often perceived binary of keeping or removing the dam. The goal of the charrette is to encourage creative, open-ended, site-specific thinking to get as many possible alternatives on the table. Participants are encouraged to think broadly and defer evaluation until later. At this stage, the goal is to explore “what if” possibilities. Critiquing ideas too early can hinder creativity and discourage participation. The emphasis of this exercise is on creative exploration, not on feasibility. The ideas generated here can serve as a foundation for later evaluation and refinement within the Structured Decision Making (SDM) framework. Community members often respond positively to this approach, recognizing the project team’s efforts to address local concerns and pursue solutions that meet multiple objectives.



SETTING UP THE EXERCISE

Depending on the size of the group, it may be helpful to divide participants into small groups of about five, seated comfortably around tables. Each table should have aerial images topographic maps at multiple scales, as well as and photographs of the dam and surrounding landscape. Each table should also be equipped with trace paper, scales, pens, and markers to support brainstorming and quick sketching of ideas.

If one of the goals of the project is to improve fish passage, it can be helpful to have an engineer at the charrette that specializes in the design of fish passage structures. The engineer can provide an overview of the design and constraints that need to be considered to make fish passage structures work for target species.

BRAINSTORMING

Begin by asking participants to individually write down their ideas for possible alternatives. Once everyone has had time to think, go around the table and invite each person to share their ideas. This approach encourages participation, reduces groupthink, and fosters creativity.

As participants describe their ideas—especially spatial ones—ask them to sketch on the trace paper. The facilitator can also help by sketching for the participant as they explain, confirming and adjusting as needed.

To help guide discussion, consider brainstorming around individual objectives. The facilitators can ask the participants:

“If you were focusing only on the objective of [insert objective], what alternatives might you consider?”

Challenge assumed constraints. Some may be real—others imagined. If an alternative seems compelling, ask: *“What would need to change to make this possible?”*

Encourage participants to consider diverse perspectives by asking: *“If we presented this alternative to others, what concerns might they have? How could we address those concerns?”*

Once an initial set of alternatives have been developed, the group can determine which are worth perusing into the next stages of work.

ALTERNATIVE PACKAGES

When analyzing a stretch of river, it may be helpful to begin by separating out the different components of the project and developing alternatives for each component separately. For example, you may start by brainstorming alternatives for each individual dam, then explore alternatives for the river channel, and lastly the entire watershed.

Keeping these components separate at first enables the project team to assess the consequences of each alternative on the project objectives before combining them into comprehensive alternative packages. These packages can then be adjusted and refined to test how different configurations or combinations of actions influence the objectives and overall project outcomes.

CHARACTERISTICS OF “GOOD” ALTERNATIVES

Value-Focused- Directly address the core values and objectives of the decision—the “things that matter” as defined by the objectives and evaluation criteria.

Technically Sound - Based on the best available data and understanding of cause-and-effect relationships, reflecting both creativity and rigor.

Clearly and Consistently Defined- Described at a consistent level of detail with coherent assumptions, including a clear base case for comparison.

Small in number and high in quality- Redundant or weak options are eliminated, leaving a focused set refined through iteration and collaboration.

Comprehensive and mutually exclusive- Composed of complete, internally consistent packages that can be directly compared to one another.

Able to expose fundamental trade-offs- Highlights, rather than hides, the key value-based trade-offs, offering meaningful choices for decision-makers.

REFERENCES and ADDITIONAL RESOURCES

Gregory, R., Failing, L., Harstone, M., Long, G., McDaniels, T.L., & Ohlson, D.W. 2012. Structured Decision Making: A Practical Guide to Environmental Management Choices. Wiley-Blackwell, Chichester, U.K.

Franklin Regional Council of Governments. 2025. River Restoration Design and Permitting in Massachusetts: A Guide for Inland Rivers, Greenfield, Massachusetts, 164 pp.

SITE VISIT

WHO:
Project Team,
Steering Committee and
General Public

TIME:
2-5 Hours

PURPOSE:
Gain familiarity with the
site and help brainstorm
possible alternatives

MATERIALS:
Aerial and topographic
survey printed at the
same scale

OVERVIEW

While discussing and developing a list of possible alternatives, it can be valuable to conduct a site visit with the project team and steering committee. Visiting the site helps ground discussions in the specific physical context and ensures that the alternatives being considered are informed by on-the-ground realities. Ideally if the public meeting is held close to the dam site, the alternatives brainstorming charrette can begin with the site visit and then participants can transition directly into the charrette.

Each potential alternative will have site-specific constraints that affect its feasibility. For example, understanding downstream conditions can determine whether a river-wide nature-like fishway is possible. Observing the available space around the dam and nearby infrastructure—such as bridges, utilities, or buildings—can clarify whether a bypass channel or partial removal is viable. Similarly, identifying which portions of the dam are visible from nearby roads may inspire design strategies that preserve elements of the structure while improving habitat connectivity.

A site visit encourages participants to think creatively within real-world constraints, helping the group identify opportunities to balance ecological restoration, cultural heritage, and physical feasibility in the design of alternatives.

PRE-SITE VISIT PREPARATION

Prior to the site visit, the project team should develop and print scaled aerial and topographic maps that can be brought on the site visit. Having the plans there can help participants connect what they see on-site with the project plans, supporting later discussions about site conditions.

DURING THE SITE VISIT

As a group, walk around the dam and the areas upstream and downstream, noting any missing data that could be gathered during the visit. Observations about height, slope, and adjacent infrastructure can help assess the feasibility of alternatives such as bypass channels, nature-like fishways, or removal, and inform what additional data may be needed.

If the dam is located in a developed or populated area, walk the surrounding streets to understand how the dam fits into the built and social fabric of the community. Consider questions such as: *Is the dam visible from nearby roads? Is the sound of the water audible? Are there homes or businesses adjacent to the structure?*

These observations can reveal how the dam contributes to the community's sense of place and how designs can respond to those conditions.



REFERENCES and ADDITIONAL RESOURCES

To access topographic maps: <https://www.usgs.gov/faqs/how-do-i-find-download-or-order-topographic-maps>

PROBLEM FRAMING	DETERMINING OBJECTIVES	IDENTIFYING ALTERNATIVES	ESTIMATING CONSEQUENCES	EVALUATING TRADE-OFFS	DECIDING AND TAKING ACTION
Project Team	Project Team	Project Team	Project Team	Project Team	Project Team
Steering Committee	Steering Committee	Steering Committee	Steering Committee	Steering Committee	Steering Committee
General Public	General Public	General Public	General Public	General Public	General Public



4

ESTIMATING CONSEQUENCES

Once the objectives and alternatives have been identified and agreed upon, the next step is to estimate the consequences of each alternative with respect to the evaluation criteria, using available knowledge and predictive tools. This step is primarily an analytical task, typically undertaken by scientists, engineers, economists, landscape architects, and specialists in traditional ecological knowledge.

Some of these specialists may be part of the core project team, while others may be external consultants engaged to provide specific expertise. For example, a fish biologist may be needed to estimate impacts on anadromous fish populations; engineers may conduct hydrology and hydraulics analyses to understand flood risk or flow changes; and landscape architects can help visualize aesthetic and spatial impacts, including how different alternatives may affect the community's sense of place.

The information gathered during this stage should be relevant to the decision context and developed according to best practices for avoiding bias, addressing uncertainty, and maintaining transparent documentation.

Once the data has been collected, it is essential to consider how this information will be communicated to the steering committee and the broader public. Technical results must often be translated into accessible, decision-relevant formats so that participants without disciplinary expertise can meaningfully engage with the material.

We recommend using visualizations and well-designed graphics—such as maps, diagrams, or before-and-after renderings—to facilitate dialogue and develop shared understanding. These visual tools can reveal relationships and insights that may not emerge through verbal or quantitative explanations alone, helping participants build a more holistic picture of the potential consequences of each alternative.

FEASIBILITY STUDIES

WHO:
Project Team and Consultants

TIME:
Months

PURPOSE:
To gather information that will help estimate consequences of the alternatives on the objectives.

MATERIALS:
Engineering and design software and programs.

OVERVIEW

The feasibility study provides concept-level plans and quantitative information on the environmental and engineering feasibility necessary to make final decisions about the project approach. Typically, this study includes analyses to evaluate how various alternatives would affect the structure itself, protect surrounding infrastructure, restore in-stream and riparian habitat, and manage sediment. This data can be used to populate and refine the consequence table, supporting a transparent evaluation of trade-offs among alternatives.

While every project is site-specific, the following components are commonly included in a feasibility study scope of work:

CONCEPTUAL DRAWINGS

Develop concept-level drawings for the full range of design alternatives, including options for repairing, modifying, or removing the structure and restoring the surrounding landscape.

HYDROLOGIC AND HYDRAULIC (H&H) MODELING

H&H modeling is a fundamental tool for engineering analysis and for evaluating how different alternatives affect water flow and flood risk.

- **Hydrology** examines the quantity of water (runoff) generated from a given watershed.
- **Hydraulics** evaluates how that water moves—its velocity, depth, and behavior in channels, pipes, or floodplains.

Combined H&H modeling allows for the simulation of various scenarios, helping to assess how each alternative could influence flood levels, flow regimes, and downstream impacts.

SEDIMENT MANAGEMENT PLAN

Quantitatively assess both sediment quality and quantity, and develop a conceptual plan for managing sediment under each alternative. A key part of this analysis is determining whether sediments are contaminated, how that compares to conditions downstream of the dam, and determining how much sediment would mobilize downstream with the alternatives.

PRELIMINARY STRUCTURAL STUDY AND PLAN

While final removal or modification methods will be determined during the engineering design phase, several key considerations should be addressed during the feasibility phase, including:

Dam condition: Assess structural stability, safety risks, potential demolition methods.

Access and staging: Identify access routes, staging areas, and potential constraints for construction equipment.

Site limitations: Note utilities, easements, or topographic features that could affect construction.

Material disposal: Determine suitable locations for disposal or reuse of dam debris and sediment.

COST ESTIMATES

Develop preliminary cost estimates for the preferred and alternative approaches, including anticipated costs for final design, permitting, construction, and oversight. At this stage, these should be considered probable costs—informed by the consulting team’s professional judgment and relevant past projects.

RIPARIAN RESTORATION PLAN

Evaluate potential restoration approaches for both in-stream and riparian habitats within and around the former impoundment area. This analysis should identify opportunities for fish passage, native vegetation establishment, bank stabilization, and habitat enhancement.

FISHERIES

Early coordination with state and federal fisheries agencies is essential to ensure that proposed alternatives support aquatic habitat restoration and comply with regulatory requirements.

