November 14, 2001

YARMOUTH COMPREHENSIVE PLAN

CHAPTER 12 - WATER RESOURCES PLAN - UPDATE

EXECUTIVE SUMMARY

PURPOSE

The Town of Yarmouth has recognized the need to conserve and protect its water resources, to secure the ecological health, economic productivity, and scenic beauty of wetlands, ponds, and marine waters, and to ensure an adequate supply of clean drinking water for current and future residents.

This Water Resource Plan inventories surface water bodies and wells, analyzes the soils, recharge areas, sources of pollution, and population patterns which affect them, and proposes Town actions to address drinking water supply, as well as surface water, management, and usage issues.

The November 2001 - Update is designed to re-organize and bring up to date with existing conditions the Plan Chapter that was adopted originally in July 1997. It is expected that regular updating will be done on an as needed basis in the future.

COORDINATION WITH THE COMPREHENSIVE PLANNING PROGRAM

The Water Resources Plan serves as Chapter 12 of the local Comprehensive Plan, now being completed. The Yarmouth Comprehensive Plan will serve as Yarmouth's response to the Regional Policy Plan, and help guide the Town's planning and growth decisions. Related chapters that have been endorsed by Town Meeting include Coastal Resources, Wetlands, Land Use/Growth Management, and Economic Development.

At present 16 of 18 subject chapters of the Comprehensive Plan have been endorsed by Town Meeting, and work is rapidly advancing on the remaining two. Yarmouth is the only town of the 15 on the Cape to use this incremental approach, and it has worked well for us. In addition it is expected that regular updates of subject chapters will be made to keep the Plan up to date. This revision is an update.

PROPOSED GOALS OF THE WATER RESOURCES PLAN

The major goals for water resource planning have changed little since first adopted. They are:

1. **GOAL** - To maintain the overall quality and quantity of Yarmouth's ground water in order to ensure a sustainable supply of high quality drinking water.
2. **GOAL** - To preserve and restore the ecological integrity of Yarmouth's fresh water ponds, lakes, and streams, as well as its marine surface waters.

SUGGESTED POLICIES

1. Development and redevelopment should minimize new nitrogen loading in nitrogen sensitive water resources areas.

2. The Town should investigate water conservation strategies beyond those that have already been adopted.

DEVELOPMENT REVIEW POLICIES

1. Water withdrawals should be managed so that they do not adversely affect surface water resources, wetlands, private wells, or the safe yield of the aquifer.

2. Development and redevelopment should make use of water conservation technologies.

3. Development and redevelopment should minimize the use of chemical fertilizers and pesticides.

4. Development and redevelopment should utilize best stormwater management practices.

ECOLOGICAL BACKGROUND

In order to understand Yarmouth's water resources, it is necessary to have an understanding of the region's geomorphology, soils and hydrology. The "long summary" contains a considerable description of the Cape's physical conditions for water resources.

GEOMORPHOLOGY

Cape Cod was formed by advancing and retreating glaciers. The Sandwich moraine, the terminal moraine marking the limit of the glaciers advance at the time, runs east-west through the upper 1/3 of Yarmouth to Follins Pond. Its deposits are partially clayey, full of large boulders, and underlain by gravel and sand.

SOIL TYPES

Yarmouth soils consist principally of glacial outwash materials, along with the moraine and kame deposits. The outwash soils have been classified into several types. These soils, with well sorted sands, are well drained, good for on-site sewage treatment, but pose a threat to ground water by percolating too quickly.

DEFINITIONS OF TERMS USED IN REPORT

1. AQUIFER - An underground geologic formation, or group of formations, containing useable amounts of ground water, that can supply wells and springs.

2. EUTROPHICATION - The process by which a body of water becomes, either naturally, or by pollution, rich in dissolved nutrients, such as phosphates, and often shallow with luxuriant plant growth as a result, but suffering from a seasonal deficiency in dissolved oxygen as a result. Such water bodies often naturally fill in to become swamps and then bogs.

3. GROUND WATER - Water that lies below the ground, fully saturating the tiny spaces between the grains of sand and rock.

4. HYDROLOGY

Water that lies below the ground, fully saturating the tiny spaces between the grains of sand or gravel is called "ground water". The soil surface zone occupied by the ground water is termed the "zone of saturation."

5. KETTLE POND - A hole in the terrain left by a large chunk of glacial ice, sufficiently deep to expose the surface of the water table.

6. IMPAIRED AREAS - Consist of areas where ground water may have been degraded by point and non-point sources of pollution, including but not limited to areas with un-sewered residential developments,

where, on average, lots are less than half an acre; landfills; septage and wastewater treatment plant discharge sites; high density commercial and industrial areas; and those down-gradient areas where groundwater may have been degraded by these sources.

7. POINT SOURCE DISCHARGE - Pollution of ground or surface water supplies at well-defined, usually manufactured "points", or locations; discharges of treated wastewater from municipal or industrial treatment plants are common point sources of pollution.

8. RECHARGE AREA - A land area in which, water reaches to the zone of saturation from surface infiltration, e.g., an area where rain water soaks through the earth to reach an aquifer.

9. RUNOFF - That part of precipitation, snow melt, or irrigation water that runs off the land into streams or other surface water, rather than evaporating or infiltrating the soil.

10. SALT WATER INTRUSION - The infiltration of salt water into the ground water and ultimately into drinking supply wells, public or private.

11. WATER DEPENDENT USE - Any uses that requires direct access to, or location in fresh and marine waters, and therefore cannot be located away from said waters. Examples include commercial or recreational boating and fishing facilities water based transportation and recreational facilities, pedestrian facilities that promote enjoyment of the shoreline.

12. WELLHEAD PROTECTION AREAS - Areas that contribute ground water to existing public and community water supply wells. A Zone-I is a 400 ft. radius around an existing well point. The state defines a Zone II as "that area of an aquifer which contributes water to a well", under a specified pumping scenario.

WATER RESOURCES INVENTORY

AREAS OF THE TOWN SERVICED BY PUBLIC COMMUNITY, AND INDIVIDUAL SUPPLY WELLS

Most of the areas of the Town are serviced by public water supply. Notable exceptions to this are Great Island in the southwest quadrant of Yarmouth, where homeowners have individual supply wells. The Yarmouth water system serves an area of about 24 sq.miles, with a permanent population of approximately 25,000 swelling to just over 50,000 in the summer. Highest maximum day water demand was 10.3 million gallons per day, with an average day's demand at about 3.5 million gallons.

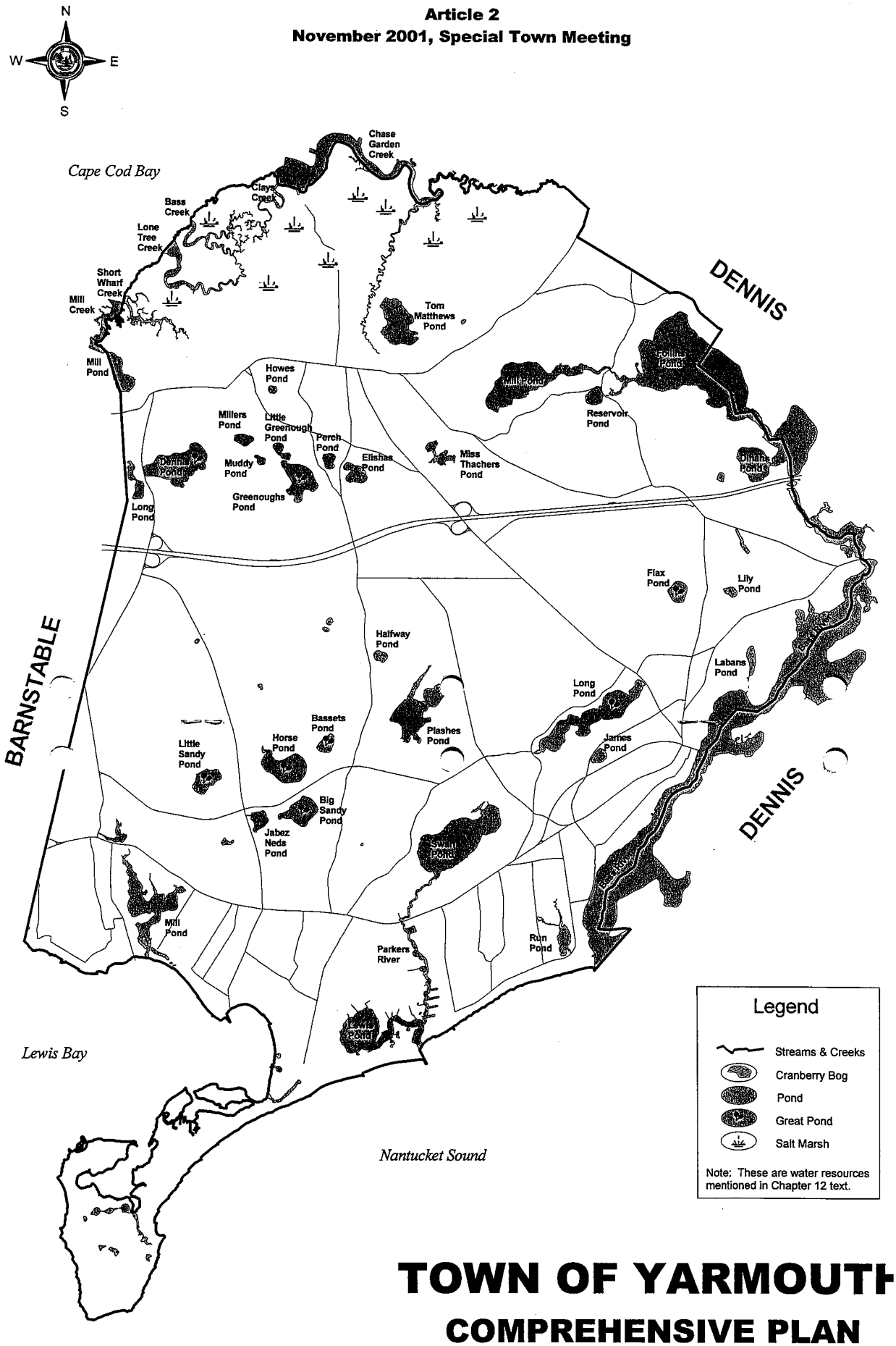
PUBLIC WATER SUPPLY WELL STATISTICS

Yarmouth's source of public water supply consists of 24 wells located throughout the Towns, 23 are gravel packed wells, and there is one well field at the Main Station with 4 gravel packed wells. The total pumping capacity of these wells is 10.2 million gals per minute, although no more than 19 are usually on line. Treatment consists of the addition of chemicals to increase PH and to sequester iron and manganese.

WATER SUPPLY AND DISTRIBUTION SYSTEM MANAGEMENT PLAN

1. In June 2001 a study was completed by SEA Consultants, Inc. for the Yarmouth Water Division. Its purpose was to formulate and present a long-range management plan for water supply storage and distribution system improvements, which would correct any existing deficiencies and meet the requirements of future water needs.
2. Our intent is to enhance the management plan proposals and findings and to assist, when appropriate, its

Article 2
November 2001, Special Town Meeting



TOWN OF YARMOUTH

COMPREHENSIVE PLAN

WATER RESOURCES CHAPTER
2001

YARMOUTH GIS

Note: Public water supply well and tank locations are not shown for security reasons.

implementation, and not to involve ourselves in the day-to-day operation of any department.

3. This study is extremely appropriate to the Comprehensive Plan and it is proposed that the report be adopted by reference here as part of the Water Resources Plan.

LACK OF POTENTIAL WELL SITES TO MEET FUTURE WATER SUPPLY NEEDS OF THE TOWN

1. There are some findings of the SEA report that are very significant planning wise however - Quoting directly from the section on "adequacy of water supplies", it says, **"Water Supply sources should be capable of meeting the maximum day demand projected several years ahead into the future with a factor of safety incorporated....."**
2. **"We have projected the water supply surplus, or deficit, through the year 2015... The results show the Yarmouth water supply, as currently permitted, will not provide adequate supply under maximum day conditions sometime after 2010. Options for adding water supply in Yarmouth are limited. The development of new sources would require construction of additional wells, but there are few available locations for well construction remaining in Yarmouth."**
3. **...."Modifying the existing Water Management Act permit would provide additional supply."**
4. Adding to the amount of public water supply available is a major control over planning assumptions in Yarmouth.

SURFACE WATER BODIES AND THEIR WATERSHEDS AND RECHARGE AREAS

Yarmouth's fresh water bodies include ponds, cranberry bogs, and streams. Within the "long summary" are tables giving details about these various bodies. In addition they are located on the fold out map.

POND AND STREAM INVENTORY

Fresh water ponds on Cape Cod are generally high quality by nature. All Yarmouth ponds are rated Class B, which is the highest ranking for ponds not used as a source of drinking water.

GREAT PONDS

"Great Ponds" are those that are 10 acres or more in their natural state. The two largest are Long Pond 57 acres, and Dennis Pond, 50 acres. There are a total of 8 "Great Ponds."

CRANBERRY BOGS

There are 7 active cranberry bogs in Town of Yarmouth. The two largest are, Sandy Pond, and Oliver's, and are leased by the town to private operators. The total acreage of these 7 bogs is 325 acres.

ANALYSIS

This section analyses the point sources and non-point sources of pollution that threaten Yarmouth's water resources. The adequacy of existing by-laws, regulations or activities in addressing these threats is examined.

POINT SOURCES OF POLLUTION

According to the Yarmouth Wetlands Protection Regulations there are several land use practices that present serious threats to the quality of our lake and pond recharge areas. Some of these are listed below:

Underground Storage Tanks - Petroleum stored in underground storage systems is one of the greatest threats to ground water quality. The average expected life span of steel tanks in our acidic soils is 15 years.

Road Salt - High concentration of chlorides, calcium and sodium, pose a threat to fresh drinking water

supplies and fresh surface waters. Health and biologic problems are also associated.

Impervious Parking Areas - Impervious surfaces increase storm water run-off and concentrated hydrocarbons from auto uses.

Automotive and construction equipment repair - Improper disposal of oil and petroleum products affect the aquifer.

Golf Courses - Inorganic plant nutrients can infiltrate the ground water. Yarmouth's public courses have been leaders in advanced turf management practices.

Non-Point Sources of Pollution - Several groups of pollutants originate from non-point or non-specific sources. The following are applicable in Yarmouth:

Suspended Solids - Suspended solids are mostly organic soil particles that do not dissolve in water, but are carried in surface water run off. This "dirt" acts as a carrier.

Organic Wastes - Organic wastes of animal or vegetable origin produce nitrogen or phosphorous compounds from such sources as sewage, fertilizers, grass clippings, street litter, or garbage collection. These compounds may also be classified as organic wastes.

Heavy Metals - Heavy metals contribute most to the toxicity to surface water runoff. Heavy metals may accumulate in the tissue of aquatic animals causing fish kills or organism mutations, as well as shifts in species diversity. Lead and zinc are the heavy metals found in largest quantity in surface water.

Hydrocarbons - There are a wide range of organic or carbon based chemicals which are a threat to drinking water supply and surface water. These may be divided into two main groups: oils and chlorinated hydrocarbons (e.g. pesticides and solvents.)

Eutrophication - Eutrophication is a problem of over supply of organic or inorganic nutrients to fresh surface water usually this is nitrogen or phosphorus from surface runoff; or it may be caused by the leaching of these nutrients into the water table from point sources like septic systems.

