Progress Report

Tri-Community Working Group

June 2004

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Glossary of Terms

ABBS – Alewife Brook Branch Sewer

Acre-Foot – the volume of water that is one foot deep and covers one acre of land

CFS – cubic feet per second of flow

CSO – combined sewer overflow

DCR – Department of Conservation and Recreation, formerly the Metropolitan District Commission

DEM – Department of Environmental Management, currently part of the Department of Conservation and Recreation

I/I – Infiltration and Inflow

MDC – Metropolitan District Commission, currently part of the Department of Conservation and Recreation

MEPA – Massachusetts Environmental Policy Act

MGD – million gallons per day

MWRA – Massachusetts Water Resource Authority

NGVD – National Geodetic Vertical Datum

Executive Summary

This progress report provides a summary of the information presented to and gathered by the tri-community working group for the purpose of understanding the flooding issues attributed to the Alewife Brook and the municipal sewer systems of Arlington, Belmont, and Cambridge. The working group is comprised of municipal employees of Arlington, Belmont, and Cambridge as well as concerned residents (Appendix B).

For two years the working group has facilitated the dialogue between residents impacted by flooding and municipal engineers and planners dedicated to solving the adverse impacts. The main areas of discussion included surface flooding, sewage overflows, public policy, and personal responsibility. Each section of this report summarizes the information as discussed and provides a series of proposed next steps.

Surface Flooding

The discussion of surface flooding included local and regional watershed characterization, local hydraulics of the Alewife Brook, and open discussions of recent flood events. The working group agreed that next steps should include collecting accurate hydrological data, evaluating certain stormwater storage sites, exploring low-impact development approaches, and maintaining channels to prevent obstructions which may exacerbate flooding.

Sewage Overflows

The discussion of sewage overflows (including backflows) included the causes of sewer overflows, current engineering efforts and the interactions among river flooding, the municipal sewer systems and the Massachusetts Water Resource Authority collection system. The working group identified a number of potential regional sewer system upgrades that merit detailed evaluation.

Public Policy and Personal Responsibility

The discussion of public policy and personal responsibility included homeowner advice on flood prevention and backflow prevention and community responsibilities. The working group agreed that next steps should include educating the public on stormwater issues and preventative actions and the general need to work regionally.

Section 1: Background

Evolution of the Tri-Community Working Group

In early 2002, The Mystic River Watershed Association, the Department of Environmental Protection and officials from Arlington, Belmont and Cambridge began meeting together to consider collaborative approaches to Alewife sub-watershed issues. As the dialogue advanced, the group began to focus particularly on the issue of flooding. By the fall of 2002 an informal working group convened to openly discuss flooding issues. The group was formed out of a shared concern for the serious impact that surface flooding and sewage backflows have in Arlington, Belmont and Cambridge. The group also recognized that both citizen activists and officials would play an important part in the political resolution of major flooding issues. Accordingly, the group's conversations have been open to all interested persons. Our goal has been to make as many people as possible that are active on Alewife issues aware of our conversations. A summary of the Mathematics of Flooding and a list of those who received our regular mailing are provided in Appendices A and B respectively.

Goal of the Tri-Community Working Group

The primary goal of the tri-community working group was to develop a consensus among actively concerned parties as to:

- What we know about the causes of surface flooding;
- What we know about the causes of sewage backflow;
- What we do not know about these issues;
- What actions should be taken based on what we do and do not know; and
- What are the priorities for further investigation.

The term surface flooding describes stormwater overflowing out of the banks of the Alewife Brook and into surrounding neighborhoods; and the term sewage backflow describes sewage rising out of plumbing fixtures and flooding basements in homes. The discussion also included the relationship between the two problems.

The discussions were focused on the areas prone to flooding within the Alewife Brook sub-watershed: East Arlington, North Cambridge, and the Winn Brook area in Belmont.

Progression of the Tri-Community Working Group

Based on the conversations we had in the Fall and Winter of 2002, we determined that a public symposium, assembling the expertise of state and federal agencies would be helpful. The following agencies participated: Federal Emergency Management Agency, the Department of Conservation and Recreation (formerly Metropolitan District Commission) and the Massachusetts Water Resources Authority. Our meetings in early 2003 were focused on planning for that symposium, which was held on April 22, 2003.

The symposium answered many questions and raised more. It served to underline both the urgency of the flooding problem and the extent of public confusion about basic factual issues. We worked through the summer of 2003 in group meetings with the presenting agencies to sort through complexities and apparent conflicts in the information available. Through the fall, we met without additional presenters to work towards an objective synthesis of “what we know and what we don’t know” and to make appropriate priorities for further investigation. This report summarizes the information. Appendix C provides a list of the presenters.

In addition to the larger group meetings, town engineers conducted several off-line meetings to compare notes and develop materials that were then discussed with the larger group. An engineering working group comprised of Arlington, Belmont, and Cambridge met and continue to meet to share information and techniques.

To date, the tri-community working group meetings have not been formal, and no votes have been taken. Definition of voting authority seemed unnecessary given that the fundamental goal of the group was to develop a consensus. However, one product of the group’s efforts has been the pending creation of a Tri-community Environmental Joint Powers Entity. The three communities hope that this agreement will serve as a useful vehicle when funding becomes necessary to further the goals of the group. Prior to instituting the joint powers agreement, the Executive Office of Environmental Affairs must approve the draft and a public meeting must be held.

Section 2: Surface Flooding

Surface flooding describes overflowing stormwater, and can be a serious safety issue during large storm events. Safety concerns are exacerbated by the potential presence of sewage and groundwater toxins.

Introduction

During the course of the working group's meetings, we heard from residents and groups whose property and quality of life have been impacted by serious flooding events. Residents of Arlington, Belmont and Cambridge chronicled the long and difficult history of flooding. The residents wanted to know the causes of flooding. In addition, residents voiced concerns regarding the presence of sewage in the floodwaters; residents wanted more information on the impacts these large flood events have on public health and how to prevent those impacts.

In order to address the questions raised by the community, the working group investigated the functionality of the Alewife Brook sub-watershed and the relationship between the Alewife Brook, the MWRA interceptor sewers, and the municipal sewer systems. This section provides a summary of those findings.

Reasons for Arterial Flooding in the Alewife

Surface flooding in the Alewife Brook sub-watershed is caused when the demand for stormwater conveyance exceeds the capacity of the system. In general terms, the Alewife is like a bathtub with a slow drain. During extreme storm events, stormwater enters the tub faster than it can drain and causes the tub to overflow. The proclivity to flood can be explained by analyzing a variety of local and regional parameters that characterize the Alewife Brook, the Alewife Basin and the Mystic River Watershed. These parameters include but are not limited to geographic size, topography, soil characteristics, urbanization (extent of development), capacity of conveyance channels, and constrictions.

Watershed Characterization

The Alewife Brook sub-watershed includes approximately 8 square miles of land in Belmont, Arlington, Cambridge and Somerville; and constitutes approximately 10% of the greater Mystic River watershed. The shape of the sub-watershed is essentially that of a bowl. The steeper sloped areas of the system characterize the western, eastern and southern fringes, and the central area is predominantly flat. The system has very little topographic relief; the primary relief point is the Alewife Brook.

