EVOLUTION OF WATER SUPPLY MECHANISMS TO REFLECT CHANGING VALUES: A CASE STUDY OF THE MASSACHUSETTS WATER MANAGEMENT PROGRAM

by

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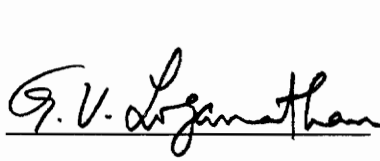

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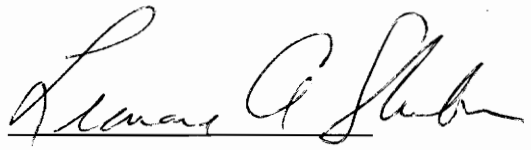

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(ABSTRACT)

Industrialization and urbanization have brought about localized demand and regional competition for water resources in parts of the eastern United States. Thus, some states have faced critical decisions concerning how to best manage their available water supplies. As fundamental public values have changed over time, public opinion concerning the way in which water supplies should be managed has changed as well, especially in recent years. Consequently, many eastern states have restructured the institutional mechanisms governing water supply management to reflect those changing values and opinions.

Massachusetts is a prime example of a state where changes in publicly held values have caused a thorough restructuring of the institutional mechanisms governing water supply management. A case study examines developments that led to the current institutional mechanisms in Massachusetts. Special attention is given to the issues and values that shaped the State's water supply policy, legislation, and regulatory programs.

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I wish to express my sincere thanks and appreciation to a number of individuals who have contributed significantly to the completion of this work and to my life over the past two years. Dr. William E. Cox has shown tremendous patience and concern as I have slowly, but surely, researched, written, and re-written this paper. I thank him for helping me become a better researcher and writer.

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Most of all, I want to thank my beautiful and loving wife Robin for her support over this past year as I have struggled to balance my three roles as husband, working engineer, and student. She has been a constant source of encouragement, especially during the most difficult times. I dedicate this work to Robin, my, "true friend," and to our King, who graciously brought us together.

"For the Lamb at the center of the throne will be their shepherd; he will lead them to springs of living water. And God will wipe away every tear from their eyes." *Revelation 7:17*

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CHAPTER ONE

WATER SUPPLY MANAGEMENT IN THE EASTERN UNITED STATES: RESPONDING TO CHANGING PUBLIC VALUES

Water is a relatively abundant resource in the eastern United States; widespread water scarcity has typically been a problem only in the West. Industrialization and urbanization, however, have brought about localized demand and statewide competition for water resources in parts of the eastern United States. Thus, some states have faced critical decisions concerning how to best manage their available water supplies. As fundamental public values have changed over time, public opinion concerning the way in which water supplies should be managed has changed as well, especially in recent years. Consequently, many eastern states have restructured the institutional mechanisms governing water supply management to reflect those changing values and opinions.

BALANCING WATER SUPPLY AND DEMAND

In most eastern U.S. cities, water demand can be satisfied by diversion of surface water from streams flowing through or around the city, or by harvesting ground water supplies in the local area. In recent years though, some expanding urban areas, including Atlanta, Virginia Beach, and Greenville/Spartanburg, South Carolina, have reached the point where existing water supplies cannot satisfy existing demand.[1] Larger cities, such as New York and Boston, began experiencing such problems long ago. As cities continue to grow, water demand may repeatedly threaten to outstrip water supplies, requiring municipal water managers and water supply engineers to balance supply and demand.

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[1] James Hite, "Interbasin Water Transfers in Riparian Doctrine States: The Case for Interregional Compensation," *Growth and Change*, Vol. 17, October 1986, p. 11.

Overview of Water Supply Management Options

There are four general approaches to striking a balance between water supply and demand: (1) controlling or reducing demand; (2) increasing the efficiency of the municipal water system; (3) recycling municipal wastewater; and (4) augmenting water supply. The selected strategy may be one or any combination of these four approaches, and may vary depending on geographic location, availability of resources, the level of available technology, and the prevailing public attitudes toward water supply. Historically, however, demand reduction, via pricing strategies and long term conservation strategies, wastewater recycling, and improvements in system efficiency have not been popular alternatives with water supply engineers in the eastern United States. In fact, measures other than supply augmentation have usually been considered only in times of severe drought as reactive measures. They have rarely been used proactively.

History shows that expanding urban areas tend to favor balancing water supply and demand through supply augmentation, but these municipalities frequently find that they have already captured their best local water sources. Any remaining local sources are often polluted or difficult to capture. Rather than undertake costly projects to develop these sources, if such projects are even technologically feasible, cities have turned to interbasin water transfer to increase their water supplies and meet growing water demand.

The Interbasin Transfer Option and Changing Public Values

Interbasin transfer for municipal water supply is just one of many water supply management issues; however, it is both historically and currently an important issue. Interbasin transfers impact the water resources of a region beyond the community proposing a transfer; therefore, the interbasin transfer

issue is generally a state issue as well as a local issue. Because of its regional and often controversial nature, the issue of interbasin transfer for municipal water supply provides a good focal point for examining changes in publicly held values regarding water supply management in the eastern United States. Once these changing values are understood, it becomes clear that the institutional mechanisms governing water supply management have evolved to mirror those values.

Issues and Values of the Past

As European colonists came to what is now the United States, towns were established near sources of water supply. During the early history of the country, water supply for young towns and cities was not a major problem. Local springs or surface water bodies were generally sufficient to meet local water demand. During the nineteenth century, however, larger eastern cities, such as Boston and New York, began to quickly outgrow their local water supplies. These cities turned to interbasin water transfer to meet the water demand for their growing populations.

In the nineteenth century and early twentieth century the plans to implement interbasin transfers were met with only minimal objection. In this technology and development-oriented age, engineers, decisionmakers, and the general public all appreciated sound, conservative engineering projects that promoted the "greatest good" for society. What was considered to be the best for society at the time were abundant, pure sources of water for the expanding cities. Any potential damages to donor areas or to the environment paled in comparison to the benefits of supplying good clean water to the cities:

> In the past, water was not considered to be an economic good, subject to the laws of supply and demand, but rather a physical substance required by a particular community. . . . Typically, in response to either a burgeoning demand or a prolonged

> drought, communities sought to increase their available supply, often through the construction of a new reservoir. Other alternatives seldom were considered; . . .[2]

During this early period, civil engineers and other water supply professionals were highly respected and trusted as public servants. They were touted as champions of the public health and welfare. For the most part, their interbasin transfer proposals were only weakly opposed by interests in the more rural areas from which water would be transferred. More powerful interests, such as mill owners and other industrial water users, were often appeased with compensatory reservoirs. The populous and influential urban areas supported the interbasin transfer of pure water to meet their growing water demands. Thus, interbasin transfer projects could be implemented without significant resistance on the local or state level.

Issues and Values Today

Interbasin transfers are still a frequently proposed solution to municipal water supply problems. Holtz and Sebastian suggest that today, engineers are still likely to recommend a physical construction project (i.e., supply augmentation) from a set of possible solutions to a given water supply problem. Furthermore, water supply professionals often assume that the public will not be supportive of water management alternatives other than supply augmentation. To some extent, their perception of public opinion reinforces the supply augmentation and interbasin transfer choice and, when voiced, can actually influence the public to favor an interbasin transfer. But, in the latter part of this century, resistance to interbasin transfer proposals has increased significantly as publicly held values with regard to water supply management have changed. This resistance comes from a variety of sources

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[2] David Holtz and Scott Sebastian, Editors, *Municipal Water Systems: The Challenge for Urban Resource Management*, Indiana University Press, Bloomington, IN, 1978, p. 3.

including individuals and local governments in the donor region as well as environmental and citizens groups. These groups may oppose an interbasin transfer proposal on the basis of the direct and indirect costs imposed upon the donor region or potential damage to the environment.

Direct costs of an interbasin transfer relate to impacts on potential and existing water users. Owners of waterfront property fear that a water transfer will reduce their land values. Removing water from a stream also raises concern among environmental and recreational interest groups for the quality of water in the stream, the fisheries dependent on the stream, and the stream's aesthetic attributes.[3]

Opposition to interbasin transfers by local governments in the donor region often stem from the indirect costs to the donor region. Local governments fear that transfers could mean a loss in ability to attract industry and a subsequent slow-down in the growth of their tax bases. If, in the absence of an interbasin transfer, the cost of water in a nearby urban area increased substantially, the availability of an abundant, low cost water supply in the undeveloped donor region could make it an attractive location for economic activities with large water demands. If an interbasin transfer is implemented, the undeveloped donor region is more likely to remain undeveloped.[4]

Aside from the potential economic and environmental damages, many people in the donor region may voice opposition to an interbasin transfer for political reasons. The donor region in a transfer tends to be a water rich, relatively rural area. The receiving region, on the other hand, is generally a large,

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[3] William E. Cox and Leonard A. Shabman, "Virginia's Water Law: Resolving the Interjurisdictional Transfer Issue," *Virginia Journal of Natural Resources Law*, Vol. 3, No. 2, 1984, p. 183.

[4] *Ibid.*

expanding urban area. A sense of rivalry and distrust of the city that may exist in the rural donor region could create or intensify opposition to the interbasin transfer.

Many of the concerns now raised over interbasin transfer proposals were also raised in the nineteenth and early twentieth centuries; yet, earlier proposals were generally not met with the forceful opposition common today. The strength of the opposition today may be partially attributed to the fact that technical professionals, including those proposing interbasin transfers, are not afforded the same public trust that technical professionals received in the past. Rather than being hailed as "trustworthy public servants," their recommendations frequently come under intense scrutiny and criticism from special interest groups and the general public alike. Thus, people in suburban and rural areas no longer resign themselves to the idea that the city should get whatever water it needs, especially if it has to come from their "backyard." They demand that alternative solutions be studied and implemented and frequently organize themselves to press their demands at the state government level.

In addition, while public trust and confidence in professionals has diminished, environmentalism has grown. In some eastern U.S. states, the goals of "technological advancement" and "development" have been replaced, to some extent, by an environmental and conservation ethic. Since the 1970s, environmental opposition to interbasin transfers has become a formidable force. Environmental issues sometimes played a part in the interbasin transfer debates of the past, but "ecology" and "the environment" did not become major public concerns until recent years. Today, environmental issues may play a powerful part in determining the fate of an interbasin transfer proposal.

It is apparent that as publicly held values have changed, the public perception of water supplies and the manner in which they ought to be managed has changed also, as evidenced by shifts in the public

attitude toward interbasin transfer proposals. Thus, over time, the institutional mechanisms governing water supply management and decisionmaking have evolved in response to changes in values.

EVOLUTION OF INSTITUTIONAL MECHANISMS

Eastern states have historically adopted one or more of three basic approaches to governing water supply issues: (1) the riparian doctrine of water law, (2) special statutory allocation of water resources, and (3) administrative permit systems. No two states have constructed identical mechanisms for dealing with water supply issues, such as interbasin transfers proposals, but there are some similarities among the eastern states. For example, the original basis of most surface water rights and surface water allocation systems in the eastern United States was the common law doctrine of riparianism. Riparianism consists of a set of judicially defined principles concerning water use. The courts take no responsibility for water supply planning and management, they simply settle water use conflicts.

A number of states have circumvented or modified some of the original concepts of riparianism, sometimes to the point of total replacement. Most circumventions or modifications of riparianism in the eastern states consist of placing more authority for controlling the use of a state's water resources in the hands of the State legislature or a number of legislatively created administrative agencies. In response to changing public values, many of these states have attempted to establish comprehensive water supply policy and water supply management programs on the state and local levels to reflect those values.

The following three sub-sections provide an overview of the institutional mechanisms governing water supply management that have been adopted by eastern states, with special attention given to how

these mechanisms deal with the issue of interbasin transfer for municipal water supply. This discussion reveals that institutional mechanisms governing water supply management in the eastern United States have evolved to reflect broad changes in publicly held values.

The Riparian Doctrine

The word "riparian" comes form the Latin word *riparius* meaning "of or belonging to the bank of a river." Riparian is defined as "belonging or relating to the bank of a river; or on the bank."[5] Therefore, riparian land is land bordered or crossed by a natural watercourse. Riparian water rights are incidental to the ownership of riparian land.

Since riparianism is a common law doctrine, courts base their decisions in water-use conflicts upon principles established in previously decided cases. A court first looks for precedent in previous decisions made by the supreme court of its own state. Decisions from other riparian doctrine states, however, have persuasive precedential value and are often considered, especially when riparian principles concerning the particular situation in question are not completely developed in the given state. A generalized statement of the principles of riparianism thus can be derived from a collective view of precedent set in several states rather than from rulings made in one particular riparian doctrine state.[6]

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[5] Henry Campbell Black, *Black's Law Dictionary*, Revised 4th ed., West Publishing Co., St. Paul, MN, 1968, p. 1490.

[6] William E. Cox, "Water Law Primer," *Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers*, Vol. 108, No. WR1 March, 1982, p. 110.

The basis of riparian rights is ownership of riparian land. All riparian landowners have equal, constitutionally protected rights to use the water in a stream, subject to certain restrictions, while non-riparians have no water-use rights. A tract of land must not only touch the water, but also be within the watershed of the body of water to be considered riparian. Any part of the tract outside the watershed is not considered riparian, even if it is attached to a riparian tract. The severance of a tract of land not touching water from a larger tract of riparian land destroys the riparian right connected to the severed portion, although some jurisdictions may allow it to regain riparian status if again joined to the riparian tract in common ownership. The riparian right exists independently of and may be severed from the property interest.[7]

Restrictions on the extent of water use under riparianism depends upon which of two theories of riparianism has been adopted by a particular state. The highly restrictive natural flow theory limits riparians to domestic uses, such as household purposes and watering livestock, and to artificial, or non-domestic, uses that do not result in a perceptible dimunition of the natural flow of the stream. Even if there is no adverse effect on other riparians, the limitation applies.[8]

The reasonable use theory, now the widely accepted form of the riparian doctrine in most eastern states, is based upon the principle that each riparian landowner has the right to make any use of the available water in the water body, provided that his or her use does not have an unreasonable, adverse impact upon any other riparian owner. Reasonableness is a flexible, relative concept that must be determined in the context of a specific water use conflict. Reasonableness is a question of fact

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[7] Joseph L. Sax and Robert H. Abrams, *Legal Control of Water Resources: Cases and Materials*, West Publishing Co., St. Paul, MN, 1986, p. 158.

[8] Cox, *supra*, note 6, p. 111.

dependent on the circumstances of the individual water use.[9] So, under the riparian rights doctrine, the basic question to be answered in resolving any water use question, including use for municipal water supply, is whether or not the proposed use is reasonable with respect to the needs of other riparians.

In the early history of the reasonable use theory, many courts decided that diversion of water to non-riparian land, including land outside the watershed of the stream, was not legal. Later, some courts began to allow diversion and use on non-riparian lands if the use was reasonable in itself and caused no actual, perceptible damage to downstream riparians. One of the most well known cases presenting this modification is the Massachusetts case of *Stratton v. Mt. Hermon Boy's School.* In the *Stratton* case, the Supreme Judicial Court of Massachusetts stated:

> The governing principle of law in a case like the present is this: A proprietor may make any reasonable use of the water of the stream in connection with his riparian estate and for lawful purposes within the watershed, provided he leave the current diminished by no more than is reasonable, having regard for the like right to enjoy the common property by other riparian owners. If he diverts out of the watershed or upon a disconnected estate the only question is whether there is actual injury to the lower estate for any present or future reasonable use. The diversion alone without evidence of such damage does not warrant a recovery even of nominal damages.[10]

The Court noted that the precise question is whether or not riparian rights allow a diversion of reasonable quantities of water for use on non-riparian land or outside of the watershed. It pointed out that in numerous cases in which courts decided that the riparian right did not extend to such uses,

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[9] *Ibid.*

[10] 103 N.E. 87 at 89 (1913).

there was actual, perceptible damage wrought by the diversion (a condition that also existed in the *Stratton* case leading the Court to decide against the party making the diversion).[11]

The Court identified the case of *Lawrie v. Sillsby* as one that allowed the possibility that water use on a non-riparian tract might be considered reasonable. In *Lawrie v. Sillsby*, the Supreme Court of Vermont declared the following:

> The fact that such orators were taking the water to their non-riparian lands did not per se make their use unreasonable. But that fact, together with the size and character of the stream, the quantity of water appropriated, and all the circumstances and conditions, might make their use unreasonable. . . . The mere fact that the defendants reduce the natural flow of the stream would not be decisive. To entitle the orators to relief, they must show that they suffer an injury to the use of the water which the law recognizes as belonging to them.[12]

The rulings of the Vermont and Massachusetts Courts left open the possibility that transferring water to non-riparian lands or lands outside the watershed of a stream for the purpose of municipal water supply could legally occur. The option of legally making such a transfer within the structure of riparian rights was confirmed by the Virginia case of *Gordonsville v. Zinn:*

> The English doctrine, as usually stated, is that the riparian owner cannot rightfully divert to non-riparian land water which he had the right to use on the upper riparian land, but which he does not so use.[13]

But, the Court went on to say the following:

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[11] *Ibid.*

[12] 74 A. 94 at 96 (1909).

[13] 129 Va. 542 at 558 (1921).

> This rule makes the diversion of water for use there illegal. There are some exceptions to the rule thus broadly stated. To give the lower owner a ground of complaint the quantity taken to the non-riparian land must be sufficient to inflict a perceptible injury on him.[14]

The Virginia ruling left municipalities with the option to transfer water for water supply if there is no perceptible injury to downstream owners. Alternatively, a municipality would have to condemn the rights of downstream riparians in order to use water from the stream if use by the municipality were considered unreasonable.

The Vermont, Massachusetts, and Virginia court rulings may open the possibility for interbasin water transfers under the reasonable use theory, but the riparian doctrine still faces the problem of water rights uncertainty. All water uses must be reasonable in relation to the water uses of other riparian owners. Uses of the stream, however, may be ever changing and, consequently, the definition of what is reasonable in relation to other riparians might also change. A municipality withdrawing "surplus" water from a stream or transferring the water after condemning the water rights of affected riparians may find, in the future, that new uses of the stream render its transfer unreasonable. The municipality has no secure title or right to the use of water from the transfer. In the future it could find itself desperate to secure another source of water supply.

On the other hand, if a municipality proposes to transfer water from a stream to augment its water supply, there must be a riparian willing to challenge the municipality's proposed use in court in order to block the transfer. Rather than having guaranteed protection of the rights of other water users or

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[14] *Ibid.*, at 559.

protection of the resource itself, under the riparian rights system, protection might involve a long, costly court battle of which the outcome is extremely uncertain.

Some eastern states, perhaps recognizing the water rights uncertainty inherent in the riparian rights system, have sought solutions to water supply problems outside the ordinary rules of riparianism, without completely abandoning the riparian doctrine.[15]

Special Statutory Allocation

In the past, special statutory allocation was practiced in states such as New York and Massachusetts to meet the needs of large cities that quickly outgrew local water supplies. These states circumvented the riparian system without completely eliminating it. In Massachusetts, for example, the *Constitution of Massachusetts* gives the State legislature (called the "General Court" in Massachusetts) great authority to pass laws for the good of the Commonwealth and its citizens:

> And further, full power and authority are hereby given and granted to the said general court, from time to time, to make, ordain, and establish, all manner of wholesome and reasonable orders, laws, statutes, and ordinances, directions and instructions, either with penalties or without; so as the same be not repugnant or contrary to this constitution; as they shall judge to be for the good and welfare of this Commonwealth, and for the government and ordering thereof, and of the subjects of the same . . . .[16]

The powers given to the legislature were apparently broad enough to include the authority to empower municipalities and corporations to procure water supplies, both inside and outside of the

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[15] Sax and Abrams, *supra*, note 7, pp. 206-207.

[16] *Constitution of Massachusetts*, Chapter I, Section I, Article IV.

corporate and watershed limits of the municipality receiving the water. This power was granted to municipalities by special acts of the legislature and to water companies through the charters incorporating them. The Massachusetts legislature used its authority to enable private companies, the City of Boston, and various state agencies to expand the water supply systems of the Boston and its metropolitan area. The water supply expansions included sources requiring interbasin transfers to the metropolitan area.

The forty-ninth amendment to the Massachusetts Constitution, ratified in 1918, gave the legislature more specific powers over the natural resources of the Commonwealth:

> The conservation, development and utilization of the agricultural, mineral, forest, water and other natural resources of the commonwealth are public uses, and the general court shall have power to provide for the taking, upon payment of just compensation therefor, of lands and easements or interests therein, including water and mineral rights, for the purpose of securing and promoting the proper conservation, development, utilization and control thereof and to enact legislation necessary or expedient therefor.[17]

In a case involving attempts by the State of New Jersey to give its Legislature control of the Delaware River, the U.S. Supreme Court upheld the rights of New Jersey to exercise broad power in controlling its water resources in a manner similar to the control exercised by the Massachusetts legislature. In the opinion of the Court, Justice Butler stated the following:

> The state undoubtedly has power, and it is its duty, to control and conserve the use of its water resources for the benefit of all its inhabitants, ... The power to determine the conditions upon which water may be so diverted is a legislative function. The state may grant or withhold the privilege as it sees fit. . . . The diversion of waters from the sources of supply for the use of the inhabitants of the

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[17] *Ibid.* at Article XLIX.

> state is a proper and legitimate function of the state. This function may be left to private enterprise, subject to regulation by the state; it may be performed directly; or it may be delegated to bodies politic created for that purpose, or to the municipalities of the state.[18]

Special acts like those passed by the Massachusetts legislature in the nineteenth and early twentieth centuries were responses to water supply crises or to studies by water supply engineers and planners asserting that demand was rapidly growing and that supply augmentation via interbasin transfer was the "only reasonable solution" to balancing supply and demand. In an age when public health was a major concern and urban and industrial growth were highly valued, an abundant supply of pure water was a necessity for a growing city. Furthermore, the men proposing the transfers were perceived as protectors of the public health and champions of urban development. For the most part, the public trusted their expert recommendations.

Because of these prevailing values, opponents of an interbasin transfer of water from a rural area to a thirsty city had little influence over legislative decisions. Alternatives to supply augmentation were not considered. Raising water prices or requiring conservation practices were unthinkable. Filtering local sources that had become polluted was considered an inferior solution to transferring pure water to the City, even after filtration became technically feasible. Further hindering the efforts of the opposition was the fact that it came mostly from the rural western areas of the state that would supply the water for the transfer. The interests and influence of the small towns "donating" the water to Boston were overshadowed in legislative hearings by the interests of populous eastern Massachusetts.

Thus, in Massachusetts, special acts of legislature helped to secure the rights of Boston and its metropolitan area to transfer water and headed off potential adversarial conflicts. Since the prevailing

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[18] 43 S.Ct. 534 at 536 (1923).

public values favored supplying the City with pure and abundant sources of water, these acts did little or nothing to promote the interests of parties opposing the transfer or encourage alternative water supply management solutions.

Administrative Permit Systems

A number of eastern states, dissatisfied with the common law riparian system, have gone beyond simply circumventing the system with special legislative acts. These states have adopted administrative permit systems.[19] Administrative permit systems differ in principle from the riparian system. Under the riparian system the controlling interest in the water resources of a state are the riparian landowners. Most administrative permit systems adopted in eastern states turn controlling interest of the state's water resources over to the state itself. The primary concern of a administrative permit system, in theory, is not protecting the water use rights of individual water users, but allowing individual water users to benefit from the resource while protecting the resource as a whole. Unlike special legislative acts, administrative permit systems supplement or replace the riparian system altogether. These systems cover water use in the entire state rather than dealing only with specific water use questions as they are brought before the legislature.

States adopting permit systems usually leave administration of the system to a state agency. Applicants for a permit are required to follow a specific statutory or regulatory application procedure. The agency in charge of administering the permit system may approve or deny a permit in order to

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[19] By the mid-1980s, fifteen eastern states had adopted some form of statutory allocation system. The State of Mississippi enacted a prior appropriation statute. The fourteen states adopting a permit system are Delaware, Florida, Georgia, Indiana, Iowa, Kentucky, Massachusetts, Maryland, Minnesota, New Jersey, North Carolina, South Carolina, Virginia (groundwater only), and Wisconsin.

protect other water users or promote the public welfare. Existing water users are protected by virtue of the fact that the agency will not issue permits that impair their ability to use the water.[20]

States operating under permit systems do not require ownership of land along a watercourse in order to obtain the right to use water. Nonriparians, including municipalities, may perfect a water right by obtaining a water use permit according to the proper procedure. The agency may also allow water to be transferred across basin or watershed boundaries. Permit applicants must specify the place of use and the permits specify the time and place of use and the quantity of water available to the user. Permits are either terminable by the issuing agency or simply issued for a specified period of time after which the user may apply to have the permit renewed. In some cases, permits are appurtenant to the land and cannot be transferred to another water user.[21]

There is a broad range in the comprehensiveness of the various state permit systems. The permit systems in some states, such as Maryland, are only weakly connected to water supply planning and management.[22] Other states, such as Massachusetts, have created a permit system as one piece of a comprehensive program that gives administrative agencies extensive regulatory control over water supply planning, management, and allocation. Such comprehensive state programs may be particularly appealing in a state where the prevailing public values are environmentalism, preservation, and conservation -- values which many believe are better served by a comprehensive regulatory approach to water supply management than by a less structured approach, such as the riparian system.

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[20] Richard Ausness, "Water Rights Legislation in the East: A Program for Reform," *William and Mary Law Review*, Vol. 24, No. 4, Summer 1983, pp. 555-556.

[21] *Ibid.*

[22] *Ibid.*, p. 579.

THE MASSACHUSETTS CASE STUDY

Massachusetts is a prime example of a state where shifts in prevailing public values over time have caused a dramatic restructuring of the State's institutional mechanisms governing water supply management. Early in its history, Massachusetts circumvented the riparian system to allow Boston to secure the necessary rights to provide abundant water supplies for its expanding population. This practice continued through the early part of the twentieth century. Then, in the 1970s and 1980s, Massachusetts adopted a water supply policy around which it has built an administrative permit system and a comprehensive water supply regulatory and management program. The groundwork for these programs was laid during the late 1960s when the Boston metropolitan area's water supplier attempted to increase its water supply through an interbasin transfer from the Connecticut River in western Massachusetts. A coalition of environmental and other interest groups attempted to block the transfer. The ensuing controversy was a catalyst for completely restructuring the State's water supply policy as well as the water supply management strategy of the Boston metropolitan area. The remainder of this paper examines the developments that led to the current institutional framework governing water supply management in Massachusetts. Special attention is given to the issues and public values that shaped Massachusetts' water supply policy, legislation, and regulations.

Chapter two traces the early history of the Boston water supply and the roots of the City's water supply management strategy, while chapter three examines the history of Wachusett Reservoir. The 1895 plan for building Wachusett Reservoir led to the creation of the first metropolitan water district in the nation and laid out a blueprint for acquiring sources of pure water supply for metropolitan Boston. Chapters two and three both follow the political and technological history of the time and the effects of historical developments on the passage of relevant water resources legislation.

Chapter four discusses the proposals made in the 1920s for expansion of the metropolitan water district supplies. Among the proposed sources were the Ware River and the Swift River, two sources identified as possible future water supply sources in the 1895 Wachusett Reservoir plan. Issues raised in the debates surrounding the Ware-Swift proposals later formed the foundation for restructuring Massachusetts water supply policy. Chapter five examines the controversy over the metropolitan district's proposed interbasin transfer from the Connecticut River to its supply system. The chapter traces the events that led to restructuring the institutional framework governing water supply planning and management in the State.

The Massachusetts Water Resources Commission, the Massachusetts Department of Environmental Protection, and the Massachusetts Water Resources Authority (the current water supplier for the Boston metropolitan area) are all key players in implementation of Massachusetts' current water supply policy and water management programs. Chapters six, seven, and eight discuss the important roles of each of these administrative bodies.

Finally, chapter nine summarizes the evolution of Massachusetts' framework governing water supply management as it relates to the publicly held values in the State. Appendix A provides a list of the abbreviations used throughout the case study and Appendix B presents a summary of the major events in the development of Massachusetts' water supply policy and water management program. Appendicies C through H provide additional information concerning Massachusetts water management laws, regulations, and programs.

CHAPTER TWO

EARLY HISTORY OF BOSTON'S WATER SUPPLY SYSTEM

In 1630, officials of the Massachusetts Bay Colony moved from Salem intending to settle in Charlestown. They found that the water in Charlestown was not suitable, but that good springs were available for water supply across the Charles River on the Shawmut Peninsula. They decided to settle on the peninsula and established themselves in what became the City of Boston.[23]

PERCEIVING THE NEED FOR A MAJOR WATER SUPPLY SOURCE

By 1652, the springs supplying Boston were insufficient to meet water demands in the City. The Water Works Company was incorporated on petition of the inhabitants of Conduit Street (now Blackstone Street) to build a twelve foot square reservoir and a conduit. As the City grew and desired to increase its water supply, additional cisterns were added as sources.[24] Yet, even the additional cisterns eventually could not provide a sufficient water supply for the growing City.

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[23] Frank A. McInnes, "The Boston Water Supply," *Journal of the New England Water Works Association*, Vol. 46, No. 1, Boston, MA, March 1932, p.8.

[24] Metropolitan District Commission, *Water Supply Study and Environmental Impact Report -- 2020, Task 18.20: A History of the Development of the Metropolitan District Commission Water Supply*, Prepared by Wallace, Floyd, Associates Inc. for the Metropolitan District Commission, Boston, MA, September 1984, p. 1.

Growing Demand for Water in Boston

In 1795, the population of Boston was approaching 20,000, and the City's water supply sources were once again exhausted. The City then began to seek sources outside Boston's Shawmut Peninsula.[25] On February 27 of that year, the Jamaica Pond Aqueduct Company was incorporated by a Special Act of the General Court (legislature) of Massachusetts. A year later, another act changed the name to the Aqueduct Corporation. The Aqueduct Corporation was empowered to bring water to Boston from Jamaica Pond in Roxbury by gravity, via subterranean pitch log pipes.[26] This transfer, illustrated in Figure 1, was one of the earliest cases in the U.S. where one community imported water for domestic uses from a source lying within the jurisdiction of another community.[27]

Though the Jamaica Pond supply provided water for some City residents, it offered almost no fire service. In addition, the low elevation and small capacity of the source severely limited the domestic service the pond could provide.[28] Soon, Boston felt the need to develop a major water supply source and began looking farther westward into Massachusetts to find it.

During the early 1800's, population growth in Boston strained its water supplies once again. Between 1795 and 1850, the City's population grew from 20,000 to about 180,000. With this growth came degradation of water quality in the City and growing demand for the provision of a greater quantity of water. Water from cisterns became contaminated by soot on the roofs of houses and dust and dirt

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[25] McInnes, *supra*, note 23, p. 8.

[26] Massachusetts General Court, *Acts of 1796*, Chapter 1.

[27] Metropolitan District Commission, *supra*, note 24., p. 1.

[28] McInnes, *supra*, note 23, p. 8.

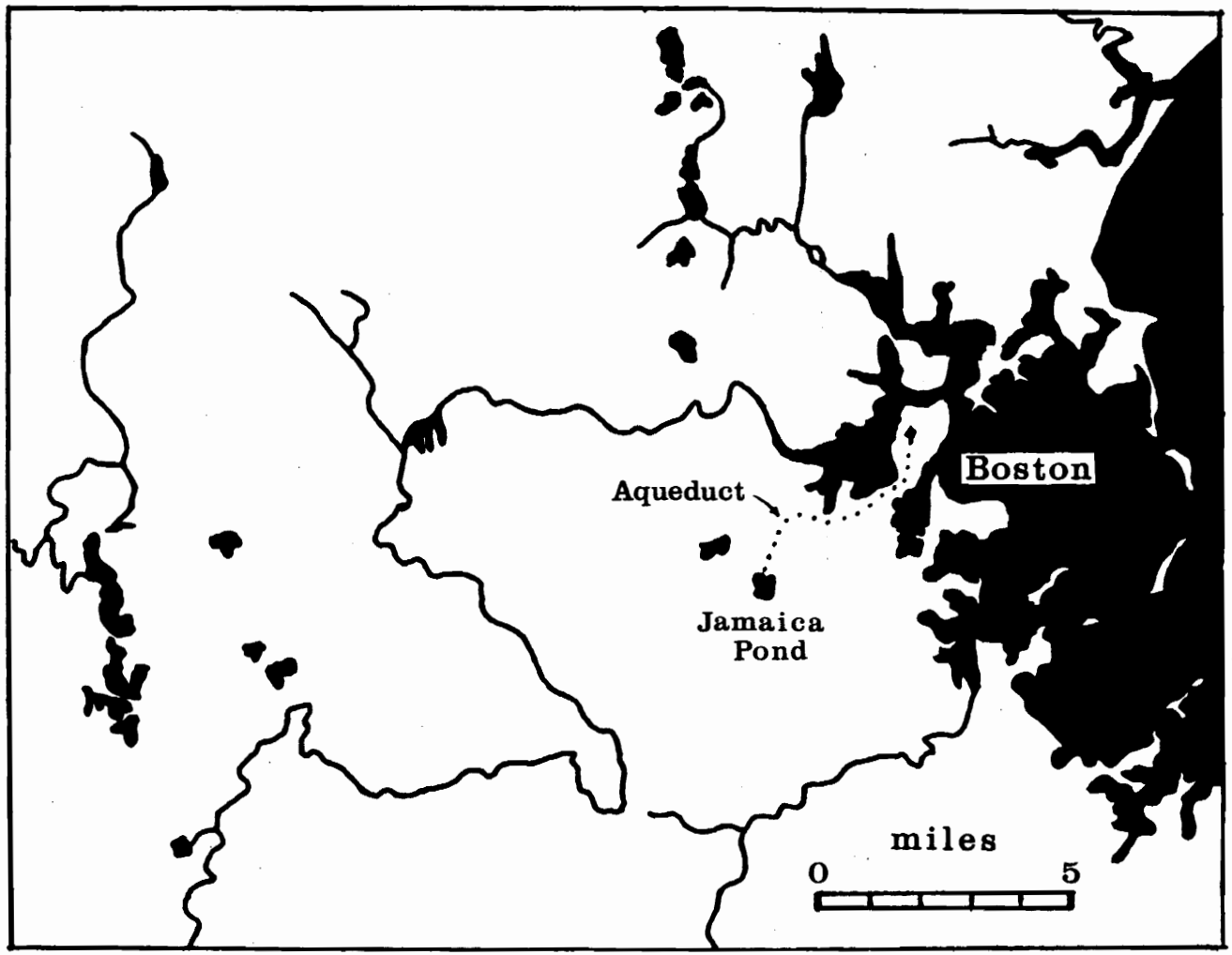

Figure 1. The Jamaica Pond Transfer (Source: Blake, *Water for the Cities*, p. 213.)

from the streets collecting in gutters. Boston's well-water was also of poor quality and often could not be used for drinking or even laundering.[29]

The needs for fire protection and public sanitation provided further incentive to increase the quantity of water available for use in the City. Major fires occurring in 1711, 1760, 1792, 1794, and 1825 devastated City residences and businesses. The damage to homes and property was great, leaving the public feeling a need for some form of fire protection.[30]

Also, in the late eighteenth and early nineteenth centuries, public understanding of disease and disease prevention linked epidemics with unsanitary conditions in the cities. Sanitary practices such as washing down city streets were used to fight the spread of diseases like cholera and yellow fever.[31] Campaigns to prevent disease through sanitation measures were popular with both the medical profession and the general public; however, cleaning the streets of Boston required large quantities of water. The sanitation campaigns helped create a public demand for a pure and abundant water supply, a demand that could not be satisfied by the works of the Aqueduct Corporation.[32]

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[29] Fern L. Nesson, *Great Waters: A History of Boston's Water Supply*, University Press of New England, Hanover, NH, 1983, p. 1.

[30] *Ibid.*, p. 2.

[31] *Ibid.*

[32] *Ibid.*, p. 3.

Boston's Water Supply Debate

Boston officially recognized a need to develop a major water supply in 1825 when a committee was appointed to study the possibility of supplying the City with pure water. For twenty years the water supply question was the subject of surveys, reports, and hearings. Boston government officials and citizens debated two major water supply issues.[33]

The first point of debate was the question of who should supply water to the City. The City debated whether the water supply system should remain in private hands or be controlled by the City itself. Mayor Josiah Quincy drew upon the experience of Mr. Joseph S. Lewis, chairman of the Philadelphia Watering Committee, concerning matters of bringing water into Boston. Quincy, and successive Boston mayors, adopted Lewis's position that water should be brought into the City by the City itself.[34] There was, however, support for private ownership as well. Powerful private individuals with interests in the Jamaica Pond Aqueduct Corporation and Spot Pond, in the town of Stoneham, successfully blocked an attempt to create a municipal supply.[35] The issue then became the subject of public debate for years. The benefits of municipal ownership -- having an abundant and readily available water supply for fire protection, sanitation, and daily domestic uses -- were weighed against the expense of a City owned and operated system.[36]

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[33] McInnes, *supra*, note 23, p. 8.

[34] Nelson Manfred Blake, *Water for the Cities*, Syracuse University Press, Syracuse, NY, 1956, pp. 172-173.

[35] Mark L. Primack, "Technological Conception of Boston's First Water Supply: 1835-1848," *Journal of the New England Waterworks Association*, Boston, MA, June 1984, p. 156.

[36] Nesson, *supra*, note 29, p. 5.

The second issue was the choice between a moderate plan to meet present water supply requirements and a long range supply plan. The most popular moderate plan was known as the Treadwell/Eddy plan. Daniel Treadwell, a local engineer, was appointed in June 1825 to study the Boston water supply question. By November, he submitted a report to Mayor Quincy advocating the Charles River, above the falls at Watertown, or Spot Pond as the best potential water sources. He established that either source could supply the City with what he calculated to be the minimum daily requirement of 1.6 millions of gallons per day (mgd). Some judged his estimate of the water need at 100 gallons per family per day, with ordinary use forbidden when water was needed to extinguish fires, as far too conservative.[37]

Over the next several years City officials gave the water issue some attention, but took no specific action. Then, in 1834, Loammi Baldwin, a local engineer who had built Massachusetts' Middlesex Canal, conducted a new survey of possible water supply sources at the request of the City Council. Baldwin dismissed Spot Pond and the Charles River as viable water supplies because they were too small. Furthermore, the Charles River alternative would require pumping, which was not technologically reliable at the time.[38] Baldwin estimated that Boston's water need would quickly exceed 5 mgd, and suggested that the most feasible sources were the Farm and Shakum Ponds in Framingham or Long Pond in Natick. Long Pond itself could provide nearly 9 mgd, a sufficient quantity for present and future needs of the City.[39] Many Bostonians were unhappy with the

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[37] Blake, *supra*, note 34, p. 174.

[38] Primack, *supra*, note 35, p. 159.

[39] Nesson, *supra*, note 29, p. 88.

Baldwin plan because of its great expense, the time required for construction, and the 25 mile distance of the proposed sources from Boston.[40]

In 1835, a new City Council water committee appointed R. H. Eddy to analyze the problem. His report, dated June 13, 1836, criticized proposed projects like Baldwin's because they were based upon future estimates rather than present needs. The initial cost of such large projects, he argued, would take so long to recover that it would be difficult to justify building them. He preferred the strategy of building smaller works and adding to them as the need arose.[41] Attached to Eddy's report was the Charter granted by the General Court to the Boston Hydraulic Company, perhaps indicating a feeling on the part of Eddy that Boston should take advantage of this previously established organization for supplying the City with water. The Boston Hydraulic Company was formed by a group of private citizens in 1836. The legislature granted the Boston Hydraulic Company the right to supply Boston with water from the Mystic Lakes and Spot Pond. The City of Boston was given the right to purchase up to one third of the stock issued to finance the project, but the City Council voted against purchase. The company subsequently collapsed due to lack of financing.[42]

The issue of present versus future oriented planning once again became an issue of debate when Treadwell, James F. Baldwin, brother of Loammi Baldwin, and Nathan Hale were appointed as commissioners by the City Council on March 16, 1837 to devise a water supply plan for Boston. Treadwell and Hale, in the majority report, recommended taking water from Spot Pond and adding

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[40] Blake, *supra*, note 34, p. 179.

[41] *Ibid.*

[42] J.R. Greene, *The Creation of the Quabbin Reservoir: The Death of the Swift River Valley*, Second edition, Athol, MA, The Transcript Press, 1987, p.10.

Mystic pond to the system when it became necessary to do so.[43] Baldwin objected in his minority report and urged that Boston reach westward for water by building the Long Pond aqueduct. The debates raged on among the Spot Pond and Long Pond factions, with advocates of other projects only further complicating matters.[44] Figure 2 illustrates water sources proposed for Boston between 1825 and 1848.

As the debates progressed and time passed, support for the Long Pond plan grew. Private enterprise supported the Spot Pond alternative. The Spot Pond Aqueduct Company was formed in 1843 to bring water to Boston from Spot Pond, but it ran into financial difficulties similar to those experienced by the Boston Hydraulic Company.[45] Naturally, the advocates of municipal ownership supported the Long Pond project.

Meanwhile, the City grew, and water demand grew with it, leaving the smaller Spot Pond project looking less promising to some. By 1844, Nathan Hale, who had previously favored the Treadwell/Eddy plan, spoke in favor of the Long Pond alternative. In the report of the newest water commission, made up of Hale, James Baldwin, and Patrick Tracey Jackson, the commissioners were unanimously in support of the Long Pond scheme.[46]

On December 23, 1844, the City Council, acting on the results of a water referendum, passed resolutions instructing the Mayor to apply to the legislature for powers that would allow the City to

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[43] Blake, *supra*, note 34, p. 182.

[44] *Ibid*, p. 183.

[45] Greene, *supra*, note 42, p. 10.

[46] Blake, *supra*, note 34, p.195.

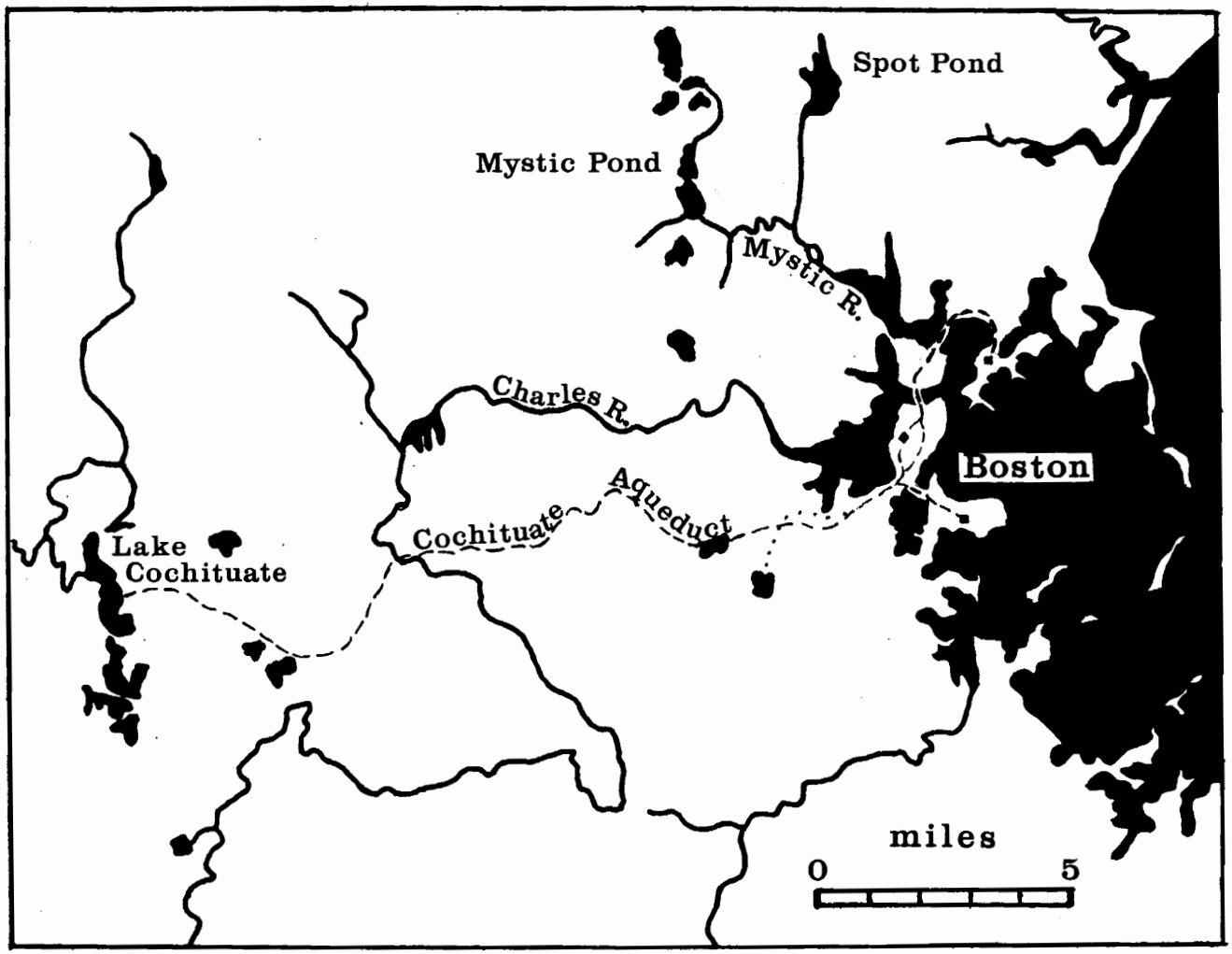

Figure 2. Proposed Water Sources for Boston: 1825 to 1848 (Source: Blake, *Water for the Cities*, p. 213.)

construct the Long Pond aqueduct.[47] The legislature heard arguments from both sides of the water issue and passed a bill giving Boston the necessary powers to proceed with the Long Pond plan. The Governor signed the bill on March 25, 1845, but approval was still subject to acceptance by the citizens of Boston in another water referendum. The Spot Pond faction rallied its forces in vigorous opposition to the plan. The May 19 referendum ended in a 3,999 to 3,670 vote defeat for the water bill.[48]

Following the defeat of the water bill, the water debates re-opened. Private companies began seeking investors once more. The Spot Pond Aqueduct Company asked the Water Committee to recommend that the City purchase Company stock. Long Pond backers fought back, forming local, politically active groups of Long Pond supporters known as "Water Unions." The Water Unions urged the City Council to refrain from purchasing Spot Pond or the Spot Pond Aqueduct Company stock.[49]

On June 23, 1845, Boston's Joint Standing Committee on Water brought in John Jervis and Walter Johnson to help end the debate. The men were hired as consultants to determine how much water the City needed, how much could be provided by Spot Pond, Long Pond, or the Charles River, and what would be the cost of each alternative.[50] Johnson was a science professor from Philadelphia and Jervis was an engineer. Jervis learned his trade through the engineering apprenticeship system set up for constructing the Erie Canal. He became Chief Engineer of the Canal in 1827. Part of his

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[47] *Ibid.*, pp. 197-198.

[48] *Ibid.*, pp. 202-204.

[49] *Ibid.*, p. 205.

[50] *Ibid.*, p. 206.

engineering work involved designing artificial reservoirs to supply water to the upper levels of the Chenago Canal, of which he became Chief Engineer in 1833.[51]

Jervis was hired by New York City in 1836 to construct a water supply system for the area. The result of his efforts was the Croton system.[52] The Croton River lies forty miles away from New York City. The cost of the Croton Dam, the largest in America at the time,[53] the aqueduct, and the distribution system was $10,300,000, twice the original estimated cost. The financial burden caused serious fiscal problems for the City, but few New Yorkers regretted the decision to build "one of the most notable public works of the nineteenth century."[54] The Croton system supplied them with pure water in greater abundance than other more moderate, less costly alternatives under consideration at the time.

Because of his recent successes, Jervis was extremely popular when he arrived in Boston. He was allowed a substantial amount of independence and had the responsibility of making the final decision on the water question. The Jervis/Johnson report was presented to the Water Committee on November 18, 1845. The report advocated the costly, future-oriented Baldwin plan as the solution to Boston's water problem. Jervis estimated the cost at $3 million and the potential supply at 18 mgd.[55]

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[51] Primack, *supra*, note 35, p. 162.

[52] Nesson, *supra*, note 29, p. 24.

[53] Primack, *supra*, note 35, p. 163.

[54] Blake, *supra*, note 34, p. 169.

[55] Nesson, *supra*, note 29, pp. 5-6.