Water Resources in Need of Inter-Town Management - Ground water, in terms of both quality or quality, and the Town's coastal waterways, are the two water resources most in need of inter-town management.

Existing by-laws - Wetlands Protection regulations in the Town Of Yarmouth are stricter in many areas than the Mass. Wetlands Protection Act. New construction may not be within the 50ft, buffer for most resource areas.

ACTIONS AND IMPLEMENTATION

Proposed Town Actions

1. The Town should identify the location of private wells and septic systems, especially in densely developed areas, and undertake inspection and improvement programs for up-grading pre- Title 5 and failing septic systems.
2. The Town should map, protect, and as appropriate, acquire, needed future water supply areas.
3. The Town should work with the Cape Cod Commission to identify impaired and water quality improvement areas to prioritize areas for upgrades to nitrogen reducing systems.
4. The Town should develop a snow removal management strategy for roadways that minimize the total application of salt or other harmful de-icing chemicals.
5. The Town should work with the Cape Cod Commission to identify and monitor Zone 2 nitrogen levels, and work with them to identify and monitor nitrogen and phosphate levels up-gradient from coastal embayments.
6. The Town should establish a local by-law regulating nutrient loading in order to protect fresh surface waters from eutrophication.
7. The Town should develop a public education program in order to fully inform the Town's residents about ground and surface water protection.
8. The Town's fresh water ponds should be monitored by acidity (pH level) in order to maintain fish productivity.

9. Habitat restoration projects for the Town's herring runs should be continued to enhance its fisheries.
10. The Planning Board, as the Local Planning Committee, should organize a working group, a "Water Resources Steering Sub-Committee," made up of a cross section of concerned parties, to advise it on the regular update of this chapter.
11. The Town should identify and plan for the installation of new drainage components that presently discharge stormwater into the various ponds, lakes, and streams.
12. The Town should include stormwater quality and aquifer recharge concerns in all local reviews of proposed developments.
13. The Town should monitor fresh water ponds for sodium/calcium chloride, heavy metals, pH, fecal coliform, herbicides, nutrients, pesticides and rare plants, as indicated in the Pond Inventory.
14. The Town should develop programs to mitigate contamination of water resources by underground storage tanks.
15. The Town should develop programs to mitigate contamination by its five PSTF's. (Private Sewage Treatment Facilities)
16. The Town should develop programs to mitigate contamination of water resources by automotive and construction equipment repair.
17. The Town should implement, as appropriate, improvements to its water supply and distribution system, as recommended by SEA Consultants, Inc. in its report to the Yarmouth Water Division of June 2001

SUBJECTS NEEDING FUTURE EXAMINATION AND PERHAPS PROGRAMS TO MITIGATE

A. Stump Dumps
B. Septic Leaching systems - More than 2,500 gal/day
C. Self Storage Sheds
D. Impervious Parking Areas - Over 5,000 sq. ft.
E. Hazardous Waste Sites

Consultants Credit: We are pleased to acknowledge the professional assistance we have received from the consulting firm of Horsley and Witten, Inc. of Sandwich, MA In particular we wish to thank Ms. Samantha Woods, Environmental Scientist, for her help in reviewing and editing the Water Resources Chapter, and in re-organizing it with suggestions for other subject matter needed to be studied in the future.

Note: In this project we were assisted by a grant from the County of Barnstable, Ma., making use of surplus County funds.

Contacts: *Should you have further questions please contact the Yarmouth Planning Division at the Yarmouth town Offices, 1146 Route 28, South Yarmouth, MA 02664, or call at (508) 398-2231 ext. 275.*

YARMOUTH COMPREHENSIVE PLAN

CHAPTER 12

WATER RESOURCES

- Long Summary Report -

Revision of 11/27/01

Prepared By:
Horsley & Witten, Inc., Consultants
Sandwich, MA,
and the Staff of the
Planning Division of
The Department of Community Development, Town of Yarmouth, MA

TABLE OF CONTENTS

	Page Number
SCHEDULE OF PLAN ENDORSEMENTS	**4**
SETTING THE SCENE	**6**
SECTION 1: INTRODUCTION	**8**
SECTION 2: GOALS AND POLICIES	**15**
SECTION 3: INVENTORY	**19**
SECTION 4: ANALYSIS	**30**
SECTION 5: ACTION AND IMPLEMENTATION	**39**

CONSULTANT'S CREDIT PAGE

To update the Water Resources Chapter of the Comprehensive Plan which had originally been endorsed by Special Town Meeting of July 1997 we retained, Horsley & Witten, Inc. of SAndwich, MA to review the previous chapter and to edit and re-organized it, with suggestions for the subject needed to be studied in the near future.

We are pleased to acknowledge the professional assistance we received from the firm and in particular we wish to thank Ms. Samantha Woods, Environmental Scientist, for her help. The very considerable part of the re-write of the previous chapter and the substantial amount of the draft of the new replacement chapter, were the result of her efforts.

It has been the pleasure of the Planning Division staff and the Land Use and Growth Management Steering Committee to work with her on this subject chapter up-date.

LIST OF MAPS

Map 12-1	Water Resources - Location Map
Map 12-2	Surficial Geology
Map 12-3	General Soil Map - Barnstable County, MA.
Map 12-4	Public Wellheads and Zones of Contribution
Map 12-5	Lakes and Pond Re-charge Areas
Map 12-6	Watersheds of the Town of Yarmouth

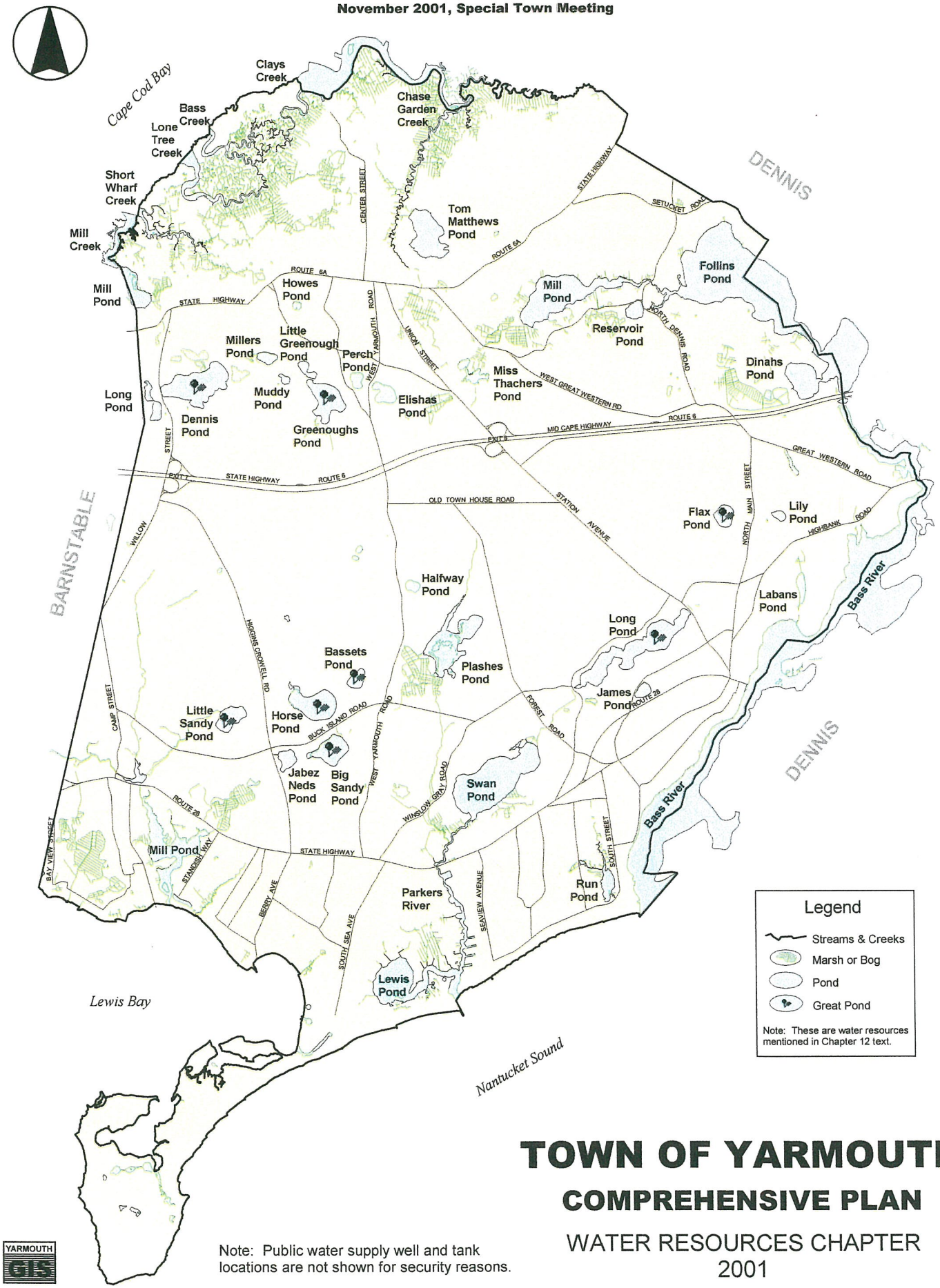
Inventory

12-3.1	Groundwater Supplies - Inventory
12-3.2	Projected Population's (2005-2015)
12-3.3	Projected Water Consumption (2005-2015)
12-3.4	Private Septic Treatment Facilities in Yarmouth
12-3.5	Yarmouth Pond Inventory
12-3.6	Yarmouth Stream Inventory
12- 3.7	Yarmouth Cranberry Bog Inventory
12.4.1	Source of Heavy Metals in Runoff

YARMOUTH COMPREHENSIVE PLAN SCHEDULE OF PLAN ENDORSEMENTS

CHAPTER NO.	TITLE	TYPE OF ARTICLE	TOWN MTG. TYPE-DATE	ARTICLE NO.	ACTION
	Vision Statement	Policy *Amendment*	ATM- 27 Apr 94 ATM- 10 Apr 01	Art. 24 Art. 16	Endorsed Endorsed
1	Introduction to Comp Plan	Research			Not Presented
2	Outreach Program	Research			Not Presented
3	Population Study and Forecasts, 1995-2015	Research			Not Presented
4	Economic Development - Inventory	Research			Not Presented
5	Intergovernmental Coordination and Resources of Regional Importance	Research			Not Presented
6	Recreation and Open Space	Policy *Replacement*	ATM- 10 Apr 97 STM- 27 Nov 01	Art. 26 Art. 2	Endorsed Endorsed
7	Coastal Resources	Policy	ATM- 10Apr 97	Art. 27	Endorsed
8	Land Use/Growth Management	Policy	STM-1 Dec 98	Art. 1	Endorsed
9	Transportation Plan	Policy	ATM- 11 Apr 00	Art. 15	Endorsed
10	Economic Development, Analysis and Plan	Policy	STM- 11 Jan 00	Art. 7	Endorsed
11	Wetlands	Policy	ATM- 14 Apr 98	Art. 14	Endorsed
12	Water Resources Plan	Policy *Replacement*	STM- 29 Jul 97 STM- 27 Nov 01	Art. 2 Art. 2	Endorsed Endorsed
13	Wildlife and Plant Habitat	Policy	ATM- 14 Apr 99	Art. 14	Endorsed
14	Affordable Housing	Policy	STM- 10 Feb 98	Art. 2	Endorsed
15	Community Character Chapter - Scenic Vistas - Historic Preservation Portion	 Policy Policy	 ATM- 10 Apr 01 ATM- 10 Apr 01	 Art. 15 Art. 15	 Endorsed Endorsed
16	Infrastructure Chapter -Solid & Liquid Waste Portion	 Policy	 STM- 27 Nov 01	 Art. 3	 Endorsed
17	Intergovernmental Coordination and Resources of Regional Importance	Policy *Supercedes Chapter 5*	ATM- 10 Apr 01	Art. 16	Endorsed
18	Implementation, Financial Information, and Capital Programming	Policy	STM- 27 Nov 01	Art. 3	Endorsed
19	Community Facilities and Services - Energy Portion	Policy	STM- 27 Nov 01	Art. 4	Endorsed

Article 2
November 2001, Special Town Meeting



TOWN OF YARMOUTH

COMPREHENSIVE PLAN

WATER RESOURCES CHAPTER
2001

Note: Public water supply well and tank locations are not shown for security reasons.

MAP 12-1

WATER RESOURCES
SETTING THE SCENE

No subject arouses more concern than water resources for Yarmouth and Cape Cod generally. The quality and quantity of the Cape's ground water is of critical importance as it is the only source of drinking water for most of Cape Cod. Of equal concern is the health and productivity of both marine and freshwater bodies, also both here and on the Cape generally. These resource areas provide a wealth of economic and recreational opportunities and their aesthetic appeal serves as a defining characteristic of the Cape.

Ground water is Yarmouth's and Cape Cod's only source of drinking water and it is also used for wastewater disposal. For this reason, wastewater impacts need to be carefully managed. In 1986 the Yarmouth Board of Health established a 5 parts-per-million (PPM) nitrogen loading standard to regulate these impacts. Of 135 of the Cape's public water supply wells, 47% were near (in 1996) background or un-altered water quality (below 0.5ppm), 47% were moderately impacted (between 0.5 and 2.5ppm) and 6% were between 2.5 and 5.0 ppm. Because nitrogen is a flag for other associated impacts from development, it is not unusual to find additional compounds in ground water associated with disposal of household chemicals, hazardous waste spills, underground storage tanks, and/or landfills.

As the intensity of land use increases and less open space is available, the conflicts between preserving high quality drinking water and land use activities from a growing year-round population are becoming more complex and difficult to solve.

Excessive withdrawal of drinking and irrigation water near lakes, ponds, wetlands, or rivers threaten ground water dependent resources. The Mass. Dept. of Environmental Management estimates that by the year 2000, ground water withdrawals from the Cape Cod Aquifer will exceed 23 million gallons per day!

The Cape Cod Aquifer is the sole source of drinking water, but it feeds freshwater ponds and wetlands as well and ultimately discharges to the surrounding marine water. Water quality concerns in marine and surface and fresh water bodies are also increasing as the population increases.

Ground water containing waste water from septic systems and treatment plants carry nutrients that act as fertilizers in these waters. Excessive nutrients lead to losses in shellfish habitat, increased bacterial survival, decreases in water clarity, and generally less pleasing aesthetically water.

Other sources of pollution in these waters include stormwater and boat wastes. The impacts are clear: increase in shellfish bed closures, extensive loss of eelgrass nests, and decreased dissolved oxygen concentrations and increasing nitrogen concentrations.

Since all of the Cape's water resources, including Yarmouth's, are linked together by ground water, a comprehensive strategy that addresses all the quantity and quality needs is required.

A number of ground water protection strategies have been implemented on Cape Cod and in Yarmouth over the past quarter century. They have primarily focused on drinking water quality. But they have evolved to address other needs. The former CCPEDC delineated "zones of contribution" for all public water supply wells on the Cape and developed model by-laws for regulating land use within these zones. Yarmouth has adopted an Aquifer Protection Overlay District (APD) for its zoning covering those zones of contribution, as updated by computer models of the State to define boundaries.