In addition to topography, the principal natural hydrologic features of the watershed include various ponds: Spy Pond, Little Pond, Blair Pond, and Clay Pit Pond. At one time Fresh Pond in Cambridge was hydrologically connected to the system, but it is now divorced from the watershed and is used principally as a water supply reservoir for the City of Cambridge. Spy Pond in Arlington covers an area in excess of 100 acres and flows toward Little Pond in a culvert. Little Pond in Belmont is at the upstream end of the Little River and is 18 acres in extent. Clay Pit Pond in Belmont flows toward Blair Pond in Cambridge via Wellington Brook, which is partially in a culvert. Blair Pond is connected to Little Pond/Little River by the continuation of Wellington Brook.

Urbanization of the sub-watershed communities has fundamentally changed the natural hydrologic characteristics of the area. Natural detention and storage of stormwater has been largely eliminated and replaced by impervious surfaces with constructed drainage systems. It is important to note that the Alewife Brook area has always experienced flooding, even prior to the development of the contributing municipalities. Subsurface investigations have revealed a relatively shallow layer of clay around the Brook. This clay layer presents an impenetrable barrier for infiltration and also causes the ground water table to be high.

It should also be noted that the extent of development has increased the demand on the constructed drainage system. Movement of peak stormwater discharges through the system is limited by the conveyance rate and capacity of the trunk line pipes. As a result of flat topography and limited conveyance capacity, ponding and flooding problems occur throughout the municipal system. These areas may not have experienced flooding in the earlier history of this watershed. In summary, the natural flashiness of the system is exacerbated by the extent to which the area has been urbanized over the past century. This has resulted in fundamentally altering the natural runoff characteristics of the system. Thus, during large storm events, more significant flooding is experienced along the Brook itself, as well as upstream of those areas where the constructed drainage systems are inadequate to provide conveyance for the peak discharges.

Alewife Brook Hydraulics

At the base of our bowl shaped sub-watershed is the Alewife Brook. The Alewife Brook system extends from Little Pond to the confluence with the Mystic River. The Brook is approximately 2 1/3 miles long and drops only 3 feet in bed elevation along its length. In other words the average slope of the channel is approximately 1:4,000. The steepest section is between the Alewife MBTA Station and the Mystic River.

In addition to the urbanized nature of the catchment and the flatness of the channel, the capacity of the Alewife Brook system is further impacted by a loss in its cross sectional area due to silt deposition. Survey work conducted by the City of Cambridge in 2000 showed that almost 1 foot of sediment has accumulated in the channel between the MBTA Station and the Massachusetts Avenue Bridge when compared with a 1981 survey prepared by Camp Dresser and McKee (CDM) for the Metropolitan District Commission (MDC), now called the Department of Conservation and Recreation (DCR). This sedimentation problem is noticeably evident in Blair Pond as well.

Characterizing the conveyance limitations of the Alewife Brook would not be complete without exploring the potential constrictions posed by the numerous bridges and channel crossings. The narrowest and most restrictive bridges are the Route 2 bridge, the Massachusetts Avenue bridge and the Broadway bridge. Another restriction in the system is the railroad and MWRA interceptor crossing of the Wellington Brook downstream of Blair Pond.

When bridges are being designed today, they are designed to allow unobstructed conveyance of the 100-year storm event. In the case of the Alewife Brook, the current 100-year flood elevation is estimated to be 8.2 feet NGVD. The height of the Route 2 and the Massachusetts Avenue bridges are 5.68 NGVD and 7.53 NGVD respectively. These bridges were designed prior to the establishment of this design standard and therefore represent constrictions below the presently established design standards.

The MDC commissioned CDM to undertake a study of the Mystic River Hydrology and Hydraulics, which included the Alewife Brook in 1981. The consultants concluded that there would be only a 0.4-foot headloss between the upstream side of the Massachusetts Avenue Bridge and the downstream side of the Broadway Bridge during a 50-year storm event. CDM further concluded that there may be occasions when the widening of these bridges would exacerbate flooding upstream of the bridges, given the magnitude of the stormwater backflow contributed by the Mystic River.

The railroad and MWRA interceptor crossing of the Wellington Brook is a significant restrictor to large flows from Blanchard Road and the Clay Pit systems in Belmont. There is evidence that this restriction causes blockages and back ups of the Wellington Brook system as it flows to the Little River. The result is serious flooding in the Hittinger Street area of Belmont and areas adjacent to Blanchard Road in Cambridge. In addition, debris accumulation, such as that which was recently removed at the Craddock Locks by the MDC, can contribute to back ups in the river system.

The flooding experienced by people living near the Brook will vary depending on the duration and intensity of the particular rainfall event. Alewife Brook is a flashy catchment, and responds quickly to intense rainfall events. Therefore, during intense short duration events, the flooding experienced along Alewife Brook is typically a result of inadequate conveyance capacity in the Brook. The Mystic River is a system that exhibits a slower response. During a longer duration event, the Alewife Brook is further impacted by the tailwater of the Mystic River.

Direct abutters to the Brook, residents of the Sunnyside neighborhood and near Lafayette Street and Boulevard Road in East Arlington, experience frequent flooding. Existing drainpipes behind the East Arlington Sunnyside neighborhood appear to exacerbate the flooding problems. The backflow of water through the pipes creates a pond that forms at the low point on the downstream end of Sunnyside's back alley, prohibiting access and use of the alley (an easement of private property) and all the rear private parking spaces and rear entries to houses. The edge of the bank acts as a berm between this pond and Brook and is the only visible land at times, before the entire bank overflows. Back flow preventors on each pipe outlet may stop the backflow of water and the excessive ponding.

It is important to note that the Amelia Earhart Dam is believed to have adequate pumping capacity. The Dam, constructed in 1981, is capable of pumping 4,200 cubic feet per second with three pumps working together, operated as recommended by CDM's 1981 Comprehensive Flood Study, the dam is capable of reducing 50-year flood event flood levels by almost one foot in Alewife Brook.

Recent Flooding History

There exist a variety of different flood measurements from a variety of different sources concerning the magnitude of the recent events along the Little River and Alewife Brook. Those interested have had to rely on hearsay, video evidence, debris surveys and photographs taken at various stages during the events, rather than that information typically used by hydrologists, scientists and engineers when studying storm and flood events. Typically, hydrologists use spatially and temporarily varied rainfall information together with stage (elevation), and stage – discharge relationship information to develop a profile of a river system. That profile provides information relating to rainfall – runoff relationships, the flashiness of a river, and the statistical distribution that best describes flood frequency. This information is needed to inform risk analysis when considering development and system changes within the watershed.

There have been three major flood events since the mid 1990s: the October 1996 storm, the June 1998 storm, and the March 2001 storm. The three events were distinctly different from a rainfall intensity/distribution perspective. The October 20-21st 1996 event was a long duration event of medium intensity. During the initial stages of that storm as measured at Logan Airport, the average intensity was approximately 0.4 in/hr. After 7 hours, this reduced to approximately 0.2 in/hr for a further 19 hours, amounting to approximately 8 inches of rainfall over a two-day period. The June 13th 1998 storm followed a particularly wet late spring. A total of almost 7 inches fell over two days, the majority of that falling over the late morning and afternoon hours of Saturday June 13th. The March 21-22nd storm of 2001 occurred when over 3 inches of rain fell when a saturated snow covered watershed with the consequence of creating a significantly higher volume and rate of runoff than typical. Unfortunately, the primary source of rainfall information heretofore has been Logan Airport in Boston. However, stations at Cambridge Public Works, Somerville Public Works and Cambridge Water Department, thus providing more spatially diverse sources of information, now supplement that station. Beyond these sources, satellite tracking can further supplement and, with appropriate goodness-of-fit techniques, more accurately depict rainfall as it moves through the area.

