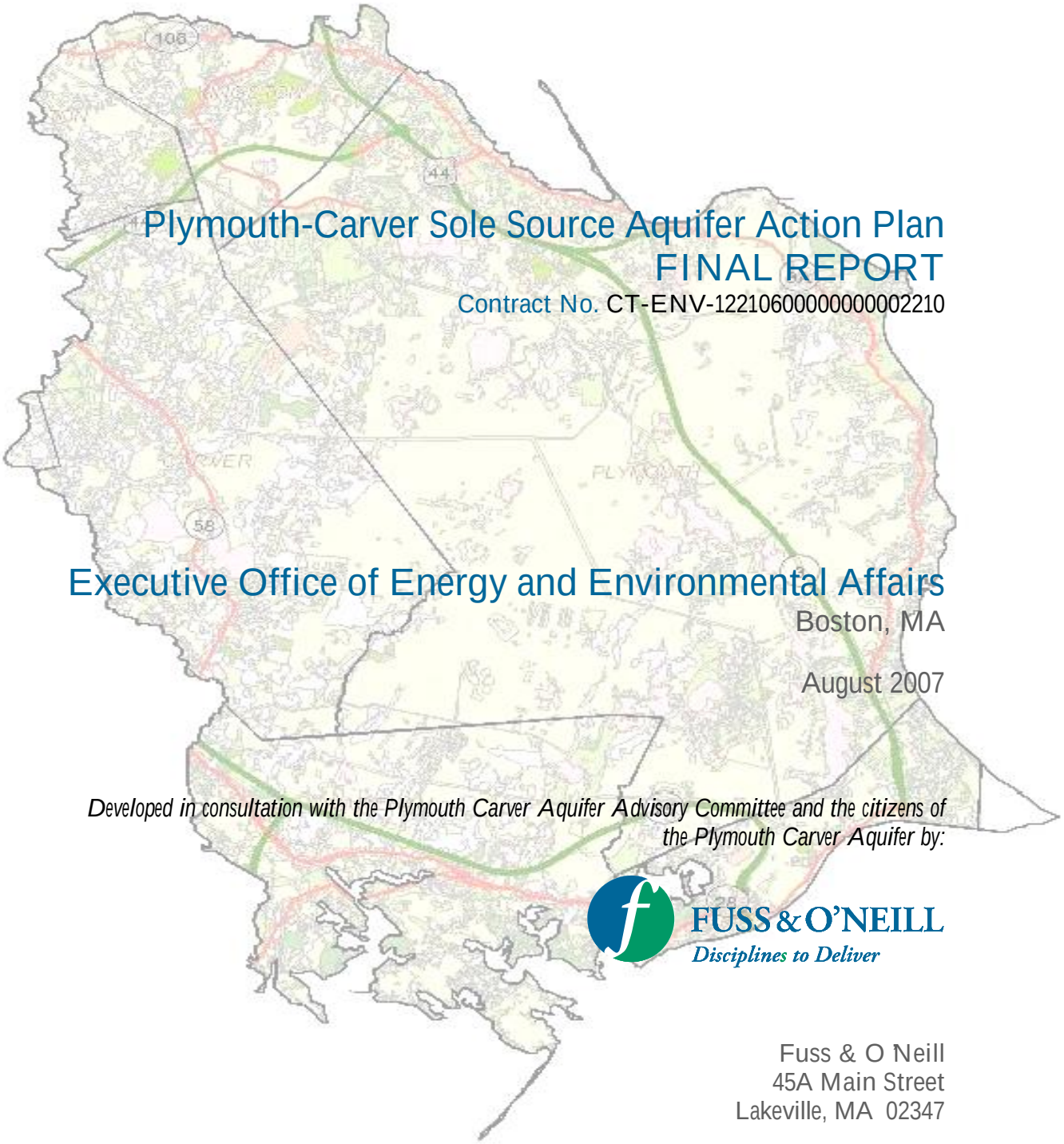


Plymouth-Carver Sole Source Aquifer Action Plan
FINAL REPORT

Contract No. CT-ENV-12210600000000002210

Executive Office of Energy and Environmental Affairs

Boston, MA

August 2007

Developed in consultation with the Plymouth Carver Aquifer Advisory Committee and the citizens of the Plymouth Carver Aquifer by:

FUSS & O'NEILL
Disciplines to Deliver

Fuss & O Neill
45A Main Street
Lakeville, MA 02347

ACKNOWLEDGEMENTS

This plan was developed in close consultation with the Plymouth Carver Aquifer Advisory Committee. Municipal designees and alternate designees to the committee are as follows:

Designees

David Gould, Plymouth
Sarah Hewins, Carver
Brendan Mullaney, Bourne
Jack O'Leary, Plympton
Wayne Perkins, Middleborough
Fred Svenson, Kingston
Marjorie Teitelbaum, Wareham

Alternates

Marsha Brunelle, Middleborough
Edward Fuller, Carver
Christian Lawrence, Plympton
Sheila Sgarzi, Plymouth
Maureen Thomas, Kingston

Additional participants in the planning process included:

Dean Audet, Fuss & O'Neill
Paul Blain, Massachusetts Department of Environmental Protection
Thomas Bott, Kingston
Michael Bumpus, Carver
Robin Carver, AD Makepeace
Joseph Cerutti, Massachusetts Department of Environmental Protection
John Clarkeson, Massachusetts Executive Office of Energy and Environmental Affairs
Alice Cole, Carver
Andrew Cunningham, Wareham
Claire DeLoid, Carver
Dave DeLorenzo, Massachusetts Department of Environmental Protection
Dave Foss, Fuss & O'Neill
Jim Grimes, Carver
Frank Harris, Carver
Dave Harwood, Stantec
Jack Hunter, Carver
Robb Johnson, The Nature Conservancy
John Kelly, Plymouth
Alan Kingsbury, Carver
Kevin Klein, Norfolk Ram Group
Judith Kohn, AD Makepeace
Johanna Leighton, Carver
John Masterson, United States Geologic Survey
Tom McLehan, AD Makepeace

Frank Muscato, Carver
Bill Napolitano, Southeastern Regional Planning and Economic Development District
Peter Newton, Wareham Fire District (SEA)
Kevin O Reilly, Plymouth
Neil Price, Horsley & Witten
Christine Reardon, Plymouth
Jim Riordan, Fuss & O'Neill
Ed Russell, Plymouth
Bob Schreiber, Camp, Dresser and McKee
Casey Shetterly, The Nature Conservancy
Bobbi Sistrunk, Old Colony and Carver Reporter
Jay Tamagini, Wareham
Jan Tracey, Carver
Kevin Tracey, Carver
Judy Ward, Carver
Richard Ward, Carver
Jim Watson, Old Colony Planning Council
Brian Wick, Cape Cod Cranberry Growers 'Association

LETTERS OF SUPPORT

The following are letters of support for the *Plymouth-Carver Sole Source Aquifer Plan.* The letters were provided by member municipalities and stakeholders in the Plymouth-Carver Aquifer Advisory Committee.

The Commonwealth of Massachusetts

Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Deval L. Patrick
GOVERNOR

Timothy P. Murray
LIEUTENANT GOVERNOR

Ian A. Bowles
SECRETARY

Tel: (617) 626-1000
Fax: (617) 626-1181
http://www.mass.gov/envir

23 July 2007

Plymouth-Carver Aquifer Advisory Committee Members:

Thank you for the time and effort dedicated to developing the Plymouth Carver Sole Source Aquifer Action Plan. I congratulate you for developing a Plan with many valuable guiding principles to help advise the citizens living and working in the Aquifer region.

This plan can help guide state and local environmental actions, industrial and agricultural interests, and the civic interests of local residents. Development of this plan involved extensive public participation and outreach. I hope such broad public participation will continue as the Committee takes steps to implement the Plan.

Without local support and subscription to the ideas contained in this Plan, it will have little impact. Given the open and informative public process you followed, I am confident these ideas will find their way into actions having a beneficial impact on the protection of the valuable natural resources the seven communities of the aquifer region share.

I commend the delegates from the towns of Bourne, Carver, Kingston, Middleborough, Plymouth, Plympton, and Wareham for their service to the Committee, and the many others who participated in this endeavor. I trust you will continue your efforts to protect the Plymouth Carver Sole Source Aquifer.

Sincerely,

Ian Bowles
Secretary

TOWN OF BOURNE
Town Administrator
24 Perry Avenue
Buzzards Bay, MA 02532
Phone 508-759-0600 x 304 - Fax 508-759-8026

Thomas M. Guerino
tguerino@townofbourne.com

July 10, 2007

Ian Bowles, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street – Suite 900
Boston, MA 02114

Dear Secretary Bowles,

Over the past year, the Executive Office of Energy and Environmental Affairs (EEA) has assisted the communities within the Plymouth Carver Aquifer in the development of the Plymouth-Carver Sole Source Aquifer Action Plan. We wish to thank you for the dedication of EEA staff in helping this effort. Working with our delegate Brendan Mullaney and delegates from each community, the Plan provides helpful guidance each community can use to protect an important resource for generations to come. We have a unique situation in Bourne as we have two completely separate water sources that are split geographically by the Cape Cod Canal. The problems that we have encountered on the Cape Cod side have really raised our awareness regarding groundwater contamination issues and have highlighted the need for an Action Plan such as the one that has been developed.

On June 26 2007 the Bourne of Selectmen Board met with John Clarkeson of your office and recommended the Aquifer Advisory Committee continue to meet, bringing the member communities together to begin implementing the Plan. We hope EEA will offer continuing assistance with the Advisory Committee and thank you again for your support and dedication to protecting our natural resources.

Respectfully,

Thomas M. Guerino
Town Administrator

BOARD OF SELECTMEN

Richard J. LaFond
Town Administrator

Jean M. Bouchard
Ass't. to Town Administrator

108 Main Street
Carver, MA 02330
Telephone: 508-866-3401/Fax: 508-866-4213

July 5, 2007

Ian Bowles, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street – Suite 900
Boston, MA 02114

Dear Secretary Bowles,

On behalf of the Town of Carver, thank you for the efforts of the Executive Office of Energy and Environmental Affairs in coordinating the Plymouth-Carver Sole Source Aquifer Advisory Committee over the past fiscal year. The Committee has held a series of informative meetings and completed the Plymouth Carver Sole Source Aquifer Action Plan. On Tuesday May 22, 2007, the Carver Board of Selectmen discussed the Plan and voted unanimously to approve it. As a member community, we recognize that the Plan will help provide guidance for the protection of this precious resource for generations to come.

The protection of this valued natural resource is not solely a responsibility of any one town or government agency, nor any particular business or citizen. The responsibility for protection is ours to share as this resource is one we all depend on in our day to day lives. The Plan incorporates broad input from a variety of Aquifer citizens. The Board of Selectmen also asked that the Plymouth-Carver Aquifer Advisory Committee continue to meet. In fiscal year 2008, Carver looks forward to working with neighboring communities to address the issues that face the Aquifer and begin implementing the Plan.

Sincerely,

Jack Angley, Chair
Board of Selectmen

CAPE COD CRANBERRY GROWERS' ASSOCIATION

3203-B Cranberry Highway – East Wareham, MA 02538
Telephone: (508) 295-4895 / (508) 759-1041 Facsimile: (508) 759-6294
Email: cccga@cranberries.org Web: www.cranberries.org

May 21, 2007

John Clarkeson
Assistant Director of Water Policy
Executive Office of Energy & Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Dear John:

On behalf of the Cape Cod Cranberry Growers' Association, it has been a pleasure working with you and attending the monthly Plymouth-Carver Aquifer Advisory Committee meetings. Approximately 50% of the entire cranberry acreage in Massachusetts lies over the Plymouth-Carver Aquifer and these growers rely on this water source to help support their operations. Collectively cranberry growers retain the highest volume of Water Management Act registrations and permits in the State and need continued access to quality water now and in the future. Access to water is not just important to cranberry agriculture, it's an absolute necessity.

To this end, the Cape Cod Cranberry Growers' Association has worked and will continue to work with growers, municipalities, and state agencies to help insure the long-term viability of water, both in terms of quality and quantity, in the region. The cranberry industry provides long-term value to the Aquifer as a beneficial partner in water management and stewardship. We support the mutual goal of resource protection for the Aquifer as outlined in the *Plymouth-Carver Sole Source Aquifer Action Plan Final Report*. However, any future water policies that may be developed out of this report must insure that cranberry grower's water use is protected. Furthermore, we are supportive of the recognition that the cranberry industry has received in the report, specifically in the profile of the industry in section 2.1.4.

Looking ahead, if the Plymouth-Carver Aquifer Advisory Committee is going to continue to exist beyond the June 30, 2007 legislative mandate, we want to continue to be an active part of the process. In particular, we want to have a voting member representing the cranberry industry be an official part of the committee and be so noted in any future legislation. We would also suggest that the Nature Conservancy or similar environmental organization also have a voting member seat on this committee. In closing, on behalf of the Massachusetts cranberry industry, the Cape Cod Cranberry Growers' Association continues to look forward to working collaboratively to help protect and manage the Plymouth-Carver Aquifer for generations to come.

Sincerely,

Jeffrey LaFleur
Executive Director

TOWN OF KINGSTON

Office of the Board of Selectmen
Town House
26 Evergreen Street
Kingston, Massachusetts 02364

Tel: 781-585-0500
Fax: 781-585-0534

Please Read and Initial:

SM

JLN

June 8, 2007

Ian Bowles, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street – Suite 900
Boston, MA 02114

Dear Secretary Bowles,

The Town of Kingston thanks the Executive Office of Energy and Environmental Affairs for coordinating the Plymouth-Carver Sole Source Aquifer Advisory Committee over the past fiscal year. Kingston has participated in the development of the Plymouth Carver Sole Source Aquifer Action Plan and views this Plan as helpful guidance for the protection of this precious water resource. The Board of Selectmen heartedly endorses the findings in the Plan.

Congratulations are due the Committee for completing the Plan, and special thanks go to Kingston designees Fred Svenson and Maureen Thomas for their participation.

The Selectmen also recommend that the Advisory Committee continue to bring the member communities together to address the issues and challenges that face our shared resource and that EEA continues to help facilitate those meetings.

If you have any questions, please feel free to contact me.

Very truly yours,

Kevin R. Donovan
Town Administrator

Cc: Water Commissioner Fred Svenson
Conservation Agent Maureen Thomas

CRANBERRY CAPITAL
OF THE WORLD

Phone: 508-946-2405
Fax: 508-946-0058

Town of Middleborough

Massachusetts

August 7, 2007

Ian A. Bowles, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street – Suite 900
Boston, MA 02114-2119

RE: Plymouth-Carver Sole Source Aquifer Action Plan

Dear Secretary Bowles,

At their meeting held on Monday, August 6, 2007, the Middleborough Board of Selectmen unanimously voted to support the final report of the Plymouth-Carver Aquifer Advisory Committee concerning the Plymouth-Carver Sole Source Aquifer Action Plan.

Please contact this office if you need any further information.

Sincerely,

Diane Henault, Secretary
BOARD OF SELECTMEN

cc: Board of Selectmen
John Clarkson

Old Colony Planning Council

Jeanmarie Kent Joyce
President

Pasquale Ciaramella
Executive Director

70 School Street
Brockton, MA 02301-4097

Telephone: (508) 583-1833
Fax: (508) 559-8768
EMAIL: info@ocpcrpa.org

May 24, 2007

John A. Clarkeson
Assistant Director of Water Policy
Executive Office of Energy and Environmental Affairs
Suite 900
100 Cambridge St.
Boston, Ma 02114

Re: Comments on Final Report of Plymouth-Carver Aquifer Sole Source Aquifer Action Plan

Dear Mr. Clarkeson:

The Old Colony Planning Council is pleased to following comment on the above noted plan.

The report is quite valuable for building on the long-term efforts of the Plymouth Carver Sole Source Aquifer Advisory Committee (particularly since its 2003 reactivation under the leadership of the Regional Planning Agencies and the Nature Conservancy), summarizing much data and many findings, reviewing locally-sensed priorities, and setting directions for continuing efforts.

The Plan pulls together much information about the aquifer, overlying land uses, development trends, local plans and protective regulations, and prospective water supply demands, and reviews potential protective actions used elsewhere and inter-governmental approaches to aquifer protection. It also reviews alternate approaches to protection, e.g., prescriptive system design requirements versus performance standards to be met by various measures.

The plan then suggests areas for future joint efforts by the aquifer communities such as drafting model provisions and programs for erosion and sedimentation control, recharge, storm water management, earth removal, water conservation, open space residential development, and management of on-site wastewater disposal. Related potential local actions should become apparent during the joint drafting of such protective provisions and through comparison of the local provisions summarized in the report.

In all the Plymouth-Carver Sole Source Aquifer Action Plan is quite impressive in its scope and vision. We congratulate the participants and look forward to working with member communities to implement its recommendations regionally and locally.

Sincerely,

Pasquale Ciaramela
Executive Director

c.c: Lee Hartmann, Plymouth Delegate,
Paul Basler, Kingston Delegate
John Rantuccio, Plympton Delegate; James Mulcahy, Alternate

Southeastern Regional Planning & Economic Development District
◄ 88 Broadway▼*Phone (508)824-1367*▼*FAX (508)823-1803*▼*ssmith@srpedd.org*▼Taunton, MA 02780►

July 5, 2007

Ian A. Bowles, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, 9th Floor
Boston, MA 02114

Dear Secretary Bowles:

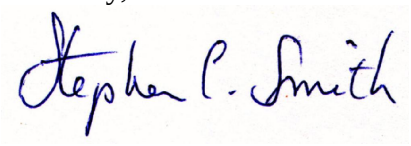
I am pleased to offer the support of the Southeastern Regional Planning and Economic Development District (SRPEDD) for the Plymouth – Carver Sole Source Aquifer Action Plan.

We have worked with the Plymouth Carver Aquifer Advisory Committee (PCAAC) on related projects since 1991 – most notably the recent reactivation of the PCAAC and efforts to promote public awareness and establish a formal memorandum of understanding under which to work together cooperatively to preserve the aquifer and its resources. The new Action Plan addresses these issues as well as a multitude of others, and provides the unifying guidance document that the group has sought and been working towards for so many years.

Thanks to the determination and commitment of the community representatives, the thorough work of the project consultant, and the outstanding leadership and oversight provided by John Clarkeson of your staff, we are much closer to employing a regional approach to resource management, protection, and education within the Plymouth – Carver Aquifer boundaries.

If you have any questions, please do not hesitate to contact me.

Sincerely,



Stephen C. Smith
Executive Director

TOWN OF PLYMOUTH

11 Lincoln Street
Plymouth, Massachusetts 02360
FAX (508) 830-4140

Board of Selectmen
Town Manager
(508) 747-1620 ext. 100

Human Resources
(508) 747-1620 ext. 101

June 26, 2007

John Clarkeson, Assistant Director of Water Policy
The Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Dear Mr. Clarkeson,

On behalf of Plymouth's Board of Selectmen, I would like to express the Town's support for the Plymouth-Carver Sole Source Aquifer Action Plan, as presented at our June 12, 2007 meeting.

As you know, the Board voted unanimously at the June 12, 2007 meeting to endorse this action plan. The Board appreciates the collaborative relationship outlined within the action plan, and we look forward to working further with your office and our neighboring town leaders to protect the valuable resource that exists beneath Plymouth and the six other communities within the aquifer zone.

Additionally, I would like to offer you our gratitude for the diligent and impressive work that you have accomplished in partnership with the Plymouth-Carver Aquifer Advisory Committee. If we can be of any further assistance, please do not hesitate to contact our offices at Plymouth's Town Offices.

Regards,

Richard J. Quintal, Jr.
Chairman, Board of Selectmen

TOWN OF PLYMPTON
Commonwealth of Massachusetts
OFFICE OF THE BOARD OF SELECTMEN

Town House
5 Palmer Road
Plympton, MA 02367

(781) 585-2700
FAX:(781) 585-2700

June 11, 2007

Ian Bowles, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street – Suite 900
Boston, MA 02114

Dear Secretary Bowles,

On behalf of the Town of Plympton, we wish to express our support for the Plymouth Carver Sole Source Aquifer Action Plan developed by the Plymouth-Carver Aquifer Advisory Committee over the past year. The Committee has held a series of informative meetings and representatives have briefed this Board on their activities and on the Plan. As a member community, we recognize that this Plan will help provide guidance for the protection of this precious resource for generations to come. We intend to encourage Plympton's Boards and Commissions to enact local regulations as recommended in the Plan.

The protection of the Aquifer is not solely a responsibility of any one government or agency, or any particular business or citizen. The responsibility for protection is ours to share as the resource is one we all depend on in our day to day lives. We hope the Advisory Committee will continue to bring the member communities together to address the issues and challenges that face our shared resource, and encourage you to continue to fund this activity.

Congratulations to the Committee on completing the Plan and special thanks to the Plympton designees Jack O'Leary and Christian Lawrence for their participation.

Sincerely,

PLYMPTON BOARD OF SELECTMEN

Joseph Freitas Abdu Nessralla, Jr. Barry DeCristofano

The Nature Conservancy
Protecting nature. Preserving life.™

Southeast Massachusetts Program
204 Long Pond Road
Plymouth, MA 02360-2607
508.732.0300/Voice · 508.732.9198/Fax

June 29, 2007

John Clarkeson
Assistant Director of Water Policy
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114-2119

Dear Mr. Clarkeson,

As an active participant in the Plymouth Carver Aquifer Advisory Committee, The Nature Conservancy (TNC) is pleased to endorse the recently completed Plymouth-Carver Sole Source Aquifer Action Plan. Appropriate management of the Plymouth Carver Aquifer is a priority for TNC because its waters support dozens of globally rare and endangered species and several rare ecosystems, including coastal plain ponds and Atlantic white cedar swamps. It is also the source of water for coastal rivers such as the Jones, Wareham, Agawam, Wankinko, Eel, Weweantic and Red Brook.

The vast water resources of the Plymouth Carver Aquifer cannot be taken for granted, especially in light of rapid growth rates in the seven towns that share it. For this reason, TNC is grateful to the Legislature for appropriating funds that allowed the Executive Office of Energy and Environmental Affairs (EOEEA) to effectively coordinate the completion of this Action Plan. We are gratified that the Advisory Committee has expressed its intention to continue meeting in order to pursue implementation of the Plan. We concur with the municipally appointed members of the Committee who identified two key next steps to include the pursuit of increased consistency among the Towns' respective land and water use bylaws, and the development of a regional open space plan to determine which lands are most important to maintaining the condition of the Aquifer.

Through the process of developing this Plan, the Aquifer Advisory Committee has successfully opened the door to municipal cooperation on Aquifer issues. To make tangible progress on implementing the Plan, every effort must now be made to directly engage policy makers (professional water managers as well as the volunteers who constitute the Boards of Selectmen, Planning Boards and Conservation Commissions) and foster communication among them. Actively engaging town leaders is the only way the Plymouth-Carver Sole Source Aquifer will be protected for future generations.

The Nature Conservancy is enthusiastic about the goals of the Aquifer Advisory Committee and intends to remain actively engaged in order to help turn plans into action.

Sincerely,

Robb Johnson
Southeast Massachusetts Program Director

TOWN OF WAREHAM

Office of the Board of Selectmen

54 Marion Road
Wareham, MA 02571
(508) 291-3100

Board of Selectmen

Brenda Eckstrom, Chairman
James L. Potter, Clerk
Bruce D. Sauvageau
John P. Cronan
M. Jane Donahue

July 6, 2007

John Clarkeson, Assistant Director
Of Water Policy
Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114-2524

Dear Mr. Clarkeson:

The Wareham Board of Selectmen thanks you for coming to speak with us. We appreciate your hard work on this project. The Board generally supports the Acquifer Protection and your efforts. We are concerned however of the Town relinquishing its zoning and planning to a county advisory board.

While we agree with the intent of your project, we would refer you to the Wareham Planning Department at 508-295-9344. Any discussions concerning the Town's land use would be better addressed with our land use boards. We also believe the Wareham Water Department at (508) 295-0450 would be helpful in these discussions.

Please feel free to call if you need further assistance, you can reach the Selectmen's Office at (508) 291-3100, extension 3103.

Sincerely,

Brenda Eckstrom

Brenda Eckstrom, Chairman
Board of Selectmen

Cc: Board of Selectmen

WAREHAM FIRE DISTRICT

WATER DEPARTMENT
2550 CRANBERRY HIGHWAY, WAREHAM, MA 02571
Phone (508) 295-0450 Fax (508) 291-2737

May 21, 2007

Ian Bowles, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street - Suite 900
Boston, MA 02114

Re: Plymouth-Carver Aquifer Advisory Committee (PCAAC) Action Plan

Dear Mr. Bowles:

On behalf of the Wareham Fire District Water Commissioners, we would like to take this opportunity to express our support for the PCAAC Action Plan and to thank Mr. Clarkson and the staff of the Executive Office of Energy and Environmental Affairs for their commitment to protecting our aquifer. In addition, we would also like to recognize the dedication and invaluable contribution made by the Town's representative Marjorie Teitelbaum to this effort.

The Fire District has maintained a presence on the Advisory Committee since its inception. While we lament that water districts were not included as stakeholders in the original legislation, your staff made certain that our input was incorporated into the plan. We believe the Action Plan developed by the Committee is a crucial starting point for the regions communities. It provides valuable guidance for developing a regionally consistent set of planning objectives and by-laws to preserve the aquifer for generations to come.

We hope the Committee continues to meet beyond the June 30 funding deadline. Much work remains to be done, and we are of the opinion that EOEEA should remain involved to provide valuable guidance to the Committee. With continued assistance, we will succeed in developing a comprehensive framework for future development within our region. You can count on our continued support.

Respectfully,

For The Wareham Fire District Board of Water Commissioners

Edward J. Tamagini III, Chairman

Cc: Kathleen Baskin, Director of Water Policy
John Clarkeson, Project Manager
Board of Selectmen, Wareham
Peter Newton, S E A Consultants

PLYMOUTH-CARVER SOLE SOURCE AQUIFER ACTION PLAN
FINAL REPORT
Executive Office of Energy and Environmental Affairs

TABLE OF CONTENTS

PLYMOUTH-CARVER SOLE SOURCE AQUIFER ACTION PLAN
FINAL REPORT
Executive Office of Energy and Environmental Affairs

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

PLYMOUTH-CARVER SOLE SOURCE AQUIFER ACTION PLAN
FINAL REPORT
Executive Office of Energy and Environmental Affairs

TABLE OF CONTENTS (continued)

TABLES PAGE

FIGURES FOLLOWING PAGE

PLYMOUTH-CARVER SOLE SOURCE AQUIFER ACTION PLAN
FINAL REPORT
Executive Office of Energy and Environmental Affairs

TABLE OF CONTENTS (continued)

PHOTOGRAPS

APPENDICES

END OF REPORT

EXECUTIVE SUMMARY

A Plan of Action

Part of the charge by the legislature to the Executive Office of Energy and Environmental Affairs, and thus to the Plymouth-Carver Aquifer Advisory Committee, was *"to develop...a written action plan to protect and manage the Plymouth-Carver Sole Source Aquifer."*

Developed through a public process, the Plymouth-Carver Sole-Source Aquifer Action Plan (PCAAP) reflects the input obtained from the citizens of the Plymouth-Carver Aquifer. This plan identifies strategies to guide local citizens in all walks of life to protect their common resource, the Plymouth-Carver Aquifer, be they approaching aquifer issues from the perspective of government official, business employer or employee, agriculturalist, or local resident.

Key Features of the Plan

- At the center of this Plan is a respect for self-determination and home rule. Taking the steps to protect this resource will rely on local actions.

- The PCAAP grew out of broad public participation:
  - 7 primary designees
  - 5 alternate designees
  - Over 40 additional participants
  - Information shared through both print and electronic media

- The PCAAP provides a framework of strategies for protection of the Plymouth-Carver Aquifer so it may continue to be a productive resource for many generations to come.

- Recommendations focus on four primary categories of action:
  - Policy
  - Coordination and technology transfer
  - Outreach for target audiences
  - Grants and funding

Why Develop an Action Plan?

The Plymouth-Carver Aquifer is the second largest sole-source aquifer in Massachusetts, supplying drinking water for seven Southeastern Massachusetts towns. The PCA covers approximately 200 square miles.

This region has and continues to experience high growth rates, which put strains on water resources and affects the overall condition of the aquifer. Not only do water supply issues concern residents, they are also affect rare species of plants and animals, forest and open space quality, and aquatic ecology. A significant number of agricultural operations— largely cranberry farming— also rely on the Plymouth-Carver Aquifer.

Further, hydrologic studies indicate that groundwater in the PCA generally moves in a north to south direction from Middleborough toward Wareham, or in an east to west direction, toward Plymouth Harbor.

The purpose of this plan is to develop policy that will lead to maximizing the Plymouth-Carver Aquifer's ability to continue to supply water for this region. The long-term viability of this fragile resource begins with a strategic analysis of threats and adequacy of ongoing protection.

Immediate Actions

Analysis found a critical need to establish— via municipal collaboration— a level playing field of protective policy. Over the next one to two years, the PCAAP recommends undertaking the actions described below. These are intended as first steps, that is, initial implementation. We anticipate that they will form a precursor to continued implementation and a process of continually improving management of the Plymouth-Carver Aquifer.

Continue PCAAC Meetings
We recommend continued monthly meetings with the PCAAC. This will help to ensure participation of all seven towns as well as the general public.

Continue the Public Participation Program
We recommend continuation the public participation program, which should consist of:

- Preparation of press releases to be distributed to the PCAAC for use in town meetings as well as distribution to print and radio media.
- Preparation of notices/advertisements to be used before each meeting by the PCAAC to both notify the public about the meeting, as well as further public education on the issues.
- Maintain and update the PCAAC Webpage.

Protect and restore critical land and water resources
Municipalities of the PCAAC should work together to develop an areawide open space protection plan. This plan should encourage municipal and partner-organization protection of unfragmented open space for the purposes of maintaining recharge to the aquifer, base stream flow, and critical habitat areas. Further, water resources can be preserved through the support of water conservation efforts as well as the diligent oversight of water infrastructure, including leak detection and repair.