The Yarmouth Board of Health adopted a 5 parts-per-million (ppm) planning guideline over 15 years ago and the Town has carefully adhered to it. The number is designed to ensure that nitrogen concentration in drinking water wells would rarely exceed the federal EPA 10 ppm drinking water standard. In 1982 the EPA designated Cape Cod as a "sole source aquifer". This effort spurred complementary efforts within many of the towns, including Yarmouth, to protect their individual drinking water.

The Cape Cod Commission has built on the foundation established by these efforts to develop the ground water classification and protection strategy that was originally contained in the 1991 Regional Policy Plan. That strategy provided for delineation of re-charge areas for drinking water supplies, coastal embayments, ponds and lakes, the development of appropriate water quality standards, and implementation of protection and remediation efforts. The water quality standards identified in the Comprehensive Plan focus on nitrogen impacts of developments and development of nitrogen capacity limits for resources.

The water resource issues that confronted Cape Cod a decade ago are still of concern today. Considerable progress has been made towards addressing these issues over that time frame. The Cape Cod Commission has worked with U.S.G.S. to identify land available for future public water supply wells. Only 5-6% of the Cape's land area is suitable for new well sites. And, critically enough, there are no potential future well sites in Yarmouth!

Several regulatory mechanisms exist to apply what we have learned about water quality protection: local Board of Health permits for on-site wastewater systems under Title 5, state Ground Water Discharge and Water Management Permits, federal and state environmental reviews (NEPA and MEPA) and Cape Cod Commission Development of Regional Impact reviews (DRI).

Regulatory programs need to be better integrated to protect and maintain the Cape's and Yarmouth's water resources. The local Comprehensive Plan offers the opportunity to develop and coordinate local, regional and state level objectives. Critical issues to be addressed are still the management of drinking water, wastewater, and stormwater; the protection of marine and fresh water quality; the recognition of the unique characteristics of the area's hydro-geology.

We have tried to incorporate into the goals, policies, and standards, what has been learned, and to seek to ensure that Yarmouth's water resources will meet the needs of all its users.

WATER RESOURCES
SECTION 1: INTRODUCTION

1.1 PLANNING BACKGROUND

1.1.1 Purpose of the Water Resources Plan

The Town of Yarmouth recognizes the need to conserve and protect its water resources, to secure the ecological health, economic productivity, and scenic beauty of wetlands, ponds and marine waters, and to ensure an adequate supply of clean drinking water for current and future residents. This Water Resources Plan inventories surface water bodies and drinking water wells, examines the soils, recharge areas, sources of pollution and population patterns which affect them, and proposes town actions to address drinking water supply, as well as surface water, management and usage issues.

The Cape Cod Commission's Regional Policy Plan establishes a water resources classification system to manage and protect Cape Cod's water resources. The water resources classification system recognizes four primary resource areas and their respective recharge areas: wellhead protection areas, fresh water recharge areas, marine water recharge areas and potential water supply areas. The classification system also recognizes areas where water quality may have been impaired from existing development. The Town of Yarmouth has adopted this classification system and our standards for protection are equal to or more stringent than the Commission's standards in the Regional Policy Plan.

1.1.2 Yarmouth's Comprehensive Plan

This Water Resources Plan serves as Chapter 12 of Yarmouth's Comprehensive Plan. The Comprehensive Plan serves as Yarmouth's response to the Regional Policy Plan, and guides the town's planning and growth decisions. Related chapters include Land Use/Growth Management, Wetlands, Open Space/Recreation, and Coastal Resources.

This chapter contains the "Water Resources" element in a "long summary" form. The first five chapters were reference chapters that did not have to request Town Meeting "endorsement". In April 1997, chapters on "Recreation and Open Space" and "Coastal Resources" were adopted by Annual Town Meeting. The Water Resources updated chapter was endorsed by Town Meeting on November 27, 2001.

1.1.3 Preparing the Plan

Primary guidance for the Comprehensive Plan was given by the "Local Planning Committee," which is made up of the Planning Board, with the assistance of the Growth Policy Advisory Council. Much of the technical work was completed by the Planning staff, with assistance by consultants. In addition, a student intern from Cape Cod Community College assisted in gathering data for the inventory and analysis sections, and the Town Conservation Administrator and Water Superintendent reviewed each section of the Water Resources chapter.

In preparing such a far-reaching and complicated plan, it was realized there must be an extensive and continuous outreach program. In addition to required public hearings, television and radio were used whenever possible. Each of the Plan's chapters is a "stand alone" document in itself so that it can be used separately, or as part of the overall program.

1.1.4 Presentation of the Plan

One of the problems in presenting any town's comprehensive plan is that it is must be readable by people with varying degrees of interest. Our approach was to develop three versions of the plan to satisfy these different levels of interest. Executive summaries were developed to satisfy the majority of the people who might be interested in reading the plan and getting the "basics". More technical and planning information was provided in the following document to satisfy those with more interest. Finally, detailed research materials, the so-called, "green notebook" used to research each element is available for those interested, as are the consultant's reports.

The level of detail most printed and read is this document, the "Long Summary." The Long Summary is sufficient in detail to satisfy most interested persons, and usable at Town Meeting, as well. The following document is one of those "long summaries". They are bound in loose-leaf notebook form so that they may be added to, amended, or deleted fairly easily. They are not in fancy, glossy form on purpose! They are intended to be used by appropriate individuals or committees, and updated on a regular basis.

Use of the "Long Summary" Approach

The Community Development Department gets regular requests from people who would like more than the basic technical information and so our documents, including this one, are in "long summary" form sufficient to that need and for Town Meeting use as well. Finally, a very few want our detailed research materials. These materials are being kept in the Planning Division library.

1.2 ECOLOGICAL BACKGROUND

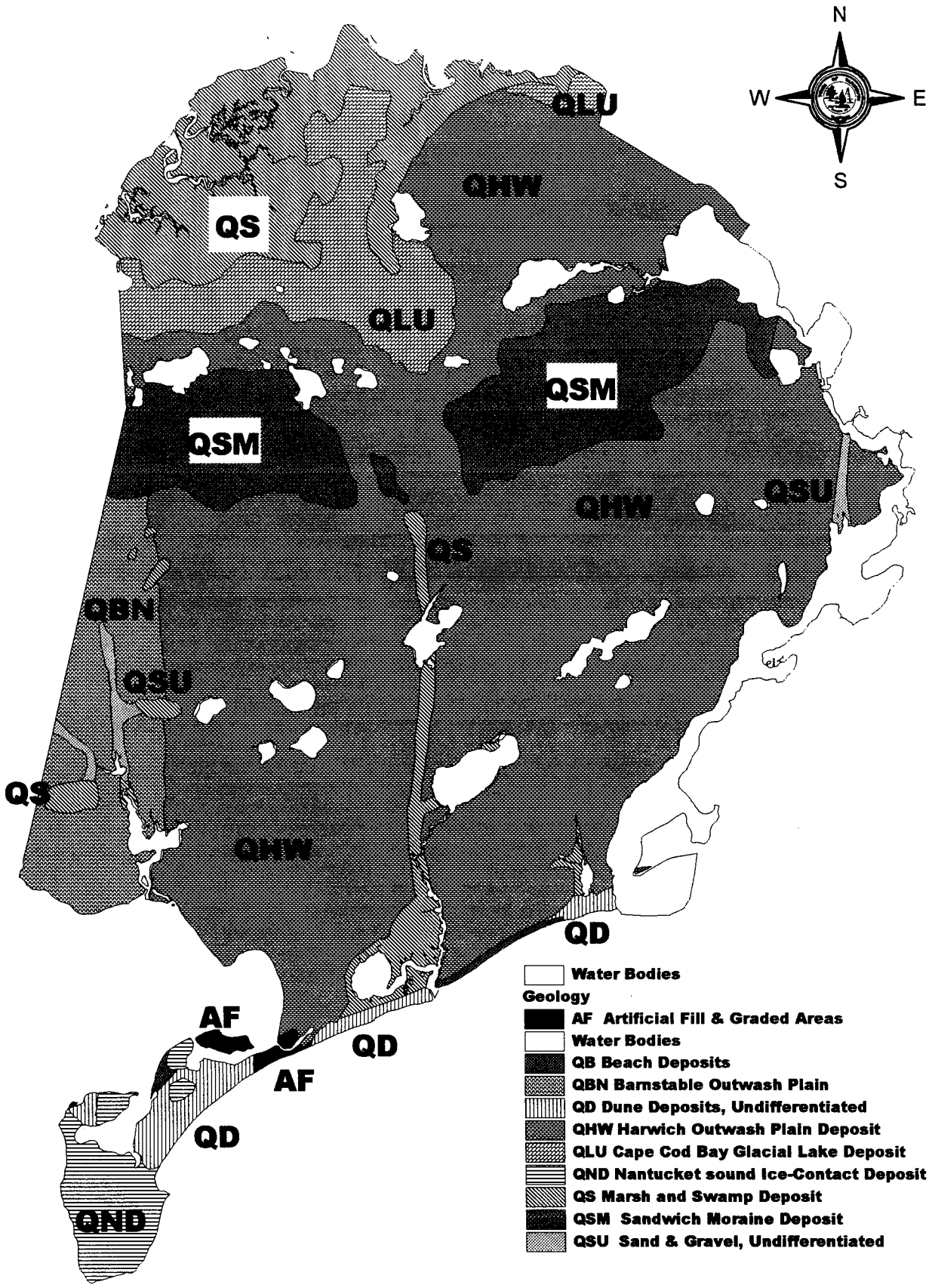
In order to understand Yarmouth's water resources, it is necessary to have an understanding of the region's geomorphology, soils, and hydrology. Each of these topics are explained in the following sections.

1.2.1 Geomorphology

Cape Cod was formed by advancing and retreating glaciers. A terminal moraine, the Sandwich moraine, extends along the western half of the Cape like a spine marking the limit of the glacier's advance formed by the retreating glacier. In Yarmouth, this feature runs east to west through the northern 1/3 of Town to Follins Pond, where it then gives way to the sandy soils of the Harwich outwash plain. Sandwich moraine deposits are mostly clayish and sandy till, full of large boulders underlain by sand and gravel, and generally higher in elevation than the rest of the glacial deposits. The moraine forms the divide for the Towns' drainage system. Generally, water drainage north of the moraine is into Cape Cod Bay; and south of the moraine is into Nantucket Sound. In the eastern part of Town, some of the drainage tends toward the east into the Bass River Watershed which ultimately flows south into Nantucket Sound.

1.2.2 Soil Types

The surficial geology in Yarmouth is described on Map 12-2 and describes the origin of soil in the Town. (USGS Geologic Map of Dennis Quadrangle, GQ-114). Yarmouth soil consists principally of glacial outwash material along with moraine and kame deposits. The Soil Conservation Service (now known as the Natural Resources Conservation Service) recently mapped and classified all of the soil in Barnstable County (Map 12-3). The soil north and south of the moraine which overlays the Harwich outwash plain, is mostly well-sorted sand. While this soil characteristic is suitable for draining onsite sewage, this same characteristic may also threaten ground water quality by allowing nitrogen and other contaminants from sewage to readily enter the water table. The outwash soils have been further classified into many types with the most common occurring as the "Carver" series. The moraine and kame deposits are also further classified in the "Plymouth -Barnstable Nantucket" series and "Plymouth-Carver-Barnstable" series, respectively. An additional soil series known as the "Ipswich-Pawcatuck-Matunuck" occupies the salt marsh areas of Barnstable County. There are a few areas of fine clay scattered throughout the Town with little drainage capacity which could present localized septic treatment problems.



TOWN OF YARMOUTH

YARMOUTH GIS

Surficial Geology

Map 12-

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

LEGEND

1. HOOKSAN-BEACHES-DUNE LAND: Beaches, Dune land, and nearly level to steep, drained, sandy soils formed in windblown deposits; along coastal shorelines
2. IPSWICH-PAWCATUCK-MATUNUCK: Nearly level, very deep, very poorly drained peats formed in marine organic and sandy deposits; in areas sheltered from ocean waves along coastal shorelines and adjacent to bodies of brackish water
3. PLYMOUTH-EASTCHOP-CARVER-BOXFORD: Nearly level to steep, very deep, excessively drained and moderately well drained, sandy and clayey soils formed in glacial lake sediments and glacial till; in areas of glacial lake deposits
4. PLYMOUTH-CARVER-BARNSTABLE: Nearly level to steep, well drained and excessively drained, sandy and loamy soils formed in sandy, loose glacial till and glacial outwash; on ground moraines and outwash plains
5. ENFIELD-MERRIMAC-CARVER: Nearly level to steep, very deep, well drained and excessively drained, loamy and sandy soils formed in glacial outwash and loamy eolian material; on outwash plains
6. PLYMOUTH-BARNSTABLE-NANTUCKET: Nearly level to steep, very deep, excessively drained and well drained, sandy and loamy soils formed in reworked glacial outwash and glacial till; on moraines and outwash plains
7. CARVER-HINESBURG-NANTUCKET: Nearly level to steep, very deep, excessively drained and well drained, sandy and loamy soils formed in glacial outwash, glacial lake sediments, and glacial till; on outwash plains and in areas of glacial lake deposits
8. CARVER: Nearly level to steep, very deep, excessively drained, sandy soils formed in glacial outwash and ice-contact deposits; on outwash plains and kames

Compiled 1991

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
BARNSTABLE COUNTY, MASSACHUSETTS

Scale 1:316,800
1 0 1 2 3 4 5 Miles
1 0 5 10 Km

MAP 12-3

1.2.3 Hydrology

Water that lies below the ground, fully saturating the tiny spaces between the grains of sand or rock, is called ground water. The subsurface zone occupied by ground water is termed the zone of saturation. The top of this fully saturated zone marks the water table. Above the water table, lies the zone of aeration, which not fully saturated, still contains some moisture which clings to soil particles by capillary action.

Salt water intrusion is, simply put, the infiltration of salt water into the ground water and ultimately into drinking supply wells, public or private. To understand how this process occurs one must understand that, due to differences in density, the fresh ground water on Cape Cod floats on the salt water lying below it like a heavily laden ship. In order for the fresh water body to "float", there must be about 35 to 40 feet of fresh water below sea level holding it above the salt water. The base of the fresh water body is, therefore, approximately 400 feet below sea level. The base curves upward toward the northern and southern Cape Cod shorelines narrowing as it approaches the sea; the contact point between salt and fresh water - the interface slants upward and emerges above the ocean floor offshore. It is this unseen underground body of water, below sea level, that must maintain its volume in order to keep the fresh-salt interface intact.

There are differences in the elevation of the water table as it arches across the Cape. Toward the center of the Cape's narrow land mass, the ground water is at its highest elevation above sea level. Observation of the elevations of kettle ponds on USGS geologic maps demonstrates this variance in elevations. A kettle pond is a hole in the terrain left by a large piece of glacial ice, sufficiently deep to expose the surface of the water table. The difference between two given points on the water table is known as the hydraulic head. Water will move underground from higher to lower elevations. For Cape Cod ,this means that water generally flows from the "backbone" of the Cape (underlying the Sandwich moraine where the water table arches upward), outward under the outwash plains to the north and south. This movement of ground water through the sandy till of glacial deposits is fairly unrestricted, flowing over the underlying bedrock, and is termed the aquifer. While the general flow of ground water is as described above, locally ground water moves unpredictably, moving vertically, horizontally and sometimes through tiny fissures in rock.