There has been considerable controversy and disagreement among the various interested parties concerning flood elevations associated with these storm events along the Alewife Brook. The US Army Corps conducted field debris surveys after the October 1996 storm. The Corps itself expressed concern about the accuracy of this information. The Alewife Neighbors Inc. engaged Bruce Jacobs to investigate flooding after the events of 1996 and 1998. He referenced and also questioned the US Army Corps survey of the 1996 flood. The MDC engaged CDM to update and reexamine flooding along the Alewife Brook in 2002. The City of Cambridge, as part of its sewer separation and stormwater management efforts, has spent considerable energies since 1998 measuring and examining the rainfall and runoff within and along the watershed. This investigation included measuring and examining the rainfall and runoff within and along the watershed based on metered data as gauged from gauging stations upstream of the T station footbridge on the Little River (since 2001) and upstream of the Massachusetts Avenue bridge on the Alewife Brook (since 1998). In addition, Steve Kaiser independently monitored these storms, and his estimates provide further information concerning the relative magnitudes of historic flood events along the river, more details are provided in Appendices D, E, and F.

At the end of October/November 1996 the Army Corps reconnaissance teams recorded debris levels along the Alewife Brook. Only three marks were recorded in their subsequent report to FEMA. They indicated a discrepancy between the upstream and downstream elevations when compared with an expected return period perspective. The elevations and discharge estimates were 8.86 and 8.97 NGVD within the Arthur D Little Complex with an estimated discharge of 575 cfs, while the downstream debris elevation recorded at Bicentennial Park in Arlington immediately adjacent to Massachusetts Avenue Bridge was 5.65 NGVD, and this elevation was consistent with a flow of approximately 300 cfs.

Steve Kaiser using contour maps and his own records of the event of October/November 1996 states that the water level within Arthur D Little property was approximately elevation 7.0 feet NGVD for this 50-year storm event. The MDC report prepared by CDM generated river elevations using the SWMM hydraulic model also predicted elevation at 7.0 feet NGVD.

For the 1998 event, Steve Kaiser indicated that his estimation of the peak elevation was 6.3feet NGVD at Massachusetts Avenue and 6.5feet NGVD upstream of Route 2. No other surveys were conducted during that storm. After this event, the City of Cambridge installed a gauge immediately upstream of the Massachusetts Avenue Bridge so as to further monitor the river during large storm events. During survey work conducted in association with the City of Cambridge CAM004 sewer separation project, two residents in the Lafayette Street area of Arlington pointed out their recollections of the maximum elevations of floodwaters during the 1998 storm event. These elevations were computed as 7.2-feet and 7.6-feet NGVD. Concern was voiced as to the accuracy of that survey and of the reference USGS datum used. This was subsequently checked as a first order USGS datum point and furthermore another survey by a professional surveyor, employed by the City of Cambridge, validated this datum when closed with a survey to an adjacent datum point.

Finally, in March 2001, the City gauge recorded a stage elevation of 5.28 feet NGVD upstream of the Mass Avenue Bridge, while Steve Kaiser recorded an elevation of 6.2 feet at the same location, with a corresponding Route 2 flood elevation of 6.4 feet NGVD. The MDC SWMM model in this instance computed elevations of 3.58 feet NGVD and 4.78 feet NGVD at Mass Ave and Route 2 respectively.

The City of Cambridge has since installed another meter at the Pedestrian Bridge upstream of Route 2 so as to better establish elevations at this location and better understand the hydraulics within these reaches of the river.

Next Steps

Hydrological Data: Metering and Gauging Information

Members of the working group have been vocal about the lack of useful data relating to historical storms along the Little River/Alewife Brook. There is no continuous water elevation monitoring data except for that which the City of Cambridge has recently begun to gather. The Town of Belmont gathered stage information at Little Pond for a considerable period of time by manually measuring depth during large storm events. However, due to personnel constraints in recent years, collecting data has become increasingly more difficult. Similarly, there is very limited information on the local rainfall history in the Alewife watershed. People generally tend to depend on Logan Airport data, which might be very different from rainfall timing, intensity and extent at Alewife. At present, there is no central repository for hydrological data that relates to the Alewife Brook. Thus, estimates for large return period storms may not be completely reliable. Our statement that the 100-year flood event stage elevation in Cambridge adjacent to the Alewife Brook is 8.2 feet NGVD, is based on ungauged catchment hydraulic analysis. Therefore, the standard error associated with the estimate is relatively large.

Some members of the tri-community working group also questioned the accuracy of the finding in the CDM report described above. These members are concerned that the headloss is likely to be greater due to the reduction in width of the Alewife channel at the Broadway Bridge (33 feet to 12.5 feet) and the Massachusetts Avenue Bridge (33 feet to 14 feet). Additional data is needed to develop a well-calibrated model to fully examine the impacts of these restrictions.

Any improvements that convey more water beyond the bridges may exacerbate flooding conditions downstream of the restrictions. Data needs include flow metering, brook level and rainfall information. In addition, given the significant impact of the Mystic River tailwater on the Alewife Brook during long duration storm events, any inlet restrictions removed by widening of the various bridges should be weighed against the dampening effect caused by the Mystic River and potential to move flooding to other locations. Particular attention should be given to the area surrounding the neighborhoods of East Arlington, where people have experienced hardship as a result of current flooding conditions.

To address the need for better data, the tri-community working group is proposing to support and seek funds to undertake a monitoring program to measure flow and elevations of the Alewife Brook. The objectives of the study would be to:

- Conduct an authoritative elevation survey
- Install water elevation gauges at key locations
- Provide visible markings to facilitate volunteer flood elevation observations
- Create a mixed municipal and volunteer operation to monitor flood measurements
- Create a publicly accessible repository of measurements to support analysis.

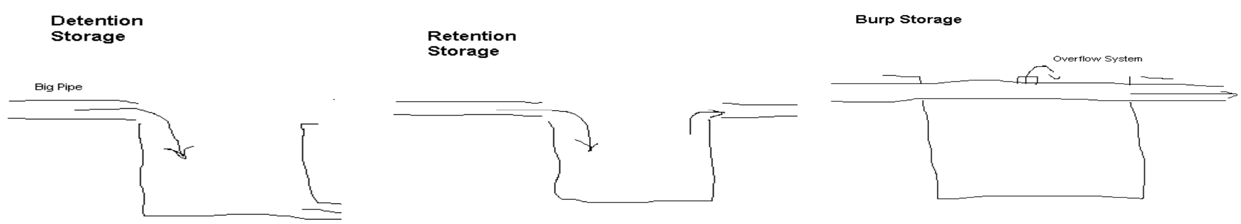
Storage Alternatives

Considerable time was spent within the tri-community working group, as well as, in separate meetings among engineers representing the three towns discussing alternative flood protection storage options along the Brook and within the broader Alewife catchment area. There are a variety of different ways to store water within a watershed, and the storage method employed depends on the reason for storing water in the first place. These methods are referred to as Detention, Burp and Retention storage.

