Executive Summary

The Clean Water Act (CWA) requires, among other things, states to identify waters within their boundaries that fail to meet applicable surface water quality standards, and develop limits for each pollutant contributing to their impairment. These limits are expressed as "total maximum daily loads" (TMDLs). TMDL calculations determine the amount of a particular pollutant that a water body can receive while still meeting water quality standards. The TMDL calculation also estimates the degree to which a pollutant load must be reduced for that water body to achieve water quality standards.

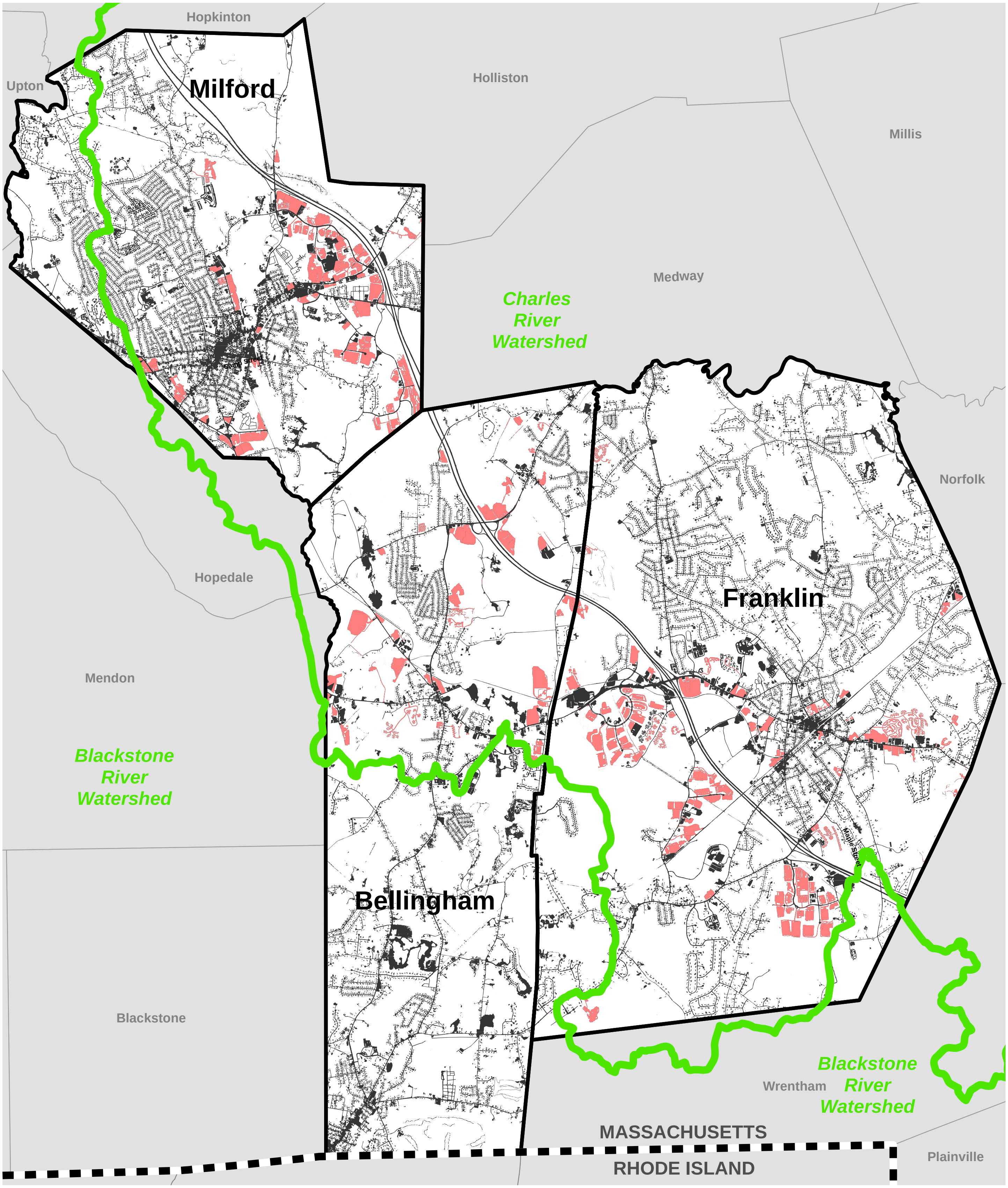
The Charles River runs approximately 80 miles from its source at Echo Lake in Hopkinton to its mouth in Boston and drains a 308 square mile watershed containing all, or part, of 35 Massachusetts' municipalities and a range of land uses and activities. The Charles River is not currently meeting Massachusetts Surface Water Quality Standards for a number of parameters, including most notably, phosphorus. In the fall of 2007, US Environmental Protection Agency (EPA), Region 1 approved a TMDL for phosphorus for the Lower Charles River that established the total allowable phosphorus loads from the contributing watershed. The lower Charles River TMDL established the required stormwater derived phosphorus load reductions for watershed areas upstream of the Watertown Dam.