When ground water is removed by pumping, a loss of pressure results around the wellhead, causing the water table to be lowered in the shape of an inverted cone. This is called the cone of depression, which will expand in a widening radius lowering the water table in the well's zone of contribution (ZOC) (See Map 12-4). Stable pumping rates from a well or wells change the natural flow of ground water toward the sea and reverse part of the flow toward the well or wells. This, in turn, causes the base of the fresh water body to be pulled upward toward the well. If wells are overdrawn, the threat is that the water table will continue to drop and the base of the water table will be drawn upward pulling the salt and fresh water interface upward with it. Salt water intrusion into fresh water wells is always a potential threat to the safe drinking supply even though it is not considered a widespread problem at this time. Overdrawing of wells, as population continues to grow, could cause this to occur, resulting in serious water quality problems for the Town. In Yarmouth, salt water intrusion is only a threat to some private wells and not the Town's public drinking supply.

1.3 DEFINITIONS

Aquifer: An underground geologic formation, or group of formations, containing usable amounts of groundwater that can supply wells and springs.

N
W E
S

Buildings
Streets
Gravel Roads
Lakes
Streams & Wetlands
ZOCs

Public Wellheads and Well Zones of Contribution (ZOCs)

Town of Yarmouth, Massachusetts

YARMOUTH GIS

MAP 12-4

Source: Whitman and Howard, Inc, Wellesley, MA, Land Uses Within Zones of Contribution Map, June 1995

Cluster Development: A form of development that permits a reduction in lot area requirements, frontage and setbacks to allow development on the most appropriate portions of a parcel of land in return for provision of a compensatory amount of permanently protected open space within the property subject to a development application, while not increasing the total number of units allowed overall on that site.

Cone of Depression: When ground water is removed by pumping, a loss of pressure results around the wellhead, causing the water table to be lowered in the shape of an inverted cone.

Development: Any of the following undertaken by any person: any building, construction, mining, extraction, dredging, filling, excavation, or drilling activity or operation; the division of land into parcels; the clearing of land as an adjunct of construction; or the deposit of refuse, solid or liquid waste, or fill on a parcel of land or in any water area.

Ground Water: Water that lies below the ground, fully saturating the tiny spaces between the grains of sand or rock

Hydraulic Head: The difference between two given points on the water table.

Impaired Areas: Areas where ground water may have been degraded by point and non-point sources of pollution, including but not limited to, areas with unsewered residential developments where lots, on the average, are less than 20,000 sq. ft.; landfills; septage and waste water treatmentplant discharge sites; high density commercial and industrial areas ;and those downgradient areas where ground water may have been degraded by these sources. For the purpose of these standards, all certified growth/activity centers shall be classified as Impaired Areas unless ground water monitoring shows ground water quality has not been significantly degraded.

Infrastructure: Facilities and services needed to sustain residential, commercial and industrial development including, but not limited to, water supply and distribution facilities, sewage collection and treatment facilities, streets and roads, communications, energy, and public facilities such as schools and fire stations.

Kettle Pond: A hole in the terrain left by a large chunk of glacial ice sufficiently deep enough to expose the surface of the water table.

Marine Water Recharge Areas: Areas to marine embayments as mapped by a method acceptable to the Town or as mapped by the Commission, including those mapped on its "Regional Policy Plan – Cape Cod Water Resources Classification Map" dated November 27, 1996.

Mitigation: Appropriate measures that, at a minimum, offset any adverse impacts of a proposed development.

Non-point Source Discharge: Pollution of surface or ground water supplies originating from land-use activities and/or the atmosphere, having no well-defined point of entry.

Open Space: Land set aside and permanently restricted for conservation, agriculture or recreation purposes by a municipality, nonprofit conservation organization or land trust, homeowners association, or person. As appropriate to the site, open space may include woodlands, pasture, landscaped areas, gardens or play areas, golf courses, walking and riding trails, and similar areas, but shall not include structures such as tennis courts, buildings, swimming pools, or other impervious areas. Open Space may be open for public use, or access to such areas may be restricted.

Point Source Discharge: Pollution of ground or surface water supplies at well-defined. usually manufactured, "points" or locations; discharges of treated wastewater from municipal and industrial treatment plants are common point sources of pollution.

Potential Public Water Supply Area: Public water supply areas that have been identified by the Town or by the Commission on the "Regional Policy Plan – Cape Cod Water Resources Classification Map" dated November 27, 1996 as future well sites and their associated recharge areas.

Private Sewage Treatment Facilities: Privately owned package sewage treatment plants for residential development.

Recharge Area: A land area in which water reaches to the zone of saturation from surface infiltration, e.g., an area where rainwater soaks through the earth to reach an aquifer. (Also referred to as a zone of contribution, particularly for a well.)

Redevelopment: The reconstruction, reuse or change in use of any developed property including but not limited to the following: any increase in the intensity of use of already developed land, such as increase in the number of dwelling units in a structure or change to a commercial or industrial use from a less intensive use; enlargement of a structure; additions to usable interior floor area within residential, commercial and industrial buildings; and the conversion of a seasonable use or dwelling to year-round use.

Runoff: That part of precipitation, snow melt or irrigation water that runs off the land into streams or other surface water (rather than evaporating or infiltrating the soil).

Salt Water Intrusion: The infiltration of salt water into the ground water and ultimately into drinking supply wells, public or private. When a well is overdrawn, the water table will drop and the basement of water body will continue to be drawn upward, pulling the salt water-fresh water interface upward with it

Significant Natural Resource Area: Areas as shown on the Cape Cod Significant Natural Resource Area Map dated September 5, 1996, as amended, including wellhead protection areas, designated potential public water supply areas, rare species habitat, priority natural communities, wetlands, critical upland areas, unfragmented forest habitat, and land within 350 feet of vernal

pools and 300 feet of ponds.

Water-Dependent Use: Any use that requires direct access to or location in fresh and marine waters and therefore cannot be located away from said waters, including but not limited to, those uses identified by Chapter 91 regulations. Examples include: commercial or recreational boating and fishing facilities, water based transportation and recreational facilities, pedestrian facilities that promote public use and enjoyment of the shoreline, facilities that are related to marine research and education, aquaculture facilities and cranberry bogs, beach nourishment, dredging, shoreline protection structures, water level control facilities, and any other uses or facilities that cannot be reasonably located away from the shoreline.

Water Resource Protection Areas: Zones of contribution to existing public and community water supply wells and surface water supplies approved by Department of Environmental Protection (DEP).

Water Quality Improvement Areas: Impaired Areas that are located within Water Protection Areas and Freshwater and Marine Water Recharge Areas. In such areas improvement of water quality is a major goal.

Watershed: The land area that drains into a surface water body. It is defined by topographic high points.

Wellhead Protection Areas: Areas that contribute ground water to existing public and community water supply wells. The State (310CMR 22.02) defines a Zone II as "that area of an aquifer which contributes water to a well" under a specified pumping scenario. A Zone I is a 400' radius around an existing wellpoint.

Zone of Saturation: The subsurface zone occupied by ground water. The top of this fully saturated zone marks the water table.

Zone of Aeration: The zone above the water table that is not fully saturated, yet still contains some moisture which clings to soil particles by capillary action.

1.4 ACRONYMS

ACEC	Area of Critical Environmental Concern
CCC	Cape Cod Commission
DCPC	District of Critical Planning Concern
DEM	Department of Environmental Management (State of Massachusetts)
DEP	Department of Environmental Protection (Massachusetts)
DRI	Development of Regional Impact

EPA Environmental Protection Agency (U.S.)

FEMA Federal Emergency Management Agency (U.S.)

MMR Massachusetts Military Reserve

RPP Regional Policy Plan

1.5 REFERENCES

Cape Cod Commission Regional Policy Plan. November 1996.

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Metropolitan Area Planning Council. December 1983. Runoff and Recharge - Improving Water Quality and Ground Water Recharge Through Alternative Drainage Designs.

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WATER RESOURCES
SECTION 2: GOALS AND POLICIES

GOAL: To maintain the overall quality and quantity of Yarmouth's ground water to ensure a sustainable supply of high quality drinking water and to preserve and restore the ecological integrity of marine and fresh surface waters.

DEVELOPMENT REVIEW POLICIES

Water withdrawals should be managed so that they do not adversely affect surface water resources, wetlands, private wells, or the safe yield of the aquifer.

Development and redevelopment should make use of water conservation technologies.

Development and redevelopment should minimize the use of chemical fertilizers and pesticides.

Development and redevelopment should utilize stormwater best management practices.

MINIMUM PERFORMANCE STANDARDS

2.1 Except as otherwise specified in the classification system below, all development and redevelopment shall not exceed a 5 parts per million (ppm) or mg/L nitrate-nitrogen loading standard for impact on ground water based on the methodology contained in Cape Cod Commission Nitrogen Loading Technical Bulletin 91-001 and Frimpter et al. 1988.

2.2 All development and redevelopment shall comply with the minimum performance standards outlined in the following water resources classification system. If a property is located where two classifications overlap, the more stringent standards shall apply. The water resources classification system is illustrated on the Cape Cod Water Resources Classification Maps I and II, dated September 5, 1996, as amended and described below:

2.2.A Wellhead Protection Areas:

Consist of areas that contribute ground water to existing public and community water supply wells. These areas shall be delineated by a consistent method and recognized by the Cape Cod Commission in conjunction with state standards for Zone IIs (as defined in 310 CMR 22.02).

2.2.A.1 Nitrogen Loading: The maximum loading standard for nitrogen impact on ground water shall be 5 ppm for development and redevelopment unless a cumulative impact analysis indicates a more stringent loading standard is necessary.

2.2.A.2 Hazardous Waste: Commercial and industrial development and redevelopment that involves the use, treatment, generation, storage or disposal of hazardous wastes or hazardous materials, with the exception of household quantities, shall not be permitted.

2.2.A.3 Sewage and Septic: Public and private sewage or septage treatment facilities shall not be permitted in these areas, except as subject to section 2.11 to 2.17 below.

2.2.A.4 Uses prohibited in Zone II by state regulations shall not be permitted in these areas.

2.2.B Fresh Water Recharge Areas :

Consist of recharge areas to fresh water ponds as mapped by a method acceptable to the Cape Cod Commission.

2.2.B.1 In order to limit phosphorus inputs, no subsurface disposal systems shall be permitted within 300 feet of mean high water of fresh water ponds unless the applicant demonstrates by a ground water study that the site is not within the Fresh Water Recharge Area.

2.2.B.2 Developments of Regional Impact that generate over 2000 gpd of sewage effluent may be required to delineate the ground water recharge areas to potentially affected fresh water ponds and conduct a phosphorous loading assessment in order to identify and mitigate adverse impacts.

2.2.B.3 Public and private sewage treatment facilities may be used within Fresh Water Recharge Areas subject to section 2.11 to 2.17 below.

2.2.C Marine Water Recharge Areas:

Consist of recharge areas to marine embayments as mapped by the Commission, on Cape Cod Water Resources Classification Map II, dated September 5, 1996, as amended:

2.2.C.1 Except as specified in subsection C.2 below, development and redevelopment shall not exceed identified critical nitrogen loading standards for impact on marine ecosystems. For watersheds where the critical nitrogen load has not been determined, Developments of Regional Impact shall be required to make a monetary contribution to determine the flushing rate of the embayment in order to calculate the critical nitrogen loading rate. In watersheds to embayments where the critical nitrogen loading rate has been identified, Developments of Regional Impact may be required to make a monetary contribution towards the development or implementation of appropriate nitrogen management strategies.

2.2.C.2 Where existing watershed development exceeds identified critical loading standards for a marine recharge area or where there are documented marine water quality problems in the associated embayment, development and redevelopment shall maintain or improve existing levels of nitrogen loading.

2.2.C.3 All Developments of Regional Impact within Marine Water Recharge Areas shall use DEP approved alternative systems with enhanced nitrogen removal, unless a Commission-approved cumulative nitrogen loading assessment of the embayment and recharge area indicates that nitrogen loading from a standard Title 5 system is acceptable.

2.2.C.4 Public and private sewage treatment facilities may be used within Marine Water Recharge Areas subject to subsection section 2.11 to 2.17 below.

2.2.D Impaired Areas

Consist of areas where ground water may have been degraded by point and non-point sources of pollution, including but not limited to areas with unsewered residential developments where lots, on

average, are less than 20,000 sq ft; landfills, septage and wastewater treatment plant discharge sites; high density commercial and industrial areas and those downgradient areas where the ground water may have been degraded by these sources. For the purpose of these standards, all certified growth/activity centers shall be classified as Impaired Areas.

2.2.D.1 Development shall generally meet a 5 ppm nitrogen loading standard for impact on ground water, but may increase to a 10 ppm nitrogen loading standard where it can be demonstrated to the permitting authority that such increase will cause no significant adverse impact on ponds, wetlands, marine waters, public or private drinking water supply wells and potential water supply wells as identified in Section F below.

2.2.D.2 Where existing development exceeds the 10 ppm nitrogen loading standard, development and redevelopment of that property shall not increase existing levels of nitrogen loading.

2.2.D.3 Public and private sewage treatment facilities, as well as other remediation measures such as community systems and DEP approved alternative systems with enhanced nitrogen removal shall be encouraged in Impaired Areas. Public and private sewage treatment facilities shall be subject to section 2.11 to 2.17 below.

2.2.D.4 The development of public or community water supply systems shall be encouraged for areas serviced by private wells in Impaired Areas.

2.2.E. Water Quality Improvement Areas:

Consist of Impaired Areas that are located within Wellhead Protection Areas, Fresh Water and Marine Water Recharge Areas. In such areas improvement of water quality is a major goal.

2.2.E.1 Development shall not exceed a 5 ppm nitrogen loading standard or an identified marine water quality standard as applicable. Where existing development exceeds the identified loading standard or where there are documented marine water quality problems, development and redevelopment shall improve existing levels of nitrate-nitrogen loading.

2.2.E.2 Use of public and private sewage treatment facilities shall be as follows: within Water Quality Improvement Areas that are in Wellhead Protection Areas, public and private sewage treatment facilities may be used only to remediate existing problems; within Water Quality Improvement areas that are in Fresh Water and/or Marine Water Recharge Areas, public and private sewage treatment facilities may be used in conjunction with any development or redevelopment. All such facilities shall be subject to section 2.11 to 2.17 below.

2.2.F. Potential Public Water Supply Areas:

Consist of potential public water supply areas that have been identified by the Commission on the Cape Cod Water Resources Classification Map I, dated September 5, 1996, as amended, and future well sites and their associated recharge areas that have been identified by towns, water districts, or private water companies.

2.2.F.1 No development shall be permitted within 400 feet of an identified future well site.

2.2.F.2 Within an identified Potential Public Water Supply Area, the same standards apply as in Wellhead Protection Areas above.

Other Development Review Policies

2.3 Development and redevelopment shall identify their proposed wells and existing private wells on abutting properties within 400 feet and assess the impact of the development on the water quality of these wells. Septic systems and other sources of contamination shall be sited so as to avoid contamination of existing or proposed wells. A minimum 100-foot setback is required from private drinking water wells and soil absorption systems.

2.4 Conversion from seasonal to year-round uses in FEMA A flood zones or within 100 feet of wetlands shall not be permitted unless the proponent installs a DEP approved alternative system with enhanced nitrogen removal. The proponent must also demonstrate that the project will not have other adverse impacts on ground water or adjacent surface water areas and wetlands.

