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EXECUTIVE SUMMARY

Purpose and Scope

This project focuses on balancing the water budget in the Town of Ipswich, Massachusetts, in order to improve streamflow conditions and water quality in the Egypt/Rowley River and the Ipswich River. The Egypt/Rowley River and the Ipswich River are high quality coastal rivers that flow into Plum Island Sound and the Gulf of Maine. Both rivers experience extreme low-flow conditions and water quality problems due to the impacts of water withdrawals, out-of-basin transfers, reduced aquifer recharge, and stormwater pollution.

This report is intended to assist the Town of Ipswich in evaluating program options and financing mechanisms for integrated management of water resources, with a focus on water and stormwater. It provides detailed recommendations on program design for two key financing mechanisms: a water demand mitigation program and a stormwater utility.

The project also serves as a model for integrated water resources management in the Ipswich River watershed region and other communities throughout Massachusetts. It is funded under a Watershed Improvement Grant from the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), and is intended to advance the recommendations of the Ipswich River Watershed Management Plan and the Parker River Watershed Action Plan.

Project Goals

The primary goal of this project is to balance the water budget in Ipswich. Balancing the water budget involves two complementary strategies: balancing the water budget environmentally, and balancing the water budget financially.

Environmentally, the goal is to balance the water budget in the Town’s source basins, with a particular focus on the Egypt/Rowley River watershed, which includes Dow Brook, Bull Brook, and Muddy Run. An inflow-outflow analysis of the Egypt/Rowley watershed finds that the watershed is highly stressed with an overall water deficit of 874,000 gallons per day. The challenge facing Ipswich is to return as much water to the watershed as is pumped out, through three basic water balance strategies: withdrawing less water, recharging stormwater, and reducing wastewater exports. The proposed comprehensive water conservation program, including a water demand mitigation program, would improve the water balance by reducing water withdrawals.

Wastewater management was not the focus of this project, but may present the most significant opportunity to balance the water budget in Ipswich. The Egypt/Rowley watershed is highly impacted by out-of-basin transfers of water and wastewater. Households and businesses located outside the watershed, as well as all those connected to the sewer system, discharge their treated wastewater outside the Egypt/Rowley watershed. The Ipswich wastewater treatment plant currently discharges into the Ipswich River estuary at Greenwood Creek. The Town of Ipswich has completed a preliminary evaluation of the possibility of discharging treated wastewater to the...
Egypt/Rowley watershed, in addition to or instead of the existing discharge to Greenwood Creek. This project could yield substantial water balance benefits, and is worthy of further consideration.

Financially, the goal is to balance the water budget by implementing financing mechanisms that generate sustained funding for water resources management programs in Ipswich. Water resources management programs in Ipswich are currently underfunded. Stormwater in particular suffers from a lack of dedicated funding. Existing stormwater programs are funded out of the Town’s general funds, and funding is inadequate to meet the full range of maintenance, regulatory, engineering, and water quality improvement needs. The proposed water demand mitigation program and stormwater utility would help to balance the water budget financially by generating dedicated funding for water resources management through a system of fees and enterprise funds housed within existing Town departments.

An additional goal is to improve water quality in the Ipswich River by preventing and ameliorating the discharge of untreated stormwater and wastewater. Several known stormwater hotspots exist in Ipswich, including Farley Brook, which drains the urbanized downtown area, and Topsfield Road, which has experienced problems with stormwater infrastructure. Water quality sampling has detected unusually high levels of pathogens and other stormwater-derived pollutants at these hotspot locations. Stormwater runoff from Farley Brook contributes to the closure of shellfish beds after rainfall events, and also degrades high quality spawning habitat for rainbow smelt. The proposed stormwater utility would help fund essential stormwater management activities that would remediate nonpoint source pollution.

**Water Demand Mitigation Program Recommendation**

The report recommends that the Town consider implementing a more comprehensive water conservation program focused on residential and commercial audits and retrofits, beginning with implementation of a water demand mitigation program. Water demand mitigation programs are designed to mitigate the water demands of new developments, thus capping water losses even as growth and development continue. We offer several key recommendations for design of a water demand mitigation program, based on consultations with Town officials and a review of similar programs in other Massachusetts communities:

**Jurisdiction:** We recommend that the water demand mitigation program apply to all new and expanded residential and commercial developments, including single-family homes, without exception. It should also apply to renovation projects that increase water use or capacity of the building.

**Program Structure:** While some communities have allowed developers to directly implement water-saving projects, a fee-based approach is recommended for Ipswich to give the Water Department maximum flexibility to control the types of project implemented, ensure the effectiveness of mitigation projects, and reduce the burden of oversight and verification.
**Mitigation Fee:** We recommend a mitigation fee of $18.83 per gallon per day (gpd) of anticipated new demand. The fee is based on water use projections based on Title 5 sewage flow design criteria, and incorporates a 2:1 mitigation ratio as a margin of safety. The fee is calculated based on the estimated costs of achieving the required water savings through retrofits of indoor fixtures and appliances.

**Credit System:** A credit system is encouraged to create incentives for residents to upgrade their own homes during renovation, and/or to promote installation of ultra-efficient fixtures and appliances and highly water-efficient outdoor landscaping features in new construction. The credit system must be simple, transparent, and verifiable.

**Program Budget:** Water demand mitigation fees should be collected into an enterprise fund managed by the Water Department. The estimated annual budget for the program would vary based on rates of development and renovation, and depends on the fee that is selected. At current rates of development and assuming a mitigation fee of $18.83 per gpd, the annual budget for the program would be approximately $200,000.

**Water Conservation Programs Funded:** To ensure the integrity of the program, the water-saving projects implemented must deliver the required level of mitigation. Indoor retrofits to replace conventional fixtures and toilets with low-flow models are recommended as the core of the program. Other programs that generate quantifiable water savings can also be considered, such as leak detection and appliance rebates. Water savings should be tracking in a spreadsheet-based accounting system.

**Management Structure:** We recommend retaining in-house management of the program, and using the fees to pay for a Water Conservation Coordinator to oversee the program, as well as other water conservation activities. Outside consultants can be used to implement specific aspects of the program, such as bulk toilet replacement or household audits.

**Permits and Processing:** A permit process is recommended to notify applicants of the fee at the time of application for a building permit. The fee should be paid prior to issuance of a building or occupancy permit.

**Regulatory Language and Approval Process:** The water demand mitigation program could be adopted by the Water Department through its Rules and Regulations, but a public outreach process is suggested to engage developers early-on and explain why the fee is necessary.

**Stormwater Utility Program Recommendation**

The Town of Ipswich faces the challenge of developing a more comprehensive stormwater management program to address regulatory requirements, meet water quality goals, and address flooding concerns. A fee-based stormwater utility is recommended to generate funding for this program. Based on the information presented in this report and discussions with the Ipswich Stormwater Committee, we offer several key recommendations for the Town of Ipswich and the Ipswich Stormwater Committee to consider:
Stormwater Enterprise Fund: A stormwater enterprise fund is recommended for implementation in the Town of Ipswich rather than a fully staffed stormwater utility for several reasons. The Town of Ipswich is a relatively small community with a small town staff. A stand-alone stormwater utility would require significant staffing and administrative needs that could overwhelm the Town’s capacity at this stage.

Jurisdiction: We recommend implementing a stormwater utility town-wide for a host of reasons, including ease of management and equity across town.

Management of Stormwater Program: Through discussions with the Stormwater Committee, there was no single consensus on where the stormwater program and the billing responsibilities should be housed. The Department of Public Works (DPW) currently provides all stormwater services in town. Based on this past experience and knowledge, it is recommended that the technical aspects of the stormwater program be managed out of the DPW to start. There are two primary billing mechanisms in the town that could be amended to include the stormwater billing: the assessor’s bill and the utilities bill. The assessor’s office may be an easier link to stormwater billing since every lot in town is included in the assessor’s database and presumably receives a bill (except exempt properties). However, the ease of tying into this database versus the utilities database should be explored, as well as the capacity of the billing administrators in each department to add and manage another line item on the bill.

Provide a Limited Set of Stormwater Services to Start: The first priority in Ipswich is development of a program to address illicit connections to the stormwater infrastructure. Implementing a stormwater enterprise fund based on a budget and fee structure that supports this limited goal will provide a simpler budget and smaller stormwater fees as the program gets up and running. This allows the town to introduce residents to the idea of a stormwater fee with a fee that is inexpensive and targeted. We also recommend that the stormwater utility should provide for a stormwater coordinator to manage the program and provide engineering services, some additional maintenance funding, and a small budget for public education to let people know about the program. At the beginning of the program, existing stormwater services such as maintenance could continue to be funded out of the general fund if the Stormwater Committee is concerned about high initial fees.

Credits and Exemptions: We recommend implementing a very simple credit system targeted to large commercial and industrial users. We also recommend not providing any full exemptions through the program.

Enabling Language: We recommend including enabling language within a new or amended bylaw. The bylaw must clearly identify a stormwater authority responsible for managing the stormwater utility. An example of simple enabling language is provided in this chapter.

Simple Fee Structure Based on Equivalent Residential Units (ERUs): A fee structure based on ERUs is a proven method for connecting each individual lot to the stormwater management service being provided by the Town. We recommend a simple rate structure for residential units
that either uses one ERU for all residential units, or includes a tiered structure that differentiates between single, two, and three-family residences.

**Monitoring Recommendation**

A water quality monitoring program in the Ipswich River and an instream flow monitoring program in the Egypt River are recommended. Monitoring is crucial to ensure that stormwater management and water conservation activities are achieving the desired environmental results. We recommend a baseline water quality monitoring program, a monthly sampling program focused on stormwater and wastewater hotspots in the Ipswich River, and monthly monitoring of streamflow at a staff gage in the Egypt River downstream of the Town’s reservoirs. All monitoring efforts should leverage volunteers in order to reduce costs and minimize the burden on Town staff.

**Next Steps: Integrated Water Resources Management**

The proposed water demand mitigation program and stormwater utility would constitute a major step towards balancing the water budget financially, and would yield important environmental benefits to water quantity and quality in Ipswich. However, fully balancing the water budget environmentally is an extremely ambitious goal, given the current level of water losses from the Town’s source watersheds.

The Town of Ipswich has completed a preliminary evaluation of the possibility of discharging treated wastewater to the Egypt/Rowley watershed, in addition to or instead of the existing discharge to Greenwood Creek. This project would be the single most important step the Town could take to balance the water budget and mitigate water losses. A 2006 study investigated potential sites for groundwater discharge based on ownership and groundwater geology, and identified a site between the Dow Brook and Bull Brook reservoirs as having the most potential. We recommend further consideration of this option as part of an integrated water resources management program designed to balance the water budget in Ipswich.

MassDEP is currently developing guidance for communities interested in developing integrated water resources management plans. Integrated planning around water, wastewater, and stormwater does not generally occur in Ipswich at present, due to an administrative structure that houses the Water and Sewer Departments under the Utilities Department, and stormwater management programs under the DPW. Moving towards integrated management of water resources in Ipswich would require steps to expand communication between these two departments. As a first step, we recommend creating an integrated water resources management committee charged with identifying areas of overlap between stormwater and water/sewer activities.
CHAPTER 1:
PURPOSE AND SCOPE

1.0 Introduction

This project focuses on balancing the water budget in the Town of Ipswich, in order to improve streamflow conditions and water quality in the Egypt/Rowley River and the Ipswich River. It is intended first and foremost to assist the Town of Ipswich in evaluating program options and financing mechanisms for integrated management of water resources, with a focus on water and stormwater. The project also serves as a model for integrated water resources management in the Ipswich River watershed region and other communities throughout Massachusetts.

The report first develops a simple water budget for the Egypt/Rowley River watershed, which provides most of the Town’s water supplies, as the basis for setting water balance goals. It then provides in-depth descriptions of two key programs designed to mitigate the impacts of development on water resources and generate sustained funding for water resources management activities: a water demand mitigation program and a stormwater utility. The report concludes by offering recommendations for an integrated water resources management program with the long-term goal of balancing the water budget in Ipswich.

The project is funded under a Watershed Improvement Grant from the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), and is intended to advance the recommendations of the Ipswich River Watershed Management Plan and the Parker River Watershed Action Plan 2006-2010. The Ipswich River Watershed Management Plan, released in 2003, has been adopted by EOEEA as the 5-year Watershed Action Plan for state planning purposes. The plan estimates the hydrologic benefits of six key recommendations for restoration of the Ipswich River watershed: improved water conservation, alternative water supplies, reduced export of wastewater, enhanced stormwater infiltration, increased water storage, and better land use policies and practices. The plan specifically highlights water banks and stormwater utilities, and emphasizes the need to mitigate water losses due to growth. The Parker River Watershed Action Plan sets forth the goal of maintaining instream flow and evaluating water use, specifically noting the need to set instream flow standards for the Egypt/Rowley River, evaluate impacts of withdrawals on Rowley River, and develop a water budget to evaluate impacts of out-of-basin water or wastewater transfers.

1.1 Project Setting

Ipswich is a coastal community of approximately 14,000 residents on the North Shore of Massachusetts. It retains the character of a classic New England small town, with a compact and vibrant downtown surrounded by rural land and open space, including farms, forests, wetlands, salt marshes, and barrier beaches. The Town supports a diverse economic base that includes manufacturing and fishing industries, and is closely linked by road and rail to Boston, located 30 miles to the south. The Ipswich River flows through downtown Ipswich, where homes and businesses line the riverbanks, before flowing into Plum Island Sound at Crane Beach. Ipswich’s total land area of 33.5 square miles encompasses portions of both the Ipswich River watershed,
the Egypt/Rowley River watershed, which is part of the Parker River watershed, and the North Coastal watershed (Map A-1).

The Ipswich River and Egypt/Rowley River are high quality coastal rivers that flow into Plum Island Sound and the Gulf of Maine. The estuarine portions of these watersheds are part of the Great Marsh and Parker River/Essex Bay Area of Critical Environmental Concern, an extensive salt marsh ecosystem widely recognized for its outstanding ecological, economic, and recreational values, including important shellfish areas that produce the famous “Ipswich Clam.” Substantial portions of these watersheds are state-designated as BioMap Core Habitat and Living Waters Critical Supporting Watersheds, representing habitats that support rare species or exemplary aquatic habitats. Both rivers historically supported anadromous fisheries including river herring, American shad, and Atlantic salmon. The watersheds together form part of the Essex National Heritage Area, federally designated because of its unique historic, cultural, and natural resources.

The Town of Ipswich obtains its water supplies from a mix of surface and groundwater sources located in the Egypt/Rowley and lower Ipswich watersheds, with the majority coming from the Egypt/Rowley watershed. The Ipswich River is recognized as one of the most endangered rivers in the nation (American Rivers 2003), “highly stressed” by the Massachusetts Water Resources Commission (2001), and “impaired” under S. 303(d) of the Clean Water Act due largely to the combined impacts of water withdrawals and out-of-basin transfers by the fourteen communities that rely on the river for municipal water supplies, as well as reduced aquifer recharge due to increased impervious area. The Egypt/Rowley River is also affected by water withdrawals, out-of-basin transfers, and reduced aquifer recharge. Both rivers experience extreme low flow conditions, especially during the summer and fall.

In addition to streamflow problems, stormwater pollution is the principal cause of shellfish bed closures and occasional beach closures. The lower Ipswich River, Egypt/Rowley River, and Plum Island Sound are listed as impaired due to pathogens on the 2002 Integrated List of Waters, and the Massachusetts Department of Environmental Protection has drafted a pathogen TMDL for these basins. Water quality problems have also been associated with overflows from the Ipswich wastewater collection system into the lower Ipswich River during major storm events. Many dams are present in both watersheds, on both river mainstems and tributary streams. These dams were typically built to power historic mills or create ponds for water supply or recreation, but they also fragment aquatic habitat and obstruct anadromous fish migration.

The challenge facing Ipswich and all the communities that rely on these stressed water sources is to mitigate the impacts of water withdrawals by saving water and using treated wastewater and stormwater as a resource to balance the water budget.
1.2 Project Goals

The primary goal of this project is to balance the water budget in Ipswich. Balancing the water budget involves two complementary strategies: balancing the water budget environmentally, and balancing the water budget financially.

Environmentally, the goal is to balance the water budget in the Town’s source basins, with a particular focus on the Egypt/Rowley River watershed, which includes Dow Brook, Bull Brook, and Muddy Run. This long-term goal involves returning as much water to the watershed as is pumped out, through three basic water balance strategies: withdrawing less water, recharging stormwater, and reducing wastewater exports. Chapter 2 provides an inflow-outflow analysis of the Egypt/Rowley watershed and quantifies an overall water balance goal for the Town of Ipswich. Chapter 3 describes water conservation programs designed to mitigate additional water demands and reduce overall water withdrawals.

Wastewater management was not the focus of this project, but may present the most significant opportunity to balance the water budget in Ipswich. The Egypt/Rowley watershed is highly impacted by out-of-basin transfers of water and wastewater. Households and businesses located outside the watershed, as well as all those connected to the sewer system, discharge their treated wastewater outside the Egypt/Rowley watershed. The Ipswich wastewater treatment plant currently discharges into the Ipswich River estuary at Greenwood Creek. The Town of Ipswich has completed a preliminary evaluation of the possibility of discharging treated wastewater to the Egypt/Rowley watershed, in addition to or instead of the existing discharge to Greenwood Creek.

Financially, the goal is to balance the water budget by implementing financing mechanisms that generate sustained funding for water resources management programs in Ipswich. Water resources management programs in Ipswich are currently underfunded. Stormwater in particular suffers from a lack of dedicated funding. Existing stormwater programs are funded out of the Town’s general funds, and funding is inadequate to meet the full range of maintenance, regulatory, engineering, and water quality improvement needs. The proposed water demand mitigation program (Chapter 3) and stormwater utility (Chapter 4) would help to balance the water budget financially by generating dedicated funding for water resources management through a system of fees and enterprise funds housed within existing Town departments.

An additional goal is to improve water quality in the Ipswich River by preventing and ameliorating the discharge of untreated stormwater and wastewater. Several known stormwater hotspots exist in Ipswich, including Farley Brook, which drains the urbanized downtown area, and Topsfield Road, which has experienced problems with stormwater infrastructure. Water quality sampling has detected unusually high levels of pathogens and other stormwater-derived pollutants at these hotspot locations. Stormwater runoff from Farley Brook contributes to the closure of shellfish beds after rainfall events, and also degrades high quality spawning habitat for rainbow smelt (Division of Marine Fisheries, 2006). The proposed stormwater utility would help fund essential stormwater management activities that would remediate stormwater hotspots.
Sewage overflows from the Ipswich wastewater collection system also cause water quality problems in the lower Ipswich River.\(^1\) The wastewater collection system has experienced overflows during large storm events due to the infiltration and inflow (I/I) of stormwater and clean groundwater into leaky sewer pipes, resulting in discharges of untreated sewage into the Ipswich River at the Town Wharf. This has been an ongoing concern, and while partially addressed due to improvements in the sewer collection system, major pollution discharges still occur during major flood events, such as in spring 2006 when untreated sewage discharged into the river for an extended period. An integrated water resources management program would include initiatives designed to reduce the inflow of stormwater and infiltration of clean groundwater into the sewer system, reducing sewage overflows as well as water losses.

1.3 Program Options

Lack of funding is one of the major factors preventing communities like Ipswich from implementing more comprehensive water resources management programs. A variety of options exist to design financing mechanisms or instruments that achieve both environmental and financial results. Financing mechanisms “connect monetary sources (the ultimate payers) to sinks (project costs)” (EFAB 2007). They include taxes, benefit assessments, and fees. In order to be effective, financing mechanisms must be fair and equitable, produce adequate funds, be politically acceptable, provide incentives for efficient use of environmental services, and avoid free riders (EFAB 2007).

The ultimate goal of balancing the water budget in Ipswich requires implementation of an integrated water resources management program that includes water conservation, leak detection, stormwater management, I/I removal, and wastewater management programs. Many of these programs have already been implemented in Ipswich in some form, but more funding is needed to undertake more comprehensive efforts, particularly in the area of stormwater management. This report proposes two distinct programs, a water demand mitigation program and a stormwater utility, as the first steps toward an integrated program. These programs are described in chapters 3 and 4.

These programs are recommended for Ipswich because they would generate substantial funding for water conservation and stormwater management activities, and because the Town has expressed serious interest in implementing them in the short-term. Water demand mitigation programs and stormwater utilities are becoming more common and politically acceptable in Massachusetts as communities grapple with environmental and fiscal challenges. Both provide an equitable, fee-based approach that is politically acceptable and legally defensible.

The two proposed programs have distinct goals, budgets, target user groups, and administrative structures, and could be implemented independently, according to the Town’s desired timeline. Implementing two separate programs would be significantly easier than creating a single comprehensive program, given the Town’s existing management structures. Administratively,

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\(^1\) Wastewater that reaches the Ipswich Wastewater Treatment Plant is treated and discharged to Greenwood Creek, a tidal tributary to the Ipswich River. Water quality problems are associated with wastewater that has not yet reached the treatment plant, which overflows directly from the sewer system during storm events.
Ipswich’s Water Department and Sewer Department are housed within the Utilities Department, while stormwater management is a function of the Department of Public Works. Co-management of water and stormwater programs would be difficult for the Town and could require major restructuring of management, administration, and billing functions – an unlikely outcome.

That said, in the long-term, an integrated water resources management program that includes water, stormwater, and wastewater is necessary to balance the water budget – both fiscally and environmentally – while allowing for continued economic development and smart growth in Ipswich. Chapter 6 provides a brief overview of how an integrated program might be structured.

1.4 Project Methodology

In order to recommend program options for implementation in Ipswich, IRWA surveyed the landscape of financing mechanisms across Massachusetts and the United States, including water banks, water demand mitigation programs, sewer banks, stormwater utilities, stormwater offset programs, impact fees, and enterprise funds. Krista Anderson, a graduate student at Yale University, prepared a study titled, “Analysis of Water Offset Programs for Implementation in the Ipswich River Watershed, Massachusetts” (2006) that provided a comprehensive overview of many such programs and their applicability to Ipswich.

IRWA and its consultant, the Horsley Witten Group, also consulted extensively with Ipswich stakeholders, including the Utilities Director, Director of Public Works, Town Manager, Board of Selectmen, Water Commissioners, Planning Department, and Stormwater Committee to gather feedback. IRWA also worked with an advisory group of representatives from state agencies including the Massachusetts Riverways Program and the Massachusetts Department of Conservation and Recreation, as well as members of the Massachusetts Instream Flow Task Force. The participation of Town officials and agency representatives in no way constitutes an endorsement of the report’s recommendations.
CHAPTER 2:
SETTING WATER BALANCE GOALS

2.0 Introduction

This chapter describes the Ipswich water supply system and the impacts of that system on the Egypt/Rowley watershed, the primary water source for the town. An inflow-outflow analysis of the Egypt/Rowley watershed serves as the basis for setting goals designed to balance the water budget, referred to in this report as water balance goals.

2.1 Ipswich Water Supply System

The Ipswich Department of Public Utilities (DPU) Water Department serves approximately 14,000 people and 70 percent of Ipswich’s land area. The Water Department obtains its water from a mix of surface and groundwater sources located in the Egypt/Rowley and lower Ipswich watersheds, with the majority coming from the Egypt/Rowley watershed (Map A-2). The largest single water source in Ipswich is the Dow and Bull Brook Reservoir system, located within the Egypt/Rowley watershed. The two reservoirs operate as a combined system, with water from the Bull Brook Reservoir being transferred to the Dow Reservoir by gravity through a 36-inch diversion pipe. The usable storage volume of the Dow reservoir is 53.1 million gallons, and the usable storage volume of the Bull Brook reservoir is 27.4 million gallons, for a total volume of 80.5 million gallons. The remainder of the Town’s water supply comes from six ground water sources. Two gravel packed wells, Mile Lane Well and Browns Well, are located within the Egypt/Rowley watershed. Four other groundwater sources, Winthrop Well 1, Winthrop Well 2/3, Essex Road Well, and Fellows Road Well, are located within the Ipswich River watershed (Map A-3).

Under the Massachusetts Water Management Act (WMA), water withdrawals that pre-dated the WMA could be “registered,” and additional withdrawals exceeding the threshold volume of 100,000 gallons per day are subject to permitting by the Massachusetts Department of Environmental Protection (MassDEP). The Town of Ipswich registered withdrawals of 0.64 million gallons a day (mgd) from the Parker River Basin sources and 0.20 mgd from its Ipswich River Basin wells. The Town’s withdrawals exceed the registered amount in the Parker River Basin by more than 100,000 gpd, so the Town has obtained and now operates under a WMA water withdrawal permit for Parker River sources. In 2005, according to the WMA Annual Statistical Report filed with MassDEP, the Ipswich DPU Water Department pumped a total volume of 405.5 million gallons (1.11 mgd). All of this water was destined for use within Ipswich.

Based on 2005 data, 70 percent of the water withdrawn by the Ipswich Water Department served residential water demand (4,427 service connections), while 15 percent served commercial and municipal water users (229 service connections). The remaining 15 percent of pumped water was not metered, but according to the Water Department, 11 percent could be confidently estimated as resulting from hydrant flushing, water main breaks, flow testing, and service/hydrant leaks.
The Town considered the remaining 3.5 percent as true unaccounted for water (UAW), presumably resulting from undetected leaks and other such unmeasured water losses.

Ipswich operates under a Drought Management Plan (2002) that determines drought stage based on reservoir storage capacity. For example, reservoir storage capacity at 60-75 percent of normal conditions is considered Stage 3 (Moderate), while storage capacity below 40 percent of normal conditions is considered Stage 5 (Emergency). Mandatory water restrictions enforced by the Water Department are enacted at moderate drought stage (Stage 3).