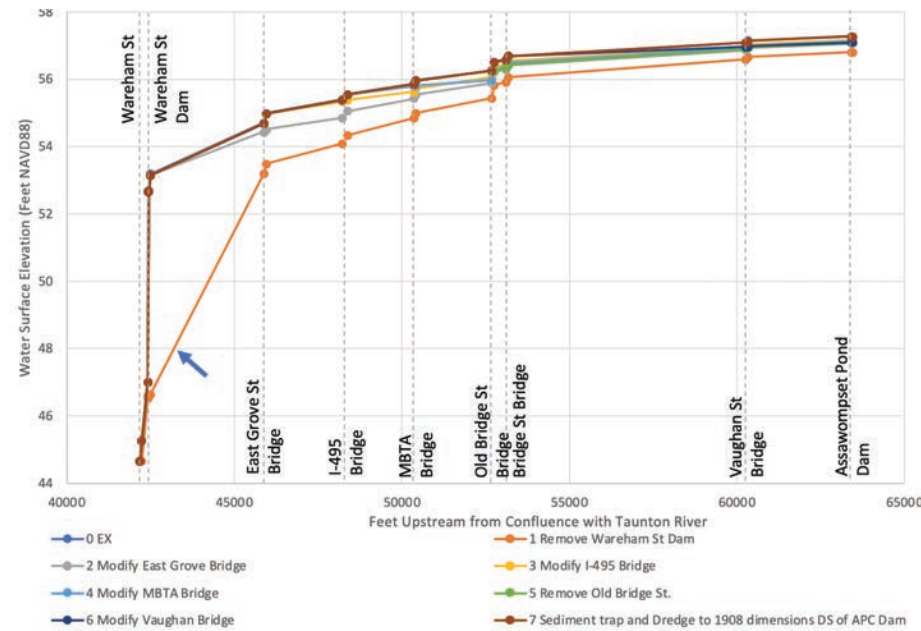
In Massachusetts, coordination should include:

- **The Division of Marine Fisheries (DMF)** for projects involving anadromous or catadromous fish runs.
- **MassWildlife (Division of Fisheries and Wildlife)** for projects involving cold-water fisheries resources or waterfowl breeding and feeding habitats.

In Rhode Island, coordination should include:

- **The Rhode Island Department of Environmental Management (RIDEM) Division of Fish and Wildlife**, which oversees anadromous fish restoration, freshwater fisheries, and wetland and habitat protection.
- **RIDEM’s Office of Water Resources**, which administers dam safety and freshwater wetlands permitting, and can help ensure that proposed modifications align with both habitat and regulatory goals.

Engaging these agencies early allows the project team to clarify design criteria for fish passage, understand species-specific timing or migration considerations, and identify potential funding or partnership opportunities.



Results of H&H Model conducted by Horsley Witten Group for the Upper Nemasket River Enhancement Plan

REFERENCES and ADDITIONAL RESOURCES

<https://civiltechinc.com/the-benefits-of-hydrologic-hydraulic-modeling-a-case-study/>

Executive Office of Energy and Environmental Affairs (2007). *DAM REMOVAL in MASSACHUSETTS: A Basic Guide for Project Proponents.*

PROBLEM FRAMING	DETERMINING OBJECTIVES	IDENTIFYING ALTERNATIVES	ESTIMATING CONSEQUENCES	EVALUATING TRADE-OFFS	DECIDING AND TAKING ACTION
Project Team Steering Committee General Public	Project Team Steering Committee General Public	Project Team Steering Committee General Public	Project Team Steering Committee General Public	Project Team Steering Committee General Public	Project Team Steering Committee General Public

VISUALIZING THE ALTERNATIVES

WHO:
Project team

TIME:
Weeks

PURPOSE:
Help visualize the alternatives to understand the impact to the surrounding landscape

MATERIALS:
Graphics programs such as Photoshop and 3-D modeling program such as Auto CAD and RHINO

OVERVIEW

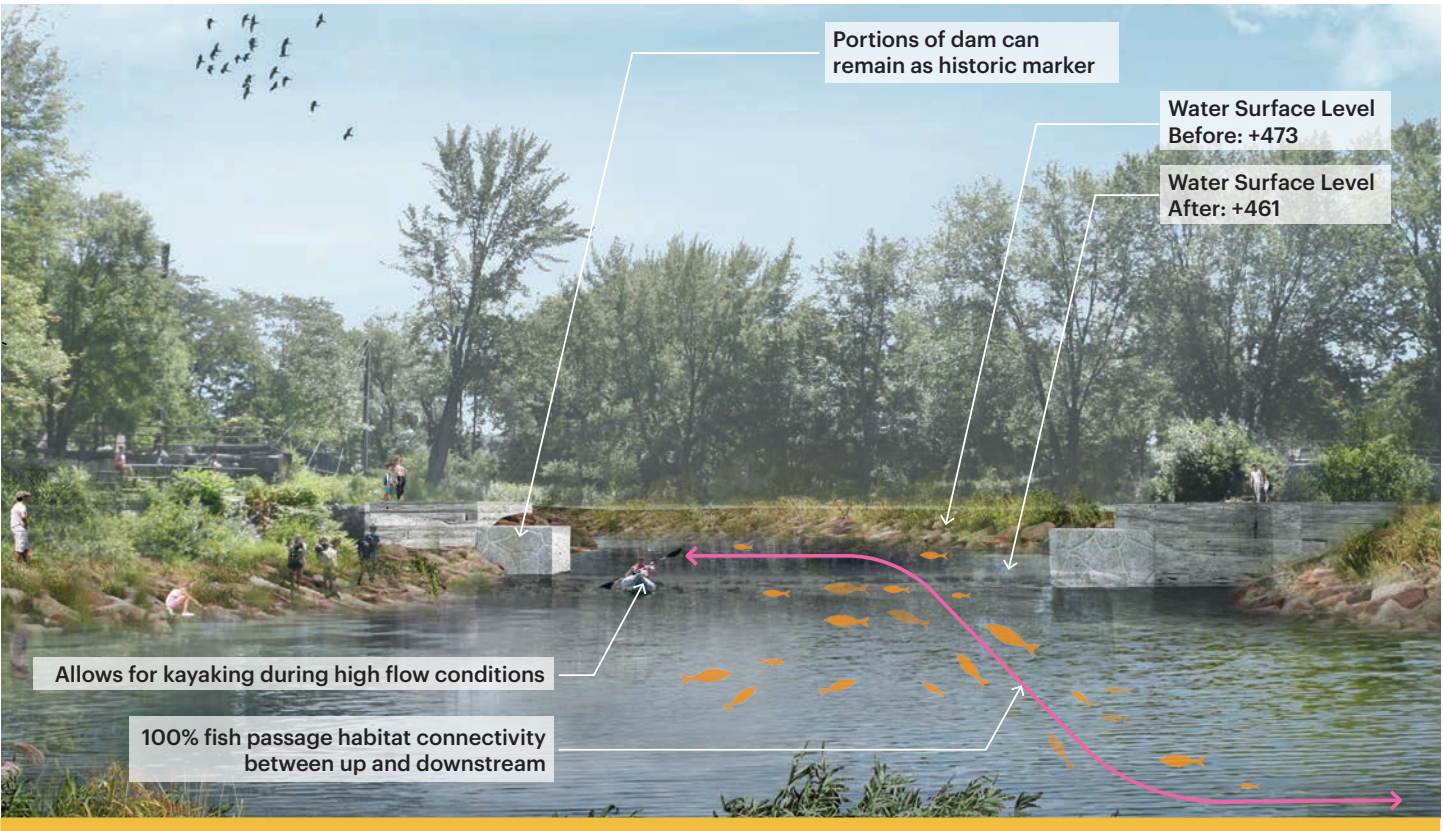
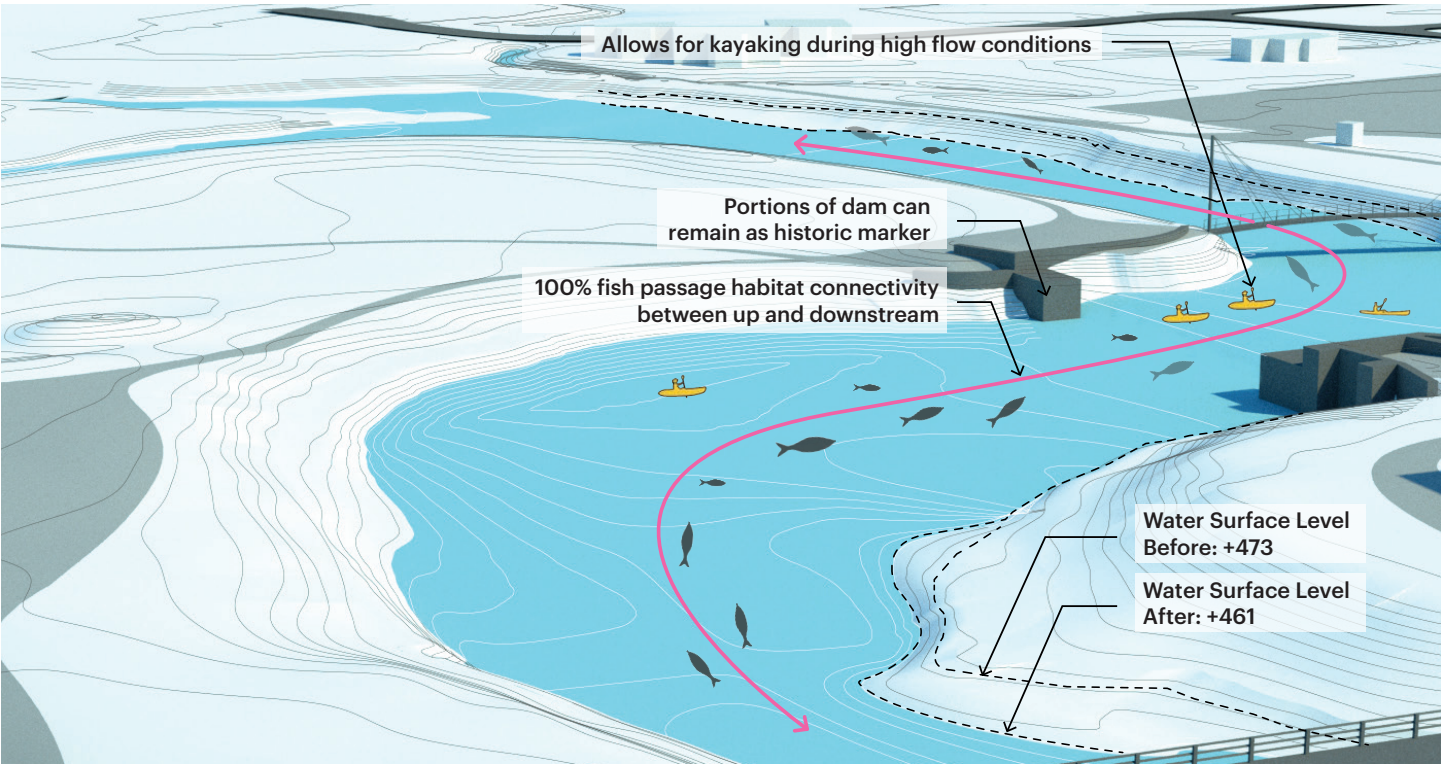
One of the most visible consequences of the proposed alternatives will be the aesthetic and physical impact on the dam site and its upstream and downstream environments. For sites with high public visibility or cultural value, these visual and spatial changes can be a critical factor in decision-making. In other locations—where the dam is less visible or socially significant—these effects may be less consequential.

