Up Against the Wall

Barriers and Incentives for Dam Removal

Rachel Dowley, Meredith Houghton, Cullen Mitchell, Savannah-Nicole Villalba
UEP Field Projects 2019

Tufts University
Urban and Environmental Policy and Planning

IPSWICH RIVER WATERSHED ASSOCIATION
The Voice of the River

Preface

Table of Contents

List of figures and tables

Tables

Figures

Meet the Team

Rachel Dowley

Rachel is pursuing an MS in Environmental Planning and Policy with the desire to create systems where people thrive and nature flourishes. Specifically, she is interested in urban park design and how these public spaces can act as structures for climate resiliency as well as convivial areas for social cohesion. She has previously worked in environmental licensing and permitting. She also has conducted independent socio-ecological research on the human perceptions of climate change vulnerability. Rachel has a BS in Marine Biology with a minor in Oratory from Northeastern University.

Meredith Houghton

Meredith Houghton's academic interests include sustainable land use planning, integrated water resources management, and community resiliency. Meredith has professional experience in environmental permitting and compliance in the private sector, and most recently supported regional transportation and environmental planning projects at the Rockingham Planning Commission in southern New Hampshire. She has a BA in Environmental Studies with a minor in Spanish from College of the Holy Cross. She is currently a MA candidate for the Urban and Environmental Policy and Planning degree program, pursuing graduate certificates in Geographic Information Systems and water resources planning/management.

Cullen Mitchell

Cullen Mitchell's academic interests include climate change resiliency and corporate sustainability. He previously worked at Tufts Institute of the Environment with the Sustainable Water Management Program, and now works as a research assistant studying climate change adaptation planning. He has a BA in Environment and Sustainability from Sewanee: The University of the South and is currently an MS candidate in Environmental Policy and Planning.

Savannah-Nicole Villalba

Savannah-Nicole Villalba's academic interests include community economic development and revitalization of deindustrialized cities. She previously conducted grant-funded research in Waterbury, Connecticut studying their food environment, and will be interning with Dudley Street Neighborhood Initiative this summer. She has a BA in Sociology and Urban & Community Studies from the University of Connecticut and is currently an MA candidate in Urban and Environmental Policy and Planning at Tufts University.

Acknowledgements

We would like to thank the Ipswich River Watershed Association staff and partners within the Parker – Ipswich – Essex River Watershed for their time and knowledge. We're grateful to Kaitlyn Shaw for her guidance, patience, and support throughout this project. Thank you to Nick Wildman and Kris Houle at the Massachusetts Department of Ecological Restoration, Nicole Benjamin-Ma of Vanasse Hangen Brustlin, as well as Sally Soule, Deborah Loiselle, and Kevin Lucy at the New Hampshire Department of Environmental Services for the assistance in navigating the intricacies of dam ownership and the restoration process. A special thank you to the willing dam owners who participated in this project and provided their invaluable perspective. Thank you to Coco McCade for her stunning photos of the Great Marsh, featured throughout this report. Finally, we are incredibly thankful to our teaching team at Tufts University, Michelle Lambert and Alice Maggio, for their extensive support, insight, and encouragement throughout the semester.

Executive Summary

Executive Summary

Throughout American history, dams have contributed to the success of businesses and communities, often at the expense of ecological systems. In New England, small rivers within watersheds have been successfully manipulated to redirect water and harness energy to create viable, prosperous towns. However, as these numerous historical dams age and no longer serve their original purpose, various environmental and infrastructure safety groups have begun to challenge the need for continued upkeep and maintenance of these structures.

There is a large body of literature that points to the environmental and financial benefits of modifying or removing dams, in comparison to the costs of ongoing maintenance. Nevertheless, it remains unclear how these benefits compare when considering the rich cultural history tied to these dams and the local politics within towns that advocate for their preservation. Dams prove to be a complex topic throughout the region, putting people up against the wall, whether it is facing burdensome increased maintenance costs, or fighting to preserve the altered topography they have built and benefited from.

This Field Project worked in partnership with the Ipswich River Watershed Association (IRWA) to better understand the complexities surrounding dam removal in the Parker-Ipswich-Essex Rivers region. Our project focuses on understanding the dam owner's perspective on the ecological impacts, financial costs, and politics regarding their dam. We conducted interviews that were informed through a robust literature review and two rigorous case studies of successful dam removals.

Our case studies revealed that dam owner support for removal is key, but not a guarantee, of success. While quite a bit of research has been conducted on the process of dam removal, there is a lack of understanding about the steps leading up to dam removal and its consequences. It is our hope that our project can inform future outreach by IRWA by giving a voice to dam owners, thoughtfully considering the tensions between the built environment and preserving nature, and forming a bridge between scientific literature and community perspectives.

Interview Results

We interviewed five dam owners, three privately-owned and two publicly-owned dams. While each interview was a unique case, strong trends and specific complexities were arose in our analysis. Most respondents were had not ever considered dam removal, or could foresee no reason why they would. Some of these responses were because of a lack of awareness of the benefits of dam modification or removal, while others were due to a desire to preserve reservoirs created by the dams. Dam owners interested in more information suggested seminars, information sessions, and other networking opportunities amongst dam owners that facilitated discussion of their individual questions and circumstances.

Table A Owner responses to modification/removal consideration

HAVE YOU CONSIDERED MODIFYING OR REMOVING YOUR DAM? WHY OR WHY NOT?

YES – We have considered and may be a candidate for removal	*YES – We have considered, and are not interested in removal*	*Not sure what to make of removal, or why I should consider it*
- Does not rule out removal, even while acknowledging the current value/uses: recreation, aesthetics of pond, property abutters enjoy ponded landscape, consumptive uses	- Pond has active uses, so advantages of dam outweigh the potential disadvantages	- Not enough information at disposal to make a good decision
- Sees that there may be potential ecological benefits to removal	- Recreational value of the pond is a key town asset	- No impetus to consider it
- No urgency for action, not a safety issue, but may be a future consideration	- Acknowledges conflicts between upstream and downstream water levels, but likely would only consider modification, if anything	- No one has approached the owner about the issue
		- Pond has current uses and decision-makers see no need to consider changes to the landscape

Public and private dam owners differed on how they preferred to share information and what considerations they took into account when thinking about dam removal. Publicly owned dams prioritized financial and recreational use (swimming, canoeing, etc.), while private owners valued recreational and environmental uses. For private owners, expert opinions are crucial to decision-making, and for public owners it was a tool to facilitate further discussion. Public opinion is merely a consideration for private dam owners, while it plays a pivotal role in the decision-making process of public dam owners.

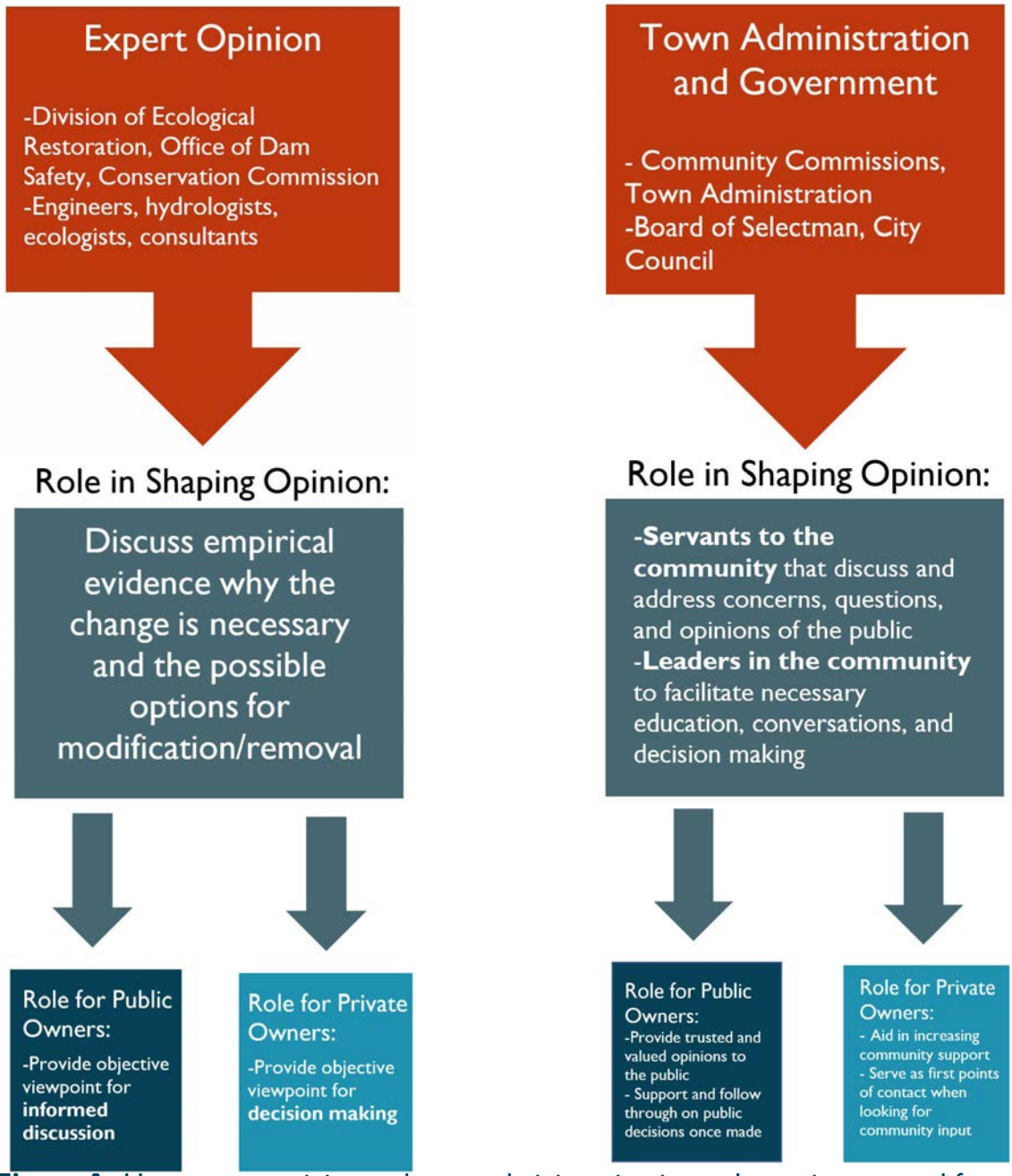


Figure A How expert opinion and town administration input determine removal for public and private dam owners

Key Takeaways for Future Dam Owner Outreach and Policy

Takeaway 1 – Encourage Maintenance Assistance

Dams are acquired through a land purchase, and often with the dam considered a liability, not an asset. IRWA could act as a liaison between owners and the Department of Ecological Restoration and the Office of Dam Safety so that they can make more informed decisions about maintenance, modification, and removal.

Takeaway 2 – Local Context is Key

Knowing key players in the town, giving people concrete examples of successful removal, and contacts for funding sources are necessary for the process.

Takeaway 3 – Acknowledge and Substitute Current Watershed Activities

Supporters of dams are not detached from interacting with the watershed, but rather feel connected to the environment created by the dam. Introduce them to alternative recreational activities that could take place in a free-flowing river.

Takeaway 4 – Facilitate Knowledge Sharing

Dam owners want interactive ways of getting information, hearing stories, and sharing concerns with people. This will build collaborative relationships with new and existing entities.

Takeaway 5 – Multi-Lens Approach to Understanding Dam Removal

One must distinguish between the differing concerns of individual private dam owners, public dam owners, and watershed-wide organizations. There is a need for some incremental paradigm shift in terms of how dam owners view themselves as a piece of the greater health of the watershed. Building strong relationships with local government can also help make these connections between local and regional decision making.

Takeaway 6 – Benefits of Further Ground-Truthing

Dam removal is case specific. Successful dam owner outreach then necessitates in-person encounters to glean understanding of the community context and environmental interactions associated with the dam in question. Fostering relationships with public officials in towns that own dams, or in which privately owned dams are located, may aid in effective outreach.

Introduction

Our Project Partner

Our Field Project is partnered with the Ipswich River Watershed Association (IRWA), a non-profit 501(c)(3) organization. Its mission is to 'protect nature and make sure that there is enough clean water for people, fish and wildlife, today and for our children and theirs' ("Mission and Vision" 2019). It was established in 1977 and since then, has accomplished numerous policy, science, habitat restoration, education, and community engagement initiatives. Some of IRWA's programs include volunteer outreach, river science and monitoring, river recreation events, dam removal, fish and habitat restoration, and the Parker-Ipswich-Essex Rivers Restoration Partnership ("What We Do" 2019). The Parker-Ipswich-Essex Rivers Restoration Partnership, or PIE-Rivers, represents a variety of organizations including local municipalities, state, and federal government agencies. PIE-Rivers was founded to 'increase communication, coordination, and collaboration between those involved in restoration, preservation, and management of the watersheds' ("The Partnership – PIE-Rivers" 2019). PIE-Rivers supports the work IRWA does in prioritizing barriers in the watershed. As such, the work of IRWA and PIE-Rivers will be attributed simply to IRWA in this report for expediency's sake.

IPSWICH RIVER WATERSHED ASSOCIATION
The Voice of the River

Logo Courtesy of the Ipswich River Watershed Association (2019).

"...to protect nature and make sure that there is enough clean water for people, fish and wildlife, today and for our children and theirs."

Project Inspiration

In February of 2018, IRWA completed a regional inventory and assessment of the risks and impacts of barriers in the PIE-Rivers Region called the Great Marsh Barriers Assessment. The report notes that 'barriers' refer to "human-made structures that may impede flow, fluvial and coastal processes (dams, non-tidal stream/river crossings, tidal crossings, and coastal stabilization structures)" (Brian Kelder 2018). IRWA found that 91 dams fell within the PIE-Rivers region, and 84 of the dams were chosen for analysis. When conducting their analyses, dams were prioritized for removal based on the ecological impact (EI) and infrastructure risk (RI) scores (Brian Kelder 2018). The Ecological Impact score was calculated by using the Massachusetts Division of Ecological Restoration (DER)'s Restoration Potential Model tool that considers "indicators of position, ecological integrity and aquatic habitat connectivity" (Brian Kelder 2018). The Infrastructure Risk score was calculated based on the "severity of hazards presented to communities in the event of dam failure" (Brian Kelder 2018). IRWA used the Massachusetts Office of Dam Safety's classifications to determine infrastructure risk (Brian Kelder 2018). The Massachusetts Division of Ecological Restoration (DER) has aided IRWA's efforts in dam removal and watershed restoration by contributing models and technical support (Brian Kelder 2018). American Rivers and Trout Unlimited are conservation organizations that have also contributed to dam removal and watershed restoration efforts in the region (Brian Kelder 2018).