2.2 Assesing Water Efficiency

Water system performance is typically assessed based on overall efficiency and the ability of the water infrastructure to deliver water supplies. By many of these measures, Ipswich is performing admirably. Between 2001 and 2005, Ipswich averaged per capita water demand of 55.2 gallons per capita per day (gpcd), well below the Water Management Act performance standard of 65 gpcd (Water Assets Study, 2004). The Water Management Act sets a performance standard of 10 percent UAW. Ipswich’s unmetered water use has averaged about 14 percent over the same period, while its reported UAW has averaged about 7 percent during this period due to the deduction of certain unmetered water losses from the reported UAW value.

Ipswich’s water system also performs well in terms of its ability to meet peak water demands. Maximum daily demand (MDD), the amount withdrawn on the day with the highest level of demand in a given year, ranged from 2.2 to 2.6 mgd from 2001 to 2004. This falls well within the physical pumping capacity of 5.12 mgd available from existing Ipswich DPU Water Department supplies and the DEP Approved Daily Volume of 4.52 mgd for all sources, based on the amount that DEP determines can be safely extracted and treated from a given source during a single day. This physical pumping capacity does not take environmental impacts into account.

On the other hand, Ipswich exceeded its registered withdrawal for the Parker River basin in the 1990s, resulting in the issuance of an Administrative Consent Order (ACO). Since the mid-1990s, the Town has reduced its total water use from a high of 1.31 mgd to about 1.11 mgd. The Town’s water withdrawal permit, issued in 2002, is under appeal, and the Town has been operating under the ACO, which allows a total withdrawal of 1.18 mgd, 0.98 mgd from the Parker River watershed and 0.20 mgd from the Ipswich River watershed. From 2001 through 2005, Ipswich had an average daily demand (ADD) of 0.90 mgd from the Parker River watershed, and ADD of 0.23 mgd from the Ipswich River watershed – slightly below the withdrawal limit overall, but above the registration in the Ipswich Basin.

2.3 Assessing Water Stress

While Ipswich’s water infrastructure may be adequate to meet peak demands, its water resources are highly stressed by existing withdrawals by the Town of Ipswich and the thirteen upstream communities that use the Ipswich River for their municipal water supplies. Rivers and streams within the Ipswich and Egypt/Rowley watersheds experience extreme low flow.
conditions during the summer and fall, and some are completely dewatered. These resources could face even more severe stress under a full buildout scenario, if current trends continue.

By the time it flows into Ipswich, the Ipswich River is already heavily impacted by upstream water withdrawals that deplete the river to extremely low levels, especially in summer and occasionally at other times of year. The Town of Ipswich has several wells in the Ipswich River watershed, including Winthrop Wells #1 and #2/3, which are “streamside wells” located very close to the Ipswich River just downstream of the US Geological Survey (USGS) Ipswich streamflow gage. This section of the river is one of the longest and most important riffles on the river’s mainstem, and hosts one of the only populations of reproducing brook trout known on the river. Riffles provides extremely valuable aquatic habitat when sufficient water is present, but they are highly susceptible to flow reductions, which cause riffles to dry up sooner than other sections of the river. Frequent low-flow conditions cause the direct loss of critical habitats, as well as segmentation of the river into a series of stagnant pools instead of flowing water (USGS 2001).

While Winthrop Well #1 is rarely used, Winthrop Well #2/3 is regularly used, especially in the summer months when the Ipswich River is most vulnerable to flow reductions. Between 1995 and 2005, Ipswich decreased its pumping from the Winthrop wells by 73 percent (T. Henry, Pers. Comm., July 17, 2007). Reducing summer withdrawals from streamside wells is an explicit objective of the Ipswich River Watershed Action Plan.

We performed an inflow-outflow analysis on the Egypt/Rowley watershed to estimate net water losses. We focused on the Egypt/Rowley watershed because approximately 80 percent of the town’s water withdrawals come from the two reservoirs and two groundwater wells located in this basin (Map A-4). Moreover, as a small stream, it is even more dramatically affected than the mainstem of the lower Ipswich River by excessive water withdrawals and summertime low flow conditions. We followed the Massachusetts Water Resources Commission’s “Method to Determine if a Sub-basin is Hydrologically Stressed” (from the Report on Stressed Basins in Massachusetts, 2001) to perform the inflow-outflow analysis (Exhibit 2-1).

This method is a basic inflow-outflow approach incorporating simulations of natural streamflows based on the USGS StreamStats program, as well as water withdrawal data and estimated returns of wastewater via septic systems. StreamStats is a hydrological model to evaluate the natural flow characteristics of Massachusetts streams that do not have gages or streamflow records, or are impacted by flow alterations. This computer program incorporates precipitation, geomorphological and other data, allowing a program user to generate low-flow statistics for any location in Massachusetts.
Exhibit 2-1.
Method to Determine if a Subbasin is Hydrologically Stressed

The stressed sub-basin analysis is a simple water budget comprised of withdrawals and discharges to the sub-basin. The amount of withdrawals and discharges are related to base flow to determine the relative impact of water use on the hydrology of the sub-basin with a focus on low flow periods.

1. The first step in the method is to delineate the tertiary or secondary sub-basin to be assessed. If a mainstem river is to be assessed an appropriate planning unit should be determined such that key hydrologic characteristics and water uses are captured in the sub-basin delineation.
2. Once the sub-basin has been delineated, municipal water supply withdrawals should be located. If possible average annual withdrawals, on a daily basis, for a three year period should be used.
3. Wastewater returns to the sub-basin should also be located and summarized. Careful attention should be paid to determining which portions of a community discharge to the sub-basin via a treatment plant versus areas that discharge via septic systems.
4. The total sub-basin withdrawals, wastewater treatment plant returns and septic returns should be summarized as well as the resulting net inflow or outflow of water from the sub-basin.
5. Determine the estimated natural 7Q10 and August Median flows for the sub-basin. This data is available from the U.S. Geological Survey at http://ma.water.usgs.gov/streamstats/.

Stress Classification Criteria
HIGH: Net outflow equals or exceeds estimated natural August median flow
MEDIUM: Net outflow equals or exceeds estimated natural 7Q10 flow
LOW: No net loss to the sub-basin


The stressed sub-basin analysis reveals that the Egypt/Rowley watershed is highly stressed by water withdrawals and wastewater exports, with a net consumptive loss to the subbasin of 0.874 mgd on an annual basis and 1.024 mgd in the summertime (based on 2003-2005 data) (Exhibit 2-2). These water losses exceed the August median combined streamflows of 0.71 mgd for the Egypt River plus Muddy Run. The stressed subbasin analysis does not include infiltration and inflow into sewer pipes or loss of stormwater recharge due to impervious area within the watershed. Both of these impacts would exacerbate water stress.

In its “new source approval” process as well as Water Management Act Policy, DEP uses 50 percent of the August median streamflow as an indicator of basins or sub-basins where water losses have the potential to have significant adverse impacts, requiring a higher level of review, more stringent conditions on permits, and mitigation. By its current policy, where such impacts cannot be mitigated, additional water withdrawals would likely be denied. For comparison, in Ipswich, the existing annual water losses to the subbasin are more than double the DEP trigger, and almost triple in the summer period.

Several other methodologies to determine hydrologic stress are currently under development and consideration at the state level, and could be applied to the Egypt/Rowley watershed once they are available. USGS is developing a “Sustainable Yield Estimator,” a computer program that will use MassGIS databases, precipitation data, streamflow values, and other factors to evaluate how much water could be available for allocation, while preserving reasonable instream flows.
necessary to maintain ecological and other functions. This project is due to be completed in 2008.

The Charles River Watershed Association (CRWA) is calculating water budgets for all the subwatersheds in Massachusetts, under a contract with the Executive Office of Environmental Affairs. The program developed by CRWA analyzes water inputs and outputs and translates the results into streamflow impacts. Every municipality in Massachusetts will receive an individualized report, enabling refinement of the Stressed Basins classifications and a better understanding of the stress level in currently unassessed basins. The water budgets project will also play a key role in mitigating increased water withdrawals because the information will tell communities where putting water back in the ground will provide the most benefit. An interactive component will also enable communities to assess the impact of new water infrastructure decisions on streamflow. The CRWA Water Budgets project incorporates assumptions about the impacts of imperviousness and sewer infiltration and inflow, and uses a monthly time step, as opposed to the annual and seasonal time periods evaluated here. IRWA consulted with CRWA during the development of the water budget for this project.

The Massachusetts Riverways Program, in collaboration with the Stockholm Environment Institute and Tufts University, is adapting the WEAP (“Water Evaluation And Planning”) system to Massachusetts watersheds. WEAP is a user-friendly software tool that takes an integrated approach to water resources planning to enable evaluation of management alternatives and economic factors. The software will be available for free to Massachusetts municipalities.
## Exhibit 2-2.
### Stressed Subbasin Analysis of Egypt/Rowley River Watershed

<table>
<thead>
<tr>
<th>Streamflow Statistics from USGS StreamStats</th>
<th>Cubic Feet Per Second (cfs)</th>
<th>Million Gallons Per Day (mgd)</th>
<th>Notes and Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>7Q10 streamflow (Egypt River + Muddy Run)†</td>
<td>0.18</td>
<td>0.116</td>
<td>If subbasin net loss exceeds this: stressed</td>
</tr>
<tr>
<td>August median streamflow (Egypt River + Muddy Run)</td>
<td>1.1</td>
<td>0.711</td>
<td>If subbasin net loss exceeds this: highly stressed</td>
</tr>
<tr>
<td>50% August median streamflows</td>
<td>0.55</td>
<td>0.356</td>
<td>Index used by MassDEP in water budget assessments</td>
</tr>
</tbody>
</table>

### Egypt/Rowley Subbasin Inflow-Outflow Analysis (Annual Basis)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Notes and Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Town of Ipswich average daily withdrawals 2003-2005 (Egypt/Rowley watershed only)</td>
<td>0.877</td>
<td>Town of Ipswich Annual Statistical Reports</td>
</tr>
<tr>
<td>Turner Hill withdrawal</td>
<td>0.015</td>
<td>Turner Hill reported data</td>
</tr>
<tr>
<td>Other withdrawals (estimated, year-round basis)</td>
<td>0.006</td>
<td>Estimated private irrigation in Egypt/Rowley watershed</td>
</tr>
<tr>
<td>TOTAL subbasin withdrawal</td>
<td>0.892</td>
<td></td>
</tr>
<tr>
<td>Estimated water use by unsewered homes in Egypt/Rowley watershed</td>
<td>0.025</td>
<td>Based on 185 unsewered homes in watershed, 2.45 persons per household; 55 gpcd (number of homes based on SGS topographic map, windshield survey; people per household based on US Census; water use per person based on Town of Ipswich Annual Statistical Reports</td>
</tr>
<tr>
<td>TOTAL subbasin recharge</td>
<td>0.018</td>
<td>Assumes 72% of above use by unsewered homes is recharged to the Egypt/Rowley watershed; conservative estimate assumes 80% of total use is indoor and 90% of indoor use is recharged via septic</td>
</tr>
<tr>
<td>TOTAL NET LOSS TO EGYPT/ROWLEY SUBBASIN (ANNUAL AVERAGE)</td>
<td>0.874</td>
<td>Highly stressed: net loss of water exceeds August median streamflow</td>
</tr>
</tbody>
</table>

† Measured just downstream of water withdrawal locations.
2.4 Aquatic Habitat Impacts in the Egypt/Rowley River

The finding that the Egypt/Rowley watershed is highly stressed by water losses is borne out by preliminary field observations of aquatic habitat and fish assemblages, but more research is needed to understand the impact of reservoir operations on streamflow conditions and to establish specific flow indices for the Egypt/Rowley River.

The Egypt River forms at the confluence of Dow Brook and Bull Brook. Downstream near the confluence of Muddy Run, where it mixes with salt water, it is referred to as the Rowley River (Map A-4). The Egypt River and the section of Bull Brook downstream of the Town’s reservoir have extensive high quality riffles, areas of swift, turbulent flow that aerates the water and provides excellent habitat for fish and other aquatic species (see Appendix B for photos of the Egypt/Rowley River).

The Egypt/Rowley River system historically supported a diverse community of resident freshwater and diadromous (migratory) fish species. As recently as the 1980s, there was a productive fish community including banded sunfish, pumpkinseed, bluegill, redfin pickerel, chain pickerel, smallmouth bass, bullhead, brook trout, fallfish, killifish, golden shiner, rainbow smelt, alewife, blueback herring, American eel, and white sucker. The Massachusetts Division of Marine Fisheries (DMF) has documented excellent smelt spawning habitat in the Egypt/Rowley River if flows are sufficient during late spring. Spawning habitat for river herring is limited, primarily due to fish passage obstructions. A DMF scientist has testified that “water withdrawal is a concern and has impacted species in the river system” (Chase 2006).

Several rare species and vernal pools exist in close proximity to the Town’s water supply sources in the Egypt/Rowley watershed, and concerns have been raised about adverse impacts to them as a result of water withdrawals. According to the Massachusetts Natural Heritage and Endangered Species Program’s performance standard used in evaluating impacts of potential projects, no short- or long-term adverse impacts should occur to rare species habitat.

Bull Brook and Dow Brook are Class A waters, the Egypt River freshwater portion is Class B, the estuarine portion of the Egypt-Rowley Sub-Basin and Parker River Basin is Class SA, and all these resources are Outstanding Resource Waters under the Massachusetts Surface Water Quality Standards (314 CMR 4.00) (Mackin 2002). Outstanding Resource Waters have

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2 The Antidegradation Provisions of the Massachusetts Surface Water Quality Standards require that in all cases existing uses and the level of water quality necessary to protect the existing uses shall be maintained and protected (314 CMR 4.04(1)). Class A waters are designated as a source of public water supply. To the extent compatible with this use they shall provide excellent habitat for fish and other aquatic life and wildlife, be suitable for primary and secondary contact recreation, and have excellent aesthetic value. These waters are designated for protection as Outstanding Resource Waters under 314 CMR 4.04(3). Class A waters are High Quality Waters under the antidegradation provision (314 CMR 4.04(2), 4.06 Table 27). Class B waters are designated as a habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation (314 CMR 4.05(3)b). Class SA waters are excellent habitat for fish, aquatic life and wildlife, primary and secondary recreation, and suitable for shellfish harvest without depuration (314 CMR 4.05(4)a).
exceptional socioeconomic, recreational, ecological, and/or aesthetic values, and are subject to more stringent regulatory standards.

MassDEP’s Parker River Water Quality Assessment indicates that the Aquatic Life Use is on Alert Status for the Egypt and Rowley River segments. This report identifies shellfish beds in the Rowley River and recommends instream biological monitoring to determine the effects of water withdrawals on habitat and aquatic life.

Dow Brook has been impounded by the Town for water supply since the late 1800s, and Bull Brook was first impounded in 1923, but due to poor water quality it was not used as a water supply for the Town, except on an emergency basis during the severe drought of the 1960s. Bull Brook’s original earthen dam was reconstructed and raised in the late 1980s, preventing the leakage and spillage that had previously sustained perennial flows in Bull Brook downstream of the reservoir. This dam reconstruction, in conjunction with the construction of the Town’s water treatment plant to address the water quality problems, allowed the diversion of water from Bull Brook into Dow Brook Reservoir, thus greatly increasing the amount of water that could be withdrawn from Bull Brook. These actions together cut off flows downstream of the Bull Brook Reservoir for the first time in the late 1980s, significantly impacting fisheries and other ecological and recreational values in the downstream reaches. Now, when water levels in the reservoirs fall below the spillways, flow ceases in the sections of Bull Brook and Dow Brooks downstream of the reservoirs. This typically occurs from June to October every year (T. Henry, Pers. Comm., May 29, 2007).

Brown’s Well, Ipswich’s highest producing well, is located near Muddy Run. This well has been used to a greater extent in recent years than its 0.18 mgd registered water use volume, and MassDEP has approved withdrawals up to 0.49 mgd. Mile Lane Well is located near the eastern bank of the Bull Brook Reservoir. This well has yielded about 0.05 mgd, and is approved for withdrawals up to 0.15 mgd (Town of Ipswich Water Withdrawal Permit).

DMF made a number of streamflow measurements in the Egypt River downstream of Route 1A in Ipswich, and based on these measurements and professional judgment, estimated that flows of 7 cfs would provide adequate smelt spawning habitat and passage for eels and river herring, and that flows below 3.5 cfs are sub-optimal. DMF strongly urged that additional flow measurements and an instream flow study be conducted to establish specific flow indices for the Egypt/Rowley River (Chase 2006).

Additional research is sorely needed to better understand streamflow conditions and aquatic habitat impacts in the Egypt/Rowley River watershed. Such research could potentially serve as the basis for more active management of the reservoir system. Because the system is not currently managed to optimize instream flow levels, flow downstream of the Town’s reservoirs essentially ceases when water levels seasonally fall below the spillways. Unless a system of active management is initiated, then measures to withdraw less water or recharge more stormwater or wastewater to the Egypt/Rowley watershed may succeed only in returning more water to the reservoirs, rather than restoring streamflows downstream. Further evaluation is
needed to determine whether active management of the reservoir system is feasible, and to better characterize the relationship between water losses and streamflow conditions.

2.5 Development Pressures

Ipswich faces development pressures that would increase the demand for water, sewer, and stormwater services and place further stress on water resources, unless a mitigation program is implemented. A Water Assets Study (2004) prepared for the Town and EOEEA investigated whether the Town’s existing supplies could meet projected average daily demands under a full build-out scenario. According to Metropolitan Area Planning Council (MAPC) projections, Ipswich’s population may rise to 23,089 residents under full-buildout, potentially leading to daily average water demand of 2.29 mgd. This represents 194 percent of the total WMA regulated annual withdrawal volume for Ipswich municipal water supplies (Water Assets Study, 2004).

Ipswich has a dense village center full of older historic homes, along with several commercial and industrial zones along or near major roadways, including Route 1. Since 1970, new construction in Ipswich has added 6.0 million square feet of building area in Ipswich, including 3.5 million square feet of single-family residential space (1,374 new homes), 1.3 million square feet of commercial/industrial space, 600,000 square feet of condominiums and multifamily residential space, and 300,000 square feet of municipal space (Energy Use and Greenhouse Gas Inventory 2007).

While new single-family homes tend to include more water- and energy-efficient indoor fixtures and appliances, the average size and lawn area of homes in Ipswich has increased substantially in recent years, reducing these efficiency gains. While the average single-family home in Ipswich is 2,138 square feet in size, the 181 homes built since 2000 have been an average of 3,418 square feet. Condominium units have also increased in size (Energy Use and Greenhouse Gas Inventory 2007). Many of the new single-family homes have been built in subdivisions in the rural residence zoning districts outside of the town center. Research from Clark University indicates that low-density areas of Ipswich use about twice as much water per-capita as high density areas during summer months, mostly due to increased lawn-watering (Del Vecchio 2007).

Since 2000, an average of 51 residential units per year have been developed in Ipswich, a growth rate of about 1 percent per year, based on data provided by the Ipswich Planning Department. Residential development, particularly single-family and condominium development, is expected to continue at a similar rate or slow slightly in Ipswich (G. Gibbs, Pers. Comm., May 31, 2007). Several developments have been recently approved or are expected to be approved, and will likely be built over the next few years. Some of these developments are proposed under Chapter 40B of the Massachusetts General Law, a state zoning law that allows developers to override local planning and zoning regulations in exchange for provision of affordable housing.

3 However, this projection may not adequately factor in water conservation potential. The projected residential population, based on today’s residential per capita daily use of 55 gallons, would use about 1.25 mgd. If residential use accounts for about 70 percent of the total water use in town, that would imply a total daily use of about 1.81 mgd at buildout. This figure does not factor in potential further reductions in per capita use or unmetered water use, for example.
The rate of commercial development is lower, with an average of three commercial building permits issued per year since 2004. Rates of new commercial and industrial development are expected to slow due to the shortage of developable commercially and industrially zoned land in Ipswich, and construction may shift to enlargement and renovation of existing facilities (Energy Use and Greenhouse Gas Inventory 2007).

2.6 Balancing the Water Budget: Water Balance Goals

The stressed subbasin analysis for the Egypt/Rowley watershed calculates a net consumptive loss of 0.874 mgd on an annual basis (based on 2003-2005 data). This level of water loss exceeds the August median combined streamflow of 0.71 mgd for the Egypt River plus Muddy Run, the threshold for designation as a highly stressed watershed. Balancing the water budget in this watershed would therefore require returning 0.874 mgd annually to the Egypt/Rowley River. Exhibit 2-3 identifies five possible water balance goals that the Town of Ipswich could set, and programs that could meet the goals.

<table>
<thead>
<tr>
<th>Exhibit 2-3. Water Balance Goals (Annual Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
</tr>
<tr>
<td>Cap existing levels of water loss</td>
</tr>
<tr>
<td>Avoid highly stressed designation (reduce daily water loss below August median streamflow)</td>
</tr>
<tr>
<td>Reduce daily water loss below 50% of August median streamflow</td>
</tr>
<tr>
<td>Avoid stressed designation (reduce daily water loss below 7Q10 streamflow)</td>
</tr>
<tr>
<td>Balance the water budget</td>
</tr>
</tbody>
</table>

Expanded water conservation and efficiency programs, including a water demand mitigation program for new developments, have the potential to cap existing water withdrawals and to reduce water demand by approximately 20 percent. A water demand mitigation program would target new or expanded water users, rather than existing users. Most mitigation programs are designed to cap water demand at current levels in the face of continued growth and development. It would be difficult to achieve sustained reductions in water demand substantially below current levels solely by requiring new users to mitigate their demand, though it may be possible if very high offset ratios are employed. Meeting more ambitious water balance goals would likely necessitate surcharges paid by existing users. Conservation rates, deposited into an enterprise fund, may be designed to serve the dual purpose of generating more funding for water
conservation programs and providing an incentive for water-efficient behaviors, with the goal of reducing water demand by 20 percent and avoiding highly stressed designation.

Higher goals such as balancing the water budget in the Egypt/Rowley watershed, or even reducing daily water loss below 50 percent of the August median streamflow, are extremely ambitious relative to Ipswich’s current daily average water use of 1.1 million gallons per day, and would require aggressive actions to return treated wastewater to the Egypt/Rowley River and recharge stormwater. The Town of Ipswich has completed a preliminary evaluation of the possibility of discharging treated wastewater to the Egypt/Rowley watershed, in addition to or instead of the existing discharge to Greenwood Creek. Though not the focus of this report, this wastewater effluent diversion project would be an essential component of an integrated water resources program to fully balance the water budget in Ipswich.
CHAPTER 3:  
WATER DEMAND MITIGATION PROGRAM

3.0 Introduction

Water conservation is an integral part of a strategy to balance the water budget in Ipswich. Given the severity of the water deficit in the Egypt/Rowley watershed, aggressive measures to reduce water withdrawals and recharge stormwater and treated wastewater are needed.

This chapter describes a comprehensive water conservation program designed to meet Ipswich’s environmental and financial goals. The core of the program is a water demand mitigation program designed to cap existing levels of water withdrawal in the face of continued growth and development. This chapter provides detailed program design recommendations for a water demand mitigation program focused on new water customers. Recommendations for further expansion of water conservation programs in Ipswich are also offered, with the goal of reducing water demand by approximately 20 percent.

A 20 percent reduction would help Ipswich avoid highly stressed designation for the Egypt/Rowley watershed by reducing daily water losses below the August median streamflow, according to the stressed subbasin analysis presented in chapter 2. Additional assessment and monitoring is needed to better understand how this level of water savings would affect streamflow conditions and aquatic habitat in the Egypt/Rowley River watershed. An instream flow monitoring program for the Egypt River is therefore recommended in chapter 5.

3.1 Background: Water Management and Conservation in Ipswich

The Ipswich Department of Public Utilities is managed by a Utilities Director, who oversees the Water Department, Electric Department, and Wastewater Department. Since hitting its highest-ever level of water consumption in 1995, more than 480 million gallons per year, Ipswich has taken several major steps to reduce water demand that have resulted in substantial water savings (Exhibit 3-1). In 2006, Ipswich achieved its lowest water consumption since the late 1980s, 380 million gallons per year, a more than 20 percent reduction from peak values even as the customer base increased (T. Henry, Pers. Comm, July 17, 2007).
Annual acoustic leak detection surveys began in 1995. Given Ipswich’s early settlement and history, the water system is very old. Leaks are an ongoing source of wasted water given the age of the system. The leak detection program is highly cost-effective, credited by the Utilities Director with saving up to 30 million gallons per year for an annual cost of less than $10,000.4

Automated meter reading technology was installed in 1997-1998 for both the electric and water systems, and enabled monthly billing of water customers. Since installation of automated meters in 1997, customers have been billed monthly, and receive a combined bill containing water and sewer, as well as electric, charges. Ipswich is one of very few Massachusetts communities offering a monthly bill to its water customers. Monthly billing is much more transparent than quarterly or semiannual billing, and allows customers to promptly detect household leaks or respond to price signals by reducing their water use.

Since 2003, Ipswich has employed a seasonal water rate structure to promote summertime water conservation. From 2003-2006, summer rates (May-October) averaged $6.21 per hundred cubic

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4 This estimate includes only the cost of the leak detection survey by a consulting firm, not the cost of repairing the leaks. Water Department staff are responsible for leak repair.
feet (HCF) and winter rates averaged $2.33/HCF. The rate is structured to be revenue-neutral. The water department budget is set at the beginning of the year and a flat rate estimated that would fund the water department at the budgeted level. The summer water rate is set to be approximately 1.5 times this flat rate. The winter rate is then set in October based on actual water use in the summer. For example, if more water than anticipated is used in the summer, then winter rates are adjusted downward to maintain revenue neutrality. Revenues are deposited in an enterprise account dedicated to the Water Department.