Develop Model Bylaws for Implementation in the Plymouth-Carver Aquifer Area
Building on work from the PCAAP, we recommend development of model bylaw(s) that include topics such as low impact development, soil erosion and sediment control, stormwater management, aquifer protection, sand and gravel operations, decentralized wastewater management, and related utilities (i.e., stormwater and wastewater utilities).

As follow-up steps, the PCAAP should also focus on the following either within the next two years or as soon as time allows.

Collaborative Work with Cranberry Growers and Other Farmers
Work with the cranberry growers and other farmers to develop a plan of work and implementation schedule to address water quality and water withdrawal issues.

Landscape Watering and Grounds Management
Develop a policy and public education approach to encourage water conservation and water quality protection through appropriate landscape, water, and grounds management.

Develop Local Water Withdrawal Policy
Explore water withdrawal policy for the Plymouth-Carver Aquifer region. Identify specific water withdrawal concerns for the region (e.g., exportation of water outside the recharge area, prioritizing users, withdrawal rights, etc.).

Funding

We anticipate that short-term implementation will be funded through grants or other non-municipal funding sources. Efforts to improve local conditions will carry some costs, yet financial assistance can be found in many ways. The PCAAP recommends collaborative effort to secure grants and other financial assistance.

In Conclusion…

Members of the PCAAC are not interested in new layers of government or establishing a water resource management authority with jurisdiction over the Plymouth-Carver Aquifer. And none has ever been expected or recommended by any participant in the Plymouth-Carver Aquifer action planning process. Home Rule is a proud tradition in Massachusetts and will likely continue on for generations to come. Yet all who have participated in the PCAAC to date see tremendous value in maintaining open communication with each other and in coordinating efforts to protect this shared resource. We anticipate and recommend that the PCAAC continue to meet into the future.

URL

For a full copy of the final report see:

http://www.mass.gov/envir/water/

http://www.fando.com/documents/File/Final_Report_5-2007.pdf

Additional information on the recent work of the Plymouth-Carver Aquifer Advisory Committee can be found at:

http://www.fando.com/index.cfm/SiteMap/Plymouth-Carver_Aquifer_Action_Plan

1.0 A PLAN OF ACTION

Part of the charge by the legislature to the Executive Office of Energy and Environmental Affairs, and thus to the Plymouth-Carver Aquifer Advisory Committee, was *"to develop...a written action plan to protect and manage the Plymouth-Carver Sole Source Aquifer."*

Developed through a public process, The Plymouth-Carver Sole-Source Aquifer Action Plan (PCAAP) reflects the input obtained from the citizens of the Plymouth-Carver Aquifer. This plan identifies long-term strategies to help guide local citizens in all walks of life throughout the Plymouth-Carver Aquifer, be they approaching aquifer issues from the perspective of government official, business employer or employee, agricultural expert, or local resident. As we all know, many of us fall into more than one of these categories— often two or three.

At the center of this Plan is a respect for self-determination and home rule. The dependence each community, each business, and each resident has on the both the quality and quantity of this precious and limited resource now and in the future has attracted the attention of individuals from many walks of life. But taking the steps to protect this resource will rely on local actions.

The PCAAP provides a framework of strategies for protection of the Plymouth-Carver Aquifer so it may continue to be a resource for many generations to come. The PCAAP outlines watershed issues and proposes actions to address those issues brought forward by the participants in the Plymouth-Carver Aquifer Advisory Committee (PCAAC) meetings. Recommendations of the PCAAP are not solely the responsibility of governments. Just as everyone— in whatever role in life— relies upon the Plymouth-Carver Aquifer, we all must help protect it.

1.1 Overall Recommendations for Protection of Plymouth-Carver Aquifer

During the course of committee discussion, our ideas focused on four primary categories of action:

- Policy
- Coordination and Tech Transfer
- Outreach for Target Audiences
- Grants and Funding

1.1.1 Policy

The importance of resource protection originally motivated the Plymouth-Carver Aquifer communities to begin meeting many years ago and to seek the funding needed to help them gather together and write this plan. Strategies to protect water resources and guide land use to support resource protection are under constant development and review, and their use is best implemented at the local level, supported by local concern and enforced more by social agreement for a principle than by regulatory mandate. Conservation standards need to be supported by planning and building codes, for example, and vice-versa.

Though many of the items cited below will fall upon local authorities to enact, the goal of resource protection is one we all share. Guidelines within a community should remain consistent across jurisdictions. We recognize that, from time to time, effective resource management may require innovation beyond standard protections.

The state has developed guidelines for many of the issues discussed in this report. For the sake of consistency across the aquifer, this plan recommends that municipalities cite state policy as a baseline. Making such references also forms a clear legal basis for enforcement and helps to eliminate questions about whether or not state standards are enforceable at the municipal level.

Consistency of policy is *at best* improbable without routine structured communication. We believe continued cooperation between the communities is critical to protect the Plymouth-Carver Aquifer (*see also Coordination and Tech Transfer below*). We strongly recommend formulation and continued improvement of aquifer protection policy with continuing involvement and feedback to the PCAAC.

– Protect and restore critical land and water resources: Open space is critical to recharging groundwater and stream flow. Because of its highly permeable soils (see Section 2.2.2), the Plymouth-Carver Aquifer is particularly reliant on locally protected open space to maintain quantity and purity of recharge. Large tracts of open space also support the continued existence of rare species and critical habitats.

  Each of the Plymouth-Carver Aquifer municipalities currently practices open space acquisition and protection. Open space acquisition should be continued and, to the extent practicable, targeted to encourage efficacious groundwater recharge, stream flow maintenance and habitat protection.

  Assistance is available through a variety of sources. Most notable is the Drinking Water Source Protection Grant Program administered through MassDEP. This program provides funding for the acquisition of land, critical to the protection of current and future drinking water supplies, and provides for continued passive recreation opportunities on such lands. Other open space protection support is available from the Massachusetts Division of Conservation Services, local land trusts, as well as through private donation of land. For more information, see Section 1.1.4, "Grants and Funding," below.

  To enhance existing municipal open space protection efforts, municipalities of the PCAAC should work together to develop an areawide open space protection plan. An areawide plan will foster the development of clear priorities for the PCA and will help to maintain the integrity of existing intermunicipal open space tracts. An areawide plan will also increase the likelihood of receiving financial assistance from the state.
  In addition to land protection, water conservation education and continuing efforts to ensure a sound water distribution infrastructure helps protect water resources from unnecessary waste.

  Actions Recommended

  Ÿ This plan recommends that all towns work together on development of an areawide open space protection plan.

- Ÿ The following towns should consider updating their expired plans— Bourne, Kingston and Plympton. (Plympton is doing so currently.)

- Ÿ This plan recommends that Middleborough amends its plan to include a specific discussion of the Plymouth-Carver Aquifer.

– Massachusetts Soil Erosion Guidelines: Aquifers and surface waters are integrated. Soil erosion and sedimentation adversely effect wetlands and other water resources. Not only are soils disturbed during construction, proper soil management and grading when properties are developed or cultivated have lasting impact on the Plymouth-Carver Aquifer. Permeability and recharge characteristics require ongoing attention. Municipalities should cite the *Massachusetts Erosion and Sediment Control Guidelines* (http://www.mass.gov/dep/water/esfull.pdf.).

Actions Recommended

- Ÿ This plan recommends that all towns work together on development a model enforceable soil erosion and sediment control policy (e.g., bylaw or regulation).

- Ÿ To encourage consistency this plan recommends that the Plymouth-Carver Aquifer area municipalities cite state guidelines.

– Recharge Standards: Forests and open spaces allow precipitation to percolate into the soil and recharge groundwater. Development creates impervious surface (e.g., roads) that increase runoff and prevent groundwater recharge. Massachusetts has developed recharge standards in its stormwater policy (http://www.mass.gov/dep/water/laws/2103ch.doc). Municipalities should incorporate these guidelines by reference and may wish to enhance them in sensitive areas. For example, the United States Environmental Protection Agency (USEPA) recently developed a guidance manual for impaired waters restoration that recommends infiltration of the first two inches of runoff from impervious surface as this is equivalent to managing 99 percent of storms in the Northeast Region.

Actions Recommended

- Ÿ This plan recommends that all towns work together on development a model enforceable policy (e.g., bylaw or regulation), which includes recharge standards.

- Ÿ Bourne, Kingston and Wareham cite state guidelines for stormwater management, but may wish to clarify their references to include recharge requirements.

- Ÿ Carver, Middleborough, Plymouth and Plympton do not cited state guidelines in the materials reviewed during development of this plan. For consistency, all towns should establish such a reference.

– Massachusetts Stormwater Management Policy: Stormwater is a significant source of pollution. Development that improperly manages stormwater may cause loss of recharge and introduce pollution to the water cycle. Municipalities should cite the Massachusetts stormwater policy (http://www.mass.gov/dep/water/laws/2103ch.doc) in their regulations regarding stormwater management.

In some instances, municipalities may wish to go beyond these standards. For example, the Town of Plymouth recently developed a *Model Stormwater Management* Bylaw with the towns of Duxbury and Marshfield. Wherever possible, model bylaws should maintain consistency with state policy and the policy of other towns in the PCA area.

Actions Recommended

- This plan recommends that all towns work together on development a model enforceable policy (e.g., bylaw or regulation) for stormwater management.

- Bourne, Kingston and Wareham cite state guidelines for stormwater management. Carver, Middleborough, Plymouth and Plympton do not cited state guidelines in the materials reviewed during development of this plan. For consistency, all towns should establish such a reference.

– Aquifer Protection Bylaws: New commercial and residential development may stress groundwater resources through pollution discharge increase, recharge interception, and water withdrawal. MassDEP recommends establishing groundwater protection districts in sensitive areas. In some cases, the municipalities have already done so.

  Other examples of protection include the Cape Cod Commission's model zoning bylaw that incorporates performance standards for nitrogen reduction, minimization of impervious surface, and stormwater management (See http://www.capecodcommission.org/bylaws/wateroverlay.html)

  As stated above, municipalities should consider these model bylaws as a starting point in developing water resource protection bylaws and regulations, while striving for consistency within their own overlay jurisdictions and those of neighboring municipalities.

  Actions Recommended

  - This plan recommends that all towns work together on development a model enforceable policy (e.g., bylaw or regulation) for aquifer protection. Although several towns have developed related bylaws, there are many inconsistencies from town to town. We recommend that such a bylaw includes performance standards such as those contained in the Plymouth and Bourne bylaws.

– Massachusetts Sand and Gravel Operation Guidelines: Vegetation and the upper soil horizons provide a pollution buffer for shallow groundwater. Improperly managed sand and gravel operations may reduce this protection and introduce hazardous materials and other toxins directly to groundwater. Massachusetts has developed guidelines for managing sand and gravel operations. The *Massachusetts Clean Water Toolkit – NPS Management Manual* provides guidance on this and many other subjects regarding nonpoint source pollution. (See http://www.mass.gov/dep/water/resources/nonpoint.htm#megaman).

  Further, local adoption of a bylaw creating groundwater protection district (see above) limits earth removal, consisting of the removal of soil, loam, sand, gravel, or any other earth material to within four feet of high groundwater. While farming is permitted in these districts, storage of certain products used in the agricultural process does require

management practices designed to protect the Plymouth-Carver Aquifer from runoff and spills.

Actions Recommended

- This plan recommends that all towns work together on development a model enforceable policy (e.g., bylaw or regulation) for sand and gravel operations.

- Bourne, Carver, Kingston, Plymouth and Wareham all regulate sand and gravel extraction; however, none of these five communities cite state guidelines for sand and gravel extraction. Middleborough and Plympton do not cite state guidelines in the materials reviewed during development of this plan. For consistency, this plan recommends that all towns establish such a reference.

- Water Reuse and Recharge: More and more, water is becoming a limited resource. Water reuse for non-drinking purposes (e.g., landscape irrigation), reduces drawdown on the water supply. In 2005, the Metropolitan Planning Commission released a report *Once is Not Enough*.[1] The report observes:

  > The use of reclaimed water can provide many advantages to communities and businesses. Large-scale water reuse will reduce the need for expanding water supplies. Where drinking water quality is affected by well drawdown, water reuse will result in higher quality water for residents. Cost-effective water reuse systems will allow business and industry to operate and expand at lower cost. Wastewater treatment facilities will discharge less wastewater and may be able to sell some wastewater back to recycled water users, increasing cost efficiencies. Reduced water demand will result in healthier rivers, streams, and lakes for recreation and wildlife.

  MassDEP notes the controlling factor in water reuse is the protection of public health. For this reason, the water to be reused must be virtually pathogen and contaminant free. MassDEP's guidelines ensure that this standard is met, for example:

  - The public must be told that reclaimed water is in use.
  - Wastewater treatment plants producing reclaimed water are required to maintain a high level of treatment with redundant mechanical systems and backup power.
  - Comprehensive monitoring of both the wastewater effluent and the groundwater is required to demonstrate that standards are met.
  - For the most stringent uses, tests for fecal coliform must show a median of zero, with no test results greater than 14 parts per million.

  Any facility that is designed to reuse treated wastewater must have a valid discharge permit from the MassDEP. As demand in the area for water increases, conservation and reuse will become increasing important sources of water. With development expanding in the area, and the use of cluster development and transferable development rights utilized to promote clusters, reuse opportunities can only expand.

1 http://www.mapc.org/regional_planning/MAPC_Water_Reuse_Report_2005.pdf

Actions Recommended

- Ÿ None of the Plymouth-Carver Aquifer communities discuss wastewater reuse in the policy or documents that we reviewed. This plan recommends that all towns work together to establish reuse policy consistent with state policy.

– Consistent Water Conservation Requirements: In addition to reuse, water conservation practices can significantly reduce water withdrawals. Several water suppliers implement water conservation, others do not. Developers, municipalities and suppliers should work together to develop standard water conservation practices that can be applied consistently throughout the region. See the *Massachusetts Water Conservation Standards* (http://www.mass.gov/envir/mwrc/pdf/Conservation_Standards.pdf). Building code adoption of low impact development strategies, including cluster zoning and small lot developments, as well as the current plumbing codes supporting low-flow designs, are all developed with resource protection and conservation in mind.

Actions Recommended

- Ÿ This plan recommends that all towns work together on development a model program for water conservation. State standards would make a good basis for such a program.

- Ÿ Public education regarding water conservation must be a continuing effort. In the schools, in the office, in the agricultural community, and in the home, the frugal use of a limited resource should be everyone ŝ concern.

– Water Use and System Audits: Regular water-use audits, particularly at rental and commercial properties, have been shown to significantly reduce water demand. Systemwide water audits help identify leaks in the delivery infrastructure. Suppliers and municipalities should consider developing water audit protocols. Protocol development should start from the *Massachusetts Department of Environmental Protection Water Audit Guidance Document* (http://www.mass.gov/dep/water/approvals/guidance.doc). MassDEP provides financial assistance to support water conservation education and outreach programs, water audits, and leak detection surveys of drinking water systems. Recipients include public water suppliers and municipalities. (See http://www.mass.gov/dep/public/press/0207wate.htm).

Actions Recommended

- Ÿ This plan recommends that all towns work together on development a model program for water conservation. State standards would make a good basis for such a program.

- Ÿ All public suppliers should aggressively pursue leak detection and repairs.

- Ÿ Commercial and residential property owners should be encouraged to employ modern appliances that reduce water use, limit outdoor water use, and be sure leaks are repaired swiftly.

– Open Space Residential Design Guidelines: Large-lot zoning is currently used by many communities to reduce the adverse density-related affects of development, yet cluster zoning may be used to further reduce these adverse effects by concentrating development

away from sensitive areas and reducing its overall footprint and the extent of impervious surfaces.

Open space residential design is a closely related approach that incorporates specific environmentally protective approaches and practices. Municipalities should incorporate Open space residential design in their zoning policy. At a minimum, developers should prepare a comparative analysis of open space residential design versus conventional development when they apply for permits. Open space residential design is discussed on www.greenneighborhoods.org. A similar development approach, conservation design, is discussed in *Growing Greener— Putting Conservation into Local Codes* (http://www.greenneighborhoods.org/site/growinggreener.pdf) as well as in the Smart Growth Toolkit maintained by the Massachusetts Office on Energy and Environmental Affairs at http://www.mass.gov/envir/smart_growth_toolkit/pages/links.html. (For specific information on cluster development, see http://www.mass.gov/envir/smart_growth_toolkit/pages/mod-lid.html)

Actions Recommended

- This plan recommends that all towns work together on development a model enforceable policy (e.g., bylaw or regulation) for open space residential design.

- Currently, all towns, but Plympton have some form of flexible zoning; however, these policies are not necessarily consistent. We recommend that Plympton consider hiring a town planner as it is the only town in the Plymouth-Carver Aquifer area that does not employ one.

– Operation and Maintenance and Upgrade of Substandard Systems: Improper operation and maintenance of onsite sewage disposal is known to contribute to premature system failure. Substandard systems, such as cesspools, lack the capacity to serve modern wastewater disposal needs. Generally accepted industry practice is to inspect septic systems on a 3-5 year basis. Title V requires system inspection at time of home sale, but this requirement may not always meet the 3-5 year standard. Municipalities should consider development of wastewater management programs that require regular inspection and maintenance of onsite wastewater systems as well as upgrade of substandard systems.

The installation of nitrogen-reduction systems near the coast, along stream banks and near the many ponds prevalent in the region, as well as other nutrient-sensitive areas should be considered. Several Massachusetts municipalities (e.g., Gloucester) have implemented programs that should be examined as case studies.

Massachusetts has developed Managing Wastewater: Prospects in Massachusetts for a Decentralized Approach (http://www.mass.gov/dep/water/wastewater/wwtrmgmt.doc), which discusses the policy backdrop in Massachusetts and several case studies.

Actions Recommended

- This plan recommends that all towns work together on development a model program and policy (e.g., bylaw or regulation) for improved management of onsite sewage disposal systems. Plymouth is currently working on such a program.

- Ÿ Bourne and Plymouth have both established performance standards. We recommend that the other five towns follow this lead.

– Promote Groundwater Discharge of Sanitary Wastewater: Wastewater treatment practices are varied throughout the Plymouth-Carver Aquifer. As development marches forward, a move toward more centralized wastewater treatment may be preferred. Remembering the importance of recharge to the long-term health of the Plymouth-Carver Aquifer, treatment that promotes groundwater discharge, in addition to the promotion of reuse, should be the goal.

– Pollution Prevention: Many of the items discussed already will promote pollution prevention. Stormwater management, groundwater protection overlay districts, careful storage and management of agricultural and industrial products, all serve to prevent a problem; and prevention really is less costly than the cure of restoring a polluted water source.

  Hydrologic studies find that groundwater in the PCA generally moves in a north-to-south direction, toward Buzzards Bay; or east-to-west direction, toward Plymouth Harbor. The aquifer's transmissivity is high and water moves through it readily. Thus, one can imagine a spreading plume of contamination after a catastrophic spill on the north or east side of the recharge area... and the painful evidence of the shared, sole-source nature of the Plymouth-Carver Aquifer. Sharing resources, training, and preparedness in hazardous material (i.e., HazMat) exercises, coordinating education efforts regarding pollution prevention with local businesses and homeowners alike, will all contribute to a better awareness of the Plymouth-Carver Aquifer as a shared resource and will lead to better protection of the aquifer for generations to come.

  We have already discussed the affect of stormwater as a significant pollutant to surface water and groundwater. Nonstructural preventative techniques reduce the threat of contamination. Massachusetts stormwater policy includes a number of preventative techniques. These are discussed on the Massachusetts Smart Growth Toolkit and the Clean Water Toolkit, cited previously.

  Actions Recommended

  - Ÿ Each of the Plymouth-Carver Aquifer area towns currently have policy related to pollution prevention. However; this plan recommends that all towns work together to improve consistency on their pollution prevention policy and standards.

– Increased Municipal Involvement in Monitoring Responsible Parties at Existing Contamination Sites: Owners of sites where contamination is known to exist and remediation steps have been mandated are generally required to produce regular reports on containment and remediation. Close monitoring and public involvement will encourage more careful attention to mandated management efforts. The Plymouth-Carver Aquifer municipalities should consider requiring annual inspection, report review, and annual public meetings for contaminated sites as a way to raise awareness and encourage action. The PCAAC could hold an annual meeting to discuss these sites publicly and offer owners an opportunity to their progress on remediation.

Actions Recommended

Ÿ This plan recommends that all towns in the Plymouth-Carver Aquifer area coordinate to establish a consistent approach on this issue. No town specifically addresses this issue in the documents and policies reviewed to develop this plan.

– Long-Term Water Resource Management: Some communities have expressed concerns over the availability of water for the long term and wish to become more involved in the permitting process for new source development. Statutorily, a governmental entity may not allow greater leniency than is imposed by a governmental entity with broader jurisdiction, yet the right to impose higher standards is typically available. Though efforts to fully control water as a resource may be limited by a community's infrastructure for water delivery, municipalities may take steps to strengthen local authority, excepting conflict with Chapter 21G of the Massachusetts General Laws (the Water Management Act).

Actions Recommended

Ÿ This plan recommends that all towns in the Plymouth-Carver Aquifer area continue the coordinated discussions regarding ways to address this issue, providing continuing opportunities for economic growth while assuring resource protection.

1.1.2 Coordination and Tech Transfer

Members of the PCAAC are not interested in new layers of government or establishing a water resource management authority with jurisdiction over the Plymouth-Carver Aquifer. And none has ever been expected or recommended by any participant in the Plymouth-Carver Aquifer action planning process. Home Rule is a proud tradition in Massachusetts and will likely continue on for generations to come. Yet all who have participated in the PCAAC to date see tremendous value in maintaining open communication with each other and in coordinating efforts to protect this shared resource. We anticipate and recommend that the PCAAC continue to meet into the future.

– Continue to Meet with Plymouth-Carver Aquifer Advisory Committee and Share Ideas for Protection of the Plymouth-Carver Aquifer: Just as businesses form trade groups or networking forums develop and foster successful ideas, stakeholder groups and intermuncipal organizations unite to promote mutually beneficial approaches to public resource management. The Plymouth-Carver Aquifer Advisory Committee members continue to find value in meeting together, and can use the committee to discuss issues which impact them all. Implementation of the ideas captured in this Action Plan can be one goal the revived Committee may address. The Committee could provide a forum for outreach and education to targeted audiences, such as developers, or specific business groups. The viability of the Plymouth-Carver Aquifer in perpetuity is a goal all the participants share.

Actions Recommended

We recommend continued monthly meetings with the PCAAC. This will help to ensure participation of all seven towns as well as the general public. The committee would like to address two issues as their *"Next Steps."*

1. Coordination of the development of an areawide open space protection plan.
2. A center of education, communication and idea sharing regarding potential bylaws and consistent practices for local review.

1.1.3 Outreach for Target Audiences

Minor transgressions— seemingly insignificant in isolation— like applying a little too much fertilizer, burying a quart of used oil, failure to fix a leaky faucet, may culminate in chronic problems. In this way, the accepted practice of specific groups may present serious ramifications to the Plymouth-Carver Aquifer. Targeting messages for particular audiences raises awareness that appropriate practice makes a real difference and can reduce threats.

Actions Recommended
This plan recommends that all towns in the Plymouth-Carver Aquifer area coordinate to establish a consistent approach for outreach to the target audiences discussed below.

- Developers: Clearly, developers play a critical role in building infrastructure and establishing land-use patterns. Municipalities should use the land-use regulation process to educate developers as to state-of-the-art regulatory, financial, and environmental conservation techniques and their benefits.

- Farmers: Farmers use a large fraction of the water extracted from the Plymouth-Carver Aquifer, as well as create and manage a large percentage of surface water that contributes recharge to the aquifer. The viability of their operations rests on the availability of water that is of sufficient quality and quantity, especially water intensive crops such as cranberries. Trade associations, municipalities, and farmers should coordinate to ensure that access to these water supplies remain, especially those growers owning current Water Management Act registrations and permits, that the water continues to be of good quality, and that best management practices for water quantity and water quality are continually researched, implemented, and supported.

  Cranberry growing represents the majority of agriculture over the Plymouth-Carver Aquifer. The Cape Cod Cranberry Growers 'Association (CCCGA, http://www.cranberries.org), University of Massachusetts Cranberry Station (UMASS, http://www.umass.edu/cranberry) and the United State Department of Agriculture's Natural Resources Conservation Service (NRCS, http://www.ma.nrcs.usda.gov/) provide research, guidance, education and technical assistance on the latest available practices for water quality and conservation in cranberry agriculture. Municipalities should encourage and support growers who obtain USDA certified conservation farm plans and growers that continue or improve aquifer stewardship through the use of the CCCGA "Grower Advisories" publications, UMASS best management practices guides and NRCS programs. This plan recommends that the municipalities also participate in any way possible, to enable growers to access and implement state and federal cost-share conservation improvement programs on their farm.

- General Public: Consistency of message is critical when communicating. Effective public outreach should include targeted as well as general messages. This plan recommends that the Plymouth-Carver Aquifer Advisory Committee continue to keep everyone aware of the

importance of the aquifer in their everyday lives, and encourage new and growing energy to participate in committee activities.

- Water Suppliers: We recommend that public water suppliers encourage conservation. The Massachusetts Water Resource Commission's recently adopted Water Conservation Standards provide suppliers as well as businesses and municipalities many strategies for promoting conservation. Suppliers can also play a role in land protection (as discussed above).

- Elementary and High School Curricula on Aquifer Protection: Because we want them to grow and prosper, we listen to our children and encourage them when they bring us positive ideas. Public education channeled through children tends to reach beyond its primary audience to parents and other caregivers. Early education also sets up a constituency for thoughtful resource management as its audience grows to adulthood. This plan recommends that municipalities include aquifer protection as part of their public school curricula.

1.1.4 Grants and Funding

Energy, valuable as it is, is best matched by financial commitment. Efforts to improve local conditions will carry some costs, yet financial assistance can be found in many ways to help fund the ideas discussed elsewhere.

Actions Recommended
We recommend that all towns in the Plymouth-Carver Aquifer area coordinate on financial assistance issues.

- Grants in Aid: Though budgets and priorities change over time, land protection has remained a priority of the Commonwealth over the life of many administrations. Information on grants for a variety of programs, including land and water resource protection, is available at : http://www.mass.gov/envir/grant_loan/

- Coordinate with Natural Resources Conservation Service to assist cranberry farmers: Cranberry farming is the predominant form of agriculture in the Plymouth-Carver Aquifer area. Due to the use of bogs, cranberry farming involves large volumes of water, much of which is recycled. The Natural Resources Conservation Service (http://www.ma.nrcs.usda.gov/ provides farmers with financial and technical assistance that promotes resource conservation and sustainable agriculture. This plan recommends that municipalities cooperate with cranberry growers that have contracted with the NRCS to implement conservation projects. Additionally, wherever possible, municipalities should consider economic incentives or similar programs to those growers who have partnered with the NRCS to improve their operation through specific water conservation and quality projects.

- Grants information clearinghouse: All stakeholders will need financing to make proper management of the Plymouth-Carver Aquifer a reality. Grants provide a valuable resource for growing existing financial resources. Cooperation among stakeholders frequently improves the likelihood of winning grants. This plan recommends that the Plymouth-

Carver Aquifer Advisory Committee consider opportunities to establish a grant clearinghouse that shares grant information and where appropriate submits joint applications or provide strong letters of support to applications within neighboring community borders.

- Enterprise Fund: Water and wastewater infrastructure requires regular operation and maintenance as well as structured retrofit and upgrade from time to time. We recommend that municipalities consider fee-for-service, enterprise funds, and utilities in order to provide a reliable revenue stream to manage and improve their infrastructure. Water, sewer, and stormwater infrastructure have all been supported by enterprise funds in a variety of Massachusetts municipalities. For more information see http://www.mass.gov/legis/laws/mgl/44-53f.5.htm.

1.2 Timeline— Short-Term Actions

Over the one to two years, we recommend undertaking the actions described below. These are intended as first steps, that is, initial implementation. We anticipate that they will form a precursor to continued implementation and a process of continually improving management of the Plymouth-Carver Aquifer.

Continue PCAAC Meetings
We recommend continued monthly meetings with the PCAAC. This will help to ensure participation of all seven towns as well as the general public.

Continue the Public Participation Program
We recommend continuation the public participation program, which should consist of:

- Preparation of press releases to be distributed to the PCAAC for use in town meetings as well as distribution to print and radio media.
- Preparation of notices/advertisements to be used before each meeting by the PCAAC to both notify the public about the meeting, as well as further public education on the issues.
- Maintain and update the PCAAC Webpage.
- One public meeting will be held in each municipality in approximately September and February to review work plan, status, and discuss resources needs as for aquifer protection.

Protect and restore critical land and water resources

Municipalities of the PCAAC should work together to develop an areawide open space protection plan. This plan should encourage municipal and partner-organization protection of unfragmented open space for the purposes of maintaining recharge to the aquifer, base stream flow, and critical habitat areas.

Develop Model Bylaws for Implementation in the Plymouth-Carver Aquifer Area

Building on work from the PCAAP, we recommend development of model bylaw(s) that include topics such as low impact development, soil erosion and sediment control, stormwater management, aquifer protection, sand and gravel operations, decentralized wastewater management, and related utilities (i.e., stormwater and wastewater utilities).

As follow-up steps, the PCAAP should also focus on the following either within the next two years or as soon as time allows.

Collaborative Work with Cranberry Growers and Other Farmers

Work with the cranberry growers and other farmers to develop a plan of work and implementation schedule to address water quality and water withdrawal issues of interest to both the growers and the PCAAC related to the health and sustainability of the Plymouth-Carver Aquifer and agriculture in the region.

Landscape Watering and Grounds Management

Develop policy and public education approach to encourage water conservation and water quality protection through appropriate landscape, water, and grounds management.