Visualizations play an essential role in helping both decision-makers and the general public imagine and understand the physical transformations that each alternative would produce.

- Different types of visualizations can be used depending on what needs to be communicated:
- **Bird’s-eye views** (such as the upper image at right) illustrate the broader spatial context, including upstream and downstream effects, landform changes, and floodplain relationships.
 - **Eye-level renderings** (such as the lower image at right) convey the aesthetic and perceptual changes at the human scale, helping participants understand how the site might look and feel after implementation.

Because these visualizations will inform decision-making, it is crucial that they accurately communicate technical information. Close coordination between the engineering team and the visualization designer is recommended to ensure that water levels, topography, structures, hydrology, and vegetation are represented as accurately as possible.

In the example shown at right, both existing conditions and design alternatives were modeled in Rhinoceros, allowing for accurate representation of topographic surfaces and water level changes. The model views were then composited with site photographs in Adobe Photoshop, and annotations were added to highlight key changes in site conditions. This workflow enables both precision and clarity, producing visuals that are technically grounded yet accessible to non-specialist audiences.



REFERENCES and ADDITIONAL RESOURCES

PROBLEM FRAMING			DETERMINING OBJECTIVES			IDENTIFYING ALTERNATIVES			ESTIMATING CONSEQUENCES			EVALUATING TRADE-OFFS			DECIDING AND TAKING ACTION		
Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public

FILLING IN THE DECISION MATRIX

WHO:
Project team

TIME:
Weeks

PURPOSE:
Identity and communicate how the alternatives impact the project objectives.

MATERIALS:
Feasibility studies.
blank matrix.

OVERVIEW

Once the feasibility studies have been completed, the decision matrix can be filled in to reflect the results of those studies. The matrix serves as a summary table, linking each alternative to its expected performance on the project objectives. It helps both the project team and the community visualize trade-offs and understand how different choices align with shared goals.

If the matrix is being used as part of an early exploratory round, the feasibility studies may not yet be complete—and that's okay. At this stage, the goal is not precision but understanding. The matrix can be filled in using constructed or qualitative scales to reflect general relationships rather than detailed quantitative data. For example, an early matrix might simply indicate "greater fish passage" versus "less fish passage," "higher cost" versus "lower cost," or "water levels will be lower" versus "water levels remain the same."

As studies progress, the decision matrix can be refined and updated with more detailed, quantitative information drawn from hydrologic modeling, ecological assessments, cost estimates, and engineering analyses. The matrix is designed to be iterative—evolving alongside the project as new information emerges and as participants deepen their understanding of values, trade-offs, and consequences.

Facilitators can use this evolving table to guide discussion and highlight how new data may shift perceptions of alternatives. Whether qualitative or quantitative, the key is to ensure the matrix remains transparent, understandable, and relevant to the decision at hand—supporting informed dialogue and helping the group move toward a clear, shared understanding of the choices before them.

PROBLEM FRAMING			DETERMINING OBJECTIVES			IDENTIFYING ALTERNATIVES			ESTIMATING CONSEQUENCES			EVALUATING TRADE-OFFS			DECIDING AND TAKING ACTION		
Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public

DEVELOPMENT OF THE MATRIX

To create the matrix, list the alternatives along the top of the sheet and the objectives or trade-offs along the left side. Within each cell, indicate the impact of each alternative on the corresponding objective.

GUIDANCE FOR TECHNICAL SPECIALISTS

For engineers, scientists, and technical consultants contributing to the matrix, the goal is not to provide every data point, but to translate complex findings into decision-relevant insights. Each performance measure should distill

how an alternative performs relative to an objective, using units or indicators that can be compared across options. Where possible, simplify or normalize results so they can be understood at a glance—for example, converting habitat models into "percent improvement," or expressing cost as "relative order of magnitude."

Technical experts should collaborate with the facilitator or design team to agree on thresholds or visual conventions (e.g., high/medium/low, increase/decrease, or positive/negative effect). When data are uncertain, note assumptions and ranges clearly. The intent is not to eliminate

complexity, and uncertainty but to make it legible and useful for decision-making, ensuring that scientific rigor supports, rather than overwhelms, the collaborative process.

For public workshops, consider using visual formats to make the matrix more accessible. Icons, color coding, or directional arrows can help participants quickly grasp relative impacts—for instance, green arrows pointing upward for positive outcomes and red arrows downward for negative ones. Such visual cues make complex data easier to interpret, support dialogue across technical and non-technical audiences, and reinforce transparency in the evaluation process.

		Keep and Repair Dam	Denil Fish Ladder	Nature Like Fishway	ByPass Channel	Remove Dam
ECOLOGICAL TRADE-OFFS	Fish Passage up and downstream	0% Passage	30%-50% Passage	60%-70% Passage	30%-50% Passage	100% Passage
	Conservation of upstream wetlands	 Upstream Wetlands Conserved	 Upstream Wetlands Conserved	 Upstream Wetlands Conserved	 Upstream Wetlands Conserved	 Potential Loss of Wetlands
CULTURAL AND AESTHETIC TRADE-OFFS	Recreational Opportunities on the impoundment	 Recreation Maintained	 Recreation Maintained	 Recreation Maintained	 Recreation Maintained	 No recreation on impoundment
	Visibility of Historic Dam	 Dam visible	 Dam visible	 Dam no longer visible	 Dam visible	 Dam no longer visible
	Impact to existing park	Remove vegetation from berm	Remove vegetation from berm + Denil fish ladder	Remove vegetation from berm + downstream channel elevated	Remove vegetation from berm + new bypass channel construction	Keep vegetation on berm + dam removed + water elevation lowered
ECONOMIC TRADE-OFFS	Up-Front costs	\$	\$\$	\$\$	\$\$\$	\$\$
	Long-Term costs and maintenance	\$	\$\$	\$\$	\$\$\$	0
	Likelihood of external funds to offset upfront cost	NOT LIKELY	LESS LIKELY	LESS LIKELY	LESS LIKELY	MORE LIKELY

Example of a Matrix Used for an Exploratory Workshop

REFERENCES and ADDITIONAL RESOURCES



5

EVALUATING TRADE-OFFS

The Structured Decision-Making (SDM) process provides a transparent framework for evaluating how well each alternative meets the project objectives. Individual participants may assign different levels of importance—or weights—to each objective, influencing how they rank their preferred alternatives.

By clearly organizing objectives and alternatives within a consequence matrix, the process makes subjective values visible and open for discussion. The matrix encourages participants to focus on their interests—the underlying reasons behind their positions—and to recognize that multiple alternatives may satisfy those interests in different ways.

Given the complexity of dam decisions and the number of often competing objectives, the consequence matrix serves as a visual tool for organizing and comparing information. It helps participants track the implications of each alternative, preventing discussions from reverting to entrenched positions or relying on quick cognitive shortcuts.

DECISION MATRIX

WHO:
Steering Committee +
General Public

TIME:
2-5 Hours

PURPOSE:
Gain understanding of
how the alternatives
meet the project
objectives and indicate
preferences

MATERIALS:
Printed matrix,
Red, green, and
yellow stickers

OVERVIEW

A consequence table is a summary matrix that illustrates how each alternative performs relative to each project objective. It provides concise estimates of the predicted outcomes, highlighting the trade-offs among objectives across the different alternatives under consideration. By clearly organizing this information, the consequence table makes subjective values visible, discussable, and comparable.

Although the matrix is often a new tool for participants, it has proven effective in helping stakeholders understand the options and recognize how their priorities may shift when seeing trade-offs side by side.

PRE-WORKSHOP PREPARATION

Before the workshop, organizers should have prepared a decision matrix. See Step 4.3 for guidance on filling out the matrix. Prior to the wokshop, print enough matrices for each participant to have one.

SETTING UP THE EXERCISE

Hand out a copy of the decision matrix to each participant. Display the matrix using a projector or screen share, and take time to walk through the evaluation of how each alternative performs relative to the objectives.

RANKING

Provide each participant with red, yellow, and green stickers, and ask them to rank the alternatives using the following system:

- GREEN = Preferred option** – “This is a great solution.”
- YELLOW = Acceptable option** – “Not the best, but I could support it.”
- RED = Opposed** – “I cannot support this option.”

Each participant must use at least one green and one yellow sticker. The yellow “acceptable” category helps participants identify areas of potential negotiation or compromise.

Once participants have placed their stickers, go around the group and ask them to briefly explain their reasoning—why they support or oppose specific alternatives. As

participants speak, the note taker should compile the rankings into a master sheet, recording the number of preferred, acceptable, and opposed votes for each alternative.

After the discussion, participants may re-rank the alternatives to reflect any shifts in perspective that occurred during dialogue. Provide each participant with a new set of stickers (one green, one red, two yellow, and one optional color).

Ask participants to share their final rankings and reasoning. As before, the facilitator should record the results on the master sheet to document how the group’s preferences evolved through discussion.

PROBLEM FRAMING			DETERMINING OBJECTIVES			IDENTIFYING ALTERNATIVES			ESTIMATING CONSEQUENCES			EVALUATING TRADE-OFFS			DECIDING AND TAKING ACTION		
Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public

REFERENCES and ADDITIONAL RESOURCES

Gregory, R., Failing, L., Harstone, M., Long, G., McDaniels, T.L., & Ohlson, D.W. 2012. Structured Decision Making: A Practical Guide to Environmental Management Choices. Wiley-Blackwell, Chichester, U.K.