Aside from these successful programs, Ipswich water conservation programs are primarily offered in conjunction with the energy conservation offerings through the Electric Department. The Utilities Director remains skeptical of the effectiveness of public education programs, and prefers to concentrate department efforts on quantifiable programs. Nevertheless, a modest residential water conservation program offers occasional newsletters as well as bill inserts. Free energy audits offered to Ipswich residents through the municipal Home Energy Loss Prevention Service (HELPs) program include a water component, with free faucet aerators and low-flow showerheads installed by the auditor. Rebates on Energy Star dishwashers and washing machines ($50 for each appliance) are offered through the Electric Department, with the hope that these energy-efficient appliances will also be water-efficient. A staff member visits the public schools once a year to educate students about water and offer tours. The budget for all educational and school programs is approximately $5,000 per year, with an additional $5,000 allotted annually to water audits of large commercial customers.

3.2 Overview: Water Demand Mitigation Program

Water demand mitigation programs are an emerging strategy to balance the water budget and fund water conservation activities in communities across the United States. These programs are designed to mitigate the water demands of new or expanded developments. Some water demand mitigation programs require developers to implement water-saving projects directly, while others require developers to pay a fee into an enterprise fund dedicated to water conservation activities. Water conservation projects carried out under the mitigation program must be quantifiable and verifiable, and must be accounted for through a tracking system.

In Massachusetts, such systems to account and pay for measures to balance the water budget have been referred to as “water banks.” This term may be confusing because it differs from the more common use of the term in western US states. In these states, which mostly follow the prior appropriation legal doctrine of surface water rights, water banking is an “institutional mechanism that facilitates the legal transfer and market exchange of various types of surface, groundwater, and storage entitlements” (Clifford et al. 2004). Water rights cannot be bought and sold in the same manner in Massachusetts, which follows the regulated riparian doctrine of water rights.

While some communities in Massachusetts, such as Weymouth, continue to call their programs water banks, Danvers terms its program a “water use mitigation program.” This report follows Danvers’ example and calls the proposed program a water demand mitigation program to avoid confusion with the western states’ water banks and most accurately characterize the program.
3.3 Legal and Regulatory Issues

State agencies including EOEEA and the Department of Conservation and Recreation (DCR) are promoting water demand mitigation programs, often called water banks in the context of state policy discussions. An appendix to the recently revised Massachusetts Water Conservation Standards (2006) provides some guidance, identifying four organizing principles that communities should follow when developing water demand mitigation programs:

1) A dedicated fund, or banking mechanism is necessary
2) At least a 2:1 ratio for mitigation should be the goal in medium and high stressed basins
3) If fee-based, the fee charge must bear a reasonable relation to the cost of implementing the offset and the program’s administrative costs, and
4) If the work is performed by the developer, documentation must be provided, and there must be verification of the local department or board administering the program. (EOEEA 2006)

Simultaneously, MassDEP is promoting so-called “water offsets” through their regulatory authority under the Massachusetts Water Management Act (WMA). The WMA regulates surface and groundwater withdrawals above 100,000 gallons per day, and MassDEP issues permits to water suppliers assigning conditions for water withdrawals. MassDEP has developed performance standards for permit holders based on the level of stress in the watershed, summarized in Exhibit 3-2. These performance standards require an “offset feasibility study” if a certain baseline water withdrawal is exceeded.

<table>
<thead>
<tr>
<th>WMA Performance Standards Based on Stress Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>High and Medium Stressed Basins</td>
</tr>
<tr>
<td>Residential gpcd</td>
</tr>
<tr>
<td>Unaccounted for Water (UAW)</td>
</tr>
<tr>
<td>Summer Withdrawals</td>
</tr>
<tr>
<td>Baseline Water Withdrawals</td>
</tr>
</tbody>
</table>

These MassDEP-defined “offsets” are somewhat different than the water demand mitigation programs described in this report. MassDEP is promoting offsets broadly as a way for communities to mitigate the impacts of water withdrawals above a baseline level through a variety of means, in contrast to the narrower definition used here, in which the new water demands of individual customers are mitigated through a quantifiable and verifiable accounting mechanism. The “baseline” water withdrawal is defined by MassDEP in its WMA guidance document as the “volume withdrawn the prior calendar year in compliance with the Water Management Act, the average volume withdrawn in compliance with the Water Management Act for the prior 3 years, or the registered volume, whichever is higher” (2006). If permit holders in high and medium stressed basins exceed this baseline, then an “offset feasibility study” is required.

The WMA guidance defines the feasibility study as:
A study that: (a) identifies Offsets reasonably likely to manage the water balance within the Basin so that the impacts to the Basin from withdrawals in excess of a supplier’s Baseline are eliminated or minimized; (b) conducts a detailed comparative evaluation of the effectiveness, difficulty of implementation, short and long-term reliability, costs, risks, and benefits of the Offsets identified in (a); and (c) results in the classification of Offsets identified in (a) that are feasible to implement and Offsets required in (a) that are not feasible to implement. The information and reasoning used to perform the study must be documented and described in sufficient detail to support the results of the study. (DEP 2006)

Permit holders must implement the findings of the offset feasibility study if the WMA permit is exceeded in any future reporting year. MassDEP is currently developing an offset feasibility guidance to further define this offset feasibility study. A variety of possible offset types are under consideration, including stormwater recharge, wastewater return/reuse, infiltration and inflow removal, private well regulation, and best management practices (BMPs) such as water conservation programs, low impact development bylaws, and source optimization plans. The possible inclusion of water conservation as an offset has been a source of some controversy because reducing water demand would affect the baseline, which triggers the study. MassDEP may therefore recommend water conservation as a way to avoid exceeding the baseline, rather than as a type of offset.

Another challenge has been determining how to quantify and verify the results of offset measures. To address this, MassDEP is considering a BMP-based approach that would recommend desirable practices rather than strictly requiring a 1:1 mitigation for exceedances over the baseline. MassDEP is currently engaged in conversations with water suppliers and other stakeholders about the offset feasibility study guidance, and plans to reconvene a technical workgroup to consider the issue (LeVangie, Pers. Comm., June 21, 2007).

In the Ipswich River watershed, MassDEP has required several communities to implement water demand mitigation programs (termed water banks) as part of strengthened WMA permits and related negotiations. In this context, MassDEP is returning to the standard, narrower definition of water demand mitigation programs as used in this report. The Town of Topsfield will be required to implement a water bank if its new water connections exceed two percent in any single year. The communities of Danvers and Middleton reached a settlement with MassDEP requiring implementation of an innovative “water usage mitigation program” to offset water demand from new or expanded development. Most of the basin permittees have a requirement to implement a water demand mitigation program if their water use in any year exceeds their allocation.

Communities that choose to implement water demand mitigation programs voluntarily, rather than as a requirement of WMA permitting or under a legal settlement, may face limitations in their ability to collect fees to fund water conservation activities. Under Massachusetts state law, municipalities do not have the authority to impose impact fees, which are one-time charges imposed on new developments. They also cannot impose taxes on individuals “…for the harm that his or her actions causes the municipality” (Barron et al. 2004). Therefore, while home rule authority gives municipalities some ability to impose user charges – voluntary payments for specific services – they must carefully construct fees to avoid characterization as taxes or impact...
fees. The Emerson test, established in the decision of the case *Emerson v. City of Boston 391 Mass. 415* (1984), creates three criteria for valid fees:

1) Whether the charge was sufficiently particularized to justify distribution of costs among a limited group of beneficiaries instead of the general public
2) Whether the charge was voluntary and the service could be refused
3) Whether the revenues collected by the charge were used exclusively for the services provided

To avoid legal challenges, communities planning water demand mitigation programs should carefully consider the Emerson test when designing program and fee structures. Enabling legislation to specifically authorize water suppliers to collect fees to fund activities designed to conserve water or keep water within a basin has been introduced in Massachusetts. This legislation may significantly expand communities’ flexibility and authority to implement water demand mitigation programs. At the time of writing, the legislation had been introduced as Senate Bill No. 1200, and included the following language:

Section 39M. Establishment of Sustainable Water Resource Fund. Notwithstanding any general or special law to the contrary, a city, town, board of water commissioners, officers performing like duties, or water district having a water supply or water distribution system may collect a reasonable fee to be used exclusively to remedy and offset the impacts of water withdrawals and other activities that deplete streamflow or impair recharge to ground waters, and to sustain the quantity, quality and ecological integrity of waters of the commonwealth. Such measures for water return or preventing water loss include without limitation, local recharge of stormwater and wastewater, reuse of water, removal of infiltration and inflow, and water savings achieved by retrofitting existing development with low impact development methods or water-saving devices. The fee, which may be based on retaining within the basin or saving at least two gallons for every gallon of new water demand, shall be assessed in a fair and equitable manner, and separate uniform fees may be established for residential and commercial uses. All such fees shall be deposited in a separate account classified as a "Sustainable Water Resource Fund." This Fund shall not be used for any purpose not provided in this section.

### 3.4 Program Goals and Design Options

Based on consultation with Ipswich stakeholders and review of similar programs in other communities, this report offers recommendations for the design of a water demand mitigation program in Ipswich. Water demand mitigation programs must be carefully designed to meet water conservation goals without creating undue administrative burden. The goal of the water demand mitigation program described in this report is to cap current levels of water withdrawal in the face of continued growth and development.

Ipswich should consider a range of issues in developing the program:

- Jurisdiction;
- Program structure;
- Mitigation fee;
- Credit system;
- Program budget;
- Water conservation programs funded;
- Management structure;
• Permits and processing; and
• Regulatory language and approval process.

It is helpful to consider the approaches that other Massachusetts communities have taken in developing their water demand mitigation programs. As of June 2007, water demand mitigation programs have been adopted in Abington-Rockland, Danvers, Hingham, and Weymouth. Exhibit 3-3 summarizes these communities’ programs.
### Exhibit 3-3.
Massachusetts Water Demand Mitigation Program Examples

<table>
<thead>
<tr>
<th>Massachusetts Water Demand Mitigation Program Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Mitigation</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Abington-Rockland Joint Water Works</td>
</tr>
<tr>
<td>Danvers Water Department</td>
</tr>
<tr>
<td>Hingham (Massachusetts-American Water Company)</td>
</tr>
<tr>
<td>Weymouth Water Department</td>
</tr>
</tbody>
</table>
3.5 Jurisdiction

Water demand mitigation programs generally apply to new water users that will connect to the public water supply system, and to existing users proposing to expand their water use above current levels. This general approach is recommended in Ipswich in order to accommodate additional residential and commercial growth and development without increasing overall levels of water use in town.

Some communities have exempted certain small developments from jurisdiction. For example, the Massachusetts-American Water Company in Hingham exempts residential developments with only one service connection or expansions of less than 100,000 gallons per year (274 gallons per day), which excludes most new single-family homes. The Water Use Mitigation Plan (WUMP) in Danvers is not applied to residential developments of less than three units. It focuses instead on commercial developments, subdivisions, and condominium or apartment developments with three or more units. While both the programs in both Hingham and Danvers apply to increases in demand from current water customers, their exemptions are broad enough to exclude all but the very largest residential additions. In contrast, Weymouth’s water bank applies to all new and expanded residential and commercial development, including residential additions that increase the number of bedrooms in an existing home.

A previously drafted, but not adopted, “Policy to Sustain Water Resources in the Town of Ipswich” proposed requiring mitigation of water demand only for applications with anticipated average daily demand greater than 1,000 gallons. This exemption would exclude nearly all single-family homes as well as many smaller commercial operations. While residential subdivisions of three homes or more might be subject to the policy, many subdivision developments could avoid jurisdiction by sequencing construction so that building permits are obtained separately for each home as it is built, rather than applied for together in a single application.

Given that single-family homes constitute the bulk of new development in Ipswich, it is recommended that the water demand mitigation program apply to all new and expanded residential and commercial developments, including single-family homes, without exemption. It should also apply to residential additions that create additional bedrooms, but not to home renovations that do not increase the number of bedrooms. The program should incorporate a system of credits to reduce the burden on homeowners who retrofit their own homes with water-efficient fixtures and appliances as part of the proposed renovation project. It could also include a hardship provision, but such a provision should be narrowly defined to apply only in instances of true economic hardship, with a focus on reducing the burden on existing Ipswich residences and businesses that are undertaking expansions.

3.6 Program Structure

Water demand mitigation programs are implemented in one of two ways: applicants can directly implement projects to mitigate their anticipated water use, or they can pay a fee into a dedicated fund to pay for water conservation programs that achieve the required mitigation.
The longest-running program, in Weymouth, began in 1999 by creating a Water Use Permit Program administered by its Department of Public Works (DPW). The program initially required new and expanding water users to accomplish the required 2:1 water savings directly. The DPW developed a list of older businesses and residences suitable for retrofitting with water saving devices, or in the case of businesses, modifying water use processes to generate the required savings. Permit applicants were required to provide documentation that the water savings had been accomplished, and Water Use Permits were issued after verification by the Water and Sewer Department. Weymouth initially set up a water bank with a beginning balance of 100,000 gpd: 15,000 gpd municipal/emergency, 53,000 gpd residential, 32,000 gpd commercial/industrial). Water is deducted from the bank upon issuance of a water withdrawal permit. If there is no water in the bank, then a new permit cannot be issued. Water is added to the bank upon completion and verification of water-saving projects.

More than 3,000 homes have been retrofitted to-date in Weymouth (D. Tower, Pers. Comm., June 11, 2007). In fact, after several years of running the program, Weymouth found that so many homes had been upgraded that it was difficult for applicants to locate additional homes needing retrofits. The town also found the verification process to ensure that contractors had indeed installed the required water-saving devices to be time-consuming and problematic (D. Tower, Pers. Comm., June 11, 2007). Starting in 2000, the Water Department gave permit applicants the option of paying a water conservation mitigation fee in the amount of $10 per gallon proposed water demand in lieu of performing the actual installation work. Applicants retain the option to directly install retrofits, but most choose to pay the fee instead. The Massachusetts-American Water Company in Hingham also requires applicants to directly install retrofits as 1:1 mitigation for new demand, under a Water Balance Plan that must be submitted to the water company. In contrast, Danvers and Abington-Rockland require the payment of a 2:1 mitigation fee, and do not give applicants the ability to directly install retrofits.

This fee-based approach is recommended in Ipswich to give the Water Department maximum flexibility to control the types of water saving projects implemented, ensure the effectiveness of mitigation projects, and reduce the burden associated with verifying and overseeing projects implemented directly by applicants.

3.7 Mitigation Fee

Three key questions drive the setting of a water demand mitigation fee:
1) What is the basis for estimating the water demand associated with new residences and businesses?
2) What mitigation ratio should be incorporated into the fee?
3) The fee should “bear a reasonable relation to the cost of implementing the offset and the program’s administrative costs” (Massachusetts Water Conservation Standards 2006). Therefore, on what basis should the costs of implementing the required mitigation be estimated?

Required mitigation in Abington-Rockland, Hingham, and Weymouth are based on System Sewage Flow Design Criteria under Title 5 of the State Environmental Code, 310 CMR 15.000.
Danvers uses Title 5 as the basis for estimating water demand for commercial/industrial developments. Residential applicants may use Title 5 as the basis for estimating per-bedroom water demand, but can also propose other defensible methods of calculation. Title 5 requires the proper siting, construction, and maintenance of all on-site wastewater disposal systems, including residential septic systems. Section 15.203 of the Title 5 regulations defines the design sewage flows for a variety of residential and commercial use categories. Design flows are equivalent to estimated generated flow of wastewater into an onsite subsurface sewage disposal system for the proposed use plus a factor representing flow variations.

It is recommended that Ipswich also use Title 5 design flow volumes to estimate water use for new and expanded developments in its water demand mitigation program. Given that evaporative and consumptive loss for indoor water uses is minimal, then Title 5 design flows provide a reasonable basis for estimating water uses for residential and commercial uses. This approach has been used statewide and provides the only widely accepted basis for estimating flows for the full range of commercial and institutional establishments. Moreover, Title 5 design flows are generally based on size criteria (e.g., number of bedrooms, number of chairs, square footage) that can be estimated up-front, rather than per-capita estimates that may vary widely, particularly for residential developments. Exhibit 3-4 lists Title 5 design flows for representative residential and commercial establishments likely to be developed in Ipswich.

| Exhibit 3-4. Title 5 Design Flow Volumes for Residential and Commercial Developments |
|-------------------------------|---------------------|----------------|
| Type of Establishment          | Design Flow          | Unit          |
|                               | (gallons per day)    |               |
| Single Family Dwelling         | 110 Per bedroom      |               |
| Multiple Family Dwelling       | 110 Per bedroom      |               |
| Hotel/Motel                    | 110 Per bedroom      |               |
| Barber Shop/Beauty salon       | 100 Per chair        |               |
| Doctor Office                  | 250 Per doctor       |               |
| Gasoline Station               | 75 Per island        |               |
| Restaurant                     | 35 Per seat          |               |
| Office Building                | 75 Per 1000 square feet |         |
| Retail Store                   | 50 Per 1000 square feet |         |
| Nursing Home/Rest Home         | 150 Per bed          |               |
| Day Care Facility              | 10 Per person        |               |
| School                         | 5-20 Per person, depending on presence of cafeteria, gymnasium, showers | |

Source: Title 5 of the State Environmental Code, 310 CMR 15.203

It is recommended that the water demand mitigation fee in Ipswich be set at a level that accomplishes 2:1 mitigation. In other words, if a new home will generate 330 gallons per day of new water demand, then the applicant for that home should pay a mitigation fee at a level that will pay for 660 gallons per day of water savings elsewhere in Ipswich. The 2:1 mitigation ratio incorporates a margin of safety to ensure that at least as much water is saved as is demanded. A higher ratio (3:1 or 4:1) could be chosen to begin to achieve real reductions in overall community water demand below current levels, but could be susceptible to legal challenge under the

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5 Ipswich uses an assumption of 180 gpd for septic design flows, exceeding Title 5 requirements.
Emerson test criteria, since the higher ratio would have the effect of shifting onto a small group of new water users the burden for mitigating the water losses created by community at large. Weymouth’s sewer bank, which operates in parallel to the water bank to fund infiltration and inflow removal, requires a 6:1 offset, but that program was developed under an Administrative Consent Order with MassDEP.

Once the required mitigation volume and ratio have been set, then the final step is translating that water volume into a fee that is reasonably related to the actual costs of accomplishing the water savings. Both Danvers and Weymouth calculated the fees based on the costs and water savings associated with retrofitting existing dwellings with low-flow faucets, showerheads, and toilets. Danvers also looked into including washing machine and dishwasher replacements.

Danvers considered three methods of calculation to develop possible fees for the Water Use Mitigation before settling on the intermediate method, Method B (Peeling, Pers. Comm, June 7, 2007).

Danvers used the following approach to calculate its fee:
- Calculate gallons/day of water savings to be achieved by retrofitting a typical Danvers household with efficient devices (based on estimates of residents/house, age of structure, fixtures per house, ownership status, etc);
- Calculate costs to retrofit a typical Danvers household based on cost estimates for efficient fixtures and appliances;
- Calculate total cost to implement household retrofits that mitigate the water demand from an average new home in Danvers at a 2:1 mitigation ratio (household water demand based on the Water Management Act performance standard of 65 gallons per capita per day (gpcd) multiplied by 2.44 persons per household (Census 2000)); and
- Convert total mitigation costs to per-bedroom estimate based on average bedrooms per household (Census 2000).

Danvers chose to use the Water Management Act as the basis for its water use estimates because its Water Use Mitigation Plan was the result of a Settlement Agreement on its Water Withdrawal Permit under the Water Management Act (Final Decision, Docket No. 2003-066, 2006). Exhibit 3-5 lists the fees considered by Danvers.
Exhibit 3-5.
Mitigation Fees Calculated by Danvers

<table>
<thead>
<tr>
<th>Development Type</th>
<th>Method A: Full cost for all new low-flow appliances &amp; fixtures</th>
<th>Method B: Full cost for all new appliances &amp; fixtures, except dishwashers</th>
<th>Method C: Cost differential between low-flow and conventional</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Bedroom</td>
<td>$3,800</td>
<td>$3,200</td>
<td>$1,800</td>
</tr>
<tr>
<td>2 Bedroom</td>
<td>$7,600</td>
<td>$6,400</td>
<td>$3,600</td>
</tr>
<tr>
<td>3 Bedroom</td>
<td>$11,400</td>
<td>$9,600</td>
<td>$5,400</td>
</tr>
<tr>
<td>4 Bedroom</td>
<td>$15,200</td>
<td>$12,800</td>
<td>$7,200</td>
</tr>
<tr>
<td>Commercial/Industrial</td>
<td>$21.40/gpd</td>
<td>$17.51/gpd</td>
<td>$8.52/gpd</td>
</tr>
</tbody>
</table>

Source: Danvers Water Use Mitigation Plan (WUMP) to Offset New Demands, Presentation to Massachusetts Water Works Association, March 14, 2007

A similar approach to fee development is recommended for Ipswich. Exhibit 3-6 estimates water savings and costs for retrofitting conventional fixtures and appliances with efficient and low-flow devices. It estimates water savings for an average Ipswich household of 2.42 persons, based on Census 2000 data. Opportunities to retrofit outdated conventional fixtures and appliances are abundant in Ipswich, which has particularly old housing stock. Nearly 80 percent of Ipswich homes were built before 1980, and 37 percent were built before 1940. Only 11 percent were built between 1980 and 1990, and 11 percent between 1990 and 2000 (Census 2000).

This method of calculating water savings solely incorporates indoor water savings from residential retrofits. Other water conservation programs, such as leak detection, outdoor irrigation efficiency, and public education can also yield water savings and could be incorporated into a mitigation program. However, these programs are not recommended as the basis for fee development because the water savings associated with them are highly variable and unpredictable. In contrast, the water savings and costs associated with retrofitting a suite of typical fixtures and appliances – faucet aerators, low-flow showerheads and toilets, and efficient washing machines and dishwashers – are predictable, and provide the most reasonable and defensible basis for a mitigation fee.

Exhibit 3-7 takes the water savings and per-device costs presented in Exhibit 3-6 and translates them into a per-gallon water demand mitigation fee. Exhibit 3-7 presents four different methods of calculating the fee. All methods assume that an average Ipswich household includes 2.42 persons and 6 rooms, based on Census 2000 data. This average household is assumed to contain three faucets, two showerheads, two toilets, one washing machine, and one dishwasher. Method A calculates the fee based on the full cost to replace all of these devices. Method B includes the full cost to replace the faucets, showerheads, and toilets, but only the cost differential to replace a conventional washing machine and conventional dishwasher with highly efficient models. Method C is based on the cost differentials to convert from all conventional to all efficient devices. Method D includes the full costs to retrofit only the three faucets, two showerheads, and two toilets, and does not include washing machines and dishwashers. All methods include a 20 percent administration fee to cover the cost of managing the program.
In terms of the cost per gallon saved, the cost/benefit analysis for washing machine and dishwasher replacements is substantially worse than for the less expensive faucet, showerhead, and toilet retrofits. Adding a simple $2 faucet aerator to an existing faucet has the most favorable cost/benefit result: substantial water savings at minimal cost. In contrast, dishwashers and washing machines are very expensive to replace for relatively low daily water savings, though the water savings could be substantial over the lifespan of the appliance. Rather than retrofitting all conventional models of these appliances, it makes more sense to offer incentives to help residents purchase energy- and water-efficient models when it is time to upgrade.

