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CITY OF CAMBRIDGE

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February 12, 1990

To the Honorable, the City Council:

Enclosed are copies of the Cambridge Reservoir Watershed Protection Plan, Volumes 1 and 2. These reports were prepared by the Metropolitan Area Planning Council, for the Massachusetts Water Resources Authority and the City of Cambridge. Representatives from Cambridge, Waltham, Weston, Lincoln and Lexington, participated with the MAPC in this study.

This planning effort was primarily funded by $38,000 from the MWRA of the total cost of $39,000, as part of their Local Water Sources Protection Requirement.

Very truly yours,

Robert W. Healy
City Manager

RWH/dls
enclosure

Agenda # 10 S-107

Volumes # 1 and 2 of the Cambridge
Watershed Protection Plan.

In City Council,

Feb. 12, 1990

Referred to the
Environment Committee
Copy sent to Environment
Committee 2/14/90 (dl)

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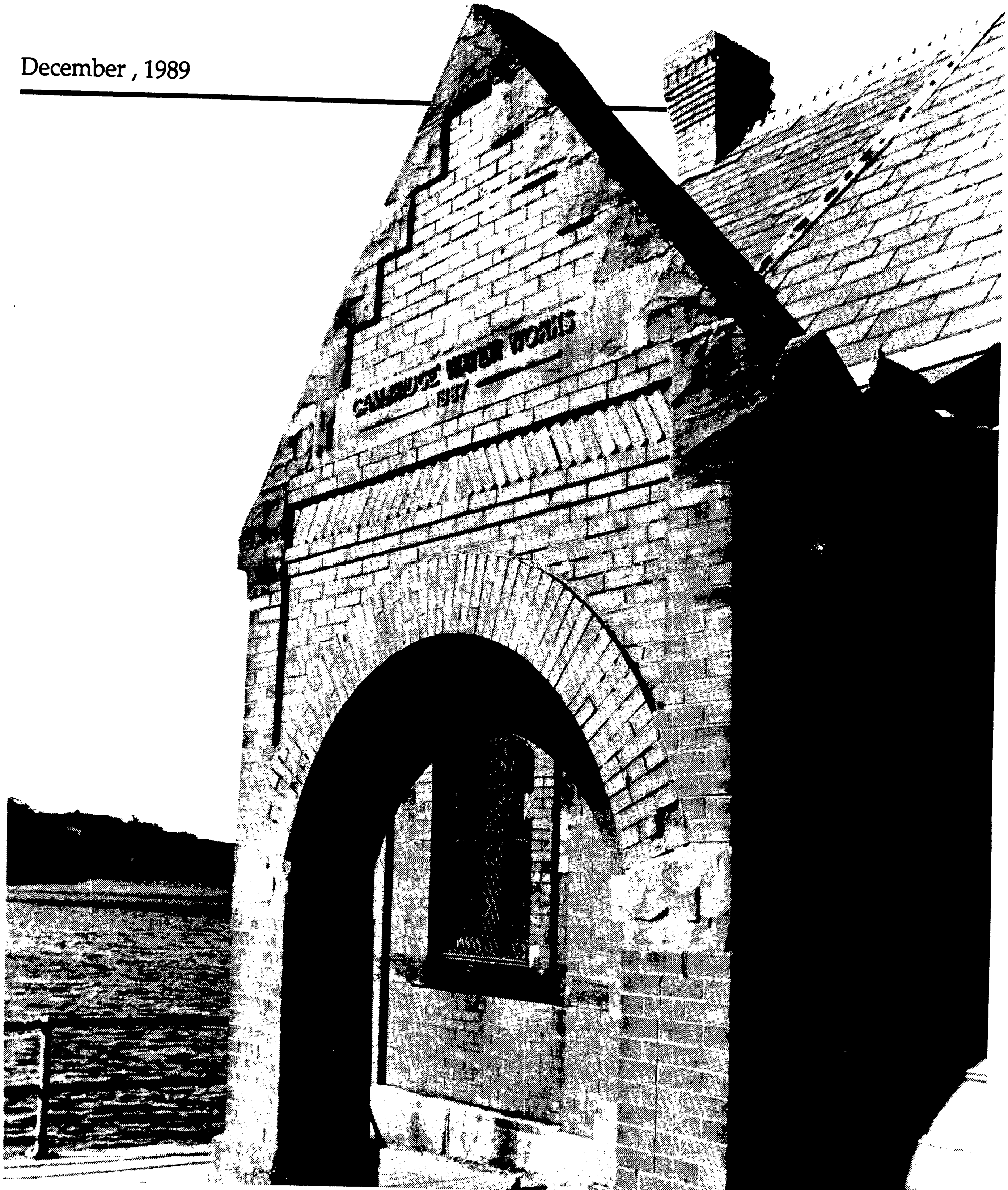

Cambridge Reservoir Watershed Protection Plan

Volume 1. Main Report

Prepared for the Massachusetts Water Resources Authority and Cambridge Water Board

MAPC
Metropolitan Area Planning Council
60 Temple Place
Boston, MA 02111

CAMBRIDGE RESERVOIR WATERSHED PROTECTION PLAN

Volume 1 Main Report

December, 1989

Prepared by
Metropolitan Area Planning Council

Prepared for
Massachusetts Water Resources Authority

and

Cambridge Water Department

MWRA Contract No. 5008

ABOUT THIS REPORT

This report was prepared by the staff of the Metropolitan Area Planning Council in cooperation with the Massachusetts Water Resources Authority, the Cambridge Water Department, and the Cambridge Reservoir Watershed Advisory Committee, representing the towns of Lexington, Lincoln, and Weston and the cities of Cambridge and Waltham. The Metropolitan Area Planning Council is the officially designated regional planning agency for 101 cities and towns in the Boston metropolitan area.

This project has been financed with funds from the Massachusetts Water Resources Authority and the City of Cambridge.

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Cover: Stony Brook Reservoir, Weston. Photo: Martin Pillsbury

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Note: One set of hand-colored maps and a set of reproducable mylars maps at scale of 1:25,000 have been prepared for this report. The Appendix contains a set of reduced copies of the maps.

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"...pollution of these water resources
deprives the citizenry of many sections
of the country of their God given right.

we need more planning more than we
need more water."

John F. Davis, President
Cambridge Water Board
1965

CHAPTER ONE Introduction and Summary

This chapter summarizes a plan which has been developed to provide long term protection for the watershed of the Cambridge water supply reservoirs. The plan includes four major elements: (1) an inventory of natural resources in the watershed; (2) an assessment of land use, zoning, and potential sources of contamination; (3) an evaluation of existing federal, state, and local protection measures; and (4) a set of findings and recommendations for actions to protect the quality and quantity of water supplies in the watershed.

This plan has been developed with the assistance of the Cambridge Watershed Advisory Committee, which met throughout the course of the project and reviewed and commented on each chapter as it was developed. The committee is comprised of three members from each of the five communities, Cambridge, Lexington, Lincoln, Waltham, and Weston. At its last meeting, the committee endorsed the idea of establishing an ongoing forum for cooperation between the five communities.

What is the Cambridge Reservoir Watershed?

The City of Cambridge gets most of its public water supply from two reservoirs located in Lexington, Lincoln, Waltham, and Weston. The two reservoirs--Hobbs Brook (or Cambridge) Reservoir and Stony Brook Reservoir collect and store water from the Stony Brook watershed, which is part of the Charles River Basin. The land area which drains toward these two reservoirs is the watershed which is the subject of this plan. The watershed area is about 23.6 square miles, and lies within portions of the four communities as shown on the map below and the following table. Water collected in the Hobbs Brook reservoir flows to Stony Brook Reservoir. From Stony Brook Reservoir, water flows in an underground pipeline through Waltham and Watertown to Fresh Pond in Cambridge. At Fresh Pond, the water is treated and pumped into the city's water distribution system.

Table 1-1 Watershed Land by Community

	Area (sq.mi.)	Percent of Watershed in Community	Percent of Community in Watershed
Lexington	1.8	8	10
Lincoln	9.2	39	62
Waltham	3.9	16	28
Weston	8.7	37	51

The Cambridge water system was built over 100 years ago, and it still reliably supplies the city with an average of 17 million gallons per day of drinking water. This water supply resource is important not only to the city of Cambridge, but to the entire Boston metropolitan area. Most other communities in the region rely on the MWRA water system, which gets its water from Quabbin and Wachusett Reservoirs. However, if the Cambridge reservoirs were contaminated or otherwise made unusable, the city would have no alternative but to turn to the MWRA for water. This would place a severe burden on the water system which most other communities in the metropolitan area rely upon. It is therefore important to manage and protect the valuable water resources in the watershed.

What Are the Potential Threats to the Cambridge Reservoir Watershed?

When the Cambridge water system was built 100 years ago, most of the watershed was dotted with farms, a few homes, and wetlands and forests. Since that time, major changes in land use have taken place which pose potential threats to the quality of the drinking water. The single most important factor was the construction of Route 128 along the eastern edge of the watershed in the 1950's. Not only does the highway affect the reservoirs directly, but the land adjacent to the highway was opened up to more intensive industrial and commercial development. Some of the major impacts on the watershed are summarized below.

Urban Runoff. Between 1951 and 1985, residential uses in the watershed increased by 63 percent, while industrial uses increased five-fold and commercial uses increased six-fold. Land use in 1985 is illustrated below. About half of the land area was developed by 1985, and there were 500 acres of industrial development and 230 acres of commercial. Such development in the watershed increases the area of pavement and structures, which reduces recharge and increases urban runoff. This has implications for both water quality and quantity. The quality may be impaired by increased sedimentation, oils and greases, salts, and heavy metals. Quantity impacts include increased peak stormwater flows, which exacerbates flooding and erosion downstream, and decreased recharge, which may decrease the water supply yield of the watershed.

Highway Drainage. There are about 20 lane-miles of state highways in the watershed, including Routes 2, 2A, 20, and 128. Sections of Routes 2 and 128 drain directly into the reservoirs, with about 20 drain pipes discharging to Stony Brook Reservoir, and 37 discharging to Hobbs Brook Reservoir. Highway drainage to the reservoirs poses two problems: under normal conditions, runoff containing road salt, oils and greases, and heavy metals is discharged to the reservoir every time it rains. Secondly, with direct discharges, there is the potential for an accidental spill of fuel or other chemicals from a truck accident on the highway. Several such accidents have occurred in recent years, but contamination of the reservoirs has been averted...so far.

Recently, the state DPW began a study to evaluate alternative drainage systems in the Cambridge watershed. The study will compare diverting the highway runoff out of the watershed with treating the runoff within the basin. Since 1986 the DPW has also reduced the amount of sodium chloride used by substituting a mixture of sodium chloride and calcium chloride.

Fuel Storage. According to local records, there are 43 underground gasoline tanks in the watershed, and 690 underground heating oil tanks. These are summarized by community in the table below. Many of these are steel tanks over 15 years old, which indicates that there is a greater risk of leakage due to corrosion. There have already been two known cases of underground fuel leaks in the watershed. In addition to underground fuel storage, there is a large fuel storage terminal which has 20 aboveground tanks ranging in size from one million to 4.4 million gallons. The facility, operated by Exxon, is adjacent to Stony Brook. There have been several spills and leaks on the site.

Table 1-2 Underground Storage Tanks and Hazardous Waste Generators

	Underground Gasoline Tanks	Underground Fuel Oil Tanks	Hazardous Waste Generators
Lexington	7	115	15
Lincoln	16	201	2
Waltham	7	121	48
Weston	13	253	3

Hazardous Wastes. There are 68 firms in the watershed which are registered generators of hazardous wastes; 14 of these are large quantity generators. These are listed by community in the table above. There have been three confirmed releases of hazardous wastes in the watershed, and there are six other sites under investigation. Uncontrolled releases of hazardous wastes represent one of the most significant threats to the quality of drinking water in the watershed. Only one community, Waltham, has a local ordinance regulating the storage of hazardous materials and fuel. However, this ordinance exempts storage tanks less than 1100 gallons

Other Potential Threats. Other activities which could affect water quality include: landfills (there are former landfill sites in Weston and Lincoln); pesticides (herbicides may be applied on some utility and railroad rights-of-way); and wastewater discharges, such as septic systems.

What is the Potential Impact of Future Development on the Watershed?

In addition to evaluating existing activities in the watershed, the plan considered the potential for future growth and development in the watershed according to the zoning regulations adopted by each of the four communities. Taken together, the zoning maps of the four communities would allow for the watershed to eventually "build out" to a land use mix of 84 percent residential, 10 percent commercial, and one percent industry (the remaining 5 percent includes open water and recreation). The zoning of the watershed is shown in the chart below, and summarized by community in the table. As currently zoned, the watershed could accommodate about 1625 acres of commercial and industrial development, an increase of about 900 acres over what is currently developed.

Table 1-3 Watershed Zoning by Community

	Percent of watershed in each community zoned:			
	Residential	Industrial	Commercial	Other*
Lexington	64	0	28	8
Lincoln	95	0	0	5
Waltham	37	2	43	18
Weston	98	0	2	0
Total	85	1	10	5

*Other includes open water and recreation/conservation

What Can Be Done to Protect the Cambridge Reservoir Watershed?

The plan includes a set of recommendations for action by state and local agencies which will increase the protection of the watershed and reduce the risk of contamination of the water supply resources. These are summarized on the following two pages, and the major recommendations are described below.

Intercommunity Coordination. In order to promote coordination between the various watershed communities and the city of Cambridge, the communities should adopt a Memorandum of Understanding which establishes an ongoing mechanism for regional cooperation. The MOU would create an intercommunity advisory committee similar to the existing Cambridge Watershed Advisory Committee which worked on this plan, and it would establish a mechanism for regularly sharing information on proposals, changes in bylaws or regulations, and other issues of mutual interest to all the communities. The advisory committee would also serve as the focal point for implementing the recommendations of this plan.

Zoning. It is recommended that each community amend its zoning by adopting a Watershed Protection Overlay District. This would prohibit certain high-risk uses such as landfills, junkyards, open salt storage, hazardous waste generators (greater than 100 kg per month), and on-site industrial discharges. Commercial and industrial uses would be allowed by special permit, with site plan review (see below).

Site Plan Review. It is recommended that the communities adopt Site Plan Review procedures for commercial and industrial sites, which incorporate performance requirements for handling runoff from the site. Peak rates of discharge should not be increased, and runoff should be recharged on site whenever possible. Runoff from parking lots should be treated by oil and grease traps before discharge. Lexington and Weston already have site plan requirements which address these concerns.

Underground Fuel Storage and Hazardous Materials. It is recommended that the communities adopt local bylaws/ordinances or health regulations which require the registration of all underground storage tanks and the storage of hazardous materials in quantities greater than 50 gallons or 25 pounds. The regulations should also prohibit any additional underground residential fuel tanks, and require removal or periodic testing of any tanks over 30 years old. Waltham already has a local ordinance, but it would need to be amended to meet the standards suggested in the recommendation.

Wetlands Protection. It is recommended that the communities adopt local wetlands regulations which supplement the state Wetlands Protection Act. The regulations should require no increase in peak runoff from a site; oil and grease traps on parking lots; restrictions on application of road salt and pesticides; and water quality monitoring of runoff leaving the site. Lincoln and Lexington already have local bylaws more stringent than state standards under the Wetlands Protection Act.

The Conservation Commissions should also adopt guidelines regarding the use of artificial wetlands to replicate natural wetlands.

State Discharge Permits. The Dept. of Environmental Protection should adopt the proposed changes in the state water quality classifications which would designate the entire watershed as Class A Outstanding Resource Waters. DEP should also adopt a consistent policy which requires the control of stormwater discharges from commercial and industrial facilities in the watershed through the NPDES (Clean Water Act) Discharge permit program. Such stormwater permits should be modelled after the permit already issued to the Bay Colony development, including discharge limitations, water quality monitoring, and restrictions on road salt, fertilizers, and pesticides. DEP should also adopt much more stringent conditions on the renewal of the discharge permit for the Exxon bulk fuel storage facility.

State Highway Drainage. The state DPW should expedite its studies of alternative highway drainage in the watershed, and implement a solution as soon as possible. The selected alternative should consider impacts on both the quality and quantity of water in the Cambridge reservoirs.

Road Salt. The Mass. DPW should use salt substitutes such as calcium chloride or CMA or take other steps to significantly reduce the use of sodium chloride in the watershed. The DPW should also mitigate the sodium contamination of groundwater at its highway maintenance yard at Routes 128 and 2A. Communities should use the minimum amount of salt possible in treating local roads. Waltham already uses calcium chloride on roads in the Hobbs Brook Reservoir watershed; similar measures should be taken for roads treated with straight salt in the Stony Brook reservoir watershed. Lincoln, Lexington, and Weston already use minimum amounts of salt.

Emergency Response. The five communities should work together to develop coordinated procedures for emergency response to a chemical leak in the watershed. This may take the form of a mutual aid agreement which brings the best response possible to bear in any emergency situation, including the resources of the Cambridge Fire Department.

Board of Health Regulations. Communities which rely on septic systems for wastewater disposal (Lincoln and Weston) should adopt local health regulations to supplement the requirements of Title 5. These would require periodic inspection and pump-out of septic systems, increased setbacks between septic systems and water bodies, minimum percolation rates, and prohibition of septic system cleaners containing organic solvents

Landfills. Local landfills in Lincoln and Weston should be properly capped and ongoing groundwater monitoring should be conducted. This is currently the case in both communities. Runoff and drainage from transfer stations should be controlled so that downstream waters are not impaired.

Watershed Monitoring. The Cambridge Water Department should establish a watershed monitoring program designed to evaluate key indicators of the status of resources in the watershed over time, and provide an early warning of potential problems. This could include monitoring of surface and groundwaters in critical watershed locations as well as sanitary surveys of the watershed.

Land Acquisition. The Cambridge Water Department should consider the purchase of land or easements on selected key parcels which are critical to the water resources of the watershed.

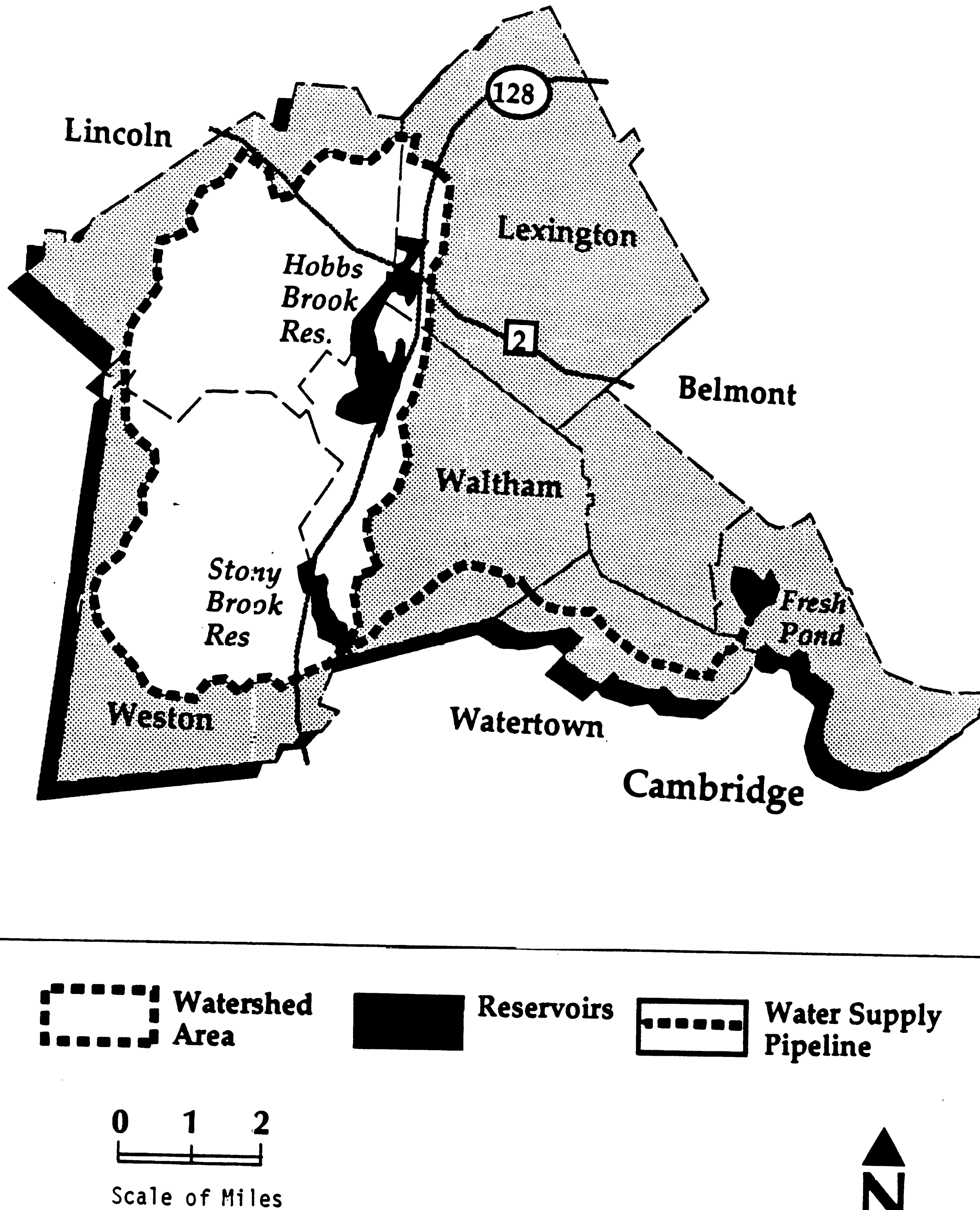
Environmental Reviews. Additional scrutiny should be given to projects in the watershed under MEPA by reviewing agencies, including MWRA, DEP, MAPC, and the Cambridge Water Board.

MWRA Local Source Protection Policies. The MWRA should apply its policy encouraging protection of local sources to all user communities with local sources of supply within their borders. Currently this policy is only applied to contract communities.

Taken together, these recommendations form a comprehensive watershed protection program which will help to assure the viability of the Cambridge water supply sources for the long term. Continued use of these sources is important not only for Cambridge, but for all the communities which rely on the MWRA for their public water supply.

Successful implementation of a watershed protection program depends entirely on the ongoing efforts of the communities and state agencies which control land use and other activities in the watershed. Their actions and decisions today can help assure that these vital water supplies will continue to provide potable water in the future.

Figure 1-1 Watershed Location Map



CHAPTER TWO Watershed Resource Inventory

2.1 Introduction

The city of Cambridge draws its public water supplies from two reservoirs in the Stony Brook basin, a tributary of the Charles River about seven miles west of the city. The watershed of the Stony Brook and Hobbs Brook Reservoirs is located in portions of Lexington, Lincoln, Waltham, and Weston. When the reservoirs were built in the 1890's, the watershed area was largely rural and undeveloped, with few if any significant sources of contamination and little alteration of the drainage and hydrologic systems. Over the last century, and especially since World War II, the watershed has undergone a dramatic increase in development which was part of a larger regional trend of expanding urban and suburban growth at the margins of the metropolitan area. In the watershed, growth has been particularly influenced by Route 128, which was sited along the eastern edge of the watershed and actually traverses Stony Brook Reservoir.

Given the level of current and potential future development in the watershed, there is a need to assure that the quantity and quality of water in the reservoir system will continue to be adequate to serve the needs of the city of Cambridge. This chapter is the first component of a planning document which is designed to inventory the critical resources in the watershed, evaluate existing and potential threats to water quantity and quality, assess the current framework of state and local policies and regulations which govern land use and development activities in the watershed, and propose a comprehensive set of measures to insure the long-term integrity of the water supply system. This chapter presents a base-line data inventory of the water and related land resources of the watershed, including hydrology, geology, soils, topography, and wetlands, and interprets the significance of these resources for the water supply system. It also provides a description of the development and operation of the Cambridge water supply system. These data provide the context in which subsequent planning analysis and recommendations will be made.

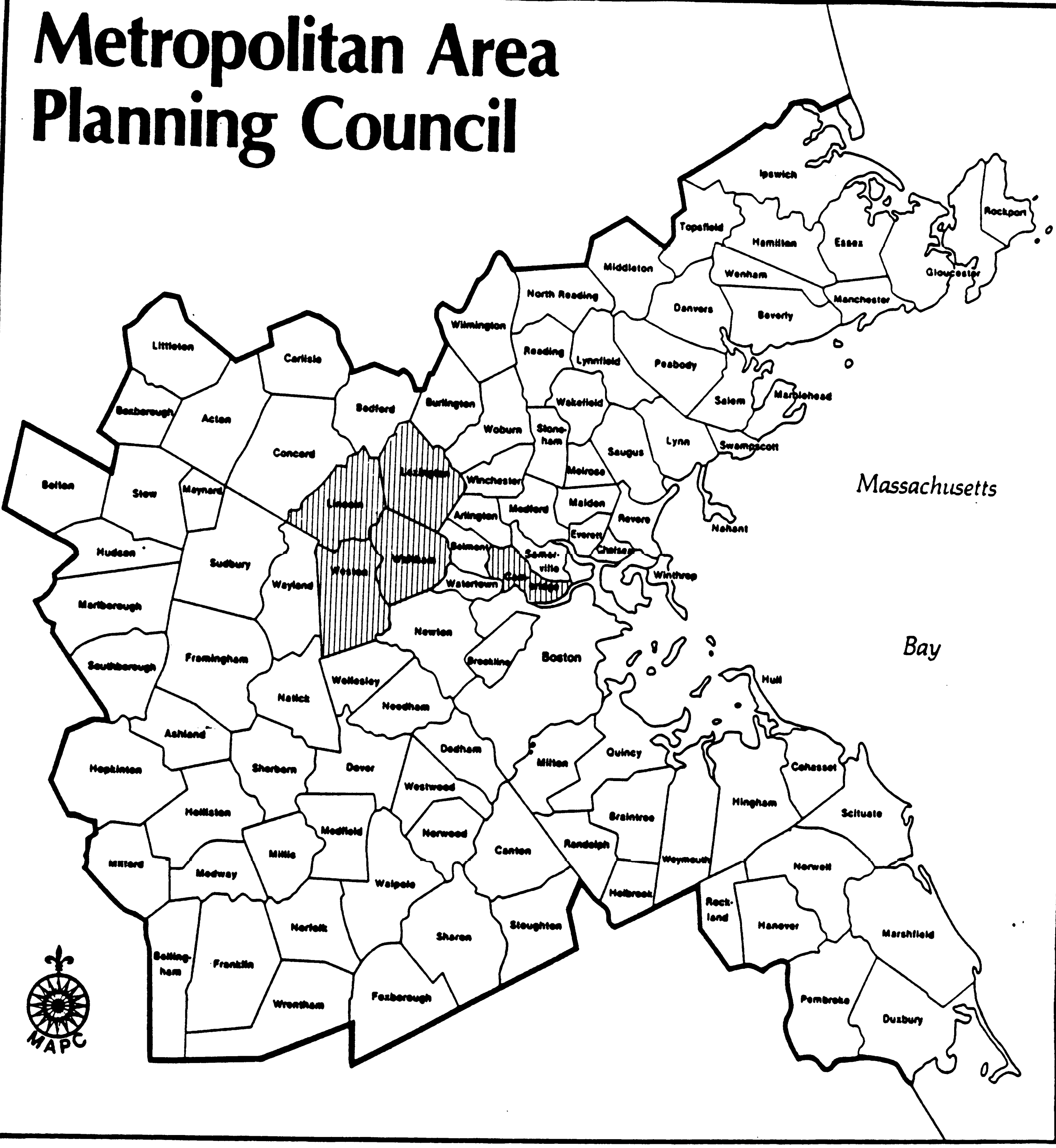


Figure 2-1

Regional Location Map

4 2 0 4 8 12

Scale in Miles

2.2 Topography

The Stony Brook Watershed is an area of about 23.6 square miles located in portions of Lincoln, Lexington, Waltham, and Weston. The major topographic features of the watershed were formed by the weathering and erosion of the bedrock in pre-glacial times, and modified by the action of glaciers as they advanced and subsequently melted. The elevations range between 66 feet above mean sea level (MSL) at Stony Brook Reservoir to 478 feet at Prospect Hill, along the eastern border of watershed in Waltham. The terrain varies from extensive level wetland areas in the western and northern portions of the watershed, to gently rolling and steep hilly terrain in the central and eastern portions. There are 22 hills over an elevation of 250 feet MSL, the majority of them in Waltham and Weston (see Table 2-1 and Figure 2-2).

Table 2-1 Major Topographic Features

	Elevation (feet MSL)	Location	Map Reference (Fig. 2-2)
Prospect Hill	478	Waltham	A
Unnamed	370	Lincoln	B
Unamed (Lincoln Res.)	370	Lincoln	C
Doublet Hill	356	Weston	D
Bear Hill	355	Waltham	E
Unnamed	354	Lexington	F
Jupiter Ridge	350	Lincoln	G
Unnamed	350	Waltham	H
Fullers Hill	345	Lexington	I
Cat Rock Hill	334	Weston	J
Unnamed	330	Weston	K
Unnamed	330	Lincoln	L
Unnamed	310	Waltham	M
Fiske Hill	300	Lexington	N
Unnamed	300	Waltham	O
Sanderson Hill	300	Weston	P
Cranberry Hill	290	Lexington	Q
Unnamed	290	Waltham	R
Unnamed	280	Lexington	S
Unnamed	260	Lexington	T
Pigeon Hill	250	Weston	U
Saddle Hill	250	Weston	V
Unnamed	250	Waltham	W

There are scattered areas of steep slopes (greater than 15 percent) throughout the watershed, with the most extensive areas along several ridges west of Hobbs Brook and Stony Brook Reservoirs in eastern Weston and Lincoln and western Waltham. (see Map 1). There are a few areas of very steep slopes (greater than 25 percent) in Lincoln east of Sandy Pond and in Weston south of Hobbs Brook Reservoir.

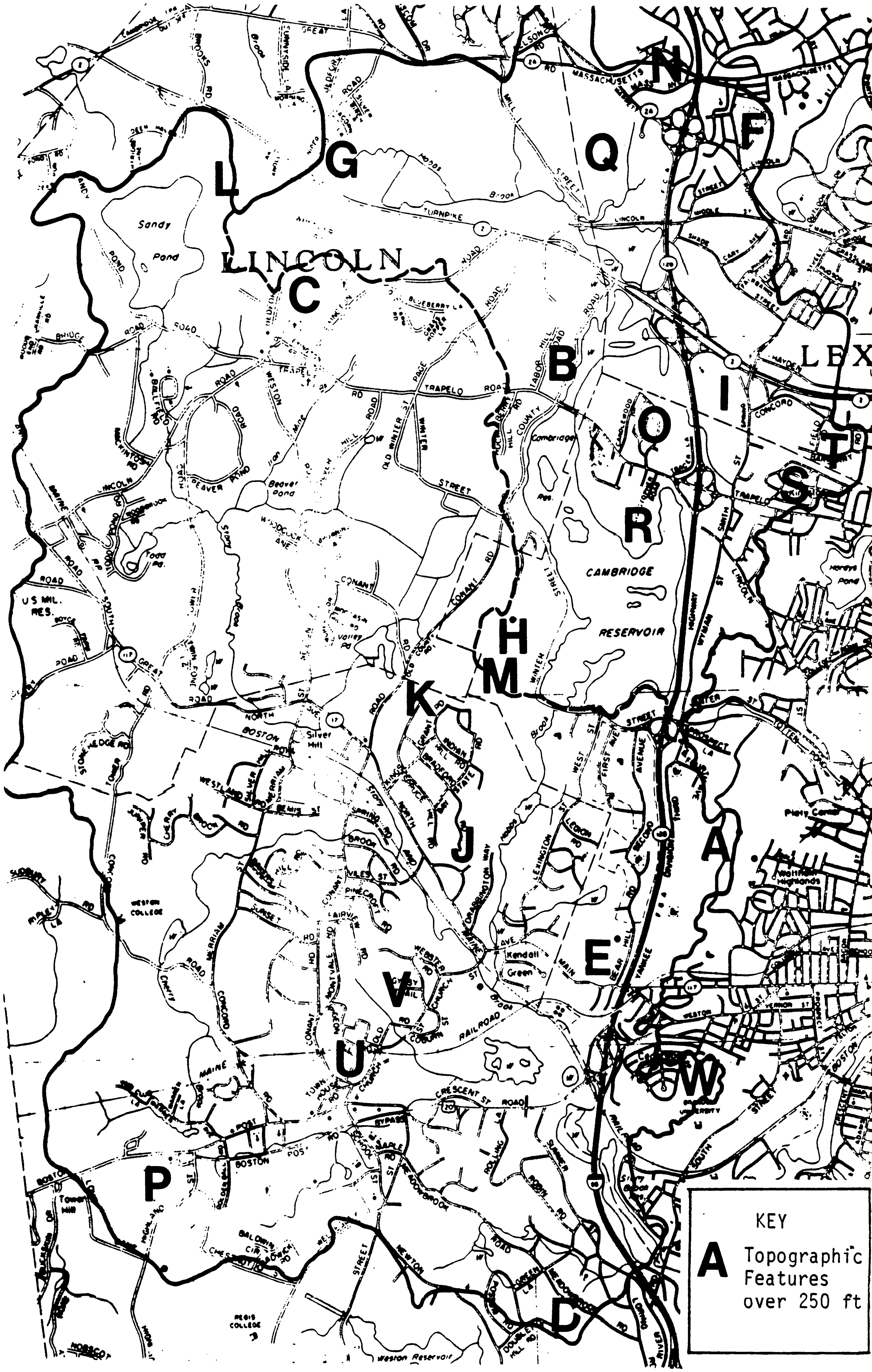


Figure 2-2 Major Topographic Features

Significance to Water Resources

Areas with steep slopes are sensitive in relation to water quality due to the high potential for erosion resulting from disturbing the natural vegetative cover and other development activities. Increased rates of runoff and erosion from severe slopes can cause sedimentation and siltation in surface waters, increased flood flows, and reduced recharge to aquifers.

2.3 Geology

2.3.1 Bedrock Geology

The geology of the watershed consists of granitic bedrock overlaid at various depths by a mantle of unconsolidated surficial deposits. The bedrock formations include Andover granite and the Marlboro formation in the western part of the watershed; Dedham quartz monzonite and the Cherry Brook formation (basalt and amphibolite) in the central watershed; and granodiorite in the eastern portion (see Figure 2-3). There is a fault, called the Bloody Bluff fault, at the contact between the Marlboro formation and the Dedham Quartz Monzonite. The fault trends northeast to southwest through the center of the watershed, and is part of a system of northeast - trending faults crossing eastern Massachusetts. The faults are zones of weakness in otherwise resistant rock formations. Weathering and erosion have reduced many of the fault areas to low areas which are occupied by wetlands, ponds, and streams.

Throughout the watershed there are extensive areas of bedrock outcrops (see Map 2).

2.3.2 Surficial Geology

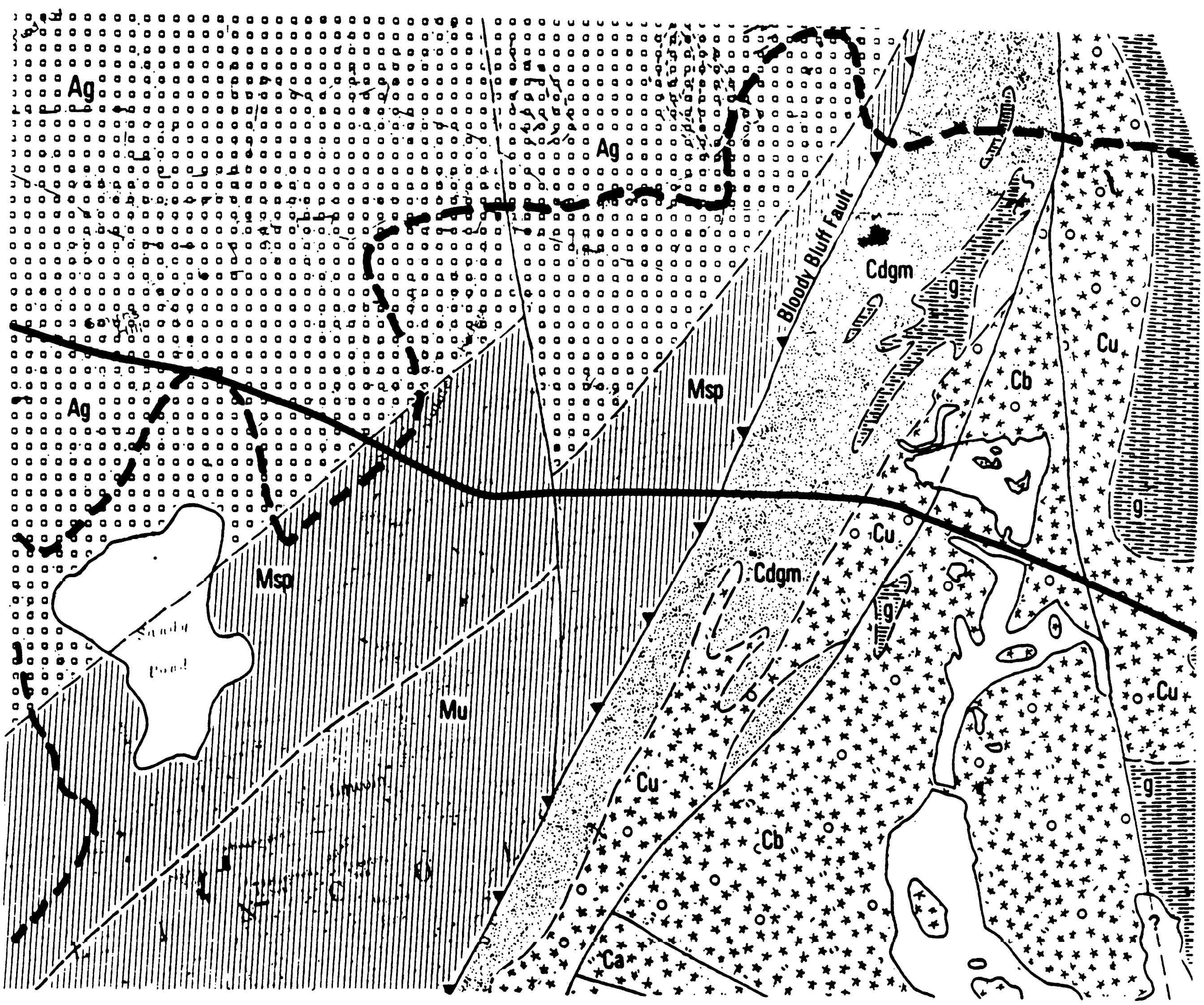
Overlaying the bedrock is a layer of unconsolidated materials deposited by glaciation (see Map 2). The surficial geological formations can be classified into two major groups: those deposited directly by the advancing ice sheet, and those deposited by meltwater flowing from the glaciers as they receded. Continental glaciers originating in Canada spread southward across New England several times over the last one million years. The ice of the most recent glaciation formed the majority of the surficial deposits now existing. This glaciation occurred late in the Wisconsinan period, beginning about 26,000 years ago and retreating about 10,000 years ago.

Glacial Deposits

The movement of the ice sheet across the landscape acted as a huge earth mover, picking up previously deposited materials, transporting them southward, and using them to abrade and erode the bedrock. The advancing ice incorporated everything from fine particles to large blocks of bedrock into the base of the glacier, depositing these materials as till.

