**Mystic River Watershed Initiative Science Forum**
April 30, 2019 | 8:30am – 12:45pm
EPA Region 1 Office | Boston, MA
Meeting Summary
Prepared by the Consensus Building Institute

## Welcome and Introductions

Sean Dixon, EPA Region 1 Chief of Staff, opened the meeting by welcoming participants to the Mystic River Watershed Initiative Science Forum. Ona Ferguson, facilitator form the Consensus Building Institute (CBI), said the Science Forum was designed to enable people to both share information and deepen their connections and collaboration.

This summary provides a high-level summary of projects described in the presentations. Presenters are listed in section titles and participants are listed in the appendix. For more details on particular projects, see the presentation slides on the MyRWA website under EPA Steering Committee 4/30/2019: https://mysticriver.org/epa-steering-committee.

## Climate Resilience

Resilient Mystic Collaborative – *Julie Wormser, Mystic River Watershed Association (MyRWA)*

The Resilient Mystic Collaborative is a new climate partnership to help towns in the Mystic River Watershed collaborate and address issues on a watershed scale. Two-thirds of the towns in the watershed are in the collaborative, and others are welcome to join as soon as they have prepared their climate vulnerability assessments. The Collaborative developed a vision statement in January, which articulated the following principles:

- We are data-driven and action-oriented.
- We share a pragmatic, optimistic vision that recognizes the Mystic River as a tremendous asset.
- We are mutually supportive.
- We have the governance, trust, and participation to maximize our effectiveness.

The group is spending its first year on science and data. It has created five working groups: Upper Mystic, Social Resilience, Lower Mystic, Policy & Advocacy, and Collaborative Governance. The Lower Mystic working group is working with the Department of Homeland Security on a regional preparedness plan to identify the conditions under which infrastructure might fail, and approaches for caring for the most vulnerable residents who rely on public utilities. The Social Resilience working group is partnering with service providers and community leaders to understand how to increase the resilience of vulnerable residents to extreme weather, including heat, air quality issues, and flooding. The Upper Mystic working group is conducting watershed-wide flood scenario modeling, looking at how much flooding can we manage, and what can we do as a region to address flooding.

Watershed Model Results – *Kathy Watkins, City of Cambridge*

The City of Cambridge has begun to develop a Climate Change Preparedness and Resilience Plan, as well as a Climate Change Vulnerability Assessment (CCVA). The CCVA has involved developing scenarios for increased precipitation, extreme heat and sea level rise. With respect to precipitation, the CCVA looked at 10-year, 25-year and 100-year flood events in the year 2070, accounting for climate forecasts. The CCVA has also modeled flooding when the Amelia Earhart Dam has all three pumps functioning versus only two. The data from the CCVA will be used to advocate for infrastructure and funding, and help with developing improved approaches to protect residents, business owners, and property owners. The City has also developed an online tool, the Cambridge Flood Viewer, which allows users to look at projected flooding and property elevations. A number of property owners and investors have already begun using the tool.

There have been some initial efforts to expand this kind of mapping to the broader Mystic River Watershed. With a regional model it will be possible for municipalities to work collaboratively to think about the benefits to the region of different projects. For example, there might be projects in an upstream community that would benefit multiple other downstream communities. A beta version of the regional tool is available at geo.stantec.com/mysticriver/viewer, which shows areas of expected flowing, low lying areas, and localized depressions. Overall, the regional model highlights areas that are most prone to flooding, but is stripped down and less detailed than the CCVA modeling. There has been some follow up with communities around whether the model matches their observations of areas prone to flooding, and whether there are certain areas where they may want more detail.

In a question and answer period following this presentation, the following points were clarified:

- The regional model does not account for the sewer or drainage system. That is why it is important to spot check the model to see if it matches real world experiences.
- For areas in the flood plain, Cambridge requires that private developments create compensatory storage and include measures to protect for a 10-year storm and recover from a 100-year storm in 2070. In the future, as this area gets wetter, it will be necessary to learn to live with and manage periodic flooding.

