A Century of Planning for Environmental Concerns in the Alewife Brook Watershed, Boston, MA

by

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Abstract

Landscapes are ever changing, both ecologically and culturally, making it difficult for planners to understand and balance environmental, social, and economic needs. The Alewife Brook Watershed located in Boston, Massachusetts, USA is part of the Mystic River Watershed and is known for its ecological, cultural, and industrial history. Currently the watershed is surrounded by a network of roads and homes and is under continued threat of flooding and suburban and industrial development. A historical context overview of the landscape change and a case study analysis of six plans are selected for the current research of the Alewife Brook Watershed. The historical data will help identify the consequences of landscape change. The case study analysis will articulate similarities and differences and explore planning process theory. The research will provide insights on what has been done in the past to move forward in urban planning together planners, landscape designers, engineers, and ecologist can take. The research will reveal important findings that can be integrated into today's planning efforts. Additionally, the research contributes to connecting citizens to nature.

List of Abbreviations Used

ADL	Arthur D. Little
BMPs	Best Management Practices
DCR	Department of Conservation and Recreation
DEP	Department of Environmental Protection
DPW	Massachusetts Department of Public Works
EIS	Environmental Impact Statement
EOTC	Executive Office of Transportation and Construction
FAR	Friends of Alewife Reservation
GIS	Geographic Information Systems
MAPC	Metropolitan Area Planning Council
MBTA	Mass Bay Transportation Authority
MDC	Metropolitan District Commission
MPC	Metropolitan Parks Commission
MWRA	Metropolitan Water Resource Authority
MyRWA	Mystic River Watershed Association

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Chapter 1: Introduction

The Alewife Brook Watershed, located in Boston, Massachusetts, USA, has gone through rigorous landscape change over the last 50-100 years. As part of the Mystic River Watershed, the area is linked between multiple urban residential cities including: Cambridge, Arlington, Somerville, and Belmont. Bodies of water in the area include: Alewife Brook and Little, Fresh, Jerry, Blair, and Yates Ponds (Figure 1.1 and Figure 1.2).

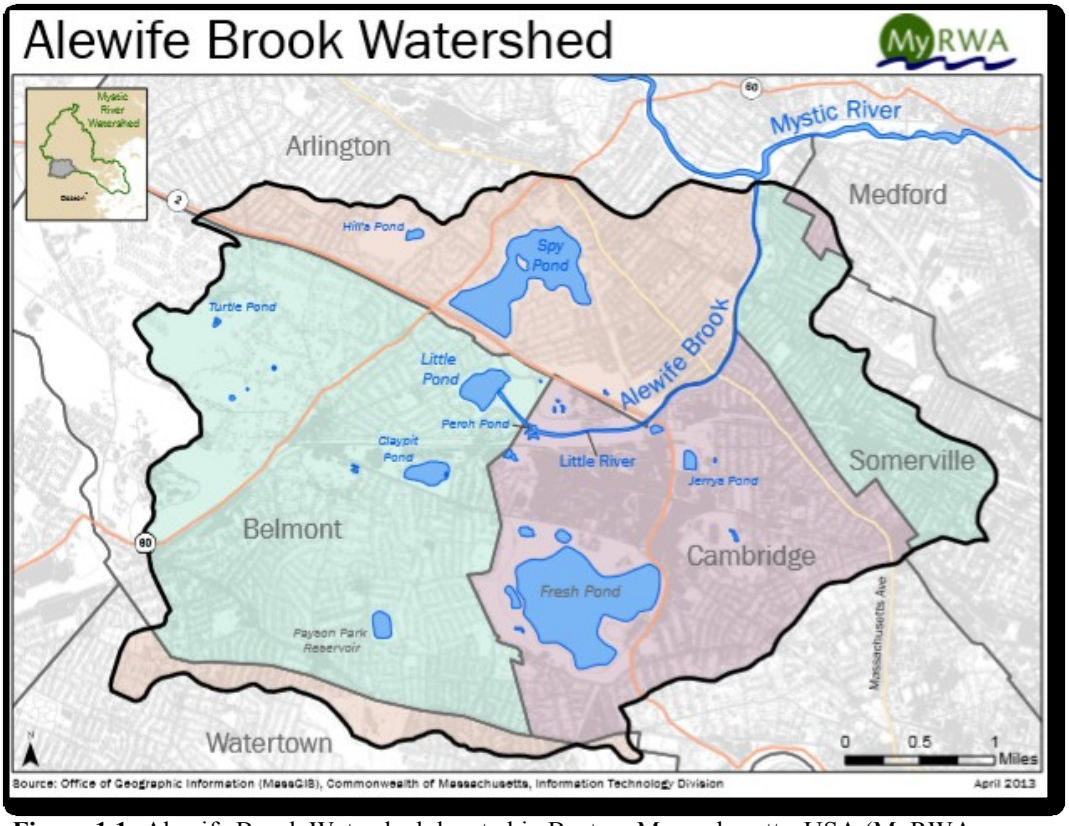

Figure 1.1: Alewife Brook Watershed, located in Boston, Massachusetts, USA (MyRWA, 2018).

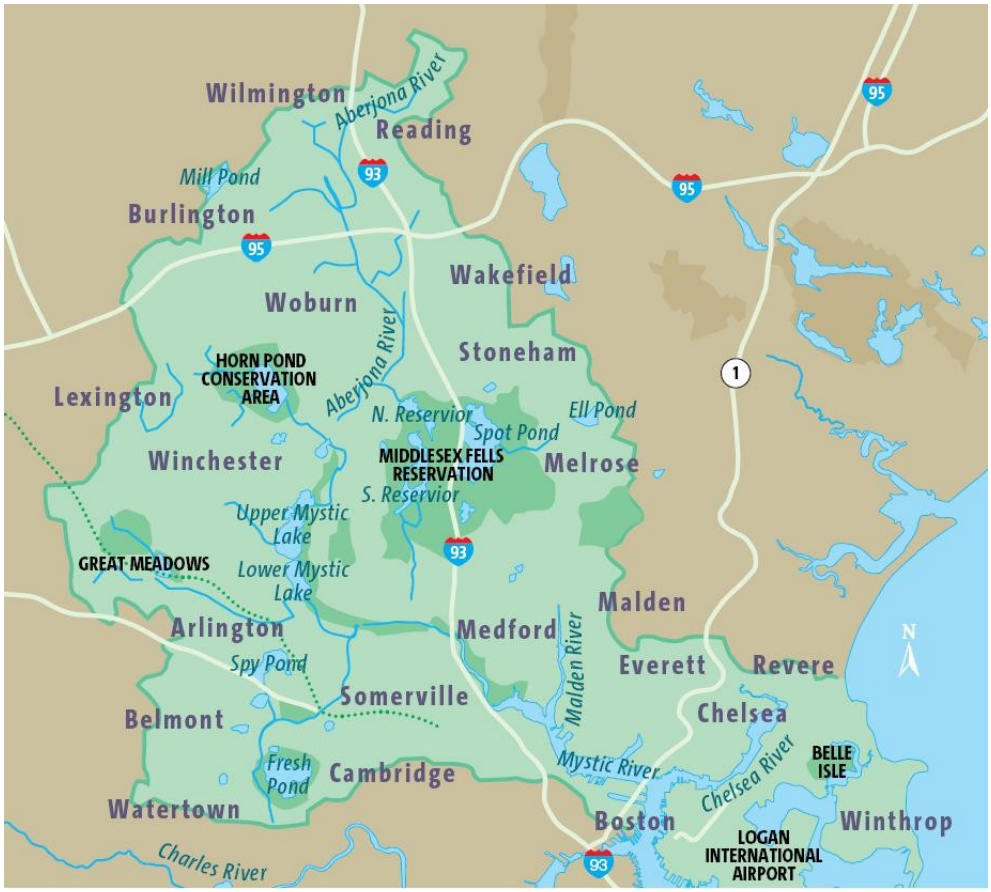

Figure 1.2: Mystic River Watershed (MyRWA, 2018). The Alewife Brook Watershed is located in the south-west corner, intertwined between the cities of Belmont, Arlington, Cambridge, and Somerville, including Fresh Pond.

The Alewife Brook Reservation (115-130-acres), formerly known as the Menotomy River, is located within the Alewife Brook Watershed (Beinecke, 2013). It is one of the biggest urban wilds in the Boston area and is home to different species of flora and fauna, including large and small mammals such as coyotes, deer, and skunks. Years of landscape change due to both natural and social factors, have destroyed one of the largest wetlands, known as the Great Swamp (Figure 1.3). Once spanning over 1000-acres, between Fresh Pond and the Alewife Brook Reservation, the Great Swamp has dwindled significantly, covering only 1/4 of its original landscape today.

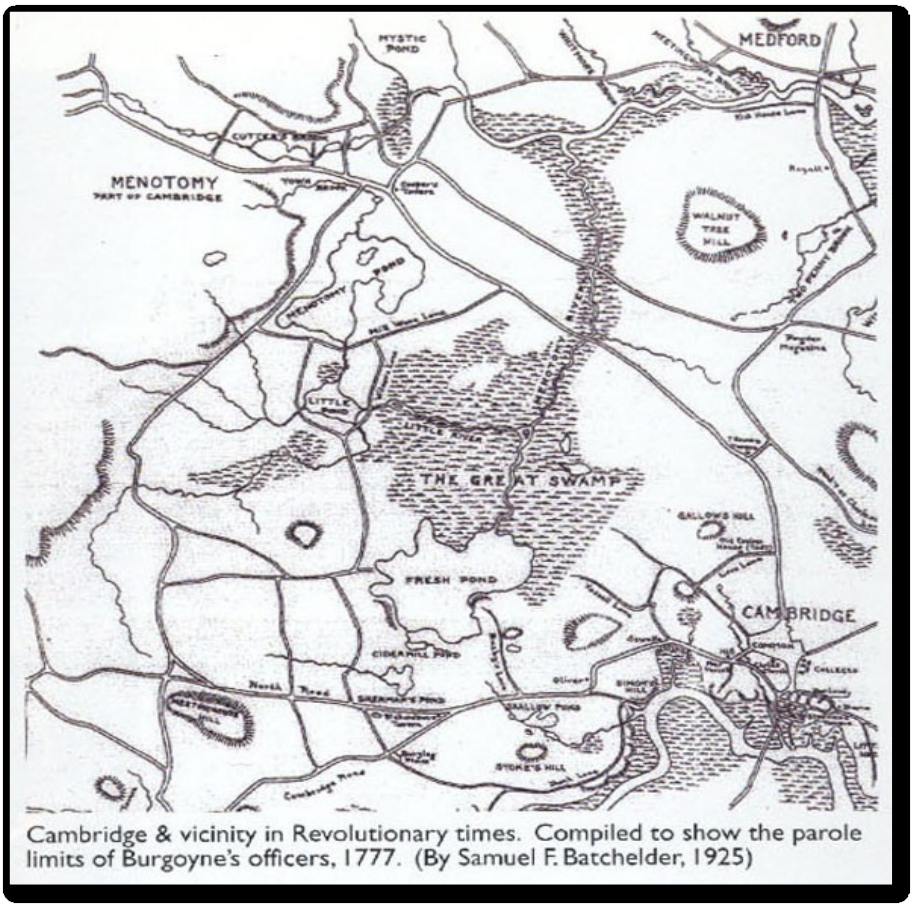

Figure 1.3: The Great Swamp in 1777 expanding from Fresh Pond to the Alewife Reservation (Cook, 2007).

The area has been exposed to rapid growth and development that has threatened wildlife habitat, biodiversity, and water quality of the Alewife Reservation and watercourses within the Alewife Brook Watershed. The planning efforts for the area have been well documented and extend as far back as the early 1900s, as for example, Frederick Law Olmsted's (1822-1903) vision of the Emerald Necklace, a linear system of parks and parkways, for the entire Boston Metropolitan Region, which included the Alewife Reservation and Brook.

The Silver Maple Forest, 15-acre of dense woods in the Belmont Uplands, is located west to the Alewife Reservation near Little Pond. The forest provides habitat for species of birds, plants, and insects and is critical to prevent flood damage during heavy rainstorms, absorbing excess water and slow rising water levels (Hofherr, 2015). The area is privately owned by O'Neill Properties Group

who proposed to build a 298-condominium unit in 1998, which would destroy most of the forest. The loss of the natural habitat would be devastating to the surrounding communities who enjoy the natural landscape and for wildlife species. The loss would also increase wastewater during storm events causing issues as the local sewer system already exceeds its capacity (Belmont Citizen Forum, 2005). Will Brownsberger, State Legislator of Massachusetts Senate, local groups, and communities surrounding the forest are battling the owner to prevent development.

Water quality is an ongoing issue in the Alewife Brook Watershed. The water quality in the Alewife Brook is frequently impaired due to bacterial and other pollutants such as stormwater runoff and CSOs (combine sewer overflow) resulting in the Brook failing to meet state bacteria standards for fishing and swimming (Wilcox, 2015). Flooding is another ongoing issues in the watershed. Some of the cause is due to minimal flood storage capacity to accommodate large storm events and impermeable surfaces. Invasive species has wiped out native species in the many area within the watershed making it difficult to control.

Because of these issues; wildlife habitat loss, development pressure, poor water quality, and flooding, community groups within the Alewife Brook Watershed have been fighting to protect the ecological health and historical features of the Alewife Brook Watershed. The area is fortunate to have a large number of groups, see list below, focusing on a number of items. These include: flooding and poor water quality issues, cleaning up the Alewife Reservation, Fresh Pond and other areas, educational opportunities for local schoolchildren, and recommending development and re-development in the areas as well as prohibit development in areas with ecological importance.

List of supporting groups in the Alewife Brook Watershed:

- Alewife Neighbors
- Alewife Study Group
- Belmont Citizens' Forum
- Boston Society of Architects

- Cambridge Highlands Neighborhood Association
- Coalition for Alewife
- Concord-Alewife Study Group
- East Arlington Good Neighbor Association
- Friends of the Alewife Reservation (FAR)
- Friends of Blair Pond
- Friends of the Community Path
- Friends of Fresh Pond
- Friends of Jerry's Pond
- Fresh Pond Residence Alliance
- Massachusetts Bicycle Coalition
- Massachusetts Forest and Park
- Mystic River Watershed Association (MyRWA)
- North Cambridge Stabilization Committee

The area's vital ecosystem connections, rich documentation of landscape change and planning efforts, and historical wetland location of the Great Swamp, makes the Alewife Brook Watershed an apt case study for examining planning efforts aimed at protecting and conserving the natural landscape. The research addresses the question as to what the value of urban/environmental history and ecology are in the planning process. The purpose of the current research is to provide a historic review of planning in the Alewife Brook Watershed, characterized by hundreds of years of documented development, more than a century of landscape regenerative design, and urban restoration planning of an urban wild. The research objectives are to: (1) illustrate the landscape change of the Alewife Brook Watershed from Indian (common American parlance) and colonial times to mid-to-late twentieth century; and (2) review the strength and weakness of the six plans produced in the late twentieth to early twenty-first century with a focus of the importance of urban ecology in the planning process. This research will provide a historical overview of the changes and attempts made to protect and conserve the natural landscape of the Alewife Brook Watershed through time. Ultimately, it will provide lessons on what guidelines for future environmental management practices should and could be used.

The remainder of the introduction will describe factors that impact landscape change and the adverse effects of urbanization on the ecosystem and human health, as well as some examples of influential planners from the past. Chapter 2 outlines the methods used in the historical review and case study analysis. Chapter 3 provides a snapshot of landscape change in the study area. Chapters 4 and 5 present the results and discussion of the cross comparison of the six plans. Future research directions and important findings on the strengths and weaknesses of planning are proposed in the Conclusion in Chapter 7.

Landscapes are elements of both social and ecological systems (Wiens, 2002). They symbolize geomorphic processes, the colonization of organisms, and wildlife, as well as disturbances that continue to change the landscape's physical, biological, and cultural structure. Some of these changes occur daily, while others materialize over a decade or millennia. These changes are caused by naturally occurring environmental factors, such as wildfires and/or human interaction with the natural environment. Humans are an integral component of the ecosystem that should not be ignored, and have become the most dynamic factor for landscape change (Xing-Yuan et al., 2006; Marcucci, 2000). As the human population increases worldwide, more resources are needed for its survival, such as food and water, heat (firewood), and shelter (homes). In addition to survival resources are modern conveniences such as shopping malls and infrastructure. In most cases, these needs and wants put pressure on the natural environment, and can cause adverse effects. These impacts can frequently be seen in urban landscapes, which are highly influenced by human activities (Young, 2009). Human encroachment on rural landscapes does not go unnoticed. It can lead to human-wildlife conflicts, decrease wildlife population, and restrict farmers' ability to perform their daily activities.

The movement of people living in urban areas continues to increase along with the built environment (Freeman, 2007; Whitney, 1994). Urban areas can be described in many forms, and have many features. The most common

characteristic is the high density of people, as well as the urban geographic territory of land used for residence, roads, other paved surfaces, and commercial buildings (Niemela, 1999; Yli-Pelkonen and Niemela, 2005; McIntyre et al., 2000). It is predicted that by 2050, two-thirds of the world's population will be living in urban areas (M'uller and Kelcey, 2010). The expansion of development in urban areas is referred to as urbanization, which is also linked to landscape change (Antrop, 2005). Urbanization can threaten the ecosystem's ability to provide clean air and water by increasing toxic substances in our atmosphere and watercourses (Kemp and Spotila, 1999; Freeman, 2007; Wang and Hofe, 2007). This results in a change in the climate, hydrology, and biodiversity of the landscape (Whitford et al., 2001). In general, any development or land use practices can alter the natural drainage network of the watershed or stream flow patterns, channel size, depth, or location of stream orders (Whitney, 1994). Biodiversity refers to all living things on earth, including: plants, animals, fungi, and microorganisms. Urbanization can cause habitat loss, the introduction of invasive species, and fragmentation of the landscape (Freeman, 2007; Young, 2009; Whitford et al., 2001). To adjust to human population growth and human demands in urban areas, large areas are used for shopping malls, condominiums, and/or office buildings, leaving only small patches of habitat for wildlife or none at all. Habitats along the banks of streams can also be lost and fragmented (Marsh, 1991). The connectivity between these small patches can make it difficult to support wildlife species (Whiteford et al., 2001). Wildlife animals, especially larger species such as bears, require an adequate amount of space for survival and in most cases both terrestrial and aquatic habitats for foraging, nesting, protection, and breeding. For example, birds, amphibians, reptiles, and invertebrates depend on movement between aquatic and upland habitats (Schneider et al., 2002). Smaller mammals (raccoons and skunks) and bird species (doves, house sparrows, and song birds) have adapted and thrived in urban environments (Kattel et al., 2013). The introduction of invasive plant species to urban areas can impact biodiversity. Native plant species are choked out by invasive plants and can directly impact wildlife animals and pollinators native to the area. When these

species rely on the native plants for survival, when the plants disappear, so does the wildlife. Invasive plant species can be introduced in urban areas from ornamental planting in yards and throughout the city (Freeman, 2007).

Impermeable surfaces from urban growth increases the rate and amount of stormwater runoff into watercourses, resulting in bank erosion and contaminates entering the watercourse, causing property damage to home owners and municipalities from flooding (Marsh, 1991). The replacement of grassland and trees with buildings and roads makes it difficult for rain to reach the soil surface reducing interception, evapotranspiration, and infiltration (Whitford et al., 2001; Cadavid and Ando, 2013). Any green area within a city, whether on the edge of a stream/pond or located in a parking lot, has the potential to filter sediments, control erosion, and regulate water temperature (Ahern, 1995). Vegetation and forest landscapes absorb rain and snowmelt, regulating the amount of water flowing to nearby streams, and thereby reducing floods (Whitney, 1994). Over time, flooding will widen stream channels and make them lose their natural meander, resulting in poor habitat for aquatic life. Living in an area where flooding is common causes financial and emotional stress to homeowners (Cadavid and Ando, 2013).

Stormwater runoff, from rainfall or snow, can carry different contaminants to nearby watercourses including: oil, from vehicle leaks, garbage, septic system seepage, commercial effluent, fertilizers, and pesticides used on ornamental plants and lawns. These contaminants jeopardize aquatic health, damaging the food source for many fish and birds, and possibly killing aquatic life. Human health can be greatly impacted as well. Residents who get their water supply from wells (ground) or lakes (surface water) can find that the water becomes unsafe to drink, leaving home owners in search of another source of water. In many coastal areas, it is common to have public beach closures and boil-water advisories put in place after a large rain storm, mostly in the summer, due to stormwater runoff. This can negatively impact on the local fishing industry and public recreational activities.

To ensure the wellbeing of the human population and the health of landscapes, multiple disciplines and perspectives are required to understand landscapes and their social and ecological value. The role of landscape architects, urban planners, and urban designers is, therefore, vital to understanding all elements and functions of the urban landscape in order to achieve strategies and policies that respond to the landscape change from the growing demands of humans (Kattel et al., 2013; Musacchio and Wu, 2004). This approach was not the case in the early nineteenth and twentieth centuries of planning. During the industrial revolution of the nineteenth century, planning focused on improving the market, and maximizing economic growth (Mitchell et al., 2004). Research of species in urban areas was not well studied during this time (McIntyre et al., 2000). Concerns about public health and safety during the end of the twentieth century led to new environmentalism in planning. Prominent figures; Frederick Law Olmsted, Charles Eliot, and Henry Wright, understood the scientific knowledge of the environment, and land use impacts causing pollution (Fabos, 1979). Their visions of planning incorporated the natural conditions and processes of the landscape.

Two most notable individuals in landscape architecture and greenway planning from 1867 to 1900 were Frederick Law Olmsted, Sr., and Charles Eliot. Olmsted's (1822-1907) concerns about the impact on culture and human health led to his work in urban designs and nature (Young, 2009). He is well known for his greenway movement in America. His most featured and earliest work was the Boston Park System, also known as the Emerald Necklace, which included the Alewife Brook Watershed. The park system linked 25 kms, from areas in Cambridge to areas in Charles River, Massachusetts (Fabos, 2004). Charles Eliot (1859-1887) worked with Olmsted and linked the entire Boston Metropolitan Region of approximately 600 km² from five coastal river corridors. This included Charles River Greenway Corridor to the ocean, and the Boston Back Bay area (Fabos, 2004).

Frederick Law Olmsted's two sons, John and Frederick Jr., the "Olmsted brothers" completed a 40-mile long park system, called the "40-Mile Loop", in Portland, Oregon in 1903. Henry Wright's (1878-1936) work in 1926 on the regional plan for the state of New York is still well recognized today. During this period, the National Park Service contributed to many planning efforts of parkways, including the Blue Ridge Parkway along the Appalachian Mountains throughout Virginia from Washington, DC to North Carolina (Fabos, 2004). Charles Eliot II (1899-1993), the nephew of the Charles Eliot described above, followed in the foot-steps of his uncle. Within his lifetime he became a city planner, landscape architect, government official, professor, and the president of the Cambridge Historical Society. In 1928, Eliot II was the landscape architect for the Open Space Commission for the Governor of Massachusetts (Fobos, 2004). During the 1960s, Ian McHarg was known as a leader of the environmental movement (Fabos, 2004). His ecological wisdom shaped design practices and urban planning (Yang and Li, 2016).

These aforementioned, and many more, brought ecology and social sciences together to aim at solving the negative impacts of urbanization on the natural landscape. Going into the second half of the twentieth century, landscape and greenway planning were studied most frequently in academic environments and research was conducted at the Universities of Wisconsin, Pennsylvania, and Massachusetts (Fabos, 2004). This carved the path for the interdisciplinary field known today as urban ecology. Ecology is a branch of science that studies the natural ecosystem's matter, energy and distribution, and abundance of organisms (Niemela, 1999; Yli-Pelkonen, and Niemela, 2005). Urban ecology has become a diverse field of research in both social and ecology science to examine urban ecosystems and their ecological services (Niemela, 1999; Young, 2009). When people think of urban ecosystems, it is possible that many envision high tower buildings, malls, asphalt roads, and dense patches of residential homes, instead of trees, wetlands, and grassy areas. Bolund and Hunhammar (1999) identified seven different natural urban ecosystems: 1) street trees, 2) lawns/parks, 3) urban

forests, 4) cultivated land, 5) wetlands, 6) lakes/sea, and 7) streams. All seven provide ecosystem services to humans, and are beneficial for the ecosystem itself (Bolund and Hunhammar, 1999).

Trees that are surrounded by paved areas are considered street trees, unlike dense tree stands, which are called urban forest ecosystems. Lawns and parks have a combination of grass, trees, shrubs, and other plant species, also referred to as green space. Playgrounds, recreational fields, and golf courses can fall under this category. Cultivated land refers to land that is used for gardening. Marsh and swamp areas are wetlands; open water areas such as lakes/sea and streams are considered flowing water (Bolund and Hunhammar, 1999). These ecosystem services provide many benefits to wildlife species, such as habitat, food, water, the production and process of biomass, nutrient cycling, water cycling, and genetic pools to name a few (Gomez-Baggethum et al., 2013). Humans also benefit from urban ecosystem services where the historical and cultural value is protected, recreation options are provided and aesthetic beauty is enjoyed for rest and meditation purposes. Green spaces also have the ability to connect communities and provide economic benefits in the form of tourism (Ryan et al., 2006).

It is acknowledged by many professionals and citizens alike that as the human population continues to increase in urban areas, an understanding of urban ecosystem patterns and process is essential to preserve biodiversity and urban function, and to sustain the delivery of ecosystem services (M'uller and Kelcey, 2010; McPhearson et al., 2016). Urban ecology research and practice over the last two decades have expanded globally to include ecology in, of, and for cities (McPhearson et al., 2016). Incorporating a social-ecological approach into the planning and designing process has the potential to not only aid in our understanding, but also to improve the ecosystem services, to make better decisions and set regulations (Bolund and Hunhammar, 1999). Urban ecology also offers collaboration with urban planners, landscape architects, city residents,

engineers, artists, city government officials, and local environmental groups to plan for an urban space functional for both humans and wildlife species (Herrmann et al., 2016; Musacchio and Wu, 2004).

Efforts in urban planning techniques are improving; however, there are still many challenges remaining to develop a successful plan (Ryan et al., 2006). Determining methods to integrate urban ecology into urban management and planning is still weak (Niemela, 1999). More knowledge is needed about the dynamics of the change in natural conditions and the function of urban areas (Breuste and Qureshi, 2011). For the most part, research into traditional watershed management on the impact of stormwater runoff on the ecological health of urban areas has been poorly documented (France, 2005).

Little data are available regarding the past and current urban development processes (Pauleit et al., 2005). Planning for the wellbeing of humans and environmental integrity requires an understanding of the past, which can show the historical cultural value of people and ecological processes (Marcucci, 2000). Environmental history concepts can be a useful tool in the planning process, such as the inventory phase, to help planners and others understand the different processes that took place as a result of landscape change (Marcucci, 2000). This could contribute to developing a solution to manage both human and wildlife benefits.

Similar to urban ecology, environmental history did not become formally recognized as a discipline until the environmental movement in the 1960s (Worster, 1996). Urban environmental history surfaced in the United States of America in the early 1990s as a subfield of environmental history (Schott, 2004). Like environmental history, urban environmental history can offer an ecological analysis of the city for scholars and policy makers to deepen their understanding of the evolution of the urban problems (Schott, 2004). Urban environmental history offers the study of the urban built environment but also the impact it has

on the natural ecosystem (Rosen and Tarr, 1994). Joel Tarr and Martin Melosi have influenced the field of urban environmental history with their research on urban technical infrastructures, water supply and quality, sewage, and waste collection and disposal (Schott, 2004). Such research can expand our knowledge on how and why these systems were put in place, possibly showing past efforts made in planning, which also help with making decisions for today and for the future.

My research is interdisciplinary in nature, being in equal parts a humanities study through its focus on documenting the history of the landscape change and a science study by conducting a case study analysis of plans concerned with the development and design of land use and the environment, including biodiversity and water quality. My research is not an environmental history of the Alewife Brook Watershed; however, the landscape change described in chapter 3, touches on the concept of environmental history in that it expands our understanding of how humans have impacted the natural environment through time. The research will reveal important findings that can be integrated into today's planning efforts. Additionally, the research contributes to connecting citizens to nature. Many residents and visitors, all users of the land, may not know the impacts of their actions on the environment, or what has been done in the past resulting in adverse effects to the landscape (Marcucci, 2000). Providing a history of the landscape change and planning efforts may help change attitudes towards wildlife conservation and protection for the better.

Chapter 2: Research Methodology

2.1 Selected Plans from the Alewife Brook Watershed

To achieve the research objectives, six plans from 1978 to 2003 in the Alewife Brook Watershed were chosen for analysis. These include:

- Alewife Open Space: Objectives and Recommendations for the Development of a Park and Open Space Network (1978);
- The Alewife Open Space Plan, Metropolitan Area Planning Council (1985);
- Metropolitan District Commission Parkway Restoration: A Master Plan for Segments of the Alewife Brook and Mystic Valley Parkway (1996);
- Blair Pond Master Plan, Cambridge and Belmont, Massachusetts (1999);
- Fresh Pond Reservation Master Plan (2002);
- The Metropolitan District Commission Alewife Reservation and Alewife Brook Master Plan (2003).

All six plans were collected from my supervisor Dr. Robert France's archives. However, each plan, with the exception of Blair Pond Master Plan (1999), is accessible to the public. See Table 2.1.1 for details on where each plan can be found, length in pages, and the number of figures/photos (illustrations).

Table 2.1.1: Location of plans for public access and length of each plan by number of pages.