Figure 2-3

Bedrock Geology of the Northern Watershed Area



Rocks northwest of the Bloody Bluff Fault:
Andover Granite (Ag)

Marlboro Formation:
Sandy Pond Member (Msp)
Undivided (Mu)

Rocks southeast of the Bloody Bluff Fault:
Gabbro (g)

Dedham Quartz Monzonite (Cdgm)

Cherry Brook Formation
Amphibolite (Ca) Basalt (Cb)
Lava (Cl) Undivided (Cu)

Stony Brook Watershed

Contact

Fault

High angle reverse fault

Source: Alvord, D.C., and Nelson, A.E., 1975, Unpublished data – Concord and Maynard quadrangles, Mass., U.S. Geologic Survey.

As a result, till is now found as an irregular layer over most of the bedrock in the watershed. Till is found at the surface in large areas east and west of Hobbs Brook Reservoir, Stony Brook Reservoir, and Sandy Pond. In the northern part of the study area, two distinct till deposits are recognized, the upper and lower till. They are thought to represent two different major ice advances over the area, as the lower till shows evidence of greater weathering. The single till deposit in the southern part of the watershed correlates to the more recent upper till in the northern section. In addition to forming a somewhat thin ground moraine averaging about 15 feet thick, occasional thicker deposits of till are found in drumlins, elongated oval shaped hills which may be up to 100 feet thick. One such feature is found in Lincoln southeast of Sandy Pond.

Till is a poorly sorted mixture of materials of heterogenous sizes, from fine clays and silts, to sands, gravels, pebbles, and boulders. The amount of clay and silt in the tills of the watershed is less than average, and they have a sandier texture and more boulders.

Significance for Water Resources

Because till is an unsorted mixture of small and large particles, it is generally a compact deposit with little open pore space between particles. As a result, till has a low porosity and permeability, or ability to store or transmit water. The significance of these characteristics is that:

- till is not a favorable aquifer or aquifer recharge material;
- till has higher rates of runoff, which may also result in erosion problems on slopes; and
- locally perched water tables may occur over till, causing perched wetlands.

Glacial Meltwater Deposits

Water-laid deposits consist of those materials deposited by flowing streams (glaciofluvial) and those deposited in standing bodies of water (glaciolacustrine) as the glaciers melted and receded. In the Stony Brook watershed, a broad band of glacial stream deposits is found running north to south through the center of the watershed, generally following the course of Stony Brook and Hobbs Brook. Glacial lake deposits are found in the southwestern part of the watershed in Weston (see Map 2). Topographic features associated with glacial stream deposits include outwash, kames, kames terraces, and eskers. These formations and their distribution in the watershed are described below:

- <u>Outwash</u>: well sorted and stratified beds of sand and gravel, deposited by flowing glacial melt-water. The most common glacial stream deposit, outwash covers broad, flat areas generally adjacent to streams. In the watershed, outwash forms the majority of the glacial stream formations throughout the central part of the watershed, along the course of Stony Brook and Hobbs Brook.

- <u>Kames</u>: sand and gravel deposited by streams on or adjacent to melting glacial ice, forming a hummocky topography of irregular hills. Kames are found west of Fiske Hill in Lexington and northwest of Sandy Pond in Lincoln.

- <u>Kame terrace</u>: interbedded layers of cobbles, gravel, and sand, deposited by melt-water streams flowing between the ice and adjacent hillsides. They are found in the watershed north of Bear Hill in Waltham and west of Fiske Hill in Lexington.

- <u>Eskers</u>: also known as ice-channel fillings; deposited by meltwater flowing in channels between ice blocks or tunnels within or under the ice. Eskers consist of cobbles, gravel, and sand generally stratified, with occasional beds of silt or boulders. Eskers are found in Lincoln south of Hobbs Brook marsh, in Waltham South of Hobbs brook Reservoir, in the northwestern corner of Weston, and along Stony Brook in Weston.

Significance to Water Resources

Most glacial stream deposits are well sorted by particle size, and stratified into layers of similar particle size. They generally lack significant clay or other fine grained deposits, therefore there is a relatively large amount of pore space between individual sand and gravel particles. This open texture imparts a moderate to high porosity and permeability to most sand and gravel deposits. The significance to water resources is that:

- sand and gravel deposits may form a favorable aquifer if they are sufficiently thick and permeable (see section 2.4.2 Groundwater Resources).

- sand and gravel may permit significant recharge/discharge between surface water and groundwater.

- sand and gravel areas are generally associated with high infiltration and low runoff.

- the deposits are sometimes commercially valuable sources of sand and gravel used for construction aggregate.

Glacial Lake Deposits

As the glaciers receded, melt-water was frequently impounded by ice or landforms, forming bodies of standing water called glacial lakes. The size and location of these lakes changed as the ice continued to melt. Eventually most of the glacial lakes disappeared as receding ice and/or erosion provided an outlet for their drainage, often in several stages. In areas formerly inundated by glacial lakes, the surficial materials are typical of deposits laid down in standing water: fine grained deposits such as clay, silt, and fine sand. In some areas these are graded into adjacent coarser-grained glacial stream deposit, where melt-water streams once flowed into the glacial lakes.

In the Stony Brook watershed, the southwestern section covering much of the Weston portion of the watershed is dominated by glacial lake deposits. These were deposited in several successive stages of glacial Lake Sudbury, which at one time covered parts of Sudbury, Concord, Lincoln, Wayland, and Weston. These deposits consist of clay, silt, sand, and gravel laid down in or graded to glacial Lake Sudbury. The lake bottom deposits are mostly fine and medium grained sand overlying silt and clay, well sorted and stratified. The lake deposits grade into adjacent glaciofluvial deposits which contain stratified sand, gravel, silt, and some clay, but generally have a somewhat coarser texture than lake bottom deposits.

Because of their variable texture which ranges from medium to very fine, glacial lake deposits generally have low to medium permeability. Therefore they have low to moderate groundwater potential. Wetlands are commonly associated with finer grained lake bottom deposits.

2.4 Hydrology

2.4.1 Surface Water Resources

The Cambridge water system draws water from the Stony Brook watershed, the second largest tributary to the Charles River. The two reservoirs in the watershed impound the Stony Brook near its confluence with the Charles River and the Hobbs Brook, a tributary of Stony Brook (see Map 3). The entire watershed has an area of 23.6 square miles, with 16.6 square miles draining to Stony Brook Reservoir and 7 square miles draining to Hobbs Brook Reservoir. The distribution of watershed land among the four communities is as follows:

Table 2-2 Watershed Land by Community

Community	Area (sq. mi)	Percent of Watershed	Percent of Community in the watershed
Lexington	1.8	7.6	10.5
Lincoln	9.2	39.0	61.7
Waltham	3.9	16.5	28.3
Weston	8.7	36.9	50.9
Total	23.6	100%	37.5

The Stony Brook watershed is located in the northeastern corner of the Charles River drainage basin (See Figure 2-4). Annual rainfall averages 41.36 inches, and precipitation is distributed fairly evenly throughout the year.

Table 2-3 Mean Monthly Precipitation (inches)

January	3.63
February	3.34
March	3.84
April	3.60
May	3.21
June	3.12
July	3.23
August	3.64
September	3.21
October	3.29
November	3.79
December	3.46
Annual Mean	41.36

Source: Corps of Engineers, Stony Brook Sub-Watershed, 1967.

The watershed is drained by Stony Brook, which flows southeasterly through the center of the study area; Hobbs Brook, which flows from the northeastern section, joining Stony Brook about one mile above Stony Brook Reservoir; and Cherry Brook, which drains the southwestern sector of the watershed, joining Stony Brook about one-half mile above the reservoir. The entire drainage of the watershed ultimately flows to Stony Brook Reservoir, and a significant amount of the flow is diverted to the Cambridge water system through the Stony Brook conduit in most months of the year.

In addition to the two reservoirs, there are several ponds in the watershed, including Sandy Pond at the headwaters of Stony Brook; Beaver Pond, Valley Pond, and Todd Pond, all of which are in Lincoln. Several smaller unnamed ponds are found in Weston.

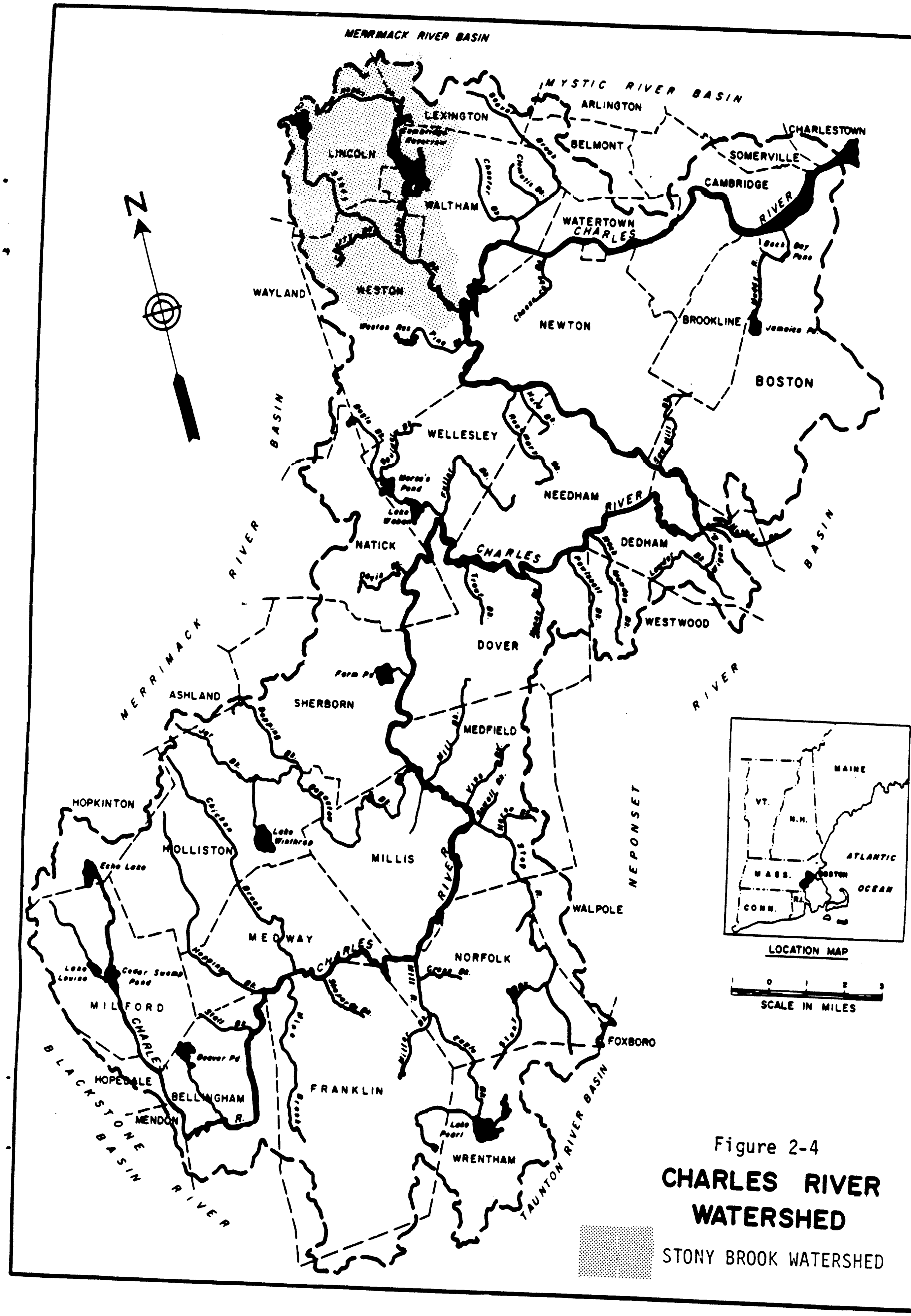
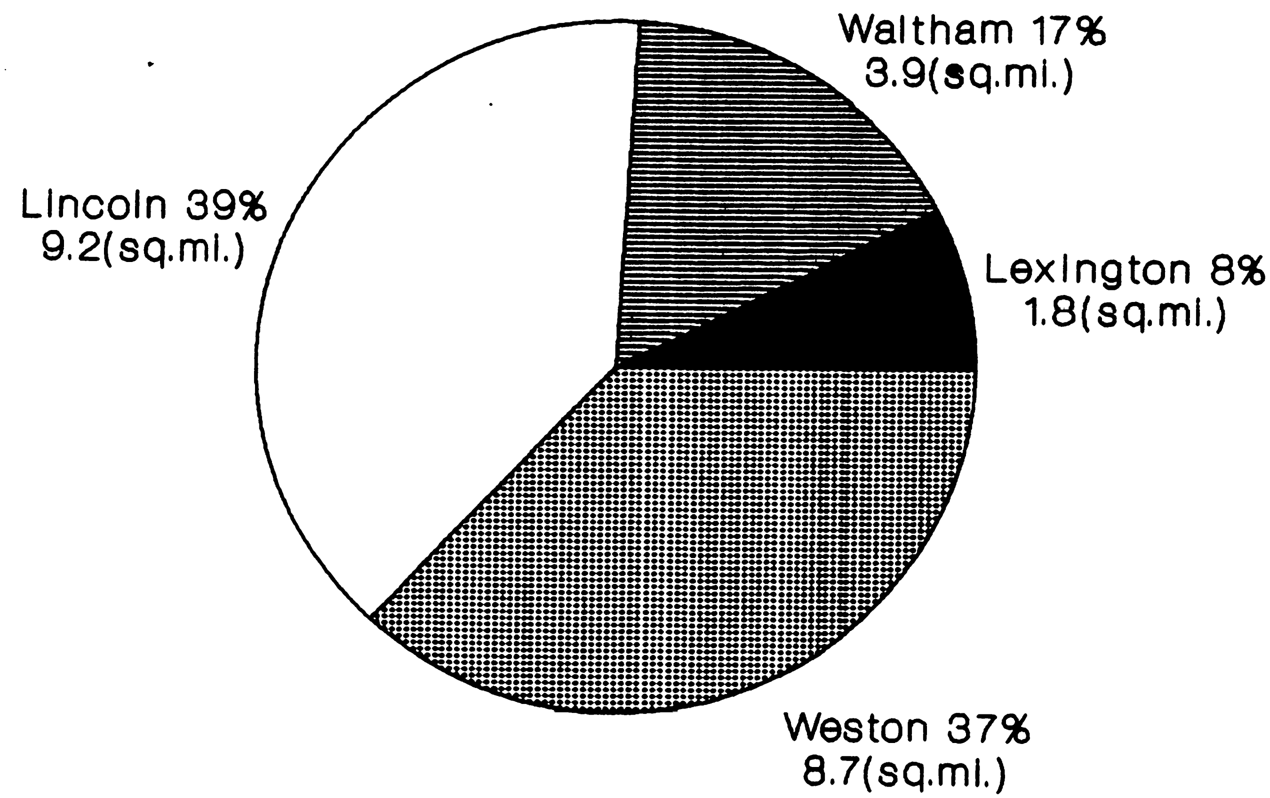


Figure 2-4
CHARLES RIVER WATERSHED

Watershed Land by Community



Portion of Stony Brook watershed in each community. Total watershed area is 23.6 square miles.

Streamflow

Figure 2-6 is an annual runoff exceedance curve for the Stony Brook watershed. The curve shows that total annual runoff from the basin ranges between 600 million cubic feet and 3 billion cubic feet. Fifty percent of the years would have a runoff of about one billion cubic feet, or an average of 20 million gallons a day.

The U.S. Geological Survey operates stream flow gaging stations at three locations on the Charles River, but none are located in the Stony Brook watershed. However, streamflow was monitored at four locations in the Stony Brook watershed between August 1968 and April 1971. Seasonal discharges at three locations are summarized in Table 2-4. The monitoring showed that Stony Brook ranged from 0.10 cubic feet per second (cfs) in the fall to 31 cfs in the spring. Cherry Brook fluctuated from 0.26 cfs to 1.3 cfs, and Hobbs Brook ranged from zero to 2.22 cfs.

Table 2-4 Flow Measurements in the Stony Brook Watershed

Date	Discharge (cubic feet per second)		
	Stony Brook Weston	Cherry Brook Weston	Hobbs Brook Lincoln
8-29-68	0.23	0.55	----
9-20-68	0.10	0.40	----
9-25-68	----	----	----
10-1-68	0.10	----	----
10-3-68	----	----	----
10-15-68	0.20	0.42	----
04-03-69	31.0	----	----
07-07-69	0.28	0.52	0.02
08-25-69	0.24	0.43	0
09-02-69	0.14	0.26	----
09-15-69	0.29	1.30	0.04
09-23-69	0.37	1.00	0.11
04-03-70	----	----	----
07-27-70	----	0.64	0.03
07-31-70	----	0.53	0.02
08-10-70	0.28	0.36	0
10-12-70	0.25	0.46	0.03
04-22-71	----	----	2.22

Source: U.S.G.S., Hydrologic Data of the Charles River Basin, 1977.

Water Quality

Surface water quality is not regularly monitored on the Stony Brook or its tributaries, with the exception of the two reservoirs, which are monitored by the Cambridge Water Department under the requirements of the Safe Drinking Water Act (See section 2.7, Cambridge Water Supply System Profile). Between 1968 and 1971, U.S.G.S. conducted surface water quality monitoring at three locations in the watershed. Selected results are summarized in Table 2-5.

Figure 2-6

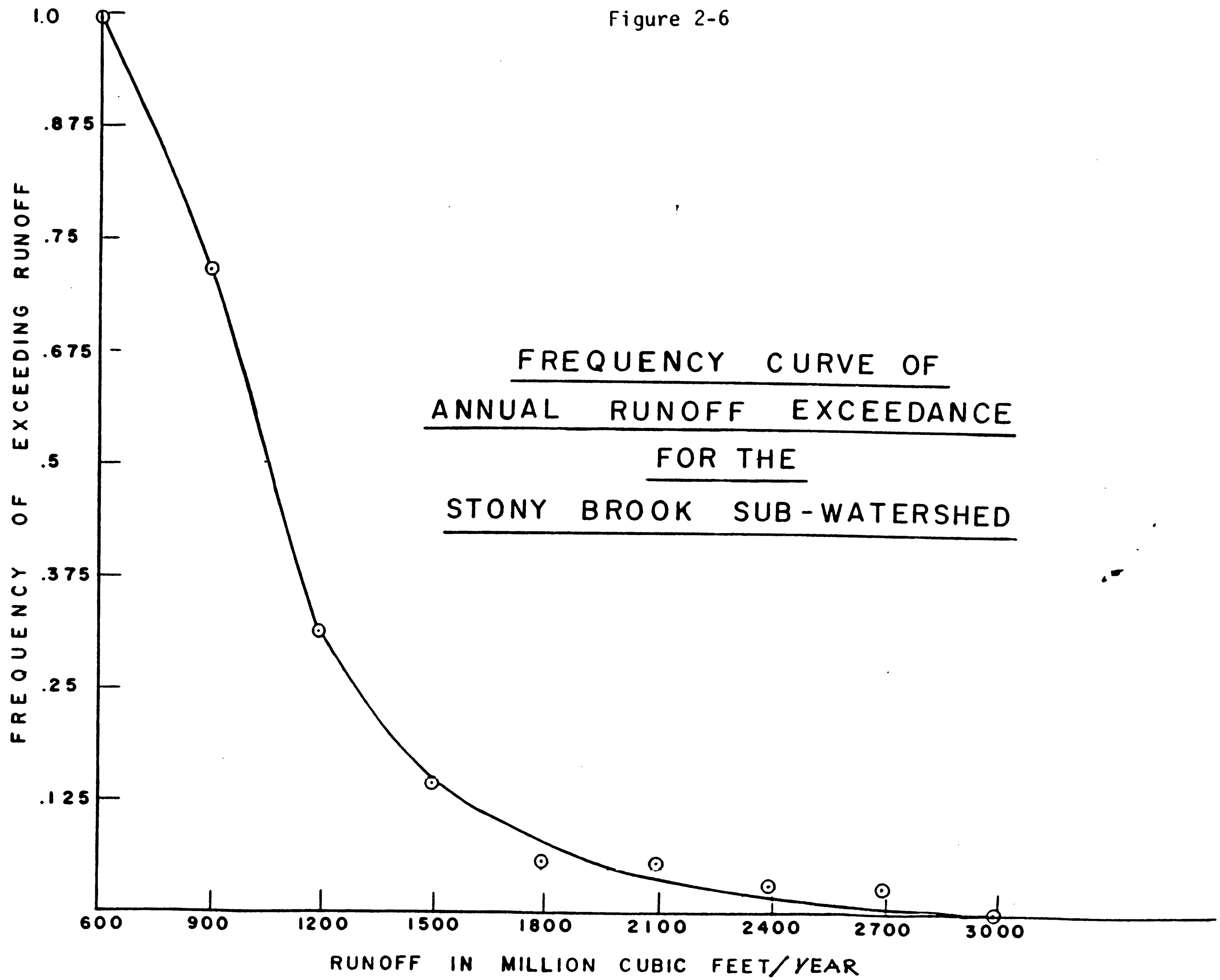

FREQUENCY CURVE OF
ANNUAL RUNOFF EXCEEDANCE
FOR THE
STONY BROOK SUB-WATERSHED
FREQUENCY OF EXCEEDING RUNOFF
1.0
.875
.75
.675
.5
.375
.25
.125
600
900
1200
1500
1800
2100
2400
2700
3000
RUNOFF IN MILLION CUBIC FEET/YEAR

Table 2-5 Surface Water Quality Analysis

Water Quality Parameter	Stony Brook/Weston 10-1-68	4-3-69	Hobbs Bk./Lincoln 10-7-69	4-22-71	Stony Bk./Waltham 6-10-70
Discharge (cfs)	0.10	31.0	0.19	2.22	---
Sodium (mgl)	8	8	24	14	19
Chloride (mgl)	15	18	46	29	36
Iron (ugl)	---	40	650	220	390
Manganese (ugl)	---	10	60	0	30
pH	7.1	6.4	6.8	6.0	7.0
Dissol. Oxygen (mgl)	---	12.0	10.5	---	5.5
Arsenic (ugl)	---	---	0	---	---
Copper (ugl)	---	---	0	---	---
Chromium (ugl)	---	---	0	---	---
Lead (ugl)	---	---	0	---	---

Key: mgl = milligrams per liter; ugl: micrograms perliter
Source: USGS, Hydrologic Data of the Charles River Basin, 1977.

As part of the Route 2 Environmental Impact Report, another water quality monitoring program was conducted from 1973 to 1974 on Hobbs Brook and in the upper Hobbs Brook Reservoir. Selected results are summarized in Table 2-6 below.

Table 2-6 Surface Water Quality--Hobbs Brook and Hobbs Brook Reservoir*

Water Quality Parameter	Hobbs Brook (near Hobbs Brook Marsh)	Hobbs Brook Reservoir (south of Rt. 2)
Turbidity (JTU)	26.9	95.9
Suspended Solids (mgl)	5.9	36.3
Dissolved Solids (mgl)	262	124
Apparent Color	94	319
Total Alkalinity (mgl)	24.4	17
BOD (mgl)	1.03	1.23
Dissolved oxygen (mgl)	11.2	10.0
Sodium (mgl)	35.5	17.6
Chloride (mgl)	68.3	32.9
Nitrate (NO3) (mgl)	0.84	2.03
Phosphate (total P, mgl)	0.39	1.25
Cadmium (mgl)	0.03	0.04
Phenols (mgl)	0.010	0.013
Lead (mgl)	<0.5	<0.5
Coliform bacteria (count/100 ml)	0.03	0.04

*Mean of 10 monthly samples taken March 1973-January 1974.

Source: Route 2 Environmental Impact Report.

2.4.2 Groundwater Resources

As described in Section 2.3, groundwater is found in significant quantities in deep stratified sand and gravel deposits. These are frequently found as "buried valleys," where glacial stream deposits filled in the pre-glacial valleys carved in the underlying bedrock. Often these pre-glacial drainage patterns closely resemble the current surface drainage network. Such is the case in the Stony Brook watershed, where favorable aquifers are fairly linear features paralleling the present course of Stony Brook (see Map 4). The USGS Hydrologic Atlas classifies aquifers into three favorability rankings, according to their estimated potential yield to wells. The mapped units and their distribution in the watershed are summarized in Table 2-7.

Table 2-7 Aquifer Areas

Potential Yield to Wells (gal./min.)	Area (acres)	Percent of Watershed
Greater than 250 gpm	52	0.3
50-250 gpm	707	4.7
5-50 gpm	2530	16.8
Total Aquifer	3289	21.8

The most favorable aquifer areas are located in Lincoln and Weston, in the buried valley beneath the present course of Stony Brook. The town of Lincoln operates one municipal well in the aquifer, and Weston is currently exploring the feasibility of developing a well near Kendall Green (see Section 2-8).

Groundwater and surface water are closely related in the hydrologic cycle. A groundwater aquifer acts as an underground storage reservoir, receiving recharge from precipitation and surface water during the spring, and discharging water back to the surface water bodies at other times of the year. Groundwater discharge contributes to the "base flow" of streams in periods of little or no precipitation. In the Hobbs Brook Reservoir watershed, a study by Geotechnical Engineers estimated that 72% of the total inflow to the reservoir comes from groundwater discharge while 28% is from surface water inflow.

Significance to Water Supply

Although Cambridge does not withdraw groundwater from the watershed, it is a significant source of discharge to the reservoirs' annual water budget. Therefore, development activities which reduce the rate of aquifer recharge may reduce the overall potential yield of the reservoirs by reducing the amount of groundwater available to supply base flows throughout the year. Increased impervious surfaces may have the effect of reducing reservoir yield by increasing runoff, which during the spring recharge season will not be able to be stored if the reservoirs are full.

Because the reservoirs receive a significant amount of groundwater discharge the quality of groundwater may also have an impact on the quality of drinking water withdrawn from these reservoirs. This was shown to be the case for sodium in the Geotechnical Engineers Study of Hobbs Brook Reservoir. The study estimated that 75% of the sodium entering the reservoir is attributed to groundwater discharge.

2.5 Soils

The soils of the watershed have been mapped by the Middlesex Conservation District and interpreted for a variety of characteristics pertaining to their potential uses. Most soils are developed in place below their geologic parent material, and their characteristics are closely related to the nature of that material and the place in the landscape it occupies. Soils with similar characteristics are classified and mapped as a unit called a soil series. All the soils within a series have major horizons that are similar in composition, thickness, and arrangement in the profile. Soils of one series may differ in texture, slope, stoniness, or other characteristics. Such differences are reflected in the further subdivision of the soil series into various phases. For example, the Canton soil series includes a phase called fine sandy loam, 3-8% slopes, extremely stony. The name of the soil phase commonly refers to characteristics which affect the potential use or management of the soil.

Significance to Water Supply

Several features of the soils of the watershed are significant to water quality. The most important of these are the suitability of the soils to be used for septic systems which discharge wastewater to the ground, and the susceptibility of the soils to erosion.

2.5.1 Soil Limitations for Septic Systems

The Middlesex Conservation District has evaluated each soil series in terms of its suitability for septic system absorbtion fields. Such systems discharge wastewater from a septic tank into the soil through subsurface leaching trenches, chambers, or perforated pipe. The Conservation District identifies a number of criteria used to evaluate the ability of the soils to support septic systems, including percolation rate, depth to water table or bedrock, and slope. Soils are categorized according to their limitations for use as septic tank absorbtion fields. These limitations are designated as slight, moderate, or severe, according to the following characteristics:

- slight: soils are generally favorable for the use and and limitations are slight and easily overcome
- moderate: soil properties or site features are unfavorable for the use, but limitations may be overcome by special planning and design
- severe: soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive management is required.

The range of values for each soil criterion and the category of limitation applied to each is summarized in Table 2-8. The soils which fall into each septic limitation category are described below, and detailed characteristics of these soils appear in Appendix F. Soils with severe limitations for septic systems are shown on Map 5.

TABLE 2-8

SOIL CONSERVATION SERVICES SUITABILITY CRITERIA

CRITERIA	CLASSIFICATION	RANGE	LIMITATION
Slopes	A	0-3%	Slight
	B	3-8%	Slight
	C	8-15	Moderate
	D	15-25%	Severe
	E	25-35%	Severe
Depth to seasonal high water table/bedrock		>60"	Slight
		48-60"	Moderate
		<48"	Severe
Permeability	Very slow	<0.05 in/h	Severe
	Slow	0.05-0.2 in/h	Moderate
	Moderately slow	0.2-0.8 in/h	Moderate
	Moderate	0.8-2.5 in/h	Slight
	Moderately rapid	2.5-5 in/h	Slight
	Rapid	5-10 in/h	Slight
	Very rapid	> 10 in/h	Severe

Source: U.S.D.A. Soil Conservation Services, Middlesex County Interim Soils Survey, 1987.
U.S.D.A. Soil Conservation Services, Study of Hopkinton, 1976.

Septic Limitations: Slow Percolation Rate

The soil survey categorizes the soil series by their rate of percolation in inches per hour. The soils which have a percolation rate of less than 0.6 inches per hour correspond to a rate which will not pass a percolation test under the Massachusetts Envronmental Code, Title 5. These soils, which are classified as severe limitations for septic systems, are shown in Table 2-9 and mapped in the Stony Brook watershed on Map 5. Detailed characteristics of these soils are presented in Appendix F. It should also be noted that all of the soil series listed here with slow percolation rates also are classified as soils with high water tables (see section below).

Table 2-9 Soil Septic Limitations: Slow Percolation Rates and High Water Tables

27 B Scituate	123 B Paxton
28 B Scituate	181 B Birchwood
32 B Ridgebury	222 B,C,D Montauk
33 A Whitman	223 B,E Montauk
34 A Whitman	241 B Rainbow
81 B Woodbridge	252 B,C Broadbrook
82 B,C Woodbridge	263 Woodbridge-Urban land
122 B,C,D,E Paxton	611 Birdsall

Septic Limitations: High Water Table

The soil survey lists soils which have a seasonally high water table. Those soils which have a depth to water table of less than 48 inches are considered to have severe limitations for septic systems. This is also in accordance with Title 5, which requires four feet of soil profile above the water table. In the Stony Brook watershed, the soils listed below in Table 2-10, as well as the soils listed above in Table 2-9, have severe limitations for septic systems due to high water tables. These soils are mapped on Map 5, and detailed characteristics of the soils are listed in Appendix F.

Table 2-10 Soil Septic Limitations: High Water Table

38 Sudbury	70 Ninigrit
39 Walpole	71, 72 Sutton
40 Scarboro	92 Winooski
42 Pootatuck	100 Tisbury
43 Rippowam	138 Deerfield
44 Saco	139 Wareham
45 Swansea	267, 591 Scio
46, 99 Freetown	602 Raypol

Note: Soils in Table 2-9 also have high water tables

Septic Limitations: Depth to Bedrock

Soils with a depth to bedrock of less than 48 inches are classified as severe limitations for septic systems. This is also a criteria under the Title 5 regulations. Soils in the Stony Brook watershed with these limitations are listed in Table 2-11, and mapped on Map 5.

Table 2-11 Soil Septic Limitations: Depth to Bedrock

7 B,C	Charlton-Hollis-Rock outcrop complex
8 C,D	Chatfield-Hollis-Rock outcrop complex
9	Rock outcrop-Hollis complex
17 B,C,D	Narragansett-Hollis-Rock outcrop complex
265	Charlton-Hollis-Urban land complex
Pq	Pits and Quarries

Septic Limitations: Slope

Soils with a slope of greater than 15 percent are considered to have severe limitations for septic system absorption fields. Severe slopes can cause breakout of septic effluent downgradient from the septic system. Soils in the Stony Brook watershed which have severe limitations due to slope are listed in Table 2-12 and shown on Map 5.

Table 2-12 Soil Septic Limitations: Slope

7 D	Charlton-Hollis-Rock outcrop complex
19 D	Charlton
35 D,E	Hinckley
67 D	Windsor
115 D,E	Canton
119 D, 120 D	Narragansett

Note: Soils with letter codes D and E in Tables 2-9 and 2-11 also have severe limitations for septic systems due to slope

2.5.2 Soil Erosion Potential

The soil survey assigns an erosion potential factor (K factor) to each soil series based on the soil structure, texture, and permeability. The erosion K factor is used in the Universal Soil Loss Equation (USLE) to calculate the erosion rate in tons per year per acre. Erosion potential of the soils in the Stony Brook Watershed has been estimated by combining the K factor and the slope for each mapped soil unit, based on the criteria shown in Table 2-13. Soils categorized with a high or moderate potential for erosion are shown on Map 6.

Table 2-13 Soil Erosion Potential Classification Criteria

Slope	Erodibility Factor (K)		
	0.17--0.24	0.28--0.37	0.43+
0--8 %	Low	Low	Moderate
8--15 %	Low	Moderate	High
15--25 %	Moderate	High	High
25 % +	High	High	High

Soils in the Stony Brook watershed which fall into the high and moderate erosion potential categories are mapped on Map 6 and listed below:

High Erosion Potential Soils

7 D	Charlton-Hollis	120 C,D	Narragansett
35 E	Hinckley	122 C,D	Paxton
37 D	Merrimac	123 E	Paxton
44	Saco	222 E	Montauk
100 A,B	Tisbury	223 E	Montauk
113 D	Canton	252 C	Broadbrook
114 D	Canton	267	Paxton
115 D,E	Canton	591 A,B	Scio
119 C,D	Narragansett	611	Birdsall

Moderate Erosion Potential Soils

7 C	Charlton-Hollis	119 B	Narragansett
8 D	Hollis-rock-Charlton	120 B	Narragansett
19 D	Charlton	122 C,D	Paxton
35 D	Hinckley	222 D	Montauk
67 D	Windsor	223 D	Montauk
82 C	Woodbridge	241 B	Rainbow
92 C	Winooski	252 B	Broadbrook
113 C	Canton	602	Raypol
114 C	Canton		
115 C	Canton		

2.6 Wetlands

Wetlands are low-lying transitional areas between terrestrial and aquatic systems where the water table is at or near the surface of the land. Freshwater wetlands may develop in wet depressions of upland areas, at the margins of rivers, streams, and ponds, in the low, wet areas of floodplains, and as late stages in the filling of lakes and ponds (see Figure 2-7). Wetlands may have a vegetative cover which ranges from grasses, reeds, and sedges to woody vegetation such as shrubs and trees.

Wetlands in the Stony Brook watershed have been mapped by the US Fish and Wildlife Service as part of its National Wetlands Inventory (see Map 7). This is the only wetlands mapping which covers the entire watershed. In addition, the town of Lincoln prepared a wetlands map based on 1968 air photos. This map shows wetlands in generally the same areas as the national inventory, but their area is somewhat more extensive in most cases. The area of wetlands in each community in the watershed is shown below. Lincoln has the most extensive wetlands, both in acreage and percent of land in wetlands, followed by Weston, Lexington, and Waltham.

Table 2-14 Wetlands in the Stony Brook Watershed

Community	Wetland acres	Percent of Community
Lexington	84	7.3
Lincoln	1024	17.4
Waltham	71	2.8
Weston	566	10.2

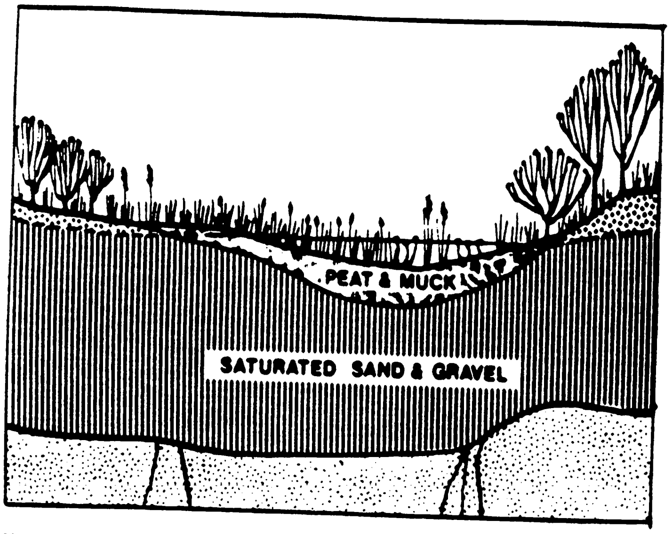
Source: National Wetlands Inventory, US Fish & Wildlife Service

The majority of the wetlands mapped in the watershed are classified by the Fish and Wildlife Service as "palustrine," which are defined as nontidal wetlands dominated by trees, shrubs, persistent emergents, and emergent mosses and lichens (see Figure 2-8).