**Mystic River Phosphorous Loading Study**

Preliminary Results and Next Steps – *Patrick Herron, MyRWA*

The Mystic River Phosphorous Loading Study has been measuring phosphorous loading in the freshwater section of the Mystic River for about the past five years. Almost every major water body in the watershed is impaired due to phosphorous or other indicators of eutrophication. Beginning in 2015, the study developed a sampling plan and standard operating procedures, and then manually took more than 2,500 samples via more than 700 visits over three years. EPA and ERG then took this data and selected a model – the BATHTUB Model – for how nutrients flow through the system and are attenuated. Preliminary results from early 2018 suggested that the Mystic River and associated waterbodies are receiving 40-60% more phosphorous than a healthy system would receive. Further results suggest the number is closer to 60% or more.

The study has also used a tool called the Opti-Tool (discussed below), which estimates runoff, helps identify locations to install green infrastructure or best management practices to reduce nutrient loading, and helps estimate the associated costs of various measures. Key themes emerging from the study for cities and towns include the following:

- By acting now, communities can seize opportunities for cost effective solutions that may not be available if and when more strict requirements are put in place.
- Communities should look for "low-hanging fruit," like installing green infrastructure during routine road work, and maximizing street sweeping and leaf collection practices.
- Communities should update their codes and ordinances to capture improvements with new developments.
- There is a need for adequate funding to move these approaches forward.

Next steps for the Mystic River Phosphorous Loading Study include sharing the results in as many venues as possible, and continuing to meet with mayors and other officials to discuss their recommendations.

The following points were clarified in a question and answer period following this presentation:

- Phase 3 of the study involved taking applications from communities for nutrient management, while Phase 4 will involve sharing practices from these communities more broadly across the watershed.
- It is not clear what impact the reintroduction of river herring into the system will have on nutrient loading.

Use of Opti-Tool in the Mystic River Watershed Nutrient Management Analysis – *Mark Voorhees, EPA Region 1*

Stormwater runoff is major source of phosphorous coming into the river system. To achieve a 50% reduction in phosphorous, we will need significant retro-fits of stormwater control mechanisms. EPA wanted to pilot a demonstration to look at the cost and extent of interventions needed to address phosphorous loading.

Opti-Tool is a spreadsheet-based stormwater management optimization tool. The model is calibrated to water quality, stormwater quality, and runoff volumes, and is suitable for MS4 permitting. The tool is usable both to 1) quantify stormwater runoff source volumes and pollutant loadings as part of the watershed and water quality modelling, and 2) perform demonstration stormwater management optimization analysis with the same stormwater source loadings for a pilot watershed to help inform the development of cost effective and feasible management strategies.

The 8 square mile Mystic River subwatershed that drains to the lower mainstem was used as a pilot. The tool was used to produce optimization solutions and a cost-effective curve, in order to identify the most cost-effective solutions. The tool looks at the cumulative impact of stormwater control measures using hourly time-steps and takes into account issues like soil type, impervious cover, slope and the presence of hazardous waste sites. EPA modeled two separate scenarios: one using existing stormwater standards, optimizing stormwater control measures with a fixed 1-inch impervious cover runoff depth, and another that allowed for a range of stormwater control types and sizes from 0.1 to 1.0-inch impervious cover runoff depth. For the fixed one-inch systems, the results show that cost increases dramatically for efforts to achieve more than a 50% phosphorous reduction. When sizes are allowed to vary, overall the costs go down dramatically. In addition, there is a very wide range in terms of the costs of different

solutions. These results suggest it is important to plan ahead and implement the most cost-effective measures possible, since costs can vary enormously.

The following points were clarified in a question and answer period:

- This project is designed to help identify the long-term best approaches to help communities implement stormwater control measures in the most feasible, cost effective and realistic ways.
- The tool is relatively new and not many people know about it. It is currently being used in Tisbury by Paradigm Environmental, and as part of a case study to address numerous stormwater issues including frequent flooding and water quality impacts.
- EPA is hoping to get some money to provide technical support for users trying to use and adapt the tool.