The TMDL sets phosphorus limits for stormwater runoff based on various land-use categories. It also establishes annual phosphorus load reduction targets for stormwater runoff from individual municipalities and from larger private property owners throughout the Upper Watershed. Total phosphorus (TP) reduction targets of 57.0%, 51.8%, 52.1% were established for the towns of Milford, Bellingham and Franklin, respectively.

These targets were incorporated by EPA into two draft general permits under the National Pollution Discharge Elimination System (NPDES) requiring enhancement of stormwater discharges from "Small Municipal Storm Sewer Systems in the Massachusetts North Coastal Watersheds" (hereafter the MS4 GP) and under the Residual Designation Authority (RDA) from "Designated Discharges in the Charles River Watershed within the Municipalities of Milford, Bellingham, and Franklin, Massachusetts" (hereafter the RDA GP).

Watershed Context and Regulatory Drivers

Table E.1 summarizes some of the basic characteristics of the three towns, including population and watershed impervious areas (IA). Figure E.1 illustrates the impervious cover distribution across the three towns. These characteristics and other supporting data, such as land use and distribution of soil types, are key variables relating to overall phosphorus loading and management.



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Legend

- Focus Communities
- State Boundaries
- Impervious Area (from 2005 Aerial)
- Impervious Area in Draft Designated Discharge (DD)/Residual Designation Authority (RDA) Parcels*
- Neighboring Towns
- Major Basins

Source - Data from MassGIS 2011 except the following:
**Derived from Vorhees, 2011*

N

Feet
7,500

Horsley Witten Group
Sustainable Environmental Solutions

Impervious Cover in Bellingham, Franklin, and Milford

Date: 8/17/2011

Figure E.1

Table E.1: Key Town Statistics Relating to Phosphorus Loading

Town	2009 Population	Area (acres)	Within Charles River Watershed			Designated Discharges*		
			Area (acres)	Impervious Area (IA) (acres)	% IA	#	Total Area (acres)	Total IA (acres)
Bellingham	15,845	11,840	6,293	924	14.7%	40	1,022.1	281.3
Franklin	32,065	17,112	15,669	2,315	14.8%	110	1,416.3	539.9
Milford	27,588	9,536	8,250	1,721	20.9%	113	809.9	401.6

*Based on data from Voorhees (2011), which may vary based on aggregation interpretation.

The draft 2010 MS4 GP requires communities to continue implementation of stormwater program elements already in place per the 2003 MS4 permit, as well as to more effectively manage their stormwater discharges by improving existing control measures or implementing new measures. For communities subject to TMDLs (including all those within the Charles River watershed), the MS4 GP requires additional measures to achieve specific pollutant reduction targets and meet State Water Quality Standards. In the Charles River Watershed, the major additional requirements include the development of a Phosphorus Control Plan (PCP); additional infrastructure and PCP mapping; increased operation and maintenance; capital projects to meet TP removal requirements; public education and outreach addressing phosphorus reduction; and fertilizer and waterfowl management plans.

The RDA GP calls for individual Designated Discharges (DDs) located in the three communities to reduce TP loads by 65% from existing conditions. Under the RDA GP, DDs can implement the 65% TP reduction on their own using structural and non-structural practices. Alternatively, DDs can join a Certified Municipal Phosphorus Program (CMPP) administered either by their municipality or by an upstream municipality. By joining a CMPP, DDs participate cooperatively with the municipality, which in turn becomes responsible for the optimized implementation of phosphorus control measures for the participating DDs.

EPA, Region 1 retained the Horsley Witten Group, Inc. (HW) and AMEC Earth and Environmental, Inc. (AMEC) to assess the feasibility of developing and maintaining a sustainable stormwater management funding source for the Upper Charles River communities in consultation with a project Steering Committee appointed by EPA, Region 1.