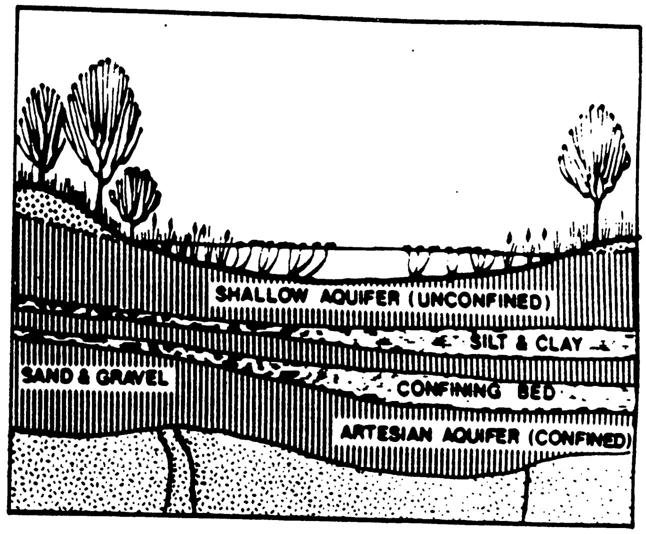
Significance to Water Supply

Wetlands have several important functions and values with respect to water supplies: they filter pollutants entering streams, provide temporary storage for flood control, supply base flows for streams and rivers, act as groundwater recharge and/or discharge areas, and retain water in the watershed, supplying it to the surface water system in periods of low rainfall. In Massachusetts wetlands are protected by the Wetlands Protection Act, which recognizes eight major functions of wetlands:

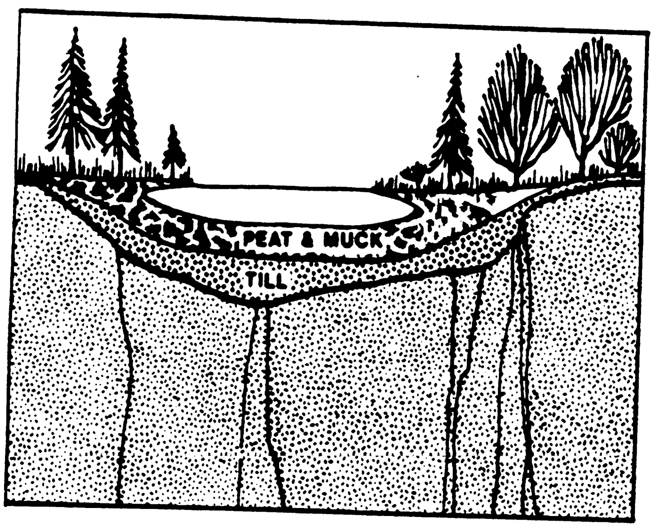
Figure 2-7 Wetlands Morphology



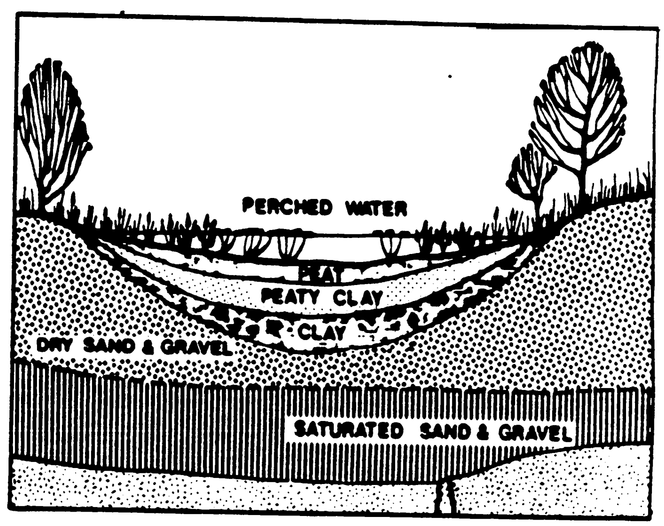
Water table wetland



Lake bottom wetland



Wetland on till and bedrock

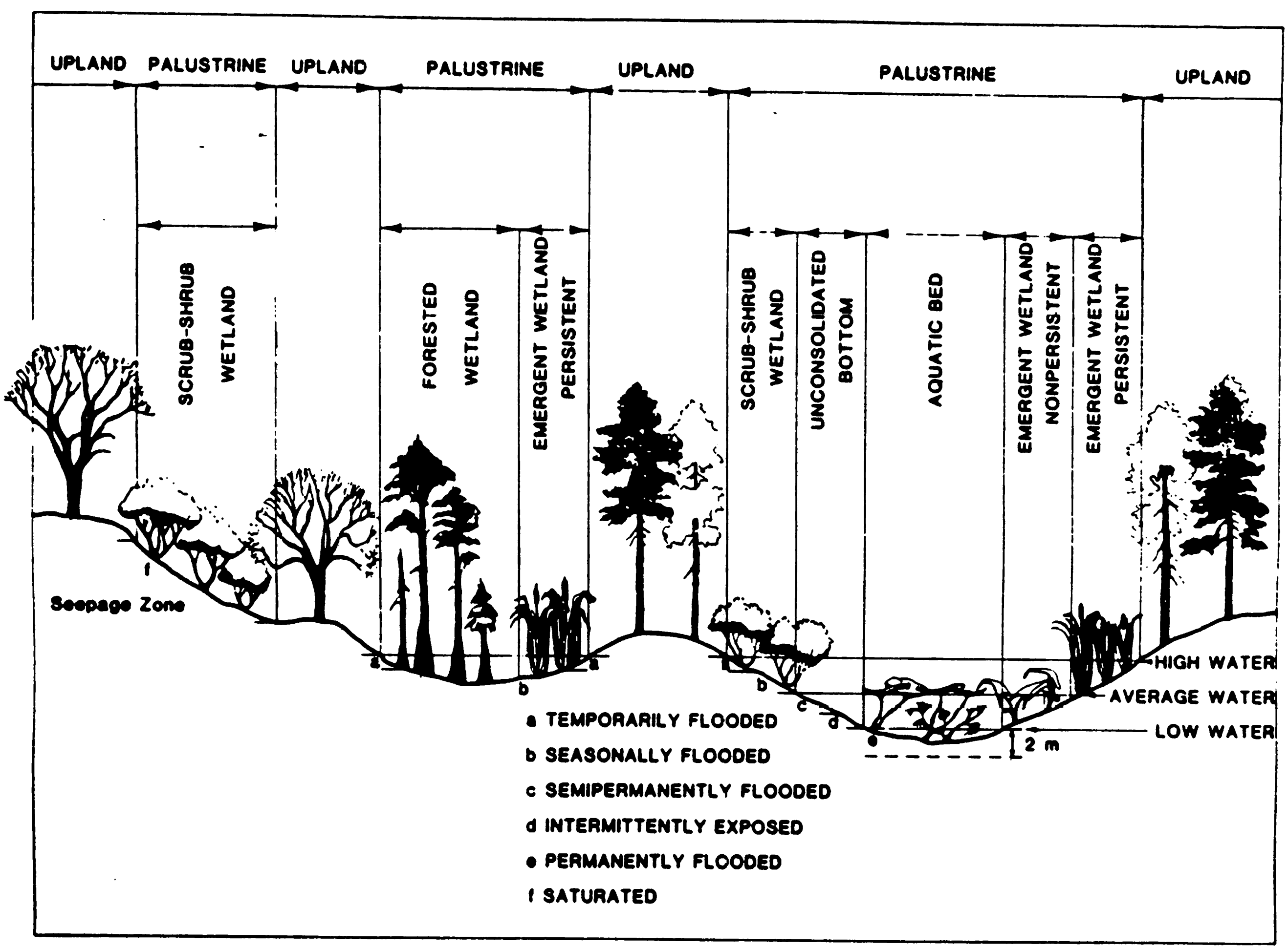


Perched wetland

o public and private water supply
o groundwater supply
o flood control
o storm damage prevention
o prevention of pollution
o protection of land containing shellfish
o protection of fisheries
o wildlife habitat

For water supply management, the most relevant functions of wetlands are: public and private water supply; groundwater supply; and prevention of pollution. The relationships between vegetated wetlands and these functions are summarized in Table 2-15. Wetlands play a beneficial role in maintaining both the quantity and quality of water supplies. It follows that the alteration or destruction of wetlands can have a significant adverse impact on water quality and quantity in the watershed.

Figure 2-8 Profile of Palustrine Wetlands



Source: Fish and Wildlife Service, Classification of Wetlands and Deepwater Habitats of the United States, 1979.

Table 2-15

Wetland Values for Water Supply

STATUTORY INTERESTS	Discharging Vegetated Wetland	Recharging Vegetated Wetland (uncommon in Mass.)	Mixed Discharge and Recharge Vegetated Wetland	High Water Table Vegetated Wetland
Public and Private Water Supply (surface)	Supplies water to surface systems in periods of limited rainfall. For streams and rivers, this is critical.	Supplies water to discharge wetlands.	Same as discharge wetland except lesser value.	If not discharging to a surface water system, no value.
Groundwater Supplies	Volume of discharge is related to groundwater fluctuations.	Critical to maintaining groundwater supplies. Pollution can enter groundwater through recharge wetlands, but is minimized by an intact wetland.	Same as discharge wetland.	If sands and gravel underlie this wetland, groundwater supply can be excellent. If peat underlies this wetland, groundwater supply may be in soils beneath the peat.
Flood Control and Storm Damage Prevention	The temporary near surface and above surface storage is of value in flood control.	Recharge vegetated wetlands are very important in reduction of flood peaks.	In the discharge state, there is much less flood control potential than in recharge state.	The only value is the above surface storage because the soil is already saturated.
Pollution Prevention	Passage of water through a wetland reduces or eliminates pollutants, so water quality is improved. In fall and early spring, some nutrients may leave the system, and may pollute downstream areas.	Nutrients consumed here are trapped here. Other pollutants leave the wetland.	If recharge dominates, then pollution buildup is possible for some pollutants. Disturbing a wetland can release pollutants that have accumulated.	Pollutants remain trapped locally if groundwater flows are slow and peat or muck are present.

2.7 Cambridge Water Supply System Profile

The Cambridge Water Supply system is the largest system which withdraws water from sources in the metropolitan Boston area. The system currently serves a resident population of about 90,000 people, as well as a student population of about 25,000, providing an average day demand of 17 million gallons per day (mgd) and a maximum day demand of 23 mgd. Characteristics of the system are described below.

2.7.1 Water System History

Prior to 1837 there was no water supply system in Cambridge. In that year, the Cambridgeport Aqueduct Company, a privately owned company, was granted a Water Works Charter to bring water to Cambridge from springs in Somerville. The system supplied water to the Cambridgeport area through piping made from hollowed wooden logs. Elsewhere in the city, water was obtained from individual wells.

In 1846, the City of Cambridge was incorporated. At that time, the population was 13,000.

In 1852, the Cambridge Water Works was chartered, and in 1856 Fresh Pond was developed as a water supply source for the city. In 1865, the City of Cambridge purchased the rights of the Cambridge Water Works, placing the water system in public ownership. At that time, the system consisted of Fresh Pond with about 200 acres of surrounding land, a pumping station, a distribution reservoir on Reservoir Street, and the distribution system.

By the late 1880 s the city reached a population of 65,000, and the waters of Fresh Pond were no longer adequate to meet the city's growing water demand, which was more that 4 mgd.

In 1887, Cambridge was authorized by statute to take the water of Stony Brook and its tributaries within the Charles River basin. These tributaries drain portions of Waltham, Weston, Lincoln, and Lexington. In that year, a dam and gate house were constructed on the Stony Brook near its confluence with the Charles River in Waltham and Weston, creating the Stony Brook Reservoir. Water from the reservoir was piped by gravity flow for 7.75 miles to Fresh Pond in Cambridge.

In 1897, a second, larger reservoir was constructed on a tributary of Stony Brook. The Hobbs Brook Reservoir (also referred to as the Cambridge Reservoir) impounds Hobbs Brook 2.5 miles upstream from the Stony Brook Reservoir.

A distribution reservoir was constructed in Belmont in 1898. Payson Park Reservoir, at an elevation of 178 feet above sea level, provides pressure throughout the distribution system.

In 1922, a water treatment plant was built next to Fresh Pond. The plant treats all water before being pumped to the Payson Park Reservoir. In 1932, the treatment and pumping facilities were upgraded.

Although no additional local supply sources have been developed since 1897, a connection to the Metropolitan District Commission Water system was made in 1952. This connection is used primarily as backup or emergency source. In 1985, the regional water system operated by the MDC was transferred to the Massachusetts Water Resource Authority (MWRA). The principal sources of supply - Quabbin and Wachusett Reservoirs - continue to be owned and managed by the MDC.

Table 2-16

Chronology of Cambridge Water System Development

1837	Cambridgeport Aqueduct Company chartered; source of supply: springs in Somerville.
1852	Cambridge Water Works chartered
1856	Fresh Pond developed
1861	Cambridge Water Works purchased Cambridgeport Aqueduct Company
1865	City of Cambridge purchased Cambridge Water Works
1887	Stony Brook Reservoir developed
1897	Hobbs Brook Reservoir developed
1898	Payson Park Reservoir developed
1922	Fresh Pond Treatment Plant constructed
1932	Treatment plant and pumping upgraded
1950	Treatment plant and pumping upgraded
1952	MDC connections installed

2.7.2 Sources of Supply and System Operation

Cambridge obtains its water supply from two surface water impoundments in the Stony Brook watershed, a tributary of the Charles River in portions of Weston, Waltham, Lincoln, and Lexington. The water collected in Hobbs Brook and Stony Brook Reservoirs is piped by gravity flow 7.75 miles to Fresh Pond in Cambridge, which is used for storage. The three reservoirs provide a total of nearly four billion gallons of storage (See Table 2-17 and Figures 2-9 and 2-10).

Figure 2-9

Map of Cambridge Water System

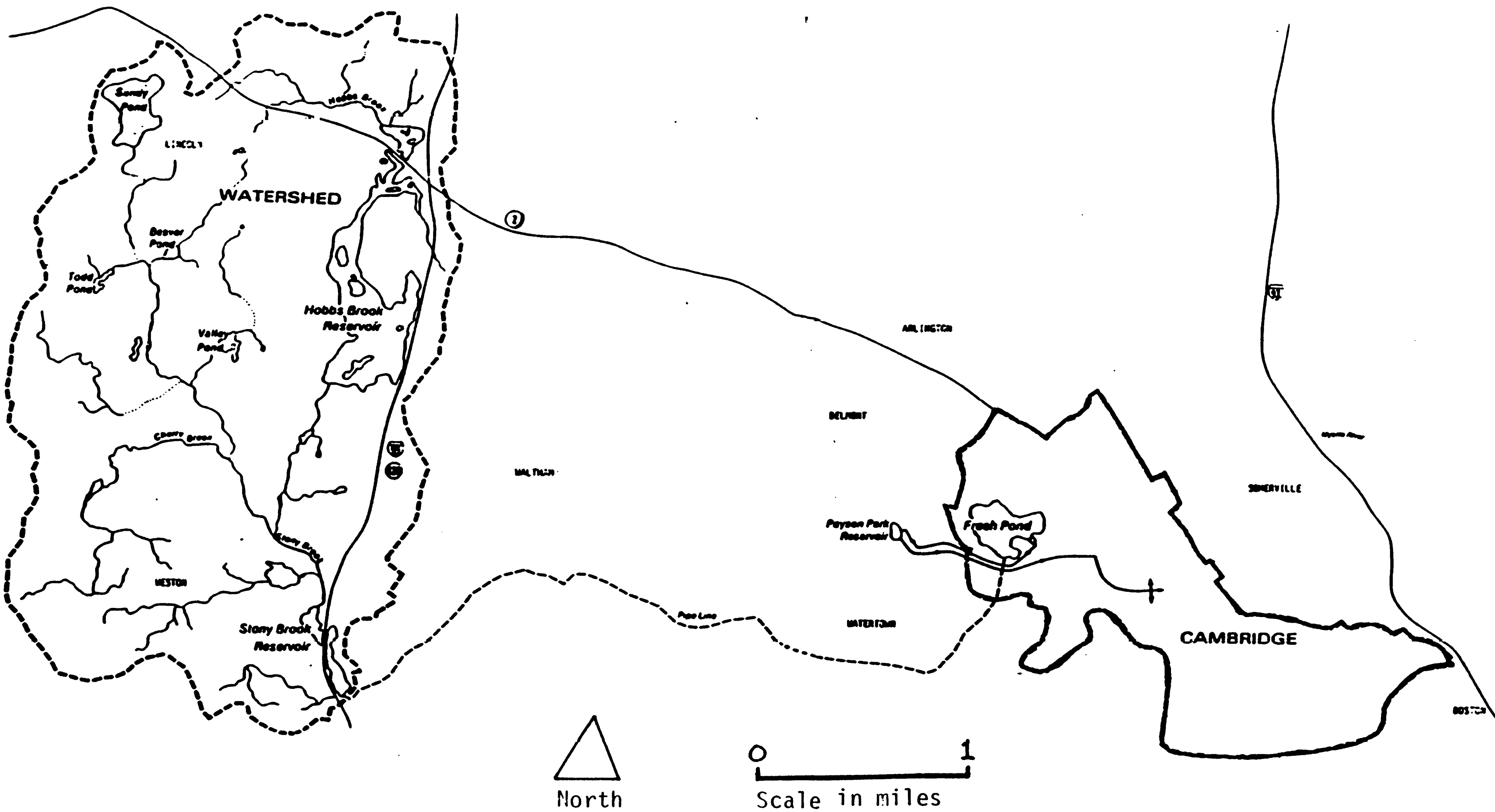


Figure 2-10

SCHEMATIC OUTLINE OF CAMBRIDGE WATER SYSTEM

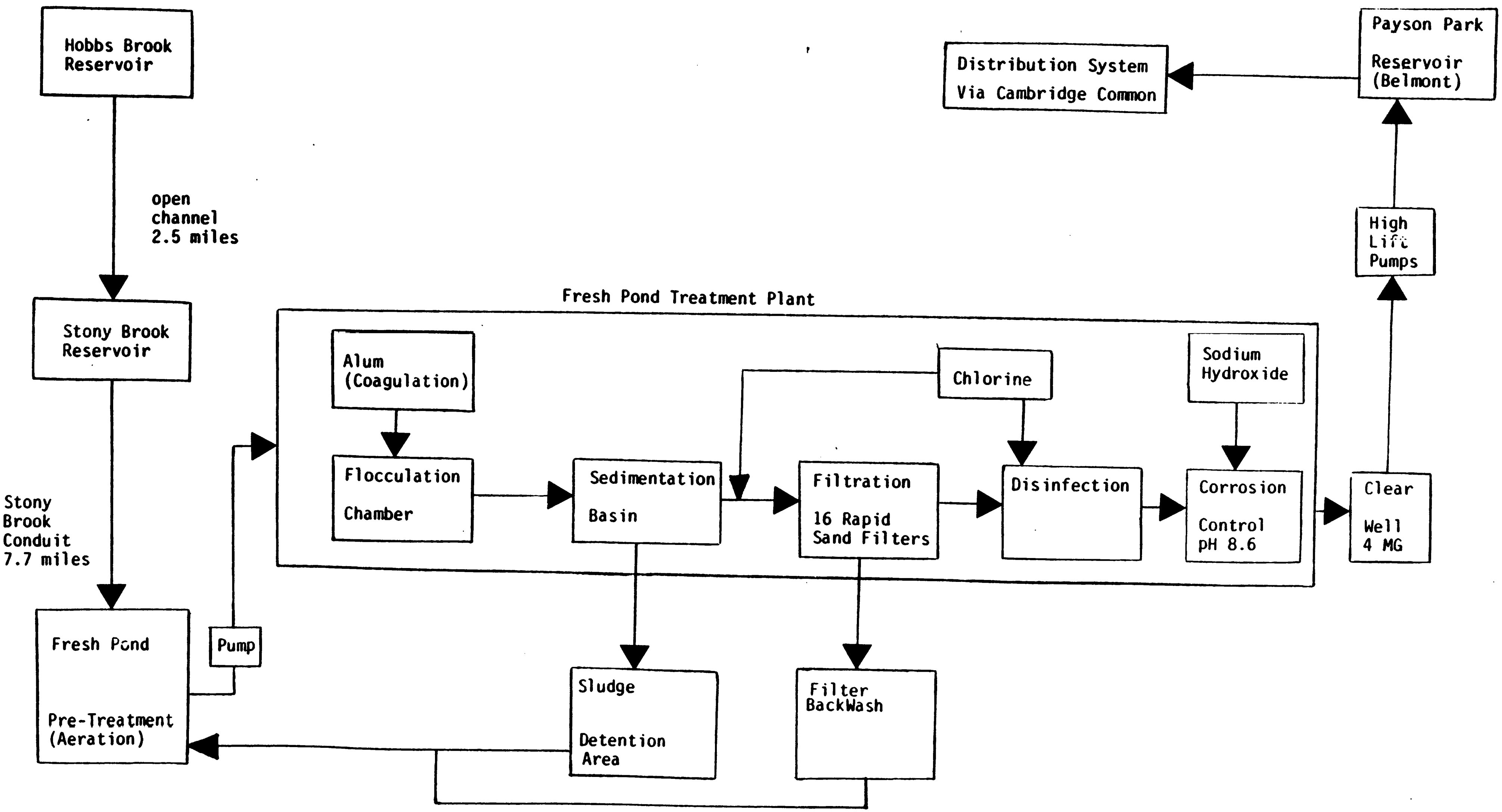


Table 2-17

Cambridge Water Works Reservoirs	Capacity (million gallons)	Water Area (acres)	Watershed Area (acres)	Elevation (feet)
Hobbs Brook	2,296	558	4,480	180
Stony Brook	339	71	10,880	80
Fresh Pond	1,308	166	640	17
Total	3,943	795	16,000	---

Stony Brook Reservoir, developed in 1887, has a capacity of 339 milliongallons (mg) at the crest of the dam. The dam impounds the Stony brook just above its confluence with the main stem of the Charles River, capturing the flow from virtually the entire 17 square mile Stony Brook watershed, in addition to the 7 square mile Hobbs Brook Watershed. The crest of the dam is at an elevation of 80.35 feet, and the lowest level from which water can be withdrawn is 61 feet (see Figure 2-11). The reservoir lies within Waltham and Weston, and the drainage area also includes portions of Lincoln and Lexington.

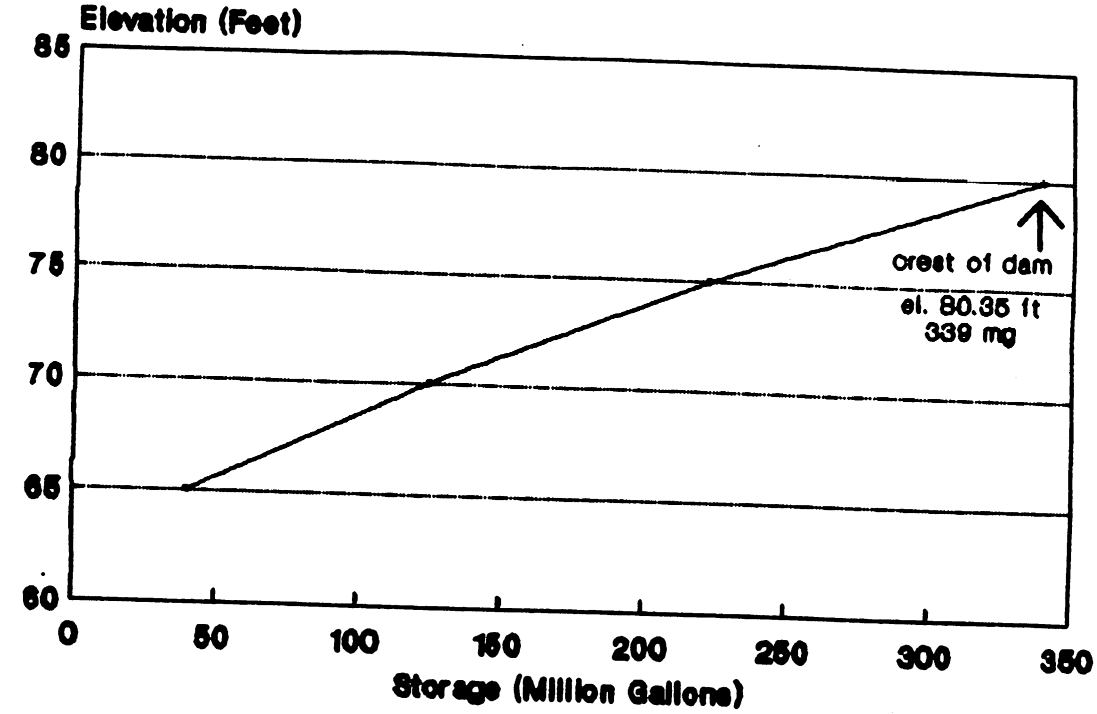
The Hobbs Brook Reservoir, built in 1897, is impounded by two dams, forming an upper and lower reservoir. The dams are located at Trapello Road and Winter Street, impounding the Hobbs Brook, a tributary of Stony Brook. The reservoir's spillway elevation is 180.7 feet, corresponding to a storage capacity of 2296 mg. Water may be withdrawn down to an elevation of 160 feet. The reservoir and its 7 square mile watershed are located in Waltham, Lincoln, and Lexington.

2.7.2 Sources of Supply and System Operation

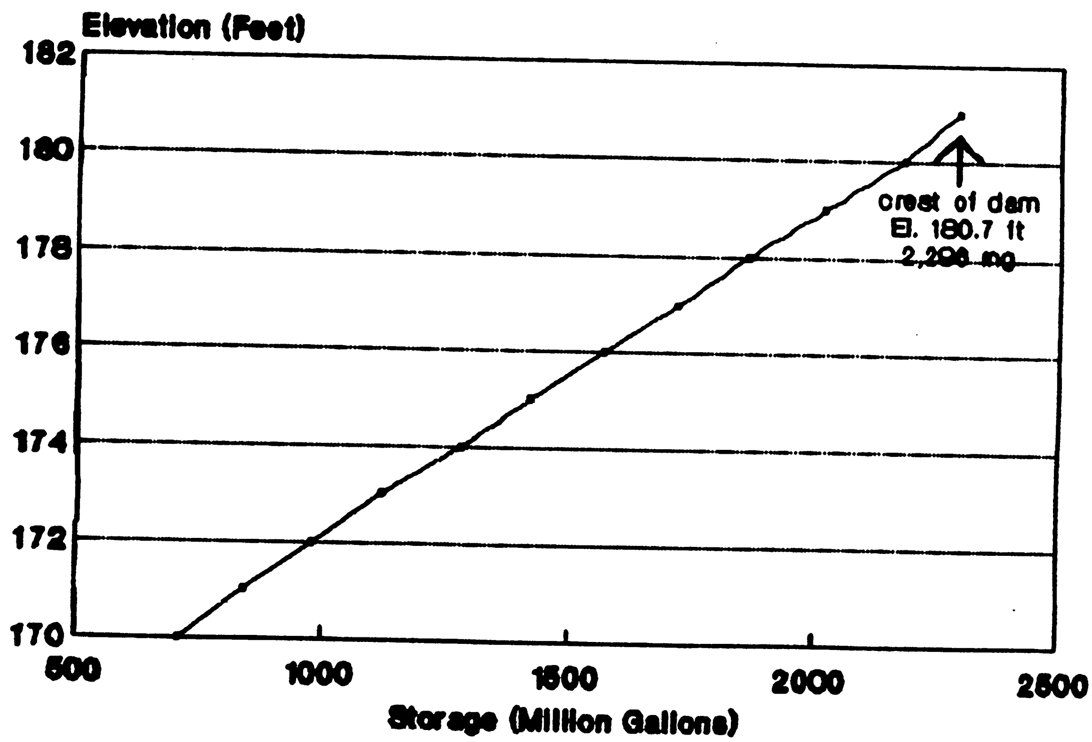
Overall system operation is outlined in Figure 2-10. Water impounded in Hobbs Brook Reservoir flows for 2.5 miles in a stream channel to Stony Brook Reservoir. The water in Stony Brook Reservoir is transported 7.75 miles in an underground gravity-flow conduit to Fresh Pond. Water arriving at Fresh Pond can either be taken directly into the Water Treatment Plant, or stored in Fresh Pond. Current practice is to divert the Stony Brook/Hobbs Brook water into Fresh Pond, where its quality is improved due to aeration, detention time, and dilution. Water from Fresh Pond is pumped by low-lift pumps into the Water Treatment Plant located on the shore of the pond. Treated water flows to a four million gallon concrete underground clear well next to the treatment plant. From the clear well, high lift pumps convey the treated water through a 40-inch steel force main to Payson Park Reservoir, a 35 million gallon distribution reservoir in Belmont.

Figure 2-11

Reservoir Elevation vs. Storage



Stony Brook Reservoir



Hobbs Brook Reservoir

At an elevation of 178 feet, Payson Park provides pressure throughout the distribution system. From Payson Park, water flows by gravity through a 40-inch transmission main to the center of the distribution system at Cambridge Common. From this point, 175 miles of piping radiates outward to convey water to all sections of the city. Pressures in the distribution system vary between 45 to 60 pounds per square inch.

2.7.3 MWRA Connection

In addition to its local sources of water, the Cambridge Water Works can draw upon the supplies of the Massachusetts Water Resources Authority (MWRA). In 1952 the city reached an agreement with the Metropolitan District Commission (MDC) to purchase MDC water while continuing to operate the Cambridge Water Works. The MWRA water system ties into the Cambridge distribution system in three places: Norfolk Street in East Cambridge, Cambridge Common, and Porter Square.

Cambridge uses the MWRA as a backup supply to meet peak demands or provide water during short term emergencies or droughts. There is no contractual limit on the amount of water the city may withdraw from MWRA. The amount of water supplied by MWRA since 1960 is shown on Figure 2-12. Purchases of MWRA water have varied widely over the period, with the greatest amount during the drought of the 1960's. For three years during the drought, Cambridge purchased more than one billion gallons per year, with a peak of 3.2 billion gallons (or 8.8 mgd) in 1966. Since 1970, MWRA purchases have ranged between zero and 416 million gallons, and averaged 188 million gallons per year, or 0.5 million gallons per day. The experience of the 1960's drought underscores the degree to which Cambridge relies upon the MWRA if for any reason its own system cannot meet the demand for water.

2.7.4 Supply and Demand

Prior to the drought of the 1960's, the safe yield of the Cambridge Water Works was estimated to be 17 million gallons per day (mgd). As a result of that drought, which was the drought of record in New England, the safe yield estimate was revised downward to 13 mgd, a reduction of nearly 25 percent. This is the amount of water which the system should be able to reliably yield during drought conditions similar to the 1960's. In years with average or above average precipitation, the system may yield more. The total pumping capacity of the system is 30 mgd.

Historically, average day demand on the Cambridge Water system grew from about 4 mgd in the 1880's to a peak of 22 mgd in the 1960's (see Figure 2-13). Since the 1960's, demand has leveled off and declined to approximately 17 mgd (see Table 2-18).

A critical parameter of water system operation is maximum day demand. This is a measure of peak demand on the system: the highest demand in a 24 hour period. In New England, water demand typically fluctuates with the seasons, reaching its peak in the summer. In recent years, the maximum day demand of the Cambridge system has been

Figure 2-12

Total Annual Water Supplied by MWRA

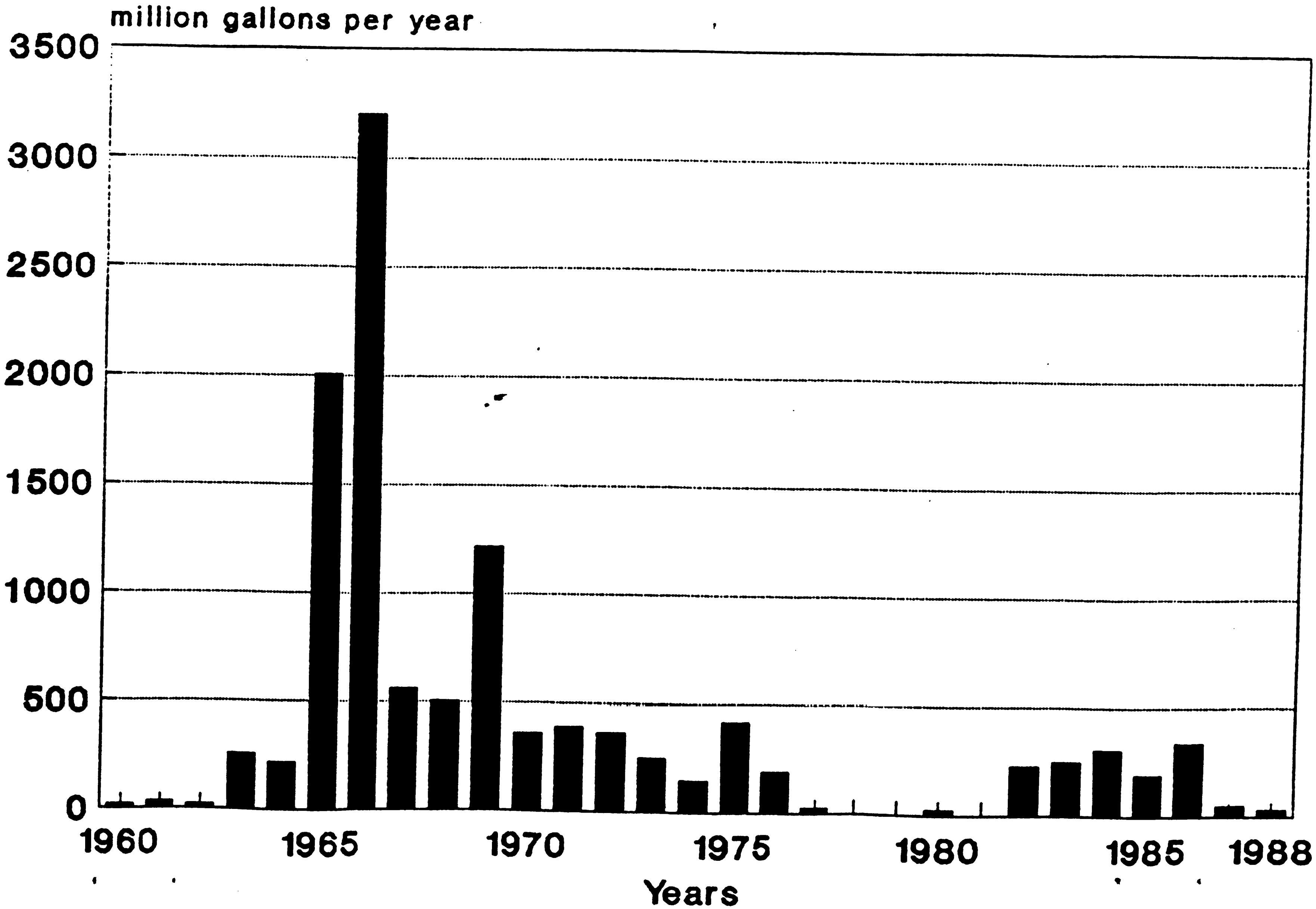
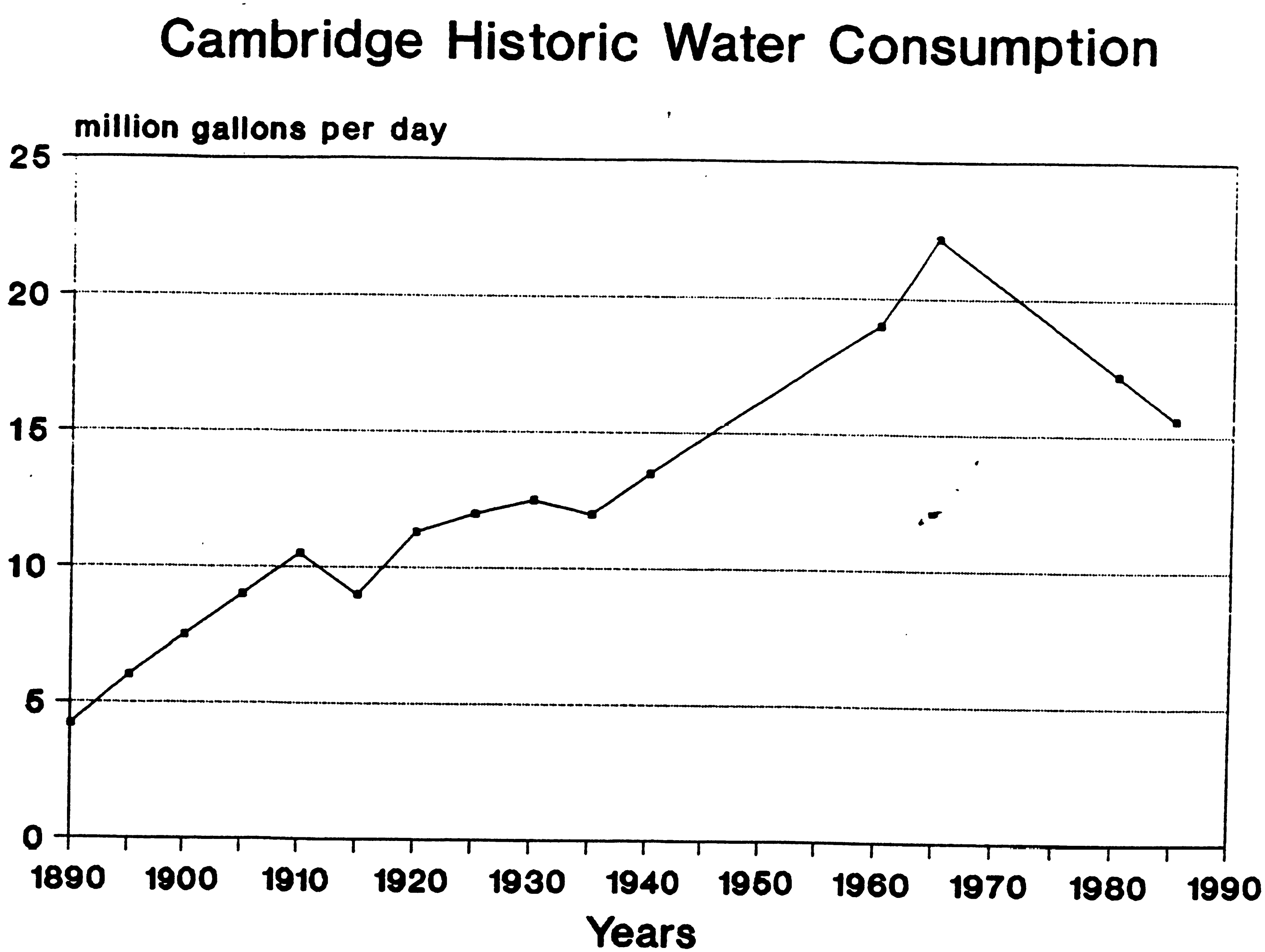


Figure 2-13


Cambridge Historic Water Consumption
million gallons per day
25
20
15
10
5
0
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
Years

approximately 23 mgd (see Figure 2-14). The ratio of maximum day to average day demand is about 1.4, which indicates a relatively moderate level of peak demand in relation to average demand.

Projections of future water demand have been estimated by the Department of Environmental Management (DEM) (see Table 2-18). The DEM projections estimate that average day demand will approach 20 mgd by the year 2020, and maximum day demand will exceed 27 mgd. This maximum day estimate represents more than double the system safe yield.

Table 2-18

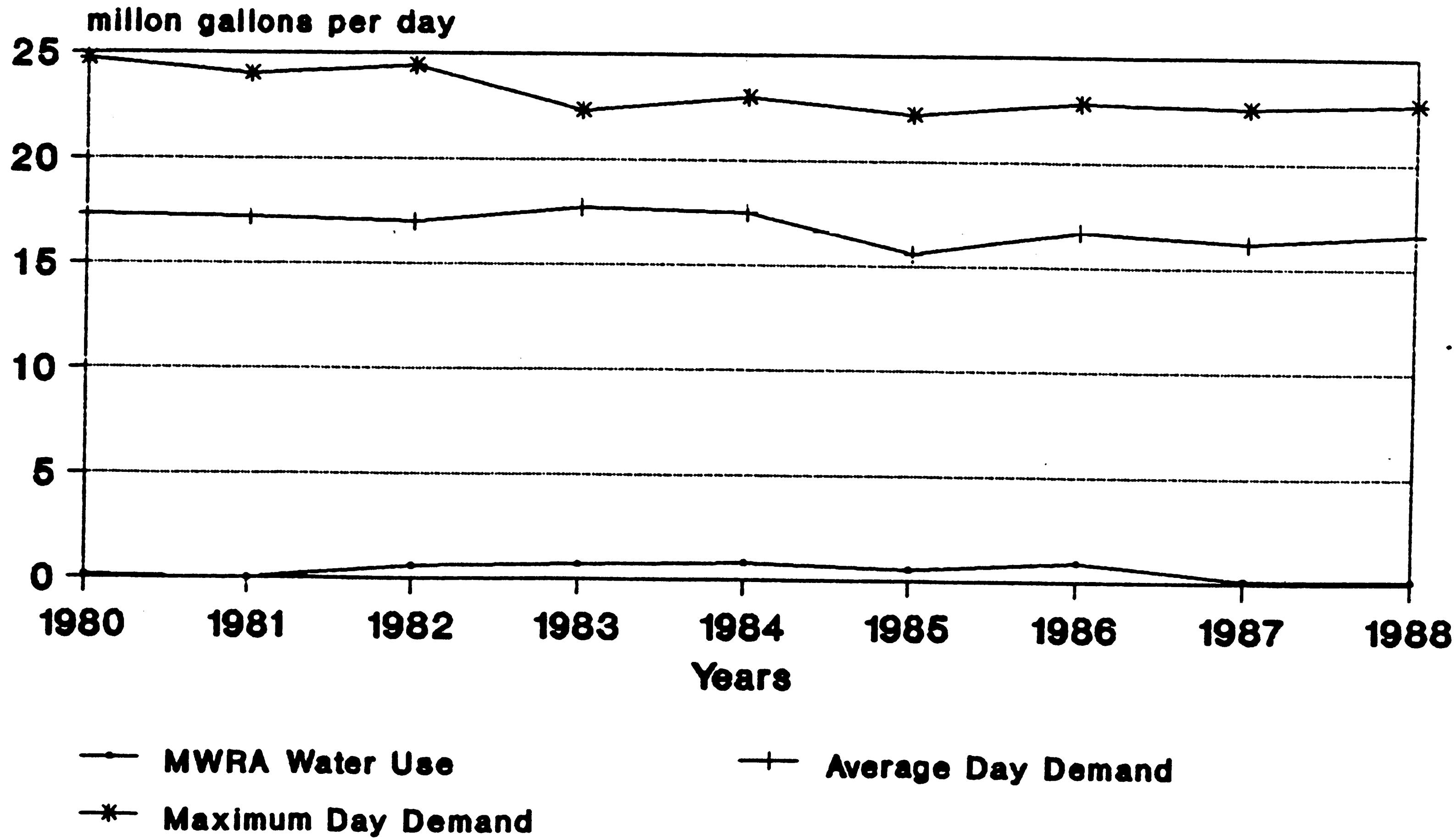
Recent and Projected Future Water Demand

	Average Day (mgd)	Maximum Day (mgd)	Percent from Stony Brook Watershed
1980	17.25	24.69	99.6
1981	17.20	24.00	100
1982	17.01	24.43	98.2
1983	17.69	22.33	96.1
1984	17.53	23.03	95.2
1985	15.59	22.02	96.6
1986	16.7	22.8	94.4
1987	16.2	22.6	99.2
1988	16.6	22.8	99.5
1995	16.92	23.09	----
2000	17.22	23.50	----
2010	17.96	24.51	----
2020	18.87	25.56	----

Source: DEM, Charles River Basin Report, Updated Demand Projections, 1989

Figure 2-14

Cambridge Average Day & Maximum Day Demand, 1980-88



2.7.5 Drinking Water Quality

The quality of drinking water is governed by the Safe Drinking Water Act (SDWA), enacted in 1974 and amended in 1986. Pursuant to this federal legislation, Massachusetts has adopted drinking water regulations which establish maximum contaminant levels and monitoring requirements for a variety of water quality parameters, including microbiological contaminants, organic and inorganic chemicals, and radionuclides (310 CMR 22, see Table 2-19). The Cambridge Water System currently meets all drinking water standards except for sodium and trihalomethanes, as shown in Table 2-20. Between 1972 and 1985, sodium levels in Hobbs Brook Reservoir have averaged 42 milligrams per liter (mgl), well above natural background levels of 5 mgl, and exceeding the drinking water standard of 20 mgl by a factor of two (see Figure 2-15). A 1985 study conducted by Geotechnical Engineers concluded that road salt application on Routes 128, 2, and 2A contributes about 72 percent of the sodium input to Hobbs Brook Reservoir, while municipal road salting in Lexington, Lincoln, and Waltham account for about 13 percent, leaching from the Massachusetts DPW salt depot contributes 8 percent, and the remaining 7 percent is from commercial and residential use. Since the 1986-87 winter season, the Massachusetts DPW has been conducting a reduced salt application program on Routes 128, 2, 2A, and 20 in the Hobbs Brook and Stony Brook Reservoir Watersheds (see Technical Memo #3). The program resulted in a 61 percent reduction in the amount of sodium chloride applied to state-maintained roadways in the watershed in the winter of 1986-87. However, the Geotechnical Engineers sodium chloride study estimated that it would take the Hobbs Brook Reservoir 15 years to reach a sodium level of 9 mgl if sodium chloride application was completely eliminated from the watershed.