Occasionally people store water for water conservation purposes, on other occasions water is stored so as to allow the most polluted first portion of runoff to be captured and allow the particulate matter to settle out, thus removing the majority of those first flush pollutants. In the case of the Alewife watershed our primary concern is to prevent flooding, and the storage objective is to store that portion of the storm that will cause the most flood damage; the peak discharge portion of the storm.

Some storage areas are more effective in preventing flooding than others, because of the type of storage provided as well as the size of the storage area. Simply creating more areas where water collects does not necessarily reduce flooding at the peak of a storm, if those areas are full of water before a storm begins or would fill with water before the peak of the storm. Detention and Burp storage are sensitive to the peak of the storm and thus have the greatest impact on flooding conditions during the critical point of the storm. Generally, the most efficient types of flood storage are referred to as detention and burp type storage systems because they are sensitive to the peal of the storm. Retention storage is storage that is filled during the initial phases of a storm, prior to the threat of flooding and of little benefit to address flooding.

Detention storage devices will allow water to continue to run through the device but with a smaller outlet capacity than inlet capacity. The difference in the flows is then captured/stored to hold the difference in inflow and outflow over a period of time. Burp storage is similar to detention storage but the storage system is off-line and will only be utilized when the conveyance capacity of the pipe system or open channel is surcharged or overtopped at which time the burp storage system will begin to fill and it will only allow water back into the system after the event has passed.



One proposal to provide storage is to lower Spy Pond and Clay Pit Pond in advance of a rainfall event, similar to the protocol used in lowering the level of the Mystic at the Dam prior to the onset of a predicted heavy rainfall. Both of these ponds would provide temporary storage, the effectiveness of which would depend on the extent to which the ponds were lowered prior to the onset of an event, the inflow into the system, and the degree to which the outflow was controlled. Considerable storage is potentially available in Spy Pond. Lowering the level of Spy Pond by one foot prior to a storm would generate approximately 32.5 million gallons of retention storage. Substantial storage quantities could also be achieved in Clay Pit Pond, which would assist in relieving flooding both upstream and downstream. Belmont High School, Hittinger Street and Blanchard Road areas would benefit most from lowering the elevation at Clay Pit Pond prior to a storm event. Considerable efforts would be required to determine the appropriate drawdown levels and outflows, as well as the recharge, water quality and ecological issues involved.

Interest was also articulated by some members of the tri-community working group concerning the provision of storage at the former MDC Skating Rink in Belmont, the ADL Parking Lot in Cambridge, and in other open or under-utilized spaces. Appendix G presents a preliminary list of potential storage locations in the Alewife area, prepared for the former MDC.

Of the options considered, lowering Spy Pond and Clay Pit Pond prior to a storm event appear to have the greatest potential for detention storage. Options involving storage at the former MDC Skating Rink, the ADL Parking Lot, and other underutilized spaces may possibly provide additional flood storage.

The tri-community working group proposes to seek funds to obtain better flow and pond measurements to evaluate and model the effectiveness of using Spy Pond and Clay Pit Pond for storage during large storms.

Low Impact Development Alternatives

In many locations throughout the Country and in many parts of Europe where water quality and quantity issues are of similar importance, communities have begun to embrace Low Impact Developments (LIDs). LIDs are alternative strategies of incorporating hydraulic, hydrologic and bio-technological strategies on a micro scale to address development and redevelopment impacts on water quality and runoff problems. These strategies require a more holistic approach to water and a commitment on the part of neighborhoods to connect with their watersheds and accept different streetscapes and landscapes, which are more sympathetic to the overall health of the watershed.

The techniques address temporary storage, sediment control, and regeneration of groundwater, and phytoremdiation. They can be incorporated in new and re development projects as well as in street, and drainage reconstruction and remediation projects. Techniques include swales, bio swales, rain gardens, green roofs etc., as well as a myriad of other methodologies for slowing water down, cleaning it and controlling it in natural ways so as to minimize harm to it and its harm to property and homes. LIDs are discussed further in Section 4.

Maintenance

It is imperative that the various agencies responsible for the maintenance of local and regional drainage systems implement comprehensive routine, capital and emergency maintenance programs. Municipal maintenance programs should at a minimum ensure that drainage systems are structurally sound and that conveyance capacities are not diminished by sediment, debris and obstructions. In addition, each municipality has the responsibility to ensure that municipal catch basins are cleaned frequently, that their major drainage arteries are frequently and systematically checked to ensure that no blockages or potential blockages exist, and that no inappropriate materials are being conveyed into the Brook or its tributaries. Each community should identify all potential blockage locations and have them checked frequently. Adequate resources need to be available to provide immediate relief in the event a blockage occurs.

Similarly, it is the responsibility of the Department of Conservation and Recreation to ensure that all of the various bridges, locks, dams and pumps are properly operated, maintained, and kept free from constrictions. Routine, structural, mechanical and maintenance inspections of all of the various structures and channel elements of the river should be conducted and recorded. Again, it is critical that appropriate emergency provisions are in place to be able to address and alleviate potentially serious flooding problems due to mechanical failures and obstruction of flows.

All of the communities in the Boston metropolitan area have problems with old stormwater and sanitary sewer infrastructure. Past expenditures to repair and replace pipes have generally not been sufficient to prevent deterioration of the sewer infrastructure. The federal stormwater regulations are requiring that all municipalities investigate and, where necessary, repair their sewers to reduce pollution of surface waters. These efforts should have positive effects on flooding and/or on the level of contamination in floodwaters. Some actions that are already being taken to address inadequate sewers are discussed in the next section.

Each community should consider a long-term capital maintenance program, to address existing problems and to maintain their systems over time. For example, over the long term, a municipality might plan to repair or replace 5 percent of its sewers each year, resulting in a complete repair/replacement of its system every 20 years. It is important that residents be aware of the need for substantial investments in sewer infrastructure, and supports these efforts in their budget decisions.

Other Flood Reduction Alternatives - Not Embraced

In considering the various possibilities to improve the situation for people living adjacent to the Little River/Alewife Brook some other typical flood protection alternatives that merit discussion, but were not embraced by the group include: construction of flood protection berms or levees, widening of the conveyance channel, and dredging the existing channel.

Berms

Berms and levees have a long history of use throughout the United States and Mainland Europe. The practice provides for the construction of levees and berms adjacent to properties of value thus protecting them from inundation during flood events. As a consequence of building the berms you allow more water to be conveyed through the open channel system. In the best-case scenario you protect low lying areas and make more use of downstream and upstream channels where there is additional underutilized capacity. Similarly, where areas of less value exist, you protect the high value areas with berms and allow more significant flooding in the adjacent low-lying areas within the watershed along the rivers. Unfortunately, in the case of the Alewife Brook, given the extent of development and the nature of the flood plain in the area, constructing a berm along the brook will cause flooding in some other area along the brook/watershed.

Initially, the MWRA and Cambridge in their sewer separation project for the CAM004 area proposed a berm in Arlington immediately upstream and to the west of Massachusetts Avenue. However, because of regulatory and hydraulic reasons this proposal was ultimately rejected. If the berm were constructed the Wetland Protection Act regulations would require the replacement of an equivalent amount of lost flood plain within the same hydraulic reach along the Alewife Brook as was lost due to the berm construction. Furthermore, construction of the berm could potentially increase the peak, rate of conveyance, bank erosion, and/or increase the extent of the flood as a result of a reduced cross sectional area available for conveyance.