Plan (year)	Accessible	Link	Length (Pg #)	Illustrations
1978	Internet Archive: a non-profit library of digital artifacts.	https://archive.org/details/alewifeopenspace00mass	31	7
1985	Internet Archive: a non-profit library of digital artifacts.	https://archive.org/details/alewifeopenspace00mass_0	35	10
1996	Internet Archive: a non-profit library of digital artifacts.	https://archive.org/details/metropolitandis00mass	47	16
1999	n/a	n/a	49	80
2002	Cambridge Water Department	https://www.cambridgema.gov/Water/freshpondreservation/aboutfreshpond/masterplandescription	147	23
2003	Mass.gov (DCR) website, FAR website, and Internet Archive: a non-profit library of digital artifacts.	https://www.mass.gov/guides/master-plans http://friendsofalewifereservation.org/2003_06_mdc_alewifemasterplan.php https://archive.org/details/alewifereservati00bioe	115	74

Collectively, the planning documents provided a conceptual layout of what has been done to protect the health of the Alewife Reservation water quality and wildlife habitat within the study area. I felt that these plans would maximize what can be discovered to guide present and future growth and development in an urban area. These plans also highlight the movement towards environmentalism, when rapid change was occurring to acknowledge the harmful impacts from

human activities on the ecosystem. To determine the growing trend of environmentalism, I conducted a key word search of six related planning topics (watershed management, green space, biodiversity, landscape ecology, stormwater, and urban ecology) from the Institute of Scientific Information's Web of Science and Scopus databases from 1970 to 2002. These years correspond with the plans selected for the current research. The results demonstrate the increase of environmental science knowledge and awareness during that timeframe. It was determined that the key words urban ecology and stormwater trend very similarly on the line graphs with a gradual incline. As do green space and watershed, which show a slow incline. Biodiversity and landscape ecology key words had a large jump after the 1990s as shown in Figure 2.1.1.

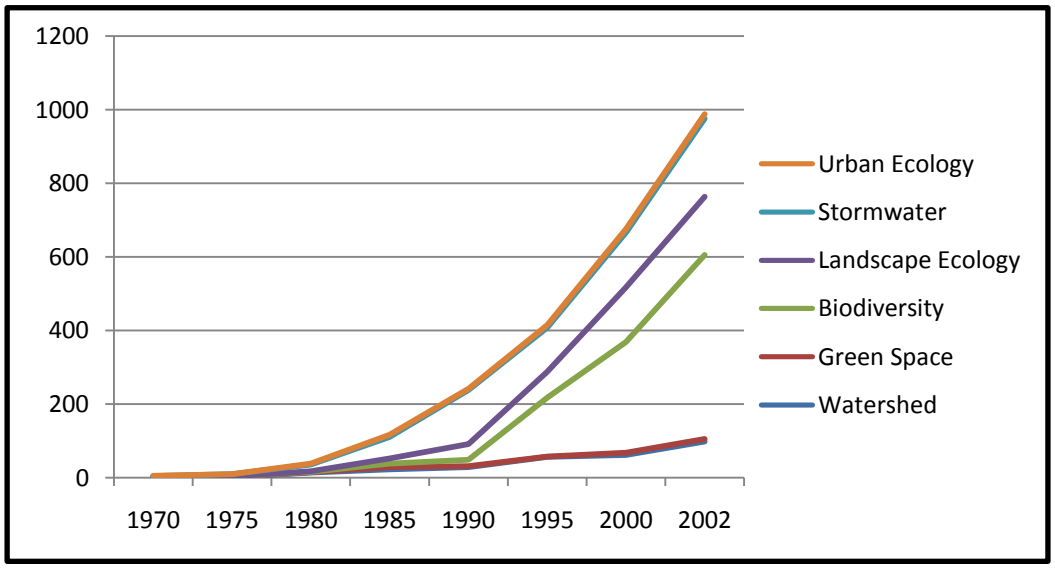

Figure 2.1.1: Key word trends of documents by year.

2.2 Methodology

To examine the implication of the case study plans and to better understand the landscape change of the Alewife Brook Watershed, I adopted several qualitative methodology techniques from the fields of environmental history, landscape theory, ecological planning, human and cultural geography, and science (Guy and Karvonen, 2011). Qualitative methods are used when researchers are interested in discovering the quality of an occurrence to make sense of or understand the

meaning (Noor, 2008; Anderson, 1993). Researchers discover phenomena or themes by studying what the data contains, rather than just numbers, as per traditional quantitative analysis (Merrian, 2009; Francis, 1999).

To meet the first objective, illustrating the landscape change of the Alewife Brook Watershed, a historical context overview was used to identify the driving forces of landscape change during five significant landscape periods. The second objective, to review the planning process in the late twentieth to early twenty-first centuries of the Alewife Brook Watershed, was achieved by using a standardized case-study approach to provide a comprehensive cross-systems comparison of six plans from the Alewife Brook Watershed area. Figure 2.2.1 illustrates the framework developed for the current research.

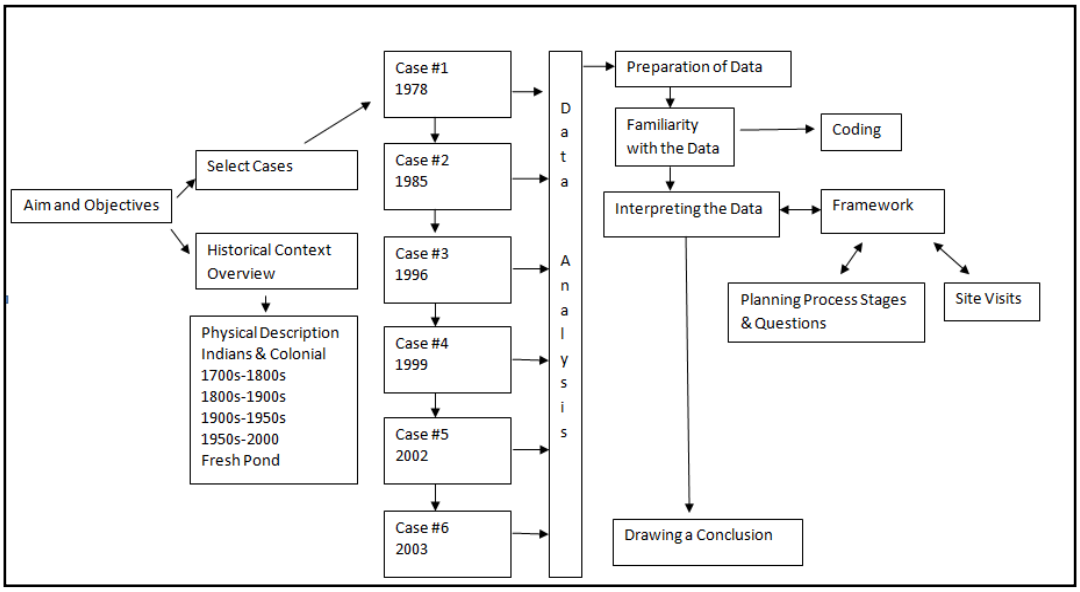

Figure 2.2.1: Framework of the cross-systems comparison of six plans from the Alewife Brook Watershed area.

2.3 Historical Context Overview

Human activities leave tracks or traces of some kind in physical forms (footprints, artifacts, landscape change) or informational forms (written documents). These forms of data already exist, known as secondary data, and are used by researchers studying the past to seek answers and to better understand a particular occurrence.

The field of environmental history uses secondary data to study human interaction with the natural world: how humans have shaped the environment as well as how humans have been shaped by it (A Round Table, 1990). Historical analysis techniques are similar in that it studies a specific topic based on evidence from the past. There have been a number of books and journal articles written about environmental history and urban landscape and planning, which use history as a way to understand current problems we face today (Armstrong et al., 2009; Campbell, 2009; Castoguay, 2011; Castonguay and Everden 2012; Deverell and Hise, 2008; Henshaw, 2011; Grunwald, 2006; Kingle, 2009; Miller, 2001; Melosi and Pratt, 2007; Mauch, 2008; Stunden, 2011; Tarr, 2003).

The secondary data that disclose the Alewife Brook Watershed are identified, collected, reviewed, summarized and organized into five landscape periods: Indians and colonial times, eighteenth century (1700s), nineteenth century (1800s), first half of the twentieth century (1900-1950s), and the second half of the twentieth century (1950s-2000). For each landscape period, driving forces are also discussed. A section on Fresh Pond is also mentioned in this chapter, as it has a rich history in landscape change. Gaining a historical background of the area will provide a better understanding of why the landscape is shaped the way it is today and demonstrates how qualitative historical data can be used in planning.

2.4 Case Study Comparison

A case study approach was used to gather data and insights from the six plans for the current research. The case study approach will help discover differences or unique variations from one plan to another and gain insights into the planning process (Anderson, 1990; Noor, 2008). Case study methods are used in architecture, planning, and urban design professions and fields of research, for examining the process, decision making, and outcomes of a particular project (Francis, 1999). It can assist with developing policies and design (Francis, 1999). For example, Ahern (1995) completed a case study research on greenway projects in the Netherlands and in the United States, that showed the difference and

similarities of greenway types. Yokohari et al. (2000) discussed concepts of urban planning in Asian megacities by viewing the history of urbanization and attempts made to reduce growth.

Prior to interpreting the six plans via case-study approach, it was important to become familiar with the plans' designs by coding water quality and quantity, biodiversity, and wildlife topics in each plan. Water quality and quantity-related topics were coded blue, and topics related to biodiversity and wildlife were colour coded green. The coding process assisted with interpreting and narrowing the data to the specific topics of the current research.

The planning processes for plans typically are described in five phases: 1) plan description, 2) goals and objectives, 3) site inventory and analysis, 4) recommendations, and 5) implementation(s) (Botequilha and Ahern, 2002; Fabos, 2004; Hackett, 1971). These phases, as well as site visits, were used as a framework to gain insight on each plan. A formulated set of questions for each planning phase was created for interpreting the data of the descriptive case study. The questions were adopted from those used in the landscape architecture cases study methodology developed by Francis (1999) as well as Merrian (2009). The framework, Table 2.4.1, was used to identify themes and provide insights into decision making, and tools used.

These five phases of planning will be described in the current research as it is written in the six plans, which are presented in descriptive cases in Chapter 4 and in Appendix A-F. The plan description for each plan will outline the location and any specific sites the plan is addressing, whom the plan is written for, and if anyone was hired to assist with the planning effects, and/or conduct the field work. Goals are used in many plans and projects to achieve an outcome. Objectives are sometimes used along with goals, which provide steps on how the goals will be reached. Any data collected, such as the ecological, historical, and social elements of the landscape, will be outlined in the site inventory and

analysis section. The inventory and analysis gives the current condition of the landscape, possible impacts to the future landscape, and how and what tools can be used to make a sustainable and functional landscape for human and wildlife species. The recommendations and implementations suggested in each plan will be discussed. The implementations suggested in the plans are slightly different than recommendations. Implementations can provide budgets and funding opportunities, allocate responsibilities, and schedule activities that are outlined in the recommendations to achieve desired goals and objectives. Chapter 5 will describe the common themes and differences between the six plans.

Table 2.4.1: Framework for interpreting data from the five planning phases (Francis, 1999 and Merrian, 2009).

Planning Process Steps	**Question**
Plan Description	What year was the plan published? Who were the main drivers for the plan? What professionals were involved to develop the plan? Location of the study area? What is the health of the ecosystem? What are the natural resources?
Goals and Objectives	What are the goals and objectives? Is water quality/quantity and/or biodiversity a top priority?
Site Inventory and Analysis	What data were collected and how? What are the key issues addressed in the plan? Are there management issues addressed? Any challenges?
Recommendations	What recommendations were made and to what subject?
Implementation(s)	How and when will the recommendations be addressed? How much will implementation cost? What management and monitoring plans are mentioned?
Site Visit	Date of site visit? What is my location/site? What can I see that has been accomplished? Is there more work to be done? What is surrounding the area?

2.5 Implementation Assessment: Site Visits

To assist with interpreting the six plans and to become familiar with the landscape history, a six-day site visit to the Alewife Brook Watershed was conducted in October, 2013. The site visits helped to expand my knowledge and insights on new and completed projects within the research study area. Site visits can also uncover new details and issues that may not be represented in secondary data.

As part of the site visits, data were collected each day through photographs and journal entries on what was observed at each particular site that was noted in the six urban plans. I personally joined a public guided tour of Little River and the Silver Maple Forest natural habitat by a Massachusetts Department of Conservation and Recreation (DCR) staff member. The DCR currently own and manage the Alewife Reservation and Brook. The data obtained from site visits (journal notes, public tour, and photos) are applied in Chapter 6 to support what recommendations were completed or any ongoing projects at specific sites.

2.6 Drawing Conclusions

Chapter 7 draws conclusions on the planning efforts' in the Alewife Brook Watershed and provides recommendations for future research. Reflecting on a historical overview of planning will aid in understanding the unique contribution of the many people involved in the planning process, and lead to more effective collaboration between the different professions as well as what makes a successful plan successful.

Chapter 3: Historical Overview of Landscape Change of the Alewife Brook Watershed

It is common knowledge that the landscape around us is changing, and what is seen today is the result of harmful natural processes and disasters, as well as human activities, both good, and bad. Many landscape changes can be seen within a person's lifetime; however, records of past environmental patterns show the history of the landscape, providing evidence of change which is valuable information for planners and restoration ecology (Marcucci, 2000; Hersperger, 1994). Aside from natural factors causing landscape change, human activity almost regularly has some potential relevance to landscape change. Researchers in a number of fields studying human interaction with the environment have identified driving forces such as population growth, cultural, economical, technological, and political processes (Schneeberger et al., 2007; Forman and Godorn, 1986; Antrop, 2005). Studies of landscape change face many challenges (Burgi et al., 2004). One is the combining of social science with natural science, which can be difficult to conduct in environmental history and ecology research. Identifying driving forces of a particular landscape can be difficult to distinguish from one another, as they can be interlinked (Schneeberger et al., 2007). For example, economic factors such as consumer demands, market prices, and structures, often link with laws and policies (Skokanova et al., 2016). Cultural factors can be a vague concept, describing attitudes, beliefs, values, and traditions or can express the way of life, and/or the change in population (Burgi et al., 2004).

Although each of these driving forces is important, for the purpose of this research, only economic growth (transportation, residential, and industrial development) and water resource change are reviewed in each landscape period. Both of these driving forces have influenced what the landscape looks like today, change which has motivated environmental conservation and wellness. Such a

timeline can show the history of cultural groups and the ways in which they used the land, the advancement of technology, and environmental history.

3.1 Indians, Colonial Times, and the Eighteenth Century

Written evidence of the land use history of the Alewife Brook Watershed and surrounding areas, began in the 1600s, when the first European settlers arrived in Cambridge. Archeological records show that the land during this time was used for food, shelter, and safety by the Indians (Cook, 2007). The upland wooded area offered protection from attacks by the sea, fresh water springs gave clean water, and the tideland provided hay for cutting and oyster beds (Emmet et al., 1978). Pawtuckeog Indian camps were located by the Menotomy River, currently known as the Alewife Brook and along the shores of Spy and Little Ponds (TBG, 2003). The Pawtuckeog would come to these areas in the spring to feed off the annual runs of alewife and blueback herring. The fish would migrate from the ocean to fresh water to spawn by the hundreds (TBG, 2003). In the winter, the Indians would move inland to feed off young deer, killing them with their homemade spears or arrowheads made from the bedrock of slate that lay hundreds of feet below the surface (Krim, 1977). European and English setters that came to the area for trade (fish, fur, iron and copper) and farming, ultimately took over the land by 1675 from the Indians (Cook, 2007). The Indian culture was eventually lost in Massachusetts.

Agriculture became the livelihood in Newtowne (re-named Cambridge in 1638): growing corn, beans, squash, and tobacco (Cook, 2007). The pressure for more farmland resulted in the clearing of wooded lands and meadows, also the draining of swamps, marshes, and rivers. Each town was governed by the town proprietors where each townsman had the right to plough fields for wheat, oats, or rye, and had the right to raise cattle and oxen on pasture lands (Krim, 1977). Land divisions in North West Cambridge were made between 1630 and 1640, which can be seen in Figure 3.1.1. During the early seventeenth century, more public and private buildings were developed around Cambridge, such as residential

homes, Harvard College, a courthouse, and hotels, including Taft Hotel on Spy Pond in Arlington and Fresh Pond Hotel near Fresh Pond (Emmet et al., 1978). By the late seventeenth century and early eighteenth century, two bridges across the Charles River were built. The bridges promoted more business in the area and made better access to Fresh Pond for recreational use. More roads in the area were also constructed (Emmet et al., 1978).

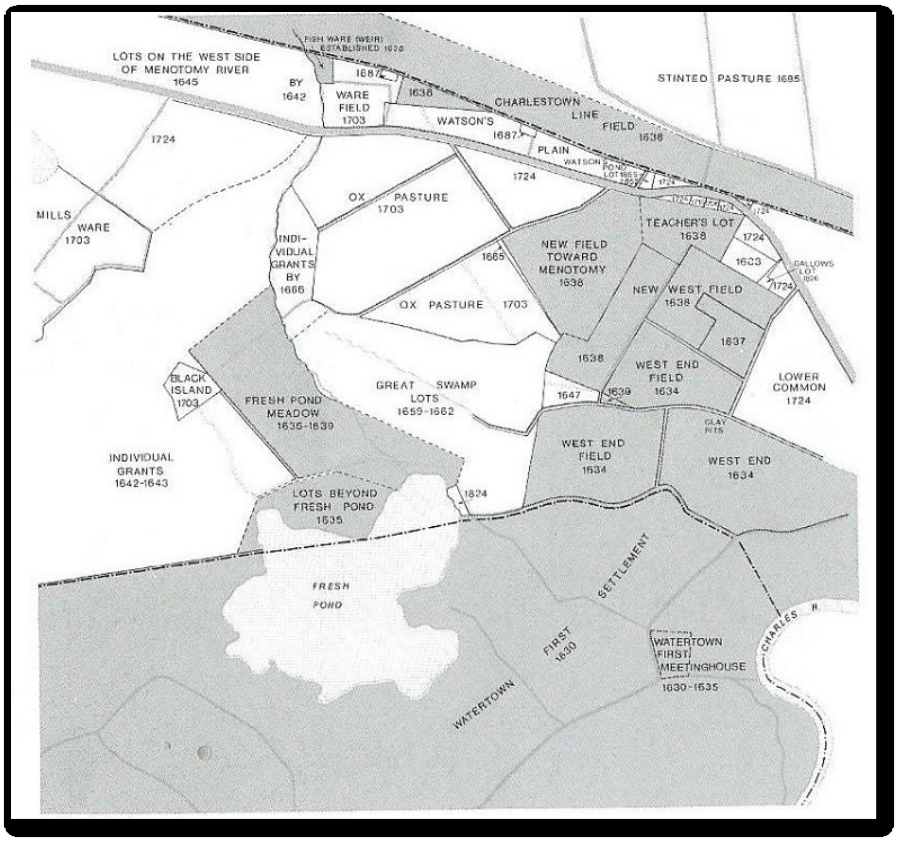

Figure 3.1.1: Common land field division near Fresh Pond (Cook, 2007).

3.2 Nineteenth Century (1800s)

With the two bridges being built, Cambridge became linked with other towns (Emmet et al., 1978). Roads and railways went through the towns. One road traveled westward through the Great Swamp to the tollhouse at Blanchard Road by the Richardson farm, continuing straight to Concord (Cooks, 2007). In 1831, one of the very first rail lines, Watertown Branch Railroad, was operated by Wyeth (the ice cutting and brick master). It contributed to Wyeth's ice industry by shipping the ice to other countries and helped with the cattle trade (Emmet et al.,

1978). Charleston Railroad was later built in 1841, and a few years later, in 1843, Fitchburg Railroad was built, parallel to Charleston Railroad (Krim, 1977). Lexington and Arlington Railroad Branch began to operate in the 1870s, running through Somerville's Davis Square and North Cambridge, and later beside Little River in 1881, connecting Massachusetts Central Railroad to Boston (Kaiser, 2000). In the 1850s, another toll bridge was constructed across the Charles River, where Boston University is now located (Emmet et al., 1978). A private horse-drawn railroad was located along Massachusetts Avenue in 1856 and was later replaced by electric ones in 1889 (Cook, 2007).

In 1893, the Alewife Brook Parkway, a scenic highway, was in the process of being built in Cambridge and Somerville, near the Alewife Brook. The parkway was considered part of Charles Eliot Jr.'s vision of the Emerald Necklace, a continuous curving green belt to protect the natural landscape from commercial development. A few years later, the Fresh Pond Parkway was built. The two parkways connected via Concord Avenue. The Alewife Parkway ends at the Mystic Valley Parkway (Emmet et al., 1978).

The two biggest industries during this time were the brick and ice industries. The brick industry in Northwest Cambridge was established by Nathaniel J. Wyeth in 1844 (Kaiser, 2000). Wyeth also worked in the ice industry, and helped finance the railroad extension in 1840 to transport the ice from Fresh Pond to the Charlestown wharves (Cook, 2007). Wyeth saw the potential growth for Cambridge. The clay was dug and transported to brick factories by rail, which was molded and baked for 24 hours in 180-200 °F temperatures (Cook, 2007). Sever Hall, Trinity Church, and other buildings were constructed by the local brick. Between 1845 and 1900, fourteen clay pits were dug by immigrants from both Europe and the southern United States (Figure 3.2.1). Due to the low elevation of the land, the pits were only dug to 80 feet deep (Cook, 2007). As a result, the abandoned pits would fill in with ground water, creating ponds. Yates and Blair Pond are two old pits known today (Kaiser, 2000). One of the largest

industries in Cambridge for many years was the ice industry; this is further discussed in Section 3.5.

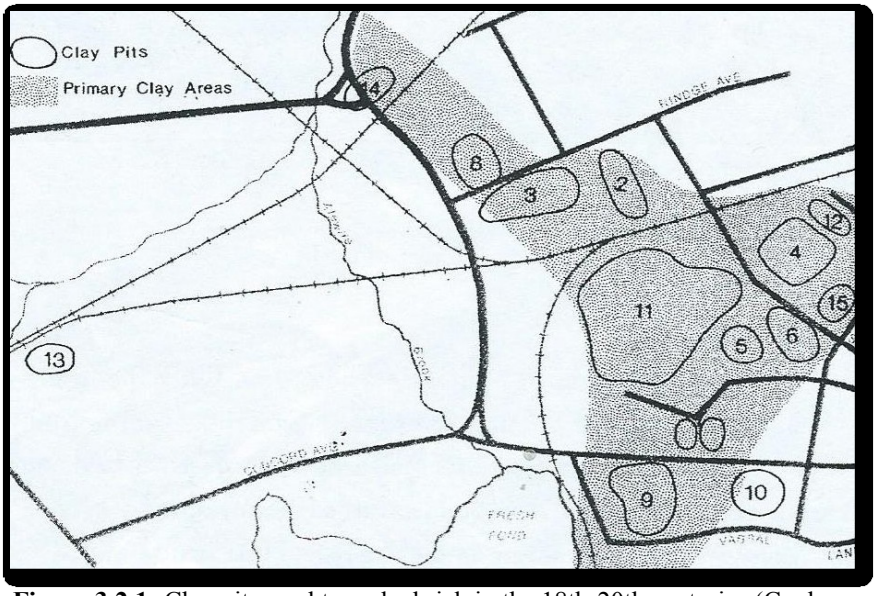

Figure 3.2.1: Clay pits used to make brick in the 18th-20th centuries (Cook, 2007).

Other business in the Alewife Brook Watershed included the tannery shop, carriage, and cattle market. The construction of new roads, bridges, and a railroad, during the early to mid 1800s, increased the production of the cattle markets (Figure 3.2.2). Slaughterhouses were built on both Beech Street and Walden Street (Emmet et al., 1978). The success of the cattle market lasted until 1868, when it closed due to the death of the owner. The land was subdivided for housing (Krim, 1977). The tannery shop, owned by William Muller in 1864, was another operation in Cambridge, shaped by high demands of the leather trade after the Civil War (Krim, 1977). In addition, a bone factory owned by John Kurtz was built on Harvey Street in 1865, now the site of Grace & Co (Krim, 1977). Production of local carriages by the mid-nineteenth century was along the north side of the Country Highway (Massachusetts Avenue) from the Middlesex Turnpike to Watson's Pond. By 1891, John Fitzgerald was the last owner of the carriage factory, located at the western end of North Avenue at Alewife Brook (Krim, 1977).

The economy was thriving during this time; however, it came with unfortunate costs to the natural landscape. Agriculture land was being sub-divided for more residential properties, and by 1887 the marsh area between Fresh Pond and the Little River were filled in and cleared for commercial development. This left only larger bodies of water and some of their tributaries still in existence (Cook, 2007). The transformation of the landscape had begun to take shape tremendously compared to the early 1700s. Burial grounds in 1820 were needed by the Catholics and, in 1846, they acquired more land for a cemetery in East Cambridge. By 1870, North Cambridge was well on its way to becoming a suburb (Cook, 2007).

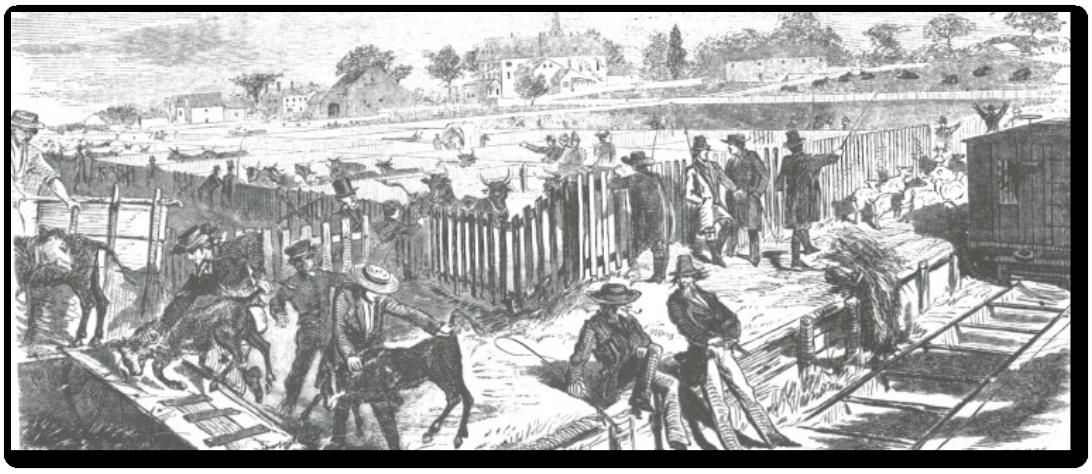

Figure 3.2.2: Cambridge cattle market from Walden Street (Krim, 1977).

The increase in residential and commercial growth in the 1830s in Cambridge put pressure on the water supply. The search for more water supply, outside from private wells, was necessary (Krim, 1977). In 1837, the private group, Aqueduct Company, purchased the natural springs on the top of Prospect Hill, currently in Somerville (Cook, 2007). It supplied water for the next fifteen years until further suburban growth in the 1850s led to another search for more water (Krim, 1977). The use of Fresh Pond as a water supply, located in northwest Cambridge, is discussed in Section 3.5.

In the early 1880s, residents of the area started to recognize the impacts of industrial pollution on the natural landscape. Water contamination was recognized

during this time, and in 1884 a metropolitan sewer was built (Cook, 2007). Later, in 1889, the state set up the Metropolitan Sewage Act. In the same year, the Trustees of Reservations pushed for metropolitan planning to identify and protect the watershed's open space (Cook, 2007). By the late 1800s, landscape architect, Charles Eliot, worked with the Metropolitan Parks Commission (MPC), which was renamed the Metropolitan District Commission (MDC) in 1919, to establish the need for better protection in the area of natural resources. The people of Boston were seeing the importance of open spaces and the need for balancing nature and humans.

3.3 Early-to-Mid-Twentieth Century (1900-1950s)

In the early 1900s, the Alewife Reservation and the Alewife Brook Parkway were considered part of the Metropolitan Park system, the first regional park system in the country (Krim, 1977). The importance placed on protecting the natural environment was heightening. Unfortunately, any efforts in protecting green space in Cambridge and continuing the visions of the Emerald Necklace vanished after the death of Charles Eliot in 1907 (Cook, 2007). Instead, the Alewife Brook was channelized, drained, and filled in, as part of a solution to cut down on the local mosquito problem and increase the area's land use for commercial and industrial developments (Figure 3.3.1 and 3.3.2). The alewives and eels that came up the Mystic and into the Alewife Brook by the thousands, slowly disappeared after the 1906 Cradock Dam was built to prevent tidal salt water from entering the lakes and marshes (Cook, 2007).

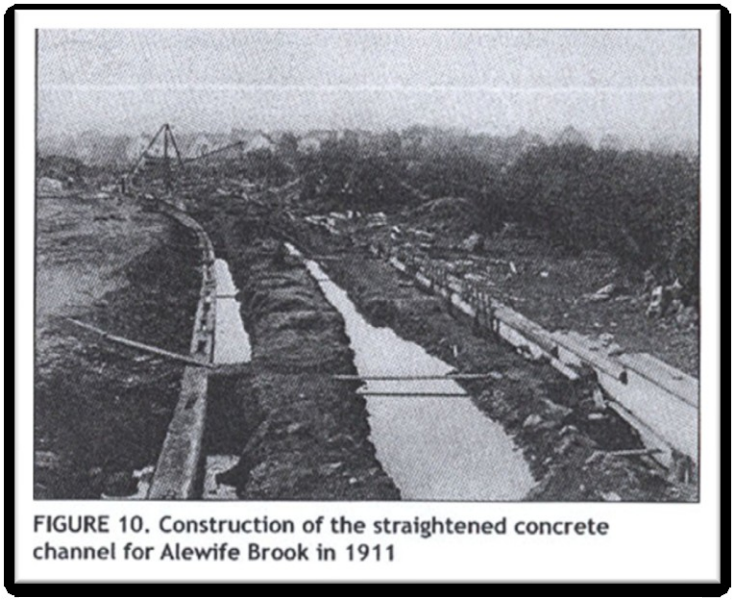

Figure 3.3.1: The Alewife Brook in 1911, straightened into a concrete channel (TBG, 2003).