Develop Local Water Withdrawal Policy

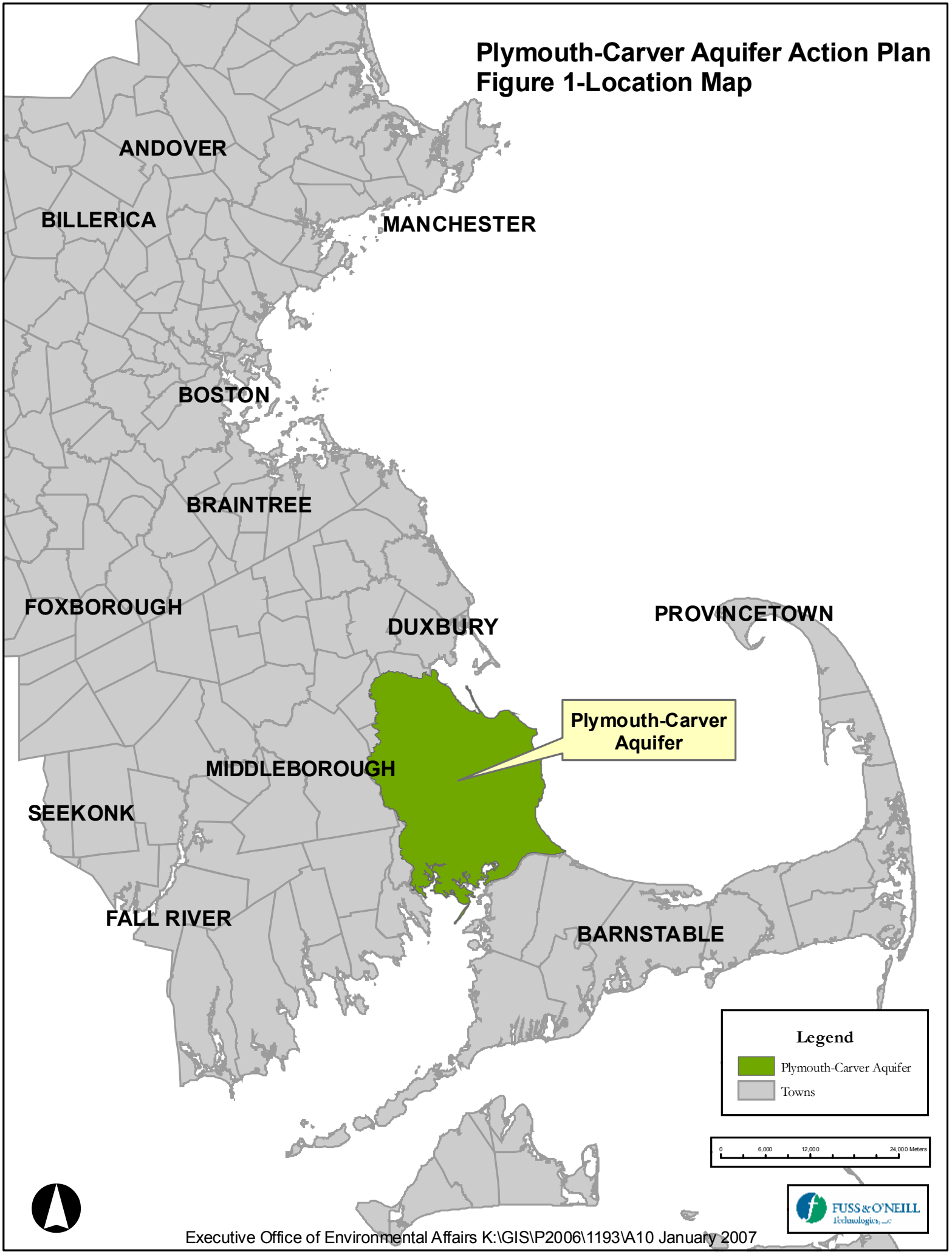
Explore water withdrawal policy for the Plymouth-Carver Aquifer region. Identify specific water withdrawal concerns for the region (e.g., exportation of water outside the recharge area, prioritizing users, withdrawal rights, etc.).

2.0 PLANNING CONTEXT

The Plymouth-Carver Aquifer (PCA) is the second largest sole-source aquifer in Massachusetts, supplying drinking water for seven Southeastern Massachusetts towns. The PCA covers approximately 200 square miles. Figure 1 shows the general location of the PCA.

This region has and continues to experience high growth rates, which will likely put strains on water resources and affect the overall condition of the PCA. Not only are water supply issues for residents a concern, the PCA also affects the environmental condition of the region including rare species of plants and animals, forest and open space quality, and surface water

Plymouth-Carver Aquifer Action Plan
Figure 1-Location Map



Executive Office of Environmental Affairs K:\GIS\P2006\1193\A10 January 2007

resources. Further, a significant number of agricultural operations— largely cranberry farming— are supported by the Plymouth-Carver Aquifer.

The purpose of this plan is to develop policy that will lead to maximizing the Plymouth-Carver Aquifer's ability to continue to supply water for this region. This plan focuses on:

- Initial research, including physical attributes of the area, expected trends in development, development of the committee to oversee the plan
- General consensus of opinions on the resources in the area, determined through interviews conducted with key residents in the region, other literature on relevant aspects of the planning process, and findings from regional planning document review.

This plan will be used to inform area residents of the next steps to best implement the plan for the involved communities.

2.1 History

Approximately 10 to 20 thousand years ago glaciers deposited large quantities of sediment and carved out a varied topography in Southeast Massachusetts. Major glacial deposits helped form many geologic characteristics of the region, including several ecologically significant coastal plain "kettle" ponds. Glaciers also scoured bedrock to form the irregular coastlines found in Massachusetts.

The Plymouth-Carver Aquifer area was home to the Wampanoag, which means "people of the dawn," so called because they lived in the east. The Wampanoag lived by farming, fishing, and hunting. In the spring, whole villages moved to the seashore to fish and plant crops— corn, squash and beans. In the fall and winter the Wampanoag migrated inland to the forests to hunt and fish. In 1620, the Pilgrims sailed to the New World and settled adjacent to Plymouth Bay.

Today the majority of the PCA area remains undeveloped, and forested areas offer great protection to the aquifer as well as recreation opportunities. The Myles Standish State Forest is the largest publicly owned recreation area in southeastern Massachusetts. Seasonal hunting is permitted in the state forest, and two wildlife management areas are stocked with game birds in October and November.

Photograph 1— Myles Standish State Forest

The region is also known for its cranberry bogs, which occupy a substantial portion of the PCA area. Formal cultivation of the cranberry began around 1816. Previously, the Wampanoag used cranberries in a variety of foods, as a medicine to treat arrow wounds, and as a dye for rugs and blankets. Cranberries grow on vines in impermeable beds layered with sand, peat, gravel and

clay. These beds, commonly known as "bogs," were originally formed by glacial activity. In recent years, changes in the economics in production of cranberries have put pressure on landowners to consider more lucrative development opportunities. Development in the region has been increasing steadily. The developed portions of the PCA area consist mostly of seasonal and permanent residential properties, small commercial developments, and limited industrial properties.

According to the USEPA 1990 Sole-Source Aquifer notice (see Appendix A), the water in the PCA is typically characterized as good to excellent, but is very susceptible to contamination due to aquifer characteristics such as high groundwater and high permeability of soils. The mixed-use residential/commercial development that is typical to the area has the potential to contribute to localized contamination and overall quality and quantity of water in the PCA.

Today seven municipalities are situated over the Plymouth-Carver Aquifer: Bourne, Carver, Kingston, Middleborough, Plymouth, Plympton, and Wareham. Table 1 shows the total acreage of each town, the acreage of each town that is located in the PCA, the percentage of the PCA that each town occupies, and the percentage of each town that is located in the PCA.

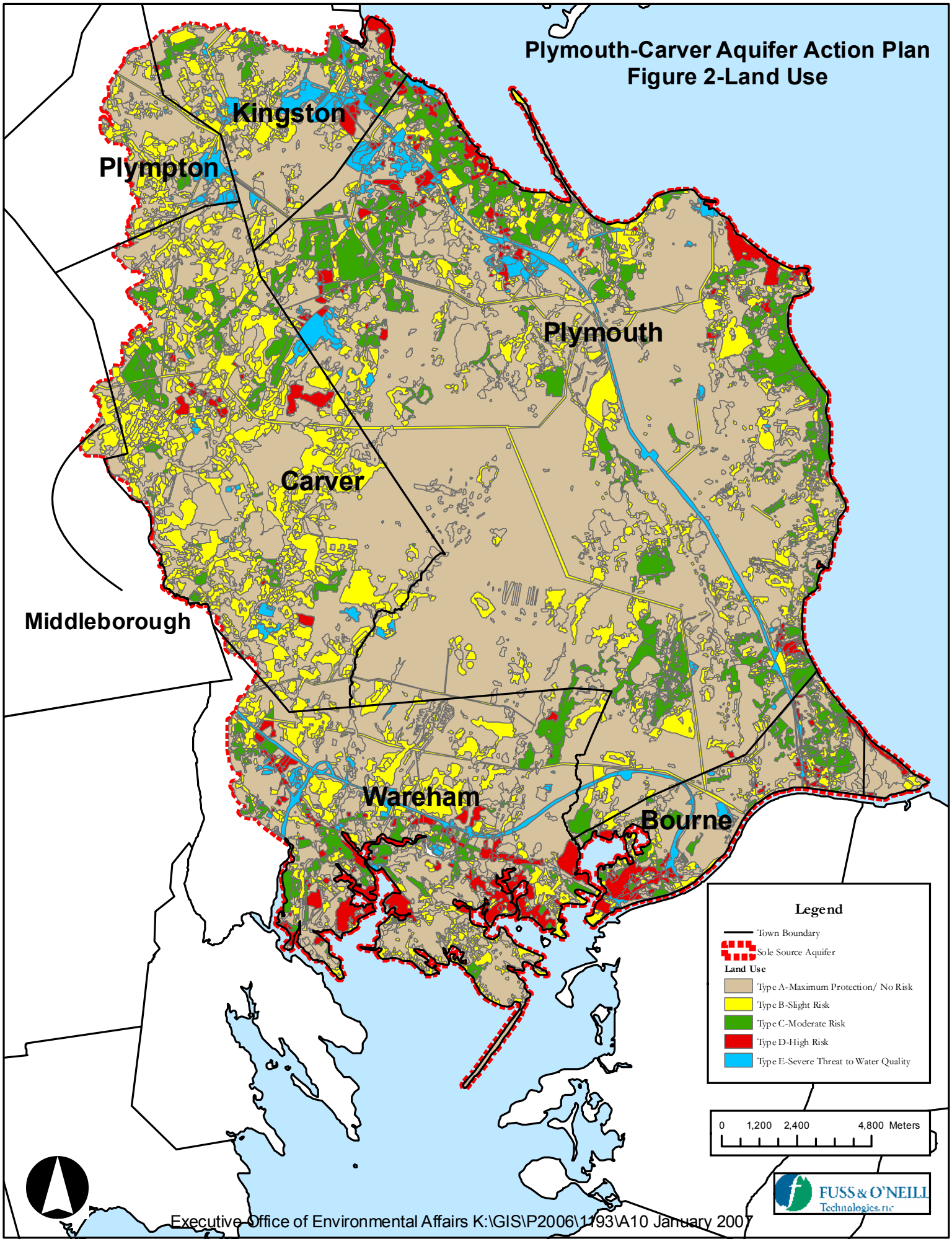
Table 1
Town Areas

Town	Town Acreage (Acres)	PCA Acreage (Acres)	Percent of PCA (%)	Percent of Town in PCA (%)
Bourne	26,464	5,798	4.6	21.9
Carver	25,447	23,652	18.7	92.9
Kingston	12,144	7,642	6.0	62.9
Middleborough	46,194	459	0.4	1.0
Plymouth	65,683	65,237	51.5	99.3
Plympton	9,647	3,519	2.8	36.5
Wareham	23,968	20,238	16.0	84.4
Total	*209,547*	*126,545*		

As shown in the table, the majority of the Plymouth-Carver Aquifer is located in Plymouth, which is almost completely in the Plymouth-Carver Aquifer. Plymouth is also the largest town by size and population. Carver and Wareham comprise the next largest portions of the Plymouth-Carver Aquifer, both of which are mostly located in the PCA. Middleborough is the second largest town, but occupies the smallest portion of the PCA at less than one percent. Middleborough does not rely on the PCA for public water supply and supplies a portion of Carver where groundwater contamination closed many of the private wells.

2.1.1 Land use

A map of the land uses in the PCA area is pictured in Figure 2, which can be found following this page. To help quantify risk, we have adapted a land use classification system where Class A has the least environmental risk and Class E has the highest environmental risk. The land uses can be an indicator of potential changes to the PCA and to identify areas of concern


Plymouth-Carver Aquifer Action Plan
Figure 2-Land Use
Kingston
Plympton
Plymouth
Carver
Middleborough
Wareham
Bourne
Legend
Town Boundary
Sole Source Aquifer
Land Use
Type A-Maximum Protection/ No Risk
Type B-Slight Risk
Type C-Moderate Risk
Type D-High Risk
Type E-Severe Threat to Water Quality
0 1,200 2,400 4,800 Meters
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Executive Office of Environmental Affairs K:\GIS\P2006\1193\A10 January 2007

(concentrated development or environmental risk areas). Table 2 shows the land uses calculated using data from MassGIS and the category assignment used for the figure.

Table 2
Land Use

Mass GIS ID	Land Use Category	Figure Classification	Area (acres)	Portion of PCA (%)
1	Cropland	C	644.5	0.5
2	Pasture	B	409.4	0.3
3	Forest	A	82980.1	58.9
4	Wetland	A	2748.5	2.0
5	Mining	E	1241.7	0.9
6	Open Land	A	2157.6	1.5
7	Participation Recreation	B	1057.1	0.7
8	Spectator Recreation	D	4.8	<0.1
9	Water Based Recreation	B	341.5	0.2
10	Multi-family Residential	D	315.2	0.2
11	< ¼ acre lot Residential	D	2426.0	1.7
12	¼ - ½ acre lot Residential	C	10604.7	7.5
13	> ½ acre lot Residential	B	8113.8	5.8
14	Salt Wetland	A	894.9	0.6
15	Commercial	D	1430.4	1.0
16	Industrial	E	765.6	0.5
17	Urban Open Space	B	876.4	0.6
18	Transportation	E	1996.2	1.4
19	Waste Disposal	E	186.3	0.1
20	Water	A	6904.5	4.9
23	Cranberry Bog	B	11388.4[a]	8.1
24	Power Lines	B	1855.6	1.3
26	Golf	B	725.0	0.5
29	Marina	D	9.5	<0.1
31	Urban Public	B	514.4	0.4
32	Transportation Facilities	D	61.2	<0.1
34	Cemeteries	B	141.8	0.1
35	Orchard	C	1.5	<0.1
36	Nursery	A	78.8	0.1

Note:

a. The figures shown in Table 2 are supplied by MassGIS, derived from aerial photography taken in 1999. These figures are subject to review and revision. The Cape Cod Cranberry Grower's Association (CCCGA) in 2007 identifies approximately 7,300 acres of cranberry bogs within the region.

As shown in Table 2, the majority of land use is forest, followed by residential (15.2% for all densities combined), and cranberry bogs (8.1%). Type A land use comprises 68% and Types D and E combined comprise 6%.

2.1.2 Demographics

According to the 2000 census, population densities at that time ranged from 180 people per square mile in Plympton (the smallest of the towns) to 640 people per square mile in Kingston. The census does not account for seasonal residents, who occupy a notable portion of the PCA area. However, records from water suppliers indicate a variety of changes in communities of the Plymouth-Carver Aquifer in the summer time. While Plymouth experiences an approximately 3 percent rise in residential population during the summer, the Village of Onset witnesses a 300% rise in population— and water use increases accordingly. Other parts of the Plymouth-Carver Aquifer see average seasonal increases in the 25 –30 percent range.

2.1.3 Socio-Political

All of the seven communities in the Plymouth-Carver Aquifer study are incorporated as towns. Six of the towns use an open town meeting form of government. Plymouth is the seventh town which uses a representative town meeting form of government.

In 1967, Massachusetts enacted Home Rule as part of the State Constitution. Home Rule allows municipalities to adopt and change their form of government without the approval of the State Legislature. It also confers a sense of control. Although in reality, a number of Massachusetts municipalities had, prior to its inception, established such authority without the benefit of Home Rule (e.g., Boston). Two towns in the study area have established Home Rule Charters. These are Wareham and Plymouth.

Management of the bylaws and regulations affecting the Plymouth-Carver Aquifer involve land use, zoning, and health codes. Whenever a town adopts or amends general by-laws or zoning by-laws the Town Clerk, within 30 days of adjournment of town meeting, is required to submit them to the Attorney General for review and approval. The Attorney General then has 90 days in which to decide whether the proposed amendments are consistent with the constitution and the laws of the Commonwealth. If the Attorney General finds an inconsistency between the proposed amendments and state law, the amendments or portions thereof will be disapproved.

2.1.4 Profile of Cranberry Agriculture in the Plymouth-Carver Aquifer Area[2]

2.1.4.1 Cranberry Agriculture History in the Plymouth-Carver Aquifer Area

Commercial cranberry growing has provided the mainstay for Massachusetts agriculture and for our region's rural and traditional way of life for over 190 years. A business rich in history and family tradition, cranberry growing represents a highly desirable and respected element in the region's heritage and in its current business environment. For generations the predominant industry within the communities of the Plymouth Carver Aquifer has been cranberry production. With over 14,000 acres in cultivation, the cranberry is Massachusetts's number one agricultural commodity crop, contributing more than $200 million in payroll to Massachusetts's workers and employing about 5,500 people. Approximately half of the Massachusetts cranberry acreage lies upon the Plymouth Carver Aquifer.

2 This profile of the cranberry industry was written with the assistance of the Cape Cod Cranberry Growers' Association.

Most cranberry operations have farmed their land for years, serving as caring stewards of a precious resource. Many of today's growers work on family farms that go back three, four or five generations. They are committed to the region's rural character and deeply rooted in the well being of the community. For these families, cranberry farming is more than a business – it's a way of life.

Cranberry growing also provides notable benefits to the environment through utilizing natural resources and in safeguarding the rural character of the Plymouth Carver Aquifer region. Thousands of acres occupied by cranberry farms are the most notable factor explaining the beautifully rural character of the region. On average, every planted acre of cranberries is supported by three to four acres of surrounding wetlands and uplands. This acreage provides open space, wildlife habitat and groundwater recharge.

Photograph 2— Cranberry farm in Carver.

Massachusetts cranberry growers own and control approximately 48,000 acres of upland and wetland support lands, outside of cranberry production acreage.

The cranberry, along with the blueberry and Concord grape, is one of North America's three commercially grown native fruits. Cranberries were first used by Native Americans, who discovered the wild berry's versatility as a food, fabric dye and healing agent. The name "cranberry" derives from the Pilgrim name for the fruit, "cranberry," so called because the small, pink blossoms that appear in the spring resemble the head and bill of a Sandhill crane. European settlers adopted the Native American uses for the fruit and found the berry a valuable bartering tool. American whalers and mariners carried cranberries on their voyages to prevent scurvy. Cultivation of the cranberry began around 1816, shortly after Captain Henry Hall, of Dennis, Massachusetts, noticed that the wild cranberries in his bogs grew better when sand blew over them. Continuing throughout the 19th century, the number of growers increased steadily.

In 1888, the Cape Cod Cranberry Growers 'Association was established and is one of the oldest farmer organizations in the country. By maintaining focus on grower issues, the goal of the Association is to enhance the economic viability of the Massachusetts cranberry grower. But beyond that function, the Association and its members deeply respect the heritage and history of cranberry growing, the unique character that it imparts on the region. To this end, the Association continuously communicates with citizens, state and local officials, to develop a symbiotic relationship that supports both agriculture and the environment of the Plymouth

Carver Aquifer region.

2.1.4.2 Cranberry Agriculture Operations and Water Use

Contrary to popular belief, cranberries do not grow in water. Instead, they grow on vines in impermeable beds layered with sand, peat, and clay. These beds, commonly known as "bogs," were originally made by glacial deposits. Perennial plants, some cranberry vines in Massachusetts are more than 150 years old. Today, new bog construction is made in upland soils, with growers replicating the conditions of a natural bog as much as possible with sand, soil, and a confining layer to retain water.

Water is the single most important resource in growing cranberries. Cranberry growers in Massachusetts rely on a clean, plentiful water supply to maintain their cranberry beds. Water is critical to the health of the plant, provides protection against frost, prevents winter damage, is used as a cultural method to eliminate pests and is used to harvest nearly 90% of the crop. Cranberry farming utilizes the greatest amount of water when the general public demands on the Aquifer are at their lowest and evaporation rates are low. This time period is late fall through the winter months.

Photograph 3— Cranberries grown in soils that replicate bogs

Although cranberries require a large volume of gross water use, the net usage is much lower. In most cases, water used in cranberry production is returned to the groundwater/surface water regime close to the point where it was temporarily removed and in basically the same quantity. This is due to recycling of the water, moving the water back to the original water source or sharing water between growers. Water conservation is a priority to cranberry growers, resulting in innovative water conservation practices such as water recovery systems, low volume sprinklers that reduce water usage and the establishment of bypass canals, enabling growers to divert water around their bogs. The use of bypass canals and water recovery ponds, in many cases creates a closed water management system on cranberry bogs, which helps increase water quantity and quality. Cranberry farms have contributed a significant amount of water storage capabilities over the Aquifer, including management of storm water and surface runoff. This water management is made possible by the daily observation and operation of dams and flumes, creation of ponds, reservoirs and maintaining bog ditches.

The Cape Cod Cranberry Growers Association works in partnership with the University of Massachusetts Cranberry Station. Many Best Management Practices (BMPs) have been developed and shared with growers throughout the region, including such water protection strategies as the promotion of lining bogs, dramatic reductions in pesticide use, and the reduction in phosphorous in harvest release water, to name a few. The Cranberry Station ranks as a leader in North America for research and outreach programs on cranberry cultivation.

The Natural Resources Conservation Service, a division of the United States Department of Agriculture, works with the agricultural community throughout the United States and has a very active office in West Wareham. This office develops comprehensive, certified conservation farm plans that are used as a blueprint for cranberry growers to manage their bogs in the most efficient and environmentally friendly manner possible. The farm plans rely extensively on the Best Management Practices established by research at the UMass Cranberry Station and the environmental/regulatory advisories published by the Cape Cod Cranberry Growers 'Association. Farm plans provide research, guidance, education and technical assistance on the latest available practices for water quality and conservation in cranberry agriculture. Having a certified farm plan also allows growers to apply for government programs. One of the most commonly utilized programs by cranberry growers is the Environmental Quality Incentives Program (EQIP). EQIP is a voluntary conservation program that promotes agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical assistance to eligible participants to install or implement structural and management practices on agricultural land.

Cranberry growers use a large fraction of the water extracted from the Plymouth-Carver Aquifer, as well as create and manage a large percentage of surface water that contributes re-charge to the Aquifer. The viability of their operations rests on the availability of water that is of sufficient quality and quantity. Trade associations, municipalities, and farmers should coordinate to ensure that access to these water supplies remain, especially those growers owning current Water Management Act registrations and permits, and that the water continues to be of good quality. The continued reliance upon the Aquifer by the cranberry industry has helped foster much research into bog operation methods and technological advances. The Cape Cod Cranberry Association continues to provide a lead role in educating the farmers about environmental regulations and best management practices, in order to assure a healthy, as well as profitable, industry. Cranberry growers recognize that continual research and education on safe and reasonable water use as part of a modern cranberry operation is necessary to insure the long-term viability of the Plymouth Carver Aquifer, providing available water to future generations.

2.2 Geologic and Hydrogeologic Characteristics of the PCA Area

2.2.1 Bedrock Geology

Two general types of bedrock underlie the soil and surficial deposits in the PCA area. The type of bedrock has a very important role in chemical and physical properties associated with the development of the soils within the region. The type and depth to bedrock also has influence on water movement and availability, construction site limitations, and plant growth.

Bedrock in the PCA area consists of crystalline igneous and metamorphic rocks. Bedrock outcrops and shallow to moderately deep soils are common in the northern part of Plymouth County and in a small area near Route 140 in the Town of Lakeville (rocky woods). The crystalline rocks are buried very deep by glacial deposits in the southeastern part of the County, ranging from 100 to 300 feet below the surface.

2.2.2 Soil Types

2.2.2.1 Glacial Deposits

As mentioned above, the pre-historic glacial periods had a significant impact on the area. During the most recent glacial period, an ice sheet covered all of southern New England reaching its terminus about 25,000 years before present (BP). The terminal moraines which formed the outer islands of Nantucket, Martha's Vineyard, Block Island (Rhode Island), and Long Island (New York) mark the furthest extent of the Wisconsinan glaciation in southeastern New England. Approximately 14,000 years BP, the glacier retreated to a position north of Boston. Four dominant types of glacial deposits occur in the PCA; till, fluvial, ice-contact, and lacustrine. These glacial deposits make up the parent material the soils formed in, often called the soil substratum. These soils are very permeable and support a rapid recharge of the groundwater.

Till

Till is the first type of material, deposited directly by the glacier as it was advancing. Till consists of a poorly-sorted, heterogeneous mixture of clay to boulder size particles. There are several different types of till mapped in the PCA including dense basal till, loose, sandy ablation till and debris flow till. Soils developed in dense till have very slow permeability, and often have perched seasonal high water tables. Some examples of glacial till soils mapped in Plymouth County include the Paxton, Montauk, Woodbridge, and Brockton series. Ablation till is a looser, sandier till than basal till, it was deposited during the melting and break-up of the static ice. Soils formed in ablation till include the Canton, Gloucester, and Plymouth series.

Ice-Contact

As the glacier began to retreat to the north, the huge amounts of water contained in the ice melted forming large rivers, temporary lakes, and braided streams that deposited material called outwash or fluvial sediments. Outwash or fluvial deposits consist of layered sand and gravel deposited from glacial melt-water. Landforms associated with outwash deposits are plains, deltas, eskers, kames, and kettles. Outwash deposits are very important aquifer recharge areas, often are prime farmland areas, and commercially important sources of sand and gravel. Some examples of outwash soils mapped in Plymouth County include the Hinckley, Carver, Sudbury and Scarboro series.

Lacustrine

The fourth type of glacial material is called lacustrine or lake floor deposits. Lacustrine deposits are fine-textured material (silts and clays) deposited in open glacial lakes which have since drained or filled with sediments. Lacustrine soils mapped in Plymouth County include Scio, Eldridge, and Raynham series. Lacustrine soils tend to have a very slowly permeable substratum, which causes seasonal high water tables.

2.2.2.2 Post-Glacial Deposits

Eolian Mantle

When the glacial ice receded to Canada, approximately 10,000 years ago, it marked the start of the formation of soil, as we consider it. A wind-blown (eolian) mantle of sand to silt size particles was deposited over the barren glacial materials (till, outwash, and lacustrine). The eolian mantle ranges from less than 10 inches up to approximately 40 inches in thickness. Most of the upland soils in New England have an eolian mantle. Areas where the eolian deposit is thicker than 40 inches are in coastal areas on dunes and coastal banks. The eolian deposit formed the solum— the A and B soil horizons. The thickness and texture of the mantle is one of the factors used to classify and delineate surface soils. Without the eolian mantle, the soils would be difficult to farm and would not easily support forests.

Organic sediments

Organic sediments have been deposited in open water and lowland positions on the landscape such as bogs, swamps, and fens (wetlands). Regional organic soils consist of freshwater organic sediments (Freetown and Swansea soils) and saltwater organic sediments in tidal marshes (Ipswich and Pawcatuck soils). These areas of freshwater organic soils are critical for the production of cranberries.

Alluvial Deposits

Sediments deposited in modern day floodplains of major rivers and streams are called alluvial deposits. Alluvial soils are prone to periodic flooding and are unsuited for most commercial uses. Examples of alluvial soils in Plymouth County are the Hadley, Saco, Limerick, and Winooski series. These soils comprise a very small proportion of geologic material within the PCA.

Human Transported Material

The last geologic agent to affect the area is humanity. Bulldozers for moving sand and gravel, dynamite for blasting rock, and the construction of homes, landfills, buildings and highways change the landscape just as any "natural" agent does. Two mechanisms of human alteration of the soil and geology are excavation of material (cuts), and deposition of material over existing soil and/or geologic material (fills). Human disturbed soils vary a great deal. Since these soils do not follow the natural development of un-disturbed soils, they are difficult to map accurately on the landscape. Examples of soil types associated with human alteration are the Udorthent and Udipsamment map units.

2.2.3 Hydrogeology and Approximate Water Yield

The PCA is the second largest aquifer in Massachusetts. Recharge to the aquifer is derived almost entirely from precipitation and averages about 1.15 million gallons per day per square mile. Water discharges from the aquifer are made by pumping, evapotranspiration, direct

evaporation from the water table, and seepage to streams, ponds, wetlands, bogs, and the ocean.

In the southeastern part of the PCA, the depth to basement bedrock is very deep, ranging from approximately 100 to 300 feet below sea level. Based on mapping of the water-table and bedrock surface, the saturated thickness of the aquifer has been determined to range from less than 20 feet to greater than 200 feet. The entire PCA encompasses an area of over 140 square miles (over 126,000 acres). The PCA has an estimated volume of 500 billion gallons stored primarily in saturated glacial sand and gravel.

The occurrence and movement of water in the PCA is determined by a set of complex and interactive aquifer characteristics. These include, but are not limited to, the configuration of the water table and the bedrock surface, saturated thickness, hydraulic conductivity, specific yield and confining units. In 1990 the United States Geological Survey performed a study of the aquifer. They have currently signed an agreement with the Massachusetts Department of Environmental Protection to update that study and create a groundwater flow model. That study is currently slated for completion in 2009.

Photograph 4— Jones River, an expression of the PCA's complex hydrogeology.