Some working group participants that a berm could be constructed between the Sunnyside area in Arlington and the Alewife Brook have also expressed interest. In this situation it is believed that the compensatory storage necessary to meet the Wetlands Protection Act requirements could be found in the MDC playing fields at Dilboy Field.

Channel widening

Widening the river channel would allow more floodwater to be conveyed through the Alewife Brook. However, the existence of the various bridges along the Alewife Brook and the conditions of the downstream receiving waters need to be considered. Widening of the Alewife Brook channel would only be able to provide some temporary additional storage. Flow capacity would still be limited by the various bridge constrictions. If the bridge constriction issue were solved we would now be conveying a larger peak discharge to the Mystic River and thus potentially change flood elevations in that river.

Dredging

Dredging is also a tool used to enlarge and improve conveyance in river systems. However, in the instance of the Alewife Brook, dredging the channel would be of limited benefit because the Amelia Earhart Dam ultimately controls the system. Before the onset of a flood event any additional channel area provided by the dredging would already be occupied with water and thus not available for flood storage/attenuation.

Section 3: Sewage Overflows

Introduction

Interactions between the stormwater drainage system and the sanitary sewers contribute to contamination of Alewife Brook and other water bodies by sewage. This is a significant problem especially during floods, because residents may be exposed to the contaminated floodwaters. Section 4 of this report makes recommendations on how residents can protect themselves from contact with polluted floodwaters. This section discusses efforts to reduce contamination of the waters.

In general, there is adequate capacity to convey sewage in all of the sanitary sewers, but the amount of stormwater in the sanitary sewers combined with the sewage may exceed the system capacity, causing backups and overflows of contaminated stormwater into Alewife Brook. In addition, pipes that are in poor repair result in inflow and infiltration (I/I). Infiltration refers to groundwater seeping into sewer pipes, and inflow refers to stormwater runoff pouring into sewer pipes. Infiltration may occur during dry weather as well as during storms whereas inflow occurs primarily during storms. The nature of interactions between the stormwater and the sanitary sewer systems depends on whether there is a combined or a separate system. In a combined system, stormwater and sewage are transported in the same pipes. A separate system has separate sanitary and stormwater sewers, which are often located next to each other.

Arlington, Belmont and Cambridge contribute to the Massachusetts Water Resources Authority (MWRA) sewage collection system. Belmont and Arlington have separate sewer and stormwater systems, while Cambridge is one of five communities in the Metropolitan area that has a combined sewer system, contributing both sanitary waste and stormwater flows to the MWRA's interceptor pipe system. The MWRA large diameter interceptor trunk pipelines flow primarily by gravity in the Alewife area. The interceptors extend from the Belmont - Cambridge border north of Blair Pond and run parallel and along the southern bank of the Alewife Reservation to the MBTA station. There they connect with lines conveying flow in MWRA pipes that start at the Alewife Rotary (at the Ground Round in Cambridge). From the MBTA station the lines continue in a northerly direction along the Alewife Brook until they reach the confluence of the Alewife Brook with the Mystic River. Here the system connects with MWRA's 18" Lexington interceptor lines and flow is lifted through the MWRA Alewife pump station and is then conveyed by gravity in large gauge pipes adjacent to the Mystic River until it gets down into the greater Boston Harbor basin and eventually to the Deer Island treatment facility.

There are eight combined sewer overflow structures (CSOs) located in the City of Cambridge that provide relief to local combined sewers and the MWRA's interceptor systems during wet weather events. Six of these belong to Cambridge; one belongs to the MWRA, and one to the City of Somerville. CSOs discharge untreated sanitary waste mixed with stormwater into the Alewife Brook during larger or more intense rainfall events. Currently there are approximately 13 CSO events and approximately 22 million gallons of combined sewage discharged into the Brook during the average year as indicated by the MWRA system hydraulic model.

A goal of the tri-community working group is to assess the hydraulic connectivity between the river and the sewer pipe lines and to determine the causes for sewer surcharge conditions on streets and in basements in the Winn Brook area of Belmont, New Street and Bay State Road areas in Cambridge, and Boulevard Road and the Sunnyside areas in East Arlington, as well as, other low lying areas in the three communities. The analysis for the revised Long Term CSO Control Plan for Alewife Brook proposed by the MWRA was reviewed through the MEPA process. While not the focus of the tri-community working group, it is important to acknowledge the significance of combined sewage contamination in floodwaters resulting from Combined Sewer Overflows and the consequent potential impact on those who live within the floodplain.

Sewage Overflows on Streets and in Basements

During certain storm events, residents in low lying areas of Arlington, Belmont and Cambridge experience sewage rising up through plumbing fixtures in their basements, and in some locations sanitary manholes overflowing onto adjacent roadways. To understand this phenomenon, the tri-community working group explored the relationship between the various sewer systems and their hydraulic connectivity, most particularly when it rains. Detailed presentations were made to the group by the MWRA and the City of Cambridge. The MWRA presentation concentrated on the nature of the MWRA infrastructure in the area, level of service issues, and the degree to which the MWRA sees opportunities in the immediate future for improving service levels to the communities. The City of Cambridge presentation concentrated primarily on further evaluations of the Cambridge combined sewer system. The evolution focused particularly on those areas other than the Fresh Pond/Concord Avenue/Huron Avenue area (CAM004) that was already evaluated as part of the MEPA process for the MWRA's revised Facilities Plan. The City of Cambridge, working with the Charles River Watershed Association, also presented a hydraulic modeling analysis demonstrating the ineffectiveness of rain barrels on private property as combined sewer overflow (CSO) and flood control devices.

The following information was presented and discussed:

- Sewer surcharging occurs in the MWRA system during rain events as small as a 3-month storm. CSOs are required on the system to relieve the system so that it doesn't back up into people's basements.
- Many local sewer systems can't handle 1-year 6-hour storm conditions due to inflow.
- Where there's a separated system, the MWRA tries to provide an acceptable level of service for a 1-year 6-hour storm.
- Potential system capacity improvements being implemented or are under review by the MWRA include:
  - Removal of Tannery Brook from the MWRA interceptor (under review). This system carries CSOs from combined systems upstream in Somerville that would require sewer separation.
  - Cleaning of the system (completed)
  - Increasing the capacity of the MWRA pump station from 60 mgd to 75 mgd (under review) **Note:** 60 mgd is 5 times the average daily flow through the Alewife pump station.
- MWRA made a commitment to reevaluate their existing system to ensure they are working as efficiently as possible and will evaluate the potential to increase the Alewife Pump station capacity beyond 75-mgd and to provide further cleaning of the system to ensure the conveyance of the maximum possible discharge.
- MWRA will provide their new hydraulic model to individual communities to allow independent analysis of the relationship between the community and the MWRA system.
- Rain barrels have no meaningful flood reduction benefit or CSO reduction benefit, because they fill up early in a storm and cannot store additional water at the peak of the storm event.
- Sewer separation of the CAM002 (North Massachusetts Avenue) area would require retention storage to ensure that post-peak discharge conditions to the Alewife Brook does not exceed pre-peak discharge conditions.
- In addition to CSO structures providing relief to the interceptor and combined sewer systems, CSOs allow two way hydraulic communications between the interceptors, the municipal systems and the river. During significant events river water can be conveyed back into the sewer systems through the CSO regulators. As a result, sewer surcharge conditions may not necessarily be due to inadequate conveyance capacity, but rather it could be due to river system inundation of the local and regional sewer systems. This occurrence of river inundation of the sewer systems requires further review prior to taking measures to keep this from happening. The primary concern voiced here being the elimination of the additional conveyance capacity presently afforded runoff through the interceptor system and the consequent adverse impact on river elevations as a result of the elimination of this interceptor sewer capacity to the river.
- Elevation of the Belmont sewer pipes in the Winn brook area is very close to the elevation of the connection to the MWRA interceptor system. Therefore, these flat pipes have difficulty pushing flow through when the MWRA system is surcharged.