RIVER ALTERNATIVES SUMMARY TABLE			No Action Alternative	Sediment Trap	Remove Wareham St Dam	Full River Restoration Remove Wareham St Dam Naturalized channel Widen 3 bridges
ECOLOGICAL OBJECTIVES	Fish Passage up and downstream		NO CHANGE	MINOR IMPROVEMENT	IMPROVED	GREATLY IMPROVED
	Improve Water quality + Habitat		— Dissolved Oxygen — Water Temperature — Sediment Transport	— Dissolved Oxygen — Water Temperature ↓ Sediment Transport	↑ Dissolved Oxygen ↓ Water Temperature ↓ Sediment Transport	↑ Dissolved Oxygen ↓ Water Temperature ↓ Sediment Transport
	Improve low-flow aquatic connectivity	Points along river where challenging for Herring to pass	7 potential low points	7 potential low points	5 potential low points	4 potential low points
INFRASTRUCTURAL AND OPERATIONAL OBJECTIVES	Minimize flood damage to infrastructure and property downstream of APC.	Flooded Area (100 Year storm)	723 Acres	723 Acres NO Reduction	680 Acres 6% Reduction	653 Acres 10% Reduction
		Impacted buildings	27 Buildings	27 Buildings	23 Buildings	19 Buildings
	Reduce ongoing maintenance by working with river morphology		Works against river morphology	Works against river morphology. Requires ongoing maintenance	Works with river morphology	Works with river morphology
	Permitting		N/A	VERY CHALLENGING	CHALLENGING	CHALLENGING
RECREATIONAL OBJECTIVES	Maximize quality and quantity of recreation on the river	Boating Opportunities Expanding fishery habitat diversity	FLAT WATER RIVER RECREATION Maintains Existing “flat water” recreation on river + ease of round trips	FLAT WATER RIVER RECREATION Maintains Existing “flat water” recreation on river + ease of round trips	FREE FLOWING RIVER RECREATION No portage at Wareham st and fewer low flow areas 	FREE FLOWING RIVER RECREATION No portage at Wareham st and fewer low flow areas 
ECONOMIC OBJECTIVES		Cost	N/A	\$	\$\$	\$\$\$
		Availability of Funding	N/A	UNLIKELY	LIKELY	LIKELY
GREEN = Preferred YELLOW = Acceptable RED = Oppose You must use at least one green and one yellow sticker						





6

DECIDING AND TAKING ACTION

While the Structured Decision-Making (SDM) process does not itself make a decision, it provides a transparent way to communicate trade-offs among alternatives and to convey the preferences of the steering committee and community to decision-makers. The ultimate goal is to support an informed and actionable decision about the future of the dam.

In contentious projects, full consensus may be unlikely, but the process helps clarify where agreement and disagreement exist and illuminates the reasoning behind different viewpoints. Using three levels of support—endorse, accept, and oppose—can reveal areas of potential compromise, highlighting alternatives that, while not ideal for everyone, may be acceptable to all parties as a foundation for moving forward.

Once the evaluation of trade-offs is complete, the project team should compile a final report summarizing both the technical analyses and the community engagement process. This report should document the alternatives considered, the objectives used for evaluation, and the range of stakeholder perspectives. A concise executive summary can then be prepared for the decision-making body—whether that is a private dam owner, select board, city council, or state agency—highlighting the preferred alternatives, areas of alignment, and key trade-offs identified through the process.

Presenting the final report to decision-makers provides an opportunity for the project team and steering committee to clearly communicate the outcomes of the process, ensuring that decisions are grounded in both community values and sound technical information. This presentation also serves as a bridge between participatory engagement and formal governance, reinforcing transparency and demonstrating that public input has been meaningfully integrated into the path forward.

FINAL REPORT

WHO:
Project Team

TIME:
Months

PURPOSE:
Summarize the technical studies and community engagement process

MATERIALS:
Final reports can be made in any word processing software including Word and Google Docs.

OVERVIEW

Once the trade-offs have been evaluated, it is important to summarize both the process and its outcomes in a clear and accessible way. This summary is best compiled into a final report that is made publicly available, ensuring transparency and accountability in the decision-making process. The report should include both the technical analyses—such as the engineering feasibility study and supporting data—and a summary of the community engagement process, documenting how local input informed the evaluation of alternatives.

Within the report, the level of support for each alternative should be summarized, along with clear documentation of the areas of agreement and disagreement among participants. This provides decision-makers with a nuanced understanding of where consensus may exist and where tensions remain. The inclusion of visuals—such as maps, diagrams, consequence tables, and photographs from workshops or site visits—can make the report more engaging and help communicate the rationale behind community preferences and trade-offs.

The final report serves multiple functions: it documents the process for transparency, provides a foundation for regulatory review or funding applications, and serves as a reference for implementation planning. The report should include recommendations for next steps, such as additional studies, permitting pathways, design milestones, or opportunities for continued community engagement during implementation.

The final report should serve as both a record of process and a decision-support tool for the next stages of implementation. It should communicate the technical, ecological, and social dimensions of the decision clearly to a broad audience—including regulatory agencies, funders, and community members. The outline below provides a recommended framework for structuring the report so that it is comprehensive, transparent, and easy to navigate, ensuring that both the methods and outcomes of the Structured Decision-Making process are clearly documented and accessible to all stakeholders.

RECOMMENDED STRUCTURE FOR THE FINAL REPORT

1. Executive Summary

A brief overview of the project, the decision context, and the main findings of the process. Summarize key outcomes, preferred alternatives, and next steps in accessible language for a broad audience.

2. Introduction and Background

Describe the dam’s location, ownership, history, and condition. Include the ecological, social, and economic factors that led to the need for decision-making.

3. Project Objectives and Decision Framework

Outline the objectives developed through the Structured Decision-Making (SDM) process. Describe how these objectives guided the evaluation of alternatives and how performance measures were selected.

4. Alternatives Considered

Provide a concise description of each alternative that was evaluated, including design concepts, assumptions, and relevant technical data. Illustrate with diagrams or maps where possible.

5. Evaluation and Trade-Offs

Present the results of the consequence table or decision matrix. Summarize how each alternative performed relative to the objectives, highlighting key trade-offs, uncertainties, and sensitivities.

6. Community Engagement Summary

Document the methods used for community participation—workshops, surveys, public meetings, or site visits—and summarize the feedback received. Identify areas of alignment and disagreement, and show how input was incorporated into the final evaluation.

7. Preferred Alternative and Rationale

If there is a clear preferred alternative that emerged from the process, it can be identified in the report. Explain the rationale for its selection based on both technical feasibility and community input.

8. Recommendations and Next Steps

Outline the recommended actions including further studies, permitting, design milestones, funding opportunities, and plans for continued community engagement.

9. Appendices

Include supporting materials such as workshop notes, raw data, detailed modeling results, case study summaries, and full versions of the feasibility and engineering reports.



REFERENCES and ADDITIONAL RESOURCES

PERMITTING

WHO:
Dam owner, consultant

TIME:
Months to years

PURPOSE:
Obtain necessary permits

MATERIALS:
Each agency will specify documents need to be submitted.

OVERVIEW

Local, state, and federal agencies all have regulatory authority over dams. The permitting process can be complex, often involving multiple agencies and overlapping review timelines. The specific permits required will vary depending on the type, size, and condition of the dam, the scope of proposed work, and the sensitivity of the surrounding environment.

PROCESS AND TIMING

Depending on the project, several permits may be required, such as wetland or water quality permits, dam safety approvals, and federal authorizations under the Clean Water Act or Endangered Species Act. Each permit has its own review timeline—some taking up to 90 days after submission for agency review and comment. The more thoroughly prepared the feasibility analysis and permit application, the more efficiently the process will proceed. Regulators may request additional information or revisions during their review, so project teams should plan adequate time for back-and-forth communication.

COSTS AND RESPONSIBILITIES

Permit preparation costs can vary widely depending on project complexity. If all filings, forms, and agency coordination are completed by consultants, permitting may cost anywhere from a few thousand to over one hundred thousand dollars. In some cases, municipalities or state agencies may qualify for fee waivers, and proponents can reduce costs by managing filings and attending hearings directly.

RECOMMENDATIONS FOR SUCCESSFUL PERMITTING

Effective communication and collaboration with regulatory agencies can streamline the permitting process and reduce delays. The following best practices are recommended:

- **Consult early and often** with relevant agencies to identify all necessary permits and requirements.
- **Invite agency personnel for a site visit** before beginning the permitting process to ensure shared understanding of site conditions.
- **Maintain regular communication** with agency staff throughout the process and respond completely and accurately to questions or requests for information.

- **Document all correspondence** and submissions, keeping clear records of agency feedback and response dates.
- **Allow sufficient time** in the project schedule for consultation, public comment periods, and formal review processes.
- **Coordinate across agencies** to align timelines and avoid redundant studies or conflicting permit conditions.

PERMITTING AS PART OF THE DECISION-MAKING PROCESS

Permitting should not be viewed solely as a compliance step at the end of a project. It is an opportunity to build trust and transparency with regulatory partners and the public.

Early coordination helps ensure that permitting agencies are aware of the decision-making framework, the alternatives considered, and the rationale for the selected approach. Integrating permitting considerations into the feasibility and design phases can prevent costly revisions later and strengthen the credibility of the overall process.

PROBLEM FRAMING	DETERMINING OBJECTIVES	IDENTIFYING ALTERNATIVES	ESTIMATING CONSEQUENCES	EVALUATING TRADE-OFFS	DECIDING AND TAKING ACTION
Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public

REFERENCES and ADDITIONAL RESOURCES

PERMITTING- RHODE ISLAND

WHO:
Dam owner, consultant

TIME:
Months to years

PURPOSE:
Obtain necessary permits

MATERIALS:
Each agency will specify documents need to be submitted.

OVERVIEW

The following section outlines the permitting process for dam removal in Rhode Island. Because there are relatively few licensed hydropower dams in the state, Federal Energy Regulatory Commission (FERC) requirements—though occasionally relevant—are not fully integrated into this overview.

WHEN IS A PERMIT REQUIRED?

In nearly all cases, dam removal in Rhode Island requires formal permitting. In compliance with the federal Clean Water Act (CWA) and state regulations, the removal, repair, or alteration of a dam typically triggers multiple permit applications. Exceptions are rare and may apply only to very small structures or to dams that have already been breached.

In such limited cases, applicants can submit a Request for a Preliminary Determination to the Rhode Island Department of Environmental Management (RIDEM). RIDEM will assess whether the proposed removal would significantly alter the functions and values of the wetland.

- If no changes are expected, a permit may not be required.
- If minor changes are anticipated, RIDEM may issue a permit with conditions.
- If significant changes are likely, a full permitting process will be necessary.

WHO ISSUES THE PERMITS?

In Rhode Island, dam removal permits are issued primarily by:

- Rhode Island Department of Environmental Management (RIDEM), or
- Rhode Island Coastal Resources Management Council (RICRMC), and
- U.S. Army Corps of Engineers (USACE)

Projects often involve multiple agencies across local, state, and federal levels, especially if they require federal funding or technical assistance. Because of this complexity, it is highly advisable to involve permitting agencies early in project planning.

WHAT FEDERAL AGENCY MUST ISSUE A PERMIT?

At the federal level, the U.S. Army Corps of Engineers must issue a Section 404 permit under the Clean Water Act for any project involving the placement of fill or dredged material in U.S. waters.

Before the Corps can issue this permit:

The state (RIDEM) must provide or waive a Section 401 Water Quality Certification, ensuring that the project will not violate Rhode Island water quality standards.

If the project is located within, or may affect, the coastal zone, the RICRMC must issue a Coastal Zone Management (CZM) Consistency Determination under the Coastal Zone Management Act (16 U.S.C. §1451 et seq.), certifying that the project aligns with Rhode Island’s approved coastal management program.

WHAT RI AGENCY ISSUES THE CERTIFICATE?