Trihalomethanes (THM) are another current water quality concern in the Cambridge Water System. THM's are a group of organic chemicals which can occur in chlorinated water supplies as a result of the interaction of the chlorine disinfectant with certain naturally occurring organic compounds frequently found in surface water supplies. In the Cambridge water system, chloroform and three other THM's have been found in the treated water in Payson Park reservoir. The 1987 and 1988 test results showed total THM's to be 122 and 134 parts per billion (ppb), which exceeds the drinking water standard of 100 ppb.

The 1986 amendments to the Safe Drinking Water Act require the Environmental Protection Agency to establish drinking water standards for 83 additional contaminants by June of 1989. Under the amendments, EPA has promulgated standards for eight volatile organic compounds which took effect on December 31, 1988 (see Table 2-21). Water quality analysis conducted in 1988 found none of the eight VOC's present in Cambridge drinking water. The 1988 analysis also tested quarterly for 51 other VOC's. None of the chemicals were found within the detection limit of the testing procedure.

Table 2-20 Cambridge Drinking Water Quality (1987)

	Hobbs	Payson	Payson	Stony Brook	Fresh Pond
Aluminum	<0.08	0.120	0.113	<0.08	0.131
Antimony	<0.004	<0.004	<0.004	<0.004	<0.004
Arsenic	<0.003	<0.003	<0.003	<0.003	<0.003
Barium	0.031	0,022	0.022	0.023	0.020
Beryllium	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	<0.02	<0.02	0.020	<0.02	<0.02
Copper	0.027	0.041	0.027	<0.02	<0.02
Lead	<0.005	<0.005	<0.005	<0.005	<0.005
Mercury	<0.0002	<0.0002	----	<0.0002	<0.0002
Nickel	0.214	0.181	0.352	0.038	0.984
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002
Silver	<0.02	<0.02	<0.02	<0.02	<0.02
Sodium	59.2	47.1	47.6	51.0	38.5
Thallium	<0.005	<0.005	<0.005	<0.005	<0.005
Vanadium	<0.04	<0.04	<0.04	<0.04	<0.04
Zinc	0.021	0.024	0.012	0.011	0.030
Molybdenum	<0.03	<0.03	<0.03	<0.03	<0.03

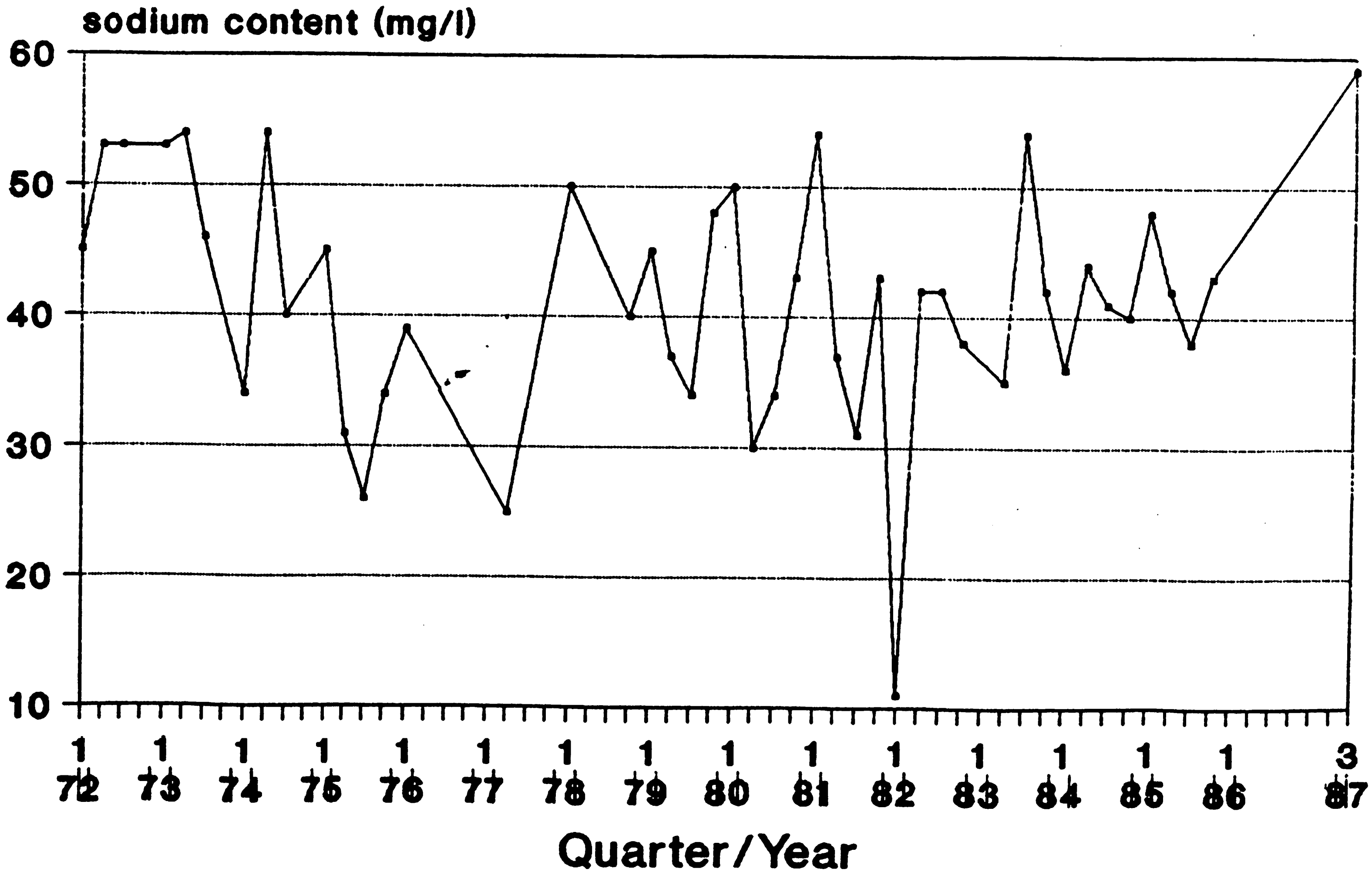
Table 2-21 New SDWA Standards for VOC's

VOC's	Maximum Contaminant Level (mg/l)	Maximum Contaminant Level Goal (mg/l)
Benzene	0.005	0.0
Vinyl Chloride	0.002	0.0
Carbon Tetrachloride	0.005	0.0
1,2 Dichloroethane	0.005	0.0
Trichloroethylene	0.005	0.0
p-Dichlorobenzene	0.075	0.075
1,1 Dichloroethylene	0.007	0.007
1,1,1 Trichloroethane	0.200	0.200

Figure 2-15

Sodium Content in Hobbs Brook Reservoir

Measured Quarterly



Other aspects of the SDWA amendments include:

- o a surface water treatment rule which sets standards for Giardia, Legionella, enteric viruses, heterotrophic bacteria, and turbidity

- o a corrosion control rule designed to reduce the levels of lead and copper contamination caused by acidic water reacting with plumbing

- o upgraded standards for filtration and disinfection

- o increased monitoring requirements

Table 2-19 Primary Drinking Water Standards for Inorganic and Organic Chemicals, and Bacteria

CONTAMINANT	MONITORING FREQUENCY	MAXIMUM CONTAMINANT LEVEL (MGL)
Arsenic	Annual	0.05
Barium	Annual	1.0
Cadmium	Annual	0.01
Chromium	Annual	0.05
Lead	Annual	0.05
Mercury	Annual	0.002
Selenium	Annual	0.01
Silver	Annual	0.05
Fluoride	Annual	1.4 to 2.4*
Nitrate	Annual	10.0
Sodium	Annual; quarterly, if >15 mgl	20.0
Endrin	Annual	0.0002
Lindane	Annual	0.004
Methoxychlor	Annual	0.1
Toxaphene	Annual	0.005
2,4-D	Annual	0.1
2,4,5-TP Silvex	Annual	0.01
Trihalomethanes	Annual	0.1
Turbidity	Daily	1 Turbidity Unit
Coliform bacteria	3 per week	one per 100 ml as the mean of all samples taken in a month; or four per 100 ml in more than 5% of the samples in a month

The Water Department operates a laboratory at Fresh Pond which performs testing and analysis for coliform bacteria, turbidity, manganese, chlorine, alkalinity, color, pH, conductivity, and flouride. Analysis for volatile organic compounds is done by a private laboratory certified by the state.

2.7.6 Water Treatment

The Cambridge Water Department treats all water drawn from the Stony Brook watershed at the Fresh Pond Water Treatment Plant. The treatment process is depicted in Figure 2-10, and is described below:

o Pre-treatment in Fresh Pond: water from the Stony Brook conduit flows into Fresh Pond, where it is stored before being drawn into the water treatment plant. Water in Fresh Pond is aerated by a system that pumps diffused air through perferated air hoses installed at the bottom of the reservoir. This process serves to increase dissolved oxygen and destratify the reservoir, thus eliminating problems with soluble manganese which can discolor the water in the distribution system. The Stony Brook water also benefits from increased residence time in Fresh Pond.

o Coagulation and Flocculation: water entering the treatment plant is treated with liquid alum, which is a coagulant. The alum binds to suspended solids in the water, causing them to form clusters. The water is then agitated in the flocculation chamber, causing the clusters of solids to coalesce and become large enough to settle out in the subsequent sedimentation process.

o Sedimentation: the water leaving the flocculation chamber flows into sedimentation basins, allowing the settleable solids to sink to the bottom of the basin. The accumulated solids form a sludge which is periodically pumped from the bottom of the sedimentation basins and discharged to a detention area.

o Pre-chlorination: before filtration, chlorine is added to control the growth of algae and bacteria, and remove metals.

o Filtration: the water passes through 16 rapid sand filters, which remove fine suspended solids. Each filter can handle 1.6 million gallons per day, for a total plant capacity of 25.6 mgd.

o Disinfection: after filtration, chlorine is added to the water to destroy bacteria and other pathogenic organisms. The amount of chlorine added is enough to insure a residual chlorine level of 0.3 mgl at the Payson Park reservoir.

o Corrosion control: Caustic soda (NaOH) is added to the water in order to raise the pH to 8.6, which controls corrosion in the distribution mains and service connections, reducing leaching from lead pipes.

Fluoridation: Fluoride is added to the finished water at at rate of 1 ppm in order provide protection against tooth decay.

After treatment, the water is stored in a four million gallon underground concrete clear well located next to the treatment plant. From there, it is conveyed by the high lift pumps to the Payson Park storage/distribution reservoir in Belmont. From there it flows by gravity into the distribution system.

2.8 Other Municipal Water Supplies in the Watershed

The preceding section described the Cambridge water system, which withdraws nearly all of its water from the Stony Brook watershed. This section provides a brief overview of the water supply systems of the four communities within the watershed area.

2.8.1 Lincoln

The town of Lincoln has a municipal water system which draws almost half of its supplies from surface and groundwater sources in the Stony Brook watershed, and the balance from the Concord River basin. The system serves about 5384 people, or 90 percent of the population of the town. Sources within the Stony Brook watershed include the Tower Road well and Sandy Pond, shown on Figure 2-16 and Table 2-22 below.

Table 2-22 Lincoln Water Supplies in Stony Brook Watershed

SOURCE	PUMP CAPACITY (MGD)	1985 AVERAGE DAY PUMPING (MGD)
Flint's Pond	1.62	0.07
Tower Road Well	0.72	0.11

In addition to these sources, Lincoln operates the Farrar Pond well in the Concord River basin. This well provided about 55 percent of the town's water in 1985. There are also about 1500 people in Lincoln who draw water from private residential wells.

Average day demand on the Lincoln water system is about 0.44 mgd, and peak day demand fluctuated between 0.58 mgd and 1.17 mgd between 1980 and 1985, averaging 0.84 mgd over the six year period.

2.8.2 Weston

The town of Weston currently withdraws its water supplies from the Massachusetts Water Resources Authority. Prior to 1972, the town was fully supplied by a local wellfield in the Charles River basin, but outside of the Stony Brook watershed. The groundwater was contaminated with sodium chloride from a Massachusetts Turnpike Authority road salt stockpile, and the wells were permanently closed, forcing the town to turn the the MDC for water. However, in recent years the town has been conducting hydrogeologic investigations to locate a new well site. Several potential sites have been identified by field reconnaissance, and one of them is in the Kendall Green section of the Stony Brook watershed (see Figure 2-16). The town plans to do follow up studies to determine the feasibility of siting a well in this area.

The Weston water system serves about 9,700 people, 90 percent of the town's population. The average day demand from 1980 to 1985 averaged 1.12 mgd, while the maximum day demand over the same period averaged 2.8 mgd.

2.8.3 Waltham and Lexington

Both Waltham and Lexington receive their water supplies from the MWRA. Lexington joined the Metropolitan Water District in 1903, and Waltham in 1949. There are no known viable local sources of potable water within either community.

Waltham's average day water demand over the period 1980 to 1985 was 10.5 mgd, and the maximum day demand averaged 15.9 mgd. The city's water system serves about 58,000 people, or 100 percent of the population.

Lexington's water system serves the entire town population, about 29,500 people. Average day demand is approximately 3.7 mgd, and maximum day demand 6.5 mgd.

2.8.4 Regional Water Supply Issues

Although this study focuses on the Cambridge water supply system, this subject should be approached with an understanding of the regional context of water supply planning in eastern Massachusetts, and particularly the MWRA water system. The MWRA supplies water to about 2 million people in 35 cities and towns in eastern Massachusetts. For several years the MWRA water system has been withdrawing water from its principal sources--Quabbin and Wachusett Reservoirs--at a rate which exceeds the estimated safe yield of those sources. With the recent period of below average precipitation and runoff, this situation has been exacerbated, resulting in a system-wide emergency declaration in February of 1989. The MWRA has undertaken a variety of short and long term programs to bring about a balance between supply and demand on the system. One of these programs is designed to assist communities which are partially supplied by non-MWRA sources to maintain and protect those local water sources in order to prevent increased reliance on the MWRA system by those communities. The Cambridge water system is the largest such local water system operated by a community which has rights to use MWRA water. The Cambridge system supplies about 17 mgd in an average year, representing five percent of the safe yield of the MWRA system. Considered in this context, the Cambridge water system is a resource of regional as well as local significance.

CHAPTER THREE Land Use, Potential Sources of Contamination, and Zoning

3.0 Introduction

This chapter describes the land use in the watershed and identifies a host of existing activities which could be potential sources of contamination if not properly managed. In later chapters, existing management techniques and regulatory controls over these potentially polluting activities will be evaluated, and a recommeded watershed protection plan will be presented.

The experience of other Massachusetts communities demonstrates that the threat of water supply contamination is very real. Statewide, over 40 communities have lost water supplies to chemical or bacterial contamination, representing over 47 million gallons per day in capacity. Of those supplies contaminated, only about 25 percent have been restored to use through treatment or remediation. The most common type of contaminants are volatile organic compounds (VOC's), which are responsible for about 75 percent of the contamination cases in the Boston metropolitan area. VOC's are followed by petroleum products and road salt as sources of contamination in the MAPC region. Nearly every contamination incident documented has been caused by an inappropriate or high risk land use in relative proximity to a water supply source. This study is designed to inventory and evaluate the existing and potential future land use in the Hobbs Brook and Stony Brook Reservoir watersheds, focusing particularly on land uses and activities which may pose a potential threat of contamination or water quality degradation of the water supply resource.

The maps which accompany this study are printed at a scale of 1:25,000 on separate oversized sheets. Reductions of these maps are included in Volume 2 of this report. The three maps which accompany this chapter depict the location of land uses, protected open space, potential sources of contamination, and zoning districts in the watershed.

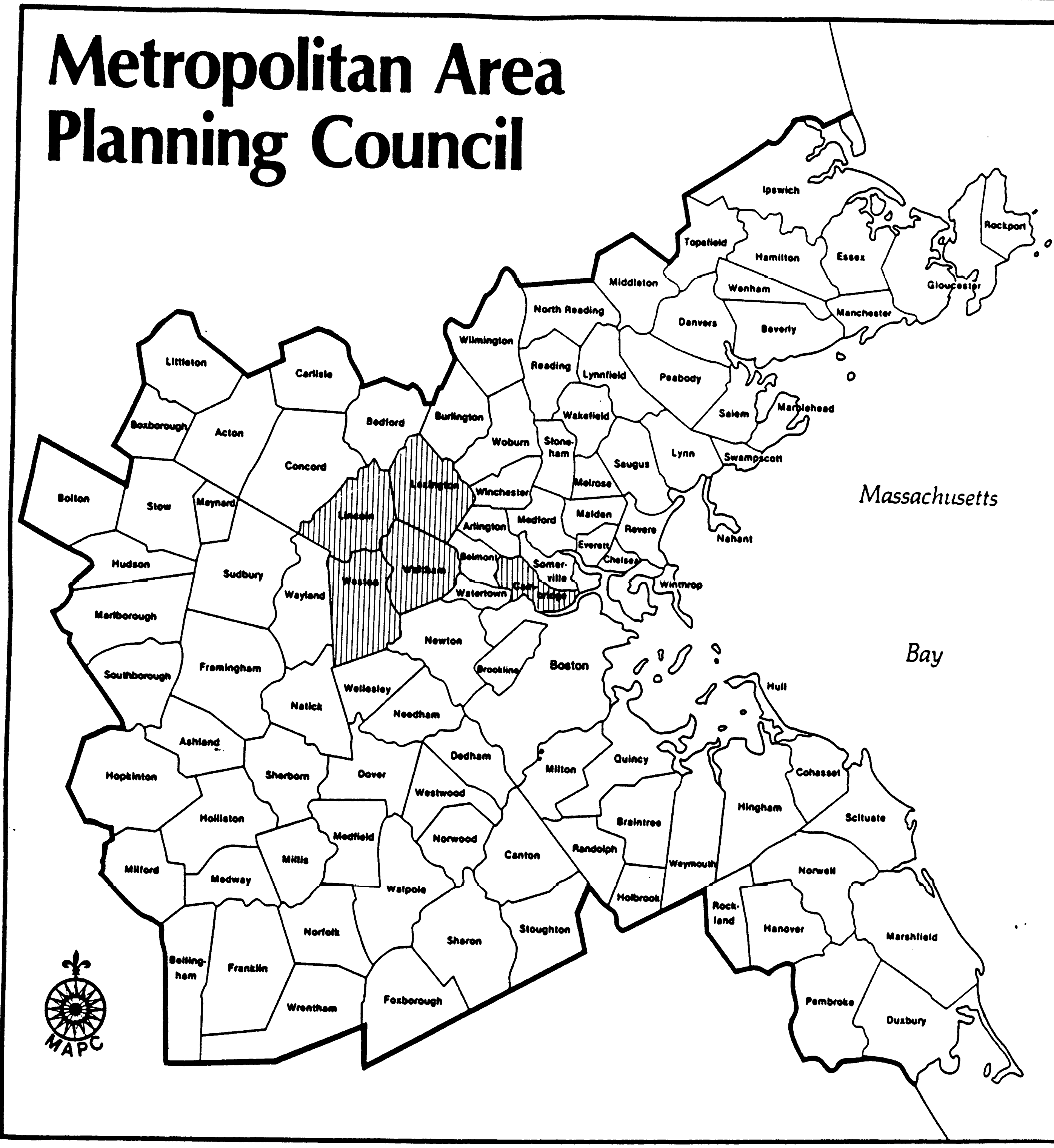
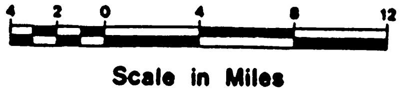


Figure 3-1
Regional Location Map



3.1 LAND USE

This chapter describes the uses of land in the four Cambridge Reservoir Watershed communities and examines the potential impacts of land use on the quality and quantity of this Cambridge Water supply source. After a brief review of the recent growth and development trends of the area, water supply impacts will be addressed in terms of the potential sources of contamination associated with land use.

HISTORIC DEVELOPMENT TRENDS

This section reviews the last three decades of growth and development in each of the communities. This perspective aids in understanding the existing land uses, as it provides information on land development trends that today may affect the water supply sources.

3.1.1 POPULATION TRENDS

The total population in the Cambridge Reservoir Watershed communities grew 1.4 times between 1950 and 1985. The highest rate of growth occurred between 1950 and 1970. Populations in the 1970's and 1980's have decreased slightly for the region (see Table 3-1). A summary of population trends for each of the communities in the study area follows.*

Table 3-1
Cambridge Reservoir Watershed Communities
Population Data, 1950 - 1985 *

Year	Population *	Population density per square mile **	% Change
1950	72,375	1,150	
1960	96,978	1,541	34%
1970	111,905	1,778	15%
1980	105,946	1,684	-5%
1985	104,824	1,666	-1%

Lexington

Table 3-2 summarizes the population and population density of Lexington between 1950 and 1985. The data show that the 1985 population is 1.6 times what it was in 1950. The highest rate of growth occurred before 1960. Moderate growth occurred in the 1960's. Since then, the population has decreased and stabilized.

*Population figures in this report are based on the U.S. Census. The figures may vary from local municipal cesus based on different methods.

**Based ib 62.9 square miles in the four communities.

Table 3-2
Lexington Population Data, 1950 - 1985

Year	Population	Population density per square mile	% Change
1950	17,735	1,035	
1960	27,691	1,616	56%
1970	31,886	1,860	15%
1980	29,479	1,720	-7%
1985	29,224	1,705	-1%

Lincoln

Between 1950 and 1985, the population in Lincoln grew 2.8 times. The highest rate of growth occurred before 1970. The population has decreased slightly since that time (see Table 3-3).

Table 3-3
Lincoln Population Data, 1950 - 1985

Year	Population	Population density per square mile	% Change
1950	2,427	163	
1960	5,613	376	31%
1970	7,567	508	35%
1980	7,098	476	-6%
1985	6,902	463	-3%

Waltham

Between 1950 and 1985, Waltham's population increased 1.2 times. The highest growth rates occurred between 1950 and 1970. Since 1970, population has decreased slightly (see Table 3-4).

Table 3-4
Waltham Population Data, 1950 - 1985

Year	Population	Population density per square mile	% Change
1950	47,187	3,427	
1960	55,413	4,024	17%
1970	61,582	4,[illegible]	11%
1980	58,200	4,[illegible]	-5%
1985	57,955	4,209	-1%

Weston

Weston's population increased 2.1 times between 1950 and 1985. The highest growth rates occurred in the 1950's and 1960's. Population stabilized in the 1970's and has decreased slightly in the 1980's (see Table 3-5).

Table 3-5
Weston Population Data, 1950 - 1985

Year	Population	Population density per square mile	% Change
1950	5,026	294	
1960	8,261	483	64%
1970	10,870	635	32%
1980	11,169	653	3%
1985	10,743	628	-4%

3.1.2 LAND USE TRENDS

The historic population growth in these communities is reflected in the changing land uses over the last 35 years. The following data on historic land use was taken from a study by William MacConnell of the University of Massachusetts, who has classified and mapped land uses by interpretation of aerial photography. The minimum parcel size mapped in the land use study was one acre. The following tables and figures show the breakdown of land uses for 1951 and 1985 for each of the Cambridge Reservoir watershed communities. This is a significant period for land use change, since it shows the changes since the construction of Route 128.

Table 3-6
Watershed Community Land Use Change, 1951-85
Lexington, Lincoln, Waltham, Weston

Land Use	1951 (acres)	1985* (acres)	Change (acres)	Percent Change
Residential	9,212	14,991	5,779	63%
Industrial	151	893	742	491%
Commercial	126	890	764	606%
Transportation	29	915	886	3,155%
Mining	**	116	**	**
Waste Disposal	**	42	**	**
Recreation	**	888	**	**
Total developed land	9,518	18,735	9,217	97%
Forest	17,373	13,207	-4,166	-24%
Wetlands	1,808	2,102	294	16%
Water	1,182	1,385	203	17%
Agriculture	8,088	1,857	-6,231	-77%
Open & Public	2,304	2,987	683	30%
Total undeveloped land	30,755	21,538	-9,217	-30%
TOTAL	40,273	40,273		

*Land Use data for Lincoln is based on 1980 mapping
**Category not mapped in 1951

Watershed Summary

The historic land use data for the watershed shows that between 1951 and 1985, "developed" land uses nearly doubled, while undeveloped uses decreased by 9217 acres, or 30 percent. The largest gain was made by residential land use, which increased by 5779 acres. Significant increases were also made to industrial and commercial land, each of which gained about 750 acres, representing five- to six- fold increases. Transportation, most of which represents the Route 128 and Route 2 corridors, increased by 886 acres, a 3,155 percent gain.

Land uses which lost acreage include agriculture, which decreased by 6231 acres, or 77 percent, and forest, which lost 4166 acres, or 24 percent.

Figure 3-2

Community Land Use Change
Lexington, Lincoln, Waltham, Weston

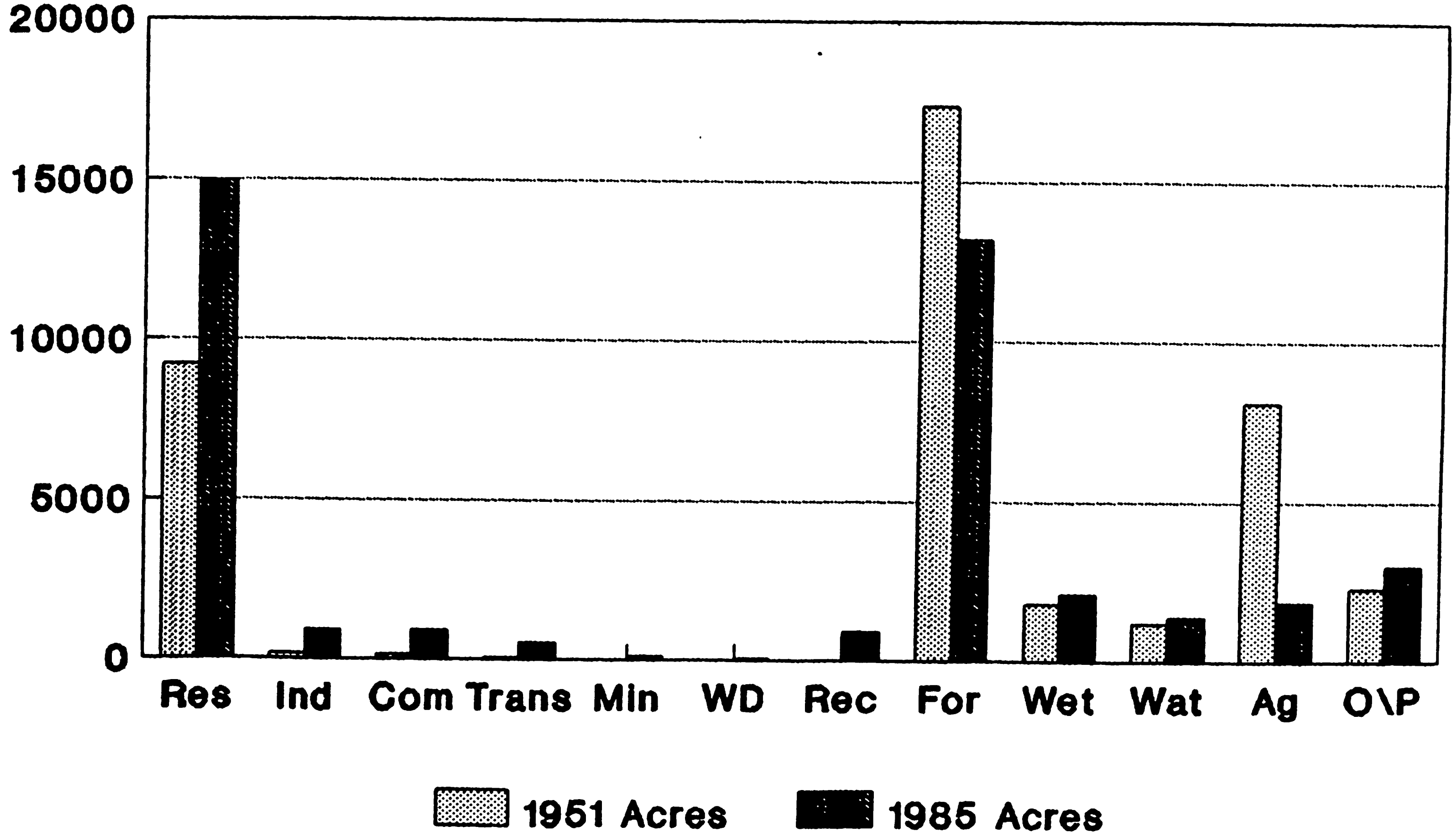


Table 3-7
Lexington Land Use Change, 1951-1985

Land Use	1951 (acres)	1985 (acres)	Change (acres)	Percent Change
Residential	3,258	5,226	1,968	60%
Industrial	0	191	191	100%
Commercial	0	194	194	100%
Transportation	0	368	368	100%
Mining*	--	10	--	--
Waste Disposal*	--	40	--	--
Recreation*	--	267	--	--
Total developed land	3,258	6,296	3,038	93%
Forest	3,468	2,604	-864	-25%
Wetlands	385	643	258	67%
Water	93	105	12	13%
Agriculture	2,451	392	-2,059	-84%
Open & Public	1,317	932	-385	-29%
Total undeveloped land	7,714	4,676	-3,038	-39%
TOTAL	10,972	10,972		

*Mining, Waste Disposal and Recreation were not included in the 1951 survey.

Lexington

Between 1951 and 1985, "developed" land use in Lexington almost doubled from 3,258 acres to 6,296 acres. The single greatest acreage increase was 1,968 acres of Residential land, representing a 60% growth rate. Industrial, commercial and Transportation land uses all increased 100% as none existed in 1951. "Undeveloped" land uses dropped 3,038 acres or 39%. Agricultural land experienced the greatest loss of 2,059 acres. This also represents the greatest percentage loss of 84%.

Table-3-8

Lincoln Land Use Change, 1951-1980

Land Use	1951 (acres)	1980 (acres)	Change (acres)	Percent Change
Residential	374	2,185	1,811	480%
Industrial	0	0	0	0
Commercial	0	15	15	100%
Transportation	0	30	30	100%
Mining*	-	5	-	-
Waste Disposal*	-	0	-	-
Recreation*	-	45	-	-
Total developed land	374	2,280	1,906	510%
Forest	5,414	4,570	-844	-16%
Wetlands	833	757	- 76	- 1%
Water	250	418	168	67%
Agriculture	2,427	1,041	-1,386	-57%
Open & Public	246	478	232	94%
Total undeveloped land	9,170	7,264	-1,906	-20%
TOTAL	9,544	9,544		

*Mining, Waste Disposal and Recreation were not included in the 1951 survey.

Lincoln

Between 1951 and 1980, "developed" land use in Lincoln increased five times from 374 acres to 2,280 acres (see Table 3-8). The largest acreage gain was in Residential which increased 1811 acres. The greatest percentage growth was 480%, also in Residential, "Undeveloped" land uses decreased by 1,906 acres or 20%. The greatest decrease in acres was in Agricultural land which also experienced the greatest percentage loss of -57%.

Table 3-
Wal:.am Land Use Char.e, 1951-1985

Land Use	1951 (acres)	1985 (acres)	Change (acres)	Percent Change
Residential	3,490	3,185	- 305	- 9%
Industrial	150	697	547	364%
Commercial	126	653	527	418%
Transportation	29	202	173	600%
Mining*	--	15	--	--
Waste Disposal*	--	0	--	--
Recreation*	--	162	--	--
Total developed land	3,795	4,914	1,119	29%
Forest	2,946	1,835	-1,111	- 38%
Wetlands	43	116	73	170%
Water	605	629	24	4%
Agriculture	1,070	181	- 889	- 83%
Open & Public	350	1,134	784	224%
Total undeveloped land	5,014	3,895	-1,119	- 22%
TOTAL	8,809	8,809		

*Mining, Waste Disposal and Recreation were not included in the 1951 survey.

Waltham

"Developed" land uses in Waltham increased 29% between 1951 and 1985 from 3,795 to 4,914 acres (see Table 3-9). The largest gain in acres was Industrial which increased 547 acres. Transportation land experienced the greatest percentage growth of 600%. "Undeveloped" land uses decreased by 1,119 acres or 22%. The greatest decrease in acres was 1,111 acres of Forest land while the greatest percentage decrease was 83% of Agricultural land.

Table 3-10
Weston Land Use Change, 1951-1985

Land Use	1951 (acres)	1985 (acres)	Change (acres)	Percent Change
Residential	2,090	4,395	2,305	110%
Industrial	1	5	4	400%
Commercial	0	28	28	100%
Transportation	0	315	315	100%
Mining*	--	86	--	--
Waste Disposal*	--	2	--	--
Recreation*	--	414	--	--
Total developed land	2,091	5,245	3,154	151%
Forest	5,545	4,198	-1,347	-24%
Wetlands	547	586	39	7%
Water	234	233	-1	-1%
Agriculture	2,140	243	-1,897	-89%
Open & Public	391	443	52	13%
Total undeveloped land	8,857	5,703	-3,154	-36%
TOTAL	10,948	10,948		

*Mining, Waste Disposal and Recreation were not included in the 1951 survey.

Weston

In Weston, "developed" land uses increased by a factor of two and a half from 2,091 acres in 1951 to 5,245 acres in 1985 (see Table 3-10). The largest gain in any one land use was residential which increased 2,305 acres. Industrial land use showed the greatest percentage increase of 400%, increasing from 1 to 5 acres. "Undeveloped" land uses dropped 3,154 acres, or 36%. Agricultural land had the greatest decrease in acres and percentage wise, 1,897 acres and 89% respectively.

3.1.3 EXISTING WATERSHED LAND USE

Land use in the 15,000 acre watershed area is dominated by two uses: residential (30 percent) and forest (38 percent), which together comprise over two-thirds of the land area. Industrial land totals nearly 500 acres, commercial land 228 acres, and transportation 350 acres. All "developed" land use types combined comprise nearly 6,000 acres, or 38 percent of the watershed. About half of the watershed in Lexington, Waltham and Weston is developed, while 23 percent in Lincoln is developed land.

The majority of the residential land is located in the Weston and Lincoln portion of the watershed, while almost all of the industrial land use and about half of the commercial land use is in Waltham.

In addition to forest, major undeveloped land uses include wetlands (1019 acres), agriculture (903 acres), water (895 acres), and open land (735 acres). About 80 percent of the forest land and 95 percent of the wetlands in the watershed are found in Lincoln and Weston, while 80 percent of the agriculture land is in Lincoln.

Table 3-11 Cambridge Reservoir Watershed Land Use, 1985*

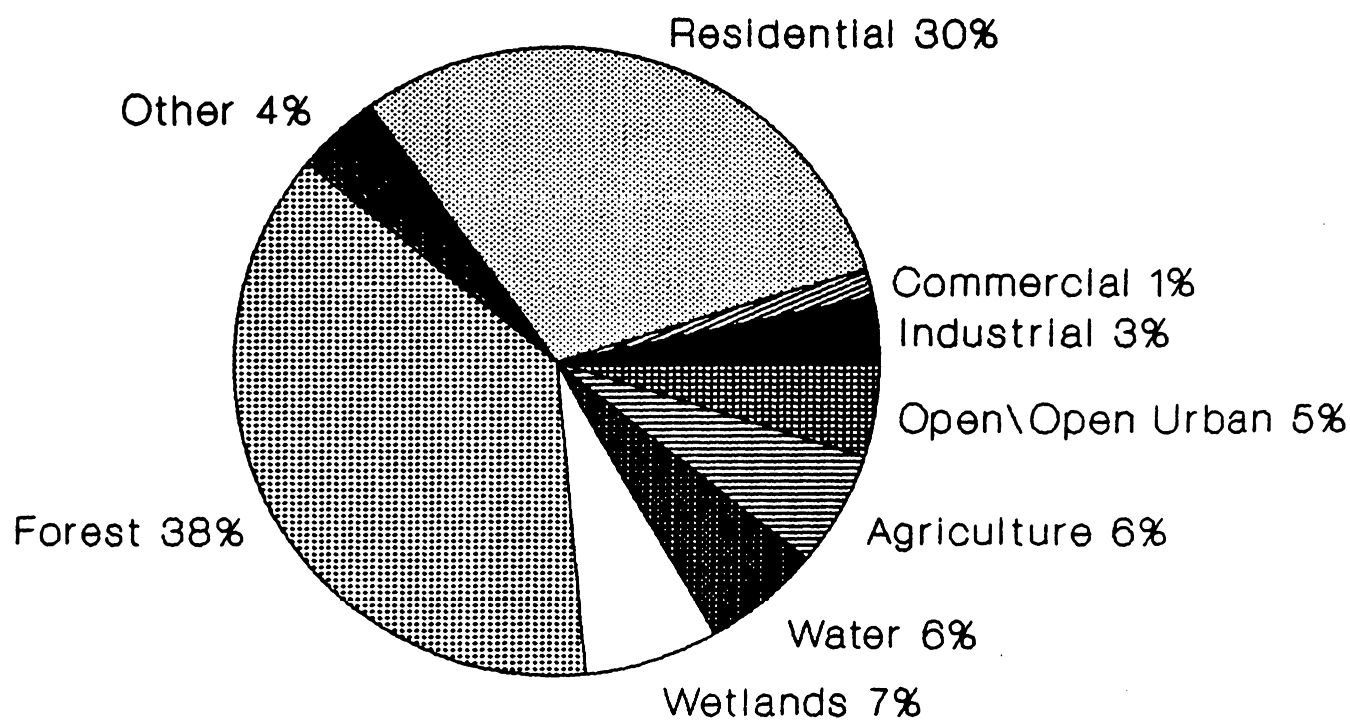
Land Use	Acres	Percent
Residential	4,571	30%
Industrial	499	3%
Commercial	228	1%
Transportation	349	2%
Mining	106	1%
Waste Disposal	3	0%
Recreation	185	1%
Total Developed Land	5,941	38%
Forest	5,708	38%
Wetlands	1,019	7%
Water	895	6%
Agriculture	903	6%
Open	327	2%
Urban Open	418	3%
Total Undeveloped Land	9,270	62%
TOTAL	15,211	100%

*Lincoln Data is from 1980 Land Use Maps.