BOSTON SECURES A MAJOR WATER SUPPLY

On March 30, 1846, the Governor signed the "Boston Water Act," securing a major water supply for Boston. The Act provided for the formation of a Water Board by the City Council. The Water Board was to consist of three members who would direct the development of Long Pond.[56]

The Cochituate Water Supply System

The "Boston Water Act" authorized Boston to:

> . . . take, hold and convey to, into and through the said city the water of Long Pond, so called, in the towns of Natick, Wayland and Framingham, and the waters which may flow into and from the same, and any other ponds and streams within the distance of four miles from said Long pond, and any water rights connected therewith; and may also take and hold, by purchase or otherwise, any lands or real estate necessary for laying and maintaining aqueducts for conducting, discharging, disposing of, and distributing water, and for forming reservoirs; and may also take and hold any land on and around the margin of said Long pond, not exceeding five rods in width, measuring from the verge of said pond, when the same shall be raised to the level of eight feet above the floor of the flume at the outlet thereof, and on and around the said other ponds and streams, so far as may be necessary for the preservation and purity of the same, for the purpose of furnishing a supply of pure water for the said city of Boston.[57]

The City Council was authorized to issue up to $3 million in "Boston Water Scrip," municipal bonds to be used to finance the project, and to set the price of water with the goal of repaying the bonds.[58] The City was also permitted to purchase the Aqueduct Corporation's works and connect them with

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[56] Blake, *supra*, note 34, p. 210.

[57] Massachusetts General Court, *Acts of 1846*, Chapter 167, § 1.

[58] *Ibid.* at § 9.

the City system. Final approval was left to the voters of Boston, who gave their consent in an April 1846 referendum.[59]

The City Council selected a Water Board in May 1846 and hired John Jervis as consulting engineer for the project. As construction began on August 20, 1846, the name of Long Pond was changed back to its original Native American name, Lake Cochituate.[60]

The Cochituate system consists of a storage reservoir formed by raising the lake level and supplementing its capacity with storage in Dug Pond and Dudley Pond, a 14.6 mile long aqueduct which could transport up to 18 mgd of water from Cochituate to a 90 million gallon receiving reservoir in Brookline, three small distributing reservoirs in Boston, and a distribution system of cast iron pipes. In order to satisfy the demands of industry, the legislation required construction of two compensatory reservoirs. One reservoir, in Hopkinton, had a capacity of 940 million gallons and discharged into the Sudbury River. A 1,400 million gallon reservoir was built in Marlborough and discharged into the Assabet River. The reservoirs were built to compensate and appease mill owners on the Sudbury and Concord Rivers and on the Middlesex Canal for water taken from Lake Cochituate.[61]

Construction of the project was completed within 26 months of its inception. On October 25, 1848, Boston celebrated the introduction of water from the new system into the City:

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[59] *Ibid.* at § 16.

[60] *Ibid.*

[61] McInnes, *supra*, note 23, pp. 9-10.

> The parade terminated at Boston Common, where a crowd estimated at between 50,000 and 100,000 were gathered around a fountain placed in the center of the famous Frog Pond. The spectators heard the school children sing an ode written for the occasion by James Russell Lowell and listened to speeches by Water Commissioner Nathan Hale and Mayor Josiah Quincy. Cutting short the program, the Mayor then asked the crowd whether it were their pleasure that the water should be introduced. In response to a thunder of "ayes," the valve was opened and water began to rise in the fountain. As the column climbed to a majestic eighty feet, there was a moment of awed silence and then a roar of cheers. A children's choir sang: "Thanks be to God! He laveth the thirsty land. The waters gather! they rush along; they are lifting their voices. The stormy billows are high, their fury is mighty: But the Lord is above them and almighty." As the sun sank below the horizon, its last rays gave a touch of color to the soaring water. Bells rang; cannons boomed; and rockets streamed across the sky. The spectators waved their hats, shouted, laughed and even wept.[62]

Expansions of the Boston Water Supply System

Because of its success in developing the Cochituate system, the Cochituate Water Board was given the responsibility of managing Boston's entire water supply system in 1851.[63] In April of that same year, the Board tested its new authority by offering the Aqueduct Corporation $45,000 for the property and franchise without first gaining the approval of the City Council. The Corporation accepted the Board's offer and, subsequently, the City Council determined that the Board had the authority to bind the City in the transaction. In the transaction, Boston also gained the right to supply water to the City from Jamaica Pond that the legislature had given the Corporation. This right was later sold back to a new Aqueduct Corporation.[64]

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[62] Blake, *supra*, note 34, pp. 215-216.

[63] Nesson, *supra*, note 29, p. 7.

[64] Blake, *supra*, note 34, pp. 217-218.

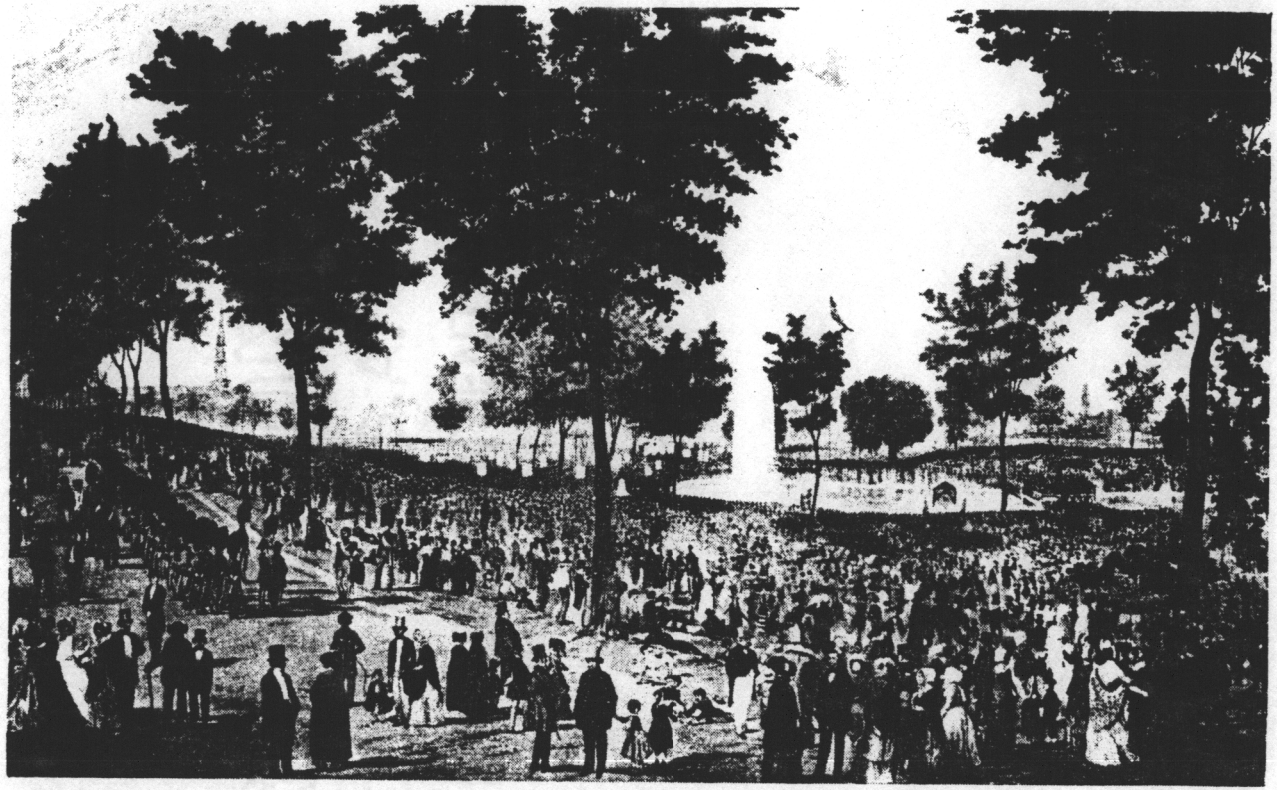

Figure 3. The Boston Water Day Celebration (Source: Blake, *Water for the Cities*, p. 199, from the New York Public Library.)

Between 1848 and 1872, the population of Boston and the demand for water in the City had continued to grow rapidly. Boston's 1860 population of approximately 200,000 people consumed nearly 17 mgd of water. The increase in water use was due to waste and to a rise in the standard of living, particularly an increase in the use of indoor plumbing, that accompanied the introduction of a major water supply to the City.[65]

In 1865, the Cochituate Water Board sought authorization to build a new storage reservoir to meet increasing water demand. Construction of the 731 million gallon Chestnut Hill Reservoir, in the line of the Cochituate Aqueduct and about 5.5 miles from Boston City Hall, was authorized by the General Court in 1865 and completed in 1870.[66] The annexation of Roxbury and Dorchester increased the need for service to higher elevations in the City. When the Roxbury annexation was under consideration, the Water Board warned that the additional consumers would bring about a need for augmenting the water supply within five years. Temporary connections to the Mystic System in Charlestown and to the Sudbury River helped to alleviate a shortage incurred during a dry period in 1871-72.[67]

The first major step toward major augmentation of the Cochituate system occurred when the Water Board suggested to the City Council that the Sudbury River be used for a permanent additional water supply. The City Council applied to the State legislature and received authorization to use the

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[65] Nesson, *supra*, note 29, p. 10.

[66] *Ibid*, p. 11.

[67] McInnes, *supra*, note 23, p. 11.

Sudbury River as a permanent water supply source. The "Sudbury River Act" authorized the taking of an additional supply of water from the Sudbury River and Farm Pond in Framingham.[68]

Construction of the Sudbury works began in 1875, and the system was put into service in 1878. The Sudbury system was made up of seven reservoirs, three put into service in 1878, the other four added over the course of the next 20 years, with a total storage capacity of 19 billion gallons.[69] The Sudbury Aqueduct connected the system to the Chestnut Hill Reservoir. The combined Cochituate and Sudbury systems were capable of delivering 62 mgd to Boston.[70] Figure 4 illustrates the Chestnut Hill and Sudbury expansions to Boston's water supply.

Meanwhile, the Water Board had made arrangements in 1869 to use Charlestown's Upper Mystic Lake as a water source. In 1874, after the annexation of Charlestown, the Mystic Lake system was incorporated into Boston's supply.[71] It had to be abandoned in 1898 due to contamination.[72]

FACTORS CONTRIBUTING TO THE SUCCESS OF EARLY TRANFER PROPOSALS

The early success of water supply augmentation proposals in Boston is attributable to five major influencing factors: public perception of the need for and value placed upon obtaining a water supply, technological advances and constraints, lack of opposition on economic grounds, lack of broad public

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[68] Massachusetts General Court, *Acts of 1872*, Chapter 177.

[69] Metropolitan District Commission, *supra*, note 24, p. 2.

[70] Nesson, *supra*, note 29, p. 7.

[71] McInnes, *supra*, note 23, pp. 12-13.

[72] Greene, *supra*, note 42, p. 10.

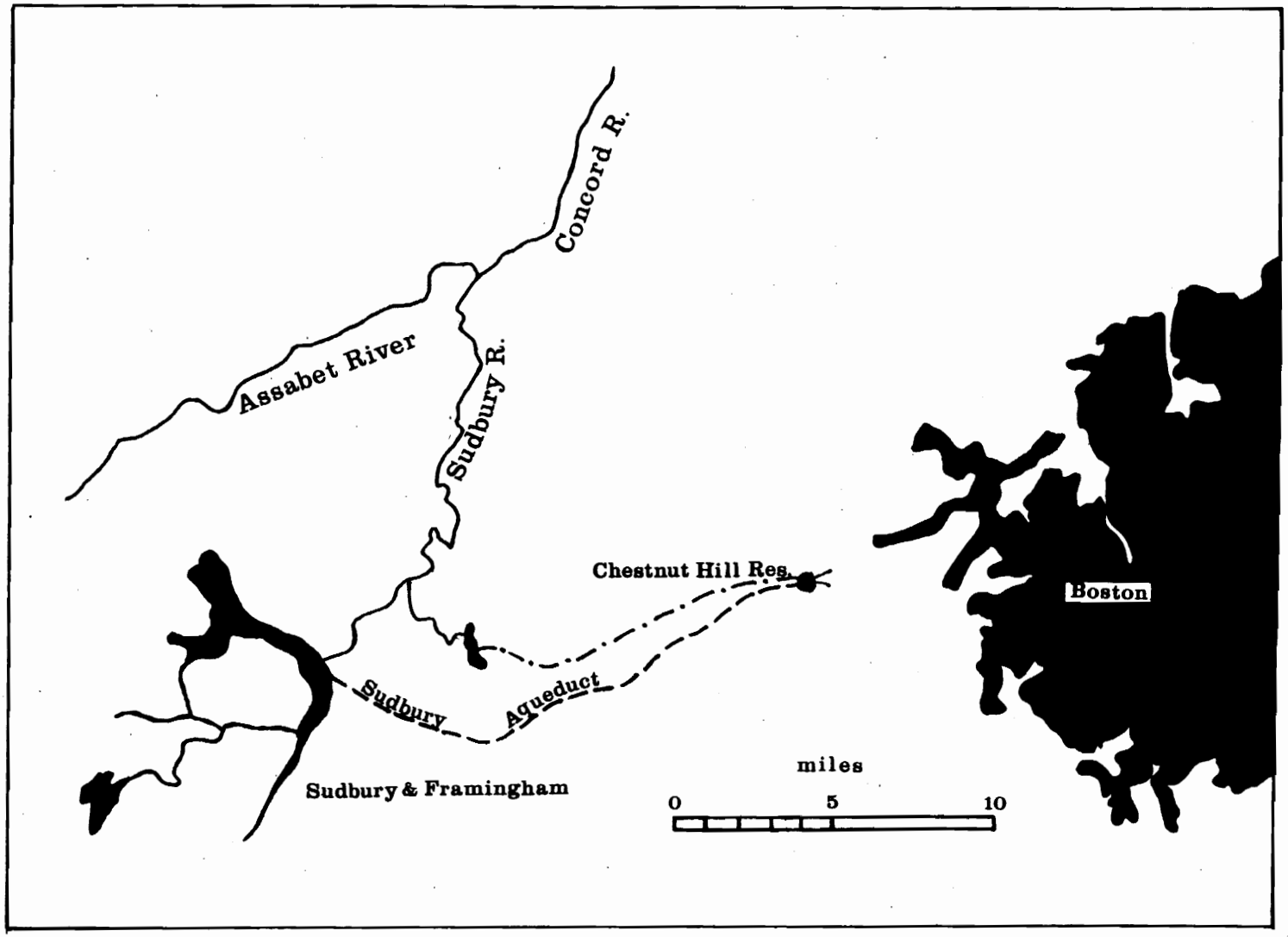

Figure 4. Chestnut Hill and Sudbury Expansions of Boston Water Supply (Source: MWRA Water System Map.)

concern for environmental protection, and the public prestige and trust of professionals and experts. These factors helped to depoliticize the water issue in Boston for years.

Need for and Value of a Water Supply

There were a number of indications in the early nineteenth century that Boston needed to secure a major water supply. The great fire in April of 1825 woke up Boston to its need for a reliable water supply for fire protection. Shortly afterward, the City realized that its drinking water supply was an even greater problem.[73] As the City Council considered the Treadwell plan, it received a letter from Dr. John Warren, a prominent Boston physician, in which he stated that the many complaints of disease in Boston could be attributed to the common spring water used for drinking:

> The introduction of an ample supply of pure water to this place would therefore contribute materially to the health and comfort of the inhabitants of Boston and would be one of the greatest blessings which could be bestowed on this city.[74]

Bostonians agreed that a pure water source was necessary; they simply had difficulty choosing the best source. The Baldwin plan involved the construction of works capable of transferring large quantities of water from Lake Cochituate to Boston in excess of the City's then current need. Though the plan may have been "far-sighted" when it was first proposed in 1834, by 1846 Boston was coming close to demonstrating a present need for the quantity of water that could be supplied by the lake.[75] Even those who had regarded the plan as too expensive and too future-oriented began to see its advantages,

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[73] Primack, *supra*, note 35, p. 152.

[74] *Ibid.*, p. 155.

[75] Nesson, *supra*, note 29, p. 11.

as evidenced by the shift in support by Nathan Hale from the Treadwell/Eddy plan to the Baldwin plan. Similarly, when the Sudbury system was proposed, the City felt a present need for the water it could supply.

Accompanying the increasing perception of the need for water was an increasing value placed upon the availability of an abundant, pure water supply. All people need water for survival, but in modern times, many take for granted that they may turn on a faucet and clean water will flow from the spigot. In nineteenth century Boston, water was highly valued, as evidenced by the pageantry and emotion of the Water Day Celebration on the Boston Common in October 1848. The supply of water for the "greater good" of an expanding urban area was considered a reasonable and necessary thing, even if that water had to be imported from well outside the City, and both the natural and man-made environments were altered in the process. People were much more aware of the benefits of a pure water supply and less aware of the costs of obtaining it, particularly the costs of environmental degradation.[76]

Technological Advances and Constraints

The technology of the day was a factor in the success of the Cochituate and Sudbury proposals. At the time, the technology and experience required to build a successful system involving filtration and pumping were not well developed. Any attempt to build such a system would have been highly experimental. Sources requiring filtration or pumping were dismissed. Of the fifteen possible water sources that Baldwin investigated, Long Pond was the only one that did not require pumping, and was

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[76] Massachusetts Water Resources Authority, *Draft Five Year Progress Report*, Boston, MA, May 1989, p. 1.

of sufficient natural purity for a water supply.[77] Gravity systems had proven to be reliable, and the engineers who could build them, including Jervis, who had built the Croton System for New York City, were available to Boston. Similarly, the technology used for design and construction of the Sudbury system was the best established technology of the time. Engineers knew how to construct small artificial reservoirs; yet, pumping and filtration remained infeasible.[78]

Lack of Opposition on Economic Grounds

Third, the lack of opposition to the transfers from outside of Boston and the provision of compensatory reservoirs in the areas from which water was taken guaranteed political success once Bostonians decided on a course of action. The legislation granting authority to the City to construct the Cochituate system required that the City pay all damages that occurred from the taking of land, water, or water rights:

> The said city of Boston shall be liable to pay all damages that shall be sustained by any persons in their property, by the taking of any land, water, or water rights, or by the constructing of any aqueducts, reservoirs, or other works, for the purposes of this act. And if the owner of any land, water, or water rights, which shall be taken as aforesaid, or other person who shall sustain damage as aforesaid, shall not agree upon the damages to be paid therefor, he may apply, by petition, for the assessment of his damages, at any time within three years from the taking of the said land, water or water rights, as aforesaid, and not afterwards, to the court of common pleas, in the county in which the same are situate; . . .[79]

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[77] Primack, *supra*, note 35, p. 159.

[78] Nesson, *supra*, note 29, p. 13.

[79] Massachusetts General Court, *Acts of 1846*, Chapter 167, § 6.

If either party were dissatisfied with the amount of damages awarded, such party was entitled to have a jury "hear and determine all questions of fact relating to such damages, and to assess the amount thereof."[80] The decision of the jury was final. In addition, compensatory reservoirs were designed to maintain water power for mill owners using Cochituate and Sudbury water appeased the affected mill interests.

In addition, nobody objected to the method of financing the project, because the terms of the legislation left Boston entirely responsible for the debt incurred.[81] The method of financing the Cochituate system helped to guarantee little resistance to the project and future proposals. The "Boston Water Scrip" provided the necessary funds at low interest rates. Maintenance costs, which were low due to the nature of the system, and financing costs were spread out over the entire City because everyone used the water. Thus, paying back the debt was not a great burden on anyone. The Cochituate system set a precedent that paved the way for future large scale projects to be proposed without fears of a tremendous fiscal burden on the City.[82]

Lack of Public Concern for Environmental Protection

Fourth, there was not a broad public concern for environmental protection at the time. Preservation of "sensitive environments" was not an issue in the Boston water debates. For example, the Sudbury reservoirs were constructed on mostly marshy, uninhabited land. Nobody voiced concern that the

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[80] *Ibid.* at § 7.

[81] Nesson, *supra*, note 29, p. 12.

[82] *Ibid.*, p. 10.

reservoirs might be destroying "valuable" wetlands. Development of a water supply for Boston was certainly viewed as a more valuable use for the land at the time.

Prestige and Trust of Professionals

Finally, the prestige and trust afforded to professionals at the time the proposals were made contributed greatly to their success. The development boom in the early nineteenth century created a great demand for civil engineers. Nineteenth century engineers were busy building the infrastructure of the day and changing the face of society with technical advances. One of their most impressive achievements was their success in combating disease and preserving the public health. The people of Massachusetts were greatly concerned about public health in the nineteenth century. They believed that water supply engineers could and did protect the public health. In fact, introducing pure water supplies to the City eliminated the outbreaks of disease epidemics that had plagued Boston for years. Soon, the public came to insist that public health issues be left to the experts and kept out of politics.[83]

Civil engineers were regarded as public servants responsible for distributing the benefits of technology to society. Engineers had gained the public trust, especially when it came to municipal projects that benefited all citizens.[84] The engineers advocating the Lake Cochituate plan were no exception. Loammi Baldwin has been considered by some to be the "Father of American Civil Engineering." His father, Colonel Loammi Baldwin, had been the chief engineer on the Middlesex Canal. Both Baldwins

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[83] *Ibid.*, pp. 8-9.

[84] *Ibid.*

were highly respected in Boston.[85] Jervis had the success of the Croton aqueduct upon which to build his reputation. This previous work in water supply engineering won for him the trust and respect of Bostonians.

DEPOLITIZATION OF THE WATER ISSUE IN BOSTON

When the Boston City Council turned over responsibility of running the Cochituate System to the Cochituate Water Board in 1851, the water issue left Boston's political arena and became a technical issue. For a substantial period after 1851, experts operated the system and handled questions of how to balance demand and supply.[86]

The major effect of this depolitization of the water issue in Boston was that the decisions of "experts" that supplies should continually be expanded to meet uncontrolled growth in demand remained unquestioned water supply policy for years. An example of this effect was the relative ease with which the Cochituate Water Board gained approval from the General Court for the Chestnut Hill Reservoir and the Sudbury system. The Water Board had done its job well in the case of the Cochituate system, and it was regarded as the best judge of the City's water supply needs. As a matter of fact, Boston never again experienced a serious water supply shortage. The "experts" were able to project need years into the future and request supplies to meet the projected demands.[87] Boston continued farther westward for each new water supply source while the citizens of Boston remained passive in the ensuing water supply debates:

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[85] Primack, *supra*, note 35, p. 156.

[86] Nesson, *supra*, note 29, p. 7.

[87] *Ibid.*, p. 8

> . . . Boston and the cities and towns of the Metropolitan District, like the communities in western Massachusetts, were relegated to the position of respondents, sometimes acquiescing in, sometimes protesting against the board's decisions.[88]

By the late 1800's, Boston and several of its suburbs were again in need of water. When the issue of finding an acceptable water supply for the Boston area was raised in 1893, a State agency, staffed with professional engineers, was prepared to handle the problem. The State Board of Health, originally created in 1869 and having undergone two reorganizations, stood ready to assume the role of water supply policymaker and planner for Massachusetts.

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[88] *Ibid.*

CHAPTER THREE

THE STATE BOARD OF PUBLIC HEALTH AND ITS WATER SUPPLY POLICY

In 1850, Lemuel Shattuck, renowned in Boston as a great compiler of statistics, published a study of the sanitary conditions of the State of Massachusetts. His studies showed that densely populated areas experienced higher incidences of disease and higher mortality rates than less heavily populated areas. He believed that the health problems of the cities were attributable to unsanitary conditions and impure water. Part of his strategy for combating public health problems called for the State to locate and maintain pure water supplies.[89]

EMERGENCE OF BOARD OF PUBLIC HEALTH AS A SOURCE OF WATER SUPPLY POLICY

Public awareness of the need for improved sanitary conditions and disease control continued to grow during the Civil War period. During the Civil War, more soldiers died from diseases caused by unsanitary conditions and infected wounds than died on the battlefields. As a result of increasing public knowledge of health issues, the legislature created the Massachusetts State Board of Health in 1869.[90] In June, 1879, the legislature, seeking to reduce expenses, combined three separate administrative bodies to form the Massachusetts State Board of Health, Lunacy, and Charity. This agency proved ineffective in discharging its duties; therefore, in 1886, the legislature re-formed the State Board of Public Health as a separate agency.[91]

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[89] Nesson, *supra*, note 29, p. 87.

[90] *Ibid.*

[91] Barbara Gutmann Rosenkrantz, *Public Health and the State: Changing Views in Massachusetts, 1842-1936*, Harvard University Press, Cambridge, MA, 1972, pp. 71-72.

The Mandate and Structure of the Board

The State Board of Public Health was chaired by Dr. Henry P. Walcott. Dr. Walcott established an engineering department within the Board to oversee the care of the State's inland waters and to advise towns, cities and the State on matters of water supply, drainage, and sewerage. The three engineers initially hired for the department were Frederic P. Stearns, Joseph P. Davis, and X.H. Goodnough. These three men and their influence within the Board of Health had profound impact upon water supply policy and planning in Massachusetts.[92] Stearns became chief of the department of Sanitary Engineering and was the primary author of the Board's important 1895 water supply report. His work had long lasting influence on the selection of water sources for the Boston area. Davis became a consulting engineer with the Board and assisted Stearns in completing the 1895 report. Goodnough later became the individual with the greatest influence in the creation of the Massachusetts' Quabbin Reservoir. He worked for the State health agency for 44 years.[93]

The Board of Health was given authority to exercise general oversight of the inland waters of the State. As part of its responsibility, the Board was to:

> . . . consult with and advise the authorities of cities and towns, or with corporations, firms or individuals either already having or intending to introduce systems of water supply or sewerage, as to the most appropriate source of supply, the best practicable method of assuring the purity thereof or of disposing of their sewage, having regard to the present and prospective needs and interests of other cities, towns, corporations, firms or individuals which may be affected thereby. . . . All such authorities, corporations, firms and individuals are hereby required to give notice to said board of their intentions in the premises, and to submit for its advice outlines of their

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92 Greene, *supra*, note 42, p. 12.

93 *Ibid.*

> proposed plans or schemes in relation to water supply and disposal of drainage and refuse.[94]

The Board's influence was expanded by the 1888 requirement that ". . . all petitions to the legislature for authority to introduce a system of water supply, drainage or sewerage shall be accompanied by a copy of the recommendation and advice of the said board thereon."[95]

The Department of Public Health was created in 1914 as a full executive department and remained the primary source of state water supply policy until the creation of the Water Resources Commission in 1956.[96] From the time the first Board of Health was created in 1869, each successive State health agency voiced its powerful opinion in favor of obtaining abundant, pure water supplies for municipalities.[97] The first major step by the Board of Health toward setting water supply policy for Massachusetts came in 1893 when the Board began a critical water supply study.

The 1895 Board of Public Health Water Supply Study

In 1889, the State Board of Public Health completed a four year study of the State's sewerage problems.[98] The Board determined that the sewerage problems of the Boston metropolitan area

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[94] Massachusetts General Court, *Acts of 1886*, Chapter 274, § 3.

[95] Massachusetts General Court, *Acts of 1888*, Chapter 375, § 3.

[96] Edward R. Kaynor, *Connecticut River Diversion: A Case Study in Water Allocation Policy*, Massachusetts Water Resources Research Center Publication No. 98, University of Massachusetts, Amherst, MA, 1978, pp. 8-9.

[97] Nesson, *supra*, note 29, p. 87.

[98] *Ibid.*, p. 15.

could only be solved by cooperative action among the affected communities. The Board recommended to the legislature that one drainage system be constructed for the entire metropolitan area. The legislature established the Metropolitan Sewerage District to carry out the recommended plans.[99]

In 1893, water problems in Boston, resulting from the rapidly growing population in the City and its suburbs, annexation of surrounding towns, and a rise in industrial activity, prompted the legislature to ask the State Board of Public Health to study the water needs of the Boston metropolitan area. The Board was a logical choice for the task because its earlier sewerage study included a survey of the drinking water in the area, and because the current water problem was of a regional nature.[100] The legislature directed the Board to:

> . . . investigate, consider and report upon the question of a water supply for the city of Boston and its suburbs within a radius of ten miles from the state house, and for other cities and towns as in its opinion should by included in connection therewith.[101]

Chairman Walcott and the Board selected Frederic Stearns as chief engineer for the job and Joseph Davis as consulting engineer. The Board named X. H. Goodnough as one of the project's assistant engineers.[102]

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[99] *Ibid.*, p. 16.

[100] *Ibid.*, pp. 15-16.

[101] Massachusetts General Court, *Acts of 1893*, Chapter 459, § 2.

[102] Greene, *supra*, note 42, p. 13.

As chief engineer on the project, Stearns became a central figure in the history of the Boston metropolitan area water supply. Stearns, an engineer in the apprenticeship tradition, was hired by the Board in 1886. In 1893 he completed an analysis of Massachusetts' drinking waters for a report to the legislature. His work established him as an authority on water supply and as a devoted public servant. His reputation made him a sound choice to take on an investigation of the water supply question for Boston and its suburbs.[103]

Stearns filed a 220 page report with the legislature on February 1, 1895. The report included population and water-use projections for the period covering 1895-1930, a survey of alternative water supply sources, recommended supplementary sources for the future, and recommendations for a metropolitan water district.

The Stearns report recommended a regional plan to solve the water supply problems of the area. Most of the communities in the area needed new water supplies in 1895, and others would follow soon. Stearns suggested the formation of a metropolitan water supply district consisting of most of the towns within a 10 mile radius of the State House in Boston. The proposed district would consist of 28 communities: Arlington, Belmont, Boston, Brookline, Cambridge, Chelsea, Everett, Hyde Park, Lexington, Lynn, Malden, Medford, Melrose, Milton, Nahant, Newton, Quincy, Revere, Saugus, Somerville, Stoneham, Swampscott, Wakefield, Waltham, Watertown, Winchester, Winthrop, and Woburn. Of these 28 cities and towns, those with their own water supplies would not be included in the district immediately, but would have the option to join later.[104]

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[103] Nesson, *supra*, note 29, pp. 16-18.

[104] *Ibid.*, p. 19.

Stearns's population projections included the 28 cities and towns eligible to join the district. He used a simple straight line projection to predict population, assuming that growth would continue at the same rate as it had over the previous twenty-five years. Based upon this assumption, Stearns expected the population of the district to reach 2 million by 1920 and 2.5 million by the end of the planning period in 1930. His projections assumed a population increase of 2.7 percent per year. The actual population growth was lower, about 1.7 percent per year, due in part to stricter immigration laws and the outbreak of World War I. The actual population in the proposed district was 1.8 million in 1930. By 1930, however, not all of the eligible towns had joined the water district, so its population was only 1.5 million, or 60 percent of the projected total.[105]

Overestimation of population growth on the part of Stearns and the Board led to overestimation of the total water demand. Water use was at 83 gallons per capita per day in 1893. Stearns estimated that this figure would climb to 100 gallons per capita per day by 1920 and remain constant through 1930. The actual rise in per capita water use was not steady. From 1895 to 1907 the level of use rose much more rapidly than expected, from 83 to 127 gallons per capita per day, then decreased with the passage of a 1907 law requiring metering at an incremental rate of 5 percent per year of the total number of water connections. By 1915, the rate of water-use was down to 95 gallons per capita per day, then gradually began to rise again. The Board overestimated the total water demand on the system in 1930 by 109 mgd, or 76 percent of the actual total use of 143 mgd.[106]

Stearns and the Board rejected the idea that yield from the system could be substantially increased by a program of metering and leak detection, even though it estimated that 25 percent of the water

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[105] Metropolitan District Commission, *supra*, note 24, p. 6.

[106] *Ibid.*, pp. 7-9.

in the system was "wasted."[107] The Board by no means suggested enacting a program of conservation in order to slow the rate of consumption.[108] Rather, Board's policy was one of "augmenting metropolitan water sources from protected upland watersheds with abundant supplies of clean water. . . ."[109]

Stearns considered most every possible surface water supply within 100 miles of Boston and selected three for further study: the south branch of the Nashua River above Clinton, the Merrimack River above Lowell, and Lake Winnipesaukee in New Hampshire. He quickly rejected Lake Winnepesaukee because of the expense to convey the water to Boston, $34 million, and because it was an out-of-state source. Stearns rejected the Merrimack River, despite the fact that it would provide a sufficient quantity of water, because it was polluted and would require filtration. By this time, purifying water by filtration was technologically and economically feasible, but was still considered potentially risky due to possible breakdowns in the system. The estimated cost of the project was $17.5 million, $1.5 million less than the estimated cost of the Nashua project. Stearns, however, believed that it would be wiser to pay more for a supply of pure water from the Nashua than to rely on filtration.[110] His ideas lined up with the standing Massachusetts policy of seeking pure, upland sources of water supply rather than sources requiring any kind of treatment.[111]

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[107] *Ibid.*, p. 10.

[108] Nesson, *supra*, note 29, p. 19.

[109] Metropolitan District Commission, *supra*, note 24, p. 5.

[110] Albert F. Noyes, "The Metropolitan Water Supply of Massachusetts," *Journal of the New England Water Works Association*, Vol. 10, No. 2., Boston, MA, December 1895, pp. 119-120.

[111] Metropolitan District Commission, *supra*, note 24, p. 13.

Stearns's water supply choice, the south branch of the Nashua River, lies 32 miles west of Boston. The Nashua's watershed was relatively unpopulated, and the river could easily feed a large reservoir. Stearns proposal called for constructing a dam above the Lancaster Mills in Clinton to create a 63 million gallon reservoir.[112] The reservoir would be much larger than what was actually needed so that runoff from the watershed could be collected and the storage time in the reservoir would be increased to provide for natural treatment of the water.[113] Water from the proposed reservoir could be transported to the Sudbury conduit and would not require pumping on its trip to Boston. Addition of the reservoir would add 105 mgd to the system. Stearns recommended abandoning the Upper Mystic Lake system when the new reservoir was put into service. The total available yield from the system would then be about 173 mgd.[114]

Finally, Stearns's report considered supplementary sources which might be added to the system when necessary. He highly recommended the Ware and Swift Rivers in western Massachusetts and the Assabet River in east-central Massachusetts for extensions of the system. His report contains a map showing the outline of the present day Quabbin Reservoir on the Swift River and a tunnel connecting it to the Ware and the proposed reservoir on the Nashua.[115] Figure 5 illustrates Stearns's proposed expansions of the Boston area water supply system.

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[112] Noyes, *supra*, note 110, p. 120.

[113] Metropolitan District Commission, *supra*, note 24, p. 12.

[114] Noyes, *supra*, note 110, pp. 118, 120.

[115] Metropolitan District Commission, *supra*, note 24, p. 14.

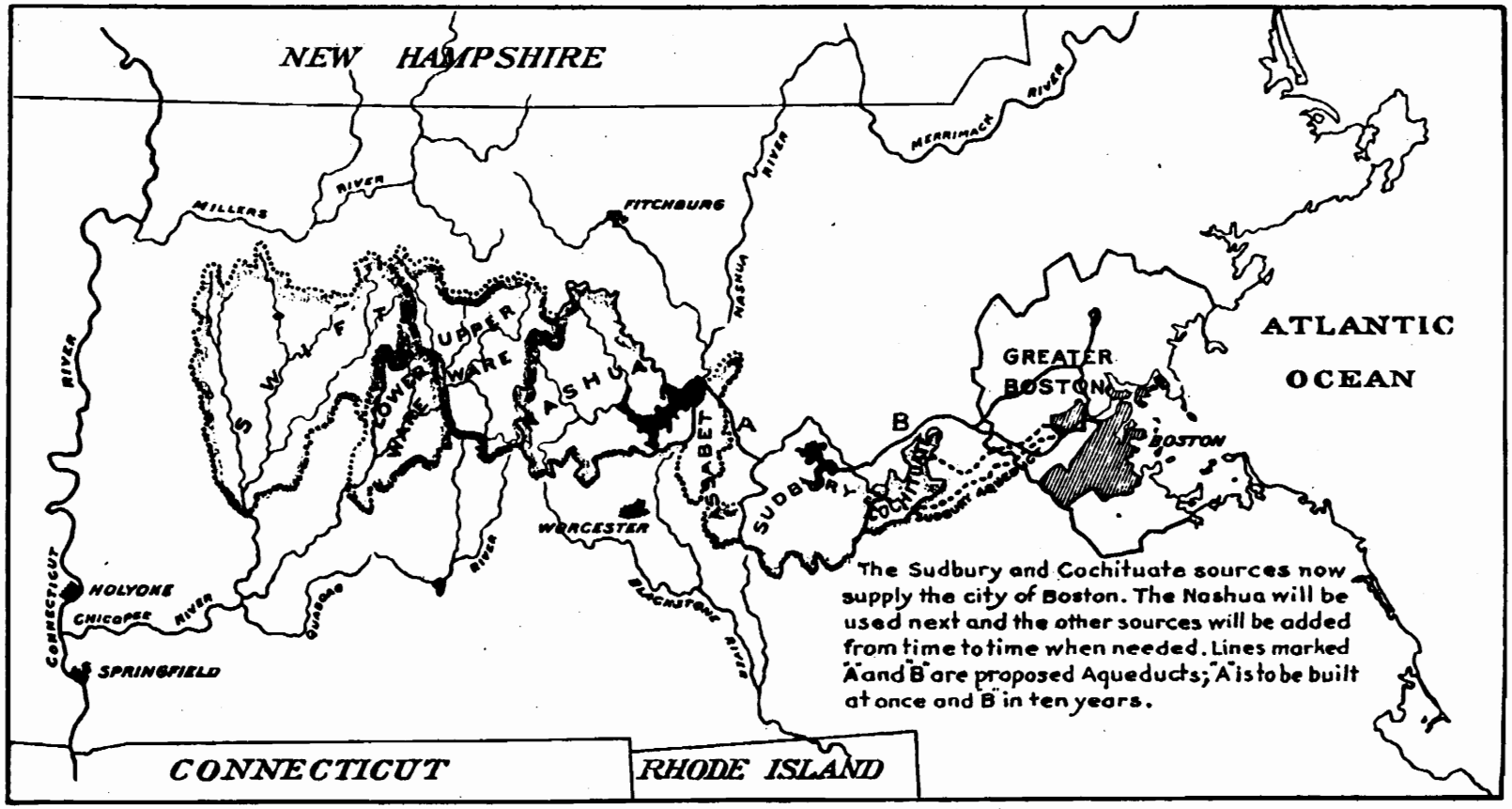

Figure 5. Stearns's Proposed Expansions of the Boston Water Supply System (Source: Noyes, *Journal of the New England Water Works Association*, Plate I.)

Stearns noted that the Board of Health was establshing a policy of extending the metropolitan system westward:

> The very great merit of the plan now submitted is to be found in the fact that this extension of the chain of the metropolitan water supplies to the valley of the Nashua will settle forever the future water policy of the district, for a comparatively inexpensive conduit can be constructed through to the valley of the Ware River and beyond the Ware River lies the valley of the Swift; and, in a future so far distant that we do not venture to give a date to it, are portions of the Westfield and Deerfield Rivers, capable, when united, of furnishing a supply of the best water for a municipality larger than any now found in the world.[116]

The Board recognized that construction of the proposed reservoir would require inundating large portions of the towns of Boylston and West Boylston, but Stearns argued that the benefits of the supply would exceed these costs:

> . . . we have been impressed by the very serious changes which will be produced in the towns of Boylston and West Boylston. It does not appear to us to be a very important objection to our plan that certain mill sites will be 80 feet below the surface of the basin, nor that the homes of many industrious people dependent upon these mills for their living will also be submerged, because all these can be paid for, and an equivalent will be given . . . .[117]

THE METROPOLITAN DISTRICT WATER SUPPLY

The State Board of Public Health unanimously adopted Stearns's report and filed it in February 1895. The legislature then drafted a bill to provide a water supply for the Boston metropolitan area based

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[116] Nesson, *supra*, note 29, p. 21-22.

[117] Greene, *supra*, note 42, p. 14.

upon the report's recommendations.[118] The bill provided for the creation of the Metropolitan Water Board consisting of three members appointed by the Governor and vested with the responsibility of caretaker of the water supplies of the cities and towns within 10 miles of the State House. The new Board would oversee the construction of Stearns's proposed reservoir on the Nashua River. Hearings on this bill lasted from February through April.[119]

Debates on the Metropolitan Water Supply Bill

Walcott, Stearns, and Colonel W.S.B. Hopkins, counsel for the Board of Health, testified before the legislature in support of the water supply bill. Walcott spoke of the Board's conclusions that the public demanded "a pure and attractive water."[120] The large project would allow communities to abandon their local supplies for the more desirable Nashua River water. Stearns remarked that the plan was designed to meet the metropolitan area's needs well into the future. The Nashua could meet supply needs until 1920, and addition of the Swift River to the system would carry the district to 1970.[121]

Both eastern and western Massachusetts towns raised objections to the plan. Boston objected because it desired to build the system itself, thereby securing the entire water supply for its own use and for sale to other communities. Boston also objected on the grounds that the plan provided no

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[118] Nesson, *supra*, note 29, p. 24.

[119] Greene, *supra*, note 42, p. 14.

[120] Nesson, *supra*, note 29, p. 25.

[121] *Ibid.*

compensation to the City for the use of its waterworks.[122] One group of towns in the proposed district objected on the grounds that they had sufficient supplies and did not wish to be forcefully included in the district, having to pay for service they did not need. Other towns needed water but were concerned about the cost if some of the larger towns and cities did not join the district.[123]

The eastern towns and cities were appeased by amendments to the Act. One amendment outlined a scheme to distribute the costs of the project among communities based on their size and ability to pay. Boston would be paid for its waterworks, and membership in the district was made optional for all towns. Boston withdrew its objections, and the smaller towns followed. Towns deciding to join the distrct later would not be required to pay for construction costs before they joined and would be charged only for water they used in an emergency. After joining the district, the amount charged for prior construction costs and debt service would be reduced by the value of each town's water-works.[124]

West Boylston objected to being inundated for the purpose of creating a water supply for the metropolitan area; however, the town was resolved to the idea that the plan could not be blocked and simply requested that it be carried out "with reasonable dispatch."[125] Concerning the anticipated inundation of the town, representatives for West Boylston stated that it "has palsied business, and

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[122] *Ibid.*, p.26.

[123] *Ibid.*, pp. 26-28.

[124] *Ibid.*, pp. 29-30.

[125] *Ibid.*, p. 29.

until this matter is finally disposed of, West Boylston will be a kind of living death. So we depreciate any postponement."[126]

An Act to Provide for a Metropolitan Water Supply

"An Act to Provide for a Metropolitan Water Supply" was passed on June 5, 1895.[127] It created the Metropolitan Water District, consisting of thirteen cities and towns: Boston, Belmont, Chelsea, Everett, Hyde Park, Malden, Medford, Melrose, Newton, Revere, Somerville, Watertown, and Winthrop. Figure 6 shows the original Metropolitan Water District. The other towns within 10 miles of the State House were permitted to join upon application to the new Metropolitan Water Board.[128]

The Metropolitan Water Board was authorized to:

> . . . take, by purchase or otherwise, the waters of the south branch of the Nashua river, at and above a point above the dam of the Lancaster Mills in the town of Clinton, . . . take the waters of Sandy pond, so-called, in the town of Clinton, and the waters which may flow into and from said pond or river, and the tributaries thereof above said point; . . . take, by purchase or otherwise all real estate which will be submerged or flooded, or submerged to an increased depth, by the construction of the proposed reservoir on the Nashua river hereinafter provided for, and all parcels of real estate above the dam of said reservoir used for mill purposes and owned by the owner of any mill property of which any part will be submerged or flooded by the construction of said reservoir, including all the machinery used on such real estate

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126 *Ibid.*

127 Massachusetts General Court, *Acts of 1895*, Chapter 488.

128 *Ibid.* at § 3.

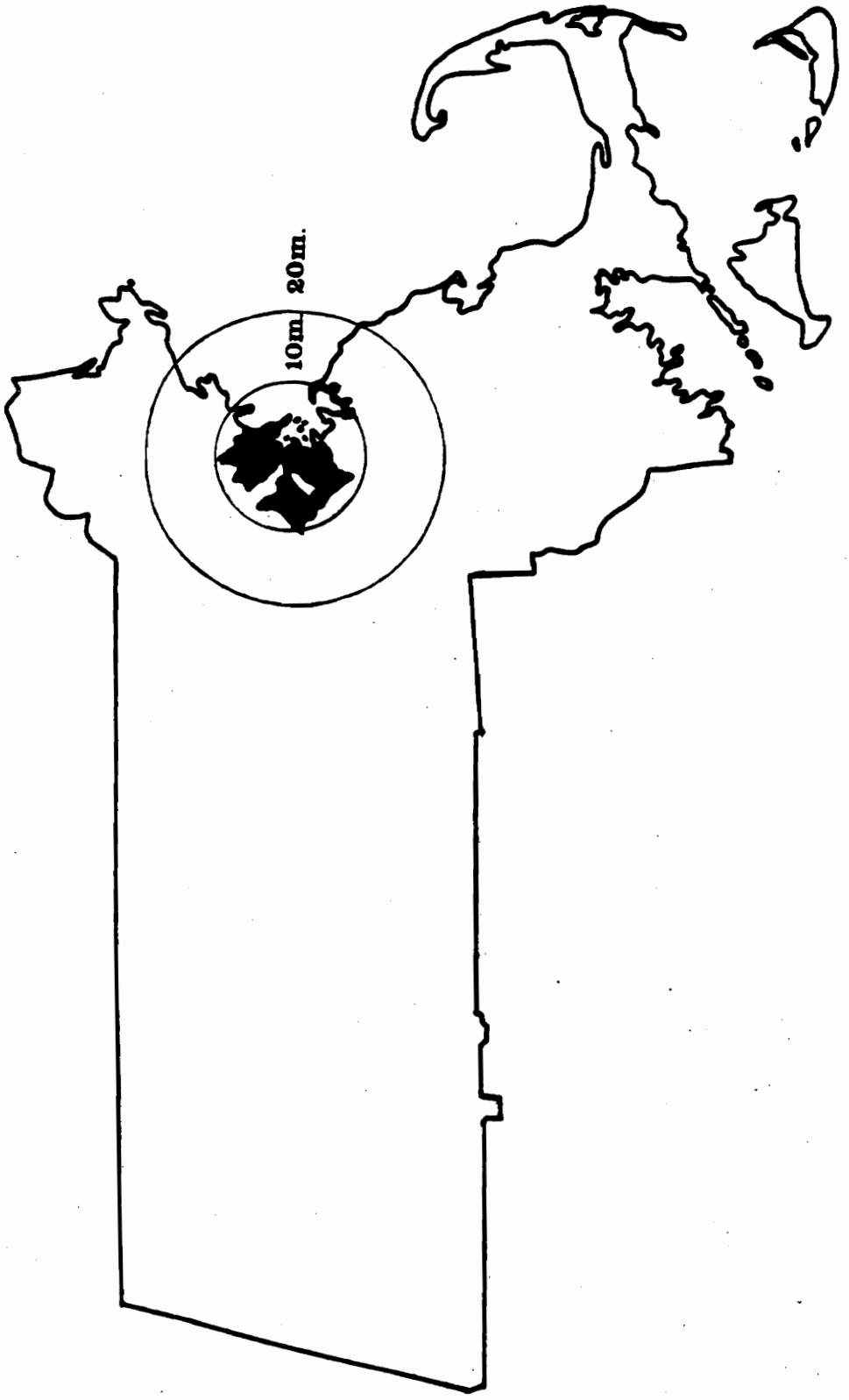

Figure 6. The Boston Metropolitan Water District in 1895

> and tenements for operatives; . . . [and] construct a storage reservoir upon said Nashua river above said dam of Lancaster Mills; . . .[129]

The Metropolitan Water Board was instructed to take Spot Pond and the entire water supply system of the city of Boston. It was also instructed to complete the construction, begun by Boston, of the Sudbury Storage Reservoir in the town of Southborough.[130]

The Act required payment to injured parties for the taking or devaluation of real estate, including water rights, or businesses and for other direct damages to the towns affected.[131] The Act allowed a time period of two years for any persons affected by any act of the Metropolitan Water Board causing damage to file a petition in court for the assessment of damages if the value could not be agreed upon by the parties involved. The Metropolitan Water Board itself had the right to appeal decisions of court appointed commissions concerning the assessment of property.[132]

Besides the payment of direct damages, the Act required the treasurer of the Commonwealth to:

> . . . pay as part of the expenses of said metropolitan water works to the town of Boylston the sum of two thousand dollars a year and to the town of West Boylston the sum of twelve thousand dollars a year for the year of and each year succeeding said taking of the waters of said Nashua river, so long as each of said towns remains a municipality, and shall pay no tax or other payment to either of said towns on

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[129] *Ibid.* at §§ 4, 6.

[130] *Ibid.*

[131] *Ibid.* at §§ 12, 14.

[132] *Ibid.* at §§ 13, 15.