Jurisdiction depends on whether the dam is located within the coastal zone. Ask the following questions:

- Does the dam lie within tidal waters or within 200 feet inland of a coastal feature (e.g., coastal beach, dune, barrier island, cliff, bluff, rocky shore, or manmade shoreline)?
- Would the removal affect activities within the watershed of a poorly flushed estuary?

- Does the project influence industrial or utility infrastructure, such as power plants, petroleum facilities, wastewater treatment, or solid waste sites?

If you answered yes to any of these, the project generally falls under RICRMC jurisdiction—with the exception of wetlands historically used for agriculture, which remain under RIDEM authority.

If no, or if the site includes agricultural wetlands, RIDEM will typically hold jurisdiction.

In cases where jurisdiction is unclear—such as when wetlands span both sides of a boundary—either agency can issue a joint determination upon written request. Factors considered include the extent and location of wetlands, potential land disturbance, and watershed planning guidance. In rare cases, both agencies may share jurisdiction.

IS THERE PERMITTING ASSISTANCE AVAILABLE?

Because of the complexity of the permitting process, applicants are encouraged to seek early guidance.

If under RICRMC jurisdiction:

- Request a Pre-Application Meeting with CRMC professional staff
- Submit a Preliminary Determination Report for written feedback on the project’s merits relative to the CRMC management program.

If under RIDEM jurisdiction:

- Contact the RIDEM Office of Customer and Technical Assistance for pre-application support.
- Review previously submitted dam removal applications—RIDEM maintains public records accessible by appointment.
- Schedule a meeting with the RIDEM Watershed Quality and Wetland Restoration Team, which assists proponents in identifying required permits and clarifying data and design requirements.

GENERAL BEST PRACTICES FOR APPLICANTS

- Engage with permitting agencies early and often.
- Invite agency staff to site visits before formal applications are submitted.
- Provide complete, accurate responses to agency questions and information requests.
- Allocate ample time for consultations and regulatory reviews—some permits may take 60–90 days after submission, and additional information requests can extend this timeline.
- Track submissions using certified mail or other documented methods to ensure compliance with agency review deadlines.

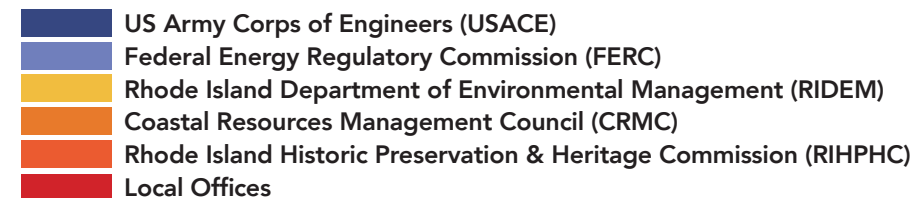


REFERENCES and ADDITIONAL RESOURCES

www.crmc.ri.gov/applicationforms/PreAppMeeting.pdf

<http://www.dem.ri.gov/> .

Who do I notify?
What permits do I need?



1. **Rhode Island General Permit** - <https://www.nae.usace.army.mil/Portals/74/docs/regulatory/StateGeneralPermits/RI/Rhode-Island-General-Permit.pdf>
2. **Ferc License Surrender Process** - <https://www.ferc.gov/administration-and-compliance/how-surrender-license-or-exemption>
3. **CRMC Assent Application** - <http://www.crmc.ri.gov/applicationforms/Assentapp.pdf>

PERMITTING- MASSACHUSETTS

WHO:
Dam owner, consultant

TIME:
Months to years

PURPOSE:
Obtain necessary permits

MATERIALS:
Each agency will specify documents need to be submitted.

OVERVIEW

This section outlines the permitting and regulatory framework for dam removal in Massachusetts, with emphasis on key state and federal authorities. Because Massachusetts has a denser institutional environment around rivers, wetlands, and dam safety, projects often involve more layers of review and more stringent standards than some other states.

WHEN IS A PERMIT REQUIRED?

Permits are generally required for most dam removal, modification, or repair projects in Massachusetts. The project typically triggers multiple regulatory acts—such as the Clean Water Act, Massachusetts Wetlands Protection Act, River Protection Act, and dam safety statutes. Exemptions are rare and might only apply in very limited cases where the structure is extremely small or already compromised. In those exceptional situations, local permitting bodies or state agencies may issue preliminary determinations, but a full review is more common.

WHICH AGENCIES ISSUE PERMITS?

In Massachusetts, dam-related permits and reviews are issued by a mixture of local, state, and federal agencies. Typical major institutions include:

- Massachusetts Department of Environmental Protection (MassDEP)
- Massachusetts Office of Dam Safety
- Massachusetts Division of Fisheries & Wildlife / Division of Marine Fisheries
- Municipal Conservation Commissions (under the Wetlands Protection Act)
- U.S. Army Corps of Engineers (USACE)
- Massachusetts Historical Commission (MHC)
- NOAA Fisheries / U.S. Fish & Wildlife Service, when migratory fish or wildlife habitat is involved

Projects must navigate overlapping jurisdiction among these agencies—especially for wetlands, fish passage, cultural resources, and dam safety. Early coordination and interagency consultation are critical to avoid delays or conflicting conditions.

FEDERAL PERMITTING IN MASSACHUSETTS

Any dam removal that involves altering or placing material in waters of the U.S. generally requires a Section 404 permit from USACE, and prior to that, a Section 401 Water Quality Certification from MassDEP, to ensure state water quality standards are maintained. Additionally, if the project affects tidal areas or coastal waters, consultation under the Coastal Zone Management (CZM) Act may be needed through the Massachusetts Office of Coastal Zone Management (CZM).

STATE & LOCAL JURISDICTION IN MASSACHUSETTS

Permitting jurisdiction in Massachusetts depends on the location of the dam, the presence of wetlands or riparian zones, and local municipal bylaws. Key permitting processes include:

- Wetlands Protection Act (WPA) (through local Conservation Commissions)
- River Protection Act, for buffer zones along streams
- Dam Safety (via Office of Dam Safety)
- Historic/Cultural Resource Review (through MHC)
- Endangered Species / Habitat Review, if applicable

If a dam lies within protected or resource-sensitive zones (e.g. in core river corridors or near wetlands), local and state agencies may require Notice of Intent (NOI), Order of Conditions, and coordination with multiple divisions.

PERMITTING ASSISTANCE & PRE-APPLICATION COORDINATION

Given the varied regulatory paths, applicants are encouraged to pursue early coordination and assistance:

- Request pre-application meetings with MassDEP, Office of Dam Safety, and local Conservation Commissions to clarify required permits, review timelines, and submittal expectations.
- Visit prior project files—MassDEP or local conservation offices often retain past permit records for dam removals; reviewing them can provide templates or insights.
- Engage with agency staff early, invite them to site visits, and build shared understanding of project context.
- Prepare a preliminary environmental review package (maps, hydrologic data, baseline conditions) to help agencies assess feasibility and comment early.



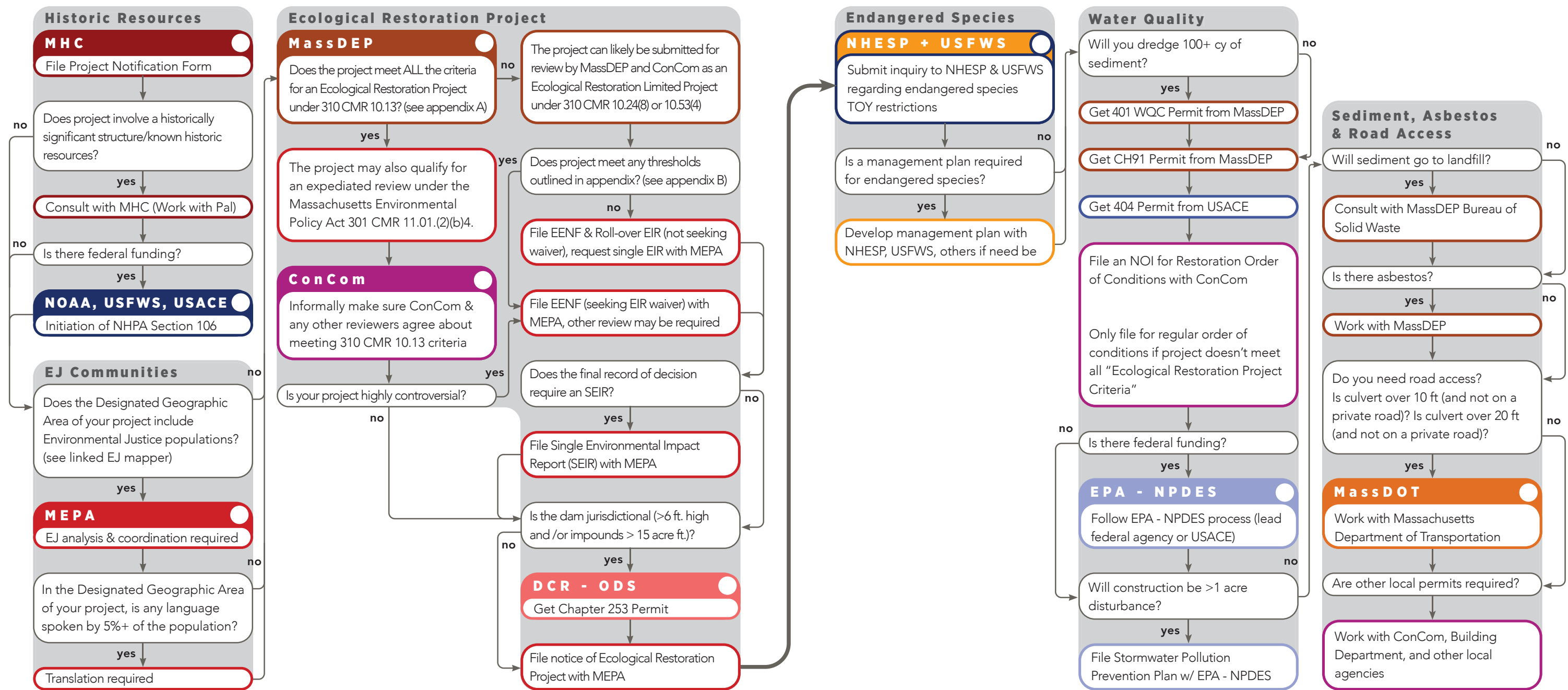
REFERENCES and ADDITIONAL RESOURCES

Franklin Regional Council of Governments. 2025. River Restoration Design and Permitting in Massachusetts: A Guide for Inland Rivers, Greenfield, Massachusetts, 164 pp.

www.crmc.ri.gov/applicationforms/PreAppMeeting.pdf

<http://www.dem.ri.gov/>

Dam Removal Process (Massachusetts)