**Updates on Initiatives in the Watershed**

Town of Winchester – *Beth Rudolph, Town Engineer*

Winchester is a town with many long-standing water issues. It faces flooding along the Aberjona River and Horn Pond Brook, water quality concerns, low-flow conditions in the summer, sedimentation of waterways, and financial constraints, among other issues. The town has been engaged in a flood mitigation program since 1996. It has also implemented local regulations requiring projects to match pre and post-development runoff rate and volumes, engaged in various stormwater management projects (including a 319 Grant with MyRWA for "green infrastructure"), completed of a fish ladder at Center Falls Dam in 2019, and conducted a stormwater utility analysis.

The town's $3.7 million West Side Field Drainage Project involved installing a large-scale infiltration/detention system to mitigate downstream flooding. The project was coordinated with a 319 grant to install tree trenches in the downstream area. The town completed a similar project in 2011, the Manchester Field Drainage Project. The town's future goals and initiatives include:

- Maintaining and improving waterways as cultural and recreational resources, and improving aquatic habitat.
- Preserving investments in flood mitigation.
- Climate resiliency and preparation for increased precipitation amounts and extremes.
- Coordination with the Town's Master Plan.

Town of Arlington **–** *Wayne Chouinard, Town Engineer*

The Town of Arlington is engaged in various initiatives. This year, it is installing infiltration trenches, which it can design itself, and is hoping to get phosphorous removal credit for the installations. The town is utilizing all the funding sources it can to address stormwater issues, including sidewalk funds and handicapped funds. It is also trying to use requests from residents to reduce traffic speed in order to build curb extensions and create future room for rain gardens. The town is looking into ways to leverage these activities with grants. Overall, the town is moving forward and taking small steps to pull phosphorous out of the ground, and benefits from its collaboration with the Mystic River Watershed Initiative.

MassDEP Sampling in Mystic Lakes – *Matt Reardon, MassDEP*

The Mystic lakes — Horn Pond, Spy Pond, and Wedge Pond — all suffer from phosphorous and multiple other impairments. EPA has conducted a lot of work that could be used for a Lake Loading Response Model, but updated water quality sampling data is needed. MassDEP hopes to update the water quality data from these three lakes through sampling in 2019. MassDEP will conduct four visits to the ponds from June to October, measuring their surface and bottom nutrients, depth integrated chlorophyll a, and conduct a dissolved oxygen profile. The sampling will also include bathymetric mapping once for each pond. The results will be shared in order to allow for parallel work on a Lake Loading Response Model, and the results will be available in draft by request.

MRWA Monitoring Program – *David Wu, MWRA*

The Massachusetts Water Resources Authority (MWRA) has conducted regular sampling in the Mystic River, Charles River, and Dorchester Bay from 1989 to the present, focused on bacteria and nutrients. Since 2017, MWRA has also conducted storm sampling, seeking to "follow" water quality impacts from storms for five days. Overall, the results show improvements in wet weather conditions in Alewife Brook since 1989, but dry conditions have stayed mostly the same. The main stem of the Mystic River shows the opposite: some improvements over time in dry weather conditions while wet conditions have stayed mostly the same. Sampling results from 2017 generally show higher bacteria counts in damp and wet weather at nearly all sampling locations. They also show that levels of bacteria tend to decrease the further downstream you go.

**Malden River Health Risk Assessment** – *Andy Hrycyna, MyRWA*

The 2018 Malden River Human Health Risk Study for Boating has favorable new for boating on the Malden River, showing that conditions in the river are favorable even for intensive, daily boating activities. The Malden River has a long history of industrial pollution. There is a well understood body of evidence that contaminants are present in significant levels, and as a result there have been precautionary health warnings by officials in the communities along the river.