Based on the findings of the regional assessment, IRWA identified approximately 20 priority dams for potential restoration efforts. The context of the impact of dams on riverine ecology is demonstrated by this excerpt:

"Dams have a profound impact on river processes and ecology. They interrupt natural downstream sediment transport, alter nutrient cycles and temperature regimes, block fish and wildlife migration corridors. The combination of these and other factors associated with dams has resulted in a drastic change in species composition and abundance throughout the region. Removing a dam can quickly remove many of the negative effects and begin to restore a river to a more natural state. For this reason, river restoration experts have become more and more focused on removing dams when they are no longer needed or when their costs outweighs their benefits."
(Brian Kelder 2018)

The scope of our project focused on gathering information from dam owners, seeking to better understand their perspectives on the impact their dams have on the watershed.

Site Description and Scope

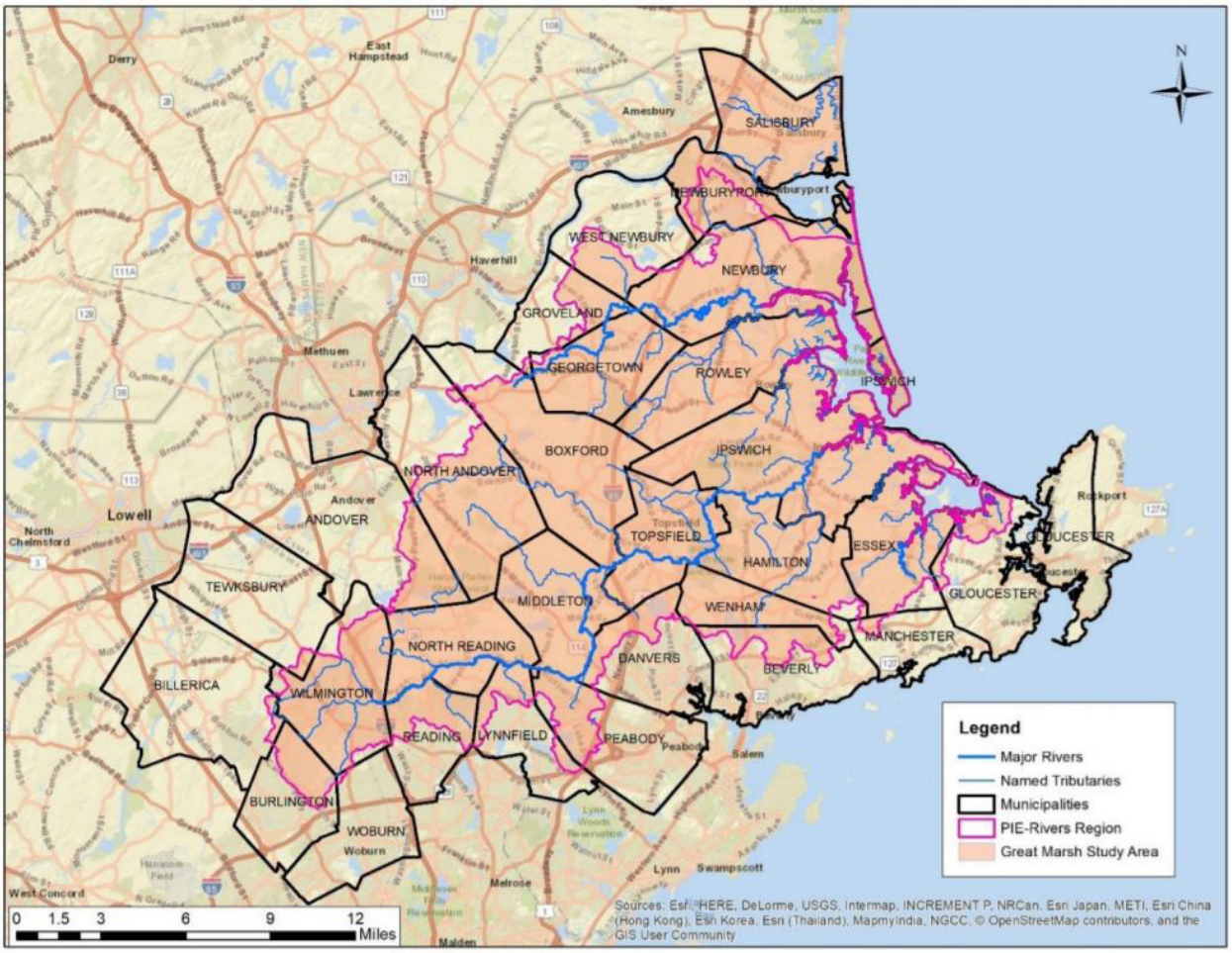


Figure 1 Map of the Parker-Ipswich-Essex River Watershed. *Map courtesy of Great Marsh Barriers Assessment (2018).*

The Great Marsh Barriers Assessment, conducted by the Ipswich River Watershed Association, includes the watersheds of the Parker, Ipswich, and Essex Rivers in addition to areas in the coastal municipalities of Newburyport and Salisbury, MA (Brian Kelder 2018). The additional areas in Salisbury and Newburyport were included so that the study region would include all of the municipalities included in the Great Marsh Coastal Adaptation Planning effort. The project area includes 280 square miles and 29 towns.

Beyond the PIE-Rivers Region, New England has a long history with dam infrastructure. There are more than 14,000 dams throughout New England's watersheds that were constructed in the 19th and 20th centuries to provide power for industrial purposes (Fox, Magilligan, and Sneddon 2016). New England has the highest density of small, medium, and large-scale dams of any region in the United States (Fox, Magilligan, and Sneddon 2016).

Even though technological advancement and changing industries have rendered them obsolete, many of the dams still linger throughout New England. These structures have significant individual and cumulative ecological impacts on the region's hydrology, including the obstruction of pathways for migratory fish, the trapping of sediment behind reservoirs, the inundation of habitats, and decline of river fisheries (Fox, Magilligan, and Sneddon 2016). Fox et. al found that of the 3,000 dams in Massachusetts, "only about 10 percent provide energy, flood control, or drinking water" (Fox, Magilligan, and Sneddon 2016). For the other 90 percent, the dam structures are becoming costly to repair or maintain, which can put a significant financial burden on a dam owner.

Fox et. al also found that New England's unique political and environmental characteristics influence decision-making about the built environment, which is not as common in other regions of the country (Fox, Magilligan, and Sneddon 2016). They state that "dam removal typically involves a lengthy period of public discussion with the opportunity for multiple actors to frame and express their positions surrounding dam removal." Even though this process is lengthy and complex, organizations like the PIE-Rivers Partnership and the Ipswich River Watershed Association have been working to educate and advocate for modification and/or removal of dams throughout their watershed to restore it to its original state.

The purpose of this Field Project was to better understand the extent to which environmental, financial, historical, and political factors play into the perspectives of individual public and private dam owners. There is consensus in the literature about the ecological effects of dam structures on the environment. Given this understanding of the ecological problems that dams present and the fact that so many dams in New

England have reached obsolescence, we wanted to gain a better understanding of what complicated the process of dam removal. Through our literature review, we identified an underrepresentation of the perspective of dam owners. To best aid IRWA, the Field Projects team aimed to address the identified gap in the literature: understanding the incentives and barriers to dam modification from the perspective of dam owners within the PIE Rivers Region. This was done through conducting a case study analysis of two successful dam removal projects and interviewing dam owners in the PIE-Rivers Region directly. Our analysis will help guide IRWA's efforts of education, outreach, and eventual dam removal and/or modification of the select priority dams.

Section References

Brian Kelder. (2018). Great Marsh Barriers Assessment. Retrieved from Ipswich River Watershed Association website: http://www.pie-rivers.org/id_20/

Fox, C. A., Magilligan, F. J., & Sneddon, C. S. (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. https://doi.org/10.1016/j.geoforum.2016.02.013

Mission and Vision. (2019). Retrieved February 18, 2019, from Ipswich River Watershed Association website: https://www.ipswichriver.org/about/mission-and-vision/

The Partnership – PIE-Rivers. (2019). Retrieved February 18, 2019, from https://www.pie-rivers.org/the-partnership/

What We Do. (2019). Retrieved February 18, 2019, from Ipswich River Watershed Association website: https://www.ipswichriver.org/our-work/

Methods

Our research methodology consisted of three distinct stages. Each piece served to answer the sub-questions of our project and included both primary and secondary research.

Part 1: Literature Review

Research question addressed:
What environmental, financial, and sociocultural barriers and incentives exist for dam owners affecting their decision to modify or maintain their dams?

The first portion of our research consisted of studying the existing knowledge on dam removal. The goal was to identify gaps in the understanding of dam removal that our research would seek to fill. We conducted a literature review of articles in peer-reviewed journals as well as practitioner-based reports. The knowledge gleaned from the literature review served to better inform the questions we asked in our interviews with dam owners.

The literature review encompassed four broader themes related to dam removal and modification:

- The **ecological** impact of dams as well as the impact/benefits that removing the dam may have
- The **financial** costs and benefits of the current dam and the potential dam removal
- The **historical** background and importance of dams
- The **sociocultural** context of dams and dam removal

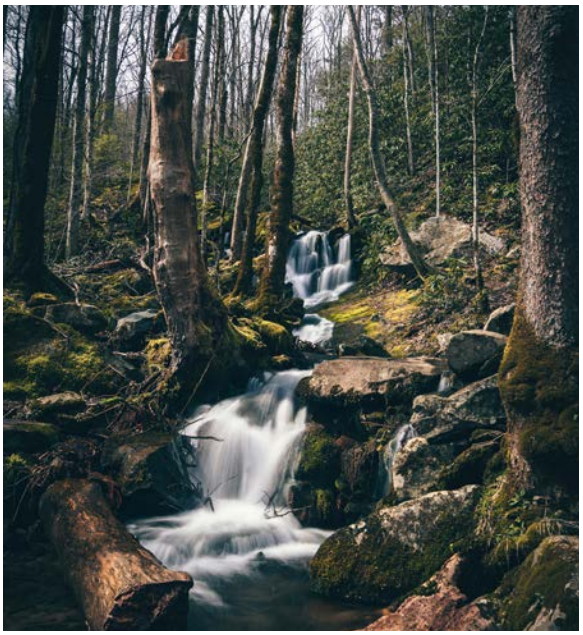
Part 2: Case Studies

Research questions addressed:
How do the owners of public and private dams share and differ in perceptions of these barriers and incentives?

What environmental, financial, and sociocultural barriers and incentives exist for dam owners affecting their decision to modify or maintain their dams?

Following the literature review, we completed case studies of two dams that have successfully gone through the dam removal process. These dams are the Great Dam in Exeter, New Hampshire (publicly owned) and the Briggsville Dam in Clarksburg, Massachusetts (privately owned). These two dams were chosen by our project partner at IRWA based on the complexity of the cases and/or the available information on each, in order to provide relatively current examples of dam removal projects for both publicly and privately owned dams in the region.

The purpose of the case studies was to develop a regional review of the steps taken, timeline of the process, as well as the costs and benefits that had proven to be most pertinent to dam owners interested in removal or modification. Like the literature review, the information gathered in the case studies helped determine what questions to ask in the interviews with dam owners. The team identified stakeholders and analyzed the context, project



outcomes, costs, and funding sources. The information was gathered from professionals in the field of dam removal and publicly available material.

Part 3: Interviews with Dam Owners

Research questions addressed:

How do the owners of public and private dams share and differ in perceptions of these barriers and incentives?

What environmental, financial, and sociocultural barriers and incentives exist for dam owners affecting their decision to modify or maintain their dams?

What is the level of access to and awareness of resources (information, funding, etc.) for dam owners when choosing whether or not to modify their dam?

Using what we learned through the literature analysis and case study analysis the team designed an interview process to establish the regional context surrounding dam maintenance, modification, and removal. In addition, the interviews aimed to better understand the perspectives, needs, and challenges of the public and private dam owners related to their decision-making process.

The sample population for interviewing was established by two factors: the specific geographical area of the Parker – Ipswich – Essex watershed and the *Great Marsh Barrier Assessment,* a regional inventory and assessment conducted by the Parker – Ipswich – Essex Rivers Partnership (PIE-Rivers). Within this geographic area, 84 dams were chosen for further analysis. Out of this list, IRWA directed us to focus on 20 dams that had been considered high or moderate priority for potential restoration efforts. Based on existing knowledge of these 20 dams, IRWA then either excluded certain dam sites from further inquiry via interviews (if contact had already been established through other means) or added additional dam sites for inclusion in our project if they were of particular interest. Based on this selection process, a total of seventeen dams and their associated owners were ultimately included as potential participants in the interviews.

We conducted five interviews with public- and private- dam owners out of the seventeen dams of interest.

Prior to interviewing the dam owners, we had to:

1. Confirm dam ownership.

To begin to identify who may be the most appropriate contacts to interview per priority dam, we started with a list of dam names/identification numbers by town. Using this list (which corresponded to MassGIS data), we cross-referenced three separate mapping resources to identify associated ownership:

- National Inventory of Dams interactive viewer
- MassGIS Level 3 Assessors' Tax Parcels online application
- MassGIS Assessor layer with an overlay of the MassGIS Dams layer (maintained by the Massachusetts Office of Dam Safety) in ArcGIS Desktop, ArcMap 10.6.1

In addition, our Field Projects group contacted representatives at DER, as well as ODS, who suggested that we additionally complete a Public Records Request with the Massachusetts Department of Conservation and Recreation (DCR) in order to confirm dam ownership information where there were discrepancies in the GIS data or incomplete information. This process was completed for both the private and public dams on the interview list. Our project partner at IRWA provided some additional contact information for both public and private dam owners per local and regional resources/knowledge as well.