> account of any property held by said water board for the purposes of a water supply.[133]

Finally, the flow of the Nashua River was regulated to protect the interests of mill owners in Clinton, eliminating their opposition to the project. The Act stated that the Metropolitan Water Board:

> . . . shall not allow less than twelve million gallons of water to flow from a reservoir above said dam [on the Nashua River] in each week, and such further quantity, not exceeding twelve million gallons a week, as the owner of said mills shall from time to time certify to be necessary for use therein and in other buildings now or hereafter owned by him, for domestic and manufacturing purposes, other than the production of water power, and said board, in regulating the flow of said quantities, shall, as far as practicable, conform to any reasonable request in writing of the owner of said mills; . . . [134]

> Said board, until they shall have completed the dam of said proposed reservoir on the Nashua river, and rebuilt the dam of said Lancaster Mills, shall, unless otherwise agreed by said board and the owner of said mills, deliver each week day at, and at the level of, the present top of the dam of said mills at least one million gallons of the water of said river, unpolluted by any acts or doings of said board, conforming in the delivery of said quantity, so far as practicable, to any reasonable request in writing of the owner of said mills.[135]

The project was financed by the sale of property and by State bonds with the designation "Metropolitan Water Loans." The legislation permitted issuance of up to $27 million in bonds.[136] The total construction cost was $21.6 million. Boston received $14 million for its water supply system and $1.2 million was paid for Spot Pond.[137]

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[133] *Ibid.* at § 16.

[134] *Ibid.* at § 4.

[135] *Ibid.* at § 8.

[136] *Ibid.* at § 17.

[137] Nesson, *supra*, note 29, p. 30.

Construction of the project began in 1895, with Frederic Stearns as chief engineer, and was mostly completed by 1906. The system consists of the 67 billion gallon Wachusett Reservoir, formed by Wachusett Dam, on the Nashua River, and having a 109 square mile watershed, the Wachusett Aqueduct, capable of transporting 360 million gallons per day of water from Wachusett Reservoir to Sudbury Reservoir (Basin 5 in the Sudbury system) and the 300 mgd capacity Weston Aqueduct, which carries water from the Sudbury Reservoir to the Weston Reservoir for distribution throughout the Boston area. Part of the water was also carried to the Chestnut Hill Reservoir from the Sudbury Reservoir via the Sudbury and Cochituate aqueducts.[138] Figure 7 illustrates the Metropolitan District water supply system as of 1906. It is interesting to note that the capacity of the aqueducts was much greater than required to support the Wachusett system. The project designers had designed the system planning on future westward extensions.[139]

Upon completing the system, Stearns and the Water Board were highly praised by the engineering community for their work. Stearns's career and prominence as an engineer were boosted by the success of the Wachusett system. After his death, in 1919, the American Society of Civil Engineers noted that he "was intensely human and service was his governing thought,"[140] a role model for all engineers to follow.

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[138] McInnes, *supra*, note 23, pp. 14-15.

[139] Nesson, *supra*, note 29, p. 30.

[140] *Ibid.*, p. 31.

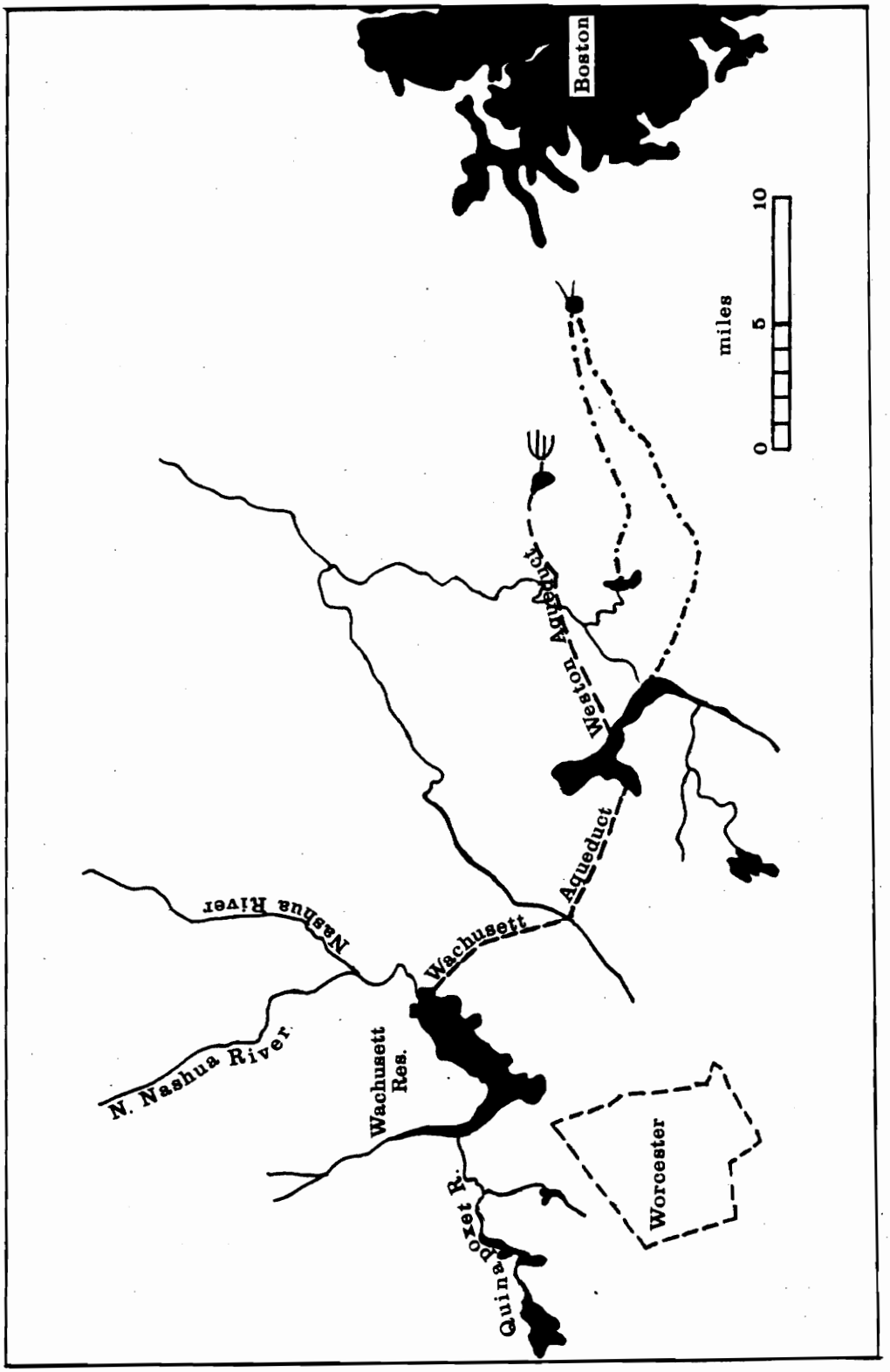

Figure 7. Metropolitan District Water Supply System in 1906 (Source: MWRA Water System Map.)

FACTORS INFLUENCING THE SUCCESS OF METROPOLITAN WATER SUPPLY PROPOSAL

Much of the success of the 1895 Wachusett proposal is attributable to the same factors prompting passage of the "Boston Water Act" of 1846. These factors include public perception of the need for an abundant, pure water supply, prior technological successes and continuing technological constraints, lack of opposition from western Massachusetts interests, lack of broad public concern for environmental protection, and public trust of experts and professionals, particulary Frederic Stearns.

Based upon demand projections, the metropolitan area needed an additional water supply source, and Wachusett could satisfy its water demands for years. The system could supply pure water to the district without a hefty increase in water rates. Also, the public wanted pure water. The Board of Public Health promoted acquisition of abundant, pure water supplies for the good of the Commonwealth's citizens and helped create a public demand for pure water. Filtration was still experimental technology and was not completely reliable. The risk of endangering the public health upon the occurrence of a malfunction in the filtration system was not acceptable.[141]

A second influencing factor was that the Wachusett system was an extension of the Cochituate and Sudbury systems, not only physically, but technologically as well. The public officials and the public alike considered it expedient and efficient to continue using the reliable, conservative engineering practice used for these earlier systems.[142] As previously noted, filtration of local, polluted sources was infeasible.

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[141] *Ibid.*, p. 32.

[142] *Ibid.*, pp. 32-33.

Third, there was no significant opposition to the plan from within or outside the metropolitan area. Though some metropolitan communities objected to his plan at first, all of their objections were addressed at the hearings on the bill and answered by amendments. West Boylston stood alone as the only voice of opposition to the project. No other western Massachusetts interests were concerned about the plan or its possible long range effects.[143] The interests of West Boylston seemed insignificant in light of the greater interests of the Commonwealth and, particularly, the metropolitan Boston area.

The Boston area's predominance in water supply decision making was clear. Once the issue was decided in the East, it was decided for everyone involved:

> The rise of urban commercial and industrial centers in the last half of the 19th century shifted the balance of political power in places such as Massachusetts. Boston, which had been a big brother among equals in the early part of the century, now represented the dominant part of the state. Its own population had grown to the point where referendums, such as the water votes taken in the 1840's, were not viewed as being practical. The city gained power, but the power was wielded more often by bosses and bureaucrats, ostensibly representing the inhabitants. The small town, and its ways, lost out to the overwhelming power and pervasive influence of cities.[144]

Fourth, there was still no broad public concern for the possible environmental impacts of such a major water development project. Little, if any, thought was given to the potential long term effects of constructing a reservoir on the Nashua River on the ecosystem of the river. Environmental protection had not yet become an important public value.

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[143] *Ibid.*, p. 31.

[144] Greene, *supra*, note 42, p. 17.

Finally, as far as the State government and the Metropolitan Water District communities were concerned, the plan was a good one. The decisionmakers and the public had confidence in Stearns's expertise. He had gained the trust of the public and of the Board of Public Health through his careful studies and devotion to public service.[145]

The plans laid down by Stearns in 1895 and his blueprint for augmenting the metropolitan area water supply in the future were embraced by the engineers he trained. Stearns solidified the Massachusetts policy of acquiring pure, abundant water sources for the Boston area, and he set the stage for the planning and implementation of future interbasin water transfers to meet the Metropolitan Water District's water needs.

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[145] Nesson, *supra*, note 29, p. 35.

CHAPTER FOUR

THE WARE AND SWIFT RIVER SUPPLIES

By the time Wachusett Reservoir was finished in 1908, the Metropolitan Water District included 19 cities, and the demand on the metropolitan water supply system had reached 128 mgd. Figure 8 shows the Metropolitan Water District in 1908. At the rate of growth experienced since 1895, Wachusett was in danger of being depleted by 1918. Demand declined between 1907 and 1915, however, due to metering, but it rose again to 131 mgd by 1920.[146] Metropolitan Water District officials began to worry about the long-term adequacy of the metropolitan water supply and considered options for augmentation.

FORMATION OF THE JOINT BOARD

Part of the concern over the metropolitan supply was the anticipated needs of towns and cities eligible to join the Metropolitan Water District, but not yet part of it. Some municipalities with their own water supplies experienced increasing demands as a result of population growth and faced risks of water source contamination. Also, the city of Worcester was purchasing 5 mgd from Wachusett Reservoir in 1920, but was still in need of greater supplies.[147] The growing demands upon the water supplies of Worcester prompted City officials to set up a study commission in 1918 to recommend a solution to the City's water supply problems. The study found that Worcester could meet its water needs by building a reservoir on a tributary of Wachusett Reservoir, and by using the Ware River as a water supply in the future.

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[146] Metropolitan District Commission, *supra*, note 24, pp. 14-15.

[147] Greene, *supra*, note 42, pp. 19-20.

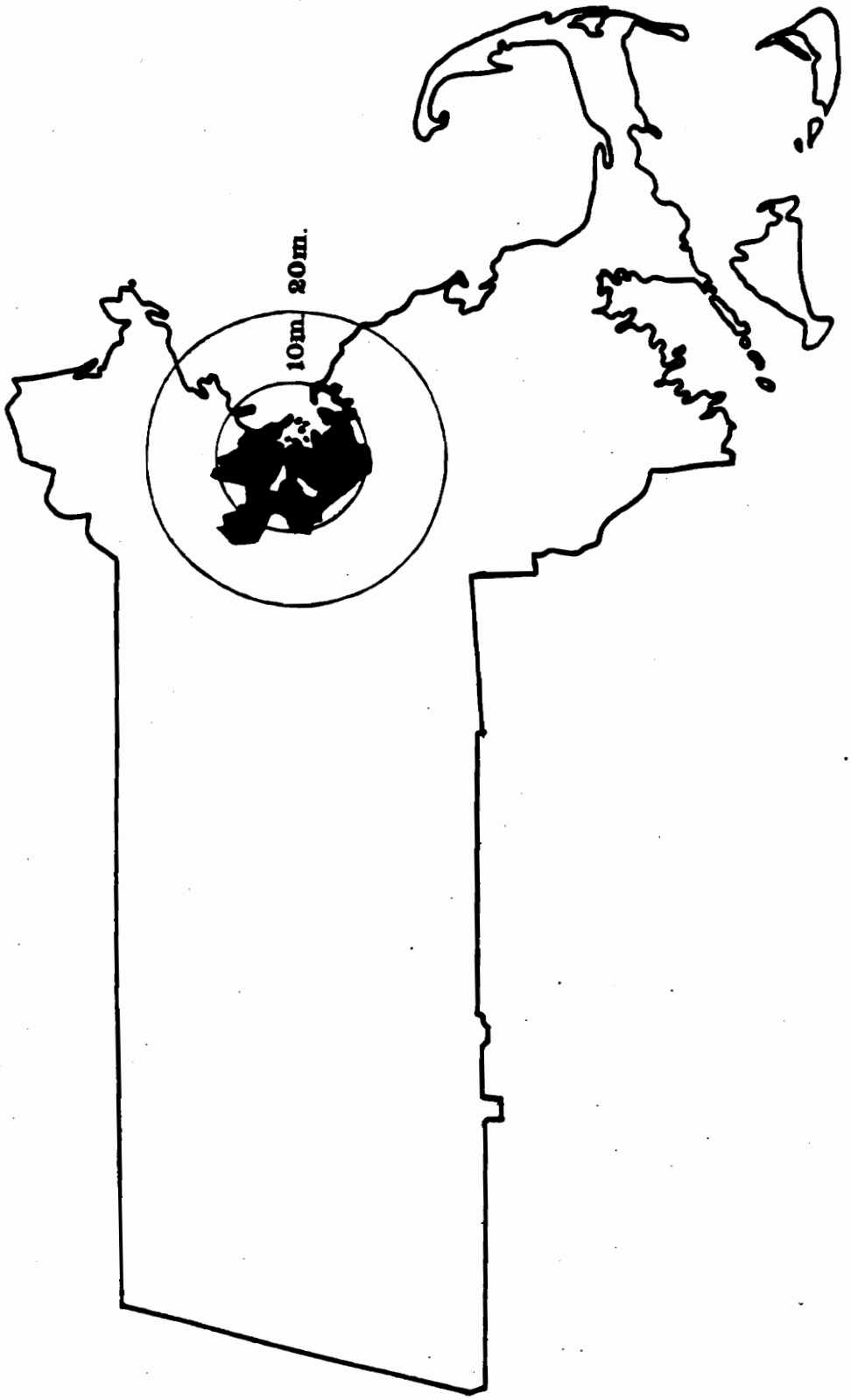

Figure 8. The Boston Metropolitan Water District in 1908

The Metropolitan Water and Sewerage Board continued to grow anxious over the depletion of its water supplies. The Board's concern was heightened by a 1918 report of the Department of Public Health, formerly the Board of Public Health. A portion of the report was written by X.H. Goodnough, the Department's chief sanitary engineer. Goodnough expressed his belief that the water supply systems of eastern Massachusetts, particularly the Metropolitan Water District system, were being overdrawn. Goodnough had been involved in drafting and implementing the Stearns plan in 1895. He was well aware that the twenty year period after which Stearns recommended re-evaluation of the metropolitan supply had been exceeded. The Department of Health and the Metropolitan Water and Sewerage Board petitioned the General Court to authorize and fund a State-wide water supply study.[148] The General Court, under the provisions of Chapter 49 of the Resolves of 1919, asked the State Department of Health and the Metropolitan Water and Sewerage Board, referred to together as the Joint Board, to consider the quantity, quality, and methods of obtaining water from the State's available water supply sources. The deadline for completion of the study was set for January 1921.[149]

The Joint Board was organized on July 3, 1919 and named Henry Walcott chairman and Frederic Stearns consulting engineer. X.H. Goodnough was named engineer for the water supply investigation. In December 1919, the Joint Board underwent several changes. Frederic Stearns died and was replaced by J. Waldo Smith. Dr. Walcott resigned as chairman and was replaced by Dr. Eugene Kelley, Commissioner of Public Health. Also, by an act of the General Court, the Metropolitan District Commission (MDC) replaced the Metropolitan District Water and Sewerage Board.[150]

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[148] *Ibid.*, pp. 18-19.

[149] Nesson, *supra*, note 29, p. 36.

[150] Greene, *supra*, note 42, p. 20.

MDC was created in order to consolidate the responsibility for the Metropolitan District's water supply, sewage disposal, and parks under a single agency.

THE JOINT BOARD REPORT OF 1922

The Joint Board had decided by January 1921 to implement Stearns's plans for expanding the metropolitan water supply by diverting water from the Ware River to Wachusett Reservoir and by creating a 400 billion gallon reservoir on the Swift River. The Joint Board asked the General Court for a one year extension for drawing up specific project plans. In mid-March, the Senate and House Committees on Water Supply held hearings on the bill to extend the report deadline. Boston and the other Metropolitan District towns offered no comment, but opponents from western Massachusetts spoke out against the Ware-Swift proposals and demanded that the Joint Board investigate the potential for making eastern Massachusetts water supply sources available for use to the Metropolitan District by pumping and filtering.[151] Amendments satisfying the western demands were added to the bill, and the Joint Board was given until 1922 to complete its study. The Joint Board filed its 284 page report on Massachusetts state water supply with the General Court on January 28, 1922.[152]

Goodnough's Water Supply Study

The Joint Board Report of 1922 was completed by X. H. Goodnough. Goodnough studied the future population and water use projections for the Metropolitan District. He assumed that the only safe ground for population projections was that future growth would parallel past experience. He

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[151] Nesson, *supra*, note 29, pp. 38-39.

[152] Greene, *supra*, note 42, pp. 21-22.

compared the rate of population growth in Boston with growth in other large metropolitan areas in the U.S. He found that Boston was keeping pace with other large cities and would continue to follow the general curve indicated by past experience.[153] The 19 cities and towns of the Metropolitan District had grown from a population of 763,417 in 1895 to 1,252,903 in 1920. Based upon historic trends, Goodnough estimated that the population would reach 1.5 million in the early 1930's, 2.0 million in 1950, and 2.5 million in 1970. Furthermore, he expected more cities and towns to join the Metropolitan District in the near future, but only one town, Brookline, actually joined between 1909 and 1945.[154]

Goodnough went on to discuss projected water consumption in the Metropolitan District. He traced the increase in water consumption in the District from 69 mgd in 1895 to 131 mgd in 1920. Goodnough cited several factors contributing to the increase in per capita water consumption, including an increase in the general standard of living, growth of business and industry, and the low cost and abundance of water. He predicted that per capita water use might decrease slightly after 1920 with continued metering of services and not rise above 105 gallons per capita per day until after 1925. He estimated an average rate of increase of one gallon per capita per year for the period between 1925 and 1970. At the projected rate of increase, demand on the MDC system would be 165.5 mgd by 1930, 270.7 mgd in 1950, and 378.9 mgd in 1970.[155]

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[153] X. H. Goodnough, "Proposed Extension of the Metropolitan Water District," *Journal of the New England Water Works Association*, Vol. 36, No. 2, The New England Water Works Association, Boston, MA, June 1922, pp. 189, 194.

[154] *Ibid.*, pp. 189-191.

[155] *Ibid.*, pp. 212-216.

Goodnough discussed the potential of metering and leak detection for reducing water demand. He examined in detail the results of metering programs in five major cities and a number of smaller cities and came to the following conclusion:

> In general then, so far as these records show, the full effect of metering is reached after a total of about 75 per cent of the services have been metered, but the effect of applying meters to the remaining services in many cases is to effect a further reduction for a time and to delay for a few years the beginning of the increase in the consumption of water per capita after the application of meters has become nearly or quite complete. The practically invariable rule, however, is that after 75 per cent of the services have been metered the consumption of water again increases, and even in fully metered cities continues to increase in spite of the complete adoption of the meter system.[156]

Goodnough noted that the per capita consumption of water was higher in Boston than in the District as a whole since, as the business center of the District, it had a daytime population that included many people who worked in Boston but lived elsewhere within the District.[157] The percentage of metered services in the District as a whole had increased from 66.6 percent in 1915 to 74.6 percent in 1920, but the per capita consumption of water in the District had risen as well. In the city of Boston, 62 percent of the services were metered in 1920, while 91 percent of services in the remainder of the District were metered.[158] Taking these facts into consideration, Goodnough drew the following conclusion concerning further metering of service in Boston:

> In view of the fact that consumption has begun to increase since 62 per cent of the services [in Boston] were metered, there is no great encouragement to expect that

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[156] *Ibid.*, p. 205.

[157] *Ibid.*, p. 207.

[158] *Ibid.*, p. 195.

> a further material reduction in the consumption of water per capita will be effected by metering the remaining services.[159]

Furthermore, Goodnough rejected the possibility of substantially reducing demand for importing water into the District by further developing local sources for industrial use or by attempting to eliminate losses from leakage in the distribution system. Goodnough assessed the future water supply needs of the Metropolitan District with the following statement:

> It is of course impossible to estimate with certainty the quantity of water that will be used per capita in the Metropolitan District in future years; but in the face of the evidence that the use of water has ever been a constantly increasing one and that the indications point to a growing use in the future, it is unreasonable to ignore the available facts, and while every effort must be made to keep the water consumption within reasonable limits, the health of the people should not be placed in jeopardy or the public put even to serious inconvenience because of the assumption that means can and will be found and applied in the immediate future to restrict the growing use of this important necessity. Prudence requires, that -- in estimating for the future -- allowance shall be made for and increase in the consumption of water per capita to the extent indicated by past experience.[160]

The projected demands within the existing Metropolitan District, Goodnough's expectation that several eligible communities would join the District within a short period of time, and the study conducted for Worcester recommending that the city take water from an area that feeds Wachusett Reservoir, as it was authorized to do by the original "Metropolitan Water Act", all prompted Goodnough to recommend the creation of a major new water supply source for the Metropolitan District.

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[159] *Ibid.*, p. 207.

[160] *Ibid.*, p. 212.

Goodnough then turned to his review of the current status of the metropolitan water supply and a list of alternatives for augmentation. In 1920, MDC was able to draw water from the Cochituate, Sudbury, and Wachusett systems. The estimated allowable safe yield of these sources for supply to the Metropolitan District was 154.5 mgd. Water from the Cochituate and southern Sudbury sources was judged to be of poor quality and in need of filtration.[161] Goodnough recommended disconnecting these supplies from the system in the future, leaving 125 mgd of good quality water from Wachusett Reservoir, Sudbury Reservoir, and Framingham Reservoir No. 3.[162] By Goodnough's estimates, the safe yield of the MDC system would be exceeded by more than 10 mgd in 1930 even if the Cochituate and southern Sudbury sources were in use at the time.

Recommendations of the Goodnough Report

To assess the viability of various alternatives for meeting the Metropolitan District's needs, Goodnough went back to the 1895 Board of Health report produced by Frederic Stearns. Goodnough rejected the Charles, Merrimack, Shawsheen, Concord, and Sudbury Rivers, Assawampett Pond, and Lake Winnepesaukee as possible sources. In some instances, his rejections were based upon Stearns's rejections of these sources in 1895, or upon the fact that purification would be necessary before the waters could be used.[163] Goodnough investigated the Assabet River as a possible source for extending the metropolitan water supply. Stearns had suggested the Assabet in his 1895 plan. Increased pollution of the stream since 1895 and use of the stream for water power would have

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[161] *Ibid.*, p. 219.

[162] *Ibid.*, p. 217.

[163] *Ibid.*, pp. 235-236.

limited the amount of water available for municipal supply. Goodnough found it inadvisable to take any water from the Assabet based upon the conditions at the time.[164]

Goodnough's solution was diversion of the Ware River to the Wachusset Reservoir and the creation of a large reservoir in the Swift River Valley. At a cost of $60 million, these sources would guarantee an ample supply of water for the Metropolitan District until at least 1970. A unique aspect of Goodnough's plan was his proposal to take only the flood flows from the Ware and the Swift. By doing so, the diversions would not adversely affect downstream industries dependent upon mill power, and the flow of the river would be regulated, helping to eliminate damage that was sometimes caused by the freshets.[165] The proposed Swift River reservoir would force the removal of the entire populations of the towns of Enfield, Greenwich, and Prescott and a significant portion of the town of Dana.[166] He considered the sacrifice of these towns a necessity in light of the need to supply the Metropolitan District with pure water.

Goodnough's plan followed the traditional, conservative engineering practice that was used to construct Wachusett Reservoir. The plan completely avoided pumping and filtration. Goodnough, like Stearns, rejected sources requiring filtration for fear of endangering the public health. Should an accident allow contaminated water into the distribution system, the results would be disastrous; therefore, Goodnough reasoned, it was best to provide the District with naturally pure water. But, Goodnough, unlike Stearns, had the experience of at least 11 major cities using filtered water systems to draw upon. The technology of filtration was much more reliable and less costly than it had been

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[164] *Ibid.*, p. 238.

[165] *Ibid.*, pp. 239-242.

[166] *Ibid.*, p. 246.

in the past;[167] yet, Goodnough believed that a large, naturally pure source was the only solution to the Boston area's water supply needs.

Goodnough also followed Stearns's blueprint for expanding the system beyond the Swift River by proposing diversions into the "great reservoir" from other sources:

> Beginning with the diversion of the upper portion of the Ware River watershed, the plan provides not only for extension to the Swift River but looks ahead ultimately to a much larger supply. Water can be diverted into the great reservoir on the Swift River not only from its own watershed and the watersheds of the Ware and Millers rivers as proposed, but also from the Quaboag, the Deerfield and the Westfield rivers, the waters of which will flow by gravity into the great reservoir on the Swift River.[168]

The Goodnough plan was highly touted by the engineering community. The majority of the Joint Board approved of the plan as well. Only one member, James Bailey of MDC, filed a dissenting report. Bailey believed that population growth in the District would not be as great as predicted. He felt that there was no need for the Swift River reservoir. Instead, he proposed filtration of local sources to meet the immediate needs of the District and that MDC and Worcester share water from the Ware River.[169]

The Joint Board submitted its report to the Joint Legislative Committee on Water Supply in January 1922, prompting negative reaction from Swift and Ware River towns. These towns began hiring

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[167] Nesson, *supra*, note 29, pp. 44-45.

[168] Goodnough, *supra*, note 153, p. 254.

[169] Greene, *supra*, note 42, pp. 22-23.

counsel to represent their interests in Boston before the General Court. Hearings on the report commenced in March.

Hearings on the Goodnough/Joint Board Report

Hearings on the Goodnough report were held in Boston, Springfield, Ware, and Enfield (a Swift River Valley town) between March and June. Legislators from western Massachusetts, James Bailey, and representatives of the Swift and Ware River Valley spoke out sharply against the plan, while Goodnough and his colleagues at the Department of Health defended his proposal. The long delays and lack of a definite decision began to wear down the resistance of the western Massachusetts towns. While continuing to oppose the projects, representatives for the affected towns began calling for immediate action on the proposal one way or another. Greene notes that there was "a growing resignation on the part of Valley people that the project would go through."[170] In a May hearing, a selectman from the Swift River town of Dana stated that the delays were causing stagnation in the business and real estate trade of Valley towns. He believed that many Valley residents whose homes were to be inundated by the reservoir would accept leaving the Valley if they were paid a fair price for their properties.[171] No action was taken in 1922, however, and the General Court adjourned, referring the question to the next legislative session.

In 1923, the General Court once again considered the Goodnough plan. A water bill was filed on January 9, 1923 and the Joint Committee on Water Supply again heard testimony from both sides. In March, a bill was introduced that would have allowed the Joint Committee to conduct its own

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[170] *Ibid.*, p. 28.

[171] *Ibid.*, p. 29.

investigation of the water supply question with the assistance of a "disinterested and competent engineer" appointed by the Governor. The General Court never appropriated money for an engineer; so, the Governor refused to make the appointment. Consequently, the Joint Committee had to rely upon the assistance of Goodnough, hardly a disinterested engineer, for its investigation.[172]

The Legislative Joint Standing Committee on Water Supply filed three reports in May 1924. Six representatives filed a "majority" report supporting Goodnough's plan and advising that a commission cbe formed to construct the project. A three person minority report recommended a commission to study the water issue with the assistance of a disinterested engineer. The report's authors were dissatisfied with Goodnough's water-use projections.[173] Representative Roland Sawyer of Ware, a long-standing opponent of the project, wrote his own dissenting report. Sawyer objected to rushing through the legislation at the end of the session. He believed that the projections of water demand were overstated and that the project costs were seriously understated. Sawyer decried the fact that building the Swift River reservoir would displace 3,000 people and sacrifice 40,000 jobs and expressed extreme dissatisfaction at having only Goodnough as advisor to the Committee. He felt that the majority had been "led away into a byway of political intrigue" and pushed into adoption of Goodnough's plan by his false claim of a water emergency.[174] After conducting hearings on the reports, the General Court sided with the dissenters and set up a new commission to investigate the water issue.

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[172] Nesson, *supra*, note 29, p. 50.

[173] Greene, *supra*, note 42, pp. 35-36.

[174] Nesson, *supra*, note 29, p. 51.

THE METROPOLITAN WATER SUPPLY INVESTIGATING COMMISSION

The Metropolitan Water Supply Investigating Commission was appointed by the Governor on August 20, 1924.[175] Charles R. Gow of Brookline chaired the Investigating Commission. The other commissioners were George Booth of Worcester and Elbert E. Lockridge of Springfield. The Commission hired Allen Hazen as its chief engineer.[176] Allen Hazen was a highly acclaimed engineer at the peak of his career in 1925. Some of his most important work was designing filtered water supply systems for municipalities. Hazen was responsible for the installation of filters for the water supplies of Albany, Philadelphia, Washington D.C., Providence, and Denver.[177]

Hazen's Water Supply Study

In his study, Hazen considered both the western Massachusetts projects promoted by Goodnough and eastern Massachusetts sources that would provide sufficiently pure water when filtered. He pursued study of several alternatives with three objectives in mind:

> . . . first, that if any existing water supplies were hit in any way, they must be absolutely protected; second, that water needed for process water in mills, or for maintaining sanitary conditions in streams, must be maintained. Where water was proposed to be taken from any stream, with reference to these conditions, enough water must be allowed to remain or to be returned from compensating reservoirs to fully maintain present conditions. This has, I believe, been rigorously carried out in each of the projects considered. Third, where water power was affected, compensation in cash could be assumed, and this would frequently be the only compensation

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[175] Massachusetts General Court, *Acts of 1924*, Chapter 491.

[176] Greene, *supra*, note 42, p. 38.

[177] Nesson, *supra*, note 29, p. 53.

> that could be provided. In other words, water power was to be taken and paid for if needed, but process water and municipal supplies must be protected.[178]

Hazen and the Investigating Commission recommended discontinuing use of Cochituate and filtering the South Sudbury supply. Hazen estimated the quantity of available water of satisfactory quality from the South Sudbury source at 145 mgd. The Investigating Commission estimated that this water supply, based upon its own population projections, would be sufficient to meet the needs of the Boston metropolitan area until 1929.[179] Hazen, like Goodnough and Stearns, believed that metering and conservation programs could not significantly reduce the growing demand for water.

Hazen presented studies recommending the Ipswich and Assabet Rivers for supplying the MDC system, and the Ware River for Worcester and the MDC system. Stearns's 1895 report had proposed the Assabet and the Ware Rivers, along with the Swift, for future development of the metropolitan water supply. The only deviation from Stearns's report was Hazen's Ipswich River recommendation. Stearns had considered the Ipswich for future development, but he did not recommend it as a source.[180] Figure 9 illustrates both Goodnough's and Hazen's proposed sources of water supply for the Metropolitan District.

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[178] Allen Hazen, "The Massachusetts Water Report," *Journal of the New England Water Works Association*, Vol. 40, No. 1, Boston, MA, March 1926, p. 47.

[179] Metropolitan Water Supply Investigating Commission, "Report of the Metropolitan Water Supply Investigating Commission," *Journal of the New England Water Works Association*, Vol. 40, No. 1, Boston, MA, March 1926, pp. 69, 71.

[180] Colonel Charles S. Gow, "Discussion: The Massachusetts Water Report," by Allen Hazen, *Journal of the New England Waterworks Association*, Vol. 40, No. 1, Boston, MA, March 1926, p. 53.

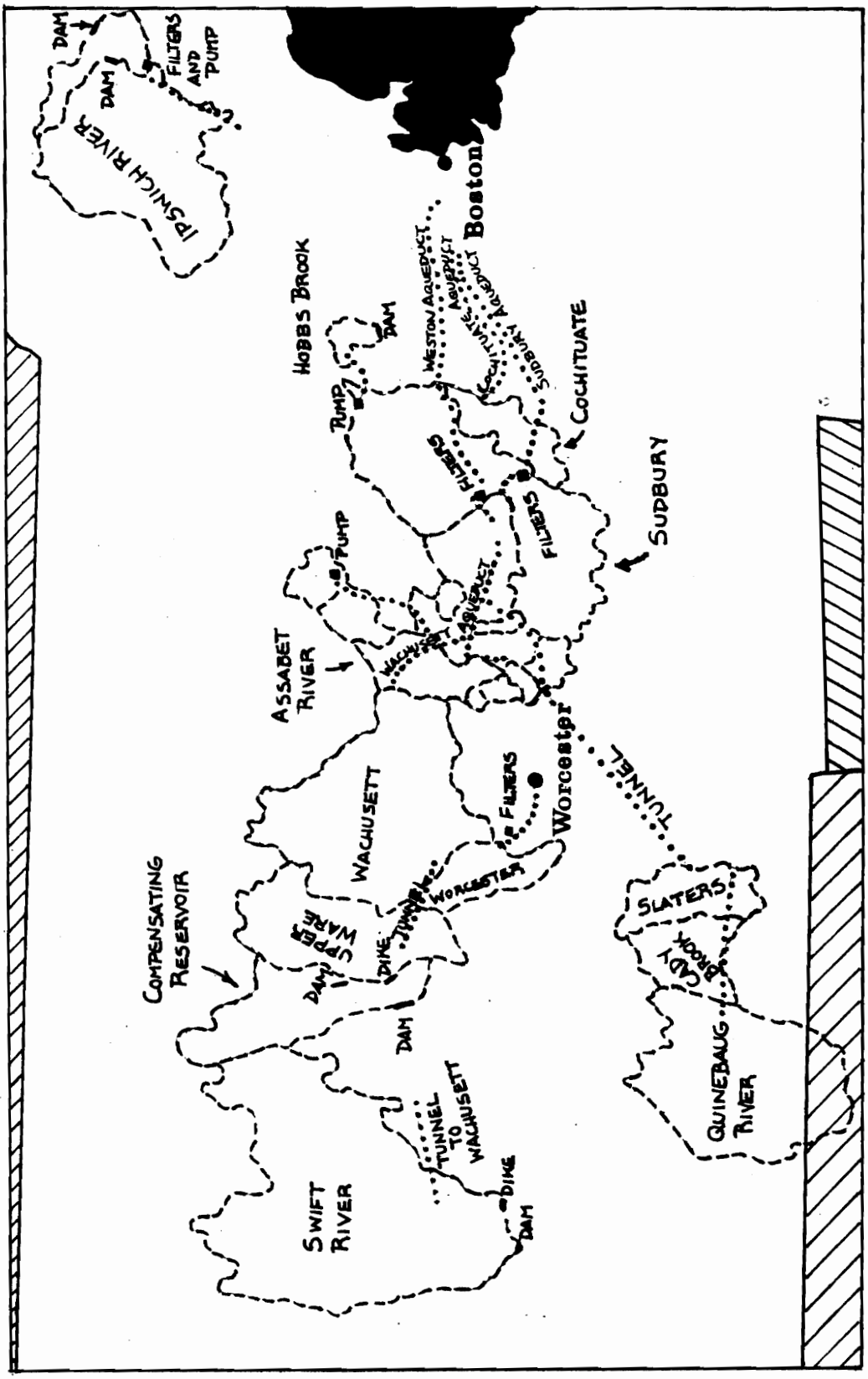

Figure 9. Goodnough and Hazen's Proposed Sources of Water Supply for the Metropolitan District (Source: Hazen, *Journal of the New England Water Works Association*, Plate I.)

Recommendations of the Hazen/Investigating Commission Report

In its final report, the Investigating Commission recommended that the aqueduct passing from the Wachusett to the Sudbury be used to divert the waters of the Assabet River. Hazen estimated that 47 mgd could be acquired from the Assabet, mainly in flood flows, at a cost of about $8.4 million, plus at least $10.5 million for filtering the entire MDC water supply system. A reservoir on the Assabet above the town of Hudson was proposed for regulating the downstream flow.[181]

Second, the Investigating Commission suggested that MDC and Worcester jointly construct a reservoir on the Upper Ware River at Barre to provide a 45 mgd supply. MDC would pay eight-ninths of the construction and annual maintenance costs and Worcester would pay the remaining one-ninth. The total cost of the project was estimated at $14 million. The division was based upon the assumption that Worcester would initially need to take only 5 mgd of the 45 mgd available from the supply. As Worcester required more water it would be required to pay a proportional share of the costs.[182] Potential adverse effects of the diversion on downstream industrial users on the Ware and Chicopee Rivers would be avoided by constructing a compensating reservoir near Coldbrook. Flood flows stored in the reservoir and released during periods of low flow would compensate mill owners for water diverted for water supply.

The third stage of development proposed by Hazen and the Investigating Commission was a reservoir on the Ipswich River at Topsfield. The reservoir could provide 80 mgd, with 30 mgd allotted to the surrounding cities and towns for water supply purposes and 50 mgd available for use by the

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[181] *Ibid.*, pp. 81-83.

[182] *Ibid.*, pp. 83-85.

Metropolitan District.[183] The Investigating Commission felt that each stage of the overall plan could be implemented as necessary. The plan allowed for adjustments in the time frame for implementation if projected population growth was severely overestimated. The Commission concluded its water supply recommendations with the following statement:

> In any event, it would appear to be futile to speculate at this time upon the water requirements of such a remote period as forty years or more hence. Improvements in the art and other conditions which cannot now be foreseen will undoubtedly render any conclusions at this time worthless when that date arrives.
>
> The precise selection of the most satisfactory additional supply for that period may well be left to the choice of the people then primarily interested, who, presumable, will be in a much more advantageous position to judge of the respective merits of the various proposals then open to them.[184]

The Investigating Commission's language seems to indicate that its water supply planning strategy was completely opposite of the future-oriented development strategy proposed by the Joint Board. In fact, it objected to the Joint Board plan on several counts: the required taking of large tracts of western Massachusetts land, the inadequacy of the plan in fairly addressing the needs of Worcester, and the high initial outlay for such a large project.[185] Hazen also pointed out that the Joint Board's estimate of $60 million for construction of its entire project was likely to be lower than the actual cost.[186] Ironically though, Hazen and the Investigating Commission appeared to contradict their own planning strategy as they pointed out some of the advantages of the Joint Board plan:

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[183] *Ibid.*, pp. 86-87.

[184] Metropolitan Water Supply Investigating Commission, *supra*, note 179, pp. 87-88.

[185] The total cost of the Hazen plan was estimated at $71.2 million, but only $40.2 million would have been needed before 1950.

[186] Metropolitan Water Supply Investigating Commission, *supra*, note 179, pp. 77-78.

> There can be no question that from an engineering standpoint this proposal offers an excellent solution for the water-supply needs of the eastern portion of the state. From considerations of both quantity and quality this supply would be unexcelled by any substitute suggestion which can be offered. The water could be used without filtration, would flow to the district by gravity, and would entail no serious maintenance expense. The area flooded by the proposed reservoir is very sparsely inhabited, so that a minimum of hardship or inconvenience would be occasioned to present occupants. The cost *per million gallons* for developing this supply would probably be as low as that of any other possible alternative proposed, although since only a small fraction of the capacity would be required for many years to come there would be an idle investment during this period of a considerable amount. The taking of the water in the manner proposed would not be likely to damage any existing or prospective user of water below the point of diversion. The recommendation of the Joint Board, therefore, has much to commend it. Furthermore, if the assumptions made by the engineer for the Joint Board with respect to future consumption in the Metropolitan District should prove to be substantially correct, it is unlikely that any better source can be found that will meet the requirements as satisfactorily as will this one.[187]
>
> It cannot be honestly contended that the taking of the water of the Ware and Swift rivers as proposed in the Joint Committee's report is the only solution of the problem available at this time, even though in some respects it may be the best one. The interests of the several communities adjacent to the Connecticut River Valley are of such importance as to entitle them to the greatest consideration by the State at large. It seems extremely likely that the time may ultimately come when there is no other practical alternative by which a sufficient supply of water for domestic purposes can be obtained for the large metropolitan population in the eastern portion of the Commonwealth, and when that time arrives the wishes of the citizens of these local communities will necessarily be compelled to yield to this paramount consideration.[188]

It appears that the Investigating Commission was resolved, as were the citizens of the Swift River Valley, to the eventual implementation of the Goodnough plan.

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[187] *Ibid.*, p. 76.

[188] *Ibid.*, p. 77.

Hearings on the Hazen/Investigating Commission Report

The Hazen report, which came to be known as the Gow Plan after Commissioner Gow, was filed with the General Court on December 1, 1925. The immediate reaction to the plan was mixed. Ware Valley interests thought that too much water would be taken from the Ware. Worcester objected to having to share the expenses of the Ware River development when it could rightfully take water from the Wachusett watershed. Ipswich and Assabet River communities objected to transferring their water to the Metropolitan District. MDC was initially in favor of the plan due to the low initial costs.[189]

As expected, when hearings on the Gow plan opened in February 1926, speakers from the Investigating Commission, as well as Allen Hazen himself, spoke in support of the plan while representatives from the proposed donor areas attacked numerous aspects of the report. Communities outside the Metropolitan District were strongly opposed to the inundation of portions of towns for the purpose of reservoir construction and to the lack of adequate compensation for the taking of water. The state representative for Oakham, a town to be inundated by the Ware River reservoir, stated that monetary compensation was not sufficient payment for inundating the Town or for driving out downstream industries.[190]

Opposition to the plan was so great that the Water Committee dropped the Ipswich and Assabet transfer proposals from the plan in April 1926. The changes were made after a group of proponents for each plan met with the Governor to attempt to reach a compromise. Meanwhile, Gow had obtained support for his plan from Ware and Chicopee River industries by demonstrating to them that

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[189] Greene, *supra*, note 42, p. 39.

[190] Nesson, *supra*, note 29, pp. 60-61.

their water power would be maintained by the compensating reservoir at Coldbrook. Gow, by giving in to the proponents of the Assabet and Ipswich portions and securing support for only the Ware diversion, was effectively committing his support to the eventual construction of the Swift River reservoir.[191]

The group meeting with the Governor also proposed that Worcester either buy the rights to the Quinnepoxet River in the Wachusett watershed from MDC or construct the Ware River reservoir on its own.[192] Worcester representatives were alarmed by this proposal and developed a compromise plan with MDC. Dubbed the "Booth Plan", after the Commissioner from Worcester, the scheme called for Worcester to pay two-ninths of the initial costs of the Ware project and take it over in twenty years. By that time, MDC would be using the Swift River and have no need of the Ware.

The Booth Plan was received favorably by many Water Committee members and was due for a vote on April 16, but Boston finally spoke up. Boston protested Worcester's move and was granted a request for a one week delay in Water Committee's vote on the compromise plan until the City could get its own engineer, John R. Freeman of Providence, Rhode Island, to testify as to which plan would be the best for Boston. Freeman attacked Hazen's engineering skill and proposed an alternate citing for the Ware River dam. The Committee was not impressed by Freeman's proposal and voted to recommend the Booth plan.[193]

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[191] *Ibid.*

[192] *Ibid.*, p. 62.

[193] Greene, *supra*, note 42, pp. 46-47.

The next hurdle for the Booth Plan was the Senate Ways and Means Committee. Worcester tried, unsuccessfully, to get a suspension of the rules to by-pass the hearing before the Senate committee. This move is thought to have seriously harmed the City's interests. The Senate Ways and Means Committee met on April 30, inviting the House Ways and Means Committee to join it in order to avoid having to duplicate testimony for the House. The Committees heard testimony for the Booth, Goodnough, and Freeman plans. Although Freeman's plan continued to be unpopular, he testified that he believed that the Swift River reservoir would eventually have to be constructed, thereby giving a boost to the Goodnough plan.[194]

Resurgence of the Goodnough Plan

The Senate committee decided to send the Booth bill to the Senate floor. The committee members were not entirely satisfied with the bill and reserved the right to amend it. Senator Bacon of Boston stated that he would move to substitute the Goodnough plan for the Booth plan on the Senate floor. Bacon made the motion when the bill reached the Senate, and it passed, sending the Goodnough bill back to the Ways and Means Committee.

The Ways and Means Committee reached a compromise that amended the Goodnough plan to allow Worcester to take the waters of the Quinnepoxet River from MDC.[195] (The Quinnepoxet River is one of the streams feeding Wachusett Reservoir.) An act passed by the General Court in 1897 amending the 1895 Metropolitan Water Act, preserved rights for Worcester and other cities and towns in the area of Wachusett Reservoir to take the waters in the Wachusett watershed above the

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[194] Nesson, *supra*, note 29, pp. 63-64.

[195] Greene, *supra*, note 42, p. 49.

Wachusett Dam for supplying their inhabitants with water.[196] Worcester would be required to pay MDC $800,000 for the supply from the Quinnepoxet and was also to receive rights to waters in the northern reaches of the Ware watershed. The Senate passed the bill and sent it to the House Ways and Means Committee.[197]

At a hearing on May 20, representatives from the Swift River Valley urged that immediate action be taken. The citizens of the Valley were growing weary of being in doubt. Also at the hearings, Representative Sawyer of Ware raised an objection to the bill. He felt that a special commission, rather than MDC, should be put in charge of construction.[198] Amendments were added to the bill to meet, at least in part, the requests of Sawyer and the Swift River representatives. One amendment authorized the immediate purchase of land in the Swift River Valley, despite the fact that actual construction of the project would be delayed for some time. Another amendment provided for the appointment of a special three-member committee for construction of both the Ware and Swift projects. Other amendments prohibited the taking of Ware River water between May 31 and December without the approval of the State Department of Public Health and limited Worcester to a 5 mgd withdrawal form the Quinnepoxet River.[199]

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[196] Massachusetts General Court, *Acts of 1897*, Chapter 456, § 22.

[197] Greene, *supra*, note 42, p. 49.

[198] Nesson, *supra*, note 29, p. 67.

[199] *Ibid.*, p. 68.

THE WARE AND SWIFT RIVER SUPPLY ACTS

On May 29, 1926, the Governor signed the "Ware River Supply Act" after it was passed by both houses of the legislature.[200] The Act created the Metropolitan District Water Supply Commission (MDWSC) as strictly a construction commission. It would construct works on the Ware and Swift Rivers for use by MDC. The "Ware River Supply Act" directed MDWSC to construct a tunnel on the Ware River at Coldbrook for the diversion of water to Wachusett Reservoir. The tunnel would be large enough to divert water from the Swift River as well. Construction was financed by $15 million in State bonds.[201]

On July 28, 1926 the Governor appointed Davis Kenniston, who had chaired MDC, as chairman of MDWSC. The other two commissioners were Charles N. Davenport of Boston and Joseph W. Soliday of Dedham. MDWSC formally organized on July 30. It appointed X.H. Goodnough and J. Waldo Smith as consulting engineers and Frank E. Windsor as chief engineer.[202] There was no representation of the Ware or Swift River Valleys within MDWSC, but both MDC and the Department of Public Health were afforded much influence on MDWSC decisions since Kenniston was chairman and many of MDWSC's appointees were in some way connected with the Department of Public Health or MDC.

The "Ware River Supply Act" ordered MDWSC to draft enabling legislation for the development of the Swift River supply by January 1927. In the meantime, MDWSC began surveying the Swift River

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[200] Massachusetts General Court, *Acts of 1926*, Chapter 375.

[201] *Ibid.*

[202] Greene, *supra*, note 42, p. 52.

Valley. In December 1926, the legislature authorized MDWSC to make an emergency diversion of water from the main Sudbury Reservoir because the Metropolitan District would be in need of water before the Ware River supply could be obtained.[203]

Just before the commencement of the General Court's 1927 session, the Swift River Valley Protective Association, composed of selectmen of the Swift River towns, prepared a list of demands regarding the taking of property in the Valley and compensation of Valley residents. The Association requested a March 1928 deadline for all taking of property, compensation for loss of livelihood for businessmen and professionals, and removal and reburial of bodies in Valley cemeteries taken for the purposes of the project.