Alternatives for Program Implementation

The draft MS4 and RDA GPs do not specify how municipalities might structure a stormwater management program or fund permit requirements. Instead, the draft GPs set out compliance options, such as the CMPP, and only requires that municipalities state how they intend to fund permit compliance. Consequently, this report evaluates four scenarios for stormwater program implementation that seem to be the most likely candidates for permitee adoption (Table E.2).

The elements of each scenario differ based on timeframe for implementation, choice of funding mechanism, and municipal management approach as follows:

- **Implementation Timeframe**: This analysis contemplates timeframes for implementing stormwater control measures that extend from a minimum of 10 years from the effective date of the GP to a maximum of 25 years.
- **Funding Mechanisms:** The municipalities may choose to fund their programs through a user fee/enterprise fund under a Stormwater Utility structure, or through other sources such as the municipality's general fund, permit fees, and grants.
- **Management Approach:** A municipal stormwater management program may be implemented individually or cooperatively.
    - Town-by-Town: This involves implementation through a cooperative agreement between the municipality and regulated DD property owners, or the municipalities might work to manage runoff without the participation of the DD properties; or
    - Regional: The municipalities might elect to work together to cooperatively implement program elements. Doing so could be more cost-effective than if each municipality implemented these elements on their own.

Table E.2: Stormwater Management Implementation Scenarios Evaluated in this Feasibility Report

Each Town Manages Stormwater Program Individually			**Scenario 4** Regional Stormwater Management Program – DDs fully participate
No Stormwater Utility		**Scenario 3** Town enacts Stormwater Utility – DDs fully participate in the program	
Scenario 1 DDs on their own	**Scenario 2** DDs participate in a CMPP		

Existing and Future Program Costs

Cost estimates for stormwater program services for the three municipalities have been developed for the existing program, as well as for projected future services. Existing costs encompass expenditures related to the administration and implementation of the current stormwater program for each town (Table E.3). Future costs assume adding new services to the existing program costs as necessary to fulfill conditions of the draft MS4 GP and to meet phosphorus load reduction targets. Future services are divided into operational costs (Table E.4) and capital expenditures (retrofitting with structural best management practices (BMPs) for phosphorus reductions, Table E.5).

Both current and future operational costs were evaluated within five major cost centers as listed in the tables. The cost centers and activities included in this analysis are comprehensive in order to accommodate future program requirements and to help communities redefine the scope of their stormwater programs; therefore, current stormwater services (e.g., catch basin cleaning and storm sewer maintenance), as well as required future services that the towns may not currently account for (e.g., code development and zoning support or leaf pickup) are included.

Table E.3: Summary of Existing Estimated Annual Stormwater Program Costs (FY 2010)

Major Cost Centers	Existing Stormwater Program Annual Costs		
	Bellingham	**Franklin**	**Milford**
Administration	$18,000	$59,000	$18,000
Regulation/Enforcement	$2,000	$51,000	$26,000
Engineering and Master Planning	$17,000	$153,000	$13,000
Operations and Implementation	$195,000	$760,000	$488,000
Monitoring	-	-	-
Total Cost	$232,000	$1,023,000	$546,000

Costs are rounded to the nearest $1,000 (totals may not add up due to round-off error) and include staff labor and direct costs for equipment, materials, disposal, supplies, etc. Current monitoring costs are assumed to be $0, but future costs are assigned.

Table E.4: Summary of Future Annual Stormwater Program Operational Costs

Town	Existing	Future Operational Costs (2011 Dollars)				
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Bellingham	$232,000	$872,000	$1,029,000	$879,000	$799,000	$879,000
Franklin	$1,023,000	$1,652,000	$2,080,000	$1,888,000	$1,695,000	$1,763,000
Milford	$546,000	$1,098,000	$1,274,000	$997,000	$912,000	$905,000

Total cost estimates are rounded to the nearest $1,000 and include staff labor and direct costs for equipment, materials, disposal, supplies, etc.

Three alternative approaches were used to estimate and compare the potential capital costs for each municipality to comply with the TP reduction targets specified in the TMDL, including: 1) scaling-up costs derived from the recently completed watershed plan for the Spruce Pond Brook in Franklin, MA; 2) applying cost data drawn from a GIS-based spreadsheet model to estimate size and costs of hypothetical structural BMPs as a function of watershed land cover and treatment volume; and 3) comparing stormwater retrofit implementation costs per impervious acre treated using results from studies completed in other New England and Mid-Atlantic watersheds. The analysis assumes that 15% of the TMDL target values will be achieved through non-structural control measures, and that the costs for these non-structural controls are already included in the operational costs presented in Table E.4 or are cost neutral. The value of 15% TP reduction from non-structural controls was derived assuming:

- 2% TP load reduction from enhanced street sweeping;
- 2% TP load reduction from semi-annual catch basin cleaning;
- 1% TP load reduction from collection of organic wastes and leaf litter; and
- 10% TP load reduction from a ban on phosphorus in fertilizers.