- | Federal Agencies | State Agencies |
|---|---|
| National Oceanic and Atmospheric Administration (NOAA) | Massachusetts Historical Commission (MHC) |
| U.S. Fish & Wildlife Service (USFWS) | Massachusetts Environmental Policy Act Office (MEPA) |
| US Army Corps of Engineers (USACE) | Department of Conservation and Recreation (DCR) |
| Federal Energy Regulatory Commission (FERC) | + Office of Dam Safety (ODS) |
| Environmental Protection Agency (EPA) | Mass. Department of Environmental Protection (MassDEP) |
| + National Pollutant Discharge Elimination System (NPDES) | Massachusetts Department of Transportation (MassDOT) |
| | Massachusetts Department of Fish & Game (DFG) |
| | + Natural Heritage & Endangered Species Program (NHESP) |
| | Massachusetts Office of Coastal Zone Management (CZM) |
| Local Agencies | |
| Conservation Commissions (ConCom) | |

- List of Abbreviations**
- **NHPA** - National Historic Preservation Act
 - **EJ** - Environmental Justice
 - **CMR** - Code of Massachusetts Regulations
 - **ENF** - Environmental Notification Form
 - **EENF** - Extended Environmental Notification Form
 - **EIR** - Environmental Impact Report
 - **SEIR** - Single Environmental Impact Report
 - **TOY** - Time of Year
 - **WQC** - Water Quality Certification
 - **NOI** - Notice of Intent

Dam Removal Process (Massachusetts)

Appendix A

Ecological Restoration Project Criteria

- Not intended to mitigate alteration of a Resource Area (except through in-lieu fee)
- No short or long-term adverse effect on specified habitat sites of Rare Species
- No significant adverse effects on flood control and storm damage prevention
- Will not reduce capacity of Resource Area to serve habitat functions
- If includes a stream crossing, crossing is designated for work in coastal and inland resource areas
- No discharge of dredged or fill material into Class A surface water
- No discharge of dredged/fill material to vernal pool
- No point source discharge to ORW

For Dams:

- Dam is not managed for flood control by municipal, state or federal agency
- No adverse impacts to public or private wells or withdrawals
- No FERC licensing involved

For daylighting:

- Meets performance standards for Bank and Land Under Water Bodies and Waterways.
- Includes revegetation with natives

For tidal:

- No new or relocated tidal inlet/breach through Barrier Beach or armoring of a Barrier Beach
- No new water control devices or a change in management of existing devices, if for flood/storm damage prevention

Appendix B

Does your project meet any of these thresholds:

- Direct alteration of 25+ acres of land, unless consistent with conservation farm, forest cutting or other similar plan.
- Disposition or change in use of land/interest in land
- Conversion of active agricultural use to nonagricultural use
- Alteration of designated significant habitat (per MESA)
- >2 acres disturbance of designated priority habitat
- Alteration of coastal dune, barrier beach or coastal bank
- Alteration of 500+ ft of bank along fish run or inland bank
- Alteration of 1,000+ sf of salt marsh or ORW
- Alteration of 5,000+ sf of BVW or IWW
- New fill or structure or expansion of existing fill or structure
- Alteration of 1/2+ acres of any other wetlands
- Dredging of 10,000+ cy of material
- Disposal of 10,000+ cy of dredged material
- Construction, reconstruction or expansion of an existing solid fill structure of 1,000+ sf base area or of a pile-supported or bottom-anchored structure of 2,000+ sf base area, provided the structure occupies flowed tidelands or other waterways.
- Cut 5+ living public shade trees of 14 or more inches in DBH (Transportation)
- Eliminate 300+ ft of stone wall (Transportation)
- Unless the Project is subject to a Determination of No Adverse Effect by the MHC or is consistent with a MoA with the MHC:
 - Demolition of all or any exterior part of listed Historic Structure
 - Destruction of all or any part of listed Archaeological Site
 - 1/2+ acres within a designated ACEC
- Direct alteration of 50+ acres of land, unless consistent with conservation farm, forest cutting or other similar plan.
- Alteration of 1+ acres of salt marsh or BVW
- Alteration of 10+ acres of any other wetlands
- Alteration requiring a variance in accordance with the WPA
- Structural alteration of an existing dam that causes an expansion of 20% or any decrease in impoundment Capacity

REFERENCES and ADDITIONAL RESOURCES

1. [MHC Project Notification Form](#)

2. [Section 106 Tutorial](#)

3. [Environmental Justice Mapper](#)

4. [Ecological Restoration Project 310 CMR 10.13](#)

5. [MEPA EENF & Single EIR request form](#)

6. [MEPA Single Environmental Impact Report \(SEIR\)](#)

7. [DCR - ODS Chapter 253 Permit](#)

8. [MEPA Notice of Intent Ecological Restoration Project](#)

9. [MassDEP ePLACE Portal - 401 WQC Forms](#)

10. [MassDEP CH91 Forms](#)

11. [USACE 404 Forms](#)

12. [EPA - NPDES Stormwater Pollution Prevention Plan \(SWPPP\)](#)

IMPLEMENTATION

WHO:
Project team, consultant, construction crew

TIME:
Years

PURPOSE:
Implement chosen path of action for a dam site

MATERIALS:
Will depend on implementation plan

OVERVIEW

Following the completion of feasibility studies, the selection of a preferred alternative, and the necessary permitting and final design phases, the project moves into implementation. Implementation is the stage where the design becomes reality—requiring careful coordination among the design team, contractors, permitting agencies, and community partners. Successful implementation depends not only on the quality of the design but also on thoughtful sequencing, clear communication, and adaptive management during construction.

Implementation can extend over multiple seasons or years, depending on the complexity of the site, funding cycles, and environmental conditions. The construction process often includes site preparation, dam removal or modification, sediment and water management, habitat restoration, and long-term monitoring. Each of these steps must be undertaken with precision to ensure that ecological and safety objectives are achieved and that the work complies with approved permits and design specifications.

CONSTRUCTION OVERSIGHT

It is critical that the design engineer or an authorized representative be present during all key phases of construction to ensure that the project is implemented as designed and to address any field conditions that may require adjustments. Field oversight should include verifying construction methods, confirming material specifications, documenting daily progress, and coordinating with regulatory inspectors. Regular site meetings between the contractor, engineer, and client are recommended to review progress, resolve issues, and approve any design modifications.

CONTRACTOR COORDINATION

A pre-construction meeting should be held to review the design, specifications, staging, safety protocols, and permit conditions with all contractors and subcontractors. The meeting provides an opportunity to clarify sequencing, roles, and lines of communication. Clear documentation of expectations and field decisions—through meeting minutes, inspection logs, and daily reports—helps maintain transparency and accountability throughout the process.

ADAPTIVE MANAGEMENT DURING CONSTRUCTION

Despite thorough planning, site conditions during construction are often unpredictable—exposing buried infrastructure, unexpected sediment deposits, or previously undocumented habitat features. The implementation phase should therefore include flexibility for adaptive management. This may involve adjusting dewatering plans, modifying grading or stabilization approaches, or refining habitat treatments in response to observed site conditions. Any adjustments should be documented and communicated to both the regulatory agencies and the project team.

SITE STABILIZATION AND HABITAT RESTORATION

Once the structural components of removal or modification are completed, stabilization and restoration activities can begin. These may include streambank grading, soil stabilization, re-vegetation with native species, and installation of in-stream habitat features such as woody debris, boulder clusters, or riffle-pool sequences. Restoration should be tailored to the site’s hydrology, sediment dynamics, and ecological goals. The design team should inspect these features after major flow events during the first year to assess stability and performance.

POST-CONSTRUCTION MONITORING AND MAINTENANCE

Monitoring is essential to evaluate whether the project objectives are being met and to identify any maintenance needs. Post-construction monitoring should track hydrologic performance, sediment movement, vegetation establishment, and ecological responses (e.g., fish passage, habitat connectivity). Data from monitoring can inform adaptive management and serve as a valuable resource for future dam removal or modification projects. Maintenance activities—such as invasive species management, erosion control repairs, or replacement of plantings—are often necessary during the early years of site recovery.

FINAL DOCUMENTATION AND REPORTING

At project completion, the design team should compile a construction completion report summarizing as-built conditions, permit compliance, and lessons learned. The report should include final drawings, photographs, and monitoring data. This documentation not only fulfills regulatory requirements but also provides a record for future projects, supporting broader learning and capacity-building around dam removal and river restoration efforts in the region.



REFERENCES and ADDITIONAL RESOURCES

Executive Office of Energy and Environmental Affairs (2007). *DAM REMOVAL in MASSACHUSETTS: A Basic Guide for Project Proponents*.

STEWARDSHIP

WHO:
Steering Committee +
General Public

TIME:
Long-Term

PURPOSE:
Build a community of
stewards for the river

MATERIALS:
Will depend on
stewardship activities

OVERVIEW

Rivers and oceans are some of the last remaining resources that are still held in common by the people. These are some of the most ecologically dynamic and diverse landscapes, and they will be the most likely to experience the impacts of climate change. We all depend on rivers for drinking water, flood control, recreation, and sustenance and the more-than-human-species depend on the rivers as habitat and migratory corridors.

One of the goals of the decision making process outlined in this document is to build community and develop shared social practices that help care for the river. The community involvement that is initiated through the decision making around the dam can continue and evolve into other forms of community stewardship of the river over time. There may be opportunities for community members to participate in community restoration projects, or help advocate for the river, or just spend time paddling the river which ensures that there are “eyes on the river.” If there is not an existing watershed management plan for the river or access plan, the discussion of a dam can help initiate larger discussions about the health of the river and how communities can “turn back” to the rivers and support the human and more than human communities that surround them.

The Structured Decision-Making and community engagement processes described in this guide are designed not only to support informed, transparent decisions about infrastructure but also to build a foundation for ongoing stewardship. As communities engage in dialogue about the future of a dam, they begin to rebuild their connections to the river itself—connections that can evolve into sustained, local forms of care and governance long after the formal project ends.

FROM DECISION-MAKING TO LONG-TERM CARE

Community involvement initiated through dam decision processes can continue as stewardship in many forms. Some communities may organize volunteer stream clean-ups, monitoring programs, or citizen science initiatives that track water quality, habitat, or migratory fish. Others may focus on cultural and recreational programming—such as paddling events, educational tours, or art installations—that encourage ongoing engagement and awareness.

Partnerships with schools, local nonprofits, watershed associations, and tribal nations can help institutionalize this stewardship. By embedding river education and participation in community life, the sense of collective ownership deepens. Over time, this can lead to the establishment of river stewardship committees, watershed councils, or “friends of the river” groups that serve as long-term advocates and caretakers.

establish water quality and habitat goals, and build partnerships among municipalities, conservation districts, and residents. The planning process also provides an opportunity to integrate equity and access—ensuring that all community members, including those historically excluded from decision-making, have the ability to connect with and benefit from the river.

goals. When people have the opportunity to interact with and learn from the river, they are more likely to feel a sense of responsibility toward its ongoing care.