MDWSC did not wish to obligate itself to purchasing all of the necessary property by the March 1928 deadline, nor did it feel that it should compensate businessmen and professionals for the loss of their jobs. In January 1927, MDWSC filed its Swift River recommendations with the General Court, including its own system of compensation for takings necessitated by the reservoir construction. Compensation issues were the focus of the debates preceding passage of the "Swift River Act" in April 1927, with the majority of the speakers representing Swift River towns and asking for greater amounts of compensation in various forms.[204]

The "Swift River Act" outlined the procedures by which the Board would take the lands necessary for construction and protection of the Swift River reservoir:

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[203] Nesson, *supra*, note 29, p. 69.

[204] Greene, *supra*, note 42, pp. 53-54.

> At any time after the passage of this act, the commission before or after the actual diversion of water may make such settlements as it may deem for the best interests of the commonwealth with any person or corporation who may be or has been damaged by any taking of or injury to his water rights under this act and in making any such settlements the commission may, subject to the approval of the governor and council, make a contract, which shall be in a form approved by the attorney general and shall be binding upon the commonwealth and such owner or person and his successors in title, with respect to the amount of the flow down the stream to which such water rights are appurtenant, or to the time and manner of such flow, or may agree to furnish in some other way a substitute for the water rights which have been or may be taken or injured. . . .[205]

Owners of property or businesses within one mile of lands taken for the reservoir or reservoir protection were entitled to recover damages if their lands or businesses suffered a decrease in value. Anyone suffering such damage whose property or business was located near to, but outside of, the one mile limit could be compensated at the discretion of MDWSC. In either case, the affected party was required to file a claim for damages with MDWSC. Disputes over claims would be heard by boards of referees appointed by a justice of the Supreme Judicial Court. Objections to any board of referees' ruling was subject to review by the Court.[206] The boards of referees were authorized to include depreciation in value between January 1, 1926 and the date of passage of the Act by reason of the proposal of the legislation in their valuation of damages.[207]

The Act required MDWSC to compensate blue collar workers in the Valley for up to six months of wages if such persons were deprived of employment by the carrying out of the act and were unable to secure other employment after a "reasonable" effort had been made to do so. Each affected person

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[205] Massachusetts General Court, *Acts of 1927*, Chapter 321, § 4.

[206] *Ibid.* at § 5.

[207] *Ibid.* at § 6.

was required to file a claim for damages with MDWSC.[208] Certain sections of the act provided for removal and relocation of roads, buildings, cemeteries, and other public properties as well as sections of railway.[209]

The towns of Enfield, Greenwich, and Prescott were to be taken and disincorporated. Portions of the towns were annexed to nearby towns. As land takings proceeded, it became apparent that the Town of Dana would lose so much territory to the project that it would also have to be disincorporated. The Act required MDWSC to pay Hampshire County $55,000 as compensation for the loss of taxation or any other losses associated with the annexation of its towns.[210] A total of 2,500 persons were forced to move out of the area.[211]

Finally, any Swift River fire or water district or town could continue taking the same quantity of water from the Swift River watershed as it had previously taken. The location of the town or district works for diversions made after the passage of the Swift River Act would be determined by agreement between the town or district and MDC. Any such town or district was required to compensate the Commonwealth, via the MDC account, for damages to all land, structures, and other property owned by the Commonwealth incurred as a result of the taking. Also, the town or district was required to pay the Commonwealth fair proportions of the costs incurred by MDWSC in acquiring the waters of the Swift River and for the construction, maintenance, and operation of the works and structures on the Swift River, including the costs of maintaining the purity of the water. If the amount of payment

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[208] *Ibid.* at § 5.

[209] *Ibid.* at §§ 8-10.

[210] *Ibid.* at § 20.

[211] Nesson, *supra*, note 29, p. 72.

could not be agreed upon by the two parties, a determination would be made by an appointed master of the Supreme Judicial Court.[212]

Up to $50 million in State bonds could be issued to pay for the Swift River project,[213] which consisted of an extension of the Wachusett-Coldbrook tunnel to the Swift River and the construction of a 412 billion gallon reservoir in the Swift River Valley. By 1928, much of the preliminary work on the Ware River project was completed; however, completion of the projects was delayed by one final obstacle: a suit in the U.S. Supreme Court.

THE BATTLE IN THE U.S. SUPREME COURT: *CONNECTICUT V. MASSACHUSETTS*

The Ware and Swift Rivers are both tributaries of the Chicopee River, which flows into the Connecticut River. The Connecticut flows down the center of the State of Connecticut to Long Island Sound (see Figure 10). The river's extreme importance to Connecticut prompted the State to oppose the Goodnough plan. Connecticut had threatened as early as 1926 to sue Massachusetts if it passed the bills permitting the Ware and Swift River diversions.[214] In 1929, Connecticut filed a suit against the Commonwealth of Massachusetts in the U.S. Supreme Court to enjoin Massachusetts from making the Ware and Swift River diversions.[215]

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[212] Massachusetts General Court, *Acts of 1927*, Chapter 321, § 22.

[213] *Ibid.* at § 27.

[214] Greene, *supra*, note 42, p. 44.

[215] 51 S.Ct. 286 at 286 (1931).

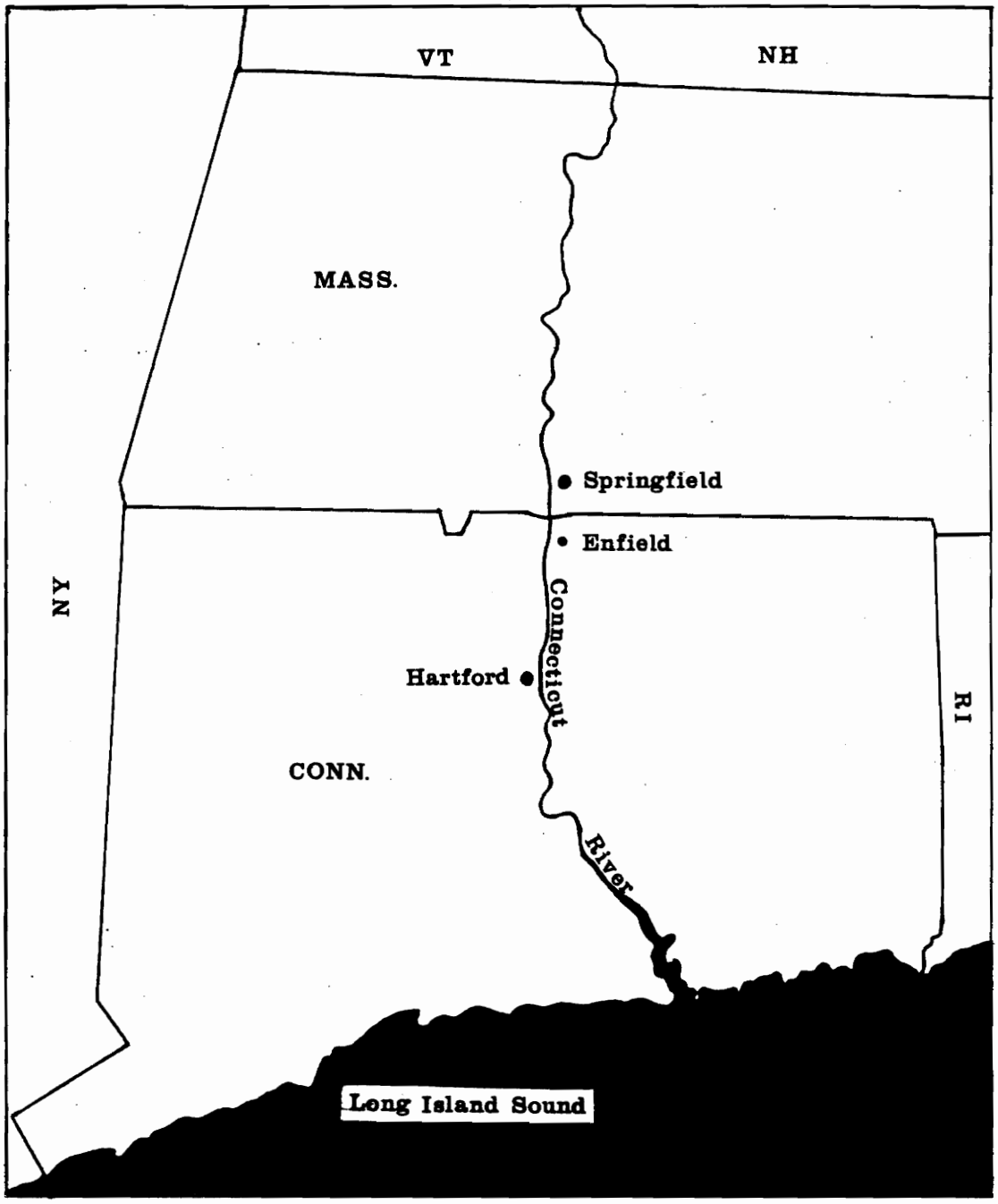

Figure 10. The Connecticut River through Massachusetts and Connecticut

Connecticut's Arguments

Connecticut's suit raised the issue of the allocation of the waters of an interstate river. Connecticut appeared before the court as owner of riparian lands along the Connecticut River and of the bed of the river and as *parens patriae*. Connecticut argued that any interbasin transfer of waters out of the Connecticut watershed would cause serious damage to the State and her people by impairing navigation on the river, lessening productivity of river bottom lands by diminishing flood flows, diminishing the potential power development at the King's Island power plant in Connecticut, interfering with the river's shad run, and decreasing the capacity of the river to assimilate waste.[216]

Connecticut alleged that Massachusetts could find an adequate water supply for the Boston metropolitan area among the waters of eastern Massachusetts and pointed out that the Ware-Swift diversions were only one step in a larger plan adopted by the Commonwealth. The plan, Connecticut argued, called for the transfer of waters from other tributaries of the Connecticut in the future and would lead to further injury of the State and its citizens.[217]

Massachusetts' Defense

Massachusetts was well prepared to defend its actions. MDWSC had been required by the War Department to apply for a permit to divert the waters of the Ware and Swift in accordance with the Department's regulations concerning navigable streams. Permit provisions disallowed diversion of the Ware River between mid-June and mid-October, and a formula for determining the required release

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[216] *Ibid.*, p. 287.

[217] *Ibid.*

of water from the Swift River reservoir was based upon a minimum streamflow requirement in the Connecticut River during the summer months. The minimum flow of the Swift was set at 20 mgd. Between June 1 and November 30, however, the Secretary required a release of 71 mgd from the impounding dam when the flow of the Connecticut at Sunderland, Massachusetts, 20 miles north of the point of confluence of the Chicopee and the Connecticut, is 4,650 cubic feet per second (cfs) or less, and a release of 45 mgd when the flow is between 4,650 cfs and 4,900 cfs. These restrictions permitted diversions of 191 mgd, a quantity amounting to 2 percent of the average yearly flow of the Connecticut River at the Massachusetts-Connecticut border.[218]

Based upon these constraints Massachusetts claimed that the amount of water to be taken would be negligible. It claimed that the "state of emergency" existing in Massachusetts justified the transfers as a reasonable use of the waters. According to Massachusetts, the projects would stabilize the flow of the Connecticut, bringing more good than harm to the lower riparians. On the other hand, disallowing the diversions would have caused considerable damage to the Commonwealth and its citizens. Massachusetts stated that it had no intention of going beyond the provisions of the Secretary of War.[219]

The Special Master's Findings

Charles W. Bunn of Minnesota was appointed as Special Master for the Court. His findings were decidedly in favor of Massachusetts. He began with the premise that the Boston area's need for an

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[218] *Ibid.*, pp. 287-288.

[219] *Ibid.*, p. 287.

additional water supply was indisputable.[220] Then, citing the requirements of the Secretary of War, he stated that the projects would not interfere with navigation of the Connecticut. In regard to the spring floods, Bunn found that the diversion would reduce the height by one to six inches. This reduction would cause some damage to hay land, naturally irrigated by overflow, but the damages could not be shown to be large. In addition, the reduction in flooding would have some advantages due to the stabilization of streamflow.[221]

The Special Master found that Connecticut failed to show that diversion of the Ware and the Swift would be materially harmful to the shad run in the Connecticut River or that the diversions would perceptibly increase pollution in the stream. The only potential downstream injury caused by the transfers was to the King's Island power plant. The plant was authorized to build a dam which could increase its power generating capabilities from 4,000 horsepower to 50,000 horsepower. If the alterations were made, the diversion would cause $80,000 in damage. The power company, however, had not shown any intent to act upon its authorization.[222]

Finally, Bunn dismissed the idea of requiring Boston and the Metropolitan District to develop eastern Massachusetts sources and purify the waters for municipal use. Considering two separate plans submitted by Connecticut for utilizing eastern sources, he found both inferior to the Ware-Swift proposals. As it reported the findings of the Special Master, the Court's language supporting the Ware-Swift proposal sounded strikingly similar to that of Goodnough and the Joint Board.

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220 *Ibid.*

221 *Ibid.*, p. 288.

222 *Ibid.*

Concerning a plan involving use of water from 15 watersheds on the Assabet, Sudbury, Shawsheen, and Ipswich Rivers, the Court stated:

> The plan involves pumping and also treatment of the water for its purification. From an engineering standpoint it is inferior to that adopted for the Ware-Swift development. And, while a considerable amount of water from these sources may be made available, most of it is of a quality much inferior to the waters of the Ware and Swift.[223]

The Court assessed the second plan, taking water from the Merrimack River, in the following manner:

> That stream drains a large watershed mainly in New Hampshire. It is polluted and the pollution is practically beyond the control of Massachusetts. There is no certainty of its improvement or that it will not become worse. Unquestionably, polluted water may be made wholesome by proper treatment. A considerable amount of industrial waste from mills, cellulose plants, tanneries, rendering works, and gas works, of which there are many in New Hampshire, is peculiarly difficult to eliminate from water. The necessary treatment of waters so polluted involves several processes -- storage for 30 to 90 days in a large reservoir, aeration, filtration, chlorination. These introduce a human element subject to weaknesses and failures of human nature. Instances of breakdowns are given. There is a small element of danger involved in every elaborate system of water purification. With a single exception, all the witnesses expressed preference for a supply of originally pure water over a purified polluted one.[224]

Ruling of the Court

As one may expect from the Special Master's findings, the Supreme Court decided in favor of Massachusetts. Connecticut insisted that the traditional rules of riparianism, the applicable doctrine of water law in both Connecticut and Massachusetts, be applied to the case at hand and that an

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[223] *Ibid.*

[224] *Ibid.*, pp. 288-289.

injunction against any diversions from the watersheds of the Ware and Swift be granted on the grounds that such diversions would be unreasonable under riparian law. Unfortunately for Connecticut, the Court decided that the fact that Connecticut and Massachusetts operated under the rules of riparianism did not bind the Supreme Court to make a ruling based upon that doctrine. According to the Court:

> . . . the laws in respect of riparian rights that happen to be effective for the time being in both States do not necessarily constitute a dependable guide or just basis for the decision of controversies such as that here presented. The rules of the common law on that subject do not obtain in all the States of the union, and there are variations in their application. The doctrine of appropriation prevails in some States. And every State is free to change its laws governing riparian ownership and to permit the appropriation of flowing waters for such purposes as it may deem wise.[225]

The Court went on to explain how the question was to be decided:

> . . . such disputes are to be settled on the basis of equality of right. But this is not to say that there must be an equal division of the waters of an interstate stream among the States through which it flows. It means that the principles of right and equity shall be applied having regard to the "equal level or plane on which all the States stand, in point of power and right, under our constitutional system" and that, upon a consideration of the pertinent laws of the contending States and all other relevant facts, this court will determine what is an equitable apportionment of the use of such waters.[226]

The Court also refused to issue an injunction on the grounds that future injury might occur to the King's Island power plant or on Connecticut's fears that Massachusetts would seek to divert other streams in the future. The power plant had not shown intent to expand its production capability, nor

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[225] *Ibid.*, p. 289.

[226] *Ibid.*

had Massachusetts shown intent to exceed the limits for diversion set upon it by the War Department.[227] The Court could not issue an injunction in the absence of actual or presently threatened injury or on the basis of "something merely feared as liable to occur at some indefinite time in the future."[228] Dismissal of Connecticut's complaint was made without prejudice to Connecticut's right to bring suit against Massachusetts in the event that its interests were injured or under the threat of being injured due to an increase in the amount of water diverted by Massachusetts over the authorized amount.[229]

The Court summed up its view of the water supply question with language that supported the long standing views of Massachusetts water supply planners:

> Drinking and other domestic purposes are the highest uses of water. An ample supply of wholesome water is essential. Massachusetts, after elaborate research, decided to take the waters of the Ware and Swift rather than to rely on the sources in the eastern part of the Commonwealth where all are or are liable to become polluted. We need not advert to other considerations, disclosed by the evidence and findings, to show that the proposed use of the waters of the Ware and Swift should not be enjoined.[230]

With Massachusetts' victory in court, serious work on the projects began. The Ware works were completed and began supplying water to the Metropolitan District on March 20, 1931. Intensive construction work on Quabbin Reservoir, as it was named in 1932, began in 1936.[231]

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[227] *Ibid.*, p. 290.

[228] *Ibid.*, p. 291.

[229] *Ibid.*

[230] *Ibid.*, p. 290.

[231] Greene, *supra*, note 42, p. 79.

THE WARE AND QUABBIN WORKS

The Quabbin works consist of the 412 billion gallon Quabbin Reservoir in the Swift River Valley, the dams impounding the water, and the aqueducts for diversion of the water. Quabbin's waters are impounded by the Windsor Dam, 2,640 feet long and 170 feet above the bed on the Swift River, and the Quabbin Dike, 2,140 feet long and 135 feet above the bed of Beaver Brook. Diversion of the water is accomplished by means of the Quabbin Aqueduct, a 24.6 mile aqueduct connecting Quabbin Reservoir with Wachusett Reservoir. The tunnel passes under the Ware River at Barre where provision is made for the diversion of Ware River water. The Ware Intake Works are at an elevation higher than Quabbin Reservoir. Thus, Ware River water may be diverted by gravity westerly for storage in Quabbin Reservoir before passing back through the tunnel to Wachusett Reservoir.[232] Quabbin began to fill on August 14, 1939. It took 7 years to fill the reservoir, which began supplying the Metropolitan District in 1946. (Figure 11 shows the Metropolitan District as of 1946.) After Quabbin went on line, Lake Cochituate and parts of the Sudbury system were abandoned as permanent water supply sources and retained only for emergency use.

The total cost of the Ware and Swift projects was $50.3 million, less than the amount budgeted. MDWSC purchased 104,210 acres of land from the Ware and Swift River watersheds at a total cost of $10,307,638 or $98.91 per acre. Thus, real estate purchases amounted to about 22 percent of the overall cost of the projects.[233]

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[232] Karl R. Kennison, "Water Supply Developments in Boston, Massachusetts and Recent Additions to the Works," *Journal of the New England Water Works Association*, Vol. 60, No. 3, Boston, MA, September 1946, pp. 302-306.

[233] James A. Christenson, "Real Estate Acquisitions for Metropolitan Boston's Water Supply," *Journal of the New England Water Works Association*, Vol. 59, No. 3, Boston, MA, June 1945, p. 139.

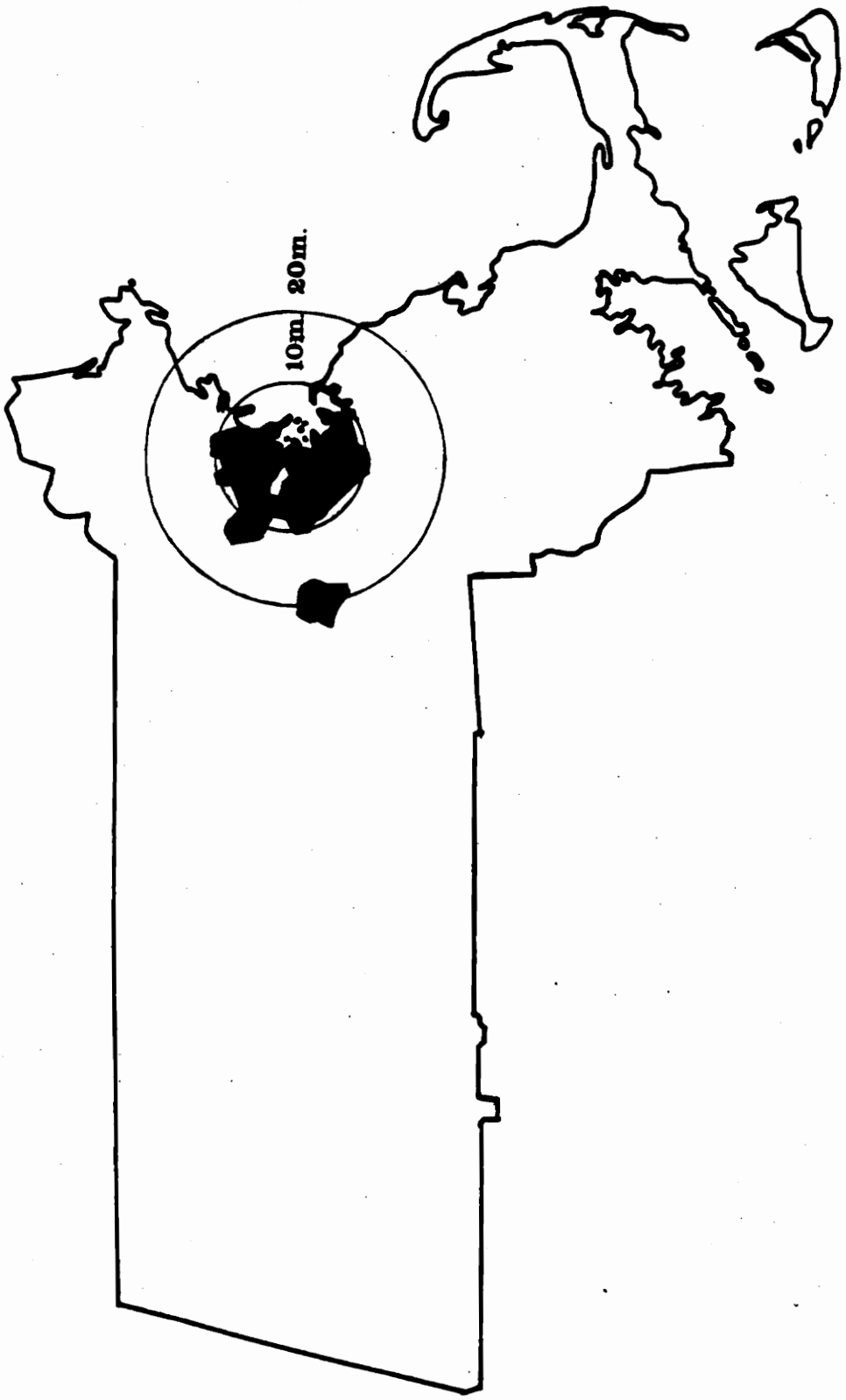

Figure 11. The Metropolitan District in 1946

MDWSC also constructed additions to the metropolitan distribution system, including the Hultman Tunnel, running from the terminus of the Wachusett Aqueduct to Weston, and the City Tunnel extension, connecting the Hultman Aqueduct to Chestnut Hill Reservoir and continuing on to serve communities north of Boston. Figure 12 illustrates MDWSC's additions to the Boston metropolitan water supply system. MDWSC was abolished by the General Court in 1947, and its duties and functions were transferred to MDC.[234] Today Quabbin Reservoir is the major water supply source for the Boston metropolitan area. Because of its vast size and the large tracts of land which were purchased by MDWSC for the purpose of protecting the reservoir, it serves as a refuge for many species of wildlife.

THE IMPORTANCE OF THE WARE-SWIFT DEBATES: CHANGING PUBLIC VALUES

The debates leading to the choice of the Ware and Swift Rivers as water supplies for the Boston area are important in the history of water supply policy and planning in Massachusetts for two major reasons: they mark the climax of the influence of water supply engineers and experts on major water management decisions in the State of Massachusetts, and they present four issues that later formed the foundation for major changes in State water supply policy.

Climax of the Engineers' and Experts' Influence

Political support for the Ware and Swift proposals from the populous and powerful eastern portion of the state, not to mention the approval from the authors of competing proposals, helped guarantee their implementation. But, the question of why the proposals received support in the first place when

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[234] Massachusetts General Court, *Acts of 1947*, Chapter 583.

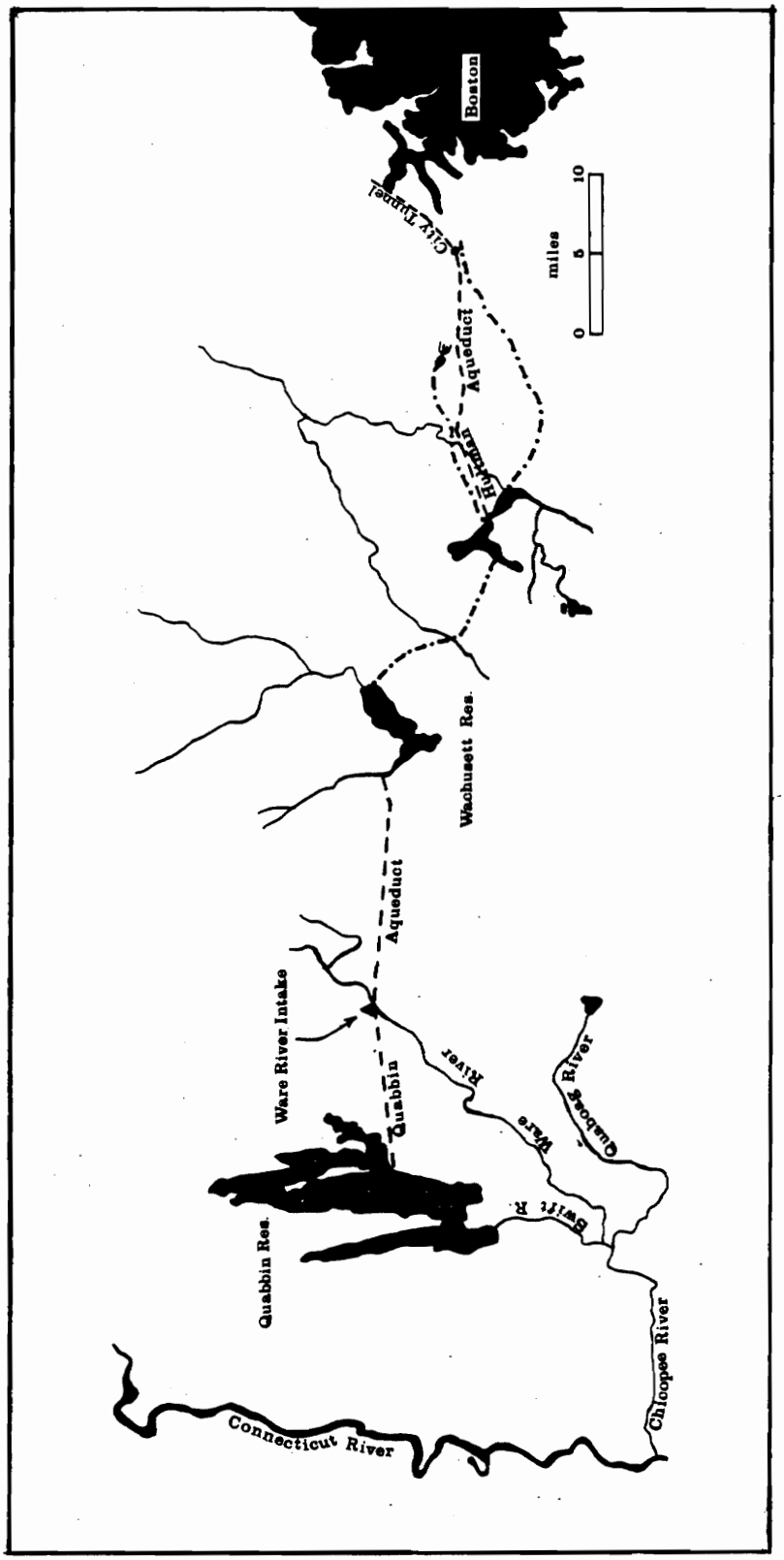

Figure 12. MDWSC Additions to the Boston Metropolitan Area Water Supply System (Source: MWRA Water System Map.)

filtration of eastern sources was a less costly and, by 1926, a safe and reliable method of supplying water requires a broader answer. Nesson argues that the answer lies in the ability of the engineers to create a public demand for pure, unfiltered water in unlimited quantities.[235] The "experts" testified that providing unfiltered water to Boston was the best solution. As in the past, the majority of the public trusted these experts and, eventually came to demand the unfiltered water which they had been given in the past and which the engineers proposed to give them once again. Even the U.S. Supreme Court agreed that plans involving pumping and filtration were inferior to the Ware-Swift proposals.

The engineers were able to gain approval for their plans by framing the water supply issues as a choice between abundant, naturally pure water supplies and limited, filtered supplies. Their cause was assisted further by their ability to remove any industrial opposition by proposing compensatory reservoirs to meet the needs of affected industries. The engineers, like the general public, were interested in industrial expansion and economic growth, even at the cost of extensive flooding of small towns and residential areas.[236]

Also, the General Court realized that construction of the Ware and Swift projects was a good investment, despite the high initial costs. Selection of the Ware Diversion and Quabbin Reservoir projects was a logical decision on the part of the legislature. Passage of the Ware and Swift River Supply Acts, however, marked the climax of the influence of experts and engineers on major water management decisions in Massachusetts.

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[235] Nesson, *supra*, note 29, pp. 80-81.

[236] *Ibid.*, p. 83.

Seeds of Change for Massachusetts Water Supply Policy

At first glance, it appears that the Ware-Swift debates and the resulting decision to construct the projects as proposed would have served only to further cement the policy of meeting uncontrolled demand for water with new sources of pure, unfiltered supply from regions progressively farther west of Boston. Four key issues were raised in the debates, though, that planted the seeds of change for Massachusetts water supply policy.

The four issues, the "fairness" of interbasin transfer of water from western to eastern Massachusetts, environmental degradation of water resources, lowering water demand by reducing waste, and questions about the soundness of expert recommendations had only been briefly considered in the past if considered at all. But, in the nine years of legislative and public hearings and debates, the introduction of the Goodnough plan to the General Court, and the Supreme Court case of *State of Connecticut v. Commonwealth of Massachusetts*, these four issues presented important challenges to the Massachusetts water supply policy and management strategy.

Plans for supplying the Boston metropolitan area with pure water from western Massachusetts had no real political opposition in the 1800s, but the joint efforts of Swift River Valley residents and mill owners on the Ware and Chicopee Rivers in the early 1920s were successful in blocking progression of Ware and Swift project implementation until 1924. Only after Charles Gow had convinced the mill owners that the planned compensatory reservoirs would meet their needs, and the Swift River towns stood alone in opposition to the reservoir, was the eventual implementation of the projects assured.[237] The chief concern of the towns shifted to getting adequate compensation for their

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[237] *Ibid*, p. 74

properties. Valley residents resolved themselves to the fact that the diversions would take place and simply wanted to get out with the best possible deal they could. The issue, however, had been raised. MDC could no longer make plans to take western Massachusetts waters without a fight. In fact, the next time MDC proposed a westward extension of its system, it got more organized resistance than it expected from western Massachusetts interests.

A second issue, which had been of no concern previously but was at least touched upon in the Ware-Swift debates, was environmental damage caused by diversion. Though the Supreme Court dismissed Connecticut's claims in favor of the paramount need to supply Boston with drinking water, Connecticut raised some important questions concerning the effects of a reduction in streamflow on the Connecticut River. Connecticut was worried about possible damage to the shad run and reduction of the assimilative capacity of the stream as well as having the usual concerns of the time for the effects of streamflow reduction on instream uses like power generation and navigation. While there was certainly not a high level of environmental consciousness at the time the Ware and Swift River proposals were considered, there was some understanding of the need to protect streams such as the Connecticut River and the natural processes dependent upon their sustained flow.

The third issue, demand management, was brought into the arena of debate through James Bailey's minority report for the Joint Board. Bailey made a strong statement in his report urging efforts to reduce waste of water in the Metropolitan District before seeking to augment water supply. He was opposed to the assumptions of the Joint Board and of previous water supply studies that consumers should have an unlimited supply of water at their disposal. Instead, he called for voluntary conservation measures to be instituted.[238] Though Mr. Bailey's ideas were dismissed at the time,

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[238] Metropolitan District Commission, *supra*, note 24, p. 24.

they eventually became prevailing public values and now form the cornerstone of Massachusetts water supply policy.

Fourth, for the first time, expert recommendations were seriously questioned by lay persons. Representative Sawyer of Ware and the State of Connecticut raised strong objections to Goodnough's recommendations and even questioned the validity and completeness of his studies. Of course, both Sawyer's district and the State of Connecticut would suffer negative impacts when the Ware and Swift proposals were implemented; therefore, it was in their representatives' best interest to oppose the projects. Yet, this criticism marks the first intance where the technical expertise of the Massachusetts water supply professionals was seriously questioned by parties outside the water supply engineering field.

The three major concerns raised by opponents of the Ware and Swift diversions were dismissed in favor of the priority of providing a naturally pure, abundant supply of water to the Boston metropolitan area. In the 1960s and 1970s, however, these four issues resurfaced when the MDC proposed another westward extension of its water supply system. At that time, these concerns had a profound impact upon the outcome of the water supply decision and on the formation of new water supply policy for the Commonwealth.

CHAPTER FIVE

THE TURNING POINT IN MASSACHUSETTS WATER SUPPLY POLICY

The northeastern United States experienced a sustained drought in the mid-1960s that severely threatened the MDC water supply system in Massachusetts. By 1966, Quabbin Reservoir was at one half of its capacity with most of this drop occurring between 1964 and 1966. Adding to the problems from lack of precipitation and runoff was an increase in per capita consumption that raised total consumption from 239 mgd in 1959 to 284 mgd in 1966.[239] These figures were alarming enough to send MDC searching for a solution to anticipated water supply problems.

THE NORTHFIELD MOUNTAIN PROPOSAL

Since the 1700s, Boston had chosen water supply augmentation each time demand threatened to exceed supply. In the late 1960s, MDC operated with the same strategy. Continuing on the course set by Stearns in his 1895 report, MDC looked westward beyond Quabbin and proposed a Connecticut River diversion.

MDC's Diversion Plans

Northeast Utilities, a holding company for four Connecticut Valley utilities, formulated a plan in the early 1960s to build a pumped storage project on the Connecticut River at Northfield Mountain in Erving, Massachusetts. The pumped storage project operates by drawing water out of the Connecticut

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[239] Edward R. Kaynor, *Connecticut River Water Resource Decision-Making*, Massachusetts Water Resources Research Center Publication No. 83, University of Massachusetts, Amherst, MA, 1976, p.87.

River and pumping it to a reservoir on the mountain 800 feet above river level. Pumping takes place when consumer demand for electricity is low and the wholesale price of electricity, which must be purchased by the company for pumping, is also low. When consumer demand is at its peak, Northeast Utilities releases the water, allowing it to fall over turbines at the base of the mountain. The company is then able to generate electricity and sell it at peak prices.[240] In order to obtain licensing for the Northfield project from the Federal Power Commission, Northeast Utilities needed to meet the prerequisite of developing a multipurpose project. This prerequisite exists to provide for public water-use benefits from projects such as Northfield.[241] First, Northeast Utilities developed a plan to create recreational benefits, but Howard Caldwell, President of Western Massachusetts Electric, one of the four companies included in Northeast Utilities, suggested that one possible additional benefit of the project was water supply. The company went to the City of Springfield with the suggestion of using the storage in its upper reservoir for water supply purposes, but was turned down. Subsequently, the same offer was made to MDC. Worried about the drawdown of the Quabbin, MDC accepted Northeast Utilities' offer.[242]

Northeast Utilities offered to divert up to 375 mgd of water from the Northfield reservoir to Quabbin. The diversion would require that the dam for the upper reservoir be built four feet higher than needed for power generating purposes only. A 9.8 mile aqueduct was proposed to carry the water by

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[240] Charles Stephenson, "Interstate Rights to the Waters of the Connecticut River: Issues Raised by the Proposed Northfield Diversion," *Western New England Law Review*, Vol. 4, pp. 645-646.

[241] Michael Augustino DeFalco, *A History of the Proposed Northfield Diversion Project*, A Staff Publication of the Massachusetts Steering Committee for the Connecticut River/The Northfield Citizen's Advisory Committee, Staff Report No. 2, February 14, 1980, p. 5.

[242] Edward R. Kaynor, Staff Associate, Massachusetts Water Resources Research Center, University of Massachusetts, Amherst, MA, personal communication, July 24, 1989.

gravity to Quabbin, 450 feet below the elevation of the Northfield reservoir.[243] Figure 13 illustrates the proposed Northfield Diversion.

MDC prepared a bill for the legislature requesting $25 million for the Northfield project. Northeast Utilities received licensing from the Federal Power Commission to build its pumped storage facility, and the Northfield Diversion was authorized by the Massachusetts legislature. The Act provided MDC with $25 million for further carrying out the water supply projects and works authorized by previous acts of the legislature and for developing the Northfield project.[244]

Critical Delays in Implementation

MDC spent $14 million of its funding on its existing distribution system and was left with a balance of only $11 million. So, it went back to the legislature in 1969 with a request for more funding. Meanwhile, negotiations between MDC and Northeast Utilities had reached an impasse. Difficulties with Northeast Utilities prompted MDC to ask the legislature to allow the agency to build its own pumping station and tunnel elsewhere on the Connecticut River.[245]

MDC's failure to act after receiving initial authorization and funding for the project in 1967 proved to be a critical delay; when the new bill came to the attention of the active Springfield Conservation Commission, the Commission rallied emerging environmental forces to organize legislators in the

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[243] Kaynor (1976), *supra*, note 239, p. 89.

[244] Massachusetts General Court, *Acts of 1967*, Chapter 699.

[245] *Ibid.*

Connecticut River Alternative

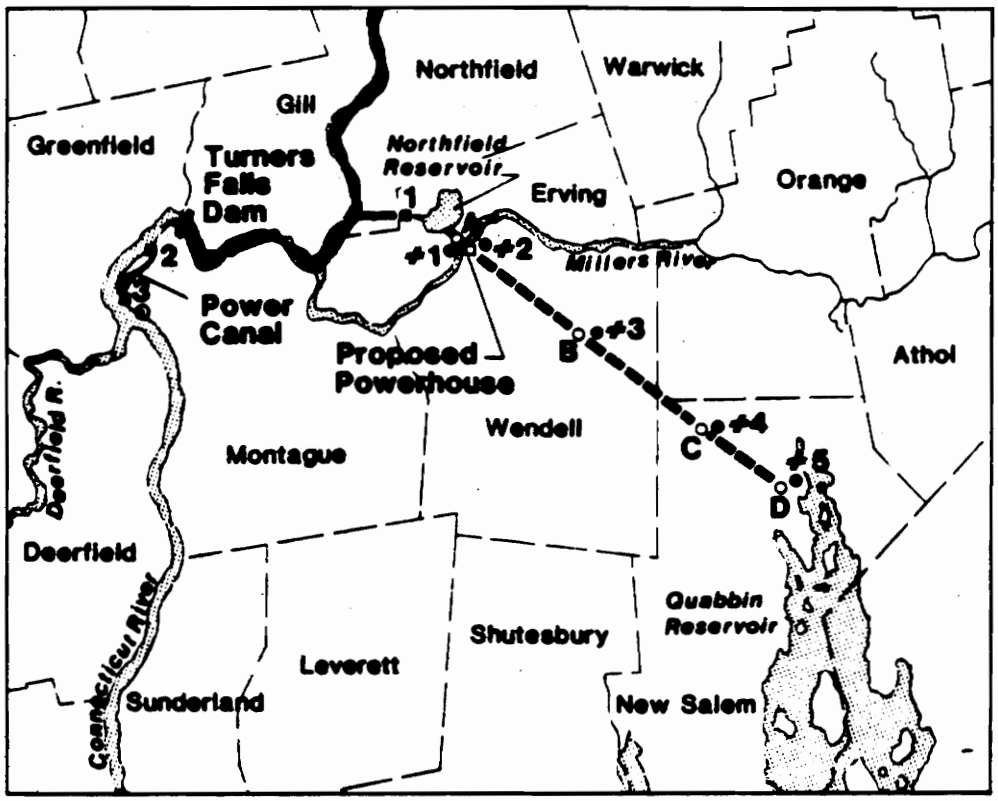

Figure 13. Proposed Connecticut River Diversion at Northfield Mountain (Source: MWRA, *Water Supply Study and EIR-2020: Summary Report*, p. 3.)

Connecticut Valley in opposition to the bill.[246] The legislature responded by forming a special study commission to investigate the proposal and report its findings at the following legislative session.[247]

The special commission held hearings on the proposal in the Connecticut Valley in February 1970. On April 8, it filed a report recommending the Northfield Diversion using a "flood skimming" technique. The report proposed that MDC be allowed to divert up to 375 mgd when the flow of water in the Connecticut was greater than 17,000 cubic feet per second (cfs) at Montague City. The legislature amended the diversion bill to restrict diversion to the Northfield site and to days when the 17,000 cfs minimum flow standard was achieved.[248] Official estimates stated that the restrictions would allow a diversion of 72 mgd.[249] Fear of contamination of Connecticut River water from a nuclear power plant under construction 13 miles upstream from Northfield in Vernon, Vermont further delayed passage of the bill. Hearings led to a partial resolution of this issue through promises of monitoring.[250] On August 25, 1970, the act passed;[251] however, by that time, the environ-

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[246] Defalco, *supra*, note 241, p. 6.

[247] Edward R. Kaynor, "Historical, Political, and Social Factors Affecting Public Policy on River Diversion: Out-of-Basin Diversion of Connecticut River Flood Waters to the Boston Metropolitan Area," *Formation of Public Policy on Issue of Out of Basin Diversion of Connecticut River Flood Waters to Boston Metropolitan Area*, Bernard B. Berger, principal investigator, Massachusetts Water Resources Research Center Publication No. 28, University of Massachusetts, Amherst, MA, 1972, pp. A-1 to A-2.

[248] *Ibid.*, p. A-3.

[249] Kaynor (1976), *supra* note 239, p. 95.

[250] *Ibid.*, p.92.

[251] Massachusetts General Court, *Acts of 1970*, Chapter 766.

mental movement in Massachusetts was gaining strength and was powerful enough to exert substantial influence in determining the fate of the project.

MDC felt that if it were unable to transfer water from the Connecticut River, it would simply not have enough water for its users. MDC estimated that the safe yield of its system was 300 mgd; water use had consistently exceeded that level since the late 1960s. In the past, MDC's statement that it needed more water might have been enough to secure additional supplies for the district. In fact, had the Commission pursued implementation of the plan after receiving legislative authorization in 1967, there would likely be a Connecticut River diversion today.[252]

While MDC hesitated to act, environmental and citizens groups in western Massachusetts and Connecticut prepared for a fight. Their actions succeeded in delaying passage of the second Northfield bill until August 1970. The impact of the delay was largely due to its timing, for in the period between the introduction of the 1969 bill and its passage in late 1970 the United States Congress passed the National Environmental Policy Act (NEPA).[253]

NEPA became a factor in the MDC diversion proposals through the involvement of the U.S. Army Corps of Engineers. NEPA requires that all Federal agencies proposing actions with significant environmental effects identify and evaluate all of the potential environmental impacts of the action and prepare a list of alternatives to the proposed action. The Corps of Engineers had recommended the Northfield Diversion in 1974 as a part of its *Northeastern Water Supply Study*. The same study

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[252] Stephen Estes-Smargiassi, Program Manager, Long Range Water Supply Program, Massachusetts Water Resources Authority, Boston, MA, personal communication, July 26, 1989.

[253] Title 42 *USCA* Sec. 4321 *et. seq.*

recommended additional diversions to Quabbin Reservoir of 24 mgd from the Tully flood control dam on the east branch of the Tully River and 52 mgd from the Millers River. The Corps estimated a need of an additional 141 mgd for the MDC system by 1990. The recommended diversions would add an additional 148 mgd to the system.[254] After NEPA was passed, the Corps' studies had to be amended with Environmental Impact Statements.

Then, in 1972, the legislature passed the Massachusetts Environmental Policy Act (MEPA).[255] MEPA requirements include the following:

> All agencies, departments, boards, commissions and authorities of the commonwealth shall review, evaluate and determine the impact of the natural environment of all works, projects or activities conducted by them and shall use all practicable means and measures to minimize damage to the environment.[256]

The law also allows the Secretary of Environmental Affairs (the head of Massachusetts' environmental regulatory agency) to require the preparation of a full Environmental Impact Report (EIR) by any person applying to an agency for a permit or financial assistance for a project or by an agency proposing a project if, by the nature and location of the project, it is likely to cause damage to the environment.[257] The law requires that an EIR contain the following:

> . . . statements describing the nature and extent of the proposed project and its environmental impact; all measures being utilized to minimize environmental

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[254] Edward R. Kaynor, *supra*, note 96, pp. 46-47.

[255] *Massachusetts General Laws Annotated*, Chapter 30, §§ 61-62H (1979).

[256] *Ibid.*, at § 61.

[257] *Ibid.* at § 62A.

> damage; any adverse short-term and long-term environmental consequences which cannot be avoided should the project be undertaken; and reasonable alternatives to the proposed project and their environmental consequences.[258]

If the Secretary designates a project as a "Major and Complicated Project," the Secretary, with the agreement of the party proposing the project, is authorized to "establish a specific procedure for the evaluation and review of the environmental impacts of the project."[259]

MDC began slowly working through the investigation and reporting of the anticipated environmental effects of the project, fully expecting the eventual implementation of its plans. Part of the reason for MDC's casual approach to implementing the Northfield Diversion was that Quabbin began refilling in the 1970s. A series of "wet years" between 1972 and 1976 allowed the reservoir to recover substantially from the drought, despite an increase in MDC water usage from 268 mgd in 1967 to 338 mgd in 1977.[260] Meanwhile, environmental consciousness in the State of Massachusetts and citizen awareness of the possible consequences of MDC's proposed actions were growing.

RISING OPPOSITION TO THE NORTHFIELD PROPOSAL

MDC claimed that there would be no significant environmental damage resulting from the Northfield Diversion; environmentalists and western Massachusetts citizens questioned that view. There was concern over the proposed taking of the Connecticut's flow. Environmentalists claimed that the spring freshet provides for natural cleansing of the river and estuary. A reduction in the flow of the

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[258] *Ibid.* at § 62B.

[259] *Ibid.* at § 62A.

[260] Kaynor (1976), *supra*, note 239, p. 88.

Connecticut would result in a reduction in the assimilating capacity of the stream and increased salinity in the lower Connecticut basin. The spring flooding also helps to maintain flood plain swamps, marshes and forests. The effect of diversion on the aquatic life of the river was another concern. Environmentalists pointed to the possible harmful effects of the diversion on the anadromous fish in the river, particularly American shad and Atlantic salmon.[261] Other major environmental objections to the project stemmed from the fact that the diversion would transfer "Class B" water from the Connecticut River to the "Class A" Quabbin Reservoir. There was tremendous concern over the potential harmful effects on Quabbin's fisheries if lamprey eels were transferred into the reservoir from the Connecticut River. Possible contamination from the Vernon Nuclear Power Plant was still an issue, as were the increased turbidity and accelerated rate of eutrophication of Quabbin water if Connecticut River water were introduced.[262]

Environmental issues were not all that stimulated opposition to the Northfield Diversion. The political schism that had long existed between eastern and western Massachusetts was widened by the actions of MDC and helped create opposition in the western communities.[263] The methods by which MDC had arrived at their projected figures of future water demand were highly suspect and under intense scrutiny by citizens groups in the western part of the State, which viewed MDC's actions as attempts to fulfill Frederic Stearns's water supply policies and plans:

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[261] Robie Hubley, Environmental Advocate, Massachusetts Audobon Society, Lincoln, MA, personal communication, July 25, 1989.

[262] A.D. Dawson and E.M. Hartman, "The Northfield Alternative," Water Supply Citizens Advisory Committee Newsletter, August 1983, p.3.

[263] Kaynor (1976), *supra*, note 239, p. 92.