After obtaining the best available ownership information for each dam per the above resources, contact information associated with each owner was then identified via general web searches where dams were publicly owned, or where the private owner was a business or other entity with an online presence. Where private owners were individual residences, the research team contacted Town Conservation Agents or similar local administrators in the hopes of locating contact information or asking assistance through town agents to forward on the interview request when possible.

2. Reach out to dam owners.

To ensure that the dam owners were aware that IRWA had evaluated their dams as part of the Great Marsh Barriers Assessment, our project partner made initial contact with the public dam owners. We provided IRWA with a potential script to send via email to each of the public dam owners. Given the time constraints of the interviewing period, we initiated first contact with private dam owners, following a common script, slightly modified from the one sent to public dam owners.

3. Recruit interview participants.

After first contact was initiated with public dam owners, or in the case of private dam owners, concurrent with initial contact, a recruitment email for the interview was sent. The recruitment email provided the consent form and established a time to conduct our phone interviews with them. The

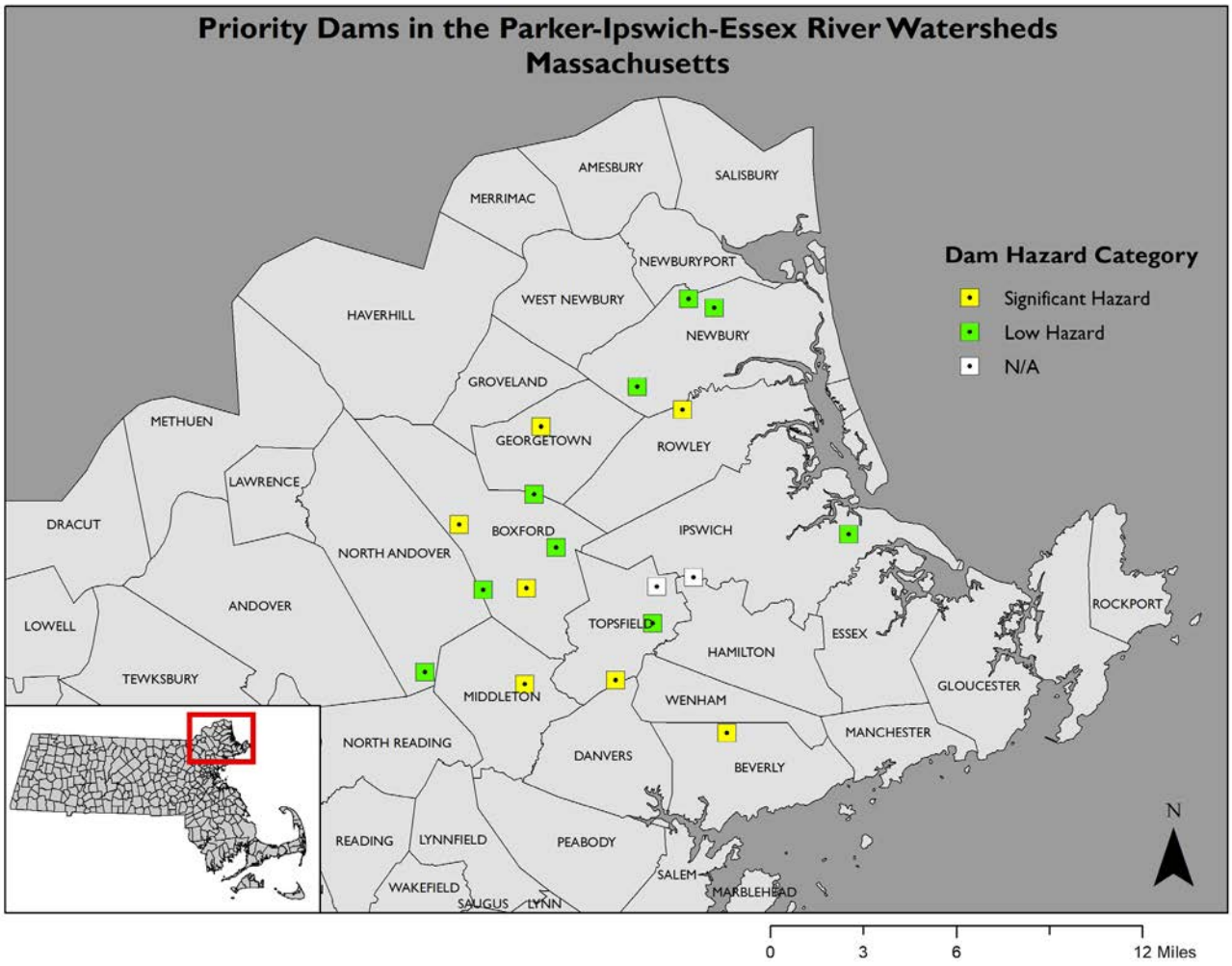


Figure 2 Hazard index level of high-priority dams in the PIE watershed. *Map courtesy of Meredith Houghton (2019).*

interviews were conducted in pairs and lasted approximately 30-60 minutes. One member from the research team directed the interview and asked questions of the dam owners, while the other assumed an administrative role (i.e. collecting notes, recording responses, keeping time). The phone calls were audio-recorded, provided consent was obtained from the respondents prior. No audio-recordings were created if the interviewee did not first provide consent.

At least two points of contact (initial email for recruitment, followed by a follow-up effort, via phone or email) was relied upon to engage participants, and all recruitment efforts were complete thereafter.

Limitations of Outreach

The Public Records Request went unanswered during the research period, which limited the dam ownership information available to the research team. Every reasonable effort was made to pursue alternative sources to verify the owner information through assessor records, current town agents, regional contacts, and other publicly available information. There were also

some discrepancies between ownership information gleaned from mapping resources and other records. Based on these challenges and the number of interviews ultimately conducted, the team acknowledges that the perspectives of the dam owners included in the project should not be construed to constitute the majority opinion or experience of all dam owners in the region. Rather, the project emphasizes the unique experience of the respondents, in the hopes of providing a glimpse into the perspective of dam ownership in the PIE Rivers region.

Interview Question Development

The interview questions were created based on the literature review, case study findings, and the insights of our project partner and contacts at the Department of Ecological Restoration (DER). The interviews begin with a brief introduction on the research conducted in the PIE-Rivers region through the Great Marsh Barriers Assessment.

Each question was specifically designed to:

Establish the baseline for the dam owner's understanding.

By understanding the dam owner's knowledge of the history, financial costs and gains, and observed environmental impact of their dam, IRWA can create more targeted education and advocacy materials.

Understand the considerations for dam modification.

We aim to understand the dam owner's previous considerations for dam removal and/or modification. By hearing the dam owner's perspective on the barriers that are preventing them from moving forward on dam removal and/or modification, IRWA can provide better assistance to owners hoping to move through this process.

Understand the considerations for external factors.

We aim to understand dam owner's perspectives on external factors such as

the role of community in this decision making process, awareness of resources, if they have been contacted about this issue before, and questions that will help us understand the social, cultural, and historical factors that influence dam removal and/or modification decisions.

Perform a 'Final Check'.

We allotted time to allow the interviewed dam owners to tell us anything that they feel would be beneficial for future IRWA outreach. By providing the dam owners space to speak their minds, we hope to highlight their voices, opinions, concerns, and questions.

Part 4: Analysis and Recommendations

Research questions addressed:

What is the level of access to and awareness of resources (information, funding, etc.) for dam owners when choosing whether or not to modify their dam?

Do the owners of public and private dams share the same perceptions of these barriers and incentives?

What environmental, financial, and sociocultural barriers and incentives exist for dam owners affecting their decision to modify or maintain their dams?

After conducting interviews with the dam owners, we identified common themes and concerns, and any points of disagreement that appeared from the data. These findings were then used to draw conclusions and formulate robust recommendations for future outreach to dam owners in the region.

Drawing upon the team's knowledge of qualitative analysis methodology and strategies, **the researchers performed the following steps:**

Established Analysis Methodology.

Our research team reviewed all of the interview questions and determined the main themes and concepts that we aimed to understand through asking each question. These themes were translated into a Codebook Spreadsheet for data organization, so that when each interview was evaluated, the researcher could determine the present themes using binary markers (i.e. if theme X is present = 1; if theme X is not present = 0). Two members of the research team expanded upon the main themes by establishing definitions and building consensus on what would determine a response for each defined concept/ theme.

Ensured Inter-Rater Reliability.

Each of the researchers analyzed all of the interviews independently and recorded the results in their own Codebook Spreadsheet. After the initial analysis was completed, the research team reconvened and compared their aggregated results recorded in their Codebooks. Any discrepancies were discussed, and agreement was reached to consolidate the results.

Extracted Commonalties and Points of Disagreement.

After the research team established inter-rater reliability, the results were shared with the rest of the Field Projects group. The Codebook Spreadsheet results were aggregated and discussed to show what common themes/concepts were present, missing, and conflicting among the five interviews.

Derived Recommendations from Analysis.

Using the interview results, the research team discussed key findings and takeaways for IRWA. This included both general recommendations, such as how to best target their desired audience, as well as more specific observations, such as the unique barriers and incentives private- and public- dam owners identified in our conversations.

Regional Context

A Literature Review and Case Studies

Environmental

Image Courtesy of Coco McCabe (2018)

Dams have served many important purposes including power generation, flood control, water supply, irrigation, and countless recreational opportunities (Bednarek 2001). However, dams are often problematic for many aquatic ecosystems. In 'Exploring Dam Removal,' researchers found that most dams result in one or more negative effects ("Exploring Dam Removal: A Decision Making Guide" 2002). These include:

Disruption of natural functions and connectivity of ecosystem

When a dam is implemented it often floods the upstream habitat, which can create an impoundment or reservoir where the river once freely flowed ("Exploring Dam Removal: A Decision Making Guide" 2002). The size of a dam and the topography are important factors in determining the effect the impoundment will have on the water source. In addition, the downstream flow and habitat will be affected by the dam. Bednarek found that rivers vary widely in the fluctuations, magnitudes, duration, and regularity of flow they experience (Bednarek 2001). When a dam structure is in place, there is a possibility of decreased diversity of fauna, or an increased density of certain species where the new ecosystem stimulates their growth. Regardless, the variation in water characteristics can damage habitat, impact timing of reproductive cues, and

either flood or strand fish and wildlife ("Exploring Dam Removal: A Decision Making Guide" 2002).

Blockage of movement for fish and other aquatic species

Dams can block both upstream and downstream movement of fish and other wildlife. This poses problems for various migratory fish species ("Exploring Dam Removal: A Decision Making Guide" 2002). Bednarek (2001) highlights that continuous passage through a river is necessary because it allows fish to migrate up and down stream, search for optimal sediment and water levels for spawning, and provides more area for fish and aquatic species to look for food and lower predation (Bednarek 2001). Furthermore, the slow water flow and large surface area of impoundments created by dams can increase predation due to the increased access of fish and aquatic species being stuck upstream of a dam.

Fish passage devices, such as fish ladders, may be implemented to allow some species of fish to move upstream or downstream of the structure. However, these passage devices can still cause 'delays and mortality' to the fish and aquatic wildlife ("Exploring Dam Removal: A Decision Making Guide" 2002). Research has found that a fish's ability to travel through the ladder is related to its species and age ("Exploring Dam Removal: A Decision Making Guide" 2002).

Blocking or slowing river flow

Bednarek found that in most cases, the impoundment created by a dam structure will produce sediment that can accumulate for many years, and in some cases, will entirely fill the impoundment (Bednarek 2001). Sediment is an "essential component of the river ecosystem, containing a variety of important nutrients that riverine species require to survive and thrive" ("Exploring Dam Removal: A Decision Making Guide" 2002). Sediment is naturally found on streambanks, in the riverbed, and in the water column ("Exploring Dam Removal: A Decision Making Guide" 2002).

When the sediment accumulates in the upstream impoundment, it can negatively impact fish and wildlife by reducing the kinds of sediment traveling through the river, increasing water temperature,

Image Courtesy of Coco McCabe (2018)

and depleting the water of dissolved oxygen("Exploring Dam Removal: A Decision Making Guide" 2002). This can have significant effects on the diversity of species found in an ecosystem.

Alter water temperature and quality

Dams can change many aspects of water quality including temperature, nutrient transport, oxygen, and turbidity ("Exploring Dam Removal: A Decision Making Guide" 2002). Bednarek found that temperature stratification can occur because the impoundment changes the habitat from a free-flowing one to one more similar to a lake, characterized by a larger surface area and slower moving water (Bednarek 2001). Additionally, depending on if the dam releases water from the top or bottom of the impoundment, the temperature of the water varies, which can alter the composition of species that were adapted to the natural water temperatures (Bednarek 2001).

The body of existing literature has found that restoration of a river through dam modification and/or removal can result in a variety of positive characteristics for a river ecosystem. These benefits include improving the water quality, re-establishing the river to its natural habitat and aquatic species, providing rehabilitation for threatened or endangered species, and eliminating the growing dam safety concerns as more and more dams outlive their original purposes.

Image Courtesy of Coco McCabe (2018)

Courtesy of Ipswich River Watershed Association

Economic/Financial

To best determine the overall financial cost of maintaining a dam, it is recommended to conduct a cost-benefit analysis of dam removal. In order to be as accurate an analysis as possible, it should encompass six elements: benefits and costs (the value of all goods and services derived from streams, reservoirs, and other resources), positive and negative impacts on jobs, distribution of consequences, rights and responsibilities (who benefit and who will be responsible for costs), uncertainty and sustainability (reliance on insufficient information), and ecological impacts (Whitelaw and Macmullan 2002). It is also important to remember that oftentimes tax payers subsidize private dam ownership through public funding opportunities for dam maintenance (Whitelaw and Macmullan 2002). There are also passive-use benefits, or non-use value, associated with a restored stream, essentially the financial benefits of simply knowing that a stream has been restored to its natural state (Whitelaw and Macmullan 2002).