The assumed value of 15% TP reduction from non-structural measures is believed to be a conservative assumption and the actual TP reduction from these control strategies is likely to be higher as additional research is completed and evaluated. The estimated capital costs presented in Table E.5 include construction costs, design, permitting, construction administration, and land acquisition costs.

Table E.5: Recommended Capital Cost for Implementation of Structural Stormwater Controls to Achieve Compliance with Phosphorus Load Reductions (2011 Dollars)

Town	% Phosphorus Removal from Structural Controls[1]	Total Cost of Structural BMPs (Charles River Watershed)[2]
Bellingham	37%	$29,700,000
Franklin	37%	$74,600,000
Milford	42%	$75,800,000

[1]Assumes 15% TP reductions in each community via non-structural controls
[2]Estimated costs are based on a calibration against Spruce Pond Brook subwatershed and rounded to the nearest $100,000

Funding Options and Revenue Alternatives

Various funding options are presented in four major categories of municipal revenue generation: taxes, service charges, exactions, and assessments.

- Taxes are primarily used to generate revenue. No particular relationship is necessary between tax revenues and the activities or improvements that they fund. These include property tax, income tax, sales tax, etc.
- Service charges must be tied to the cost of providing specific services and/or facilities. The charge to each rate payer must relate to that ratepayer's impact, or "use" of the service.
- Exactions are related to the extension of an approval or privilege to use. Licenses, tap fees, fees in lieu of detention, and capital recovery charges are also forms of exactions.
- Assessments are geographically or otherwise limited fees levied by municipalities to pay for improvements or activities of direct and special benefit to those who are being charged.

Stormwater utilities are user-fee service charge systems based on the premise that stormwater drainage systems are public, similar to municipally-operated wastewater or water supply systems. This project evaluated the preliminary framework for a Stormwater Utility as an option to fund the future stormwater programs for Bellingham, Franklin and Milford.

Stormwater Utility billing rates are often based on units of imperviousness calculated to reflect the total coverage of impervious surface of a typical residential property. These units of impervious are called an Equivalent Residential Unit (ERU). The value of one ERU is then used as a multiplier for non-residential properties. The ERU values in the Upper Charles were computed by taking the median of the impervious areas for the residentially designated parcels in each municipality. Using satellite-derived impervious polygons, as adjusted to reflect data variability, the value and total number of ERUs were calculated for each town (Table E.6).

Table E.6: Equivalent Residential Unit (ERU) Data Town-Wide

Town	ERU Value (sq ft)	Number of ERUs
Bellingham	3,260	21,189
Franklin	3,252	33,769
Milford	3,029	28,523

The total number of ERUs presented in Table E.6 includes all properties in each municipality whether located in the Charles River watershed, or not. If only parcels within the Charles River watershed are used as a basis to generate revenue, the numbers of ERUs are 12,055, 31,724, and 25,633 in Bellingham, Franklin and Milford, respectively. A smaller number of ERUs means that a higher fee per ERU is needed to generate the same level of revenue. The municipalities will need to further evaluate and decide on the area of service in establishing a Stormwater Utility.

The sources of the revenue from ERUs can be classified based on different land use categories as (1) DDs, (2) all other impervious area, (3) local roads, and (4) state and federal roads. This allows the municipalities to evaluate each source and its potential to generate revenue. Total revenue capacity is calculated by multiplying the number of ERUs for each category by the monthly fee per ERU, and then by a factor of 12 to calculate an annual fee. Table E.7 lists the number of ERUs available for each of the three towns and the total for all towns combined (includes town area beyond the Charles River Watershed).

Table E.7: Basic Revenue Capacity Information – ERUs within Each Town and Total for 3 Towns

Town	DD ERU	Other IA ERU[1]	Local Road ERU	MDOT ERU	TOTAL ERU
Bellingham	3,594	11,205	5,642	748	21,189
Franklin	6,291	15,074	10,903	1,501	33,769
Milford	5,821	14,431	6,997	1,274	28,523
TOTALS	15,706	40,710	23,543	3,522	83,481

[1] Other IA includes all non-road and non-DD impervious area associated with all other parcels (residential, small commercial, institutional, etc.).