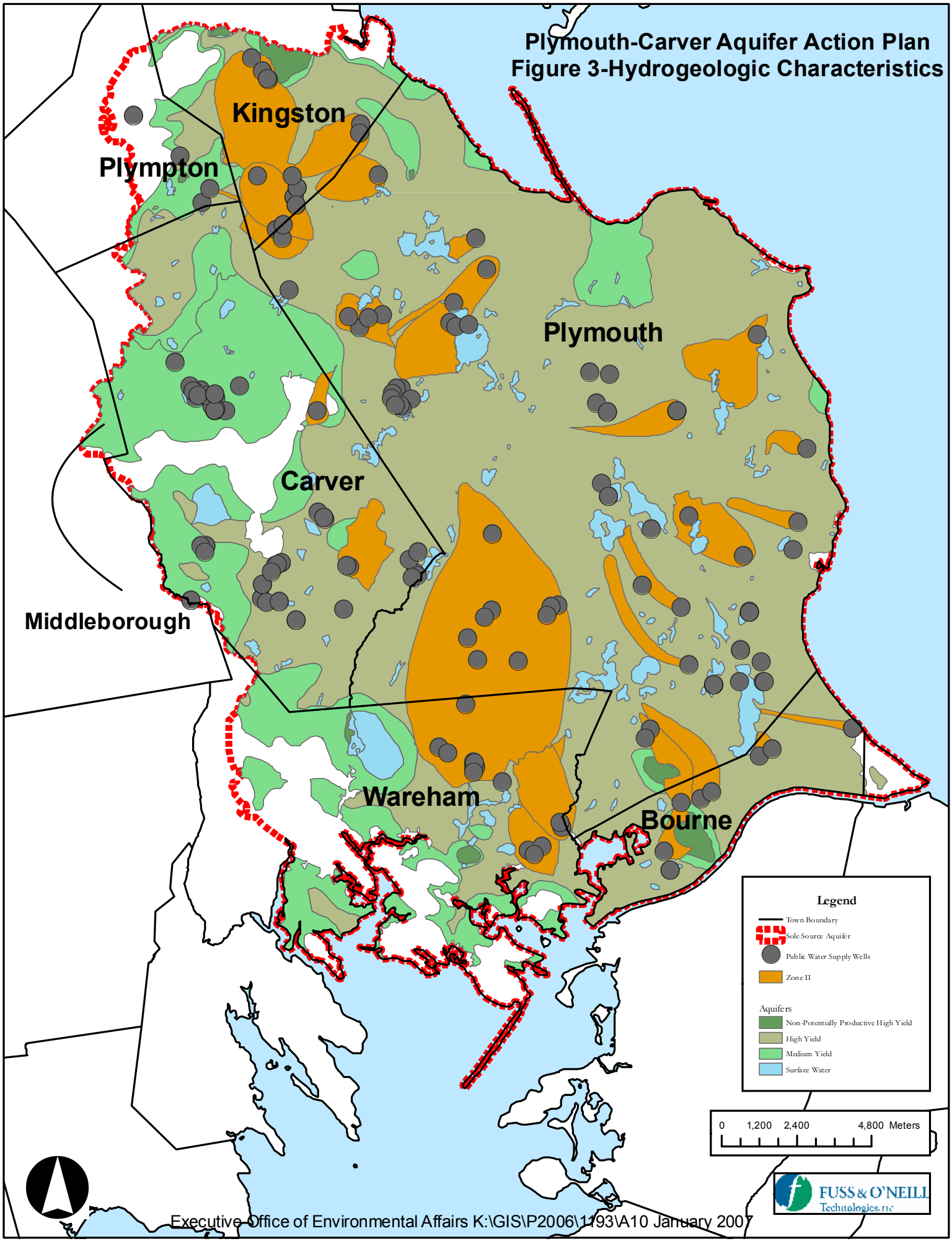
Hydraulic conductivity values for the geologic components of the PCA vary based on the soil type. Published hydraulic conductivity for dense, basal till is typically less than 10 feet per day; for fine to medium grain-size sand estimates range from 40 to 100 feet per day; for coarse sand 90 to 150 feet per day; for fine gravel 150 to 200 feet per day and for well-sorted coarse gravel 300 to 700 feet per day.

Public-supply wells in sand and gravel have yields ranging from 45 to greater than 1,100 gallons per minute (gpm), and average 325 gpm. Fine-grained sand, silt, and clay were deposited in temporary lakes that formed in valleys as the glacier melted. Well yields of 5 to 50 gpm have been obtained from sand layers within these fine-grained sediments.

2.2.4 Map of Hydrogeology

The PCA includes portions of the Buzzards Bay Watershed and the South Coastal Watershed. A map of hydrogeologic characteristics of the PCA is presented as Figure 3, which follows this page. The MADEP mapped regional features highlighted on the map include the following:

- The boundary of the PCA. The entire PCA is a mapped Sole Source Aquifer.
- Zone II: That area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated, as approved by the Department's Division of Water Supply.
- High Yield Aquifer: Areas with estimated yields greater than 300 gpm.
- Medium Yield Aquifer: Areas with estimated yields from 100 to 300 gpm.
- Public Water Supply Wells.


Plymouth-Carver Aquifer Action Plan
Figure 3-Hydrogeologic Characteristics
Kingston
Plympton
Plymouth
Carver
Middleborough
Wareham
Bourne
Legend
Town Boundary
Sole Source Aquifer
Public Water Supply Wells
Zone II
Aquifers
Non-Potentially Productive High Yield
High Yield
Medium Yield
Surface Water
0 1,200 2,400 4,800 Meters
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As depicted on Figure 3 approximately 20 percent of the PCA is mapped Zone A, indicating areas that contribute to current public water supplies. There are over 200 public water supply wells in the aquifer, and they are highlighted on Figure 3.

Approximately 70 percent of the PCA area is mapped as High Yield aquifer and 27 percent of the PCA area is mapped as Medium Yield aquifer. As described in the summaries of regional geology and hydrogeologic conditions, the sand and gravel outwash deposits are both excellent media for the storage and conductivity of groundwater and are sensitive receptors that may be affected by anthropogenic influences and uncontrolled releases to the environment.

2.2.5 Aquifer Susceptibility

Water enters the aquifer naturally as recharge, derived almost entirely from precipitation. Because the recharge of the PCA requires infiltration of precipitation, water entering the PCA hydrologic cycle passes through the atmosphere, surficial soils and deeper glacial deposits. The migration of water through shallow soil can flush chemicals and other constituents into the mobile water supply.

This rinsing mechanism makes the PCA particularly sensitive to human activities and influences. Releases of oil and/or hazardous materials to the shallow soil and groundwater are not impeded from migration into the PCA without human intervention and response actions.

Similarly, the application of fertilizers and other chemicals to surface soil increases the risk of migration of these chemicals to the subsurface waters of the aquifer.

The increasing population in the PCA area in combination with the increasing proportion of land area occupied by development will lead to the greater potential for releases of regulated compounds to the potable water of the PCA. The same aquifer characteristics that make the PCA an excellent formation for public water supply also increase the potential for risk associated with contamination. The coarse-grained soil, the sand and gravel glacial outwash deposits that comprise the PCA are more susceptible to the infiltration and migration of contaminants than less permeable soils typical of non-potentially productive aquifers.

Further, the cranberry growers take a number of measured steps to preserve their water resources through the reuse of tailwater and using a series of flow management techniques to share water, especially during the fall harvest. Their efforts do contribute greatly to aquifer recharge, yet also introduce risk of contamination from nitrates and pesticides. The Cape Cod Cranberry Growers Association and the University of Massachusetts Cranberry Station provide state of the art technical advice to advance the industry while protecting our natural resources.

2.3 Forecasts for PCA

2.3.1 Demographic trends

Growth in the region has typically seen the conversion of agricultural cranberry bogs and forested areas to commercial and medium- to low-density residential properties. Population in the Southeastern Massachusetts area over the last decade has generally climbed at

approximately 1 percent per year. This is also true of most of the Plymouth-Carver Aquifer towns.

2.3.2 Affects on Water Use

Water use increases due to the additional users, especially from irrigation of lawns in residential areas. Recharge levels decrease with increased development as impervious surfaces (e.g., buildings and roads) replace pervious undeveloped forested areas where most of the groundwater recharge currently takes place. Table 3 shows the expected water use as build-out in each town, based on Water Assets Study Community Reports prepared for the Environmental Office of Energy and Environmental Affairs (EEA).

Table 3
Projected Water Demand at Full Build-Out

Town	Water Use: Yr 2000 (mgd)	Water Use: Build Out (mgd)
Bourne	2.07	4.17
Carver	2.26	3.36
Kingston	1.31[b]	2.33
Middleborough[c]	1.59	6.22
Plymouth	5.04	12.25
Plympton	0.20	1.08
Wareham	2.09	6.28

Note:
a. Data Source: EEA Build-Out Study 2000 (unpublished).
b. Data provided by Kingston (May 18, 2007) through personal communication (fax dated June 29, 2007) from EEA.
c. Middleborough use occurs outside PCA.

3.0 PLYMOUTH-CARVER AQUIFER ADVISORY COMMITTEE

3.1 Formation of the Committee

Recognizing the critical nature of the situation of the PCA as potable supply, the Massachusetts Legislature, through the leadership of Senators Murray and Pacheco, voted to create the Plymouth-Carver Aquifer Advisory Committee (PCAAC) and provided funding of $100,000 a plan for protection of the aquifer, which is being developed as part of this project in conjunction with PCAAC and the EEA.

The first meeting of PCAAC, an organizational planning meeting, was held on September 28, 2006. Regular meetings of PCAAC have been held the second Thursday of each month at Carver Town Hall, 108 Main Street, Carver, Massachusetts.

The first five meetings focused on development of the Plymouth-Carver Aquifer Action Plan (PCAAP) as well as the following topics:

- Negotiation strategies with local developers and other users of water resources for effective management and conservation.

- Education regarding legislative and administrative policies on water permitting, use, and mitigation at the state, regional, and local level.

- Strategies and regulatory parameters for water resource protection for state and local governance, including but not limited to the reuse of effluent, stormwater management, resource protection model by-laws, and multiple community strategies in use elsewhere.

- Dewatering and the impacts of earth removal activities on groundwater levels.

- Relationship of private water supplies on existing and future potential water supplies (i.e. impact of private community supplies; impact of irrigation projects).

Attendance by the general public has been encouraged and promoted through a variety of media.

3.2 Legislative Mandate

PCAAC is enabled under Chapter 139 of the Commonwealth's Fiscal Year 2007 General Appropriations Act. Section 2000-0100 states in part:

> $100,000 shall be expended for the Executive Office of Energy and Environmental Affairs to develop and implement a scope of work and a written action plan to protect and manage the Plymouth-Carver Sole Source Aquifer in consultation with the Towns of Bourne, Carver, Kingston, Middleborough, Plymouth, Plympton, and Wareham, through a Plymouth-Carver Aquifer Advisory Committee (PCAAC) to be comprised of a Coordinator from the Executive Office of Energy and Environmental Affairs and one member, and one alternate member, from each Town to be appointed by the chief elected body in each Town; provided further, that the Coordinator shall complete a final written action plan, and procure services needed to complete the plan, with the input of the PCAAC; provided further, that the Coordinator and the PCAAC shall meet at least until the final written action plan is completed.

3.3 Project Outreach Strategy

As part of coordinating the PCAAC, Fuss & O'Neill prepared a public participation program. The public participation program consisted of:

- Preparing press releases to be distributed to the PCAAC for use in town meetings as well as distribution to print and radio media. The three press releases that were prepared for this purpose can be found in Appendix B of this report.

- Preparing of notices and advertisements to be used before each meeting by the PCAAC to both notify the public about the meeting, as well as further public education on the issues. The public is invited to attend these meetings. The public notices that were prepared can be found in Appendix B.

- Coordinate with local cable access channel and radio on broadcasting PCAAC meeting information. We conducted two on-air radio interviews with WATD 95.5FM.

- Development of a web page on which PCAAC-related documents can be posted. These will include, but not be limited to, press releases, PCAAC meeting presentations, meeting agendas, and meeting summaries. Meeting summaries can be found in Appendix C of this report.

4.0 INTERVIEWS WITH PUBLIC WATER SUPPLIERS AND WASTEWATER DEPARTMENTS

Interviews were conducted with many municipal officials, water suppliers and wastewater departments to assess their concerns about the aquifer, identify data gaps for water supply and wastewater, and gauge the sense of involvement that may be expected from the municipalities from various departments. The interview process helped to better understand growth areas, local interest levels, gaps in regional concerns, and differing attitudes toward the protection of the PCA. Interviews with planners, town administrators, and conservation commissioners were conducted and are discussed in the Review of PCA Municipal Documents section. Additional interviews are expected to be conducted with privately affiliated individuals to be identified by the PCAAC.

4.1 Methodology

Interviews with water suppliers and wastewater departments were conducted based on the questionnaire that was developed for this process. A copy of the questionnaire is provided in Appendix C. Each of the identified interviewees was contacted to set up appointments to go over system layout, withdrawal points, extent of distribution, accuracy of reported annual statistics, general operations, consumption patterns, conservation measures, future growth potential, and input and interest in PCA protection planning.

4.2 Interviewees

Interviews were conducted with the primary contacts for the water supply facilities and wastewater departments.

4.2.1 Water Suppliers

The Town Plympton does not have a municipal water supply system and was not contacted for a water or wastewater interview. Carver has small privately run water distribution systems that supply condominium villages as well as a trailer park, the largest of which is Cranberry Village. The Town of Bourne has three privately run water supply companies, two of which are located in the PCA, all three were interviewed. Kingston and Wareham have municipal water supply. Plymouth has municipal and private water suppliers. Middleborough has municipal water supply which also supplies a portion of Carver but does not withdraw from the PCA.

The interviews were conducted with the individuals identified in Table 4. Table 4 also provides the company and town in which the water supply is provided.

Table 4
Water Supplier Interviewees

Water Supplier	Contact	Town	Ownership	2004 Water Consumption (gal per year)
Bourne Water District	Ralph Marks	Bourne (south of canal – not in PCA)	Private	482,614,080
Buzzards Bay	Glen Doherty	Bourne Plymouth	Private	176,302,440
Cranberry Village	Marisa Picone-Devine (Sarian)	Carver	Well – Town of Carver Managed by Sarian	20,010,000
Kingston Water	Matthew Darsch	Kingston	Municipal	522,051,800
Middleborough Water	Dick Tinkham	Middleborough Carver (Supply not from PCA)	Municipal	622,109,600
Plymouth Water	Paul Wohler	Plymouth	Municipal	1,750,915,174
Plymouth Water Company	Marisa Picone-Devine (Sarian)	Plymouth	Private	50,070,258
Pine Hills	Don Rugg	Plymouth	Private	25,256,000
Onset Fire District	Bill Gay	Wareham	Municipal	240,220,756
Wareham Fire District	Mike Martin	Wareham	Municipal	588,715,300
North Sagamore Water District	Paul Gibbs	Bourne	Private	181,872,000

One of the main concerns that arose from the water supplier interviews is the ability to reach the consumers about responsible water use without rate increases. All of the water departments and private companies provide educational materials, at a minimum through conservation tips printed on water bills. However, even with more comprehensive public education programs in place, there are some areas where water usage is high. When reviewing water use data from 1998 to 2002, residential water use (measured as gallons per person per day) ranged from a low of 71.76 in Onset to a high of 121.89 within the Plymouth Water Company service area. In 2006 the Massachusetts Water Resources Commission adopted revised Water Conservation Standards.[3] The 2006 Standards establish updated statewide goals for water conservation and water use efficiency, and provide guidance on the most current conservation measures. This comprehensive guidance document includes, among other items, a recommended residential use standard of 65 gallons per person per day.

Another concern interviewees identified is a need for better coordination and planning during land development permitting on availability of water supply and other infrastructure as well as

3 http://www.mass.gov/envir/mwrc/pdf/Conservation_Standards.pdf

aquifer pollution risks. While some water suppliers have been included in the early stages of the permitting process, there are others who do not get this opportunity and are left with reactive response as their only opportunity for involvement in the process.

4.2.2 Sewer Departments

Carver and Plympton do not have municipal wastewater systems. Bourne has a wastewater collection system with sewage treated by neighboring Wareham. Kingston, Plymouth, and Wareham have municipal wastewater systems that extend to many of the denser areas of development in the towns. Middleborough's wastewater system extends through the older town centers and to some commercial facilities through more recently installed force mains. Interviews were conducted with the following wastewater department representatives.

- Kingston Wastewater – Ken Vandal
- Bourne Engineering[4]
- Middleborough Wastewater – Joe Ciaglo
- Wareham Sewer – David Simmons
- Plymouth Sewer – Kim Michaelis (for mapping information only)

5.0 REVIEW OF MUNICIPAL DOCUMENTS FROM THE PCA AREA

5.1 Purpose

As part of this Technical Memorandum, we reviewed existing municipal documents including master plans and bylaws to determine the status of local efforts related to protection of the PCA. These reviews were supplemented by interviews with town staff. To date, we have interviewed the following municipal staff:

Table 5
Interviews with Municipal Staff from the
Plymouth-Carver Aquifer Area

Town	Interviewees
Bourne	Coreen Moore, Town Planner Brendan Mullaney, Conservation Agent Cindy Coffin, Health Agent
Carver	Jack Hunter, Town Planner Richard LaFond, Town Administrator
Kingston	Thomas Bott, Town Planner
Middleborough	Jack Healey, Town Manager Ruth McCawley Geoffroy, Town Planner
Plymouth	David Gould, Acting Public Works Director Lee Hartmann, Planning Director Valerie, Senior Town Planner

4 Fuss & O'Neill contacted Bourne Engineer Department and spoke departmental staff. (The department engineer was unavailable.) A map was then mailed to Fuss & O'Neill, which was used to confirm location of sewers.

Town	Interviewees
	Kim Michaelis, Environmental Technician
Plympton	Chris Lawrence, Open Space Committee Chairman Jack O Leary, Planning Board Chairman
Warren	Charles Gricus, Planning & Resource Management Director Michael Martin, Wareham Fire District –Water Department, Superintendent

5.2 Methods of Assessment

The general methods we used for conducting this municipal regulatory assessment included:

- Obtaining municipal planning documents and bylaws.
- Reviewing documents systematically, based on a checklist.
- Developing recommendations for enhancement of municipal aquifer management.

The details of our approach are discussed below.

5.2.1 Plans and Policy Documents Obtained and Reviewed

We collected and reviewed plans and policy documents from each of the seven subject communities that comprise the area overlying the PCA. Table 6 shows the common plans and policies we reviewed and the formats in which they are available.

Table 6
PCA Towns
Municipal Documents Obtained and Assessed

Municipality	Master Plans	Zoning Bylaws	Subdivision Regulations	Sand and Gravel Policy	Open Space Plans	Stormwater Management Policy
Bourne	•	•		•	•	•
Carver	•	•	•	•	•	•
Kingston	•	•	•	•	•	•
Middleborough	•				•	
Plymouth	•	•		•		•
Plympton		•	•			
Wareham	•	•			•	

In addition, we reviewed the following documents:

- Carver Water Conservation Plan.
- Kingstown Board of Health Rules and Regulations.
- Plympton Business Park Single Environmental Impact Report.
- Plymouth Water Supply Master Plan.
- Plymouth Watershed Management Program General Bylaw.

5.2.2 Structure of the Review Checklist

To facilitate consistency in our review, we developed a consolidated review checklist. The completed checklists for each Town are provided in Appendix D of this report. The checklists indicate:

- Types of plans and policy documents reviewed.
- Review items found in each town's documents.
- Type of plan and page number and/or section where each review item was found.

The checklists include items under the following general review categories:

- Land Development.
- Storm Water Management.
- Soil Erosion and Sediment Control.
- Wastewater.
- High Risk Land Uses.
- Land Acquisition.
- Sand and Gravel.
- Other Miscellaneous Items.

5.3 Land Development

5.3.1 Bourne

Photo 5— Bourne is relatively built out.

Bourne is a relatively built-out community. As stated in the *Bourne Master Plan* "nearly 90 percent of Bourne's land area outside the Massachusetts Military Reservation is now developed." (p. 3, Town of Bourne). Bourne estimates its year-round population at approximately 20,000. According to the master plan this could double in 20 – 30 years or, if Bourne aggressively enforces its zoning, could peak at approximately 24,000.

Interviews with staff indicate that Bourne's population is currently stable and may actually be falling slightly. Most residential development occurs as affordable housing, redevelopment, and conversion of season homes to year-round homes. Due to scarcity of vacant land, there are few new subdivisions. Reportedly, most owners of converted homes continue to use their homes seasonally and convert the homes for convenience rather than for permanent occupancy.

Bourne's comprehensive plan indicates that the town intends to direct development into existing village areas. Bourne cites fiscal management, efficient provision of town services and natural resource protection as reasons to manage growth; however, perhaps the most significant concern appears to be maintaining character.

The *Bourne Master Plan* identifies the following growth management policies:

- Manage growth at sustainable rates that do not threaten Bourne's fiscal stability or natural environment.
- Direct growth into areas that can be efficiently served by highways, public transit, sewerage, water and other services.
- Preserve and expand village centers for neighborhood commercial and service uses, integrated with housing and traditional cultural institutions.

Bourne has established zoning bylaws and regulations that include five water resource overlay districts:

- A North
- A South
- Buzzards Bay
- North Sagamore
- South Sagamore

Bourne has also established a rate of residential development under Section 2640 of their zoning bylaws that limit building permits to 120 per year on a town-wide basis. However, Section 2650 exempts redevelopment, owner-occupied units, affordable housing and over-55 housing.

5.3.2 Carver

Carver is a rural community at present however land development in Southeast Massachusetts applies significant pressure on Carver, like all the aquifer communities. As stated in the *Carver Master Plan* "according to most predictions, the population of Carver will increase by 50% over the next 20 years, and the population of the Town could eventually reach 34,000 or even higher" (p. 1, Town of Carver).

Section 1.3 of the *Carver Master Plan* identifies the following growth management strategies for the purpose of protecting environmental resources (e.g., groundwater) and quality of life:

- Increase minimum lot size
- Encourage/require cluster development
- Acquire open space
- Land trust
- Agricultural preservation and conservation restrictions
- Transfer of development rights
- Agricultural preservation zoning
- Nutrient limiting regulation

Carver has established three village centers as areas where relatively dense and mixed-use development currently occurs and where it should continue to be directed.

Carver has already established zoning bylaws and regulations that will assist the Town in guiding development. These include:

- Flexible development
- Conservation subdivision
- Town house development
- Water resources protection overlay district
- Wetland overlay district

Carver has established rate of development and subdivision phasing standards that limit building permits to 30 per year on a townwide basis and seven per each subdivision. Based on our interview with town staff we determined that at present most development in Carver is light commercial development and that virtually all residential subdivisions are clustered.

5.3.3 Kingston

Kingstown most recently revised its master plan in 1998. As discussed in the introduction to this plan:

> Kingston has been the fastest growing town in that region with a 15.5 percent growth rate in the 1990-1996 period. Overall, Kingston was the fifth fastest growing town within the entire Route 495 beltway during the same period. If this astonishing growth rate is allowed to continue unchecked, Kingston will undergo significant changes that will eliminate its small town character and rural atmosphere. (p. i)

Among other issues, Kingston's Master Plan discusses land use, natural and cultural resources. The plan makes the following recommendations related to these issues:

Photograph 6— Construction of a home in Kingston.

Land Use (p. ii)

- Develop and implement a focused growth strategy that phases in and balances business and residential development with the existing land use patterns
- Create Kingston Historic District(s)
- Designate additional areas as Open Space
- Centralize the Town's planning efforts by creating a professionally staffed Planning Department
- Balance development costs between the Town and developers

- Explore and implement innovative zoning provisions that encourage managed growth, such as:

  ⇒ Modified Cluster Zoning that utilizes density bonuses
  ⇒ Planned Unit Developments
  ⇒ Transferable Development Rights
  ⇒ Development Impact Fees
  ⇒ Point Based Systems (Incorporating requirements for adequate public facilities)

Natural and Cultural Resources (p. iii)

- Eliminate pollution of water resources and protect drinking water
- Protect the Town's natural resources including Open Space, water bodies, waterways and the regional aquifer
- Restore the natural resources of shellfish beds and fishing in the rivers and Kingston Bay
- Establish measures necessary to preserve and protect the historical properties and sites in Town
- Establish historic district(s), where appropriate, for the protection of the Town's heritage
- Retain the Town's sense of spaciousness and its rural surroundings

5.3.4 Middleborough

Middleborough is a developing community. As described in its master plan:

> Over the last decade, the town's population changed from 17,867 people in 1990 to 19,950 people in 1999. This was an 11.66% increase, or little more than 1.3% annually. In the local region, i.e. the towns surrounding Middleborough, the population grew from slightly more than 400,000 residents in 1990 to more than 435,000 residents in 1999, an increase of 35,226 or an annual change of 1% per year. (p. 84)

Although its growth originates from a series of small villages, development is filling between these nodes and over time they are likely to disappear.

> The remnants of this scattered pattern of clustered settlements, is visible in many locations today although their identity has often become obscured by time and the imposition of subsequent development. (p. 9)

The Town's villages include:

- Titicut Green (also called North Middleborough Green)
- Eddyville
- Waterville
- Middleborough Center
- Rock Village
- The Green

Although the master plan sets a goal of reinforcing village character, it is somewhat unclear on the Town's intent for managing future development.

> If the Town seeks to channel and manage growth, then additional regulations will be needed... The current zoning standards for General Use allow an excessively wide range of uses and are too large relative to likely demand for general commercial uses. (p. 7)

5.3.5 Plymouth

Plymouth is a developing community. Approximately 34 percent of Plymouth's land area could be developed for new housing and about 88 percent of that area is currently zoned as large-lot rural residential (Town of Plymouth, 2004). Although Plymouth has established progressive zoning bylaws including village centers, overlay districts, and transfer of development rights, the Town finds itself at a crossroads:

> Since the 1980 Village Center Plan, Plymouth has embraced the concept of encouraging growth with the existing village centers. But current land use policies have been less effective than hoped in curbing sprawl and helping the Town maintain a balance between growth and preservation that Plymouth citizens desire. (p. 6, Town of Plymouth)

Photograph 7— Plymouth Rock. The Plymouth-Carver Aquifer region has undergone many changes throughout its history.

The Plymouth Strategic Action Plan sets a framework of actions and tools to implement smart growth for the Town:

Actions

- Establish natural resource and open space and cultural heritage networks (Green, Blue and Cranberry Networks).
- Establish Growth Areas and preservation Areas.
- Establish a People Network where most people will live and where businesses will be located.
- Plan for economic growth based on Plymouth's natural and cultural heritage assets.
- Provide the human infrastructure and capacity to implement the plan.

Tools

- Geographic and conservation constraints on expanding public infrastructure.
- Density and design standards to ensure that development fits in with surrounding context and protects environmental health.
- Refined transfer of development rights program.
- Provisions for open space in growth areas and establishment of rural service centers in preservation areas.
- Comprehensive wastewater management.
- Transportation system planning focused on growth areas.

5.3.6 Plympton

Plympton does not have a Town Planner on staff and has not developed a comprehensive plan or local master plan. No specific information regarding land development is available from the Town.

5.3.7 Wareham

Wareham is a town of approximately 20,000 residents, year-round, and seasonal population of approximately 35,000 (p. 11, Town of Wareham). The Town contrasts many relatively low-density areas with several areas of high-density, which were developed as seasonal residences prior to current zoning. Areas of relatively high population density include:

- Onset Village
- Swifts Beach
- Rose Point
- Weweantic Shores
- Hamilton Beach
- Pinehurst
- Agawam Beach
- Swifts Neck
- Tempest Knob
- Indian Mound
- Briarwood
- Parkwood Beach
- Shangri-La

A build-out analysis was conducted as part of the 1998 Wareham Comprehensive Community Plan estimated a total of 2,800 existing buildable lots with up to 6,000 potential buildable lots on open space area owned by cranberry farmers. The build-out analysis also addressed rate of growth:

> Over the last several years, Wareham has seen slow but steady growth in residential housing, averaging about 47 new homes per year. Most would agree that this represents a low point in the market cycle of the construction industry. The average number of new dwellings over the last 15 years is 77... If the rate of growth of 77 homes per year

> continues Wareham will not begin to approach its build-out capacity for another century. (p. 45 –46)

Interviews with staff indicate that Wareham's population is currently increasing at a fairly high rate. Both, the Town Planner, Charles Gricus, and the Wareham Water Department Superintendent, Michael Martin, agreed that growth was proceeding at an accelerated pace.

The *Wareham Comprehensive Community Plan* identifies the following growth management strategies:

- Comprehensive upgrade of the subdivision regulations.
- Use of a building cap limit annual building permits and phase subdivisions.
- Large lot zoning.
- Limit potential for apartments and other multifamily dwellings.

5.4 Soil Erosion and Sediment Control

5.4.1 Bourne

Bourne has established erosion control under Section 1238(B)(2)(j), which requires a soil erosion and sediment control plan and Section 3520 of the *Bourne Zoning Bylaws*. This section requires:

> All slopes exceeding 15% resulting from site grading shall either be covered with loam to a depth of 4" and planted with vegetative cover sufficient to prevent erosion or be retained by a wall constructed of masonry, reinforced concrete or creosote-treed pile or timber.

Section 3570 of the *Bourne Zoning Bylaws* requires that a special use permit be obtained from the Planning Board for land disturbance of 10,000 square feet or more.

5.4.2 Carver

Carver has established erosion control under Section 3620 of the *Carver Zoning Bylaws*. This section requires permitting of land disturbance activity for contiguous areas of 2 or more acres. It also establishes performance standards for grading and revegetation. It does not make specific requirements for other best management practices.

5.4.3 Kingston

Chapter 12 of Kingston's General Bylaws establishes enforceable policy related to earth removal activities. It prohibits removal of more than 1,000 cubic yards per year unless pursuant to a permit.

Application requirements are established under Article 6 of the bylaw and include— among other things— provision of information regarding:

- Natural features such as wetlands, the 100-year floodplain, ground cover, surface water, and groundwater.

- Dust, erosion, and sediment control plan for the site and trucks removing earth.