2.5 Development of Regional Impact that withdraw over 30,000 gallons of water per day shall be required to evaluate *(water quality and quantity)* impacts on the water table and surface water bodies.

2.6 New direct discharge of untreated storm water, parking lot runoff and/or wastewater into marine and fresh surface water and wetlands shall not be permitted. Storm water shall be managed and disposed of on site. Development and redevelopment shall use best management practices such as vegetated swales, to minimize runoff and maximize water quality treatment. A maintenance schedule shall be developed for all drainage structures. Storm water drainage should be based on projected 25-year-24 hour storm.

2.7 Cleanup of chemical spill and contamination sites should be expedited.

2.8 All public and private sewage treatment facilities shall be designed to achieve tertiary treatment with denitrification that meets a maximum 5 ppm total nitrogen discharge standard in the ground water at the downgradient property line.

2.9 The construction of private sewage treatment facilities (PSTFs) shall not allow development to occur at a higher density than would be allowed by Yarmouth Zoning Bylaws.

2.10 The construction of PSTFs shall be consistent with municipal capital facilities plans where they exist. Municipalities shall have the opportunity to assume ownership and maintenance responsibilities for such facilities where desired by the municipality.

2.11 PSTFs shall not be constructed in FEMA V zones and floodways, *Areas of Critical Environmental Concern (ACECs),* wetlands and buffer areas, barrier beaches, coastal dunes or critical wildlife habitat. PSTFs may be constructed in FEMA A zones only to remediate water quality problems from existing development within such A zones and consistent with Yarmouth's Comprehensive Plan.

2.12 The long-term ownership, operation, maintenance and replacement of PSTFs shall be secured as a condition of approval in accordance with Commission, State and local guidelines.

2.13 Applications for approval of public and private sewage treatment facilities shall include a plan for sludge disposal.

2.14 Towns may provide bonus provisions to allow increased development density through their local bylaws/ordinances provided ,that the development supplies a substantial public benefit, such as the provision of affordable housing substantially above the required 10% level, or treatment of substantial amounts of sewage from existing non-sewered development.

2.15 When allowing additional development, in areas where existing high density development or large numbers of failing septic systems have led to public health or water quality problems, the Town *shall* require PSTFs or DEP approved alternative systems with enhanced nitrogen removal, to be installed as a remedial measure.

2.16 All proposed drainage projects shall conform to DEP's latest stormwater policies.

2.17 Natural buffer zones shall be required along ponds, lakes, and marine surface water margins.

WATER RESOURCES
SECTION 3: INVENTORY

3.1 Areas of the Town Serviced by Public, Community, and Individual Supply Wells

Most areas of the Town of Yarmouth are serviced by public water supply. Notable exceptions to this are Great Island in the southwest quadrant of the town, where homeowners have individual supply wells.

Yarmouth's source of public water supply consists of 24 wells located throughout the town: 23 gravel packed wells and one well field at the Main Station with 4 gravel packed wells. The groundwater wells are treated with potassium hydroxide for pH adjustment and a sequestering agent to limit iron and manganese precipitation. The total water supply capacity is 14.66 million gallons a day (MGD) from all wells. The permitted withdrawal from the wells is a maximum of 13.14 MGD for a period not to exceed 10-days during any 30-day period. The permitted average daily withdrawal is 4.95 MGD. (SEA, 2001) Well source statistics are listed in Table 12-3.1.

Table 12-1 Groundwater Supplies

Well Number	Location	Type	Actual Pump Capacity (MGD)	Permitted Day Withdrawal (MGD)
Well #1 M (4 Wells)	Union Street	Well Field	1.44	1.44
Well #1	Higgins Crowell Road	Gravel Packed	.36	.36
Well #2	Higgins Crowell Road	Gravel Packed	.50	.50
Well #3	Higgins Crowell Road	Gravel Packed	.58	.58
Well #4	Long Pond Drive	Gravel Packed	.50	.50
Well #5	Long Pond Drive	Gravel Packed	.50	.50
Well #6	North Main Street	Gravel Packed	.36	.36
Well #7	North Main Street	Gravel Packed	.36	.36
Well #8	North Main Street	Gravel Packed	.36	.36
Well #9	North Main Street	Gravel Packed	.86	.86
Well #10	Forest Road	Gravel Packed	.43	.43
Well #11	Forest Road	Gravel Packed	.43	.43
Well #13*	Chickadee Lane	Gravel Packed	.72	.48
Well #14*	Higgins Crowell Road	Gravel Packed	.50	.34
Well #15	North Dennis Road	Gravel Packed	.72	.72

Well #16	North Dennis Road	Gravel Packed	.72	.72
Well #17*	Horse Pond Road	Gravel Packed	.86	.58
Well #18*	Chickadee Lane	Gravel Packed	.65	.43
Well #19*	Chickadee Lane	Gravel Packed	.65	.43
Well #20	Higgins Crowell Road	Gravel Packed	.50	.50
Well #21	Setucket Road	Gravel Packed	.65	.65
Well #22	Setucket Road	Gravel Packed	.79	.79
Well #23	Mid Tec Drive	Gravel Packed	.72	.48
Well #24	Higgins Crowell Road	Gravel Packed	.50	.34
Total Pumped			**14.66**	**13.44**

*Water Management Act withdrawal restriction in effect

Source: SEA Consultants, Inc., 2001

Three water tanks provide water distribution storage, with a total capacity of 9.25 million gallons (MG). The Prospect Hill tank has a capacity of 4.0 MG, the German Hill tank can hold 3.75 MG, and the Sandy Pond tank has a capacity of 1.5 MG. (SEA Consultants, Inc., 2001)

Yarmouth's existing water distribution system is comprised of 243.34 miles of pipe, ranging from 1 ½ to 20 inches in diameter cast iron, ductile iron, plastic, and cement-lined steel pipe. Some still active pipes are over 60 years old. (Whitman and Howard, 1993)

Yarmouth has generally good water quality that meets EPA and State standards. Water quality testing has indicated slightly elevated sodium, chloride, and specific conductivity levels. This is attributed to the influence of ocean derived salt aerosols, road salt runoff, and possibly sewage disposal. In addition, most wells have nitrogen concentrations elevated above natural background levels, but below drinking water quality standards. This is attributed to the density of septic systems and the application of lawn fertilizers within the recharge areas to the wells. (IEP, 1988)

3.2 Recharge Areas to Public and Community Water Supply

Map 12-4 shows Yarmouth's public wellheads and their zones of contribution (water supply recharge areas). (See P.12 previous)

3.3 Public and Community Water Supply Wells that have not yet had their Recharge Areas Mapped

None exist

3.4 Potential Well Sites to Meet the Future Water Supply Needs of the Town

The Yarmouth Town Planning Division prepared population projections as part of the Town Comprehensive Plan in 1997. The study was based on historical population data, a land use inventory,

and build out analysis based on current zoning. The 1997 population projections were developed through the year 2015, as presented in Table 3-2. (SEA Consultants, Inc., 2001)

Table 3-2: Population Projections

YEAR	POPULATION
2005	26,282
2010	27,888
2015	29,058

Future water requirements were established using the population projections and a historic per capita domestic water consumption rate of 113 gallons per day. The projected water requirements summarized below include industrial, commercial, municipal and unaccounted water consumption. (SEA Consultants, Inc., 2001)

Table 3-3: Projected Water Consumption

Year	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Peak Hour Demand (MG)
2005	4.252	10.927	.684
2010	4.512	11.595	.726
2015	4.701	12.081	.756

Based on these water consumption projections, Yarmouth will need additional water supply between 2010 and 2015. There are not any sites available for additional wells in Yarmouth. The existing wells are capable of providing sufficient supply if the current Water Management Act (WMA) permit restrictions are lifted. (SEA Consultants, Inc., 2001) However, the total storage capacity in Yarmouth is 9.25 MG, 5.37 gallons of which is usable. The estimated total required water storage for the year 2015 will be 4.94 million gallons. The current usable water storage should meet the storage demands through 2015. (SEA Consultants, Inc., 2001)

3.5 Areas of the Town Served by Public Sewers and Private Sewage Treatment Facilities (PSTF)

There are currently no public sewer systems within the Town of Yarmouth. There are five private septic treatment facilities (PSTF) currently operating within the town. These locations are identified in Table 3-3 below:

Table 12-3.4 Private Septic Treatment Facilities in Yarmouth

Facility	Gallons Per Day	Acreage	Location
Buck Island Condominiums	50,000	32	Buck Island Road W.Y.
The Cove Motel	39,900	23.6	Route 28, W. Y.
Kings Way	165,000	200	Route 6A, Y.P.
Mayflower Place	25,000	40	Buck Island Road, W.Y.
Thirwood	24,000	45	N. Main St., S.Y.

3.6 Surface Water Bodies and Their Watersheds

Yarmouth's fresh water bodies include ponds, cranberry bogs, and streams. Table 12-3.5 is a summary of Yarmouth's freshwater ponds inventory that was conducted by Brad Hall, Conservation Administrator, in 1997. This table includes general information about the ponds (condition, acreage, depth, watershed), an inventory of known species that are found there, possible contamination sources, human uses, and management recommendations. Table 12-3.6 lists similar information about Yarmouth's streams and rivers. Table 12-3.7 lists the characteristics of cranberry bogs in Yarmouth. Please also refer to maps showing Yarmouth's water recharge areas (Map 12-5), and Yarmouth's watersheds (Map 12-6).

Fresh water ponds on Cape Cod are generally of high quality by nature. All Yarmouth ponds are rated class B which is the highest ranking for ponds not used as a source of drinking water (DEP, 1990). Class B waters are designated as a habitat for fish, other aquatic life, and wildlife, and for primary or secondary contact recreation (swimming and boating). Although the Cape's freshwater ponds are naturally acidic due to the soil, acidification has been accelerated by acid precipitation carried by weather systems from the mid-western industrial areas (DEP, 1990).

Table 12-3.5 Yarmouth Pond Inventory

"Pond Table" (See following 3 pages)

YARMOUTH'S PONDS

General Description

YARMOUTH'S PONDS	Max. depth (feet)	Acres	Watershed (1)	Flows (2)	Condition (3)	Other description (4)	Well recharge zones	Surrounding Development (5)
Bassett's Lot Pond	20	10	AFS	N	[illegible]	[illegible]	[illegible]	GC
Baxter Mill Pond	5	8	MC	I O	G	MM	No	DR C
Big Sandy Pond	20	30	PR	O	[illegible]	CBR	No	DR
Cat Swamp Pond	[illegible]	[illegible]	AFS	[illegible]	A	MM	6 7 8 9	GC
Crow Pond	5	[illegible]	MC	O	A	[illegible]	Many	None
Dennis Pond	[illegible]	50	AFN	I	G	PGP	1 2 3	DR C I
Elisha's Pond	20	19	AFN	N	[illegible]	[illegible]	[illegible]	DR SC
Flax Pond	20	10	AFS	[illegible]	G	PGP	6 7 8 9	SC GC RA
Greenhough Pond	25	20	AFN	[illegible]	G	PGP	[illegible]	SC RR CV

Species Inventory

YARMOUTH'S PONDS	Endangered species habitat	Rare plants	Small woodland animals (racoon, skunk, possum, squirrel, rabbit, mice)	Migratory animals (fox, coyote, deer)	Birds of prey (raptors)	Waterfowl	Herring spawning	Amphibians and reptiles
Bassett's Lot Pond	Y	Y	Y	Y				
Baxter Mill Pond			Y				Y	
Big Sandy Pond	Y	Y						
Cat Swamp Pond			Y					
Crow Pond	Y	Y	Y	Y				
Dennis Pond		Y	Y	Y				
Elisha's Pond		Y	Y	Y	Y	Y		
Flax Pond		Y	Y	Y				
Greenhough Pond		Y	Y	Y				

Contamination Sources

YARMOUTH'S PONDS	Waterfowl feces	Septic systems	Pesticides	Herbicides	Fertilizers	Stormwater runoff	Underground storage tanks	Wastewater treatment plant
Bassett's Lot Pond								
Baxter Mill Pond								
Big Sandy Pond								
Cat Swamp Pond								
Crow Pond								
Dennis Pond								
Elisha's Pond								
Flax Pond								
Greenhough Pond								

Human Uses

YARMOUTH'S PONDS	Fishing (bass, perch, sunfish)	Swimming	Motorboats	Canoeing	Birdwatching	Hiking, nature study	Public Parking	Public boat access	Public restroom facilities
Bassett's Lot Pond	Y					Y			
Baxter Mill Pond	Y								
Big Sandy Pond	Y			Y					
Cat Swamp Pond									
Crow Pond									
Dennis Pond	Y	Y				Y			
Elisha's Pond	Y	Y		Y	Y				
Flax Pond		Y							
Greenhough Pond	Y								

Management

YARMOUTH'S PONDS	Monitoring Recommendations (6)	Mgmt Recommendations (7)	Notes
Bassett's Lot Pond	N		
Baxter Mill Pond			Slated for revitalization
Big Sandy Pond			
Cat Swamp Pond	P H		
Crow Pond	Rp		No fish
Dennis Pond	Ph		Naturally very acidic
Elisha's Pond	N		
Flax Pond	Hm N S		
Greenhough Pond	P H		Conservation Deed

1. Watershed Key:
AFN Aquifer Fed, NORTH of Rte.6
AFS Aquifer Fed, SOUTH of Rte.6
BR Bass River Watershed
CC Cape Cod Bay Watershed
FP Follins Pond Watershed
LB Lewis Bay Watershed
MC Mill Creek Watershed
PR Parker's River Watershed