The number of ERUs (either in each town or across all three towns) is then used as the basis for calculating revenue potential per dollar charged per ERU as a monthly fee. Table E.8 shows the revenue potential for the three towns per dollar charged per ERU with all local state and federal roadways removed.

Table E.8: Basic Revenue Capacity Information within Each Town (with Roads Removed) –Annual Revenue for One Dollar/ERU/Mo (including DDs)

Town	DD $$	DD %	Other IA $$	Other IA %	TOTAL $$
Bellingham	$43,128	24%	$134,460	76%	$177,588
Franklin	$75,492	29%	$180,888	71%	$256,380
Milford	$69,852	29%	$173,172	71%	$243,024
TOTALS	$188,472	28%	$488,520	72%	$676,992

The town operational and the capital costs presented in Tables E.4 and E.5 provide estimates in 2011 dollars. To evaluate revenue potential over time, it was necessary to calculate the change in program costs moving forward. To do this, the following assumptions were made as a percentage of current capital costs:

- Inflation rate: 2.5%;
- Bond interest rate: 4.0% for a bond maturation life of 20 years;
- Operations and maintenance cost on new construction beginning in the year after construction: 3.5% annually;
- Stormwater Utility billing and administrative cost: $0.65/account billed quarterly;
- Capital costs were inflated to 2017 to begin construction; and
- One-time bonding costs are included in the bonded capital interest rate.

Table E.9 summarizes the estimated operational costs as well as the capital implementation costs for construction of structural stormwater controls for both the municipalities and the DDs, in 2011 dollars. Table E.9 presents estimated total capital costs plus annual operational costs, but does not present Stormwater Utility billing costs and annual maintenance costs on capital projects.

Table E.9: Estimated Operational and Capital Costs – Charles River Watershed (2011 dollars)

Town	DD CIP	Town CIP	Total CIP	Operating Costs[1]
Bellingham	$2,600,000[2]	$27,100,000	$29,700,000	$891,000
Franklin	$10,900,000	$63,700,000	$74,600,000	$1,815,000
Milford	$11,100,000	$64,700,000	$75,800,000	$1,037,000
TOTALS	$24,600,000	$155,500,000	$180,100,000	$3,744,000

[1] Annual Average for first five years
[2] Bellingham DD implementation costs per impervious acre are estimated to be significantly lower due to the presence of higher infiltration capacity soils underlying subject properties and the lower ratio of impervious to pervious surfaces compared to DD properties in the other two municipalities.
Costs are rounded to the nearest $1,000 (totals may not add up due to round-off error).

Total implementation costs include capital expenditures, operational costs, billing, BMP maintenance costs, as well as interest costs on bonds used to fund capital projects and inflation over time. As stated in E.2, implementation of structural controls was evaluated over four different time periods. Each time period evaluation assumed that initial construction would begin in Year 6 of the permit and continue for another 5, 10, 15, or 20 years thereafter. Total program costs to be paid by the Stormwater Utility for each year includes: interest on capital bonds + operations and maintenance cost on accumulated capital construction + general program operating costs + billing and administration costs.

Each year's inflated cost totals were based on the assumed inflation rate. Loan interest, and operations and maintenance costs on accumulated capital construction varied according to the construction program chosen. Payment of the interest on bonded capital construction continues for twenty years from the last date of borrowing. For example, in the case of the 25-year program with construction beginning in 2017 and ending in 2037, bond interest payments extend to 2057. As a consequence total implementation costs vary significantly as a function of implementation timeframe. The sum of all estimated costs over a 25-year period, beginning in 2012 is presented for the four implementation time periods in Table E.10.