The tri-community working group agreed to work with the MWRA to further evaluate the relationship between the sewer and river systems as it impacts Belmont residents in the Winn Brook area and the other low lying properties in the three communities.

Questions remain as to the extent to which inflow and infiltration removal alone will resolve the surcharge situation in the community system. The MWRA Flood Forum presentation suggested that, during a rainfall event in the Spring of 2000, the flow increase in the sewer system in Belmont in the area adjacent to Winn Brook was in the order of 4 times dry weather flow. In reviewing the profile of the Alewife Brook interceptors during the one-year event simulation, it is noteworthy that in a number of locations the hydraulic grade line is within two feet of the ground surface. One possible relief mechanism that could be reviewed when other optimization options are being considered by the MWRA is the placement of a sanitary pump station along the MWRA Belmont lines. In order to make this attractive as an option, the inflow percentage should be aggressively reduced, thus reducing the size and expense and location obstacles associated with siting a pump station.

Better metering of sanitary systems is necessary in order to support analysis of proposals mentioned above, to identify local problems, and to identify potential benefits to opening CSOs sooner. Cambridge currently meters the flows in their sanitary systems. To help gather data, Cambridge installed two flow meters, one in Arlington and one in Belmont for 6 weeks. Results from these meters indicate that inflow and wet flows in the interceptor have an adverse impact on service levels. However, given the limited duration of the metering and the lack of significant storm events during the metering, it is impossible to reach firm conclusions from this effort. Arlington and Belmont would benefit from initiating a local metering program in their system. The metering data would allow both Arlington and Belmont to better query the MWRA model with specific input from their communities.

Current Efforts to Remove Inflow and Infiltration

To address existing Inflow/Infiltration problems in the sanitary systems, the town of Arlington has recently replaced 255 linear feet (lf) of 8" sanitary sewer, 100 LF of 15" stormwater drains, relined of 420 LF of 18" stormwater drains, cleaned 575 LF of 8" sanitary sewer, joint tested 192 units of 8" sewer, and sealed 153 units on streets in east Arlington.

The Town of Belmont has had a longstanding program of removing I/I. Their current contract includes construction of approximately 5,825 linear feet of new 10-inch, 12-inch and 15-inch PVC and RCP storm drains and appurtenant catch basin and drain manhole structures; installation of approximately 7,340 linear feet of 6-inch drain service laterals connecting to new or existing storm drains; replacement of up to 3,390 linear feet of 6-inch sanitary service laterals; disconnecting existing sump pumps from sanitary sewers and connecting to new drain service; capping existing open pipes; installing a sump and approximately 90 sump pumps in private homes and connect to new drain service; and appurtenant restoration work.

The City of Cambridge is predominately a combined sewer community. Cambridge is working with the MWRA to separate a portion of the combined sewer area in Alewife, which will eliminate a significant contribution of stormwater from the MWRA interceptor system. Sewer separation is proposed to begin in 2005 in the CAM004 and the CAM400 areas. In areas that are currently separated, Cambridge has eliminated 16 common manholes in the Alewife area that convey stormwater to the sanitary system when it rains. Another 3 common manholes are scheduled for separation during 2004 and another 21 are in the design phase. Cambridge is also involved in a multi-phased stormwater management project around the Fresh Pond golf course that involves cleaning and lining existing stormwater lines and the design of storage swales and other options to limit the extent of flooding.

Next Steps

The tri-community group should make a formal request to the MWRA regarding specific system optimization and evaluation measures, such as:

- Evaluate the impacts to the sewer systems, river elevations and system operations of installing flap gates on CSO structures to eliminate river inundation of the sewer system.
- Incorporate Alewife Brook elevations into sewer system modeling to better reflect river flow into the interceptor system.
- Evaluate increasing the Alewife Pump station capacity beyond 75 mgd
- Provide cleaning and inspection of the interceptor system on a regular basis to ensure conveyance of the maximum possible discharge.
- Evaluate the impacts from the proposed MWR003 modulating gate on the low lying areas in the Hittinger Street/Winn Brook area of Belmont to ensure protection of this area.
- Evaluate the placement of a sanitary pump station along the MWRA Belmont lines to reduce surcharging in low-lying areas in Belmont.
- Clarification as to the condition of the two siphons under the Wellington Brook and assurances that they are constructed in such a way so as not to unduly increase head loss.

- Report back to the communities on the status of MWRA's review to remove Tannery Brook from the MWRA interceptor.

The engineering departments of the tri-communities should continue to work together and share information, specifically:

- Each community should continue to reduce inflow and infiltration in their sanitary system and inspect and clean their systems to ensure conveyance of maximum possible discharge.
- The engineers should continue to meet on a semi-annual basis to discuss current efforts, system information and proposed future efforts within the watershed.
- Arlington and Belmont should develop a sanitary sewer-metering program and install meters within their communities.
- Maintain communications with MWRA as they proceed with their modeling efforts.
- Ensure that MWRA cleans and inspects their system on a regular basis.

Section 4: Public Policy and Personal Responsibility

Introduction

As previous chapters make clear, there are no simple or easy answers to the problems of flooding in the Alewife. A variety of players have to make both short-term and long-term changes in their actions to reduce the problems presented by flooding. Many of the actions involving engineering and floodplain management have been discussed in previous chapters. This chapter discusses what residents can do, both to protect them from flooding and to reduce their own contribution to flooding. The chapter also discusses actions communities can take to educate their residents about the problems and hazards associated with flooding. Finally, this chapter discusses actions communities as a whole can take to reduce flooding or to prevent increased flooding in the future, through their land use and development policies.

The following matrix lists the kinds of actions both homeowners and municipalities need to take to deal with flooding:

	Homeowner	Community
Reduce Stormwater Runoff	X	X
Maintain/Increase Capacity of Sewers	X	X
Increase Stormwater Storage	X	X
Reduce Pollutants in Stormwater	X	X
Reduce Basement Flooding and Backflow	X	X
Prevent Exposure to Contaminated Floodwater	X	X

Homeowner Self-Help

There are a variety of things residents, as potential victims of flooding, can do to reduce the damages caused by floods. Essentially, these include reducing the potential for flooding of basements, reducing the potential for sewage backflow into home plumbing, and reducing exposure to contaminated floodwater should flooding occur. This section provides a brief overview of the self-help actions residents can take. Appendices H through K provide more detailed information.

Actions to Prevent Basement Flooding

FEMA's *Homeowner's Guide to Retrofitting* (June 1998) provides information on a variety of ways to retrofit your house to prevent flooding damage – all the way from moving your house or elevating it above the flood level to waterproofing your basement and installing check valves. See Appendix I for information on obtaining this guide.