> Not only is MDC alive and well, but its water supply amplification efforts of the past have been the result of what is generally conceded to be imaginative, anticipatory planning implemented through a series of orderly and prudent actions. Even present supply augmentation plans amount to the logical completion of a broad plan first promulgated in 1895.[264]

Estimates of MDC's water need by the year 1990 ranged from 70 mgd to 141 mgd above the 300 mgd safe yield of the system, as calculated by the Corps and MDC.[265] A report indicating the possibility of tremendous waste in the MDC system led to part of the outrage at MDC's request for this additional supply. In order to fulfill obligations of its enabling act, MDC awarded a contract to the Massachusetts Water Resources Research Center in 1974 to study the water use in its member communities. The Research Center subcontracted the field work to Curran Associates, Inc. of Northampton, Massachusetts.[266] The so-called Curran report, issued in 1975, showed a large discrepancy between the quantity of water that could be accounted for by MDC communities and the amount of water sold by MDC. The difference was on the order of 80-90 mgd.[267] These figures raised cries in western Massachusetts of, "MDC wants to take 70 mgd of water from the Connecticut and let it flow down the streets of Boston."[268]

The Corps' study of the Tully-Millers Diversions aroused more suspicions. The study, requested by MDC, was "evidence" to the Northfield Diversion opponents that MDC would not keep a previously

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[264] Kaynor (1978), *supra*, note 96, p. 12.

[265] *Ibid.*, pp. 54-55.

[266] *Ibid.*, p. 56.

[267] Kaynor (1976), *supra*, note 239, p. 94.

[268] Estes-Smargiassi, *supra*, note 252.

made promise to limit the amount of water it would divert.[269] People feared that if the Northfield Diversion were implemented, increasing the level of MDC supply, the demand for water would rise to meet the level of supply and bring about the "need" for another transfer.

One final complication facing MDC involved Northeast Utilities. In 1973, the Northfield station began generating electricity. Northeast Utilities had made provision for the MDC diversion when it constructed its facility; but, once the company had received the necessary permits to proceed with construction, the diversion proposal was no longer a vital part of the plan. Northeast Utilities had a strong position from which to bargain with MDC. It demanded that MDC submit itself to compulsory arbitration on disputed issues of the Northfield proposal. A bill in the legislature which would have given MDC this "right" died in committee, leaving MDC unable to negotiate with Northeast Utilities.[270]

Opposition from citizens and environmental groups to the taking of western water for eastern water supply had grown steadily throughout the 1970s; but, it was not until late in the decade that action the State government took action to block implementation of the Northfield plan.

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[269] Kaynor (1976), *supra*, note 239, p. 92.

[270] Kaynor (1972), *supra*, note 247, p. A-3.

NORTHFIELD IMPLEMENTATION BLOCKED

The Massachusetts State Government was organized to create gubernatorial secretariats in 1969.[271] One of the secretariats created was the Secretary of Environmental Affairs. Reorganization of Massachusetts' natural resource programs in 1974 gave the Secretary authority over most resource-oriented agencies of the state.[272] The Executive Office of Environmental Affairs (EOEA) now has principal authority and oversight of the state's natural resource policies and regulations. Figure 14 illustrates the structure of the Massachusetts EOEA.

In 1975, EOEA and the Massachusetts Water Resources Research Center sponsored a number of seminars on Massachusetts state water supply planning. The seminar participants concluded that the State needed a set of water supply policies that would "provide the framework for intensive, yet flexible, project planning to meet projected water needs through the year 2020."[273]

In 1976, Evelyn Murphy, then Secretary of Environmental Affairs, began a study of Massachusetts water supply with the goal of producing a collection of principles to guide State water policy decisions. Secretary Murphy and EOEA wanted this set of principles to recognize the importance of water supply to the public health and economic welfare of the State, but also relate to overall water resources concerns such as water quality, ecological systems, recreation and wastewater facilities.[274]

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[271] Massachusetts General Court, *Acts of 1969*, Chapter 704.

[272] Kaynor (1978), *supra*, note 96, p. 9.

[273] Massachusetts Water Resources Commission, *Massachusetts Water Supply Policy Statement: 1984 Update*, Boston, MA, August 1984, p. 1.

[274] *Ibid.*

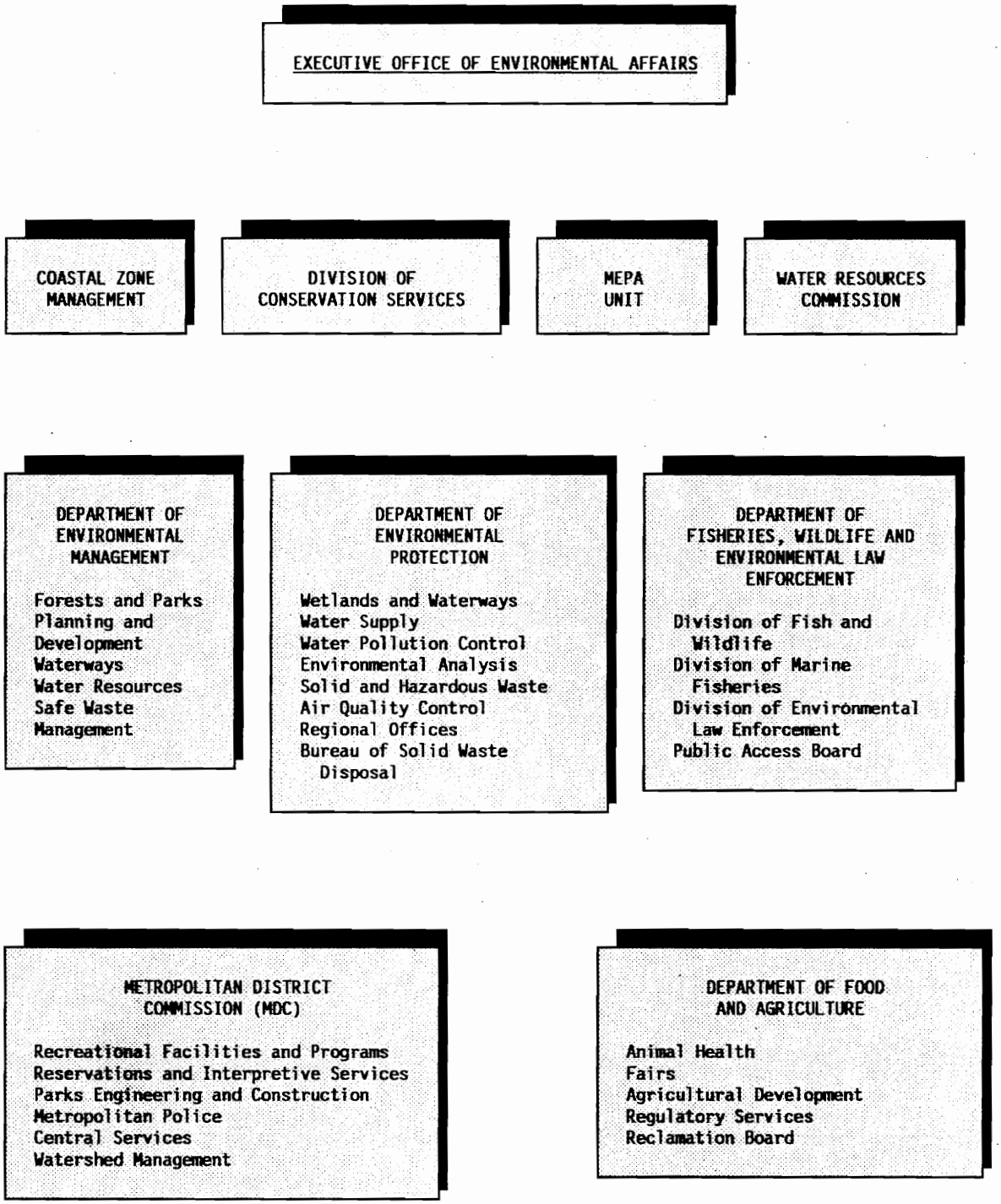

Figure 14. Structure of the Massachusetts Executive Office of Environmental Affairs

The result of the analysis was the *Draft Massachusetts Water Supply Study*, issued in January 1977. The Draft Study recommended policies, programs and actions that were subject to extensive review through the MEPA process. One action supported by the Draft Study was the Northfield Diversion. The Draft Study judged the Northfield Diversion as the most cost effective and environmentally sound solution for increasing MDC's water supply.

In response to the report, the Massachusetts Steering Committee on the Connecticut River, an organization created to organize Connecticut Valley communities for the purposes of evaluating and voicing their opinions on issues affecting the Connecticut Valley, and the Connecticut River Committee, a similar organization in the State of Connecticut, issued a statement of opposition to the diversion until the following conditions were met:

(1) Comprehensive scientific, planning and legal studies are conducted to insure that valley interests are protected;

(2) A system of water quality monitoring is established in the lower Connecticut River;

(3) An institutional mechanism for making regional policy decisions bearing on riverine resources and rights is initiated.[275]

This statement and further criticism of the report prompted Secretary Murphy to reject the recommendation of the Northfield Diversion and direct MDC to prepare an EIR on the Northfield project. She said that interbasin transfers were an option for municipalities seeking water supply, but only as a last resort:

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[275] Defalco, *supra*, note 241, p. 9.

> Interbasin transfers will be considered and approved only upon showing of necessity including convincing evidence . . . that effective water conservation measures have been instituted . . .[276]

On June 27, 1978, the Massachusetts House and Senate passed a resolution opposing the Northfield Diversion unless all other feasible alternatives were exhausted, including conservation. The final version of the *Massachusetts Water Supply Study* was adopted in May 1978 by the Governor and the Massachusetts Water Resources Commission as the *Massachusetts Water Supply Policy Statement.* The *Statement* supported the same policies as the legislature's resolution on the Northfield proposal.[277]

In December 1977, Secretary Murphy, MDC, and the Massachusetts Steering Committee on the Connecticut River signed a "Memorandum of Understanding" creating the Water Supply Citizens Advisory Committee (WSCAC).[278] In January 1979, Secretary Murphy established a declaration, through the MEPA process, designating the Northfield Diversion as a "Major and Complicated Project." The declaration was added as an amendment to the "Memorandum of Understanding." Under this agreement, WSCAC was directed to play a formal advisory role in the environmental review process of the Northfield proposal. The process included: review of the MDC's "Request for Proposal" on EIR services, selection of consultants, determining the scope of services for the consultant, pre-review of important EIR draft sections, pre-review of the draft EIR, and formal review and comment on the final EIR.[279]

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[276] Kaynor (1978), *supra*, note 96, p. 54.

[277] Defalco, *supra*, note 241, pp.10-11.

[278] The original name of WSCAC was the Northfield Citizens Advisory Committee.

[279] Water Supply Citizens Advisory Committee (WSCAC), "History and Function of WSCAC", p. 1.

In 1979, under the "Agreement on Major and Complicated Project," the scope of the report was expanded to include the study and evaluation of a total of nine alternatives. These nine alternatives were evaluated on the basis of incremental yield, costs, implementation time, engineering and operational characteristics, physical environmental impacts, ecological environmental impacts, and socio-economic impacts. The alternatives are: 1) demand management, 2) no action, 3) Connecticut River, 4) Millers/Tully Rivers, 5) watershed management, 6) Merrimack River, 7) Upper Sudbury Watershed, 8) User Sources, and 9) Plymouth aquifer. (For a description of each alternative see Appendix C.) WSCAC acted as a "watchdog" throughout the study, which was renamed as the *Long Range Water Supply Study and EIR -- 2020.* WSCAC suggested changes in the way some aspects of the study were conducted and commented on conclusions drawn from the study.

By the end of the 1970s in Massachusetts, public values and public opinion regarding water resources management had dramatically shifted from the values and opinions of earlier years. The rise of the environmental movement had caused many to carefully consider the potential ecological effects of proposed development projects. In addition, the public no longer completely trusted engineers and other water supply professionals to make the best decisions. Their recommendations were closely scrutinized and sharply contested by citizen groups and environmentalists. No longer did the people of western Massachusetts give up "their water" for the "greater good" of the City. On the contrary, western Massachusetts was outraged at Boston's request for more water and organized themselves to fight the transfer proposal.

The *Massachusetts Water Supply Policy Statement* provides solid evidence of a turning point in Massachusetts water supply policy and management strategies in response to these changing public values. The incorporation of thorough ecological and socio-economic impact evaluations, the

inclusion of conservation and demand management alternatives in the scope of the *Long Range Water Supply Study and EIR -- 2020*, and the creation of WSCAC as a "watchdog" citizens' committee to overview, assist in, and comment on preparation of the study are also strong indicators of this change. As the 1980s approached, Massachusetts made a significant departure from its old water supply policy of allowing demand to grow unchecked and meeting it with large, pure sources of water supply promoted by a group of professionals within the State bureaucracy. Throughout the 1980s, legislation, regulations, and programs adopted statewide and in the Boston metropolitan area restructured the institutional framework governing water supply management in response to the broad changes in publicly held values and the growth in influence of environmental and citizens' interest groups.

CHAPTER SIX

NEW DIRECTIONS IN WATER SUPPLY POLICY AND MANAGEMENT: THE WATER RESOURCES COMMISSION

Throughout the late 1970s and the 1980s, Massachusetts began forming the foundation of a comprehensive water supply policy tied to a Statewide water resources management program. The Massachusetts Water Resources Commission has played a major role in establishing State water supply policy and in coordinating the water resources management program.

OVERVIEW OF THE WATER RESOURCES COMMISSION'S ROLE

The Massachusetts Water Resources Commission (WRC) was created by a legislative act in 1956.[280] WRC was chaired by the Commissioner of Natural Resources and was given authority to supervise and control the Division of Water Resources, established within the Department of Natural Resources by the same act. The powers and duties of WRC were defined as follows:

> The commission shall meet and consult on matters concerning watersheds, water systems, storage basins, both natural and artificial, underground and surface water supplies, and shall study the needs, supplies and resources of the commonwealth with respect to water conservation and flood prevention. The commission shall hold hearings for these purposes at times and places convenient to the public and shall from time to time make recommendations for legislation designed to provide the commonwealth with a basic water policy based upon the common and interdependent interests of agriculture, industry, recreation, wild life, conservation, domestic consumption and flood prevention. It shall act as a coordinating agency between all departments of the commonwealth and shall co-operate with the agencies of the federal government and all other states in carrying out water conservation and flood prevention programs. . . .[281]

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[280] *Massachusetts General Laws Annotated*, Chapter 21, § 8 (1990).

[281] *Ibid.* at § 9.

WRC was placed within the Executive Office of Environmental Affairs (EOEA) when EOEA was created in 1969. It was not until 1983, however, that the legislature firmly established WRC's lead role in forming Massachusetts water supply policy and coordinating water resources planning and management in the Commonwealth. The reorganized WRC consists of the Commissioner of the Department of Environmental Protection (formerly the Department of Environmental Quality Engineering or DEQE),[282] the Commissioner of the Department of Environmental Management, the Commissioner of the Metropolitan District Commission, the Commissioner of the Department of Fisheries, Wildlife and Environmental Law Enforcement, the Commissioner of the Department of Food and Agriculture, the Secretary of the Executive Office of Communities and Development, and six qualified persons appointed by the Governor to represent six major types of water users. The Secretary of EOEA serves as Chairman of WRC and brings the total membership number to 13 persons.[283]

The 1983 legislation expanded WRC's authority over water resources decisionmaking. WRC's duties include the following:

- Development of a water resources management policy framework within which the water resource policies, plans and management programs of the several agencies and departments under the secretary shall function;
- Coordination of water resources planning and management functions among the several agencies and departments under the secretary;
- Review and comment on all policies brought before the commission;

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[282] DEQE was renamed the Department of Environmental Protection in July 1989. Although the water resources legislation and regulations discussed in this paper were enacted and promulgated when the department was known as DEQE, the name DEP, the current name of the department, will be used throughout this paper.

[283] *Massachusetts General Laws Annotated*, Chapter 21A, § 8A, (1989).

- Annual review and comment on all programs relating to water resource management of the several agencies and departments under the secretary;
- Establishment of criteria and priorities for all water resource-related cooperative programs with the federal government, with any other state, or with any executive office, department, or division of the commonwealth;
- Development and periodic updating of comprehensive water resource management plans for river basins, giving consideration to regional and statewide needs and to integration of waste-water management into water resource planning;
- Development of water allocation criteria which takes into account demographic, hydrologic, and environmental characteristics;
- Development of a management information system and data processing capability for the central collection, storage and retrieval of water resource management information. Further, the commission may be responsible for dissemination of said information to the several agencies and departments under the secretary, to other state agencies and to the public on request. A fee may be charged for retrieval of information from said system; and
- Development of an education program which encourages broad public participation at both municipal and regional levels, with emphasis on encouragement of long term water resource and wastewater planning and management by municipalities and by regional planning agencies.[284]

WRC has assumed specific responsibilities for establishing and coordinating water supply policy and water resources planning and management in the Commonwealth. In its 1983 enabling legislation, WRC was given the task of updating the *Massachusetts Water Supply Policy Statement* at five year intervals.[285] In December 1983, the Massachusetts legislature passed the "Massachusetts Interbasin Transfer Act,"[286] which gave WRC the authority to regulate certain interbasin transfers in the Commonwealth. In addition to these duties, WRC is responsible for overseeing the development of State and local water resources management plans.

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[284] *Ibid.* at § 8B.

[285] *Ibid.* at § 8C.

[286] *Ibid.* at §§ 8B-8D

THE MASSACHUSETTS WATER SUPPLY POLICY STATEMENT UPDATE

In 1983, WRC established an in-house task force to fulfill its responsibility of updating the *Massachusetts Water Supply Policy Statement*.[287] WRC completed and approved a draft update of the *Massachusetts Water Supply Policy Statement* (the Update) in January 1984.[288] The Update centers around the philosophy that the State should ensure the availability of water for the Commonwealth's current and future consumptive and non-consumptive uses. This philosophy acknowledges the imbalance between the availability and quality of water supply and the patterns of growth and development in the State and recognizes "the importance of water to the economic and environmental well being of the state and a paramount concern for ensuring public health and safety."[289]

At first glance, the water supply philosophy of the 1984 Update could be interpreted as language that supports the historic water supply augmentation policies of the former Massachusetts health agencies. A closer look at the actual policies enumerated in the Update, however, reveals that a markedly different water supply policy has been adopted. The Update advocates a "balanced" approach to providing for water supply. Rather than concentrating solely on water supply augmentation, the Update encourages demand management measures and long-range water supply planning and management measures.[290]

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[287] *Ibid.*

[288] Massachusetts Water Resources Commission, *supra*, note 273, p. 2.

[289] *Ibid.*, p. 3.

[290] *Ibid.*, p. 4.

The Update calls for a Statewide demand management program to promote and guide demand reduction. The program includes measures such as extensive metering; leak detection and leak repair programs; rehabilitation of metering and distribution systems; support of retrofitting with water saving devices; water recycling and installation of water saving equipment in industries, businesses, and institutions; setting water rates that reflect the actual cost of delivering the water; establishment of enterprise accounts; requirement of a local demand management program prior to state approval of emergency water connections; and public conservation education programs.[291]

The Update goes well beyond a policy of locating naturally pure sources of water to augment supply and promotes sound management of existing sources. It encourages water utility systems and other water suppliers to take measures to protect existing water supply sources. It also promotes development or expansion of existing sources where environmentally and economically feasible rather than development of new sources. If new sources must be developed, the Update encourages suppliers to draw upon sources in their own basins rather than increase the rate of interbasin transfer from another basin.[292]

The Update urges localities to develop management plans for local supplies and watersheds. Plans should include multiple uses of water sources, where consistent with health and safety concerns, and provide standards and means of monitoring minimum streamflows and maximum withdrawals from water sources. Localities should strongly consider the possible impacts of land use decisions on current and potential future water supplies.[293] Thorough water management plans are essential

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[291] *Ibid.*, p. 6.

[292] *Ibid.*, pp. 4-5.

[293] *Ibid.*, p. 5.

for coordinating local planning and decisionmaking in this manner. Communities are urged to restrain new growth until they determine that a safe and sufficient water supply is available to service the new demand. Where necessary and feasible, regional water supply systems should be developed. At the least, communities should have contingency plans for emergency connections and mutual aid among communities in case of water shortages.[294]

Massachusetts water policy relies heavily upon action at the local level to meet policy goals; yet, it promotes strong State government influence, centralized within WRC, in water supply planning and management through legislation, regulations, and State programs. The aim is to establish a water supply policy framework that reaches across agency boundaries; to develop comprehensive water resource management plans on a Statewide, regional, and basin-wide scale; and to establish water allocation criteria that consider demographic, hydrologic, and environmental characteristics of the particular regions involved.[295]

WRC's primary responsibility for water supply planning and policy formation includes:

- Ensuring that policies and regulations written to implement departmental programs are reviewed for consistency with state water policies;
- Carrying out state level responsibilities for broad, long-range water supply planning using defined watershed basins for analysis. Continuing to implement the (313 CMR 2.00) water resources planning regulations;[296]

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[294] *Ibid.*

[295] *Ibid.*, p. 7.

[296] See the subsection *Water Resources Management Planning* in this chapter for a discussion of these regulations.

- Establishing and coordinating a process for the implementation of a comprehensive water supply management program consisting of planning and data collection; source protection, expansion, rehabilitation and development; demand management and system maintenance at the local, regional and state levels.

- Being available to mediate intra-state, inter-community disputes over water resource related issues at the request of the parties involved.[297]

Since its creation in 1956, WRC's mission has been to engage in developing sound water resources management policy and programs. WRC's strength and influence in these areas have grown over the past three decades.

THE INTERBASIN TRANSFER ACT

The policies outlined in the first *Massachusetts Water Supply Policy Statement* in 1978 and the support of a number of citizens and some State agency officials led to the passage of the "Massachusetts Interbasin Transfer Act," (IBT Act) in 1983,[298] then known as "An Act to Protect the Connecticut River."[299] The IBT Act was first introduced to the legislature in 1978 in much the same form as it was passed in 1983.[300]

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[297] Massachusetts Water Resources Commission, *supra*, note 273, p. 8.

[298] *Massachusetts General Laws Annotated*, Chapter 21, §§ 8B-8D (1990).

[299] Elizabeth Kline, Executive Director, Massachusetts Water Resources Commission, Boston, MA, personal communication, July 26, 1989.

[300] Water Supply Citizens Advisory Committee, "WSCAC Newsletter," Hadley, MA, February 1984, p.1.

Requirements of the Interbasin Transfer Act and Regulations

The IBT Act is a reflection of the change in publicly held values that occured in the late 1970s and early 1980s and the growing consensus that water supply planning in Massachusetts should be tied to Statewide water resources management. Substantial input into the drafts of the interbasin transfer legislation came from WSCAC as well as legislators from the Connecticut and Merrimack River Valleys. Their influence guaranteed that the IBT Act would include strict conservation and demand management requirements. WSCAC and several environmental organizations lobbied for the passage of the bill.[301]

The IBT Act itself is brief and straightforward. Any significant increase over the current rate of interbasin transfers of surface or groundwaters, including wastewater, of any river basin must be approved by WRC (apart from certain exempted transfers and emergency connections). Emergency connections must be approved under special provisions of the *Massachusetts General Laws*.[302]

The IBT Act allows public input into WRC's decision through public hearings. At least two hearings must be held, one in the proposed receiving basin and one in the proposed donor basin, before WRC may reach a decision to approve or deny a proposed transfer. A report must also be filed with the clerks of the legislature. The legislature retained a provision added to the Massachusetts General Laws in 1973 stating that "no river or stream may hereafter be diverted for water supply purposes

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[301] Robie Hubley, *supra*, note 231.

[302] These connections may be made for six months of any calendar year. An emergency exists at the determination of the Department of Environmental Protection (DEP). See *Massachusetts General Laws Annotated*, Chapter 40, §§ 40, 41A.

outside its own basin without the express approval of the general court."[303] Thus, it appears that legislative approval, as well as WRC approval, is necessary for any interbasin transfer for water supply purposes. Furthermore, the IBT Act requires compliance with the "Massachusetts Environmental Policy Act" and the "Massachusetts State Administrative Procedure Act."[304] MEPA regulations require that an environmental impact report be filed for any interbasin transfer over five million gallons per day.

WRC has the authority to determine the significance or insignificance of a proposed interbasin transfer. WRC decision-making criteria are based upon the impact to the donor basin. The law itself, however, states that no increase over one million gallons per day may be deemed insignificant. The IBT Act also made WRC responsible for promulgating rules and regulations to delineate the State's river basins and to establish application procedures and criteria for the approval or disapproval of proposed interbasin transfers.

WRC created the Water Resources Planning Task Force to help develop interbasin transfer regulations. Representatives from the agencies within EOEA, Federal water planning agencies, regional planning agencies, environmental organizations, watershed associations, and the water supply industry are all part of the Task Force, which continues to assist the commission in water resources planning and management. Departments within EOEA and superintendents of municipal water supply systems provided additional input to the interbasin transfer regulations. After six drafts and

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303 *Massachusetts General Laws Annotated*, Chapter 21, § 17B (1990).

304 *Ibid.* at § 8D.

five public hearings, the "Interbasin Transfer Regulations" (IBT Regulations) were officially promulgated on July 11, 1985.[305]

The IBT Regulations define twenty-seven river basins within the Commonwealth and the Massachusetts Coastal Basin, a twenty-eighth basin consisting of "all areas within the Commonwealth lying below the mean high tide elevation."[306] Figure 15 shows each of the twenty-eight basins. WRC used the report *Hydrological Characteristics of Massachusetts Streams*, published jointly by the United States Geological Survey and WRC, to define the basins.[307] A redefinition of the boundaries may be made based upon research of the United States Geological Survey and the Massachusetts Division of Water Pollution Control.[308]

The IBT Regulations are written to affect any person proposing action to cause an increase in the present rate of interbasin transfer of surface or groundwater, or anyone proposing a capital improvement that could reasonably be expected to increase the capacity to make an interbasin transfer. An interbasin transfer is defined as "any transfer of surface water or groundwater of the Commonwealth outside of a river basin, as defined by the Commission (WRC)."[309] The statute provides an exemption, however, for intra-town, interbasin transfers. A transfer must not only cross one of the defined basin boundaries, but a municipal boundary line as well in order to be considered

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[305] Massachusetts Department of Environmental Management, Division of Water Resources, *A Guide to the Application of the Interbasin Transfer Act and Regulations*, Boston, MA, December 1985, p. 2.

[306] 313 *Code of Massachusetts Regulations* 4.00 at 4.03.

[307] *Ibid.* at 4.02.

[308] Massachusetts Department of Environmental Management, *supra*, note 305, p. 4.

[309] 313 *Code of Massachusetts Regulations* 4.00 at 4.01, 4.02.

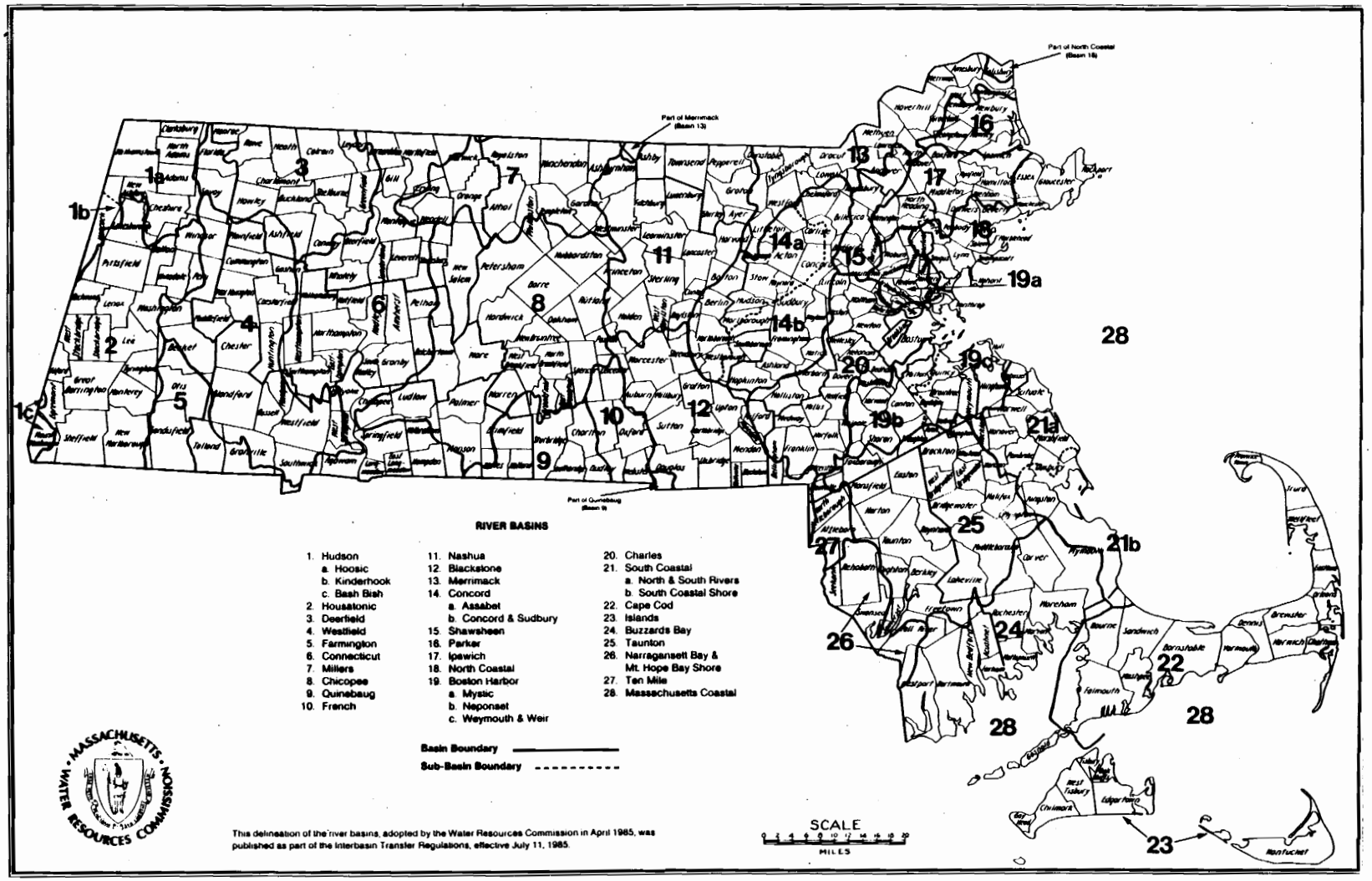

Figure 15. Massachusetts River Basins (Source: Executive Office of Environmental Affairs, Water Resources Commission.)

an interbasin transfer under the law. Extension of water services to a portion of a municipality outside of the river basin from which the municipality withdraws the water is not an interbasin transfer and is not regulated by the IBT Act. Thus, in order to be "interbasin" for the purposes of the IBT Act, a transfer must be "interjurisdictional" as well.[310] Figure 16 illustrates an example of an exempted intra-town transfer.

General permitting procedures require that any person proposing an increase in the present rate of interbasin transfer file either a request for determination of applicability or insignificance or apply directly to WRC for approval of the proposed action.[311] WRC reviews a proposed action to determine whether or not it is an interbasin transfer and, for proposed increases of less than one million gallons per day over the present rate of interbasin transfer, to determine if it is significant. The process for determination of applicability and/or insignificance is shown in Table 1. If the proposed transfer is deemed significant and the IBT Act is applicable, a second level of the review process is engaged. This second level of review, the interbasin transfer approval process, is outlined in Table 2. Transfers in place before the effective date of the IBT Act are not affected by the Act. WRC reviews interbasin transfer applications based on criteria outlined in the IBT Act and the IBT Regulations.

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[310] Massachusetts Department of Environmental Management, *supra*, note 305, pp. 5-6.

[311] 313 *Code of Massachusetts Regulations* 4.00 at 4.04, §§ 1-2.

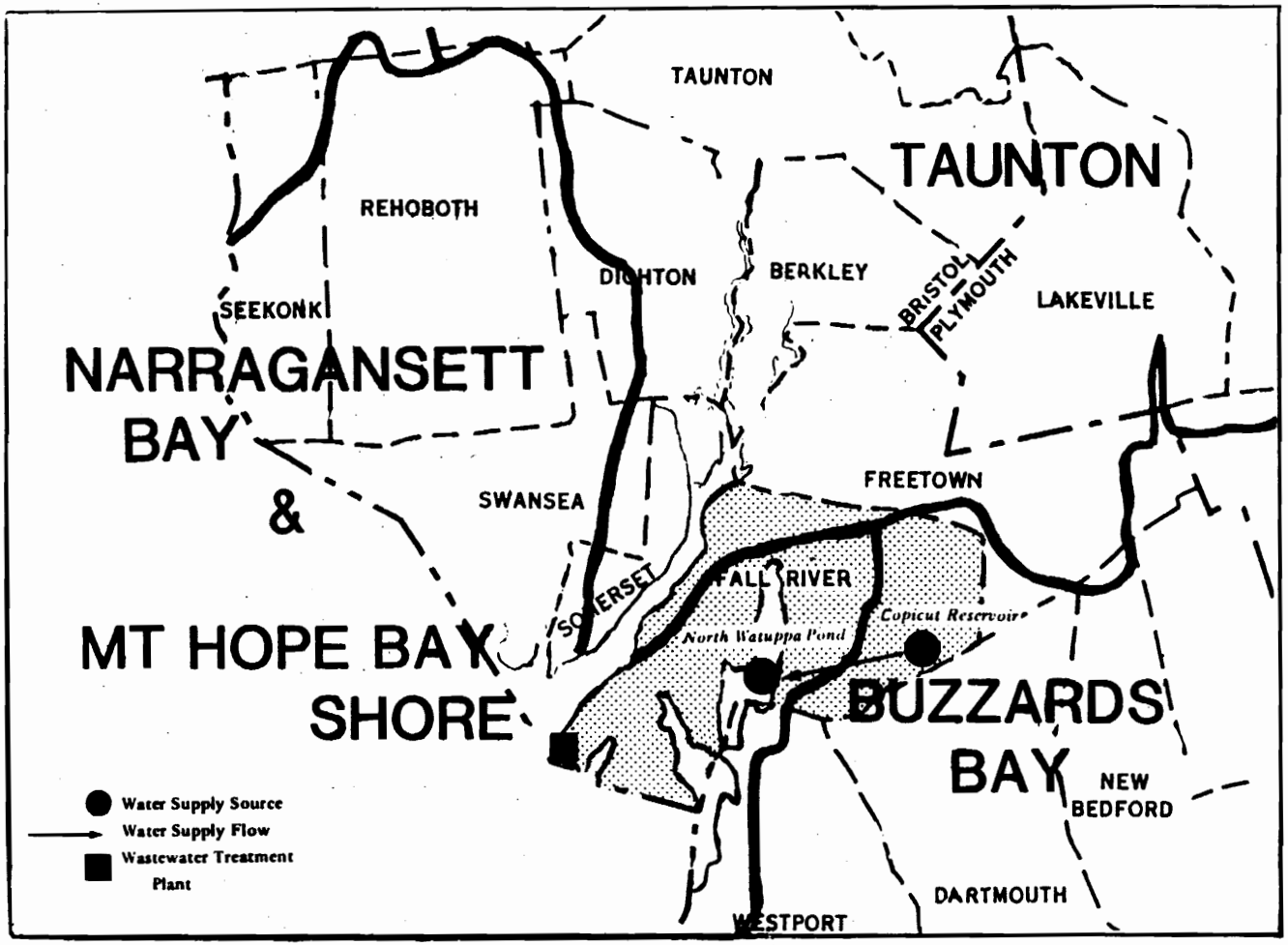

Figure 16. Exempted Intra-Town Transfer (Source: Massachusetts Department of Environmental Management, *A Guide to the Application of the Interbasin Transfer Act Regulations*, p. 6.)

Table 1. Determination of Applicability and/or Insignificance of the IBT Act (Source: Massachusetts Department of Environmental Management, A Guide to the Application of the Interbasin Transfer Act and Regulations, p. 10.)

STEPS	TIME PERIOD
1. **Request for Determination** prepared on form available from WRC.	
2. **Notice of Receipt** of the request published in the MEPA Environmental Monitor and sent to the municipalities directly affected.	Within 31 days after receipt of request.
3. **Request Reviewed** and staff recommendation prepared; additional information can be requested by WRC.	
4. **Determination of Insignificance** made by WRC; decision must receive majority roll call vote during a public meeting of the WRC.	Within 90 days of receipt of request or of receipt of requested additional information.
5. **Requester Notified** of WRC action.	
6. **WRC Determination** with reasons for decisions printed in the MEPA Environmental Monitor	

Table 2. Interbasin Transfer Approval Process (Source: Massachusetts Department of Environmental Management, A Guide to the Application of the Interbasin Transfer Act and Regulations, pp. 11-12.)

STEPS	TIME PERIOD
1. Preapplication Conference Proponents of a proposed action meet with WRC staff for informal Discussions early in project planning process.	
2. Coordination with MEPA a. MEPA and WRC staff and proponents hold joint scoping session(s) where feasible and desired by the parties. b. If proposed action requires completion of an Environmental Impact Report (EIR), the data required by these regulations should be prepared, to the extent possible, as a component of the EIR.	
3. Receipt of Application Application for Approval prepared on application form available from WRC.	
4. Notice in MEPA Monitor Notice of the Receipt of application published by WRC staff in Environmental Monitor, and a copy of the notice mailed to the affected communities.	
5. Request for Additional Information Additional information as it deems necessary to conduct this review may be requested of proponents, other appropriate persons or agencies.	
6. Complete Application WRC makes a determination that application is complete.	

Table 2. Interbasin Transfer Approval Process (Continued)

7. MEPA Compliance If MEPA review of proposed interbasin transfer is required, WRC hearings held only after the Secretary of Environmental Affairs issues a Letter of Compliance.	
8. Public Hearings a. Notice of hearing published by WRC staff in Environmental Monitor, a newspaper in general circulation in donor and receiving areas with a mailing of same to appropriate local and regional officials. b. Two public hearings, one in the donor area and one in receiving area, conducted by WRC staff. Additional public hearings may be required by The Commission.	Within 60 days of a determination that the application is complete or that all requested additional information has been received, or within 60 days after MEPA compliance if it is required and more than 21 days after publication of hearing notice in MEPA Monitor.
9. WRC Staff Review a. Application, additional information submitted, MEPA documents, hearing records reviewed and recommendation prepared by WRC staff. b. Review period may be extended upon written consent of WRC and applicant for a mutually agreed upon period.	
10. WRC Decision Approval or disapproval of proposed interbasin transfer by WRC requires a majority roll call vote during a public meeting.	Within 60 days of completing the hearings.
11. Filing of Commission Decision Written report by WRC staff of the findings and justification of its decision filed with House and Senate Clerks and the Secretary of State.	Within 30 days of WRC final action.
12. Publication of Decision Secretary of State published decision of WRC in the Massachusetts Register.	

The legislative criteria emphasize five requirements:

(1) All reasonable efforts have been made to identify and develop all viable sources in the receiving area of the proposed interbasin transfer;

(2) All practical measures to conserve water have been taken in the receiving area;

(3) An environmental review (MEPA), pursuant to section sixty-one and section sixty-two H, inclusive, of Chapter 30 has been complied with for the proposed interbasin transfer;

(4) A comprehensive forestry management program which balances water yields, wildlife habitat and natural beauty on watershed lands presently serving the receiving area has been implemented; and

(5) A reasonable instream flow in the river from which the water is diverted is maintained.[312]

The IBT Regulations expand upon these requirements to more specifically define criteria for WRC decisions on interbasin transfer permits. Appendix D contains portions of the IBT Regulations that detail these decision making criteria, define all practical measures of conservation, and list the considerations for determining reasonable instream flow. Interpretive guidelines for the criteria were drafted by WRC in 1986 and appear in Appendix E.

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[312] Massachusetts Department of Environmental Management, *supra*, note 305, p. 2.

Application of the IBT Act and Regulations: The Brockton Case

After the IBT Act became effective on March 20, 1984, several requests for determination of applicability and/or insignificance of proposed actions were made by water users. Most of the cases resulted in a staff recommendation of non-applicability or insignificance.[313]

The first proposal for a major interbasin transfer coming under the requirements of the Interbasin Transfer Act and the accompanying regulations was made by the City of Brockton, located about 20 miles south of Boston. The proposed Brockton transfer involved taking water from the Pine and Howard Brook watershed in the South Coastal River Basin and transferring the water to Silver Lake Reservoir, the main source of Brockton's water supply. The water would then be transferred to Brockton, located in the Taunton River Basin, and eventually discharged into a tributary of the Taunton River.[314] Figure 17 illustrates Brockton's proposed interbasin transfer.

Brockton filed a four page application for its proposed transfer on June 4, 1985. WRC responded by sending the application back to Brockton detailing 29 items that required additional information. Brockton re-submitted its application in December and had it returned again for incompleteness. Finally, on April 14, 1986, WRC voted to accept the application as complete. On June 30, 1986, WRC voted unanimously to deny an interbasin transfer permit to the City of Brockton because it had not met the criteria for an approved interbasin transfer.[315] The City failed to meet the criteria for

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[313] Executive Office of Environmental Affairs, Water Resources Commission, "Implementation of the Interbasin Transfer Act and Regulations," August 1, 1985 - June 1, 1986.

[314] Kline, *supra*, note 299.

[315] Water Resources Commission, Commonwealth of Massachusetts, "Decision on Proposed Interbasin Transfer by the City of Brockton," Boston, MA, 1986, p. 1.

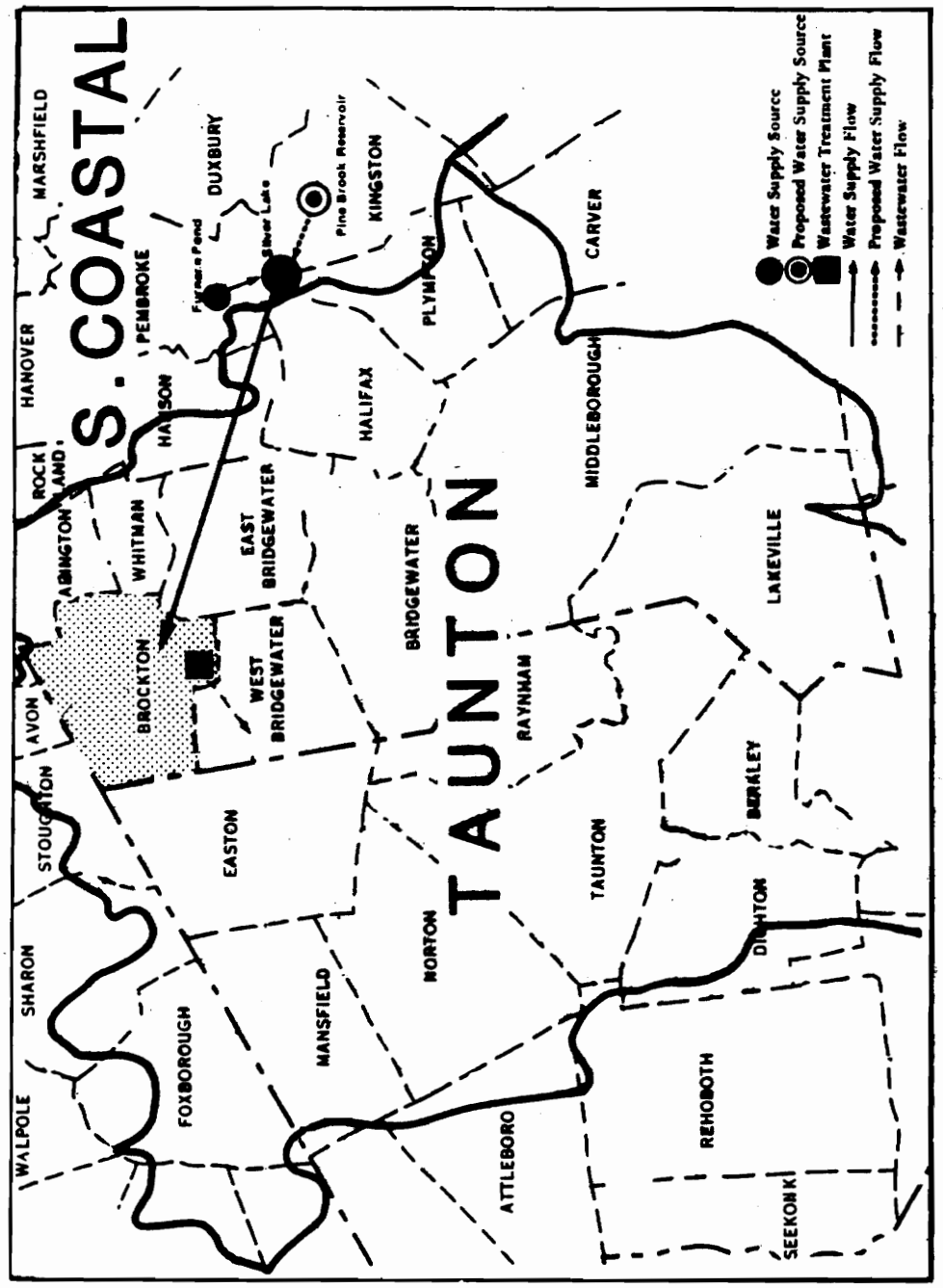

Figure 17. The Proposed Brockton Transfer (Source: Massachusetts Department of Environmental Management, *A Guide to the Application of the Interbasin Transfer Act Regulations, p. 5.)*

investigating viable sources in the receiving area, taking adequate conservation measures, implementing a comprehensive forestry management program, and guaranteeing that reasonable instream flow in the donor basin would be maintained.[316]

According to Elizabeth Kline, WRC Executive Director, Brockton had neglected its water and wastewater infrastructure. Brockton's water users had been in jeopardy of a water supply shortage for years. In 1980-1981 the situation was so serious that Brockton was within ten days of not having enough water for 125,000 users.[317] When the City realized that its water supply was far short of demand, it approached DEP and was allowed to divert water from Pine Brook to Silver Lake on an emergency basis.[318] DEP soon began putting tighter restrictions on Brockton's emergency water use. Brockton applied for the interbasin transfer seeking to entice development in its declining downtown area by adding to the City water supply. With its current supply, it could not service any growth. WRC, by denying the interbasin transfer permit, effectively told Brockton that it must not grow any more until it handled the existing problems within its water supply system.[319]

In the June decision, WRC laid out a blueprint for alleviating Brockton's water problems through conservation and through development and treatment of local sources such as Avon Reservoir. Brockton realizes that its long term need is to seek a major water supply source from the Taunton River. In the meantime, the City is trying to augment its supply enough to help alleviate its water shortage and attract development by putting a portion of the additional water toward growth. The

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316 *Ibid.*, p. 4.

317 Kline, *supra*, note 299.

318 Massachusetts Water Resources Commission, *supra*, note 315 p. 4.

319 Kline, *supra*, note 299.

State has committed itself to assisting Brockton in treating water from Avon reservoir through DEP's water filtration construction grants program. WRC has sent a message to Brockton that it must rehabilitate its system and start conserving its existing water supplies if it expects to transfer water from an out of basin source and receive help in developing long term plans for utilizing the Taunton River.[320]

Through the Brockton decision, WRC consciously set precedent for future interbasin transfer decisions.[321] The Brockton decision outlined what WRC perceives as practical conservation: development and protection of viable local sources, a strong metering leak detection program, implementation of rate structures that encourage water conservation, and a drought contingency plan. The decision gave other communities a model to follow, in addition to WRC regulations and interpretive guidelines, when considering an application for an interbasin transfer permit.[322]

WATER RESOURCES MANAGEMENT PLANNING

Following the adoption of the *Massachusetts Water Supply Policy Statement* in 1978, WRC promulgated regulations facilitating the development of water resource management plans within the State. The "Water Resource Management Planning Regulations" were officially promulgated on July 1, 1979. The purpose of the regulations is:

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320 *Ibid.*

321 *Ibid.*

322 *Ibid.*

> . . . to facilitate the development of comprehensive water resources management plans for Massachusetts and to assure that such plans are based on local, regional and state assessments of water needs and water resources; are in conformance with the Massachusetts Water Supply Policy; and are based on adequate data, aggregated by river basins. The plans are intended to provide a basis for state and federal action; to support and assist in providing for legitimate local needs for water supply, recreation, waste disposal, and other water-related uses and activities; to encourage water conservation; for flood control programs; drought contingency planning; and to provide a basis for legislative recommendations where appropriate.[323]

Under the provisions of the regulations, WRC must prepare and annually update a "State Water Resource Management Plan" and management plans for each individual river basin in Massachusetts. The plans must conform to the *Massachusetts Water Supply Policy Statement* and must be considered by all State agencies making decisions affecting the State's water resources, including resource allocation decisions, decisions on expenditure of funds, and legislative recommendations affecting water policies and programs. WRC must approve any decision made contrary to the water resources management plans. The *Massachusetts Water Supply Policy Statement: 1984 Update* refers to WRC's "Water Resources Management Planning Regulations" as "the umbrella for state water planning efforts."[324] The Update strongly supports continued development of the basin-wide and State-wide plans.