Figure 3-3

Cambridge Reservoir Watershed Land Use

1985



Other: Transportation, Mining, Waste Disposal, and Recreation.

Table 3-12 Lexington Watershed Land Use, 1985

Land Use	Acres	Percent
Residential	296	26%
Industrial	5	0%
Commercial	70	6%
Transportation	154	13%
Mining	0	0%
Waste Disposal	0	0%
Recreation	0	0%
Total Developed Land	525	45%
Forest	391	34%
Wetlands	29	3%
Water	59	5%
Agriculture	28	2%
Open	45	4%
Urban Open	75	7%
Total Undeveloped Land	627	55%
TOTAL	1,152	100%

Table 3-13 Lincoln Watershed Land Use, 1980

Land Use	Acres	Percent
Residential	1,308	22%
Industrial	0	0%
Commercial	16	0%
Transportation	0	0%
Mining	9	0%
Waste Disposal	0	0%
Recreation	22	1%
Total Developed Land	1,355	23%
Forest	2,692	46%
Wetlands	629	11%
Water	331	6%
Agriculture	723	12%
Open	72	1%
Urban Open	86	1%
Total Undeveloped Land	4,533	77%
TOTAL	5,888	100%

Table 3-14 Waltham Watershed Land Use, 1985

Land Use	Acres	Percent
Residential	426	16%
Industrial	486	19%
Commercial	125	5%
Transportation	187	7%
Mining	0	0%
Waste Disposal	0	0%
Recreation	4	0%
Total Developed Land	1,228	47%
Forest	748	29%
Wetlands	27	1%
Water	422	16%
Agriculture	0	0%
Open	53	2%
Urban Open	125	5%
Total Undeveloped Land	1,375	53%
TOTAL	2,603	100%

Table 3-15 Weston Watershed Land Use, 1985

Land Use	Acres	Percent
Residential	2,541	46%
Industrial	8	0%
Commercial	17	0%
Transportation	8	0%
Mining	97	2%
Waste Disposal	3	
Recreation	159	3%
Total Developed Land	2,833	51%
Forest	1,877	34%
Wetlands	334	6%
Water	83	1%
Agriculture	152	3%
Open	157	3%
Urban Open	132	2%
Total Undeveloped Land	2,735	49%
TOTAL	5,568	100%

3.2 POTENTIAL SOURCES OF CONTAMINATION

Land uses in the watershed may affect the quality of the drinking water through alteration of drainage patterns and the quality of runoff to the reservoirs, as well as discharge of contaminants to surface or groundwater. In this section the potential water quality impacts of land uses are described in terms of the potential physical alterations and/or chemical contaminants associated with each. For each of these potential sources of contamination, the analysis presents:

- Potential impacts: the characteristics of the activity and the potential water quality impacts associated with it
- Land use associations: the land uses normally associated with each potential source of contamination
- Existing conditions: an inventory which describes the extent of the activity within the watershed study area, and an accompanying map which shows its location within the watershed

The potential sources of contamination addressed are:

- urban runoff
- wastewater discharges
- hazardous materials and wastes
- underground storage tanks
- landfills
- pesticides

These are described and inventoried in the following section, and their location in the watershed is shown on Map 9.

3.2.1 Stormwater Runoff

A. Potential Impacts: Runoff results from the interception of precipitation by impervious surfaces such as roads, parking lots, and buildings. Runoff flows over these surfaces, picking up dissolved and suspended pollutants, and is ultimately discharged to streams, ponds, or wetlands either directly or through a system of storm drains. The degradation of water quality by urban runoff is related to a number of constituents commonly found in runoff, including suspended solids, organic wastes and nutrients, heavy metals, hydrocarbons, bacteria, and salts. Tables 3-16 and 3-17 present the results of runoff quality monitoring conducted for the EPA's Nationwide Urban Runoff Program (NURP). The results are based on the monitoring of sites in 22 cities, with a statistically significant number of storm events at each site. The NURP data shows that urban runoff contains significant amounts of both standard and priority pollutants.

FIGURE 3-4

EFFECTS OF LAND USES ON WATER SUPPLY SOURCES

Potential Drinking Water Contaminant

▲ Probable Relationship
☆ Possible Relationship

Land Use	Underground Fuel Storage Tanks	Wastewater	Road Salts	Leachate	Surface Waste Impoundments	Hazardous Waste & Materials	Pesticides
Residential	☆	▲	☆			☆	☆
Institutional	☆	▲	☆			☆	☆
Commercial	▲	▲	☆	☆		▲	
Industrial	▲	▲	☆	☆	☆	▲	
Agriculture	☆	▲				☆	▲
Transportation/Utilities	☆		▲			☆	▲
Waste Disposal/Mining	▲			▲	☆	▲	

Table 3-16 Runoff Quality: Standard Pollutants

Pollutant	Median Concentration
Total Suspended Solids	100 mg/l
Biological Oxygen Demand	9 mg/l
Chemical Oxygen Demand	65 mg/l
Total Phosphorus	0.33 mg/l
Suspended Phosphorus	0.12 mg/l
Total Kjeldahl Nitrogen	1.50 mg/l
Nitrite + Nitrate (as N)	0.68 mg/l
Total Copper	34 mg/l
Total Lead	144 mg/l
Total Zinc	160 mg/l

Source: EPA, Nationwide Urban Runoff Program, 1983

Table 3-17 Runoff Quality: Priority Pollutants

Pollutant	Frequency of Detection (%)	Pollutant	Frequency of Detection (%)
Lead	94	Chlordane	17
Zinc	94	Fluoranthene	16
Copper	91	Lindane	15
Chromium	58	Pyrene	15
Arsenic	52	Phenol	14
Cadmium	48	Antimony	13
Nickel	43	Beryllium	12
Cyanides	23	Phenanthrene	12
Bis(2-ethylhexyl)	22	Selenium	11
Hexachlorocyclohexane	20	Methylene Chloride	11
Endosulfane	19	4-Nitrophenol	10
Pentachlorophenol	19	Chrysene	10

Source: EPA, Nationwide Urban Runoff Program, Vol. 1, 1983

Sources of pollutants in urban runoff include road salt, vehicle oils and greases, fuel and combustion products, fertilizers, pesticides, tire wear, brake linings, engine plating and parts, and soil erosion.

B. Related Land Uses

Urban runoff is associated with all developed land uses, but it is particularly related to more intensely developed areas, including transportation corridors, commercial, industrial, and dense residential areas. Construction activity, especially in areas with highly erodable soils, can also degrade the quality of runoff.

C. Existing Conditions

The major sources of urban runoff in the reservoir watershed are the roads and highways which ring both reservoirs and the commercial and industrial sites which have large parking lots and building areas. In the watershed there are 220 acres of commercial land and 490 acres of industrial land, as shown in Table 3-18 and on Map 8.

Table 3-18 Commercial and Industrial Land in the Watershed

Community	Commercial land (acres)	Industrial land (acres)
Lexingtor	74	---
Lincoln	14	---
Waltham	125	486
Weston	7	4
Total	220	490

Highway drainage has the potential for direct impacts to the reservoirs because several sections of state and local roads drain directly to both Hobbs Brook and Stony Brook Reservoirs. There are approximately 100 lane-miles of state roads and highways in the watershed, about 20 lane-miles of which drain directly into the reservoirs through catch basin systems (see Map 9). In the case of Stony Brook Reservoir, about one linear mile (eight lane-miles) of Route 128 straddles the reservoir, and 20 stormwater discharge pipes in this section drain to the reservoir. In one section, the highway is built directly over Stony Brook Reservoir, bisecting it into two parts which are connected to each other through two 12 by 12 foot box culverts under the roadway. Along the Hobbs Brook Reservoir, about one linear mile (eight lane miles) of Route 128 and .5 linear miles (3 lane miles) of Route 2, as well as the Route 2 and 128 interchange ramps drain toward the reservoir. In this section, there are 25 discharge pipes on Route 128 and 12 discharge pipes on Route 2 which drain to the Reservoir. The only section of state highway which was designed to drain away from the reservoir is the recently reconstructed interchange at Route 128 and Winter Street. In that section, all road drainage is directed to a detention basin which discharges downgradient from Hobbs Brook Reservoir. The drainage of state highways to the two reservoirs is summarized in Table 3-19.

Table 3-19 Drainage of State Highways to Reservoirs

Reservoir	Lane Miles	Stormwater Discharges
Stony Brook	8	20
Hobbs Brook	12	37
Total	20	57

In addition to the state highways, there are several local streets which drain to the reservoirs. These include sections of Hayes Road, Sibley Road, and Reservoir Road which drain to Stony Brook Reservoir, and sections of Trapello Road, Winter Street, Woodchester Road, Leslie Road, Melody Lane, Hobbs Brook Road, and Christopher Road which drain to Hobbs Brook Reservoir. There are four stormwater discharges from local streets into Stony Brook Reservoir, and twelve into Hobbs Brook Reservoir (see Map 9).

Road Salt

One of the major water quality impacts of drainage from roadways is the elevated levels of sodium ususally associated with urban runoff. Sodium chloride applied to roads as a deicing chemical or stored in uncovered piles can wash off pavements and be carried by stormwater runoff into surface water bodies, or percolate through soils to groundwater. Since standard water treatment systems are unable to remove sodium from drinking water, sodium levels that could be harmful to some individuals may result. State drinking water standards for sodium require notification of water customers if levels exceed 20 mgl. In recent years sodium levels in the Cambridge water system have exceeded that standard. A 1985 study by Geotechnical Engineers concluded that the average annual sodium input into Hobbs Brook Reservoir from 1967 to 1988 was 1673 tons per year, of which 72 percent came from state highways, 13 percent from local streets, 7 percent from MDPW salt storage, and 7 percent from private commercial and residential application. Current state and local road deicing practices are summarized below.

Massachusetts Department of Public Works: The state maintains Routes 128, 2, 2A, and 20 within the watershed study area. These highways comprise about 100 lane-miles in the watershed. Since 1986, the MDPW has conducted a reduced sodium program on about 96 lane miles plus ramps and interchanges within the watershed (covering all but 4 lane miles on Route 20 in Weston). Rather than following the standard procedure of applying sodium chloride at a rate of 300 pounds per lane-mile, the MDPW applies one part sand to one part Pre-Mix (by volume) at a rate of 400 pounds per lane mile. Pre-Mix is a commercially available material which contains four parts sodium chloride to one part calcium chloride. For the first two years of the reduced sodium program, MDPW estimated that the amount of sodium applied in the watershed was reduced by 61% compared to standard treatment.

In addition to road salt application, another source of sodium contamination is uncontrolled storage and handling of sodium chloride. There is a MDPW salt storage shed in the watershed, at the junction of Routes 2A and 128. The 1985 GEI study determined that 125 tons per year of salt enters the Hobbs Brook Reservoir from the depot. This is the result of current and past spillage at the depot and leaching of salt already in the ground from previous uncovered storage. Runoff from the site of the depot flows into an adjacent marsh which feeds a tributary of the Hobbs Brook Reservoir, which is about 2000 feet downgradient from the depot.

Lexington. The town uses a sand and salt mixture at a ratio of 10:1 (10 percent salt) to maintain local streets. Straight salt is sometimes used on heavily travelled streets such as Massachusetts Avenue. Salt is stored in a covered shed located outside of the watershed area.

Lincoln. The town uses a sand and salt mixture at a ratio of 20:1 (5 percent salt) throughout the community. Heavily travelled roads such as Trapello Road, Route 117, and Route 126 are given more frequent treatments as needed. Salt is stored in a covered shed on Lewis Street, in the watershed near its western upgradient boundary.

Waltham. The city has a program of salt reduction in the Hobbs Brook Reservoir watershed. Calcium chloride is used instead of sodium chloride on Trapello Road, Smith Street, and Wyman Street, a total of about six lane-miles. Currently the city uses two trucks to apply calcium chloride on these streets. Beginning in the winter of 1989-90,the city plans to outfit two trucks with tanks capable of applying liquid calcium chloride. Straight salt is used on other heavily travelled roads in the Stony Brook Reservoir watershed, including Bear Hill Road and Main Street (Route 117), a total of about 4 lane-miles. On other less heavily travelled streets, the city uses a sand and salt mixture at a ratio of 10:1 (10 percent salt). Salt is stored at the town DPW, outside of the watershed.

Weston. The town uses a sand to salt mixture at a ratio which varies between 7:1 and 10:1. Salt is stored in a covered shed at the town DPW garage, located near the southwestern upgradient boundary of the watershed.

Table 3-20 Summary of State and Local Road Salt Practices

	Sand:Salt Ratio	Application Practices	Salt Storage
Lexington	10:1	Some straight salt on Mass Ave	Covered shed outside watershed
Lincoln	20:1	More applications on Rt. 117, 126, Trapello Road	Covered shed in watershed
Waltham	10:1	Calcium Chloride on Trapello Road, Wyman, Smith St; Straight salt on Bear Hill Rd, Main St.	Covered shed outside watershed
Weston	7:1-- 10:1	Sand/salt mixture used on all roads	Covered Shed in watershed

3.2.2 Wastewater Discharges

A. Potential Impacts

In unsewered areas, improper on-site disposal of wastewater can degrade the quality of surface and groundwater. Problems associated with sewage include nitrates, bacteria, viruses, chlorides, and heavy metals. Inadequate treatment can be caused by improper siting, installation, or maintenance of septic systems. Soil characteristics, depth to bedrock, and depth to the water table can be major factors in septic system failure. Proper maintenance, particulary regular pumping of septic tanks, is important for adequate functioning of septic systems.

In sewered areas, potential wastewater impacts are related to discharge of treated wastewater and leaking or overflowing sewers. Non-domestic wastewater may also contain toxic components such as heavy metals or volatile organic compounds.

B. Related Land Uses

Wastewater disposal is associated with residential, commercial, and industrial land uses. Higher density development is generally associated with public sewers, while low density development often relies on septic systems. In unsewered areas, some larger developments may provide an on-site treatment system.

C. Existing Conditions

In the watershed, puplic sewers are available in Lexington and Waltham, representing about 24 percent of the watershed area. Wastewater from these areas is conveyed to the MWRA treatment facility at Deer Island, which discharges to Boston Harbor. Lincoln and Weston, comprising 76 percent of the watershed area, are unsewered, relying on septic systems for wastewater disposal (see Map 9).

In the unsewered area, there is a wastewater problem area in Weston center. Because of unsuitable soils, several businesses use holding tanks which must be pumped out frequently. There are also some older septic systems and cesspools which do not function properly.

In the sewered area, there are two sewer lines operated by the city of Waltham which are located along the edge of Hobbs Brook Reservoir. The Bear Hill Valley trunk sewer runs between the reservoir and Route 128, from Winter Street to Trapello Road. It is a 21 inch vitrified clay sewer which was installed in 1954. The sewer line connects to a pumping station which is located near the interchange of Route 128 and Trapello Road. The sewer line crosses under Route 128 in four places. The Hobbs Brook Valley trunk sewer extends along a section of Winter Street near the southwestern corner of Hobbs Brook Reservoir. It is a 15 inch plastic sewer which was installed in 1965. It joins the Bear Hill Valley trunk sewer at Second Avenue south of the reservoir. There are indications of a possible sewage leak at the Silers facilitiy off of Second Avenue. Water analysis conducted by the Cambridge Water Department indicates elevated bacteria counts in this area.

There is one groundwater discharge in the watershed permitted under the state groundwater discharge permit program. Lincoln Homes, a residential development in South Lincoln, has a permitted discharge of 26,000 gallons per day of treated wastewater. The development has its own on-site treatment plant.

There is one pending application for a groundwater discharge permit in the watershed. The application is for a mulitfamily residential development in Weston, which would provide its own package treatment plant and discharge the effluent to the ground on site. The pending permit is for a discharge of 19,000 gallons per day.

In addition to sewage, there are three other kinds of wastewater discharges currently permitted by DEQE in the watershed. These are as follows:

o Massachusetts Broken Stone, Weston: This inactive facility, which used to manufacture crushed stone and asphaltic concrete, holds a discharge permit for 384,000 gallons per day of process wastewater. During operation of the facility, wastewater was discharged to the Stony Brook about one-half mile upstream of Stony Brook Reservoir. The wastewater from three bituminous concrete plants and one stone crushing plant flowed through three settling ponds before being discharged to the river. The original 1974 permit set limits on Total Suspended Solids of 20 mgl daily average and 45 mgl daily maximum, and required monthly monitoring, with weekly monitoring in the month of June. In 1979, the company applied for a permit renewal and requested a relaxation of the standards to 55 mgl daily average and 110 mgl daily maximum. To date, a new permit has not been issued, so the conditions of the original permit are still in effect. However, since the quarry is not operational, there is no discharge at the present time. Currently there are plans to redevelop the site.

o Corporate Center at Waltham: This facility has two permitted discharges for storm runoff into Hobbs Brook Reservoir. The 1985 permit establishes the following maximum daily discharge limitations:

Total Dissolved Solids	500 mgl
Suspended solids	20 mgl
Settleable solids	0.3 mgl
Nitrate (as N)	10.0 mgl
Total phosphates	1.0 mgl
Lead	0.05 mgl
Oil and Grease	5.0 mgl
Turbidity	10 NTU

In addition, the permit prohibits the use of sodium chloride de-icing agent and the use of pesticides, herbicides, fungicides, and insecticides. Fertilizer use is restricted to semiannual applications in the spring and autumn on 1.5 acres of sodded area.

o Exxon Bulk Oil Terminal, Waltham: This facility was issued a discharge permit for two stormwater discharges in the early 1970's. The discharges are to Stony Brook about one half mile uspstream of the Stony Brook Reservoir. The discharge limits for volatile organics are equal to the drinking water standards. Discharge #001 handles stormwater runoff from 11 diked tanks. Discharge #002 handles stormwater discharge from 8 other diked tanks, as well as groundwater pumped from recovery wells on-site. The water is treated at an on-site air stripper before discharge at #002. The groundwater recovery wells and air stripper were installed in 1985 in response to petroleum leakage at the site. No strict NPDES limits have been in place during the operation of the groundwater recovery and treatment system since 1985. However, the original NPDES permit is currently being reviewed for renewal by DEQE and EPA.

3.2.3 Hazardous Materials and Wastes

A. Potential Impacts. A material is considered hazardous if it has certain properties that could pose dangers to human health and the environment. Materials are classified as hazardous if they are toxic, corrosive, reactive, or ignitiable. Improper handling or disposal of hazardous materials or wastes can result in contamination of surface and groundwater.

B. Related Land Uses. The most significant handlers of hazardous materials and wastes are industrial and commercial facilities. The most common types of hazardous materials are solvents, cleaning fluids, thinners, inks, dyes, paints, acids, pesticides, oils, and other petroleum products. Small quantities of hazardous wastes may also be generated by households. In unsewered areas, septic systems may not be able to properly treat a number of hazardous wastes.

C. Existing Conditions

Within the watershed a number of businesses and industries are registered handlers of hazardous materials or generators of hazardous wastes. There are 68 generators of hazardous waste in the watershed registered under the Resource Conservation and Recovery Act. These generators range from gasoline stations and auto body shops to large high-tech industries (see Table 3-21 and Appendix A). The majority of the hazardous waste generators are located in the eastern part of the watershed, in the Route 128 corridor (see Map 9). The wastes generated include solvents, cyanide, mercury, chromium, lead, and sludges and other byproducts of electroplating operations.

There are 18 companies in the watershed in Waltham and Lexington which are registered as handlers of hazardous materials (see Appendix C). Five of these handle quantities less than the Threshold Planning Quantity under Title III of the Superfund Amendments and Reauthorization Act (SARA).

According to DEQE records, there have been three confirmed hazardous waste releases within the watershed, and there are six other sites which are listed as "Locations to be Investigated." The confirmed hazardous waste sites are as follows:

Polaroid, 1265 Main St., Waltham: In 1987, about 1500 gallons of untreated chemicals was released outside of Building W-6 on the site. The chemicals released included methanol, isoproponol, acetone, and toluene. Polaroid responded by removing about 1500 gallons of chemicals and 107 tons of contaminated soil from the site.

Hewlett Packard, 175 Wyman Street, Waltham: In 1987 there was a leak of No. 4 fuel oil from a 15,000 gallon underground tank on the site. The company entered into a contract with a consultant and a hazardous waste cleanup firm to remediate the site.

Exxon, Jones Road, Waltham: In 1985 there was a leak of heating oil from an underground line adjacent to the loading rack. The company responded by installing a groundwater recovery and air stripping treatment system and replacing the underground lines from the pumps with aboveground lines. In 1988, a small amount of heating oil leaked from one of the storage tanks into the adjacent diked area. The contaminated soil was removed and disposed of under DEQE supervision. In addition to on-site petroleum contamination, the groundwater monitoring wells installed by Exxon have found evidence of chlorinated hydrocarbons which appear to be migrating onto the Exxon site from an upgradient site. The neighboring site was formerly occupied by the Stohler Chemical company, and is now vacant.

The six sites currently listed as Locations to be Investigated are:

63-65 Second Avenue, Waltham (Industrial Property)
550 Winter Street, Waltham (Fruehauf Factory Branch)
40 Second Avenue, Waltham (ADP)
584 Boston Post Road, Weston
170 South Great Road, Lincoln (Lincoln Automotive)
Route 128 and Route 2A, Lexington (Highway spill)

Table 3-21 Hazardous Waste Generators in the Watershed

Community	0-99 kg/month	100-999 kg/month	1000+ kg/month	Total
Lexington	1	11	3	15
Lincoln	0	2	0	2
Waltham	1	36	11	48
Weston	0	3	0	3
Total	2	52	14	68

Another possible source of hazardous waste contamination is accidental spills during the transportation of hazardous wastes or materials through the watershed. As noted in section 3.2.1, highway drainage from major routes such as Routes 2 and 128 flows directly into the Stony Brook and Hobbs Brook reservoirs and their tributaries. This creates the potential for direct and immediate contamination of the Cambridge water supply due to a highway accident involving hazardous materials. In fact in the last several yearsthere have been a number of dangerous accidents which were near misses in terms of contaminating the reservoirs:

October 1975 chemical spill: about 50 gallons of ethyl acrylite, a highly toxic chemical used in the plasitics industry, was spilled onto Route 128 immediately adjacent to Hobbs Brook Reservoir. The chemical saturated an area about 100 yards long and 5 feet wide along the edge of the highway. Some of the chemical went into a storm drain which discharges to the reservoir, but the drain was clogged with leaves and sand, preventing the chemical from entering the reservoir. Local police and fire departments and the EPA responded, and the Waltham Public Works Department removed the contaminated soil and deposited it in the city dump.

. August 1986 gasoline spill: about 15 to 25 gallons of gasoline from an unknown origin spilled into Stony Brook Reservoir from an area near the Route 128 and Route 20 interchange. The Cambridge Water Department shut down the intake and allowed the gasoline to evaporate.

February 1987 diesel fuel spill: about 7000 gallons of diesel fuel was spilled at the Route 128 and Route 2A interchange when a truck turned over and ruptured. The site is near a tributary which flows to the Hobbs Brook Reservoir. Fortunately, the appropriate response personnel were in the immediate vicinity at the time of the spill, and a quick clean up response prevented contamination of the reservoir.

1988 diesel fuel spill: an unknown amount of diesel fuel leaked into the Stony Brook Reservoir from an area near the Route 128 and Route 20 interchange. The Cambridge Water Department shut down the intake and allowed the reservoir to spill over the dam until the diesel fuel flowed out the system.

These incidents clearly illustrate how vulnerable the reservoirs are to accidental spills as long as highway drainage discharges directly into the reservoirs. According to state DPW accident statistics, seven intersections in the watershed have some of the highest accident rates in the state, as shown on Table 3-22.

Table 3-22 Accident Rates at Key Intersections in the Watershed

Intersection	Number of Accidents (1983)
Route 2 & Route 128	65
Route 128 & Route 2A	33
Route 2 & Bedford Road	44
Route 128 & Route 20	73
Trapelo Rd & Route 128 Exit	42
Winter Street & Route 128	47
Main St & Bear Hill Road	29

3.2.4 Underground Fuel Storage

A. Potential Impacts. Leakage of tanks or piping which are subject to corrosion or puncturing can lead to contamination of water resources with petroleum products. Underground storage tank leaks may be caused by a number of factors including defects in tank manufacturing, improper installation, corrosive soils, or tank fatigue due to age. Unprotected steel tanks in corrosive soils such as Massachusetts' have an average reliable life of about 15 to 20years. After that, such tanks are at a significant risk of leakage due to corrosion. Once a tank leaks, petroleum products can move through the ground and contaminate downgradient surface or groundwater. A relatively small amount of fuel can contaminate a large amount of drinking water, since concentrations as low as several parts per billion are considered unsafe. In terms of mobility in the evvironment, gasoline moves more rapidly through soil and water systems than heavier products such as fuel oil and diesel fuel.

B. Related Land Uses. Underground fuel storage is typically associated with automotive service stations, fuel companies, auto dealerships, vehicle fleets, public works facilities, schools, and churches. Many residences also have fuel oil stored in underground tanks.

C. Existing Conditions. Data on underground fuel tanks are available through commercial tank registrations and burner permits, both of which are kept on file in the fire departments of each community. The data available from commercial tank registrations are fairly complete in most communities, and includes detailed information about the size, type, and age of underground tanks. Heating oil tanks connected to a burner are exempted from registration requirements, and data on these are only available in the local burner permits issued by each fire department. Data for these tanks are less reliable, as the burner permits were never intended to provide a comprehensive inventory of underground fuel tanks.

There are 43 underground gasoline storage tanks in the watershed, the majority of which are in Weston and Lincoln (see Tables 3-23 and 3-24). Thirteen of these tanks are more than twenty years old. The total storage in these 43 tanks is over 200,000 gallons.

Table 3-23 Summary of Gasoline Storage Tanks in Watershed

Age	Lexington	Lincoln	Waltham	Weston	Total
0--10	4	8	3	5	20
11-20	3	1	1	4	9
20+	0	7	3	3	13
Unknown	0	0	0	1	1
Total	7	16	7	13	43

Table 3-24

Gasoline Storage Licenses
In Cambridge Reservoir Watershed

	Tank Size	Tank Type	Install. Date	Fuel
Lincoln				
Lincoln Automotive 170 South Great Road	3,000	Steel	'71	Diesel
	6,000	Steel	'81	Gasoline
	6,000	Steel	'81	Gasoline
	6,000	Steel	'81	Gasoline
	2,000	Steel	'71	Used Oil
Doherty's Garage 161 Lincoln Road	10,000	Gal. Steel	'68	Gasoline
	8,000	Gal. Steel	'68	Gasoline
	5,000	Gal. Steel	'68	Gasoline
	5,000	Gal. Steel	'79	Diesel
Town of Lincoln Lewis Street	4,000	Gal. Steel	'85	Diesel
	3,000	Gal. Steel	'85	Gasoline
	4,000	Gal. Steel	'85	Gasoline
Tracy's Rt. 2 + Bedford	8,000	?	<'66	Gasoline
	5,000	?	<'66	Gasoline
	4,000	?	<'66	Gasoline
	2,000	?	<'66	Gasoline
	2,000	?	'82	Diesel
Waltham				
Bay Colony 950 Winter Street	1,500	--	'85	Diesel
Claude Cormier Service Station 1420 Main Street	6,000	Steel	'68	Gasoline
	6,000	Steel	'68	Gasoline
	4,000	Steel	'76	Gasoline
	500	Steel	'68	Used Oil
Middlesex Mutual 225 Wyman Street	1,000	Tested	'87	Gasoline
	1,000	Tested	'87	Gasoline

Table 3-24 -- Continued, Gasoline Storage

Name Address	Tank Size (gal)	Tank Type	Installation Date	Fuel
Weston				
Amoco Service Station 88 Boston Post Road	6,000	Steel	1984	Gas
	6,000	Steel	1984	Gas
	8,000	Steel	1979	Gas
	550	Steel	1984	Used Oil
Weston Police Department 180 Boston Post Road Bypass	5,080	Steel	1974	Gas
	5,080	Steel	1974	Diesel
	5,080	Steel	1979	Diesel
Weston Highway Department 190 Boston Post Rd. Bypass	3,000	Steel	1978	Gas
	2,500	Steel	1953	Sand
Weston Fire Department 394 Boston Post Road	1,000	Steel	1966	Gas
	1,000	Steel	1966	Used Oil
Campion Res. & Renewal Ctr. 319 Concord Road	10,000	Steel	1974	#6 Oil
	10,000	Steel	1974	#6 Oil
	1,000	Steel	1962	Gas
Weston Golf Clut Grounds 226 Meadowbrock Road	1,000	Steel	1957	Gas
	500	Steel	?	Gas
Mobil Oil Corp. 290 North Averue	5,000	Steel	1983	Gas
B.L. Ogilvie & Sons Inc. 39 Warren Avenue	2,000	Steel	1974	Gas
Lexington				
Shell Service Station 286 Lincoln St.	10,000	Steel	1969	Gas
	10,000	Steel	1969	Gas
	10,000	Steel	1969	Gas
Rt. 128 Sercice Area Rt. 128 at Route 2A	?	?	1988	Gas
	?	?	1988	Gas
	?	?	1988	Diesel

There have been two reported cases of gasoline leakage from underground tanks in the watershed. Early in 1989, a leak was detected at a Shell service station at Marrett Road and Lincoln Street in Lexington. Groundwater monitoring at the site found the following gasoline constituents:

Benzene	2800 ug/l
Toluene	1500 ug/l
Ethyl Benzene	500 ug/l
Total Xylenes	1800 ug/l
Total BTEZX	6600 ug/l

Remedial actions undertaken at the site include groundwater monitoring, dewatering, temporary treatment, and tank replacement. The other underground tank leak was discovered in 1987 at the highway service area on Route 128 near the Route 2A interchange in Lexington. Leaked fuel from this site was detected in conjunction with monitoring conducted for the truck accident which caused a diesel fuel spill on Route 128 in February 1987 (see section 3.2.2). Remedial action taken included groundwater monitoring and replacement of the underground tanks at the service area .

There are about 690 underground fuel oil storage tanks in the watershed (see Table 3-25 and Appendix D). Because of the nature of the records, it is not possible to reliably determine the age of the fuel oil tanks. Of particular concern in this category of tanks are the smaller tanks, most of which are 275 gallons. These tanks are the standard type degsigned for installation in basements. As such, they are not constructed of heavy gauge steel, and are therefore more vulnerable to corrosion when installed underground. There are 97 of these small tanks in the watershed, most of which are in Lexington and Weston. It should also be noted that unlike commercial gasoline tanks, residential fuel oil tanks are not subject to periodic leak tests.

Table 3-25 Summary of Fuel Oil Tanks in the Watershed

Size(gal)	Lexington	Lincoln	Waltham	Weston	Total
275	42	16	3	36	97
500	22	72	34	64	192
1000	32	54	38	61	185
2000	4	30	9	34	77
2000+	10	10	36	15	71
Unknown	5	19	1	43	68
Total	115	201	121	253	690

In addition to the gasoline and heating oil tanks listed above, there are several other miscellaneous underground storage tanks at the Exxon bulk petroleum terminal in Waltham. These are listed below in Table 3-26.

Table 3-26 Miscellaneous Underground Storage Tanks, Exxon Bulk Petroleum Terminal, Waltham

Tank Size (gal)	Tank Type	Age	Tank Contents
Unknown	Steel-Double Wall	1987	Oil/water separator slop
8,000	Steel	1972	Truck pump-back
2,000	Steel	Unknown	Vapor recovery drop out
500	Steel	1978	M.P.L. pressure relief
8,000	Steel-Double wall	1987	Gasoline additive

Aboveground Fuel Storage

In addition to underground fuel storage in the watershed, there is a petroleum bulk terminal operated by Exxon in Waltham, near the Weston border and adjacent to Stony Brook about one-half mile upstream from the Stony Brook Reservoir. The terminal has 20 aboveground tanks which range from 21,500 to 80,000 barrels and contain heating oil, diesel fuel, and gasoline (see Table 3-27). The direction of groundwater flow from the site is to the southwest, toward Stony Brook. Stormwater runoff from the site is regulated by an NPDES permit. The permit is currently being reviewed for renewal.

There have been two incidents at the Exxon facility which resulted in the leakage of petroleum products to the environment. In 1985, an underground heating oil line near the loading rack developed a leak. Subsequently, all underground lines from the pumps to the loading rack were relocated aboveground, and a groundwater recovery and treatment system was installed. The treatment system is an air stripper unit which discharges treated effluent to Stony Brook. The second incident occured in 1988, when heating oil leaked from the base of one of the tanks into the adjacent diked area. The contaminated oil was removed and disposed of off-site.

The Exxon terminal is supplied by an underground fuel line which runs from Chelsea to Waltham, extending through a portion of the watershed in Waltham north of Route 20. The pipeline is cathodically protected, and sections which are buried beneath the railroad right-of-way are housed in oversized sleeves.

Table 3-27

ABOVEGROUND STORAGE TANKS

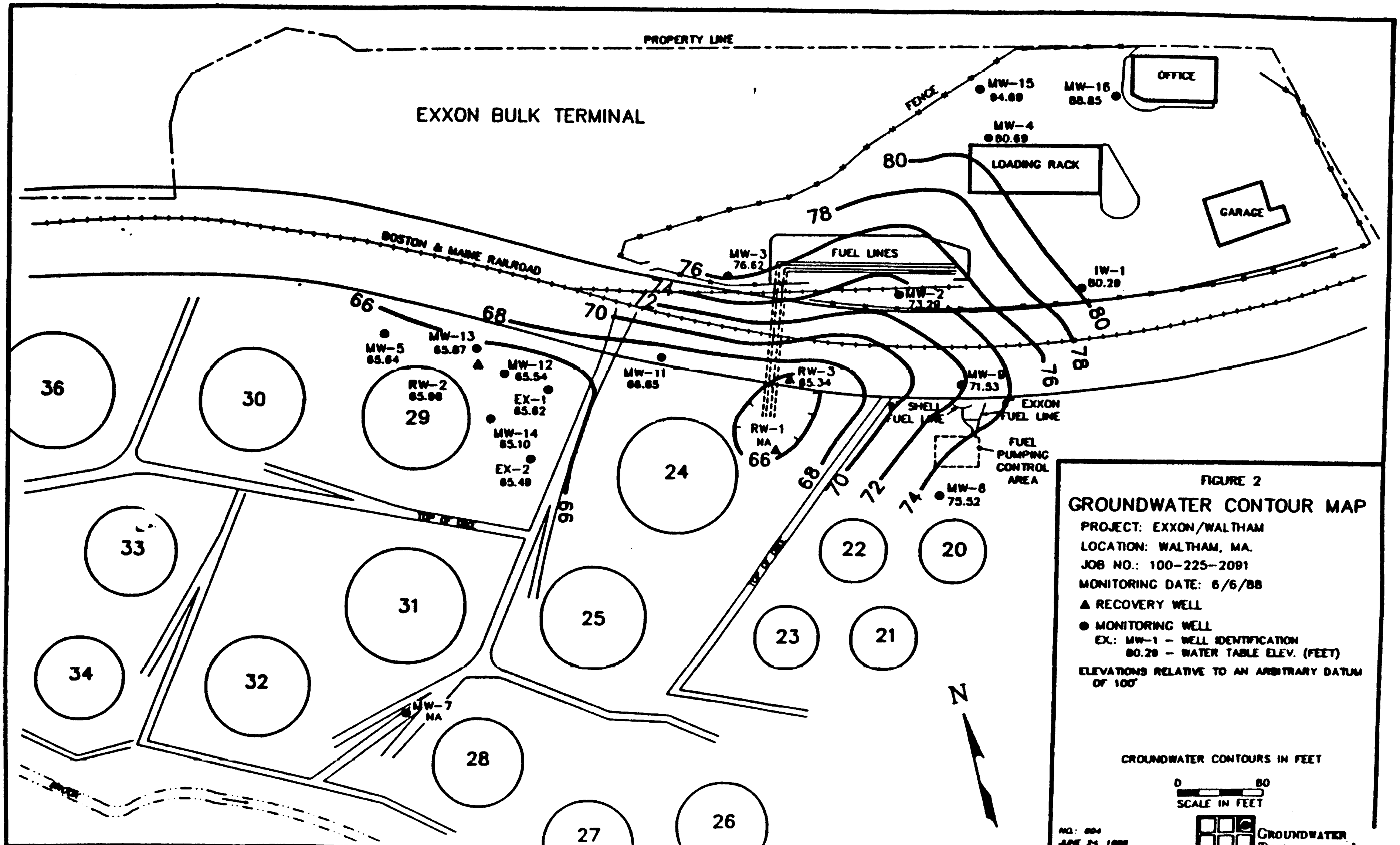
I.D.	Capacity (BBL)	Type	Service	Maintenance
20	21500	Internal Floating Roof	Reg. N/L	Fiberglass lined bottom
21	21500	Internal Floating Roof	Reg. N/L	Fiberglass lined bottom
22	21500	Internal Floating Roof	Supreme	Fiberglass lined bottom
23	21500	Internal Floating Roof	Plus	Fiberglass lined bottom

Note: Above mention tanks have Aluminum dome cover roofs.

24	80000	Cone Roof	Heating Oil	Fiberglass lined bottom
25	69000	Cone Roof	Heating Oil	Fiberglass lined bottom
26	50000	Cone Roof	Diesel Oil	Fiberglass lined bottom
27	50000	Cone Roof	Heating Oil	Fiberglass lined bottom
28	50000	Cone Roof	Heating Oil	Fiberglass lined bottom
29	80000	Cone Roof	Heating Oil	Fiberglass lined bottom
30	69000	Cone Roof	Heating Oil	
31	80000	Cone Roof	Heating Oil	Under inspection/maintenance
32	69000	Cone Roof	Heating Oil	Under inspection/maintenance
33	50000	Cone Roof	Heating Oil	Under inspection/maintenance
34	50000	Cone Roof	Heating Oil	
35	50000	Cone Roof	Heating Oil	
36	80000	Cone Roof	Heating Oil	
37	69000	Cone Roof	Heating Oil	
38	80000	Cone Roof	Heating Oil	
39	69000	Cone Room	Heating Oil	

Note: All above mention tanks built in 1953

Figure 3-5 Exxon Bulk Petroleum Terminal, Waltham



There is a second underground petroleum pipeline in the watershed which is operated by the Shell Oil Company. This is part of a line which extends from Fall River, MA to a fuel terminal on Waverly Oaks Road in Waltham, outside of the watershed. The portion of the line in the watershed extends along the B&M railroad right-of-way through Weston and Waltham (see Map 9), and passes beneath the Exxon terminal near Stony Brook. The six inch pipeline is of welded construction, and is cathodically protected. It is used to carry gasoline.