Article 12 discusses "standards of operation" including:

- 10-foot vertical separation to season high groundwater.
- Control of erosion from stock piles.
- 5-acre limitation aerial extent of excavation.

Article 13 discusses "restoration" standards including:

- Phasing of restoration and excavation so that while three acres are in active excavation, two acres are being restored.
- Slopes of 50% or less.
- Restoration of original hydrologic conditions.

5.4.4 Middleborough

Middleborough provided us with their local comprehensive plan; however, this plan does not discuss soil erosion policy. No specific information regarding soil erosion policy was made available by the Town.

5.4.5 Plymouth

Section 205-18(H) of the Plymouth Zoning Bylaw establishes requirements for soil erosion and sediment control, which include:

- Minimizing site disturbance
- Temporary stabilization of soils
- Permanent stabilization
- Temporary sediment control for protection of drainage
- Responsibility of the developer for prevention of erosion and buildup of sediment

5.4.6 Plympton

Section 3 of Plympton's Subdivision Regulations describes the "Procedure for the Submission and Approval of Plans." It requires submission of both a preliminary plan and definitive plan. Section 3(D) describes submission requirements for a definitive plan and states that with the definitive plan an applicant must include an assessment of surface water and soils that:

> Describes methods to be used during construction to control erosion and sedimentation; i.e., use of sediment basins and mulching, matting or temporary vegetation; describe acreage and location of land to be cleared; covering of soil stockpiles, and other methods of control. Evaluate effectiveness of proposed methods on the sited and the surrounding areas. (Section 3(D)(3)(b)(2))

As well as:

The permanent methods to be used to control erosion and sedimentation including the following:

a. Areas subject to flooding or ponding.
b. Proposed surface/subsurface drainage system.
c. Proposed grading and vegetation cover.
d. Methods to be used to protect existing vegetation.
e. Relationship of the development to the topography.
f. Any proposed alterations to the marshes or the wetlands.
g. Proposed flood control devices or wetland easements.
h. Increase in peak runoff caused by construction and new impervious areas, and the methods to reduce the generated runoff. (Section 3(D)(3)(b)(3))

5.4.7 Wareham

The *Wareham Comprehensive Community Plan* notes that "sedimentation of Wareham's wetlands and waterways has become a concern in many locations" (p. 87). The plan does not make a specific recommendation to abate this concern. Section 1541 of Wareham's Zoning Bylaws notes "reduc[ing] soil erosion" as an evaluation standard, but provides nothing more specific.

5.5 Stormwater Management

5.5.1 Bourne

Bourne has established stormwater management requirements under Section 1238 of its zoning bylaws. This Section 1238(2)(c) states:

> All drainage shall be recharged on site based on a calculated 25-year storm and designed so that runoff shall not be increased, groundwater recharge is maximized, pollution impacts are minimized and neighboring properties will not be adversely affected. Stormwater design shall incorporate best management practices as prescribed in the *Massachusetts Stormwater Handbook* or *Bourne Subdivision Regulations* or other standards, which may be adopted by the Planning Board of the Town of Bourne.

5.5.2 Carver

The Carver Board of Health has established *Regulations for Stormwater and Runoff Management*. Under "Purpose" the regulations are described as "intended to protect the public and environmental health by providing adequate protection against pollutants, flooding, siltation, and other drainage problems."

The regulations apply to subdivisions of five lots or more as well as industrial, commercial, institutional, multifamily residential and roadway projects. Two to four lot subdivisions must meet the regulations to the extent practicable.

The regulations require use of BMPs to the maximum extent practicable. More specifically, stormwater management plans are required to provide for

- Capture and treat the first inch of precipitation over the impervious surface.

- Ÿ No net increase in volume or rate of discharge offsite during the 1, 10, 25, 50, and 100 year storms.
- Ÿ Source controls and BMPs in accordance with state regulations and guidance.

5.5.3 Kingston

Kingston's *Rules and Regulations Governing the Subdivision of Land* discusses storm drainage in Section 4.10.4, which states that:

> A complete system of drainage shall be constructed in a manner satisfactory to the Planning Board and in conformance to the Commonwealth of Massachusetts Highway Department... standard specifications and provide adequate control of surface and subsurface water information from the subdivision and adjacent land.

Section 4.13.2 further states "retention and detention basin as well as all stormwater management shall conform to Stormwater Management Volumes I and II prepared by MA Department of Environment Protection and MA Office of Coastal Zone Management."

The Water Resources Protection Overlay District of Kingston's Zoning Bylaws prohibits:

> Any use or development of land which includes creation or maintenance of impervious surfaces covering more than fifteen (15) percent of the premises area. (Section 4.13.4(r))

5.5.4 Middleborough

Middleborough provided us with their local comprehensive plan; however, this plan does not discuss stormwater policy. No specific information regarding stormwater policy was made available by the Town.

5.5.5 Plymouth

Section 205-9(C)(4)(f) discusses surface water drainage and requires that:

> All surface water... be disposed of in a safe and efficient manner which shall not create problems of water runoff or erosion on the site... or other sites [and] insofar as possible natural drainage courses, swales properly stabilized with plan materials or paving when necessary, and drainage impounding areas shall be utilized to dispose of water on the site through natural percolation.

Plymouth has an Aquifer Protection Overlay District under Article VI of the Plymouth Zoning Bylaws. Section 205-57(D)(6)(b) of Article VI requires that:

> Uses render impervious [area of] not more than 15% or 2,500 square feet of any lot unless artificial recharge for excess runoff is provided, and develop the remainder [of the lot] such that there is no increase in the rate runoff over that experienced prior to development for rainfall intensity less than or equal to the one-hundred-year storm; or runoff from all developed surfaces shall be prevented by capture in a closed drainage system from infiltrating directly into the ground; and before discharge from the closed

drainage system, the runoff shall be treated through an oil and grit separator manhole and lined stormwater retention pond designed to capture a one-year frequency storm with a percolation rate no faster than 40 minutes per inch or by some other means proven or which may be shown to be of equal or superior effectiveness; and said retention pond, oil and grit separator or other mechanical means by which to filter and retain potential contaminants shall be constructed, operated and maintained in a manner acceptable to the Plymouth Department of Public Works.

Plymouth's Strategic Action Plan (i.e., master plan), entitled *Growing Smarter in Plymouth's Fifth Century*, and discusses development of a "Blue Network" for protection of its water resources, including the PCA. The plan recommends the following implementation actions:

- Identify recharge areas to surface waters
- Implement a townwide stormwater management plan
- Review subdivision and building requirements to promote lower impact development

5.5.6 Plympton

Section 5 of Plympton's Subdivision Regulations describes the design requirements for utilities including "disposal of surface water" (i.e., stormwater). Section 5(B) states that adequate disposal of surface water must be provided in a manner including the following:

a. Design analysis.
b. Design storm
c. Computation of runoff
d. Selection of drain size
e. Type of pipe
f. Slope of pipe.
g. Inlets
h. Catch basins— manholes
i. Excavation
j. Bedding
k. Pipe laying
l. Backfilling
m. Security bars
n. Headwalls
o. Scour protection

Also, Plympton's Zoning Bylaws establish special requirements for Groundwater Protection Districts. Section 8.3.6(a)(4) requires "a design to maintain aquifer recharge at prepermit amounts where the impervious surface will exceed 20% of the lot area, and a design to cleanse and filter the runoff from such impervious surfaces recharged to the aquifer."

5.5.7 Wareham

Page 87 of the *Wareham Community Comprehensive Plan* recommends that the Planning Board adopt regulations regarding stormwater management and the Town adopt these as part of the Zoning Bylaws and site plan review process.

Section 1541 of the *Wareham Zoning Bylaws* notes "reduc[ing] stormwater" as an evaluation standard. Section 742.7.0 requires stormwater retention in accordance with Massachusetts state policy in the Town's industrial (i.e., IND) district.

5.6 Water Supply

5.6.1 Bourne

Bourne has established public water supply for the majority of the municipality to the west of Route 28. Yield and flow are not typically problems for residents or water suppliers in Bourne since the Town is at the bottom of the aquifer gradient. Quality can be of issue. Bourne indicates contamination as an issue in their Comprehensive Plan:

> Most of the town lies over a portion of the Sagamore groundwater lens, the Cape's most productive source of freshwater. All of these resources are now impaired or threatened, however, by toxic plumes from the military reservation and other contamination from numerous sources. (p. 15)

To this end the comprehensive also recommends development of a management plan:

> Such a plan should include a biological, chemical and physical profile of each waterway, and a program to monitor them for changes over time. Additional regulations and enforcement may be needed to limit nitrogen and phosphorous loading from lawn fertilization and other activities. (p. 16)

5.6.2 Carver

Currently, Carver operates two public water supplies. These include "the municipal well located in Center Carver off Meadowbrook Way and the Cranberry Village well on Cranberry Road" (Hewins, 2006, p. 2). The *Carver Water Conservation Plan* indicates that:

> Sixty-four residents at the Housing Authority are served by the Meadowbrook Way well. Town Hall, Library, Police/Fire, and Ambulance employees and volunteers served by the Meadowbrook Way well number 273. The number of residents served by the Cranberry Village well as of this writing is 278. Any commercial hook-ups in Carver are either private wells or served by the Town of Middleborough. (p. 4)

The *Carver Water Conservation Plan* also discusses a proposal to locate a new well on the Cole Property.

> The proposed municipal public drinking water well will be located on the eastern portion of the Cole Property... [which,] contains important natural resources including diverse wildlife and plant habitats, potential vernal pools, wetland and waterbodies, high-quality upland woodlands, and scenic and open space values. (p. 5)

Section 3.4 of the water conservation plan states that the proposed well will serve:

> Forty-four current connections from those presently served by Middleborough: this includes some 30-odd houses; the remainder [is] commercial connections. There are currently at least 15... commercial Middleborough connection in North Carver. The proposed well on the Cole site will take the 24,000 gallons presently supplied by Middleborough and 75,000 gallons of new commercial connections. (p. 6)

Carver also has plans to establish public water for three relatively dense parts of the community. As stated in the Carver Master Plan "a townwide water system is neither necessary nor economically feasible... However a decentralized system is both desirable and feasible." Carver has identified three areas of town that would benefit from such a system:

- North Carver
- Central Carver
- South Carver

Based on interviews with the town planner and town administrator, we understand that Carver is currently exploring options for new wells in North Carver and South Carver.

5.6.3 Kingston

Article 2 of Chapter 8 of the *Kingston General Bylaws* establish precedence for the Town to declare a water emergency and restrict use to the extent needed. No other information is available by the Town.

5.6.4 Middleborough

Currently, there are 11 wells capable of supplying approximately 2.7 MGD to the Town. The Town's average daily demand is approximately 1.82 MGD. Most of Middleborough is outside the PCA and the Town has sited the majority of its wells on the west side of town well outside the PCA.

As of the development of its master plan, Middleborough was in the process of revising the local regulations so that they accord with State regulations regarding water supply protection, particularly within the zones of protection around wellheads.

The Town has an ongoing water exploration program. Its master plan reports the following potential future well sites:

> Future well sites being considered include a site owned by the Town on Marion Road, known as the Wilbur site, which could produce water at about 250,000-300,000 gallons per day. A second site is being considered for acquisition off Vaughn Street, and is known as the egg farm or Wampanucket site. This latter site could potentially produce up to 500,000 gallons per day. Other sites for banking against future demand are also being considered by the Water Department. One such site is off of Cross Street.
>
> The potential for obtaining water around the Assawompsett Pond complex will probably only be realized if one or more of the municipalities receiving water from the

> pond complex were to find another source and was willing to release their water rights. This option does not appear highly probable at this time. (p. 182)

5.6.5 Plymouth

Plymouth's Strategic Action Plan recommends preparation of a "water supply study and master plan, including attention to the impact of water withdrawals on surface waters such as fragile ponds" (p. 21). The plan also recommends development of a "blue network," which is in part intended to protect the PCA. Plymouth has established an Aquifer Protection Overlay District as part of its Zoning Bylaw (Section 205-57). Plymouth has developed a draft *Watershed Management Program Bylaw*, which includes performance standards related to land-use change, development, and septic systems. This section establishes nitrogen loading factors for various land-use categories

5.6.6 Plympton

At present Plympton relies entirely on private wells for water supply. An environmental impact report prepared for the proposed Plympton Business Park indicates that a well is being proposed near the southeast corner of Plympton.

The report indicates that such a well is anticipated to have a safe yield in excess of 400,000 gallons per day. At full buildout the business park is anticipated to require up to approximately 89,000 gallons per day. The remaining capacity (approximately 300,000 gallons per day) could be available for general use by the Town.

Pumping tests indicate that water withdrawal from the well would be fed from the Taunton River Aquifer and not the Jones River.

5.6.7 Wareham

Section H of the *Wareham Community Comprehensive Plan* discusses public water supply:

> Public water service is available to more than 50% of all residences in the Town... Public and private wells are exceptionally productive; some public wells have a withdrawal capacity of 1,200 gallons per minute.

Photograph 8— Lake in Wareham

While aquifer yield does not appear to a problem for Wareham, potential contamination and withdrawal by other suppliers may be. As noted in the Town's comprehensive plan:

> The impact of future water demand does not appear to be problematic for either department. Wareham is geographically situated over the Plymouth Aquifer, which has a storage capacity in excess of Wareham's needs for the foreseeable future... Potential impacts to Wareham's public water supply include contamination and withdrawals by other suppliers. (p. 127)

There are two water providers in town— the Wareham Water Department, which operates under an independent board of commissioners and supplies over 6,000 customers; and the Onset Water Department, which also operates independently and serves approximately 3,000 customers.

Michael Martin, Superintendent of the Wareham Water Department, joined an interview we scheduled with the Town Planner. Mr. Martin indicated that approximately 1,600 new services have been established and are anticipated to come on line in the near future.

Mr. Martin also noted that as part of the Wareham Water Department's mission to protect water supply that it actively pursues land acquisition. He pointed out a number of recently acquired and planned acquisitions.

5.7 Wastewater

5.7.1 Bourne

Bourne has established sewers in several small areas of Town, which are north of the Cape Cod Canal and west of Route 28. Bourne has recognized wastewater management as an important issue in the Bourne Local Comprehensive Plan (Bourne LCP):

> Public attention has recently focused on individual septic wastewater disposal systems and antiquated cesspools as a major collective source of pollution in the Cape's ponds, rivers and embayments... As more and more... house are used year-round, the need for advanced septic systems, package treatment plants or other means of sewage treatment becomes crucial.

The Bourne LCP further establishes the need for a wastewater facilities plan as a high priority. Interviews with Town staff confirmed this need and that such work has been undertaken. However, Town staff also pointed out that current nitrogen-reduction standards, which have been established by the Cape Cod Commission, apply infrequently due to regulatory thresholds and the nature of redevelopment activities.

Page 61 of Bourne's Zoning Bylaws requires that if a special use permit is required for onsite disposal that the portion of the site with the water resource district shall not exceed an application rate of 10 parts per million of nitrate using criteria including the following:

- Sewage volume based on realistic estimates (not Title V design volume).
- Annual rainfall equal 42 inches.
- Fertilizer application of 0.6 pounds per 1,000 square feet of lawn or garden.
- Nitrate application and recharge rates as follows in Table 7:

Table 7
Bourne Zoning Bylaw
Assumed Nitrate Application and Recharge Rates from Various Sources

Source	Nitrate Application Rate (ppm)	Recharge Percentage Rate
Leachate effluent	40.00	95%
Pavement runoff	3.00	95%
Roof runoff	0.75	45%
Natural and fertilized area recharge	0.05	45%

5.7.2 Carver

At this point in time, Carver does not foresee the need for a townwide wastewater system. Carver may establish small community (i.e., decentralized) systems for dense areas of town where wastewater pollution may be a threat.

One particular area of concern for the town is Crystal Lake. Crystal Lake includes a number of cottages on small parcels (e.g., 5000 square feet), which have been winterized for year-round occupancy. Crystal Lake is reputed to have elevated ambient nitrates.

5.7.3 Kingston

Kingston has established regulations regarding sanitary sewers. Kingstown has also established a water resources overlay district, in part, for the purposes of protecting the Plymouth-Carver Aquifer. This district prohibits individual sewage disposals systems with greater capacity than 440 gallons per day per acre per owner. For systems smaller than 2,000 gpd, an increase nutrient loading to 550 gpd per acre may granted by the Water Quality Review Committee through a Certificate of Water Quality Compliance. Section 4.13.4(q) of Kingston's Zoning Bylaws specifically states:

> Individual sewage disposal systems designed to receive more than four hundred forty (440) gallons per 40,000 sq. ft. under one ownership per day, provided that this prohibition shall not apply to the replacement or repair of a system in existence on the date of the adoption of this provision. For systems with a sewage design flow below 2000 gallons per day, an increase in calculated allowable nutrient loading per acre to 550 gallons per acre, may be allowed for the use of Department of Environmental Protection approved Certified Technology when the system technology, system design and the required maintenance program have been approved by the Water Quality Review Committee through the issuance of a Certificate of Water Quality Compliance.

5.7.4 Middleborough

According to its master plan:

> The current wastewater collection system consists of approximately 29 miles of sewers with 1,650 connections serving approximately 6,500 people or approximately one-third of the current population. (p. 182)

There is currently a moratorium on sewer hookups due to the limited capacity of the treatment plant.

5.7.5 Plymouth

Section 149-2 establishes a requirement for mandatory tie-in of any new occupied structure and any occupied structure built prior to March 31, 1995 along public ways where town sewers with sufficient capacity exist.

Plymouth has also established an Aquifer Protection Overlay District under Article VI of the Plymouth Zoning Bylaws. Section 205-57(D)(6)(a) requires that "discharge of all wastewater shall be via the municipal sewerage system or discharge shall be of only normal sanitary wastewater to subsurface disposal systems such that said discharge will not impair the quality of a public or private water supply nor promote eutrophication of a restriction lake."

Discharge volumes are limited to 330 gallons per day per 40,000 square feet of gross density. The Town has also established the following discharge standards:

- Biochemical oxygen demand less than or equal to 10 mg/l.
- Suspended solids less than or equal to 10 mg/l.
- Total phosphorus less than or equal to 1 mg/l.
- Total nitrogen less than or equal to 5 mg/l.
- Fecal coliform less than or equal to 200 [colonies] per 100 ml. (Section 205-57(D)(6)(a))

5.7.6 Plympton

Private onsite systems provide wastewater service for the entire Town of Plympton. In its enforceable policy, Plympton has established several requirements for subsurface disposal that are over and above Massachusetts state standards. These include:

- Ÿ 200-foot horizontal setback of leaching systems to up-gradient wells and 300-foot horizontal setback to down-gradient wells.
- Ÿ 4-foot vertical separation from seasonal high groundwater and 5-acre lots if fill is required to maintain this separation.
- Ÿ Effluent filters on all systems.
- Ÿ Double-size tanks (not less than 2,000 gallons) when garbage disposals are installed.

During an interview with the Planning Board and Conservation Commission Chairmen, we learned that because of the prominence of wetlands and high groundwater tables throughout

the Town, virtually all systems are installed with mounded leachfields and, therefore, necessitate five-acre lots.

5.7.7 Wareham

As described in the *Wareham Comprehensive Community Plan* "sewer service is provided to approximately 60% of the Town's population, concentrated in 20% of geographic area" (p. 127). The plant also serves parts of the Town of Bourne, which has purchased 20 percent of the plant capacity. During summer months the plant operates close to 100 percent of capacity.

According to the comprehensive plan "because the treatment plant is fairly close to capacity new development will likely use septic systems for waste disposal" (p. 49). The plan then goes on to state "as population continues to increase, and exploitation of undersized lots intensifies, the Town may find it necessary to enact more stringent septic regulations than the State." As of the writing of this report, no such standards have been developed by the Town.

5.8 High Risk Land Uses

5.8.1 Bourne

Bourne controls high risk uses through its water resource overlay districts. Overlay districts apply special standards over and above the standards of their underlying zoning district. Hence standard permitting requirements continue to apply for uses not specifically restricted or regulated by overlay. Table 8, below, summarizes prohibited and restricted uses established by Bourne's overlay district.

Table 8
Summary of Use Restrictions Pursuant to
Bourne's Water Resources Overlay Districts

Overlay District	Prohibited Use in Well Head Zones	Use Requiring Special-Use Permit
Water Resource	Ÿ Uses prohibited by well head protection zones by 310 CRM 22.21 2(a) and (b): (e.g., landfills, junkyards, snow disposal, sewage treatment facilities, hazardous materials storage, earth removal within 4 feet of season high groundwater, petroleum storage, impervious surfaces greater than 15%of lot area or 2,500 square feet without recharge systems. Ÿ Manufacture, use or storage of hazardous materials. Ÿ Service stations, car washes, airports, dry cleaning, manufacture processing. Ÿ Coal storage greater than 100 tons. Ÿ Road salt storage.	Ÿ Impervious cover of 40% or more on any lot. Ÿ Removal of more than 70% of groundcover on any lot. Ÿ Animal feeding operations. Ÿ Contractor's yard.

5.8.2 Carver

Carver controls many high risk uses through their water resource and wetlands overlay districts. Overlay districts apply special standards over and above the standards of their underlying zoning district. Hence standard permitting requirements continue to apply for uses not specifically restricted or regulated by overlay. Table 9, below, summarizes prohibited and restricted uses established by Carver's overlay districts.

Table 9
Summary of Use Restrictions Pursuant to
Carver's Water Resources and Wetlands Overlay Districts

Overlay District	Allowed Use	Prohibited Use	Use Requiring Special-Use Permit
Water Resource	Agriculture	Ÿ Solid waste disposal (e.g., landfills, junkyards). Ÿ Hazardous waste storage. Ÿ Snow disposal.	Ÿ Underground petroleum storage. Ÿ Road salt storage. Ÿ Manufacture, use or storage of hazardous materials. Ÿ Service stations, car washes, airports, dry cleaning, manufacture processing. Ÿ Impervious cover of 10,000 square feet on any lot.
Wetlands	Nonstructural uses (e.g., agriculture, forestry, recreation, etc.).	No specific prohibitions.	Structures and buildings.

5.8.3 Kingston

Kingston has established a Conservancy Overlay District, Flood Plain Overlay District and a Water Resources Overlay District under Section 4 of its Zoning Bylaws. Table 10, below, summarizes permitted, prohibited and restricted uses established by Kingston's overlay districts.

Table 10
Summary of Use Restrictions Pursuant to
Kingston's Overlay Districts

Overlay District	Allowed Use	Prohibited Use
Conservancy	– Farming. – Recreation. – Public buildings. – Cemeteries. – Camp sites. – Single-family homes. – Schools. – Hospitals.	

Overlay District	Allowed Use	Prohibited Use
	– Funeral homes. – Marinas.	
Flood Plain	– Agriculture. – Forestry. – Outdoor recreation. – Conservancy. – Temporary nonresidential structures.	
Water Resource		– Petroleum storage. – Landfills. – Junk yards. – Wastewater treatment facilities. – Repair shops. – Car washes. – Stockpiling of road salt or other deicing chemicals. – Hazardous materials storage. – Fertilizer storage including manure. – Dry cleaning. – Chemical laboratories. – Metal plating. – Earth removal. – Large septic systems. – Boat repair.

5.8.4 Middleborough

Middleborough has established two overlay districts under its Zoning Bylaws. Page 16 of the Middleborough Master Plan describes these as follows:

> Flood Plain District-Regulation of Flood Hazard Areas District – Many areas of the Town are subject to flooding, and the land within defined flood plains has been regulated to minimize losses to property due to floods. The provisions of this overlay regulation also include controlling filling and grading that may increase flood damage, and the regulation of infrastructure construction to accommodate flood conditions. The extent of the Flood Plain District is linked to technical studies of certain flood parameters established by the Federal Emergency Management Agency (FEMA). Although buildings are permitted in these areas, they must generally be constructed to meet flood-proofing criteria.
>
> Water Resource Protection District (WRPD) – This overlay district has been created to protect water quality for water supplies. The overlay district distinguishes between two levels of protection. The designation "WRPD-A" covers watersheds and associated recharge areas for public water supplies. This provision generally restricts the storage of certain harmful materials, discourages use of polluting substances, and limits coverage of permeable soils. It restricts minimum lot size to 60,000 square feet. It contains important limits on site disturbance and setbacks from watercourses. It does not prohibit any of the underlying use designations or the ability to construct buildings within its limits. The designation "WRPD-B" is intended to specifically protect natural water resources and areas hydraulically linked to public water supplies. It contains

relevant conditions on development, notable a 100-foot setback requirement from qualifying rivers, brooks and ponds. (p. 16)

5.8.5 Plymouth

Among several other overlay districts, Plymouth has established an Aquifer Protection Overlay District and a Wetland Protection Overlay District. Table 11, below, summarizes permitted, prohibited and restricted uses established by Plymouth's overlay districts.

Table 11
Summary of Use Restrictions Pursuant to
Plymouth's Wetlands Overlay Districts

Overlay District	Allowed Use	Prohibited Use	Use Requiring Special-Use Permit
Wetlands	Single-family dwellings on lots of 120,000 square feet or more.	– Extractive industry. – Recreation facilities. – Day nurseries. – Recreational campgrounds subject to conditions. – High tech PUDs on over 250 acres. – Transfer of development rights.	– Medium and small lot residential. – Commercial. – Industrial. – Junkyards. – Retirement home PUD.
Aquifer Protection	– Single-family dwellings on lots of 40,000 square feet or more. – Two-family dwellings.	– Solid waste disposal and landfills. – Petroleum product storage. – Landfilling of leachable or liquid wastes. – Use of septic cleaners. – Impervious areas of over 25% of any lot. – Industrial uses that discharge waste on site. – Open road salt storage or use of sodium chloride. – Snow disposal. – Land mining including sand and gravel. – Storage, generation or disposal of hazardous wastes. – Automotive service shops. – Treatment works. – Commercial fertilizer storage including manure.	– Expansion of nonconforming uses. – Conversion of seasonal dwellings. – Storage and handling of toxic and hazardous substances.

Zoning Code Table 5 provides a thorough listing of all districts and schedule of uses in Plymouth.

5.8.6 Plympton

Under its Zoning Bylaws, Plympton restricts the following uses throughout the Town:

- Asphalt manufacture
- Car washes
- Cement manufacture
- Storage of more than 10 vehicles
- Fertilizer and pesticide manufacture
- Hazardous waste storage, processing, or disposal
- Commercial sewage and septage treatment facilities

Section 4.2 of the Zoning Bylaw provides a complete "Schedule of Uses."

Section 8 of the Town's Zoning Bylaw establishes three levels of groundwater protection districts. Section 8.3.5 establishes uses that are prohibited and those that are allowed by special-use permit.

5.8.7 Wareham

Wareham controls high risk uses through its water resource overlay districts. Overlay districts apply special standards over and above the standards of their underlying zoning district. Hence standard permitting requirements continue to apply for uses not specifically restricted or regulated by overlay. Table 12, below, summarizes permitted, prohibited and restricted uses established by Wareham's overlay districts.

Table 12
Summary of Use Restrictions Pursuant to
Wareham's Water Resources Overlay Districts

Overlay District	Allowed Uses	Prohibited Use in Well Head Zones	Use Requiring Special-Use Permit
Groundwater Protection	Ÿ Use allowed in the underlying district, except those requiring special use permits, provided impervious surfaces do not exceed 15% of lot area or 2,500 square feet without recharge systems. Ÿ Normal operation of waterbodies and dams. Ÿ Agriculture except piggeries or fur farms.	Ÿ Uses prohibited by well head protection zones by 310 CRM 22.21 2(a) and (b): (e.g., landfills, junkyards, snow disposal, sewage treatment facilities, hazardous materials storage, earth removal within 4 feet of season high groundwater, petroleum storage, impervious surfaces greater than 15%of lot area or 2,500 square feet without recharge systems. Ÿ Manufacture, use or storage of hazardous materials	Ÿ Fertilizer and pesticide application that is nondomestic and nonagricultural in nature. Ÿ Use allowed in the underlying district with impervious surfaces that exceed 15%of lot area or 2,500 square feet without recharge systems, provided that runoff is mitigated.

Overlay District	Allowed Uses	Prohibited Use in Well Head Zones	Use Requiring Special-Use Permit
		Ÿ Service stations, car washes, airports, dry cleaning, manufacture processing Ÿ Road salt storage.	
Buttermilk Bay	Ÿ Uses having no nitrogen impact that are allowed in the underlying district.		Ÿ Uses substantiated to have no nitrogen impact.

5.9 Land Acquisition

5.9.1 Bourne

Bourne is largely developed and few open spaces exist; however the town has set a goal of preserving at least half the remaining open space. To this end, Bourne has developed an open space plan:

> The goal of the open space plan is to preserve half of the remaining open land that is subject to development, approximately 1,000 acres, by purchase of fee, easement, or by other means, land open... Town meeting in 2004 took a big step toward reaching this goal by acquiring tow parcels totaling 96 acres in Bournedale and Buzzards Bay. (p 7, Town of Bourne, LCP)

As with other of the towns 'land management strategies, the primary purpose is fiscal in nature:

> It may be substantially less expensive for the town to buy a parcel than to pay the cost of building new schools, educating additional students, upgrading roads and public utilities, and employing additional public service employees to service the growth that would be created by development of the parcel. (p. 8, Town of Bourne, LCP)

Bourne's open space plan was prepared in 1997 and is now expired. Notwithstanding, the opens space plan does identify several "highlights," which are pertinent to aquifer protection. These include:

- Ÿ Targeted open space acquisition identified on a map and ranked.
- Ÿ Water resources protection including enhanced stormwater management and water resources remediation.

Photograph 9— South Meadow Pond in Carver.

5.9.2 Carver

Carver adopted its Open Space and Recreation Plan in 2004. The plan remains valid until 2009. The plan provides an extensive discussion of community setting, environmental issues, community needs, and sets an open space protection strategy based on a parcel

inventory. Section IV.C. provides a discussion of water resources, which in part reviews the Plymouth-Carver Aquifer recharge area. Page 37 states:

> Recently, the town of Wareham initiated discussions with the towns of Carver and Plymouth to encourage the signing of a memorandum of understanding that would allow the three towns to comment on application for development that would affect the Wankinko and Agawam River watersheds and the creation of a watershed advisory board that would work to protect the rivers and the Plymouth-Carver Aquifer.