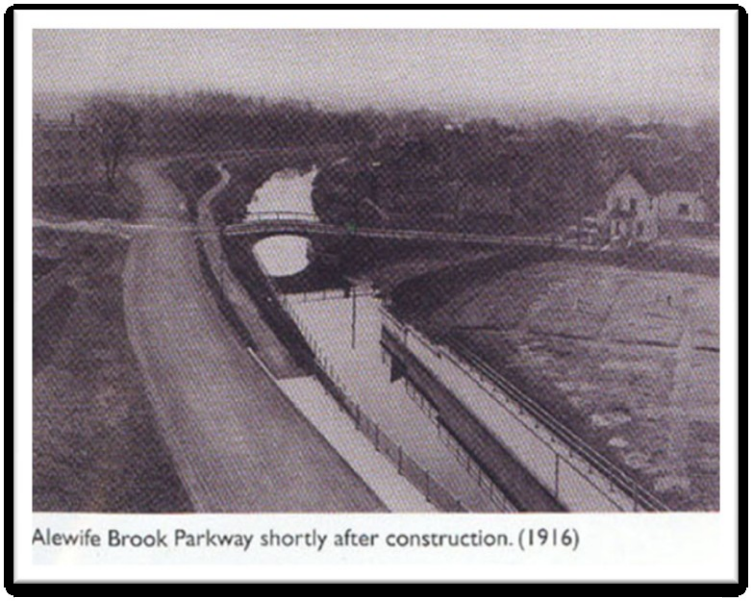

Figure 3.3.2: The aftermath of the Alewife Brook being straightened (TBG, 2003).

With more land available for development, a chemical plant, called Deway and Almy, was built in the early 1900s. The steel fabricator business, owned by A.O. Wilson, opened in 1928 on 170 acres located between the Alewife Brook Parkway, Blanchard Rd, and Concord Ave to the railroad tracks. To ensure that his employees had easy access to work, he convinced the Metropolitan Transit Authority to operate a motorbus from Harvard Square's subway to Concord Avenue (Cook, 2007). To accommodate the steel industry, the Alewife Brook was diverted into culverts (Kaiser, 2000).

Before World War II, the streets of Cambridge were filled with trolley lines, until the invention of the automobile, in the 1885, roads between Cambridge and Belmont were filled with electric battery and gasoline filling stations (Krim, 1977). Due to the popularity of the automobile, the MDC upgraded its carriage parkways for vehicles (Krim, 1977). In 1934, the MDC decided to widen Fresh Pond, Alewife Brook and Mystic River Parkways to a two lane highway in each direction (Cook, 2007). During the same time, Massachusetts Department of Public Works (DPW), built Route 2, a two-lane highway located along the Cambridge-Arlington line. It connected with the Alewife Brook Parkway at a traffic rotary near the abandoned Yates clay pit (Krim, 1977). In 1948, Governor John Volpe promoted the expansion of Route 2 from Cambridge to Lexington from a 4-lane highway into an 8-lane highway (Cook, 2007). Volpe explained that the new highway would create a pleasant buffer between the railroad and housing properties in Cambridge and Somerville; others saw it differently. Members from the Conservation Commission took Volpe to court to save the natural habitat near Alewife Brook. Volpe fought back, saying that the route would help the people of Cambridge escape in the event of a nuclear attack. Consequently, the project went forward (Cook, 2007). The "Inner Belt" expressway was designed in the early 1940s by the Planning Board to surround the entire area of Boston. It was believed that Cambridge was turning into a highway and not a place of community and harmony (Emmet et al., 1978).

The industrial, commercial, and suburban growth in Cambridge caused expansion across the Alewife Brook and out to Route 2, leaving farmers no choice but to sell their properties to developers (Krim, 1977). Landscapes once known for their beautiful marsh land was covered with concrete buildings and roads (Cook, 2007).

3.4 Mid-to-Late Twentieth Century (1950s-2000)

The industrial expansion was slow during the 1950s, and many of the vacant industrial buildings were turned over to shopping centers or buildings (Kaiser, 2000). One of the oldest shopping centers, built in 1949, was replaced with another mall near Fresh Pond (Emmet et al., 1978). Arthur D. Little Company (ADL) built offices and leased land from MDC to put in parking lots at Acorn Park, land that was once used for farming. W.R. Grace Asbestos purchased Dewey and Almy (chemical plant), and built White Village Shopping Centre on the vacant lot of New England Brick Co (Cook, 2007). Sites all around the Alewife Brook Reservation were proposed for shopping malls, markets, and apartment buildings. Pending developments were in Belmont Uplands (where the last standing Silver Maple Forest exists), Mugar, W.R. Grace, and the ADL locations. The efforts to protect the natural landscape of the Alewife Brook Reservation from local environmental groups and residents during this time were overshadowed by the Cambridge City Council that valued new tax revenues over creating open space.

The Brick Company's clay pit excavations ended in 1951. The pits were sold to the City of Cambridge. Some of the old pits were used for storing garbage or filled in for development purposes. The steel industry lasted until the early 1980s with the departure of West End Iron and Bethlehem Steel (Kaiser, 2000). The new development transformed the area from an industrial landscape to a suburban region.

The 1950s brought on many conflicts between contractors, builders, and local environmental and conservation groups. Concerns with protecting the natural landscape of the Alewife Reservation heightened after multiple storm events which caused adverse effects to the nearby communities. In the early 1950s, two back-to-back Hurricanes, Diane and Carol, caused extreme flooding in the area, where Route 2 was covered in water (Kaiser, 2000). Large storm events caused the basements of residents to flood and streets to fill with contaminants/raw sewage (Cook, 2007). Years of ignoring the importance of the wetland's natural function of absorbing and temporarily slowing down floodwaters was showing. The wetlands within the Alewife Brook Watershed could no longer do their job (Cook, 2007).

Unlike the industrial development, the traffic in the area was not slowing down. Traffic had become increasingly backed up by the 1950s. Approximately 22,072 cars per day filled Route 2 from Cambridge to the Belmont, not including the traffic through residential and community streets (Kaiser, 2000). To better control the traffic, it was proposed to widen Route 2, and extend the Red Line, from Harvard Square to Alewife Brook, and from Alewife Brook to Arlington, all underground (Emmet et al., 1978). The Red Line was the last of the four major Boston subway lines to be built. The widening of Route 2 occurred in the 1960s to a 4-lane highway, which divided the communities of Belmont and Arlington. In the 1970s, it was proposed to build an 8-lane highway to control the massive traffic issues. In the end, it was never constructed due to the communities' opposition because of the potential threat to the Alewife Reservation and what is left of the Great Swamp (Beinecke, 2013). By 1964, the Transit Authority joined all town buses and subways within Route 128, and formed the Mass Bay Transportation Authority (MBTA), which planned for the Red Line extension (Kaiser, 2000). During the same time, the need for open space encouraged the production of several Acts, the 1962 Federal Aid Highway Act and the National Environmental Policy Act which required environmental impact statements (EIS). The Acts considered social, environmental, and economic effects of highways

(Cook, 2007). Funding from the 1962 Act was available for implementing the Red Line extension; however, the line was only constructed from Harvard Square to the Alewife Brook Reservation. It was thought by local residents that the extension from the Alewife Brook to Arlington would damage the ecosystem of the Alewife Reservation and Spy Pond (Cook, 2007). This was a major win for people in the area who were worried about the negative impacts of increased urbanization and development to the natural landscape of the Alewife Brook Reservation. The Alewife Brook Reservation area became the final Red Line Terminal (transit hub). Buses could connect from the north and west. To aid in the congested streets, old rail lines, such as the Lexington Branch Railroad, were converted to bike paths. The Lexington Branch Railroad right-of-way through Arlington and Lexington to Bedford connected to Somerville's Davis Square and Boston. A new bike path was built Northwest of the Alewife, called the Minute Man Bike Path, to promote bicycle commuters (Cook, 2007).

Another win for local communities was the halt to develop a large highway proposed to run through Cambridge, Arlington, and Belmont in the 1990s, a solution to prevent further damage to the "truss bridge" over the railroads. This win prevented any additional damage to the health of the natural landscape of the Alewife Brook Reservation. The communities felt that the truss bridges were being held “hostage” at one point by the Executive Office of Transportation and Construction (EOTC) to get leverage concessions from the neighborhoods (Kaiser, 2000). After years of rejecting the highway plans by the communities, in 1992, the State Department of Public Works insisted that the bridges be replaced, and the large highway project was discarded. The new bridges were completed by 1995 (Kaiser, 2000).

Planning for the location of the MBTA Station, bridge replacements and parkway improvements were determined by the tri-community Task Force, created by Governor Dukakis in 1975, to help with traffic issues in the area. Regrettably, planning that was completed by the Task Force during this time was designed for

agencies and politicians which left little consideration for social and environmental benefits (Cook, 2007). The site for the MBTA's Station, known at the Alewife T-Station, opened in 1985 and was built near Yates Pond in the MDC's Alewife Reservation, which in fact violated the 1962 Federal Aid Highway Act. The facilities include: a multi-level parking garage which holds 2,733 vehicles, three secured bicycle cages, a busway with shelter to serve multiple bus routes in the area, and connections to the Minuteman Bikeway Cambridge Linear Park and the Fitchburg Cutoff Path. Direct access is available to the Alewife Brook Parkway and the Massachusetts Route 2 freeways. The traffic by the year 2000 was improving, which could be a result of the T-Station opening (Cook, 2007).

Conservation became more popular in the 1970s. This was a time when legislation, at all levels of government, was implemented towards environmental protection; however, urbanization was not slowing down, damaging the natural quality of watersheds. This may have influenced the Federal and State National Environment Policy Act to require all major development proposals to complete an Environmental Assessment (Emmet et al., 1978). In the same year, the Clean Air Act was published, which pushed the state to decrease car and truck emissions (Cook, 2007). Open space, particularly around the Fresh Pond and the Alewife Brook, was given more importance than ever before. To enforce environmental change, the Citizens for Alewife Coalition was formed. The group included individuals from Northwest Cambridge, Friends of Blair Pond and the East Arlington Good Neighbors Group (Cook, 2007). The Mystic River Watershed Association (MyRWA), founded in 1972, is a strong group of volunteers fighting to protect and restore the Mystic River and its tributaries. Many of these environmental groups protected, and even stopped, proposed development over the last decade. They were, and still are, an enormous help in recognizing and preserving environmental protection, because in some cases, environmental assessments had flaws. In 1977, the Red Line Extension Environmental Assessment was criticized by the MyRWA. They pointed out that the hydrology

data was poor and the highway planning should have been included, because the traffic analysis was inadequate.

Flooding issues are ongoing in the area and the storm events in 1996, 1998 and in 2001 caused damage to many basements of local residents (Cook, 2007). The community and environmental groups demanded a solution to the Cambridge City Management to solve all of the flooding issues, and to protect the Alewife historical landscape once and for all (Kaiser, 2000).

3.5 Fresh Pond History

Fresh Pond, located at the northwest edge of Cambridge, was created over 15,000 years ago. A large piece of ice broke off from its main glacier, and started to melt into a large hole (160-acre lake) surrounded by marshland and gravely moraine hills (Sinclair, 2009). Like other ponds and streams created by glaciers, Fresh Pond was used for fishing by the Indians. When the European settlers arrived, Fresh Pond was considered too swampy. By 1700, lots were divided around the pond for farm land and the Coolidge homestead on Grove Street to the Southwest of Fresh Pond (Sinclair, 2009). At this time, the land was owned by Nathaniel Sparhawk, and then by Justinian Holden and his children.

In 1793, the West Boston Bridge was built so that people could cross over the Charles River to the middle of town at Cambridge port. Fresh Pond became more accessible and land was sold to Bostonians (Sinclair, 2009). Many people described Fresh Pond as a place of beauty, rich pasturage, and wonderful gardens of vegetables that had a country retreat atmosphere. In 1784, Richardson bought a piece of land from owner Joseph Holden, during this time, and built the Concord Turnpike. This was a road that went across the Fresh Pond Moraine to his hotel. Unfortunately, his investments with Mr. R. Wrightson, who ran another hotel on Fresh Pond in 1811, were unsuccessful. In 1792, Jacob Wyeth, a graduate from Harvard, bought his father's eight-acre family farm, which stretched from the pond to Mount Auburn. It became a very popular place for people to come and

enjoy the fresh air. After the Civil War, the hotel declined, and was moved to Lakeview Avenue which is still there today (Emmet et al., 1978).

The ice industry was one of the largest businesses at Fresh Pond, founded by Frederic Tudor in 1805. He harvested, transported (by railroad), and shipped ice to Europe and India (Krim, 1977). There were many people who owned the Fresh Pond Farm land over the years. In 1816, C.C. Foster sold it to William Tudor's son, Frederic (Sinclair, 2009). Ice that was shipped to the southern port hotels to keep meat and vegetables cold, and to make desserts and drinks had increased in the 1820s (Cook, 2007). In 1824, Tudor hired Nathaniel J. Wyeth, owner of Fresh Pond Hotel, to help with managing his business. In the same year, Wyeth expanded the ice industry and solved the problem of the ice melting in storage by designing a horse-drawn ice-cutter that cut blocks significantly larger (Figure 3.5.1). Conflicts over the ice harvest, in 1841, resulted in a survey of Fresh Pond (Cook, 2007). It was then zoned into pie shaped sections from each owner's shoreline. This empowered Tudor and Wyeth to open a railroad in 1843, linking the icehouses directly to the export wharves in Charlestown. Over 65,000 tons of ice were shipped across the world in 1846, a number that tripled ten years later (Emmet et al., 1978). To keep up with the demand, Tudor dredged his meadowland between Alewife Brook, and Concord Avenue in the 1860s, building an artificial pond called Glacialis (Cook, 2007). The ice industry ended when the competition from Maine increased and refrigeration improved in the South. For many years, the Glacialis was used for a local skating pond and later used for a dump in 1928.

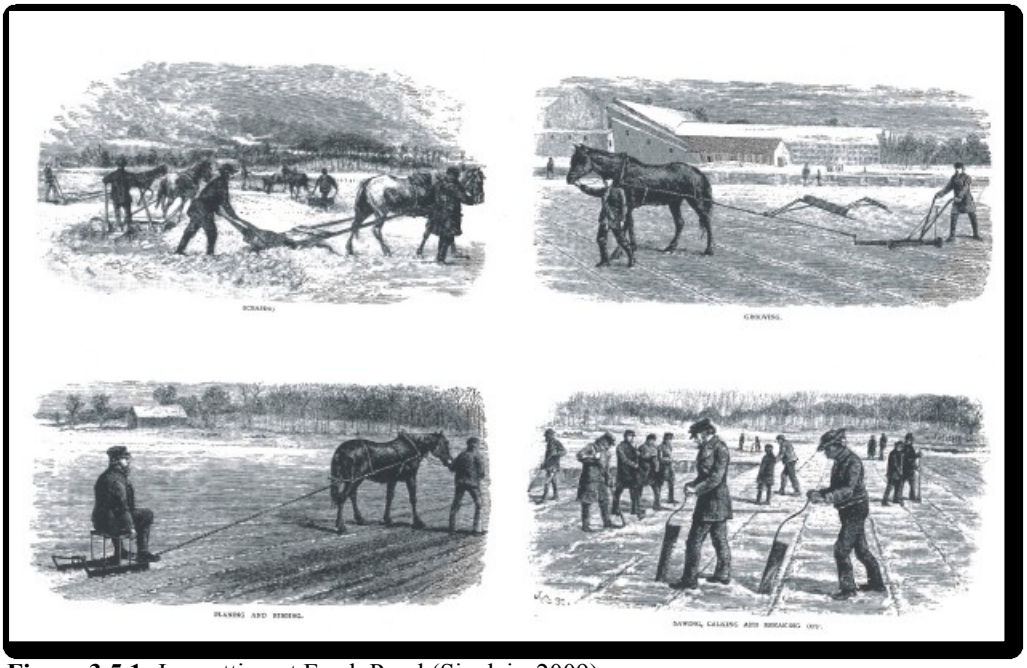

Figure 3.5.1: Ice cutting at Fresh Pond (Sinclair, 2009).

As mentioned previously, the growth of Cambridge put pressure on finding clean water to supply the public. Water supply from private wells was not sufficient, which led to the private group, Cambridge Water Works, tapping into Fresh Pond in 1852 (Krim, 1977). Authorized by the Legislative Act in 1856, water was pumped upstream through a pipe from Fresh Pond to a reservoir on the Fayerweather Estate, which was gravity-fed, supplying it to the city with pure water (Cook, 2007). Figure 3.5.2 and 3.5.3 maps show Fresh Pond and its surrounding landscape in 1866 and in 1897. Cambridge Water Works and another private group, the Aqueduct Company, were combined into one municipal system and bought by Water Works in 1861. Five years later, the City purchased Water Works for $291,000, including the engine house at Fresh Pond, distribution system, reservoir on Reservoir Street, and 200 acres of land around Fresh Pond (Sinclair, 2009). In 1875, the city had planned to tap water from other ice ponds and link Little and Spy Ponds in Belmont, and Arlington with Fresh Pond at Black Nook. However, there was sewage contamination from the ice industry, and other businesses shut down the use of the line (Krim, 1977). In 1888, the Commonwealth of Massachusetts gave all rights of the pond to the City of

Cambridge to ensure the health of the pond. The city began to purchase the 170 acres of land around the pond and demolish any buildings around Fresh Pond to better the quality of the water in the reservoir (Davis, 1965). Engineers started to reform the pond's edges by filling in coves, straightening the shore, and constructing level roads around the perimeter. Near the end of the 1800s, a dam was built across Stony Brook, and the water was pumped through a ten-mile-long pipe to a holding tank in Belmont, before it entered Fresh Pond.

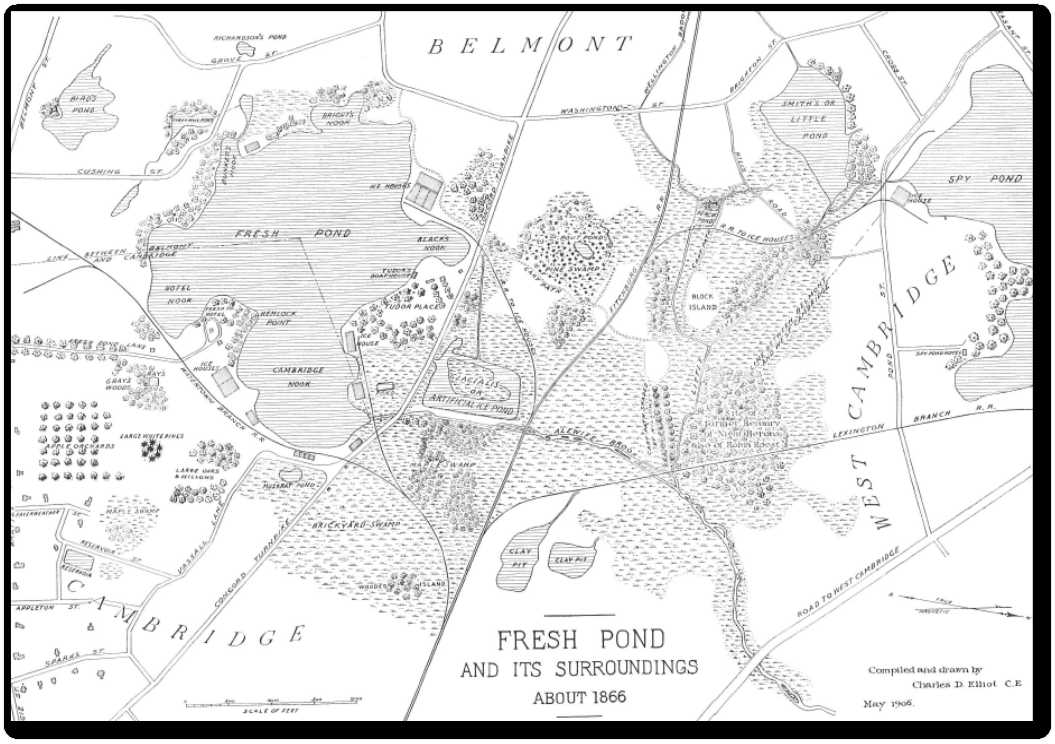

Figure 3.5.2: Fresh Pond in 1866 (Cook, 2007).

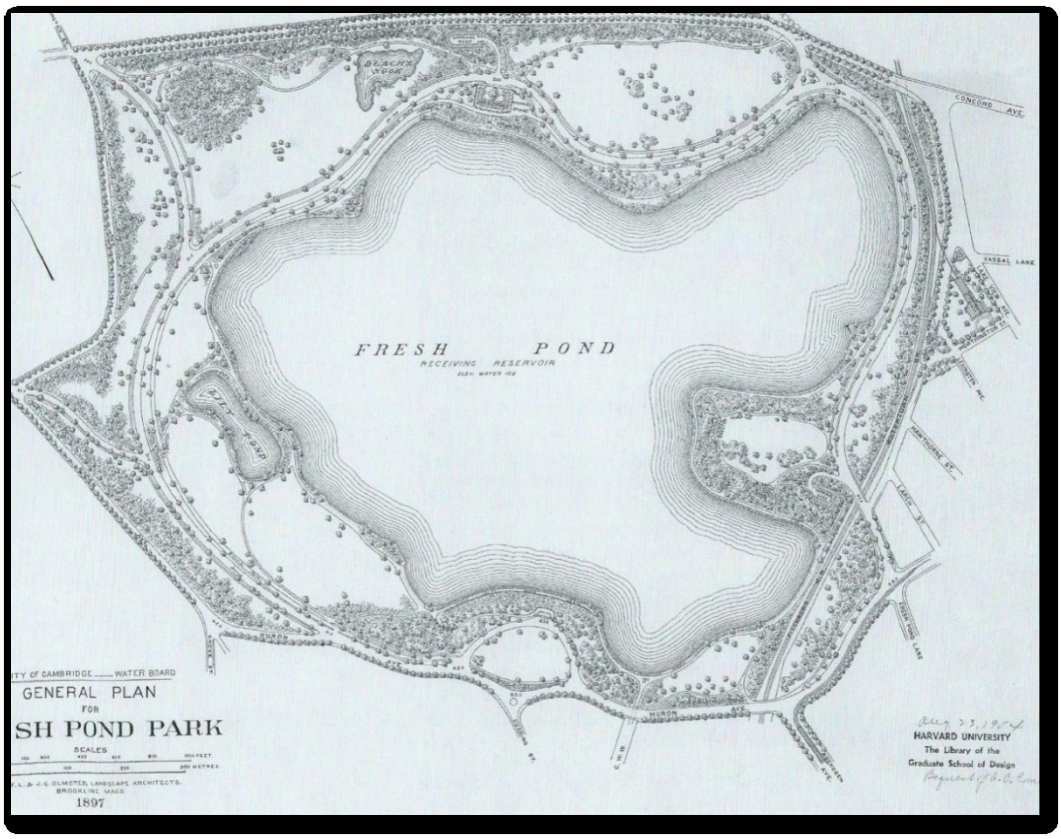

Figure 3.5.3: Fresh Pond in 1897 (Cook, 2007).

Due to the increase in consumption of water in the 1950s, Cambridge City connected to three locations of the Metropolitan District Commission water system (Krim, 1977). These connecters worked automatically, and were controlled by pressure regulating valves to supply emergency water. The cost of water increased over the years, increasing from ten cents per 100 cubic feet in 1910 to thirteen cents per 100 cubic feet in 1957. This was possibly due to the boost in water consumption and the cost of up-dating equipment at the water plant (Davis, 1965). To protect the quality and quantity of the Fresh Pond water, the City of Cambridge built a water purification plant on the shores of Fresh Pond in 1923, referred to as Kingsley Park. The underground settling basin was 137 feet long by 96 feet wide and 16 feet deep. The plant obtained ten rapid sand filters with beds, administration offices, a laboratory, and facilities for chemical treatment of water and engine pumps. The new building was the most up-to-date and largest water purification plant in New England (Davis, 1965).

In the late 1800s and early 1900s, Cambridge Water Board hired the well-known influential landscape architects, Frederick Law Olmsted and Charles Eliot Jr., to plan for more green space at the Fresh Pond Reservation. Both Olmsted and Eliot believed in the "restorative powers of natural scenery" and that public parks are an essential part of the city, not for its aesthetic quality, but a necessary element for the conservation of the civilization of cities, just as sewers, and streets lights are (Sinclair, 2009). Fresh Pond was part of the Emerald Necklace. However, like the Alewife Reservation, the plan was not implemented at this time. Instead, development occurred along the pond. In the 1920s, the City's Home for the Aged and Infirm was built, as well as the Water Department's maintenance yard. In 1934, a nine-hole golf course was built on the western side of the meadow by Fresh Pond, taking up one third of the Reservation landscape. Lots were sold to city officials and employees for homes along the western edge of the Reservation near Grove Street and Blanchard Road (Cook, 2007).

It wasn't until the 1970s when people in Cambridge saw Fresh Pond as Olmsted and Eliot had, a place to connect with nature. The Cambridge Plant and Garden Club planted over 40 pines and swamp maples around the pond, inspired by Eliot's vision. The club continued to plant trees around the pond years after (Cook, 2007). During the 1990s, a number of studies were conducted to examine the ecological health of the Fresh Pond Reservation. In 1997, when the replacement of the water plant was required, the city recognized the importance of managing the Reservation landscape for future site improvements. To protect and enhance water quality and open space at Fresh Pond, the city manager selected 18 members to create a Fresh Pond Master Plan Advisory Committee. The committee assisted with the development of the Fresh Pond Reservation Master Plan, which was completed in 2002, and is one of the six plans analyzed for the current research. The committee members had a wide range of views on what Fresh Pond should symbolize, and had many debates on dog walkers, signage, fencing, and recreation (Sinclair, 2009).

Chapter 4: Summary of Plans from the Late Twentieth to Early Twenty-First Centuries in the Alewife Brook Watershed

This chapter distills and summarizes the planning phases of the six plans from the late-twentieth to early twenty-first centuries to represent a wide range of planning in the Alewife Brook Watershed. The chapter is divided into sections as previously outlined in Section 2.3. However, only plan description and goals and objectives are described below; site inventory and analysis, recommendations and suggested implementation(s) are outlined in Appendix A-F. Remarks on pedestrian or bicyclist paths in the plans will only be discussed tangentially. Planning for recreation is recognized as an important part of planning; however, the main focus of my research is examining the roles of water quality, quantity, and biodiversity habitat in the planning process. Below I have added two aerial photographs indentifying specific sites in the Alewife Brook Watershed (Figure 4.1 and Figure 4.2). These sites were mentioned in the six plans analyzed which are also repeatedly discussed throughout the next few chapter. Figure 4.1 deals with the larger scale of the Alewife Brook Watershed and Figure 4.2 narrows into the Alewife Reservation. Tables 4.1 and 4.2 provide coordinates to identify each site. The star (*) symbol in Table 4.1 are sites that are shown in more detail in Table 4.2 and Figure 4.2.

Table 4.1: List of coordinates and names that corresponds to the aerial photography in Figure 4.1 to identify location of specific sites within the six plans analyzed. The symbol (*) on site names can also be seen in Table 4.2 and Figure 4.2.

Coordinate	Site Name
4 C	Acorn Office Park *
4 C	ADL Wetland *
4 D	ADL Parking Lot *
4 D and 3-1E	Alewife Brook *
4 C	Alewife Reservation *
4 B	Blair Pond *
4 B	Belmont Uplands *
5/6 E	Danehy Park (Cambridge Dump Site)
1/2 E	Dilboy Field
6/7 C	Fresh Pond
4/5 D	Jerry's Pond *
4 B	Little Pond *
4 BCD	Little River *
3/4 D	Magnolia Playground *
3 B	MDC Rink *
3/4 C	Mugar *
4 B	Perch Pond *
4 E	Russell Field
2 B	Spy Pond
2/3 E	St. Paul's Cemetery
4 C	Stormwater Wetland *
4 C/D	Thorndike Playing Field *
4 D	T-Station*
4 D	Yates Pond *

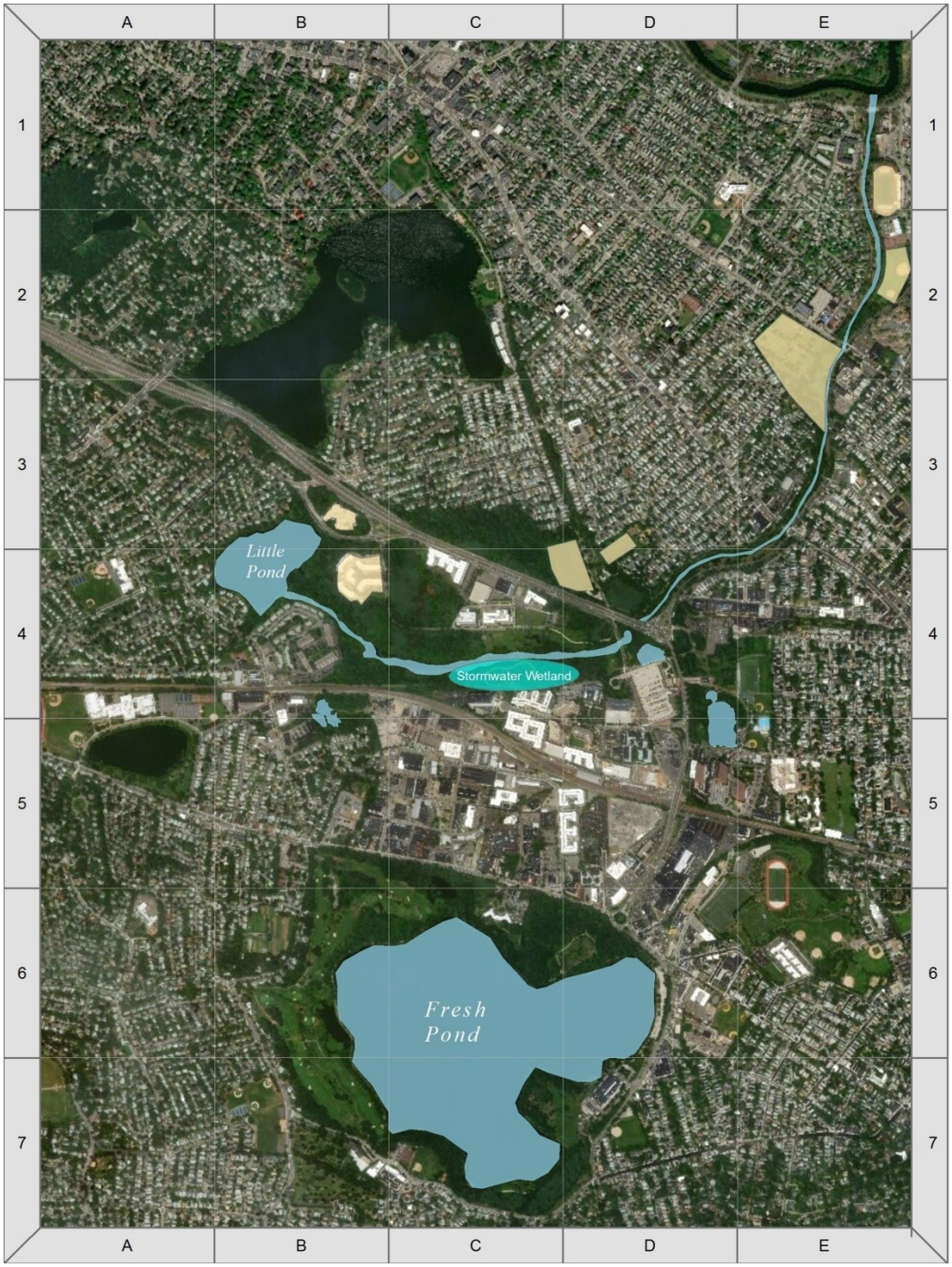

Figure 4.1: Aerial photography of the Alewife Brook Watershed specific sites mentioned in the six plans analyzed (Esri).