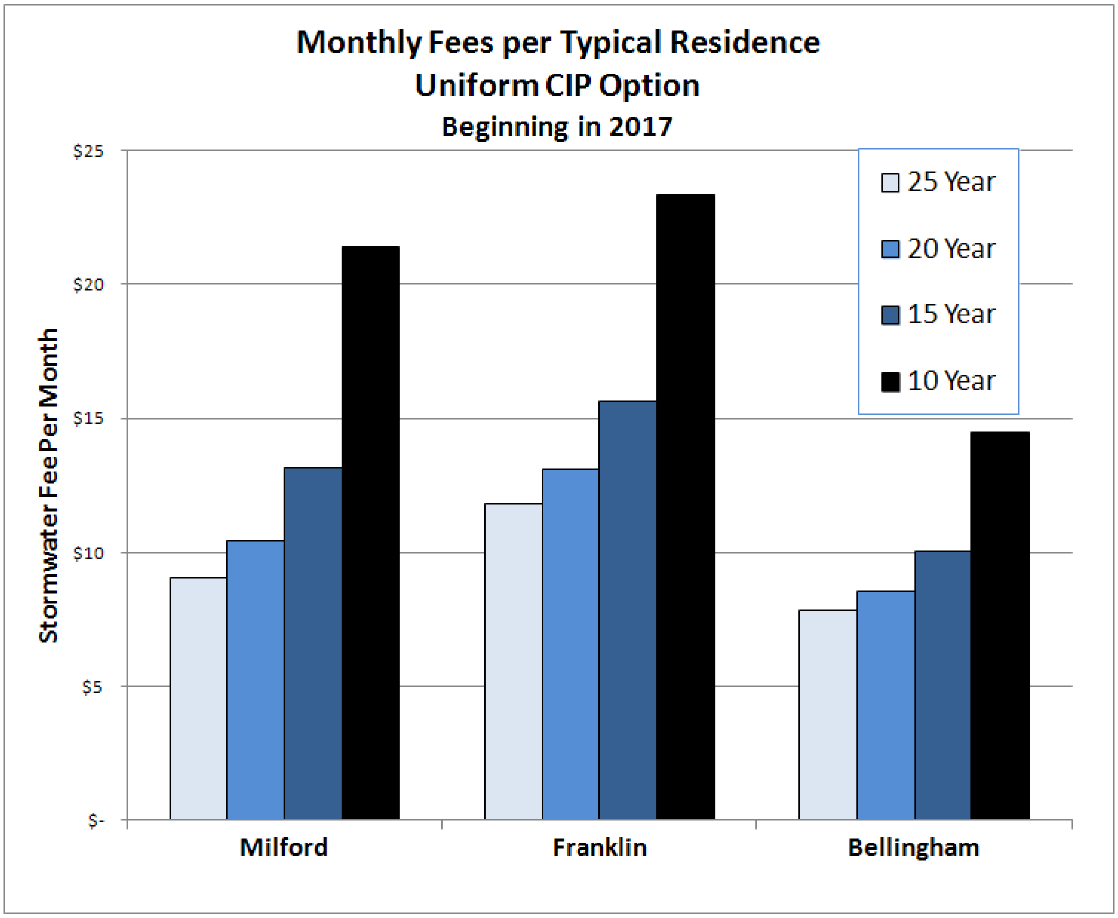
Table E.10: Estimated Total Implementation Costs over 25 Years Beginning in 2012 (2011 Dollars)

Town	10-Year Implementation	15-Year Implementation	20-Year Implementation	25-Year Implementation
Bellingham	$70,800,000	$65,900,000	$60,700,000	$55,000,000
Franklin	$165,900,000	$153,400,000	$140,400,000	$127,000,000
Milford	$146,000,000	$133,400,000	$120,200,000	$107,000,000
TOTALS	$382,700,000	$352,700,000	$321,300,000	$289,000,000
Costs are rounded to the nearest $100,000.				

The revenue capacity assessment (Table E.8) is used to evaluate the ERU fee amount necessary to meet the costs presented in Tables E.9 and E.10. Figure E.2 illustrates the monthly fee per household for the four different time periods of implementation beginning in the first year of construction of structural BMPs (assumed 2017). The Uniform Cost Allocation Approach presented in Figure E.2 assumes constant expenditures of capital investments over the term of construction.

If a stormwater utility was immediately formed in each of the three towns to cover just initial annual operational cost from 2012-2016, the monthly ERU fee in Bellingham, Franklin, and Milford, would be approximately $5.10, $7.20 and $4.40 respectively.