The plan provides a strong framework for open space protection that includes protection of the aquifer. Page 81 specifically sets a goal to "preserve the quality of Carver's natural resources, including ground and surface waters, wetlands, and wildlife habitat." Page 81 also establishes the following objectives:

Objective 1: Protect Carver's groundwater resources.

a. Work with the towns of Plymouth and Wareham to protect the Plymouth-Carver Aquifer by participating in the formation of a watershed advisory board.
b. Protect land (especially land over the Plymouth-Carver aquifer) by purchase or conservation restrictions, using state and federal funds whenever possible and assistance from land trusts.
c. Identify and protect sites designated as potential sources of public water.

Objective 2: Preserve and restore water quality in Carver's rivers, streams, and ponds.

a. Establish a monitoring program of major town water bodies to identify problem areas and oversee the correction of them by appropriate town agencies.
b. Regulate and enforce stormwater management through the cooperative efforts of various town officials and boards.
c. Encourage use of landscaping and agricultural practices that minimize erosion and nutrients from fertilizers entering surface and groundwater.

Objective 3: Support protection of wetland resources and areas bordering wetlands throughout Carver.

a. Work with the school system and other interested groups to document and inventory vernal pools and other wildlife habitat in Carver.
b. Amend zoning by-law to require a minimum upland area on new lots created in town to limit encroachment on wetlands.

Objective 4: Encourage retention of existing cranberry grower-owned lands as wildlife habitats, water recharge areas, etc.

a. Encourage tax policies, such as a tiered tax, that will support the financial viability of the cranberry industry and tax each grower at the proper rate.
b. Encourage State and federally supported programs that help growers maintain their land as wildlife habitat, water recharge areas, etc.

Objective 5: Preserve critical wildlife habitats.

a. Protect lands identified by the Natural Heritage and Endangered Species Program as critical habitat for rare and endangered species.

The *Carver Master Plan* discusses the advantages of open space acquisition on pages 1-7. The plan includes an action item for the acquisition of 4,500 acres of open space.

5.9.3 Kingston

Kingston most recently updated its Open Space and Recreation Plan in 2001. The plan will expire in September 2007; however the Town is in the process of revising the plan. In part Kingston revised the plan to update its "environmental inventory and analysis of needs" (p. 1). Section 8 of the plan addresses seven goals, which in part include:

- Protection of the quality of Kington's natural environment. (p. 86)
- Ensuring that land use activities will be compatible with maintaining the quality of local water supplies. (p. 87)
- Working with other authorities to ensure that minimal adverse impact to natural resources and recreational lands occurs with the development of new transportation facilities. (p. 88)

5.9.4 Middleborough

Middleborough's Master Plan describes significant involvement in land acquisition.

A complete listing of the open space, conservation and recreation lands is included in the 1998 Open Space Plan. In summary, land currently protected and preserved within Middleborough as listed in the last Open Space Plan includes:

- A total of 42 Town-owned parcels covering approximately 1368 acres.
- Five state-owned parcels totaling about 3708 acres.
- Ten privately-held parcels of land with about 640 acres of land. (p. 67)

The master plan does not discuss whether any of these are within the Plymouth-Carver Aquifer. Middleborough will likely continue this through its own purchases and through partnerships with other entities. Their Open Space and Recreation Plan, required for applying for land protection funds through the Commonwealth of Massachusetts Division of Conservation Services, has expired.

Middleborough's Open Space Plan does indicate several goals, which are consistent with aquifer protection. These include:

- Protection of groundwater resources.
- Protection of surface water resources and

Photograph 10— Marsh in Middleborough

riparian lands.
- Preservation of rural character.
- Maintenance of diversity of natural habitats.
- Natural resources education.
- Establishment of a nonprofit land trust.
- Support for agriculture and forestry.
- Preservation of recreational opportunities.

Notwithstanding, the plan does not specifically discuss the Plymouth-Carver Aquifer.

5.9.5 Plymouth

Plymouth has developed a Strategic Action Plan (i.e., master plan), entitled *Growing Smarter in Plymouth's Fifth Century*. While Plymouth has limited land under permanent protection (p. 6); Plymouth's Strategic Action Plan does recommend development of a green infrastructure (i.e., a greenway system of contiguous open space) using land acquisition in concert with other land management tools such as transfer of development rights and establishment of growth centers.

Page 12 of the Strategic Action Plan discusses "green network" goals and implementation and recommends the following actions:

- Evaluate and rank unprotected open space resources
- Work with nonprofit conservation organizations
- Seek donations of conservation restrictions
- Establish low maximum densities in Rural Preservation Areas
- Establish development standards with incentives for protection
- Seek additional dependable revenue streams for conservation purposes.

Plymouth has an approved open space plan. The plan will expire in December 2009. No specific information regarding sand and gravel policy was made available by the Town.

5.9.6 Plympton

Plympton has established a conservation commission and is in the process of developing an open space plan. No other information is available.

Photograph 11— Lady Slippers are one example of a sensitive species in the PCA.

5.9.7 Wareham

Wareham is involved in significant open space acquisition efforts both for purposes of natural resource protection and enhancement of quality of life. To this end, the Town has partnered with a number of private and public land conservation entities. Methods of preservation utilized include:

- Acquisition
- Chapter 61 (forestry, agriculture, and

open space) protection
- Article 97 protection
- Conservation restrictions
- Land banks

As of the 1998 Wareham Comprehensive Community Plan, the Town and its partners had preserved 961 acres of land in perpetuity. Despite this effort, the Wareham Comprehensive Community Plan notes that "according to the Buzzard's Bay Project, Wareham has a lower percentage of permanently protected land than any other community in the Buzzards Bay Watershed" (p. 92).

During an interview conducted with the Town Planner and Michael Martin, the Superintendent of the Wareham Water Department, Mr. Martin noted a number of recent instances during which the water department has engaged in land preservation activities. There is no specific estimate of the extent of department's acquisition efforts, but Mr. Martin's reports appeared to indicate several hundred acres of recent acquisitions.

It should also be noted that the Wareham Fire District actively engages in land acquisition.

Wareham revised its current open space and recreation plan in 2004. This plan will remain effective until January 2009. The plan notes that:

> Wareham shares various resources with its neighboring towns. The river systems that flow through Wareham originate in other towns. (p. 4)

The open space plan contains many goals and actions related to aquifer protection, including public education and protection of water resources, habitat, and recreation. The plan also contains several specific actions regarding protection of the aquifer. These include:

- Work with Wareham Water Department, private organizations, and other Town committees to have the Plymouth-Carver Aquifer designated as an Area of Critical Environmental Concern. (p. 81)
- Introduce warrant and/or work with appropriate Town committees to require that all building which takes place in the watershed of any stream, river, pond, lake, wetlands or coastal water or in the Zone II area of any drinking water aquifer must install, at a minimum, nitrogen-reducing septic systems or alternative sewage treatment facilities. Include an annual certification by a competent authority that the system is working properly. Systems must be located in an area that would cause the least amount of environmental impact. (p. 82)
- Introduce warrant and/or work with the appropriate Town committees to permanently protect, for current and future generations of Wareham residents, a 1,100-acre parcel of land located in Zone II of the Plymouth-Carver Aquifer by:

    a. Purchasing the land outright and adding it to the Myles Standish State Forest; or
    b. Purchasing the development rights for this land and maintaining it for agricultural use. (p. 83)

- Permanently protect lands containing endangered or threatened species as identified by the Massachusetts Natural Heritage and Endangered Species Program. (p. 84)

5.10 Sand and Gravel

5.10.1 Bourne

Section 4400 of the Bourne Zoning Bylaw requires a special use permit be obtained for "removal from any premises of more that 50 cubic yards of sand, gravel, stone, topsoil or similar materials with a 12-month period." Such permits are subject to development of a plan of existing and proposed conditions, screening of the excavation areas for control of noise and dust, a performance bond, and restoration of the site:

> Following removal, all excavated areas shall be restored by grading to provide drainage and for slopes not to exceed one foot horizontal to two feet vertical, and by covering with four inches of topsoil, and by planting with cover vegetation, which shall have been established prior to release of the bond. (Section 4430)

5.10.2 Carver

Carver regulates earth removal under its general bylaws, Section 9.1 "Earth Removal." This section states that:

> Permanent changes in the surface contours of land resulting from the removal and realignment of earth materials will leave the land in a safe and convenient condition for appropriate reuse without requiring excessive and unreasonable maintenance or creating danger of damage to public and private property, as well as to provide that earth removal activities shall be conducted in a safe manner and with minimal detrimental effect upon the district in which the activities are located.

This section does not make specific statements regarding protection of the aquifer or water resources. Earth removal in Carver is governed by a seven-member committee.

5.10.3 Kingston

Chapter 12 of Kingston's General Bylaws establishes enforceable policy related to earth removal activities. It prohibits removal of more than 1,000 cubic yards per year unless pursuant to a permit. Earth removal may only be permitted when it is determined to be incidental to uses such as construction and agriculture (Article 3). Therefore, sand and gravel removal for the purpose of sale is not allowed. Moreover, earth removal is expressly prohibited in the water resources protection overlay district within 10 feet of groundwater (Kingston Zoning Bylaws, Section 4.13.4(o)):

> Earth removal within ten feet of the United States Geological Survey historic high water table or equivalent data determined by the Water Quality Review Committee more specific to the site, except for excavations necessary for building foundations, roads and utilities.

Photograph 12— When raw land is developed, soil erosion and sediment control may be of issue.

5.10.4 Middleborough

Middleborough provided us with their local comprehensive plan; however, this plan does not discuss sand and gravel policy. No specific information regarding sand and gravel policy was made available by the Town.

5.10.5 Plymouth

Section 205-18(F) of the Plymouth Zoning Bylaw prohibits excavation of materials (e.g. sand and gravel) in excess of 10 cubic yards except where it is incidental to use (e.g., development activity).

5.10.6 Plympton

Plympton regulates sand and gravel operations under Article VII of its bylaws. Operations other than construction of a building or continued operation of a sand and gravel pit must obtain a permit from the Plympton Board of Selectmen.

5.10.7 Wareham

Wareham regulates earth removal under its general bylaws. This bylaw was not available for review.

6.0 LITERATURE REVIEW

Research was conducted to gather an understanding of the concerns that should be addressed as part of this plan. Documents from the state of Massachusetts, each of the towns in the PCA, and the following agencies and groups were reviewed.

- Cape Cod Commission
- Woods Hole Research Center
- The Nature Conservancy
- U.S. Environmental Protection Agency
- USGS
- U.S. Army Corps of Engineers
- State of New York
- Florida Department of Environmental Protection
- Southwest Florida Water Management District
- Northwest Florida Water Management District
- Greater Edwards Aquifer Alliance
- Twin Cities Metropolitan Council
- Aquifer Guardians in Urban Areas
- The Community Environmental Legal Defense Fund
- Australian Government Department of the Environment and Heritage
- The Organization for Security and Co-operation in Europe

- The United Nations University
- Western Governors 'Association
- The National Academy of Public Administration
- Organization of American States

The results of the research are organized into the following sections.

6.1 Bylaws and Other Enforceable Policy

As part of our review of literature, we examined and focused on the following bylaws related to aquifer protection:

- Model Aquifer Protection Bylaw— Cape Cod Commission Bylaws and Regulations
- Wilton, New Hampshire Zoning Ordinance
- Stormwatercenter.net Model Groundwater Protection Ordinance
- EPA Sole Source Aquifer Protection Program
- State of Connecticut Aquifer Protection Program
- Holyoke, Massachusetts Zoning Ordinance— Water Protection and Aquifer Recharge Areas
- Douglas, Massachusetts Aquifer Protection Special Permit
- Model Stormwater Management Bylaw— Prepared for the Towns of Duxbury, Marshfield, and Plymouth, MA

We also examined programs and bylaws from other regions of the country such as Texas, Arizona, and Oregon. However, we chose to focus mainly on local programs due to the likely similarity in technical issues and political context.

6.1.1 Anatomy of an Aquifer Protection Bylaw

Aquifer protection ordinances should be designed to include coordination with other related enforceable policy such as wetlands regulations, wastewater regulations, well installation regulations, and subdivision regulations.

Below we provide an outline of important characteristics of effective aquifer regulation. The extent to which a governing body opts to adopt each of these aspects of regulation is really a matter of preference for strong verses laissez-faire management approach. Notwithstanding, there exist certain aspects of enforceable policy that are essential to good policy writing. Therefore, we have annotated the outline to describe issues related to good practice and preference.

- Introduction:
  These aspects of an ordinance are critical to establishing legal authority and standing.
  - Purpose
  - Applicability (boundaries of aquifer protection overlay district)
  - Exemptions
  - Variance Process
  - Compatibility with other bylaws

  - Severability

- Definitions

  Definitions should include all terms that are not defined by other bodies of enforceable policy or that might be defined differently than in the pursuant regulation. Definitions should also include all technical terms for which there is not an accepted legal definition (e.g., in Black's Legal Dictionary).

- Submission and Approval Process

  This should be described to the extent that it will be implemented. A strong approval process is critical wherever resources are considered to be fragile and rules may be subject to interpretation or misunderstanding.

  - General permitting
    - Preapplication process
      A preapplication process helps to eliminate potential misunderstanding early in the regulatory process.
    - Determination of applicability
      Helps to prevent unnecessary work by regulators and the regulated community.
    - Notice of intent

  - Special permitting

- Application Fees

  Prevents taxpayers from bearing the full burden of regulatory programs.

- Standards

  Many communities in the Plymouth-Carver Aquifer Region have already established performance standards for wastewater, stormwater, and related issues in their regulations and ordinances. Many regulators and members of the regulated community prefer performance standards (e.g., allowed levels of pollutant discharge) over prescription standards (e.g., specific required management practices) because they provide flexibility of implementation. One good example of a performance standard is a limit on nitrogen discharge concentration from a developed lot.

  - Acceptability of uses
    - Prohibited land uses
    - Uses requiring general permit
    - Uses requiring special permit
  - General design and operating guidelines
  - Performance standards
    - Pollution (e.g., nitrogen allowable concentrations from various uses)
    - Stormwater (e.g., infiltration requirements)
- Performance Surety (e.g., posted bond)
- Enforcement Schedules

Enforcement schedules are critical to provide the regulated community with a full understanding of the legal administration of a bylaw or regulation. Failure to establish enforcement will hamstring the regulatory authority should a violation occur.

  - Enforcement notification process
  - Permit revocation
  - Hearing process for civil violations
  - Criminal acts

- Effective implementation date
  Failure to establish an implementation date may invalidate a bylaw or regulation.

6.2 Intergovernmental Approaches

Since the PCA is an important resource and is located in and supplies water for seven towns, intergovernmental cooperation could be valuable. The cooperation could be conducted at various levels between municipalities, as well as between the state and local governments and private water suppliers. Intergovernmental operations can be extremely beneficial for protection of the PCA as well as financially when carried out in a way that will work for everyone involved. However, when thorough development of the approach to intergovernmental cooperation is not defined, they can become detrimental, so it is important to develop an approach that is geared toward the individual character of the towns, including their assets and concerns.

It is important to maintain clear communication to establish an effective process. Some of the aspects that need to be considered before the cooperation begins are:

- Form of intergovernmental cooperation
- Financial obligation of parties involved and funding opportunities
- Responsibility of the group and each of its members
- Determination of legal aspects of implementation when the group has different bylaws
- Definition of the goal
- Development of the framework which provides focus and allows flexibility
- Expectations of the coordinated effort

Cooperative management approaches may take many forms. In order to form a mutually beneficial and cooperative management approach, the form of that intergovernmental cooperation should be defined early. Some *examples* include:

- Outline for intergovernmental cooperation, such as a cooperative agreement. This would be the least structured option for coordination.

- Advisory board for technical matters. This would provide an organized forum for the involved parties to come together and request input.

- Form a committee for intergovernmental coordination. This could be a continuation of the existing PCAAC.

- A water supply planning agency that is empowered to seek grants and conduct special projects related to the PCA, but does not have regulatory authority. Such an agency could be overseen by a board of municipal appointees.

- Shared public agency which could oversee and provide assistance with aspects of water supply through review of proposed development plans, infrastructure expansions, and planning procedures. This essentially combines the functions of an advisory board, intergovernmental committee, planning agency, and water supply company.

6.3 Protection Plans

Watershed, aquifer, and water supply protection plans have been developed in many areas. Several plans were reviewed which discuss areas of concern facing water suppliers, data needed to make further assessment of the condition of the water supply, and solutions being recommended to ensure the continued use of the resources.

The protection plans typically start with a statement of the condition of the water supply. This includes municipal involvement, environmental concerns, water supply concerns, forecasted supply demands. This information is used to identify the concerns that need to be addressed. Most of the areas that are developing water supply protection plans are experiencing high development rates combined with impacting surface water resources. Depending on the regional history, current use, and future projections, water supply concerns range from contamination in highly industrial areas to lack of recharge because of geologic composition to streamlining intergovernmental procedures in areas where water supply issues have been more well-defined. Some of the issues that were widely detected or that were relevant to the PCA include:

- Threats to the water supply
    - Effect of future growth
    - Salt water intrusion
    - Seasonal demands
    - Sources of pollution
- Water supply availability
- Alternative water supply sources
- Infrastructure assessment
- Environmental impacts
- Sensitive areas of the water supply
- Data collection
- Municipal involvement and controls
- Regional controls
- Intergovernmental cooperation
- Funding sources
- Public participation and education
- Conservation measures

Once the issues have been defined, approaches to address these issues are identified and described. Some examples of approaches involve the following:

- Identification of performance standards and future plan audits
- Explanation of funding sources
- Definition of methods to ensure environmental quality
- Development of regional water management agencies and statutes
- Definition of timelines to critical milestones
- Clarification of responsibilities and roles for involved parties
- Identification and implementation of conservation measures and reuse
- Integration of water supply planning in local comprehensive plans
- Incorporation of drought plans
- Expansion of water supply infrastructure
- Improvement of public education
- Description of intergovernmental. cooperation

6.4 Performance Standards

Many regulators and members of the regulated community prefer performance standards (e.g., allowed levels of pollutant discharge) over prescription standards (e.g., specific required management practices) because they provide flexibility of implementation. One good example of a performance standard is a limit on nitrogen discharge concentration from a developed lot. Many communities in the Plymouth-Carver Aquifer Region have already established performance standards for wastewater, stormwater, and related issues in their regulations and ordinances.

The following text provides some examples of performance standards:

Nitrogen discharge concentration

Nitrogen concentration is often noted as a concern in water resources planning both for its potential to create adverse human health effects (e.g., Blue Baby Syndrome) and ecologic effects (e.g., eutrophication). The Cape Cod Commission has developed a model bylaw that addresses nitrogen concentrations. Several of the PCA communities have adopted similar standards into their bylaws. A common approach to structuring related policy is to set a standard (e.g., 5 mg/l from any land use) and establish application rates from typical elements of land uses (e.g., septic systems, pavement, roofs, fertilized grounds, etc.).

Stormwater quantity

Many regulatory agencies establish performance standards related to stormwater quantity and quality. Some of the most commonly used standards include:

- Reduction of 80 percent of total suspended solids from discharge.
- No net increase in peak flows from 2-, 10-, 25-, and 100-year storms.
- No volume or peak flow increase from 2-, 10-, 25-, and 100-year storms.
- Maximize recharge to the extent possible.

- Treatment of a volume equal to 1 inch over the impervious surface.

Soil erosion and sediment control

Most site planning policies include some standards for soil erosion and sediment control. As with stormwater management rules, many soil erosion and sediment control regulations require 80 percent reduction of total suspended solids during construction activity as well as post construction. Other performance standards may include avoidance of steep slopes (e.g., 15 percent grades or greater), avoidance of erodible soils, and phasing projects to avoid overstripping plant cover.

Several towns have established policy and in some cases performance standards related to sand and gravel operations. Some examples include restoration of vegetation, vertical separation to seasonal high groundwater and phasing.

Land use density

Most PCA communities have already established zoning standards that could be considered performance standards through policy such as cluster zoning, transfer of development rights, and establishment of special land-use densities in village centers. At this time, most of this policy is focused on "quality of life" as opposed to aquifer protection. PCA towns may wish to establish low-density land use over sensitive recharge areas to reduce risk of contamination and to increase potential recharge.

High risk land use

All the Plymouth-Carver Aquifer towns have established policy to prohibit high risk land uses, such as junk yards, dry cleaners, and landfills, from sensitive water resource areas. Policy related to high-risk land uses appears to be based mostly on state policy and is relatively consistent across the towns.

Water withdrawal

Allocations for water withdrawal and discharge are currently set by the State. We anticipate that the allocation approach may be augmented once a water balance is completed for the Plymouth-Carver Aquifer.

7.0 RECOMMENDED PROTECTION ACTIONS

7.1 Candidate Actions

We identified candidate actions through interviews as discussed in Section 4.0, review of municipal documents as discussed in Section 5.0, and review of the literature as discussed in Section 6.0. A thorough description of each candidate recommendation can be found in Section 1.1. Section 1.2 provides a list of short-term recommended actions for the first year of implementation. Brief descriptions of candidate actions are also provided in Table 13.

We reviewed candidate actions with the PCAAC on March 8, 2007. During the meeting, the PCAAC provided feedback, which we used to inform the list of candidate recommendations and identify short-term recommendations for the first year of implementation.

7.2 Costs and Advantages of Candidate Actions

Table 13 provides candidate actions with associated advantages, implementation issues, range cost per municipality, and relative level of protection anticipated. Costs are provided for a single municipality. Costs for a group of municipalities would be likely to achieve economies of scale, reducing unit cost. Table 13 provides a brief description of each candidate action. Readers may find a thorough description of each action in Section 1.1. Section 1.2 discusses actions selected for the first year of implementation.

Table 13
Advantages and Costs of Candidate Recommendations

Recommendation	Advantages	Implementation Issues	Range of Implementation Cost per Municipality[a]	Relative Protection Anticipated
Policy				
Massachusetts Soil Erosion Guidelines— Municipalities should cite the Massachusetts soil erosion guidelines	Ÿ Consistency with state policy Ÿ Reduces sedimentation of water resources Ÿ Reduces municipal stormwater infrastructure maintenance	Ÿ Requires development or amendment of enforceable policy Ÿ Requires technical reviews of projects	$10,000 - $20,000	Aquifer: Limited Surface Water: High
Massachusetts Stormwater Management Policy— Municipalities should cite the Massachusetts stormwater policy	Ÿ Consistency with state policy Ÿ Reduces pollution of water resources Ÿ Reduces municipal stormwater infrastructure maintenance	Ÿ Requires development or amendment of enforceable policy Ÿ Requires technical reviews of projects	$10,000 - $20,000	Aquifer: High Surface Water: High
Cape Cod Commission Model Aquifer Protection Bylaw— Municipalities should consider the Cape Cod Commission model bylaw as a starting point in developing water resource protection bylaws and regulations	Ÿ Incorporates multiple aspects of aquifer protection Ÿ Works from existing model	Requires development or amendment of enforceable policy	$20,000 - $30,000	Aquifer: Very High Surface Water: High
Massachusetts Sand and Gravel	Ÿ Consistency with	Requires development	$10,000 - $20,000	Aquifer: High

Recommendation	Advantages	Implementation Issues	Range of Implementation Cost per Municipality[a]	Relative Protection Anticipated
Operation Guideline— Municipalities should reference state guidelines.	state policy Ÿ Reduces potential contamination of aquifer Ÿ Reduces adverse affects to landscape	or amendment of enforceable policy		Surface Water: Limited
Recharge standards— Municipalities should incorporate state guidelines by reference and may wish to enhance them in sensitive areas.	Ÿ Consistency with state policy Ÿ Reduces adverse affects of water withdrawal from development Ÿ Reduces need for structural stormwater controls	Ÿ Requires development or amendment of enforceable policy Ÿ Requires technical reviews of projects	$5,000 - $10,000	Aquifer: High Surface Water: High
Water reuse and recharge— The Plymouth-Carver Aquifer municipalities should consider implementation of water reuse as described in *Once is Not Enough— A Guide to Water Reuse in Massachusetts*	Ÿ Reduces adverse affects of water withdrawal from development	Ÿ Requires complex technical reviews of projects Ÿ Requires special permitting from state	Uncertain[b]	Aquifer: Project specific[c] Surface Water: Project specific
Consistent water conservation requirements— Municipalities and suppliers should work together to develop standard water conservation practices	Ÿ Consistency with state policy Ÿ Reduces adverse affects of water withdrawal from development	Ÿ May require development or amendment of enforceable policy Ÿ Existing standards not clearly defined	$20,000 - $30,000	Aquifer: High Surface Water: Limited
Water use and system audits—	Ÿ Consistency with	Ÿ May require some	$10,000 - $20,000	Aquifer: High

Recommendation	Advantages	Implementation Issues	Range of Implementation Cost per Municipality[a]	Relative Protection Anticipated
Suppliers and municipalities should consider developing water audit protocols.	state policy Ÿ Reduces unnecessary water use due to leaks Ÿ General saves money	staff training and special equipment to implement		Surface Water: Limited
Open Space Residential Design Guidelines— Municipalities should incorporate Open space residential design in their zoning policy.	Ÿ Reduces adverse affects of development on natural resources	Ÿ May require development or amendment of enforceable policy Ÿ Requires technical reviews of projects	$10,000 - $20,000	Aquifer: High Surface Water: High
Wastewater management programs for operation and maintenance and upgrade of substandard systems— Municipalities should consider development of wastewater management programs that require regular inspection and maintenance of onsite wastewater systems as well as upgrade of substandard systems and may wish to consider requirements for nitrogen reduction.	Ÿ Reduces pollution of water resources, particularly groundwater Ÿ Increases longevity of septic systems	Ÿ Requires development or amendment of enforceable policy Ÿ May require technical reviews of projects Ÿ Can be controversial to general public Ÿ Requires ongoing municipal staff support	$10,000 - $20,000	Aquifer: Very High Surface Water: High
Pollution prevention— The Plymouth-Carver Aquifer municipalities should consider incorporating pollution prevention	Ÿ Consistency with state policy Ÿ Reduces adverse affects of water	Ÿ Requires development or amendment of enforceable policy	$5,000 - $10,000	Aquifer: High Surface Water: High

Recommendation	Advantages	Implementation Issues	Range of Implementation Cost per Municipality[a]	Relative Protection Anticipated
techniques into their stormwater guidance materials and enforceable policy.	withdrawal from development Ÿ Reduces need for structural stormwater controls			
Increased municipal involvement in monitoring responsible parties at existing contamination sites— The Plymouth-Carver Aquifer municipalities should consider requiring annual inspection, report review, and annual public meetings for contaminated sites as a way to raise awareness and encourage action.	Ÿ Exposes potential adverse affects of existing contamination sites Ÿ May prevent catastrophic aquifer contamination	Ÿ May be awkward to require	$1,000 - $5,000	Aquifer: Location specific Surface Water: Location specific
Protect and restore critical land and water resources— Each of the Plymouth-Carver Aquifer municipalities practice open space acquisition and protection. The PCAAC communities should work together to develop an areawide open space protection plan.	Ÿ Protects specific sensitive resources Ÿ Prevents fracturing of open space Ÿ Makes open space available for passive uses (e.g., recreation) Ÿ May be implementable through protection bylaws Ÿ Areawide planning	Ÿ Land acquisition can be quite expensive Ÿ Acquisitions tend to be piecemeal and will need to be thoughtfully planned and managed for maximum benefit	Planning: $50,000 Acquisition: Uncertain	Aquifer: Very High Surface Water: Very High

Recommendation	Advantages	Implementation Issues	Range of Implementation Cost per Municipality[a]	Relative Protection Anticipated
	increases likelihood of state financial assistance			
Grants and Funding				
Coordinate with Executive Office of Energy and Environmental Affairs, Division of Conservation Services regarding open space acquisition	Ÿ Reduces cost of open space acquisition	Ÿ Subject availability of funding Ÿ Requires match	Uncertain	Aquifer: Project specific Surface Water: Project specific
Coordinate with Natural Resources Conservation Service to assist cranberry farmers	Ÿ Reduces cost of BMPs Ÿ Generally, requires implementation of state-of-the-art BMPs	Ÿ Subject availability of funding Ÿ Requires match	Uncertain	Aquifer: Project specific Surface Water: Project specific
Grants information clearinghouse— The Plymouth-Carver Aquifer Advisory Committee should consider opportunities to establish a grants clearinghouse that shares grant information and encourages partnerships among stakeholders.	Ÿ Raises awareness of grant opportunities Ÿ Fosters intermunicipal cooperation Ÿ May increase likelihood of awards	Ÿ Subject availability of funding	$5,000 - $7,000	Aquifer: Project specific Surface Water: Project specific
Enterprise accounts— Municipalities should consider establishing fee-for-service, enterprise funds, and utilities in order to provide a reliable revenue stream to manage and improve	Provides a predictable source of	Ÿ Requires new enforceable policy Ÿ May be unpopular with voter	$10,000 - $20,000	Aquifer: High Surface Water: High

Recommendation	Advantages	Implementation Issues	Range of Implementation Cost per Municipality[a]	Relative Protection Anticipated
their infrastructure.				
Coordination and Tech Transfer				
Continue to meet with Plymouth-Carver Aquifer Advisory Committee and share ideas for protection of the Plymouth-Carver Aquifer	Ÿ Fosters intermunicipal cooperation Ÿ Encourages earmark financial support Ÿ Provides means for highest level of consistent aquifer protection	Requires continued trust	Uncertain	Aquifer: Very High Surface Water: Very High
Public Outreach for Target Audiences				
Developers— Municipalities should use the land-use regulation process to educate developers as to state-of-the-art regulatory, financial, and environmental conservation techniques and their benefits.	Ÿ Fosters cooperation and awareness Ÿ Awareness is usually required for desired action to occur	Uncertain benefits	$10,000 - $20,000	Aquifer: Uncertain Surface Water: Uncertain
Farmers--Trade associations, municipalities, and farmers should coordinate to ensure that best management practices for water quantity and water quality are implemented.	Ÿ Fosters cooperation and awareness Ÿ Awareness is usually required for desired action to occur	Uncertain benefits	$5,000 - $10,000	Aquifer: Uncertain Surface Water: Uncertain
General public-- The Plymouth-Carver Aquifer Advisory	Ÿ Fosters cooperation and	Uncertain benefits	$10,000 - $20,000	Aquifer: Uncertain Surface Water:

Recommendation	Advantages	Implementation Issues	Range of Implementation Cost per Municipality[a]	Relative Protection Anticipated
Committee should develop a public outreach message that can be used generally and adapted for target audiences.	awareness Ÿ Awareness is usually required for desired action to occur			Uncertain
Water suppliers-- The Plymouth-Carver municipalities should partner with water suppliers to encourage conservation and should use water suppliers as a channel to water users for appropriate water conservation messages.	Ÿ Fosters cooperation and awareness Ÿ Awareness is usually required for desired action to occur	Uncertain benefits	$5,000 - $10,000	Aquifer: Uncertain Surface Water: Uncertain
Elementary and high school curricula on aquifer protection-- Municipalities should include aquifer protection as part of their public school curricula.	Ÿ Fosters cooperation and awareness Ÿ Awareness is usually required for desired action to occur Ÿ Fosters long-term success	Uncertain benefits	$10,000 - $20,000	Aquifer: Uncertain Surface Water: Uncertain

Notes

a. Costs are provided for a single municipality. Costs for a group of municipalities would be likely to achieve economies of scale, reducing unit cost.
b. "Uncertain" means that a cost or benefit is unknown due as the recommendation refers to undertaking a project of unknown size at an unknown location.
c. "Project specific" means that benefit will depend on the size and extent of a project, which is undefined at this time.