Method B is the recommended method of fee calculation, resulting in a mitigation fee of $18.83 per gallon per day (gpd) of anticipated new demand. This fee is in the same range as the per-gallon fees in Danvers and Weymouth. Danvers, using a similar method, derived a per-bedroom fee of $3,200 or $17.51/gpd for commercial/industrial users. Weymouth charges a fee of $10/gpd for water demand, but most applicants in Weymouth must also pay a $10/gpd fee to mitigate their impact on the sewer system as part of sewer bank that operates in parallel to the water bank. Weymouth also charges a $7 connection fee to new sewer connections, resulting in an overall fee of $27/gpd for most new development.
## Exhibit 3-6.
Water Savings and Costs for Efficient Versus Conventional Fixtures and Appliances

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Efficient Fixture Capacity</th>
<th>Per Capita Water Use (gpd)</th>
<th>Ipswich Household Water Use (gpd)</th>
<th>Per Capita Water Savings (gpd)</th>
<th>Ipswich Household Water Savings (gpd)</th>
<th>Cost Of Fixture/Appliance</th>
<th>Cost Per Gallon Per Day Saved</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Faucet</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficient</td>
<td>1.5 gal/min</td>
<td>6.0</td>
<td>14.5</td>
<td>7.2</td>
<td>17.4</td>
<td>$2</td>
<td>$0.28</td>
<td>USEPA Water Conservation Plan Guidelines (Appendix B)</td>
</tr>
<tr>
<td>Conventional</td>
<td>3.3 gal/min</td>
<td>13.2</td>
<td>31.9</td>
<td>NA</td>
<td></td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td><strong>Showerhead</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficient</td>
<td>1.7 gal/min</td>
<td>8.2</td>
<td>19.7</td>
<td>8.2</td>
<td>19.7</td>
<td>$20</td>
<td>$2.45</td>
<td>USEPA Water Conservation Plan Guidelines (Appendix B)</td>
</tr>
<tr>
<td>Conventional</td>
<td>3.4 gal/min</td>
<td>16.3</td>
<td>39.5</td>
<td>$20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Toilet</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficient</td>
<td>1.3 gal/flush</td>
<td>6.0</td>
<td>14.5</td>
<td>16.0</td>
<td>38.7</td>
<td>$150</td>
<td>$9.38</td>
<td>USEPA Water Conservation Plan Guidelines (Appendix B)</td>
</tr>
<tr>
<td>Conventional</td>
<td>5.5 gal/flush</td>
<td>22.0</td>
<td>53.2</td>
<td>$100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Clothes Washer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficient</td>
<td>20.1 gal/load</td>
<td>7.4</td>
<td>18.0</td>
<td>5.3</td>
<td>12.8</td>
<td>$750</td>
<td>$56.70</td>
<td>DOE Energy Star Savings Calculator</td>
</tr>
<tr>
<td>Conventional</td>
<td>34.4 gal/load</td>
<td>12.7</td>
<td>30.8</td>
<td>$450</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dishwasher</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficient</td>
<td>5 gal/load</td>
<td>0.5</td>
<td>1.2</td>
<td>0.4</td>
<td>1.0</td>
<td>$500</td>
<td>$125.00</td>
<td>(Vickers 2001)</td>
</tr>
<tr>
<td>Conventional</td>
<td>9 gal/load</td>
<td>0.9</td>
<td>2.2</td>
<td>$450</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL WATER SAVINGS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>36.7 88.7</td>
</tr>
</tbody>
</table>

**Assumptions:**
- Household size: 2.42 persons/household in Ipswich (Census 2000)
- Faucet: 4 faucet-use-minutes per person per day (USEPA Water Conservation Plan Guidelines, Appendix B, Table B-6)
- Showerhead: 4.8 shower-use minutes per person per day (USEPA Table B-6)
- Toilet: 4 flushes per person per day; does not include leaks (USEPA Table B-6)
- Clothes washer: 0.37 loads per person per day (Vickers 2001)
- Dishwasher: 0.10 loads per person per day; levelized to include households without dishwashers (Vickers 2001)
### Exhibit 3-7. Methods of Calculating Mitigation Fees

<table>
<thead>
<tr>
<th></th>
<th>Method A: Full Cost to Replace All Household Fixtures and Appliances</th>
<th>Method B: Full Cost for Faucet, Showerhead, Toilet; Cost Differential for Clothes Washer, Dishwasher</th>
<th>Method C: Cost Differential for All Fixtures and Appliances</th>
<th>Method D: Full Cost To Replace Faucet, Showerhead, Toilet, No Clothes Washer, Dishwasher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faucet</td>
<td>$6</td>
<td>$6</td>
<td>$6</td>
<td>$6</td>
</tr>
<tr>
<td>Showerhead</td>
<td>$40</td>
<td>$40</td>
<td>$0</td>
<td>$40</td>
</tr>
<tr>
<td>Toilet</td>
<td>$300</td>
<td>$300</td>
<td>$100</td>
<td>$300</td>
</tr>
<tr>
<td>Clothes Washer</td>
<td>$750</td>
<td>$300</td>
<td>$300</td>
<td>$0</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>$500</td>
<td>$50</td>
<td>$50</td>
<td>$0</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$1,596</td>
<td>$696</td>
<td>$456</td>
<td>$346</td>
</tr>
</tbody>
</table>

### Household Water Savings (gal/day)

<table>
<thead>
<tr>
<th></th>
<th>Method A: Full Cost to Replace All Household Fixtures and Appliances</th>
<th>Method B: Full Cost for Faucet, Showerhead, Toilet; Cost Differential for Clothes Washer, Dishwasher</th>
<th>Method C: Cost Differential for All Fixtures and Appliances</th>
<th>Method D: Full Cost To Replace Faucet, Showerhead, Toilet, No Clothes Washer, Dishwasher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faucet</td>
<td>$6</td>
<td>$6</td>
<td>$6</td>
<td>$6</td>
</tr>
<tr>
<td>Showerhead</td>
<td>$40</td>
<td>$40</td>
<td>$0</td>
<td>$40</td>
</tr>
<tr>
<td>Toilet</td>
<td>$300</td>
<td>$300</td>
<td>$100</td>
<td>$300</td>
</tr>
<tr>
<td>Clothes Washer</td>
<td>$750</td>
<td>$300</td>
<td>$300</td>
<td>$0</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>$500</td>
<td>$50</td>
<td>$50</td>
<td>$0</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$1,596</td>
<td>$696</td>
<td>$456</td>
<td>$346</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Household Water Savings (gal/day)</th>
<th>88.7</th>
<th>88.7</th>
<th>88.7</th>
<th>75.9</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Required Mitigation for 1 Bedroom (gal/day)</th>
<th>220</th>
<th>220</th>
<th>220</th>
<th>220</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Multiplier: # Household Retrofits Needed for Required Mitigation</th>
<th>2.5</th>
<th>2.5</th>
<th>2.5</th>
<th>2.9</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Cost to Mitigate 1 Bedroom of Water Demand</th>
<th>$3,959</th>
<th>$1,726</th>
<th>$1,131</th>
<th>$1,003</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Administrative Fee (20%)</th>
<th>$792</th>
<th>$345</th>
<th>$226</th>
<th>$201</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Total Fee Per Bedroom</th>
<th>$4,750</th>
<th>$2,072</th>
<th>$1,357</th>
<th>$1,204</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Fee Per Gallon Per Day</th>
<th>$43.19</th>
<th>$18.83</th>
<th>$12.34</th>
<th>$10.94</th>
</tr>
</thead>
</table>

Sources:
- Fixture cost data: Retail data sample
- Appliance cost data: DOE Energy Star Savings Calculator

Assumptions:
- Mitigation volume: 220 gal/day per bedroom based on Title 5
- Household water savings: based on average Ipswich household of 2.42 persons (Census 2000)
- Household rooms: based on median 6 rooms per household (Census 2000); assumes 3 bedrooms, 1 living room, 1 dining room, 1 kitchen, 2 bathrooms
- Household fixtures and appliances: assumes 3 faucets, 2 showerheads, 2 toilets, 1 clothes washer, and 1 dishwasher

### 3.8 Credit System

A system of credits may be applied to applicants who can demonstrate that their level of new water demand will be less than the estimated level. Credits can improve the equitability of the fee structure, but must be carefully designed to be clear, transparent, and easy to administer.

Credits can be designed to create incentives to upgrade the efficiency of existing buildings, or to build new construction that uses ultra high efficiency features to exceed the present requirements of the Massachusetts Plumbing Code. Weymouth’s credit system is specifically aimed at reducing the burden of the fee on residents who are renovating existing homes. Weymouth reduces the estimate of new water demand by 20 gallons per person per day if the homeowner...
retrofits their own house as part of the renovation project. For example, if a family of four is building one new bedroom (renovations that do not increase the number of bedrooms are exempt), then Weymouth estimates new water demand of 110 gpd based on the larger capacity of the house. If the family agrees to retrofit their fixtures and appliances, however, then Weymouth will reduce the estimate of new water demand by 80 gpd (20 gpd * 4 persons), for a new estimate of 30 gpd of new demand. Instead of paying a fee of $1,100 (110 gpd * $10/gpd) to mitigate the impact of the new bedroom, the family would pay only $300 (30 gpd * $10/gpd). Weymouth does not offer a credit aimed at new construction because fairly efficient fixtures and appliances are already required for new buildings under the Massachusetts Plumbing Code. The town sees little benefit in reducing the fees paid by developers, who are likely to reap significant profits from their projects.

Danvers does not offer a credit to renovation projects because such projects are largely exempt from the Water Use Mitigation Plan already, since it only applies to residential developments of three or more units. Likewise, Danvers does not offer a credit for new construction, seeing little benefit in doing so because the settlement agreement under which the Water Use Mitigation Plan was developed already mandates that new connections to the public water supply must meet the following standards:

- All applicable provisions of the state plumbing code must be met;
- Each faucet, showerhead, clothes washing machine, dish washing machine, and toilet shall be energy efficient, water saving, and shall meet the EPA’s Water Efficiency Standards and as may be amended; and
- In-ground irrigation systems shall be equipped with a controller with a rain and moisture sensing device and shall otherwise incorporate commercially available technology to minimize water use (Danvers Settlement Agreement 2006)

We recommend using a similar approach to Weymouth to create incentives for homeowners to retrofit their own homes when proposing a renovation project that would increase the number of bedrooms. A credit of 30 gpd is suggested based on the estimated per capita water savings of replacing one faucet, showerhead, and toilet with an efficient version. This credit would eliminate the fee entirely for a family of four.

For new construction, one option is to follow the Danvers model and simply require all new buildings to use highly water-efficient fixtures and appliances, rather than offering a credit. This requirement could be adopted through the Water Rules and Regulations. For example, the Town of Sharon, Massachusetts has adopted the following regulation:

Article III, Paragraph 7. Low Flow Fixtures. Ultra low flow toilets and washing machines shall be installed in all new construction whose building permits have been issued on or after (month/day/year). Only those fixtures approved by the Department of Public Works, listing available on request, shall be installed. Appeals to this provision may be addressed in writing to the Superintendent of Public Works. (Lauenstein, Pers. Comm., May 3, 2007)

If this regulatory approach is not favored, another option is to adopt a system of credits that incentivizes developers to go beyond the requirements of the state plumbing code and incorporate high efficiency measures into new residential and commercial developments.
Ipswich could create a set of standards that would qualify a new development as a “water-efficient development” and reduce the water demand mitigation fee for those that qualify. The standards might include:

- Installation of highly efficient indoor fixtures and devices, including:
  - ultra low-flow toilets (less than 1.3 gallons per flush);
  - ultra low flow faucets (not more than 1.5 gallons per minute);
  - ultra low flow showerheads (not more than 1.5 gallons per minute);
  - efficient washing machines (less than 18 gallons per load; Energy Star water use factor less than 6 and preferably less than 5);
  - water-efficient dishwashers (less than 5 gallons per load);

- Installation of water-efficient outdoor landscaping features, including:
  - Limited lawn areas (less than 25 percent of lot size or 0.25 acres, whichever is less);
  - Use of non-invasive, drought resistant, and native plants, shrubs, and trees;
  - Loam retained onsite and amended with 2 inches of compost on lawn areas; and
  - If present, irrigation system uses drip irrigation and is regulated by a weather-based sensors.

For a new development that meets these high standards for water efficiency, a system of credits could be designed to reduce the fee. Exhibit 3-8 estimates the magnitude of per-capita and per-household water savings that could be achieved by installation of highly efficient indoor devices rather than the standard devices required under the state plumbing code.

### Exhibit 3-8.
**Water Savings: Efficient Versus Standard Devices and Appliances**

<table>
<thead>
<tr>
<th></th>
<th>Efficient Fixture Capacity</th>
<th>Standard Fixture Capacity</th>
<th>Efficient Per Capita Water Use (gpd)</th>
<th>Standard Per Capita Water Use (gpd)</th>
<th>Efficient Ipswich Household Water Use (gpd)</th>
<th>Standard Ipswich Household Water Use (gpd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faucet</td>
<td>1.5 gal/min</td>
<td>3.3 gal/min</td>
<td>6.0</td>
<td>13.2</td>
<td>14.5</td>
<td>31.9</td>
</tr>
<tr>
<td>Showerhead</td>
<td>1.7 gal/min</td>
<td>2.5 gal/min</td>
<td>8.2</td>
<td>12.0</td>
<td>19.7</td>
<td>29.0</td>
</tr>
<tr>
<td>Toilet</td>
<td>1.3 gal/flush</td>
<td>1.6 gal/flush</td>
<td>5.2</td>
<td>6.4</td>
<td>12.6</td>
<td>15.5</td>
</tr>
<tr>
<td>Clothes washer</td>
<td>20.1 gal/load</td>
<td>30.0 gal/load</td>
<td>7.4</td>
<td>11.1</td>
<td>18.0</td>
<td>26.9</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>5.0 gal/load</td>
<td>9.0 gal/load</td>
<td>0.5</td>
<td>0.9</td>
<td>1.2</td>
<td>2.2</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>27.3</td>
<td>43.6</td>
<td>66.1</td>
<td>105.5</td>
</tr>
</tbody>
</table>

Sources:
Ultra-efficient fixture capacity: See Exhibit 3-6

An average new home in Ipswich, assuming a size of 3 bedrooms and 2.44 persons, would save an estimated 39.4 gpd by installing ultra-efficient indoor fixtures and appliances. At a fee of $18.83 per gpd, this translates into a savings of $743 for a three-bedroom home, or $248 per bedroom. If Ipswich chooses to implement a credit system to incentivize highly water-efficient new construction, a credit of $248 per bedroom or $2.25 per gpd of new water demand is recommended.
A system of credits must ensure that results can be verified without creating an overly burdensome oversight process. We recommend revisiting the credit system over time to assess how well it is working and make changes as needed, and to incorporate improvements in water efficiency technology.

### 3.9 Program Budget

Water demand mitigation fees should be collected into a dedicated account or enterprise fund to pay for water conservation programs. Enterprise funds segregate the revenues and expenditures of a particular service into a separate fund with its own financial statements. We recommend that a water demand mitigation enterprise fund be created within the Water Department to collect and disburse the fees collected for this program. Less formally, a dedicated account or line-item within the overall Water Department budget could be created, but this account would be much more susceptible to commingling with other department revenues and services. An enterprise fund would allow for better management, transparency, and tracking of the funds specifically generated by the water demand mitigation fees. It would also maintain the integrity of the program by ensuring that the funds collected are actually used to pay for the required mitigation.

The total annual budget for a water demand mitigation program in Ipswich would vary each year based on rates of development and renovation in town. Since 2000, an average of 51 residential units per year have been developed in Ipswich, based on information from the Planning Department. Residential development, particularly single-family and condominium development, is expected to continue at a similar rate or slow slightly in Ipswich (G. Gibbs, Pers. Comm., May 31, 2007). The rate of commercial development is lower, with an average of three commercial building permits issued per year since 2004. Rates of new commercial and industrial development are expected to slow due to the shortage of developable commercially and industrially zoned land in Ipswich, and construction may shift to enlargement and renovation of existing facilities (Energy Use and Greenhouse Gas Inventory, 2007).

Given an estimate of 51 new two-bedroom units per year at a fee of $18.83 per gallon, the recommended rate based on method B of fee calculation, the total annual budget for the water demand mitigation program would be $211,273. A lower fee of $10.94 based on method D would generate a budget of $122,747. These estimates may be conservative since they do not include the fees collected from commercial/industrial developments or expansions of existing buildings.

This level of funding would allow Ipswich to implement a substantially more robust water conservation program than is currently offered. Within an overall Water Department budget for fiscal year 2007 of $2,288,705, only about $20,000 is dedicated to water conservation and leak detection (Ipswich Utilities Department 2007).

### 3.10 Water Conservation Programs Funded

The key to any successful water demand mitigation program is ensuring that the water saving projects implemented actually deliver the required level of mitigation. The water demand
mitigation enterprise fund could be used to fund a range of water-saving programs. Retrofits of indoor fixtures and appliances serve as the basis for calculating the mitigation fee, and should be a major component of the overall water conservation program. However, retrofits need not be the only type of water-saving project funded. Other projects that generate meaningful water savings or help to balance the water budget can also be considered.

Using the water demand mitigation program only for indoor retrofits would be unnecessarily restrictive, and could limit the Town’s ability to design the most effective water conservation program. Weymouth’s water bank, for example, has evolved from an exclusive focus on installation of residential and commercial retrofits to a program that can fund a broader range of beneficial projects, including leak detection. However, all projects funded through this mechanism must yield quantifiable and verifiable water savings. It is not appropriate to use the water demand mitigation fund to pay for water conservation projects with results that cannot be readily or accurately quantified. For example, certain public education programs, such as awareness campaigns and school programs, serve an important role, but may not yield readily quantifiable results. Other examples of water conservation programs with results that are difficult, though not impossible, to quantify include residential and commercial audits that do not also include retrofits, price-based approaches such as seasonal and inclining block rate structures, and regulatory requirements.

The core program funded by the water demand mitigation fund should be retrofits of residential, municipal, commercial, and industrial buildings with low-flow fixtures and toilets. These retrofits are highly quantifiable and form the basis for fee calculation. Retrofit projects can take several forms. A contractor can be retained to conduct comprehensive audits of existing homes and businesses, or the focus can be on replacement of specific fixtures or devices through giveaway programs. For example, Weymouth has a program to replace 250 conventional toilets with low flow toilets every year. The program offers free toilet replacements to users with the highest bills and levels of water use (D. Tower, Pers. Comm., June 11, 2007).

Other water conservation programs that could be funded, at least in part, through the water demand mitigation fund include leak detection, audits and retrofits of large-volume residential and commercial customers, expanded rebates for water-efficient washing machines and dishwashers, and projects to reuse “graywater” or treated wastewater for nonpotable use in industrial or irrigation applications. These programs are recommended because they yield quantifiable and verifiable water savings, and build on existing Water Department water conservation programming to target the highest water users. In the longer term, projects to recharge stormwater and treated wastewater to the Egypt/Rowley subbasin also could be considered for funding from the water demand mitigation fund. Such projects would need to yield quantifiable improvements to the water balance by recharging more water to that subbasin.

Several levels of verification are needed to maintain the integrity of the mitigation program. A careful review process must be established for all new water applications to ensure that all new water customers and existing customers increasing their water use pay the fee. Equally important is ensuring that the water conservation projects implemented actual deliver the required 2:1 mitigation on an annual basis. A spreadsheet-based accounting system is recommended to track
water savings. The water demand mitigation program should be evaluated annually by the Water Department, and adjustments made to improve the program’s water-saving results and cost-effectiveness.

3.11 Management Structure

Ipswich must decide whether to manage the funds directly or contract out aspects of program administration and implementation. Weymouth and Abington-Rockland manage their programs directly, and Danvers anticipates doing the same with their new program. The Water and Sewer Division Business Manager is the primary program manager in Weymouth, and spends approximately 20 percent of his time on management and oversight of the water bank. Weymouth hires contractors to implement water saving projects, such as conducting an annual bid process for a plumbing contractor to install 250 low-flow toilets (D. Tower, Pers. Comm., June 11, 2007). Danvers anticipates using a similar approach to administer the Water Use Mitigation Plan in-house but intends to hire contractors to implement specific projects such as toilet replacements.

The Utilities Director would prefer to use an outside consultant to manage the program, as well as implement water-saving projects (T. Henry, Pers. Comm., May 29, 2007). The Water Department has a small staff of nine persons, most of whom work on water treatment and system maintenance. Current staff have limited capacity to take on additional program management responsibilities. In addition, the processing associated with collection and accounting of fees could present a significant additional labor burden. The “Policy to Sustain Water Resources in the Town of Ipswich” drafted in 2005 suggested the following process: “Applicants with anticipated demands greater than 1000 gallons per day will engage the services of a Water Conservation Company who will survey residential, commercial and municipal properties to determine water use reduction opportunities. Once the consultant has achieved the desired water use reductions the department will review the reported projects and approve the application.”

We recommend using a fee-based system and retaining in-house management of the program for several reasons. Outsourcing the program completely to an outside Water Conservation Company would obviate the need for fees, but conversely would not generate any funding for the Water Department to manage and oversee the program. The program as proposed in the 2005 “Policy to Sustain Water Resources,” which was never adopted, requires the department to review the water-saving projects and approve the application, but does not provide any budget for those tasks. A total outsourcing approach also reduces the ability of the Town to verify the effectiveness of water-saving projects and ensure that they are meeting the 2:1 mitigation requirements. While the ability to hire and fire a consultant does represent a check on the process, that oversight capacity is constrained in comparison with direct management by the Town.

Most significantly, the water demand mitigation program as recommended in this report allows for some flexibility in implementing water-saving projects beyond indoor retrofits of plumbing fixtures and appliances. The approach previously considered by Ipswich, and originally used in Weymouth, strictly requires mitigation to be accomplished before a new development can
connect to the public water supply. The fee-based approach, in contrast, would accomplish the mitigation on an annual rather than per-project basis, giving Ipswich the flexibility to pool funding together to accomplish larger water-saving projects, such as large water reuse projects, bulk toilet replacement campaigns, or large-scale upgrades of outdoor irrigation systems.

Ipswich could still rely heavily on outside consultants to implement many aspects of the program, engaging specialists in leak detection, water audits and retrofits, and plumbing. Even the development of a billing database could be outsourced. In-house tasks accomplished by the Water Department could focus on management, oversight, and verification of water savings. Given that existing staff are already at capacity and do not have time to take on additional responsibilities, we recommend creating a part-time Water Conservation Coordinator position within the Water Department to oversee the water demand mitigation program and other water conservation activities. A conservation-focused staff person could potentially be shared with the Electric Department, since both are housed within the Utilities Department. Funding for this staff person would be generated by the 20 percent fee administrative fee included in the mitigation fee. For example, assuming that current rates of residential development continue, then a fee of $18.83 per gpd fee based on method B would generate a total budget of $211,273, with $42,255 for administration and management. A lower fee of $10.94 per gpd based on method D would generate a budget of $122,747, with $24,549 for administration and management.

3.12 Permits and Processing

A system must be created to require payment of the water demand mitigation fee before the applicant can connect to the public water supply. Fee payment can be required prior to issuance of a building permit or occupancy permit, or required at the time of payment of a water application. Ipswich presently charges $500 for the water application and inspection fee, along with a $200 tapping charge, and requires new connections to complete an Application for Water. However, these fees do not apply to increases in water demand by existing customers.

Most communities require the mitigation fee to be paid before a building permit can be issued. Weymouth informs applicants of the fee at the time of application for the building permit and requires that the application be reviewed and approved by the Water Department before the building permit can be issued. To capture renovations and other projects that may not require a building permit, Weymouth also checks to make sure the fee has been paid before issuance of an occupancy permit.

Weymouth has a formal permit process by which applicants submit a Water Use Permit Application to the Weymouth Water Department. The permit requires the applicant to specify the amount of new water requested based on Title 5 design flows. Applicants that are directly implementing water-saving retrofits, rather than paying the fee, must describe the type of plumbing fixture replaced and the number of persons to calculate a total volume of savings. They must also provide documentation as proof of the work. Documentation can include a bill of purchase or sales receipt for water saving devices, invoices or work orders for installation of the devices, and pre- and post-process modification water use calculations certified by a professional engineer. Weymouth’s Water Use Permit Application is provided in Appendix B.
We recommend that Ipswich use a similar approach to provide the applicant with a simple permit form and instructions at the time of application for a building permit or occupancy permit. Representatives of the Building Department must be involved in program development, since the Building Inspector will play a crucial role in enforcing the payment of the mitigation fee prior to issuance of the building or occupancy permit.

3.13 Regulatory Language and Approval Process

The water demand mitigation program could be adopted by the Water Department through its Rules and Regulations, with approval by the Ipswich Water Commissioners. In Ipswich, the Selectmen serve as Water Commissioners, but generally adopt the recommendation of a water subcommittee that includes two members of the Board of Selectmen, the Utilities Director, the Town Engineer, a member of the Finance Committee, and two at-large community members.

A public outreach process will likely be required to explain why the mitigation fee is necessary. We recommend that developers, in particular, be engaged early on and given the opportunity to comment on the proposed regulations before they are formally adopted.

3.14 Expanded Water Conservation Program

A water demand mitigation fee would be paid by new water users in Ipswich, in order to mitigate increases in water demand and prevent further losses from the Egypt/Rowley subbasin. This fee would pay for greatly expanded water conservation programming, focusing on programs with quantifiable results such as indoor retrofits and leak detection. The goal of the water demand mitigation program would be to cap current levels of water use in the face of continued growth and development in Ipswich.

In order to reduce water use below current levels, we recommend considering additional expansions in water conservation programming that would be funded by existing water users through a surcharge on their water rate. This surcharge could either be listed as a line item on the water bill or incorporated into the overall water rate structure. Given that water conservation is a legitimate aspect of the water services provided to customers, the latter approach is suggested.

A written water conservation plan could give focus to the Town’s already substantial water conservation efforts, and would begin the process of setting specific water conservation goals. A goal of a 20 percent reduction below current levels of water consumption is suggested. That goal would reduce water losses in the Egypt/Rowley watershed below the threshold for designation as a highly stressed subbasin, and is also in the same range as the community goals laid out in the Regional Water Conservation Plan for the Ipswich River Watershed. That Plan, which was adopted unanimously in 2003 by the Ipswich River Watershed Management Council, set watershed-wide goals to reduce average water use by 15 percent and peak water use by 20 percent by 2012.
Conserving water by reducing demand generally costs less than finding new sources of supply, which require additional infrastructure and energy costs to pump and treat the water. A water conservation plan would help the Town analyze the cost-effectiveness of water conservation programs under consideration, prepare demand forecasts based on development projections, and set up an adaptive management process. EPA’s Guidelines for Preparing Water Conservation Plans recommend the following steps in developing a plan:

1. Specify Conservation Planning Goals;
2. Develop a Water System Profile;
3. Prepare a Demand Forecast;
4. Describe Planned Facilities;
5. Identify Water Conservation Measures;
6. Analyze Benefits and Costs;
7. Select Conservation Measures;
8. Integrate Resources and Modify Forecasts; and

While Ipswich’s existing water conservation programs – leak detection, monthly billing, and a seasonal rate structure – have been highly effective, opportunities exist to expand programming in certain areas. Sources such as Appendix A to EPA’s Guidelines for Preparing Water Conservation Plans, the Massachusetts Water Conservation Standards, and the Regional Water Conservation Plan for the Ipswich River Watershed recommend water conservation measures or best management practices (BMPs) for implementation at the community level. Exhibit 3-9 summarizes these measures and the status of implementation in Ipswich.

The water demand mitigation program could provide full or partial funding for many of these programs. A surcharge on the water rate paid by existing customers could fill in funding gaps and pay for programs with results that may not be easily quantified, such as public education programs. Based on discussions with the Utilities Director and review of leading community water conservation programs, including Concord and Sharon, the following water conservation programs are recommended for consideration in Ipswich:

- Residential water audits and retrofits, especially targeted to high water users;
- Commercial/industrial water audits, especially targeted to large customers;
- Municipal water audits and retrofits in Town Hall, schools, and other Town buildings to set an example for the community;
- Water efficiency standards for new construction;
- Expanded rebate program with higher rebates for water-efficient washing machines and dishwashers, and including rebates for high-efficiency toilets (HETs);
- Expanded public education program focused on reducing outdoor water use on lawns and landscapes; and
- Water conservation coordinator to manage the program.