Table 4.2: List of coordinates and names that corresponds to the aerial photography in Figure 4.2 to identify location of specific sites within the six plans analyzed.

Coordinate	Site Name
4 C	Acorn Office Park
3 C	ADL Wetland
4 D	ADL Parking Lot
3/2 E	Alewife Brook
4 BCD	Alewife Reservation
5/6 B	Blair Pond
3 B	Belmont Uplands
5/6 E	Jerry's Pond
3 A	Little Pond
4 BCD	Little River
2/3 D	Magnolia Playground
2 B	MDC Rink
2 C	Mugar
4 B	Perch Pond
5 C/D	Stormwater Wetland
3 D	Thorndike Playing Field
5 D/E	T-Station
4 D/E	Yates Pond

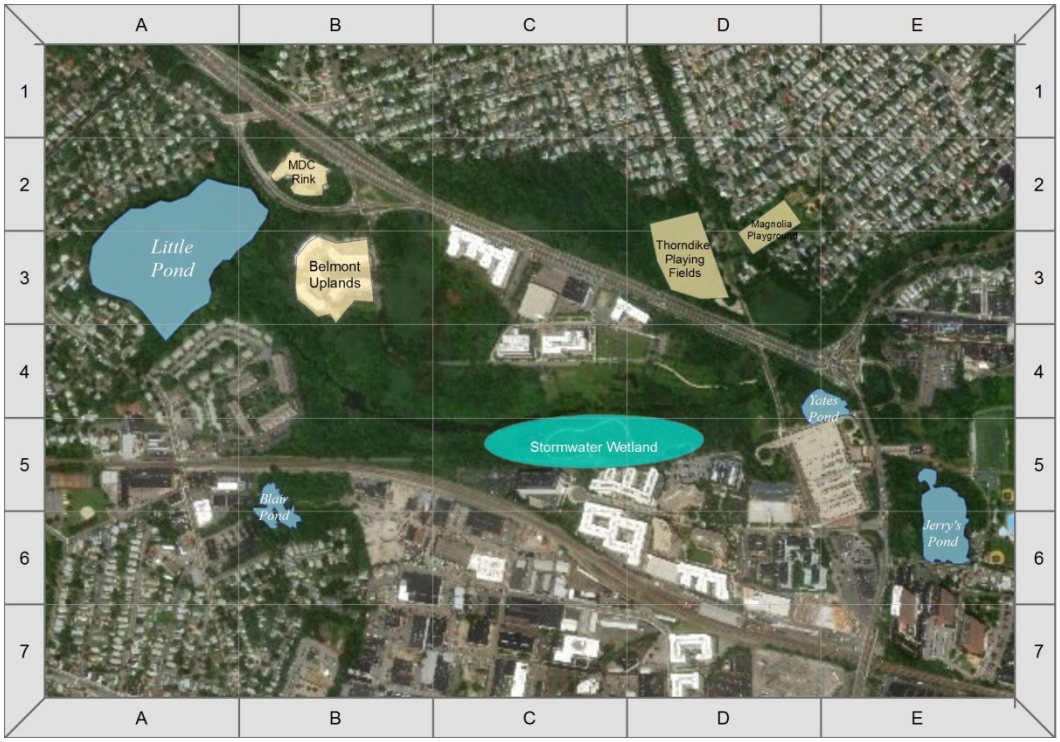

Figure 4.2: The Alewife Brook Watershed and specific sites outlined in the six plans (Esri).

4.1 Alewife Open Space: Objectives and Recommendations for the Development of a Park and Open Space Network (1978)

The Alewife Open Space plan was published in 1978 for the Alewife Task Force by the Metropolitan Area Planning Council, a planning agency for the cities and towns of the Boston Metropolitan area. A subcommittee was created in 1977 to ensure that environmental and open space concepts were acknowledged during the planning process. The subcommittee members consisted of: residents, conservation and planning department staff from the three communities of Arlington, Belmont, and Cambridge, MDC, MAPC, Central Transportation Planning Staff, Massachusetts Bay Transportation Authority, Executive Office of Environmental Affairs, and the MyRWA.

The Open Space Subcommittee of the Alewife Task Force proposed the expansion and linkage of existing open and recreational areas in the Alewife Brook Watershed in North Cambridge, East Belmont and East Arlington. These areas included: Russell Field, Jerry's Pond, Alewife Brook and Reservation, Perch

Pond, Yates Pond, the Cambridge dump site, Fresh Pond Reservation, Thorndike Field, and the Magnolia Street Playground. See Appendix A, Figure A-1.1 and A-1.2 for specific site locating. Land use was analyzed and field surveys and wildlife inventory were conducted. The plan describes that maps were used by the subcommittee to indicate areas of land suitable for open space. Nine policies and objectives, developed by the subcommittee, helped prioritize new open space areas for public preservation and improvement of existing lands (see below). The 1978 plan outlined three specific topics: Proposed Areas for the Expansion of Open Space, Proposed Bicycle and Pedestrian Paths and Other Open Space Issues.

The Task Force members believed that open space should be highly valued, preserved and extended. Green spaces should be linked to one another to connect natural wildlife habitats and improve the image of the area. It was also mentioned that open space networks should complement and enhance economic development and residential development.

The policies and objectives included (MAPC, 1978):

1. Preserve and manage existing open land areas (such as the Alewife Reservation),
2. Encourage the expansion of the Alewife Reservation as a protective measure against encroachment by development,
3. Designate certain areas of the Alewife Reservation as wildlife sanctuaries where paved paths and motor vehicles are prohibited,
4. Assure that those areas which will be most heavily disrupted by transit and roadway construction are restored to a condition supportive of appropriate public and or wildlife uses,
5. Take advantage of opportunities created by transit and road construction to establish small open park areas to soften and relieve the urban environment, for example, Jerry's Pond and the east station entrance, and the grounds of the station/large complex,

6. Encourage natural and landscape buffers between developed and open space lands,
7. Develop a network of green space between the Fresh Pond Reservation on the south, and the town of Arlington on the north, as a link in the park network between the Charles River and the Mystic River,
8. Protect the wetlands from development so as to maintain or improve, if possible, their hydrologic functions,
9. Assure that any development within the floodplain conforms to strict regulations and restrictions.

4.2 The Alewife Open Space Plan, Metropolitan Area Planning Council (1985)

The Alewife Open Space Plan, developed in 1985, was prepared by MAPC staff. The EOTC was responsible for overseeing the development of all transportation improvements in the Alewife study area. MDC was involved in the planning process, as they were the owners of the Alewife Brook, Reservation, and Alewife Brook Parkway. The towns of Arlington and Belmont and the city of Cambridge, as well as their conservation commissions, were also involved as well as the MyRWA. The plan was identified as an open space effort, building on previous planning recommendations. The plan directly related to the protection and enhancement of the open space areas, as well as acknowledging environmental issues and concerns in the areas.

The study area included the towns of North Cambridge, East Arlington, and East Belmont. The boundaries, which included open space areas in need of protection and enhancement, spread from the southern side lying towards Concord Avenue in Cambridge, starting at a point east of Loomis Street, and continuing east until Alewife Brook Parkway. The boundary continues north along Alewife Brook Parkway to Rindge Avenue, east on Rindge Avenue to Clifton Street, and north on Clifton Street to Whittemore Avenue. The boundary continues west, with the Magnolia Playground, Thorndike Playfield, Mugar site, and the MDC Skating Rink (MAPC, 1985).

The development of the goals and objectives was driven by the need for open space protection, and improvements. Assumptions, situations or conditions which were unchangeable or fixable, were described and played a role in developing the goals and objectives of the plan.

1. Preserve open space in an urbanized area: the land should be set aside before active or passive recreation areas can be developed. The largest open space area in need of preservation was the Alewife Brook Reservation. Objectives: prevent encroachment on existing open space lands by site design and buffer areas; preserve unprotected open space lands; encourage plant diversity for wildlife habitat, aesthetic value and ecological stability; and maintain isolated and undisturbed areas naturally (MAPC,1985).

2. Mitigate flooding and pollution hazard: preserving open space would decreasing the amount of paved surfaces which will aid in flooding and water quality issues of the area. Preservation of wetlands would contribute by acting as floodwater retention and filtering out pollutants. Objectives: preserve and enhance wetlands; enhance the flood storage capacity of present open space lands and surface waters by wetland management techniques; and encourage on-site compensatory storage in new development (MAPC,1985).

3. Give form to the area and provide linkages: open space elements in the Alewife study (offices, industry, transportation facilities, roads and railroad tracks) do not connect and work well with other surrounding land uses. The goal was to better link these elements with other surrounding land uses. Objectives: use indigenous and natural landscape in order to link open space elements both physically and visually; build paths for pedestrians and bicycles; enhance existing views and vistas; and incorporate major automotive routes into the open space system by well-suited landscaping (MAPC,1985).

4. Integrate public and private open space: publicly-owned or privately-owned should be included in the overall open space system. Objectives: support the appearance and hydrological functioning of water bodies in private ownership by landscaping, grading and hydrologic improvements; provide natural and indigenous landscape fundamentals; provide links between public and private open space where appropriate; and encourage public input on site development affecting privately-owned open space for sensitivity to the public open space areas (MAPC,1985).

5. Provide for needed active open space uses where they will not impinge on the natural environment: understand the different types of open space and where they are best suited in the landscape. Natural areas should be given priority over active recreation areas. Objectives: locate more intensive public uses in areas where land has already been disturbed and where access was relatively good; locate more intensive public uses in areas where native vegetation and wildlife habitats would not need to be distressed; and assign less intensive public use to be in the more undisturbed locations (MAPC,1985).

4.3 Metropolitan District Commission Parkway Restoration: A Master Plan for Segments of the Alewife Brook and Mystic Valley Parkway (1996)

The MDC decided a master plan was needed to guide the reclamation and management of the Parkway. This came years after the formation of the East Arlington Good Neighbor Committee, which was created by local residents. The committee pushed the MDC and the Department of Environmental Protection (DEP) to take better responsibility for the brook's poor water quality and the physical damage to the banks. The 1996 master plan is a result of communities working together to better the health of the natural landscape (MDC, 1996). Brown and Rowe, Inc. Landscape Architects and Planners were hired to develop the master plan. The Algonquin Gas Transmission Company, which at the time was upgrading their existing gas lines within the MDC parkland, agreed to fund the master plan research.

The study area consisted of the historic 2.2-mile MDC parkland between the intersection of the Alewife Brook Parkway and Route 2 and the intersection of the Mystic Valley Parkway and the Medford Square Foot Bridge. The watershed system included the Mystic Lakes, Spy, Little, Jerry's, Blair, and Fresh Ponds. The plan divided the study area into five segments, each having its own recommendations and implementations (Figure 4.3.1). Segments One, Two and Three will be discussed for the purpose of this thesis as they are within the research study area of interest.

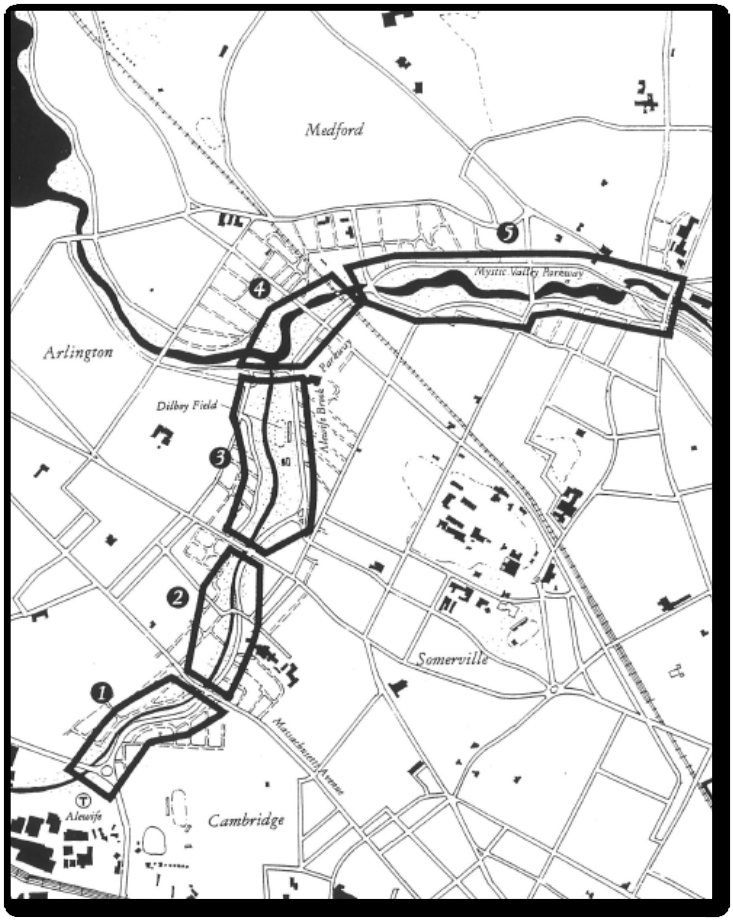

Figure 4.3.1: Five recommended segments of the Alewife Brook outlined in the plan (MDC, 1996).

The primary goals of the plan were to establish an image and strategy for reclaiming the parks' land. The eight objectives are listed below (MDC, 1996):

1. To reclaim the parkway character, that of a tree-shaded boulevard with appropriate lighting, signage, and curbing, for this segment of the Alewife Brook and Mystic Valley Parkway,
2. To develop a landscape design and maintenance plan to guide the planting and long-term maintenance of existing and proposed plan materials,
3. To heighten public awareness of the area's unique wetlands character to increase visibility and use of the Alewife Brook and Mystic River,
4. To provide safe, convenient travel routes for pedestrians, cyclists, and in-line skaters and to provide convenient links to other existing multi-purpose paths, such as the Minuteman Bikeway,
5. To update the existing MDC recreational facilities and parking lots,
6. To mitigate the safety and aesthetic park land impacts of existing aboveground utility pipes and to render them less of a hazard and visual intrusion on the landscape,
7. To reclaim parkland from private encroachments for public use, especially riverbanks and wetlands,
8. To estimate restoration cost for each park land segment and to recommend construction phasing as funds become available.

4.4 Blair Pond Master Plan: Cambridge and Belmont, Massachusetts (1999)

The Blair Pond Master Plan was created by the Berkshire Design Group, Inc., Landscape Architects, and the Bay State Environmental Consultants, Environmental Engineers. The plan was prepared for the MDC of Boston, Massachusetts as a document to assist in future design work. The Blair Pond site consists of a 1.3-acre pond, and the 7.09 acres of landscape surrounding the pond. It is located in the northwestern section of Cambridge and is adjacent to the MDC Alewife Reservation and the Belmont town line. The pond functions as a stormwater detention area which connects to Wellington Brook (BDG, 1999).

Goals were developed after public meetings by the MDC (BDG, 1999). The expectation of the plan was to promote public use of the pond, as well as to protect the resources from influences that could decrease its ecological value. The goals of the plan were to (1) enhance public access and circulation; (2) design for regional and local users; (3) protect natural resources; (4) restore wetlands and reclaim the pond; and (5) promote environmental awareness and education at the Pond. See Appendix D, Figure D-1.1 of Blair Pond.

4.5 Fresh Pond Reservation Master Plan (2002)

The 165-acre Fresh Pond Reservoir is located in the City of Cambridge, bounded by Fresh Pond Parkway, Huron Avenue, Concord Avenue and Grove Street, and Blanchard Road (Figure 4.5.1). To protect the water quality, a 6-foot high fence surrounds the pond. Both natural and developed areas exist around Fresh Pond. Three smaller ponds (Black Nook, Little Fresh Pond and North Pond) are within the Reservation as well as wetlands, upland wood, and many wildlife species. Development that occupies the space around the pond includes a golf course and its clubhouse and maintenance building, an elderly care facility, several paved parking lots, and the City of Cambridge Water Treatment Plant (FPRMPAC, 2002). Refer to Appendix E-1.1 of the Fresh Pond map with surrounding sites as listed above.

In 1997, the city manager requested an advisory committee to develop a master plan of the Fresh Pond at the same time the water treatment plant was being upgraded. The Fresh Pond Master Plan Advisory Committee was created and consisted of 12 resident volunteers, 6 city officials and one person from each of the following groups, who had a wide range of skills and experience: Watershed Manager, Conservation Commission Executive Director, Director of Recreation, Community Development Department, Housing Authority and the School Department. From the committee, 9 subcommittees were created to address specific issues and develop recommendations for the area of study. These subcommittee titles included: Horticultural, Recreation and Facilities, Land Use,

Stewardship, Cultural Resources, Education, Wetlands and Water Bodies, Master Plan Editing and Formatting, and Ad Hoc. In 1998, Rizzo Associates was hired to conduct an ecological study of the Reservation's natural resources.

The Master Plan Committee created preliminary goals to be undertaken at the Reservation. These were: maintain and improve water quality, no net loss of natural character at site, maintain and improve wildlife habitat, maintain and improve education opportunities and maintain recreational use with minimum conflict between user groups.

Figure 4.5.1: Location of Fresh Pond, south from the Alewife Reservation (FPRMPAC, 2002).

4.6 The Metropolitan District Commission Alewife Reservation and Alewife Brook Master Plan (2003)

The Master Plan for the Alewife Reservation and Brook was completed in 2003 for the MDC and prepared by The Bioengineering Group, Inc. The plan was developed in association with Carol R. Johnson Associates, Inc. (landscape architects and environmental planners), Robert France, an associate professor of Landscape Ecology from Harvard University, Pouder Associates, Inc. (Landscape Architecture, Environmental Planning and Permitting), Nobis Engineering, Inc. (Environmental, Geotechnical and Civil Engineering), and Judith Nitsch Engineering, Inc. (civil engineers, planners, and land surveyors). The study area included the Alewife Reservation and the Alewife Brook Greenway, both south and north sides (TBG, 2003). Other sites included: MDC skating rink, Little River, Alewife Subway Station, Little Pond, Yates Pond, and the ADL wetland. Due to the development of the Blair Pond Master Plan, Blair Pond was not included in Alewife Master Plan. See Appendix F, Figures F-1.5 and F-1.6 of the Master Plan maps of the south and north side of the Alewife Reservation. The Master Plan was created to provide recommendations and guidelines to improve the biodiversity and hydrological functions in the Alewife Reservation and Alewife Brook. The purpose of the Master Plan was to preserve, protect and restore the natural environment of the Alewife. Four goals were created with three to four objectives (TBG, 2003).

Goal 1: Improve water quality and restore natural hydrology

Objectives:

- "Protect existing and increase future storage capacity of stormwater runoff to reduce threats of flooding,
- Decrease pollution from combined sewer and stormwater overflows,
- Decrease nonpoint sources of pollution from stormwater runoff by implementing traditional and innovative best management practices (BMPs),

- Re-establish a more stable and natural stream geomorphology" (TBG, 2003).

Goal 2: Protect and enhance wildlife habitat

Objectives:

- "Improve migratory and spawning habitat for anadromous fish, especially alewife, the namesake species of the entire region,
- Enhance and expand aquatic and riparian habitat for birds and mammals,
- Protect and expand ecological connections to surrounding, non-MDC, open space with a broadened habitat perspective,
- Manage the study area to enhance species and habitat diversity" (TBG, 2003).

Goal 3: Improve recreational, educational and cultural opportunities

Objectives:

- "Facilitate public use of the Alewife Reservation and Alewife Brook Parkway,
- Increase stewardship of the Reservation by users and other stakeholders,
- Interpret ecological and cultural history from the time of the Great Swamp to today's relict wetland ecosystem" (TBG, 2003).

Goal 4: Provide for maintenance that minimizes cost and maximizes effectiveness

Objectives

- "Create a low-maintenance, long-term, self-sustaining landscape,
- Implement MDC-managed citizen-based monitoring and stewardship program,
- Identify sources for funding and partnerships for implementing the Master Plan,
- Properly fund and staff the Reservation" (TBG, 2003).

Chapter 5: Results

The six plans presented in the previous chapter show a movement towards environmentalism, preservation, and protection of the Alewife Brook Watershed. I conducted a cross-analysis study evaluating the proposed goals, inventory conducted, recommendations, and implementations strategies that were suggested in each plan. The cross-analysis study of the six plans will highlight recurring themes and what is potentially missing in relation to water resources, biodiversity, and wildlife habitat protection and management.

5.1 Plan Comparisons

The planning team for each plan is summarized in Table 5.1.1. Symbol (--) means the occupation was not included in the plan, and a letter X indicates that it was included. The Alewife Master Plan (2003) adopted the belief in collaborating and recognized the need for an interdisciplinary approach, drawing from two or more disciplines rather than the traditional approaches used in the past. The planning teams for the older plans (1978 and 1985) only included professionals with a planning background. Engineers and environmental consultants were only included in the planning process in the 1999 and the 2003 plans. Having several professionals involved in the planning process can make the workload more achievable with less pressure on one individual. Everyone has a duty which they are responsible and accountable for (Patterson and Grundel, 2014).

Table 5.1.1: An outline of the planning team for each plan (*LA-Landscape Architects, P-Planners, EC-Environmental Consultants, E-Engineers, LE-Landscape Ecologist). Symbol (--) means the occupation was not included in the plan, and a letter X indicates that it was included.*

Plans	LA	P	EC	E	LE	Stakeholders
1978	--	X	--	--	--	Subcommittee: • MDC • Non-Profit • Residents • Conservation & Planning Department • Executive Office of Environmental Affairs
1985	--	X	--	--	--	EOTC MDC City of Cambridge, Arlington , Belmont and their Conservation Commissions Non-Profit (MyRWA)
MDC 1996	X	X	--	--	--	MDC Public Meetings Non-Profit Groups Mayors of Somerville and Medford State Representatives Medford Historical Commission Conservation Commissions of Cambridge, Somerville, Medford, and Arlington Planning Officials from Arlington, Somerville, and Cambridge
Blair 1999	X	--	X	X	--	MDC Public Meetings
Fresh 2002	X	X	X	X	--	*Fresh Pond Master Plan Advisory Committee:* • Residents • City Officials • Watershed Manager Conservation Commission Executive Director • Director of Recreation, Community Development Department • Housing Authority • School Department Subcommittees (9) Public Meetings
Alewife 2003	X	X	X	X	X	Land Surveyors, Public Meetings, Elected Officials, Community Groups

Involving the public and building relationships with government agencies, non-profit groups, business group(s) and/or private landowners, also known as stakeholders, is considered a valuable resource in the planning process (Musacchio et al., 2005; Ryan et al., 2006; Sandsrom et al., 2006; Young, 2009; Patterson and Grundel, 2014; Musacchio and Wu, 2004; Leitao and Ahern, 2002; Gray, 1996; Kaplowitz and Lupi, 2012). Citizen participation in urban planning is also a form of interdisciplinary work or collaborative management, that can assist in combining ecological and social systems together to manage the natural landscape (Yli-pelkonen and Niemela, 2005). All six plans stated some form of relationship with key stakeholders. In two of the plans I analyzed, the Alewife Open Space Plan (1978) and the Fresh Pond Master Plan (2002), stakeholders and local residents were part of a committee. The Fresh Pond Master Plan included educational professionals as part of the Advisory Committee. The use of public meetings to gain local input, became more prevalent in the planning process of the three later Master Plans.

Goals are general statements concerning the physical, social, and economic environment of the study area, whereas objectives are actions towards achieving such goals. The development of goals for urban plans can be driven by political agendas, planners or the community's desire to protect the natural landscape or even promote development for economic purposes (Leitao and Ahern, 2002). It is important that goals are clear and are re-examined as the landscape evolves and changes. This will help the general public, businesses, community leaders, and elected officials understand the direction that should be taken to achieve such goals (Leitao and Ahern, 2002; Marcucci, 1998). The goals and objectives in the older plans (1978 and 1985) were unclear and had broad statements, which made it difficult to determine the benefits towards biodiversity protection. The first goal for the 1978 and 1985 plans were practically the same, except that in the 1985 plan it specified that the open space was to be preserved for active or passive recreation. In the Fresh Pond (2002) and Blair Pond (1999) master plans, goals were precise and clear. The Alewife Master Plan (2003) and the MDC Plan

(1996) both provided several specific objectives, including activities needed to address the goals and the concerns within the study area.

Ahern (1995) suggested that goals for greenways should include four functions: biodiversity, water resources, recreational, and historical and cultural resource protection. I used Ahern's considerations as a helpful tool to examine how well each plan incorporated the four functions within their goals in Table 5.1.2. Symbol (--) means the type of function was not included in the plan, and a letter X indicates that it was included.

Table 5.1.2: Four functions for greenway planning goals (Ahern,1995). *Symbol (--) means the type of function was not included in the plan, and a letter X indicates that it was included.*

Plans	**Biodiversity**	**Water Resources**	**Recreational**	**Historical & Cultural**
Alewife 1978	X	X	X	--
Alewife 1985	--	X	X	--
MDC 1996	--	--	X	--
Blair 1999	X	X	X	--
Fresh 2002	X	X	X	--
Alewife 2003	X	X	X	X

Preserving open space for passive and active recreation was the most common goal for all six plans. The MDC Plan (1996) strictly focused on reclaiming the park for public use. Across all six plans, the second most recurring theme was improving water quality. The Fresh Pond and the Alewife Master Plans were the only two plans that made improving water quality as a top priority.

Biodiversity protection was not directly applied in any of the goals; however, wildlife habitat protection was specifically set as a goal in the 1978 plan, Fresh

Pond Master Plan (1999), and the Alewife Master Plan (2003). For the purpose of this research, I used the terms wildlife (mammals, birds, frogs, etc) and biodiversity interchangeably. Goals that indirectly related to wildlife habitat were included in the 1985 plan and Blair Pond Master Plan. For example, in the Blair Pond Master Plan, the goal "protect natural resources" would relate to wildlife habitat and biodiversity.

Goals to reclaim the parkway and preserve open space to prevent encroachment, were two other common themes in the three plans in 1978, 1985, and 1996. Improving environmental awareness and education were not considered a goal until 1996 in the MDC Plan. Following this plan, maintaining and improving education opportunities was considered important. Protecting and managing the historical and cultural character of the Alewife Brook Watershed was not considered significant until the Alewife Master Plan in 2003.

The process of the inventory and analysis is an important step in urban planning. Reviewing the ecological, cultural, sociological, and physical aspects of the urban landscape can provide a description of the study area's functions, issues, and potential improvements (Sandstrom et al., 2006). It can also help identify which areas need protection and can show the connections between biodiversity, wildlife, human health, and the economy (Cohn and Lemer, 2003). The inventory for all six plans was collected through on-site inspection consisting of: soils, hydrology, terrestrial and aquatic vegetation, wetland resources, water quality, wildlife habitat, and land-use elements and function. The Alewife Master Plan (2003) took inventory of invasive species rates and endangered species of special concern. Social and cultural data can be obtained from multiple sources. The Fresh Pond Master Plan (1999) and the Alewife Master Plan (2003) collected qualitative data during the planning process from older plans, reports, maps, photographs, and historical land use obtained from archives and libraries. The ecological and social history of the Fresh Pond was completed by the Cultural Resource subcommittee. The Blair Pond Master Plan (1999) also compiled maps,

photos, older plans, and background information for the development of the plan. Public participation can play a large role in gaining ecological, social and cultural knowledge of the landscape. Public meetings were indicated in all plans examined, except for the 1978 plan. The meetings helped gain feedback and comments on issues and/or concerns regarding the study area. Several techniques were summarized in the MDC Plan (1996).