The basin-wide plans are being produced by the Division of Water Resources of the Department of Environmental Management (DEM). DEM is a part of the EOEA and is the technical support arm for WRC. The entire planning process involves interaction among State agencies, communities, and environmental organizations and agencies concerned with a particular river basin. The Water Resources Division was scheduled to complete basin-wide plans for the Ipswich, Blackstone and

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[323] 313 *Code of Massachusetts Regulations* 2.00 at 2.01.

[324] Massachusetts Water Resources Commission, *supra*, note 273, p. 4.

Charles Basins and the Hoosic portion of the Hudson Basin by the end of 1989. Plans for the Taunton and Concord Basins and the Boston Harbor sub-basins were also being produced in late 1989.[325] The steps of the Division's planning process are as follows:

(1) Inventory of the existing water supplies and demand within the basin.

(2) Projection of water demand to the year 2020 based upon population projections by regional planning agencies and the Massachusetts Institute for Social and Economic Research. Project per capita water use for various classes of users.

(3) Development of a list of alternatives to meet the projected needs, looking first at local alternatives, including conservation, and then at regional solutions, such as contracts with MWRA or river diversion.

(4) Preparation of a draft water resources management plan, selecting the best mix of alternatives for the basin. The plan is reviewed and commented upon by local, regional and state agencies, and by WRC.

(5) Preparation of the final plan.

(6) Review and adoption of the plan by WRC, perhaps with modifications.[326]

The regulations require the plans to describe measures for the full development and protection of local supplies and to establish a minimum streamflow for each of the state's 27 river basins. The minimum streamflow establishment is designed to consider the needs of Massachusetts communities and out-of-stream water users while maintaining an acceptable streamflow for instream uses such as

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[325] Michele H. Drury, Regional Planner, Commonwealth of Massachusetts, Department of Environmental Management, Division of Water Resources, Boston, MA, personal communication, July 27, 1989.

[326] Massachusetts Water Resources Commission, *Charles River Basin, Volume I: Inventory and Analysis of Current and Projected Water Use*, prepared by the Massachusetts Department of Environmental Management, Division of Water Resources, Boston, MA, July 1988, pp. vii, 1.

resident and anadromous fisheries, shellfish, recreation, wildlife habitat, wetlands, navigation, and hydroelectric power generation.[327]

The development process for the basin-wide plans is designed to integrate local water resource management plans into the basin plans. The regulations require municipalities to submit local water resource management plans that include reviews of water use, water supply, potential local sources of supply, and measures for the development, protection, and conservation of local sources.[328] The Water Resources Division considers these plans as it develops the basin-wide plans.

WRC is offering assistance to localities preparing their water resources management plans. Due to budgetary constraints, WRC is not able to offer extensive technical assistance in this area, but it has created a simple questionnaire for localities that desire help. By filling out this questionnaire, communities gain a better understanding of their flood control needs, fishery habitat needs, wetland protection concerns, and recreation needs, in addition to their water supply needs. The result of filling out the questionnaire is a simple plan of action for managing local water resources.

Presently, WRC is focusing its technical assistance efforts on the water supply portion of the plan, particularly in the area of conservation. The Water Resources Management Regulations require communities to consider, at a minimum, the following water conservation measures in developing their plans:

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[327] *Ibid.*

[328] 313 *Code of Massachusetts Regulations* 2.00 at 2.04, 2.05.

(1) Revision in local codes to maximize use of water conservation devices, water saving appliances or techniques used to reduce flows such as recycling and recovery systems;

(2) Water conservation education program;

(3) Voluntary or mandatory programs for leak detection and correction;

(4) Meter programs for full metering, and repair and replacement of defective meters; and

(5) Rehabilitation of water distribution systems.[329]

WRC has created guidebooks that explain how to develop these elements of a conservation plan, and it interacts with communities to help them develop and implement their plans.

WRC has taken the lead role in establishing water supply policy in Massachusetts and in tying water supply issues to Statewide water management planning. The IBT Act and the Water Resources Management Planning Regulations give the State strong regulatory authority over water use in general, and interbasin transfers in particular. These measures also reflect both a concern for environmental protection and protection of instream water uses and the value the State places on conservation and protection of existing water supplies. WRC's actions have led Massachusetts to adopt and implement policies and programs that are strikingly different than those adopted by the public health agencies and water supply engineers that determined water supply policy in the past.

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[329] *Ibid.* at 2.05.

CHAPTER SEVEN

NEW DIRECTIONS IN WATER SUPPLY POLICY AND MANAGEMENT: THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

The Department of Environmental Protection (DEP) was placed within EOEA through reorganization of Massachusetts' natural resources agencies in 1974. The Department of Public Health's powers and duties related to environmental protection were transferred to DEP by the act reorganizing EOEA.[330] The Bureau of Environmental Sanitation, within the Department of Public Health, had previously been assigned powers and duties relating to "environmental health, air pollution control, noise regulation, community sanitation, water supply and water quality . . . ." The Bureau's duties were transferred in whole to DEP.[331]

WATER SUPPLY SOURCE APPROVAL

An important part of each successive State health agency's responsibility of protecting water supplies was approving potential sources of municipal water supply. The Board of Health's influence in the selection of water supply sources was expanded during the late 19th century. The Board of Health's authority in such matters was upheld in a 1908 Supreme Judicial Court of Massachusetts case of *Dorr v. Inhabitants of Sharon*.[332] The case involved a petition to recover compensation for 213 acres of land, known as "Beaver Hole Meadow," taken by the Town of Sharon for the purpose of increasing and preserving its water supply. The town bought the franchises and property of a water company in 1895 and was authorized to issue bonds to retire the bonds previously issued by the water company,

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[330] Massachusetts General Court, *Acts of 1974*, Chapter 806.

[331] *Massachusetts General Laws Annotated*, Chapter 21A, § 8 (1989).

[332] 84 N.E. 446 (1908).

as well as an additional $20,000 in bonds for increasing water supply. In writing for the Court, Justice Loring stated:

> The additional issue of $20,000 authorized by section 2 are to be issued for the purpose of the original act (St. 1894, p.216, c.241) and "for the further extension and improvement of its water supply system," and is made conditional on this: "That no source of water supply for domestic purposes shall be taken under this act without the consent of the state board of health, and that the location of all drains, reservoirs and wells shall be subject to the approval of said board." The consent of the state board of health was not obtained to the taking of the 213 acres of land here in question.
>
> Apart form other possible objections we are of opinion that the taking now before us was not valid as a taking of water because the consent of the state board of health had not been obtained as required by St. 1905, p.60, c.91, section 2.[333]

In 1938, the legislature passed a law that gave the Department of Public Health (formed in 1914) full authority to approve potential public water supply sources.[334] This authority was transferred to DEP in 1975. The current law reads:

> A city or town having a water supply or water distributing system may develop and use any source of water supply within its limits, not already appropriated for purposes of public water supply, and for such purpose may proceed under any laws applicable to such system as through the authority granted hereby had been contained in such laws; provided, that no source of water supply and no lands necessary for protecting and preserving the purity of the water shall be taken or used without first obtaining the advice and approval of the department of environmental protection.[335]

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[333] *Ibid.* at 448.

[334] Massachusetts General Court, *Acts of 1938*, Chapter 172.

[335] *Massachusetts General Laws Annotated*, Chapter 40, § 38 (1990).

The act continues as follows:

> For the purpose of establishing a water supply or water distributing system as authorized by section thirty-nine A, any town, by its board of water commissioners or selectmen authorized to act as such, may take by eminent domain under chapter seventy-nine, or acquire by purchase or otherwise, and hold, the waters, or any portion thereof, of any pond, brook, spring, stream, or ground water sources within its limits, not already appropriated for purposes of public water supply,and any water or flowage rights connected therewith; and also for said purpose may take by eminent domain under chapter seventy-nine, or acquire by purchase or otherwise, and hold, all lands, rights of way and other easements necessary for collecting, storing, holding, purifying and treating such water and protecting and preserving the purity thereof and for conveying the same to any part of the town; provided, that no source of water supply and no lands necessary for protecting and preserving the purity of the water shall be taken or used without first obtaining the advice and approval of the department of environmental protection, and that the location and arrangement of all dams, reservoirs, wells or filter galleries, filtration and pumping plants or other works necessary in carrying out the provisions of sections thirty-nine A to thirty-nine E, inclusive, shall be subject to the approval of said department.[336]

Currently, there is some controversy over DEP's role in permitting municipalities to use a particular water source for water supply. DEP tends to have conservative standards for purity of potential sources of water supply, as did the Department of Public Health. Because of these conservative standards, DEP will not allow development of sources that, in the opinion of some State and local officials, could be safely used for water supply.[337] A particular instance illustrating this controversy involves DEP's refusal to allow the Town of Chicopee, which lies on the Connecticut River, to draw water from the Connecticut River for municipal water supply. Town officials and other interested parties feel that the purity of the water is satisfactory at the proposed point of withdrawal. In cases where municipalities, such as Chicopee, are not permitted to develop local sources for water supply,

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[336] *Ibid.* at § 39B.

[337] Estes-Smargiassi, *supra*, note 252.

DEP's conservative criteria seem to oppose the policy objective behind the "Interbasin Transfer Act" of developing local sources first before implementing an interbasin transfer.[338]

Other recent DEP actions strongly support the State's water policy objective of protecting local sources of water supply. DEP taking the lead in making water resources protection a major consideration of State regulatory programs. DEP's own water supply source approval regulatory process requires that a community evaluate all of the environmental risks to the resource a establish a source protection plan before it will approve the source. DEP is also working to orient a number of the current regulatory programs for design and siting of facilities such as landfills, hazardous waste facilities, and resource recovery facilities to ensure that protection of natural resources is the focus of the programs.[339]

DEP is communicating with departments in other secretariats to encourage them to build sound environmental policy into their grant application decisions and regulatory decisions. The goal of these efforts is to form and implement an overall water management plan that ties all of the State's basins together as a single system and builds the foundation for informed regulatory and policy decisions by State agencies dealing with water resources in any manner.[340]

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[338] *Ibid.*

[339] Kline, *supra*, note 299.

[340] *Ibid.*

THE MASSACHUSETTS WATER MANAGEMENT ACT

Perhaps the greatest expansion of DEP's role in implementing water supply policy came in 1985 when it was given regulatory authority over intra-basin water allocation in Massachusetts. In December 1985, the Massachusetts legislature passed the "Water Management Act."[341] A more comprehensive measure for allocating water than the "Interbasin Transfer Act" of 1983, the "Water Management Act" grew out of concerns that simply managing across river basin boundaries was not enough -- administrative allocation within basins was also needed.

The availability of water for all users, even in a relatively water-rich state such as Massachusetts, cannot be taken for granted. Many of the sources in Massachusetts cannot be fully utilized due to water quality problems. These kinds of environmental concerns, as well as concerns about attracting business to certain areas of the State that are relatively water-poor and being able to service those businesses, led to the consideration of ways to connect land use, environmental issues, and the allocation of water. The result was the "Water Management Act" (the Act).[342]

The Act calls for DEP and WRC to "cooperate in the planning, establishment and management of programs to assess the uses of water in the Commonwealth and to plan for future water needs."[343] The Water Management Act is designed to regulate water use within Massachusetts. It applies to all surface water and groundwater sources lying wholly or partially within the State.[344]

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341 Massachusetts General Court, *Acts of 1985*, Chapter 592.

342 Kline, *supra*, 303.

343 *Massachusetts General Laws Annotated*, Chapter 21G, § 3 (1990).

344 *Ibid.* at § 2.

DEP must consult with WRC and receive and receive its approval of:

> . . . such regulations as it deems necessary to carry out the purposes of this chapter, establishing a mechanism for managing ground and surface water in the commonwealth as a single hydrological system and ensuring, where necessary, a balance among competing water withdrawals and uses.[345]

An eleven member Water Resources Management Advisory Committee was established within DEP to develop water resources management regulations, rules, and standards and to suggest ways in which existing water resources management practices could be improved, supplemented, and financed.[346] The most recent revisions of the Water Management Act Regulations were approved by WRC on May 8, 1989 and became effective on July 7, 1989, though previous drafts of the regulations were in effect prior to that date. The purpose of the regulations is to:

> . . . establish a program whereby withdrawals of water in the Commonwealth above a threshold quantity are registered and regulated by the Department, Division of Water Supply. The withdrawal registration program is intended to provide a procedure and deadline for persons making existing withdrawals above a threshold quantity to file a registration statement with the Department. These regulations are intended to enable the Department to document baseline water use in the Commonwealth and begin the process of comprehensive management of the surface and groundwater of the Commonwealth. These regulations are also intended to establish a permit program for new water withdrawals. They provide a procedure for applying for, obtaining, maintaining and transferring permits for new water withdrawals in the commonwealth above the threshold volume, and establish the criteria by which the Department will be guided in promoting the objectives of the Act. The purpose of the permit program is to assist the Department in the comprehensive management of the Commonwealth's water resources within its river basins in a manner which ensures an appropriate balance among competing water withdrawals and uses, as well as preservation of the water resource itself.[347]

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[345] *Ibid.* at § 3.

[346] *Ibid.*

[347] 310 *Code of Massachusetts Regulations* 36.00 at 36.02.

Registration Program

The Water Management Act's registration program required each person making an existing water withdrawal in excess of the threshold volume for a single source to file a registration statement for his or her withdrawal before January 1, 1988. The threshold volume for all sources was set at 100,000 gallons per day. DEP has the authority to raise or lower the threshold volume from the standard for any source.[348] Existing withdrawals are defined as the average volume of water withdrawn during the five years prior to January 1, 1986. Any water transfers from a different water source are not included in the total withdrawal volume.[349]

Upon the request of the registrant, a registration statement may be amended to include a quantity of water determined by DEP to be within the average volume withdrawn between January 1, 1981 and December 31, 1985 unless that quantity of water exceeds one standard deviation of the average withdrawal volume, as stated on the registration statement, or if that quantity of water, together with the volumes of water withdrawal permitted in the first round of new withdrawal permits exceeds 50 percent of the total volume of water available for permitting.[350]

Exemptions from registration requirements are granted for withdrawals that, in the opinion of DEP, constitute non-consumptive uses. Non-consumptive uses are defined by the regulations as uses of water that result in the water "being discharged back into the same water source at or near the

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[348] *Massachusetts General Laws Annotated*, Chapter 21G, §§ 4-5 (1990).

[349] 310 *Code of Massachusetts Regulations* 36.00 at 36.03, 36.04.

[350] *Ibid.* at 36.39.

withdrawal point in substantially unimpaired quality and quantity."[351] Those registrants claiming a non-consumptive use are required to file a "Non-consumptive Use Notification Statement" with DEP.[352]

Registration statements for existing uses must contain the following information:

(1) Documentation of the actual or estimated amounts of water withdrawn;[353]

(2) The use for which the water is being withdrawn;

(3) An identification of the water source and specific part of a water source from which the withdrawal is being made, in sufficient detail to describe the water source adequately;

(4) The locations of all withdrawal points;

(5) The volume of the withdrawal; provided however, that persons whose volume of withdrawals varies seasonally according to an established pattern shall describe that variation;

(6) Conservation measures instituted or to be instituted, by the registrant;

(7) The point or points at which the water is discharged after use;

(8) Any other information requested by the Department relative to the withdrawal, use and discharge.[354]

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[351] *Ibid.* at 36.03.

[352] *Ibid.* at 36.05.

[353] Estimation of withdrawal must conform to guidelines established by the DEP and be verified by actual data within five years.

[354] *Ibid.* at 36.06.

All registration statements filed before January 1, 1988 and accepted by DEP will expire on January 1, 1998.[355] Prior to the expiration of a registration statement, the registrant may file a registration renewal request. A registration renewal request, if filed by the registration expiration date, allows the user to continue the withdrawal specified on the original registration statement for an additional period of ten years. If a person fails to file a registration renewal request prior to the deadline for filing, he or she loses the right to withdraw water as specified by the registration statement and must obtain a permit for the withdrawal from DEP.[356]

Registration statements are transferable in whole or in part as long as DEP is notified by the current registrant at least 30 days before the proposed transfer date and the notice includes a written agreement of the transfer of registration responsibilities on a specific date.[357]

Permitting System for New Withdrawals

The second portion of the Water Management Act, together with the applicable DEP regulations, establish a permitting system for new water withdrawals. Any withdrawal that is not covered by a registration statement, that cannot be classified as a non-consumptive use, and that exceeds the threshold volume for the source, requires a permit. The effective dates for permit regulations, application filing, and application completion are shown in Table 3.[358]

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[355] *Ibid.* at 36.08.

[356] *Ibid.* at 36.10.

[357] *Ibid.* at 36.09.

[358] *Ibid.* at 36.18.

Table 3. Effective Dates for Water Management Act Permit Regulations, Application Filing, and Application Completion (Source 310 CMR 36.00 at 36.18.)

Water Source	Effective Date and First Application Form Filing	Completed Applications	Subsequent Filings	Subsequent Completed Applications
Hudson River Basin	August 31, 1988	February 28, 1989	August 31, each year	February 28, each year
Blackstone, Charles Basins	February 28, 1989	August 31, 1989	February 28, each year	August 31, each year
Ipswich, North Coastal Basins	August 31, 1989	February 28, 1990	August 31, each year	February 28, each year
Boston Harbor, Taunton Sasins	February 28, 1990	August 31, 1990	February 28, each year	August 31, each year
South Coastal, Cape Cod Basins	August 31, 1990	February 28, 1991	August 31, each year	February 28, each year
Islands, Buzzards Bay Basins	February 28, 1991	August 31, 1991	February 28, each year	August 31, each year
Concord, Ten Mile Basins	August 31, 1991	February 28, 1992	August 31, each year	February 28, each year
Deerfield, Housatonic Basins	February 28, 1992	August 31, 1992	February 28, each year	August 31, each year
Farmington, Westfield Basins	August 31, 1992	February 28, 1993	August 31, each year	February 28, each year
Millers, Connecticut Basins	February 28, 1993	August 31, 1993	February 28, each year	August 31, each year
Quinebaug, Chicopee Basins	August 31, 1993	February 28, 1994	August 31, each year	February 28, each year
Nashua, French Basins	February 28, 1994	August 31, 1994	February 28, each year	August 31, each year
Shawsheen, Merrimack Basins	August 31, 1994	February 28, 1995	August 31, each year	February 28 each year
Parker, Narragansett Basins	February 28, 1995	August 31, 1995	February 28, each year	August 31, each year

DEP may grant an interim permit for a period of up to one year with the possibility of renewal. An interim permit authorizes a withdrawal that existed prior to the filing date for a particular source, but does not qualify as an existing withdrawal, while the application for a withdrawal permit is in review.[359]

Permit applications must contain a description of the source of withdrawal and the details of the proposed withdrawal including location, volume, frequency, rate of withdrawal, reason for use, and length of time for which the permit is sought. The applicant must describe the expected impacts of the withdrawal upon the environment and upon other uses of the source. Finally, the applicant must conduct a thorough economic and environmental study of alternatives to the withdrawal and detail water conservation measures that have been or will be instituted. DEP may reject all or part of the conservation plan submitted by the applicant or choose to amend the plan. The conservation plan and a timetable for implementation may be included as a condition of an approved permit.[360]

The water withdrawal application process is designed to be a public process. Copies of the application for a permit must be filed in the office of the water resources management official of the city or town in which the withdrawal is proposed. The applicant must provide notification and details of the proposed withdrawal and the submission of the application to a newspaper in the town where the withdrawal is to take place and in each city or town within the same basin as the source of the proposed withdrawal. Copies of the notice must be sent to owners of property abutting property from

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[359] *Ibid.*

[360] A detailed list of the required content of withdrawal permit applications is contained in 310 *Code of Massachusetts Regulations* 36.00 at 36.20. This section of the regulations is reproduced in Appendix G.

which the withdrawal is to be made by the applicant.[361] DEP sends a copy of the applicant's public notice to all registrants, permit holders, and non-consumptive water users who withdraw water from the same source as the proposed withdrawal and to the regional planning agency and chief elected official of the community in which the proposed withdrawal is located. A summary of the public notice is also published in the MEPA Environmental Monitor within a month of DEP's receipt of the notice.[362]

The public comment period on the proposed withdrawal lasts for 30 days. DEP accepts written comments from the local water resources management official in the town where the proposed withdrawal is located. Certificates from the water resources management official may be submitted in support of the application. The certificates may state that the proposed withdrawal is not inconsistent with the local water resources management plan and that there have been no statements of opposition filed within thirty days of the notice of the proposed withdrawal.[363] Any other person having an interest in the withdrawal may also send comments to DEP.[364]

The applicant is required to respond, within 30 days of the close of the comment period, to all written comments deemed reasonable by DEP. No application is considered complete until all written comments are answered by the applicant. DEP may schedule a public hearing within 30 days of the

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[361] 310 *Code of Massachusetts Regulations* 36.00 at 36.22.

[362] *Ibid.* at 36.23.

[363] *Ibid.* at 36.22.

[364] *Ibid.* at 36.23.

close of the comment period if it determines, based upon the written comments received, that such a hearing is in the public interest.[365]

DEP is required to rule on an application within 30 days of the time the certificates are filed by the local water resources management official or within 30 days after the application has been determined to be complete, whichever is latest. If the Secretary of Environmental Affairs requires an Environmental Impact Report, DEP is given ninety days from the time the requirements of the MEPA process are met to rule on the completed application. DEP may extend the deadline for ruling up to nine months if deemed necessary. If no ruling is made within the allotted time, the application stands approved automatically.[366]

In its reviewing a permit application, DEP must consider, at a minimum, the following:

(1) The water available within the safe yield of the water source from which the water is to be withdrawn;

(2) The impact of the proposed withdrawal on the other withdrawal points and on other water sources that are hydrologically interconnected with the water source from which the withdrawal is to be made;

(3) The anticipated times of year when the withdrawal is or will be made, and any projected changes in the withdrawal over a twenty (20) year period;

(4) Reasonable protection of water uses, land values, investments and enterprises that are dependent on previously registered, permitted or otherwise allowable withdrawals;

(5) The use to be made of the water proposed to be withdrawn and other existing, presently permitted or projected uses of the water source from which the withdrawal is to be made;

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365 *Ibid.*

366 *Ibid.* at 36.26.

(6) The approved water resources management plan for any city or town in which the withdrawal located;

(7) Any State water resources management plan adopted by the Commission;

(8) Reasonable conservation practices and measures;

(9) Reasonable protection of public drinking water supplies, water quality, wastewater treatment capacity, groundwater recharge areas, navigation, hydropower resources, water-based recreation, wetland habitat, fish and wildlife, agriculture and flood plains; and

(10) The impact of the proposed withdrawal on reasonable economic development and the creation of jobs in the Commonwealth.[367]

DEP may approve a permit application, approve the application with restrictions, or deny the application. DEP may attach conditions to a granted permit to assure compliance with the Act or with its regulations; to fix the term of the permit; to limit the use to which the water may be put; to require implementation of conservation measures; to ensure that the total volume of water withdrawn from the source does not exceed the safe yield[368] of the source; and to minimize the impact of the withdrawal on water source and watershed characteristics.[369] DEP is authorized to modify, suspend or terminate a permit if any provisions of the "Water Management Act," regulations, permit conditions, or DEP orders are violated or if such an action is deemed necessary to fulfill the purposes of the Act.[370]

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[367] *Ibid.*

[368] The safe yield of the source is based upon the minimum streamflow guidelines established by DEM and WRC and upon the impacts of proposed, permitted, and existing withdrawals. The safe yield of a severely impacted sub-basin may also be considered in the review process.

[369] 313 *Code of Massachusetts Regulations* 36.00 at 36.27, 36.28.

[370] *Ibid.* at 36.29.

DEP may deny a permit application if the application is incomplete or contains false information; if the withdrawal does not meet the standards of the act or has negative effects on the water source or watershed; or if the safe yield of the source would be exceeded due to the new withdrawal. If the combined volumes of existing, permitted and proposed withdrawals exceed the safe yield of the source or are otherwise in conflict, DEP may deny all proposed withdrawals. After January 1, 1994, no permit will be issued unless the town or city where the water is to be used has gained approval of its water resources management plan from WRC.[371]

DEP has set expiration dates for permits for each basin. The maximum period of validity of a permit is 20 years. Permits with terms greater than five years are subject to review and modification by DEP every five years. All permit holders must file annual statements of withdrawal that detail water use over the previous 12 months, conservation measures instituted and the resulting savings, metering records, system updates, and projected changes in water use.[372]

Authorized permits may be amended, renewed, and transferred. Modification of a permit requires filing a request for amendment with DEP. An applicant may modify his or her permit to increase or decrease withdrawal volume or other conditions of the withdrawal or discharge of water.[373] Applications for permit renewal may be filed with DEP between 120 and 90 days before the permit expiration date for a water source. The application, review, and public comment processes are similar to those established for new permits.[374] Transfer of permits in whole or in part is allowed,

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[371] *Ibid.* at 36.30.

[372] *Ibid.* at 36.32, 36.33.

[373] *Ibid.* at 36.35.

[374] *Ibid.* at 36.34.

provided that there is no change in the conditions or provisions of the permit; that the transfer does not result in the possibility of the safe yield of the source being exceeded; and that the permit transfer is not contrary to the intent of the Water Management Act. An application for transfer must be filed at least 30 days before the proposed transfer date and must contain a written agreement between the parties in which the transferee accepts the provisions and conditions of the permit and the date of transfer is stated. If the transfer of a permit requires any amendment of the volume, conditions, or provisions of the withdrawal, it is considered a request for a permit amendment.[375] Presumably, a voluntary permit transfer would be accompanied by adequate compensation and would ensure that the water was going to the most beneficial use of the water.

There is a provision for persons aggrieved by a decision of DEP with regard to the Water Management Act to request an adjudicatory hearing before DEP. If the decision reached in the hearing still aggrieves the person, he or she may seek judicial review of the matter in Superior Court.[376]

Water Emergency Provisions

The final portion of the "Water Management Act" allows operators of public water systems to petition DEP to declare a state of water emergency in a city, town, or other geographic area served by the system. A state of water emergency may last for up to six months in aggregate out of any twelve month period, or longer if determined by DEP to be in the interest of the public health, safety, and welfare. A state of emergency gives water suppliers special powers of eminent domain in order to

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[375] *Ibid.* at 36.36.

[376] *Ibid.* at 36.40.

acquire an emergency water supply. DEP may require that a water supplier submit plans for demand reduction measures and supply management measures that will bring an end to the state of water emergency. Likewise, during the declared state of water emergency, DEP may establish priorities for distribution of any water or quantity of water use, issue orders implementing water-use restrictions, and mandate the denial of all withdrawal permits in the geographic area of the water emergency.[377] Statewide drought contingency planning is covered by the State Water Management Plan.

Massachusetts' Water Management Act is designed to provide comprehensive water management mechanism for the Commonwealth while allowing consideration for the diverse circumstances of various water users. The Act gives DEP extensive regulatory authority to control water allocation within river basins and, like the IBT Act, reflects the value the State places on environmental protection, instream water uses, and conservation and protection of existing water supplies. The Act is significant step in restructuring the institutional framework governing water management in Massachusetts to reflect the broad changes in publicly held values that have occurred over the past 20 years.

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[377] *Massachusetts General Laws Annotated*, Chapter 21G, §§ 15-17 (1990).

CHAPTER EIGHT

NEW DIRECTIONS IN WATER SUPPLY POLICY AND MANAGEMENT: THE MASSACHUSETTS WATER RESOURCES AUTHORITY

Among the measures Massachusetts took as a result of reforming its water supply policies was replacing the Metropolitan District Commission with a new administrative body, the Massachusetts Water Resources Authority (MWRA). Along with the new name came a new mandate. The legislature required MWRA to adopt a much broader water supply planning strategy than its predecessor, MDC, ever considered.

THE ROLE THE MASSACHUSETTS WATER RESOURCES AUTHORITY

MWRA was created by legislation in December 1984. The legislature placed MWRA within EOEA, but as an independent authority not subject to the control of the EOEA or any other State agency or department. MWRA is under the supervision of its Board of Directors. Membership of the eleven member Board of Directors includes the Secretary of Environmental Affairs, serving *ex officio*, and one member each from a Connecticut River basin community and a Merrimack River basin community, appointed by the Governor. There are also three members appointed by the Mayor of Boston, one member appointed by the Governor from a list of three persons recommended by the Mayor of Quincy and one member appointed by the governor from a list of three persons recommended by the board of selectmen of the Town of Winthrop.[378] (Both Quincy and Winthrop are adjacent to Boston and serviced by MWRA.) MWRA replaced MDC as the water and sewer

[378] *Massachusetts General Laws Annotated*, Chapter 92 App., § 1-3 (1990).

authority for the district. The waterworks and sewage systems formerly owned by MDC were passed to MWRA by its enabling act.[379]

A new division of MDC was created by the act as well. The Watershed Management Division of MDC is directed to:

> . . . construct, maintain and operate a system of watersheds, reservoirs, water rights and rights in sources of water supply, shall supply thereby a sufficient supply of pure water to the Massachusetts Water Resources Authority, and shall utilize and conserve said water and other natural resources in order to protect, preserve and enhance the environment of the commonwealth and to assure the availability of pure water for future generations.[380]

Thus, the Division of Watershed Management is the caretaker of the supplies while MWRA is the distributor and vendor of the water. MWRA's service area is shown in Figure 18. Eminent domain powers for the purpose of acquiring a water supply source or the right to a water source are not given to MWRA but are reserved for the Division of Watershed Management.[381]

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[379] *Ibid.* at § 1-4.

[380] *Massachusetts General Laws Annotated*, Chapter 92, § 105 (1990).

[381] *Massachusetts General Laws Annotated*, Chapter 92 App., § 1-9 (1990).

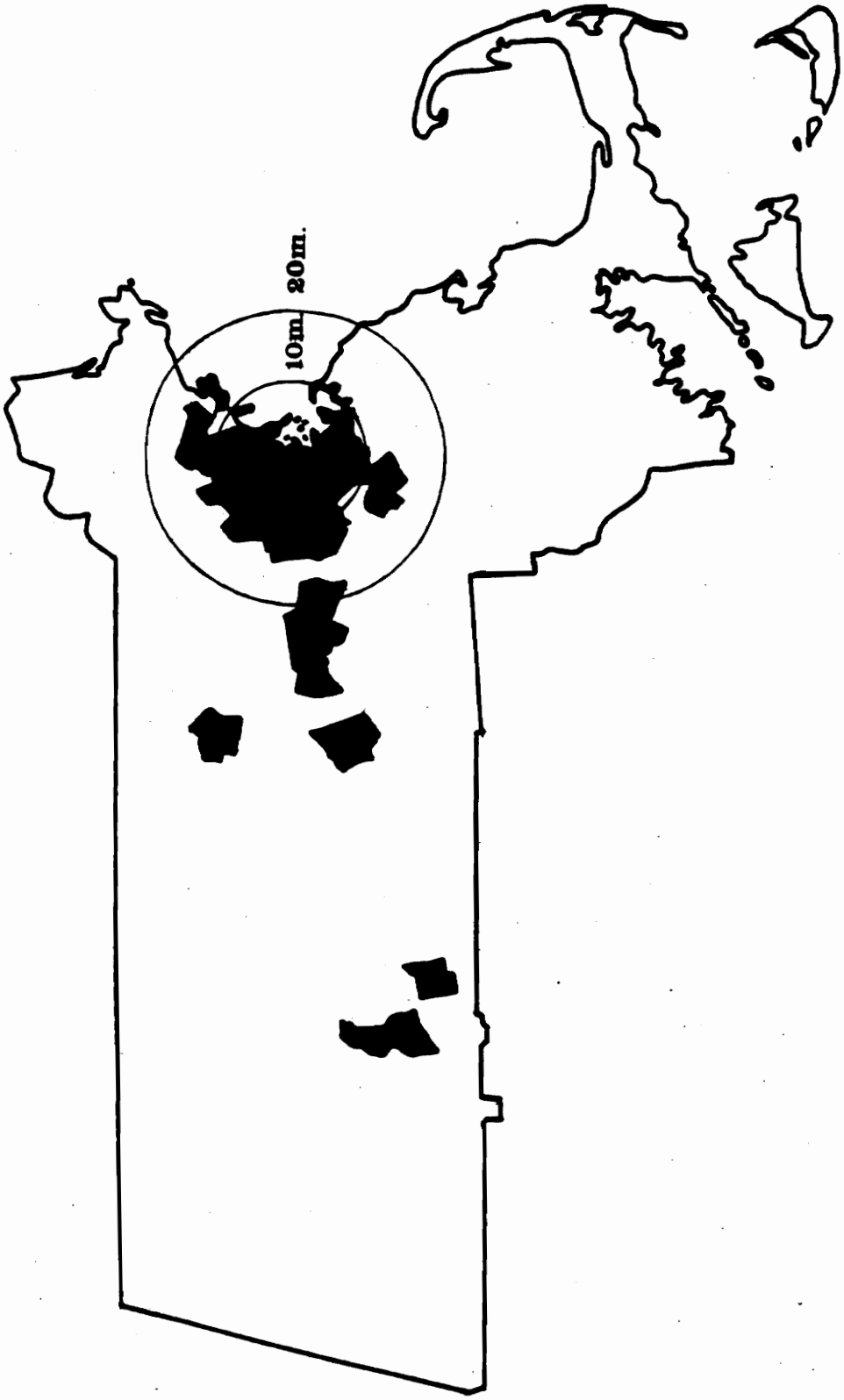

Figure 18. The MWRA Service Area

MWRA's Mandate

The mandated goals, purposes, and objectives of MWRA are as follows:

> (1) Efficient and economical operation of water delivery and sewage collection, disposal and treatment systems including programs for leak detection and reduction of infiltration and inflow for the service areas of the Authority;
>
> (2) Repair, replacement, rehabilitation, modernization and extension of the delivery of water and sewage collection, disposal and treatment systems for the service areas of the Authority, including the financing on a self-sustaining basis of capital and operating expenses relating thereto;
>
> (3) Establishment and administration of equitable charges, consistent with the objectives of this act to conserve water and improve the quality of the environment, for water delivery and sewage collection, disposal and treatment services; and
>
> (4) Professional and productive management of and system-wide planning for the delivery of water and sewage collection, disposal and treatment services; . . .[382]

MWRA's statement of purpose includes conservation of the waters of the commonwealth and protection of the environment. MWRA is instructed to promote water conservation and protection of the environment through its schedule of charges and to conduct programs of public education on water conservation and environmental quality. In addition, it is directed to:

> . . . identify and consider demand management and water conservation solutions to new and existing water consumption requirements and, wherever reasonably practicable, to implement such solutions in preference to solutions which would increase water withdrawals from any natural or artificial source of ground or surface waters;. . . .[383]

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[382] *Ibid.* at § 1-1.

[383] *Ibid.* at § 1-8.

It is clear that MWRA's mandate was heavily influenced by changing public values in Massachusetts. These changing values affected a change in the State's water supply policy and, in turn, forced the Boston metropolitan area water supplier to change its policies as well. The most convincing evidence of policy changes within MWRA is its response to the results of the *Long Range Water Supply Study*, which had evolved from the original EIR for the proposed Connecticut River diversion.

MWRA Long Range Water Supply Program

In the fall of 1985, MWRA replaced MDC as the sponsor of the *Long Range Water Supply Study and EIR-2020.* WSCAC was retained to continue to "review, comment and recommend changes in the execution of the scope of the project," as well as to "represent public response to the study, inform the Secretary, proponent, and consultants, and to offer constructive changes through an ongoing dialogue."[384] WSCAC fulfilled its advisory role with MWRA by critiquing the more than 50 reports produced by the study. The reports projected the water demands of MWRA communities until the year 2020 and analyzed various alternatives for meeting MWRA water demand. In March 1986, MWRA released a *Summary Report* for the *Long Range Water Supply Study and EIR-2020.*

The major conclusions of the study, as outlined in the *Summary Report* were as follows:

- The existing MWRA/MDC system safe yield (the amount of water that can be withdrawn from the system consistently over a period of time) is approximately 300 million gallons per day (mgd).
- Demand projections indicate the demand for water from MWRA/MDC sources my be about 390 mgd in 1990, 410 mgd in 2000 and 450 mgd by the year 2020.

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[384] Water Supply Citizens Advisory Committee, *supra*, note 279, p.2

- Projected water demand can be reduced by about 30 mgd by implementing the Demand Management Alternative.
- The additional water need projected for MWRA communities (assuming implementation of the Demand Management Alternative) is 60 mgd in 1990, 75 mgd in 2000 and 120 mgd by 2020.[385]

When MWRA releases the Summary Report in March 1986, WSCAC responded by outlining the areas where it disagreed with MWRA's figures. In particular, WSCAC's figures for projected water demand in the MWRA service area disagreed with those in the MWRA report. While the MWRA study projected a steadily increasing water demand through the year 2020 and a constant safe yield for the system of 300 mgd, WSCAC projected a decreasing demand for water from the MWRA system and calculated safe yields of 318 mgd in 1980, 323 mgd in 1990 and 2000, and 325 mgd in 2020. According to WSCAC, MWRA could eliminate the need for water supply augmentation through the year 2020 and, perhaps, indefinitely by expanding its leak repair program, cutting back on unnecessary reserves and estimates of "system unaccounted for losses", and by increasing system yield through an MDC watershed management program. WSCAC's comments were among the four volumes of comments MWRA received from the over 1500 recipients of the *Summary Report*. MWRA's Board of Directors held three public hearings across the State in June 1986 to gather further public comment on the report and had three technical briefings on the study by Wallace, Floyd, Associates Inc., the engineering firm that conducted the studies.[386]

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[385] Massachusetts Water Resources Authority, *Water Supply Study and Environmental Impact Report -- 2020, Summary Report: Impact Assessment and Criteria for Evaluation of Alternatives*, prepared by Wallace, Floyd, Associates Inc. for MWRA, Boston, MA, March 1986, p. 9.

[386] Massachusetts Water Resources Authority, *Long Range Water Supply Program*, Boston, MA, November 1986, pp. 7-8.

The Board of Directors went into deliberations on the report and comments in the summer and responded positively to the comments of WSCAC and others who had called for the implementation of conservation and watershed management measures. On November 12, 1986, the Board of Directors issued a policy statement concerning the MWRA drinking water system. It adopted 18 short range water supply policies and projects and 7 long range policies. The Board established programs in three major areas: conservation and demand management; local source development and improved use of existing sources; and development of tools for planning and management. The programs are summarized in MWRA's *Long Range Water Supply Program*, released on March 25, 1987.

Conservation and Demand Management

The conservation and demand management programs adopted by the Board included establishment of ongoing leak detection and repair programs in each MWRA community; a pilot retrofit program to test the effectiveness of the installation of domestic water conservation devices; a water conservation information and technical assistance program; metering and monitoring of the MWRA system and sub-systems; promotion of water conservation through water rate systems; development of water conservation criteria for the continuation of MWRA water contracts with contract communities; and development of conservation compliance guidelines for all MWRA communities regardless of status.[387]

MWRA has been vigorously pursuing implementation of these programs since 1986. For example, an initial leak detection of all 6,000 miles of community-owned pipes in the 43 MWRA communities

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[387] *Ibid.*, pp. 16-23.

was scheduled for completion in the fall of 1989. In addition, MWRA inspects all 260 miles of its pipes for leaks each year and promptly makes any necessary repairs.[388]

MWRA is also attempting to implement conservation measures throughout its service area using its regulatory authority. MWRA interprets its enabling legislation as giving it broad powers to enforce conservation requirements in its member communities. Though some aspects of its conservation programs are dependent upon the cooperation of the communities it services, MWRA has written, or is in the process of writing, regulations requiring various conservation and water management measures throughout its service area.[389] The first set of regulations, which went into effect in April 1989,[390] deal with the 19 communities receiving water from MWRA under contract. Upon the expiration of its contract with MWRA, each community is required to file a supplementary report with MWRA in order to facilitate negotiation of a water supply continuation agreement. The supplementary reports must contain:

(1) A Demand Analysis Report;

(2) A Supply Analysis Report;

(3) A Water Management Plan that has been approved by WRC and adopted by the community;

(4) Either a copy of the ordinance for protection of local water sources that the community has enacted or a proposed schedule for the enactment of such an ordinance;

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388 Estes-Smargiassi, *supra*, note 252.

389 *Ibid.*

390 360 *Code of Massachusetts Regulations* 11.00.

(5) Either a detailed description of the local user charge and accounting system that the community has adopted or a proposed schedule for the adoption of revisions, if any, to such a system; and

(6) A proposed schedule for the evaluation, development and use of potentially feasible new local water supply sources identified in the Supply Analysis Report.[391]

The purpose of the regulations is to "ensure the sufficiency of the existing MWRA water supplies, the development, efficient use and protection of all feasible local water supplies, and the local implementation of proper water conservation and demand management programs."[392] The required report forces communities to analyze their water needs from a perspective that considers source protection and demand management as necessary aspects of a water management program.

In addition to implementing the contract community regulations, MWRA is working on finding methods of enforcing demand management measures in the other communities that it serves. MWRA has written regulations that will require all of its user communities to have full metering and to implement a bi-annual leak detection program; it also plans to write water-use regulations for non-contract communities. Part of the process of regulating demand management measures is to provide technical assistance in implementing the programs. Because MWRA is able to generate its own revenue from the sale of its water, it is able to fund the programs and the technical assistance required.[393]

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[391] 360 *Code of Massachusetts Regulations* 11.00 at 11.07.

[392] *Ibid.*, Summary of Regulation.

[393] Stephen Estes-Smargiassi, Program Manager, Long Range Water Supply Program, Massachusetts Water Resources Authority, personal communication, December 5, 1989.

Local Source Development and System Efficiency

MWRA developed programs designed to make better use of its existing water supply sources and to protect and develop local sources. MWRA planned to assist the MDC in conducting an environmental review of its watershed management program. Other efforts to better utilize its existing supplies include continuation of the planning and environmental review process for the reactivation of the Sudbury Reservoir and re-evaluation of the Swift River release requirement from the Quabbin Reservoir. The Board of Directors proposed programs to help prevent communities not yet served by MWRA from having to turn to MWRA's system and to prevent existing MWRA member communities from increasing their dependence on the system. MWRA will meet these objectives by identifying and developing new or previously abandoned local sources and by protecting existing local sources in MWRA communities and adjacent communities.[394] Some provisions in the MWRA regulations written by MWRA for its member and contract communities also deal with protection of existing water supplies and development of local sources.

Planning and Management Tools

MWRA's Board of Directors developed planning and management programs in order to provide the data and tools necessary to allow MWRA to anticipate required management actions and avoid problems with the system rather than always assuming a reactive position to changes occurring in the system. The management and planning programs include: development of a data base for keeping daily records of water use and analyzing the effectiveness of demand management programs; development of a drought management programs; and identification of key water supply planning

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[394] Massachusetts Water Resources Authority, *supra*, note 386, pp. 4-5.

parameters that may be monitored over time and that indicate when action should be taken to avoid potential water supply problems.[395]

Recently there was a concerted effort by MWRA, WSCAC, and various State agencies to focus on management of MWRA's water supply system. By February 1989, MWRA's reservoirs reached their lowest levels since the drought of the 1960s. The drop was a result of a combination of high water use and lack of rainfall and snowfall. MWRA was able to utilize much of the water conservation program that it had already developed, only in an accelerated fashion, to face the potential emergency situation. A massive public education program was initiated, and water use restrictions and mandatory leak repair orders were issued through DEP. The net result of the actions taken was a major reduction in water use. The system consistently operated at a rate of water use under the 300 mgd safe yield figure, and by the end of the summer, with the help of some above average rainfall, there was no longer the threat of a water emergency.[396] Such results, argues William Elliott of WSCAC, shows that the system can operate at water use rates significantly lower than those projected in *Long Range Water Supply Study*, and demonstrate the effectiveness of a strong water management program.

When the MWRA Board of Directors adapted the *Long Range Water Supply Program*, it had no particular goals for water conservation or demand reduction. Rather, the programs for conservation and renovation of MWRA's existing system were to be aggressively implemented over the three year period from 1987 to 1990. WSCAC's role in this process has been to assist MWRA in developing the water system data base and evaluating the conservation and leak repair programs. WSCAC was

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[395] *Ibid.*, pp. 21-22.

[396] William Elliott, Acting Director, Water Supply Citizens' Advisory Committee, Hadley, MA, personal communication, July 25, 1989.

expanded in 1987 to include members representing interests in MWRA watershed associations, water supply professionals, the legislature's Special Commission on Water Supply, industrial users, environmental groups, and other water resource interests.[397] WSCAC has viewed its role throughout the Long Range Water Supply Program implementation period as one of "helping the Authority [MWRA] make its water conservation program a success, so that the diversion alternative need never be considered again."[398]

Regarding the development of additional MWRA water supplies, the final conclusion was as follows:

> The Board explicitly deferred any decision as to whether or not development of new water supplies will be necessary until on or after December 31, 1989. Diversion of rivers is designated as a "last alternative."[399]

FUTURE PLANS FOR THE MASSACHUSETTS WATER RESOURCES AUTHORITY

MWRA decided that would consider augmenting its supply only after evaluating the results of the Long Range Water Supply Program. On January 24, 1990, MWRA submitted to its Board of Directors a progress report and a set of recommendations on the *Long Range Water Supply Program* containing water supply planning recommendations for the next five years. MWRA noted a number of achievements since the start of the program in March 1987:

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[397] Water Supply Citizens' Advisory Committee, "WSCAC Column for Water News," Hadley, MA, December 5, 1988, p. 1.

[398] *Ibid.*, p. 2.

[399] Massachusetts Water Resources Authority, *supra*, note 386, p. 8.

- Finding and repairing MWRA pipes leaking 5 million gallons per day;
- Finding 25 million gallons per day in leaks in 5,000 miles of community water pipes;
- Developing regulations requiring leak detection and accurate metering in MWRA member communities;
- Distributing over a million pieces of conservation information and educating school children throughout the MWRA service area on conservation;
- Helping to change the Massachusetts Plumbing Code to require low flow toilets;
- Installing water saving devices in over 7,000 homes and planning for expansion of this program to all MWRA customers;
- Helping hundreds of industrial, commercial and institutional users to save water;
- Letting contracts to evaluate 14 potential sources of water in MWRA user communities;
- Letting contracts to protect 14 local sources of water in MWRA user communities and in an additional 26 communities near the MWRA service area;
- Completing a plan for redundancy in the MWRA aqueduct system and beginning design for the rehabilitation of the Sudbury Aqueduct; and
- Negotiating twelve water supply continuation agreements with MWRA contract users based on MWRA policy and regulations.[400]

As a result of the MWRA *Long Range Water Supply Program*, water demand in the MWRA service area has decreased significantly. In 1987, before the program began, water demand was 336 mgd, more than 10 percent above the 300 mgd safe yield of the water system. Demand in 1988 was 324 mgd and progressed steadily downward. Annual demand for 1989 was 287 mgd.[401]

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[400] Massachusetts Water Resources Authority, *MWRA Long Range Water Supply Program: Program Briefing and Recommendations to the Board of Directors*, Boston, MA, January 24, 1990, pp. 3-4.

[401] *Ibid.*, p. 4.

MWRA recommended that the Board approve a five year program to expand and build upon the results of MWRA's previous work. The program would include demand management, improved use of existing and new local sources, source protection, and management and planning for the future. Appendix H presents an overview and summary of the *Long Range Water Supply Program* and MWRA's recommendations for 1990-1995. MWRA believes that if its proposed programs are implemented, demand in the MWRA service area will stay below the safe yield of the system for at least 10 years and possibly through the year 2020. Thus, MWRA recommended that its Board postpone its decision on a major new supply for the MWRA service area at least until 1995.[402]

Whatever action MWRA decides to take after 1995, one thing is clear: the shift in publicly held values and the resulting changes in the institutional mechanisms governing water management in Massachusetts have prompted MWRA, and the communities it serves, to take a completely different approach to water supply management than MDC and its predecessors took prior to the 1970s. Rather than allowing the metropolitan area to give supply augmentation via interbasin transfer top priority among approaches for balancing supply and demand, the prevailing public values and the current State water management programs compel MWRA and its communities to implement system rehabilitation, conservation, and local source protection programs before seeking additional sources of supply.

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[402] *Ibid.*

CHAPTER NINE

SUMMARY AND CONCLUSIONS

Massachusetts is an example of an eastern state that has thoroughly restructured its institutional framework for making water supply management decisions. This restructuring has taken place in response to broad changes in publicly held values in the State. The State's current water supply management framework has evolved out of the riparian system, through a period where major water supply management decisions were made through special legislative acts, to the administrative permit system and State water management programs that exist today.