A LIVING RELATIONSHIP

Ultimately, stewardship is an ongoing, adaptive relationship rather than a fixed outcome. Rivers will continue to change—through natural dynamics, climate shifts, and evolving community needs. By cultivating networks of stewards who are attentive to those changes, communities can ensure that their rivers remain resilient and life-supporting for generations to come. The process of deciding the future of a dam, then, becomes not an endpoint but a beginning: the renewal of a shared commitment to the river as a living commons.

INTEGRATING STEWARDSHIP INTO PLANNING

If a watershed management plan, open space plan, or river access plan does not yet exist, the discussion surrounding a dam project can become the catalyst for creating one. These plans can help coordinate restoration priorities, identify access points,

DESIGNING FOR STEWARDSHIP

Physical design can also foster stewardship. Providing safe and visible public access to rivers—through trails, overlooks, boat launches, or restored riparian parks—helps keep people connected to the water. Interpretive signage, community art, and storytelling can celebrate the river’s cultural history while conveying ecological processes and restoration



REFERENCES and ADDITIONAL RESOURCES

PROBLEM FRAMING	DETERMINING OBJECTIVES	IDENTIFYING ALTERNATIVES	ESTIMATING CONSEQUENCES	EVALUATING TRADE-OFFS	DECIDING AND TAKING ACTION
Project Team	Steering Committee	General Public	Project Team	Steering Committee	General Public



Fish Passage Parade and Gathering on the Blackstone River.
May 2023. Source: Andy Moran

CONCLUSION

Given that there are more than 14,000 dams in New England—many of them aging and nearing the end of their functional lifespan—there will be thousands of decisions to be made in the coming years. These decisions are critical: they will shape how we protect downstream communities, restore ecological connectivity, and build resilience to climate change. They also represent an opportunity to reimagine our collective relationship with rivers as living systems.

Our goal with this work is to offer a structured, transparent, and inclusive method for engaging communities in decision-making around dams. By providing clear frameworks and accessible tools, we hope to reduce the number of projects that are stalled or delayed due to community resistance—often the result of misunderstanding, lack of trust, or limited opportunity for participation.

The materials presented in this document are available as open-source resources on the web (www.damatlas.org). We invite others to use, test, adapt, and evolve these methods in their own contexts. While every dam and every community is unique, we believe that openly sharing tools, lessons, and outcomes can help build a growing “library of approaches” for collaborative water governance and landscape restoration.

We also hope that this spirit of collaboration extends beyond practitioners to the communities themselves—empowering residents and local leaders in shaping resilient and thriving river systems.



ACKNOWLEDGMENTS

This work would not have been possible without the collaboration, generosity, and insight of many partners, practitioners, and community members across New England. I am deeply grateful to the agencies, watershed organizations, residents, local leaders, and towns who participated in the workshops and pilot projects that shaped these methods. Their perspectives, stories, and care for their rivers have been central to this work.

I would also like to thank the many colleagues, students, and collaborators who contributed to the development and refinement of these tools—from early research and facilitation to the design of the objective cards, consequence matrices, and case study templates. Their creativity and commitment to bridging science, design, and community knowledge have been invaluable.

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Finally, we acknowledge and are grateful to the broader network of practitioners, scholars, and communities working to frame water as a commons and to strengthen the relationships between the human and more than human communities that depend on our rivers.

APPENDIX 01

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APPENDIX 02

FACILITATOR SUPPORT

FACILITATING GROUP DISCUSSIONS*

FACILITATION GOALS

- Create an environment for effective communication (the achievement of mutual understanding)
- Keep discussion focused
- Keep people engaged.
- Advance and deepen discussion.
- Provide opportunity for all voices to be heard.
- Create environment of trust and support so disagreement and understanding can surface.
- Leave participants challenged and willing to engage in follow-up conversations.

PREPARATION

Decide who should facilitate the discussion. Consider who knows the topic, can assume an “objective” role, will be accepted by the group and has group experience. Consider what you know about the topic, whether your views are known to participants, and whether that makes your role as a facilitator too difficult.

Know yourself before you begin as a facilitator.

- What are my personal beliefs, values and stereotypes about the issue?
- Can I assume an objective role in the discussion?
- How do I establish trust and openness among the group?
- How do I show respect for the opinions of others?
- How do I tactfully mediate conflict?
- How do I keep discussion flowing smoothly?
- How do I encourage the participation of everyone and avoid domination by a few?
- How do I deal with someone showing disrespect for another?
- What should I do when I don’t know how to respond to a comment or question?
- Will I feel comfortable facilitating a group discussion on this issue?

Identify the goals of the session. What are you trying to accomplish?

Schedule tentative time blocks, so that the introduction and key points will be covered before the end of the discussion.

Plan for any materials or help you will need. Will you need a writing surface such as a blackboard, or newsprint and marker pens. If it is an event where you will be writing down information, ideas, choose someone else to be the recorder. Hint: It is very hard to facilitate a discussion and be the one doing the recording.

STARTING OFF

Introduce the purpose of the discussion and ensure that the participants have the same understanding.

Explain the organization and structure (including the time line) of the discussion, when it will end, and whether or not there are formal follow-up plans.

Explain your role as facilitator - a person whose role it is to remain neutral or objective, to keep the discussion focused and energized and to create an environment for all to have a chance to participate. This does not mean that you are neutral and have no opinions, but as a facilitator you need to play an objective role. Set the appropriate tone. Show your comfort with the topic so that others feel comfortable. Create a safe and open environment so that the participants will feel comfortable and share their views openly and honestly.

“I (we) am (are) here to help us have a good discussion about We are here to learn from one another, to get a sense about how we think and feel about Our job as facilitators is to help us have a good discussion where all views can be voiced in a safe and respectful environment. That doesn’t mean that there won’t be disagreement and some tension about important issues. We hope that you will say what is on your mind. To create a safe and respectful atmosphere we ask that all of us follow a few groundrules.”

*Adapted from Stanford University: How to Effectively Facilitate Group Discussions by Ann Porteus, Nanci Howe, and Tommy Woon. <https://www.coursehero.com/file/55580661/Facilitating-Group-Discussionsdocx/>

Establish groundrules for the discussion so that the participants feel the environment is safe to speak about their ideas and feelings. Groundrules should be explicit. Groundrules may not fit everyone because we have different cultural backgrounds. Ask the group if these rules make sense and if everyone can honor them. The following are some suggestions (add your own):

- We ask that you speak from your own perspective; personal “I” statements are useful ways for keeping your view points personalized, and keep you from generalizing about what others think or feel
- We ask that you respect the viewpoints of others--that you listen respectfully and attentively, and that you withhold judgment about other’s views. Our goal here is not to persuade each other of our ideas, but to get ideas out on the table so people can make their own decision.
- To show your respect for others in the room, we ask that you stay focused on the discussion and avoid side conversations. We ask that you make a conscious effort to listen actively to hear what is being said.
- We expect that everyone here will try to make this experience a good one; that we are all responsible for how this discussion goes.
- We ask that you be willing to voice disagreements, but we ask that if you disagree with someone’s idea that you criticize the idea, not the person. With sensitive issues, people make take things personally. Please try to be sensitive to each other’s needs and concerns. Try to speak up if you feel hurt in anyway. Avoid derogatory or sarcastic comments at the expense of others.
- We ask that you don’t interrupt each other.
- All questions are good ones. We encourage you to ask questions of each other no matter how simplistic you might think they are. Chances are there are others who have the same question. The goal of the discussion is to learn and explore.
- We ask that you limit your exchanges with one person to no more than 3 exchanges. If it goes beyond three then others need the chance to express their opinion.
- We ask that you don’t make assumptions about what others think or mean. Remember that others will not always attach the same meanings to words that you do or perceive the world the same way you do.

GETTING THE DISCUSSION STARTED

Open questions requiring more than a “yes” or “no” response (as opposed to closed questions which lead to a one word response) generate discussion and stimulate thinking. (Keywords: “how”, “why”, “what”, “what if”, “tell us about”)

- “How do you feel about the points made in the presentation?”
- “What in your experience has led you to the view that you just expressed?”

Group oriented questions encourage group participation and tend to stimulate everyone’s thinking. (Keywords: “who”, “anyone”)

- “Would anyone be willing to share their reactions to the program?”
- “Does anyone have any ideas about how we should start this discussion?”
- “Does anyone have an issue or concern that they would like to raise to get us started?”

“What experiences have any of you had with this issue?”

Individual oriented questions encourage individual response (but may put people on the spot) and can tap known resources of a “expert” in the group:

- “Tom, what do you think about the issues raised in the article?”
- “Allison, how do you feel about what is happening in the dorm now, on the topic of X?”
- “ Eric, you have done a lot of reading in this area, how do you see the issue?”
- Factual questions seek information. (Keywords: “what”, “which”, “how much”)
- “What are some of the major pros and cons from your perspective?”
- “What statements did you actually hear made during the presentation that made you upset?”
- “Who on campus is best suited to talk further about this issue?”

DURING THE DISCUSSION

Checking Yourself

Remain neutral (objective and open). This does not mean that you don’t have opinions, but facilitators usually do not offer their own views; they help group members share theirs. Your role is to facilitate the group’s discussion. If you have valuable ideas or opinions that are essential to what is being discussed, put your facilitator role aside and ask someone else to act as facilitator while you give your input

- “How do some of the rest of you feel about that?”
- “That may be your experience, but others may see things differently. Do any of you have a counter example or opinion.?”
- “I have an opinion I would like to share, so I am taking my facilitator hat off for a comment.”

Stay off the soapbox. Successful facilitators listen rather than talk. Watch for danger signals:

- Talking too much
- Feeling the need to address all questions
- Talking more than your co-facilitator(s)
- Seeing the group interacting more with you rather than with each other
- Engaging in dialogue with individual members of the group

Avoid being put in the position of the “expert”. Some may look to you to provide the answers to challenging questions or situations. Refrain from immediately providing “your answer” to the issue at hand. Turn the situation back to the questioner or ask the question of the whole group. If you are stuck or lost, admit it honestly to the group; someone is almost always likely to come to your rescue.

“ How would you handle that?”

Stay aware of your own “hot buttons”. Know where you stand on the issues, where your own prejudices/biases lie and where you are in your own personal discovery. If you feel you won’t shut down discussion you could own up to them at the very beginning of the discussion and say that although you have deep feelings about the issue, you are

committed to creating an environment where all feelings can be heard and respected.

Acknowledge contributions, validate people’s ideas, and give credit where credit is due.

- “Thanks for saying that Linda. No one had mentioned that before.”
- “Thanks for that helpful contribution. It is not easy to share such a personal experience. That was very courageous.”
- “Dave, I appreciate your offering a different view.”
- “You made a strong general statement, Mary. Is that what you think (or feel)?”
- “Could you restate your point using ‘I’ instead of ‘we’ or ‘you’ or ‘people think’?”