<u>Waterproofing or sealing cracks in the foundation.</u> Commercial firms will waterproof your basement. Waterproofing can be done from the inside or from the outside. A persistent and able do-it-yourselfer can do this by digging a trench around the outside of the house and applying suitable waterproofing materials. This takes a good deal of time and effort, however.

Some residents use sealers for inside leaks that may have been there for quite some time, or holes that suddenly burst open (usually at the base of the cellar wall where pipes enter or at the base of the bulkhead stairs). These projects may seal the leak, but could also simply divert the leak for a persistent problem.

FEMA's *Homeowner's Guide to Retrofitting* provides information on more extensive waterproofing methods, as well as cautions about when waterproofing could increase risks of damage to your basement walls.

<u>Direct downspout drainage away from the home</u>. It is important to have runoff drain away from basement walls, by using drainpipes that are curved out at the bottom and by landscaping to drain away from the house. Extensions can be connected to the drainpipes to move water further from the house, or they can drain into a piece of gutter or purchased units that fit under the bottom of the drainpipe, carrying water away from the house. Runoff from the downspouts can also be directed to an underground dry well. (See the discussion below.)

<u>Install sump pumps</u>. Many local residents have sump pumps in their basements. In the Alewife sub-watershed, particularly, residents may have two and even three sump pumps. The capacity needed depends on the height of the water table and the elevation of the site. These pumps pump out water that collects in the low part of the basement. Be sure to pump the water away from the house and do not pump water directly into the storm drains, since this adds to amount of stormwater in the system.

Actions to Prevent Sewage Backflows

Install check or shut off valves. These valves are set in the building sewer line close to where it exits the structure. Wastewater is allowed to flow out of the house, but cannot reverse itself when the municipal sewer system is surcharging and flow back into the house. You must have approval from the local Department of Public Works before installing such a valve.

Raise or remove basement plumbing fixtures. Some homes have toilet fixtures, sinks and washing machines in the basement that may back up during rainstorms due to backflow from sewers. Toilets can sometimes be plugged with a heavy weight, but it is preferable to raise the fixtures to a higher level or to remove them entirely if they are not absolutely necessary fixtures.

Actions to Avoid Damages and Public Health Risks Limit valuables at risk. Residents who know their homes are subject to basement flooding should be careful to store valuables in a dry place. Even a small amount of moisture can be damaging to unprotected articles and materials. Storing things in heavy plastic bags or hooking up and using a dehumidifier will help to keep things somewhat dryer, but are unlikely to prevent damage during flood events. Long-term storage, even in a relatively dry basement, can cause mustiness. Carpets on the floor that tolerate water do not dry underneath. Residents might also want to move their washer and dryer and hot water heater upstairs, to avoid damage to this equipment during floods.

Raise the basement floor level. Creating a false basement can isolate living areas from floodwaters. More extensive work to elevate the entire structure is described in FEMA's *Homeowner's Guide to Retrofitting*. (See Appendix I)

Avoid contact with contaminated floodwaters. Floodwaters can contain a variety of contaminants from sewage, including disease-causing agents (pathogens including bacteria and viruses), toxic metals, and toxic organics. In general you should avoid direct contact with floodwaters – keep children from wading, and wear boots, eyewear and gloves when cleaning up.

Clean and disinfect areas that are exposed to flooding. You will need to clean and disinfect any areas that are exposed to floodwater, inside and possibly outside. Guidelines for cleaning up provided by the Mass. Department of Environmental Protection and the Mass. Department of Public Health are provided in Appendix H and are also available at http://www.state.ma.us/dep/brp/stormwtr/files/flooding.htm. These guidelines discuss methods for cleaning up inside and out, as well as prevention measures.

Obtain flood insurance. Your homeowners insurance probably does not cover flood damage. Some private insurers offer flood insurance. In addition, the National Flood Insurance program (NFIP) provides federally backed insurance, sold through private insurance agents and companies, with standard coverage and rates. If you are located in a Special Flood Hazard Area (SFHA) shown on a FEMA Flood Insurance Rate Map, you may be required to buy flood insurance as a condition of having a mortgage, to receive a home improvement loan from a federally-regulated lender, or to obtain federal disaster assistance. FEMA is currently updating the Flood Insurance Rate Map for the Alewife area.

The Federal Emergency Management Agency (FEMA) administers the NFIP. This program provides for insurance as a protection against flood losses to property owners in participating communities. Rates vary depending on whether residences are located in or out of the floodplain, and (for new or substantially improved houses) their elevation in relation to expected flood levels. You can obtain a policy through your insurance company or agent. Don't wait until a flood is coming to purchase your policy. It normally takes 30 days after purchase for a flood insurance policy to go into effect. For more information about the NFIP and flood insurance, contact your insurance company or agent or call the NFIP at 1-888-FLOOD29.

Homeowner Responsibilities

Residents' management of their own properties can make a significant difference in the amount of stormwater runoff that contributes to flooding. This includes both properties located in flood-prone areas and properties located in steep areas that experience little or no flooding but that contribute substantial runoff to lower-lying communities.

Actions to Reduce Runoff

Avoid channeling stormwater into the sanitary sewers or the stormwater system. Do not direct water removed by sump pumps into the sewer system, e.g. by connecting into internal drains, or by discharging water into catchbasins. Instead, try to direct stormwater into areas where it will drain into (infiltrate) the soil away from buildings.

Increase On-Site Stormwater Storage. Rain barrels, dry wells, vegetated swales, and rain gardens are all methods for holding stormwater on-site. Their effectiveness varies, and some methods may not be practical in areas where the groundwater table is high or where the soils are impervious (e.g., clay soils).

Arlington and Cambridge have programs that help residents purchase rain barrels. Studies have shown that use of rain barrels does not reduce flooding, because the barrels fill up before the peak of a storm. Use of rain barrels does conserve water, which can be used for garden irrigation purposes, at the same time saving on sewer and water charges because the water does not go through the house meter.

A dry well is constructed by digging a hole in the yard (more than one if necessary), and filling the hole with various-sized rocks and sand. The downspout is directed to the dry well through a small trench that is cut and covered. (You have to make sure you have good soil above the dry well or your lawn in that area might suffer.) Homeowners can construct small dry wells; help may be needed for larger dry wells. Dry wells retain water on-site and increase infiltration to the soil.

Rain gardens are depressed planted areas that collect and infiltrate stormwater. Research has shown that, even in densely developed areas, small rain gardens can absorb enough water to make a difference in runoff.

Add a rain garden to your yard. A rain garden is a small depression that captures and infiltrates or detains rainwater. They are generally planted with native species that are wet- and dry-weather tolerant. Rain gardens have been very effective in areas with permeable soils, as demonstrated by a pilot project in Maplewood, MN. Depending on where you live, they may not infiltrate, as much rainwater in the Alewife area where the soils are very compact and the groundwater level is high, but would still help to store rainwater and slow the rate of runoff.

Reduce impervious surfaces. Homeowners contribute to expansion of impervious surfaces by paving and enlarging asphalt driveways, and eliminating lawns. If you don't want to mow a lawn, consider a low-maintenance lawn cover instead of paving.

Improve the permeability of your soil, by aerating and incorporating compost.