Opposition to dam removal can stem from the potential loss of recreational and landscape value of a reservoir (Jørgensen and Renöfält 2013). There are also a variety of ecosystem services (water supply/purification, natural flood control) that could either be lost or gained from dam removal (Jørgensen and Renöfält 2013). It is important to consider the original use of a dam when considering its removal. Most dams built for flood retention have few substitutes, while there are usually alternatives to a hydroelectric dam (Noda et al. 2018). Dam removal presents a variety of economic incentives including cost savings over repairing or maintaining the dam, eliminating the need for insurance payments to cover liability related to safety concerns about the dam, revitalization of riverfront property values, decreased costs from water quality improvements, and increased income from local fishing and boating industries ("Exploring Dam Removal: A Decision Making Guide" 2002).

Socio-Cultural & Historical

Image Courtesy of Coco McCabe (2018)

Though the ecological concerns and environmental effects of dams are relatively well-studied, the socio-political, cultural and historical considerations for dam maintenance, modification, and/or removal in New England are not as thoroughly understood (Fox, Magilligan, and Sneddon 2016). In this region, the value associated with a dam is often defined by the consumptive rather than productive uses (Fox, Magilligan, and Sneddon 2016), and therefore the roles of aesthetic, identity, history, and culture can be significant in the conversation surrounding dam modification.

Aesthetics and Landscape Interpretation

When a dam structure no longer serves the original purpose for which it was built (i.e. hydropower or water supply, etc.), the community may assign a greater value to the aesthetics of either a free-flowing river ("Exploring Dam Removal: A Decision Making Guide" 2002) (for those in favor of dam modification or removal), or the existing impoundment(Born et al. 1998) (for the opponents). Additionally, existing dammed landscapes with perceptions of high aesthetic value appear to be most resistant to change (Brummer et al. 2017), and can pose a significant hurdle to dam modification when such projects are being considered in a community. Community interpretations of beauty and nature in the altered landscape are also critical to understanding the local assigned value to such resources (Fox, Magilligan, and Sneddon 2016b), in order to conduct an accurate cost-benefit evaluation for dam modification.

Image Courtesy of Eric Sloane (1980)

Cultural Identity and History

Often, the aesthetic value goes beyond physical appearance of the landscape, and is typically strongly linked to experience and history (Fox, Magilligan, and Sneddon 2016a; Brummer et al. 2017). The "memory-factor" can elicit a strong emotional attachment to place and trigger the fear of losing a nostalgic location (Fox, Magilligan, and Sneddon 2016; Born et al. 1998). These community experiences can fuel the defense of the dammed landscape, even where the historical and cultural value may be in conflict with other critical functions (Brummer et al. 2017).

The conversation about dam removal "often spurs a community to examine its heritage, values, and vision for the future"("Exploring Dam Removal: A Decision Making Guide" 2002) . A dam structure may be symbolic of the region or locality's pride and identity in some cases; however, in other instances, the residents may not even be aware of its existence("Exploring Dam Removal: A Decision Making Guide" 2002). Where former industry related to the dam structure may have "made the town" or was a major influence on the formation of the community's development and history, the dam can become a kind of monument with high historical value (Brummer et al. 2017; "Exploring Dam Removal: A Decision Making Guide" 2002; Fox, Magilligan, and Sneddon 2016). The dam itself may also be viewed in a more holistic manner as part of a historical landscape, and so the implications for dam modification can become much more complex as a result (Fox, Magilligan, and Sneddon 2016).

In other instances, the dam structure and the implications of its maintenance, modification, or removal may present a cultural conflict related to tribal rights to natural resources or the landscape's ecological services (Baish, David, and Graf 2002; Gosnell and Kelly 2010), though these issues are less prominent in the conversation in New England as compared to other areas of the country.

Micropolitical Complexities

Image Courtesy of Coco McCabe (2018)

National and local movements for dam removal have created unique political interplays that have only begun to be studied by theorists of political ecology. Political ecology in itself is a broad term that seeks to explore social power dynamics in relationship to environmental matters, covering topics ranging from rural agriculture in Niger (Batterbury 2001) to sweetgrass basketmaking in South Carolina (Hurley and Halfacre 2011). For the sake of our research, we will follow Grabowski et al.'s model for political ecology in dam removal, which seeks to understand the relationship between constituents and authority figures during the dam removal process (Grabowski et al. 2017).

Answering this question of politics takes on many different levels, ranging from national movements to micro-politics within one given community (Grabowski et al. 2017). The national movement for dam removal has spurred state-run initiatives such as the Massachusetts Division of Ecological Restoration (DER) providing funding and expertise to expedite the process, leading to the removal of 40 dams state-wide over the past 14 years ("River Restoration: Dam Removal" 2019). State leadership has spurred more local analyses which have identified top priority dams for removal due to high safety and environmental concerns (Brian Kelder 2018; "Exploring Dam Removal: A Decision Making Guide" 2002).

The study of micro-politics for dam removal in New England has been a topic of research, though findings emphasize just how case-specific the dam removal process is. Because of the strong local ties with these structures, tensions are heightened when the powers promoting dam removal have outsider status, even if they are from a neighboring town (Fox, Magilligan, and Sneddon 2016). Further, parties sometimes choose sides on issues of dam removal to bolster alliances on other problems (Fox, Magilligan, and Sneddon 2016). One such example was an historical society president, who opposed the dam removal, who used his other position of zoning administrator to persuade all those seeking personal permits to side with him.

As contentious and grid-locked local politics may seem for dam removal, public opinions within towns are always shifting and exceptions to established norms are continually forming. Focus group interviews with dam removal opposers have revealed that often protests are less for protecting the dam and more as a means to advocate for a fair assessment of all the costs and benefits of dam modification (Fox, Magilligan, and Sneddon 2016). Although numerous case studies have been done on New England dam removal, there is no clear checklist to ensurea smooth political process for dam removal. Key components of every success case study may be present, such as dam owner support, but they are not guarantees to successful removal, as there are instances where projects with key support and finances still stall out (Magilligan, Sneddon, and Fox 2017). Thus, future studies must seek to understand the power complexities of their regions of study, compare them to existing literature, and be open to anomalies that challenge current findings.

Section References

Baish, S. K., David, S. D., & Graf, W. L. (2002). The complex decision making process for removing dams. Environment, 44(4), 20–31.

Batterbury, S. (2001). Landscapes of Diversity: A Local Political Ecology of Livelihood Diversification in South-Western Niger - Simon Batterbury, 2001. Ecumene, 8(4), 437–464.

Bednarek, A. T. (2001). Undamming Rivers: A Review of the Ecological Impacts of Dam Removal. Environmental Management, 27(6), 803–814. https://doi.org/10.1007/s002670010189

Born, S. M., Genskow, K. D., Filbert, T. L., Hernandez-Mora, N., Keefer, M. L., & White, K. A. (1998). Socioeconomic and Institutional Dimensions of Dam Removals: The Wisconsin Experience. Environmental Management, 22(3), 359–370. https://doi.org/10.1007/s0026799001 11

Brian Kelder. (2018). Great Marsh Barriers Assessment. Retrieved from Ipswich River Watershed Association website: http://www.pie-rivers.org/id_20/

Section References (cont'd)

Brummer, M., Jordà-Capdevila, D., Rodríguez-Labajos, B., & Nguyen, T. T. (2017). "They have kidnapped our river": Dam removal conflicts in Catalonia and their relation to ecosystem service perceptions. Water Alternatives; Montpellier, 10(3), 744–768.

Exploring Dam Removal: A Decision Making Guide. (2002). 85.

Fox, C. A., Magilligan, F. J., & Sneddon, C. S. (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. https://doi.org/10.1016/j.geoforum.2016.02.013

Gosnell, H., & Kelly, E. C. (2010). Peace on the river? Social-ecological restoration and large dam removal in the Klamath basin, USA. Water Alternatives; Montpellier, 3(2), 362.

Grabowski, Z. J., Denton, A., Rozance, M. A., Matsler, M., & Kidd, S. (2017). Removing dams, constructing science: Coproduction of undammed riverscapes by politics, finance, environment, society and technology. Water Alternatives; Montpellier, 10(3), 769–795.

Hurley, P. T., & Halfacre, A. C. (2011). Dodging alligators, rattlesnakes, and backyard docks: a political ecology of sweetgrass basket-making and conservation in the South Carolina Lowcountry, USA. GeoJournal, 76(4), 383–399. https://doi.org/10.1007/s10708-009-9276-7

Jørgensen, D., & Renöfält, B. M. (2013). Damned If You Do, Dammed If You Don't: Debates on Dam Removal in the Swedish Media. Ecology and Society, 18(1). https://doi.org/10.5751/ES-05364-180118

Magilligan, F. J., Sneddon, C. S., & Fox, C. A. (2017). The Social, Historical, and Institutional Contingencies of Dam Removal. Environmental Management; New York, 59(6), 982–994. http://dx.doi.org.ezproxy.library.tufts.edu/10.1007/s00267-017-0835-2

Noda, K., Hamada, J., Kimura, M., & Oki, K. (2018). Debates over dam removal in Japan: Debates over dam removal. Water and Environment Journal, 32(3), 446–452. https://doi.org/10.1111/wej.12344

River Restoration: Dam Removal. (2019). Retrieved February 18, 2019, from Mass.gov website: https://www.mass.gov/river-restoration-dam-removal

Whitelaw, E., & Macmullan, E. (2002). A Framework for Estimating the Costs and Benefits of Dam Removal. BioScience, 52(8), 724. https://doi.org/10.1641/0006-3568(2002)052[0724:AFFETC]2.0.CO;2

Case Study: Public-Owned Dam

The Great Dam; Exeter, NH

Case Overview

The Great Dam, previously located on the Exeter River, was an iconic landmark situated in the heart of downtown Exeter, New Hampshire. The dam was approximately 136 feet long and 16 feet high, and consisted of a reinforced concrete run-of-river dam and a spillway that included a fish ladder with weir, a low-level outlet, and a penstock (Vanasse Hangen Brustlin, Inc. 2013). The most recent dam structure prior to removal in 2016 was constructed in 1914, though historic records suggest that a dam had been present in the approximate location since the end of the 17th century and had been utilized for manufacturing purposes (Town of Exeter 2010). The dam was owned privately until 1981 when it was acquired by the Town of Exeter, who owned it until it was removed (Town of Exeter and New Hampshire Department of Environmental Services 2005).

The upstream impoundment created by the Great Dam maintained Exeter's water supply, provided a water source for upstream fire suppression systems, and supported recreational uses (Levergood 2004; Town of Exeter 2010). At the same time, upstream flooding issues resulting from the presence of the dam became apparent, as well as other safety hazards, and a Letter of Deficiency (LOD) was first issued to the Town of Exeter by the New Hampshire Department of Environmental Services (NHDES) Dam Bureau in July of 2000 (Levergood 2000). The initial LOD, as well as subsequent amendments in 2004 and 2009, noted major deficiencies in the dam structure, the most significant of which included the dam's inability to pass the runoff resulting from a 50-year precipitation event (Town of Exeter 2010). Per safety requirements mandated by NHDES, the Town was required to either modify or remove the dam (Town of Exeter 2010).

The dam deficiencies and regulatory requirements brought other complexities to the forefront surrounding water quality and quantity issues associated with the Exeter River, its tributaries, and the watershed. The Exeter River Study Committee was established in 2004 to oversee these issues which were highly intertwined with the decision-making.

Case Overview (cont'd)

conversations relative to the Great Dam (Town of Exeter and New Hampshire Department of Environmental Services 2005). Following a series of studies surrounding the Exeter River that established a baseline understanding of the issues affecting the waterway, as well as the potential impacts caused by the Great Dam, a Feasibility and Impact Analysis of the potential removal of the Great Dam in 2013 was conducted. (Town of Exeter 2010). The following year, voters approved the dam removal project during a Town Meeting, and the project planning took place from 2014 through 2016 (Exeter Historical Society, VHB 2015). The construction phase of the removal and restoration project occurred over a four-month period and was complete by October of 2016 (VHB 2017).

Takeaways

The Great Dam removal reopened 21-miles of river habitat for various sea-run fish species and the elimination of safety hazards related to the aging dam structure that had fallen in disrepair (Fisheries n.d.). The case of the Great Dam Removal is an example of tremendous collaboration across groups at the federal, state, and local level, and the eventual success of the project is a testament to the Town's commitment to a robust public process.

Key Stakeholders

Town of Exeter, various officials—including the Town Engineer, Paul Vlasich, and the Board of Selectmen. These two entities served as the leads for the Great Dam Removal Project, and were involved in the committees, preliminary and final studies, bids, and project implementation phases of the process.

Town Committees and Working Groups—including the Exeter River Advisory Committee and the Great Dam Remembrance Committee. These groups were integral to advising the Board of Selectmen on all matters related to the Exeter River, and were important in honoring the historical value associated with the Great Dam.

Officials beyond the local level who served as additional members of the Exeter River Study Working Group: Deb Loiselle (NHDES Dam Bureau), Eric Hutchins (NOAA Restoration Center), Sally Soule (NHDES Watershed Assistance).

Various officials serving at the NHDES Dam Bureau: These individuals issued the LODs, performed inspections of the Great Dam, and served an advisory role with the Town through the dam removal process.

Numerous private consulting engineering/environmental firms (i.e. Weston and Sampson, VHB, Wright-Pierce, SumCo): These firms carried out the baseline studies and implementation phases of the Great Dam Removal Project.

Stakeholders (cont'd)

Groups involved with National Historic Preservation Act Section 106 Regulations: NH Division of Historical Resources, Exeter Heritage Commission, Exeter Historic District Commission, Exeter Historical Society, and Federal Agency representatives.

Funding institutions or organizations that made the Great Dam Removal Project possible: National Oceanic and Atmospheric Administration (NOAA) and various NH state funding grants.

The residents of the Town of Exeter who participated in the public meetings and cast their vote to engage in the decision-making processes surrounding the Great Dam.

Timeline

2000 and 2004: Letter of Deficiency and Letter of Deficiency, Amendment 1 issued by the NHDES Dam Bureau to the Town of Exeter for the Great Dam. Upstream flooding issues and safety concerns were cited, and a dam inspection indicated the structure is unable to pass the runoff resulting from a 50-year precipitation event (Town of Exeter 2010).