Over time, we recommend giving additional consideration to innovative integrated water resources management projects. Such projects could include reuse of graywater and treated wastewater, and recharge of stormwater and treated wastewater in the Egypt/Rowley source watershed. An integrated water resources management program is further described in chapter 6.
### Exhibit 3-9.
Status of Water Conservation Programs in Ipswich

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
<th>Current Budget</th>
<th>Status of Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EPA Level 1 Measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Universal metering</td>
<td>100% automated metering of all systems</td>
<td></td>
<td>Fully implemented</td>
</tr>
<tr>
<td></td>
<td>Meter public-use water</td>
<td></td>
<td>Fully implemented</td>
</tr>
<tr>
<td></td>
<td>Test, calibrate, repair, and replace meters</td>
<td></td>
<td>Large meters greater than 1 inch diameter are tested annually; residential meters every 10 years</td>
</tr>
<tr>
<td>Water accounting and loss control</td>
<td>Analysis of non-account water</td>
<td></td>
<td>Implemented via annual leak detection survey and consultant report</td>
</tr>
<tr>
<td></td>
<td>Annual system audit</td>
<td></td>
<td>Fully implemented</td>
</tr>
<tr>
<td></td>
<td>Leak detection and repair strategy</td>
<td>$9,800</td>
<td>Annual survey by consultant</td>
</tr>
<tr>
<td></td>
<td>Automated sensors/telemetry</td>
<td></td>
<td>Supervisory Control And Data Acquisition (SCADA) system allows for fully automated monitoring of the entire water system and trend assessment</td>
</tr>
<tr>
<td></td>
<td>Loss prevention/capital improvement</td>
<td></td>
<td>Implemented</td>
</tr>
<tr>
<td>Costing and pricing</td>
<td>Seasonal or increasing block rate</td>
<td></td>
<td>Fully implemented (seasonal rate only)</td>
</tr>
<tr>
<td></td>
<td>Analysis of price elasticity of demand</td>
<td></td>
<td>In progress (project underway by Clark University PhD student)</td>
</tr>
<tr>
<td>Information and education</td>
<td>Informative water bill</td>
<td></td>
<td>Fully implemented; monthly water bills show water use trends over the prior year</td>
</tr>
<tr>
<td></td>
<td>Water bill inserts</td>
<td></td>
<td>Occasional</td>
</tr>
<tr>
<td></td>
<td>School program</td>
<td></td>
<td>Annual visit by Water Department Staff, tours</td>
</tr>
<tr>
<td></td>
<td>Public education program</td>
<td>$5,000</td>
<td>Minimal</td>
</tr>
<tr>
<td></td>
<td>Management by water conservation coordinator</td>
<td></td>
<td>Not implemented</td>
</tr>
<tr>
<td><strong>EPA Level 2 Measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water-use audits</td>
<td>Audits of large-volume users</td>
<td>$5,000</td>
<td>Planned but not implemented</td>
</tr>
<tr>
<td></td>
<td>Large-landscape audits</td>
<td></td>
<td>Not implemented; Ipswich once partnered with Corliss Landscaping and Aquasave to conduct irrigation audits at the Ipswich Country Club</td>
</tr>
<tr>
<td></td>
<td>Residential audits and retrofits</td>
<td></td>
<td>No residential audits focused on water; some water retrofits offered through HELPS energy audits</td>
</tr>
<tr>
<td>Retrofits</td>
<td>Distribution of retrofit kits</td>
<td></td>
<td>Some water retrofits offered through HELPS energy audits</td>
</tr>
<tr>
<td>Pressure management</td>
<td>Systemwide pressure management</td>
<td></td>
<td>Not implemented, but could be regulated via tank levels using SCADA system</td>
</tr>
<tr>
<td></td>
<td>Pressure-reducing valves</td>
<td></td>
<td>Not needed in Ipswich system</td>
</tr>
<tr>
<td>Landscape efficiency</td>
<td>Promotion of landscape efficiency</td>
<td></td>
<td>Not implemented</td>
</tr>
<tr>
<td></td>
<td>Irrigation submetering</td>
<td></td>
<td>Ipswich allows submetering, but only used by 10 customers</td>
</tr>
<tr>
<td></td>
<td>Landscape renovation and irrigation management of municipal properties</td>
<td></td>
<td>Not implemented</td>
</tr>
<tr>
<td>EPA Level 3 Measures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------</td>
<td>--------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Replacements and promotions</td>
<td>Rebates and incentives</td>
<td>$50 rebate for Energy Star washing machine and dishwasher through Electric Department; no rebate offered for high efficiency toilets</td>
<td></td>
</tr>
<tr>
<td>Reuse and recycling</td>
<td>Water reuse of “graywater” or treated wastewater for nonpotable use in industrial or irrigation applications</td>
<td>Not implemented</td>
<td></td>
</tr>
<tr>
<td>Water use regulation</td>
<td>Water use standards and regulations</td>
<td>Implemented via Water Department Regulations and Drought Management Plan</td>
<td></td>
</tr>
<tr>
<td>Efficiency standards for new developments</td>
<td></td>
<td>Not implemented</td>
<td></td>
</tr>
<tr>
<td>Integrated resource management</td>
<td>Integrated planning and management of energy, chemical, and wastewater treatment on supply and demand sides</td>
<td>Some assessment of integrated wastewater management, but not broadly implemented</td>
<td></td>
</tr>
</tbody>
</table>

### 3.15 Conclusion

An inflow-outflow analysis of the Egypt/Rowley watershed shows that the Town’s primary source watershed is highly stressed by water losses. The Water Department has taken several important steps to conserve water, including leak detection, automatic meter reading and monthly billing, and implementation of a seasonal rate structure.

Water demand mitigation programs are an emerging strategy to mitigate the water demands of new developments and fund water conservation activities in Massachusetts and throughout the United States. We recommend that Ipswich consider expanding its water conservation efforts by implementing a water demand mitigation program. The program would fund programs with quantifiable water savings, primarily retrofits of conventional fixtures and appliances with water-efficient models.
CHAPTER 4:
STORMWATER UTILITY

4.0 Introduction

This chapter provides detailed program design recommendations for a stormwater utility in Ipswich. The utility would generate sustained funding for the Town’s priority stormwater management programs, helping to meet environmental and regulatory goals. This chapter also reviews a complementary effort to develop a comprehensive stormwater bylaw in Ipswich.

The primary environmental goals of the stormwater management program are to improve water quality in the Ipswich and Egypt/Rowley watersheds and address flooding concerns. To the extent that projects to improve stormwater recharge take place within the Egypt/Rowley watershed, some additional water balance benefits may be realized. A program to monitor water quality in the Ipswich River and assess the effectiveness of the stormwater utility is recommended in chapter 5.

4.1 Background: Stormwater Management in Massachusetts

The demands for more comprehensive stormwater management programs are growing in many communities across Massachusetts, as well as nationwide. Under the Federal Clean Water Act, many pollutant point sources, such as untreated or inadequately treated wastewater discharges, have been cleaned up to the extent that pollution from non-point sources is now the main concern in many water bodies across the nation. Non-point sources of pollution are generally diffuse and difficult to trace to a single source. They include stormwater runoff that picks up pollutants from roads and other surfaces, illicit discharges of “gray water” from washing machines or basement sinks or other inappropriate substances, contaminated water pumped through sump pumps, and in some cases direct connections of wastewater that flow into stormwater drainage systems and directly into surface water bodies and wetlands.

The US Environmental Protection Agency (EPA) instituted a permit program for these municipal stormwater drainage systems in an effort to improve the water quality in our nation’s waters. The National Pollutant Discharge Elimination System (NPDES) permit program was initiated in 1990 and focused on large communities with populations greater than 100,000. These large communities with municipal separate storm sewer systems (MS4s) were required to apply for permit coverage for discharges from their stormwater system into surface waters. Phase II of the program was instituted in 1999 to address smaller municipalities not covered under Phase I, including all those with urbanized areas defined by the 2000 census. As a result of the NPDES Phase II Stormwater Program, these smaller MS4s communities had to file a notice of intent for coverage under a 5-year general permit (2003-2008), and had to meet six minimum control measures through a stormwater management program during the term of the permit. This program includes approximately two thirds of the communities in the Commonwealth and practically all of eastern Massachusetts.

Many municipalities across Massachusetts are struggling to fund the stormwater management program that is required to meet local needs and the requirements of the NPDES Phase II.
Program. In Ipswich, as in other communities, the regular stormwater management services that are provided, such as catch basin cleaning and street sweeping, are budgeted to some degree into the annual fiscal budget, but often not at amounts sufficient to meet town-wide needs. Programs to map the drainage system and track maintenance and repair for the drainage network are expensive and often get overlooked in the budgeting process when competing with other services such as schools, fire and police. Additional services, such as addressing drainage obstructions, responding to public complaints, and responding to emergencies such as flooding are provided by the Department of Public Works (DPW) but not accounted for in the stormwater budget. In addition, the capacity of the DPW to perform studies, develop designs for drainage and water quality improvements, and educate the public about reducing stormwater pollution is severely limited by a lack of funding.

The way in which stormwater is managed is also changing. Rather than piping it as far away as possible, stormwater is being recognized as part of the hydrologic cycle, and therefore integral to the health and stability of our rivers and aquifers, particularly in the face of continuing development and conversion of land. Many communities are beginning to move toward a more integrated approach to stormwater management, and are looking to manage stormwater in a way that improves water quality, reduces flooding and erosion, and improves the maintenance of ecologically sustainable baseflows in streams and rivers.

The 2004 revision of Massachusetts General Law Chapter 83, Sewers, Drains and Sidewalks, was key in facilitating the defensible establishment of stormwater utilities in the Commonwealth. The inclusion of language regarding stormwater drainage treatment and disposal into this chapter allowed for the adoption of rules and regulations for stormwater management by municipalities. In addition, revisions to Chapter 83 include the allowance of rates or fees to be used for stormwater drainage infrastructure or “other available funds as may be necessary to plan, construct, operate and maintain stormwater facilities and to construct stormwater programs.”

4.2 Overview: Stormwater Utility

First, it is important to define the term “stormwater utility,” as it is used in a number of different ways – often interchangeably when describing the funding mechanism for stormwater management as well as the actual management department. In Massachusetts, as in other parts of the country, the term stormwater utility is used to describe what is essentially a fee-based enterprise fund managed by a division of the municipal government, such as the DPW, to implement a stormwater management program. Strictly speaking, a stormwater utility would be a separate entity with its own staff, equipment, management structure and financing. For example, the City of Titusville, Florida, has established a separate service unit within the city – a stormwater utility – staffed with 14 employees. This new unit or department is responsible for the planning, operation, construction, and maintenance of the stormwater system. However, more commonly, and for the purposes of this report, the term utility is used to describe a fee-based enterprise fund that is created to support a municipal stormwater management program. The primary examples used in this report are from the Town of Reading and the City of Newton, Massachusetts, and the Town of South Burlington, Vermont; while each of these examples is referred to as a stormwater utility, none has a wholly separate entity but rather each has a dedicated fee-based program.
A distinction should be made between typical stormwater management funding and stormwater utility funding. Typical stormwater management programs draw on a municipality’s general fund for revenue. Funds are then reallocated from the general fund (i.e., capital funding) to a town’s stormwater management program, as is the case in Ipswich. This type of funding allocation can be unstable as it is provided on a year-to-year basis only, and is therefore subject to competition from other budget needs in the community, such as schools, employee health benefits, fire, police and other variable expenditures. In addition, stormwater managers are not guaranteed these funds, and in some towns financial or political issues stand in the way of managers receiving them. A stormwater utility, alternatively, consists of the special assessment of a long-term funding source for the sole purpose of funding stormwater management operations and maintenance, improvement projects, stormwater planning, project review, regulatory compliance, inspections and other stormwater management services.

4.3 Stormwater Management in Ipswich: Needs and Challenges

The purpose of this chapter is to provide a starting point and reference for the Town of Ipswich in establishing a funding mechanism to address stormwater management needs in the community. The stormwater utility as described herein is a component of an integrated water resources management program to address water quantity and water quality issues while meeting the Town’s water, wastewater, and stormwater management needs.

The Town of Ipswich, like most other communities in Massachusetts, has a broad mandate to meet its stormwater permit requirements, as well as to maintain its existing stormwater infrastructure throughout the community, protect the safety and welfare of the public, and remediate water quality problems that have developed over time. Ipswich faces stormwater permit requirements under the NPDES Stormwater Phase II Program, which are generally extend beyond the routine drainage maintenance and repair responsibilities of the DPW. The responsibilities and goals of the DPW in the arena of stormwater management have grown in recent years to address all of these issues, but funding in Ipswich to meet these responsibilities and goals has not grown commensurately.

In addition, stormwater is a significant source of pollution that is affecting the water resources in Ipswich, including Plum Island Sound and the Ipswich River. The lower Ipswich River, Egypt/Rowley River, and Plum Island Sound are listed as impaired due to pathogens on the 2002 Integrated List of Waters, and the Massachusetts Department of Environmental Protection has drafted a pathogen TMDL for these basins (Map A-5). Ipswich is known for its clams, but the clam flats have been routinely closed to shellfish harvesting over the years due to bacteria contamination. In particular, Farley Brook, which drains the highly urbanized downtown, has been named as a stormwater hotspot and priority for remediation. Unmanaged stormwater can also impact the natural hydrology of a watershed, as water that previously infiltrated into the ground and recharged rivers and groundwater now runs over the land surface to receiving waters and discharges rapidly to the ocean. This change in flow regime can alter the availability of baseflow in rivers and streams and can create damaging flood flows during storm events. As demonstrated in the Mother’s Day Storm of 2006, the town center is at risk of flooding, which is
worsened by increased stormwater runoff from upstream areas. Basement flooding is also a major concern among residents.

This stormwater utility concept presented in this chapter was developed by Horsley Witten Group (HW) in support of the EOEEA Watershed Improvement Grant project to improve the water budget in Ipswich’s watersheds. Background information for this report was collected from a variety of sources, including existing reports about stormwater financing, websites for several towns referenced as example stormwater financing programs, and the Town of Ipswich website. HW also contacted several staff in the Ipswich municipal offices, including the DPW Director and Town Engineer to gather additional information. The Town Engineer provided HW with the Town’s GIS database, including parcel information and zoning districts. In addition, HW and IRWA met four times from February through June with the Ipswich Stormwater Committee to introduce the project, discuss the stormwater utility concept, and to gather feedback about existing stormwater management practices and financing in the town, as well as future goals for stormwater management in Ipswich. The Ipswich Stormwater Committee is chaired by the Chairman of the Conservation Commission and includes representatives of multiple municipal departments, including the DPW Director, Town Engineer, Planning Director, Health Agent, Building Inspector, and representatives of the Board of Selectmen and Planning Board. As this chapter of the report was developed, the Stormwater Committee reviewed an initial draft and an addendum to the draft and discussed aspects of the draft with HW and IRWA at the meetings.

The Ipswich Stormwater Committee has identified several key stormwater management challenges facing the community. A top priority for the Town is the establishment of an Illicit Discharge Detection and Elimination (IDDE) program, which is one of the six minimum control measures required under Phase II. Other priorities include improving oversight and maintenance of stormwater infrastructure, complying with other Phase II regulatory requirements, providing more support for site plan review of proposed new stormwater best management practices (BMPs), and developing better data and mapping of storm drains, pipes, catch basins, and sump pumps.

Over the past several years, the Town began setting a priority of identifying and managing illicit discharges to the stormwater drainage system. Illicit discharges are an issue in Ipswich primarily because of the presence of the number of underground springs throughout town and the Town’s high groundwater table, resulting in frequent and numerous occasions of flooded basements. Several years ago, under a blanket policy developed by the DPW, the Town allowed the sump-pumps that property owners install to alleviate basement flooding to be directly connected into the stormwater system. This DPW policy described under what conditions sump-pumps were allowed; however, a permitting process was not established. As a result, the Town has not been able to regulate sump-pump use, which has resulted in some level of contaminated water being pumped into the stormwater infrastructure, most likely as gray water, particularly in areas where centralized wastewater management is not available. An effective IDDE program will require long-term funding for: 1) the development of a Stormwater Management/Illicit Discharge Bylaw; and 2) the hiring of personnel to manage the IDDE program, including IDDE inspections.
In addition, the town does not have a record of the full network of the town’s public stormwater infrastructure system (i.e., the town does not know where all pipes lead and discharge, or how all catch basins are connected to the system). This makes it even more difficult to establish an IDDE program without funding for complete stormwater infrastructure mapping.

A major need also exists across town to install stormwater BMPs to address water quality problems. The following sources of bacteria within stormwater runoff were documented in the Coastal Stormwater Remediation Plan for the Town of Ipswich, particularly in the Farley Brook subwatershed area (Keane and Castonguay 2000):

- Urban runoff from development, through the existing street drainage system, in both dry and wet weather; and
- Overflow of untreated wastewater from the municipal sewage system due to excessive infiltration of stormwater.

Although the Town has taken great steps to eliminate bacterial pollution from stormwater runoff, primarily to protect the most sensitive water resource areas, funding for these projects has been chiefly from grant funds, as described in Exhibit 4-1 below. These efforts must be continued and similar projects implemented across town to remediate stormwater pollution and improve water quality.

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Description</th>
<th>Funding Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Green</td>
<td>Stormwater upgrade and installation of deep sump catch basins with hoods, large sand filter and hydrodynamic separation water quality units in the North Green area to address stormwater in this part of the Farley Brook watershed.</td>
<td>Massachusetts Department of Environmental Protection Section 319 Grant; Massachusetts Coastal Zone Management Coastal Pollution Grant</td>
</tr>
<tr>
<td>Farley Brook</td>
<td>Water quality sampling, assessment, and mapping of Farley Brook and preliminary design of stormwater BMPs.</td>
<td>Massachusetts Coastal Zone Management Coastal Pollution Remediation Program Grant</td>
</tr>
<tr>
<td>Town Hall</td>
<td>Implementation of remediation technologies (hydrodynamic separation [Vortech] units and catch basin upgrades).</td>
<td>Massachusetts Chapter 90 Local Roads Program</td>
</tr>
</tbody>
</table>

Despite the significant stormwater management challenges facing the Town, funding is extremely limited in Ipswich, as in many communities. According to the Town’s Fiscal Year 2007 Operating Budget, there is very little funding directly targeted to stormwater management. For example, the Town only budgeted approximately $65,000 for stormwater items, such as catch basin cleaning, flood control, street sweeper maintenance and sweeping, and consultants, even though the total cost of all stormwater-related initiatives was close to $200,000. A line item explicitly for Stormwater Phase II Planning is listed in the spreadsheet but has been budgeted at $0 for fiscal years 2005, 2006 and 2007. In order to meet these stormwater needs, funds were diverted from other budgets within the DPW for stormwater management projects (2007 Ipswich...
Town Budget Spreadsheet; Gravino, Pers. Comm., June 2007). A more detailed discussion of current stormwater budgeting is provided in Section 4.10.

A dedicated, long-term funding source is needed to continue and expand the following activities:

1. Compliance with the NPDES Phase II Stormwater Permit, which includes six minimum measures: public education and outreach, public participation, illicit discharge detection and elimination (mentioned above), construction site runoff control, post-construction runoff-control, and pollution prevention/good housekeeping.

2. Maintenance of current stormwater infrastructure, which includes: 1) maintenance of public facilities, 2) maintenance of new private stormwater management facilities under easement agreements, and 3) maintenance of private stormwater management systems in developments that are increasingly permitted through planning and zoning regulations. The latter stormwater maintenance scenario has become an additional responsibility for the DPW. Easements to the DPW have been placed on private property for stormwater system management and maintenance; however, no additional funds are allocated for DPW to maintain this new infrastructure.

3. Inspections of projects, both during construction and post-construction.

4. Continued assessment and engineering design to improve specific subwatersheds in town.

5. Retrofits of the existing stormwater management system with current best management practices (BMPs).


7. Additional stormwater management planning program areas:
   a) Continued upgrade of the existing GIS system (e.g., creating new data layers delineating stormwater infrastructure);
   b) Investigation of infrastructure components (i.e., determining exactly where pipes lead and where and how catch basins are connected). This is particularly useful for the control of reported spills; and
   c) Development of a more detailed maintenance schedule (i.e., accounting for variations in system failure when scheduling cleanouts).

8. Funding for stormwater engineering services (currently only the Utilities Department has engineering staff, specifically for water and sewer engineering).

9. Long-term DPW support for review of development permits.
Exhibit 4-2 presents a list of potential stormwater services that could be provided through the creation of a stormwater utility to meet the Town’s needs and challenges listed above.

Exhibit 4-2.
Potential Stormwater Services to be Provided by a Stormwater Utility

- Oversight of NPDES Phase II requirements;
- Management of an IDDE program;
- Maintenance of existing stormwater infrastructure;
- Repair of existing stormwater infrastructure;
- Purchase of new equipment to perform stormwater maintenance;
- Hiring of staff to administer the stormwater program, including fee collection and disbursements;
- Hiring of field staff to perform maintenance and repair services;
- Performance of watershed stormwater studies, assessments and project design;
- Project review services for permit applications for new projects and redevelopment;
- Inspection and enforcement;
- Public education and outreach; and
- Other initiatives, such as bylaw development and interdepartmental coordination.

The Ipswich Stormwater Committee was asked to provide feedback about the stormwater services listed above, and to prioritize these services for funding by a stormwater fee. Five responses were received and discussed with the committee at their April 26, 2007 meeting. In general, the lowest priority service to be provided by the stormwater program was interdepartmental coordination, and several services listed as medium priority were determined to be services that could be funded primarily by grant awards. These included watershed assessments and studies, and design and construction of stormwater improvement projects to improve recharge or water quality. All other potential services, including the creation of an IDDE program, oversight and coordination of the NPDES permit implementation, and development of a stormwater bylaw, were noted to be of high priority by a majority of responses.

4.4 Jurisdiction

The extent of jurisdiction of a stormwater utility is typically across the entire municipality. This is the simplest approach since the public roads, public drainage infrastructure, and town government serve the entire community, and management of stormwater throughout the town will benefit water resources in the public domain. The service area would include all properties that contribute stormwater to the public drainage system, which are essentially all properties that have any impervious area that ultimately drain to any public street or water body in the town. For individual properties on which stormwater is controlled onsite and for which owners can show that they do not contribute stormwater to the municipal system or Waters of the Commonwealth, a credit or exemption system can reduce or eliminate the fees.

In some stormwater utility programs, the extent of jurisdiction could be limited to urbanized areas covered under a municipality’s NPDES Phase II permit, or to certain watersheds that require special attention to mitigate impacts from stormwater. However, this approach can be cumbersome since drainage infrastructure often extends beyond these limits and stormwater
services beyond these limits can be overlooked and under-funded. Furthermore, creating these types of boundaries within the town can be politically difficult and may inhibit the passage of a stormwater program by the Town Manager and Select Board. Alternatively, in some communities, the jurisdiction can be combined with neighboring communities to cover an entire watershed or county. However, in the case of Ipswich, this approach is not recommended since the Town, rather than the county or watershed, is the primary management unit. In discussions with the Ipswich Stormwater Committee, there appeared to be general agreement that stormwater management should be addressed on a town-wide basis.

4.5 Exemptions and Credits

A set of standards can be established to determine how a property owner can become exempt from the stormwater fee or earn a credit to reduce their individual fee. The stormwater authority may create a system of credits for property owners who install and maintain BMPs to reduce stormwater runoff from their property or improve the treatment of stormwater runoff from their property (Exhibit 4-3). Credits are partial to total rebates applied to the total stormwater service bill for a property. For example, credits may be given for placement of a permanent conservation easement on a property or installation of stormwater BMPs that fully manage stormwater on-site. An education credit can also be offered to schools and other institutions that offer a stormwater education program to inform and engage students and members of the public.

Credits are an important component of a utility since they improve the equitability of the application of fees and act as an incentive for private on-site stormwater management improvements. However, a credit system must be simple, and at the same time must support the revenue stream of the utility. Credits for BMPS should be tied to a set of stormwater management standards, such as the Massachusetts Stormwater Policy or to a local stormwater bylaw or regulations with specific measures for quantifying the credit. This will enable ease of design to meet the standard and ease of review by the utility or DPW to evaluate whether the credit has been earned. In the case of conservation restrictions or educational credits, proof of the restriction or the educational program must be submitted. The scale of the credit should reflect the extent to which the volume of runoff is reduced and/or the quality of runoff is improved. A maximum credit amount or minimum fee can be set in order to account for the possible cost associated with future maintenance of any private onsite BMPs that are installed and ultimately have to become part of the utility’s responsibility. A credit program needs to be closely coordinated with the Town’s inspection program to ensure on-site measures are maintained in accordance with minimum requirements.
Exhibit 4-3.
Possible Credits and Exemptions from the Stormwater Fee

<table>
<thead>
<tr>
<th>Credits</th>
<th>Exemptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMPs: Infiltration Basin, Bioretention System, Other</td>
<td>Undeveloped Property</td>
</tr>
<tr>
<td>Conservation Easement</td>
<td>Town-Owned Property</td>
</tr>
<tr>
<td>Reduction in Impervious Cover</td>
<td>Public Parks</td>
</tr>
<tr>
<td></td>
<td>Churches</td>
</tr>
<tr>
<td></td>
<td>Isolated lands that do not drain to the town drainage system or regulated Waters of the Commonwealth</td>
</tr>
</tbody>
</table>

In the case of exemptions, meaning that the property is exempt from the utility’s jurisdiction, the utility needs to decide whether undeveloped properties in the service area are liable for paying service fees, how properties owned by entities other than private landowners or the Town are rated, and whether the Town itself is a customer of the stormwater management system. Certain categories of land use are commonly excluded from utility fee rates, such as government property of any type, public parks, railroad rights-of-way, streets and highways and undeveloped land. However, the relative contribution of each land-use type in the town should be considered before it is exempted.