This study sought to thoroughly identify hazards and health risks from boating, based on estimates of dose and exposure to harmful chemicals. The study took sediment and water column samples from nine potential boat launch locations along the Malden river. It then made conservative assumptions around the amount of exposure to the hazards present, looked at multiple age groups and types of boaters, and applied both state and federal safety guidelines. The study analyzed six different types of boaters, and found that for none of these types did the boating cancer risk exceed EPA's limit of 1 in 10,000 or MassDEP's limit of 1 in 100,000. The highest additional cancer risk was for the employee of a boat house who kept wading into sediments, working without a dock, for his or her entire lifetime. The risk for this individual was still less than the EPA and MassDEP limits. In addition, no hazard exceeded the EPA and MassDEP target hazard index of 1 for non-cancer hazards.

In addition to cancer risks and other hazards, the Malden River has microbial contaminants that vary on a daily basis, which can render the water unsafe. The Mystic Daily Boating Advisory,

available online at mysticriver.org/boatingadvisory, is a live, daily predictive model for bacterial levels in the Mystic River, the Malden River, and Upper Mystic Lake. Bacteria levels tend to rise after heavy rain-fall events, so prospective boaters should check the model after it rains.

The following points were clarified in a question and answer period:

- The data in this study is consistent with historical data from prior studies by the U.S. Geological Survey and Army Corps of Engineers.
- Mr. Hrycyna has made a number of public presentations about the study. During these presentations, it is important to make sure people do not hear the message that the Malden River has *no* pollution. The river is definitely polluted, but the study suggests it is nonetheless safe for people to engage with.
- Mystic Daily Boating Advisory incorporates a suite of environmental variables that are associated with rainfall. The technical model is posted on the website. The best predictor of boating conditions on the Upper Mystic is flow in the Aberjona River, based on the amount of rain in the last 48 hours.

**Herring Run**

Nighttime Study – *Andy Hrycyna, MyRWA*

River herring include two species of migrating fish, Alewife and Blueback, that live in the ocean for most of their lives but migrate annually to spawn in freshwater environments. They migrate to the river they were born in. Historically, herring is a very important species both economically and ecologically, and their population collapsed in the 1970s mainly due to over-harvesting. In addition, because the herring migrate inland, they require freshwater habitat to breed. By damming our rivers, we have systematically taken away this freshwater habitat. Now, because we have put a moratorium on commercial herring fishing, the availability of freshwater habitat is the key limiting factor determining whether the herring population can recover. On the Mystic River, the Amelia Earhart Dam does not impede herring migration because it is opened at low tide. The real obstacles were large dams in Medford and Winchester. Now, a fish ladder at Upper Mystic Lake means that the breeding area for herring in the Mystic is 60% larger than it was prior to 2012.

Since 2012, there has been a citizen science initiative to count fish as they climb the fish ladder to enter Upper Mystic Lake. The initiative has involved around 100 volunteers per year. The results have shown that the population of herring in the Mystic Herring Run more than doubled from 2012-18. Significant gains were seen beginning in 2015, which was expected because the fish ladder was constructed in 2012 and the fish return to breed when they are three years old. This suggests that the relatively cheap intervention of introducing a fish ladder has had a dramatic ecological impact. Another fish ladder has already been installed at Center Falls dam, further increasing the herring habitat, and the next target is Horn Pond in Woburn.

MyRWA also received a grant to install a camera where the dish are coming back into the lake, and a website (www.mysticherring.org) where volunteers can go to count the fish. The input from the volunteers is then entered into a database, put through a statistical model, and used to improve our measure of the count of the herring run. The website initiative shows that the vast majority of herring using the Upper Mystic fish ladder travel during the day. In some other watersheds, more herring travel at night. One hypothesis is that this difference is due to the

landscape. In more protected fish landscapes like the Mystic, fish will travel during the day. But if the landscape includes more of a shallow network of streams, where fish may be susceptible to bird predation, the fish may be more likely to travel at night.

The following point was clarified in a question and answer period:

- As of last year, the Mystic is the second largest herring run in Massachusetts. The largest is the Herring River on Cape Cod.