8.0 SHARED STANDARDS AND INTERGOVERNMENTAL COOPERATION IN PCA

All who have participated in the PCAAC to date see tremendous value in maintaining open communication with each other and in coordinating efforts to protect this shared resource. We anticipate and recommend that the PCAAC continue to meet into the future. Implementation of the ideas captured in this Action Plan can be one goal the Committee may address. The Committee could provide a forum for outreach and education to targeted audiences, such as developers, or specific business groups. The viability of the Plymouth-Carver Aquifer in perpetuity is a goal all the participants share.

Consistency of policy is *at best* improbable without routine structured communication. We believe continued cooperation between the communities is critical to protect the Plymouth-Carver Aquifer (*see also Coordination and Tech Transfer below*). We strongly recommend formulation and continued improvement of aquifer protection policy under the auspices of the PCAAC. As a starting point, we recommend that:

- Municipalities of the PCAAC work together to develop an areawide open space protection plan. This plan should encourage municipal and partner-organization protection of unfragmented open space for the purposes of maintaining recharge to the aquifer, base stream flow, and critical habitat areas.

- Building on work from the PCAAP, we recommend development of model bylaw(s) that include topics such as low impact development, soil erosion and sediment control, stormwater management, aquifer protection, sand and gravel operations, decentralized wastewater management, and related utilities (i.e., stormwater and wastewater utilities).

Efforts should also focus on:

- Work with the cranberry growers and other farmers to develop a plan of work and implementation schedule to address water quality and water withdrawal issues of interest to both the growers and the PCAAC related to the health and sustainability of the Plymouth-Carver Aquifer and agriculture in the region.

- Development of policy and public education approach to encourage water conservation and water quality protection through appropriate landscape, water, and grounds management.

- Exploration of water withdrawal policy for the Plymouth-Carver Aquifer region. Identify specific water withdrawal concerns for the region (e.g., exportation of water outside the recharge area, prioritizing users, withdrawal rights, etc.).

APPENDIX A

USEPA SOLE SOURCE AQUIFER NOTICE

Plymouth/Carver FR

EPA NE Home
A-Z Index

Drinking Water Program Home
New England's Drinking Water
Drinking Water Laws & New Regulations
Private Well Owners
Preventing Contamination
Ground Water Discharges
Source Water Assessment Program
Wellhead Protection Program
Sole Source Aquifer Program
Water Conservation
Drinking Water Security
Pandemic Preparedness for Drinking Water Systems
Your Drinking Water Source
EPA, State, & Other Contacts
EPA Funding for Drinking Water Activities
Hot Topics / New Initiatives
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(Cite as: 55 FR 32137)

NOTICES

ENVIRONMENTAL PROTECTION AGENCY

[FRL-3817-7]

Sole Source Aquifer Designation for the Plymouth-Carver Aquifer, Massachusetts

Tuesday, August 7, 1990

AGENCY: U.S. Environmental Protection Agency (EPA).

ACTION: Notice.

SUMMARY: In response to a petition from the Massachusetts Department of Environmental Protection (DEP), Division of Water Supply (DWS), the Town of Kingston, and the Plymouth County Coalition for a Better Environment, notice is hereby given that the Regional Administrator, Region I, of the U.S. Environmental Protection Agency (EPA) has determined that the Plymouth-Carver Aquifer satisfies all determination criteria for designation as a sole source aquifer, pursuant to section 1424(e) of the Safe Drinking Water Act. The designation criteria include the following: Plymouth-Carver Aquifer is the principal source of drinking water for the residents of that area; there are no reasonably available alternative sources of sufficient supply; the boundaries of the designated area and project review area have been reviewed and approved by EPA; and if contamination were to occur, it would pose a significant public health hazard and a serious financial burden to the area's residents. As a result of this action, all federal financially assisted projects proposed for construction or modification within the Plymouth-Carver Aquifer will be subject to EPA review to reduce the risk of ground water contamination from these projects which may pose a threat to the health of persons in the acquifer's service area.

DATES: This determination shall be promulgated for purposes of judicial review two weeks after publication in the Federal Register.

ADDRESSES: The data upon which these findings are based are available to the public and may be inspected during normal business hours at the U.S.

Environmental Protection Agency, Region I, J.F. Kennedy Building, Water Management Division, GWP-2113, *32138 Boston, MA 02203. The designation petition submitted may also be inspected at EPA Region I, or the Plymouth Public Library in Plymouth, or the Carver Public Library in Carver, Massachusetts.

FOR FURTHER INFORMATION CONTACT: Robert E. Adler, Ground Water Management Section, Water Management Division, EPA Region I, J.F. Kennedy Building, WGP- 2113, Boston, MA 02203, and the phone number is 617-565-3600.

SUPPLEMENTARY INFORMATION: .

I. Background

Section 1424(e) of the Safe Drinking Water Act (42) U.S.C. section 300h-3(e), Public Law 93-523, states:
If the administrator determines, on his own initiative or upon petition, that an area has an aquifer which is the sole or principal drinking water source for the area and which, if contaminated would create a significant hazard to public health, he shall publish notice of that determination in the Federal Register. After the publication of any such notice, no commitment for Federal financial assistance (through a grant, contract, loan guarantee or otherwise) may be entered into for any project which the Administrator determines may contaminate such aquifer through a recharge zone so as to create a significant hazard to public health, but a commitment for federal financial assistance may, if authorized under another provision of law, be entered into to plan or design the project to assure that it will not so contaminate the aquifer.
On April 7, 1989, EPA received a petition from the Massachusetts DEP requesting designation of the Plymouth-Carver Aquifer as a sole source aquifer. EPA determined that the petition, after receipt and review of additional requested information, fully satisfied the Completeness Determination Checklist. A public hearing was then scheduled and held on January 10, 1990 in Plymouth, Massachusetts, in accordance with all applicable notification and procedural requirements. A four week public comment period followed the hearing.

II. Basis for Determination

Among the factors considered by the Regional Administrator as part of the detailed review and technical verification process for designating an area under section 1424(e) were: (1) Whether the aquifer is the sole or principal source (more than 50%) of drinking water for the defined aquifer service area, and that the volume of water from an alternative source is insufficient to replace the petitioned aquifer; (2) whether contamination of the aquifer would create a significant hazard to public health; and (3) whether the boundaries of the aquifer, its recharge area, the project designation area, and the project review view are appropriate. On the basis of technical information availble to EPA at this time, the Regional Administrator has made the following findings in favor of designating the Plymouth-Carver Aquifer as a sole source aquifer:

1. The Plymouth-Carver Aquifer is the sole source of drinking water for nearly all of the residents within the service area.
2. There exists no reasonably available alternative drinking water source or combination of sources of sufficient quantity to supply the designated service area.

3. The petitioners, with EPA assistance, have appropriately delineated the boundaries of the designated aquifer area, the aquifer recharge area, the project review area and the aquifer's service area.
4. Although the quality of the aquifer's ground water is rated as good to excellent, it is highly vulnerable to contamination due to its geological characteristics. Because of this, contaminants can be rapidly introduced into the aquifer system from a number of sources with minimal assimilation. This may include contamination from several sources such as the following: chemical spills; highway, urban and rural runoff; septic systems; leaking storage tanks, both above and underground; road salting operations; saltwater intrusion; and landfill leachate. Since nearly all residents are dependent upon the aquifer for their drinking water, a serious contamination incident could pose a significant public health hazard and place a severe financial burden on the service area's residents.

III. Description of the Plymouth-Carver Aquifer, Designated and Project Review Area

The Plymouth-Carver Aquifer is a 199.0 square mile aquifer located in eight (8) towns in southeastern Massachusetts, primarily in Plymouth County, north of the Cape Cod Canal in Bourne and south of the Jones River in Kingston. Plymouth Bay borders the aquifer on the northeast with Cape Cod Bay bordering the eastern edge. As delineated in this petition, the Cape Cod Canal forms the southeastern border, Buzzards Bay forms the southern border, and the Weweantic River forms the southwestern border. To the west and north, the aquifer is bordered successively by the Weweantic River, Rocky Meadow Brook, Muddy Pond Brook, River Brook, wetland areas, and finally, along the northern border, the Jones River. It includes the entire area of the Towns of Plymouth, Bourne and Sandwich north of the Cape Cod Canal, most of the Towns of Carver and Wareham, substantial portions of Kinston and Plympton, and a small section of the Town of Middleborough (8 towns).
The Plymouth-Carver aquifer exhibits regional ground water flow patterns that are typical of coastal aquifers in eastern Massachusetts. Unlike upland stream-valley aquifer systems in which ground water flow is generally convergent or inward from high elevations of till and bedrock to low elevations within valleys, the flow pattern within the Plymouth-Carver aquifer is divergent, radiating outward from a topographically high area toward low lying bodies of both salt and fresh water. Ground water discharges to steams and the ocean.
The unconsolidated stratified glacial deposits which form the aquifer were deposited during the last retreat of glacial ice about 15,000 years ago. These deposits are saturated with water fed by direct infiltration of precipitation (recharge). The saturated thickness of the aquifer is the entire thickness of the aquifer from the water table to the top of bedrock. Ground water table elevations range from approximately sea level to approximately 125 feet at interior ground-water highs, with the maximum saturated thickness of more than 160 feet at some locations occurring along the axis of the underlying bedrock valley and its tributaries. Average hydraulic conductivities (ability of the aquifer material to transmit water) for stratified sand and gravel, range from 55 to 313 feet/day and average 188 fee/day. These values are consistent with values for similar deposits on nearby Cape Cod. The average rate of recharge to coarse-grained stratified drift is at least 1.15 million gallon/day/square mile (24 inches/year) and to fine-grained deposits is somewhat less.
Ground water in the aquifer system discharges to the many rivers and streams that drain the aquifer, to ponds, swamps, bogs and directly to the ocean. Average ground water discharge leaving the aquifer area as stream flow is about 140 cubit feet/second. All ponds and surface waters within the aquifer

receive nearly all of their recharge from ground water and hence can be considered part of the Plymouth-Carver aquifer system. Much of the water that discharges to swamps and bogs is lost as a result of evaporation, transpirtation, and consumption water use.
The Plymouth-Carver aquifer is quite vulnerable to contamination. Because of its highly permeable and transmissive character, and large size granular materials, ground water contaminants can quickly travel long distances, and affect a large area. The recharge area is characterized by moderate relief. Activities occurring in the upland areas can have direct impact on ground water quality in the rest of the aquifer. The present quality of the water from the aquifer has been characterized as good to excellent. Municipal supply wells in the aquifer area have been affected by relatively few instances of major contamination. There are, however, several instances of local contamination which have occurred at several places in the aquifer.
The designated area is defined as the surface area above the aquifer and its recharge area, which in the case of the Plymouth-Carver aquifer, comprises the project review area as well. The project review area is also the same as the designated area.

IV. Information Utilized in Determination

The information utilized in this determination includes: the petition submitted to EPA Region I by the petitioners; additional information requested from and supplied by the petitioners; written and verbal comments submitted by the public, communities in the region, state legislators; coordination with the U.S. Geological Survey and technical information obtained from them, and the technical papers and maps submitted with the petition. This information is available to the public and may be inspected at the libraries or EPA Region I office identified under the "Addresses" section previously.

V. Project Review

EPA Region I is working with the federal agencies most likely to provide financial assistance to projects in the project review area. Interagency procedures and Memoranda of Understanding have been developed through which EPA will be notified of proposed commitments by federal agencies to projects which could contaminate the Plymouth-Carver Aquifer. EPA will evaluate such projects and, where necessary, conduct an in-depth review, including soliciting public comments when appropriate. Should the Regional Administrator determine that a project may contaminate the aquifer as to create a significant hazard to public health, no commitment for federal financial assistance may be entered into. However, a commitment for federal financial assistance may, if authorized under another provision of law, be entered into for planning or designing a project to ensure that it will not contaminate the aquifer. Included in the review of any federal financially assisted project will be the coordination with state and local agencies and the project's developer. Their comments will be given full consideration and EPA's review will attempt to complement and support state and local ground water protection measures. Although the project review process cannot be delegated, EPA will rely to the maximum extent possible on any existing or future state and/or local control measures to protect the quality of ground water in Plymouth-Carver Aquifer.

VI. Summary and Discussion of Public Comments

Forty five people attended the January 10, 1990 public hearing regarding the Plymouth-Carver Sole Source Aquifer Petition. Many delivered supportive oral comments, but the Town of Plymouth expressed some concern regarding the

implications of a designation on their public works projects. Forty formal comments were made in total during the hearing and the four-week comment period. Comments were received from state legislators, local water supliers and fire districts, local communities, a regional planning agency, environmental interests, etc. All but one of these supported the designation. Questions were raised regarding the following:

1. The location of the northwest corner of the delineated boundary; and
2. The extent and limitations of protection provided by the federal Sole Source Aquifer Program and the need for local government to continue with taking actions to protect the aquifer.

In response to questions about delineation of the designated aquifer area, EPA explained that the aquifer is charaterized by divergent ground water flow from a high ground water table elevation in the interior area of the aquifer. The area along the northwest section of the aquifer is characterized by bogs, wetlands, meandering streams, flat topography, and low ground water gradient. The boundary issue that was raised at the hearing related to the precise placement of the boundary line in specific localized areas. Following explanation of the basis for delineation, no further comments were made. The boundary, as originally proposed in the petition, is the boundary that is delineated in this designation.
EPA responded to comments which expressed concern and confusion that the effectiveness of sole source aquifer designations is limited because only a small part of the development in the designated area will receive federal financial assistance. EPA recognized the limited applicability of the program and acknowledged that a comprehensive ground water protection program must include land use planning and management at the state and local levels as well. The DEP and EPA noted, however, that Massachusetts state regulations for underground storage tanks, site assignment for new solid waste landfills, and for hazardous waste facilities, give added protection by restricting these facilities when sole source aquifers are involved. Also, SSA designation often brings a new awareness locally for protecting resources.
The Town of Plymouth opposed the designation of the aquifer. In its opposition, the Town asserted that the designation will result in more government overview and interference, will delay certain public road improvements to route 44, and will favor an ocean outfall over a land based treatment option in planning for a sewage treatment facility. EPA agreed that the designation would add another layer of review for impacts affecting the quality of ground water in the aquifer. It is noted that such aquifer reviews generally do not hinder or delay projects because the reviews conducted on large projects are in conjunction with federal Environmental Impact Statements (EISs), environmental assessments, or state Environmental Impact Reports (EIRs). EPA routinely participates in the scoping and assessment of EISs and EIRs for major projects. This has been the case in the route 44 improvements. On smaller projects, reviews are generally less complicated, take three to six weeks, and do not cause undue delay. It is also noted that protection of public health is the principal concern of the program. Project delays that result in the protection of public health are favored over project expediency.
In addition to the concern that designation causes local project delays, the Town took the position that a sole source aquifer review is an unnecessary layer of review because local government can "protect its own." At the hearing, EPA observed that if local authorities, state and federal environmental and regulatory agencies are all carrying out their statutory and regulatory duties, the sole source aquifer review will be minimal, and in most cases will be incorporated into the existing environmental review processes.
*32140 In response to the issue that designation of a sole source aquifer would likely favor an ocean outfall option over a land based discharge option in

Plymouth's sewage treatment planning, it is noted that the designation would not necessarily prelude a land based discharge. It is further noted that for land disposal to be allowed, Massachusetts ground water discharge permit regulations would probably require advanced treatment and effluent that would meet Massachusetts drinking water standards. As such, the performance standards would be determined under state regulations and scrutinized by EPA in their implementation.

The Town of Plymouth also expressed concern over the apparent lack of definitive guidelines from EPA governing the sole source aquifer program resulting in confusion and uncertainty. It is noted that EPA has clear and definitive Petitioner Guidance, Reviewer's Guidance, regulations concerning the implementation of the program at the Edwards aquifer, Region II post-designation guidance, relevant applicable state performance requirements, risk assessment capabilities, and others. Notable letters of support were received from state and local governemnts and representatives, water suppliers, environmental organizations and residents. Reasons given for support include: (1) The nearly total dependence of the residents on the aquifer's ground water for their drinking water supply; (2) the fact that there are no reasonably available alternative sources of water, and that proper boundaries have been delineated; (3) growth and development in the Plymouth-Carver region threaten the continued purity of the resource; and (4) the Plymouth-Carver Aquifer's designation as a sole source aquifer would heighten public awareness of the vulnerability of the resource and would encourage further protection efforts.

VII. Findings

Given the information before me, all criteria for designating the Plymouth-Carver aquifer as a sole source aquifer have been met, and the region's aquifer is a resoruce that fully deserves efforts to protect it.

Dated: July 31, 1990.

Julie Belaga,

Regional Administrator.

[FR Doc. 90-18457 Filed 8-6-90; 8:45 am]

BILLING CODE 6560-50-M

55 FR 32137-01, 1990 WL 329590 (F.R.)
END OF DOCUMENT

APPENDIX B

PRESS RELEASES AND MEETING ANNOUNCEMENTS

Plymouth-Carver Aquifer Action Committee
Meeting Announcement

7:00 p.m, Thursday, June 14, 2007
Carver Town Hall—Board of Selectmen Hearing Room, Second Floor
108 Main Street
Carver, Massachusetts

The towns of Plymouth, Carver, Wareham, Bourne, Plympton, Middleborough, and Kingston all depend on the Plymouth-Carver Aquifer as their source of water for household, commercial, and agricultural use as well as recreation! Recognizing the critical nature of the Plymouth-Carver Aquifer, the Massachusetts Legislature voted to create the Plymouth-Carver Aquifer Advisory Committee (PCAAC).

Working with the Executive Office of Energy and Environmental Affairs (EEA), the PCAAC is developing the *Plymouth-Carver Aquifer Action Plan.* The Lakeville consulting engineering firm, Fuss & O'Neill, Inc. has been retained to complete this study and coordinates the monthly meetings of the PCAAC.

Our May meeting included:

- A discussion of progress made on the *Plymouth-Carver Aquifer Action Plan.*
- Dry-run of the presentation for the PCA municipal boards of selectmen.

The next meeting will be held:

Thursday, June 14, 2007
Carver Town Hall –
Board of Selectmen Hearing Room, Second Floor
7:00 p.m.

The meeting will include:

- A discussion of progress made on the Plymouth-Carver Aquifer project.
- Next Steps for the PCAAC.

Attendance by the general public is encouraged.

For further information, please contact Jim Riordan, AICP, project manager, Fuss & O'Neill, Inc. at (508) 946-1747 ext. 4571 or John Clarkeson, Assistant Director of Water Policy for the Executive Office of Energy and Environmental Affairs at (617) 626-1175.

Plymouth-Carver Aquifer Advisory Committee
Meeting Announcement

7:00 p.m, Thursday, May 10, 2007
Carver Town Hall—Board of Selectmen Hearing Room, Second Floor
108 Main Street
Carver, Massachusetts

The towns of Plymouth, Carver, Wareham, Bourne, Plympton, Middleborough, and Kingston all depend on the Plymouth-Carver Aquifer as their source of water for household, commercial, and agricultural use as well as recreation. Recognizing the critical nature of the Plymouth-Carver Aquifer, the Massachusetts Legislature voted to create the Plymouth-Carver Aquifer Advisory Committee (PCAAC).

Working with the Executive Office of Energy and Environmental Affairs (EOEEA), the PCAAC is developing the *Plymouth-Carver Aquifer Action Plan.* The Lakeville consulting engineering firm, Fuss & O'Neill, Inc. has been retained to complete this study and coordinates the monthly meetings of the PCAAC.

Our April meeting included:

- A discussion of progress made on the *Plymouth-Carver Aquifer Action Plan.*
- A discussion of the draft action plan.
- A discussion of the prioritization of options for recommendations.

The next meeting will be held:

Thursday, May 10, 2007
Carver Town Hall –
Board of Selectmen Hearing Room, Second Floor
7:00 p.m.

The meeting will include:

- A discussion of the final *Plymouth-Carver Aquifer Action Plan* and next steps for the PCAAC.
- Selectmen meetings to provide information on the plan.

Attendance by the general public is encouraged.

For further information, please contact Jim Riordan, AICP, project manager, Fuss & O'Neill, Inc. at (508) 946-1747 ext. 4571 or John Clarkeson, Assistant Director of Water Policy for the Executive Office of Energy and Environmental Affairs at (617) 626-1175.

Plymouth-Carver Aquifer Action Committee
Meeting Announcement

7:00 p.m, Thursday, April 12, 2007
Carver Town Hall—Board of Selectmen Hearing Room, Second Floor
108 Main Street
Carver, Massachusetts

The towns of Plymouth, Carver, Wareham, Bourne, Plympton, Middleborough, and Kingston all depend on the Plymouth-Carver Aquifer as their source of water for household, commercial, and agricultural use as well as recreation! Recognizing the critical nature of the Plymouth-Carver Aquifer, the Massachusetts Legislature voted to create the Plymouth-Carver Aquifer Advisory Committee (PCAAC).

Working with the Executive Office of Environmental Affairs (EOEA), the PCAAC is developing the *Plymouth-Carver Aquifer Action Plan.* The Lakeville consulting engineering firm, Fuss & O'Neill, Inc. has been retained to complete this study and coordinates the monthly meetings of the PCAAC.

Our March meeting included:

- A discussion of progress made on the *Plymouth-Carver Aquifer Action Plan.*
- An interactive discussion to work towards development of appropriate recommendations for inclusion in the action plan.

The next meeting will be held:

Thursday, April 12, 2007
Carver Town Hall –
Board of Selectmen Hearing Room, Second Floor
7:00 p.m.

The meeting will include:

- A discussion of progress made on the *Plymouth-Carver Aquifer Action Plan.*
- A discussion of the draft action plan.
- A discussion of the prioritization of options for recommendations.

Attendance by the general public is encouraged.

For further information, please contact Jim Riordan, AICP, project manager, Fuss & O'Neill, Inc. at (508) 946-1747 ext. 4571 or John Clarkeson, Assistant Director of Water Policy for the Executive Office of Environmental Affairs at (617) 626-1175.

Plymouth-Carver Aquifer Action Committee
Meeting Announcement

7:00 p.m, Thursday, March 8, 2007
Carver Town Hall—Board of Selectmen Hearing Room, Second Floor
108 Main Street
Carver, Massachusetts

The towns of Plymouth, Carver, Wareham, Bourne, Plympton, Middleborough, and Kingston all depend on the Plymouth-Carver Aquifer as their source of water for household, commercial, and agricultural use as well as recreation! Recognizing the critical nature of the Plymouth-Carver Aquifer, the Massachusetts Legislature voted to create the Plymouth-Carver Aquifer Advisory Committee (PCAAC).

Working with the Executive Office of Environmental Affairs (EOEA), the PCAAC is developing the *Plymouth-Carver Aquifer Action Plan.* The Lakeville consulting engineering firm, Fuss & O'Neill, Inc. has been retained to complete this study and coordinates the monthly meetings of the PCAAC.

Our February meeting included:

- A presentation on dewatering and the impacts of earth removal activities on groundwater levels.
- A presentation on progress made on the *Plymouth-Carver Aquifer Action Plan.* As of February, progress included development of a webpage to post information and materials regarding the PCAAC:

  http://www.fando.com/index.cfm/SiteMap/Plymouth-Carver_Aquifer_Action_Plan)

  Collection of data on the aquifer through literature search and interviews with local stakeholders.
- A presentation on the development of the first of two reports, which will lead to development of the Action Plan.

The next meeting will be held:

Thursday, March 8, 2007
Carver Town Hall –
Board of Selectmen Hearing Room, Second Floor
7:00 p.m.

The meeting will include:

- A discussion of progress made on the *Plymouth-Carver Aquifer Action Plan.*
- An interactive discussion to work towards development of appropriate recommendations for inclusion in the action plan.

Attendance by the general public is encouraged.

For further information, please contact Jim Riordan, AICP, project manager, Fuss & O'Neill, Inc. at (508) 946-1747 ext. 4571 or John Clarkeson, Assistant Director of Water Policy for the Executive Office of Environmental Affairs at (617) 626-1175.

Plymouth-Carver Aquifer Action Committee
Meeting Announcement

7:00 p.m., Thursday, February 8, 2007
Carver Town Hall
108 Main Street
Carver, Massachusetts

The towns of Plymouth, Carver, Wareham, Bourne, Plympton, Middleborough, and Kingston all depend on the Plymouth-Carver Aquifer as a source of potable water. Recognizing the critical nature of the Plymouth-Carver Aquifer, the Massachusetts Legislature, through the leadership of Senators Murray and Pacheco, voted to create the Plymouth-Carver Aquifer Advisory Committee (PCAAC).

Working with the Executive Office of Environmental Affairs (EOEA), PCAAC is developing the *Plymouth-Carver Aquifer Action Plan*. The Lakeville consulting engineering firm, Fuss & O'Neill, Inc. has been retained to complete this study and will coordinate monthly meetings of PCAAC.

- Our January meeting included a presentation on the USGS study being conducted on the Plymouth-Carver Aquifer hydrogeology. The primary objective of the USGS Plymouth-Carver investigation is to develop, calibrate, and apply a new ground-water-flow model of the region to evaluate the effects of (1) potential future ground-water withdrawals, (2) seasonal variations in ground-water pumping and aquifer recharge, and (3) extended periods of drought on the ground-water flow system and on the sources of water to public-supply wells and streams. The flow model also will be used to delineate areas contributing recharge to supply wells and streams, along with selected ponds and coastal estuaries.

The next meeting will be held:

Thursday, February 8, 2007
Carver Town Hall
7:00 p.m.

The meeting will include:

- A presentation on dewatering and the impacts of earth removal activities on groundwater levels.
- A discussion of progress made on the *Plymouth-Carver Aquifer Action Plan*. Progress to date includes development of a webpage to post information and materials regarding the PCAAC (http://www.fando.com/index.cfm/SiteMap/Plymouth-Carver_Aquifer_Action_Plan); collection of data on the aquifer through literature search and interviews with local stakeholders; development of the first of two reports, which will lead to development of the Action Plan.

Attendance by the general public is encouraged.

For further information, please contact Jim Riordan, AICP, project manager, Fuss & O'Neill, Inc. at (508) 946-1747 ext. 4571 or John Clarkeson, Assistant Director of Water Policy for the Executive Office of Environmental Affairs at (617) 626-1175.

Plymouth-Carver Aquifer Action Committee
Meeting Announcement

7:00 p.m., Thursday, January 11, 2007
Carver Town Hall
108 Main Street
Carver, Massachusetts

The towns of Plymouth, Carver, Wareham, Bourne, Plympton, Middleborough, and Kingston all depend on the Plymouth-Carver Aquifer as their principal source of water. Recognizing the critical nature of the situation of the Plymouth-Carver Aquifer as potable supply, the Massachusetts Legislature, through the leadership of Senators Murray and Pacheco, voted to create the Plymouth-Carver Aquifer Advisory Committee (PCAAC).

Working with the Executive Office of Environmental Affairs (EOEA), PCAAC is developing the *Plymouth-Carver Aquifer Action Plan*. The Lakeville consulting engineering firm, Fuss & O'Neill, Inc. has been retained to complete this study and will coordinate monthly meetings of PCAAC.

The December meeting included a presentation on Strategies and Regulatory Parameters for Water Resource Protection. Open discussion in the meeting resulted in the following points of agreement:

- The *Plymouth-Carver Action Aquifer Plan* should provide the PCAAC communities with flexible options and adaptive-management approaches for protection of the aquifer.
- The PCAAC should establish a method for adjacent towns to cooperate on policy and land development issues.

The next meeting will be held:

Thursday, January 11, 2007
Carver Town Hall
7:00 p.m.

The meeting will focus on the following topics:

- The USGS study being conducted on the Plymouth-Carver Aquifer hydrogeology: The Massachusetts Department of Environmental Protection and the United States Geological Survey have begun a three-year investigation to improve the understanding of the water resources of the Plymouth-Carver region. The extensive sand and gravel aquifer that underlies this region extends across watershed boundaries typically used by State water-resource managers in planning and protection efforts. The primary objective of the USGS Plymouth-Carver investigation is to develop, calibrate, and apply a new ground-water-flow model of the region to evaluate the effects of (1) potential future ground-water withdrawals, (2) seasonal variations in ground-water pumping and aquifer recharge, and (3) extended periods of drought on the ground-water flow system and on the sources of water to public-supply wells and streams. The flow model also will be used to

delineate areas contributing recharge to supply wells and streams, along with selected ponds and coastal estuaries.