Exemption programs may lead to an increased administrative burden and lost revenue, so they should be narrowly defined with clear parameters. In addition, while credits and exemptions may be necessary or perceived to be necessary to provide economic relief and equity, the actual value of a credit may not be high enough to create an incentive for action by most landowners. Only a large site with a large area of impervious cover, such as a commercial or industrial location, may see any substantial economic value in implementing onsite stormwater improvement to abate the fee. The Ipswich Stormwater Committee expressed a valid concern about introducing a credit system given that few people would likely invoke the system. Therefore, a very simple credit system targeted to large commercial or industrial users is recommended in order to maintain the equity of the fee structure.

The City of Newton did not include a credit system in its initial year of existence, but plans to incorporate a credit, or abatement, system in future years. This credit system would allow people who put on an addition to their house or building to apply for a reduction in their stormwater fee if they collect and manage the stormwater from the addition in accordance with an existing City stormwater policy promoting stormwater recharge (CRWA Ab 2007). In the Town of Reading, exemptions are given to undeveloped properties with no impervious surface. The Town of Reading also issues credits of up to 50 percent of the stormwater fee to property owners that reduce or manage runoff from their property using infiltration or other stormwater treatment. Anyone seeking a credit must complete a stormwater credit application and submit it to the Engineering Division. A discount of 10 percent is awarded to anyone who pays their utility bill early (CRWAa 2007; CRWA Ab 2007).
The experience of the stormwater utility in Beaufort County, South Carolina supports the Ipswich Stormwater Committee’s concern that credits may be cumbersome, particularly for homeowners or small operations, but also for the utility itself. Beaufort County revised its fee structure after only four years to make the system more equitable and more defensible in linking stormwater fees to stormwater impacts. The utility opted to remove all exemptions for tax-exempt lands, remove all relief for residents based on property value or income, and offer credits only to non-residential properties, with a maximum credit of 50 percent of the original fee, and a set minimum fee. Credits are offered for sites that manage and treat their stormwater onsite. A limited credit is also offered for non-residential property owners that engage in stormwater education efforts. A comprehensive Credit Manual has been developed to guide applicants through the detailed credit application process. Only very large planned unit developments (PUD) have found it worthwhile to apply for the credit, and the credit is only allotted based on the non-residential development within the PUD (Wallace, Pers. Comm. June 20, 2007).

4.6 Enabling Language

Enabling language is needed to allow for the establishment of a stormwater utility in Ipswich. This enabling language can take several different forms. This section explores which approach may be politically and logistically feasible in Ipswich.

The first option is to create a section within the stormwater management bylaw that is currently under development by the Stormwater Committee. This language can be relatively basic, allowing for the creation of a utility, but not specifying the details of administering that program. It would define who is the responsible party or entity for creating the utility, and it would enable that party to develop regulations to define the parameters of the utility. Following is an example of how this language may read (‘stormwater utility’ can be interchanged with ‘stormwater enterprise fund’):

Stormwater Utility. The [Stormwater Authority] may adopt, through the Regulations authorized by this Stormwater Management Bylaw, a Stormwater Utility pursuant to M.G.L. Chapter 83 Section 16 and Chapter 40 Section 1A. The [Stormwater Authority] shall administer, implement and enforce this Utility. Failure by the [Stormwater Authority] to promulgate such a Stormwater Utility through its Regulations or a legal declaration of its invalidity by a court shall not act to suspend or invalidate the effect of this Bylaw.”

In the language presented above, the Stormwater Authority may be the DPW, or it may be a newly formed Authority that would also manage the utility.

A second mechanism for enabling the creation of a stormwater utility is to amend an existing related bylaw to include this language. The language for such an amendment may be as simple as the language provided above.

A third mechanism for enabling the creation of a stormwater utility is to create a unique bylaw solely for this purpose. Such a bylaw would describe in detail the issues described in this document, including the purpose, jurisdiction, administration, authority, fee or rate schedule, credit system, and enforcement.
In addition, the creation of a stormwater utility funding program requires a vote by the Town Select Board to amend the accounting for those funds (Department of Revenue, June 2002).

### 4.7 Funding Alternatives

The creation of a dedicated funding source through a utility requires some level of dedicated staff to administer the program, including the collection of service fees, the identification and oversight of projects and activities, and disbursement of payments. This funding mechanism also requires the use or creation of a database containing ownership information and parcel data for all properties that contribute to the town’s stormwater infrastructure (i.e., all properties with altered or impervious surfaces). The staffing requirements depend on the existing administrative capacity in the town government and the structure of the various departments within the government. In Ipswich, the Utilities Department already provides water, sewer and electric services, but stormwater management services are the responsibility of the DPW. The DPW currently has only two dedicated staff working in the office, the DPW Director and a part-time administrative assistant. In addition, the equivalent of one full time DPW employee’s time, from either the Highway Division or the Forestry Division, is spent on stormwater maintenance and street sweeping.

There are two likely options for the administration of a stormwater utility in Ipswich. The first option is to have the program included within the DPW and the second option is to create a separate utility that can be combined into the Utilities Department. The functional benefits of each option should be considered.

One option is administering the stormwater utility by the DPW to provide dedicated stormwater management funding to the DPW. Stormwater responsibilities currently fall within the DPW so this arrangement would provide for continuity. In addition, the DPW Director would prefer to manage the stormwater program rather than have it fall under the direction of another department. The DPW Director is most familiar with the stormwater infrastructure and watershed impairments that need attention, and has been managing the maintenance of the drainage infrastructure and the implementation of the NPDES Phase II Stormwater permit for the Town, from preparation of the Notice of Intent to the current Year 5 implementation of the permit.

However, the DPW does not have staff to administer the collection of fees. The DPW would need to develop a database of accounts for which a stormwater fee would apply, and would have to develop a billing system and an accounting system to manage the fund. This likely could be performed by a single new staff person, or potentially a part-time staff person once the database has been created and the billing system is operational. Billing potentially could be tied to the property tax database maintained by the Assessor’s Office since all properties are presumably listed in the database. Additional information could be added to the database, such as impervious area of the lot. The DPW Director could also use funds to hire additional technical staff and field labor to perform stormwater management duties. One important benefit of this structure is that staff can support the stormwater program as a primary responsibility and also provide assistance for other DPW responsibilities as time allows.
Alternatively, a stormwater utility could be formed as a somewhat separate entity, with its own dedicated staff and administration. Because the Town already has a Utilities Department, there may be an inclination to combine the stormwater services with the existing sewer, water and electric services provided by the Utilities Department. A key benefit of this approach is that the Utilities Department already has a billing system and database that could be amended to include the stormwater billing. However, a specific database would still need to be created to include all properties contributing to the drainage system of the Town of Ipswich. This group of properties is likely to be at least slightly different than the database of properties that have water, sewer and/or electricity services, and would have to be verified. One drawback of having a separate entity or folding it in with the Utilities Department is that the stormwater utility would be separated from the DPW, which has the most experience with the drainage infrastructure and stormwater permit requirements. But in the long run, the overall objective of instituting an integrated water resources management system in the Town may be best served by bringing together the utilities department, the stormwater program and the DPW under one umbrella.

In discussions with Town staff, the issue of management responsibility was raised regarding a stormwater utility program. Currently, the Water and Sewer Divisions within the Utilities Department do not handle stormwater management and therefore, education, staff hiring, and additional coordination efforts would be necessary in order for one of these departments to efficiently manage a stormwater fee program. Some concerns were raised that if a joint enterprise fund was established for all water (including stormwater) and sewer services, stormwater management funding may be merged with water and sewer fees, thereby possibly diverting funds from stormwater management projects to other priority areas.

Based on these conversations, we recommend that the Town consider establishing a stormwater utility managed by the DPW. In addition, because it is commonly acknowledged that all departments share a common goal of providing clean water, we recommend a mandate be established for all departments to support the stormwater utility program, especially relating to cross-jurisdictional concerns. It will be critical for proper communication and coordination to occur between the DPW and the Water and Sewer Divisions of the Utilities Department, particularly regarding infrastructure replacement and repair. This being said, the ultimate decision is up to the Town; incorporating stormwater management into the Utilities Department or into a new separate department could be equally effective if implemented properly.

4.8 Possible Funding Structures

There are a number of options for funding a stormwater utility. In general, most stormwater utilities are based on a rate charged to the public. The differences relate to the type of accounting system (i.e., what account the funds go to), and the assessment of the rate. A community may account for stormwater services for the utility in the general fund, special revenue fund, capital improvement fund, or an enterprise fund. As discussed previously, a general fund includes financial resources used to pay the regular operating and administrative expenses for a number of departments, particularly funds not properly accounted for by other avenues. A special revenue fund accounts for the earnings of specific revenue sources that are legally restricted to pay for specified purposes. For example, a Bicycle Pathway Fund is a special revenue fund that uses revenue from Transportation Development Act grant monies for building or improving bicycle
paths and handicapped accesses. A capital improvement fund accounts for financial resources earmarked for the acquisition or construction of major capital facilities and improvements. Lastly, an enterprise fund is a separate accounting and financial reporting mechanism for municipal services for which a fee is charged in exchange for goods or services. This funding system is entirely self-supported through user fees.

### 4.8.1 Stormwater Enterprise Fund

Enterprise funds account for the acquisition, operation and maintenance of governmental facilities and services. They can include rates for the use of water and sewer services, as well as stormwater management services. Enterprise funds are enabled under Massachusetts General Law Chapter 44 Section 53F½ (MGL Ch. 44 §53F½). Under enterprise accounting, the revenues and expenditures of the service are segregated into a separate fund with its own financial statements, rather than commingled with the revenues and expenses of all other governmental activities. According to the MA Department of Revenue guidance on Enterprise Funds (DOR, 2002), revenues are recognized when earned and expenses are recognized when incurred, under a full accrual basis of accounting. Establishing an enterprise fund does not create a separate or autonomous entity from the municipal government operation. The municipal department operating the enterprise service continues to fulfill financial and managerial reporting requirements like every other department.

The advantages of using an enterprise fund rather than other accounting methods are as follows:

1. **Better Management of Funds** – Enterprise funds include the consolidation of revenues and expenditures for a particular service, not just expenditures in capital and general funds. Therefore, town staff will be able to best track both revenue and expenditures and make management decisions regarding costs of the service, the operating performance of the fund, the community, user rates and other budgetary items. The extent to which the user fees and rates support the service will be clear, ensuring better decisions regarding the need for other revenue sources or subsidies for the enterprise fund.

2. **Transparency** – It is easiest to demonstrate the total costs of a service, including all direct, indirect and capital costs of providing the service in a consolidated fund such as an enterprise fund. Therefore, the true costs of providing the service (stormwater management) will be transparent to town staff and the public.

3. **Retention of all Earnings and Surplus** – “Unlike services operating in the general fund or a special revenue fund, all investment earnings and any operating surplus are retained in the enterprise fund rather than moved to the general fund at year-end. Once a surplus is certified as available (similar to free cash), it may be used to fund operating, capital or debt service costs associated with the enterprise fund” (MA Dept. of Revenue 2002).

Based on conversations with Ipswich staff, we recommend that the Town consider using an enterprise fund system for stormwater management. This system best creates a long-term, stable, and easily implemented solution. The feasibility of establishing an enterprise fund, managed by the DPW, is greater than the feasibility of establishing a new stormwater utility with a unique
staff, billing structure and administration within or outside of the Utilities Department. The DPW has the relevant experience, knowledge-base, and interest to manage the stormwater program.

4.9 Stormwater Budget

The amount of funding to be raised through the stormwater enterprise fund is based on an accounting of all the services to be provided in a given year by that fund. Therefore, the needs and services of the utility must be clearly identified, and then a budget established to reach those goals. The rate assessed to each property will be established to raise the required amount of funding. However, each community has a fee level that is the tipping point at which the public will no longer accept or feel comfortable with the fee. This comfort level should be assessed during the development of the stormwater budget and rate structure so that the fee will be acceptable to the public. In the Town of Reading, for example, only a portion of the stormwater budget is being funded by the stormwater utility while a line-item in the general fund continues to be allocated toward stormwater management. This helps to keep rates down, at least for the initial years of the fund.

The explicit funding for stormwater services in the Ipswich operating budget is approximately $65,000 to cover maintenance of catch basins and drainage pipes, street sweeper maintenance, consultants, and flood control. DPW staff perform most of these services, but they are listed generally under the Highway Division. Approximately $2,400 of overtime expenses were spent on street sweeping which serves to maintain the aesthetics of the town center and other areas, but also helps to keep the stormwater catch basins free of excess sediment and trash. The DPW Director provided an estimate of the budget for all stormwater services that are currently being provided, primarily through the Department of Public Works, despite the fact that they are not explicitly called out in the operating budget. These services and budgets for 2007 are presented in Exhibit 4-4 below. The total estimated budget for stormwater services funded out of the General Fund in Ipswich was $145,388 in 2007. An additional $160,000 in state funds and grants was expended in 2007, including $135,000 in Chapter 90 pavement management funds for drainage-related items (new catch basins, culverts, water quality units, and assorted plumbing), and $25,000 for the Farley Brook stormwater assessment project (B. Gravino, Pers. Comm., June 26, 2007).

The balance between stormwater management and maintenance and other DPW services can vary from year to year depending on the need for repair, the occurrence of major storms and the continuing new development throughout town. However, as in most communities, the current allotted budget is still not sufficient to fund a comprehensive stormwater program that meets the town’s needs (B. Gravino, Pers. Comm., May 30, 2007).
Exhibit 4-4.
Ipswich DPW Estimate of 2007 Stormwater Budget

<table>
<thead>
<tr>
<th>Annual Services</th>
<th>Annual Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Fund Budget</strong></td>
<td></td>
</tr>
<tr>
<td>Catch basin cleaning/repairs</td>
<td>$41,530</td>
</tr>
<tr>
<td>Street sweeping (in overtime)</td>
<td>$2,400</td>
</tr>
<tr>
<td>Street sweeper maintenance</td>
<td>$10,418</td>
</tr>
<tr>
<td>Outside consultants (NPDES Phase II implementation, stormwater and flooding investigation, assessment and remediation, Farley Brook project match)</td>
<td>$36,780</td>
</tr>
<tr>
<td>Flood control and maintenance</td>
<td>$5,000</td>
</tr>
<tr>
<td>DPW Director (10% salary based on time spent)</td>
<td>$9,300</td>
</tr>
<tr>
<td>DPW Secretary (10% salary based on time spent)</td>
<td>$4,300</td>
</tr>
<tr>
<td>DPW Labor (10% of salaries from Highway Division, spent on stormwater)</td>
<td>$30,900</td>
</tr>
<tr>
<td>DPW Labor (10% salary of Equipment Maintenance Mechanic)</td>
<td>$4,760</td>
</tr>
<tr>
<td><strong>TOTAL General Fund Budget</strong></td>
<td><strong>$145,388</strong></td>
</tr>
<tr>
<td><strong>Grant/State Funds</strong></td>
<td></td>
</tr>
<tr>
<td>Farley brook Stormwater Management Project (MA CZM grant)</td>
<td>$25,000</td>
</tr>
<tr>
<td>MA Chapter 90 Local Road Funds (used for drainage)</td>
<td>$135,000</td>
</tr>
<tr>
<td><strong>TOTAL Grant/State Funds</strong></td>
<td><strong>$160,000</strong></td>
</tr>
<tr>
<td><strong>TOTAL 2007 Stormwater Budget</strong></td>
<td><strong>$305,388</strong></td>
</tr>
</tbody>
</table>

In addition to the estimated existing stormwater budget presented above, additional stormwater services should be considered in a future stormwater budget to create an effective stormwater program that meets the needs of the Town and fulfills the Town’s NPDES Phase II requirements. These services include overall coordination of the stormwater program, development and maintenance of a billing database and budget, illicit discharge detection, project design, project review and permitting coordination, additional maintenance and repair of existing infrastructure to cover a larger proportion of the community annually, oversight for stormwater improvement projects to address water quality and flooding problems, public education and other services. Some of these services, such as illicit discharge detection and elimination and stormwater project design and oversight, are currently being provided in very limited capacity through the DPW without dedicated funding.

Because a comprehensive stormwater program would require a significant increase in funding and staff, the Ipswich Stormwater Committee and particularly the DPW Director expressed an interest in starting the stormwater utility with a discrete subset of the total program. The Committee discussed concentrating first on hiring a stormwater program coordinator to focus on illicit discharge detection and elimination. Exhibit 4-5 presents an estimated total budget for the stormwater program that incorporates the budget for new engineering and administrative positions, the current budget for existing stormwater management functions, and the one-year start-up costs to develop the program. The budgets associated with these services are speculative and require further refinement by the Ipswich Stormwater Committee. The total annual budget for a comprehensive stormwater management program may range as high as $500,000.
### Exhibit 4-5.

**Estimated Additional Budget for Comprehensive Stormwater Management Program**

<table>
<thead>
<tr>
<th>Annual Services</th>
<th>Annual Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stormwater Management Program Coordinator (Project review for permitting, design and oversight of infrastructure repairs, implement IDDE)</td>
<td>$65,000</td>
</tr>
<tr>
<td>Public Outreach</td>
<td>$5,000</td>
</tr>
<tr>
<td>Local Bylaw Development</td>
<td>$10,000 (1-year budget)</td>
</tr>
<tr>
<td>Creation of Billing Database</td>
<td>$10,000-$20,000 (1-year budget)</td>
</tr>
<tr>
<td>Administrator (Stormwater budget admin., billing, database maintenance)</td>
<td>$40,000</td>
</tr>
<tr>
<td><strong>TOTAL Estimated Additional Budget</strong></td>
<td><strong>$110,000 (annual)</strong></td>
</tr>
<tr>
<td></td>
<td>Plus <strong>$20,000-$30,000 (1 year)</strong></td>
</tr>
<tr>
<td><strong>TOTAL ESTIMATED BUDGET</strong></td>
<td><strong>$415,000 (annual)</strong></td>
</tr>
<tr>
<td>(Including Current Budget from Exhibit 4-4)</td>
<td>Plus <strong>$20,000-$30,000 (1 year)</strong></td>
</tr>
</tbody>
</table>

### 4.10 Rate Structures

First and foremost, it is critical that rates assessed to support a stormwater utility be structured as a service fee and not a tax. The defining characteristic of a stormwater service fee is that the entire amount is used to fund the express purposes for which the utility was created. In contrast, taxes are revenues collected by an authorized division of government that can be disbursed for a wide variety of purposes.

A variety of approaches to stormwater fee rates have been employed throughout the country. While no single formula has been identified as the best option across the board in terms of fairness and ease of implementation, it is generally accepted that flat rates are the most likely kind of revenue stream to raise concerns, and that adjusted rates are more acceptable to customers and most defensible in the event of a legal challenge. However, adjusted rates require collection and interpretation of parcel data, which is labor-intensive and adds to the cost of providing services. Two communities in Massachusetts, the Town of Reading and the City of Newton, have recently adopted rate structures that include a hybrid of a flat rate and an adjusted rate called an Equivalent Residential Unit (ERU). This is a flat rate for residential parcels based on a calculation of average impervious area in residential parcels. Non-residential parcels can then be assessed a fee based on actual impervious area as a multiple of the ERU. This is the case in Reading. However, in the case of the City of Newton, all non-residential development was lumped together and assigned a single flat fee of 6 ERU based on a finding that these properties had an impervious areas approximately 6 times the impervious area of an average residential lot.

The closer the correlation between service rate and service cost on a parcel-by-parcel basis, the more legally defensible the fee structure. The percent of the utility’s revenue stream from each type of land use should approximately equal the percent of services required to manage stormwater from that land use. Some utilities divide their fees into parts, such as an impervious surface component, a street-related component, and administrative component, so that customers can see how their money is being spent.
The fee-based approaches described below include a range of options that can be considered; however, the one that has the best combination of simple and fair elements is Option 2 below, in which fees are based on parcel size and impervious cover. The most popular method of billing for a stormwater fee is calculation of a rate based on impervious area alone. Other approaches include fee systems based on a combination of gross parcel area and impervious area, gross parcel area and a development factor, and various types of flat fees.

Options for rate-based billing include the following:
1. Flat fees based on land use type (residential versus commercial/industrial) and size;
2. Service fees based on parcel size and impervious cover, measured as Equivalent Residential Units (ERUs). Impervious cover on a site is the driver for calculating the fees;
3. Service fees based on Equivalent Hydraulic Acres (EHAs). Fees are derived based on site factors including impervious cover, pervious cover, water quality impacts and size; and
4. Fee based on runoff volume from a prescribed storm event. Fees are based on a site specific calculation of runoff volume from a given storm, such as a 2-year storm event.

4.10.1 Flat Fees Based on Land Use Type and Size

Flat Fees based on land use type and size. Residential and non-residential properties are categorized by size of parcel or size of impervious area, and a flat rate (monthly or annually) is applied. This rate can be supplemented by a fixed administrative or other type of fee to clarify how revenues are spent.

The City of Newton has a flat fee structure that was developed based on a small sampling of parcels for which impervious cover was calculated. The residential fee was developed based on the average impervious cover for residential parcels, and then all other land use types were lumped together and assigned a flat fee. The fees are as follows:

- Residential - $6.25/quarter or $25 annually
- All others - $37.50/quarter or $150 annually

4.10.2 Service Fees Based on “Equivalent Residential Units” (ERUs)

The impervious cover is estimated based on the land use, and is applied to both residential and non-residential land uses. The so-called ERU is identified, usually as the average size of a residential parcel. An average value for impervious cover is used and a specific square footage is assigned based on both the imperviousness of the house and the driveway, sidewalk, etc. This value is the baseline from which all service fees are calculated. A rate is set for one ERU, based on the amount of revenue that must be raised to cover the cost of services. ERU values in the communities surveyed ranged from 2,000 to 15,000 square feet.

Under the ERU method, residential properties can either be assigned a fee based on a single category for all residential land uses, or more categories of residential parcels can be established, based on size and development intensity, with a set fee for each category. A third option is for the utility to evaluate all residential properties individually for their comparative size and
impervious cover (development intensity) relative to the baseline, and calculate a proportionate
service fee that may be different for every property.

The Town of Reading, MA developed a fee essentially based on an ERU for single and two
family residential parcels (CRWA 2007a; CRWAb 2007). The GIS Department in the town used
aerial photography to measure the impervious cover in every parcel in the town. Based on these
GIS-based measurements, the average impervious cover for single and two family residential
parcels was 2,552 square feet. A flat rate was assigned to all single and two family residential
parcels based on that average impervious area, which is representative of a single ERU. The fee
for multi-family, commercial and industrial parcels was calculated as a multiple of the ERU.
These fees were established as follows:

- Undeveloped – No Fee
- Single & Two-Family Residences - Flat Fee of $9.96/quarter or $39.84 annually (Average
  impervious surface area for Single & Two-Family Residences ≈ 2,552 sq. ft. based on GIS
data)
- Multi-Family, Commercial/Industrial – Fee based on total impervious surface area

  \[
  \text{Annual cost: } $39.84 \times \frac{\text{total impervious area}}{2,552 \text{ sq.ft.}}
  \]

4.10.3 Service fees based on Equivalent Hydraulic Acres (EHA)

In this approach, the pervious and the impervious area of a parcel are each multiplied by a runoff
factor and added together. A runoff factor accounts for the amount of runoff that is generated
from varying types of land surface, such as forest versus lawn versus pavement. The result is
multiplied by the utility rate and this total is then multiplied by a water quality factor to calculate
the service fee for the parcel. A volumetric runoff coefficient or the Rational Formula “c” value
is typically used the value for the runoff factor. Since all sites do not generate the same level of
pollutant load, a utility may elect to apply a different water quality factor for certain sites, such
as sites that typically generate the highest pollutant loads and are considered “Land Uses with
Higher Potential Pollutant Loads” under the Massachusetts Stormwater Policy. This method
requires the utility to calculate the EHA for all properties in a town, which can be a significant
administrative burden.

4.10.4 Fee Based on Calculated Runoff Volume from a Prescribed Storm Event

Using generally accepted engineering practices, a runoff volume is calculated for each parcel in
the service area for storms of varying frequency, such as the 2-year, 10-year, or 25-year storm.
The service rate is based on the average annual runoff volume times a fee per unit volume, plus a
fixed administrative fee. This method requires the utility to calculate the runoff potential of all
properties in Town; a significant administrative burden.

Exhibit 4-6 compares the characteristics of possible fee structures.
Exhibit 4-6. Comparison of Fee Structures

<table>
<thead>
<tr>
<th>Fee Structure Features</th>
<th>Flat Fee</th>
<th>Equivalent Residential Unit</th>
<th>Equivalent Hydraulic Acres</th>
<th>Runoff Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Considers Parcel Size</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Considers Impervious Area</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Requires Parcel Categories</td>
<td>Yes</td>
<td>Optional</td>
<td>No</td>
<td>Optional</td>
</tr>
<tr>
<td>Standardizes Service Demands</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Administrative Requirements</td>
<td>Low</td>
<td>Medium-High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Legally Defensible</td>
<td>Low</td>
<td>High</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

The selection of a fee structure and the defensibility of the fee structure are often related to the accuracy of the data used to develop the fee. Ipswich and other Massachusetts communities currently have reasonably accurate impervious cover data from the MassGIS office. MassGIS can now provide 2005 color orthophotographs for Ipswich, as well as an impervious cover data layer created by MassGIS based on these 2005 orthophotographs. A preliminary review of this data indicated that some small impervious areas such as sidewalks, sheds, patios and some driveways are not accurately captured in Ipswich. However, this data provides a reasonable starting point for delineating impervious areas throughout the community. The other necessary data layer is an updated layer showing parcel delineations. This layer must be rectified to correctly overlay on the orthophotograph so that the parcel lines are accurately shown.