Each plan addressed issues and barriers of the landscape in the Alewife Brook Watershed. Human activities were determined to be a major contributor to landscape change in the Alewife Brook Watershed. These activities included: channel construction, building the Amelia Dam at Boston Harbor, filling in of the Great Swamp, drainage channels, sanitary conditions, runoff from agriculture farms and small businesses, and industrial waste. Traffic concerns were mentioned in the 1978 plan and MDC Plan (1996). Six common issues addressed within the plans are outlined in Table 5.1.3. These include: urbanization caused by residential and industrial development, natural features, poor water quality, flooding, invasive species, and soil erosion. Symbol (--) means the issue was not included in the plan and a letter X indicates that it was included.

Urbanization was the most common theme across all six plans. The 1978 and 1985 plans did not discuss any other major issues within the study area. Water quality was the second most common themed issue. The frequent causes of poor water quality in the Alewife Brook Watershed were identified as stormwater runoff, direct sewage discharge, and sedimentation, affecting aquatic life. Flooding, invasive species, poor soil condition, and stream bank erosion were also common themes mentioned in the 1999, 2002, and 2003 plans.

Table 5.1.3: Six common environmental issues discovered in the plans analyzed. *Symbol (--) means the issue was not included in the plan and a letter X indicates that it was included.*

Plans	Urbanization - Residential and Industrial Development	Natural Features (Soil)	Poor Water Quality	Flood-ing	Invasive Species	Bank Erosion
Alewife 1978	X	--	--	--	--	--
Alewife 1985	X	--	--	--	--	--
MDC 1996	X	X	X	X	--	--
Blair 1999	X	X	X	X	X	X
Fresh 2002	--	--	X	--	X	X
Alewife 2003	X	X	X	X	X	X

Barriers limiting the implementation and success of biodiversity and water resource recommendations can be political and financial, and depend on the planner's knowledge as well as a lack of planning tools (Sandstrom et al., 2006; Ryan et al., 2006). Financial support for implementing recommendations was noted as a barrier in the MDC Plan (1996) and in the Alewife Master Plan (2003). With this realization, the 1996 plan divided the study area into five segments, with short and long-term recommendations, to assist with the financial implementation of the plan. The Alewife Master Plan (2003) provided funding strategies, as well as detailed maps.

Encroachment on the Alewife Reservation, Alewife Brook, and Blair Pond by private land owners was another common issue identified from the cross-analysis of plans. The Blair Pond Master Plan (1999) and the Alewife Master Plan (2003) had two different approaches in resolving encroachment on MDC park land. In the Blair Pond Master Plan, it was suggested to distinguish property lines, survey, and make long-term improvements, prior to notifying the property owners, whereas in the Alewife Master Plan (2003), the process of resolving

encroachment issues involved the owners and occupants immediately, before any survey was completed.

Recommendations suggested in each plan reflected a particular area within the Alewife Brook Watershed. I discovered several sites that were examined in more than one plan. These included: Little River, ADL upland (wetland and parking lot), Yates Pond, and Blair Pond. Additional sites examined more than once included Alewife Brook (east side towards Mystic River), the Mugar site, the south side of the Little River, and Jerry's Pond. Table 5.1.4 illustrates the most common sites studied/where recommendations were made. Symbol (--) means recommendations were not located at this site and a letter X indicates that they were.

The recommendations for the ADL Wetland in the 1978 and 1985 plans were similar: protect the area from development by taking control of the wetlands by purchase. In the Alewife Master Plan (2003), the recommendations included actions involving expanding the wetlands and enhancing the wetland natural character. In older plans (1978 and 1985), recommendations for Yates Pond were similar and involved restoring the pond back to a natural condition for wildlife habitat. In the Alewife Master Plan (2003), recommendations for Yates Pond reflected more on providing educational and cultural opportunities, as well as providing boardwalks. Recommendations for the ADL parking lot in both the 1978 and 1985 plans suggested the removal of the paved area, and returning the landscape back to its natural habitat. In the Alewife Master Plan (2003) it appears that the parking lot was reverted to its natural habitat, and restoring the wetland to connect it from the north to east was suggested.

Table 5.1.4: Recommendations made for specific sites in the Alewife Brook Watershed. *Symbol (--) means the recommendations were not located at this site and a letter X indicates that they were.*

Specific sites	Alewife 1978	Alewife 1985	Alewife 1996	Blair 1999	Fresh 2002	Alewife 2003
MDC Rink	X	--	--	--	--	X
Little Pond	--	--	--	--	--	X
ADL Upland (Silver Maple Forest)	X	X	--	--	--	X
Perch Pond	--	--	--	--	--	X
Little River (north)	--	--	--	--	--	X
ADL Wetland	X	X	--	--	--	X
Mugar	X	X	--	--	--	
ADL Parking Lot	X	X	--	--	--	X
Little River (south)	--	X	--	--	--	X
Yates Pond	X	X	--	--	--	X
Alewife Brook	--	--	X	--	--	X
St. Paul's Cemetery	--	--	X	--	--	X
Dilboy Field	--	--	X	--	--	X
Wetland Marsh	--	--	X	--	--	X
Jerry's Pond	X	X	--	--	--	--
Cambridge Dump Site	X	--	--	--	--	--
Fresh Pond	--	--	--	--	X	--
Blair Pond	X	X	--	X	--	--
Thorndike Field	--	X	--	--	--	--
Magnolia Property	--	X	--	--	--	--

I found that Blair Pond, unlike Fresh Pond, played a significant role in older plans before the development of its master plan in 1999. In the older plans, access to the pond was considered important, which was not the case in the Blair Pond Master Plan (1999). Limited access to the pond was recommended because the lack of controlled pedestrian access to sensitive areas disrupted the pond's habitat

potential. Improving water quality and dredging the pond was a common theme in all three plans.

I discovered recommendations for Jerry's Pond and the Mugar site were both mentioned in the two older plans (1978 and 1985). Using Jerry's Pond as a park was suggested in both plans. With development proposed at the Mugar site, both plans recommended similar actions to preserve the area of open space for passive recreation. The 1978 plan suggested to connect the MDC rink site to Little Pond by removing the road ramps. The Alewife Master Plan (2003) saw the site as an opportunity to increase flood storage, manage biodiversity, remove invasive species, and plant native vegetation. Recommendations for the north and south side of Little River were made in the 1978 and 1985 plans as well as the Alewife Master Plan (2003). Preventing development at the ADL upland area (Silver Maple forest, west of the Reservation) echoed in all three plans. Little Pond, also west of Little River was only recognized to be used to aid in flood storage and biodiversity habitat in the Alewife Master Plan (2003). It was also suggested to remove invasive species and complete a sediment depth study at the pond. Creating a vegetative buffer between the park and the wetlands on the south side of the Reservation was recommended in the 1985 plan to prevent encroachment. In the Alewife Master Plan (2003), a 3.5-acre stormwater wetland was suggested on the south side of the Reservation to reduce sedimentation from entering the existing wetland and Little River. Bank stabilization by using bioengineering techniques was also recommended for this area in the Alewife Master Plan (2003). Recommendations for the north side of the Reservation shifted from passive recreation use in 1985 to enhancing environmental function via the removal of invasive plant species, stabilizing the stream banks, and moving walking trails away from the river in the Alewife Master Plan (2003).

Recommendations for the Alewife Brook, on the east side towards the Mystic River, were made in the MDC Plan (1996) and Alewife Master Plan (2003). In both plans, the brook was divided into three sections, 1) Route 2 Rotary to

Massachusetts Avenue, 2) Massachusetts Avenue to Broadway, and 3) Broadway to Mystic Valley Parkway. Overall I found that many of the short and long-term recommendations made in the MDC Plan (1996) focused on improving the park aesthetics. In the Alewife Master Plan, recommendations were to improve water quality and quantity, provide and protect wildlife habitat, and increase biodiversity. There were repeated recommendations in both plans for all sections of the brook. These included: removing the fence along the brook (mainly in Segment One and Three), planting native plant species along the stream banks, and restoring the Alewife Brook channel to its natural condition by removing the concrete channel.

Suggestions for the wetland, located in Segment One, were slightly different in both plans; however, I found the outcomes were equivalent. Connecting the marsh area to the brook for flood retention was suggested in the MDC Plan (1996). In the Alewife Master Plan (2003), it was suggested to restore the cattail marsh as an ecologically valuable wetland and investigate if the marsh area could be dug deeper to increase flood storage. Research on the hydrology sediment issues were recommended in the MDC Plan (1996). Unlike in the Alewife Master Plan (2003), many of the recommendations were based on actions to treat the sedimentation/stormwater runoff by creating biofiltration into the park design and widening the riparian buffer in the floodplains.

For Segment Two, suggestions to plant large shaded trees along the brook at St. Paul's Cemetery and Alewife Brook Parkway were made in both plans. Additional recommendations were made to improve the diversity and water quality of the brook in the Alewife Master Plan (2003) for this section. Recommendations to control flooding at Dilboy Stadium, located in Segment Three, were recommended in both plans. A hydrological and hydrogeological study was recommended for Dilboy Stadium in the MDC Plan (1996), whereas, in the Alewife Master Plan (2003), installing vegetative biofiltration swales and other stormwater management techniques were suggested. The only landscape

improvements made in the MDC Plan (1996) included the planting of trees along the parkway and in Dilboy parking lots. Creating biodiversity habitat was suggested in the Alewife Master Plan by planting a wildflower meadow by the baseball field near Dilboy Stadium and developing an invasive species removal program. Controlling and removing invasive plant species was recommended for all three sections of the Brook in the Alewife Master Plan (2003). Only one area, Segment Three in the MDC Plan (1996), stated that biodiversity protection was needed by spraying roundup.

From the six plans I analyzed only four of the plans incorporated implementation and monitoring strategies as part of the planning process. These plans included the 1985 plan and the Blair, Fresh and Alewife Master Plans. Overall in the Fresh Pond Master Plan (2002), the Water Department was given many of the responsibilities and maintenance requirements for the Fresh Pond and surrounding landscape; however, staffing requirements and an organizational structure were provided in the Fresh Pond Master Plan (2002) to assist with implementation. At the time of the 1985 plan, the Cambridge Conservation Commission and the Cambridge Department of Planning, and Community Development took on most of the responsibility for implementing the plan's recommendations. MDC had some responsibility during this time. Responsibilities for implementing recommendations in the Blair Pond Master Plan (1999) lay within MDC. In the 2003 Alewife Master Plan, the MDC would execute all action items or any implementation projects under close coordination of the MDC and the MDC's Master Planning Team. The Alewife Master Plan expressed that support from the public, constituents, and elected officials was required to implement recommendations made in the plan.

Implementation costs were estimated in the 1985 plan and the Blair Pond Master Plan (1999). In the 1985 plan, the costs were divided in two phases, and in the Blair Pond Master Plan (1999), a cost for site preparation, utilities, and site improvements was provided. In the Blair Pond Master Plan (1999), three phases

for completing recommendations were provided. In the Fresh Pond Master Plan (2002) and the Alewife Master Plan (2003), a five-year phase was provided. The Alewife Master Plan (2003) provided additional resources on funding opportunities, required permits, encroachment resolution, maintenance and management, and community involvement and stewardship. The plan also gave recommendations on related projects in the study area.

Chapter 6: Discussion

6.1 Introduction

One of the most challenging, yet gratifying, elements for urban planners and the multiple individuals involved in the planning process is creating a successful plan. How can planners and stakeholders ensure their plans become successful? What makes a successful plan? Robert Nuzum, Manager of National Resources at the East Bay Municipal Utility District in Oakland, CA in 1997 stated that spending more time educating participants on what worked and what didn't work before making any planning efforts was vital (Ficks, 1997). The United States Environmental Protection Agency, in partnership with over 100 watershed practitioners and their supporters, developed a Top 10 Watershed Lessons Learned document to help readers learn what works and what does not, based on past experience (Ficks, 1997). Scholars have indicated key strategies that are important to implementing greenway projects (Ryan et al.,2006; Ahern, 1995; Sandstrom et al., 2006; Kaplowitz and Lupi, 2012; Conservation Ontario, 2003).

I combined strategies and lessons learned from Ficks (1997) and Conservation Ontario (2003) to create nine key approaches to determine how well each plan for the Alewife Brook Watershed did in providing the best possible approach to having a successful plan. I provided an evaluation of high (3), medium (2), low (1), and none (0) to each plan, which is outlined in Table 6.1.1. Plans that were given a high value expressed the key approach and also provided a clear explanation to the approach. A medium value was given to plans that had mentioned the key approach but did not elaborate on the concept. Plans given a value of low to zero represented that the plan did not include the key approach in its planning process or did so very briefly.

Table 6.1.1: The evaluation of the six plans' success from nine key strategies (Ficks, 1997; Conservation Ontario, 2003)

	Plans					
Key Approach	**Alewife 1978**	**Alewife 1985**	**MDC 1996**	**Blair 1999**	**Fresh 2002**	**Alewife 2003**
Having clear goals	1	2	3	3	3	3
Building partnership	1	2	3	2	3	3
Public involvement	1	2	3	2	3	3
Having a strong coordinator at the local level	n/a	n/a	n/a	n/a	n/a	n/a
Having a good leader	n/a	n/a	n/a	n/a	n/a	n/a
Using tools available for communication & visuals	1	1	2	3	2	3
Characterizing the system's ecological, cultural, sociological, and physical aspects	1	1	2	2	3	3
Implementing clear, discrete actions and responsibilities	0	2	0	2	2	3
TOTAL	**5**	**10**	**13**	**14**	**16**	**18**
Plans only succeed if implemented	1	1	2	2	2	2
TOTAL	**6**	**11**	**15**	**16**	**18**	**20**

6.2 Having Clear Goals

In the 1978 and 1985 plans, having unclear goals and objectives could have led to a misunderstanding on what variables should be measured and how often, resulting in the wrong data collection and precision. Vague objectives can lead to differences in understanding, which can result in the loss of time and money. The 1978 and 1985 goals also had weak wording that suggested hope rather than an actual adoption of goals. In the other plans, goals had powerful meaning that gave more than hope; they gave an action. Using powerful words makes goals believable and can give participants motivation. The understanding of goals and objectives provides multiple benefits in guiding activities and individuals, at all

levels, to protect and enhance the ecological health of the Alewife Brook Watershed. Despite the ongoing issues with poor water quality and flooding in the Alewife Reservation and Brook, I was surprised to observe that only the Fresh Pond Master Plan (2002) and the Alewife Master Plan (2003) named improving water quality as the first goal.

People living in urban areas can play a large part in the success of any planning project. Setting goals to educate the public, as the plans from 1996 to 2003 did, has tremendous value as a means of informing landowners, voters, visitors, politicians, and other decision-makers and stakeholders about ways they can contribute toward wildlife and water resource conservation (Ficks, 1997). To gain their support, they must understand their function and how people and nature are connected as parts of the ecosystems. Recognizing the importance of the historical and cultural character of the Alewife Brook Watershed, which was only indicated as a goal in the Alewife Master Plan, helps to expresses the identity of the past, building a stronger bond between people and nature.

From my analysis I found that the goals and objectives in the six plans lacked measurable objectives that can later be evaluated. For example, the Alewife Master Plan (2003) focused on water quality issues but none of the objectives included water quality parameters to be sampled, such as fecal coliform and nitrogen levels. Goals to protect and enhance wildlife habitat or open space in the Blair, Fresh and Master Plan didn't state how many acres would be protected.

6.3 Building Partnership/Public Involvement

Public participation was noted as an essential part in the planning process for all the plans, except the 1985 plan. It is vital to engage the public and stakeholders early in the planning process for the implementation to succeed (Oregon, 2006; Leitao and Ahern, 2002; Patterson and Grundel, 2014; Sandstrom et al., 2006). Involving the public early on can create public support, prevent conflicts on

private property rights issues, and contribute to the implementation of recommendations, lowering the cost of production (Ryan et al., 2006).

More than a dozen conservation groups have demonstrated an interest in the well-being of the Alewife Reservation and Brook and surrounding watercourses. One of the longest standing environmental volunteer-run organizations in Massachusetts is the Mystic River Watershed Association (MyRWA), established in 1972. This particular group was mentioned in several of the plans a key stakeholder. The Alewife Master Plan (2003) encourages public participation, and multiple non-profit groups to aid in implementing and monitoring the projects within the Alewife Brook Watershed. The MyRWA long-standing interest in the Alewife Brook has engaged thousands of local residents in traditional watershed association activities such as, clean-ups, canoe trips, walks, and educational tours. The Friends of Alewife Reservation (FAR) started as an advocate committee in the year 2000 and became a non-profit volunteer organization in 2004. The group's efforts have been towards enhancing the Alewife Reservation by balancing the ecosystem for both the wildlife habitat and recreational purposes. Successful plans should take into account the needs and wants of all stakeholders while protecting the environment.

The Fresh Pond Master Plan (2002) subcommittees would help promote a sharing of information among individuals, which can build a stronger relationship between stakeholders. The MDC Plan (1996) showed efforts were made to build a strong relationship between planners, landscape architects, and the public; this improved the plan's potential of being implemented. The acceptance of plans is stronger when the public and stakeholders are involved from the beginning (Golley and Bellot, 1999). The MDC Plan (1996) also indicated that different stakeholders across multiple jurisdictions were involved in the planning process, which was difficult to determine in other plans. Ensuring that all stakeholders across multiple jurisdictions are present during the planning process would be beneficial and increase implementation success (Oregon, 2006; Ryan et al., 2006).

The opportunity to discuss distribution of funds for implementation and develop a management and maintenance program is possible when everyone is at the same table (Oregon, 2006).

Politics and timing can play a large part in determining which community projects get funded, making it crucial to have political support during the planning process (Cohn and Lemer, 2003). The MDC Plan (1996), Fresh Pond Master Plan (2002), and the Alewife Master Plan (2003) had elected officials/mayors involved in the planning process. With political support, it can help to secure funding.

6.4 Having a Strong Coordinator/Good Leader

Having a strong leader is key to success (Ryan et al., 2006; Ficks, 1997). Leaders can be anyone who has the same vision as the community and understanding of the principles of planning. Leaders are good communicators and can motivate others to bring change and help with reaching the goals of the plan (Ficks, 1997; Ryan et al., 2006). It is hard to determine who was the main leader for each plan. For example, the Alewife Master Plan (2003) had many involved in the planning process. Whether the shift towards better solutions in protecting the environment came from the planners themselves, it is determined that the enthusiastic, dedicated, and devoted environment groups and local residents in the Alewife Brook Watershed played a role engaging and empowering other citizen members to take action regarding the health of the Alewife Reservation and Brook.

6.5 Using Tools Available for Communication and Visuals

Good communication between urban planners, stakeholders, and the public is essential for plans to succeed. In some cases, poor communication can lead to ineffective watershed management. When involving the public and working with a wide range of information, modern technology, such as Geographic Information Systems (GIS), is used in the development of urban plans. GIS can be used to help visually communicate scientific and other geographically related data, with the use of maps and photos, making the

information easier to illustrate to the general public (Conservation Ontario, 2003; Cohn and Lemer, 2003)

In the Alewife Master plan (2003), considerable effort was put into developing a "readable", interesting, and visual document. This document appeals to a wide range of audiences and is easy to read. This was the same for the Blair Pond Master Plan (1999); clear maps and photos were used to illustrate the study area and recommendations in specific sites. To gain an understanding of the historical landscape change for the Alewife Reservation and Brook, photos from the 1800s and early 1900s were used in the MDC Plan (1996) and Alewife Master Plan (2003). We cannot disregard the advancement and history of GIS when analyzing plans from different time frames. In the 1960s to 1980s, GIS became popular and was developed to store, collate, and analyze data on land usages. Advancements in the technology and methods of GIS over the years have made it more effective to incorporate natural resource information into the planning process (Toms, 2010). Plans developed in the twenty-first century for the Alewife Brook Watershed may possibly have been at an advantage due to the use of this technology.

6.6 Characterizing the System's Ecological, Cultural, Sociological, and Physical Aspects

The biggest challenge planners have in developing an urban plan, in particular the Alewife Brook Watershed, is in balancing the parkway character, conserving the wetlands and wildlife habitats, and meeting recreational needs of the surrounding metropolitan population. To achieve the best solutions in protecting both terrestrial and aquatic ecosystems, good scientific, cultural, and social information is vital (Cohn and Lemer, 2003). The Fresh Pond Master Plan (1999) and the Alewife Master Plan (2003) did an excellent job at characterizing the study area by using a variety of data to address threats. Both plans analyzed and recognized terrestrial and aquatic elements together, which will help in protecting a diversity of species, as they depend on both wetlands and upland habitats to survive (Oregon, 2006). A lower value was given to the MDC Plan (1996) and the Blair

Pond Master Plan (1999), as they did not provide a great deal of cultural background. In these two plans, the ecological and physical elements were provided in good detail.

6.7 Implementing Clear, Discrete Actions, and Responsibilities

There are many approaches in implementing a plan to influence individuals or organizations with the responsibility to adopt recommendations and accept conservation plans (Cohn and Lemer, 2003). The implementation strategies for the 1985 Plan were considered poor compared to the Fresh Pond (2002), Alewife (2003), and the Blair Pond (1999) Master Plans. The 1985 plan only provided responsibilities and cost, with no specific direction; whereas, in the Fresh Pond Master Plan (2002) and the Alewife Master Plan (2003) a five year implementation schedule was provided, and a three phase plan was provided in the Blair Pond Master Plan (1999). This would help with the success of the plan by keeping participants, partnerships and others engaged in the development of the plan and making duties more manageable (Ficks, 1997; Ontario, 2003). The Fresh Pond Master Plan (1999) provided an organizational structure of staff, directing individuals with the responsibility to oversee the work needed to be completed, as laid out in the plan. This can make roles and responsibilities clear for all involved in the implementation, and also keep the motivation of the plan in progress.

From my research I determined that the issue of encroachment was dealt with differently on the Alewife Reservation and Brook than it was with Blair Pond. The Alewife Master Plan (2003), unlike the Blair Pond Master Plan (1999), involved the public in the planning process immediately to educate and mitigate negative opinions on biodiversity protection and enhancement. This method can be more successful, as private landowners are involved with resolving such issues, feeling less threatened by local governments in regards to their property rights (Ahern, 1995).

The Alewife Master Plan (2003) mentioned other sources of funding to complete recommendations made in the plan as well as community involvement and stewardship opportunities to lower the cost of implementation. The plan also reflected, in its implementation plan, the positive contribution that local groups had made in the study area. This can help build on the number of interested landowners, local organizations, and young people. Having young people involved in conservation efforts can truly benefit the long term health of the ecosystem. Maintenance and management recommendations were also outlined. Having volunteers involved at this phase can increase the efficiency and effectiveness of conservation investment. It can also ensure that the goals set in the Master Plan are followed (Botequilha and Ahern, 2002). Providing current data and new knowledge can aid in developing strategies for any ongoing issues in a watershed, such as controlling invasive species. Monitoring is an important element of successful implementation (Oregon, 2006).

When reviewing the first eight key strategies I determined that overall the Alewife Master Plan in 2003 received a slightly higher mark than the rest of the plans. My research concludes that the Alewife Brook Master Plan (2003) did a better job at highlighting both ecology science and social science.

6.8 Plans Only Succeed if Implemented: Site Visit Assessments

The amount of work put forth by multiple stakeholders and planners into developing a plan can be long and complex. It is hoped that recommendations made in any plan are implemented and goals and strategic objectives are met. The photos taken during my site visit are used to demonstrate the current site conditions and to possibly discover what has been implemented over the years. The photos provide additional knowledge and insights towards completed watershed projects and ongoing activities. Additional resources from Belmont Citizen Forum, DCR Massachusetts Government, FAR, Friends of Fresh Pond, and Cambridge Water Department websites were used to gather additional information regarding projects' progress. When comparing the historical maps of

the Alewife Brook Watershed in Chapter 3 to the current map seen in Figure 4.1, it is possible to distinguish the differences in urban development where the Alewife Reservation is crammed between communities and roads.

I started the morning of October 19, 2013 with a public nature walk to the Silver Maple Forest. also known as the Belmont Uplands. The walk was delivered by a DCR staff member who discussed the importance of the forest and wildlife habitat surrounding the area. The group started from the Acron Park Drive and ended at Little Pond. My foot path can be seen in Figure 6.8.1 aerial photography. The area provides many environmental benefits such as flood retention capacity, buffering from the highway, and a habitat for many wildlife species. From the tour I was able to discover the issues first-hand of the *Phragmitesaustralis* (common name, Common reed), a well-known invasive species in the watershed (Figure 6.8.2) which covered both sides of the narrow dirt path. Signs were placed in different locations of the path to help residents identify wildlife species in the area.

Figure 6.8.1: My foot path from Acron Park Drive towards Little Pond via a dirt path near Little River. From Little Pond, I walked to the MDC Rink (Google Earth, 2018).

Figure 6.8.2: Common reed on both sides of the path in the first section of the walk. Saulnier, October 19, 2013.

In the 1978 plan and the Alewife Master Plan (2003), the MDC skating rink had been recommended to be used as a floodwater storage basin and natural habitat for wildlife. DCR proposed a land swap in 2004 with O'Neill Properties for the Belmont Uplands in exchange for the skating rink for residential development (Belmont Citizen Forum, 2004). Several Arlington residents were opposed to using the skating rink land for development, and thought that the site should be dedicated entirely to flood water retention. During my visit it was determined that the site was used for holding construction material (Figure 6.8.3).

Figure 6.8.3: MDC skating rink current condition. Saulnier, October 19, 2013.

Recommendations to preserve the Silver Maple forest were mentioned in the 1978 and 1985 plans as well as the Alewife Master Plan (2003). The fate of the forest was still in court during my site visit so I was fortunate enough to see the beautiful forest (Figure 6.8.4 and 6.8.5). Regrettably, the decade long fight ended in 2015 when the building company A.P. Cambridge Partners, had fulfilled all requirements under the Zoning Board of Appeals comprehensive permit and the Massachusetts State Building Code necessary to secure a building permit (Hofherr, 2015 and Nunez A, P. 2014). Local groups and communities for many years fought hard to save the forest. State Sen. Will Brownsberger, had long sought to protect the Silver Maple Forest from development pushing the Governor to sign the legislation to purchase the forest as part of the Alewife Reservation. The governor top priority was affordable housing and declined to approve the legislation. The communities surrounding the forest had no means to purchase the property from O'Neill (Belmont Citizen Forum, 2015). In Figure 4.1, you can even see development in the area of the forest.

Figure 6.8.4: Silver Maple Forest. Saulnier, October 19, 2013.

Figure 6.8.5: Silver Maple Forest. Saulnier, October 19, 2013.

During the nature walk, it came to an abrupt end at Little Pond (Figure 6.8.6). I noticed that encroachment on the pond's riparian zone was still an issue, and there were no benches; however, a small sign showing the different wildlife in the area was placed next to the shore. It was impossible to determine if the pond was dredged or if any sediment studies have been completed, which was recommended in the Alewife Master Plan (2003).

Figure 6.8.6: View of Little Pond from the dirt path. Saulnier, October 19, 2013.

For many years, on the north side of Little River, the Arthur D. Little parking lot, west of Acorn Park Road, was recommended to be returned to its natural landscape. From my site visit, in 2013, it was documented the parking lot, as well as the floodplain within 200 feet or more of Little River, was recently restored to its natural landscape for wildlife habitat and flood control (Figure 6.8.7): a great accomplishment and success story. The “Alewife Brook Greenway” at the Acorn Park Road illustrates a pedestrian access point to the Alewife T-Station (Figure 6.8.8). Lighting and emergency phone connections are lined throughout the path to improve pedestrian safety at night (Figure 6.8.9).

Figure 6.8.7: Restored parking lot near Alewife Brook. Saulnier, October 17, 2013.

Figure 6.8.8: Alewife Brook Greenway Sign. Saulnier, October 17, 2013.

Figure 6.8.9: New lighting and emergency phone located throughout the path towards the T-Station. Saulnier, October 17, 2013.

Two large buildings abutting Little River were demolished, and the site was restored as wetland habitat (Figure 6.8.10). Benches and a historical and educational signage were also placed in the area (Figure 6.8.11). During one of my walks, I saw a woman from the DCR setting out nets, magnifying glasses, binoculars, and containers. She was preparing for a school group. The restored natural landscape is being used for educational purposes as an outdoor classroom where children can learn about the history and natural habitats of the Alewife Reservation. During my site visits, it was unclear if drainage ditches were expanded or if a study on vernal pools was completed, as per recommended in the 2003 Alewife Master Plan.

Figure 6.8.10: Restored wetlands near Acorn Site. Saulnier, October 17, 2013.

Figure 6.8.11: New signage and benches near Acorn site. Saulnier, October 17, 2013.

From the path at Acorn Park Road, I walked over to the newly completed stormwater wetland on the south side of Little River (Figure 6.8.12). A stormwater wetland on the south side of Little River as part of the Combined Sewer Overflow Separation project, recommended in the Alewife Master Plan (2003), opened just days before my visit (Figure 6.8.13-6.8.15).