Keep the focus on ideas not individuals. Some ways to do this are:

- Ask the group to brainstorm ideas - Ask the group to identify pros and cons of a position rather than having individuals explain or defend a position
- Divide the group in half, being sure each half includes representatives of different viewpoints and ask each group to develop one side of the argument
- Go around the circle asking everyone to say something about the topic and indicate in what ways they agree with previous speakers. Then ask a recorder to summarize the primary feelings expressed by the group
- Create small groups, each with a reporter who will bring ideas of the small group back to the whole group
- Redirect people who make personal comments about others.

Try to keep the discussion concrete rather than abstract. People tend to talk abstractly especially when dealing with uncomfortable topics. Suggesting that people share real experiences can be effective.

- “Can you give an example of what you are talking about from your own experience?”

Keep the focus on the subject without restraining free expression of ideas.

- “You have made an interesting point, but how would you say that relates to X (the topic under discussion)?”
- “It seems that we have started another topic without finishing the first. Should we return to the issue we were discussing before going on?”

Get participants to “own” their comments rather than speaking in generalizations about what others think.

Synthesize statements as a way of keeping track and bringing focus on where the discussion is going/has gone.

- “Some of the main points I have heard are...”
- “What were some of the main themes here tonight?”
- “Can someone give a brief distillation of the discussion that we just had?”

Be patient with silences. Don’t jump to fill in silence. Silence can be an important time for some and may spur others to talk.

Know and emphasize the importance of pause time. Encourage each person to be aware of their own pause time before jumping in. As a facilitator don’t jump in too quickly.

Read non-verbal cues. Are a few people dominating the discussion? Are there many interruptions? Observe who is participating and who is not? Are people looking bored? Angry? Impatient? What is the level of energy in the discussion?

- “People seem a little restless, why don’t we take a break.”
- “It looks as if people are uncomfortable with what we have just been discussing.”
- “The energy of this discussion seems low, should we wind this up for now?”

Pose disagreement constructively. If there is disagreement and the discussion is stuck, have the participants agree to disagree and move on to another subject.

- “Can we explore each of the viewpoints as a group and try to understand them rather than having one or to persons defend each view.”
- “It’s clear that there is not agreement on this issue which is perfectly fine. Can we all agree not to be in agreement on this and move on to consider another facet of this issue..”

Minimize attacks. Protect individuals and their ideas from attack by other members of the group.

- “Let’s remember our groundrule about not attacking each other.”

Minimize disruptions such as inappropriate humor, people walking in and out, private/ side conversations, etc.

Confront other problem behaviors that interfere with the progress of the discussion. (See Troubleshooting below)

- “It is really hard to focus on what is being said here. There are so many side conversations.”

ENCOURAGING PARTICIPATION

Create (and recreate) a safe and trusting environment. Monitor excessive talkers (see Troubleshooting below) and prompt the quieter members. - Consider breaking up into smaller groups or pairs(dyads) or trios for mini-discussions as a way to involve the quieter people

- “We hope that you will say what is on your mind. What we say here today is for the group and will not go beyond the group.”

Set and reinforce a pattern for participants to talk to each other, not to you. Keep reminding the group that this is conversation/questioning focuses on you.

Notice silences. Who is talking a lot, who is not talking? Is there any pattern?

- “The men in the group have been pretty quiet. We’d be interested in what you think.”

"I have noticed that some of you have not said what you think. I hope you will find a way to let us hear from you at some point" (be careful of this kind of statement; it may put people on the spot)."

" I have noticed that some of you haven't said anything. Please feel free to jump in at any point."

"John, you made some good points; let's hear from someone else."

Acknowledge the feelings of people in the group.

"Sam, I can see how upset you are. What would you like to hear from the group?"

"I bet you are not the only one here who has that reaction. Has anyone else ever felt the same way?"

Ask individuals and the group how to respond to expressions of emotions.

"It seems to me that the discussion has brought up painful feelings for several people. What shall we do at this point? Would you like to talk about feelings that have been expressed? do you want to keep going? Shall we take a break?"

"This seems to be where a lot of discussions on this issue break down--how can we keep going and get past this point?"

"When I see people angry it is hard for me to listen because I am worried about people getting (emotionally/physically) hurt. Could we just take a minute here to breathe, and make sure we can talk about this respectfully"

Reaffirm that the group is trying to deal with emotionally difficult issues.

"People are expressing many different and deep emotions here which may feel hard and uncomfortable, but that is the reason we are all here, to try to come to grips with emotionally difficult issues."

"It's not easy to share such a deeply held beliefs"

ADVANCING AND DEEPENING THE DISCUSSION

Invite amplification of new points. Encourage the contributors to explain the background behind their ideas/opinions. Help "fact spouters" get more personal.

"What is your opinion, given the facts as you have said them?"

"When I here those facts, it makes me feel like.....?"

"These are interesting facts; would you like to share how you feel about them?."

Encourage people to take risks

Take some risks yourself, including admitting your mistakes

Take a risk yourself and be vulnerable by sharing a personal experience or risky feeling

Ask open-ended questions. (What?, How?, Why?)

Ask follow-up and/or probing questions (if others don't).

"Can you say a little more about that?"

"What do you mean by that?" "Can you give us an example?"

"How did you come to this view?."

"What convinced you of your opinion?"

Paraphrase (or getting others to paraphrase) what people say; paraphrasing can help legitimize people's views, and is especially useful in legitimizing an unpopular or risky opinion/idea.

"As I understand what you are saying, ..."

"Let me see if I understand what you are saying, ..."

Clarify, without interpreting.

"Can you clarify that last comment, I am not sure that I understood what you were saying."

"Can I try to clarify what I think you just said."

"Can you restate that in a different way?"

"What do you mean by that?"

Call attention to alternative viewpoints. Beware of "group think" Sometimes a group will discuss a topic without awareness of a different approach to the same problem.

TROUBLESHOOTING DURING THE DISCUSSION

No one responds.

Ask for any comments

Suggest an answer and ask for agreement or disagreement

Someone who doesn't take the discussion seriously or gives silly comments.

Find something in their answer that is close to a serious answer and in a serious tone repeat it to the group.

Ask them if they can think of another answer

Compliment them when they give a serious answer

"I think most people are here because they think the topic is a valuable one.

Does anyone feel differently about this?"

People monopolize the discussion.

Say, "I'd like to hear what the rest of the group has to say."

Ask another person a question just as soon as they pause.

Ask for agreement or disagreement from others.

Explain that you appreciate their comments, but it is important for everyone to have a chance to talk.

Establish ground rules at the beginning (or mid-stream) that one of the goals is to provide everyone an opportunity to share.

Someone keeps changing the subject or goes on tangents.

Say, "That is very interesting but how do you feel about?"

Refocus their attention by saying "I know you are enjoying sharing your

experience with each other, but there are some issues I would like to share with you now.”

Say, “In order to accomplish our goal today, we really need to move on.

Perhaps we can go back to this topic later.”

People keep interrupting.

“Could we remember just to have one person talk at a time and let people finish their statements.”

“Okay..first Sarah, then Randy, then Marie.”

“Jim, you have got a lot of god point, but it is important to let Renee finish, and then I know that Tom is dying to say something as well.”

Hostile or belligerent group members

Keep your cool. Try to incorporate negative comments in a positive way. “That’s an (interesting, unique, different) way to look at this situation. I appreciate your contributing that different point of view.”

If it continues, try to meet with the person at a break and confront them on their behavior. If it is really disruptive, tell them that if they choose to stay, you would like their cooperation.

Someone puts another person down.

Remind the group that there are no wrong answers. Everyone has the right to his/her opinion.

The group gets stuck (lacks sufficient information to go on)

Refer to resources.

Suggest the need for further information if you or someone else in the discussion does not know the answer.

Inappropriate humor

Don’t let inappropriate humor go by.

“ I realize that you may not have intended it, but this is a pretty sensitive topic, and that kind of humor makes a lot of people very uncomfortable.”

“I don’t find that remark very funny personally. Were you aware that some people might find that remark offensive?”

You are running out of time.

Don’t panic or start rushing. Get as far as you can. - Prioritize questions/points.

Try to address the important ones

Someone challenges your role as group leader.

Don’t become defensive. Let the group air their dissatisfactions. Express your feelings after they have cooled off. Discuss solutions with the group.

People keep addressing their questions to you.

Redirect the question to the group

If no one in the group has a response, defer the question by having someone in

the group come back with pertinent information at a later time.

Conflict occurs

Don’t take sides

Remind people of the areas of agreement - Ask people in conflict to agree to restate what they heard before they state their arguments.

Remind people that they are not there to judge others or to persuade others of their views, but to further mutual understanding.

Summarize the conflict and ask for ideas from the whole group as to how to proceed.

Acknowledge the disagreement and agree to move on. Tell the group that conflict is a healthy part of group dynamics, and can enhance learning.

Acknowledge each persons concerns and needs.

Inability to move to another topic because people are overly engaged in a lively discussion

Try to be flexible about time. If something good is happening, assess the value of leaving that discussion in favor of completing an agenda. Get the group to help make this decision.

Give a two-minute warning or some other transition time to prepare the group to change direction.

Acknowledge at the beginning of the session that time will be a factor and that some issues may not be discussed.

Acknowledge the difficulty of leaving a good discussion and get the group to decide how to proceed, or set up another time to finish the agenda.

Something inappropriate is stated, i.e., something offensive, misinformation

Legitimize dissenting opinions/ideas. Don’t let misinformation stand. It implies that you agree with it. Ask for other opinions/ideas (“Are there other views?”

“Does everyone agree?”

Agree to disagree to give people space to object without destroying the discussion.

WRAPPING UP

Keep to the committed ending time, unless you ask the group if they would like to continue for a specified period of time. (Remember, ending a little too soon is better than discussing a topic to death. Ending on a high note will encourage the discussion to continue at a later time.) Indicate that you will stay around for a while if anyone else wishes to continue the discussion.

Summarize (or have a participant summarize) the major thrust of the discussion.

The major points of agreement and disagreement, if appropriate.

Issues that were discussed but not resolved

Where action has been agreed on, the decision should be stated and the next steps and person responsible should be identified.

What additional information is needed

Comment on (or have the group comment on) how the discussion went

- How do participants feel about their own participation? - What was good about the discussion and what could have been better?
- Did people feel free to express their opinions?
- Do they have suggestions for better facilitation?

Thank everyone for the discussion...for their honest participation, etc.

POST DISCUSSION REVIEW

After the discussion is over, take a few minutes with the project team to reflect on the content and process of the discussion; a few written notes for future reference might be helpful. Consider:

- How well did the group stay focused on the topic? What contributed to this?
- How did the structure and timing contribute to the discussion? What changes, if any, would you make?
- How involved were individuals in the discussion? Were there any individuals noticeably silent, angry or upset?

Seek feedback from others (other staff members present or participants). You will learn much from seeking feedback from others, especially from your co-facilitator or other staff members. Ask what you did that went well (what you did to keep the discussion moving, motivate others to take risks and set the appropriate tone., etc.) and what improvements they would recommend.