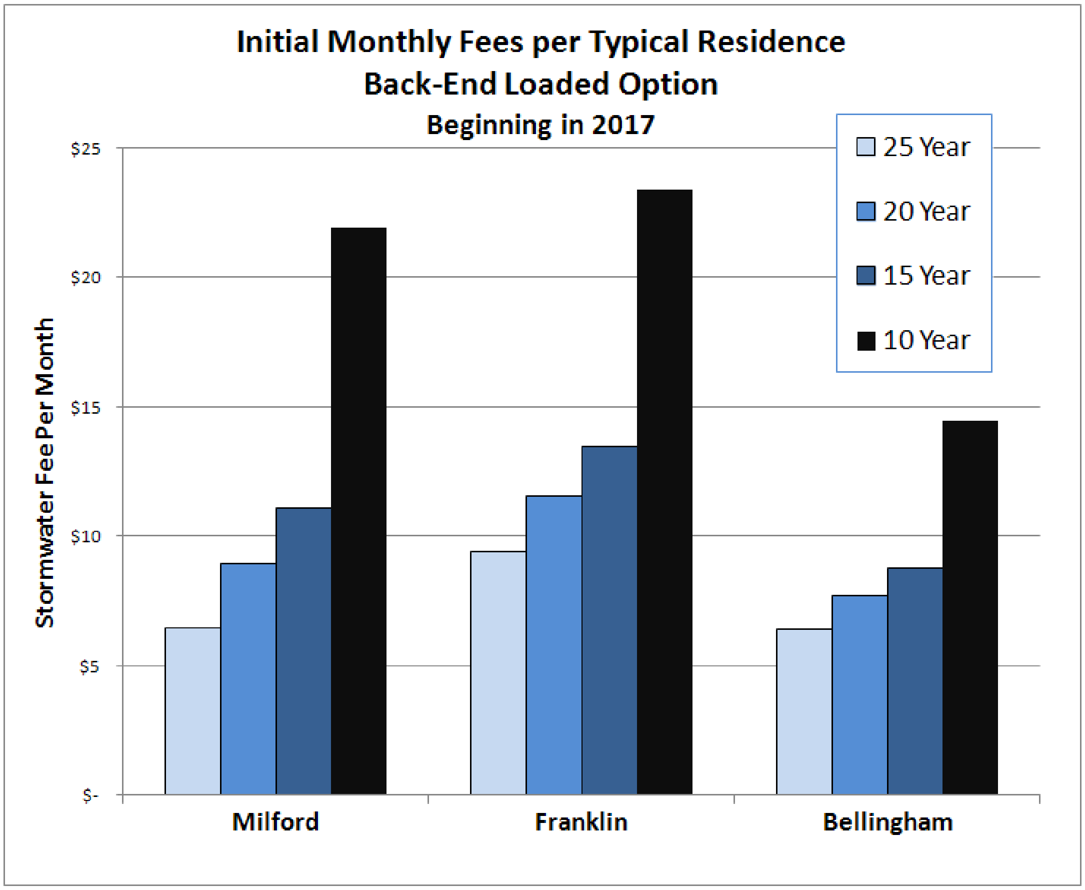
Figure E.2: Monthly Stormwater Utility Fee for Typical Residence for Four Different Capital Construction Implementation Periods Using a Uniform Cost Allocation Approach



There are several ways to evaluate implementation costs beyond just the timeframe. One option explored was the idea of "back-end loading" the capital construction costs (i.e., paying a larger amount later in the implementation process). There are many good reasons to do this including: (1) the value of starting implementation slowly to gain experience in efficiently managing multiple construction projects; (2) the possibility that better or changed data or other unforeseen factors will become available to reduce future control requirements; and (3) the possibility that better technologies or more effective non-structural phosphorous reduction approaches would become available prior to irreversible brick & mortar investments.

A back-end loading approach must balance the desire to delay initial capital investment against the challenge of having to accelerate required construction projects to meet implementation timeframes. For example, in the 25-year implementation program plan, multipliers (to the uniform approach) of 0.5, 0.75, 1.25 and 1.75 were applied in four, five-year increments. The resulting initial monthly fees for each of the four implementation time periods are illustrated in Figure E.3.

Figure E.3: Monthly Stormwater Utility Fee for Typical Residence for Four Different Capital Construction Implementation Periods Using a "Back-End Loaded" Approach



Recommendations

Based on the data and information evaluated in this project, the weight of evidence indicates that: 1) the costs for the future stormwater management programs for the three municipalities will be significantly higher than their current expenditures; 2) compliance with phosphorus reduction requirements will require a combination of non-structural and structural controls implemented over time through a comprehensive strategy; and 3) the likelihood that each community's general fund can continue to fully support implementation is low.