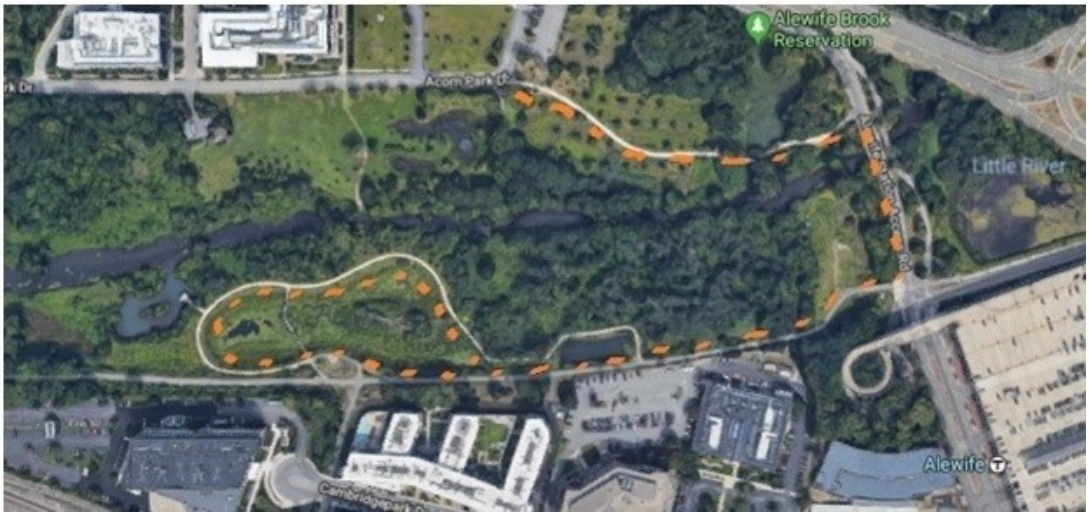

Figure 6.8.12: From Acron Park Drive on the north side of Littler River, I walk through the path to the south side of Little River to observe the newly constructed stormwater wetland at the Alewife Reservation (Google Earth, 2018).

Figure 6.8.13: Me standing in the constructed wetlands at the Alewife Reservation. Saulnier, October 17, 2013.

Figure 6.8.14: Constructed wetlands at the Alewife Reservation. Saulnier, October 17, 2013.

Figure 6.8.15: Constructed wetlands at the Alewife Reservation. Saulnier, October 17, 2013.

After a decade of complicated and collaborative efforts between the public, the City of Cambridge's Department of Public Works, the MWRA, and the DCR, Boston's largest urban wild and last few remaining acres of the Great Swamp was preserved. During heavy rains, when the sediment forebay (Figure 6.8.16) is filled with storm water, it will flow through the two forebay outlet pipes into a designed and constructed swale of native plants that will capture nutrients in the water (Figure 6.8.17). The gate, connected to the forebay, is intended for trucks to remove sediment and trash left behind (Figure 6.8.18). During my visit, not all stormwater pipes from Cambridge's urbanized areas (335-acres), were entering into the newly-built forebay and wetland. By December of 2015, approximately 400 acres of urbanized stormwater was directed to the constructed wetland (Belmont Citizen Forum, 2016).

Figure 6.8.16: Sediment forebay at the Alewife Reservation. Saulnier, October 17, 2013

Figure 6.8.17: Pipes diverting stormwater from the forebay to the constructed wetlands. Saulnier, October 17, 2013.

Figure 6.8.18: Gate into the Forebay for cleaning. Saulnier, October 17, 2013.

Other nearby implementations include: access improvements, paved bike paths (Figure 6.8.19), sitting platforms (Figure 6.8.20), a wooden boardwalk around the wetlands (Figure 6.8.21), a stone amphitheatre (Figure 6.8.22), signage of local wildlife (Figure 6.8.23), and interpretive features (Figure 6.8.24 and 6.8.25). The interpretive displays provide the landscape history of the Alewife, including its industrial, agricultural, and ecological history, as well as interpretive signage of how the wetland functions. It was apparent that considerable planting of native species was accomplished to enrich and enhance the biodiversity in the Alewife Reservation.

Figure 6.8.19: Newly paved bikeway at the Stormwater Wetland. Saulnier, October 17, 2013

Figure 6.8.20: Benches located around the stormwater wetland. Saulnier, October 17, 2013.

Figure 6.8.21: Wooden walkways around the stormwater wetland. Saulnier, October 17, 2013.

Figure 6.8.22: Stone amphitheatre located at the constructed wetlands. Saulnier, October 17, 2013.

Figure 6.8.23: Wildlife features on rocks throughout the wetland. Saulnier, October 17, 2013.

Figure 6.8.24: Interpretive feature. Saulnier, October 17, 2013.

Figure 6.8.25: Interpretive feature. Saulnier, October 17, 2013.

During my site visit I discovered that the ecological art mural, which was recommended for the Alewife subway station in the Alewife Master Plan (2003), was completed (Figure 6.8.26). The mural was supported by local businesses, citizens, and a grant from the Cambridge Arts Council. The eighty-foot painted environmental panel, which was designed by students and directed by mural painter David Fichter, illustrates the biodiversity in the area The mural represents much of the wildlife seen in the Reservation (FAR, 2004). This project demonstrates the connection of the residents in the Alewife Brook Watershed to nature.

Figure 6.8.26: Mural located at the T-Station. Saulnier, October 17, 2013

From my site visit research, I determined that implementing recommendations to the Alewife Brook, east towards the Mystic River, have not been as successful as on the south and north side of Little River. See Figure 6.8.27 of my footpath along the Alewife Brook from the Alewife Reservation towards the Mystic River. A stone sign was located at the entrance to the new wooden boardwalk, near the Thorndike and Magonlia Fields on the north side of the brook (Figure 6.8.28 and 6.8.29). The wooden boardwalk was not completely finished from one end to the other, but was a large improvement from the dirt path. I discovered that invasive species, Common Reed and Japanese Knotweed, on the north side of Alewife Brook were still heavily present, which blocked my view to the brook from the boardwalk (Figure 6.8.30). Riparian planting of trees and shrubs between the homes and boardwalk was completed (Figure 6.8.31).

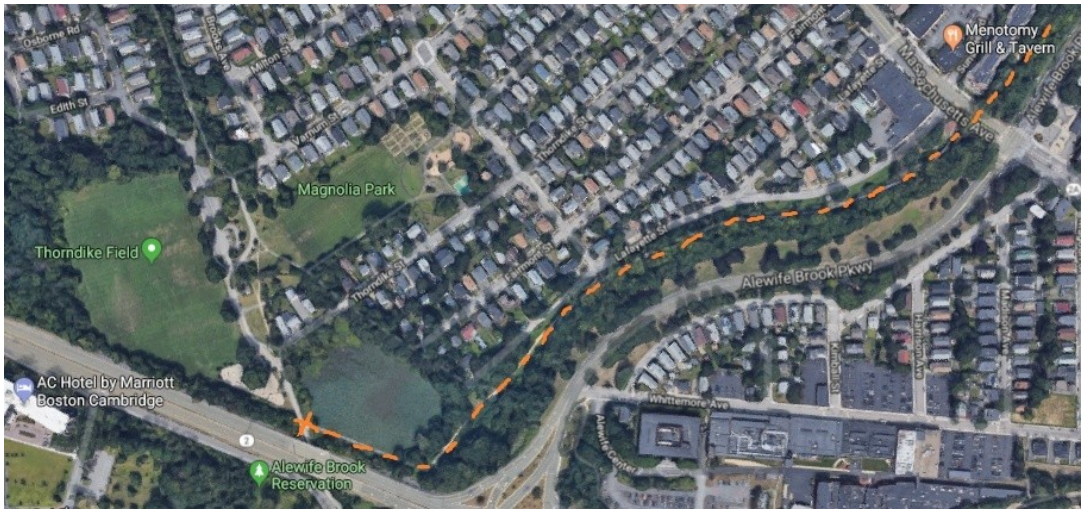

Figure 6.8.27: I started my walk on the Alewife Greenway Bike Path along the Alewife Brook at the Alewife Reservation end towards the Mystic River. I crossed over to the other side of the Brook at Cross St. and walked along the sidewalk parallel to the Alewife Brook heading towards the Mystic River (Google Earth, 2018).

Figure 6.8.28: Stone sign at the entrance to Alewife Brook new wooden boardwalk. Saulnier, October 17, 2013.

Figure 6.8.29: A map of the Alewife Brook and nearby watercourses on the back of the stone sign. Saulnier, October 17, 2013.

Figure 6.8.30: Invasive species, Japanese Knotweed, along the wooden boardwalk on the north side of the Alewife Brook. Saulnier, October 17, 2013.

Figure 6.8.31: Native tree planting along the North side of Alewife Brook. Saulnier, October 17, 2013.

On the south side of the brook, from Henderson Bridge to Broadway, the sidewalk has been improved with new railings and a wider, wooden path (Figure 6.8.32); however, nothing looks to be implemented on the cemetery side to prevent erosion or contaminants from entering the river (Figure 6.8.33). The fence along the Alewife Brook was not taken down, which was recommended in the Alewife Master Plan. I discovered that no improvements to naturalize the Alewife Brook have taken place, nor any biofiltration or restoration to the marsh area near the brook. The brook still has its unnatural concrete banks and there are numerous stormwater pipes entering into the brook (Figure 6.8.34 and 6.8.35). I could not determine if a sediment study was completed for this area.

Figure 6.8.32: New boardwalk on the South side of Alewife Brook. Saulnier, October 17, 2013.

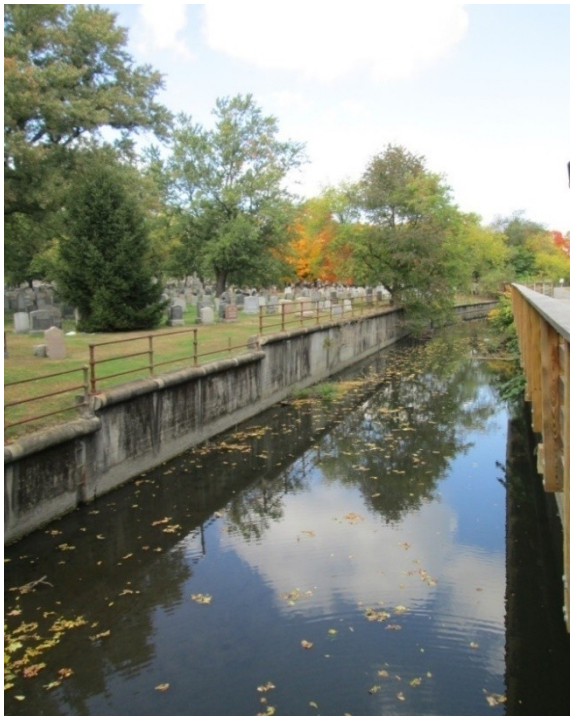

Figure 6.8.33: Cemetery abutting the Alewife Brook. Saulnier, October 17, 2013.

Figure 6.8.34: Alewife Brook with concrete banks. Saulnier, October 17, 2013.

Figure 6.8.35: Several stormwater pipes are located along the Alewife Brook. Saulnier, October 17, 2013.

Figures 6.8.36 and 6.8.37 show my footpath along the Alewife Brook from Massachusetts Ave to the Mystic River on the south side of the Brook, back towards the Alewife Reservation on the north side of the brook.

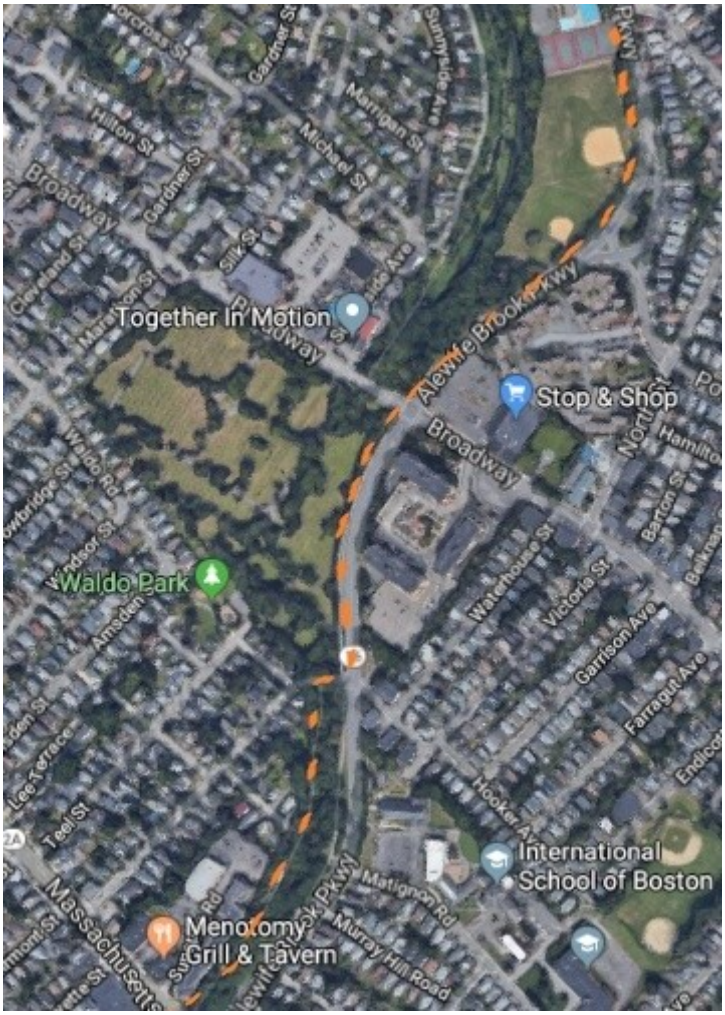

Figure 6.8.36: Once I crossed over to the south side of the Alewife Brook, I walked pass the cemetery (located on the north side) with the new boardwalk along Alewife Brook Park (Google Earth, 2018).

Figure 6.8.37: Here you can see my foot path along the south side of the Brook by Dilboy Stadium. Once I reached the Mystic River, I walked along the Alewife Greenway Bike Path on the north side of the Brook finishing my walk at the Alewife Reservation (Google Earth, 2018).

Walking towards Blair Pond from Brighton Street (Figure 6.8.38), I found a new sign and bench were at Blair Pond, as recommended in the Blair Pond Master Plan (1999) (Figure 6.8.39). Determining additional implementation during my site visit was difficult. With no path along this section of the pond, I found it difficult to observe the entire pond (Figure 6.8.40). In several newsletters on the Belmont Citizen Forum and Friends of Alewife Reservation websites, the DCR had received a permit from the Cambridge Conservation Commission to dredge

Blair Pond to its historical depth and restore native wetland plants to the shores and surrounding acres in 2010 (Flax and Feignbaum, 2010). The project included three components: dredging in the northern and southern sides of the pond, and creating a sediment forebay. It wasn't until 2012 that the pond was actually dredged. Volunteers over the years have implemented the removal of invasive species, mainly Japanese knotweed, oriental bittersweet, garlic mustard, and poplar, from the cul-de-sac area, meadows, and the trail areas at Blair Pond. Native plant species were also planted in the cul-de-sac area and premaculture plots. Clean-ups also took place at the cul-de-sac and trails around Blair Pond (FAR, 2016).

Figure 6.8.38: Walking towards Blair Pond , through a parking lot, from Brighton St.(Google Earth, 2018).

Figure 6.8.39: Sign and bench at Blair Pond. Saulnier, October 18, 2013.

Figure 6.8.40: Blair Pond view from the benches. No path along the edge to explore the pond. Saulnier, October 18, 2013.

After I examined the Cambridge Water Department website and read through the Friends of Fresh Pond Reservation annual reports, along with my observations from my site visit to Fresh Pond, it is clear that many of the recommendations outlined in the 2002 Master Plan have been implemented. The education programs at Fresh Pond continue to be a success in providing public education and stewardship opportunities. Some examples of topics over the years include: lichens, animal tracks, history of Fresh Pond, artwork displays, ecological effects of invasive weeds, and planting wildlife seeds. I started my walk around Fresh Pond at the water treatment building (Figure 6.8.41and 6.8.42).

From my site visits I determined that the following general recommendations to encourage biodiversity, wildlife habitat, and manage the natural landscape of multiple areas around the Fresh Pond Reservation have been accomplished: building woodland trails, raking leaves, mulching footpaths, removing invasive weeds, conducting inventories of plants and animals and the planting of native species and wildflowers. The following implemented projects continue to help monitor and maintain the natural landscape around Fresh Pond; tree swallow and chickadee nest box program (a total of 23 nest boxes are maintained and monitored on the Reservation), Purple Loosestrife Bio-Control Project (includes data collection and release of galerucella beetles), and the Woodland Restoration Project (Figure 6.8.43).

Figure 6.8.41: Current aerial photography of Fresh Pond. My walk around the pond started at the Water Treatment Plant (Label with a the letter W) (Google Earth, 2018).

Figure 6.8.42: Fresh Pond Water Treatment plant. Saulnier, October 20, 2013.

Figure 6.8.43: Fresh Pond Northeast Sector Woodland Restoration project. Saulnier, October 20, 2013.

During my site visit to Fresh Pond I was able to detect that very high and high priority projects, outlined in the master plan, were completed and/or in progress. Bioswales were placed at Kingsley Park to stabilize the banks and the restoration of the shoreline at Little Fresh Pond was completed. In order to improve soil infiltration, control storm water runoff, and enhance habitat quality at Glacken slope, aquatic planting, stabilization, and slope enhancement were observed. In addition, drainage improvements were completed at Perimeter Road and Glacken Field. Restoration at Blake Nook was also completed, including stabilizing the banks and improving the path and landscape areas (Figure 6.8.44 and 6.8.45). Further improvements were made by naturalizing the grounds at the water treatment plant and making several improvements to Weir Meadow such as: planting wildflowers, creating wildlife nesting areas, managing stormwater, improving the path, and adding benches. Upgrades were also completed at Lusitania Field, including forest management, habitat enhancement and shoreline improvements. Since 2006, planting and maintenance to the gardens at Neville Manor site have been accomplished as well as stabilizing the slopes, with bioengineering materials (Cambridge Water Department, 2018).

Figure 6.8.44: Black Nook Pond, located at Fresh Pond. Saulnier, October 20, 2013.

Figure 6.8.45: Newly wooden path at Black Nook pond, located at Fresh Pond. Saulnier, October 20, 2013.

It was difficult to determine if drainage and wetland improvements to the golf course fairways have been accomplished during my site visit; however, it appeared restoration work was in progress or ongoing at the slopes near the golf course (Figure 6.8.46) and along the golf course edge near the Reservoir.

Figure 6.8.46: Slope restoration near Fresh Pond Golf Course. Saulnier, October 20, 2013.

The Cambridge Water Department website indicated a swale along the Perimeter Road on the side opposite the Reservoir, and a earthen berm along the edge of Fairway 1 and the wooded area near Huron Avenue was constructed in 2009 to improve water quality at the Reservoir. Additional work to Stream C and two small ponds of Little Fresh Pond was completed to reduce flooding at the golf course. The bikeway corridor enhancement to naturalize its edge was still in progress during my site visit. Some of the edges were completed during my site visit; however, due to the size of the pond, it would take some time to make all improvements suggested in the 2002 master plan.

Open space areas, located within the Alewife Brook Watershed, can be seen in Figure 4.1 and 4.2 for better clarity when discussing implementations for each site. Yates Pond was restored to its natural landscape with vegetation along the banks, and a boardwalk/bike path along the T-station side the pond connected to the M. Bike Path, as recommended in the Alewife Master Plan (Figure 6.8.47). However, no educational or cultural opportunities, such as signs, were present. Restoring Jerry's Pond as a park, recommended in the 1978 and 1985 plans, was not accomplished. A wire fence still exists around the pond, separating the pond from public access (Figure 6.8.48).

Figure 6.8.47: Yates Pond restored to natural features. View from the top of the Alewife T-Station. Saulnier, October 17, 2013.

Figure 6.8.48: Jerry's Pond enclosed to public with a wire fence, located near Russell Field. Saulnier, October 20, 2013.

The Mugar site and Thorndike, Magnolia, and Russell Fields have been preserved for open space. Located in East Arlington, just North of the Alewife Reservation, Magnolia Field (Figure 6.8.49) and Thorndike Field (Figure 6.8.50) are used for soccer games by local residents. A new sports facility, at Russell Field, was built (Figure 6.8.51). Near Russell field, a children's playground with climbing equipment had one structure shaped as the Alewife fish, a unique piece of art and history closely tied to the area (Figure 6.8.52).

Figure 6.8.49: Magnolia Field. Saulnier, October 17, 2013.

Figure 6.8.50: Thorndike Field. Saulnier, October 17, 2013.

Figure 6.8.51: New sports facility at Russell Field. Saulnier, October 20, 2013

Figure 6.8.52: Alewife-shaped climbing fish at the playground.

One of the largest implemented projects for recreational space is the old dump site in north Cambridge, known as Danehy Park. The 55-acre landscape consists of baseball fields, soccer fields, walking paths, a track and field ground, and so much more (Figure 6.8.53).

Figure 6.8.53: Danehy Park football field and track. Saulnier, October 20, 2013.

A unique feature at the site was a sitting area made out of old material from the old dump (Figure 6.8.54). A wetland was created at the bottom of the hill with various vegetative plants to aid in flood control from the surrounding fields (Figure 6.8.55). A sprinkler play pad for children to enjoy in the summer was another feature at the park I observed (Figure 6.8.56) .

Figure 6.8.54: Sitting area at Danehy Park which was build out of the old dump material. Saulnier, October 20, 2013.

Figure 6.8.55: Constructed wetland located at the bottom of the hill at Danehy Park. Saulnier, October 20, 2013.

Figure 6.8.56: Kids splash pad at Danehy Park. Saulnier, October 20, 2013.

To summarize my site visits, I determined that many of the recommendations addressed in the Fresh Pond Master Plan (2002) and the Alewife Master Plan (2003) have been implemented; however, there is still work to be done in the Alewife Brook Watershed. One example of an outstanding project/implementation that is a key factor in creating wildlife habitat for both terrestrial and aquatic wildlife and improving water quality is the naturalization of the Alewife Brook. An example of a positive outcome is the Stormwater Wetland project. This project created wildlife habitat and natural water storage and treatment, and provides aesthetics to the general public. One of the biggest failures within the watershed is the development in the Silver Maple Forest. This is not only a loss of valuable wildlife habitat but a loss of resiliency.

Open space planning efforts in the Alewife Brook Watershed extend beyond the time of my research. In recent years, further initiatives have been undertaken by local residents to preserve wildlife and recreation quality, an example being a restoration plan for Jerry's Pond. Recommendations to restore Jerry's Pond were mentioned in several of the reviewed plans; however, the pond still remains

isolated from the rest of the community. A 2018 plan, *Jerry's Pond Park: A Community vision for Jerry's Pond,* developed by a community-based group called Friends of Jerry's Pond, illustrated the history of the pond and made conceptual site plans to restore the ecosystem. It is hoped that the plan will get others involved in the planning process and that it will be adopted by the City of Cambridge (Friends of Jerry's Pond, 2018).

In addition to plans for Jerry's Pond, other recent work in the area includes:

- the *Concord-Alewife Rezoning and Design Guideline Plan*, which was adopted by city council in 2006 (City of Cambridge Community Development, 2005),
- the *City of Cambridge Massachusetts Open Space and Recreation Plan* for 2009-2016, approved in 2016 by the Massachusetts Executive Office of Energy and Environmental Affairs (City of Cambridge, 2010),
- The *Climate Change Preparedness and Resilience: Alewife Preparedness Plan* (2017), adopted by the City of Cambridge, following the *Vulnerability and Risk Assessment Technical Reports: Climate Change Vulnerability Assessment* in 2015 (Kleinfelder, 2015), to reduce the impact from climate change at the Alewife Brook Watershed. The plan was developed by professionals in diverse fields to guide the city on ways to deal with climate change, such as flooding.

The community's efforts to protect wildlife habitats and the water quality of the Alewife Brook Watershed over the last 30 years have been tremendous. It is important that the residents and environmental groups continue to push government and city managers to make better decisions in protecting the diversity of ecosystems in the watershed.

Chapter 7: Conclusions

The landscape history of the Alewife Brook Watershed tells us that cultural values and human needs during specific time frames have shaped the watershed to what is seen today. I believe the insights from the historical chapter can broaden anyone's understanding of the human alterations to the watershed. The current vegetation and hydrology in the Alewife Brook Watershed is the outcome of a particular sequence of events, caused by natural disasters or human manipulations. For example, the straightening of the Alewife Brook has made impacts to the long-term health of the Brook. More recently, the loss of some critical habitat, the Silver Maple Forest, due to development will impact wildlife habitats and increase flooding in nearby communities.

My research is not revelatory in terms of new directions that need to be undertaken to improve watershed land-use planning, but rather validates the work others have previously argued. I found that the lack of interdisciplinary work in earlier plans improved significantly over the years. This tells us that working with multiple professionals and gaining public knowledge of the watershed, will only enhance the quality of the planning and implementation of projects. The future of planning is evolving towards a reliance on local citizens to assist in gathering data and implementing the recommendations indicated in plans. This is verified in the 2003 Alewife Master Plan, which refers to volunteers as a key solution to implement restoration projects and to monitor the health of the Alewife Reservation and Brook. The use of "citizen scientists", volunteers involved in the gathering of field data, such as water quality sampling, wildlife population monitoring, or other environmental markers will only broaden the scope of research and data collection in the Alewife Brook Watershed (Kobori et al., 2016). To build on public participation and stakeholder relationships within the planning process and monitoring of the Alewife Brook Watershed, I suggest an education tool and communication strategy for all audiences be developed for the watershed. Groups such as the FAR and MyRWA do an amazing job at educating

the public on the history and wildlife and invasive species in watershed as well as conducting baseline data. However, an education tool and communication strategy would bring together inter-departmental and multi-scale coordination, educating and engaging citizens in environmental stewardship, and the dozens of supportive non-profit environmental groups. Much of the land base in the watershed is private property. The education tool and communication strategy would help with private property stewardship, educating the public of the important role of the habitat and ecosystem services for the watershed. I propose several steps to create an education tool and communication strategy by: 1) a review of relevant academic literature, 2) an evaluation of the existing educational tools in place for citizens, 3) a review of external practices in other jurisdictions, 4) develop a watershed education tool and communication strategies, 5) apply and evaluate the program. I also suggest an incentive program be developed as part of the education tool and communication strategy.

We know that the five planning steps outlined in my research are not new concepts in planning (plan description, goals and objectives, site inventory and analysis, recommendations, and implementation(s)). However, beyond these five plan basics, monitoring and evaluating principles and practices should be included in the planning process. Implementations are often completed years after the plan has been published, which is why monitoring is important to establish in the planning process. The Fresh Pond Master Plan (2002) and the Alewife Master Plan (2003) provided thorough information on monitoring strategies. Monitoring is necessary to ensure that a plan is being implemented as intended and can provide scientific and social data of changes, which can identify new threats to the environment and the public. Even though monitoring is an important step in the planning process, we cannot forget the significance of evaluation, which was not mentioned in any of the plans' goals and objectives or implementation phase.

Implementing plans can take time, which is why the nine key strategies mentioned in Table 6.1.1 should be considered when developing a watershed

plan, authentically having a higher chance of succeeding. From my case study analysis, the clarity of goals and objectives in the plans were found to improve from 1978 to 2003. This could have played a factor in the success of implementing recommendations stated in the Fresh Pond and the Alewife Master Plans (two plans that received the highest scores). However, to gain a full understanding of why outcomes were, or were not accomplished, what types of monitoring is taking place and by whom, evaluating conservation actions should be part of the planning process. It can offer insight for future directions and increase the efficiency and effectiveness of investments (Guyadeen and Seasons, 2016). I suggest that research on evaluating Fresh Pond and Alewife Master Plans' implementation projects be conducted to address the issues of success and failure to assist with future planning efforts and to build awareness. The findings can be compared to other watersheds across the globe. The stormwater wetland project at the Alewife Reservation is a positive outcome which, by design, was not only scientific but recreational in nature. The stormwater wetland represents a change in our way of thinking about nature in cities. Evaluating the success and failures of this wetland could provide hope for other groups, planners and ecologists to build and manage for other wetlands in a heavily-developed watershed. Planners and planning agencies lack the time and capability to evaluate the impacts of their plans and activities (Lucie et al., 2010). This is why building relationships with multiple stakeholders in the beginning of the planning process is so important.

Due to the nature of the study I was limited to only the information contained in the plans themselves. In consequence it was impossible to address the very interesting role that individual different stakeholders may have had in the planning process and whether it helped, hindered or neither. Conducting interviews is a very valuable approach to address in future research. This could provide a more in-depth understanding of the barriers and successes associated with the implementation of each plan, the strategies and methods of incorporating the public in the planning process, and methods of gathering urban ecology data.

Interview questions would be similar to those outlined in Table 2.4.1 from Chapter 2.

This research suggests that future use of combined ecology science and landscape history in the planning process, be analyzed for its potential value in protecting water resources and wildlife habitat. A comprehensive planning process should take into account the perspectives and potential roles of professionals and citizens alike.

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Appendix

Appendix A: Summary of Site Inventory and Analysis, Recommendations, and Suggested Implementation(s) of the Alewife Open Space: Objectives and Recommendations for the Development of a Park and Open Space Network (1978)

Site Inventory and Analysis

After the site inventory, meetings and objectives were completed, a list of open space areas for public preservation and areas for improvements were proposed. Five sites for public preservation were identified and ranked in order of importance by the subcommittee. These included: ADL wetlands and uplands, Blair Pond, Jerry's Pond, and Mugar Property (Figure A-1.1).

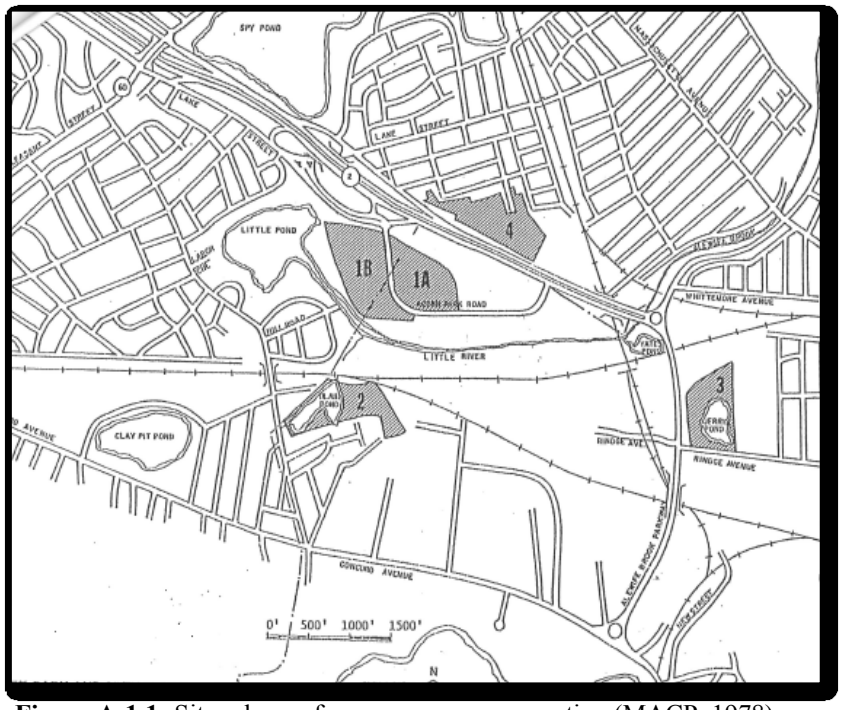

Figure A-1.1: Sites chosen for open space preservation (MACP, 1978).