According to the Ipswich Town Engineer and Planning Department, the most updated GIS parcel data is maintained in the Utilities Department. The areas in town can be divided by zoning districts or by actual land use categories. Currently, the available land use data is the MassGIS Land Use data layer that dates back to 1999. A more updated land use data layer may be created by MassGIS based on the 2005 orthophotographs, but this has not been confirmed. As a result, the creation of a defensible and accurate fee estimate based on impervious cover will require some updating of available GIS data to accurately identify residential versus non-residential parcels, and then to delineate impervious coverage on individual parcels.

GIS services within the Town of Ipswich are informally housed in the Utilities Department and maintained by the Town Engineer within the Utilities Department. The Planning Department also accesses the GIS database as needed. However, the current Town budget does not include a budget for town-wide GIS maintenance and updating. The GIS database is maintained to the extent possible by the Town Engineer, but due to constraints of other regular responsibilities, the database is not proactively updated and improved. The DPW has been working with consultants to develop a separate GIS-based Asset Management System to manage stormwater infrastructure, including mapping of the pipe network and stormwater outfalls. The Asset Management System includes town-wide parcel information and allows for improved tracking of maintenance and repairs. If the DPW serves as the overall manager for the stormwater utility, then the impervious cover analysis could potentially be performed by consultants and incorporated into the Asset Management System.
4.11 Possible Ipswich Rate Structure

We developed a preliminary estimate of an Equivalent Residential Unit (ERU) in order to provide an illustration of a possible stormwater fee that could be instituted for individual residential parcels in Ipswich. To begin this process, we used Ipswich parcel outlines and Ipswich Zoning districts (provided by the Ipswich Town Engineer) and MassGIS orthophotographs (2005) in GIS to calculate the estimated number of parcels in each zoning district. In Ipswich, there are four residential zones (Intown Residential, Rural Residential A, Rural Residential B and Rural Residential C) and several other commercial and industrial zones (Central Business, General Business, Highway Business, Industrial, Limited Industrial and Planned Commercial). Lots in each of these areas differ in size and impervious cover. A sample size of approximately 1 percent of the parcels in each zone were then selected at random and evaluated using GIS to calculate the total impervious area on each parcel. GIS staff traced the outline of the impervious cover in GIS using MassGIS orthophotographs (2005), Ipswich parcel data and Ipswich zoning districts. The results of these analyses are presented in Exhibit 4-7.

This is generally the same approach used in the City of Newton, and an abbreviated version of the approach used by the Town of Reading. The Town of Reading used GIS to delineate impervious area on each parcel in the town, using aerial photography funded by the town. However, the data presented above will need revision and additional data points to support a true and justifiable calculation of an actual fee based on impervious area. The purpose of this abbreviated approach is to provide a general estimate of the impervious area for different types of land uses within zoning districts, and to provide a potential range of stormwater fees that may be needed to support the needed stormwater budget.

Based on the impervious areas listed in Exhibit 4-7, the average impervious area for a residential parcel in Ipswich is approximately 0.1 acres (or 4,360 square feet) per parcel. This was calculated by taking the product of the average impervious area per residential zone (IR, RRA, RRB) multiplied by the number of parcels in each zone, and averaging those products. This average impervious area is effectively an Equivalent Residential Unit (ERU). The estimated total impervious area in Ipswich (excluding roadways and rights of ways that do not fall on individual parcels) is approximately 837 acres. We calculated a range of estimated fees associated with that ERU based on a range of potential annual stormwater budgets, from $150,000 to $350,000. An estimated fee per impervious acre was calculated by dividing the total estimated budget by the estimated number of impervious acres in the town.

That unit cost per acre ($179 to $418) was then multiplied by the ERU to calculate an ERU fee. These results are presented in Exhibit 4-8. The likely range of annual fees for an average residential parcel in Ipswich may be between approximately $17 and $40. The annual fee for non-residential parcels would then be calculated using actual impervious area multiplied by the

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6 This may be a slight overestimate since some parcels may be located within two zoning districts and therefore may have been counted twice, but this should result in a negligible effect.

7 Impervious cover images are available through MassGIS but were too large and cumbersome to use efficiently with the Ipswich Parcel Data. Therefore, HW opted instead to delineate the impervious area based on MassGIS 2005 orthophotos for a sample set of parcels.
same cost/acre of impervious area, or by calculating a flat rate based on average impervious area for different land uses.

As discussed earlier, a credit system can be instituted as a mechanism for commercial/industrial property owners to reduce their stormwater fee, if they so choose. Credits could be issued for property owners that manage their property onsite in accordance with a set of standards, which could include preserving part of the land in an undeveloped state, requiring onsite recharge, planting native vegetation, using approved vegetative stormwater treatment practices such as bioretention or created wetlands, or other stormwater management techniques.

A summary table providing examples of stormwater utility structures, services, and rates in other communities is provided in Exhibit 4-9.
### Exhibit 4-7. Average Parcel Impervious Area by Zone

<table>
<thead>
<tr>
<th>Zone</th>
<th>Average Impervious Area (Acres)</th>
<th>Average Total Parcel (Acres)</th>
<th>Average Percent Impervious Cover</th>
<th>Approx Number of Parcels</th>
<th>Number of Parcels ‘Sampled’</th>
<th>Total Estimated Impervious Areas (Acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Business (CB)</td>
<td>0.36</td>
<td>0.49</td>
<td>72%</td>
<td>105</td>
<td>3</td>
<td>37.8</td>
</tr>
<tr>
<td>General Business (GB)</td>
<td>0.31</td>
<td>0.51</td>
<td>62%</td>
<td>98</td>
<td>3</td>
<td>30.38</td>
</tr>
<tr>
<td>Highway Business (HB)</td>
<td>0.44</td>
<td>1.77</td>
<td>23%</td>
<td>101</td>
<td>3</td>
<td>44.44</td>
</tr>
<tr>
<td>Industrial (I)</td>
<td>1.02</td>
<td>2.48</td>
<td>41%</td>
<td>102</td>
<td>3</td>
<td>104.04</td>
</tr>
<tr>
<td>Intown Residence (IR)</td>
<td>0.08</td>
<td>0.36</td>
<td>24%</td>
<td>1110</td>
<td>11</td>
<td>88.80</td>
</tr>
<tr>
<td>Limited Industrial (LI)</td>
<td>1.52</td>
<td>3.85</td>
<td>42%</td>
<td>41</td>
<td>3</td>
<td>62.32</td>
</tr>
<tr>
<td>Planned Commercial (PC)</td>
<td>0.82</td>
<td>2.48</td>
<td>36%</td>
<td>31</td>
<td>3</td>
<td>25.42</td>
</tr>
<tr>
<td>Rural Residence A (RRA)</td>
<td>0.11</td>
<td>0.75</td>
<td>19%</td>
<td>3317</td>
<td>33</td>
<td>364.87</td>
</tr>
<tr>
<td>Rural Residence B (RRB)</td>
<td>0.06</td>
<td>0.27</td>
<td>27%</td>
<td>789</td>
<td>8</td>
<td>47.34</td>
</tr>
<tr>
<td>Rural Residence C (RRC)*</td>
<td>2.45</td>
<td>4.97</td>
<td>56%</td>
<td>13</td>
<td>3</td>
<td>31.85</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>837.26</strong></td>
</tr>
</tbody>
</table>

* Actual use in RRC is primarily sand and gravel mining.

---

### Exhibit 8. Calculation of Equivalent Residential Unit (ERU) Fee

<table>
<thead>
<tr>
<th>Estimated Annual Stormwater Budget of:</th>
<th>$150,000</th>
<th>$200,000</th>
<th>$250,000</th>
<th>$300,000</th>
<th>$350,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Fee/Acre of Impervious Area</td>
<td>$179.16</td>
<td>$238.87</td>
<td>$298.59</td>
<td>$358.31</td>
<td>$418.03</td>
</tr>
<tr>
<td>Estimated Annual ERU Fee*</td>
<td>$17.21</td>
<td>$22.94</td>
<td>$28.68</td>
<td>$34.42</td>
<td>$40.15</td>
</tr>
</tbody>
</table>

* ERU Fee calculation based on average impervious area for residential zones (IR, RRA, RRB) estimated at 0.1 acres/parcel.
<table>
<thead>
<tr>
<th>Town</th>
<th>Fee Type</th>
<th>Fee Base</th>
<th>Rate</th>
<th>Services Provided</th>
<th>Management</th>
<th>Revenue (FY07)</th>
<th>Approval Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newton, MA (pop. 83,829)</td>
<td><strong>Residential</strong></td>
<td>Flat Fee</td>
<td>$6.25/quarter ($25 annually)</td>
<td>• Personnel salaries and training</td>
<td>New Stormwater Utility Department within DPW</td>
<td>$575,000</td>
<td>Public Outreach program. DPW 2/06 presentation to Stormwater Sewer Committee, then to Public Facilities Committee (sub-committee of the Board of Aldermen). 5/06 vote of approval by BOA</td>
</tr>
<tr>
<td></td>
<td>(Single Family)</td>
<td>Size of impervious cover</td>
<td></td>
<td>• Water quality sampling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Other</strong></td>
<td>Flat Fee</td>
<td>$37.50/quarter ($150 annually)</td>
<td>• Illicit discharge investigation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/A (lump fee)</td>
<td></td>
<td>• Corrective actions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Public outreach</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Pollution prevention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Maintenance projects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading, MA (pop. 24,145)</td>
<td><strong>Residential</strong></td>
<td>Equivalent Residential Unit (Aver. = 2,552 sq. ft.)</td>
<td>$9.96/quarter ($39.84 annually)</td>
<td>• Illicit detection and elimination</td>
<td>Stormwater enterprise fund managed by DPW</td>
<td>$357,000</td>
<td>Stormwater committee established, budget review, 8/05 presentation to Board of Selectmen, approval by BOS, Town Meeting Approval</td>
</tr>
<tr>
<td></td>
<td>(Single &amp; 2-Family Homes)</td>
<td>Impervious areas of each parcel</td>
<td></td>
<td>• Mapping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Public education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Catch basin cleaning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Street sweeping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Drainage ditch maintenance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Other general tasks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Burlington, VT (pop. 15,814)</td>
<td><strong>Residential</strong></td>
<td>ERU (Aver. = 16,526 sq. ft.)</td>
<td>$39.84/ERU</td>
<td>• Capital projects</td>
<td>Stormwater program located w/ in existing DPW office. Shared management responsibilities between DPW, Planning &amp;</td>
<td>$1,100,000</td>
<td>Hired consultants, feasibility study, Stormwater Advisory Committee reviewed/assessed budget, presentations to City Council, 3/5 Council approval to amend stormwater ordinance</td>
</tr>
<tr>
<td></td>
<td>(Single Family)</td>
<td>Estimated impervious areas (2,700 sq. ft. average impervious)</td>
<td>1 ERU = $4.50/month Tiered approach: • Single Family: $13.50/qtr • Two Family: $6.75/qtr • Three Family: $4.50/qtr</td>
<td>• Engineering and Planning</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Exhibit 4-9. Examples of Stormwater Utility Structures, Rates and Services

<table>
<thead>
<tr>
<th>Town</th>
<th>Fee Type</th>
<th>Fee Base</th>
<th>Rate</th>
<th>Services Provided</th>
<th>Management</th>
<th>Revenue (FY07)</th>
<th>Approval Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Residential</td>
<td>10 tiered approach</td>
<td>ERU</td>
<td>1 ERU = $4.50 Tiered approach based on 10 tiers of % impervious cover, multiplied by ERU</td>
<td>cleaning, repairing/cleaning drainage ditches</td>
<td>Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Water quality programs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Reserve funds and misc. overhead</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beaufort County, South Carolina (pop. 73,812) – Includes City of Beaufort, Towns of Port Royal, Hilton Head, Bluffton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential (Single Family)</td>
<td>Equivalent Residential Unit for all residential. Revised to Prorated ERU Tiered Approach in 2007 for greater equity</td>
<td>Estimated impervious areas and residential land use type (ERU = 4,906 s.f.)</td>
<td>$44.43/ERUTiered approach: • Small Single Family=0.5 ERU • Medium Single Family=1 ERU • Large Single Family=1.5 ERU Mobile homes, apartments, townhouses and condos = varying multiples of ERU</td>
<td>Initial services: • Inventory drainage network • ID and improve drainage problems • Maintenance Additional services: • Management • Permitting • Water quality improvement</td>
<td></td>
<td>$1,200,000 in 2001, budget and fees revised subsequently.</td>
<td>Received $250,000 grant in October, 1999. Engaged a consultant. Worked with Public Works Committee, and then the Intergovernmental Relations Committee for town approvals. Enacted by Beaufort County Council in 2001 following three readings.</td>
</tr>
<tr>
<td>Non-Residential</td>
<td>Multiple of ERU</td>
<td>Estimated impervious areas. Initially had an Intensity Factor within rate.</td>
<td>$44.43/ERU. Initially had an intensity factor applied to rate.</td>
<td>Utility is located within the Beaufort County Public Works Department, with oversight by Stormwater Management Board</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: CRWAa 2007; CRWAb 2007; HW 2005.
4.12 Next Steps – From Concept to Funding

The key to the success of a stormwater utility or stormwater enterprise fund program is gaining public support for and understanding of the program up-front. Without public education and outreach at the beginning of the process, a fee for stormwater management may be viewed as an unnecessary “rain tax” on the public. The public often assumes that stormwater management is a given. The successful implementation of a stormwater utility depends on a change in the way that the general public and the municipal management perceive “drainage problems.”

The goal of public education is to teach residents and business owners that we all contribute stormwater runoff to the system and therefore we all should pay for the service of managing the stormwater. Without this service, the town’s public water resources are negatively impacted and property owners may suffer from flooding. It is also important to articulate a shift in thinking from the traditional “pipe it away” approach to stormwater to a more natural approach that maintains the water balance and improves water quality. This educational process is not a simple task, and can take significant time and effort.

Once the public understands the service being provided to them, and the need for funding this service, they may support the creation of a stormwater program. A stormwater task force or committee may be helpful in ensuring public acceptance. Ipswich currently has a stormwater committee that is comprised solely of municipal managers. The most effective committee would also include stakeholders, those individuals or representatives of groups that will be affected by the new program. Since a stormwater utility fee can affect all elements of a community, stakeholders may include home, apartment and condominium owners; commercial and industrial properties; other governments; and schools and other institutional entities.

There are many advantages to this approach to public awareness, as documented by the Florida Stormwater Association (2003):

- Information can be distributed to a smaller group, and the message provided can be tested on this group before distribution to the public at large;
- If the group is made up of stakeholder members, then municipal managers can receive feedback on public opinion quickly;
- Once consensus has been reached with the committee, the committee members themselves become advocates and maybe champions of the program; and
- The committee/task-force process offers knowledgeable public input that can be incorporated into the overall plan. Such input reflects positively for media and public discussions.

The Stormwater Committee or the DPW, or both jointly, may take the lead in the development of a bylaw or bylaw amendment to enable the program. This should be a public process that involves various opportunities for input from citizens. Once the language is drafted, the major task of adopting the bylaw begins. Strong public education efforts up-front can streamline adoption of the bylaw. The major steps in moving the stormwater utility from concept to reality include:

1. Public Outreach and Education: Media campaigns highlighting stormwater improvements being planned or recently performed, improvements in water resource conditions, or the
requirements of the Phase II permit can all help the public to understand the “service” being provided by the DPW. Workshops with business owners in the commercial area of town, or with residents in areas experiencing erosion, non-point source pollution impacts, low streamflow or flooding can be effective in teaching the benefits of low impact design techniques in managing stormwater. Mailers and fliers can be distributed with water, sewer, electric, or tax bills. These fliers can be used to highlight the services provided by the DPW to keep storm drains clear of debris, point out maintenance activities that the public may see in town, such as catch basin cleaning, or highlight stormwater projects that are taking place. For example, any projects being undertaken with grant money can be touted. It is also helpful to link these mailers to an event, such as a workshop or a watershed activity day, public kayak outing, or information booth at a summer fair. Another audience for stormwater outreach and education is children, who can be reached through school activities or day camp.

Local environmental and outdoor organizations can also be engaged, including the Ipswich River Watershed Association, Eight Towns and the Bay Committee, Trustees of Reservations, MassAudubon, and any other organization or interest group that can help share the message.

2. Elicit Public Support: A series of public meetings addressing stormwater management can be a helpful way to publicize the need for additional funding. These meetings could be held in a large central location, or a series of meetings could be held at various venues around town to try to attract a variety of constituents, from business owners to residents in certain individual neighborhoods. These meetings should provide a background about stormwater management, describe ongoing activities and permit requirements of the town related to stormwater management, and introduce the idea of a funding mechanism.

3. Create Enabling Language: A draft of the enabling language should be prepared during this education and outreach process. This effort will probably be led by the DPW or the Stormwater Committee, but should include an open process that allows for public input and participation. If the enabling language is a relatively modest amendment allowing for the creation of a stormwater utility or fund, this step can be simpler. However, if the Town chooses to create a full bylaw describing the parameters of the stormwater utility, this step will require a more focused effort by the DPW and/or the Stormwater Committee.

4. Adopt Bylaw: The final step in enabling the creation of a stormwater utility or enterprise fund is the adoption of the enabling language. As noted earlier, the enabling language can be in the form of a relatively modest enabling amendment to a bylaw or a more comprehensive bylaw defining all the key parameters of the program. This bylaw or bylaw amendment will need to be introduced for a vote on the Town Meeting warrant. Given our form of town government, it will be important to ensure that the public education step has been carried out effectively.

5. Create Regulations: This final step will be necessary if the enabling language that is adopted is simple and requires the creation of regulations to further define the stormwater utility or enterprise fund. Regulations can be created by the stormwater authority that is established by the enabling language. This may be the DPW, the Stormwater Committee or some other municipal entity.
6. Ongoing Public Education: As the program starts up and begins to collect fees and pay for projects and services, the progress of the program should be highlighted to the public. Progress that can be documented through water quality improvements, numbers of catch basins cleaned or replaced with deep sumps, replacements of undersized culverts, or restoration miles along a stream, is an excellent way to build support for the project. As new watershed or stormwater issues arise, the utility or fund staff should continue to communicate with the public and discuss how these issues can be addressed and how improvements will be made.

4.13 Stormwater Bylaw and Regulations

The development of a stormwater utility is often coupled with the creation of a stormwater bylaw or bylaws to define the parameters by which stormwater must be managed throughout the utility’s jurisdiction. In the case of Ipswich, there is no stormwater bylaw currently in place and the Ipswich Stormwater Committee has been discussing the creation of a stormwater bylaw concurrently with the creation of a utility. This is a natural progression given that a stormwater bylaw would create the need for inspections, enforcement, permitting, and administration. Often times, a funding mechanism is necessary to help meet these new responsibilities.

There are three major issues that are generally addressed by the institution of a stormwater bylaw or bylaws. These issues, listed below, are direct outgrowths of the NPDES Stormwater Phase II permit requirements, or “Six Minimum Control Measures:”

- Prohibiting illicit connections to the storm drain;
- Controlling stormwater from construction sites; and
- Controlling stormwater from post-construction sites.

Illicit connections must be controlled by the NPDES permit holder, in this case the Town of Ipswich, and a mechanism for prohibiting and removing such connections must be created. As discussed earlier, the Town of Ipswich allowed sump pumps to be directly connected the storm drain system under a past policy, but there was no process to track those connections and to ensure that those sump pumps would be pumping only non-contaminated groundwater. The Town also needs a program to detect illicit discharges where they are currently occurring and remove them as needed. An illicit connection bylaw would create a system to meet these needs, and would most likely place responsibility under the jurisdiction of the DPW.

A bylaw is also the primary mechanism used by most NPDES Phase II communities to control stormwater from construction sites and post-construction sites. Stormwater management from construction sites is often called erosion and sedimentation control. In many cases, a bylaw combining these two responsibilities designates responsibility to the Planning Board, since they are generally familiar with reviewing development projects, and because most new development or redevelopment, other than single family homes, must go before the Planning Board for subdivision or site plan review and permitting.

A stormwater management bylaw, or the set of regulations created to implement the bylaw, should include provisions for permitting of new and re-development, enforcement, inspection, jurisdiction and exemptions, fees and most importantly, a set of stormwater management standards. These standards set minimum limits on the level of water quality treatment and water
quantity control for all discharges to the municipal storm sewer system and to all surface waters. In Massachusetts, a set of stormwater standards is outlined by the Massachusetts Stormwater Policy, which applies to discharges to surface waters under the Massachusetts Wetlands Protection Act. This set of standards could be applied town-wide by reference, or the Town could opt to create its own standards.

Given the goal of balancing the water budget in the Town of Ipswich, a stormwater bylaw could be a significant tool in promoting recharge as a mechanism to manage stormwater runoff and reduce low flows in the watersheds contributing to the public water supply (Map A-3). A requirement for new development or redevelopment to use low impact design (LID) can be incorporated as a key aspect of the stormwater management bylaw, thereby reducing the overall impervious area on a site, reducing impacts to wetlands, buffers, habitat and other important resource areas, and increasing the use of infiltration and vegetated water quality treatment practices (Massachusetts Smart Growth Toolkit 2006). This presents an opportunity for the Town of Ipswich to require measurable water quality improvements and measurable recharge back into the groundwater that supplies base flows to the Ipswich River and the Egypt-Rowley River where the Town draws its drinking water.

Some communities opt to create one single comprehensive bylaw to address all three of these issues under a single jurisdiction. This is more often the case when the illicit discharge section is straightforward and does not involve a permitting feature, and when the authority, exemptions, responsibility for administration, permit procedures and enforcement will be the same or similar for all three issues. However, often times it is more efficient to separate the illicit discharge issue from the construction phase and post-construction phase stormwater management since it is a discrete issue and may require separate bylaw sections to address authority, exemptions, responsibility for administration, permit procedures and enforcement anyway.

4.14 Conclusion

The Town of Ipswich, like many other communities in Massachusetts and throughout the country, is facing a mandate under the Clean Water Act to improve water quality and address pollution from stormwater runoff. In order to meet this mandate, the Town must properly maintain existing stormwater infrastructure, and substantially expand its capacity to manage the stormwater system and remediate known problem areas. A stormwater utility is recommended to fund a more comprehensive stormwater management program in Ipswich. A stormwater bylaw or set of bylaws is also recommend to provide additional oversight of stormwater and meet regulatory requirements.
CHAPTER 5: MONITORING

5.0 Introduction

A monitoring strategy is necessary to ensure that the proposed programs are meeting environmental goals. An instream flow monitoring program in the Egypt/Rowley River is recommended to monitor and assess the effectiveness of the water demand mitigation program and other water conservation efforts. A water quality monitoring program in the Ipswich River is recommended to monitor and assess the effectiveness of the stormwater utility and other stormwater and wastewater management programs. These programs must be cost-effective and may be sustained through a collaboration between the Town of Ipswich and volunteer monitors.

5.1 Water Quality Monitoring Program

We recommend establishing water quality monitoring sites primarily in the Ipswich River to assess the effectiveness of stormwater and wastewater management programs. Most of the Town’s known stormwater problem areas, such as Farley Brook and Topsfield Road, discharge to the Ipswich River. Treated wastewater is discharged to Greenwood Creek, a tributary to the Ipswich River, while sewer overflows are discharged directly to the Ipswich River at the Town Wharf during storm events.

The goals of the water quality monitoring program would be to determine background water quality trends, evaluate contamination after storm events, and assess how stormwater and wastewater management programs are affecting water quality, both long-term and immediately post-storm. This section provides recommendations for a monitoring program designed to meet these goals in a cost-effective manner. It also suggests opportunities to better collect and integrate the results of other water quality efforts currently being carried out in Ipswich.

5.1.1 Parameters to Test

A two-part sampling program is recommended to best characterize water quality in the Ipswich portions of the Ipswich River. The first part establishes a baseline and background trends in the watershed, and the second samples in problem areas, both regularly and following storm events. The Mystic River Watershed Association currently uses this two-part approach for its stormwater-focused water quality monitoring program (Mystic River Watershed Association 2007). In the Ipswich River, IRWA’s RiverWatch monitoring program and nutrient monitoring carried out regularly by the Marine Biological Laboratory’s Plum Island Long-Term Ecological Research (LTER) station may provide sufficient data to serve as the baseline program.

Recommended monitored parameters include: stream flow, dissolved oxygen and biochemical oxygen demand, temperature, pH, and turbidity (EPA 1997). These parameters can be easily assessed by volunteers. IRWA’s RiverWatch program has been monitoring water quality in the Ipswich River since 1988. Currently, nearly 60 volunteers conduct monthly monitoring at 30 sites in the watershed, collecting data on air temperature, water temperature, color (visual inspection), odor, depth, velocity, conductivity, and dissolved oxygen. The RiverWatch program
includes six monitoring locations along the Ipswich River in Ipswich: Willowdale Dam, Mill Road, EBSCO Dam, Green Street, and the Town Wharf. We recommend that this volunteer-based program be continued and the results provided regularly to the Town of Ipswich.

The Ipswich Coastal Pollution Control Committee (ICPCC) conducted a stormwater monitoring program in Ipswich in the 1990s. This program focused on fecal coliform and also identified optical brighteners, an indicator of pollution associated with wastewater. The data from this sampling program should be incorporated into a water quality database to characterize baseline conditions.

In addition to this baseline data, a monitoring program specifically designed to assess pollution from stormwater runoff and sewage discharge at hotspots is recommended. The following parameters are advised: fecal bacteria, nitrates, phosphorus, dissolved oxygen, conductivity, temperature, turbidity, total solids, and pH (EPA 1997).

There are many possible fecal bacteria to measure, but EPA recommends E. coli or enterococcus as “the best indicators of health risk from recreational water contact in fresh water.” E. coli is a very sensitive indicator of fecal contamination in freshwater because it is found only in human and other animals’ intestines. Massachusetts Surface Water Quality Standards (314 CMR 4.00) allow for either to be used to evaluate waterway classes. For briny waters, enterococci testing is the only suitable option; like many dangerous pathogens, it tolerates salty water; E. coli does not.