2. Flows Key:
I Inlet
N None (classic kettle pond)
O Outlet

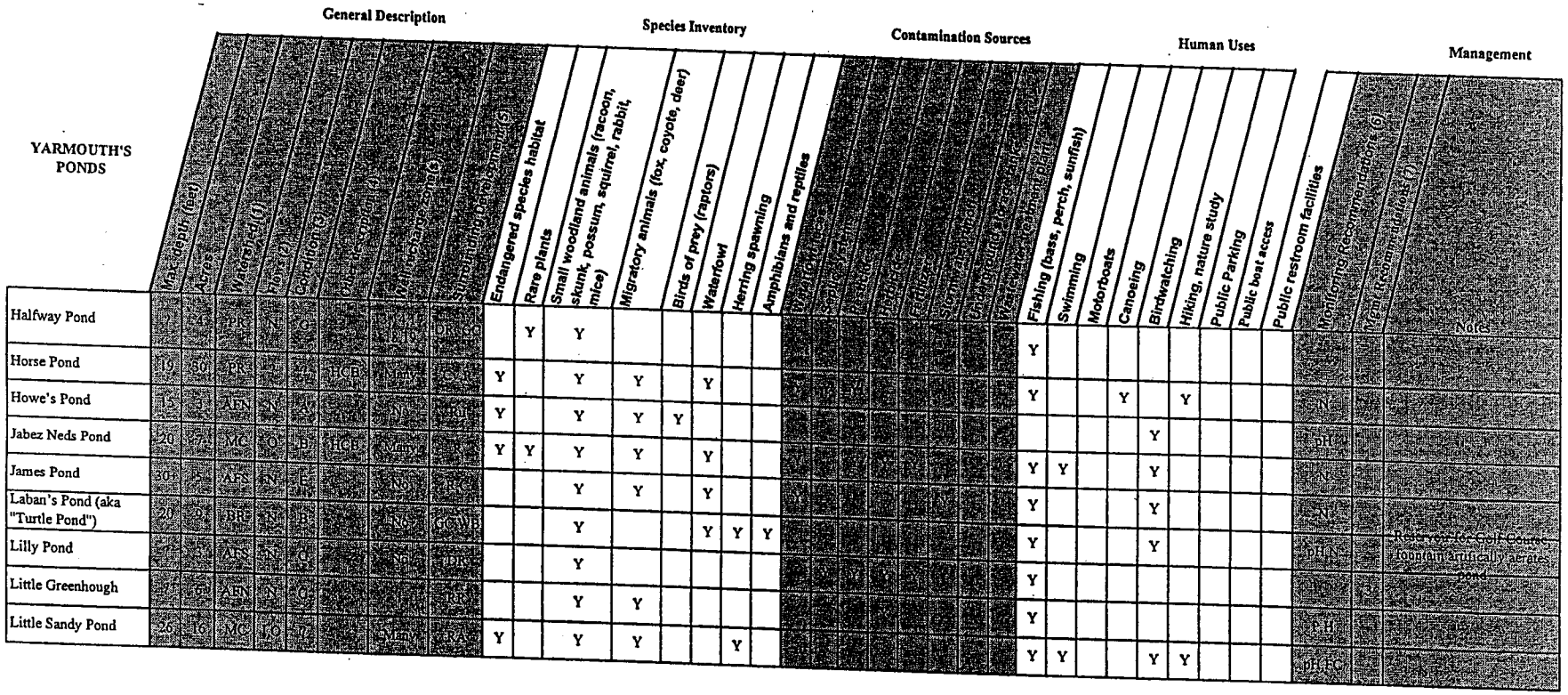
3. Pond Condition Key:
A Healthy, pristine
B Appears quite healthy
C Nutrient loading not apparent
D Assumed no high levels of contamination
E Does not appear eutrophic
F Borderline eutrophic
G Assumed some degree of eutrophication
H Excess nutrient levels
I Excess vegetation
J Advanced eutrophication

4. Other Description Key:
CBR Cranberry bog reservoir
CGP Certified "Great Pond"
HCB Historic cranberry bog reservoir
MM Manmade pond
PGP Presumed "Great Pond"

5. Surrounding Development Key:
C Commercial
CV Conservation
DR Dense Residential
GC Golf course
I Industrial
R Residential
RA Recreation Area
RR Railroad
RU Rural
SC Summer Camp
WB Wooded Buffer

6. Monitoring Recommendation Key:
Fc Should be routinely monitored for fecal coliform
H Should be routinely monitored for herbicide levels
Hm Should be routinely monitored for heavy metals
N Should be routinely monitored for nutrient levels
Ph PH levels should be monitored on a regular basis
P Should be routinely monitored for pesticide levels
Rp Should be routinely monitored for rare plants
S Should be routinely monitored for sodium/calcium chloride (salts)

7. Management Recommendation Key:
1 Excess vegetation should possibly be removed
2 Should be dredged and treated for eutrophication
3 Nearby residents should be educated about safe disposal of toxins, lawn care, and septic maintenance



1. Watershed Key:
AF Aquifer Fed Ponds
BR Bass River Watershed
CC Cape Cod Bay Watershed
FP Follins Pond Watershed
LB Lewis Bay Watershed
MC Mill Creek Watershed
PR Parker's River Watershed

2. Flows Key:
I Inlet
N None (classic kettle pond)
O Outlet

3. Pond Condition Key:
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CGP Certified "Great Pond"
HCB Historic cranberry bog reservoir
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CV Conservation
DR Dense Residential
GC Golf course
I Industrial
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RR Railroad
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SC Summer Camp
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6. Monitoring Recommendation Key:
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S Should be routinely monitored for sodium/calcium chloride (salts)

7. Management Recommendation Key:
1 Excess vegetation should possibly be removed
2 Should be dredged and treated for eutrophication
3 Nearby residents should be educated about safe disposal of toxins, lawn care, and septic maintenance

YARMOUTH'S PONDS

General Description

YARMOUTH'S PONDS	Max. depth (feet)	Acres	Watershed (1)	Flows (2)	Condition (3)	Other description (4)	Wellhead recharge zone(s)	Surrounding development (5)
Long Pond	7	57	PR	[illegible]	D F	CGP	Many	DR
Long Pond (Yarmouthport)	25	9	AFN	N	I	[illegible]	Many	R RA
Miller's Pond	25	6	AFN	N	E C		No	R RU
Miss Thacher's Pond	8	7	FP	O	J	MM HCB	[illegible]	[illegible]
Muddy Pond	20	4.5	AFN	N	B		[illegible]	RR
Perch Pond	20	6	AFN	N	[illegible]	[illegible]	[illegible]	R WB
Plashes Pond	6	44	PR	I O	[illegible]	MM G BR	[illegible]	DR
Reservoir Pond	7	7	FP	O	[illegible]	CBR	No	DR
Tar Pond	3	1	AFS	N	A		Many	WB RA
Tom Matthews Pond	5	36	CC	O	C	MM	No	DR I C

Species Inventory

YARMOUTH'S PONDS	Endangered species habitat	Rare plants	Small woodland animals (racoon, skunk, possum, squirrel, rabbit, mice)	Migratory animals (fox, coyote, deer)	Birds of prey (raptors)	Waterfowl	Herring spawning	Amphibians and reptiles
Long Pond			Y	Y				
Long Pond (Yarmouthport)	Y		Y	Y		Y		
Miller's Pond	Y	Y	Y	Y	Y	Y		
Miss Thacher's Pond			Y	Y		Y	Y	Y
Muddy Pond	Y		Y	Y				
Perch Pond	Y		Y	Y		Y		
Plashes Pond			Y	Y		Y		
Reservoir Pond			Y	Y		Y		
Tar Pond		Y	Y	Y				
Tom Matthews Pond			Y	Y		Y	Y	

Contamination Sources

YARMOUTH'S PONDS	Waterfowl (fecal)	Septic systems	Pesticides	Herbicides	Fertilizers	Stormwater runoff	Underground storage tanks	Wastewater treatment plant
Long Pond								
Long Pond (Yarmouthport)								
Miller's Pond								
Miss Thacher's Pond								
Muddy Pond								
Perch Pond								
Plashes Pond								
Reservoir Pond								
Tar Pond								
Tom Matthews Pond								

Human Uses

YARMOUTH'S PONDS	Fishing (bass, perch, sunfish)	Swimming	Motorboats	Canoeing	Birdwatching	Hiking, nature study	Public Parking	Public boat access	Public restroom facilities
Long Pond	Y	Y		Y					
Long Pond (Yarmouthport)	Y			Y	Y				
Miller's Pond	Y				Y	Y			
Miss Thacher's Pond	Y				Y				
Muddy Pond	Y					Y			
Perch Pond	Y								
Plashes Pond	Y				Y	Y			
Reservoir Pond	Y				Y	Y			
Tar Pond					Y				
Tom Matthews Pond	Y					Y			

Management

YARMOUTH'S PONDS	Monitoring Recommendations (6)	Mgmt Recommendations (7)	Notes
Long Pond		3	Possible contamination from nearby stump dump
Long Pond (Yarmouthport)	pH	1	Exceptionally high water table. Occasional closings due to Fecal Coliform
Miller's Pond	pH		
Miss Thacher's Pond	pH	2	Depth artificially regulated
Muddy Pond	P,H		
Perch Pond	pH,N		
Plashes Pond	P,H		
Reservoir Pond	Hm,S,P, Fc,H		
Tar Pond	pH		
Tom Matthews Pond			Conservation restriction

1. Watershed Key:
AF Aquifer Fed Ponds
BR Bass River Watershed
CC Cape Cod Bay Watershed
FP Follins Pond Watershed
LB Lewis Bay Watershed
MC Mill Creek Watershed
PR Parker's River Watershed

2. Flows Key:
I Inlet
N None (classic kettle pond)
O Outlet

3. Pond Condition Key:
A Healthy, pristine
B Appears quite healthy
C Nutrient loading not apparent
D Assumed no high levels of contamination
E Does not appear eutrophic
F Borderline eutrophic
G Assumed some degree of eutrophication
H Excess nutrient levels
I Excess vegetation
J Advanced eutrophication

4. Other Description Key:
CBR Cranberry bog reservoir
CGP Certified "Great Pond"
HCB Historic cranberry bog reservoir
MM Manmade pond
PGP Presumed "Great Pond"

5. Surrounding Development Key:
C Commercial
CV Conservation
DR Dense Residential
GC Golf course
I Industrial
R Residential
RA Recreation Area
RR Railroad
RU Rural
SC Summer Camp
WB Wooded Buffer

6. Monitoring Recommendation Key:
Fc Should be routinely monitored for fecal coliform
H Should be routinely monitored for herbicide levels
Hm Should be routinely monitored for heavy metals
N Should be routinely monitored for nutrient levels
Ph PH levels should be monitored on a regular basis
P Should be routinely monitored for pesticide levels
Rp Should be routinely monitored for rare plants
S Should be routinely monitored for sodium/calcium chloride (salts)

7. Management Recommendation Key:
1 Excess vegetation should possibly be removed
2 Should be dredged and treated for eutrophication
3 Nearby residents should be educated about safe disposal of toxins, lawn care, and septic maintenance

YARMOUTH'S STREAMS

	General Description								Species Inventory								Contamination Sources									Human Uses						Management		
	Condition (1)	Watershed (2)	Quantity of Flow	Channel Width (feet)	Length (miles)	Channel Depth (feet)	Water Color	Surrounding Development (3)	Endangered species habitat	Rare plants	Small woodland animals (racoon, skunk, possum, squirrel, rabbit, mice)	Migratory animals (fox, coyote, deer)	Birds of prey (raptors)	Waterfowl	Herring spawning	Amphibians and reptiles	Waterfowl	Septic Systems	Pesticides	Herbicides	Fertilizers	Stormwater runoff	Underground storage tanks	Wastewater treatment plant	Fishing (bass, perch, sunfish)	Swimming	Motorboats	Canoeing	Birdwatching	Hiking, nature study	Monitoring Recommendations (4)	Mgmt Recommendations (7)	Notes
Hamblin's Brook		FP																															
Hawe's Run		MC																															
Town Brook		MC																															
White's Brook		CC																															

1. Pond Condition Key:
A Healthy, pristine
B Appears quite healthy
C Nutrient loading not apparent
D Assumed no high levels of contamination
E Does not appear eutrophic
F Borderline eutrophic
G Assumed some degree of eutrophication
H Excess nutrient levels
I Excess vegetation
J Advanced eutrophication

2. Watershed Key:
AF Aquifer Fed Ponds
BR Bass River Watershed
CC Cape Cod Bay Watershed
FP Follins Pond Watershed
LB Lewis Bay Watershed
MC Mill Creek Watershed
PR Parker's River Watershed

3. Surrounding Development Key:
C Commercial
CV Conservation
DR Dense Residential
GC Golf course
I Industrial
R Residential
RA Recreation Area
RR Railroad
RU Rural
SC Summer Camp
WB Wooded Buffer

4. Monitoring Recommendation Key:
Fc Should be routinely monitored for fecal coliform
H Should be routinely monitored for herbicide levels
Hm Should be routinely monitored for heavy metals
N Should be routinely monitored for nutrient levels
Ph PH levels should be monitored on a regular basis
P Should be routinely monitored for pesticide levels
Rp Should be routinely monitored for rare plants
S Should be routinely monitored for sodium/calcium chloride (salts)

7. Management Recommendation Key:
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2 Should be dredged and treated for eutrophication
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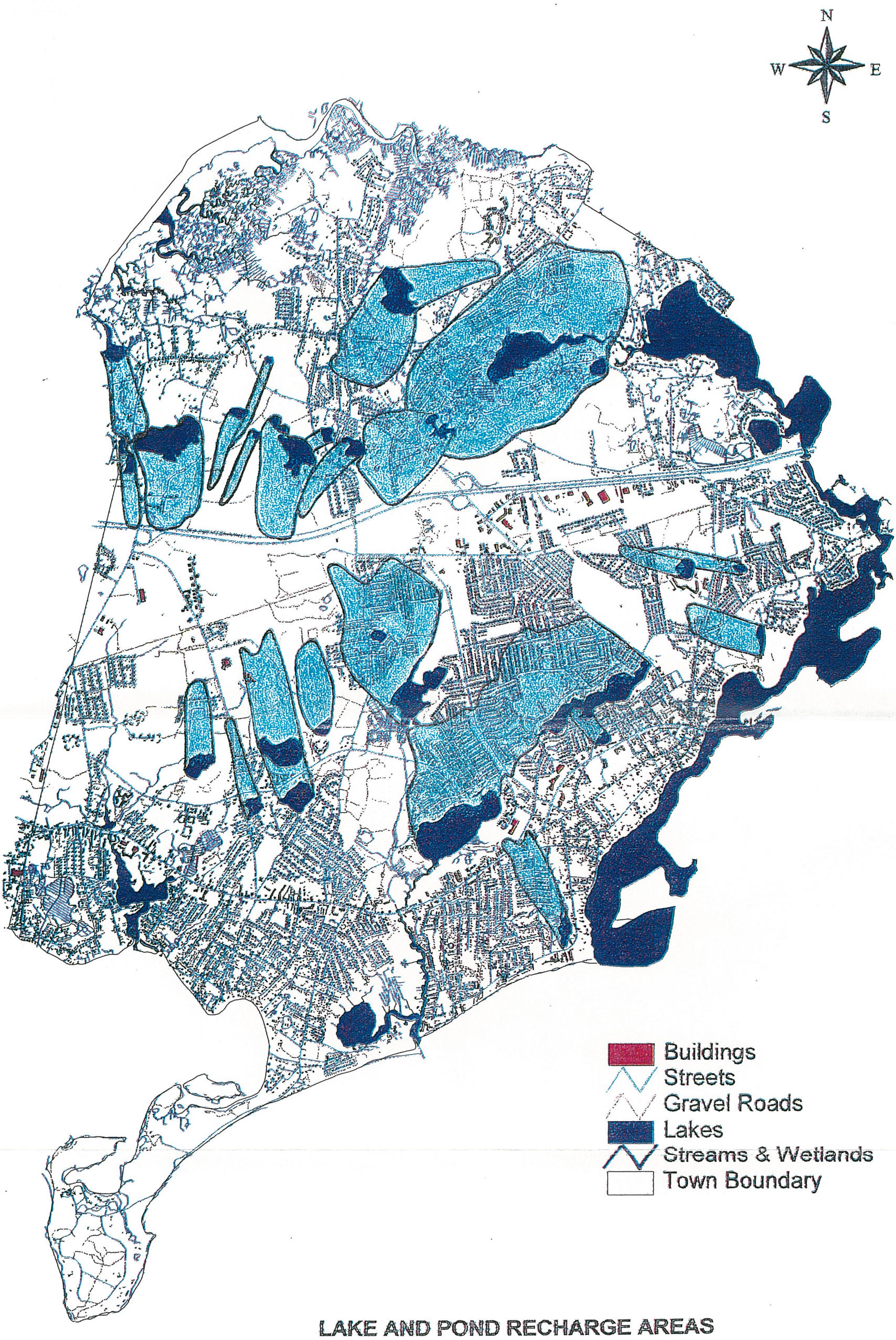