3.2.5 Landfills

A. Potential Impacts. Solid waste landfills may contaminate water resources with leachate, a liquid waste which results from the percolation of water through the landfill. Depending on the characteristics of the solid waste contained in landfills, leachate may contain dissolved solids, organic, and inorganic compounds which may contaminate water suplies. Leachate contamination can be controlled with installation of impervious liners and caps, leachate collection and treatment, runoff guidance, and groundwater monitoring.

B. Existing conditions. There are no active landfills in the watershed, but there are inactive municipal landfills in Lincoln and Weston which recently closed. Both landfills are in the process of final closure. The Lincoln landfill has a DEQE-approved closure plan which will be implemented during the summer of 1989. The plan calls for an impervious clay cap. Hydrogeologic studies conducted at the landfill site concluded that groundwater flows northward from the landfill toward Hanscom Field, and away from Hobbs Brook Reservoir. Groundwater monitoring has been conducted for the last eight years. Water samples taken from five monitoring wells, two surface water sites in Hobbs Brook, and one private well have been tested for pH, total dissolved solids, iron, manganese, chemical oxygen demand, alkalinity, and chloride. Sampling in fall of 1987 concluded that there had not been significant migration of contaminated leachate from the landfill. Three of the downgradient monitoring wells had elevated levels of total dissolved solids, chemical oxygen demand, alkalinity, and chloride. However, the consultant's report concluded that remedial action was not needed, and recommended continued semi-annual monitoring.

A closure plan has been prepared for the Weston landfill, but it is still being reviewed by DEQE. Approval has been delayed because a land owner abutting the landfill has appealed the Order of Conditions issued by the Conservation Commission for the closure plan. The landfill is located about 500 feet from Stony Brook near the confluence with Hobbs Brook. Hydrogeologic investigations of the site conducted by SEA Consultants for the town of Weston concluded that the direction of groundwater flow from the landfill is towards Stony Brook, and that the refuse at the northern portion of the landfill appears to be in contact with the groundwater. However, the study could not determine the relationship between the groundwater and Stony Brook. Although Stony Brook is hydraulically connected to the groundwater system, it could not be determined whether groundwater from the landfill area discharges to the brook or passes under it. Water cuality analyses of the groundwater and Stony Brook indicate that the landfill is having a localized impact on downgradient groundwater, and no measurable impact on the quality of Stony Brook. Groundwater in downgradient monitoring wells has elevated levels of iron, specific conductance, alkalinity, chlorides, and total organic halogens, all of which are idicative of leachate. The only parameter which exceeds drinking water standards, is iron. Three volatile organic compounds have also been found in groundwater near the landfill. These include acetone (49 ppb), 2-Butatone (25 ppb), and 4-Methyl-Pentanone (7 ppb), all of which are on the EPA's list of hazardous substances. The greatest concentration of VOC's are within the upper 25 feet of the groundwater. The hyrogeologic study concluded that leachate generation will be significantly reduced with the adoption of proper landfill management practices upon implementation of the landfill closure plan.

3.2.6 Pesticides

A. Potential Impacts. Pesticides are a group of chemicals which include insecticides, fungicides, herbicides, and rodenticides. These are all chemical compounds which are used to control unwanted organisms such as insects, weeds, and rodents. Since the compounds and their method of application vary depending on their target organisms, their potential impacts on water resources also vary greatly. Pesticides may enter water supplies by direct infiltration through soils, surface water runoff, or aerial drift. Adverse impacts on water resources may be caused by improper application, mixing, storage, or disposal of pesticide products.

B. Related Land Uses. Land uses associated with pesticide application include agriculture, utility and railroad rights-of-way, golf courses, and residential uses. Utility companies may use selective application of herbicides to maintain rights-of-way free of tall-growing trees which could interfere with the functioning of the utility lines. The general amount of herbicide used for this purpose is about one gallon per acre.

Herbicides are applied to railroad rights-of-way in order to control vegetation along the track which may cause degradation of the track and lead to fires.

C. Existing Conditions. There are four utility and railroad rights-of-way in the watershed: a Boston Edison transmission right-of-way, a Shell Oil pipeline, an Algonquin Gas line, and a Boston and Maine railroad right-of-way. The Shell Oil and Algonquin Gas pipelines are not maintained with herbicides. Although herbicides have been used on the Boston Edison and Boston and Maine railroad rights-of-way, there has been a moratorium on herbicide use for the past two years to allow for the implementation of new state regulations on right-of way maintenance (333 CMR 11.00). The regulations call for five year Vegetation Management Plans (VMP) and yearly operating plans.

Boston Edison has drafted a preliminary five year VMP which outlines methods of vegetation management and sensitive areas which receive limited or no herbicide applications (see Tables 3-28 and 3-29). The Boston Edison right-of-way follows an unused railroad line through Weston to a substation in Waltham near Polaroid. From there it proceeds north through Waltham about 1000 feet east of Hobbs Brook Reservoir to the Lexington line, following a 250 foot easement. Several large wetlands are crossed in Lexington, and the ROW crosses through part of the Hobbs Brook Reservoir watershed in Waltham and Lexington. Much of the ROW corridor in the watershed crosses parking lots and landscapped areas, minimizing the need for herbicide appilication (see Map 9).

Residential uses may also involve the use of herbicides for maintenance of lawns and landscaped areas. About 4570 acres, or 30 percent of the watershed area is currently developed with residential uses.

Table 3- 28 METHODS OF VEGETATION MANAGEMENT

Vegetation Control Technique	Target Vegetation	Examples of Target Vegetation	Height Range of Target Vegetation	Timing of Application	Equipment Utilized	Examples of Herbicides Utilized	Carriers	Adjuvants
Low-volume basal (LVB)	Hardwood tree species Softwood tree species Undesirable shrubs	Maple, ash, oak Pine, cedar Alder, buckthorn	3 to 15 feet 3 to 8 feet 3 to 20 feet	Effective year round; usually applied during dormant season	Hand-pump backpack applicators	Garlon 4 Garlon 4+Access	Kerosene	Cidekick
Low-volume foliar (LVF)	Hardwood tree species Softwood tree species Undesirable shrubs Undesirable vines Undesirable plants	Maple, ash, oak Pine, cedar Alder, buckthorn Greenbrier, p.ivy Phragmites	3 to 10 feet 3 to 6 feet 3 to 10 feet 0 to 6 feet 0 to 4 feet	Active growing season June 10-Sept 25	Motorized backpack applicators	Tordon 101 Roundup Garlon 3A Accord Escort	Water	Surfactant Lo-drift Cidekick
Cut-stump Treatment (CST)	Hardwood tree species Softwood tree species Undesirable shrubs	Maple, ash, oak Pitch pine Alder, buckthorn	0 to 100 feet	Year round; except for period of heavy sap flow	Garden type spray bottle on "stream" setting	Tordon RTU Garlon 3A		Anti-freeze
Mechanical-mowing (MOW)	Hardwood tree species Softwood tree species Undesirable shrubs Undesirable vines Undesirable plants	Maple, ash, oak Pine, cedar Alder, buckthorn Greenbriar, p.ivy Phragmites	Up to 2X" stump dia. Up to 1X" stump dia. Up to 4" stump dia.	Year round	Tractors 85HP Tracked vehicles Payloader 120HP	—	—	—
Mechanical - hand-cut (HC)	Hardwood tree species Softwood tree species Undesirable shrubs	Maple, ash, oak Pine, cedar Alder, buckthorn	0 to 100 feet	Year round	Chain saws Brush saws	—	—	—

Table 3-29

No-Herbicide Use Zones and Conditional Herbicide Use Zones Within and Surrounding Sensitive Areas on Rights-of-Way

Sensitive Area	No-Herbicide Use Zone	Conditional Herbicide Use Zone
primary recharge area	400-feet radius from a public well	the remainder of the primary recharge area[1]
public surface water supply	100-feet	100 to 400-feet[1]
private well	50-feet radius	50 to 100-feet radius[1]
standing or flowing water	10-feet	10 to 100-feet[1]
wetland	10-feet from standing or flowing water	restrictions on frequency and method of application
agricultural area	-	restrictions on timing frequency, and method of application
habitated area	-	restrictions on timing, frequency, and method of application

Notes:

1. There are restrictions on frequency and method of application in this zone.
2. As detailed in sectin (h), IPM Programs, the action level, or that point at which the average stem height and stem density falls in the range requiring treatment, usually occurs within 3 or 4 years after previous treatment.

3.3 ZONING

Zoning determines the type and intensity of development which may occur in the future within defined districts of the community. As such, it is one of the most important tools at the community's disposal to insure the long-term protection of a water supply. By defining critical water resource areas and restricting future land uses within those areas, each community can insure that incompatible or hazardous land uses do not threaten water quality in the future. Sound management of the land uses within the watershed will not only protect the public health, it will also help prevent a contamination incident which could cost millions of dollars in treatment and clean-up costs, and severely restrict availability of adequate water supplies.

3.3.1 WATERSHED SUMMARY

The existing zoning within the Cambridge Reservoir Watershed is predominantly residential. Sixty-seven percent of the watershed or 10,118 acres are zoned as residential with lot requirements of one acre or more. Residential zones with lot requirements under one acre make up 2,556 acres or 17%. Multi-family residential zones represent less than 1% of the area. However, there are 1,526 acres zoned commercial and 101 acres zoned industrial. Together these zones represent 11 percent of the watershed study area (see Map 10, Table 3-30 and Figure 3-6).

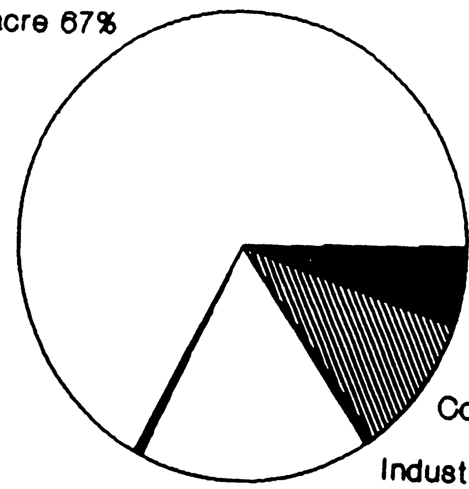
Table 3-30

Zoning Districts in Cambridge Reservoir Watershed

Zoning	Lexington		Lincoln		Waltham		Weston		Total	
District	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Residential ($\geq$ 1 acre)			5,554	94			4,564	82	10,118	67
Residential (< 1 acre)	743	64	14		956	37	843	15	2,556	17
Multi-family			20	1	7		43	1	70	
Industrial					52	2	49	1	101	1
Commercial	317	28	21		1,119	43	69	1	1,526	10
Cons/Rec					78	3			78	
Water	92	8	279	5	391	15			762	5
TOTAL	1,152	100	5,888	100	2,603	100	5,568	100	15,211	100

Figure 3-6

Zoning Districts in Cambridge Reservoir Watershed



3.3.2 COMMUNITY ZONING DISTRICTS

The zoning bylaws for each of the communities within the Cambridge Reservoir watershed are summarized below.

3.3.2.1 Lexington Zoning Districts

Eight zoning districts fall within the watershed study area of Lexington. Four of the districts are residential zones comprising 64% of the watershed. The remaining four districts are zoned commercial and make up 28% of the watershed. The following tables and figures further describe Lexington's zoning districts.

Table 3-31 shows parcel size requirements and allowable lot coverages for each district within the watershed. The conventional residence districts RS and RO require less than 1 acre as a minimum lot size. Both Residential RO and RS are designed to accommodate single family residences in a conventional manner or may accommodate a planned residential development through conventional subdivisions, cluster subdivisions or special residential developments.

Table 3-31

Lexington Zoning Districts-
Lot Size and Coverage Requirements

Zone	Minimum Lot Size (s.f.)	% Lot Coverage
Residence RO	30,000	15
Planned RO	100,000	developable area X 0.85/30,000
Residence RS	15,500	15
Planned RS	100,000	developable area X 0.85/15,500
Commercial-		
Regional Office	CRO	5 acres 25
Local Office	CLO	30,000 20
Service	CS	20,000 25
Planned	CD	

Table 3-32 and Figure 3-7 illustrates that residential zoning dominates the watershed in Lexington. However, there is a significant area zoned commercial, 317 acres or 28%.

Table 3-32

Lexington Zoning Districts - Acres and
Percentage of Watershed Area in Lexington

Zone	Acres	Percentage of Area
Residential (< 1 acre)		
(RO, PRO, RS, PRS)	743	64
Commercial		
(CRO, CLO, CS, CD)	317	28
Water	92	8
Total	1,152	100

Figure 3-7

Lexington Zoning Districts in
Cambridge Reservoir Watershed

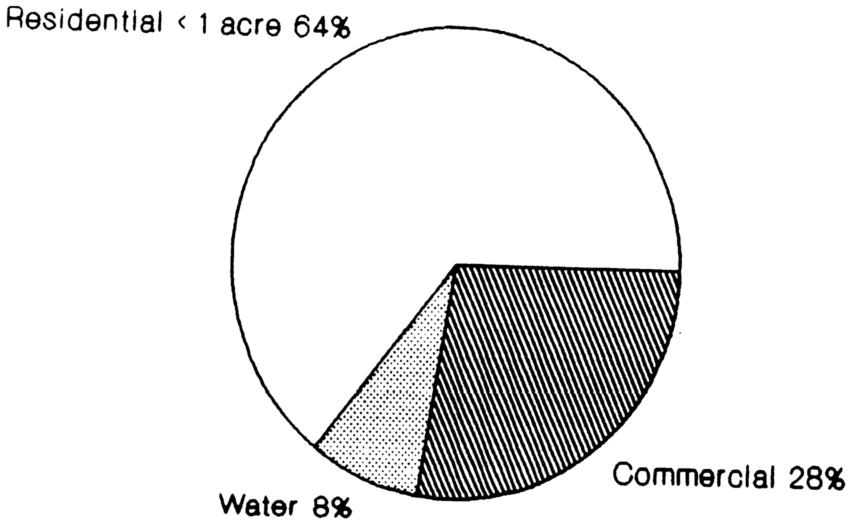


Table 3-33 describes the districts allowed uses, special permit uses and associated potential water supply impacts.

Table 3-33

Lexington Zoning Use Regulations

	Permitted Uses	Uses Allowed By Special Permit	Potential Water Supply Impacts
RESIDENTIAL - (R0 and RS)	one-family detached dwelling accessory apt. in a one-family	conversion of one family to a two family one-family attached	septic systems undergrnd fuel pesticides fertilizers

Table 3-33 continued

	Permitted Uses	Uses Allowed by Special Permit	Potential Water Supply Impacts
	churches, temples schools, public/ private non-profit schools, parks cemetery farming- crop & livestock playgrounds	two family one-family conversion to congregate facility townhouses planned residential development municipal building converted to a residence home occupation- doctor, dentist, office day care center museum, library golf course, commercial greenhouse roadside farm stand sale of earth material horseback riding	urban runoff
COMMERCIAL- CRO, CLO, & CB	churches, temples schools, colleges parks, playgrnds museums, galleries libraries, cemetery farm- crops and livestock comm operations within enclosed bldg real estate mngt bank, medical office professional serv business offices	non-profit day care, nursery school comm greenhouse CRO (only)- sale of earth material	septic systems hazardous materials undergrnd fuel urban runoff fertilizers pesticides

Lexington Overlay District

Wetland Protection District

The purpose of the district is to preserve and maintain the groundwater table; to protect the public health and safety by protecting persons against the the hazards of flood water inundation; and to protect the community against the costs which may be incurred when unsuitable development occurs in swamps, marshes, along water courses, or in areas subject to floods.

Permitted uses include woodland, grassland, wetland, agricultural, horticultural, or recreational use of land or water, provided such does not require filling of the land. Special permits are required for the construction of buildings. And, the prohibited uses include: landfills or dumping and excavation of any kind, drainage work by anyone other than an authorized agency, damming or the relocation of any water course except as part of an overall drainage plan, buildings or structures, the permanent storage of materials or equipment.

National Flood Insurance District
This district is to insure proper flood plain management consistent with the National Flood Insurance Program. A special permit must be granted for construction or substantial improvements are made to and existing structure. Areas designated as a floodway are restricted to limited construction.

3.3.2.2 LINCOLN ZONING DISTRICTS

In the town of Lincoln there are five zoning districts within the Cambridge Reservoir Watershed. Three districts are residential, R1, R2, and R4. R1 is residential with a minimum lot size requirement greater than 1 acre. R1 makes up 5,554 acres of the watershed or 94% of the watershed located in Lincoln. R2 and R4 residential zones require less than 1 acre as the minimum lot size. These zones amount to 34 acres and less than 1% of the watershed area found in Lincoln. There are two commercial zones in the study area, service business and retail business. The commercial zones equal 21 acres, also less than 1% of the watershed. The following several tables and figures further define the zoning districts found within the Cambridge watershed in Lincoln.

Table 3-34 shows parcel size and percent coverage requirements for zoning districts within the reservoir watershed. Residence 1 is a large lot district requiring nearly over two acres as the minimum lot size.

Table 3-34

Lincoln Zoning Districts-
Lot Size and Coverage Requirements

Zone		Minimum Lot Size (s.f.)	% Lot Coverage
Residence	R-1	80,000/conventional	25
		10 acres/cluster	25
General	R-2	12,000/1 unit	25
		10,000/2-3 units	25
		8,000/4+ units	25
Planned	R-4	25 acres	25
Business			
Service	B-2		25
Retail	B-1	6,000	25

Table 3-35 and Figure 3-8 illustrate the acreages of zoning districts within the watershed and the relative percentages of the various zones. The low density residential district R1 dominates the watershed area covering 94%. In Figure 3-8, Other refers to R2, R4, and Commercial districts which are higher density districts, making up 1% of the watershed in Lincoln or 55 acres.

Table 3-35

Lincoln Zoning Districts - Acres and Percentage of Watershed Area in Lincoln

Zone	Acres	Percentage of Area
R1	5,554	94
R2	14	
R4	20	1
Commercial	21	
Water	279	5
Total	5,888	100

Figure 3-8

Lincoln Zoning Districts in Cambridge Reservoir Watershed

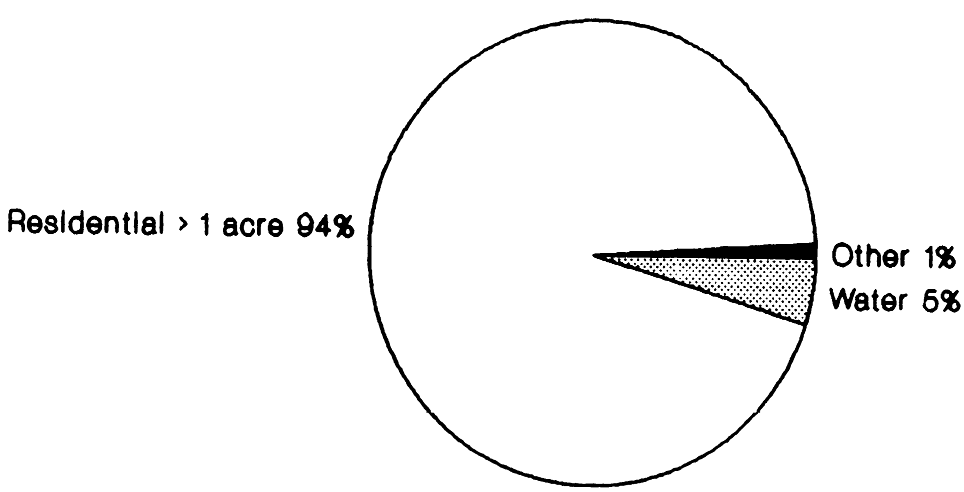


Table 3-36

Lincoln Zoning Use Regulations

	Permitted Uses	Uses Allowed by Special Permit	Potential Water Supply Impacts
RESIDENTIAL R-1	one-family detached rooming house - (only 3 lodgers) museums, libraries parks, playgrounds conservation area water supply area operated by the town or private charitable group preservation of land in natural condition, fields, pastures, woodlots orchards, nurseries truck garden and farm professional office studio, laboratory	hospitals, sanitorium nursing home community or country club comm greenhouse poultry/home use dog breeding horse riding/hire private TV/radio tower private library/museum any occupation with the need of parking for 4 cars on a regular basis	septic systems underground fuel pesticides fertilizers urban runoff
R-2	same as R-1 including- two-family dwelling (with one house/lot) limited type of multi-family- garden apts row houses or town houses		septic systems underground fuel fertilizers urban runoff
R-4	same as R-1 including- detached, semi-detached & multi-family units		septic systems underground fuel fertilizers urban runoff
BUSINESS B-1	retail store barber shop beauty shop laundry dry cleaning shoe repair business or professional office, bank restaurant rail or bus terminal Post Office		septic systems underground fuel hazardous materials urban runoff

Table 3-36 continued

	Permitted Uses	Uses Allowed by Special Permit	Potential Water Supply Impacts
B-2		car repair service or other light equipment repair business or professional offices craft workshop sale & rental of light equipment barber shop hairdresser dry cleaning outlet light manufacturing & assembly generating no noise, smoke or odor offices for general building, maintenance landscaping, electrical restaurant	

Overlay Districts

Open Space Conservation District
This overlay district is intended for the preservation and maintenance of the ground water table upon which the inhabitants of the town and other municipalities depend for water supply; for the protection of the public health and safety of persons and property against the hazards of flood water inundation; for the protection of the community against costs which may be incurred when unsuitable development occurs in swamps, marshes, along water courses, or in areas subject to floods; to preserve and increase the amenities of the Town; and to conserve natural conditions and general welfare of the public.

There are four areas within the Cambridge Reservoir watershed designated by the town of Lincoln as Open Space Conservation. These areas are: about 8 acres surrounding Valley Pond, 2 acres on a river edge adjacent to Hidden Path and Tower Road in a southern section of Lincoln, about 50 acres north of Sandy Pond, and three parcels totalling to about 119 acres which follow Stoney Brook and surround Beaver Pond.

Permitted uses include; conservation of water, plants and wildlife, recreation, grazing and farming, forestry, small structures with non-commercial recreational uses, and dams and ponds. Use by special permit are; non-residential buildings (barns, stables and kennels), temporary storage of materials or equipment, town cemetery and town well. Restricted uses are; landfills, drainage work by any persons other than those authorized by a public agency, buildings or structures and permanent storage of materials or equipment.

Wetland and Watershed Protection District
The purpose of the district is to preserve and maintain the groundwater table; to protect the public health and safety by protecting persons against the the hazards of flood water inundation; and to protect the community against the costs which may be incurred when unsuitable development occurs in swamps, marshes, along water courses, or in areas subject to floods.

Permitted uses conservation of soil, water, plants and wildlife, flower or vegetable gardens, lawns, pastures, grazing and farming, nurseries or recreational use of land or water, duck walks, foot and bike paths, and driveways and roads where alternative means of access are inappropriate and not reasonably feasible. Special permits are required for any uses prescribed by the underlying zones.

National Flood Insurance District
This district is to insure proper flood plain management consistent with the National Flood Insurance Program. A special permit must be granted for construction or substantial improvements are made to and existing structure. Areas designated as a floodway are restricted to limited construction, there shall be no encroachments, including fill, new construction, substantial improvements, or other development.

3.3.2.3 WALTHAM ZONING DISTRICTS

There are seven zoning districts within the watershed in Waltham. Four are Residential; A1, A2, A3, and C. All residential districts have minimum lot requirements less than 1 acre. These residential districts cover 928 acres, or 37% of the watershed area. Commercial uses cover 1,074 acres, or 43% of the area. Industrial uses cover 47 acres or 2% of the area. The remaining 18% or 447 acres of the watershed are surface water and conservation recreation areas. The following tables and figures further illustrate the zoning districts within the Cambridge Reservoir Watershed in the Town of Waltham.

Table 3-37

Waltham Zoning Districts-
Lot Size and Coverage Requirements

Zone	Minimum Lot Size	% Lot Coverage
Residence A1	20,000	20
Residence A2	15,000	20
Residence A3	9,600	25
Residence C	6,000	15
Commercial	10,000	--
Limited Comm.	5 acres	25
Industrial		

Table 3-38 and Figure 3-9 illustrate the acreages of zoning districts within the watershed and the relative percentages of the various zones. The greatest area of the watershed is zoned Commercial and Industrial making up 45% or 1,121 acres. The next dominant use is residential at 37% or 928 acres. These residential areas are high density requiring less than one acre parcels. The remaining 18% or 447 acres are low density areas, Water and Conservation\Recreation.

Table 3-38

Waltham Zoning Districts - Acres and Percentage of Watershed Area

Zone	Acres	Percentage of Area
Residential (A1, A2, A3)	956	37
Multi-family (Res. C)	7	
Commercial	1,119	43
Industry	52	2
Cons\Rec	78	3
Water	391	15
Total	2,603	100

Figure 3-9

Waltham Zoning Districts in Cambridge Reservoir Watershed

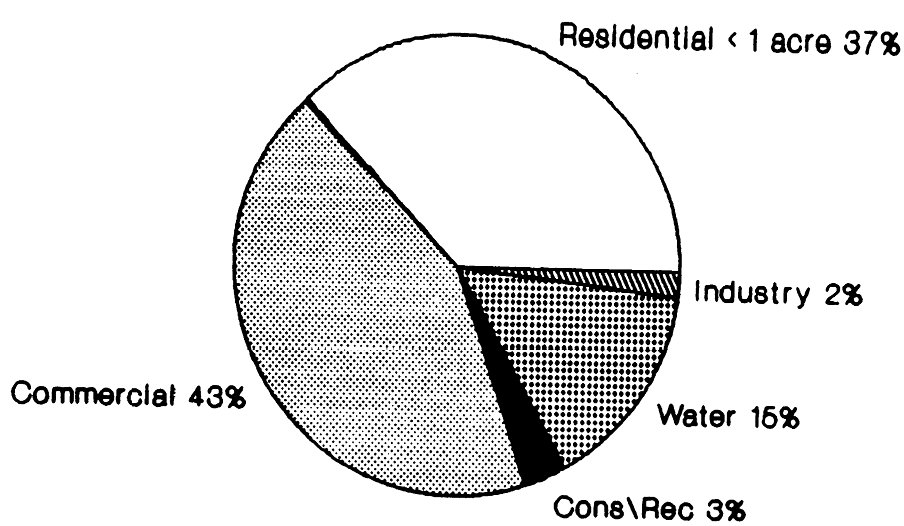


Table 3-39 describes the zoning districts allowed uses, uses by special permit and the water supply impacts associated with the various uses.

Table 3-39

Waltham Zoning Use Regulations

	Permitted Uses	Uses Allowed by Special Permit	Potential Water Supply Impacts
RESIDENTIAL A1, A2, A3	single-family rooming house hospitals in-house medical office home occupations churches, educational uses farm- livestock (under 5 acres) R.R. & transit station windmills	accessory dwelling family day care nursing homes sanitoriums public service corps membership clubs municipal bldgs cemeteries	septic systems underground fuel pesticides fertilizers urban runoff
RESIDENTIAL C	single-family 2-family detached multi-family rooming houses lodging houses day care medical offices in residences private garage churches educational uses municipal bldgs cemeteries R.R. transit stat. windmills farms livestock farms over 5 acres farm stands	hotel\motels hospitals sanitoriums public service corps. membership clubs off street parking livestock farms under 5 acres	septic systems underground fuel pesticides fertilizers urban runoff
COMMERCIAL C	private garage public garage churches educational uses membership clubs arcades	hotel/motels public service corps drive-in customer service fast food	septic systems underground fuel hazardous materials urban runoff pesticides

Table 3-39 continued

	Permitted Uses	Uses Allowed by Special Permi	Potential Water Supply Impacts
	retail store	establishments	fertilizers
	laundromat	theaters (indoor)	
	business and	car wash	
	professional	used car lot	
	offices	associated	
	banks	commercial	
	retail gas stat.	recreation	
	restaurants	heavy trucking	
	taverns	& equipment storage	
	funeral homes	research labs	
	private schools	autobody	
	radio studios	airports	
	newspaper	farm- livestock	
	& printing	(under 5 acres)	
	wholesale storage		
	& warehousing		
	R.R. & transit		
	station		
	windmills		
	light manufacturing		
	general manufacture		
	farms		
	farm stands		
Limited Commercial	private garage	hotel/motel	septic systems
	public garage	drive-in serv	undergrd fuel
	churches	theater (indoor)	hazardous
	educational uses	assoc. commercial	materials
	business\profess.	recreation	urban runoff
	offices, banks	research lab	pesticides
	arcades	airports	fertilizers
	radio & TV	accessory	
	R.R. station &	manufacturing uses	
	transit		
	Light manufacturing		
	farms		
	farm- livestock		
	(over 5 acres)		
	farm stands		
INDUSTRIAL	private garage	public service	septic systems
	public garages	drive-in consumer	undergrnd fuel
	churches	service	hazardous
	educational uses	fast food	materials
	membership clubs	establishments	urban runoff
	retail stores	theaters (indoor)	pesticides
	laundromats	car wash	fertilizers
	business & profess.		used car lot

Table 3-39 continued

	Permitted Uses	Uses Allowed by Special Permit	Potential Water Supply Impacts
	offices, banks arcades retail gas stat. restaurants taverns funeral homes private schools radio & TV studio newspaper publish & printing accessory comm. uses wholesale storage & warehousing R.R. transit & stat. windmills electric lighting, gas works & power stations fuel oil & gas storage trucking terminals light manufacturing general manufacture steam laundry accessory manufacturing uses farms, farm stand farm- livestock (over 5 acres)	assoc. commercial recreation heavy trucking & equipment storage research labs autobody shop plastics manufacturing junkyards auto recycling center farm- livestock (under 5 acres)	
CONSERVATION/ RECREATION	churches educational uses accessory comm farm farm- livestock (under 5 acres) water & water supply public outdoor recreation facility	semi-public recreation facility	septic systems undergrnd fuel fertilizers pesticides

3.3.2.4 WESTON ZONING DISTRICTS

The Cambridge Reservoir Watershed area located in Weston encompasses seven zoning districts. Five districts are residential; single-family A, B, C, D and multi-dwelling B. Residential districts A, B, and C require a parcel of greater than 1 acre and cover 4,564 acres or 82% of the watershed area in Weston. Residential D and multi-dwelling B require as the minimum lot size less than 1 acre. These higher density zones cover 886 acres and comprise 16% of the watershed area. Commercial and industrial uses cover 118 acres and make up 2%. The following tables and figure further illustrate these zoning districts.

Table 3-40

Weston Zoning Districts-
Lot Size and Coverage Requirements

Zone	Minimum Lot Size	% Lot Coverage
Residence A	60,000	
Residence B	40,000	
Residence C	30,000	
Residence D	20,000	
Multi-dwelling	600,000	20
Business A		25
B		25
Industrial		

Table 3-41

Weston Zoning Districts - Acres and
Percentage of Watershed Area in Weston

Zone	Acres	Percentage of Area
Residential > 1 acre (A & B)	4,564	82
Residential < 1 acre (C & D)	843	15
Multi-family	43	1
Commercial (Bus. A & B)	69	1
Industry	49	1
Total	5,568	100

Figure 3-10

Weston Zoning Districts
in Cambridge Reservoir Watershed

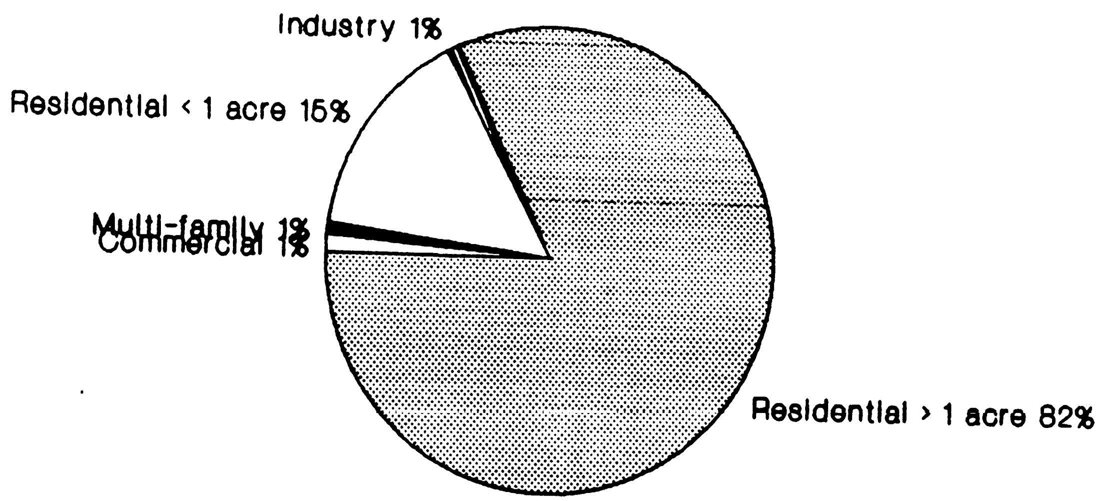


Table 3-42

Weston Zoning Use Regulations

	Permitted Uses	Uses Allowed by Special Permit	Potential Water Supply Impacts
RESIDENTIAL A, B, C & D	one-family detached office or studio of a doctor dentist, architect teacher, artist, musician, lawyer, customary home occupation farm lodging for 4 or less	non commercial club child care center charitable instit. hospital, sanitorium commercial greenhouses	septic systems undergrnd fuel pesticides fertilizers

Table 3-42 continued

	Permitted Uses	Uses Allowed by Special Permit	Potential Water Supply Impacts
Multi-Dwelling B	multiple dwellings with a requirement of open space		
BUSINESS A & B	eating place office or office building medical or health center non-commercial club store, sales or showroom for retail business personal service business filling station & garage & repair		septic systems underground fuel hazardous material
RESEARCH & DEVELOPMENT	office or office bldg research or laboratory (not manufacturing) professional or management training facility medical or health center personal service facilities-cafeterias, banks etc. (for use of occupants not general public)		septic systems underground fuel

Weston Overlay District

Wetlands and Flood Plain Protection District, A and B

No construction requiring any utility, including electric, water, gas and telephone lines, or waste disposal or drainage facilities shall be permitted within the district without a special permit. All new construction in District B shall have all utility and sanitary facilities designed so that below the base flood level the structure is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy as determined and certified by a registered professional engineer. There will be no encroachments within Distict B or its regulatory floodway including fill, structures, of any type, new construction, substantial improvements and other developments.

CHAPTER FOUR Existing Regulations and Protection Measures

4.0 Introduction

This chapter describes the existing regulations and protection measures related to the potential sources of contamination and critical resources identified in the previous chapters.

A host of federal, state, and local regulatory programs are pertinent to the potential sources of contamination identified Chapter 3. Under the Massachusetts Home Rule system, the most direct control of land use rests with local government. However, a number of specific activities are regulated by state and federal environmental statutes. Some federal regulations are delegated to the state for implementation (such as the hazardous waste regulations under RCRA), and likewise some state regulations are delegated to the local level for implementation (such as Title 5 and the Wetlands Protection Act). Taken as a whole, the patchwork of federal, state, and local regulations provides a degree of protection to drinking water resources in the Cambridge Reservoir watershed area. However, since water supply protection is not the primary aim of many of these regulations, and since jurisdiction is fragmented among many federal, state, and local agencies, there remain weaknesses in the overall existing system of controls which Cambridge must rely upon to insure the long term protection of its primary source of drinking water. The following chapter will address ways in which those protection measures could be strengthened at the state and local levels.

4.1 Regulations and Protection Measures Related to Potential Sources of Contamination

The activities which were identified as potential sources of contamination in Chapter 3 are governed by various federal, state, and local regulations. The authority, jurisdiction, and requirements of those regulations are presented in this section.

4.1.1 Wastewater Discharges

Clean Water Act, NPDES Discharge Permits

At the heart of the Clean Water Act's regulatory framework is the National Pollution Discharge Elimination System (NPDES) permit program. This program requires the permitting of all discharges of pollutants to surface waters. The NPDES permits set limits on the maximum level of pollutants based on the water quality standards for the receiving waters. Under the Act, the EPA may delegate authority to the states to implement the provisions of the law. Massachusetts has applied for delegation authority, and currently the Act is jointly implemented by the EPA and the Massachusetts Department of Environmental Protection (formerly DEQE). The state has adopted regulations necessary to implement the requirements of the Clean Water Act. These are summarized below:

314 CMR 3.00 Massachusetts Surface Water Discharge Permit Program

AUTHORITY: regulations developed under M.G.L. c. 21, s. 43

JURISDICTION: regulates all discharge of pollutants to surface waters of the Commonwealth, also regulates outlets for such discharges and any treatment works associated with these discharges.

Provisions of 314 CMR 3.00 implements those provisions of the Federal Act and regulations adopted thereunder necessary for the Division to assume delegation from the EPA to implement the NPDES permit program within the Commonwealth.

REQUIREMENTS: no person shall discharge pollutants to surface waters of Commonwealth without a currently valid permit from the Director and no person shall construct, install, modify, operate or maintain an outlet for discharge without having first obtained a permit or written approval from Director.

Discharges requiring a permit include:

a) all point source discharges of pollutants to surface water
b) concentrated aquatic animal production facilities
c) any cold or warm water aquatic animal production facility that is a significant contributor of pollution as determined by the Director
d) discharges into Aquaculture Projects
e) Silvicultural point sources
f) concentrated animal feed operations.

Other activities requiring a permit include:

a) activities which directly or indirectly result in discharges of pollutants to waters of the Commonwealth
b) storm water discharges.

Storm water discharge includes any system primarily used for collecting and conveying storm water runoff, but not including combined municipal sewer systems, and which;

1. Discharges storm water runoff contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, or oil and grease, or
2. As designated by the Director as a "storm water discharge" such discharges may include;

    a) discharges subject to effluent limitations guidelines or toxic pollutant effluent standards, or
    b) discharges located in an industrial plant where there is potential for discharge of storm water contaminated by contact with process wastes, raw materials, toxic pollutants or hazardous substances.

EXEMPTIONS:

The following are exempted from permit requirements under this program;

1) discharge of sewage from vessels
2) discharge of dredge or fill regulated under Section 404 of the Federal Act
3) introduction of sewage, industrial waste or other pollutants into treatment works
4) discharges in compliance with the instructions of On Scene Coordinator (as defined 40 CFR Part 1510) as necessary to abate an imminent hazard to public health or safety
5) non-point source agricultural and silviculture activities related pollutants
6) return flows from irrigated agriculture
7) conveyance or system of conveyance for collecting and conveying storm water runoff which does not constitute a "storm water discharge".

PERMIT PROCESS: The owner of the treatment works or activity resulting in a discharge of pollutants shall apply for a permit at least 180 days before the date on which the discharge is to commence. Renewal of permits must be submitted at least 180 days prior to expiration of existing permit. Permits are issued by the Director for a period of 5 years or less.

Permits conditions establish effluent limitations and standards, duration of the permit, monitoring, record keeping and reporting requirements and schedules of compliance where applicable. As a minimum, permit limitations are based on water quality standards of the receiving waters as assigned in the Massachusetts Surface Water Quality Standards, 314 CMR 4.00.

As noted in Technical Memo No. 3, there is one NPDES permit for a stormwater discharge in the Cambridge reservoir watershed. This permit sets maximum levels of solids, nitrates, phosphates, lead, turbidity, and oil and grease which may be discharged from the site. It should be noted that such stormwater discharges in the watershed are not automatically regulated under the NPDES program, but their inclusion in the program is at the discretion of the implementing agencies, EPA and DEP.