The recommendations provided herein offer suggestions on the next steps that the municipalities, EPA and other stakeholders may choose to pursue. These recommendations are based on the terms and conditions of the draft MS4 and RDA GPs, and thus, are subject to revision depending on the requirements of the final permits. The following list of general recommendations is offered for consideration:

1. Implement the following non-structural control measures to the maximum extent practicable:

- Pursue a phosphorus ban on fertilizers at the state level (and locally if deemed within the authority of home rule);
- Conduct enhanced street sweeping with vacuum-assisted street sweeping equipment and, where possible, using high-efficiently regenerative-air street sweeper technologies. Evaluate enhanced street sweeping effectiveness from current and future studies such as the current research being conducted by the U.S. Geological Survey in Cambridge, MA (Sorenson, 2011);
- Conduct and/or enhance an organic waste/leaf litter collection program and evaluate its effectiveness based on current and future research documenting phosphorus removal rates;
- Continue and/or enhance catch basin cleaning and evaluate its effectiveness based on current and future research documenting phosphorus removal rates;
- Identify un-needed or under-utilized impervious surfaces and eliminate them; calculate the load reduction potential; and
- Identify un-used or under-utilized turf areas that could be converted to forest or other minimally maintained vegetative cover; calculate the load reduction potential.

2. Periodically petition EPA to review and update presumed TP reduction values for non-structural controls based on data collected by the municipalities and on the results of published current and future research.
3. Implement structural control measures in the context of a watershed management plan. Periodically petition EPA to review and update TP removal efficiencies for structural controls based on data collected by the municipalities and the results of published current and future research.
4. The communities should seek EPA approval for, and EPA should consider, a longer implementation period than proposed in the draft GPs based on the data in this report that demonstrates greater flexibility associated with an extended construction period.
5. The communities should seek EPA approval for, and EPA should consider, revising the draft GPs to allow for the implementation of structural controls using a "back-end-loaded" approach. Under this approach initial funding is lessened to allow for better quantification of benefits from non-structural measures and early implementation of the most cost effective structural practices. This approach should also reduce initial expenditures as practitioners gain expertise and will likely lead to long-term savings over time.
6. Pursue the implementation of a stormwater utility at the individual municipal level initially, but structure it to allow other municipalities to join it through inter-municipal agreements in the future.

The following list of specific short-term recommendations is offered for consideration by the municipalities, EPA, and interested stakeholders:

1. Review this report's cost estimates and implementation analyses as each community decides on their next steps – refine estimates as appropriate; (refer to Sections 8.3 and 8.4).

2. Convene an inter-municipal working committee to document areas of agreement and areas of divergent positions on implementation of a comprehensive regional stormwater management program. Decide whether to move forward regionally or individually (refer to Section 8.3);
3. The DD property owners should be polled on their likely participation in a CMPP and/or stormwater utility;
4. Develop of a regional watershed management plan, or at a minimum, develop separate watershed plans for each municipality; and
5. Implement a public education and engagement project explaining the benefits of a comprehensive stormwater program. The public will need to understand why stormwater management is important, how stormwater management affects daily activities and the range of broad-scale potential benefits of a comprehensive stormwater program. Public support will be a critical and necessary component for future stormwater programs throughout the watershed.

The long-term costs of this program will be borne by the residents and businesses of the towns. As such, the most equitable, adequate, flexible, and stable source of funding to support the phosphorous reduction program and the rest of the surface water/stormwater programs is a Stormwater Utility/user fee approach. The feasibility of a Stormwater Utility for the Upper Charles was evaluated both on a town-by-town basis and as one single entity and will involve a series of assessments and key decisions by the municipalities prior to implementation.

The timeframe for development and implementation of a **single municipal utility** will likely take 12 to 18 months, assuming the town has political and public support to move forward, and that funding for full implementation is available with a modest public education and involvement campaign. The implementation costs are likely to be in the range of $200,000 to $300,000. The timeframe for development and implementation of a **multi-municipal utility** for all three communities will likely take 18 to 24 months, assuming all three towns have political and public support to move forward, and that funding for full implementation is available with an aggressive public education and involvement campaign. The implementation costs are likely to be in the range of $700,000 to $1,000,000. Based on the past experience from other municipalities, the cost to implement a Stormwater Utility is less than the first year's revenue and can be paid back over time through the utility.

Because of the similarity of the eventual programs and charges among the three towns, it also makes sense to avoid duplication of efforts and mistakes. Assuming there is consistently good political and public support across the three municipalities, significant savings can result if a joint effort is undertaken.