Replace your asphalt driveway with a permeable cover. You can use gravel or stone in your driveway, or one of a number of new materials that create a firm surface that allows water to pass through. It is important that there is sufficient depth from the surface to groundwater, to ensure that pollutants in stormwater are removed before they reach the groundwater.

Avoid Contaminating Stormwater

Protect catch basins. Most catch basins convey stormwater to rivers. Catch basins should be protected and not used to dispose of contaminates or wastes.

Pick up after your pets. Do not leave pet wastes in the street to wash into the catch basins/storm drain system.

Limit or eliminate use of fertilizers and pesticides. Testing soils to determine what is needed before applying any fertilizers, and using a variety of integrated pest management methods, can significantly reduce runoff of nutrients and pesticides in stormwater.

Ensure that your sanitary pipes do not connect internally to the storm drains. Internal roof leaders are common in flat-roof triple-decker residences, and it may be difficult, expensive, or even impossible to separate pipes in these buildings. Even there, though, it may be possible to disconnect basement wastewater pipes from the storm drain.

Never pour toxic materials down household drains or into stormdrains. Recycle used oil and discard household and lawn care chemicals, paints and varnishes at hazardous waste collection facilities.

Protect rivers and streams from contaminants conveyed through catch basins. Most catch basins convey stormwater to streams and rivers.

Community Responsibilities

Municipalities play a major role in actions related to flooding, as discussed in earlier chapters. This section discusses four additional ways in which municipal governments should address flooding problems: (1) by educating their residents about the various self-help options and responsibilities and the potential health risks from exposure to floodwaters; (2) by improving the sewer infrastructure to reduce bacteria contamination in floodwaters; (3) by increasing storage of stormwater in the region; and (4) by exercising their land use responsibilities in ways that reduce stormwater runoff over time. In many cases, these activities can be done most cost-effectively at a regional level. The Tri-community Joint Powers Agreement provides a mechanism for Arlington, Belmont and Cambridge to work together more effectively to identify effective regional solutions. At a minimum, the Tri-community process promotes better communication about actions in one municipality that will affect the residents of another.

Educate citizens about self-help options and responsibilities.

The municipalities should consider a variety of methods for distributing information presented in this report on residents' self-help options and responsibilities related to flooding and stormwater. The Phase II NPDES Stormwater Regulations require all three municipalities to conduct public education related to stormwater. It would make sense to make information on flooding available at the same time. Outreach should include enclosures with tax bills or other community-wide mailings, public access TV, newspaper articles, public forums, and town websites.

In addition to general information about flooding, residents need specific warnings when there is high risk of exposure to contaminated floodwaters. Cambridge is required under the current variance to the state's water quality standards for its CSOs to issue public notices when a specific marker CSO has activated. Currently, those notices are posted on the Cambridge website, and emailed to the Mystic River Watershed Association (MyRWA) and to Departments of Public Health in Arlington, Belmont, Cambridge, and Somerville. More work is needed to get this information out to residents in a timely fashion – for example, through public access TV announcements, posting of signs and leafleting in particularly vulnerable neighborhoods. During the recreational season (April through September), residents can also be encouraged to check the EMPACT project website (http://www.mysticriveronline.org). This website provides warnings when bacteria levels in Alewife Brook and other water bodies – whether from CSOs or from other sources – are expected to exceed boating and swimming standards, based on recent rainfall events.

Improve Sewer Infrastructure

The three communities need to investigate and remediate inflow & infiltration and illegal connections in their sewer systems, to reduce the amount of sewage reaching Alewife Brook, its tributaries and floodwaters. Much of this work is already underway, as described in Section 3. These efforts are costly, may take a number of years to complete, and will require continued effort to detect and address new problems as they arise.

Increase Storage Capacity

Actions that the communities might collaborate on include the following:

- Assessing the cumulative impact of potential new developments and redevelopments on runoff and the need for floodwater storage, as well as on wastewater demands on the sewer systems;
- Assessing the amount of storage capacity needed to control moderate flooding, in light of the plans for regional land uses; and
- Identifying and investigating stormwater storage options that might achieve the target.

Possible options for storage, including drawing down Clay Pit and Spy Ponds prior to storms, were discussed in Section 2. Other options for increasing storage might include:

- Preserving land as open space, through purchase, conservation restrictions, and other means;
- Creating stormwater basins or constructed wetlands, like that being proposed by Cambridge for the Alewife Reservation as part of the CSO separation plan; and
- Creating underground storage capacity in tanks or pipes.

Reduce Runoff through Stormwater Management and Redevelopment

Land use can have a significant impact on flooding: the greater the increase in impervious surfaces, the greater portion of rainfall and snowmelt that runs off instead of infiltrating to groundwater. More impervious surface results in higher peaks and “flashier” hydrology – both of which can cause flooding. Land use planning and regulation can reduce the impact of development and redevelopment on stormwater pollution and flooding, without necessarily reducing overall density or property tax revenues to the towns. In fact, redevelopment of already developed land offers an opportunity to correct past mistakes by reducing imperviousness of already developed sites. However, these benefits will not occur automatically, and require that the individual municipalities make stormwater management an important component of their permitting process.

Massachusetts’ home rule structure makes municipalities the most important players in determining land use patterns. Local zoning and planning boards set and enforce provisions that determine what can be built where and how developments must be designed. Local Conservation Commissions have authority over development and other activities near wetlands (including rivers, lakes, ponds and streams.) Lack of regional planning in Massachusetts has often hindered comprehensive and cost-effective approaches to regional environmental problems such as flooding. The tri-community working group is an effort to provide more effective regional planning in the case of flooding. To further reduce flooding, and even preventing the problem from getting worse, may require changes in municipal land use and development policies, and may require further regional cooperation in planning.

Currently, a number of new developments and redevelopment projects are being considered which if not designed properly can add substantially to the amount of impervious surface, runoff, sewage contamination of Alewife Brook, and flooding. Appendix L provides a list of prospective developments in the Alewife Brook sub-basin. This list, drawn from public sources, is not intended to be exhaustive, but it does present a picture of the major development proposals that could go forward in the next few years. This list can help communities evaluate long-term prospects for additional runoff and demands for sewer service in the region.

The municipalities should consider adopting “Smart Growth” and “Low Impact Development” principles in all future developments. Smart Growth and Low Impact Development (LID) are both concepts that promote land use practices that protect the environment:

- Smart Growth advocates argue, among other things, for redeveloping already developed sites rather than building on undeveloped parcels, and for concentrating development in areas with existing infrastructure and access to public transit.
- Low Impact Development advocates promote site and building designs that minimize environmental impacts where development does occur.

Both concepts have relevance to community efforts to reduce flooding.

The municipalities could also adopt local by-laws, ordinances or design guidelines that require stormwater runoff controls for any development or redevelopment project that affects the Alewife area. These include developments located near the flood-prone areas, as well as, areas that contribute runoff to lower-lying areas.

Given the severe flooding problems in the Alewife basin, the Mystic River Watershed Association (MyRWA) argued that the municipal standards for developments and redevelopments in the basin should exceed the current Massachusetts Stormwater Guidelines. These guidelines require no increase in peak runoff, but do not prevent substantial increases in total runoff. MyRWA recommends a more stringent standard, for example, detaining enough stormwater volume to prevent property damages from the peak runoff or requiring a reduction in total pollutant load relative to pre-development conditions.