2004 – 2007: Exeter River Study Committee established to address matters surrounding the Exeter River and its tributaries due to the complexity of issues within the watershed that are connected to the conversation surrounding the Great Dam. Exeter River Study Plan and the Exeter River Study Phase I Report are completed to better understand how the dam affects the water quality and quantity issues in the watershed (Town of Exeter and New Hampshire Department of Environmental Services 2005; Wright-Pierce and Woodlot Alternatives, Inc. 2007).

Funding

Total Project Budget:	**$1,786,760**
External Funding Total	**$801,020**
NOAA Coastal Resiliency Program:	$610,960
New Hampshire State Conservation Committee:	$100,000
New Hampshire State Coastal Program:	$75,060
New Hampshire State Conservation Committee:	$15,000
Town of Exeter Funding Total	**$1,200,000**

Timeline (cont'd)

March 2009: Letter of Deficiency, Amendment 2 issued by NHDES Dam Bureau, mandating that the Town make a determination to pursue repair or removal of the Great Dam by December 2009 (Town of Exeter 2010).

October 2010: Request for Proposals for Feasibility and Impact Analysis for the potential removal of the Great Dam is released (Town of Exeter 2010).

October 2013: Final version of the Exeter River Great Dam Removal Feasibility and Impact Analysis complete with public comments incorporated (Vanasse Hangen Brustlin, Inc. 2013).

2014: Town Warrant Article 8 – Great Dam Removal passes via vote at Town Meeting (Exeter Historical Society, VHB 2015).

2014 – 2015: The following phases of the Great Dam Removal Project are completed in chronological order during this two year period--final design surveys, followed by engineering design phase, environmental permitting, Section 106 Consultation, and finally the bid phase for the construction of the removal project (Exeter Historical Society, VHB 2015).

July – October 2016: Construction and restoration resulting from the Great Dam Removal is complete (VHB 2017).

December 2017: The first Annual Monitoring Report for the Great Dam Removal Project is completed, in accordance with the site's NHDES Wetlands Permit (VHB 2017).

Spring 2017 – Fall 2018: VHB assists Town with the Letter of Map Revisions (LOMR) process to update the flood maps in the area of the Great Dam Removal Project

The Exeter River following the removal of the Great Dam.

Costs and Benefits

Changes in Flooding and Hydraulics:

Costs: Dam removal and/or modification would lower water levels upstream of the dam under normal flow conditions.
Benefits: Dam removal and/or modification would reduce the depth of flooding substantially.

Sediment Transport and Potential Erosion:

Costs: Removal of the dam is 'unlikely to irritate a significant upstream migrating headcut,' but could create some erosion of stream banks (which is normal for a free-flowing river).
Benefits: Dam removal and/or modification would restore sediment transport to the river to normal or near-normal conditions.

Infrastructure:

Costs: Surface water intakes would be adversely affected by the dam removal, but engineers think the impacts could likely be mitigated.
Benefits: Bridges, walls, and foundations upstream and downstream will not be affected by removal and/or modification.*
**This would require that an investigation be conducted to ensure that the structures within the immediate vicinity of the dam are not damaged.*

Cultural:

Costs: The removal of the dam would impact the historic structure that is seen as important to downtown Exeter. Dam removal and/or modification would alter the recreational experience, but there would still be plentiful opportunities for recreation.

Natural Resources:

Costs: Dam removal and/or modification could affect wetlands and floodplain forests that rely on some degree of flooding, including a rare swamp of white oak forest upstream the dam.
Benefits: Removing the dam would result in a substantial net benefit on water quality and important fish populations. Removal is not expected to have adverse impacts to wildlife populations.

Section References

David Cloutier, PE. (2017, October). Exeter Great Dam Removal: Removing Aging Infrastructure to Increase Flood Resiliency and Aquatic Habitat. Presented at the Maine Stormwater Conference 2017. Retrieved from https://maineswc.files.wordpress.com/2017/10/03-cloutier.pdf

Exeter Historical Society,VHB. (2015, February). Public Information Meeting, Great Dam Removal Project - Impacts to Historic Resources. Retrieved from https://www.exeternh.gov/sites/default/files/fileattachments/boards_committees_and_commissions/page/9941/great_dam_removal_public_mtg_impacts_to_historic_resources.pdf

Fisheries, N. (n.d.). Exeter's Great Dam Removal :: NOAA Fisheries. Retrieved April 3, 2019, from https://www.greateratlantic.fisheries.noaa.gov/stories/2016/september/08_exeter_s_great_dam_removal.html

Levergood, G. (2000, July 25). Letter of Deficiency, DAM #082.01, Exeter River Dam, Exeter. Retrieved from https://www.exeternh.gov/sites/default/files/fileattachments/boards_committees_and_commissions/page/9941/2000-07-25_letterofdeficiency.pdf

Levergood, G. (2004, June 1). Letter of Deficiency, Amendment 1: Exeter River Dam #082.01 (Great Dam), Exeter, NH. Retrieved from https://www.exeternh.gov/sites/default/files/fileattachments/boards_committees_and_commissions/page/9941/2004-06-01_letterofdeficiency_amend1.pdf

Town of Exeter. (2010). Request for Proposals, Dam Feasibility and Impact Analysis, Exeter River Great Dam, Exeter River, Exeter, NH. Retrieved from https://www.exeternh.gov/sites/default/files/fileattachments/boards_committees_and_commissions/page/9941/rfp_dam_removal_feasibility.pdf

Town of Exeter, & New Hampshire Department of Environmental Services. (2005). Exeter River Cooperative Study [White Paper]. Retrieved from https://www.exeternh.gov/sites/default/files/fileattachments/boards_committees_and_commissions/page/9941/riverstudy.pdf

Vanasse Hangen Brustlin, Inc. (2013). Exeter River Great Dam Removal Feasbility and Impact Analysis. Retrieved from https://www.exeternh.gov/sites/default/files/fileattachments/river_advisory_committee/page/42591/great_dam_removal_feasibility_report_final_oct_2013.pdf

VHB. (2017). Annual Monitoring Report 2017 (Year 1), Exeter River Great Dam Removal Project. Retrieved from https://www.exeternh.gov/sites/default/files/fileattachments/river_advisory_committee/page/42591/2017_great_dam_annual_monitoring_report.pdf

Wright-Pierce, & Woodlot Alternatives, Inc. (2007). Exeter River Study Phase 1 Final Report (pp. 1–111). Retrieved from https://www.exeternh.gov/sites/default/files/fileattachments/boards_committees_and_commissions/page/9941/river_study_phase_1_final.07.pdf

Case Study: Private-Owned Dam

Briggsville Dam; Clarksburg, MA

Case Overview

The Briggsville Dam, previously known as the Hewatt Pond Dam, was originally constructed in 1848 in the town of Clarksburg, Massachusetts. Standing at 16 feet tall and nearly 150 feet wide (Purinton, 2010), it was built with the intended purpose to support the booming woolen textile mill operations within the region. The dam was used for over a century, periodically maintained and modified to fit the changing demands of the business. The textile mill closed in 1970 (Wildman, 2010). Though subsequent owners used the dam for light industrial purposes, it began to deteriorate.

In 2005, the current owners, Cascade School Supply Company, were notified by the Massachusetts Office of Dam Safety of the significant hazard risks and poor conditions of the dam which would cost nearly $250,000 to repair ("Briggsville Dam Removal & Hoosic River Restoration," 2019). It soon became clear that if the company were to pursue dam removal, they could qualify for local, state, and national funding. This would ultimately cover 95% of the project's costs ("Briggsville Dam Removal & Hoosic River Restoration," 2019).

In working with the Massachusetts Division of Ecological Restoration (DER), the project began investigation and permitting in 2006 and the dam was removed in 2010 (Final Report: Eastern Brook Trout Joint Venture, 2011). As a result, significant flood and safety risks were remediated, water quality was vastly improved, and over 30 miles of fish passage was cleared for fish species like the Eastern brook trout and longnose sucker (Final Report: Eastern Brook Trout Joint Venture, 2011).

Takeaway

Though the dam's removal to some felt like the closing of a chapter on the town's history in textiles, it began a new era of promoting greater environmental and social well-being within the watershed for generations to come.

CASCADE SCHOOL SUPPLIES

Image Courtesy of Cascade School Supply Company (2014)

Image Courtesy of U.S. Fish and Wildlife Service Northeast Region (2011)

Key Stakeholders

Cascade School Supplies Company - owner of the property where the Briggsville Dam was located. The company was burdened by the cost of dam maintenance, and would have potentially laid off employees to cover the cost, if the dam were not removed and there were not public funds available

Town of Clarksburg, MA – community where Briggsville Dam was located and affected by the upstream and downstream effects of the structure

MA Office of Dam Safety - ODS conducts dam safety assessments, including the ones that spurred Cascade's exploration of dam removal

Hoosic River Watershed Association (HooRWA) – community environmental group dedicated to maintaining the health of its eponymous river, much in the way that IRWA works on behalf of the Ipswich River.

The Briggsville Dam was located in the Hoosic River Watershed.

Trout Unlimited – community environmental group dedicated to the protection and preservation of wild fish species

MA Division of Ecological Restoration (MA DER) – funding source, licensing and permitting support

US Department of Agriculture: Natural Resources Conservation Service (USDA NRCS) – funding source

Eastern Brook Trout Joint Venture (EBTJV) – funding source

Corporate Wetlands Restoration Partnership (CWRP) – funding source

American Rivers – partner organization

Funding

Total Project Budget:	**$768,561**
Total Outside Funding:	**$748,561**
NRCS-Wildlife Habitat Incentive Program (WHIP):	$379,273
MA DER:	$144,000
CI Construction:	$100,000
Wildlife Action Fund:	$82,758
Sweetwater Trust:	$15,000
EBTJV:	$12,530
US Fish and Wildlife Service Partners:	$10,000
CWRP:	$5,000
Total Spent by Owner:	**$20,000**

Timeline of Dam Removal

2005: ODS contacts owner regard dam's condition
2006: Consideration of removal process began
2006-2007: Feasibility study conducted
2008-2010: Final design and permitting
2010-2011: Construction and planting
2007-2015: Monitoring

Benefits

Improve riparian and stream habitat

Reduced risk of flooding upstream

Remove threat of dam failure to downstream properties

Improve habitat diversity

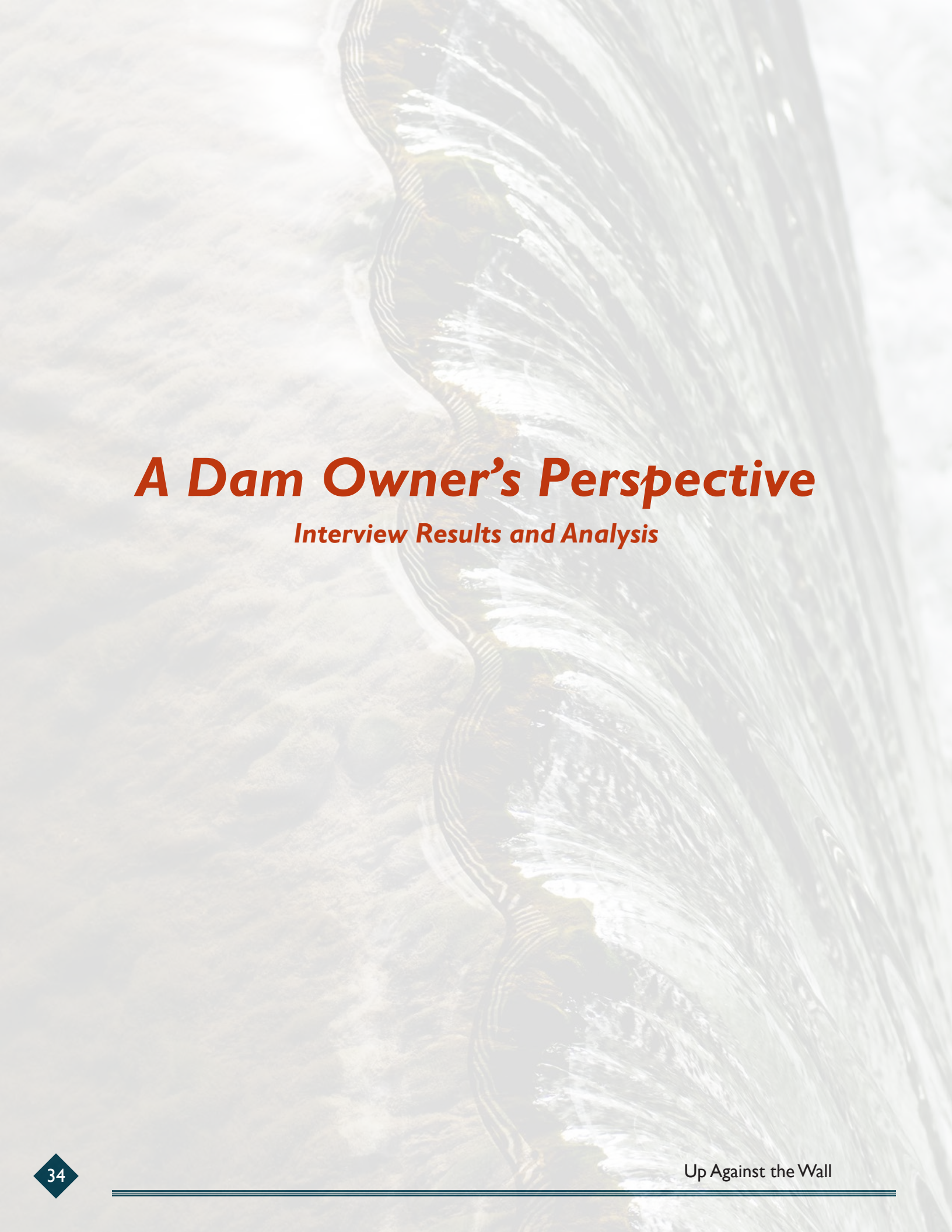
Section References

Briggsville Dam Removal & Hoosic River Restoration. (2019). Retrieved April 4, 2019, from Mass.gov website: https://www.mass.gov/service-details/briggsville-dam-removal-hoosic-river-restoration

Final Report: Eastern Brook Trout Joint Venture. (2011, January). Division of Ecological Restoration.

Purinton, T. (2010, December 2). Briggsville dam removal [Text]. Retrieved April 4, 2019, from Mass Great Outdoors Blog website: https://blog.mass.gov/greatoutdoors/environment/briggsville-dam-removal/

Wildman, N. (2010). Briggsville Dam Factsheet.