EVOLUTION OF THE MASSACHUSETTS WATER MANAGEMENT FRAMEWORK

Early in its history, the City of Boston outgrew its local water supplies. Providing water for this growing City quickly became a major concern in Massachusetts. The State apparently recognized the water rights uncertainty inherent in the riparian system and its inability to provide secure rights to municipalities seeking a water supply. As demand for water in the Boston metropolitan area began outstripping the available supply, the City received legislative approval to circumvent the riparian system and secure water supplies via interbasin transfers. These special acts placed responsibility for the metropolitan area water supplies firmly in the hands of water supply engineers and public health officials.

Throughout the nineteenth century and the early part of the twentieth century decisionmakers in the State and the general public, for the most part, completely trusted the experts' recommendations concerning the Boston metropolitan area's water supply. The experts focused on supply augmentation to balance water supply and demand as the Boston area continued to grow. They favored supply

augmentation over other demand management or supply management strategies at the expense of other potential uses of the State's water resources. Municipal water supply was considered the paramount use of the States' water resources. Environmental protection and instream water uses were not major concerns at the time. Thus, the experts repeatedly persuaded the legislature and the public to reach farther and farther westward for pure, abundant water supplies. People in the areas of western Massachusetts that supplied the water for Boston failed to organize an effective opposition to the proposed interbasin transfers, despite the fact that many of their homes were inundated by newly constructed reservoirs added to the metropolitan water supply system.

By the 1970s, however, public values had started to change dramatically. The environmental movement, growing distrust of water supply experts, and increasing hostility toward the City from the western areas of the State began to affect the way Massachusetts viewed water supply management. When MDC proposed to transfer water from the Connecticut River at Northfield Mountain to Quabbin Reservoir, it met with strong resistance from environmental and citizens groups that it would never have expected a few years earlier. This resistance proved to be a catalyst for changing the way in which water supply management issues are handled in Massachusetts.

OVERVIEW OF THE MASSACHUSETTS FRAMEWORK

As a result of changing public values in the State, evidenced by the controversy over the Northfield proposal, the Massachusetts State government has restructured the institutional framework governing water supply decisionmaking, albeit in somewhat of an ad hoc manner. The objective of this restructuring is to link water supply policy and planning to an overall water management program. The program takes a comprehensive, regulatory approach to water management in order to promote the values of environmental protection, protection of instream water uses, and conservation and

protection of existing water supplies, while fairly considering all potential uses of the State's water resources.

Massachusetts uses four major tools to support it overall water supply policy. These tools are as follows:

(1) the Water Resources Commission's Water Management Planning Regulations and the resulting basin-wide and local water management plans, which serve as the umbrella for State water management;

(2) special administrative allocation mechanisms (i.e., the Interbasin Transfer Act and Regulations and the Water Management Act and Regulations) that give certain, transferrable rights to permitted users and regulatory authority over water use to the State;

(3) existing and proposed DEP and regulations and programs promoting water management planning and local source protection; and

(4) the MWRA *Long Range Water Supply Program.*

Figure 19 presents the structure of the current Massachusetts framework and its four basic elements. The State, under the direction of the WRC, is in the process of coordinating and implementing these four elements. For example, allocation decisions must conform to the State water management plans and are based on criteria that reflect the State's strong water policy. The decision making criteria emphasize conservation, demand management, local source protection, improving system efficiency and multiple in-stream and consumptive uses -- considerations that were virtually ignored in past State water management strategies.

Also, DEP and MWRA regulations and programs emphasize these same planning and management elements on the local level. For example, communities receiving DEP grants for meter modernization

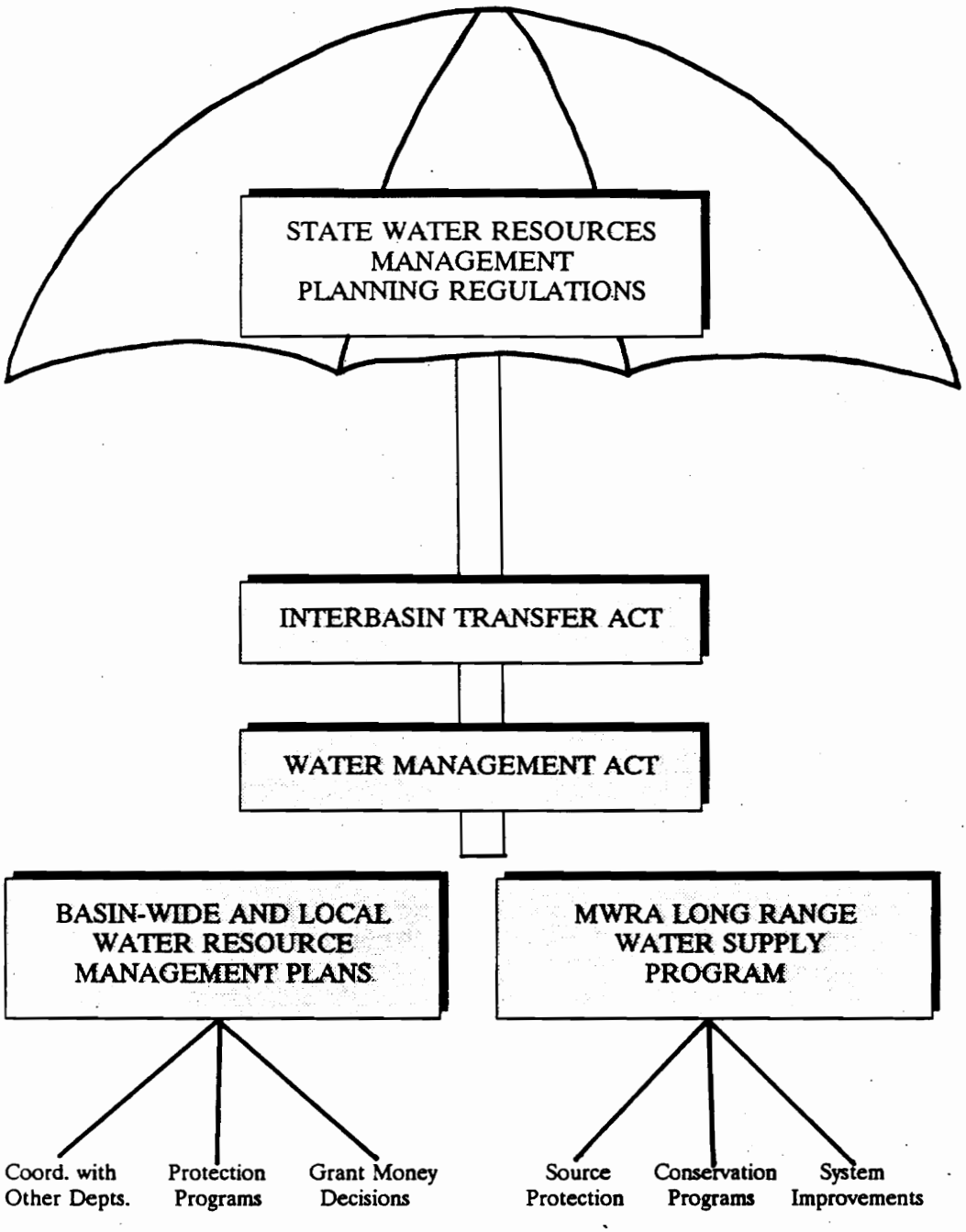

Figure 19. Massachusetts' Water Supply Management Framework

and installation must have a WRC approved water conservation plan. MWRA contract communities must develop such plans to continue receiving service from MWRA.

Finally, the State is also becoming more involved in water resources protection through new legislation. For example, legislation passed in November 1989 and effective January 1, 1991 allows cities and towns sharing a common drinking water source to establish a Drinking Water Protection Commission and a Drinking Water Protection Fund. Financing for the fund comes from fees on users of public and private water supplies in the cities and towns and may be supplemented with State funding.[403] Another bill that is before the legislature would place zoning requirements on property in the vicinity of major tributaries and aquifers within the Quabbin, Ware, and Wachusett watersheds. The legislation would establish minimum lot size requirements and requirements for minimum distances from the tributaries or aquifers for new construction as measures of protection for the downstream reservoirs.

Massachusetts' current framework has completely replaced the riparian system and the special legislative allocation procedures previously practiced in the State. Like a number of other eastern states, Massachusetts had adopted an administrative permit system to allocate its waters among competing users. Because of the value that has been placed on environmental protection, multiple uses of water resources, and water resource conservation and protection since the 1970s, and because of the influence of special interest groups promoting these values, the State has built a comprehensive water resources regulatory program around its permit system. Thus, Massachusetts provides a clear example of the effect that changing values has on state institutional mechanisms governing water supply management.

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APPENDIX A

LIST OF ABBREVIATIONS

CMR	Code of Massachusetts Regulations
cfs	cubic feet per second
DEM	Department of Environmental Management
DEP	Department of Environmental Protection
EIR	Environmental Impact Report
EOEA	Executive Office of Environmental Affairs
IBT	interbasin transfer
MDC	Metropolitan District Commission
MDWSC	Metropolitan District Water Supply Commission
MEPA	Massachusetts Environmental Policy Act
mgd	millions of gallons per day
MGL	Massachusetts General Laws
NEPA	National Environmental Policy Act
WSCAC	Water Supply Citizens Advisory Committee
WRC	Water Resources Commission

APPENDIX B

MAJOR EVENTS IN THE DEVELOPMENT OF MASSACHUSETTS' WATER SUPPLY POLICY AND WATER MANAGEMENT PROGRAM

1652 — The Water Works Company is incorporated to build a 12 square foot reservoir and conduit to supply Boston with water.

1795 — Boston's population is reaching 20,000 and the City's water supply sources are exhausted; the Jamaica Pond Aqueduct Company (later called the Aqueduct Corporation) is incorporated by legislature and empowered to supply Boston with water from Jamaica Pond, one of the earliest cases in U.S. history where one community imported water for domestic uses from a source lying within the jurisdiction of another community.

1825 — As a result of population growth, degradation in water quality, a series of major fires, and a series of sanitation campaigns for disease prevention, Boston City Council appoints a committee to study the possibility of supplying the City with pure water from a larger source.

Daniel Treadwell is commissioned to study the Boston water supply question. Treadwell advocates the Charles River and Spot Pond as the best potential water sources for the City; Treadwell's plan becomes the most popular "moderate" plan, but no action it taken to implement the plan.

1834 — Boston's City Council hires Loammi Baldwin to conduct a new survey of possible water supply sources for Boston; Baldwin dismisses Treadwell's recommended sources as too small and suggests Farm and Shakum Ponds in Framingham or Long Pond in Natick to provide for both present and future needs of the City.

1835 — R.H. Eddy is appointed by the City Council to analyze the water problem.

1836 — Eddy's report to the City Council criticizes future oriented projects like Baldwin's because of the high initial cost.

1837-1844 — The City Council appoints special commissioners to devise a water supply plan for Boston; water debates continue with present versus future-oriented planning as the main issue.

1844 The City Council passes a resolution instructing the Mayor to apply to the legislature for the power to build a Long Pond aqueduct.

1845 The Governor signs a bill authorizing Boston to proceed with the Long Pond plan; the bill is defeated in a public referendum and the water debates are re-opened.

City Council brings in John Jervis and Walter Johnson in June to settle the water-supply question; Jervis had designed the Croton system for New York City; the Jervis-Johnson report, presented to the City's Water Committee in November, advocates the Baldwin plan.

1846 The "Boston Water Act," signed by the Governor in March, provides for the formation of a Water Board to direct development of Long Pond; voters approve of the Act in a referendum and the Water Board is selected in May; construction begins in August and the name of Long Pond is changed to its original Native American name "Lake Cochituate;" the system provides 18 MGD to Boston.

1848 Water from Cochituate is introduced to the City on October 25 -- "Boston Water Day;" 50,000 to 100,000 people are on hand for the celebration.

1850 Boston's population reaches approximately 180,000 people.

1851 Cochituate Water Board tests its authority to manage Boston's water supply system and successfully binds the City in a deal to purchase the Aqueduct Corporation without prior approval of the City Council.

1865 Boston's water supplies become stressed again; the legislature authorizes the Cochituate Water Board to construct the 731 million gallon Chestnut Hill Reservoir.

1870 Construction of the Chestnut Hill Reservoir is completed.

1872 The "Sudbury River Act" authorizes taking of additional water from the Sudbury watershed; the system is now capable of providing 62 MGD to Boston.

1878 Three of the seven Sudbury system reservoirs put into service with the other four added over the next 20 years.

1886 The Massachusetts State Board of Public Health formed by the legislature and given authority to exercise general oversight over the inland waters of the State.

1893 The legislature asks the State Board of Public Health the study the water needs of the Boston Metropolitan area; the Board selects Frederic Stearns as chief engineer for the job.

1895 Stearns files his water supply report with the legislature; the report advocates a metropolitan water supply district consisting of 19 cities and towns and recommends constructing a reservoir on the Nashua River to meet present and future needs of the district; the report also considered supplementary sources farther west in Massachusetts that could be added to the system later.

The legislature drafts a bill in February providing for the creation of a Metropolitan Water Board vested with the responsibility of caretaker of the water supplies of cities and towns within a 10 mile radius of the State House; over the objections of Boylston and West Boylston, towns to be inundated by the reservoir, the bill also outlines procedures for construction of the reservoir on the Nashua River; after a series of debates, the bill is passed in June; the bill makes district membership voluntary and 13 cities and towns join.

1906 Construction of 67 billion gallon Wachusett Reservoir and the Wachusett water supply system, which began in 1985, is mostly completed giving the district system a capacity of 173 MGD.

1914 The legislature creates the Department of Public Health.

1918 X.H. Goodnough, chief sanitary engineer for the Department of Public Health, expresses his belief that the water supply systems of the Metropolitan Water District are being overdrawn.

1919

The legislature asks the State Department of Health and the Metropolitan Water and Sewerage Board, referred to together as the Joint Board, to study the possibilities for obtaining water for the Metropolitan Water District from the State's available water supply sources; X.H. Goodnough is named as engineer for the investigation.

An act of the legislature replaces the Metropolitan Water and Sewerage Board with the Metropolitan District Commission.

1922

The Joint Board files its report with the legislature in January; the report forecasts future water demand in the Metropolitan District and rejects conservation, metering, and leak repairs as means of successfully controlling demand; the report recommends diversion of Ware River water to Wachusett Reservoir and creation of a large reservoir in the Swift River Valley to meet the needs of the Metropolitan District through 1970.

The engineering community and the majority of the Joint Board back the Goodnough plan; only one Joint Board member, James Bailey of MDC, objecting to the high initial outlay required for the project and the flooding of western Massachusetts towns, files a dissenting report proposing filtration of local sources to meet the immediate needs of the District.

Hearings on the plan commence in the legislature; western Massachusetts legislators, James Bailey and representatives of Ware and Swift River Valley towns speak out against the plan.

1924

After holding hearings in May on three reports filed by the Legislative Joint Standing Committee on Water Supply, the legislature sets up a new commission to investigate the water issue; the Metropolitan Water Supply Investigating Commission, appointed by the Governor in August, chooses Allen Hazen as its chief engineer.

1925

The Investigating Commission files its report with the legislature in December; the report recommends discontinuing use of Cochituate, filtering the South Sudbury supply to meet the needs of Boston until 1929, and augmentation from additional sources in three phases: (1) diversion of the Assabet River; (2) construction of a reservoir on the Upper Ware River by MDC and Worcester; and (3) construction of a reservoir on the Ipswich River.

The Investigating Commission does not believe that metering or conservation programs can significantly reduce water demand and is resolved to the eventual construction of a Swift River reservoir.

1926 Debates on the Investigating Commission's proposals open in February with strong opposition from proposed donor areas; the Assabet and Ipswich portions of the plan are dropped.

After numerous debates and several compromise attempts, the Investigating Commission's plan is dropped from consideration and substituted with the Goodnough/Joint Board plan once again; resistance to the Goodnough plan wears down as Swift River Valley residents grow weary of being in doubt about their fate; a bill emerges from committee that would authorize the Goodnough plan amended to allow Worcester to divert water from the Wachusett watershed for its water supply.

In May, the "Ware River Supply Act" is signed by the Governor; the Act creates the Metropolitan District Water Supply Commission as a construction commission and provides for diversion of Ware River water to Wachusett.

1927 Compensation issues dominate the debate surrounding a proposed Swift River reservoir bill; the "Swift River Act," passed in April, outlines the procedures for taking of lands necessary for construction of the proposed 412 billion gallon Swift River reservoir.

1928 Much of the preliminary work on the Ware River diversion is completed.

1929 The State of Connecticut files a suit in the U.S Supreme Court to enjoin Massachusetts from making the Ware and Swift River diversions; Connecticut's objections to the projects are on both economic and environmental grounds.

1931 The Supreme Court decides the case in favor of Massachusetts on February 24, 1931; the Ware River works are completed and begin supplying the Metropolitan District with water in March.

1936 Intensive construction work begins on Quabbin Reservoir, as the Swift River reservoir was named in 1932.

1938 The legislature gives the Department of Public Health full authority to approve potential water supply sources.

1939 Quabbin Reservoir begins to fill in August.

1946 Quabbin Reservoir begins supplying the Metropolitan District with water.

1956 A legislative act creates the Massachusetts Water Resources Authority.

1966 A sustained drought in the northeastern U.S. and an increase in per capita water consumption causes Quabbin Reservoir to drop to one-half of its capacity.

1967 MDC works out a deal with Northeast Utilities to divert up to 375 mgd of water from its pumped storage project on the Connecticut River at Northfield Mountain; the legislature authorizes MDC to spend $25 million to improve existing water supply projects and implement the Northfield diversion.

1969 After spending $14 million of its funding on its existing distribution system, MDC makes a request for additional funding; negotiations between MDC and Northeast Utilities reach an impasse and MDC asks the legislature to allow it to build its own pumping station and tunnel elsewhere on the Connecticut; environmental forces rally in opposition to the bill.

The Massachusetts State government is organized into gubernatorial secretariats including the Secretary of Environmental Affairs who heads the Executive Office of Environmental Affairs (EOEA); the Water Resources Commission is placed within EOEA.

1970 In April, a special legislative study commission recommends the Northfield diversion using a "flood skimming" technique; the legislature subsequently amends the bill to restrict the diversion to about 72 mgd; the bill passes in August.

The U.S. Congress passes the National Environmental Policy Act requiring U.S. Army Corps of Engineers studies recommending the Northfield diversion to be amended with Environmental Impact Statements.

1972 The legislature passes the Massachusetts Environmental Policy Act allowing the Secretary of Environmental Affairs to require preparation of a full Environmental Impact Report on projects likely to cause damage to the environment; projects designated as "Major and Complicated Projects" by the Sectretary may require specific environmental impact evaluation procedures designated by the Secretary.

1974 A reorganization of Massachusetts' natural resource programs gives the Secretary of Environmental Affairs authority over most resource-oriented agencies; the Department of Environmental Quality Engineering (DEQE), later renamed the Department of Environmental Protection (DEP), is placed within EOEA; the Department of Public Health's powers and duties for protection of the environment are transferred to DEP.

1975 The "Curran report" shows a large discrepancy between the quantity of water that could be accounted for by MDC communities and the amount of water sold by MDC indicating significant leaking in the system.

EOEA and the Massachusetts Water Resources Research Center sponsored seminars on Massachusetts water supply planning and policy.

The Department of Public Health's powers to approve potential public water supply sources is transferred to DEP.

1976 The Secretary of Environmental Affairs begins a study of Massachusetts water supply with the goal of producing a State-wide water supply policy.

1977 The *Draft Massachusetts Water Supply Study* is issued in January; the study advocates the Northfield proposal for increasing MDC's water supply.

Also in January, the Secretary of Environmental Affairs, MDC and the Massachusetts Steering Committee on the Connecticut River sign a "Memorandum of Understanding" creating the "Northfield Citizens Advisory Committee," later renamed the "Water Supply Citizens Advisory Committee" (WSCAC).

Criticism from environmental and western Massachusetts interests prompts the Secretary of Environmental Affairs to publicly reject the recommendation of the Northfield diversion and direct MDC to prepare a full Environmental Impact Report on the project; the Secretary supports a policy of State-wide conservation measures.

1978 The legislature passes a resolution opposing the Northfield diversion until all other alternatives, including conservation, are exhausted.

The final version of the *Massachusetts Water Supply Study* is adopted by the Governor and the Massachusetts Water Resources Commission (WRC) in May as the *Massachusetts Water Supply Policy Statement*; the policy statement supports the same policies as the legislative resolution.

1979

In January, the Secretary of Environmental Affairs declares the Northfield diversion a "Major and Complicated Project" and directs WSCAC to play a formal advisory role in the environmental review of the Northfield proposal; the scope of the review is expanded to include the study and evaluation of nine alternatives and is named *Long Range Water Supply Report and EIR -- 2020.*

WRC promulgates the "Water Resource Management Planning Regulations" requiring development of a "State Water Resource Management Plan," basin-wide water resource management plans, and local water resource management plans.

1983

Legislation firmly establishes WRC's lead role in forming Massachusetts water supply policy and coordinating water resources planning and management in the State.

The legislature passes the "Interbasin Transfer Act," originally called "An Act to Protect the Connecticut River," giving WRC regulatory authority over interbasin transfers in the State; the legislature retains provision that it must expressly authorize interbasin transfers for municipal water supply; WRC's interbasin transfer decision making criteria emphasize conservation and protection of instream uses.

1984

In January, WRC completes and approves the *Massachusetts Water Supply Policy Statement: 1984 Update*; the Update centers around the philosophy that the State should ensure the availability of water for the Commonwealth's current and future consumptive and non-consumptive uses; it encourages demand management and long-range water supply planning and management measures.

The legislature creates the Massachusetts Water Resources Authority (MWRA); MWRA replaces MDC as the water and sewer authority for the district; a Watershed Management Division is created within MDC.

1985

The City of Brockton files an application for a proposed interbasin transfer in June; Brockton's application is denied.

MWRA replaces MDC as the sponsor of the *Long Range Water Supply Study and EIR -- 2020.*

The legislature passes the "Water Management Act," giving DEP authority to allocate water within river basins.

1986

In March, MWRA releases a *Summary Report* for the *Long Range Water Supply Study and EIR -- 2020*; the report concluded that MWRA would need additional water by 1990; WSCAC argued that MWRA could eliminate the need for supply augmentation through the year 2020 by expanding its leak repair program, cutting back on unnecessary reserves and estimates of "system unaccounted for losses," and by increasing system yield through a watershed management program.

MWRA holds three public hearings in June to gather further public comment on its report and has three technical briefings by the contractor for the report; the MWRA Board of Directors go into deliberations on the report and comments in the summer.

In November, the MWRA Board of Directors issues a policy statement that establishes MWRA programs in three areas: conservation and demand management; local source development and improved use of existing sources; and development of tools for planning and management.

The MWRA Board of Directors deferred any decision on development of new supplies until after December 31, 1989 and designated diversion of rivers as a last alternative.

1989

Annual demand in the MWRA service area falls below the system safe yield of 300 mgd to 287 mgd.

1990

In January, MWRA submits to its Board of Directors a progress report on its programs and recommends that the Board approve a five year program to expand on previous programs.

APPENDIX C

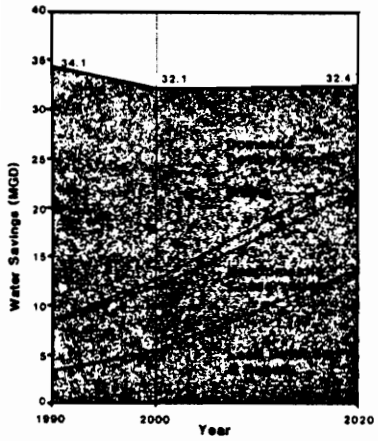
SUMMARY OF ALTERNATIVE PROJECTS EVALUATED IN THE MWRA WATER SUPPLY STUDY AND ENVIRONMENTAL IMPACT REPORT -- 2020

The MWRA/MDC water sources can safely supply 300 million gallons per day (MGD), given present operating rules which maintain reservoir levels to assure safe drinking water quality without treatment.

Since 1969 the water use of the MWRA/MDC system has exceeded 300 MGD. Above average yields have met the need. Nevertheless, projections indicate that the MWRA may need to meet an additional demand of up to 150 MGD by the year 2020. This study assesses the environmental impacts of meeting those needs from each of nine water supply alternatives.

The nine alternatives and important impacts which would result from their implementation follow.

Demand Management Alternative



This alternative is a program which was preselected for implementation by the MDC to achieve water savings in all sectors of water use over the planning period. Included are programs to retrofit residences with water conserving fixtures; repair leakage from user community distribution systems; set water rates to induce conservation; promote industrial and commercial conservation; and initiate public education. The program was selected from among ten options which were designed at different levels of effort to estimate implementation costs and likely water savings. It is designed to achieve long-term water use reductions rather than emergency reductions during periods of shortage.

Yield . . . . . 32 MGD (reduced demand)
Capital Cost $12,000,000
Annual Operating & Maintenance Cost $2,000,000
Unit Cost (net present value in dollars per million gallons) . . . . . .$204 per MG

Issues

- Difficulty in implementing a long-term water conservation program in both wet and dry years in an area perceived by the public as water rich.
- State law and policy (Interbasin Transfer Act, Chapter 21 and Massachusetts Water Supply Policy Statement, August 1984) requirement that a conservation program be undertaken prior to seeking sources of water from another watershed.

No Action Alternative

This alternative represents the baseline against which the impacts of all other alternatives are compared. No Action means that no new supply will be brought on line and the reservoirs will be operated to maintain minimum pool levels which assure drinking water quality without treatment. The projected needs of the MWRA/MDC potential service area will be met only to the extent of the current 300 MGD safe yield.

Issues:

- 120 MGD deficit in supply by 2020.
- Water shortages in MWRA service area.

Two modifications of the No Action Alternative represent the likely responses which would be used to maintain public health, safety, and welfare during the water shortages which will result from the inability to match supply with projected needs.

No Action – Water Shortage Response

Stage	Action
1	No Outdoor Water Use (summer only)
2	A year-round 5 percent reduction in use + Stage 1
3	A year-round 30 percent reduction in use + Stage 1
4	Stage 3 plus allowing Quabbin to be drawn below its minimum pool (elevation 490) to elevation 460 + Stage 1.

With supplies inadequate to meet increasing demand, severe water-use restrictions and rationing would be required in addition to the use of the reservoirs below the minimum pool levels. At the highest demand (450 MGD), a projected year-round 30 percent reduction in use would have to be maintained over 40 percent of the time. In addition, the reservoirs would have to be used below their minimum safe levels 10 percent of the time.

Incremental Yield: 28 MGD (drawdown below minimum pool) + up to 92 MGD (reduced demand). Capital Costs: (Costs of implementing these demand reductions were not developed.)

Issues:

- Temporary unemployment of up to 82,000 people resulting from water-use restrictions.

No Action – Water Treatment Plant

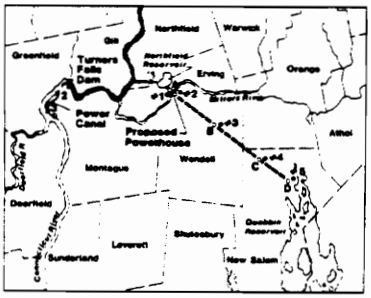
The reservoirs could be drawn down below their operational minimum pools, thus providing an additional 30 MGD of yield. The drawdown would result in degradation of the water quality, and the water would require treatment to maintain drinking water standards. Treatment plants would be constructed at Wachusett and Quabbin Reservoirs. To provide a safe yield of 330 MGD, the treatment plants would operate 16 percent of the time, when the reservoirs drop below their established minimum pool levels.

Incremental Yield . . . . . .30 MGD
Capital Cost $170,250,000
Annual Operating & Maintenance Cost $3,130,000
Unit Cost . . . . . .$456 per MG

Issues:

- Problems of sludge disposal and traffic at Wachusett Reservoir water treatment plant (designed for a peak flow of 438 MGD).
- High unit cost of water.

Connecticut River Alternative



1= Northfield Powerhouse
2= Turners Falls Powerhouse
3= Cabot Powerhouse
Turners Falls Pool
Montague Gaging Station
Tunnel Shaft
Spoil Pile
Existing Pipeline
Proposed Tunnel

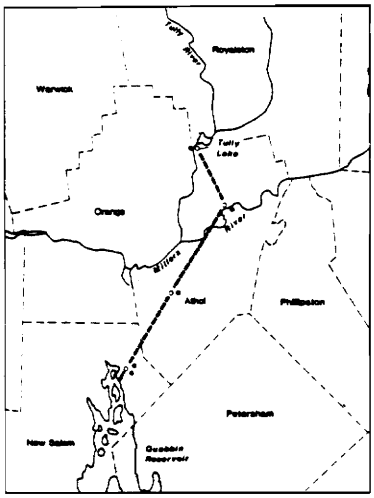
This alternative is designed to take water from the Turners Falls Pool of the Connecticut River during periods of high flow and pump it to Northfield Reservoir, using existing pumps and conduits. Diversions would occur only when minimum flow conditions in the river are met. The water would be transferred to Quabbin Reservoir through a deep tunnel 9.2 miles long. No treatment is provided; the assimilative capacity of Quabbin is expected to maintain water quality at drinking water standards. Two tunnel design options were studied; one which provides for gravity flow alone and one which includes facilities to provide for hydropower generation. The power option could generate approximately $637,000 of revenue per year.

Incremental Yield	.63 MGD
Capital Cost (gravity option)	$87,640,000
Capital Cost (power option)	$97,750,000
Annual Operating & Maintenance Cost (gravity)	$1,517,000
Annual Operating & Maintenance Cost (power)	$1,650,000
Unit Cost (gravity)	$150 per MG
Unit Cost (power)	$135 per MG

Issues:

- Progressive degradation of water quality in Quabbin over a period of several decades, especially in the shallower, northern section where the diverted river water will flow into the reservoir.
- Introduction of lamprey into Quabbin Reservoir.
- Possible disturbance of protected species due to construction near Quabbin and disposition of tunnel spoil.

Millers/Tully Rivers Alternative



◦ Tunnel Shaft
• Spoil Pile
— Proposed Tunnel

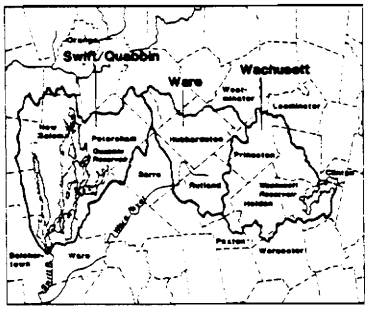
This alternative has two options: diverting flows from the Millers River at Athol or from both the Millers River at Athol and the Tully River. In both cases, diversions would take place only when flow constraints to protect fish and maintain effective wastewater dilution are met. The water from the Millers River would be transferred to Quabbin through a 7.7-mile deep tunnel. The tunnel would be 10.3 miles long to include diversion of additional water from the Tully River below Tully Lake. The unit cost of this alternative (either option) is the lowest of the structural alternatives.

Incremental Yield (Millers)	.33 MGD
Incremental Yield (Millers/Tully)	.38 MGD
Capital Cost (Millers)	$83,300,000
Capital Cost (Millers/Tully)	$112,530,000
Annual Operating & Maintenance Cost (Millers)	$255,000
Annual Operating & Maint. Cost (Millers/Tully)	$425,000
Unit Cost (Millers)	$142 per MG
Unit Cost (Millers/Tully)	$170 per MG

Issues:

- Some degradation in water quality in northern part of Quabbin Reservoir after several decades.
- Introduction of lamprey into Quabbin Reservoir.
- Loss of white water area on Millers River.

Watershed Management Alternative



Quabbin, Ware, and Wachusett Watershed Boundries

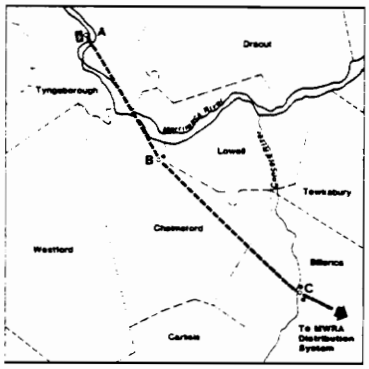
This is a program to increase yield by managing MDC-owned watershed lands to reduce the density of forest cover and thereby increase runoff to MDC reservoirs. The increased yield takes 15 years to achieve and then must be maintained at some cost. The unit cost is the lowest of all alternatives in part because a net profit from the sale of wood is realized for the first 15 years.

Incremental Yield	5 MGD
Capital Cost	$2,600,000
Annual Operating & Maintenance Cost	$420,000
Unit Cost	$-20 per MG

Issues:

- Potential wide-spread disturbance of archaeological resources.

Merrimack River Alternative



-- Proposed Tunnel
A Tunnel Shaft
• Spoil Pile
Water Treatment Plant

For this alternative, water would be diverted from the Merrimack River during high flow months, when minimum flows for maintenance of migratory fish and effective wastewater dilution are met; treated at a new 235 MGD water treatment plant in Tyngsborough; and transferred through a deep tunnel 26 miles to the MWRA distribution system in Malden.

This is the only alternative which supplies the total estimated capacity planning need of 120 MGD projected for the year 2020.

It also provides redundancy for the existing system and flexibility, because it can be constructed in phases.

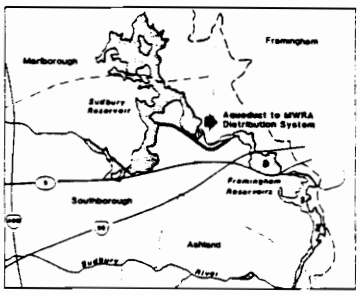
The operation of this alternative is complex, requires a high level of treatment and a complete transfer of most of the system to this source during the eight months of operation. The source water is of poor quality and therefore requires a high level of treatment. This alternative has the highest unit cost.

Incremental Yield	120 MGD
Capital Cost	$501,100,000
Annual Operating & Maintenance Cost	$14,599,000
Unit Cost (if constructed in one phase)	$567 per MG
Unit Cost (if constructed in three phases)	$498 per MG

Issues:

- Impacts on the planned capacity of downstream hydroelectric generating plants in Lowell and Lawrence due to the reduction in flows for some months.
- Traffic impacts during operation of the treatment plant.
- Significant construction noise and traffic at Shaft 9A in densely developed area of Medford.
- Potential disturbance of wildlife on the state list for special consideration at the Middlesex Fells Reservation.
- High capital and annual O&M cost.

Upper Sudbury Watershed Alternative



Water Treatment Plant
Proposed Pipeline
Watershed Boundary

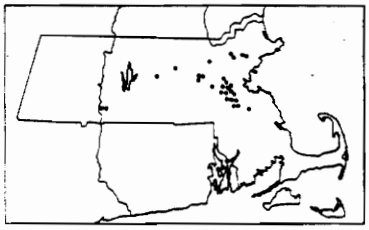
This alternative takes water from the Framingham Reservoirs in the southern part of the Upper Sudbury River Watershed and pumps it to Sudbury Reservoir when downstream flow constraints and reservoir operating constraints limiting drawdown are met. This augments the yield of Sudbury Reservoir, presently a reserve source used by MWRA/MDC as an emergency supply. To reestablish the continuous use of this source, a treatment plant must be built.

Incremental Yield . . . . . .20 MGD
Capital Cost $30,539,000
Annual Operating & Maintenance Cost $1,520,600
Unit Cost . . . . . $201 per MG

Issues:

- Potential scenic impacts in conjunction with the intermittent drawdown of the Framingham reservoirs as these are brought back into operation.
- No land or water right acquisition required as the sources are owned by MDC.

User Sources Alternative



This alternative was designed to examine the feasibility of using local water supplies, especially abandoned or underutilized supplies in the MWRA/MDC service area communities. Twenty-eight sources were assessed: there are four sites in the Assabet River basin, eight sites in the Charles River basin, three sites in the Chicopee River basin, four sites in the Ipswich River basin, one site in the Nashua River basin, six sites in the Neponset River basin, one in the Sudbury River basin, and one in the Taunton River basin.

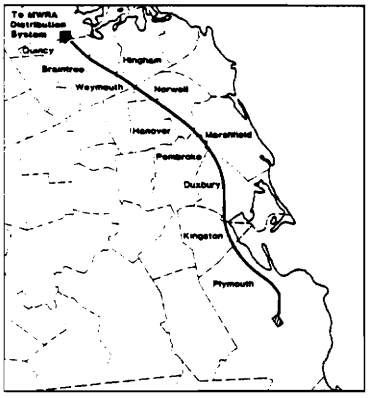
The combined yield of these sources is unknown since data were not available to determine interactive hydrologic effects of sources in the same watershed.

Design Yields . . . . . .(.06-10 MGD)
Capital Costs . . . . . $686,000-$6,185,000
Annual Operating & Maintenance Costs . . $72,700-$1,356,330
Unit Costs . . . . . $139-$3,807 per MG

Issues:

- Likely drawdown of groundwater levels affecting surface waters and wetlands near sources.
- Most sites are in developed areas without protection from sources of contamination and yield a low quality of water requiring treatment.
- Significant impact on recreational resources at several sites.

Plymouth Aquifer Alternative



Pipeline Alignment

Wellfield/Water Treatment Plant

This alternative is designed to withdraw water from a large aquifer underlying the towns of Bourne, Plymouth, Carver, and Wareham. The water would be treated at wellfields in Plymouth; pumped north 27 miles through a new pipeline along Route 3; and delivered to the MWRA distribution system at a connection in Quincy.

Incremental Yield . . . . . .15 MGD
Capital Cost $47,490,000
Annual Operating & Maintenance Cost $1,571,000
Unit Cost . . . . . $333 per MG

Issues:

- Potential drawdown of local groundwater levels affecting wetland and pond habitats.
- Changes in scenic quality and recreational activity at ponds.
- Loss of part of habitat of the red-bellied turtle, listed as an Endangered Species by the U.S. Fish and Wildlife Service.
- Potential effect on some cranberry bogs.

APPENDIX D

MASSACHUSETTS INTERBASIN TRANSFER ACT

Massachusetts General Laws Annotated, **Chapter 21, §§ 8B-8D**

§ 8B. Definitions applicable to this section and sections 8C and 8D

The following words and phrases, as used in this section and sections eight C and eight D, shall have the following meanings:

Commission	The water resources commission.
Interbasin transfer	Any transfer of the surface and groundwaters, including wastewater, of the commonwealth outside a river basin. If a city or town partially situated within a river basin takes waters from that basin, extension of water services to a portion of the same city or town outside the basin shall not be deemed an interbasin transfer of water.
Insignificant increase	An increase insufficient to invoke the provisions of section eight C and eight D as determined by the commission; provided, however, that in no event shall an increase over one million gallons per day be deemed insignificant.
River basin	A geographic area within the commonwealth determined by a body of water and its surrounding drainage area as delineated by the commission.

§ 8C. Increase in interbasin transfers of surface and groundwater; approval; exemption

Any increase over the present rate of interbasin transfers of the surface or groundwater of the river basin shall require the approval of the commission, notwithstanding the provisions of any law to the contrary to increase a present interbasin transfer in addition to such other approvals that may be required by law. Said commission shall file a report of its findings, justifications, and decisions in relation to such approval or disapproval, with the clerks of the house of representatives and the senate, and with the state secretary for publication in the Massachusetts register.

Any emergency conditions either approved under the provisions of sections forty and forty-one A of chapter forty, or authorized by a law to provide a necessary and adequate water supply shall be exempt from the provisions of this section for a period not to exceed six months of any calendar year, so long as they fulfill the criteria of the division of water supply of the department of environmental quality engineering.

The provisions of this section and section eight D shall not apply to any insignificant increase over the present rate of interbasin transfers of the surface and groundwater of a river basin. The criteria for determining any insignificance shall be established by the commission based upon the impact to the donor basin.

§ 8D. Rules and regulations; criteria for approval; hearings; procedure

The commission shall promulgate rules and regulations defining and delineating the river basins of the commonwealth, and establish application procedures and criteria upon which the commission shall base its approval or disapproval of any proposed interbasin transfer of waters. Said criteria shall include but not be limited to the following:

(1) that all reasonable efforts have been made to identify and develop all viable sources in the receiving area of the proposed interbasin transfer,

(2) that all practical measures to conserve water have been taken in the receiving area, including but not limited to the following:

(a) the identification of distribution system sources of lost water, and where cost effective, the implementation of a program of leak detection and repair;

(b) metering of all water users in the receiving area and a program of meter maintenance;

(c) implementation or rate structures which reflect the costs of operation, proper maintenance and water conservation and encourage the same;

(d) public information programs to promote water conservation, including industrial and commercial recycling and reuse; and

(e) contingency plans for limiting use of water during seasonal or drought shortages;

(3) that an environmental review pursuant to section sixty-one and sections sixty-two to sixty-two H, inclusive, of chapter thirty has been complied with for the proposed interbasin transfer,

(4) that a comprehensive forestry management program which balances water yields, wildlife habitat and natural beauty on watershed lands presently serving the receiving area has been implemented,

(5) that reasonable instream flow in the river from which the water is diverted is maintained, said reasonable instream flow shall be determined by the commission in making its determination of applicability of the proposed interbasin transfer of water.

The decision of the commission to approve or deny a proposed interbasin transfer shall be determined after at least two public hearings, one of which shall be held in the proposed donor community and one of which shall be held in the receiving community and which shall take place after compliance with said sections sixty-one and sixty-two to sixty-two H, inclusive, of chapter thirty. All proceedings under sections eight C and eight D shall be subject to the provisions of chapter thirty A.

APPENDIX E

EXCERPTS FROM MASSACHUSETTS INTERBASIN TRANSFER REGULATIONS

313 Code of Massachusetts Regulations 4.00 at 4.05

4.05: Criteria for Evaluation of Applications for Approval

The Commission shall consider the following criteria in making its decision to approve or deny a proposed action to increase over the present rate of interbasin transfer of waters.

(1) That an environmental review pursuant to M.G.L. c. 30, §§ 61 and 62H, inclusive, if required, has been complied with for the proposed increase.

(2) That all reasonable efforts have been made to identify and develop all viable sources in the receiving area of the proposed interbasin transfer.

(3) That all practical measures to conserve water have been taken in the receiving area, including but not limited to the following:

(a) The identification of distribution system sources of lost water, and where cost effective, the implementation of a program of leak detection and repair.

(b) Metering of all water users in the receiving area and a program of meter maintenance.

(c) Implementation of rate structures which reflect the costs of operation, proper maintenance, proposed capital improvements and water conservation and which encourage the same.

(d) Public information programs to promote water conservation, the use of water conserving devices, and industrial and commercial recycling and re-use.

(e) Contingency plans for limiting use of water during seasonal or drought shortages.

(f) Implementation of land use controls to protect existing water supply sources of the receiving area that meet the requirements of the department of Environmental Quality Engineering published in 310 CMR 22.20.

(4) That a comprehensive forestry management program which balances water yields, wildlife habitat and natural beauty of watershed lands presently serving the receiving area and under control of the proponent has been implemented.

(5) That reasonable instream flow in the river from which the water is transferred is maintained. The Commission shall take into consideration in determining reasonable

instream flow the impact of the proposed interbasin transfer on the streamflow dependent ecosystems and water uses to include:

(a) Length of stream below the point of withdrawal.

(b) Effects on flood flows, intermediate flows and low flows.

(c) Effect on groundwater and surface water elevations.

(d) Significance of indigenous and anadromous fisheries and fauna and effects thereon.

(e) Significance of wetlands and dependent flora and fauna and effects thereon.

(f) Effect on water quality, recreational uses, aesthetic values, areas of critical environmental concern and areas protected under Article 97 of the Amendments to the Massachusetts Constitution.

(g) Effect on established riparian uses and uses dependent on recharge from stream flow.

(h) Effect on hydropower production.

(i) Effect on other water withdrawals and undeveloped rights within the donor basin.

(j) Effect on other instream uses.

(6) In the case of groundwater withdrawals, the results of pump tests will be used to indicate the impact of the proposed withdrawal on static water levels, the cone of depression, the potential impacts on adjacent wells and lake and pond levels, and the potential to affect instream values as listed in 313 CMR 4.05(5)(a) through (j).

(7) That the communities and districts in the receiving area have adopted or are actively engaged in developing a local water resources management plan.

(8) The Commission shall consider the impacts of all past, authorized or proposed transfers on streamflows in the donor basin.

APPENDIX F

WRC INTERPRETIVE GUIDELINES FOR THE INTERBASIN TRANSFER ACT

1.*All practical conservation measures*

(a)Metering

- 100% metering of all consumptive uses including public buildings
    - does not include fire-fighting or pipe flushing
    - may include, if system use is high, meters on individual apartment units and on public places such as cemeteries and parks
    - meter replacement program in writing with evidence of an ability to test, recalibrate, repair, or replace meters on an on-going, regular basis. Evidence may include local funds being set aside, personnel, contract(s)

(b) Leak detection

- 100% of the system every 5 years (a very large system like Boston's may take longer)
- an on-going program with the frequency and scope depending on the amount of unaccounted for water. If there is more than 15% unaccounted for water, then a plan of action must be adopted describing, at least, the schedule, timing, and pipe location
- evidence of an ability to follow-through, such as a contract, funds set aside, personnel, equipment, applied for state grant funds from [DEP]
- encourage not require computer study indicating where to strengthen and expand pipes

(c) Rehabilitation

- fix every detectable leak
- fix all emergency leaks immediately
- maintain interconnections with neighboring communities
- an on-going rehabilitation program with evidence that leaks will get fixed as soon as the budgetary and administrative approvals can be worked out.

Evidence includes funds set aside, personnel, application for state grant funds

- encourage closed loops
- eliminate bleeders

(d) Pricing

- true cost pricing for water-related costs including pensions, insurance, administrative costs, utilities, equipment, capital needs
- at a minimum, a flat rate structure
- not a descending rate structure
- enterprise accounting unless it can be demonstrated that this method is not necessary because another one is in place which accomplishes the same purpose of having sufficient funds, personnel, equipment available for water supply uses whenever it is needed
- reasonable charge for water sold to other communities based on the costs of producing, treating, supplying, and protecting water [for] them
- other measures, such as seasonal pricing, ascending rate, hook-up fee, as appropriate to a specific case

(e) Billing

- at least twice a year
- preferably staggered billings

(f) Public information

- school programs including a written curriculum on an on-going, permanent basis
- general public education program which details goals, objectives, activities, time table, and means for implementation
- education program for municipal employees (such as water, sewer, transportation, personnel)

(g) Device Retrofit

- evidence of implementing Plumbing Code for new construction and substantial rehabilitation

- all public buildings retrofitted
- if high unaccounted for use (over 15%), demonstration of commitment to reduce via means such as applying for state grant funds, sales of devices at no cost or at cost

(h) Contingency Plans

- a progressively stringent reduction program adopted indicating who will reduce where, how much, and how; how will essential services be maintained
- education program
- emergency response plan&em.who is responsible to do what, when, how, and with what sources of water

(i) Pressure Reduction

- adopted plan of why pressure is above 100 psi and what will be done to reduce it

(j) Amount of Unaccounted for Water

- analysis of amount and reasons for that figure
- plan of how to reduce, if over 15%, which is written and adopted

(k) Water Source Protection for the Entire Watershed or Recharge Zone of an Aquifer

- plan including goals; priorities of action; implementation steps; time-table; map of whole watershed showing contours, recharge areas, land use activities, zoning, point sources, known non-point sources
- on-going low level maintenance program such as roots removal, cleaning of debris from water bodies, keeping fire lane accessible
- sanitary survey of watershed or recharge zone once a year with a report submitted to [DEP]. More frequent survey of treatment and chlorination facilities
- proper zoning of all lands owned by applicant
- advocate actions which can influence protection of water source on lands not owned by the applicant such as testifying, in writing and in person, at local board hearings, interacting with state agencies (MDPW, [DEP], MEPA) and federal agencies (EPA, Corps of Engineers)
- at a minimum, meet SDWA requirements for testing

- surveillance-including daily inspections of facilities; posting of signs

- demonstrate attempt to increase land-holdings via purchases of land and/or development rights, as evidenced by means such as application for state ([DEP], Food and Agriculture, Conservation Services, DEM, etc.) funds, tax title properties, seeding donations

- education program aimed at increasing people's awareness about the relationship between land-use and water quality impacts through efforts such as workshops, forums, hand-outs, news articles

(l) Emergency Actions

- program in place describing actions such as water bans, building moratorium

2. *MEPA Compliance*

- project is exactly the same as submitted to MEPA

3. *Local Viable Sources in the Receiving Area*

- "viable" means a source which meets [DEP's] water quality standards at a production cost which is reasonable in comparison to costs incurred elsewhere in Massachusetts. The costs can be higher than alternative options. Costs should be measured against comparable situations such as two sites which need a similar level of treatment not one which does and one which does not require treatment.

- "receiving area" means a locality adjacent or near the locality(ies) served by the applicant, especially if sources in these nearby communities are being considered and/or developed by the applicant.