Located in the City of Cambridge, the ADL Wetland (located as 1A in Figure A-1.1) sits between the Acorn Park Road and development at the ADL site. The wetland serves as a habitat for nesting, feeding and migration for many wildlife, waterfowl, and birds (MAPC, 1978). The wetland aids in flood control and filters pollutants from runoff. The ADL Upland (1B) is located west of the Acorn Park Road. Much of the land is filled land cover with an assortment of grasses, hedges, and shrub sprouts, which support wildlife activities. Blair Pond (2) is located south of the Alewife Reservation and is connected to the Little River by the Wellington Brook. The land around the pond was owned by Harvard College. The pond provides a resting and feeding area for waterfowl, and wildlife, and acts as a flood retention (MAPC, 1978). Jerry's Pond (3), located in Cambridge, is surrounded by Russell Field, Grace company buildings, and the Alewife Brook Parkway. The pond was once used as a clay pit, and later a fence was installed to keep residents safe. The Mugar Property (4) is located in Arlington on the north side of Route 2, across from the Arthur D. Little complex. Thorndike Playground, Route 2, and single residential homes surround the area. The site provides habitat for a variety of bird species and half the site is within the existing Arlington Floodplain Zoning map. The site serves as a flood retention area, wildlife habitat, and open land for recreational activities (MAPC, 1978).

The list of priority land areas chosen for improvements is indicated in Figure A-1.2. These included: the ADL Parking Lot, Yates Pond, Cambridge Dump Site, and Alewife Brook Parkway. The ADL Parking Lot (1) is located east of the ADL buildings and is directly beside Little River, which is in the floodplain. Because of the paved lot, the site increases runoff entering the watercourse. Yates Pond (2) is located north of the proposed MBTA station/garage complex in Cambridge. The pond serves as a retention area for flooding and a nesting and feeding area for birds and mammals. The old dump site (3), located at the Fitchburg Line ROW between New Street, on the west, and Sherman Street on the east, is no longer used as a dump site, which has been filled in. The site is used to store large materials and equipment, as well as for snow removal from the city streets. The

Alewife Brook Parkway from Dewey and Almy Circle to Fresh Pond is compressed with commercial, industrial, and residential development.

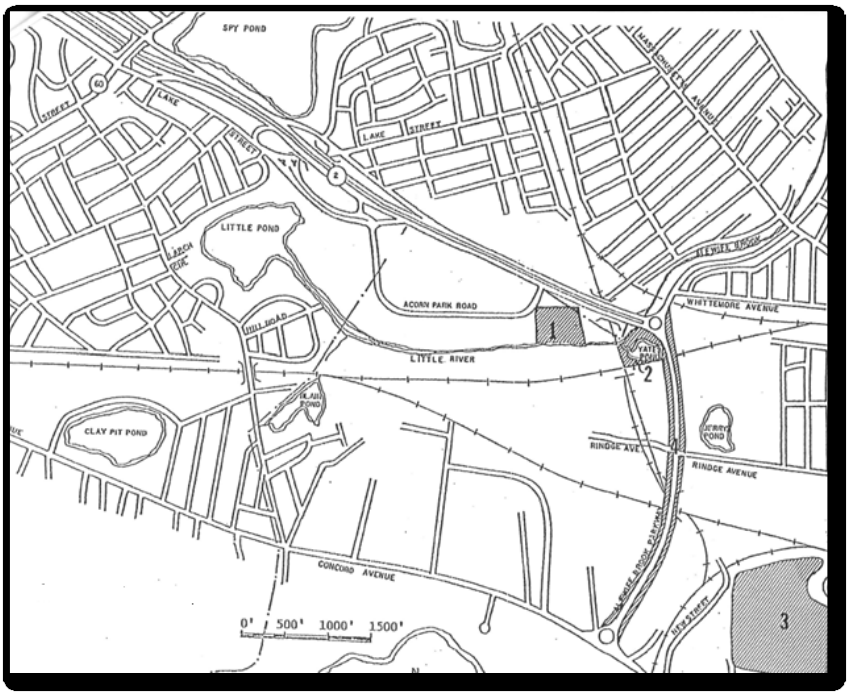

Figure A-1.2: Sites chosen for improvements (MAPC, 1978).

Recommendations

The recommendations made for the ADL Wetland, Upland and Blair Pond were to preserve, by direct purchase, easements or other controls, as an extension to the Alewife Reservation open space areas. This would aid in flood control, provide habitat, and buffer for future development near the Alewife Reservation. Recommendations for Jerry's Pond were to use it as a park area, only if the North Cambridge residents agreed. The banks should be sloped to create a shallow water depth.

The Mugar property was recommended to be preserved for open space use; however, the subcommittee did acknowledge that the area was subject to development. If the area was developed, it was recommended that environmental considerations for the site and surrounding areas be considered in the proposal.

The natural aesthetic should also be preserved by setbacks, height, and floodplain restrictions.

ADL East Parking lot, Yates Pond, Cambridge Dumpsite, and Alewife Brook Park (from Dewey and Almy Circle to Fresh Pond) were land areas selected for improvements. The removal of pavement at ADL Eastern Parking lot, located from the east of the ADL buildings to the banks of Little River, was proposed for improvement. Once the pavement was removed, planting vegetation for floodwater retention and passive recreation was recommended. After construction around Yates Pond, it was recommended to restore the pond back to its natural state for the use of wildlife habitat and potential passive recreation. To improve the old dump site, the plan recommended to transform it into a recreational open space. The plan also suggested landscape improvements at Alewife Brook Parkway along the side of the road between Dewey and Almy Circle, and Fresh Pond.

Proposed bicycle and pedestrian paths were recommended in the plan. Ecosystem health was considered for the planning objectives such as reducing the use of pavement within the land areas of the Reservation, abutting property, and allowing only soft or unpaved paths, making paths more natural.

Other proposed open space areas and recommendations in the Alewife were summarized in the final section of the report. An Environmental Impact Statement Mitigating Measure was recommended for all construction around the Alewife Reservation. Mitigating measures should take place if the service road south of route 2 is constructed through the ALD wetlands. It was recommended to link the MDC skating rink and commuter parking lot, located between Route 2 and Lake Street interchange, to Little Pond by removing one or both ramps. If only one was feasible, it was suggested the ramp on the eastbound Route 2 entrance be removed to create more shoreline for Little Pond. A Master Plan for the Alewife Brook Reservation was also recommended for the MDC to complete. For designing

criteria and future development in the area, the city should revise the zoning of the Alewife such as height limits and setback requirements. The Alewife Brook natural resources should be enhanced and to daylight (i.e. open up) the Alewife Brook west of the MBTA station/garage complex.

Suggested Implementation(s)

Implementations were not discussed in the plan.

Appendix B: Summary of Site Inventory and Analysis, Recommendations, and Suggested Implementation(s) of The Alewife Open Space Plan, Metropolitan Area Planning Council (1985)

Site Inventory and Analysis

Tables B-1.1 and B-1.2 summarize the inventory that was conducted for nine open space areas: Alewife Brook Reservation, the Arthur D. Little site, Blair Pond, Mugar Site, Jerry's Pond, Magnolia Playground, Thorndike Field, Russell Field, and Alewife Brook Parkway. Other landscape features that contribute to open space areas mentioned in the plan were the Arthur D. Little (parking lot), the Alewife T-Station, and W.R. Grace. To meet the goals and objectives outlined in the 1985 plan, a list of criteria was developed. These criteria were based on the environmental characteristics, such as vegetation, flood retention, wildlife habitat, and the degree to which the area was developed, from an owner's point of view or from regulations already in place.

Table B-1.1: Open space values/function and issues identified within the study area (MAPC, 1985).

Name	**Hydrology**	**Vegetation**	**Wildlife**
Alewife Brook Reservation a)Yates Pond b) East c) West	Flooding and pollutant issues caused by paved areas, brook channel, sewage discharge. The wetlands aid in water quality and flooding problems.	Mainly wetland plants. Vegetation is affected by the level of groundwater and soil moisture as well as transportation projects.	West - Not disturbed, many wildlife species present from mallard, blue jay to raccoon, mink, and small rodents. East - low habitat value due to development and low levels of biodiversity.
Arthur D. Little a) Wetlands b) Uplands	Both are within the 100-year floodplain. Aid in filtering pollutants.	Emergent wetland plants and some forest areas in the upland site.	Same as the Reservation
Blair Pond	Essential to flood control in the Alewife watershed.	Shrubs, brambles, thistle and trees.	Waterfowl and other birds and small mammal species.

Name	Hydrology	Vegetation	Wildlife
Mugar Site	One-half of the site is within the 100-year floodplain. Flooding is an issue in the area due to culvert backups at Route 2 and Alewife Brook.	Fields, low scrub and three wetland areas.	Not suitable for wildlife habitat.
Jerry's Pond	Man-made pond.	n/a	n/a
Magnolia Playground	Within the 500-year floodplain and is drained by a storm sewer that runs into the Alewife Brook.	Not significant	Not significant
Thorndike Field	Within the 100-year floodplain and is hydrologically connected to the Alewife Brook. Flooding can be an issue during storm events.	Not significant	Not Significant
Russell Field	Used as a playing field	n/a	n/a
Alewife Brook Parkway	n/a	Lost park-like qualities.	n/a

Table B-1.2: Open space study areas (MAPC,1985).

Name	Location	Acreage	Type of Open Space	Ownership
Alewife Brook Reservation a)Yates Pond b) East c) West	Arlington, Belmont, Cambridge	95	Vacant Conservation Conservation	Public
Arthur D. Little a) Wetlands b) Uplands	Cambridge Belmont, Cambridge	9.7 13.9	Conservation Vacant	Private
Blair Pond	Cambridge	7.09	Vacant	Private
Mugar Site	Arlington	17.3	Vacant	Private
Jerry's Pond	Cambridge	3.5	Vacant	Private
Magnolia Playground	Arlington	3.5	Active	Public
Thorndike Field	Arlington	7.8	Active	Public
Russell Field	Cambridge	9.8	Active	Public
Alewife Brook Parkway	Arlington, Cambridge	n/a	Passive	Public

Recommendations

Recommendations were made for both public and private open space areas for land acquisition and site improvements. Recommendations for preservation and enhancement through regulation and development review processes was also provided. Connecting public and private open space elements via paths and improvements to the Alewife Brook Parkway was also discussed in the plan. For land acquisition, it was recommended to expand the Reservation by connecting the uplands on the west side of the area owned by the ADL Company. This would ensure adequate wildlife habitat and would act as a buffer for future development.

Site improvement recommendations suggested for the Reservation Riverway Park were to create a passive recreation along both sides of Little River (Alewife Brook) for walking, sitting, and fishing. To accomplish this, the parking lot, located north of Little River, which was used by ADL, was suggested to be returned to its natural landscape. On the south side of Little River, site

improvements included a vegetative buffer between the park and the wetlands to discourage development in the area. Building pathways and amenities was also suggested for this site.

Residential development on the shores of Blair Pond made development restrictions and existing regulations (i.e. Wetlands Protection Act) recommendations essential. Three site improvements for Blair Pond were: (1) The wetlands should not be disturbed; (2) the capacity of the pond for flood storage should be increased; and (3) public access to the pond should be provided. Due to construction around Yates Pond, it was recommended to return the pond back to a healthy ecosystem for wildlife habitat. The firm of Monacelli Associates developed recommendations for Jerry's Pond, which included improvements and landscaping to the pond as well as pedestrian paths to the T-station entrance and Russell Field. The Mugar site was under proposal for an office building. The developer agreed to input natural landscape features and pedestrian paths. Connecting open space and building pedestrian and bike paths were recommended. Providing look-offs to view the Alewife Reservation was also recommended in the plan.

Recommendations for preservation and enhancement through the Regulations and the Project Review Process were made for the ADL Wetlands, Jerry's Pond, and Mugar Sites. The Wetland Protections Act and local land use regulations were recommended to be enforced if any development was conducted along the wetland. Conservation easements, or a change in zoning, were also recommended for consideration. This would permanently preserve the wetlands and would prevent any future development near the wetlands. Development plans for the Mugar site were proposed. The plan recommended that the 6.1 acres remain as an open space feature. Connecting open space, pedestrian, and bike paths in the Alewife Brook surrounding areas was also recommended in the plan, among other recommendations for path construction.

Suggested Implementation(s)

Implementation and responsibilities for site improvements were provided in the plan. It was suggested that changes to the parking lot should be MDC's responsibility. Two phases were suggested. Phase one involved bank stabilization along both sides of the river and phase two was the replanting of vegetation after the removal of the paved parking lot. To preserve the ADL Wetlands, it was suggested that several local government agencies be involved. To meet Blair Pond's recommendations, it was suggested to have the Harvard University Real Estate Department, Cambridge Conservation Commission, and the Cambridge Department of Planning and Community Development assist with implementation of recommendations. Any improvements to Yates Pond should be the MBTA responsibility.

The plan made estimates on the cost of potential site improvements and the Reservation river-way park recommendations. The plan also states that the city and town agencies, the MDC, private developers, and agencies completing transportation improvements would need to work together to successfully implement recommendations in the plan.

Appendix C: Summary of Site Inventory and Analysis, Recommendations, and Suggested Implementation(s) of the Metropolitan District Commission Parkway Restoration: A Master Plan for Segments of the Alewife Brook and Mystic Valley Parkway (1996)

Site Inventory and Analysis

During the beginning of the planning process, community meetings, questionnaires, letters, and phone conversations with individuals and small groups were conducted to gather local concerns and input. The biggest challenge identified in the plan was balancing the parkway character for environmental purposes and meeting recreational needs of the surrounding metropolitan population. Other issues identified during the inventory were: dense overgrowth along the banks of the Alewife Brook banks, traffic impacts, large-scale development, and populated neighborhoods. Contamination in the brook, flooding, and biodiversity loss in the plans study areas were also identified as major issues. Japanese Knotweed, an invasive plant species along segments of the Alewife Brook, was out-competing native species in the study areas. Despite the negative impact to the brook it still provides a vital open space for residents and habitat for several bird and small mammal species (MDC, 1996).

Segment One: Alewife Reservation, Alewife Rotary to Massachusetts Avenue.

The parkland varied, from the open meadow east of the former cattail marsh in Arlington's Thorndike Field area, to the heavily populated neighborhoods of East Arlington and North Cambridge. Residential properties were located on both sides of the parkway. The Alewife Brook was contained in a concrete culvert and fenced with four-foot chain link. Vegetation on the brook's western Arlington side effectively screened the parkway traffic from the residential neighborhood.

Segment Two: St. Paul's Catholic Cemetery, Massachusetts Avenue to Broadway Avenue

The St. Paul's Catholic Cemetery is located right at the edge of the brook with Massachusetts Avenue at the south, Broadway Avenue to the north, Arlington located on the west and Cambridge and Somerville on the east.

Segment Three: Dilboy Field, Broadway Avenue to Mystic Rotary

Enclosed by Broadway Avenue and by the rotary at the junction of the Alewife Brook and Mystic Valley Parkways, Somerville is east of the brook while Arlington is west. The area is located next to the active recreational facilities, Dilboy Field, where the eastern edge is mainly residential, with a large public housing project located at the Power House Road Rotary.

Recommendations

MDC requested that Brown and Rowe identify realistic recommendations/projects within each segment that could be completed independently from one another. Both short-term and long-term solutions were proposed for funding purposes (MDC, 1996).

Segment One: Alewife Reservation, Alewife Rotary to Massachusetts Avenue

Several short-term improvements included: the removal of the chain link fence and vegetation on Alewife Brook's Cambridge parkway side; leaving mature specimen trees that are native; reinforcing the parkway tree edge by replanting missing or dying shade trees along the curb; and recommending new species of red oaks, sycamores, or red maples that withstand urban conditions. A sediment analysis and research on the hydrology and hydrogeology of the area were recommended as long term projects. It was recommended to restore the Alewife Brook to a more natural state, removing the concrete culvert, and connecting the brook to the marsh to enhance the areas' wetlands and flood retention capacity. Another long-term recommendation was to diminish the impacts of utility manholes, gas farms and other utility line access points on the parkland. Planting evergreen trees, to screen the neighborhood from the multi-purpose path, was also a long term recommendation.

Segment Two: St. Paul's Catholic Cemetery Massachusetts Avenue to Broadway

Short-term recommendations included the installation of new curbing on both sides of the parkway to separate the cars from the park. When installing new

curbing, it was suggested to regrade areas where utility manholes would disturb the park's landscape. Planting large shade trees and leaving mature trees along the Alewife Brook were recommended for this segment. The path near the brook should be covered with stone dust or wood chips and plant shrubs, wetland plants and large trees wherever possible. A long-term recommendation was to restore the brook to its natural state and stabilize the banks from the Massachusetts Avenue Bridge to the Henderson Street Bridge. Educational signs for park users were also recommended.

Segment Three: Dilboy Field, Broadway to Mystic Rotary

Similar to segment two, installing new curbing on both sides of the parkway to separate the cars from the park and restore the Alewife Brook to its natural state by stabilizing its banks, was recommended. It was highly recommended that a hydrological and hydrogeological study be undertaken on the Alewife Brook floodplain area to understand why Dilboy Field and park lands on Sunnyside neighborhood had poor drainage and water issues. Biodiversity protection was needed in this area due to the over-growth of knotweed. A suggested control measure was to spray with “Roundup” in late July or early August when knotweeds start to blossom. Landscape improvements were suggested throughout the area. A long-term recommendation was to plant shade trees in the large parking lot north of the stadium so it would look more like a park.

Suggested Implementation(s)

Implementations were not discussed in the plan.

Appendix D: Summary of Site Inventory and Analysis, Recommendations, and Suggested Implementation(s) of the Blair Pond Master Plan: Cambridge and Belmont, Massachusetts (1999)

Site Inventory and Analysis

The inventory of the pond included: hydrology, pond bathymetry and soft sediment depth, bank conditions, soils, terrestrial and aquatic vegetation, wetland resources, water quality, aquatic and wildlife habitat, circulation, parking and access, and adjacent land uses. Maps, older plans, photographs, and background information were used during the planning process, as well as on-site inspections and comments from the public, neighborhood groups, Friends of Blair Pond, and civic representatives. Public meetings were also held.

From the inventory and analysis, issues and potential improvements were identified at eleven specific locations around the pond. These areas included the drainage inlet and outfall system, wetland, parking, and pedestrian access, Wellington Brook, open areas and lawns, Mooney Street, Normandy Terrace, Town Park, Santa Maria Hospital, and residential encroachments on the pond (BDG, 1999). Residential encroachment and uncontrolled access around the pond caused damage to the wildlife habitat and sensitive environmental areas, resulting from unmarked boundaries, agency and landowner indifference, development pressure, and insufficient monitoring and enforcement. It was stated that the banks at Wellington Brook had poor stabilization and a lot of debris. Flash floods increased the likelihood for contaminants to be deposited in the pond, such as heavy metals, animal wastes, and petroleum products. This affected water quality which created alga blooms. The presence of invasive species had restricted the growth of native plants in the area. Sediment input from the inlet channel, due to lack of sedimentation control and the buildup of organic matter from aquatic and dying terrestrial plants, had caused parts of the pond to be shallow (BDG, 1999).

Recommendations

Improvements for Wellington Brook and open areas were bank stabilization by planting natural species and clearing waterways of debris. Improvements for open lawn areas were to recover the edge for wildlife habitat. Suggestions for improvements at the drainage outfall were to remove sedimentation.

Six designing elements recommended for Blair Pond were: trail development, seating areas, interpretive elements, open space, access around the pond, and pond maintenance (Figure D-1.1). Recommendations for access paths were to use natural paving materials (wood chips) in environmentally sensitive areas adjacent to wetland areas. Setting aside and protecting an area for wildlife was also proposed through the use of natural screening and planting to exclude the public. To enhance wildlife and insect habitats, it was recommended to have open space areas at the pond become more natural than low cut lawns by planting grasses. Pond maintenance recommendations were to enhance the water quality of the pond by pond dredging, restoration, and wetland planting. To prevent the pond from silting in, the installation of a siltation control structure was highly recommended at the inlet to Blair Pond, trapping the bulk of silts before they entered the pond. For cleaning purposes, the structure should be accessible from Flanders Road. To increase stormwater storage capacity and the diversity of wildlife using the pond, a onetime dredging of the pond was also recommended. After the siltation control structure and pond dredging was completed, a gabion barrier should be installed between the pond edge and the existing marsh areas to limit the amount of silt from marsh areas and provide a more stable ecosystem. Seating areas and interpretive elements may not have a direct impact on improving the health of the pond; however, it was hoped that it would bring more people to the pond and have a better understanding of the landscape (BDG, 1999). To address encroachment issues around Blair Pond, it was recommended to use the MDC Action Plan. The Action Plan was created to resolve encroachment or violations on public lands for other related projects near the Alewife Reservation and Brook.

Figure D-1.1: Blair Pond Master Plan recommendation map (BDG, 1999).

Suggested Implementation (s)

It was suggested to first install a siltation control structure, and then obtain easements to construct pathways. Maintaining the park landscapes and elements was suggested to be ongoing. An estimate of the probable cost for site improvements and site preparation was provided. A grand total of $896,898.23, was provided to complete all of the Blair Pond master plan proposals.

Appendix E: Summary of Site Inventory and Analysis, Recommendations, and Suggested Implementation(s) of the Fresh Pond Reservation Master Plan (2002)

Site Inventory and Analysis

It took two years to complete the master plan. In the plan, it indicated that public meetings took place monthly, and the documents from the meetings were accessible to the public by the public library and the Water Department. Social, ecological, and history research of the Fresh Pond area was conducted. Ecological data collection and analysis at the Reservation were also completed. The subcommittees and Rizzo Associates completed an inventory and analysis of the Fresh Pond's natural conditions and issues, and recommendations on site-specific areas. These sites included: upland forest, upland scrub/shrub, meadow/open field, wetland, shorelines of Fresh Pond, little Fresh Pond, Black's Nook and North Pond, the three golf course streams/drainage channels, specimen trees and unique vegetation and wildlife, wildlife habitat, and lastly, landscaped/maintained and developed (Figure E-1.1). Each sub-committee produced an exploratory report and a policy draft document. Other projects that were ongoing in the study area, but not included in the master plan, was: Water Treatment Plant, Neville Manor, the bike path extension, and Weir Meadow channel projects.

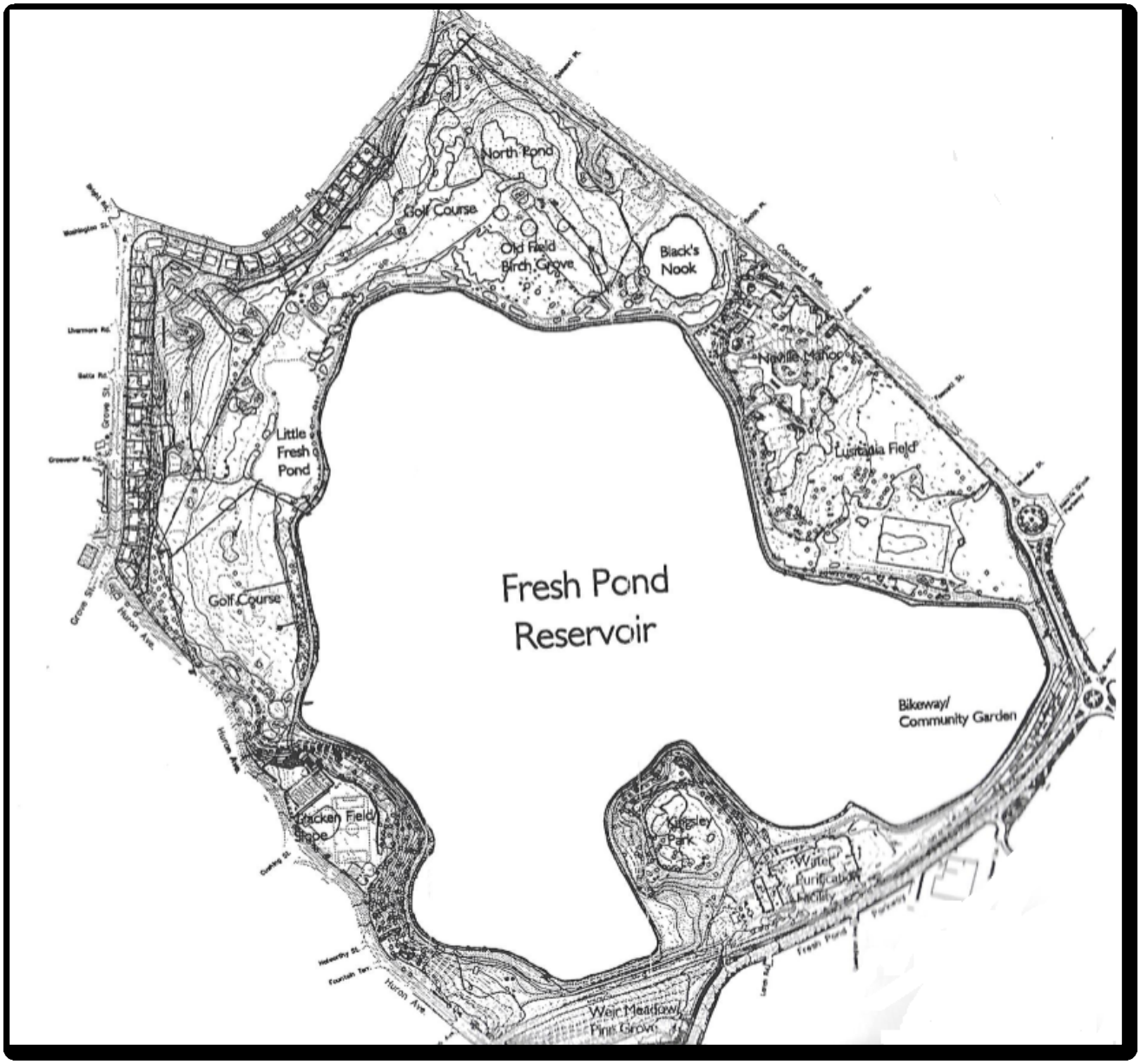

Figure E-1.1: Fresh Pond Reservoir and surrounding sties (FPRMPAC, 2002).

The main issues identified during the inventory process included, invasive plant species, human and dog disturbance, and soil compaction and erosion. The uplands, wetlands, and shoreline areas had high density of invasive plant species. Damage to the groundcover from dogs and human traffic, had created soil compaction at the wetland areas and Black's Nook area. Erosion issues were identified along the shorelines and at Little Fresh Pond and Black's Nook. Stormwater runoff enters Little Fresh Pond at the south side, creating water quality issues. Much of the golf course was built on wetlands in the 1930s, resulting in poor stormwater drainage causing flooding. A lack of buffer zones between the golf course and conservation land was identified, and Canadian Geese were also an issue (FPRMPAC, 2002).

The steep slopes at Lusitania Field caused runoff, resulting in siltation issues in nearby stream channels. Although the Reservation offered habitat for a variety of wildlife and aquatic species, it did not have appropriate space for moderate-size mammals. The eroded shorelines limited the number of reptiles and amphibians. The bird population declined dramatically because of the spread of invasive plant species and poor water quality.

Recommendations

Two policies were created for the Master Plan: the Natural Resource Management Policy, and Fresh Pond Reservation Usage Policies for site specific recommendations. The Natural Resource Management Policy developed seven general policies and site specific recommendations, which are outlined below.

1) Shoreline Management Policy: Intended to preserve the quality of the water and enhance the habitat diversity. Bioengineering techniques that emphasized vegetation and biodegradable materials, instead of hard structures or conventional bank-armoring techniques, were recommended. The removal of invasive species to encourage native growth and improve access points to water edge in order to reduce the impact from dog and human traffic was also recommended.

2) Upland Slope Management Policy: This policy was intended to direct traffic away from steep slopes and vulnerable areas, create drainage features such as porous paths, capture silt and remove invasive species, and prevent erosions on the slopes by planting trees/shrubs.

3) General Vegetation Management Policy: It was recommended that the Master Plan Advisory Board and Cambridge Water Department review the plant list on a regular basis, control invasive species to encourage native plant growth, improve diversity at Lusitania Field by planting native grass and wildflowers, and provide best forestry management practices such as pruning.

4) Management Policy for Wetlands and Small Water Bodies: It was recommended to protect and restore by planting a wide range of native aquatic and wetland plants, remove invasive species, protect wetlands by education staff and users, identify vernal pools, and enhance marginal wetland areas to ensure key wetlands are functioning properly. Monitoring the health of the wetland was also recommended.

5) Wildlife Habitat Management Policy: It was recommended to create wildlife habitat that is suitable for a range of wildlife species to encourage biodiversity. Monitoring the wildlife population on a regular basis was also important.