A Dam Owner's Perspective

Interview Results and Analysis

Part 1: Dam Ownership Context

WHO DID WE INTERVIEW?

We interviewed five total dam owners in the PIE Rivers Region: three respondents associated with privately owned dams, and two respondents associated with publicly owned dams. In order to maintain the confidentiality of interview respondents, the responses will be discussed only with identifiers such as 'public dam owner' or 'private dam owner'.

HOW DID THE RESPONDENTS BECOME DAM OWNERS?

The majority of the respondents (3 of the 5 owners) came to own the dam of as a result of some type of property transaction. This could be a transaction from a private owner to the Town, or between private entities, or similar. Other respondents received the property with the dam via a land donation, or did not have clear knowledge of how the dam had become part of town property (in the instance of a public dam owner respondent).

KNOWLEDGE OF DAMS: WHAT DO OWNERS KNOW ABOUT THE HISTORY OR CURRENT USE?

Four out of five dam owners had knowledge of the current and past purposes of their dam. While some of the dams were created in the last century, there are historical dams that have been around since the 1600s. In addition, three out of the five dams have been renovated in the last century. The building material ranged from concrete to earthen dam structures.

"Lots of New England towns have these little mill ponds that are probably created by dams. If the dam were to fail or was removed then the water would come down, and it would change the character of this whole area."
~Private Dam Owner

WHAT ARE THE MAIN COSTS AND BENEFITS OF OWNING A DAM, FROM THE OWNER'S PERSPECTIVE?

Image Courtesy of Coco McCabe (2018)

For both public and private dam owners, regulatory and maintenance requirements were noted to be significant costs. These included safety inspections, regular maintenance of vegetation around the dam, or emergency response plans. Environmental 'costs' were mentioned by both public and private dam owners; however, private owners indicated overgrown vegetation and landscape management relative to the dam as a cost, and public owners noted environmental costs associated with flooding and environmental resilience strategies.

Gains, or benefits, to owners associated with the dam were only mentioned by private dam owners through the course of the interviews. These included benefits associated with the impoundments created by dams, environmental factors (wildlife habitat supported by ponded landscape), recreational value related to the aesthetics of a dammed landscape, and consumptive purposes such as water sources.

Table 1 Cost and benefits for dam ownership across public and private owners

	COSTS	GAINS
PRIVATE OWNERS	Regulatory/maintenance costs	Environmental benefits
	Environmental issues	Recreational/aesthetic value
		Property value to adjacent parcels
		Consumptive use/functional value
PUBLIC OWNERS	Regulatory/maintenance costs	[None Noted]
	Environmental concerns	

DAMMED LANDSCAPE CHARACTERISTICS & ENVIRONMENTAL QUALITY: What stands out to owners?

Image Courtesy of Coco McCabe (2018)

Weather

During storms or significant rainfall, three out of five of the dam owners addressed concerns about the weather affecting the water levels.

Image Courtesy of Coco McCabe (2018)

Water

Every dam owner was aware of fluctuation of water levels surrounding their dams. Dam owners were more aware of the water level in the instances where the water source was being used for a specific recreational or business-related function.

Image Courtesy of Coco McCabe (2018)

Plant Life

Two out of five of the dam owners discussed plant species that exist surrounding their dam structures. In one instance, lilies flourished in the pond, and in the other, invasive species had begun to grow.

Animals

One dam owner acknowledged that the water surrounding their dam attracted "lots of wildlife," but stated that the pond levels were too low for fish.

Part 2: Considerations for Dam Removal or Modification

HAVE YOU CONSIDERED MODIFYING OR REMOVING YOUR DAM? WHY OR WHY NOT?

Table 2 Owner responses to modification/removal consideration

YES – We have considered and may be a candidate for removal	*YES – We have considered, and are not interested in removal*	*Not sure what to make of removal, or why I should consider it*
- Does not rule out removal, even while acknowledging the current value/uses: recreation, aesthetics of pond, property abutters enjoy ponded landscape, consumptive uses	- Pond has active uses, so advantages of dam outweigh the potential disadvantages	- Not enough information at disposal to make a good decision
- Sees that there may be potential ecological benefits to removal	- Recreational value of the pond is a key town asset	- No impetus to consider it
- No urgency for action, not a safety issue, but may be a future consideration	- Acknowledges conflicts between upstream and downstream water levels, but likely would only consider modification, if anything	- No one has approached the owner about the issue - Pond has current uses and decision-makers see no need to consider changes to the landscape

"There's always an ecological benefit to removing a dam, but in this case the stream coming out of this dam is really small. I don't think it has any anadromous fish runs or anything like that, but you know we're always open to learning more and understanding."
~ Private Dam Owner

Most (3 of 5) respondents were not sure why they should consider dam removal, had not previously considered it as an option, or saw no reason to consider it. Though some of these responses may be attributed to the fact that some of the dams had ponds that are actively used and a drastic change in the landscape would not be desired, some of the responses seemed to be attributed to a lack of awareness of the potential benefits of dam modification or removal as well.

FACTORS FOR CONSIDERATION FOR DAM MODIFICATION/REMOVAL

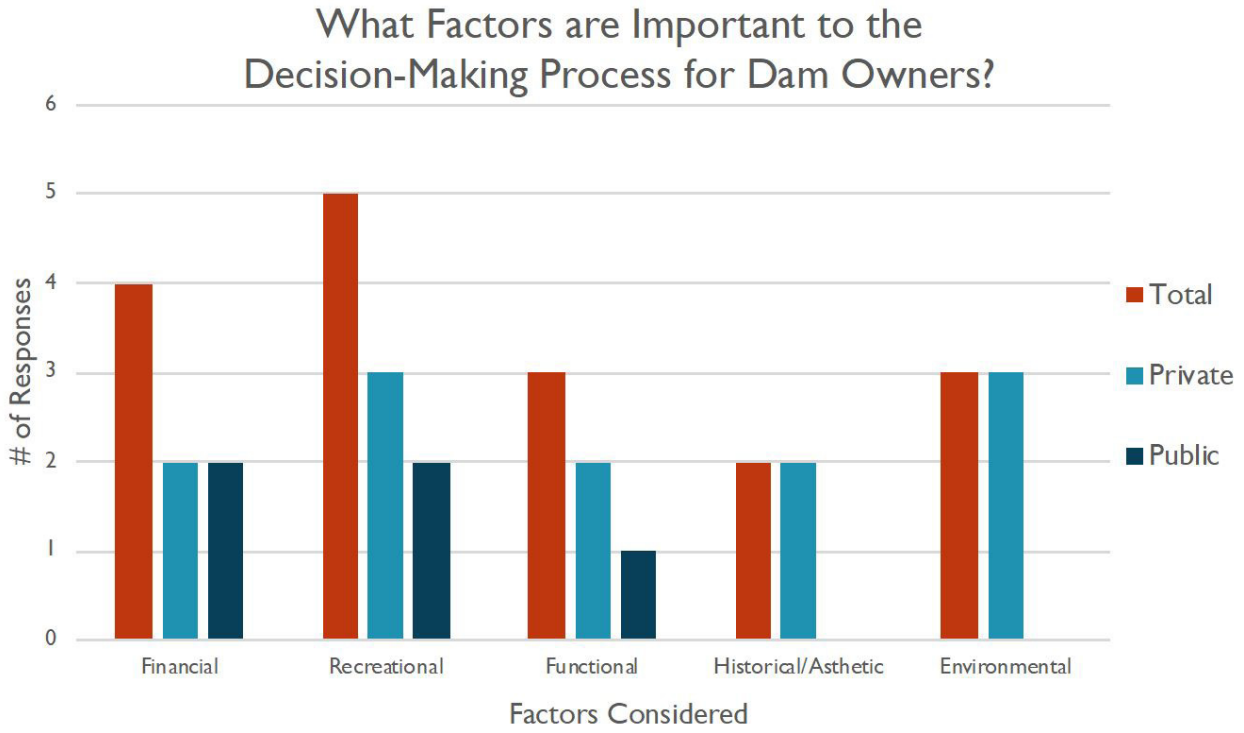


Figure 3 Aggregate totals for factors considered for dam removal/modification

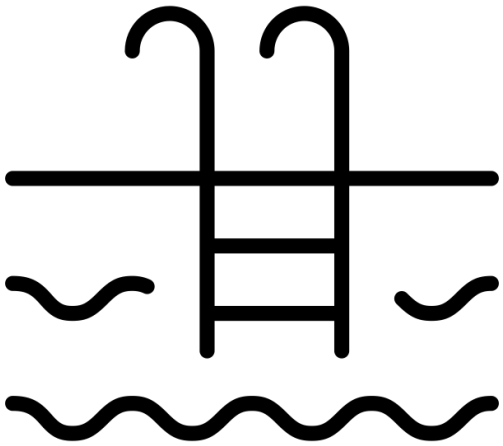
This question addressed what factors dam owners considered important when making decisions about their structure. In addition to the six main factors outlined below, dam owners discussed lack of awareness of resources and complications with land ownership as possible barriers to consideration of removal or modification.

Financial

Created by Max Hancock from Noun Project

For four of the dam owners, financial costs were perceived as a barrier to their decision-making processes. There are regulatory bodies that require specific maintenance and consideration for dams that have safety concerns. Three of our dam owners discussed various requirements they have to meet, such as permitting, analysis, and capacity required to complete these necessary steps. Each task has its own effort and financial burden the owners can't necessarily carry on their own.

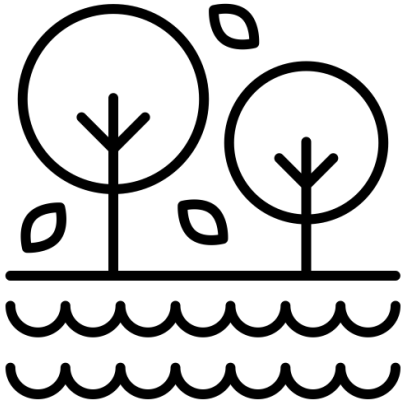
Recreational



Created by Andrejs Kirma
from Noun Project

Every dam owner discussed the recreational usage of the area surrounding their dam structure. People in their communities use the ponds year-round to ice skate in the Winter, observe nature, enjoy leisure activities in the Summer like swimming, fishing, and water skiing. The dam structures are also being used by other entities within the towns like local camps, community groups, and private-public entities such as beach and lake clubs. **Removing the dams would drastically change the built environment many communities have built recreational usage upon.**

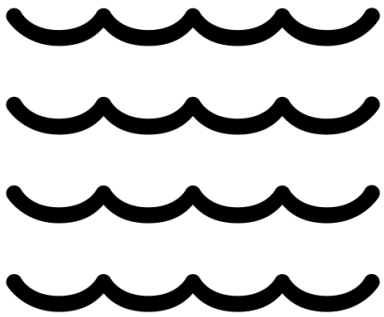
Environmental



Created by Made x Made
from Noun Project

For two of the dam owners, there were concerns that removing the dam structure would alter the current ecosystem. In one instance, the owner worried that removal of the dam would change the salinity of the pond and would cause certain species to leave the location.

Functional



Created by Bintang Anandhiya
from Noun Project

Three of the dam owners discussed particular functions of the dam associated with maintaining a specific water level above or below the structure as an important factor to their consideration. In some instances, both owners and community members are responsive when the water levels drop in the areas upstream or downstream of the dam, whether that be for consumptive or aesthetic reasons. Responses included conversations about the negative effects of the water level changes on the surrounding community (in a flood or drought scenario), water accessibility for organizations dependent on the water source (when used as an intake for consumptive use), and business-related needs of the water level being maintained (i.e. for commercial recreational use).

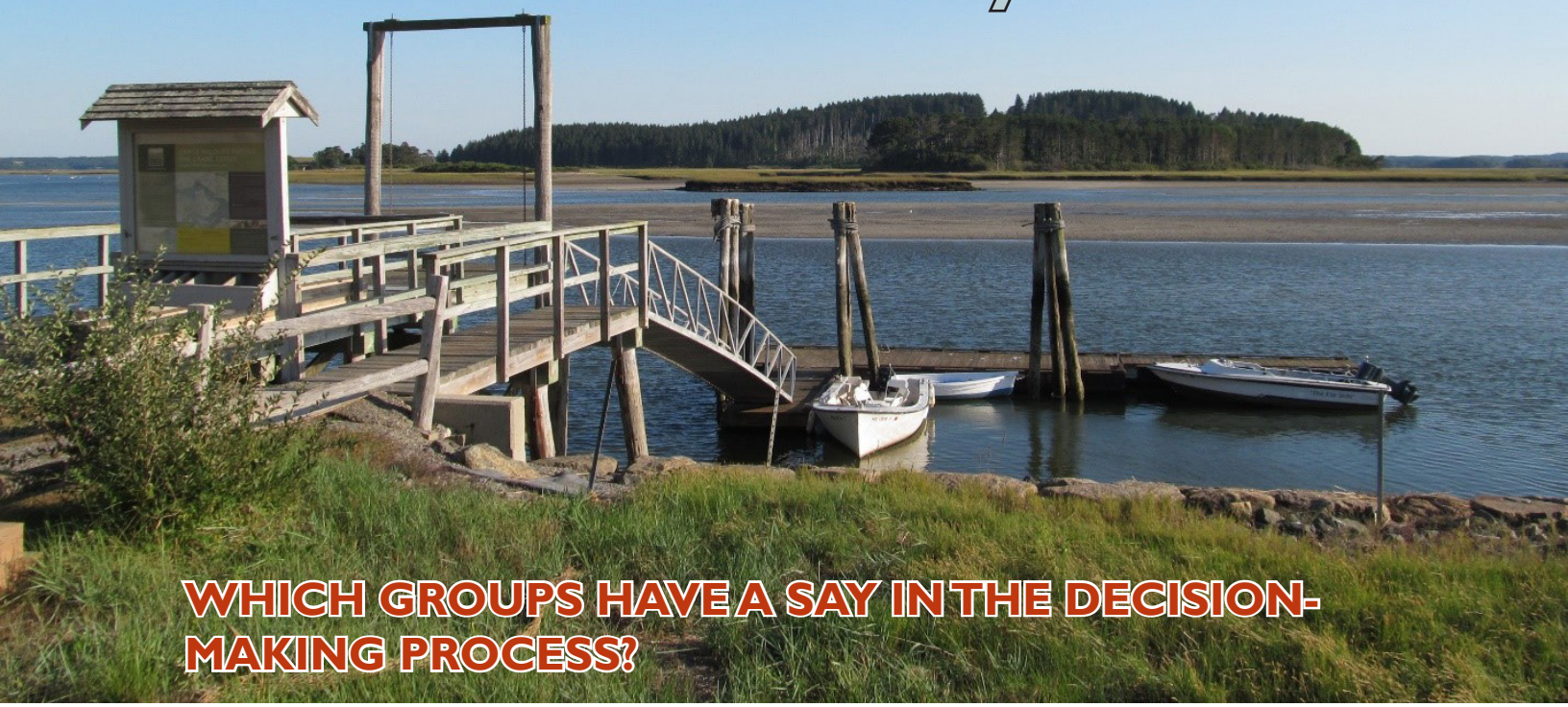
Historical

Created by Atif Arshad
from Noun Project

Two of the dam owners noted the history and aesthetic value the dams have created with their ponds. When considering removal, each dam needs to determine if their structure is historical. If that is the case, there could be more barriers to modification or removal from a preservation perspective. In addition, a dam owner discussed how people have become attached to the ponds that the dams have created. Removing the structures will alter landscapes people have associated with New England nature.