Most organizations test for E. coli in freshwater and enterococci in salty water. The Massachusetts Department of Public Health (DPH) monitors marine beaches for enterococci and freshwater beaches for E. coli. The Massachusetts Division of Marine Fisheries (DMF) tests water and shellfish for fecal coliform to determine suitability for human consumption.

Analysis is sensitive and must be carried out in a certified laboratory. The Ipswich Wastewater Treatment Plant may be able to carry out some additional analysis of water samples. Salem Sound Coastwatch, a Salem-based watershed association, uses Biomarine Inc. for its laboratory analysis; this may be an option for Ipswich. Biomarine is located in Gloucester and is a Massachusetts Department of Environmental Protection Certified Laboratory specializing in the analysis of salt and freshwater swimming areas; Biomarine also has a regular lab sample pickup location in Rowley near the Ipswich town line.

5.1.2 Site Selection

In order to isolate sources of pollution, testing should be done upstream and downstream of the confluence of suspect tributary streams or other known sites of concern. Accessibility of sampling location is important if testing is to be done by volunteers. It is generally recommended that testing be done at the end of a tributary just before the confluence so that the tributary can be adequately assessed. Sophisticated mathematical models exist for the optimal distribution of sites, but due to accessibility and property issues, it may be necessary to choose sites by virtue of availability.
More in-depth sampling for a wider range of parameters, including E. coli and/or enterococci, is recommended at known or suspected stormwater and wastewater hotspots. Along the Ipswich River, such sites might include the Farley Brook outlet, stormwater outfalls draining the Topsfield Road area, the confluence of Greenwood Creek, and the Town Wharf.

5.1.3 Timing

Baseline sampling is generally carried out monthly, and must be carried out at least three times a year in order to capture seasonal changes. EPA recommends sampling in early spring, before full leafage, when the water is high; late summer, when water is low; and late fall, when leaves are down but before freezing. The RiverWatch program collects monthly data year-round.

Weekly or monthly sampling is recommended for hotspot locations. Ideally, these locations would be sampled during and immediately after storm events to capture wet-weather monitoring data. Wet-weather sampling is crucial to characterize contaminant loads in stormwater runoff, as well as sewer overflows resulting from infiltration and inflow. However, wet-weather sampling is generally expensive because it requires monitors to be “on call,” ready to collect data at a moment’s notice depending on the weather. The monitoring program should be designed to conduct some targeted wet weather sampling. However, if budgets do not allow for planned wet weather sampling, then a weekly or monthly sampling is a reasonable alternative. Over the course of a season or year, some sampling dates will likely occur during rainfall events, while most will likely occur during dry weather, allowing for comparison of water quality in wet and dry weather.

5.1.4 Quality Assurance and Management

With proper training, sampling can be done entirely by volunteers under the supervision of trained staff. We recommend that current volunteer-based baseline sampling programs be continued, and better integrated with Town data. Hotspot sampling can also be carried out by volunteers, or alternatively could be performed by a Town of Ipswich staff member. The current Conservation Clerk has carried out water quality sampling for the Town, including during the North Green stormwater improvement project, and also provides training for the RiverWatch monitoring program. This staff person would be an ideal choice to collect storm sampling, monthly hotspot sampling, or to train and coordinate a team of volunteers to conduct the sampling.

All water quality monitoring should follow EPA-recommended quality assurance procedures, and be carried out under a Quality Assurance Project Plan (QAPP) approved by the state of Massachusetts. IRWA’s RiverWatch monitoring program is carried out under an approved QAPP, and guidelines are available to develop a QAPP focused on bacteria sampling of hotspot locations. Volunteers must be regularly trained to ensure that they are operating under the most up-to-date procedures approved in the QAPP.
5.2 Instream Flow Monitoring Program

We recommend conducting instream flow monitoring in the Egypt/Rowley River to assess the effectiveness of the water demand mitigation program and other water conservation efforts. Instream flow monitoring would also be useful in understanding the groundwater/surface water hydrology in this little-studied watershed, and better characterizing the relationship between the Town’s water withdrawals and streamflow conditions.

While the Ipswich River is also highly flow-stressed, the low-flow conditions are generally influenced more by upstream water withdrawals than by Town of Ipswich withdrawals. The Ipswich River also has two USGS gages collecting accurate, real-time streamflow data year round. One of these gages is located at the Willowdale Dam, a run-of-river dam at the Ipswich/Topsfield border. This gage is a key source of streamflow data for the Ipswich portion of the Ipswich River. The Town’s streamside Winthrop wells are located just downstream of the gage, near a river segment with riffles that are particularly susceptible to summertime low-flow conditions. Additional flow measurements downstream of this site might be useful to better understand the influence of water withdrawals from the Winthrop wells on streamflows in this river segment, if any.

No regular instream flow monitoring of the Egypt/Rowley River is currently taking place. Two primary options exist to establish a flow monitoring program. Ideally, a USGS streamflow gage would be installed, allowing for accurate real-time flow measurements through a fully automated satellite data collection system. Unfortunately, it is unlikely that a USGS gage will be added in the near-term. The Egypt/Rowley River was not included in a recent initiative by EOEEA to increase the number of stream gages in Massachusetts.

Therefore, the recommended option is installation of a staff gage at a suitable site on the Egypt/Rowley River. A staff gage is a long ruler placed semi-permanently in a stream and used to read water depth. Use of a staff gage requires regular calibration to determine the relationship between stream depth and discharge (streamflow). Once this relationship has been calculated, flow can be estimated based on depth readings from the staff gage (Michaud 1994).

We recommend installing one staff gage on the Egypt River, downstream of the Town’s reservoirs and below the confluence of Dow Brook and Bull Brook, but upstream of the confluence with Muddy Run. Streamflows in this section of the river are most directly affected by water withdrawals from the Dow and Bull Brook Reservoir system, as well as the Mile Lane well. An additional staff gage could be considered for Bull Brook downstream of the reservoir and upstream from the confluence with Dow Brook to provide information about this segment, which contains high-quality aquatic habitat.

Volunteers or Town staff must read the staff gage on a daily, weekly, or monthly basis – the more often the better. The Massachusetts Riverways Program runs a River Instream Flow Stewards (RIFLS) program to train and coordinate volunteers to collect streamflow data from staff gages. We recommend collaborating with this program and developing a QAPP to ensure data quality.
5.3 Conclusion

A water quality monitoring program consisting of both baseline and hotspot monitoring in the Ipswich River and an instream flow monitoring program in the Egypt River are needed to assess the effectiveness of stormwater management and water conservation programs. Both programs should leverage volunteers in order to reduce costs and minimize the burden on Town staff. Collaborations to share data with existing water quality monitoring programs by IRWA and the Marine Biological Laboratory are also suggested. Monitoring provides a much-needed feedback loop to ensure that programs are delivering meaningful environmental results. Monitoring can highlight the need to change course and help identify more measures that might be more effective in dealing with observed problems.
CHAPTER 6:
CONCLUSION – RECOMMENDATIONS FOR INTEGRATED WATER RESOURCES
MANAGEMENT IN IPSWICH

6.0 Introduction

This report provides a roadmap to begin balancing the water budget in the Town of Ipswich, in order to improve streamflow conditions and water quality in the Egypt/Rowley River and the Ipswich River. It provides detailed recommendations on program design for two key financing mechanisms: a water demand mitigation program and a stormwater utility. This chapter summarizes those recommendations and describes some potential next steps in creating an integrated water resources management program.

6.1 Water Demand Mitigation Program Recommendation

An inflow-outflow analysis of the Egypt/Rowley watershed shows that the Town’s primary source watershed is highly stressed by water losses. The Water Department has taken several important steps to conserve water, including leak detection, automatic meter reading and monthly billing, and implementation of a seasonal rate structure. To build on these results, we suggest that the Town consider implementing a more extensive water conservation program focused on residential and commercial audits and retrofits, beginning with implementation of a water demand mitigation program.

Water demand mitigation programs are designed to mitigate the water demands of new developments, thus capping water losses even as growth and development continue. We offer several key recommendations for consideration by the Town, based on consultations with Town officials and a review of similar programs in other Massachusetts communities:

Jurisdiction: We recommend that the program apply to all new and expanded residential and commercial developments, including single-family homes, without exception. It should also apply to renovation projects that increase water use or capacity of the building.

Program Structure: While some communities have allowed developers to directly implement water-saving projects, a fee-based approach is recommended for Ipswich to give the Water Department maximum flexibility to control the types of project implemented, ensure the effectiveness of mitigation projects, and reduce the burden of oversight and verification.

Mitigation Fee: We recommend a mitigation fee of $18.83 per gallon per day (gpd) of anticipated new demand. The fee is based on water use projections based on Title 5 sewage flow design criteria, and incorporates a 2:1 mitigation ratio as a margin of safety. The fee is calculated based on the estimated costs of achieving the required water savings through retrofits of indoor fixtures and appliances.

Credit System: A credit system is encouraged to create incentives for residents to upgrade their own homes during renovation, and/or to promote installation of ultra-efficient fixtures and
appliances and highly water-efficient outdoor landscaping features in new construction. The credit system must be simple, transparent, and verifiable.

**Program Budget:** Water demand mitigation fees should be collected into an enterprise fund managed by the Water Department. The estimated annual budget for the program would vary based on rates of development and renovation, and depends on the fee that is selected. At current rates of development and assuming a mitigation fee of $18.83 per gpd, the annual budget for the program would be $211,273.

**Water Conservation Programs Funded:** To ensure the integrity of the program, the water-saving projects implemented must deliver the required level of mitigation. Indoor retrofits to replace conventional fixtures and toilets with low-flow models are recommended as the core of the program. Other programs that generate quantifiable water savings can also be considered, such as leak detection and appliance rebates. Water savings should be tracking in a spreadsheet-based accounting system.

**Management Structure:** We recommend retaining in-house management of the program, and using the fees to pay for a Water Conservation Coordinator to oversee the program, as well as other water conservation activities. Outside consultants can be used to implement specific aspects of the program, such as bulk toilet replacement or household audits.

**Permits and Processing:** A permit process is recommended to notify applicants of the fee at the time of application for a building permit. The fee should be paid prior to issuance of a building or occupancy permit.

**Regulatory Language and Approval Process:** The water demand mitigation program could be adopted by the Water Department through its Rules and Regulations, but a public outreach process is suggested to engage developers early-on and explain why the fee is necessary.

### 6.2 Stormwater Utility Program Recommendation

The Town of Ipswich must develop a more comprehensive stormwater management program to address regulatory requirements, meet water quality goals, and address flooding concerns. A fee-based stormwater utility is recommended to generate funding for this program. Based on the information presented in this report and discussions with the Ipswich Stormwater Committee, we offer several key recommendations for the Town of Ipswich and the Ipswich Stormwater Committee to consider:

**Stormwater Enterprise Fund:** A stormwater enterprise fund is recommended for implementation in the Town of Ipswich rather than a fully staffed stormwater utility for several reasons. The Town of Ipswich is a relatively small community with a small town staff. A stand-alone stormwater utility would require significant staffing and administrative needs that could overwhelm the Town’s capacity at this stage.

**Jurisdiction:** We recommend implementing a stormwater utility town-wide for a host of reasons, including ease of management and equity across town.
Management of Stormwater Program: Through discussions with the Stormwater Committee, there was no single consensus on where the stormwater program and the billing responsibilities should be housed. The DPW currently provides all stormwater services in town. Based on this past experience and knowledge, it is recommended that the technical aspects of the stormwater program be managed out of the DPW to start. Over time, if the program grows, it may make sense to consider combining all utilities with the DPW under one umbrella. However, this requires significantly more discussion and planning, and is beyond the scope of this report. There are two primary billing mechanisms in the town that could be amended to include the stormwater billing: the assessor’s bill, and the utilities bill. The assessor’s office may be an easier link to stormwater billing since every lot in town is included in the assessor’s database and presumably receives a bill (except exempt properties). However, the ease of tying into this database versus the utilities database should be explored, as well as the capacity of the billing administrators in each department to add and manage another line item on the bill.

Provide a Limited Set of Stormwater Services to Start: The Stormwater Committee indicated that they are most concerned about IDDE at this point and would like a mechanism and funding to address illicit connections to the stormwater infrastructure. Implementing a stormwater enterprise fund based on a budget and fee structure that supports this limited goal will provide a simpler budget and smaller stormwater fees as the program gets up and running. This allows the town to introduce residents to the idea of a stormwater fee with a fee that is inexpensive and targeted. We also recommend that the stormwater utility should provide for a stormwater coordinator to manage the program and provide engineering services, some additional maintenance funding, and a small budget for public education to let people know about the program. At the beginning of the program, existing stormwater services such as maintenance could continue to be funded out of the general fund if the Stormwater Committee is concerned about high initial fees.

Credits and Exemptions: Given the discussions by the Stormwater Committee on this topic, we recommend implementing a very simple credit system targeted to large commercial and industrial users. We also recommend not providing any full exemptions through the program.

Enabling Language: We recommend including enabling language within a new or amended bylaw. The bylaw must clearly identify a stormwater authority responsible for managing the stormwater utility. An example of simple enabling language is provided in this chapter.

Simple Fee Structure Based on ERUs: A fee structure based on ERUs is a proven method for connecting each individual lot to the stormwater management service being provided by the Town. We recommend a simple rate structure for residential units that either uses one ERU for all residential units, or includes a tiered structure that differentiates between single, two, and three-family residences (similar to South Burlington, Vermont).

6.3 Monitoring Recommendation

A water quality monitoring program in the Ipswich River and an instream flow monitoring program in the Egypt River are recommended. Monitoring is crucial to ensure that stormwater
management and water conservation activities are achieving the desired environmental results. We recommend a baseline water quality monitoring program, a monthly sampling program focused on stormwater and wastewater hotspots in the Ipswich River, and monthly monitoring of streamflow at a staff gage in the Egypt River downstream of the Town’s reservoirs. All monitoring efforts should leverage volunteers in order to reduce costs and minimize the burden on Town staff.

6.4 Next Steps: Recommendations for Integrated Water Resources Management

The proposed water demand mitigation program and stormwater utility would constitute a major step towards balancing the water budget financially, and would yield important environmental benefits to water quantity and quality in Ipswich. However, fully balancing the water budget environmentally is an extremely ambitious goal, given the current level of water losses from the Town’s source watersheds. Balancing the water budget in Ipswich would require implementation of an integrated water resources management program that includes aggressive actions to return treated wastewater to the Egypt/Rowley River, as well as initiatives to recharge stormwater within the Egypt/Rowley watershed.

MassDEP is currently developing guidance for communities interested in developing integrated water resources management plans. Such plans may be recommended or required in the context of several state laws and programs, including the Massachusetts Environmental Policy Act, State Revolving Fund, and the NPDES Phase I and Phase II Stormwater Permits. MassDEP’s draft guidance describes integrated water resources management plans as the only plans that look comprehensively at all three sectors: water, wastewater, and stormwater. The plans incorporate an assessment of current infrastructure and an identification of future needs in all three sectors (MassDEP, Draft Water Resources Planning Guidance, 2007).

Integrated planning around water, wastewater, and stormwater does not generally occur in Ipswich at present, due to an administrative structure that houses the Water and Sewer Departments under the Utilities Department, and stormwater management programs under the DPW. Moving towards integrated management of water resources in Ipswich would require steps to expand communication between these two departments.

As a first step, an integrated water resources management committee could be set up and charged with identifying areas of overlap between stormwater and water/sewer activities. For example, the committee might help to plan infrastructure upgrades, such as road construction, or help address administrative issues, for example setting up a billing system that could include stormwater fees on the existing water and sewer bill. The committee could also identify situations that place water, sewer, and stormwater goals at odds, as well as opportunities for environmental or community benefit. For example, recent extensions of the sewer system may provide a water quality benefit, but also cause increased export of water from the Egypt/Rowley watershed. Conversely, initiatives to recharge stormwater could potentially be targeted to suitable locations within the Egypt/Rowley watershed.

In the longer term, it may be worth considering whether a reorganization of the Town departments makes sense. The DPW used to be housed within the Utilities Department, and the
Town could consider returning to this structure, placing the DPW as a separate department under Utilities. This approach could yield substantial streamlining of engineering and GIS services, infrastructure and maintenance activities, administration, and billing. Integrated management of water resources would also occur more naturally, with a single Department head responsible for all three sectors.

6.5 Next Steps: Wastewater Management

Wastewater management was not the focus of this project, but arguably presents the most significant opportunity to balance the water budget in Ipswich. The Egypt/Rowley watershed is highly impacted by out-of-basin transfers of water and wastewater. Most of the water that is withdrawn from the Egypt/Rowley River for drinking water supply is never returned to the watershed. Most commonly, drinking water is exported to households and businesses located outside the watershed, and wastewater is discharged outside the watershed via the sewer or septic system. In addition, some parts of the Egypt/Rowley watershed are sewered, including along the Route 1-A corridor (Map A-6). Households and businesses in these areas receive their drinking water from the Egypt/Rowley watershed, but discharge their treated wastewater to the Ipswich River via the Town’s wastewater treatment plant into Greenwood Creek. Only the households located in the Egypt/Rowley watershed that remain on septic systems return any water to the source watershed.

The Town of Ipswich has completed a preliminary evaluation of the possibility of discharging treated wastewater to the Egypt/Rowley watershed, in addition to or instead of the existing discharge to Greenwood Creek. This project would, by far, the single most important step the Town could take to balance the water budget and mitigate water losses. A 2006 report investigated potential sites for groundwater discharge based on ownership and groundwater geology, and identified a site between the Dow Brook and Bull Brook reservoirs as having the most potential.

However, initial test pits indicated that the site may not be suitable for installation of groundwater infiltration beds. Further, conversations with MassDEP identified regulatory limitations, with new discharges to Outstanding Resource Waters prohibited unless “the discharge is determined by the Department to be for the express purpose and intent of maintaining or enhancing the resource for its designated use…” (310 CMR 4.04(3)(b)). Opportunities to advance the project may depend on MassDEP’s willingness to consider the water quantity benefits as an enhancement to water quality, and to give credit to the project as an offset against Ipswich’s Water Management Act permit (SEA 2006).

Other wastewater management programs may also be considered. In particular, Ipswich may wish to consider implementing a sewer demand mitigation program, also called a sewer bank, to generate funding for infiltration and inflow (I/I) removal activities. The Town of Weymouth has implemented a sewer bank using a 6:1 mitigation ratio. Whenever I/I is removed from the system, a positive number is added to the sewer bank. For example, if a manhole is leaking.

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8 Other discharge options may be feasible as an alternative to groundwater infiltration beds, but have not yet been evaluated.
6,000 gpd and the leak is sealed, then Weymouth adds 1,000 to the sewer bank. Subtractions from the sewer bank occur every time a new home or business connects to the sewer system. Weymouth charges a $10 per gpd sewer fee and a $7 per gpd connection fee for new sewer connections, in addition to the $10 per gpd water fee, for a total of $27 per gpd mitigation fee paid by all new homes and businesses connecting to the water and sewer systems (M. Chiasson, Pers. Comm., August 10, 2005).

6.6 Conclusion

The challenge facing Ipswich and all the communities that rely on stressed water sources is to mitigate the impacts of water withdrawals by saving water and using treated wastewater and stormwater as a resource to balance the water budget. The report recommends an integrated water resources management program for Ipswich (Exhibit 6-1). A fee-based water demand mitigation program and stormwater utility are recommended for implementation in the short-term to generate needed funding for water conservation and stormwater management activities. Balancing the water budget is an ambitious goal requiring substantial changes in the planning and management around water, stormwater, and wastewater. In the long-term, an integrated water resources management program is needed to achieve this goal in Ipswich, and in other Massachusetts communities facing similar challenges.
### Exhibit 6-1.
Integrated Water Resources Management Programs to Balance the Water Budget in Ipswich, MA

<table>
<thead>
<tr>
<th>Program</th>
<th>Users</th>
<th>Administration</th>
<th>Program Funded/ Implemented</th>
<th>Potential Water Balance Benefit</th>
<th>Other Resource Benefit</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water demand mitigation program</td>
<td>New/expanded water users</td>
<td>Fee paid to Water Dept. prior to issuance of building permit</td>
<td>Retrofits of indoor devices and fixtures, other quantifiable water-saving projects</td>
<td>Cap on water losses from source watersheds</td>
<td>Reduced energy use (for water distribution and treatment)</td>
<td>Short-term</td>
</tr>
<tr>
<td>Expanded water conservation program</td>
<td>Water customers</td>
<td>Incorporated into existing water rate</td>
<td>Comprehensive water conservation programs</td>
<td>Enhanced streamflows in source watersheds (up to 20% of water balance goal)</td>
<td>Reduced energy use (for water distribution and treatment)</td>
<td>Medium-term</td>
</tr>
<tr>
<td><strong>Stormwater</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stormwater utility</td>
<td>All residents</td>
<td>Funds managed by Dept. of Public Works</td>
<td>Stormwater management program</td>
<td>Improvements in streamflow to extent recharge occurs within source watersheds</td>
<td>Nonpoint source pollution reduction; reduced flooding</td>
<td>Short-term</td>
</tr>
<tr>
<td>Stormwater bylaw(s)</td>
<td>All residents</td>
<td>Designated Stormwater Authority</td>
<td>Illicit discharge detection program, construction and post-construction stormwater permit program</td>
<td>Improvements in streamflow to extent recharge occurs within source watersheds</td>
<td>Nonpoint source pollution reduction; reduced flooding</td>
<td>Medium-term</td>
</tr>
<tr>
<td><strong>Wastewater</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge treated wastewater to Egypt/Rowley subbasin</td>
<td>Sewer customers</td>
<td>Major engineering project under Utilities Dept.</td>
<td>Groundwater or surface discharge of treated wastewater</td>
<td>Enhanced streamflows in Egypt/Rowley subbasin (up to 60% of water balance goal)</td>
<td>Water quality improvements in Greenwood Creek</td>
<td>Long-term</td>
</tr>
<tr>
<td>Sewer demand mitigation program</td>
<td>New/expanded sewer users</td>
<td>Fee paid to Wastewater Dept. prior to issuance of building permit</td>
<td>Verifiable I/I removal</td>
<td>Reduce water losses to extent I/I removal occurs within source watersheds</td>
<td>Reduced storm flows to Ipswich wastewater; water quality improvements in Greenwood Creek</td>
<td>Long-term</td>
</tr>
</tbody>
</table>
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Appendix A. Watershed Maps
*Data Source: Executive Office of Energy and Environmental Affairs, MassGIS, 2007

Map A-1
Ipswich River and Parker River Basins
Map A-2
Ipswich Water Supply Protection Areas

Legend
- Town of Ipswich
- Ipswich River Basin & Parker River Basin
- Egypt/Rowley River Watershed
- Ipswich River Watershed
- Surface Water
- Rivers, Streams
- Public Water Supply Withdrawal
- Surface Water Supply Protection Areas (Zone A)
- Surface Water Supply Protection Areas (Zone B)
- DEP Wellhead Protection Areas (Zone II)

*Ipswich River Watershed
Egypt/Rowley River Watershed
Ipswich River Basin & Parker River Basin

*Water Supply Protection Areas (Zone C)
Extend from Zone B out to the Watershed Boundary.

**Data Source: Executive Office of Energy and Environmental Affairs, MassGIS, 2007
**Legend**

- **Town of Ipswich**
- **Egypt/Rowley River Watershed**
- **Ipswich River Watershed**
- **Drinking Water Supply Subwatersheds**
- **Subwatersheds**
- **Surface Water**
- **Rivers, Streams**
- **Public Water Supply Withdrawal**

**Map A-3**

**Drinking Water Supply Subwatersheds**

*Data Source: Executive Office of Energy and Environmental Affairs, MassGIS, 2007*
Map A-4
Egypt/Rowley River Watershed

Rowley River Subwatershed

Egypt River Subwatershed

Dow Brook Subwatershed

Muddy Run Subwatershed

Bull Brook Subwatershed

Map A-5
Potential Pollution Sources and Impaired Waters in Ipswich

Legend

- Town of Ipswich
- Ipswich River Basin & Parker River Basin
- Egypt/Rowley River Watershed
- Ipswich River Watershed
- Subwatersheds
- Surface Water
- Rivers, Streams
- Impaired Waters (MassDEP 2002 Integrated List of Waters, S.305(b)/303(d))
- MassDEP Tier Classified Oil and/or Hazardous Material Sites (MGL c. 21E)
- MassDEP Oil and/or Hazardous Material Sites with Activity and Use Limitations (AUL)
- Underground Storage Tank Locations

*Data Source: Executive Office of Energy and Environmental Affairs, MassGIS, 2007

**DEP Solid Waste Facilities**
- Agresource Compost Site
- Ipswich Landfill
- Ipswich Sludge Landfill

**DEP Bureau of Waste Prevention Major Facilities**
- Toxic Use Reduction Act (TURA)
- Type II Groundwater Discharge Permit

*Horsley Witten Group*
Sustainable Environmental Solutions
www.horsleywitten.com

*The map represents potential pollution sources and impaired waters in Ipswich, Massachusetts. It includes various symbols to denote different types of facilities and locations that may contribute to pollution. The data source is from the Executive Office of Energy and Environmental Affairs, MassGIS, 2007.*
Appendix B.
Egypt River Photos

May 10, 2003

Oak tree riffle looking downstream
Gravel bar riffle looking upstream

May 28, 2003
July 26, 2003

Egypt River, Gravel bar riffle (~8" of channel wetted)

Stranded eel, Bull Brook

Bull Brook channel and culvert dry

Egypt River, oak tree riffle, downstream
Most of channel exposed

Oak tree riffle, upstream
August 5, 2003

Bull Brook (plant encroachment into channel)

Northern green frog on rock along Egypt River

Oak tree riffle looking downstream
Most of streambed exposed
Photos, October 7, 2003

Egypt River downstream of footbridge
Channel exposed, no measurable flow

Photo Credits: Kerry Mackin, Ipswich River Watershed Association