6) Path, Access Point, and Perimeter Road Management Policy: To reduce the impacts to water quality and the surrounding ecosystem, it was recommended to redesign paths to minimize ecological disturbance, while still creating an area for nature appreciation. This would be accomplished by planting vegetated barriers on primary paths to redirect people to secondary paths. To assist with filtering stormwater runoff, it was recommended to build biofiltration swales along the road and upland slopes and resurfacing all or part of the road using sufficiently porous materials. It was mentioned in the plan that a year-long test of different

surfacing materials would be conducted to resurface the Perimeter Road from the Kingsley Park parking lot to the western edge of the Weir Meadow.

7) Natural Resource Monitoring Policy: Plans, checklists, and schedules for routine maintenance and monitoring, completed by volunteers, was recommended as well as an annual report.

Site-specific recommendations were given very high and high priority, which are summarized in Table E-1.1 and E-1.2. Sites were prioritized by a set of ranking criteria including threats to the Reservoir water quality, severity of deterioration, uniqueness and ecological value, level of use, level of visibility and aesthetic value, and relationship to other scheduled capital improvements. The Fresh Pond Reservation Usage Policies included: Land-Use Policy, Access Policy, Recreation Policy, Facilities and Services Policy, and Education Policy.

Table E-1.1: Very high ranked master plan priorities for the projects and recommendations (FPRMPAC, 2002).

Kingsley Park: Extensive rehabilitation by planting native species and maintaining trees.
Glacken Field Recreation Complex: Complete a comprehensive redesign study.
Glacken Slope: Stabilization and enhancement of the slope and control invasive species.
Gold Course field of play: Conduct a stormwater and hydrological study.
Golf Course Pro Shop entrance area and slope: Stabilization and enhancement.
Little Fresh Pond area: Stabilize shoreline banks with bioengineering techniques and dredge pond if possible.
Black's Nook: Complete a limnology study to create basis for habitat restoration and landscape importance.
Black's Nook south and southwest shoreline: Stabilize with bioengineering methods and planting native wetland species.

Table E-1.2: High rankings of master plan priorities projects and recommendations (FPRMPAC, 2002).

New Water Treatment Plant area: Naturalize the entire plant grounds, and stabilize shoreline.
Weir Meadow and Pine Grove: Stabilize shoreline and slope, manage forest to prevent disease and pests, improve Perimeter Road, increase wetland buffer and restore lawn with planting groundcover, wildflowers, and control invasive species.
Golf Course (South): At Fairway 1 and 9-restore wetland and stream channel, and at Fairway 8-expand and enhance wetland.
Old Field and Birch Grove: Enhance and manage meadow by removing invasive species and planting native plants, build boardwalk/look-off platform, mange forest, enhance stream, and research vernal pool of the area.
Black's Nook: Improve drainage by stream channel, naturalize, create meanders and pools, wetland buffer management. and improvements on east and southwest side of pond.
Black's Nook on Concord Avenue: Improve entrance and path by planting a buffer of evergreens between the path and Concord Avenue and apply forest management practices.
Neville Manor Site: At the new open space area a soccer field was planned beside the new nursing home and assisted living facility. Recommendations in the area are: thinning of willow trees to allow for other tree specimen growth, stabilize slopes with bioengineering materials (i.e. compost), create butterfly habitat by planting meadow grasses and wildflowers at the community garden, and control invasive.
Beech Grove and Community Garden: Stabilize the south facing slope and control invasive species at the community garden.
Lusitania Field: Forest management, wetland buffer enhancement and addition, meadow-edge management and enhancement, research on vernal pools and stabilize shoreline.
Bikeway Corridor: Enhance the corridor by naturalization and edge.

The Land-Use Policy was vital for the long-term protection of the Fresh Pond Reservation (FPRMPAC, 2002). It was stated that public participation would review all plans and proposals for the Reservation to ensure its protection. Recommendations for general land-use provisions and special land-use provisions were determined. General land-use provisions applied to the whole Reservation whereas the special land-use provisions only applied to the golf course, clubhouse, Neville Manor site, Lusitania Field, and the community gardens. Recommendations for general land-use policy suggested that undeveloped natural areas should be left undeveloped. Any hard surfaces (paved areas) were recommended to return to natural vegetation, as well as an approved plant species list for planting in the Reservation.

Protecting the water quality and preserving the natural landscape of the Reservation while designing and maintaining the entrances and access routes fell under the Fresh Pond Reservation Access Policies and Priorities recommendations. Minimizing soil erosion, controlling invasive species, and preserving wildlife habit were also recommended for paths. Overall, it was recommended to design a Reservation circulation system that was more accessible, environmentally friendly in protecting the soil, plants, and wildlife, easy to maintain, and able to withstand emergency vehicles.

The Recreation Policy evaluated which landscape at the Reservation was suitable for different types of activities. It was recommended to plant a buffer along the shoreline and have public events in areas away from wildlife habitat. During different times of the year, temporary fencing should be placed where needed to protect and restore sensitive plants and wildlife habitat for growing, breeding, and migratory reasons. The golf course and undeveloped areas of the Reservation were two areas recommended for temporary fencing. It was believed that the new design for the perimeter fencing should preserve and improve the aesthetic and natural areas of the urban wild, while incorporating public safety and protection of sensitive environments. Fresh Pond Reservation Education Policy was created

to build public knowledge on land-use, hydrology, water quality, vegetation health and diversity, wildlife habitat, and soil quality.

Suggested Implementation(s)

A six-year implementation schedule, divided into four sections, was provided in the Master Plan. Summaries of 25 projects were indicated for planning and implementation. Estimated start and finish dates for each project were also provided. The plan implied that the public and the school department would be involved in the implementation process. It was stated that the Water Department would take on the main responsibilities in protecting the natural landscape surrounding Fresh Pond, and to ensure recommendations were implemented from the Master Plan. To assist the City and Water Department with implementation of the Master Plan, a Fresh Pond Master Plan Advisory Board with 15 local members, as well as a Watershed Protection Technician, Site supervisor, and Fresh Pond Assistant Reservation Supervisor were recommended.

Appendix F: Summary of Site Inventory and Analysis, Recommendations, and Suggested Implementation(s) of The Metropolitan District Commission Alewife Reservation and Alewife Brook Master Plan (2003)

Site Inventory and Analysis

An inventory of the physical, biological, and cultural resources in the study area was conducted. Once this was completed, opportunities and options (phase II), and planning and design recommendations (Phase III) were determined. Public meetings during each phase were completed to gather as much information and opinions from a variety of different groups as possible (TBG, 2003).

The elements examined for the physical resources were: topography, geology, soils, hydrology, and geomorphology. The biological resources were: fish species, terrestrial flora and fauna species, habitat types, invasive species, rare or endangered species of special concern, and ecosystem functions. The cultural resources of historical sites, open space recreation areas, current land use, contaminate sites, utilities, transportation linkages and residential areas were also examined. The inventory phase was accomplished by site visits and research on previous publications and data completed in the Alewife area over the years. Historical maps were used to help identify the different resources located in the Alewife Reservation and Greenway.

The Alewife Master Plan indicated that the Alewife Reservation and Brook provided habitat for many plant, mammal, and aquatic species, however, protecting the natural landscape from future damage was still a major concern (TBG, 2003). Decades of hydrology alteration in the Alewife Brook Watershed, had increased stormwater runoff, causing major floods in the area and bank erosion (TBG, 2003). More than sixty stormwater and combined sewer outfalls entered the study area causing poor water conditions (TBG, 2003). Controlling invasive species had become a major issue for the study areas.

Recommendations

General and site specific recommendations were both provided in the Master Plan. To improve water quality and restore the natural hydrology (Goal 1) it was recommended to involve neighboring communities outside the study area to lessen the impact of stormwater runoff. Low impact development (LID) methods should be used to decrease pollutants from running off parking lots and residents' lawns. Methods provided in the plan included: infiltration swales for curbs, gutters, inlets, and drains, limits to the total acres of impervious surfaces allowed to be used, and plant buffers. Improving flood storage was also suggested for improvements by dredging, creating a wetland, and removing channel obstructions.

Whenever possible, ecologically sensitive areas, within the Reservation, should also be protected to protect and enhance wildlife habitat (Goal 2). It was stated that invasive plants and animals must be controlled, and improvements to encourage fish passage, and to create new spawning habitats was needed. To improve recreational, educational, and cultural opportunities (Goal 3), it was recommended to reclaim the MDC parkland.

Recommendations to minimize the cost of implementation of all the recommendations made in the Master Plan (Goal 4), it was suggested that MDC needed to work with abutters, concerned citizens, and interest groups. The need to work with citizens for maintenance purposes was recommended, as well as the development of stewardship programs.

Two alternatives were provided in the Master Plan to achieve the goals. The first alternative was to give high priority to ecological restoration, managing the reservation for wildlife habitats, and flood-storage capacity. The second alternative was directed towards recreational development such as path systems and providing ecological value.

Six basic design criteria were developed to help achieve the goals and objectives outlined in the plan. These included (TBG, 2003):

- Incorporate stormwater management techniques into infrastructure design,
- Use native species to create a network of wildlife and plant communities,
- Install pathways along the Alewife Brook and Parkway keeping the Reservation as little disturbed as possible,
- Include educational components to capture the natural and cultural elements of the Alewife,
- Use sustainable and recycled materials for pathways.

Area-Specific Recommendations

Eight specific site conditions, key challenges, and recommendations were determined in the Master Plan, which are outlined below.

1) Little Pond: Only a few aquatic plants were present along the shore line due to encroachment. Issues included erosion and poor water quality. Approximately 20 stormwater outfalls entered the pond. It was recommended to restore the shoreline riparian buffer and regain all encroachments (Figure F-1.1); determine sediment depths and potentially dredge Little Pond; build islands in the pond to provide avian habitat; use porous pavement at the parking lot off of Brighton St; and create meadows at the south side of the pond to increase diversity of habitat types.

2) Former MDC Skating Rink: Located between Route 2 access ramps and Frontage Road, this site was one of the larger areas outside the 100-year floodplain. The west, east and north side includes woodland and the central area was once the MDC skating rink and parking lot. One of the main issues was that the site had no terrestrial habitat connection. It was recommended to explore options to use the area for flood storage, manage the different habitat types, and remove invasive species, and plant natural vegetation

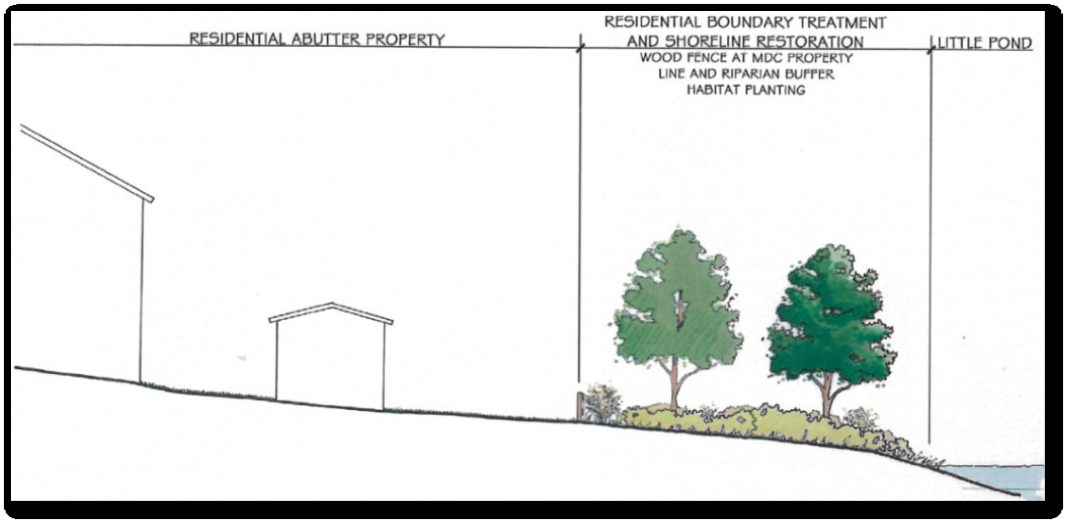

Figure F-1.1: Proposed shoreline with riparian restoration (TBG, 2003).

3) Alewife Reservation North of Little River

This section of the Reservation was mostly wetland habitat and is within the 100-year floodplain. Woodlands were present east of Little Pond and west of the Acorn Office Park (a large parcel of developed private land located on the banks of the river north to Route 2). Open grass areas and scattered trees were located east of the former ADL parking lot. It was determined in the plan that wildlife habitats were located on the abutting private lands to the northwest of the Reservation, which was facing future development.

Recommendations for this site included: dredging Little River and Perch Pond to increase channel depth and flood storage capacity; stabilizing the banks by bioengineering techniques, planting native species and removing invasive species and restoring wetlands at the former ADL parking lot; and connecting the existing wetlands to the north and east (Figure F-1.2). Other recommendations were to expand the drainage ditches that connected the ADL wetland and the Little River for habitat purposes, to identify vernal pools, and move trails away from the river to protect the habitat. It was suggested to limit parking off Acorn Park Drive at the entrance area at the Belmont Upland site and at the end of the road at the new entrance.

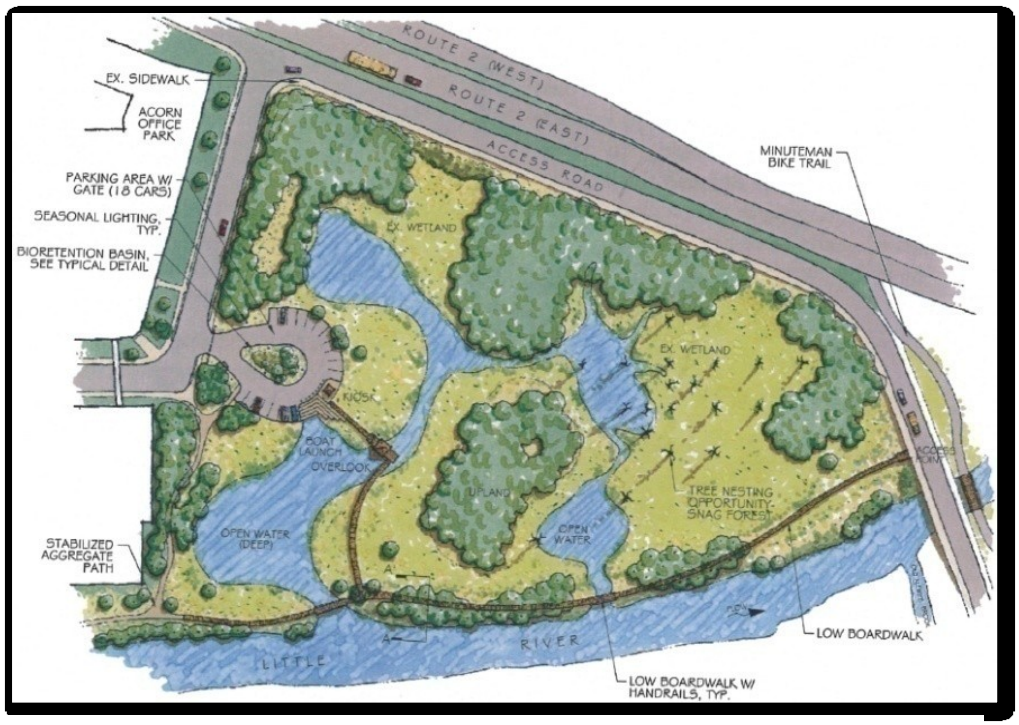

Figure F-1.2: Wetland restoration plan (TBG, 2003).

4) Reservation South of Little River: This section of the Reservation also provides wetland habitat and is in the 100-year floodplain. Water quality in this area was poor, due to combined sewer overflow entering into Little River and the Alewife Brook. Wellington Brook, which enters the western side of the Reservation by Blair Pond, contains stormwater pollutants from unauthorized sewer connections (TBG, 2003). To improve water quality, it was recommended to stabilize the banks at Wellington Brook and reduce sediment input by bioengineering techniques. It was also recommended to incorporate a 3.5-acre stormwater wetland near the current of wetland at the southwest section of the Reservation (Figure F-1.3). This wetland project was part of the Combined Sewer Overflow Separation Project by the City of Cambridge with the Metropolitan Water Resource Authority (MWRA) to improve water quality.

5) Alewife Subway Station: This site is part of the Alewife Reservation and is part of the 100-year floodplain, which also provides wetland habitat. Near the Alewife station, the Alewife Brook connects to Little River, adding further contaminated

stormwater runoff and combined sewer overflows. Erosion preventions have been put in place at parts of the Alewife Brook and Little River. Yates Pond, next to the subway station, collects runoff from the station and the parking garage. It's surrounded by roads and common reed and Japanese knotweed, which are both invasive species. The Minuteman Bicycle Trail and recreational fields in Arlington and Cambridge make the subway station a popular place for both human and car traffic (TBG, 2003). It was recommended to remove invasive species and plant native species.

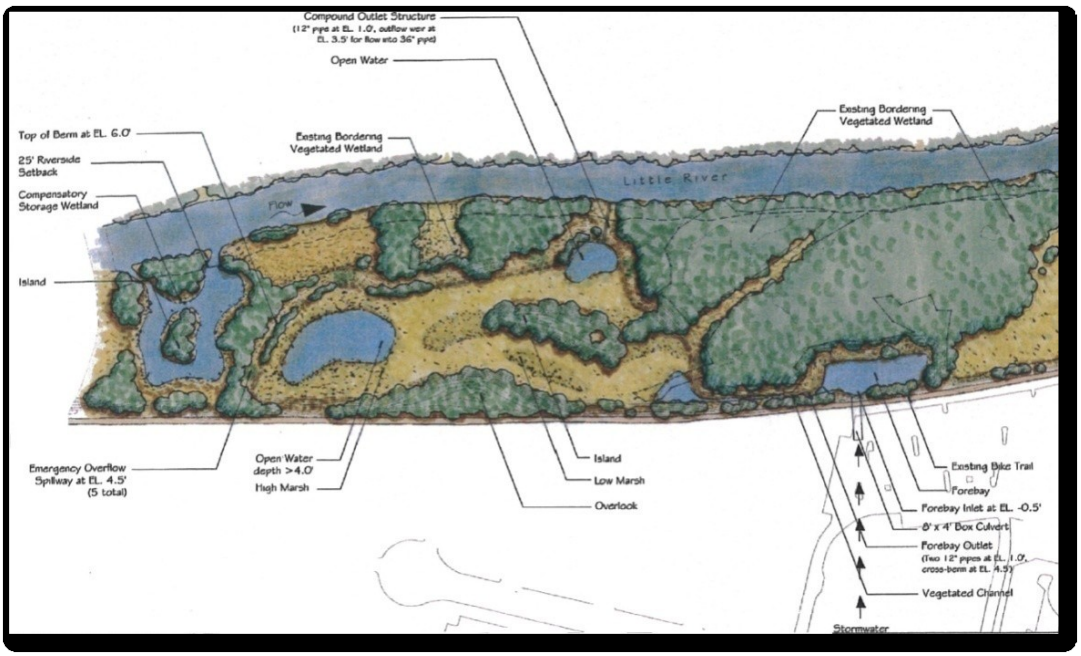

Figure F-1.3: Stormwater wetland design (TBG, 2003).

6) Alewife Brook between Route 2 Rotary and Henderson Bridge: This section of the brook flows between concrete walls surrounded by a chain-link fence. Trees and shrubs are present along the banks, as well as the Japanese knotweed. Stream habitat is poor, resulting in loss of naturally occurring plants. Neighborhoods near the Alewife Brook face numerous flooding issues. Dozens of stormwater outfalls and two combined sewer outfalls flow into the brook. Restoring the cattail marsh as an ecologically valuable wetland, removing invasive species (in marsh and riparian areas), and creating different habitat types was recommended. If practical, it was recommended to remove the concrete lining of the Alewife Brook

stream bed and banks and restore to a more natural channel. It was recommended to use bioengineering techniques to restore the banks and treat runoff via biofiltration and vegetated swales (Figure F-1.4). Planting along the brook, removing invasive species, and having low-maintenance lawns would improve biodiversity.

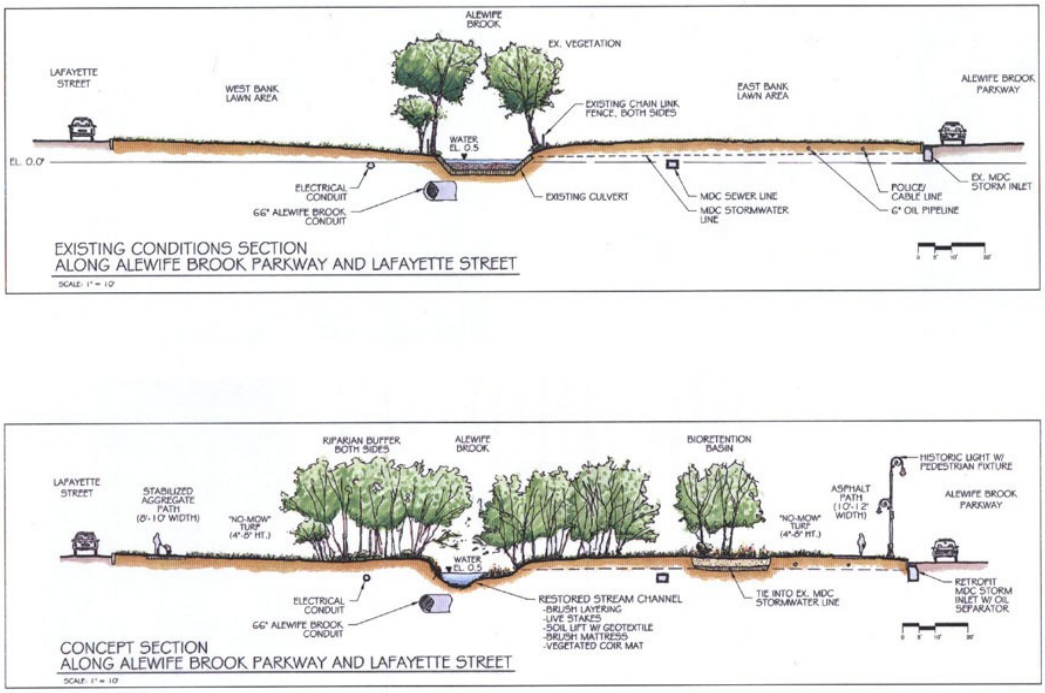

Figure F-1.4: Existing (top) and proposed (bottom) conditions along the Alewife Brook Parkway and Lafayette Street (TBG, 2003).

7) Alewife Brook between Henderson Bridge and Broadway: This section of the brook flows within a concrete channel between St. Paul's Cemetery and the Alewife Parkway. The areas between Massachusetts Avenue and Broadway have 20 storm drains outfalls entering into the brook, and three combined sewer outfalls. Bank erosion was a common issue and paved sidewalk overhangs the brook near the cemetery. Aquatic habitat is very poor. It was recommended to remove the concrete channel and bank and restore to a more natural habitat. To improve aquatic habitat in-stream restoration and riparian planting was needed.

8) Alewife Brook between Broadway and the Mystic Valley Parkway: This section of the brook has a natural channel, unlike other sections of the brook. Approximately two dozen storm drains enter the brook. Eroded banks, invasive species i.e. Japanese knotweed, and encroachment are a few major issues at this site. Similar to other site-specific areas, controlling and removing invasive species and planting native trees, shrubs, and wildflowers were highly recommended. To manage stormwater issues at MDC parking lots near the swimming pool and Dilboy stadium, installing vegetated biofiltration swales was recommended.

Maps showing all recommendations made for the Alewife Reservation and Alewife Brook (South, and north) can be seen in Figures F-1.5 and F-1.6.

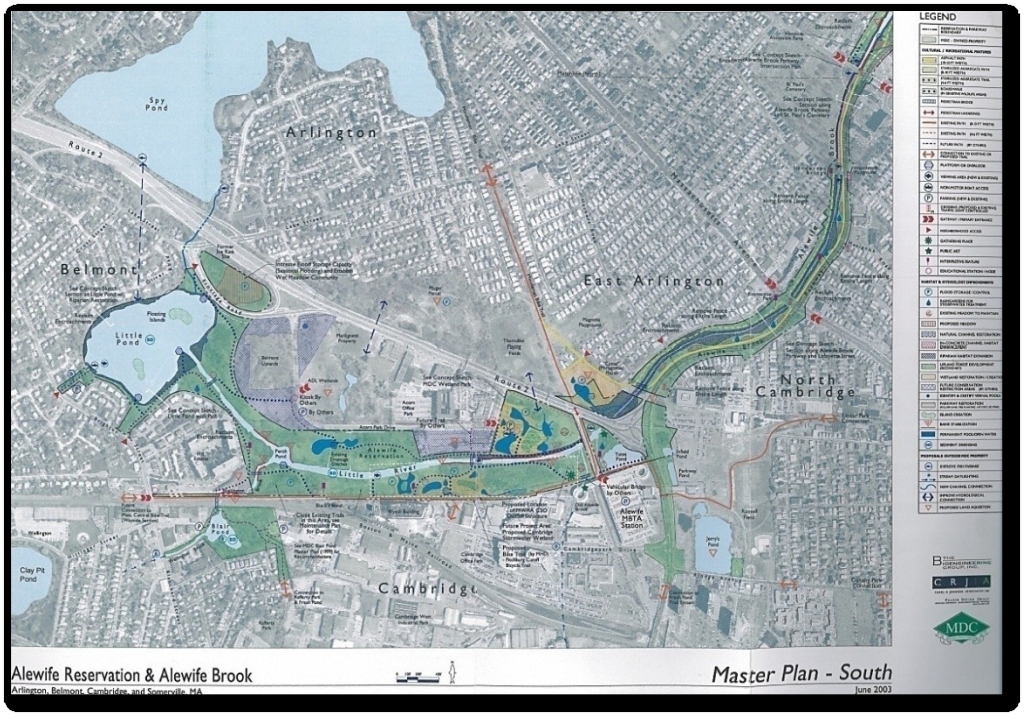

Figure F-1.5: Master Plan recommendations for the Alewife Reservation and Alewife Brook (south) (TBG, 2003).

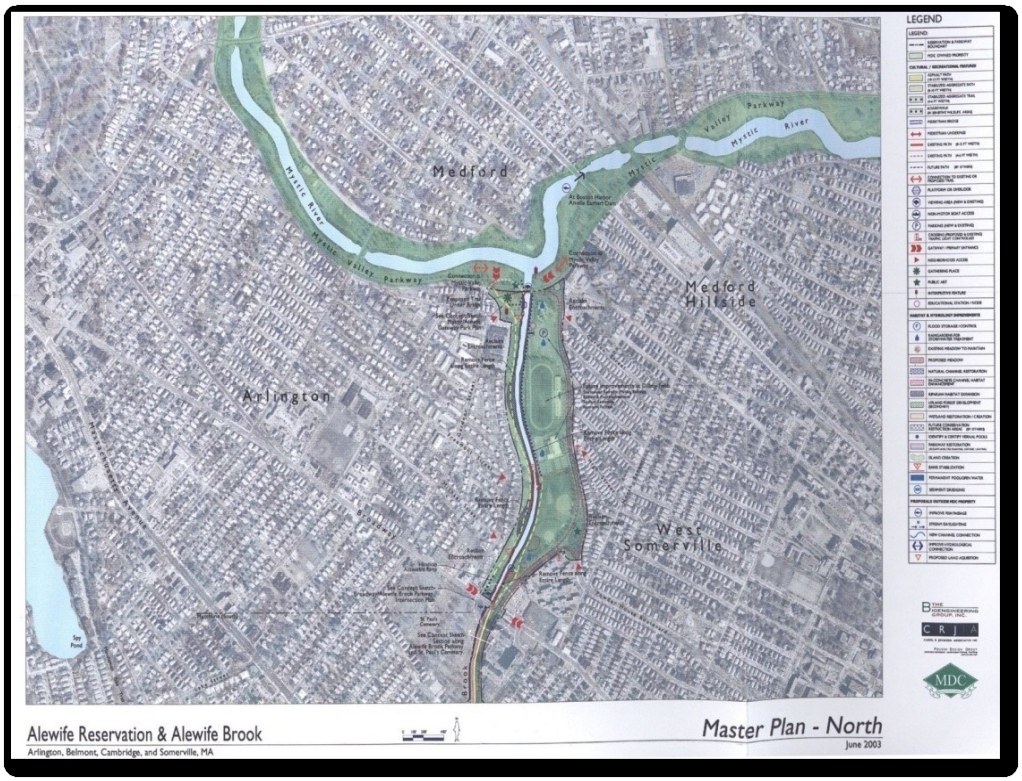

Figure F-1.6: Master Plan recommendations for the Alewife Reservation and Alewife Brook (north) (TBG, 2003).

Suggested Implementation(s)

The Master Plan acknowledged that MDC would work on implementing all recommendations appointed in the Master Plan. Site specific projects such as: Little Pond, former ADL parking lot, and the greenway along the west bank of Alewife Brook would be prioritized. MDC and the town of Belmont recognized the ecological importance of the Uplands, and was working with O'Neill Properties to ensure the Reservation was protected.

A comprehensive schedule, budget, funding sources, required permits, encroachment resolution, maintenance and management, and community involvement and stewardship were all provided in the implementation section of the Master Plan. Depending on funding, a five-year action plan was suggested to complete all recommendations. The MDC considered other funding sources, other than themselves, to support the project recommendations. O'Neill Properties have already donated to the design and construction of 7.8-acres of the Reservation. The estimated time to complete the entire process is ten to twenty years.

Long term maintenance strategies and recommendations were designed to conserve the ecological health of the Alewife Reservation and Alewife Brook Greenway. With limited funding, it was suggested for the public, who are already devoted to protecting the natural landscape of the Alewife, to volunteer time as part of the maintenance plan. It was also recommended to manage the entire Alewife area, from Little Pond to the junction with the Mystic River, as a whole. The Master Plan outlines other projects and provides recommendations that connect to the study area.