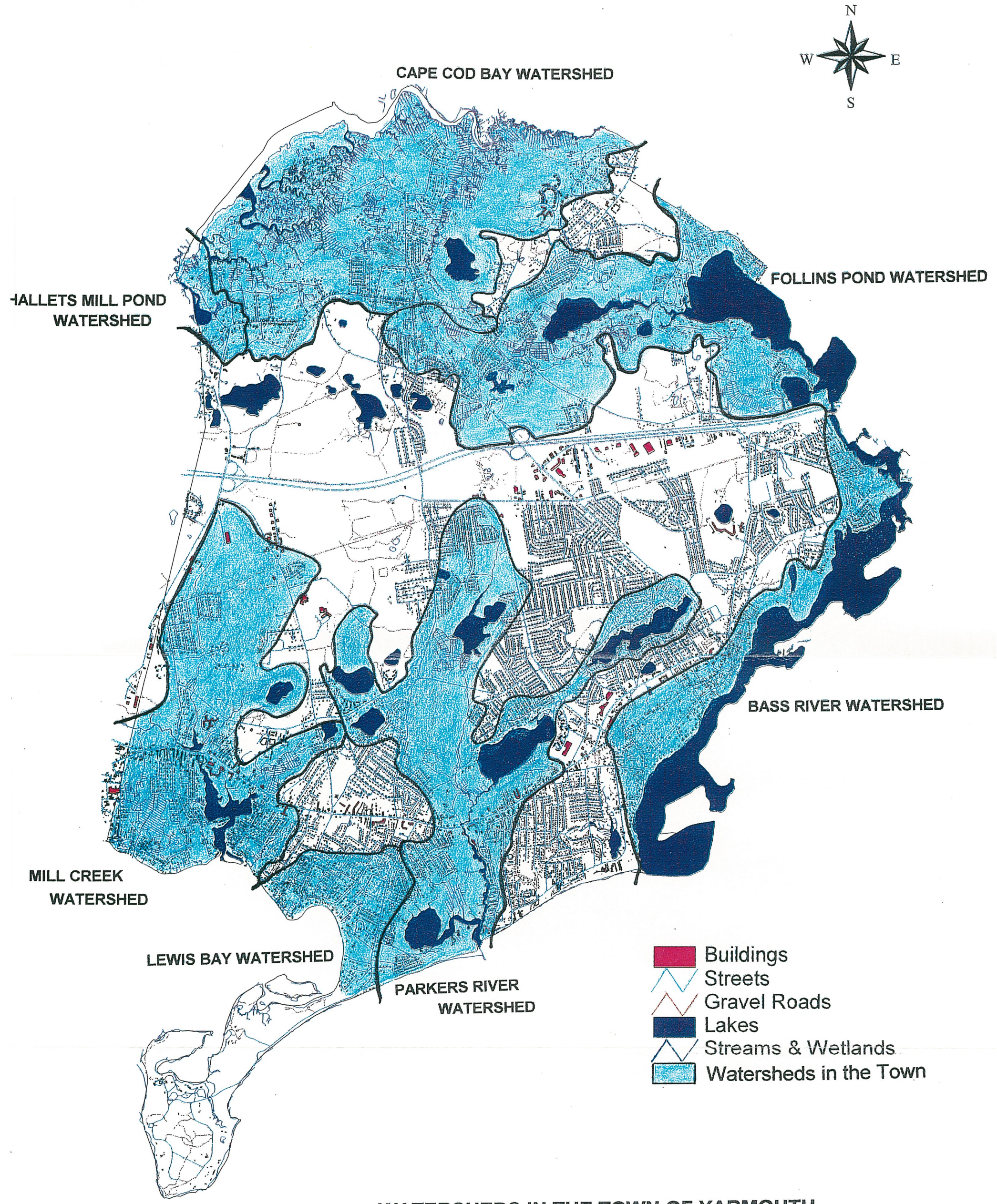
LAKE AND POND RECHARGE AREAS

Town of Yarmouth, Massachusetts

Source: IEP, Inc./Wright Pierce, Inc. Water Resources Protection Study, Town of Yarmouth, August, 1988 (Figure 3.3, Lake and Pond Recharge Areas).

YARMOUTH GIS

MAP 12-5



WATERSHEDS IN THE TOWN OF YARMOUTH

Town of Yarmouth, Massachusetts

Source: IEP, Inc./Wright Pierce, Inc., Water Resources Protection Study, Town of Yarmouth, August, 1988 (Fig. 4-1, Coastal Watersheds).

MAP 12-6

YARMOUTH GIS

Table 12-3.7 Yarmouth Cranberry Bog Inventory

BOG NAME	BOG ACRES	ASSOC. ACRES	OWNER	OPERATOR	STREET
Peter LeSage	14.03	1.4	Rocky Bog	Tom Grew, Jr.	Weir Road
Beaton Bog	16.39	0	Middletown Cranberry Co	Middletown Co.	Union Street
Chase Swamp	36	0.92	Mello-Wilson	Mello-Wilson Bog Cranberry Corp	Route 28 W. Yarmouth
Smith-Hammond Bog	56.44	14	Mystic	David McCarthy Cranberry Co.	Knob Hill Road
Five-Acre Bog	7	8	Cranberry Bog Homeowners Association	Tom Powers	Buck Island Rd
Sandy Pond Bog	75	95	Town of Yarmouth (leased)	Robert Hallet	West Yarmouth Road
Oliver's Bog	73	123	Town of Yarmouth (leased)	Robert Hallet	West Yarmouth Road
TOTAL	**325**[1]	**290**			

Source: Yarmouth Open Space & Recreation Plan (taken from Assessing Records, site visits)

[1]Of the 325 total bog acres, 282 acres are productive and 43 acres are in renovation

WATER RESOURCES
SECTION 4: ANALYSIS

This section analyzes the point sources and non-point sources of pollution that threaten Yarmouth's water resources, and the adequacy of existing by-laws, regulations or activities in addressing these threats. Where existing regulations, by-laws or accomplishments are deemed inadequate, recommendations are made, including the relevant proposed Minimum Performance Standards (described in Section 2: Goals and Policies). Action items are listed in Section 5.

4.1 POINT SOURCES OF POLLUTION

According to the Town of Yarmouth Wetlands Protection Regulations, section 305 (1) B, there are several potential point sources or land uses that present serious threats to the quality of recharge areas to both surface water and drinking water wells. These include, but are not limited to:

1. underground storage tanks
2. landfills
3. stump dumps
4. septic leaching systems with capacities of 2,500 gallons or more per day
5. road salt storage areas
6. package treatment plants
7. impervious parking areas larger than 5,000 sq.ft.
8. automotive and construction equipment repair
9. golf courses

Each of these contaminant sources are mapped in relation to the recharge areas of drinking water wells and ponds within the Town of Yarmouth.

4.1.1 Underground Storage Tanks

Petroleum stored in underground storage systems is one of the greatest threats to ground water quality in the Town. The average expected life span of steel tanks in acidic soil (such as are found on Cape Cod) is approximately 15 years. Corrosion may cause pinhole size leaks which may discharge hundreds of gallons of fuel over a several month period. Expenditures for charcoal filtration cleanup of such plumes are astronomically expensive (IEP, 1988).

The Yarmouth Board of Health has developed a computer-based data management system to track the type, size, location, and age of each tank.

4.1.2 Landfills

Landfills are well documented sources of ground water contamination. Leachate generated from water percolating through refuse can be highly mineralized and contain contaminants such as chloride, iron, lead, copper, sodium, nitrate, and variety of organic chemicals (IEP, 1988).

The Town of Yarmouth operated a landfill on Old Town House Road near Route 6. Some ground water contamination was documented at the site (CCPDEC, 1980 and CA Rich Consultants 1985, 1986, 1987). However, none of the municipal wells appear to be seriously threatened due to a semi-confining geologic condition (IEP, 1988). Half of this landfill site was capped in 1999 and was redeveloped for use as a golf course in 2000. The other half is no longer active, except as a waste transfer station. There are four other abandoned landfills located throughout the Town (IEP, 1988). The IEP report indicates no landfill leachate is migrating towards any of the Town's drinking water wells.

4.1.3 Stump Dumps

While there is very little published data concerning ground water contamination from decomposing wood, there appear to be three issues of concern:

1. Leaching of nitrogen to ground water from decomposing wood;
2. Contamination by heavy metals (e.g. cadmium), which may be present in the root systems of trees if, in fact, such metals were historically dumped on such root systems;
3. Lignin or tannic acid could cause impacts to taste and color of ground and surface water and lower pH (IEP, 1988).

Yarmouth has a number of stump dumps. A stump dump lies within the recharge area to Wells #1, 2, and 3 but presents a minimal threat (IEP, 1988). A stump dump is located just east of Wells #4 and #5, but appears to be outside the recharge area to the wells under average pumping conditions (IEP, 1988). Two stump dumps lie 600 and 1,300 feet away from Wells #15 and #16 (IEP, 1988). A stump dump lies within the recharge area to Well #20, another lies within the recharge areas of Wells #21 and #22 (IEP, 1988).

4.1.4 Septic Leaching Systems with Capacities of 2,500 Gallons Per Day or More

There are three septic systems of 2,500 gallons per day or more, one each located near Big Sandy Pond, The Run, and Hallets Mill Pond (IEP, 1988). The threat of septic contamination to ground water and surface water from nitrogen and other contaminants in wastewater is more distinct, given the larger capacity of these septic systems.

4.1.5 Road Salt

High concentrations of chlorides, calcium and sodium pose a threat to fresh drinking water supplies and fresh surface waters. Problems associated with salt usage are hypertension and/or heart disease in certain individuals, the chemical "burning" of vegetation, reduction of soil fertility (salinization), the killing of freshwater fish and the stimulation of algal growth in fresh water bodies. Salt may also contain heavy metal impurities such as zinc or lead or fillers such as

cyanide. (However, in Massachusetts such fillers are illegal)

Road salt may be considered a nonpoint source of pollution as well as a point source. A nonpoint source of such contaminants is de-icing salts, sodium chloride or calcium chloride -, used on streets and highways in wintertime. Salt storage shed stockpiles are a point source of salt contamination. Weather proofing storage sheds by completely enclosing them from the elements is one way to avoid contamination.

Sodium chloride or salt is commonly used as a de-icing agent on Yarmouth's roadways in the wintertime. In 1972, drinking supply Well #1 was shut down at Willow Street and Higgins Crowell Road because of salt contamination from an open salt storage area owned by the Commonwealth of Massachusetts. The situation was rectified by enclosure of the salt storage area into a covered shed. The well has since been reopened. Today, there are two salt storage sheds in town, one owned by the State and the other by the Town; both are covered sheds, protected from the weather elements. There still remains a problem with salt runoff from Route 6, near exit 7, near Well Stations #2 and #3.

4.1.6 Package Treatment Plants

"Package" treatment plants are private wastewater treatment plants (PSTF's). There are presently five such plants operating in the Town of Yarmouth, the largest number in any single town in Massachusetts (IEP, 1988). A complete listing and locations of those presently operating in town is given in the previous section, in Table 12-3.4. No PSTFs are located within recharge areas to drinking water wells or fresh water ponds in Yarmouth

4.1.7 Impervious Parking Areas Larger than 5000 Square Feet

Storm water runoff can be a significant source of phosphorus and other contaminants to ponds. Impervious surfaces increase storm water runoff and are significant for high concentrations of petroleum hydrocarbons from automotive drippings, high salt, concentrations and possible high coliform bacteria levels (IEP, 1988). Many such parking areas exist, but to date have not been mapped. New storm water policies should ensure that any future development prohibits storm water from contaminating water bodies. Older developed areas are in potential need of remediation where storm water may be impacting water quality.

4.1.8 Automotive and Construction Equipment Repair

Improperly disposed of oil and petroleum products can create a risk to water quality. Repair facilities must provide a means for disposal of hazardous waste. The Town of Yarmouth's Board of Health oversees these facilities and the waste disposal practices.

4.1.9 Golf Courses

Golf courses are also identified as potential sources of pollution. Inorganic plant nutrients such as nitrogen and phosphorus can infiltrate the ground water on golf courses that have poor turf management. Also pesticide use can lead to water contamination and impact wildlife.

Fortunately, the Town of Yarmouth Bass River Golf Course and Bayberry Hills Golf Course have excellent turf management practices. In fact, the Bayberry Hills Golf Course has been chosen as a national model for proper turf management to avoid contamination of ground water through the excessive use of fertilizer and pesticides. A groundwater monitoring program for each course ensures oversight of turf management practices, and results are available through the town.

4.1.10 Hazardous Waste

There are five hazardous waste sites within recharge areas of three ponds - three in the vicinity of Mill Pond, one near James Pond, and one near The Run. The IEP, 1988 Study notes that all hazardous waste sites have been mapped by the State and that these sites are typically related to leaking underground fuel storage systems. The sites noteds in the IEP, 1988 Study have been cleaned up or were undergoing remedial actions.

4.2 NON-POINT SOURCES OF POLLUTION

There are several broad groups of pollutants which originate from nonpoint (non-specific) sources: suspended solids, organic wastes, heavy metals, hydrocarbons and salt. Road and surface runoff of storm water are the primary conduit for these pollutants. For example, half of the nutrients (nitrogen and phosphorus compounds) and heavy metals are found in fine silt particles swept away by runoff.

4.2.1 Suspended Solids

Suspended solids are mostly organic (soil particles) that do not dissolve in water, but rather are carried in surface water runoff. This "dirt" also acts as a carrier absorbing other pollutants into the surface water. Sources for suspended solid pollutants are stockpiles, land grading, excavation demolition, construction, and wind erosion (which leaves soil exposed).

Suspended solids either settle out in river systems or remain suspended in surface water, resulting in the following problems: turbidity (clouding) of water and numerous effects on plants and animals. Cloudy water reduces photosynthesis, clogs fish gills, buries bottom dwelling creatures, and prevents animal and plant respiration by lowering dissolved oxygen levels at the bottom of the water body. Channels in flowing water bodies are also clogged. Beyond the ecological effects, cloudy water polluted water is aesthetically unpleasant and undesirable for swimming.

Suspended solids have little effect on ground water, if runoff is emptied onto land, except when suspended solids carry other pollutants or may clog otherwise permeable soil.

4.2.2 Organic Wastes

Organic wastes of animal or vegetable origin produce nitrogen or phosphorus compounds from such sources as sewage (or animal droppings), fertilizers, grass clippings, street litter, and/or garbage collection materials. Nitrogen compounds (from tire wear on or roads) and phosphorus compounds (from car washes) may also be classified as organic waste. There is concern for surface and groundwater nitrates contaminating the drinking water supply because they are carcinogenic and can alter the aquatic ecology of a system. Ten parts per million or less of nitrate is the acceptable Massachusetts standard for drinking water.

Eutrophication, described more fully in a later section, is an oversupply of organic or inorganic nutrients to fresh surface water from nitrogen and phosphorus compounds in surface runoff. These nutrients promote the growth of cyanobacteria and other algae, which upon decomposition use dissolved oxygen from the water column, adversely affecting fish and other desirable aquatic organisms. The Massachusetts standard for dissolved oxygen is a minimum of 6 parts per million.

4.2.3 Heavy Metals

Heavy metals contribute most of the toxicity to surface water runoff. Heavy metals may accumulate in the tissue of aquatic animals causing fish kills or organism mutations as well as shifts in species diversity. Lead and zinc are the heavy metals found in the largest quantity in surface water. Copper, chromium, arsenic and mercury are among the others found in lesser quantities. Table 4-1 below shows the major and minor environmental sources of these heavy metals.