Massachusetts Groundwater Discharge Permit Program

Unlike surface water discharges, the Clean Water Act does not regulate wastewater discharges to groundwater. However, Massachusetts has state regulations which control discharges to the ground in a manner similar to that of the NPDES permit program. This program is summarized below:

314 CMR 5.00 Massachusetts Ground Water Discharge Permit Program

PURPOSE AND AUTHORITY: establishing program whereby discharges of pollutants to groundwater are regulated by the Division of Water Pollution Control, DEP pursuant to M.G.L. c. 21, s. 43 (Dept. Environmental Protection). Also requires that the Division regulate outlets of discharges and any treatment works associated with discharges.

PERMITTED ACTIVITIES:

The following activities require a permit from DWPC;

- discharge of liquid effluent onto or below the land surface,
- discharge of a liquid effluent to a percolation pit, pond or lagoon,
- discharge of liquid effluent via subsurface leaching facilities including leaching pits, galleries, chambers, trenches fields and pipes,
- discharge of liquid effluent into Class V injection wells,
- associated unlined pit, pond, lagoon, or surface impoundment in which wastewaters or sludges are collected, stored, treated or disposed and from which a liquid portion seeps into the ground,
- storm water discharges contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances or oil and grease to a leaching facility, or percolation pit, pond or lagoon.

EXEMPTIONS:

Permits are not required under this program for the following;

- discharges as a result of sewage treatment at works designed to receive and receiving 15,000 gpd or less and in accordance with 310 CMR 15.00 (Title 5),
- recharge well to replenish water in aquifer with uncontaminated water,

- o discharges as ordered by On Scene Coordinator pursuant to 40 CFR Part 1510 as necessary to abate an imminent hazard to public health or safety (emergency discharges),
- o return of waters used for heating or cooling energy in a heat exchanger with flows less than 15,000 gpd,
- o discharge of non-contact cooling waters with flow under 2,000 gpd and temperatures under 40^{o}C,
- o recirculation of landfill leachate over an area designed with liner and collection system for recycling leachate,
- o storm water runoff, which does not constitute a "storm water discharge"
- o pollutants from non-point source agricultural silviculture, land management or right of way maintenance activity,
- o landfill not associated with a point source discharge and that do not result in water quality standard violation
- o land application of sewage sludge provided it is performed in accordance with an approved plan.

PERMIT PROCESS: permits issued for 5 years or less on a case by case basis.

- o no discharge shall result in violation of Mass. Surface Water Quality Standards (314 CMR 4.00) or the Mass. Ground Water Quality Standards (314 CMR 6.00)
- o permits include: effluent limitations, duration of permit, monitoring, record keeping and reporting requirements, and where applicable, schedules of compliance
- o regulations contain effluent limitations for different class waters.

State Environmental Code, Title 5

The state's regulations for on-site sewage disposal systems are found at 310 CMR 15.00, Title 5 of the State Environmental Code. The regulations are adopted by the state but implemented by local Boards of Health. Major provisions of the Title 5 regulations include:

- o siting criteria for septic systems, based on soil and groundwater conditions as documented by percolation tests and deep observation holes. Soil percolation rates must be at least 30 minutes per inch and depth to water table must be at least four feet.

- o septic system design requirements, including size of septic tank based on specified sewage flow estimates, and leaching facility sizing based on percolation rate and sewage flow estimates.

- o setback requirements between septic system components and surface water supplies (reservoirs or tributaries), wells, and watercourses (streams, ponds, lakes, wetlands, swamps, bogs, etc.).

- design requirements for leaching facilities, which may include leaching pits, galleries, chambers, trenches, or fields.

- permits for disposal works installers and septage haulers.

Local Health Regulations

Local Boards of Health may adopt regulations more stringent than Title 5 for the protection of public health. These may be adopted by a vote of the Board of Health. Lincoln and Weston have adopted such regulations.

Lincoln Health Regulations

- leaching area requirements: increased by 50 percent to provide for installation of garbage disposal units

- setbacks: all components of the septic system must be at least 100 feet from any watercourses.

- septic tanks: must be at least 200 percent of the design flow, with a minimum of 1500 gallons.

- leaching fields are prohibited.

- watercourses are defined to include seasonal watercourses.

Weston Health Regulations

- suitability of the site: Board of Health may require additional test pits and/or percolation tests, and may require that testing be performed at another time to obtain more valid data.

- systems approved for new construction after May 1, 1989 must be installed in naturally occurring soil, and must not be filled above the original existing grade elevations

- setbacks: all components of the septic system must be at least 100 feet from any well or wetland.

- volume of sewage: all rooms which could serve as a bedroom shall be defined as such in calculating sewage flow.

- leaching area requirements: increased by 50 percent to provide for installation of garbage disposal units.

- deep observation holes: must be installed between March 15 and April 30. If there has been inadequate precipitation to provide valid water table determinations, Board may:

    - check for mottling or oxidation marks in soil;
    - calculate probable high watermark based on historical evidence, monitoring wells, or survey data;
    - require more test data;
    - require a repeat test in a subsequent high water season.

- Water table correction factor may be established by the Board for use during any segment of a testing period

- Percolation tests: must be performed between March 15 and May 31, except sites with a percolation rate faster than ten minutes per inch may be tested at any time of year.

- Hydrological Survey to determine impact on subsurface waters may be required where design flow is greater than 2000 gallons per day, or where the discharge is non-residential.

- Maintenance and repair requirements:

  - septic tanks must be inspected and pumped every 3 years.
  - systems greater than 2000 gallons per day must be inspected by a licensed disposal works installer and pumped every 3 years, with proof of inspection and results submitted to the Board of Health.

  - the use of enzymes, degreasers, and additives requires written permission of the Board of Health.

- Systems in wetlands and floodplains shall be designed to minimize or eliminate discharges from the system into flood waters.

4.1.2 Stormwater Runoff

<u>Clean Water Act, NPDES Discharge Permits</u>

As noted in section 2.1.1 above, stormwater runoff which is designated by DEP as a "stormwater discharge" requires a discharge permit under the NPDES system. Only one such stormwater discharge has been regulated under the NPDES program in the Cambridge watershed area, that being the Bay Colony development. The NPDES permit for that facility was issued in 1985 and establishes effluent limitations for solids, nitrate, phosphate, turbidity, lead, oil, and grease. The permit also prohibits the use of sodium chloride and the application of pesticides, and restricts the use of fertilizers.

Under the regulations, not all stormwater runoff is categorically regulated by the NPDES permit program. Determination of applicability is made on a case by case basis at the discretion of the permit issuing agencies, EPA and DEP. Recent amendments to the Clean Water Act will increase the regulation of stormwater discharges in larger cities, but stormwater in the watershed communities will continue to be regulated on a case by case basis.

<u>Massachusetts Groundwater Discharge Permits</u>

As noted above in section 2.1.2, stormwater runoff may be regulated as a stormwater discharge under the Groundwater Discharge Permit program if the discharge is contaminated with process wastes, toxic pollutants, hazardous substances, or oil and grease, and the discharge is to a leaching facility or percolation pit, pond, or lagoon. There are no such groundwater discharges of stormwater runoff permitted under the program in the Cambridge watershed area.

Massachusetts DPW Reduced Salt Experiment Program

As noted in Technical Memo No. 3, the state Department of Public Works has been conducting an experimental reduced salt program on state-maintained highways since 1986. The program in the Cambridge watershed area involves Routes 128, 2, 2A, and 20, totalling about 96 lane-miles of highway. Rather than following the standard practice of applying 300 pounds of sodium chloride per lane-mile in this area, the MDPW applies one part sand to one part Pre-Mix at a rate of 400 pounds per lane-mile. Pre-Mix is a commercially available deicing agent which contains one part calcium chloride to four parts sodium chloride. In the first two years of the program (1986-88), MDPW estimates that the amount of sodium applied in the watershed was reduced by 61 percent compared to standard treatment. The program has continued through the winter of 1988-89, and MDPW is currently working on an updated status report on the program.

State Transportation Bond

Section 2(a) of the 1988 state Transportation Bond provided for up to $20 million for treatment or elimination of road drainage into Stony Brook or Hobbs Brook Reservoirs or onto land within 500 feet of the reservoirs. The Massachusetts Department of Public Works has retained an engineering consulting firm to conduct the necessary studies and environmental reviews to carry out this provision. The consultant will first prepare an Environmental Notification Form (ENF), and later an Environmental Impact Report (EIR) which evaluate and compare two alternatives:

- a closed drainage system which diverts the drainage out of the reservoir watershed; and
- a closed drainage system with treatment and discharge within reservoir watershed.

Both alternatives would include a snow berm system. In addition to undergoing environmental review pursuant to the Massachusetts Environmental Policy Act (MEPA), the project would likely require the following additional reviews and approvals:

- Federal Highway Administration approval, which may entail an Environmental Assessment or Environmental Impact Statement;
- Army Corps of Engineers Section 404 permit;
- Wetlands Order of Conditions or Variance;
- Water Quality Certificate from DEP.

Waltham Reduced Salt Program

As described in Technical Memo No. 3, the city of Waltham has a program of reduced salt application in the Hobbs Brook reservoir watershed. Calcium chloride is used instead of sodium chloride on Trapelo Road, Smith Street, and Wyman Street, over a total of about six lane-miles. The city plans to outfit two trucks with equipment capable of applying liquid calcium chloride for the winter of 1989-90. The reduced salt program does not include the portion of Waltham in the Stony Brook Reservoir watershed.

Local Subdivision Regulations

Subdivision regulations are intended to provide a community with oversight in the land development process. The regulations generally include standards for street designs, sidewalks, utilities, water supply, and drainage. The storm drainage provisions have the most relevance to the water resources of the watershed. The water resources related provisions of the watershed communities' subdivision regulations are summarized below.

Lexington

Lexington's Development Regulations require that a Preliminary Site Development Plan include a site analysis which describes:

- water systems (surface water, wetlands, 100-year flood elevations, and direction of drainage;
- significant soil types;
- contours and slopes;
- bottom elevations of streams and water bodies.

When there are extensive wetlands or topography which may cause accelerated runoff, or an extraordinary drainage system is proposed, the Board may require hydraulic, hydrologic, and drainage analysis so the town engineer may determine the feasibility of the drainage system.

The Definitive Site Development Plan must have a drainage plan which includes calculations used in design demonstrating the adequacy of the proposed drainage system; compatibility with existing systems, flood elevations of the 100-year storm, and ground and surface water elevations.

The subdivision regulations also include Design Standards which require that storm drains and culverts be designed to provide for safe, unimpeded flow of natural water courses and drainage of low areas. Culverts are to be designed for the 50-year storm flow.

Lincoln

Lincoln's subdivision regulations include a general requirement that natural water courses and ponds may not be filled, altered, drained, or relocated. An Environmental Impact Statement is required which must include:

- o location, extent, and type of existing water and wetlands, including surface drainage characteristics, within and adjacent to the subdivision;
- o methods to be used during construction to control erosion and sedimentation;
- o permanent methods to control erosion and sedimentation, including estimated increase of peak runoff and methods to be used to return water to the soils.

Waltham

Preliminary plans must show :

- o relationship of soils to surface runoff;
- o relationship of soils to seasonal high water table;
- o soil limitations for development;
- o profile of all proposed drains together with a cross section of any open channel streams.

Definitive plans must also include a profile of all proposed drains, complete with invert elevations and drain line gradients.

There are design standards which require that storm drains be installed to permit unimpeded flow of all natural watercourses and to insure adequate drainage of all low points along streets.

Weston

The town's subdivision regulations require that Preliminary Subdivision Plans show drainage provisions, including adjacent existing natural waterways, as well as boundaries of the Wetlands and Floodplain Districts with their elevations.

Definitive Subdivision Plans must include a leaching site plan which shows the location of percolation and groundwater tests on each lot, as well as the extent of the leachfield capable of accepting septic tank effluent from four bedrooms plus a garbage disposal unit.

There are Design Standards which require that slopes and areas where topsoil is removed be loamed with topsoil and seeded. The board may require appropriate measures to control erosion and sedimentation during construction.

Local Site Plan Review

Site Plan Review is used by some communities to review the development plans for significant developments such as commercial and industrial. In the Cambridge watershed, Lexington, Lincoln, and Weston have Site Plan Approval provisions.

Lexington

Lexington's site plan review procedures are part of the town's zoning bylaw. The review is required as part of a special permit for planned residential development of more than 3 dwelling units or for commercial and institutional uses of more than 10,000 square feet.

Prior to granting a special permit, the Board must make the following findings:

- the development will not create adverse impacts, including those that may occur off the site, or such potential adverse impacts will be mitigated;
- the development will not present an adverse impact on the surrounding area resulting from pollution of water ways or groundwater or discharge of hazardous materials;
- that all measures necessary to minimize soil erosion and to control sedimentation are taken, including minimizing velocities of runoff, maximizing protection of disturbed areas, and retaining sediment within the development;
- that no development shall cause downstream properties, water courses, or channels to receive stormwater runoff at a higher peak flow rate, or to receive other unreasonable impacts, than would have resulted from the same storm event over the site in its natural condition;
- that adequate water quality standards are promoted giving due regard to public water supply in communities which are downstream, by requiring that adequate pollution abatement controls are incorporated into the drainage design.

Linclon

Lincoln's Site Plan requirements are contained in Section 17 of the zoning bylaw. Requirements related to surface water drainage are found in subsection (f) which is summarized below:

- (f) Surface water drainage: Special attention shall be given to proper site surface drainage so that removal of surface waters will not adversely affect neighboring properties or the public storm drainage system. Storm water shall be...carried away in an underground drainage system. Surface water in all paved areas shall be collected at intervals so that it will not obstruct the flow of vehicular or pedestrian traffic, and will not create puddles in paved areas.

Weston

Weston's site plan review bylaw requires a description of the effect on the environment, identifying the specific respects in which the natural features of the area are being changed. The site plan must include:

- o topography, drainage, existing and proposed utilities, soil data, sewerage, storm water disposal, erosion and sedimentation controls, and hydrogeologic evaluation.

Standards and Criteria for site plans include the following:

- o minimize the use of wetlands, steep slopes, and floodplains;
- o the development shall incorporate measures that are adequate to prevent pollution of surface or groundwater, to minimize erosion and sedimentation, and to prevent increased rates of runoff. Drainage shall be designed so that groundwater recharge is maximized, and at the project boundaries the rate of runoff shall not be increased.

4.1.3 Underground Storage Tanks

Massachusetts Fire Prevention Regulations

State regulation of underground storage tanks is the responsibility of the state Fire Marshall in the Department of Public Safety. Underground fuel tanks have traditionally been considered primarily a fire and explosion hazard, thus they have been regulated under the state's Fire Prevention Regulations. In recent years a growing concern for the potential water quality impacts of leaking underground storage tanks, in addition to new federal requirements, have led to the amendment of the Fire Prevention Regulations with respect to leak prevention, monitoring, and leak detection. The current provisions of the regulations are summarized below. The regulations are enforced at the local level by the fire chiefs.

527 CMR 9.00 Board of Fire Prevention Tanks and Containers

PURPOSE: applies to design, construction, installation, testing, and maintenance of tanks and containers. Applies to above ground tanks greater than 10,000 gallons capacity, with provisions dependant on size and use for underground storage tanks

JURISDICTION: Regulations place restrictions on construction materials and emergency standards for all underground tanks, pipes, vents, etc. Requirements for fuel oil tanks of 1,100 gallons or less capacity used exclusively for consumptive use on premises must also meet specific design and construction requirements.

The local fire department must be notified of any new or replacement tank installation.

All tanks (except fuel oil tanks used exclusively for consumptive use, waste oil tanks, and hazardous waste tanks) must be proven secure through either: a) mandatory inventory record keeping, b) in-tank monitoring system, or c) approved double-walled tank with interstitial space monitoring system and liquid removal port. Any new or replacement tanks in an EPA designated sole source aquifer must be double-walled tanks with interstitial space monitoring systems. Further, the fire department may require secondary containment or equivalent protection for new tanks within zone II or within 300' of a private well or water supply reservoir.

Tanks must be tightness tested within 12-24 months of installation.

Existing facilities not designed or constructed as first noted above must have tanks tested during the 10th, 13th, 15th, 17th and 19th year after installation and yearly thereafter.

Tanks which are not double-walled with interstitial space or in-tank monitors must be tested in the 15th and 20th year following installation and at two-year intervals thereafter.

Tanks which leak cannot be relined. The fire department determines whether a tank should be removed, replaced or repaired.

Abandoned tanks include storage tanks requiring a license that are out of service for more than 6 months, and any other storage facility out of service for more than 24 months. The owner of an abandoned tank must obtain a permit for removal from the fire department. Abandoned tanks must be emptied and the tank removed within 72 hours of permit issuance.

Tanks which cannot be removed due to construction restraints as determined by the fire department must be emptied, cleaned and filled with an inert material.

Existing underground tanks, except fuel oil tanks of 1,100 gallons or less capacity used exclusively for consumptive use in the premises, must be upgraded to include a spill containment manhole by May 30, 1990. All underground tanks must be upgraded to include overfill prevention devices by May 30, 1993.

<u>PERMITS</u>: New storage facilities require a permit from the fire department prior to installation. Excluding farm or residential tanks of 1,100 gallons capacity or less used for storing motor fuel for noncommercial purposes and residential or commercial tanks storing heating oil for consumptive use on the premises, existing facilities installed prior to May 9, 1986 must be permitted by the fire department. Owners of tanks requiring a permit must provide proof of installation date or the tank is presumed to be 20 years old prior to May 8, 1986.

Local Underground Storage Tank Bylaws/Ordinances

Cities and towns may adopt measures more stringent than the state regulations through general bylaws and health regulations. Waltham has the only existing local underground storage bylaw in the Cambridge watershed area. The Waltham ordinance (Section 8-106) applies to both aboveground and underground tanks storing hazardous materials, including petroleum products, larger than 1100 gallons. Heating oil tanks connected to a heating system and used for heating purposes only, and which are stored indoors are exempted from the regulations. Major provisions of the bylaw include:

- No new tanks may be installed in the 100-year floodplain;
- Conditions of approval may include:
  - double-walled tank or concrete vaulting
  - monitoring system
  - more frequent testing
  - independent analysis of daily inventory records
- Registration of all existing tanks;
- Corrosion-resistent tank design (fiberglass, cathodic protection, double walled with monitoring, etc)
- Piping with corrosion protection
- Semiannual testing of cathodic protection systems;
- Daily inventory control (heating oil tanks exempted)
- Tank tightness testing at age 20 years and every two years thereafter.

4.1.4 Hazardous Wastes and Materials

<u>Resource Conservation and Recovery Act (RCRA)</u>

Hazardous waste generation, treatment, storage, transportation, and disposal are regulated by the federal RCRA statute, which establishes a "cradle to grave" system to track hazardous wastes from generation to ultimate disposal. EPA has delegated authority to Massachusetts to implement the program, which it does through the Hazardous Waste Management Act (Chapter 21C) and regulations (310 CMR 30.00). These are summarized in the following sections.

310 CMR 30.00 Hazardous Waste Regulations

<u>PURPOSE AND AUTHORITY</u>: promulgated by the Commissioner of the Department of Environmental Quality Engineering under M.G.L. c. 21C, ss. 4 and 6, M.G.L. c. 211, s. 6, and by s. 47 of c. 548 of the Acts of 1987 to regulate the generation, storage, collection, transport, treatment, disposal, use, reuse, and recycling of hazardous wastes. These regulations should be read together with M.G.L. c. 21C, M.G.L. c. 21E, s. 6 and by St. 1987, c. 584, s. 47 each of which has many important substantive requirements not reported in these regulations.

<u>PERMIT PROCESS</u>: Any person who generates or transports hazardous waste or who owns or operates a facility for the treatment, storage, use or disposal of hazardous wastes shall apply to the Department for an EPA identification number.

PERMITTED ACTIVITIES: The regulations identify the characteristics of hazardous wastes and/or specific types or sources of hazardous waste and of acutely hazardous waste to be regulated. Accordingly, a waste is hazardous if any of the following apply:

a) the waste is listed in 310 CMR 30.130 through 30.136 (attached).
b) the waste exhibits any of the characteristics of hazardous waste identified in 310 CMR 30.120 through 30.125 (attached).
c) the waste is a mixture of non-hazardous waste and one or more hazardous wastes limited in 310 CMR 30.130 through 30.136 unless the resultant mixture no longer exhibits any such characteristics of hazardous wastes.

REQUIREMENTS FOR GENERATORS OF HAZARDOUS WASTES

An EPA identification number from the Administrator of the EPA or from the Department is required for a generator to treat, store, use, dispose of, transport, or offer for transportation any hazardous waste.

A generator who transports, or offers for transportation, hazardous waste for off-site treatment, storage, disposal or use shall prepare a manifest. The manifest shall include the primary transporter and the facility and one alternate facility to receive the waste, and instructions for return of the waste to the generator in the event the waste is undeliverable.

Records of all manifests must be maintained by the generator for 3 years, following acceptance of waste by the facility which received the waste. Generators must submit an Annual Report to the Department no later than March 1st of each year. The Annual Report must include:

a) EPA identification of generator,
b) EPA identification of facility the hazardous waste was sent to,
c) identification of all materials shipped off-site.
d) EPA identification of the transporter,
e) description of efforts to reduce volume and toxicity of waste generated, and,
f) changes in volume and toxicity for comparison for each year going back to 1984 or before if available.

The criteria for classifying hazardous waste generators into the categories of Large Quantity, Small Quantity, and Very Small Quantity generators are shown in the table below.

LEVEL OF GENERATORS

	LARGE QUANTITY GENERATOR	SMALL QUANTITY GENERATOR	VERY SMALL QUANTITY GENERATOR
1. regulated recyclable material or non-acutely hazardous waste in calendar month.	>1000 Kilo	<1000 Kilo	<100 Kilo
2. accumulated at any one time non-acutely hazardous waste		<2000 Kilo <6000 Kilo	<600 Kilo
in containers...	>2000 Kilo		
in tanks...	>6000 Kilo		
3. generates regulated recyclable material or acutely hazardous waste in one calendar month.	>1 Kilo	<1 Kilo	0 Kilo
4. accumulated at any one time acutely hazardous waste.	>1 Kilo	<1 Kilo	0 Kilo
5. generated any residue, contaminated soil, water, or other debris resulting from clean-up of a spill, into or on any land or water.	>100 Kilo	<100 Kilo	0 Kilo
6. generates inner liners from containers or paper bags containing residues of regulated recyclable material or waste.	>10 Kilo	<10 Kilo	0 Kilo
7. accumulate hazardous waste on the site of generation without a permit provided materials are properly stored, labelled, handled and secured as stated in the regs.	up to 90 days	up to 18	

Regulations also allow a generator to accumulate hazardous waste in containers at or near the point of generation for any length of time provided the materials are under the supervision of key personnel directly responsible for the process resulting in the generation of such wastes. And provided the waste is accumulated in containers no larger than 55 gallons if the hazardous waste is listed in 310 CMR 30.120 through 30.135 or in 1 quart containers if the hazardous waste is acutely hazardous waste. Once the container is filled and closed it must within 3 days be handled as noted in #7 above.

Large quantity generators and small quantity generators must follow stringent requirements for transport of hazardous materials off site. Very small quantity generators (VSQG) do not have such restrictions and can transport hazardous waste off site of generation without a license to transport and without a vehicle identification device and without a hazardous waste manifest as long as;

a) the VSQG only transports hazardous materials it has generated,
b) the DOT does not prohibit such transport, the materials
c) are transported to either a small quantity generator,
d) a large quantity generator or a licensed hazardous waste treatment,
e) storage or disposal facility, and
f) the VSQG may not transport more than 200 kilograms of hazardous waste in one vehicle and the maximum capacity of each such container is not greater than 55 gallons.

Contingency plans are required for each facility. Such plans should include:

a) lines of communication for facility personnel
b) actions to be taken
c) equipment to be used
d) familiarity of police, fire, boards of health and emergency response teams with plan of facility
e) evacuation plan for facility personnel.

If a Spill Prevention Control and Countermeasures (SPCC) Plan is filed (as part of 40 CFR Part 112 or Part 151), the facility personnel need only update plan to include additional information required under 310 CMR 30.000.

Superfund Amendment and Reauthorization Act

The handling of hazardous substances is further controlled through the Superfund Amendment and Reauthorization Act of 1986. The regulations promulgated under this Act provide for the development of contingency plans and reporting procedures in the event of an unplanned release of toxic or hazardous materials, and for better public awareness of dangers posed by these substances in their community. The regulations are summarized below.

40 CFR Parts 300 & 355 Extremely Hazardous Substances List And Threshold Planning Quantities; Emergency Planning And Release Notification Requirements (SARA Title III)

AUTHORITY:

Regulations issued under Title III of the Superfund Amendments and Reauthorization Act of 1986. Title III of SARA is known as the Emergency Planning and Community Right to Know Act of 1986. The regulations are the responsibility of the U.S. Environmental Protection Agency (EPA).

PURPOSE:

SARA revises and extends the authorities established under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 ("CERCLA") commonly known as "Superfund". CERCLA provides authority for federal cleanup of uncontrolled hazardous waste sites and response to releases of hazardous substances. Title III of SARA establishes new authorities for emergency planning and preparedness, emergency release notification, community right-to-know reporting, and toxic chemical release reporting.

JURISDICTION:

Title III encourages and supports emergency planning efforts at the State and local levels and provides public and local governments with information concerning potential chemical hazards present in their communities. Title III is closely related to preparation and response activities under CERCLA -- the National Oil and Hazardous Substances Pollution Contingency Plan or National Contingency Plan (NCP) -- but is listed apart from NCP in Parts 355 et seq. of Title 40 of the Code of Federal Regulations.

Title III is organized into three subtitles. Subtitle A establishes the framework for local emergency planning. Subtitle B provides the mechanism for community awareness regarding hazardous materials present in the local area (this includes submission of material safety data sheets (MSDS) and hazardous chemical inventory forms to State and local authorities). Subtitle C concerns trade secret protection, enforcement, citizens suits, and availability of information to the public.

The EPA has published a list of extremely hazardous substances and threshold planning quantities (TPQs). Any facility where an extremely hazardous substance is present in an amount in excess of the TPQ is required to notify the state commission within 60 days of exceeding the threshold for an extremely hazardous substance.

The regulations also require more immediate reporting to the LEPC of certain hazardous substances releases.

Each state was required to establish an emergency response commission by April 1987. The commission had to set up local districts and coordinate local emergency planning committees (LEPC). The LEPC was to establish comprehensive emergency response plans for their community and to review them annually. Facilities subject to emergency planning had to designate a facility representative to work with the LEPC.

In the Commonwealth, authority for SARA Title III is vested with the State Emergency Response Commission (SERC) which has established an Executive Committee under the Chairmanship of the Director of the Civil Defense Agency. The Executive Committee is responsible for the day to day administration of SARA Title III. The Executive Committee is also responsible for overseeing five subcommittees of SERC. They are a Training Sub-committee based out of the Massachusetts Fire Fighting Academy, a Notification and Response Sub-committee out of the Massachusetts State Police, an Emergency Planning Sub-committee chaired by Civil Defense, a Right-to-Know Sub-committee out of the Department of Environmental Quality Engineering, and a Budget Sub-committee in the Public Health Department.

Local Hazardous Materials Regulations

Communities may adopt local hazardous materials regulations as a general bylaw or board of health provision. Such regulations may require registration of hazardous materials stored in the community, standards for storage, siting criteria, and contingency plans. Waltham has the only local hazardous materials bylaw in the Cambridge watershed area. The bylaw regulates aboveground and underground storage of hazardous materials as defined by the state Department of Public Health's Hazardous Materials Substance List (105 CMR), or the Hazardous Waste Management Act (Chapter 21C). Major provisions of the bylaw are summarized above in section 4.1.3.

4.1.5 Landfills

Massachusetts Landfill Regulations

Solid waste landfills are operated under the DEP landfill regulations (310 CMR 19.00). These regulations are summarized below.

PURPOSE AND AUTHORITY:

The Department of Public Health was responsible for developing the regulations. A 1975 Legislative Act transferred authority and responsibility for the regulations to the Department of Environmental Protection. The regulations restrict the location and operation of sanitary landfills to protect public health and safety.

REQUIREMENTS:

Sanitary landfills may be located only on sites where the potential for air, land and water pollution is minimal. Selection of a site includes consideration of: geologic formations, availability of on-site soil for cover material, potential for ground water and surface water pollution, proximity to ground water table elevation, and the importance of ground water supply to be affected by the operation. Also included in the regulations are provisions for construction, cover material, litter and dust control, drainage of surface water, and completion and final cover of the landfill.

Disposal of special wastes may require permission of DEP's Division of Solid and Hazardous Waste or the Division of Water Pollution Control. Special wastes are defined as materials such as sewage solids, radioactive wastes, pathologic wastes, explosive materials, chemicals, certain liquid wastes, or other materials of hazardous nature or materials requiring special handling or procedures for disposal.

Operation of the landfill may require application of insecticides and rodenticides to control and eliminate pests.

Any landfill in operation at the time of the effective date of the regulations must comply with all the requirements of the regulations.

New state regulations have been drafted that afford much greater protection to groundwater. The proposed regulations require an impervious liner, groundwater monitoring systems, runoff guidance, and landfill capping. Although not formally adopted as state regulations, DEQE has been applying the standards of the new regulations as guidelines for new or expanded landfills.

310 CMR 18.00 Installation, Operation, And Maintenance Of Solid Waste Transfer Stations

PURPOSE AND AUTHORITY:

The Department of Environmental Quality Engineering is the acting authority for implementation of the regulations.

REQUIREMENTS:

The regulations contain no specific restrictions on placement or operation in or near Zone II or water supply watershed. Under the regulations, special wastes are not allowed at the transfer station except when approved and conditioned in writing by the Department. Special wastes are defined as materials such as sewage solids, radioactive wastes, pathologic wastes, explosive materials, chemicals, liquid wastes or other materials of hazardous nature or materials requiring special handling or procedures for disposal.

The regulations require that all accumulated salvaged or recyclable materials be removed every sixty days and that materials that cause odor or pose a threat to public health or are detrimental to the environment shall not be accumulated. Further, the regulations allow for a routine program for control and elimination of insects and rodents at the transfer station facility site. The operator shall cause supplemental control measures, including but not limited to the use of effective insecticides and rodenticides, to be implemented when necessary. Application of pesticides shall be made only by a pesticide operator licensed by the Massachusetts Pesticide Board.

Transfer stations in operation prior to the effective date of the regulations must comply with all requirements of the regulations and will be placed on a compliance schedule for complete conformance with the regulations.

Local Landfills

In the Cambridge watershed there are two municipal landfills, in Lincoln and Weston, which are both currently undergoing final closure in accordance with DEP requirements (see Chapter 3).

4.1.6 Pesticides

Massachusetts Pesticide Board Regulations

The Massachusetts Pesticide Board has promulgated regulations for the use of herbicides on rights-of-way (333 CMR 11.00). The regulations are summarized below.

333 CMR 1.00-11.00 Pesticide Board Regulations

PURPOSE AND AUTHORITY:

Mass Pesticide Control Act is inserted as M.G.L. c.132B by St. 1978, c.3 as an emergency act to conform with federal requirements on registration and certification of pesticides as set forth in the Federal Insecticide, Fungicide, and Rodenticide Act, Public Law 92-516 (FIFRA). The Act creates administrative mechanisms to regulate labelling, distribution, sale, storage, transportation, use and application and disposal of pesticides.

REQUIREMENTS:

CMR 10.00 and 11.00 are of greatest concern to water supply protection. These sections deal with areas of application, methods of application, and notification of pesticide use. Specific areas of interest within these sections are:

a) commercial application of pesticides for control of turf pests on residential, private or private non-residential properties,
b) agricultural applications,
c) right of way maintenance applications, and
d) public health pest and nuisance control such as mosquito control.

Permits for commercial application of pesticides for control of turf pests require the applicator to supply health and safety information about the pesticide to be used to the owner of the area to be treated. The permit also requires that the area treated be posted for 72 hours after treatment.

Agricultural aerial applications are restricted to application in areas approved annually by the Department. Such approval requires a site visit by the Department and takes into consideration proximity to protected areas and public surface water supplies.

Notice by posting of signs is required if application is made within 500 feet of a protected area. Helium balloons are required to mark no spray areas. Protected areas are defined as: any residential, commercial, municipal, hospital, school and other buildings where people gather and the area 100 feet surrounding these structures up to the property line; and developed recreation areas open to public accommodations including developed public or commercial campgrounds, developed picnic areas, developed park and recreation facilities, playgrounds, school bus stops and other areas developed for organized recreation.

Pesticides for control of public health pest and nuisance control include mosquito control and include a variety of treatment measures including pesticide sprays either by truck or aerial application and pesticide application to standing water bodies.

The regulations prohibit intentional application on private property which has been designated for exclusion for such applications by a person living on or legally in control of the property. Except that the regulations do not limit the right of the holder of an easement to apply pesticides for right of way maintenance.

Right of Way Maintenance applications are specifically controlled under 333 CMR 11.00. The regulations encourage the implementation of Integrated Pest Management Techniques. Under the regulations municipalities, utilities, and other organizations responsible for controlling vegetation on rights-of-way must develop a Vegetation Management Plan and Yearly Operating Plan to be approved by the Department of Food and Agriculture. The regulations lay out specific controls on the use of herbicides regarding the height of vegetation, weather conditions during application, and touch-up applications. They also state that no handling, mixing, or loading of an herbicide concentrate is allowed on a right-of-way within 100 feet of a sensitive area, defined as an area:

(a) within the primary recharge area of a public drinking water supply well;
(b) within four hundred (400) feet of any surface water used as a public water supply;
(c) within one hundred (100) feet of any appropriately marked private drinking water supply well;
(d) within one hundred (100) feet of any standing or flowing water;
(e) within one hundred (100) feet of any wetland;
(f) within one hundred (100) feet of any agricultural or habitated area.

Under the regulations, municipalities may propose that the Department impose specific additional restrictions or conditions on the use of herbicides within or adjacent to sensitive areas as it determines necessary to protect human health or the environment. These allow for greater protection of public surface water supplies, private drinking water supplies, surface waters, wetlands, and habitated and agricultural areas. These right-of-way regulations are currently under review by the Department of Food and Agriculture.

Army Corps of Engineers Section 404 Permits

Under the Section 404 Permit Program, the Army Corps of Engineers has jurisdiction over dredge and fill activities bordering on or within U.S. waters. Activities exempted and permitted are noted below.

40 CFR Ch. 1 Part 232 - 404 Program Definitions; Exempt Activities Not Requiring 404 Permits

This section of the regulations concerns activities that are exempt from the 404 permit process.

EXEMPT ACTIVITIES:

1. Normal farming, silviculture and ranching activities such as plowing, seeding, cultivating, minor drainage and harvesting for the production of food, fiber, and forest products, or upland soil and water conservation practices so long as these activities are part of an established farming, silviculture, or ranching operation.

2. Maintenance and emergency reconstruction of serviceable structures in waters of the U.S. as long as no modifications occur which change the character, scope or size of the original structure.

3. Construction or maintenance of farm or stock ponds or irrigation ditches or the maintenance (but not construction) of drainage ditches.

4. Construction of temporary sedimentation basins on construction sites which does not include placement of fill material into U.S. waters. This includes quarrying and mining activities.

5. Construction or maintenance of farm roads, forest roads, or temporary roads for moving mining equipment where roads are constructed and maintained in accordance with best management practices (BMPs).

ACTIVITIES REQUIRING A PERMIT INCLUDE:

Permits are required for any discharge of dredged or fill material resulting from activities listed above that contain any toxic pollutants listed under Section 307 of the Act. Such discharges are subject to any applicable toxic effluent standards or prohibitions, and require a Section 404 permit.

Any discharge of dredged or fill material into waters of the U.S. if the purpose of the activity is to convert an area of water into a use which it was not previously subject, where the flow or circulation of waters may be impaired, or the reach of the water is reduced. Where discharge will result in significant discernible alterations to or impairment of circulation flow.

4.2.2 Floodplain Management

National Flood Insurance Program

Under the National Flood Insurance Program (NFIP), the Federal government provides subsidized flood insurance to property owners in communities which meet floodplain management guidelines promulgated by the Federal Emergency Management Agency (FEMA). FEMA also provides mapping of floodplains in every community (see Map 12). The regulations are summarized below.

44 CFR 59.0 FEMA General Provisions

AUTHORITY AND PURPOSE:

Under the authority of 42 U.S.C. 4001-4128, the National Flood Insurance Act of 1968 was enacted by Title XIII of the Housing and Urban Development Act of 1968 to provide previously unavailable flood insurance protection to property owners in flood-prone areas. Mudslide protection was added in 1969. Flood-related erosion protection was added to the program by the Flood Disaster Protection Act of 1973. The regulation is the responsibility of the Federal Insurance Administrator.

REQUIREMENTS:

The Flood Disaster Protection Act of 1973 requires purchase of flood insurance on or after March 2, 1974 as a condition to receiving Federal or federally-related financial assistance for acquisition or construction purposes with respect to insurable buildings and mobile homes in flood hazard areas.

Also requires that communities participate in programs by July 1, 1975 or at least one year after a community is notified by the Administrator that it's been identified as containing flood prone areas. Failure to participate in program effects Federal financial assistance within the area.

In order for a community to sell federally-subsidized flood insurance, a community must adopt flood plain management regulations according to the criteria set in 44 CFR 60.0. Local flood plain management regulations can take the form of zoning, building and subdivision regulations, health codes, special purpose ordinances (such as flood plain ordinances) or other corrective or preventive measures.

44 CFR 60.0 FEMA Requirements For Flood Plain Management Regulations

REQUIREMENTS:

The regulations require that the Administrator of FEMA provide the data base for flood plain management regulations.

The minimum standards for communities follow.

1. When special flood hazard areas have not been defined:

   (a) permits are required for all proposed construction to determine if development is proposed in flood prone areas
   (b) communities must review proposed development to assure all federal permits have been obtained
   (c) review should determine if site is reasonably safe from flooding, or, if in flood-prone area, that all sites be constructed to assure maximum flood protection
   (d) subdivision proposal review should determine if in flood-prone area and if so, to assure flood protection construction
   (e) regulations require new and replacement water supply systems be developed to minimize infiltration of flood waters into system
   (f) regulations require new and replacement sanitary systems design to minimize or eliminate infiltration and exfiltration and on-site waste disposal systems be located to avoid flood damage to them or contamination by them during flooding.

2. When flood hazards areas have been defined by the Administrator and Federal Insurance Rate Maps have been published but data does not indicate water surface elevations, identified floodway or coastal high hazard areas, the community must require that proposals for developments in the identified flood-prone areas include base flood elevation data, and the community must obtain, review, and reasonably utilize any base flood elevation and floodway data available from Federal, State or other sources.

3. More specific restrictions apply as more data is available and flood hazard areas are defined according to depth, velocity, and wave action. These restrictions deal with construction methods, location of buildings, use of walls, levees, fill, alteration of dunes or banks etc. in Zones as defined by the Administration.

In general, the Federal regulations permit with restrictions construction or alteration located in a portion of a water course so long as the flood carrying capacity within any altered or relocated portion of any watercourse is maintained.

In Massachusetts, the NFIP floodplain management requirements are implemented through state and local regulations, as summarized below.

State Implementation of NFIP Requirements

Taken together, three different state regulations meet the minimum requirements for floodplain management under NFIP. These are:

1. State Building Code, section 744, which deals with flood proofing structures in the floodplain;

2. Wetlands Protection Act, section 10.57, which regulates land subject to flooding, and requires compensatory storage;

3. State Environmental Code, Title 5 (310 CMR 15), which requires that septic systems in the 100 year floodplain may not allow flow into or from flood waters.

While these provisions meet the functional requirements of the NFIP floodplain management guidelines, FEMA also requires that the 100 year floodplain be designated as a district at the community level.