"I also think that many of these dams and the ponds they create, there's an emotional attachment to the pond. If you told people 'we're going to remove the dam, but the pond's not going to change,' they probably wouldn't care. If you told them you are going to remove the dam and the pond they've been looking at their entire lives is going to become a stream, people have a harder time with that."
~Private Dam Owner

Part 3: Who Gets a Say?



WHICH GROUPS HAVE A SAY IN THE DECISION-MAKING PROCESS?

> ***"If we propose some changes [to the dam], we'd be making every effort to reach out to everyone and get some feedback and input in terms of what options we might be looking at"***
> ***~Private Dam Owner***

> ***"The buy in of the community is item number 1, 2, and 3 in terms of importance. So that would be where you would have to start."***
> ***~Public Dam Owner***

All five dam owners agreed that the public can and should have a say in the decision-making process to remove or modify a dam structure. Private dam owners viewed the public opinion in an advisory capacity: they want to engage with commissions, key stakeholders, and the community to maintain transparency and enhance the information available for their decision. **Ultimately, the private dam owners hoped for compromise, transparency, and assistance in the decision-making process, but would make the decision they felt was best with the information available to them.**

The public dam owners viewed the public opinion as the impetus for their decision-making process. **Without the community's approval, dam modification or removal projects are very difficult to achieve for public dams.**

HOW MUCH WEIGHT SHOULD BE GIVEN TO PUBLIC OPINION VERSUS ADMINISTRATIVE KNOWLEDGE?

Public opinion is necessary for both private and public dams to achieve successful removal or modification. Additionally, the dam owners interviewed highlighted the role expert opinion and town government and administration can play in aiding both dam owners and the public to understand the structure in question. The private dam owners viewed expert opinion as the most important when making a decision, while the public dam owners viewed public opinion as the most important. Both viewed town administration and government as a mechanism for garnering public support.

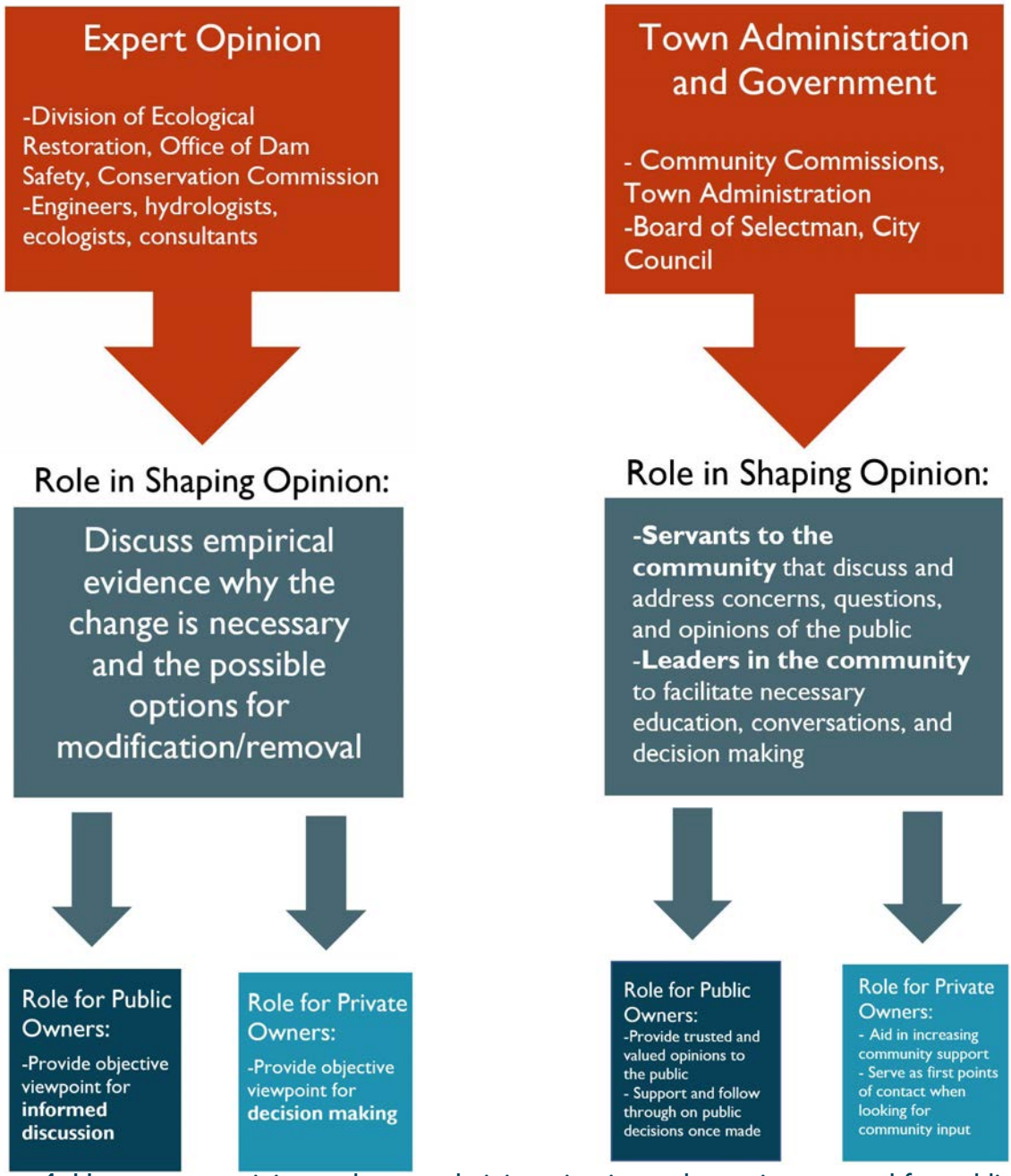


Figure 4 How expert opinion and town administration input determine removal for public and private dam owners

WHAT GROUPS HAVE CONTACTED YOU ABOUT THE DAM?

Table 3 External groups that have/have not reached dam owners

	FEDERAL GROUPS	STATE GROUPS	LOCAL GOVERNMENT	NON-PROFITS	COMMUNITY GROUPS
PRIVATE OWNERS	[None Noted]	MA Fish and Wildlife	[None Noted]	IRWA	[None Noted]
		MA Department of Environmental Protection		Mass Audubon	
PUBLIC OWNERS	[None Noted]	MA Office of Dam Safety	Board of Health (Water Quality)	[None Noted]	[None Noted]
		MA Fish and Wildlife	Conservation Commission		
		MA Department of Environmental Protection			

Image Courtesy of Coco McCabe (2018)

Part 4: EXISTING RESOURCES, OUTREACH, AND SUPPORT

GAPS, CHALLENGES, AND PREFERENCES

AWARENESS OF AND ACCESS TO RESOURCES

Common responses from interview participants indicated that both public and private dam owners were not necessarily aware of resources related to dam modification or removal projects, or had not had experience with them up until this point. Many discussed that they assumed there may be grant funding or other financial assistance, but weren't sure what that may look like, if they would qualify, or how they would seek further information as a starting point.

Some organizations or Town representatives did however feel that they had contacts either in-house or within their professional circle to request assistance or advice for resources, if they needed it.

For both public and private owners, capacity to pursue this type of project was noted as a limiting factor. They felt they had the tools to feasibly locate resources and pursue a project, but in actuality they lack the number of personnel/manpower or time to dedicate to such projects.

DO DAM OWNERS FEEL THEY HAVE THE INFORMATION THEY NEED TO MAKE INFORMED DECISIONS?

Table 4 Accessibility to information as determined by dam owners

	We have…	*We need…*
PRIVATE OWNERS	Some resources in-house	More readily available information about funding opportunities
		More opportunities for info-sharing with people who have gone through the process
PUBLIC OWNERS	Ability to handle routine maintenance and ongoing management needs	"We could always use money"
	Informal networks to rely on when seeking advice or guidance	More local level capacity to pursue initiatives and projects

WHEN DAM OWNERS ARE SEEKING INFORMATION, WHAT MEDIUMS DO THEY PREFER?

"...to hear from people who have gone through this process or are halfway through the process or whatever that scenario may be, is always helpful. Of course that's a time commitment and usually expenses associated with it, so I think being mindful of where those meetings or workshops are held so that people can come or can join virtually is really key."
~Private Dam Owner

"I feel like I have tried to cultivate those contacts and I do value the contacts that I have (IRWA, Mass association of conservation commission, Merrimack planning commission, others). I do rely upon that sort of informal network for a lot of key information and that factors into my actual decision making"
~Public Dam Owner

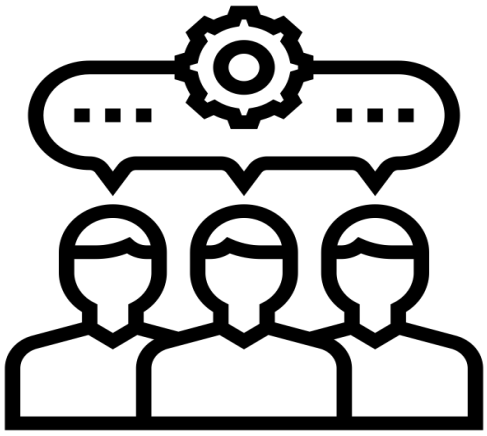
Created by monkik from Noun Project

Printed materials were noted to be useful for disseminating generic information, but the dam owner acknowledged that other mediums would more appropriately support more detailed or specific information.

Pros:
Good for visuals or contact information

Cons:
Not long lasting, and less effective for detailed resource information

Preferred Media (cont'd)

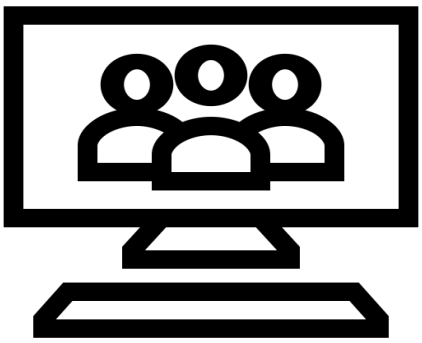


Created by Eucalyp
from Noun Project

Three of five dam owners preferred receiving information from **conferences, workshops or working groups**, or online webinars. Respondents are particularly interested in specific information, and seek examples and lessons learned from those who are going through the process or have completed a project.

Pros:
Opens the communication channels, fosters information sharing
And standardization of best practices, builds informal networks

Cons:
Can be time or resource intensive (as an attendee or an organizer)



Created by emma mitchell
from Noun Project

All of the dam owners noted that **online resources** are their most commonly used medium for information searching.

Pros:
Widely available, widely used, can get information fast

Cons:
It's impersonal—dam owners mentioned they ignore standard email blasts and generic resources may not be effective for their needs

Key Takeaways

What comes next?

Image Courtesy of Boston Magazine (2016)

Given the fruitful nature of the interviews and the myriad information that dam owners provided, we tried to condense that content into a few key takeaways. We hope these recommendations are broad enough to apply to each unique dam context, while also specific enough to be useful. Though our interviews did not comprise a representative sample of the dam owners in the PIE-Rivers Region, we hope these takeaways provide practical guidance and insight for IRWA.

Takeaway 1: Encourage Maintenance Assistance

Many dam owners acquire their dams as part of a larger property purchase. Often, the dam was not a desired asset but rather a large burden because of the required maintenance. Costs and required inspections create an opportunity for greater discussions in dam modification/removal. Whether as a policy advocate or an intermediary, IRWA could work to connect dam owners to ODS and DER to have better maintenance plans. This would build a holistic trust between IRWA and dam owners which could lead to greater dam stewardship and potentially modification/removal.

Takeaway 2: Local Context is Key

The literature and our analysis proved repeatedly that dam removal happens on a case by case basis. Regarding who should be consulted when considering removal, it is key to understand the local politics of each town, who are the critical stakeholders, and how they relate with one another. Once critical political figures are identified, it is clear that availability of funding is a powerful impetus. People seemed less likely to grasp nebulous ideas of watershed health but rather exact funding opportunities and the processes to get them. Providing case studies like Briggsville Dam can help abstract proposals seem more concrete.

Takeaway 3: Acknowledge and Substitute Current Watershed Activities

While there are clear ecological advantages for dam removal, one ought not assume that those opposed to dam removal are disconnected from the watershed. Rather, those hoping to keep their dams have strong interactions with their natural environment through fishing, bird watching, boating, and beaches that are only there because of the dam's presence. They have developed a fondness for the environment created by the structure. To remove the dam is to alter their "nature." Conversations around dam removal should thus educate people on how these freshwater pond ecosystems exist elsewhere and highlight the importance of the ecosystems not allowed because of the dam's presence. Introduce new activities that can be done in post-dam ecosystem. Provide strong substitutes like a public pool that can replace activities lost from the dam's removal.