- long-range water supply program which describes all sources being considered for future use including sites outside of the receiving area

4. *Comprehensive Forestry Management*

- plan written and adopted, for all watersheds greater than 10 acres (Chapter 61 Forest Taxation Law)

- evidence of implementation such as selective tree cuttings, vegetation replacement, use of a botanist

5. *Reasonable In-stream Flows*

- maintain existing, significant (from a state perspective) water uses including, at least:
  fish (stocking, breeding, maturing, harvesting) agriculture (cranberry production, dairy crops) recreation (active and passive)
  wastewater dilution
  hydropower production
  aesthetic beauty
  wetlands and dependent flora and fauna

- not cause the lowering of any surface water body from its DWPC designated classification

- not impact the use of an actual of planned public water supply source, as defined by [DEP]

- does not accept, as a given, any legislative water rights provided in special acts of the legislature which were not in use when the Interbasin Transfer Act became effective

6. *Local Water Resources Management Plan*

- written plan either adopted or actively engaged in developing a plan, as described in 313 CMR 2.00

- if not adopted by the Water Resources Commission, evidence of progress such as draft plan, detailed scope of plan plus a completed water supply component, or (at a minimum) responses to the Water Resources Commission/DEM's Division of Water Resources' latest questionnaire

APPENDIX G

EXCERPTS FROM THE WATER MANAGEMENT ACT REGULATIONS

310 Code of Massachusetts Regulations 36.00 at 36.20

36.20: Contents of a Permit Application

1. Each permit application filing shall include, at a minimum:

   (a) the reason(s) for the withdrawal, and the type of use (residential, industrial, agricultural, etc.) of the water withdrawn;

   (b) an identification of the water source in which the withdrawal is located;

   (c) the specific location of each of the applicant's withdrawal point(s) within the water source;

   (d) the volume, frequency and rate of water to be withdrawn from each withdrawal point, the anticipated times of year of the withdrawals, and any projected changes in this information over a twenty-year period;

   (e) the length of time for which the permit is sought, as limited by provisions of 310 CMR 36.32;

   (f) a description of water conservation measures instituted or to be instituted by the applicant, including a schedule for implementation of those measures;

   (g) the amount and location of any water discharged by the applicant, and copies of any discharge permit for such discharge issued by the Department [Department of Environmental Protection];

   (h) the history of the withdrawal volume from each withdrawal point, since January 1, 1981;

   (i) the name and address of the designated water resources management official, or chief elected official if such official is not designated, for the town or city in which the withdrawal is located;

   (j) the appropriate fee, as established by 310 CMR 36.37;

   (k) any other information requested by the Department related to the withdrawal, its use, discharge, impacts, or information related to the factors the Department must consider in reviewing applications, as listed in 310 CMR 36.26.

2. Each application for a permit for a proposed new withdrawal shall also include:

   (a) a copy of any Environmental Notification Form filed;

   (b) an evaluation, on a form provided by the Department, of the potential effect of the withdrawal on:

   - water quality
   - wastewater treatment
   - waste assimilation
   - groundwater recharge areas
   - navigation
   - hydropower resources
   - water-based recreation
   - wetland resource areas
   - fish and wildlife
   - agriculture
   - floodplain

   (c) any alternatives to the proposed withdrawal including a study of cost, feasibility and environmental effects of such alternatives, and including but not limited to leak detection and repair, conservation and demand management;

   (d) the need for the withdrawal volume proposed, including a twenty-year projection of water demand; and

   (e) the impact of the proposed new withdrawal on other withdrawal points and water sources.

3. The applicant may include in the permit application, or the Department may require the following additional information:

   (a) any water resource protection measures affecting the withdrawal which have been implemented or which are planned by the applicant or by any other person;

   (b) any agreements with an owner of property conveying an easement by deed which restricts the right of the owner of the property or of any other person to make a withdrawal from the same water source from which the applicant proposes to withdrawal;

   (c) the impact of the withdrawal on economic development and the creation of jobs in the Commonwealth;

   (d) the impact of the proposed new withdrawal on other water uses, land values, investments and enterprises that are dependent on previously allowable withdrawals in the water source;

(e) identification of the area of contribution for any groundwater withdrawal point;

(f) any other information which relates to the proposed withdrawal, its impacts, use or factors the Department shall consider in reviewing the application.

4. No applicant for, or holder of a permit, shall make any false, inaccurate or misleading statement in any record, report or application that the applicant or holder is required to keep or submit pursuant to these regulations.

APPENDIX H

OVERVIEW AND SUMMARY OF LONG RANGE WATER SUPPLY PROGRAM AND MWRA RECOMMENDATIONS FOR 1990 - 1995

BRIEF HISTORY OF WATER SUPPLY PLANNING

Since 1652 when the first public water supply was constructed in Boston, water supply planners in our region have periodically faced the problem of ensuring a sufficient supply of clean drinking water in the face of demand growth and degradation of current sources. In each instance, they chose to look west, outside the city, for larger supplies of cleaner water: in 1795 to Jamaica Pond, in 1848 to Lake Cochituate, in the 1870's to the Framingham and Sudbury Reservoirs, in 1895 to Wachusett Reservoir and in the 1930's to the Ware River and Quabbin Reservoir. When demand began to exceed the available supply in the 1970's, water supply planners looked west again to the Connecticut River. This time, however, the process was resisted. Whereas in the past, growth of demand seemed natural, and fouling of more urban supplies inevitable, those assumptions were now in question. In the past, substantial alteration of the natural and man-made environment in one location for the "greater good" of the urban dwellers was considered more than reasonable. Now, a new consciousness of the long-term destruction of the environment called the traditional trade-offs into question. The stage was set for a protracted technical and environmental review of our water supply situation, and a change in the type of solution chosen.

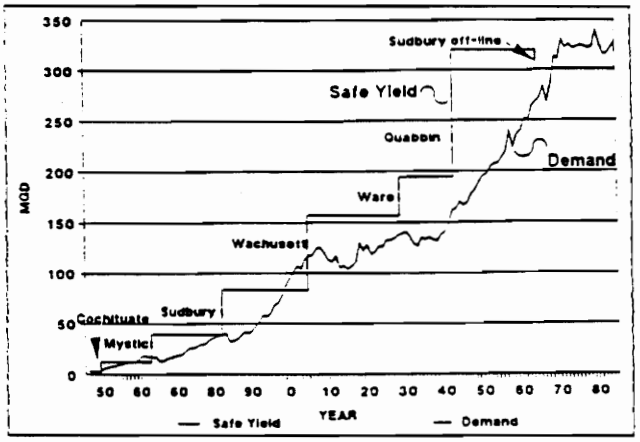


Figure 1
Water Supply and Demand 1848-1985

In 1986, the MWRA Board of Directors began to review the almost 50 volumes of material which had been produced in the Long Range Water Supply Study and EIR - 2020 to define the water supply situation, to identify a range of nine alternative solutions, and to determine the benefits and drawbacks of each of the alternatives. They also reviewed the voluminous responses to the official reports prepared by the Water Supply Citizen's Advisory Committee (WSCAC) and other groups. It seemed clear that the current use was more than 10 percent higher than the safe yield of the sources, but also clear that a portion of this demand left the

reservoirs to serve not people, but leaks and inefficient water use practices. The predicted potential of a 50 percent demand increase by 2010 was there, but so was the potential for a significant reduction in demand.

In November of 1986, the Board of Directors made a series of short term and long term water supply policy decisions. They directed staff to implement the demand management alternative studied in the LRWSS and to develop a 3-year plan to re-evaluate the core assumptions of traditional water supply planning. How much demand reduction was possible? How much would it cost? Must existing sources inexorably be contaminated and lost as supplies? Could the MDC/MWRA system supply all the legitimate water supply needs of its users without a major new supply? Staff were given three years to attempt to answer questions of that nature and to return to the Board with recommendations. The clear preference of the Board was to try all reasonable means of continuing to supply the system's needs without a major new source; only if that failed after a fair trial, would the more traditional water supply planning route of augmentation be considered. (The November 1986 policy votes are reproduced in Appendix A).

In March of 1987, MWRA staff returned to the Board with the Long Range Water Supply Program. It proposed specific programs and projects to respond to each of the Board's 28 policy decisions, with an estimated cost of about $33 million over three years. The LRWSP consisted of programs in three general areas: conservation and demand management, incremental supply enhancement, and tools for management and planning, as well as outreach and reporting programs. The entire MWRA organization was to be involved in implementing the policies and incorporating them into the Authority's standard operating procedures. By December of 1989, the Board was to receive a report giving the results of the program.

This report does just that. The three year trial has all indications of success: most programs appear to be implementable and generally cost-effective, and water use is down dramatically. Staff recommend a continuation of the current policy direction for at least the next five years.

PROGRESS SINCE 1986

The MWRA has made major progress in implementing and testing the programs proposed in the Long Range Water Supply Program. Staff from all divisions of the Authority have worked together to plan and accomplish the first steps in a demand reduction oriented policy. The following discussion provides a brief summary of what has been accomplished over the past three years; more detail is provided in the main section of this report.

Conservation and Demand Management

The MWRA's conservation and demand management programs were designed to test an integrated solution to reducing water use over the long term. By coordinating a variety of efforts focused on different segments of water use, these programs should be able to provide significant water savings. The programs included leak detection and repair, domestic conservation, and non-domestic conservation. The aim was to reduce water use every step of the way from the reservoir to the user, including MWRA pipes and aqueducts, the community distribution systems, and the residence and work place.

The MWRA program is close to unique in that it is both year-round and long-term. We are not just dealing with a drought or summer peak usage, but attempting to alter the way in which water is used and valued every day, year after year. It is not enough to temporarily reduce water use, it must stay down.

The leak detection programs were designed to find and repair leaks in the 260 miles of MWRA pipes and to provide a once through leak survey of the 6000 plus miles of community pipes. We had expected to be able to increase the percentage of water which left the reservoirs and was accounted for as sold to communities to 95 percent and to find approximately 25 mgd in leakage in community pipes. Both goals have been met. Over 95 percent of the water withdrawn from our reservoirs has been sold to our user communities in 1988 and 1989 (that is, less than 5 percent was used in system operations or wasted through leaks), and annual leak detection and repair is now part of our ongoing maintenance efforts. As of January 10, 1990, 25 mgd had been found in the first 5300 miles of community pipe surveyed. Additional savings should also be possible as communities follow up this work and begin to do leak surveys more frequently. The only major difficulties with the community project have been scheduling (particularly for communities where we are using DEP funding), and the lack of local resources (especially staff time and up-to-date maps) which have slowed some surveys. Draft regulations to require regular leak detection, prompt repair and accurate metering were issued for public comment, and will be finalized within the next few months.

The domestic conservation programs were designed to bring about long range changes in the way water is used in the home. They focus on making the public aware of water as a precious, limited resource, on developing an understanding of the cost of water, and on providing a range of practical ways water can be saved. Thus there are programs to educate and inform, to install water saving devices, to encourage household leak detection, and to reduce the amount of water used by fixtures and appliances.

The domestic device retrofit pilot program assessed various ways the MWRA could encourage the installation of water saving devices in homes. The pilot evaluated two methods, direct installation by MWRA contractors and distribution of devices from a local depot. Participation in the program exceeded original expectations: 4600 direct installations were made (about 60 percent of those in the target area) though only 3600 had been expected and 2400 households picked up device kits though only 1850 had been expected. (However, only 1300 were in the target area, over 1000 were from outside it.) We were able to determine that there was interest in participation, that the MWRA liability was not substantial, what we estimated costs per household would be and how much water would be saved. We were thus able to develop a cost-effective system-wide plan, which, if approved, should save an estimated 5 to 8 mgd after a 3-year implementation period at a cost of about $10.8 million.

The domestic outreach and information programs have developed a range of targeted and general information pieces designed to inform home owners, renters and building managers about water use and water saving techniques. We have experimented with materials targeted to specific audiences and with geographic targeting - concentrating multiple approaches on a given community. Both approaches have advantages in certain situations and we plan to continue a mix depending on the desired impact. Locally initiated activities with only MWRA technical support, and joint marketing approaches are playing a larger role as the program matures and interest in conservation increases.

The water conservation education program for schools targets students' attitudes and knowledge about residential water use. We have successfully tried a four step process where we develop curriculum materials, then test them, provide widespread teacher training and continually provide follow up with educators. Our third and fourth grade, and junior high curriculum guides have reached the fourth step, and we have just released our new high school curriculum and are providing teacher training. All have been well received and are in use in at least 39 of the 46 the communities we serve.

The retail rates technical assistance program was designed to provide information on rate structures and full cost accounting to all our user communities through workshops and guidebooks, and then to provide more detailed follow up assistance to a few communities whose civic leaders expressed an interest in making changes. We have held the workshops and developed written materials. Due, in part, we believe to other overriding municipal financial concerns, little interest has surfaced in using the Authority's assistance to create

additional conservation incentives through retail rate structures.

The Authority has also moved to further water conservation in homes through initiating the changes in Massachusetts plumbing code requiring 1.6 gallon per flush toilets, placing water saving devices on the state blanket procurement lists and working with housing authorities and community housing groups. The code change alone is expected to yield almost 11 mgd in domestic savings over what would have occurred otherwise by 2020.

The philosophy behind the non-domestic conservation program is similar to that of the domestic program - defining water as a limited resource, recognizing its true cost, providing practical information on use reduction, and identifying and removing regulatory or economic hurdles to efficient water use. The emphasis is slightly more on the economics, and specific efforts are directed at each type of use and user.

Over the past 3 years our non-domestic programs have been developing specific technical information on water savings techniques for about 20 different categories of users through water use audits; building working groups in each industry type to assist in outreach and the sharing of successful efforts; and creating a database of our largest users to target and track specific conservation strategies. The results of our first group of 19 completed audits indicate a significant potential for increases in water use efficiency: if only those measures with a payback of 3 years or less are implemented, savings of 20 to 30 percent of current water use in those facilities are possible. These measures alone would save 0.7 mgd. We have begun to translate our findings into written materials and case studies so that we can share them with all other similar users. This was done at workshops, or at the invitation of trade and professional groups. So far we have had at least one contact involving a 3 hour workshop or presentation by the Executive Director with engineering and facilities managers representing over 450 companies or institutions; 25 workshops have been sponsored by the Authority in the past year alone.

Municipal use is also considered non-domestic, and the MWRA has almost completed a program of providing low-flow toilets to municipalities which will install them in public buildings. The program's purpose was to demonstrate the effectiveness and efficiency of low flow toilets in a local public setting. We have about 120 installed in four communities, have signed agreements to provide about 540 toilets to an additional 15 communities, and anticipate another 500 in 12 other communities within the next few months. The toilets are working well and public reaction has been generally good.

As in the domestic side, code changes can be a good low-cost, long-term conservation strategy. In consultation with our wastewater engineers, we have proposed code changes eliminating the use of once-through cooling systems and improving the efficiency of other HVAC (heating, venting and air conditioning) design and operating practices. (The discharge of cooling water to MWRA sewers is already prohibited and has resulted in some savings.)

Incremental Supply Enhancement

The second principal area of the Long Range Water Supply Program was our effort to better use our existing sources and to protect and develop local sources within our existing service area. As with the conservation and demand management programs, the programs in this area were designed to allow the MWRA to live within the safe yield of the Quabbin-Ware-Wachusett system.

The local source feasibility study has been conducting feasibility evaluations of 14 potential water supply sources within user communities. The goal is to develop and use any sources which meet technical, financial and environmental criteria. An extensive in-house effort reduced a much larger number of sites down to the 14 now being evaluated by our consultant. The evaluation process will screen out unacceptable sites before expensive field testing and water quality sampling begin. The results for the first site, Legg's Hill in Marblehead, indicated that we should proceed into more detailed work: we anticipate bringing recommendations on the remaining 13 sites to the Board in the next several months. No numerical goals have been set for individual sites yet.

The Authority's water sharing initiative, while not part of the original LRWSP, has become a component of our local sources program. The initiative, developed as a product of the Additional Water Supplies Project (LR7) described below, demonstrates our open mindedness and willingness to follow through with action. In July of 1988, we proposed to consider an arrangement where we would take water from Wellesley and Needham when they have an excess and supply them with water when they need it. This would yield a net benefit to the Authority supply. We have received authorization from the Water Resources Commission (WRC) to proceed with an arrangement with Needham which should yield an average of 0.3 mgd. The design is underway and construction should occur in 1990. A similar agreement with the town of Wellesley that should yield an additional 0.5 mgd was presented to WRC in November 1989 and January 1990. The application to WRC has been withdrawn by Wellesley pending further negotiations on

environmental mitigation.

The partial users' source protection study was designed to prevent the contamination of existing and potential local sources in communities which receive only a portion of their supply from the MWRA by identifying potential sources of contamination and developing protection measures. The Cambridge portion of the study, being done by MAPC with funding from MWRA and Cambridge, is almost complete. Significant problem areas have been identified. Working with Cambridge and the four watershed communities, MWRA is evaluating feasible protection strategies. The study of the remaining 13 partial users is about one half complete and we will have identified the risks to existing sources by the spring of 1990. Recommended protection strategies will be complete by December 1990.

A similar protection study is being done for about 26 non-MWRA supplied communities which are adjacent to our service area. This should reduce the potential for these communities to lose their sources and turn to the MWRA. This study is underway and will be completed with protection recommendations by Summer of 1990.

The evaluation of the reactivation of the Sudbury Reservoir to provide approximately 17 mgd was to have had two parts: the completion of the environmental impact report and a review of previously recommended treatment plant processes and sludge disposal options. The EIR has not yet been completed due to delays in completing the MWRA drought plan and changes in our supply status, and thus the statement of project need. The second study has been completed. The results of the process evaluation were that there was no significant change in water quality, no need for substantial change in plant processes, that there would not be more sludge than previously estimated, and that the requirements of the amendments to the Safe Drinking Water Act could be met. The recommended sludge disposal option was contracting with a private firm for both removal and ultimate disposal off-site.

Our review of the Swift River releases and the technical, environmental and legal issues associated with altering the legislative or permit requirements for releases from Quabbin Reservoir was completed in June of 1988. The staff recommended that the Authority not pursue modifications to the required releases to the Swift River. However, a new alternative to improve yield from the Quabbin Reservoir through more efficient operations was identified which is fully within the existing requirements. This alternative, which involves gaging the Swift River at the legislatively mandated location in Bondsville, and adjusting flow as required by the law, is being evaluated by staff. If

implemented, it may yield about a 4 mgd increase in safe yield at a modest cost.

There had been concern that the definition of "Safe Yield" contained in the MWRA Enabling Act was too restrictive and that a clarification might be necessary. Based on our research and the discussions of a working group of Authority and MDC staff, the staffs' conclusion is that the existing definition is sufficiently broad as to encompass our current and reasonably foreseeable operations. No change in the legislation appears necessary and no alteration in the current estimate or range of estimates for the safe yield of the Quabbin-Ware-Wachusett system is anticipated. Staff continue to work with the MDC which has responsibility for the reservoirs and is charged with setting the safe yield.

MDC continues its forest management planning to increase yield in the reservoirs. MWRA assisted MDC in funding a consultant review of existing information and recommendation for the EIR on the program, which will be produced by MDC. The estimated yield will be 5 mgd.

The additional water supply proposals project was designed to ensure that the Authority stays open to new ideas in water supply, that available supply enhancement options are considered, and that all alternatives to major new supplies are fairly evaluated. Thus far, four ideas have been selected for further review from the dozens received through our outreach and research efforts. Two of the ideas have received technical evaluations, and the second two are in the consultant procurement process. Two alternative ways of increasing the storage capacity and yield of Quabbin Reservoir have been evaluated. Excavation of additional volume was found to be severely impractical and would result in little increase in yield. Raising the elevation of the reservoir by modifying the spillway could yield several mgd. However, issues of the seismic stability of the dams have caused us to place the project on hold until the MDC can conduct additional evaluation of the dams. We are in the process of procuring consultant services to evaluate the possibility of a regional system with Springfield and Holyoke jointly serving some of the growing demands of Chicopee, South Hadley and Wilbraham and to examine potential ground water resources along our aqueducts between Quabbin and Wachusett Reservoirs.

Tools for Management and Planning

The goal of this area of the Long Range Water Supply Program is to provide the management and planning tools needed to ensure that the MWRA can continue to reliably provide sufficient high quality water to our user communities. The programs presented below fit into four categories: data

gathering, analysis and planning tools; studies to increase the reliability of the system; a study of future water quality needs; and policy development and implementation for cooperation between the Authority and user communities on water supply issues.

The metering and monitoring projects were designed to collect and track accurate data on water as it flows through our system to the user communities. The goals of the projects were to provide a clearer picture of how water moves through our system, to provide reliable, accurate data on the water we sell to user communities and to improve our ability to efficiently operate our facilities. One project involved the repair and replacement of revenue meters, and the installation of additional telemetry equipment for remote readable metering. The design and construction for the more major replacement projects has been running behind the schedule set in March of 1987; however, substantial progress has been made toward the goal of accurate metering. Staff have conducted independent flow testing on most meters (139 of 151) and have repaired, recalibrated or otherwise improved every meter. The central monitoring project involved the design and construction of a central system to collect meter data, monitor key system parameters (reservoir levels, valve and gate positions, stream flows) and to centrally control certain key facilities. The design for this system is also behind schedule, but staff are pleased with the technical progress to date. Although we cannot provide detailed flow accounting reports at this time, we have installed additional temporary master metering and are able to more accurately track flow through the MWRA system. As reported above, MWRA system use is down to under 4%, about 11 mgd, from a high of 30 mgd in 1980. Completion of both projects is expected by the end of 1992.

The water system database and trigger planning projects were designed to provide the Authority with the ability to collect, organize and analyze information available on supply, demand, quality, and distribution of water in our system. Their goal was to facilitate good program design and evaluation, and to assist in timely decision making. The design of both was focussed on providing tools which will be regularly used. The database, which contains information on supply, demand and related areas, is virtually complete and training of staff is being coordinated with MIS and the consultant. We will begin to provide a more detailed regular update on water supply status within the next few months. The trigger planning project is designed to assist in water supply decision making by identifying key parameters which should be monitored over time to "trigger" when decisions must be made and to identify ways we can reduce uncertainty over data. A detailed scope of work for the trigger planning project has been developed.

Board approval of the consultant selection will be requested in January 1990.

A drought management plan has been completed for the MDC/MWRA system. The planning effort was accelerated to respond to the lower than normal precipitation in late 1988 and early 1989 and the resulting DEP declaration of a water supply emergency. The MWRA provided substantial assistance to our user communities in the preparation of their drought plans. Staff developed two drought planning models to evaluate the effects of various drought measures and to forecast water levels in the reservoirs. The plan, with associated trigger points, is now ready for any future need.

The redundancy planning effort was designed to allow operation of the system with particular components out of service without catastrophic results. We have completed our review of the aqueduct system and have recommended that the Authority proceed with the rehabilitation of the Sudbury Aqueduct to provide redundancy to the Hultman Aqueduct as the most critical need. A long term program was also presented to the Board. The review of redundancy needs in the distribution system is underway.

A study of the impacts of the Safe Drinking Water Act has been completed and an action plan for compliance was developed and approved by the Board. We are undertaking a two pronged approach to the Surface Water Treatment Rule: working with the MDC on a watershed control program to avoid or defer the need for a filtration plant, and concurrently conducting pilot plant evaluation of what the most cost-effective treatment techniques will be to comply with all the SDWA amendment requirements. We are also moving forward to meet all other aspects of the changes in regulatory requirements.

The contract communities conservation criteria project was designed to ensure that the various regulatory requirement imposed on the Authority by the Water Management Act, the Interbasin Transfer Act, our Enabling Act and others are reflected in our policies. The Authority promulgated regulations guiding the process of negotiating water supply continuation agreements with the 19 communities receiving service under contract. Thirteen of those community contracts expire at the end of 1989, and staff have been assisting the communities through the renewal process. Ten of 13 were approved by January 3, 1990, and interim water supply orders as provided for in the regulation were issued for the other three. Conservation, supply development and protection and water supply planning efforts have been substantially furthered by this process.

Reporting and Outreach

The Program Manager of the Long Range Water Supply Program has provided the Board of Directors with regular briefings on the progress of the overall program and arranged for periodic briefings on specific projects. The progress briefings have also served as status reports to other state agencies and interest groups.

The Authority conducts outreach to provide information on the Long Range Water Supply Program and our activities, as well as supporting the long-standing Water Supply Citizens Advisory Committee. WSCAC has been expanded to be more broad based and representative of all who might be affected by MWRA water supply planning efforts. Authority staff present one or two programs at each monthly WSCAC meeting as well as provide progress reports on items of interest. WSCAC continues to review and comment on water related policies and actions, and to provide public support for source protection and conservation. The Public Affairs Department maintains direct user contact through a community coordinator assigned to each service area community. The Advisory Board and its water supply liaison funded by MWRA, provide critiques and recommendations on all Authority projects.

DEMAND MANAGEMENT POLICY

The Authority's adopted policy of demand management, local source protection and development, and no or deferred major source development grew out of the strong opposition to traditional supply side planning and a sense that demand side planning should be thoroughly evaluated. In 1986 there simply was not enough information to satisfy all parties on what was the right decision. Now, three years into the implementation of that policy certain facts are becoming clear:

- the policy does work for the amount of water savings required in the short term;
- it is cost effective;
- major capital expenditures can be deferred;
- an environmentally and politically sensitive solution can be crafted within the bounds of state regulation and resource needs;
- however, the issues of the risk of supply failure and the uncertainly of long term demand planning become more critical to decision making.

The demand management and local source development projects evaluated and recommended by staff compare favorably in cost to the major new sources previously reviewed by the MDC and MWRA. Looking simply at the cost to realize water savings or to develop a source, leak detection, the domestic device retrofit program, the non-domestic demand management efforts and our water sharing efforts are less expensive than major new sources as illustrated in Table 1. Local source development costs will depend on the site, but at least some may be less costly.

As can be seen from Table 1, capital costs for most demand management activities are modest compared to developing major new sources. Thus, the current policy has the dual benefits of either fully substituting for the expenditures required for a major new supply or at least delaying them substantially. Both results will reduce the Authority's capital expenditures at least through the year 2000.

Since the 1970's, new concern regarding protection of the environment has resulted in new environmental regulation. A policy of water conservation with a preference for use of available local water resources is essentially required by current state law. The MWRA Enabling Act lists the conservation of water as one of the Authority's prime purposes for existence and provides specific conservation and local source requirements for contract communities and new users. The Interbasin Transfer Act requires that anyone wishing to transfer water from one river basin to another meet strict requirements ensuring that all local water resources have been developed and that all reasonable demand management measures have been implemented. The Water Management Act provides for the permitting of existing and new water withdrawals, and establishes a review process which sets the environmental health of the river basin as a first priority. The Massachusetts Environmental Policy Act (and the National Environmental Protection Act) provide for the evaluation, disclosure and mitigation of any adverse impact to the natural or human environment. These all lengthen the approval process and cause significant increases in costs for major and minor new source projects.

Even if the MWRA were to decide that a major new source was the best alternative, the environmental regulations described above would require that we first implement all the policy actions we now believe can obviate or delay the need for such a decision.

Table 1 - Comparative Costs of Alternatives

Alternate Source of Water	Annual $/MG[1]	Capital cost, $millions	Yield, mgd
Connecticut River	500-800[2]	120-220[2]	63
Millers/Tully Rivers	900	135	38
Merrimack River	1,600	600	120
Leak Detection & Repair	140	30	30
Domestic Device Retrofit	230-560	10	5-12
Low-Flow Toilet Retrofit	3,300	200	17
Local Sources	340-1,300	16	0.4-8
Water Sharing	50-500	0.2[3]	0.8[3]
Non-Domestic Management	50	0.1[3]	0.7[3]
Sudbury Res. Treatment Plant	800	34-37	16.5
FY90 MWRA Water Rate	511	N/A	N/A

Notes:

1. Annual O&M and amortized capital costs per million gallons. These numbers are based on a simpler calculation than the LRWSS.

2. Range from LRWSS estimates to staff estimates based on SDWA study.

3. Yields and costs from first years experience. Actual totals will be higher but $/MG will be in the range shown.

The most significant concern raised by the policy of not expanding the capacity of the water supply, but rather attempting to manage demand, is that it is a more risky and uncertain course. There will always be the risk that a major unforeseen event or failure of our efforts will drive supply and demand out of balance. Water supply planners have traditionally tried to maintain a margin between supply capacity and demand because there is significant uncertainty in our ability to predict the future. Demand may rise unexpectedly within the service area, sources be lost to contamination or new users may be added. A margin of safety allows room to adjust to circumstance.

As will be seen below, we can anticipate that our demand management and other programs will be able to keep us within a few percent of the safe yield of our system. In addition, the structure of the Authority with its financial independence and assured revenue stream permits a long term commitment to conservation. If the Authority were to become financially constrained, as the MDC was, we may not be able to adequately manage demand. Our planning and management outlook must be flexible enough to prevent a shortfall of supply.

PRESENT AND FUTURE STATUS OF SUPPLY AND DEMAND

Water Use Projections

A principle area of debate during the conduct of the Long Range Water Supply Study and EIR 2020 was the consultant's estimates of how much water the MDC would require in the future. Widely varying estimates were made by others and no real agreement was ever reached. At the heart of the matter were the very different assumptions made as to what was possible or likely to happen.

Staff have re-examined those projections, particularly the implicit and explicit assumption made, and also produced some new projections. However, certain of the underlying demographic and economic analyses will be best re-evaluated once the 1990 US Census is available. We are now laying the groundwork to effectively use that data.

Any set of water use projections for the MWRA system can be thought of as having three major components: the underlying projections of economic and population growth and change; the translation of people, employment and economic activity into water use; and the assumed extent of the service area and the availability of local sources. About the first component much informed debate is possible. Alternative projections and forecasts are to be expected, but the MWRA has little or no

practical (or statutory) control over growth. It will happen, or not, and there is little we can do about it. The second and third components are within our control to a much greater extent, and must command our attention. Our policies and programs should be focused on things we can affect. The discussion below illustrates how we plan to influence how much water the system needs to supply. The emphasis in the discussion is on the actions and their results, not on the underlying projections.

The LRWSS & EIR 2020 projections of water use within the existing service area estimated slightly less than a 10 percent increase in demand from 1980 to 2020. More recent population and employment projections show slightly lower population and employment growth estimates than had been assumed in 1982 and would yield slightly lower, but reasonably similar demand estimates, if no changes are made in the assumption of how water use is estimated. More importantly, as shown in Figure 2, the LRWSS figures included the possibility of several additional categories of potential demand which resulted in a total water demand more than 50 percent over our safe yield: they assumed the loss of over 50 mgd of partial users' local sources, 7 mgd of demand from potential future users and 27 mgd of demand from non-users due to contamination. Clearly how much risk to plan for is a key decision facing the MWRA. The magnitude of the demand problem to be managed will be much smaller if the MWRA can prevent all or most of these new demands from arising. If we can now assume that the MWRA local source protection programs will significantly reduce the potential for existing sources being lost to contamination, and that changes in available technology and state policy will allow and require that contaminated sources not be abandoned but treated, the demand management problem becomes primarily one of dealing with the use of our existing users and occasionally needing to provide emergency water to communities while they rehabilitate their own sources.

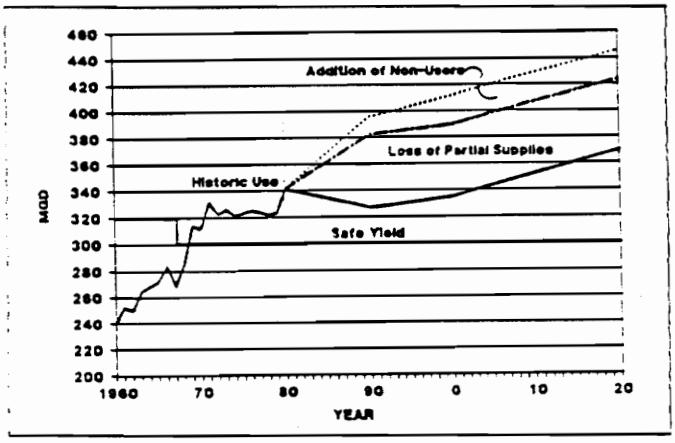


Figure 2
Potential Growth in Demand

The demand of our existing users is comprised of three major

components: domestic water use, non-domestic (commercial, industrial, institutional) water use, and community unaccounted for and MWRA system use. We have evaluated programs to reduce use in each category and can provide good estimates of what reductions in use can be expected if the programs are fully implemented. We can also expect that we will be able to improve our knowledge as we expand the programs and may be able to realize greater reductions over time. The water savings possible from each program are described below and shown on Figure 3.

The unaccounted for water use and system use are being attacked on two fronts, one to actually reduce the total amount of water wasted through leakage and the second to better account for use with improved metering. Better metering merely moves water from this category to others; leak repairs eliminate waste. Reductions in leakage in community water systems, and in MWRA system use through reduced leakage and changes in operations are expected to yield at least 30 mgd in reductions over use just a few years ago. The passage of the new 1.6 gallon per flush toilet code is estimated to save an addition of 15 mgd in residential and non-domestic use by 2020 over savings already estimated for the previous 3.5 gallons per flush water saving code. This savings will occur as new construction and renovation take place and will not require continued MWRA action. The proposed program of installing water saving domestic devices in homes system-wide is estimated to result in a savings of 5 to 8 mgd by the end of its 3 year implementation period. (This will be supplanted partially over time by additional savings from the replacement of toilets retrofitted by this program with 1.6 gallon toilets). Our demand management efforts with non-domestic users, combined with rising costs for water and sewer service and newer technologies (including low flow toilets) can be expected to result in up to a 10 to 15 percent decrease in this category of use by 2020, about 13 mgd. The last group of programs, local source development, water sharing arrangements and changes in supply system operations, will

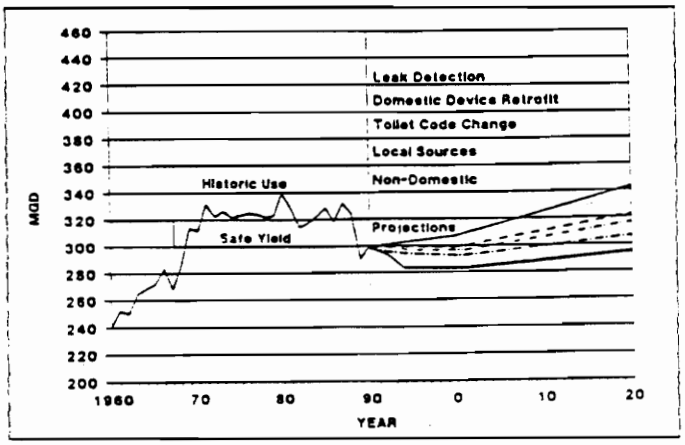


Figure 3
Potential Water Savings

either transfer demand from MDC/MWRA sources to local sources or increase the ability of our system to supply water. Firm estimates are impossible at this point, but with adequate funding and approval of state and federal regulators we might achieve a total of 10 mgd for these programs. We have not directly included the potential impacts of price elasticity as a demand management measure, but we anticipate that additional voluntary conservation and program participation are likely as water and sewer costs rise.

Implications of Projections

With continued demand management programs, the protection and development of local sources, and improvements to the MWRA system, no immediate action is required on the development of new out of basin sources. Staff believe that the successful implementation of these programs will keep supply and demand in balance for at least the next decade. Demand is estimated to remain just above 280 mgd through the year 2000. The MWRA should reevaluate its policies by 1995, five years from now, to determine how our conclusions may be affected by new information from the 1990 US Census, data on all of our programs as they move forward, and any changes in state or federal environmental and water supply regulations. Between now and then staff will report to the Board yearly on the progress of our efforts, the status of the system and any required adjustments.

The conclusion that no immediate action is required on supply development is predicated on the assumption that the Authority continues to move forward aggressively with its programs and that water supply remains an agency and state priority. There is a danger that our short term success will make us complacent and that our attention will wander to other pressing matters. Absent forceful efforts by the MWRA, it is clear that demand can quickly outstrip capacity leaving our region subject to the risk of supply failure. Even with the best of efforts it is possible that we will see in the future that additional supplies are necessary. Our planning process should account for that possibility, while doing all we can to avoid it.

Current System Status

For the first time in twenty years, the MWRA system is using less than its safe yield of 300 mgd. As shown in Figure 4, each month since April of 1989, use has been at a low enough rate to yield an annual average of under 300 mgd, and since August, the twelve month running average has also been below 300 mgd. The average for all of 1989 was 287 mgd. Each month since April we have been breaking 20 year records.

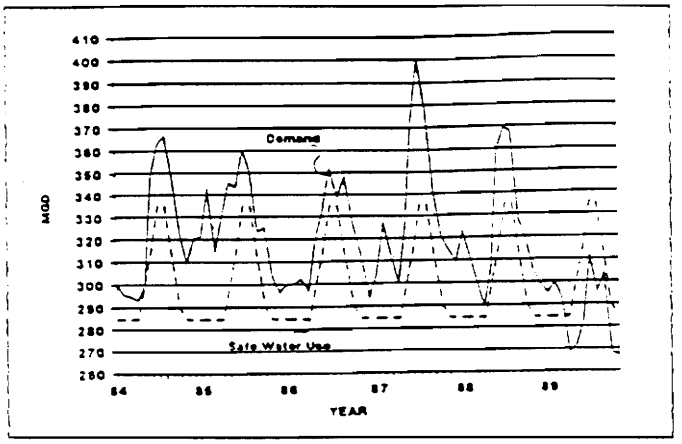


Figure 4
Monthly Water Use 1984-1989

Our analysis of the monthly data and the data on use by individual communities leads us to believe that a substantial portion of the drop in use between 1988 and 1989 (and over the last 2 1/2 years) is due to demand management efforts taken by the MWRA and communities. It is still too early to tell definitely, but our initial evaluations indicate that about 15 mgd of the approximately 40 mgd drop in 1989 is related to the drought restrictions or to summer water patterns. Reductions in use started in 1988 and continued almost every month through the present, both in normally high and low outdoor use months, indicating substantial demand management progress.

The result of our substantial reduction in demand and above average rainfall and runoff since late this spring has been a marked improvement in the storage levels at Quabbin Reservoir. We are out of drought warning and below normal status and back into normal operations range for the first time since March of 1985. The outlook for water supply decision making has moved from one of impending crisis three years ago to stability and normal operation in late 1989.

THE NEXT FIVE YEARS PROGRAM

The staff recommend that the Board of Directors approve a five year program of demand management, improved use of existing and new local sources, source protection, and management and planning for the future. A brief summary of the major components of such a program are presented below. The program

builds on the knowledge gained over the past three years, carries on the most successful of our efforts and suggests new initiatives where circumstance and experience dictate. No decision to proceed with the development of a major new source should be taken in the next five year period. In 1995, staff will return again with a report on system status and the success of our programs.

Leak Detection, Leak Repair and Metering

We recommend a continued program of an annual survey of all MWRA pipes and the prompt repair of all leaks. The goal is to maintain the percentage of water sold to communities above 95 percent of the water withdrawn from the reservoir.

We recommend that the Authority require, through regulation, that all user communities conduct leak surveys every two years and promptly repair all known leaks. The Authority should assist the communities by providing leak detection training for community staff, equipment loans and technical assistance, contractor and MWRA leak detection services (on an at-cost basis), and quality control and data analysis for all community results. Our long term goal would be to reduce unaccounted-for water use to no more than 10 percent from a range of 5 to 50 percent and a recent high of 28 percent system wide; this may not be accomplished over five years, but steady reductions are possible.

The Authority should continue its efforts to update and improve both its revenue meters and master meters, to install additional master meters as necessary to ensure an adequate flow accounting system and to complete the supervisory control and data acquisition (SCADA) system and Chestnut Hill Operations Center. All meters should have regular maintenance and quarterly calibration, and independent flow testing. These efforts will be required to support the 95 percent sold goal.

The Authority should assist user communities toward metering all services, both revenue and non-revenue, and maintaining meters in an accurate condition through regular testing and replacement or repair. The MWRA should assist the communities by providing technical assistance and guidelines. The improved metering accuracy will be required to move toward the 10 percent unaccounted-for use goal.

Conservation and Demand Management

We recommend that the Authority continue and expand its non-domestic use demand management program. The non-domestic sector represents about a third of total use and has great potential for reductions. The program should consist of

technical information development and exchange (including a limited number of water audits each year to develop additional data on conservation technology), direct technical assistance (targeted to smaller users) and fostering changes in technology (especially through code changes and coordination with other utilities). Twenty to 30 percent reductions in water use appear to be cost-effective for businesses: our goal over the next five years should be to provide targeted technical conservation information to users representing at least 75 percent of total non-domestic water use.

We recommend that the Authority continue and expand to the whole system its domestic conservation programs. The domestic device retrofit pilot should be expanded system-wide. We should offer to install water saving devices in every home in our service area using marketing done by MWRA staff and door-to-door canvassing and installation done by contractor. This would save 5 to 12 mgd. We should continue to provide conservation information to encourage behavioral changes including our 242-SAVE hot line, system wide efforts such as the poster contest and public service announcements, and bill stuffers for communities. Our major public information efforts should be targeted by community in support of the domestic device program. We should continue to develop cooperative programs with public housing and other non-profit housing groups, providing training in leak detection and conservation for maintenance staff, and educating tenants in workshops, and working to encourage charitable groups and associations to help them with conservation. We should continue to provide information on reducing outdoor water use, and to use cooperative efforts with horticultural groups. And, as in the non-domestic program, we should do as much as possible to foster changes in technology and codes and to remove regulatory obstacles because this yields long lasting results with little MWRA effort.

We recommend that the Authority expand its efforts in municipal conservation. We can provide training in conservation to maintenance staff for public buildings, encourage device and fixture retrofit, and particularly focus on schools providing a tie-in to our education program. Municipal outdoor use should also be an emphasis for both its water savings and symbolic value. Training workshops and a conference for parks and grounds personnel would disseminate information on water efficient landscaping and maintenance practices.

The school education program should continue to provide outreach and training in the use of our three published curriculum guides. Additional cooperative efforts with environmental groups, universities and energy utilities should improve our outreach effectiveness and make water conservation

an element in other environmental curricula.
Although our initial attempts at convincing municipalities to adopt more conservation-oriented pricing strategies were not as successful as anticipated, a continued refocused effort is warranted. The Authority should continue to encourage frequent billing, full cost recovery, conservation based rates and life-line rates through a smaller scale technical assistance program. It should use primarily staff effort with consultants available for limited areas beyond our expertise.

Improved Use of Sources

The Authority should proceed with the evaluation of feasibility of new or reactivated local sources. All those which meet technical and financial feasibility criteria and environmental regulations should be developed. If the user communities do not want to develop and operate feasible sources, the Authority should develop and operate the source. An estimated quantity goal for new sources should be developed as soon as possible. A working goal of 10 mgd for local sources, water sharing and operational changes has been adopted.

The water sharing arrangements initiated with Needham and Wellesley should be completed, with Needham providing excess water to the MWRA by the end of 1990. Where other partial users have excess supply yields, they should be evaluated to determine if similar arrangements are possible. Four communities should be examined each year. The regional water supply study of the three Chicopee Valley Aqueduct communities and Springfield and Holyoke should be completed and, if it appears to be workable, follow up negotiations and additional technical studies begun.

We recommend that the Authority complete and submit the final environmental impact report on the reactivation of the Sudbury Reservoir, and consider the use of the reservoir as a local source for communities within its river basin. We should complete the design the facilities needed for the reactivation of the Sudbury Reservoir to reduce the risk of future water supply failure by shortening the lead time to bring the source on line. Both the environmental reviews and design should be kept up to date once complete. The Sudbury Reservoir may be able to supply up to 16.5 mgd in a seasonal operation mode, with downstream flow protection.

There are several operational changes which the Authority should undertake to increase the available yield of the Quabbin Reservoir and to reduce system use. The stream flow gage on the Swift River should be moved downstream to Bondsville and the operation of the hydrostation changed to allow the releases to be adjusted to actual stream flow

levels. These changes could improve the quality of the Swift River for trout and may yield up to 4 mgd. Relocating the Northborough and Westborough State Hospital connections from the Wachusett Aqueduct would allow us to shut off that aqueduct completely and save about 1.4 mgd.

Water Supply Protection

The Authority should continue to provide a leadership role in the protection of water supplies.

After the study of partial users sources is completed, significant long term commitment of MWRA staff technical assistance should be made for community implementation of recommended protection measures. Special efforts should be made for sources, such as Cambridge's, which are outside the community boundaries.

Similarly, after the parallel study of sources in communities adjacent to our service area is completed, staff follow-up should be provided to encourage implementation.

A watershed control program for the Quabbin, Ware and Wachusett watersheds should continue to be developed in cooperation with the MDC. It should proceed in parallel with pilot plant investigations of treatment processes. By the end of 1992, sufficient information will be developed to determine the best technologies to comply with the SDWAA. By the end of 1991, sufficient information will be available to apply to DEP for a waiver of the filtration requirement if one appears warranted. Sufficient data on the relative costs and benefits of filtration and watershed control will also be available to assist the Board in decision making. Implementation of the watershed control program is primarily the responsibility of the MDC, and given the state's financial constraints, this is cause for concern. This issue should be resolved by the end of 1991.

Management and Planning for the Future

Efforts in this area over the next five years should provide the Authority with additional tools to evaluate options, to manage the future of the supply and to improve our cooperative system management with our user communities. Our effort should also feed into an overall framework of a 20 year master plan for all aspects of the water system; supply and demand, transmission, distribution, treatment, quality, storage, and operations.

The Authority should proceed with planning for water supply decision making including the trigger planning project and develop a framework for future decision making on supply

issues. It should encompass the collection and review of system status data, and projections and forecasts of future conditions to determine when the decision making process should be triggered. It should also develop concrete ways the Authority can reduce the uncertainty inherent in long range decision making. These are likely to include data acquisition to reduce the overall lead time for environmental review on projects we may undertake in the future, land acquisition for key parcels which would be needed if a particular decision was made, and satisfying regulatory requirements (e.g. MEPA or Interbasin Transfer Act) as part of our overall long term plans. This planning process should be presented to the Board by mid-1992. We do not propose to move forward in the regulatory environmental review process for any major source prior to a defined need and Board decision, which would be suggested no earlier than 1995.

The drought planning process should continue to be refined. A process for managing community and industry rationing in an equitable manner should be developed and agreed upon prior to the next need to use the drought plan. Evaluations of the recent drought experience should be completed and any appropriate modifications to the plan made.

Redundancy planning should continue to play a role in supply planning. We must ensure not only that there is enough water, but that we can deliver it. In addition to the transmission and distribution aspects, redundancy planning should examine the interactions and benefits of local sources and additional regionalization.

We recommend that the process of defining the roles and responsibilities of the MWRA and user communities begun during the contract community renewal process continue and be explicitly extended to all users. Staff should investigate, with the Advisory Board and communities, the most effective ways to delineate responsibilities and ensure reasonable progress toward shared conservation, source protection and development, and good system management goals. This process should also look at the issue of relative levels of service provided to various users and the concept that all users are equal partners in our water supply system.

The Authority should continue the process of seeking out and evaluating the feasibility of new water supply ideas. Staff should present 1 or 2 ideas to the Board each year, culled from a larger number developed through outreach, for detailed evaluation. This should be primarily a staff effort with consultant assistance only as needed.

Outreach and Reporting

Staff should provide an annual briefing to the Board of Directors on the status and progress of these efforts. These briefings will include a review of demographic and water use projections as these become available particularly after the 1990 Census. Any significant recommended changes in the direction of individual programs will also be presented to the Board. A comprehensive briefing will be prepared for December 1995, reviewing the overall progress, evaluating our policies, and recommending future water supply actions.

The Authority should continue to rely on the Water Supply Citizen's Advisory Committee for advice in water supply planning. They should continue in their current role, advising, educating the public, and providing credible, independent policy oversight. A reasonable level of funding for staff and office expenses should be maintained, commensurate with the intensity of their review role.

Outreach to the general public should also continue to play an important part of the Authority's long range water supply planning efforts. If we are to continue to be able to manage supply and demand with an acceptable level of risk and at an acceptable cost, we must increase the level of understanding of water supply among our rate payers, elected officials and appointed members and staff in local government the environmental community, and the responsible press.

VITA

Gregory Wayne Currey was born in Parkersburg, West Virginia on October 24, 1965. He lived in Parkersburg with his parents, Wayne and Jo Ann, and his brother, Doug, until he began attending Virginia Polytechnic Institute and State University in 1983. He graduated from Virginia Polytechnic Institute and State University in July 1987 with a Bachelor of Science degree in Civil Engineering. He now lives in Falls Church, Virginia with his wife Robin. Gregory and Robin are expecting a baby in August 1991.