Local Implementation of NFIP requirements

In order to fully comply with NFIP requirements, communities must adopt the FEMA floodplain maps as a local protection district. This is usually accomplished by adopting a zoning overlay district, which is the case in each of the four communities in the Cambridge watershed area. The overlay districts were described in the zoning section of Chapter 3.

4.3 Non-Regulatory Protection Techniques

4.3.1 Land Acquisition

The most direct way to protect sensitive watershed lands from development is through land acquisition. However, this is also the most expensive method, and only a limited amount of land can be purchased and held as open space or undeveloped land. Within the Cambridge watershed area, the city of Cambridge owns a small amount of land, generally forming a narrow buffer zone around the edge of the Stony Brook and Hobbs Brook Reservoirs. There are significant publicly and privately owned open space holdings in portions of Lincoln and Weston, three parcels of conservation land in Lexington, and one open space parcel in Waltham. However, the majority of the protected open space is in the portions of the watershed most distant from the reservoirs, while very little of the most critical land near the reservoirs is protected. Protected land is shown on Map 11.

4.2 Easements and Covenants

Restrictions may be placed on the use of land short of outright acquisition by the use of easements and covenants Both have been used in the Cambridge watershed.

GTE purchased an easement over land owned by Cambridge in order to provide access to the company's land on Winter Street adjacent to the Hobbs Brook Reservoir. As a condition of the easement, GTE signed a covenant with the Cambridge Water Board which requires the following:

- Site Plan Review for all work performed, requiring approval of the Water Board of any work which could potentially produce significant detrimental effects on the water supply;
- Approved Soil Conservation Service soil erosion and sedimentation controls;
- Immediate corrective measures in the event of a spill or accident which results in silt or other pollutants appearing in Hobbs Brook or bordering wetlands;
- Removal of 90,000 cubic yards of pig refuse and solid waste;
- Removal of all chemicals and petroleum products from the site;
- Installation of gas trap catch basins for all parking, roadway, and loading areas, with appropriate maintenance;
- Installation of retention basins to handle the peak runoff for a 100 year storm to a volume commensurate to pre-development conditions;
- Prohibition on the use of sodium chloride or other de-icing material;
- Registration of all chemicals stored on the site
- Requirements for underground petroleum tanks to be constructed of fiberglass, vaulted, and sumped;
- Requirements for a contingency plan for the control and removal of pollutant spills or leaks;
- Requirements that all domestic and unrecovered laboratory sewage must be disposed of through the Waltham sewer system.

The Cambridge Water Board also entered into a covenant with the owners of the Bay Colony development regarding control of stormwater runoff, water quality monitoring, the use of fertilizers, and pre-construction site drainage.

CHAPTER FIVE Findings and Recommendations

5.0 INTRODUCTION AND SUMMARY

This chapter summarizes the findings of the project and presents recommendations for watershed protection measures designed to ensure the long term protection of the public drinking water sources within the watershed.

The recommended watershed protection measures rely primarily on the local land use and regulatory powers of the communities in the watershed--Lexingtor, Lincoln, Waltham, and Weston. Protection of water supply resources depends on appropriate regulation of land use, and in Massachusetts local governments have primary responsibility for this under home rule powers. In addition, several protection measures are directed to the Cambridge Water Department, and to state and regional agencies, including the Department of Environmental Protection, the Department of Public Works, and the Massachusetts Water Resources Authority.

The recommendations are summarized in Figure 5-1 and described in detail in the following section. The protection measures are designed to address each of the potential threats to water quality identified in the previous volumes. The major recommendations include:

- Control of urban runoff by local site plan and wetlands regulations, and permitting under the Clean Water Act
- Measures to control drainage from state highways
- Regulation of underground storage tanks and hazardous materials by local bylaws or ordinances
- Restriction of the most hazardous activities in the watershed by zoning overlay districts
- Control of sodium contamination with alternative road deicing practices
- Control of wastewater discharges in unsewered areas by local health regulations
- Proper solid waste management practices

- Protection of wetlands by application of guidelines for replication of wetlands
- Coordination for improved emergency response to spills
- Water Quality monitoring in the watershed
- Protection of critical parcels by acquisition and/or easements
- MEPA review of projects in the watershed by DEP and MWRA
- Encouragement of local water resource protection by MWRA water users through revised MWRA policies

In order to provide an ongoing forum for inter-community cooperation on issues of mutual concern in the watershed, it is recommended that the Cambridge Watershed Advisory Committee be established as a permanent standing committee by the Chief Elected Officials of Cambridge, Lexington, Lincoln, Waltham, and Weston. The Committee would be chartered by adoption of a Memorandum of Understanding (MOU) by each of the communities. The MOU would also provide for sharing of information on proposed actions in the watershed among the five communities. The MOU would provide a useful mechanism for improved coordination among the participating communities to promote the protection of a major water supply resource which is significant to the region as a whole.

Successful implementation of a watershed protection program depends largely on the ongoing efforts of the communities and state agencies which control land use and development in the watershed. Their actions and decisions can help assure that the Cambridge water system will continue to provide potable water in the future.

Figure 5-1 Summary of Recommendations

Issue	Recommendations	Responsible Agency
Stormwater Runoff	Wetlands Protection Reg. No increased peak runoff Oil traps on parking lots Restricted salt, pesticides Water Quality Monitoring	Conservation Comm. Waltham, Weston
	Site Plan Review Same as above	Planning Board/ Board of Appeals Lincoln, Waltham
	NPDES Discharge Permits Discharge limitations Water quality monitoring Restricted salt, pesticides	EPA, DEP
	MDPW Drainage Alterations Diversion with mitigation or treatment in-basin	Mass DPW
Underground Fuel	UST Local Bylaw/Regulation Registration of all tanks Prohibit new resid. fuel oil or require 2-walled tanks Remove/monitor old tanks	Fire Chief/ Board of Health
Hazardous Wastes & Materials	Hazardous Materials Bylaw Register haz. materials >50 gal. or 25 lbs.	Fire Chief/ Board of Health
	Watershed Prot. District Prohibit haz. materials greater than 100 kg/month	Planning Board/ Board of Appeals
Road Salt	Alternative Road Salt policies Reduced sodium/substitutes Remediation--Maintenance Yard Calcium chloride--Stony Bk.	 Mass DPW Mass DPW Waltham DPW
	Wetlands Protection Bylaw/Ord. Restrict salt use on private drives, parking lots	Conservation Comm. Waltham, Weston
	Site Plan Review Restrict salt use on private drives, parking lots	Planning Board/ Board of Appeals Waltham, Lincoln
	Highway Drainage Controls	Mass DPW

*Applies to all communities unless otherwise indicated.

Issue	Recommendation	Responsible Agency
Wastewater	Septic System regulations Periodic pumping Setbacks to surface water Minimum percolation rates No septic cleaners with VOC's	Board of Health Lincoln, Weston
	Develop wastewater plan for Weston Center	Weston Sewer Comm.
	Watershed Protection District Prohibit industrial discharges	Planning Board\ Board of Appeals
	Renewal of Exxon NPDES Permit Divert or treat runoff No process wastewater Impervious dike liners Stabilize dikes	EPA, DEP
Landfills	Watershed Protection District Watershed Prot. District	Planning Board/ Board of Appeals
	Close, cap, monitor landfills	Lincoln, Weston
	Control Transfer Station runoff	Weston DPW
	Collect Household Hazardous Wastes, Used Motor Oil	Lexington, Lincoln Waltham, Weston
Watershed Land Use	Watershed Protection Zoning Overlay District Prohibit: landfills, industrial discharges, road salt storage,hazardous wastes more than 100 kg/month Special Permit with Site Plan: Industrial, Commercial Permit: Residential	Planning Board/ Board of Appeals
Wetlands Protection	Project Review Guidelines for Wetlands Replication	Conservation Comm.
Emergency Response	Coordination/Mutual Aid between communities	Fire Departments
Water Quality	Watershed Monitoring	Camb. Water Dept.
Land Acquisition	Acquire & protect key parcels	Camb. Water Dept.
Inter-community Coordination	Memorandum of Understanding Cambridge Watershed Advisory Committee	Cambridge, Waltham Lexington, Lincoln Weston

5.1 FINDINGS AND RECOMMENDATIONS

In the previous chapters, a host of potential sources of contamination and impacts to the Cambridge water supply sources were identified and inventoried. Existing regulations and protection measures pertaining to these potential sources of contamination were also described. In this section, findings and recommendations will be presented for each of the potential water supply impacts identified. These include:

- o stormwater runoff
- o underground storage tanks
- o hazardous wastes and materials
- o road salt
- o wastewater discharges
- o landfills

Other recommendations for watershed protection include:

- o wetlands protection measures
- o emergency response measures
- o watershed monitoring
- o intercommunity coordination
- o land acquisition
- o environmental reviews
- o MWRA local source protection policies

5.1.1 STORMWATER RUNOFF

5.1.1.1 Findings

Runoff from paved and developed areas has detrimental impacts on both the quality and quantity of water supply resources. Urban runoff contains a host of pollutants such as oils and grease, organic wastes and nutrients, heavy metals, hydrocarbons, bacteria, salts, and suspended solids. Much attention is often placed on sodium, since it is a contaminant regulated under the Safe Drinking Water Act in Massachusetts. However, waters with high levels of sodium are likely to be receiving many of the other pollutants associated with urban runoff. Thus sodium, in addition to being a pollutant of concern, can also be seen as an "indicator" of the overall impact of urban runoff on a water supply source. Increased impervious surfaces in developed areas of a watershed also leads to higher rates of runoff and peak stormwater discharge, which in turn may cause increased erosion and sedimentation.

In addition to the impact of urban runoff pollutants, highways which drain directly into water supplies such as the Hobbs Brook and Stony Brook Reservoirs are subject to transportation accidents which may cause an uncontrolled release of hazardous chemicals into the reservoirs. Such is the case for Routes 2 and 128, which have about 57 direct stormwater discharges into the two reservoirs.
Increased urban runoff also reduces the retention of water within the watershed by reducing groundwater recharge. Water which would normally be recharged to the ground and gradually discharge to downgradient surface waters such as the reservoirs is instead diverted through overland flow to surface water drainage. When this

occurs during the spring recharge season when the reservoirs are generally full, much of the excess urban runoff will in effect be "spilled" at the dams, rather than retained in the watershed. Given that over 70 percent of the discharge to Hobbs Brook Reservoir is derived from groundwater flow, the cumulative impact of increased urban runoff in the watershed is a reduction in the water supply yield available to the system.

Several mitigation measures are available to reduce or eliminate the negative impacts of urban runoff, including:

- o drainage controls which retain urban runoff on-site, reducing peak discharge rates and providing various degrees of water quality renovation, including: dry detention basins, wet retention ponds, recharge basins, and sediment basins
- o measures which remove some of the pollutant load of urban runoff, including oil and gas traps and vegetated buffer strips
- o measures which divert polluted runoff from a drinking water supply, such as snow berms and pumping drainage systems
- o restrictions on the use of sodium chloride, pesticides, and fertilizers

The characteristics of these measures are summarized in Appendix G.

Currently, there are no uniform requirements or standards for urban runoff mitigation throughout the watershed area. Recently, EPA has required mitigation for commercial developments on a case-by-case basis under the discharge permit provisions of the Clean Water Act, but there is no formal policy which consistently requires such mitigation. There is one existing NPDES permit in the watershed for the Exxon bulk fuel terminal in Waltham which is currently under review for permit renewal. More stringent controls on runoff discharges are being considered.

It should also be noted that DEP has proposed amendments to the state water quality classification system which would upgrade surface waters of the entire Stony Brook watershed to Class A, drinking water supply. Under such a use designation, discharges are more stringently regulated than under the present Class B classification of the watershed's surface waters.

The town of Lexington has adopted a local wetlands protection general bylaw which regulates stormwater discharges. Regulations adopted pursuant to the bylaw require that any work in a protected resource area, and work that involves storm drainage systems which discharge to a protected resource area, may not result in an increase in the peak rate of surface runoff during either a 2-year, 10-year, or 100-year storm event to areas beyond the project property. The effect of this requirement is that runoff mitigation measures such as detention basins are required for all projects which would increase the peak rate of runoff from a site. Because the regulations pertain to work which involves storm drainage to a protected resource area, in practice they apply to any project which involves stormwater discharges, whether or not the project is actually located in a protected resource area. The Conservation Commission also has required quarterly water quality monitoring of one project in the watershed, and has restricted the use of herbicides, pesticides, and sodium chloride on the property.

TABLE 5-2 POTENTIAL IMPACTS AND MANAGEMENT TECHNIQUES

POTENTIAL SOURCES OF CONTAMINATION	WATERSHED PROT. ZONING OVERLAY	SITE PLAN REVIEW	GENERAL BYLAWS/ORD.	WATERSHED MONITORING	BOARD OF HEALTH REGULATIONS	WETLANDS REGULATIONS	EMERGENCY RESPONSE	INTERMUNICIPAL COOPERATION
RUNOFF AND EROSION	●	●		●		●		●
WASTEWATER	●			●	●			●
UNDERGROUND FUEL			●	●	●			●
ROAD SALT	●	●		●		●		●
LEACHATE	●			●	●			●
HAZARDOUS MATERIALS	●		●	●	●		●	●

The town of Lincoln also has adopted a local wetlands protection general bylaw which regulates stormwater runoff impacts. The bylaw regulates any activity which will alter a resource area or buffer zone. "Alter" is defined to include activities undertaken to, upon, within, or actually affecting any resource area or buffer zone. Regulated activities include:

- o changing of preexisting drainage characteristics, sedimentation patterns, flow patterns, or flood retention characteristics
- o changing water temperature, biochemical oxygen demand, or other physical or chemical characteristics of water
- o any activities which may cause or contribute to pollution of any body of water or groundwater, including surface water runoff contaminated with sediments, chemicals, or animal wastes

These provisions provide the town with the authority to regulate adverse stormwater runoff impacts to any surface water, whether the project is located within a protected resource area or not. However, specific performance requirements, such as those included in Lexington's wetlands regulations, are not included in the bylaw.

The Lexington and Lincoln wetlands bylaws provide protection for the portion of the watershed located within those two communities, which amounts to about 47 percent of the total watershed area. The remaining 53 percent of the watershed located in Waltham and Weston does not have equivalent protection from urban runoff impacts to the water supply sources.

5.1.1.2 RECOMMENDATIONS

Department of Environmental Protection

1. The DEP, Division of Water Pollution Control should implement the proposed amendment to the state water quality regulations (314 CMR 4) which would upgrade the designation of the surface waters tributary to the Hobbs Brook and Stony Brook Reservoirs to Class A.

2. The DEP should adopt a consistent policy regulating stormwater discharges to Class A waters which would require NPDES permits for all new stormwater discharges upgradient of drinking water sources. The NPDES permits should include provisions similar to those issued for the Corporate Center at Waltham (Bay Colony), including discharge limitations for solids, nitrate, total phosphates, lead, turbidity, pH, and oil and grease; water quality monitoring; and restrictions on the use of sodium chloride, herbicides and other pesticides, and fertilizers.

3. The DEP should include more stringent controls on the Exxon bulk fuel facility in renewing the existing NPDES permit. Conditions which should be added include:

- o diversion of site runoff from the Stony Brook watershed;
- o treatment of runoff if diversion is not technically feasible;
- o installation of impervious liners within the dikes which surround the fuel tanks;
- o a prohibition of discharge of tank bottom residues or any other process wastewater to Stony Brook.

Environmental Protection Agency, Region I

1. EPA, as the joint issuer of NPDES permits along with DEP, should endorse and adopt the recommendations made above to DEP concerning water quality classification of Class A waters, stormwater permit requirements for Class A waters, and conditions for the renewal of the NPDES permit for the Exxon bulk fuel facility .

Waltham and Weston

Waltham and Weston should adopt local wetlands protection measures which control urban runoff within the Hobbs Brook/Stony Brook watersheds in a manner similar to that required by Lexington. The regulations should require on-site retention of stormwater such that peak runoff during a 2-year, 10-year, or 100-year storm event will not be increased beyond the boundaries of the property. The provisions should also require water quality monitoring of regulated stormwater discharges, and restrictions on the use of pesticides, herbicides, and sodium chloride. Appendix H contains model wetlands regulations and conditions for approval.

Lincoln

The town should consider adopted specific performance standards as described above. These could be adopted by the Conservation Commission as regulations pursuant to the Wetlands Protection Bylaw.

Lexington, Lincoln, Waltham, and Weston

The communities should amend their site plan review regulations to require: erosion and sediment control plans; stormwater drainage controls, with preference given to recharge; pollution control devices such as oil and grease separators; and restrictions on road salt within the Hobbs Brook/Stony Brook Reservoir watershed. Appendix I contains model site plan review regulation language.

Massachusetts Department of Public Works

The MPDW should expedite the implementation of measures to control the highway runoff into the Hobbs Brook and Stony Brook Reservoirs. The studies currently underway include two alternatives: diversion of the highway drainage from the watershed, and treatment of the runoff within the watershed. MDPW should also consider an alternative which would involve the construction of temporary holding basins at the reservoir drainage outlets which are sized to retain the volume of a fuel or chemical tank truck.

Any diversion alternative should consider the potential loss of watershed yield to the Cambridge water system. If all of the drainage from state highways were diverted out of the watershed, the yield to the reservoirs could be reduced by seven percent, or about one million gallons per day on average. Mitigation measures should be evaluated for this loss of yield. This could include construction of a diversion mechanism which will allow water from Stony Brook to be pumped up to Hobbs Brook Reservoir for storage during high flow periods, thus optimizing the yield of the reservoir system. Another alternative for consideration is a system for withdrawing from the Charles River an amount of water equal to the amount lost to the highway runoff diversion. Finally, the loss of yield may be minimized by designing a stormwater diversion system which removes only the "first flush" of the runoff, which contains the greatest amount of pollutants.

5.1.2 UNDERGROUND STORAGE TANKS

5.1.2.1 Findings

Underground storage tanks are a major potential source of contamination of public water supplies. Local records and surveys indicate that there are 43 commercial gasoline storage tanks and 690 underground fuel oil tanks in the watershed portion of the four communities.

State regulations have been amended recently to include more stringent requirements for commercial tanks. However, the regulations exempt heating oil tanks from most requirements, including secondary containment, monitoring systems, tightness testing, and inventory control. Studies conducted in Barnstable County found that ten of 119 underground fuel oil tanks tested were leaking, representing eight percent of the tanks tested. If that percentage was applied to the 690 fuel oil tanks in the watershed, theoretically 58 tanks would be leaking. Clearly the exempted fuel oil tanks represent a potential threat which should be addressed.

Waltham adopted a city ordinance in 1985 (amended in 1987) which regulates hazardous materials storage tanks. However, this ordinance exempts tanks less than 1100 gallons, and several of the technical requirements are less stringent than the most recent (1988) amendments to the state regulations.

5.1.2.2 Recommendations

Lexington, Lincoln, Waltham, and Weston

The communities should adopt a local general bylaw/ordinance which regulates those fuel oil tanks exempted by state regulations in the Hobbs Brook/Stony Brook Reservoir watersheds. The regulations should include:

- registration of all existing and new underground storage tanks, regardless of size or contents. The registration should include data on tank age, construction, size, and contents.

- prohibition of new underground residential fuel oil tanks (or a requirement that any new tank meet the technical standards of commercial tanks: secondary containment with continuous monitoring.)

- requirement that after [30] years, existing unprotected tanks must either be removed or an approved monitoring system must be installed and maintained, with results of the monitoring to be reported to the fire chief annually.

- upon registration, tanks of unknown age will be assumed to be 20 years old.

Waltham

The city's ordinance on hazardous materials storage tanks (Sec. 8-109) should be amended to include the above provisions. In addition, the ordinance should be amended to conform with the most recent state regulations (527 CMR 9), as summarized below:

- (d)(5) Licensing of new tanks--delete reference to concrete vaulting; double walled tanks are now required by 527 CMR 9.

- (f)(1) Design and construction--delete and replace with the language of 527 CMR 9.08 (3), (a) and (b), requiring double walled tanks with continuous monitoring systems.

- (f)(3) new piping--must have either secondary containment, or a suction system with a check valve under the dispensing pump with piping pitched to the tank.

- (i)(5,6,7) Testing for tightness--replace with language of 527 CMR 9.13. All new tanks and piping must be tested 12 to 24 months after annotation. Existing non-complying tanks must be tested at age 10, 13, 15, 17, 19, and annually thereafter. Existing tanks with cathodic protection must be tested at age 15, 20, and annually thereafter.

- (j)(4) Response to leaks--allows a leaking tank to be repaired. 527 CMR 9.21 (1) prohibits relining of any underground tank which has leaked. Such tanks must be replaced.

- Section 9.24 of 527 CMR requires the upgrading of existing tanks to include spill containment manholes by 1990 and overfill prevention devices by 1993.

Additional recommended amendments to this ordinance are presented in the following section on hazardous materials.

5.1.3 HAZARDOUS WASTES AND MATERIALS

5.1.3.1 Findings

Hazardous wastes and materials represent perhaps the most acute threat to the quality of drinking water supplies in the watershed. In the metropolitan area, contamination by hazardous chemicals, primarily volatile organic compounds, has caused the loss of water supplies in 15 communities. In the Hobbs Brook/Stony Brook watershed, there are 68 businesses and industries which are registered generators of hazardous wastes, and 18 firms which are registered hazardous materials handlers. Hazardous materials handlers must register only if they exceed the reporting thresholds, which are 500 pounds of extremely hazardous materials or 10,000 pounds of other regulated materials.

Waltham requires registration of hazardous materials storage tanks over 1100 gallons (Sec. 8-109).

5.1.3.2 Recommendations

<u>Lexington, Lincoln, Waltham, and Weston</u>

1. In order to reduce the threat of existing hazardous material handlers, each community should adopt a local general bylaw/ordinance for the control of hazardous materials in the watershed which would:

- o require registration of hazardous materials in excess of fifty gallons liquid volume or twenty-five pounds dry weight.
- o require designation of an emergency coordinator and preparation of an emergency contingency plan.
- o establish standards for storage of hazardous materials.

Appendix J contains a model Hazardous Materials bylaw which could be adopted by Lexington, Lincoln, and Weston. Waltham could amend its hazardous materials storage ordinance by adding provisions from the model bylaw as follows:

- o delete the reference to 1100 gallons in sections (b) and (c), and replace with 50 gallons liquid volume or 25 pounds dry weight.
- o amend section (f)(7)by adding the model bylaw's section 4.6 regarding aboveground storage.
- o amend section (e) by adding the model bylaw's section 4.7, requirements for emergency coordinators, and contingency plans

2. In order to reduce the threat of additional hazardous waste generators in the watershed, the communities should restrict future uses which would generate hazardous wastes in quantities greater than the threshold for Very Small Quantity Generators (less than 100 kilograms per month, with no acutely hazardous wastes). This should

be implemented by adoption of a Watershed Protection overlay zoning district, covering the portion of the Hobbs Brook/Stony Brook watershed in each of the four communities. Appendix 5-E contains a model watershed protection overlay zoning district.

3. The communities should regularly conduct collections of household hazardous wastes and provide for proper disposal. A related effort which should be implemented is a used motor oil recycling program.

5.1.4 ROAD SALT

5.1.4.1 Findings

Use of sodium chloride as a road deicing agent has led to elevated sodium levels in Hobbs Brook and Stony Brook Reservoir. Sodium concentrations in the reservoirs has exceeded 40 mgl in most recent years, and reached 59 mgl in 1987, well in excess of the state drinking water standard of 20 mgl. Detailed hydrogeologic studies have shown that about 72 percent of the sodium input to Hobbs Brook Reservoir is due to road salt application to state routes 2, 2A, and 128. Since 1986 the Massachusetts DPW has conducted a reduced salt experiment program in the watershed, substituting Pre-Mix (a blend of 3 parts sodium chloride to one part calcium chloride) for pure sodium chloride. However, due to the increased rate of application of the Pre-Mix (400 pounds per land mile versus 300 pounds for straight salt), actual reduction in the amount of sodium applied may not be significant.

Other sources of sodium include the MDPW salt storage depot at routes 2 and 128 (7 percent), sodium chloride use on local roads (13 percent) and private and commercial road salting (7 percent).
The city of Waltham has a sodium reduction program which involves the use of calcium chloride on major streets in the Hobbs Brook Reservoir watershed. However, this program is not being conducted in the Stony Brook Reservoir watershed.

o 5.1.4.2 Recommendations

<u>Massachusetts Department of Public Works</u>

1. As recommended above, the MDPW should expedite measures to control highway runoff to the Hobbs Brook and Stony Brook Reservoirs. In the interim, an alternative sodium reduction program should be implemented which will significantly reduce or eliminate the sodium input to the reservoirs. If the drainage control program selected does not involve diversion of runoff from the watershed, the sodium reduction program should be instituted permanently.

2. MDPW should carefully manage the salt stored at the maintenance yard at routes 2A and 128. Runoff from the salt storage and loading areas should be controlled, and brine should be collected on site and prevented from flowing towards the reservoir. MDPW should also institute measures to mitigate the sodium contaminated groundwater at the maintenance yard which is discharging to Hobbs Brook Reservoir.

Waltham

The city should continue its sodium reduction program in the Hobbs Brook Reservoir watershed (Trapelo Road, Smith Street, and Wyman Street), and expand the program to Bear Hill Road and Main Street in the Stony Brook Reservoir watershed. These are the only Waltham streets within the watershed which continue to be treated with straight salt.

Lexington, Lincoln, Waltham, and Weston

The communities should restrict the use of sodium chloride on commercial roads and parking lots in the watershed. This can be accomplished with the wetlands protection and site plan reviews regulations presented in section 5.1.1, Stormwater Runoff.

5.1.5 WASTEWATER

5.1.5.1 Findings

In the unsewered portions of the watershed (Weston and Lincoln), adequate disposal of wastewater depends upon properly sited and maintained septic systems. The only major septic system problem area is in Weston center, which although in the watershed, is not in close proximity to the reservoirs. The town has been in the process of developing a wastewater disposal plan for the area for several years. The largest potential new development in an unsewered area is the one proposed for the Mass Broken Stone site in Weston. Large scale and industrial discharges in an unsewered area pose a potential threat to reservoir water quality.

5.1.5.2 Recommendations

Weston and Lincoln

The Boards of Health in Weston and Lincoln should adopt local health regulations which require:

- o periodic inspection and pumping of septic systems (2 to 3 years)
- o increased setbacks between septic systems and water bodies in the watershed (increase from 50 to 100 feet)
- o establishment of a minimum acceptable percolation rate of two minutes per inch (or require larger leaching areas in areas that perc at less than two minutes per inch)
- o prohibit use of septic system cleaners which contain organic solvents (chlorinated hydrocarbons).

Weston

1. The town should develop an alternative wastewater plan for Weston center.

2. The town should help provide for adequate wastewater treatment facilities for any commercial development at the Mass Broken Stone site.

Lexington, Lincoln, Waltham, and Weston

The communities should, as part of a Watershed Protection overlay zoning bylaw, prohibit the discharge of industrial wastewater within the watershed area. See Appendix 5-E.

5.1.6 LANDFILLS

5.1.6.1 Findings

Leachate from existing or former landfills poses a potential threat to ground and surface waters. Uncontrolled runoff from transfer stations may also be a source of contamination. In the watershed, there are recently closed landfills in Lincoln and Weston, and a transfer station at the landfill site in Weston. The Weston site is in close proximity to Stony Brook, upgradient from the reservoir.

5.1.6.2 Recommendations

Weston and Lincoln

The communities should continue to properly cap the former landfills, and they should establish a long term groundwater monitoring program to assure that there are not problems with leachate contamination. Weston should carefully control and monitor surface runoff from the transfer station at the former landfill site.

Lexington, Lincoln, Waltham, and Weston

The communities should prohibit the siting of any new landfills or junkyards in the watershed through adoption of a Watershed Protection overlay zoning district (See Appendix 5-E).

5.1.7 WATERSHED PROTECTION ZONING OVERLAY DISTRICT

5.1.7.1 Findings

Certain land uses with a high degree of potential hazard to water supplies should be excluded from locating within the watershed, while other uses with potential threats which can be mitigated may be located in the watershed with appropriate safeguards. Within the watershed, this analysis has shown that there are already significant existing threats to the water supply, such as underground storage tanks, hazardous materials and wastes, wastewater discharges, urban runoff, road salt storage, and landfills. However there remains over 9000 acres of undeveloped land in the watershed which could accommodate additional land use which may in some cases pose an increased threat to the water supplies. It is crucial to the protection of the water supplies that future development be compatible with maintaining the quality and quantity of water in the watershed. A major tool for accomplishing this is a Watershed Protection Zoning Overlay District.

This measure can be adopted as an amendment to the existing zoning code. It retains the existing "underlying" zoning while adding additional restrictions and requirements designed to protect the water resources.

5.1.7.2 Recommendations

Lexington, Lincoln, Waltham, and Weston

It is recommended that a Watershed Protection Zoning Overlay District be adopted by each of the communities as an amendment to existing zoning codes. The geographic scope of the district should encompass the entire Hobbs Brook and Stony Brook watersheds within each of the the four communities. Appendix K contains model bylaw language. The overlay district designates various land uses as permitted, permitted with a Special Permit, or Prohibited, depending on the degree of potential impact to water resources. Residential uses are generally permitted, although a Special Permit is required on lots with a slope greater than 15%. In such cases an erosion and sedimentation plan is required. Commercial and industrial uses, if permitted in the underlying zone, are permitted in the watershed district with a special permit and site plan review. The site plan review addresses retention of peak runoff, sediment control, pollution control devices such as oil traps, and road salt restrictions, all of which are critical performance requirements .
in the watershed. (See Appendix I, Site Plan Review). Uses which are prohibited in the watershed protection district include: landfills, junkyards, salt storage, industrial uses which discharge process wastewater on-site, and any use which generates hazardous wastes in quantities greater than 100 kilograms per month, which state regulations classify as a Very Small Quantity Generator.

5.1.8 WETLANDS PROTECTION

5.1.8.1 Findings

Protection of wetlands is vital to the maintenance of the quality and quantity of water supply sources in the watershed. Development projects frequently involve replication of wetlands as a mitigation measure for altering natural wetlands. In order for replicated wetlands to successfully fulfill the water supply and water quality functions of the natural wetland they are replacing, they must be developed according to appropriate standards.

5.1.8.2 Recommendations

Lexington, Lincoln, Waltham, and Weston

The Conservation Commissions in each of the watershed communities should adopt the project review guidelines in Appendix L. The guidelines provide standards for wetlands replication.

5.1.9 Emergency Response

5.1.9.1 Findings

An uncontrolled release of hazardous chemicals could occur on the roads of any of the four watershed communities, yet the larger communities have more resources (equipment and training) to respond to a chemical spill. Cambridge, which relies upon the watershed for its public water supply, has emergency response resources which would not normally be available to respond to a spill in the watershed. There are also emergency response resources at nearby Hanscom Air Field which would not normally respond to an incident in the watershed.

5.1.9.2 Recommendations

Cambridge, Lexington, Lincoln, Waltham, and Weston

The communities should consider entering into a mutual aid agreement which would allow the most effective response to a chemical spill in the watershed by sharing of information and resources. The possibility of making Cambridge's equipment and expertise available to respond to a spill in the watershed should be pursued.

5.1.10 INTERCOMMUNITY COORDINATION

5.1.10.1 Findings

Given the multiple jurisdictions in the watershed area, there is a need for more effective coordination between the four watershed communities and the city of Cambridge. Such coordination could help to facilitate various aspects of the proposed watershed protection plan, as well as other issues of mutual interest to the communities.

5.1.10.2 Recommendations

In order to provide for more effective coordination between the communities, the Cambridge Watershed Advisory Committee (or a similar intercommunity organization) should be established as a permanent standing committee by the chief elected officials in each community. The Committee should be chartered by the adoption of a Memorandum of Understanding (MOU) by each community (see Appendix M). The MOU would establish a mechanism for notifying participating communities of proposed actions in the watershed, and provide an opportunity for the communities to consult together and comment on issues of mutual concern. Example of information to be shared among the communities include:

- o wetlands filings before the Conservation Commissions
- o special permit filings under zoning bylaws/ordinances
- o site plan reviews
- o underground fuel storage permit filings

- amendments to local bylaws/ordinances and regulations

- water quality monitoring data

- NPDES discharge permit applications or renewals

By formalizing the Cambridge Watershed Advisory Committee under a Memorandum of Understanding, the communities will have a mechanism to resolve problems before they become critical, and a forum for increasing cooperation and understanding their diverse perspectives. The committee could also take the lead in implementing many of the recommendations of this watershed protection plan.

5.1.11 WATERSHED MONITORING

O 5.1.11.1 Findings

The Cambridge Water Department conducts all of the water quality tests of its sources which are required by the Safe Drinking Water Act, however, more broad based monitoring throughout the watershed is not regularly conducted. Expansion of the Water Department's water quality monitoring to include surface and groundwater sampling in selected portions of the watershed may provide a more complete "diagnosis" of the health of the watershed, as well as early warning of potential problems before they reach the reservoirs.

o 5.1.11.2 Recommendations

o <u>Cambridge Water Department</u>

The Cambridge Water Department should consider establishing a watershed monitoring program which is designed to evaluate key indicators of watershed status, and provide an early warning of problems. The Department should develop the monitoring regimen in consultation with a hydrogeologist. The possibility of having this work done under the MWRA's local sources project should be investigated.

5.1.12 ENVIRONMENTAL REVIEWS

5.1.12.1 Findings

Major projects proposed for the watershed are frequently subjected to Environmental Reviews under the Massachusetts Environmental Policy Act (MEPA). This review process affords an opportunity for state and regional agencies to comment on project proposals which could affect the watershed.

o 5.1.12.2 Recommendations

<u>Mass. Water Resources Authority; Dept of Environmental Protection</u>

The MWRA and DEP should carefully review any project proposal in the Hobbs Brook/Stony Brook Watershed which is undergoing MEPA review.

The reviews should focus on potential quality and quantity impacts to the reservoirs, and alternatives and mitigation measures which would minimize adverse impacts.

5.1.13 LAND ACQUISITION

Cambridge Water Board

The Water Board should consider the purchase of land or easements on selected key parcels which are critical to the water supply resources. Such parcels may be in close proximity to the reservoirs or their tributaries, and have a high potential to be developed with uses which would adversely impact the water supply.

5.1.14 MWRA Local Source Protection Policies

Massachusetts Water Resources Authority

The MWRA currently has a policy which promotes action on the part of "contract" communities to protect local sources of water which may be used to supplement the supplies available to the community and reduce demand on the Authority's sources. The Cambridge water system is the largest local source of water used by an MWRA community. The source is not located in Cambridge, however, three of the four communities in the Cambridge reservoir watersheds rely on the MWRA for 100% of their water supply (Lexington, Waltham, and Weston). The MWRA could help promote the protection of the Cambridge water supplies by implementing its contract community local source protection policies with all other MWRA user communities which have local sources of water within their borders. In the case of the Cambridge water supply, protection of the 17 million gallon per day yield benefits not only the city of Cambridge, but all MWRA water users in the metropolitan area.

5.2 IMPLEMENTATION OF THE WATERSHED PROTECTION PLAN

This project has led to a set of recommendations which are designed to reduce the threats to a major water supply resource which is significant to the region as a whole. The recommendations are directed at a variety of local boards in the communities because each one has jurisdiction over different functions and activities which can affect the water supply resource. It is clear that there is no single authority or protection measure which can protect the water supply from the diverse potential threats and impacts. Implementation of the overall protection plan must necessarily proceed with actions taken by each of the boards identified in each of the communities. Figure 5-3 provides a summary of the major recommendations to the communities and ranks them according to their priority for watershed protection in each community.

The Cambridge Watershed Advisory Committee, which represents most of the local boards, is in the best position to play a coordinating role in moving the recommendations to implementation. The materials developed in this study are available to document the need for the various recommendations, and can continue to serve as a reference for future planning and refinement of watershed management techniques. The Committee can provide an ongoing process providing for the participation of all the communities in the development and implementation of the watershed protection program. A suggested program for implementation is shown in Figure 5-4. It is hoped that the process begun by this project will be carried forward by the communities and state agencies for the benefit of the region.

Figure 5-3 Priority Ranking of Recommended Local Protection Measures

Protection Measures	Lexington	Lincoln	Waltham	Weston
Watershed Protection Overlay Dist.	High	Med	High	Med.
Site Plan Review	Exist.	Low	High	Exist.
Wetlands Regulations	Exist.	Exist.	High	High
Underground Tank Regulation	High	High	High (Amend.)	High
Hazard. Materials Regulation	High	Low	High (Amend.)	Med.
Road Salt Reduction	Exist.	Exist.	Med. (Amend.)	Exist.
Health Reg's.	N/A	Med.	N/A	Med.
Landfill Management	N/A	Exist.	N/A	Exist.
Emergency Response	High	High	High	High

KEY: High = High Priority Med.= Medium Priority Low = Low Priority
Exist. = Existing Amend.= Existing, amendment recommended
N/A = Not Applicable

Figure 5-4

Cambridge Watershed Protection Plan----Implementation Program

1. Establish the Cambridge Watershed Advisory Committee

   a. Kickoff event--Breakfast Meeting for Chief Elected Officials

   b. Develop Memorandum of Agreement (membership, responsibilities, etc)

   c. Adopt MOA in each community; appoint members

2. Implement the Memorandum of Agreement

   a. Committee organization--meeting schedule, place, times, etc.

   b. Establish working agenda

      1) Intercommunity Notification and Review Procedures

      2) Cooperative Emergency Response Plan

      3) Prioritize proposed protection measures

3. Implement Local Protection Measures

   a. Outreach and Technical Assistance to local boards: work with boards to structure protection measures and secure their adoption as bylaws, ordinances, regulations, operating policies

      1) Chief Elected Officials
      2) Planning Boards
      3) Conservation Commissions
      4) Health Boards
      5) Boards of Appeal
      6) Fire Departments
      7) Highway Departments/DPW's
      8) Town Meetings/City Councils

   b. Administration and Enforcement: work with communities to establish procedures

      1) Establish uniform monitoring and reporting

      2) Provide administrative support

Figure 5-4--continued

4. Implement State Agency Actions

   a. Briefing of Mass. Department of Public Works

      1) Follow-up--review and comment on Highway Drainage ENF/EIR

      2) CWAC and MAPC support for local petition for MDPW action

      3) Data collection and monitoring of MDPW experimental road salt program in the watershed

   b. Briefing of Department of Environmental Protection

      1) Support proposed Class A water quality classification of Stony Brook watershed.

      2) Petition for DEP policy/regulation to control urban runoff through the NPDES permit program.

      3) Review and comment on NPDES permit applications

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CITY OF CAMBRIDGE

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EXECUTIVE DEPARTMENT
ROBERT W. HEALY
City Manager

RICHARD C. ROSSI
Deputy City Manager

February 12, 1990

To the Honorable, the City Council:

Enclosed are copies of the Cambridge Reservoir Watershed Protection Plan, Volumes 1 and 2. These reports were prepared by the Metropolitan Area Planning Council, for the Massachusetts Water Resources Authority and the City of Cambridge. Representatives from Cambridge, Waltham, Weston, Lincoln and Lexington, participated with the MAPC in this study.

This planning effort was primarily funded by $38,000 from the MWRA of the total cost of $39,000, as part of their Local Water Sources Protection Requirement.

Very truly yours,

Robert W. Healy
City Manager

RWH/dls
enclosure

Agenda # 10 S-109

Volumes # 1 and 2 of the Cambridge
Watershed Protection Plan.

In City Council,

Feb. 12, 1990

Referred to the
Environment Committee

Copy sent to Environment
Committee 2/14/90 dc