Table 12-4.1 Sources of Heavy Metals in Runoff

Element	Major Sources	Minor Sources
LEAD	fuel combustion	tire wear fallout
	motor oil	road paint
ZINC	tire wear	lane-stripe paint
COPPER	brake lining fallout	engine plating and parts
		plumbing corrosion pesticides
MERCURY	brake lining fallout	reaction with road salt
CHROMIUM	engine plating and parts	lane-stripe paint
		brake lining fallout
		asphalt
CADMIUM	tire wear	
IRON	vehicle rust	
ARSENIC	herbicides	fuel combustion detergent
NICKEL	engine plating and parts_asphalt	brake linings
		fuel combustion

Source: MAPC, 1983

4.2.4 Hydrocarbons

There is a wide range of organic or carbon based chemicals which are a threat to drinking water supply and surface water. These may be divided into two main groups: oils and chlorinated hydrocarbons (e.g. pesticides and solvents).

Oil and grease are the major hydrocarbons found on streets due to leaks and spills. Petroleum products also contain heavy metals like lead and zinc or gasoline additives like benzene and tuolene. Even the road surface itself, asphalt, is made of crude oil remnants. As the road surface wears, the asphalt particles become part of street dust. Coal tar and creosote, which protect poles and other timber from decay, contain toxic phenols.

Motor oil and heavy metals such as zinc and copper (from pipes and gutters) also find their way to the water table through the ground or storm drains. Education of residents in the Town of Yarmouth as to safe disposal of toxins should be a priority. (The DPW issues a fact sheet available to town residents explaining the proper disposal of waste.) Additionally our Board of Health conducts an annual "Hazardous Waste Collection Day" for all Yarmouth residents.

The other major grouping is the chlorinated hydrocarbons which may range from polychlorinated biphenols (PCBs) to organic solvents in pesticides such as, dieldrin or lindane. Also grease cleaning solvents like trichloromethane are released into the ground from careless disposal practices at auto repair shops. Environmental problems that may result from the presence of these compounds are oil slicks which can cause immediate fish kills or may settle and be released over long periods of time.

Chlorinated hydrocarbons also contribute heavy metals to the ground or surface water which may become concentrated in the food chain. Lowered dissolved oxygen levels in surface water may result in the mortality of desirable organisms.

4.3 EUTROPHICATION

Cultural eutrophication is a problem of oversupply of organic or inorganic nutrients to fresh surface water from manmade sources. The nutrients of concern are usually nitrogen and phosphorus. Sources include surface runoff, leaching from septic systems, organic and inorganic fertilizers used in agriculture and turf management ,and animal wastes. The oversupply of nutrients, particularly phosphorus, which is the limiting nutrient in fresh water systems, promotes the growth of aquatic weeds, algal blooms, fish kills, noxious odors, and a deterioration of visual aesthetics. The major potential phosphorus sources are septic systems, private wastewater treatment plants, and direct discharge of road runoff. (IEP, 1988)

Two ponds in Yarmouth have been documented in a 1986 study as having a borderline problem with eutrophication: Long Pond and Miss Thacher's Pond. Some of Yarmouth's smaller ponds are presumed to be suffering from this condition. Conditions in Long Pond have improved since 1986 due to improvements in drainage systems that resulted in

diversion of stormwater runoff from the pond. A comprehensive long-term monitoring program to evaluate pond health will greatly affect the Town's ability to prevent and/or remediate ponds undergoing stress due to nutrient overload.

4.4: WATER RESOURCES IN NEED OF INTER-TOWN MANAGEMENT

Ground water, in terms of both quality and quantity, and the Town's coastal waterways are the two water resources most in need of inter-Town management.

The Town of Yarmouth has a formal agreement with the Barnstable Water Quality Advisory Committee to address water source protection issues. There is no agreement with the Town of Dennis addressing water source protection issues, because the Town of Dennis lies totally within the Monomoy Lens separate from the Sagamore Lens.

In terms of coastal waterways, Bass River and Lewis Bay are managed by informal inter-town agreements. Yarmouth shellfish and harbor patrol officers have jurisdiction in the towns of Barnstable and Dennis by reciprocal agreement. Likewise, these towns' shellfish and harbor patrol officers have similar authority in Yarmouth. Furthermore, there is a Memorandum of Understanding between Dennis and Yarmouth, through the Department of Environmental Management, for cooperation on the 10-year Bass River dredging project.

4.5: EXISTING BYLAWS

4.5.1 Wetlands Protection Regulations

Wetlands Protection Regulations in the Town of Yarmouth are stricter in many areas than the Massachusetts Wetlands Protection Act, General Laws, Chapter 131, Section 40, of 1974. The Town of Yarmouth Wetland Protection Bylaw regulates activities which impact the following interests:

-private and public water supply

-ground water and ground water quality

-surface water quality in the numerous ponds, rivers, lakes and streams of the Town

-flood control

-erosion and sedimentation control

-storm prevention damage

-water pollution control

-wildlife and wildlife habitat

-fisheries

-shellfish and land containing shellfish

-recreation

For the most part the Town of Yarmouth's interests coincide with areas identified by state law; however, the Town exerts additional authority in the areas of surface water quality, recreation, and erosion and sedimentation control. Other areas where the Town of Yarmouth exerts more jurisdiction than the State are in coastal watershed areas and lake and pond recharge areas. The State does not regulate these areas, whereas the Town of Yarmouth maintains a 300' zone of jurisdiction over land in these areas. Furthermore, the State regulations do not provide for any building setback requirements for new construction.

According to the Town of Yarmouth Wetland Protection Regulations, "no new structure (with the exception of water dependent structures) will be allowed within 50 (fifty) feet of the following resource areas:

1 .Coastal dune

2. Coastal bank

3. Coastal Beach

4. Salt marsh

5. Inland banks

6. Vegetated wetlands

7. Streams

8. Rivers

9. Ponds

10. Lakes

11. Isolated land subject to flooding

12. Bordering lands subject to flooding

New construction may not be within this fifty (50) foot buffer zone." Complaints from property owners about the stringency of the rule has led to consideration of relaxing the rule to allow certain minor types of construction.

Furthermore, section 1.09, D,3,b (Town of Yarmouth Wetlands Protection Regulations) requires that "a thirty-five foot undisturbed natural vegetative buffer shall be maintained between all projects and resource areas mentioned in 1.09,D,3,a 1-12." Note that the Cape Cod Commission has 100' setback requirements for Developments of Regional Impact (DRI) that fall within its area of jurisdiction.

The Town of Yarmouth is also stricter in the governance of flood plains, coastal watershed areas, and vegetated wetlands. The Town regulates all vegetated wetlands 3,000 square feet or larger.

The Town of Yarmouth Wetlands Protection Regulation 2.10,3 Performance Standard states: "Any activity within and subject to Coastal Storm Flowage which will result in the building upon, removing, filling or altering land within 300 feet of a major estuary

defined in Section 1.04 of these regulations shall meet the following requirements: Notwithstanding this section (2.10+3+) Beach Nourishment and Coastal Engineering projects such as bulkheads and seawalls may be allowed if they meet all other Performance Standards in these regulations.

a. Existing septic system and cesspool repairs will be allowed provided that they substantially meet all Title 5 and local Board of Health thresholds

b. All ground water elevations shall incorporate seasonable adjustments if test holes and/or leaching components are 100 ft. or greater from major estuaries.

c. Any proposed deck, shed, or similar structure must be securely anchored to a footing or foundation. "

4.5.2 Zoning

The Zoning Bylaw for the Town also reinforces wetlands regulations as follows:

405.1 "In all districts, parking areas paved with bituminous concrete or other impervious material, all structures shall be set back a minimum of fifty (50) feet from a wetland as defined in M.G.L. ch. 131, sec. 40 and the Town of Yarmouth Wetlands Bylaw exclusive of land that would not otherwise be subject to regulation except for being contained within the A and B flood zones referred to in section 403 of this bylaw, except for piers, docks, floats and bulkheads, to which this setback will not apply."

405.2 "In all districts, any dwelling shall be set back a minimum of one hundred (100) feet from the edge of any cranberry bog. The edge of the cranberry bog, shall mean the edge of the bog as defined by the State Wetlands Act, M.G.L., ch. 131, sec. 40 and the Town of Yarmouth Wetlands Bylaw."

Cluster zoning is a planning tool used to control growth and protect the environment. Essentially, the concept is to subdivide land and "cluster" homes closer together in order to leave an ample portion of land in the subdivision as open or common space, while not increasing the total number of units authorized by the zoning. This concept is more sensitive to the environment than traditional zoning because the open land is left undeveloped - aesthetically pleasing, as well as practical, for providing "space" for protecting ground water, and protecting well recharge areas. As an incentive for leaving a large area of open space, the developer is allowed to subdivide the parcel into smaller lots than would otherwise be required in the R40 zone.

Cluster zoning is currently not very feasible in Yarmouth even though it is permitted by the zoning bylaw. According to Section 402.6.1 of the Yarmouth Zoning Bylaw, a parcel of land to be used for cluster development must be 10 times larger than the minimum single family lot size required in a particular zone. Since the minimum required lot size in a zoning district is 0.91 acre (R-40), the minimum size of a cluster subdivision is 9.1 acres (.91 acres x 10). As there are virtually no undeveloped parcels of land in Yarmouth that are large enough to accommodate this requirement, the cluster option is essentially impossible. Therefore, the Town Planner recommends that the total acreage requirement be reduced by 50% to encourage cluster developments on the small parcels of land (4.5 acres or less) that are still available. This amendment is scheduled as a high priority item by the Planning Board.

SECTION 5: ACTION AND IMPLEMENTATION

5.1 SUGGESTED COMMISSION ACTIONS

5.1.1 The Cape Cod Commission should identify and map special ground water protection areas, including high quality water supply, potential water supply areas, and maintain the highest possible water quality through land use controls and open space acquisition.

5.1.2 The Commission should continue to review literature on evaluating the impact of development on surface and ground water quality and develop updated standards as needed.

5.1.3 The Commission should provide on-going technical assistance to the Town as regards designation of Zone II's for public water supply wells.

5.1.4 The Commission should continue to classify the Town's marine surface waters, delineate re-charge areas, determine flushing rates for marine embayments, and evaluate land use to provide suggested management solutions.

5.1.5 The Commission should continue to maintain the regional network of ground water observation wells, from which estimates of groundwater levels are derived.

5.1.6 The Commission should provide comments and technical assistance to the Town at such times as it is conducting wastewater and septage facility plans.

5.1.7 The Commission should aid the Town with development of shared water supplies where appropriate.

5.1.8 The Commission should continue to coordinate water resource protection strategies with federal, state, county and local programs and officials including but not limited to the following projects:

5.1.8.1 The Commission should coordinate with the Department of Environmental Management and Department of Environmental Protection to develop criteria for permissible levels of maximum water withdrawal in ground water lenses based on projections of water table range and ground water quality and quantity in public supply wells and other large wells.

5.1.8.2 The Commission, should continue to cooperate with the County Health and Environmental Department to prioritize the region's fresh water ponds, delineate their recharge areas and develop protective strategies; to identify land uses that could discharge hazardous materials in order to assist with review of projects in Wellhead Protection Areas; and maintain and publish an updated database of the region's public water quality and quantity of water pumped.

5.1.8.3 County Cooperative Extension should continue to provide educational programs about the need for periodic inspection and maintenance of septic systems and the hazards of commercial septic cleaning products.

5.1.8.4 The Commission should continue to work with the Department of Environmental Protection and the County Health and Environmental Department to develop an updated catalog and map of identified hazardous waste sites and assist towns in dealing effectively with multiple waste sites.

5.1.8.5 The Commission should continue to work with the County Health and Environmental Department to identify unregistered underground storage tanks and support the County's tracking program for monitoring underground storage tanks.

5.1.8.6 The Commission should continue to provide input to the State's Title 5 working group about the unique hydro geologic conditions on Cape Cod and shall encourage the establishment of regionally appropriate standards for the design and installation of septic systems.

5.1.8.7 The Commission should cooperate with Soil Conservation Service, Department of Public Works, County Cooperative Extension and other appropriate agencies to encourage the use of alternatives to fertilizers, herbicides, pesticides, road salt, and other materials that could adversely impact surface and ground water quality.

5.1.8.8 The Commission should work with the County Health and Environmental Department and the U.S. Geological Survey to develop standards to protect against bacterial and viral contamination of ground and surface waters.

5.1.8.9 The Commission should continue to work with all involved entities to develop and implement innovative on-site wastewater management districts to address watershed specific water quality problems.

5.2 SUGGESTED TOWN ACTION

Proposed Town Actions

1. The Town should identify the location of private wells and septic systems, especially in densely developed areas, and undertake inspection and improvement programs for up-grading pre-Title 5 and failing septic systems.
2. The Town should map, protect, and as appropriate, acquire needed future water supply areas, if feasible.
3. The Town should work with the Cape Cod Commission to identify impaired and water quality improvement areas to prioritize areas for upgrades to nitrogen reducing systems.
4. The Town should develop a snow removal management strategy for roadways that minimize the total application of salt or other harmful de-icing chemicals.
5. The Town should work with the Cape Cod Commission to identify and monitor Zone II nitrogen levels, and work with them to identify and monitor nitrogen and phosphate levels up-gradient from coastal embayments.
6. The Town should establish a local by-law regulating nutrient loading in order to protect fresh surface waters from eutrophication.
7. The Town should develop a public education program in order to fully inform the Town's residents about ground and surface water protection.
8. The Town's fresh water ponds should be monitored by acidity (pH level) in order to maintain fish productivity.
9. Habitat restoration projects for the Town's herring runs should be continued to enhance its fisheries.
10. The Planning Board, as the Local Planning Committee, should organize a working group, a "Water Resources Steering Sub-Committee," made up of a cross section of concerned parties to advise it on the regular update of this chapter.
11. The Town should identify and plan for the installation of new drainage components that presently discharge stormwater into the various ponds, lakes, and streams.
12. The Town should include stormwater quality and aquifer recharge concerns in all local reviews of proposed developments.
13. The Town should monitor fresh water ponds for sodium/calcium chloride, heavy metals, pH, fecal coliform, herbicides, nutrients, pesticides, and rare plants, as indicated in the Pond Inventory.
14. The Town should develop programs to mitigate contamination of water resources by underground storage tanks.
15. The Town should develop programs to mitigate contamination by its five PSTF's. (Private Sewage Treatment Facilities)
16. The Town should develop programs to mitigate contamination of water resources by automotive and construction equipment repair.
17. The Town should implement, as appropriate, improvements to its water supply and distribution system, as recommended by SEA Consultants, Inc. in its report to the Yarmouth Water Division of June 2001

CAT SWAMP POND, So. Yarmouth
View toward the east

LILY POND, So. Yarmouth

LONG POND
two views toward the east

LONG POND
View from Indian Memorial Drive
toward the northwest

DENNIS POND, Yarmouthport
view toward the southwest

ELISHAS POND, Yarmouthport
view to the northwest

PERCH POND, Yarmouthport
view to the northwest

FLAX POND, So. Yarmouth
Two views toward the Southeast

PLASHES POND, West Yarmouth
view toward the west

HALFWAY POND, West Yarmouth
view to the southeast