Takeaway 4: Facilitate Knowledge Sharing

Given the extensive and in-depth professional and interpersonal networks among public officials, it would be beneficial to tap into that already established social capital. Our interviews indicated that dam owners would find it very beneficial to attend conferences, workshops, and in-person meetings, perhaps with the option to telecommute, where best practices and challenges can be shared by people who have already gone through the process of dam removal and modification, or are currently in the middle of it. The crucial idea here is the importance of allowing dam owners to collaborate and build off of pre-existing relationships.

Takeaway 5: Multi-Lens Approach to Understanding Dam Removal

Through our research, we determined that the stakeholders in the dam removal process generally view the topic through one of three scales: individual, community, and watershed levels. In order to effectively engage in dam removal projects, one must distinguish between the differing concerns of individual private dam owners, public dam owners, and watershed-wide organizations. There is a need for some incremental paradigm shift in terms of how dam owners view themselves as a piece of the greater health of the watershed. Building strong relationships with local government can also help make these connections between local and regional decision making.

Takeaway 6: Benefits of Further Ground-Truthing

Our interviews demonstrated that there is a much wider variety of what a dam can be. Some are made of wood, while some are made of more earthen material. They are not all the concrete structures we often think of, and their specific compositions influence the impact they have on the surrounding environment. Our literature review and case study analysis also demonstrated how site-specific the factors associated with dam removal can be. Successful dam owner outreach necessitates in-person encounters to understand the community context and environmental interactions associated with the dam in question. Fostering relationships with public officials in towns that own dams, or in which privately owned dams are located, may aid in effective outreach.

Appendices

1. One-Pager for Public Dam Owners

2. One-Pager for Private Dam Owners

3. Interview Guide

4. Image References

The Exeter River following the removal of the Great Dam.

The Great Dam in Exeter, NH

A Case Study for Public Dam Owners

The Story

The Great Dam, previously located on the Exeter River, was an iconic landmark situated in the heart of downtown Exeter, New Hampshire. The most recent dam structure prior to removal in 2016 was constructed in 1914, though historic records suggest that a dam had been present in the approximate location since the end of the 17th century and had been utilized for manufacturing purposes (Town of Exeter 2010). The Exeter River Study Committee was established in 2004 to oversee issues related to water supply and quality, which were highly intertwined with the decision-making conversations relative to the Great Dam (Town of Exeter and New Hampshire Department of Environmental Services 2005). The construction phase of the removal and restoration project occurred over a four-month period and was complete by October of 2016 (VHB 2017).

The Great Dam removal reopened 21-miles of river habitat for various sea-run fish species and the elimination of safety hazards related to the aging dam structure that had fallen in disrepair (Fisheries n.d.). The case of the Great Dam Removal is an example of tremendous collaboration across groups at the federal, state, and local level, and the eventual success of the project is a testament to the Town's commitment to a robust public process.

Funding

Total Project Budget:	**$1,786,760**
External Funding Total	**$801,020**
NOAA Coastal Resiliency Program:	$610,960
New Hampshire State Conservation Committee:	$100,000
New Hampshire State Coastal Program:	$75,060
New Hampshire State Conservation Committee:	$15,000
Town of Exeter Funding Total	**$1,200,000**

Key Stakeholders

Town of Exeter
Town Committees and Working Groups
Officials at NOAA and NHDES
Private consulting firms (VHB)
NH Division of Historical Resources
Funding Sources
Exeter Residents

Timeline

2000 and 2004: Dam inspection indicated the structure is unable to pass the runoff resulting from a 50-year precipitation event

2004 – 2007: Exeter River Study Committee established.

March 2009: Mandate that the Town make a determination to pursue repair or removal of the dam

October 2010: Request for Proposals for Feasibility and Impact Analysis for the potential removal

October 2013: Final version of the Exeter River Great Dam Removal Feasibility and Impact Analysis complete with public comments incorporated (Vanasse Hangen Brustlin, Inc. 2013).

2014: Town Warrant Article 8 – Great Dam Removal passes

July – October 2016: Construction and restoration resulting from the Great Dam Removal is complete (VHB 2017).

December 2017: The first Annual Monitoring Report for the Great Dam Removal Project is completed, in accordance with the site's NHDES Wetlands Permit (VHB 2017).

To learn more about river restoration efforts in the area:
Ipswich River Watershed Association, https://www.ipswichriver.org/

To learn more about the dam safety inspection and registration process
Office of Dam Safety, https://www.mass.gov/office-of-dam-safety

To begin the dam removal or modification process
Nick Wildman, Ecological Restoration Specialist, Massachusetts Department of Ecological Restoration 617-626-1527 nick.wildman@mass.gov

Figure 5 Timeline for Great Dam removal process

The Briggsville Dam in Clarksburg, MA

A Case Study for Private Dam Owners

The Story

The Briggsville Dam, previously known as the Hewatt Pond Dam, was originally constructed in 1848 in the town of Clarksburg, Massachusetts. The dam was used for over a century, periodically maintained and modified to fit the changing demands of the business. In 2005, the current owners, Cascade School Supply Company, were notified by the Massachusetts Office of Dam Safety of the significant hazard risks and poor conditions of the dam which would cost nearly $250,000 to repair Funding through grants would ultimately cover 95% of the project's costs In working with the Massachusetts Division of Ecological Restoration (DER), the project began investigation and permitting in 2006 and the dam was removed in 2010. As a result, significant flood and safety risks were remediated, water quality was vastly improved, and over 30 miles of fish passage was cleared for fish species like the Eastern brook trout and longnose sucker. Though the dam's removal to some felt like the closing of a chapter on the town's history in textiles, it began a new era of promoting greater environmental and social well-being within the watershed for generations to come.

Funding

Total Project Budget:	**$768,561**
Total Outside Funding:	**$748,561**
NRCS-Wildlife Habitat Incentive Program (WHIP):	$379,273
MA DER:	$144,000
CI Construction:	$100,000
Wildlife Action Fund:	$82,758
Sweetwater Trust:	$15,000
EBTJV:	$12,530
US Fish and Wildlife Service Partners:	$10,000
CWRP:	$5,000
Total Spent by Owner:	**$20,000**

Key Stakeholders

Cascade School Supplies Company
Town of Clarksburg, MA
MA Office of Dam Safety
Hoosic River Watershed Association (HooRWA)
Trout Unlimited
MA Division of Ecological Restoration (MA DER)
US Department of Agriculture: Natural Resources Conservation Service

Timeline

2006: Consideration of removal process began
2006-2007: Feasibility study conducted
2008-2010: Final design and permitting
2010-2011: Construction and planting
2007-2015: Monitoring

Want to Know More?

To learn more about river restoration efforts in the area:
Ipswich River Watershed Association, https://www.ipswichriver.org/

To learn more about the dam safety inspection and registration process
Office of Dam Safety, https://www.mass.gov/office-of-dam-safety

To begin the dam removal or modification process
Nick Wildman, Ecological Restoration Specialist, Massachusetts Department of Ecological Restoration 617-626-1527 nick.wildman@mass.gov

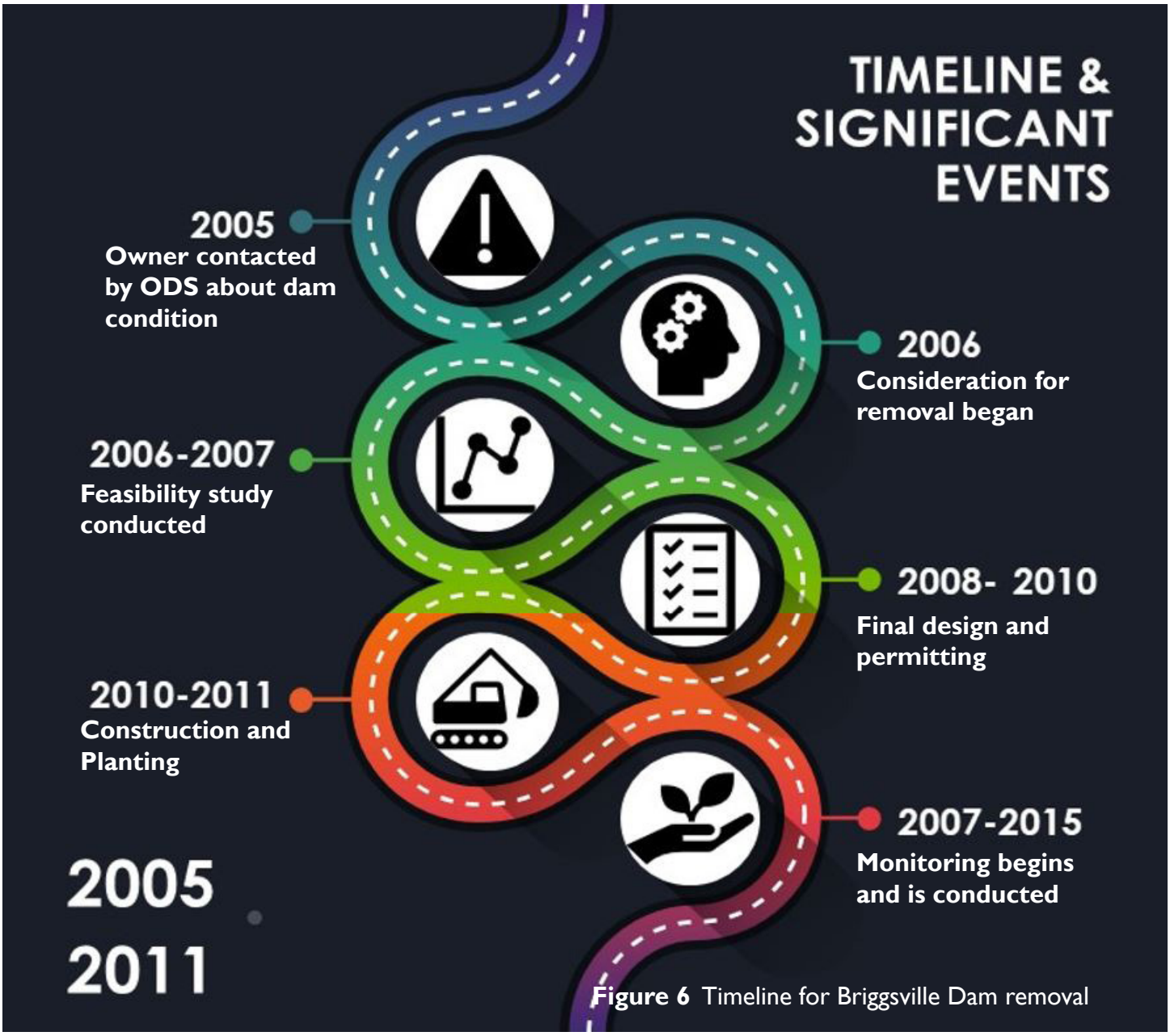


Figure 6 Timeline for Briggsville Dam removal

Interview Guide

Our purpose: to understand the perspectives of dam owners and how finances, environmental resources, cultural/historical connections shape decisions for their dam.

IMPORTANT NOTE: The following questions about removal and modification of your dam. The agenda of this research team is not for all dam owners to seek dam removal. Studies show that sometimes a complete dam removal or various modifications are not what is best for the people or the environment. We wante to understand the voices of dam owners in the watershed.

Section 1: Establish baseline for dam owner's understanding

Tell us what you know about your dam.

- What history do you know of your dam?
- How did you come to acquire the dam?
- In broad terms, what have been the financial costs/gains in owning this dam?
- What have you noticed about the environment around your dam (i.e. do you have observations of how the dam has responded during significant weather events? Do you notice or sense a difference in the health of the river upstream vs. downstream?)

Section 2: Considerations of dam modification

Have you considered modifying or removing your dam? Why or why not?
If you have, what factors are keeping you from pursuing an investigation for dam removal?
Which of these concerns worry you most? Why?

- Financial worries of costs
- Unsure of who to contact
- Historical value
- Financial value
- Functional value
- Recreational value
- Property value concerns
- Engineering concerns
- Environmental concerns

Section 3: Considerations of external factors

Is the decision to modify the dam a personal decision or collective or some mix between? Who do you think gets a say?
What external groups have contacted you regarding your ownership of your dam, if any? (This could include dam safety offices, non-profits, surveyors, etc)
What resources, if any, are you aware of for support in surveying your dam, getting funding, or permits for dam modification/improvement?
How would access to resources influence your dam maintenance/modification decisions?

Final Check

Is there anything else you'd like to add? Anything we didn't ask that you wish we did?

Image References

Anandhiya, Bintang. (2019). "Water". The Noun Project. Received from thenounproject.com

Arshad, Atif. (2019). "History". The Noun Project. Received from thenounproject.com

Boston Magazine. (2016). Crane Beach Sunset. Received from https://www.bostonmagazine.com/arts-entertainment/2016/06/17/crane-beach-pop-up-boston/
Brian Kelder. (2018). Great Marsh Barriers Assessment. Retrieved from Ipswich River Watershed Association website: http://www.pie-rivers.org/id_20/
Cascade School Supplies (2014). Cascade School Supplies company. Received from https://cascadeschoolsupplies.com/

Crane Wildlife Refuge on the Crane Estate (2019). Received from http://www.thetrustees.org/places-to-visit/northeast/crane-wildlife-refuge.html.

Eucalypt. (2019). "Collaboration". The Noun Project. Received from thenounproject.com

Hancock, Max. (2019). "Money". The Noun Project. Received from thenounproject.com

Kirma, Andres. (2019). "Ladder". The Noun Project. Received thenounproject.com

Made x Made (2019). "Environmental Geography". The Noun Project. Received from thenounproject.com

McCabe, Coco. (2018). The Groundtruth Project. Received from https://thegroundtruthproject.org/the-great-marsh/.

Mitchell, Emma. (2019). "Computer Teleconference". The Noun Project. Received from thenounproject.com

Monkik. (2019). "Brochure". The Noun Project. Received from thenounproject.com

Sloane, Eric (1980). Pennsylvania Canal. Retrieved from https://www.etsy.com/listing/584288612/rare-eric-sloane-signed-and-numbered.

U.S. Fish and Wildlife Service Northeast Region (2011). Briggsville Dam Removal Celebration received from https://www.flickr.com/photos/usfwsnortheast/sets/72157626790625867/.