Research on Herring Juveniles – *Matt Devine, UMass*

Herring population data from adult run counts provide insight into the number of adults returning annually, the timing of their returns, and the adult size/age structure. These run counts do not, however, tell us how many fish there were initially. Herring migrate from freshwater to estuaries to at sea, then return at age four, and there is mortality at every step. We lack data on estimates of recruitment. Essentially, there is a freshwater "black box."

Research on the population dynamics and restoration ecology of anadromous river herring seeks to fill this gap. The research seeks to investigate juvenile herring density, growth, and mortality in freshwater lakes, evaluate the relationship between adult counts and juvenile densities, evaluate responses to restored habitats, and model habitat suitability for prioritizing habitat restoration. From 2014-18, the research team sampled 32 coastal lakes (including five lakes every year). The sampling method involves 5-10 hauls per night during the summer months at random locations in the water body, using non-lethal fishing gear that provides a low-stress environment for the fish. The team performed the sampling at night to get higher catch rates, and also collected a suite of environmental variables at each site. The results show a lot of variation within and among lakes. Juvenile density is largely dependent on the number of adults, but the data suggests a decline in the juvenile population if the adult population gets above a certain level.

The study also uses otoliths to look at the fish's growth history, like tree cores. Growth is correlated with survival, because bigger fish are less likely to be eaten. The best predictor of juvenile growth is density, and higher density correlates with lower growth.

Overall, these results have a number of management implications. They suggest there are limits to any single restoration activity, and that it is important to prioritize both run size *and* habitat area. They also suggest that water quality and temperature play key role in growth and survival, and that appropriate water levels are important to let fish leave the system (with nitrogen and phosphorous in their systems).

The following points were clarified in a question and answer period:

- We do not know whether stunted juveniles catch up later in life, because we have little information on what happens to the fish once they enter estuaries.
- To address density concerns, the research suggests it will be helpful to get fish into the available upstream habitat, which will distribute adults more widely.
- Juveniles can get down river through fish ladder spillways, although some die. One area of research could be to determine what kind of drop juveniles can survive.
- The research team is doing trials to see the precise temperature at which growth slows. We do not know what impact warming waters will have on growth and migration.

**Closing Comments**

Patrick Herron, co-chair of the Mystic River Watershed Initiative Steering Committee, offered closing thoughts, noting that the group had done an excellent job highlighting success stories and expressing hope that the various groups present would offer feedback and advice to each other to help improve future research. He expressed optimism around what these many players can achieve in the Mystic. Ona Ferguson from CBI thanked the group and drew the meeting to a close.

**Appendix: Participants**

Sean Dixon, *EPA*
Renee Angelo, *MWRA*
Toby Berkman, *CBI*
Todd Borci, *EPA*
Caitlin Chafee, *MWRA*
Wayne Chouinard, *Town of Arlington*
Kristin Coombs, MWRA
Bill Copithorne, *Town of Arlington*
Mel Cote, *EPA*
Matt Devine, *UMass Amherst*
David Elmer, *Weston + Sampson*
Tom Faber, *EPA*
Ona Ferguson, *CBI*
Chris Goodwin, *MWRA*
Lynne Hamjian, *EPA*
Tim Heckmann, *MWRA*
Patrick Herron, *MyRWA*
Denise Ellis Hibberer, *MWRA*
Elmire Hilaire, *MWRA*
Andy Hrycyna, MyRWA
John Kilborn, *EPA*
Lise Marx, MWRA
Claire Moss, *Town of Wakefield*
Matthew Reardon, *MassDEP*
Ed Reiner, *EPA*
Beth Rudolph, *Town of Winchester*
Eric Sanderson, *MWRA*
David Van Hoven, *Stantec*
Mark Voorhees, *EPA*
Julia Wallace, *MWRA*
Kathy Watkins, *Cambridge DPW*
Caitlyn Whittle, *EPA*
Catherine Daly Woodbury, *Cambridge DPW*
Julie Wormser, MyRWA
David Wu, *MWRA*