- Progress made on the *Plymouth-Carver Aquifer Action Plan*.

Attendance by the general public is encouraged.

For further information, please contact Jim Riordan, AICP, project manager, Fuss & O'Neill, Inc. at (508) 946-1747 ext. 4571 or John Clarkeson, Assistant Director of Water Policy for the Executive Office of Environmental Affairs at (617) 626-1175.

Plymouth-Carver Aquifer Action Committee
Meeting Announcement

7:00 p.m., Thursday, December 14, 2006
Carver Town Hall
108 Main Street
Carver, Massachusetts

Predicted to increase by 200,000 residents by the year 2020, the Southeast Massachusetts area anticipates enormous change over the coming years. This prediction has led members of the Plymouth County communities to consider a number of rather daunting questions including whether the Plymouth-Carver Aquifer can reliably support the potable water needs of 200,000 new residents?

The towns of Plymouth, Carver, Wareham, Bourne, Plympton, Middleborough, and Kingston all depend on the Plymouth-Carver Aquifer as their principal source of water. Recognizing the critical nature of the situation of the Plymouth-Carver Aquifer as potable supply, the Massachusetts Legislature, through the leadership of Senators Murray and Pacheco, voted to create the Plymouth-Carver Aquifer Advisory Committee (PCAAC)

Working with the Executive Office of Environmental Affairs (EOEA), PCAAC will develop the *Plymouth-Carver Aquifer Action Plan*. The Lakeville consulting engineering firm, Fuss & O'Neill, Inc. has been retained to complete this study and will coordinate monthly meetings of PCAAC. The next meeting will be held:

Thursday, December 14, 2006
Carver Town Hall
7:00 p.m.

The meeting will focus on the following topics:

- General introduction to process of developing the *Plymouth-Carver Aquifer Action Plan.*
- Strategies and regulatory parameters for water resource protection for state and local governance, including but not limited to, the reuse of effluent, stormwater management resource protection model by-laws, and multiple community strategies in use elsewhere.

Attendance by the general public is encouraged.

For further information, please contact Jim Riordan, AICP, project manager, Fuss & O'Neill, Inc. at (508) 946-1747 ext. 4571.

APPENDIX C

MEETING SUMMARIES

FUSS & O'NEILL

MEMORANDUM

TO: Plymouth-Carver Aquifer Advisory Committee Meeting

FROM: Jim Riordan, Fuss & O'Neill

DATE: July 12, 2007

RE: Meeting Summary for June 14, 2007 Committee Meeting

Attendees:
(See attached sign-in list)

Opening
Jim Riordan opened the meeting. Attendees were asked to introduce themselves to the group by name and affiliation. He reviewed the agenda and noted that the meeting would focus on prioritizing recommendations.

Summary of Progress
Jim Riordan gave a summary of progress on the project.

As of the time of the meeting, progress included:

- Completion of 40 interviews including interviews with representatives of all the major water suppliers and sewer service providers in the Plymouth-Carver Aquifer area as well as all the study area municipalities.
- Entry of all available annual statistical report (ASR) data for the Plymouth-Carver area municipalities and verification of MassGIS data for area water suppliers and sewer service. Additional data entry has also be provided for small water suppliers (WMAs).
- Continued hosting of Plymouth-Carver Aquifer Advisory Committee website, which is on the Fuss & O'Neill, Inc. Lakeville Office webpage. Although not included in the project scope of work, a webpage was requested by attendees of the December PCAAC meeting.
- Three press releases for each of the first three meetings were prepared per the project scope of work. Meeting announcements have been prepared for each subsequent meeting. Additionally, two on-the-air interviews have been conducted with Christine James of WATD FM.
- The final report has been developed and posted on the web. Technical Memorandum 1 (TM1) was completed and has been distributed to the PCAAC. It has also been posted to the PCAAC website and can be accessed at:

  http://www.fando.com/documents/TM1DRAFT.pdf

- Meetings have been held with Boards of Selectmen in the PCA towns as follows:

Town	Status	Meeting Date
• Bourne	Scheduled	6/26/07
• Carver	Completed	5/22/07
• Kingston	Completed	6/5/07
• Middleborough		
• Plymouth	Completed	6/12/07
• Plympton	Completed	5/29/07
• Wareham	Completed	5/15/07

Next Steps for the PCAAC
John facilitated a discussion of next steps for the PCAAC. John recounted the priorities identified in previous PCAAC meetings, which include:

- Establishing consistency in municipal code as discussed in the PCA plan.
- Development of an areawide open space plan.
- Continued outreach using PCAAC meetings and meetings with interested parties such as the Cape Cod Cranberry Growers.

John suggested the following basic approach for purposes of discussion:

- Review municipal bylaws and develop specific recommendations by January. (This would be intended to build on the work already done in the PCA plan.)
- Reproduce the PCA brochure and make it available as a basic outreach tool.
- Develop an areawide open space plan involving conservation commissions and planning boards.
- Develop an RFR for the aforementioned tasks through a PCAAC meeting.

John asked attendants to offer their own recommendations and suggestions. The following suggestions and comments were made by municipal designees and other attendants:

- Consider how to use TDR more effectively for protection of land areas and identify what land areas should be protected. (Wareham)
- Areawide open space protection plan is the principal priority. (Plymouth and Carver)
- Enhancement of existing bylaws is a principal priority. (Bourne)
- Consider holding a planning board summit. (Wareham)

During open discussion the group at large suggested that:

- Open space planning should involve:
  - Land trusts
  - Conservation commissions
  - Planning Boards
  - Agricultural commissions
  - Open space committees
- Outreach should include:
  - Work with schools (e.g., Project Wet), mini Envirothon.
  - Inventorying what's already been done in the area.
  - Targeted education and outreach to board members, policy makers and voters.
- Consider adding a designee from each of the PCA towns.
- We need to perpetuate the work of the PCAAC.
- Although likely to be expensive, consider developing an advertisement campaign, which could be initiated through a pilot program.

Next Meeting

A meeting is planned for 7:00 pm on July 12, 2007 in the Carver Town Hall. This meeting will focus on development of the FY08 Workplan.

PCAAC Sign-In

June 14, 2007

Name	Affiliation
Jim Riordan	Fuss & O'Neill
Dean Avdet	" "
David Gould	Plymouth
Robb Johnson	TNC
Brendan Mullaney	Bourne
Casey Shetterly	TNC
Claire Dedoid	Carver
FRANK MUSCATO	CARVER
DICK WARD	CARVER
Brian Wick	CCCGA
Marjorie Teitelbaum	Wareham
John Clarkson	Energy & Environmental Affa
BOB SCHREIBER	CDM
Sarah Hewins	Carver Delegate
Robin Carver	AD Makepeace

FUSS & O'NEILL

MEMORANDUM

TO: Plymouth-Carver Aquifer Advisory Committee Meeting

FROM: Jim Riordan, Fuss & O'Neill

DATE: February 25, 2007

RE: Meeting Summary for January 11, 2007 Committee Meeting

Attendees:
(See attached sign-in list)

Opening
John Clarkson opened the meeting. He reviewed the agenda and introduced the evening speakers. Attendees were asked to introduce themselves to the group by name and affiliation.

Summary of Progress
Jim Riordan gave a brief summary of progress on the project. As of the time of the meeting, this included completion of 14 interviews and initiation of development of the water balance database and Plymouth-Carver Aquifer website, which is to be hosted on the Fuss & O'Neill, Inc. Lakeville Office webpage.

USGS Presentation—Water Resources Analysis for the Plymouth-Carver Region
Paul Blain (MADEP), Joe Cerutti (MADEP), and John Masterson (USGS) presented the project they are initiating to determine the effects on groundwater flow from anticipated future withdrawals, season variations in pumping and recharge, and drought conditions. Towns in the study area include Duxbury, Kingston, Plymouth, Carver, Wareham, Marshfield, Bourne, Pembroke, Halifax, Plympton, Middleborough.

They discussed the theory behind the potential for groundwater extraction to affect water levels in nearby surface waters and wells. They will examine questions such as (a) do groundwater divides shift in response to changes in pumping? (b) What is the effect of converting self-supplies to public supplies? (c) What is the effect of converting domestic septic to centralized wastewater disposal? (d) What is the effect on surface waterbodies from changes in pumping?

The study will include three simulation periods—1985, 2005, and 2025. The study will reexamine the USGS Scientific Investigations Report from 2004.

USGS anticipates conducting the study in three phases with completion scheduled for June 2008. They anticipate completing the first phase in June 2007. As the USGS study will be completed after the Plymouth-Carver Aquifer Action Plan project completion date, we do not expect to include their findings in the action plan.

A copy of the PowerPoint that USGS presented can be found at http://www.fando.com/documents/USGS_PCAAC.ppt

FUSS & O'NEILL

Sign-In
Plymouth-Carver Aquifer Advisory Committee Meeting
January 11, 2007

Name	Email/Phone #	Address
Dean Auter Fuss & O'Neill	dauter@fando.com 508-947-1355 x4560	Fuss & O'Neill
Jim Riordan	jriordan@fando.com x 4571	Fuss & O'Neill
Peter Newton SEA	Peter.Newton@seacon.com 508-743-7882	SEA
Jay Tamagini	ejaytam verizon.net	Wareham Fire District Water Dept
Dave Harwood Stantec	Dave.Harwood@stantec.com	Westford, MA
Robb Johnson	rjohnson@pnc.org	PNC Plymouth
Claire Dehoid	Box 17 N. Carver, MA 02355	1-508-866-3387
Michael Bumpus	Bumpus123@Comcast.net 508 866-5048	So. Carver, MA
Kevin Klein Norfolk Ran Group	KKlein@norfolkran.com (508) 747-7900 ext 130	
Brendan Mullaney Town of Bourne	bmullaney@townofbourne.com 508.759.0615 x344	24 Perry Ave. B. Bay, MA 02532

743.3003

FUSS & O'NEILL

Name	Email/Phone #	Address
Bob Conway	beonway@admakepeace.com	SNAPPITT RD CARVER MASS
JUDITH T. KOHN	jkohn@admakepeace.com	AD MAKE PEACE 158 TIHONET RD WAREHAM MA
BOBBI SISTRUNK	BSISTRUN@CNC.com	CARVER REPORTER
FRANKLIN HARRIS	508-866-7382	P.O. BOX 675 S. CARVER MA 262 TREMONT ST. S CARVER
Brian Wick	bwick@cranberries.org 508-759-1041 x14	3203-B Cranberry Highway East Wareham, MA 02538
JACK OLEARY	jack.oleary@comcast.net 781-585-9462	71 RING RD PLYMPTON MA 02367
Maureen Thomas	mthomas@kingstonmass.org	26 Evergreen Street Kingston, MA 02364
THOMAS BOTT	tbott@kingstonmass.org	TOWN OF KINGSTON 26 EVERGREEN ST KINGSTON MA 02364
CASEY SHETTERLY	cshetterly@tnc.org 508-732-0300 x21	TNC 204 LONG POND RD PLYMOUTH MA 02360
JOHN P. KELLY	john.kelly19@us.army.mil 508-326-2935	290 PLYMOUTH AVE EAST WAREHAM MA 02538
Neal Price	nprice@cape.com 508 833-6600	Horsley & Witten 90 Route 6A Sandwich MA 02563
Paul Blain	paul.blain@state.ma.us	1 Winter St. Boston, MA 01845

FUSS & O'NEILL

Name	Email/Phone #	Address
✓ DAVE DELORENZO	david.delorenzo@state.ma.us 508-245-6187	1 WINTER ST. BSTN 90 RIVERSIDE, CARVILLE
✓ BOB SCHREIBER	schreiberrp@cdm.com 617-452-6251	CDM 50 HAMPSHIRE ST. CAMBRIDGE, MA 02139
✓ MarjorieTeitelbaum	508-295-0131 cell 508-317-7733 marteitel@aol.com	
✓ Andrew Cunningham	AndyCunningham@Verizon.net 508-295-0450x22	2550 Cranberry Hwy. Wareham, MA.
Bill Napolitano	bnap@srpedd.org 508-824-1367 x315	88 Broadway Taunton, MA 02780
✓ Ed Russell	edrussel@aol.com 508 224 2007	725 Long Pond Rd Plymouth MA 02360
✓ Joe Cerutti	joseph.cerutti@state.ma.us 617 292-5859	1 Winter Street Boston, MA 02108
✓ Paul Blain	paul.blain@state.ma.us 617 292-5948	"
John Masterson	jpmaster@usgs.gov (508) 490-5028	10 Bearfoot Rd. Northborough, MA

Name	Representing	Address	email
JACK F HUNTER	DIRECTOR of PLANNING + COMM. DEV.	108 MAIN ST. CARVER	JACK.HUNTER@CARVERMA.ORG
Sarah Hewins	Conservation Agent	108 main St., Carver 02330	sarah.hewins@carverma.org
David Gould	Environmental Manager	11 Lincoln St Plymouth	dgould@townhall.plymouth.ma.us
FRANK MUSCARO	CARVER BOARD OF SELECTMEN	PO BOX 1211 CARVER	FRANKMUSC@VERIZON.NET
Brendan Mullaney	Bourne Cons. Agent	24 Perry Ave. B. Bay, MA 02532	bmullaney@townofbourne.com
Fred D Swenson	Kingston Water	9 Smelt Pond Rd	

FUSS & O'NEILL

MEMORANDUM

TO: Plymouth-Carver Aquifer Advisory Committee Meeting

FROM: Jim Riordan, Fuss & O'Neill

DATE: February 25, 2007

RE: Meeting Summary for February 8, 2007 Committee Meeting

Attendees:
(See attached sign-in list)

Opening
Jim Riordan opened the meeting. Attendees were asked to introduce themselves to the group by name and affiliation. He reviewed the agenda and introduced the evening speakers.

Summary of Progress
Jim Riordan gave a summary of progress on the project. A PowerPoint of the project progress is available at:

http://www.fando.com/documents/Presentation020807(intro&status).ppt.

As of the time of the meeting, progress included:

- Completion of 30 interviews including interviews with representatives of all the major water suppliers and sewer service providers in the Plymouth-Carver Aquifer area as well as all the study area municipalities. While this fulfills the number of interviews required under the PCAAC scope of work, Jim noted that Fuss & O'Neill intends to conduct additional interviews with private entities.
- Entry of all available annual statistical report (ASR) data for the Plymouth-Carver area municipalities and verification of MassGIS data for area water suppliers and sewer service. This included some data outside the study area. Executive Office of Environmental Affairs (EOEA) has identified additional ASR data that Fuss & O'Neill will also enter. Fuss & O'Neill delivered the water balance database to EOEA and Nigel Pickering, who will conduct the water balance for this project.
- Establishment of Plymouth-Carver Aquifer Advisory Committee website, which is hosted on the Fuss & O'Neill, Inc. Lakeville Office webpage. Although not included in the project scope of work, a webpage was requested by attendees of the December PCAAC meeting.
- Three press releases for each of the first three meetings were prepared per the project scope of work. Additionally, an on-the-air interview was conducted with Christine James of WATD FM.
- Technical Memorandum 1 (TM1) was completed and has been distributed to the PCAAC. It has also been posted to the PCAAC website and can be accessed at:

http://www.fando.com/documents/TM1DRAFT.pdf

Discussion
Meeting attendees raised concerns regarding the potential for private landowners to extract water for sale. One attendee discussed introduction of legislation to prohibit private water sales. Other attendees pointed out that cranberry farmers are the largest users of water.

Fuss & O'Neill explained that the current project is for development of an action plan. While the action plan could discuss or recommend enforceable policy, enforcement and development of policy is outside the scope of the project. Future project could potentially include this work. Whether or not municipalities have the authority to regulate water withdrawal under current state regulation needs to be explored.

Fuss & O'Neill explained that although the interviews required under the scope of work for the action plan have been conducted, that additional interviews will be conducted. Brian Wick of the Cranberry Growers Organization offered to assist in coordinating such a meeting.

Technical Memorandum 1
Jim Riordan presented TM1 to meeting attendees. TM1 is available at:

http://www.fando.com/documents/TM1DRAFT.pdf

The PowerPoint presentation for TM1 is available at:

http://www.fando.com/documents/Presentation020807(TM1).ppt

TM1 includes information as outlined below:

1.0 INTRODUCTION
- 1.1 Background
- 1.2 Hydrogeology of PCA Area
- 1.3 Forecasts for PCA

2.0 PCAAC
- 2.1 Formation
- 2.2 Legislative Mandate

3.0 INTERVIEWS
- 3.1 Methodology
- 3.2 Interviewees

4.0 MUNICIPAL DOCUMENT REVIEW

5.0 LITERATURE REVIEW
- 5.1 Bylaws and Other Enforceable Policy
- 5.2 Intergovernmental Approaches
- 5.3 Protection Plans
- 5.4 Performance Standards
- 5.5 Findings and Recommendations

Fuss & O'Neill requests comments on TM1 by February 28.

Discussion
The Carver delegate, Sarah Hewins, pointed out that Carver has a sand and gravel bylaw as well as an aquifer overlay district. She stated that wetlands regulation should be reviewed as part of this project as they include stormwater management.

Jim Riordan indicated that some bylaws and regulations were collected during interviews, but not in time to be included in TM1. These will be included as part of the final report.

Bill Napolitano of SRPEDD pointed out that SRPEDD developed an analysis of local policy. He also pointed that they developed a position paper on the effects of sand and gravel extraction on groundwater. Fuss & O'Neill requested that they receive copies. Some good examples of action plans include:

- Mattapoissett River Valley Advisory Committee.
- Canoe River Aquifer Advisory Committee.

Attendees discussed the need for strong communication between planners, water supply directors and selectman.

Attendees also discussed the need to schedule meetings with town boards of selectman as soon as possible in order to ensure that occur within the period of the project scope of work.

Fuss & O'Neill indicated that they will be developing recommendations for review and comment to be discussed at the next PCAAC meeting. Delegates and other interested parties should provide comments on TM1 at their earliest convenience. Fuss & O'Neill will begin scheduling meetings.

Impacts of Sand and Gravel Extraction on Groundwater
David Foss of Fuss & O'Neill presented on the effects of sand and gravel extraction on groundwater supply. The PowerPoint presentation he gave is available on the PCAAC webpage at:

http://www.fando.com/documents/Presentation_020807(Foss_Geol&dewater).ppt.

He discussed the nature of the geology in the Plymouth-Carver Aquifer area and that current geologic features and soil types were formed during the last glaciation. Soil in the area comprises primarily sand and gravel deposits. ideal for commercial purposes. The soils conduct water very freely, compared to other soil types, with relatively high rates of hydraulic conductivity. These conditions provide for excellent water yields, but also make the aquifer susceptible to contamination by chemical spill.

Gravel pits often intercept the groundwater table exposing the aquifer to direct contamination. Due the high transmissivity (tendency of water to pass through a material) of Plymouth-Carver Aquifer soils, commercial or industrial dewatering can have immediate and wide-ranging effects. This is similar to the effect of pumping a well at a high rate.

Discussion

- Attendees discussed that Carver has a sand and gravel bylaw.
- SRPEDD has developed a position paper on sand and gravel extraction.
- Attendees expressed concerns about aquifer susceptibility.

Next Meeting
Thursday, March 8, 2008
7:00 p.m.
Carver Town Hall

This meeting will focus on developing recommendations for the Plymouth-Carver Aquifer Action Plan.

FUSS & O'NEILL

Sign-In
Plymouth-Carver Aquifer Advisory Committee Meeting
~~January 11, 2007~~ Feb 12, 2007

Name	Email/Phone #	Address
Deon Audet	No need to provide it we already have.	Fuss & O'Neill
Robb Johnson		Nature Conservancy
Peter Newton		SEA
Maureen Thomas		Kingston
Brendan Mullaney		BOURNE
David Gould		Plymouth
Ed Russell	508/ 224 2007	"
Casey Shetterly	cshetterly@tnc.org	" TNC
Brian Wick	bwick@cranberries.org	CCCGA East Wareham
Jan + Kevin TRACEY	508-866-2839 thomastracey@ celticweb.com	

FUSS & O'NEILL

Name	Email/Phone #	Address
Bobbi Sistrunk	BSISTRUN@CNC.COM 508-591-6613	
Sarah Hewins (Carver Delegate)	sarah.hewins @carverma .org	108 Main St. Carver, MA 02330
Judy Ward	rjward@fbconnect.net	20 West St. Carver, MA. 02330
RICHARD WARD	rjward@fbconnect.net 508-866-2829	20 WEST ST. P.O. BOX 74 CARVER, MA. 02330
[illegible] Selectman	[illegible]@AOL.Com 508-866-5509	4 Leonard St. CARVER -
FRANK MOSCATO SELECTMEN CARVER	FRANKMOSC @verizon.net	PO BOX 1211 CARVER 02330
Marjorie Teitelbaum Wareham	marteitel@ aol.com	300 oak St wareham 02571
Bob CONWAY CARVER CONCOM " AG COM HD MAKEPEACE	bconway@ admakepeace.com	SNAPPIT Rd CARVER 02330
Fred Svenson	781-585-2710 781-389-6458	9 Smelt Pond Rd. Kingston Ma
BOB SCHREIBER	617-452-6251 schreiberrp@cdm.com	CDM 50 Hampshire St, Cambridge, MA 02139
David Fuss	DFuss@FANDO.Com 401-861-3070	F+O PROV. RI 02905
Neal Price	nprice@cape.com 508 833-6600	90 Route 6A Sandwich, MA Horsley & Witten

FUSS & O'NEILL

Name	Email/Phone #	Address
JOHANNA LEIGHTON	JMLEIGHTON@COMCAST.NET 508-322-0123	4 WENHAM SHORES DR, CARVER
Alice Cole	acole2@mindspring.com 508 525 2622	20 High No. Carver

FUSS & O'NEILL

MEMORANDUM

TO: Plymouth-Carver Aquifer Advisory Committee Meeting

FROM: Jim Riordan, Fuss & O'Neill

DATE: March 25, 2007

RE: Meeting Summary for March 8, 2007 Committee Meeting

Attendees:
(See attached sign-in list)

Opening
Jim Riordan opened the meeting. Attendees were asked to introduce themselves to the group by name and affiliation. He reviewed the agenda and noted that the meeting would focus on options for recommendations.

Summary of Progress

Jim Riordan gave a summary of progress on the project.

As of the time of the meeting, progress included:

- Completion of 30 interviews including interviews with representatives of all the major water suppliers and sewer service providers in the Plymouth-Carver Aquifer area as well as all the study area municipalities. While this fulfills the number of interviews required under the PCAAC scope of work, Jim noted that Fuss & O'Neill intends to conduct additional interviews with private entities.
- Entry of all available annual statistical report (ASR) data for the Plymouth-Carver area municipalities and verification of MassGIS data for area water suppliers and sewer service.
- Establishment of Plymouth-Carver Aquifer Advisory Committee website, which is hosted on the Fuss & O'Neill, Inc. Lakeville Office webpage. Although not included in the project scope of work, a webpage was requested by attendees of the December PCAAC meeting.
- Three press releases for each of the first three meetings were prepared per the project scope of work. Additionally, two on-the-air interviews have been conducted with Christine James of WATD FM.
- Technical Memorandum 1 (TM1) was completed and has been distributed to the PCAAC. It has also been posted to the PCAAC website and can be accessed at:

  http://www.fando.com/documents/TM1DRAFT.pdf

- Options for recommendations have developed and have been provided to the PCAAC via email.

Options for Recommendations

Jim briefly presented the draft options for recommendations, which he provided in hardcopy to the group. He noted that the options presented were intended as a strawman to encourage discussion and not necessarily as actual recommendations.

Discussion
Attendees offered the following suggestions during open discussion:

Implementing Policy
- Recommendations should indicate where [in what policy] to adopt the recommendations. One suggestion is to include soil erosion and stormwater standards in site plan review guidelines as they can be revised without public promulgation.
- Include references beyond state policy (e.g., low impact development from Prince Georges County).
- Focus recommendations on goals and provide references in another part of the document.
- Increase involvement from boards [this is largely the responsibility of the delegates and alternates].
- There is a need to encourage consistency of policy across political boundaries.
- Recommendations should be prioritized for importance, ease of implementation, and logical order of implementation.

Cranberry Growing and Other Agriculture
- Promote sustainable agriculture.
- Agriculture should be supported because it tends to have a low impact on the aquifer.
- Agriculture does divert water from the nature flow regime.
- How do we encourage growers to use the least amount of water possible?
- Cranberry growers are large users [diverters], but "nonconsumptive" users.
- The term "consumptive" needs to be defined. For example, compared forested land [and other wild and natural lands], cranberry growing is quite consumptive. Also, is cranberry growing less consumptive than residential uses on private wells and onsite wastewater systems?
- Growers should continue to enjoy their current rights to free withdrawal.
- The Cape Cod Cranberry Growers Association and other trade organizations should be the primary conduits of technical information to agriculturalists.
- NRCS technical assistance and CFSA cost-sharing programs should be used to the extent feasible to encourage use of state-of-the-art water quality and water conservation BMPs.

Industrial and Commercial Users
- How do we control heavy industrial and commercial users?
- Concrete plants use large volumes of water.

Aquifer Contamination
- How can towns require LSPs to report and present publicly? Towns could present report findings, but give LSPs opportunity to be present and present their own activities.

Landscape Watering and Grounds Management

- Landscape watering should be eliminated or at least limited.
- How do we encourage use of grey water, water reuse, watering bans, small lawn sizes? What do we do to monitor and educate regarding proper lawn care and grounds maintenance?
- We should encourage public awareness through education to the general public and through public schools.
- Kingston's Indian Pond Estates provides a good demonstration of wastewater reuse for landscape watering.
- Consider techniques used by golf courses and turf farmers.
- Patriot's Stadium is a good demonstration of reuse.

Financial Sanctions

- Consider establishing surcharges, fines, levies, taxes, etc. to go to an enterprise or restricted receipt account for use on compensatory projects. Enforcement and compensatory requirements should come from the parties interested in enforcement and compensation.

Water Withdrawal Policy

- How do we protect against water being exported from the aquifer and region? DEP controls water withdrawals and therefore controls opportunities for revenue generation from those withdrawals.
- How does the state ensure that proposed withdrawals will not jeopardize yield for other local and regional users? The state is developing a "sustainable yield estimator tool"; however, it will not be available for approximately five years.
- The plan should include appropriate withdrawal siting standards.
- Consider the information and recommendations in the Plymouth Water Master Plan.

Next Steps (Project Continuation)

- PCAAC member communities should seek additional funding to continue planning and implementation work.
- For future funding to be viable we need a very clear scope of work.

Next Meeting
Thursday, April 12, 2008
7:00 p.m.
Carver Town Hall

This meeting will focus on the draft Plymouth-Carver Aquifer Action Plan.

FUSS & O'NEILL

MEMORANDUM

TO: Plymouth-Carver Aquifer Advisory Committee Meeting

FROM: Jim Riordan, Fuss & O'Neill

DATE: May 6, 2007

RE: Meeting Summary for April 12, 2007 Committee Meeting

Attendees:
(See attached sign-in list)

Opening
Jim Riordan opened the meeting. Attendees were asked to introduce themselves to the group by name and affiliation. He reviewed the agenda and noted that the meeting would focus on reviewing and prioritizing recommendations.

Summary of Progress
Jim Riordan gave a summary of progress on the project.

As of the time of the meeting, progress included:

- Completion of 40 interviews including interviews with representatives of all the major water suppliers and sewer service providers in the Plymouth-Carver Aquifer area as well as all the study area municipalities.
- Entry of all available annual statistical report (ASR) data for the Plymouth-Carver area municipalities and verification of MassGIS data for area water suppliers and sewer service. Jim noted that development of the water balance is now underway.
- Continued hosting of Plymouth-Carver Aquifer Advisory Committee website, which is on the Fuss & O'Neill, Inc. Lakeville Office webpage. Although not included in the project scope of work, a webpage was requested by attendees of the December PCAAC meeting.
- Three press releases for each of the first three meetings were prepared per the project scope of work. Additionally, two on-the-air interviews have been conducted with Christine James of WATD FM.
- The final report is in development. Technical Memorandum 1 (TM1) was completed and has been distributed to the PCAAC. It has also been posted to the PCAAC website and can be accessed at:

  http://www.fando.com/documents/TM1DRAFT.pdf

- Options for recommendations have developed and have been provided to the PCAAC via email.

Review of Recommendations and Prioritization by Dot-Voting

John led the discussion of recommendations and introduced the concept of dot-voting. He asked members of the audience, one by one, to offer and describe an asset the Plymouth-Carver Aquifer brings as well as a threat to that asset. Jim and John recorded the threats and assets on flip-charts.

Once each member of the audience offered a threat and an asset, adhesive dots were distributed—six to each person—to be used for voting. Voting involved each audience member selecting the threat(s)/asset(s) felt to be most important and prioritizing them by placing between one and six dots on them. Thus, a voter could place six dots on one item, one dot on each of six items, or vote some intermediary combination involving up to six dots and six threat(s)/asset(s).

Threats, assets and dot tallies are presented below:

Threats		**Assets**	
Transportation (due to the development it brings)	3	Wetlands	1
Sand and gravel (because it encourages mining)	2	Open space	5
Impervious surface	5	Year-round stream flow	4
Water exportation	1	Agriculture	2
Habitat fragmentation	3	Water supply	5
Unprotected open space	4	Pine barrens	3
Inconsistency in local zoning	7	Rural character	5
Carver sand (because it creates susceptibility in the aquifer to pollution)	3	Pine Hills	1
Form-A house lots	1	Incentive-based zoning	1
Pollution	3	Habitat connectivity	7
Lack of education	1	Model bylaws	2
Lack of growth control	6	Abundant water	2
Family farms	0	Transportation	0
Well placement	0	Carver sand	0
Artificial drawdown	0	Indigenous plantings	0
Landscape practices	0	Myles Standish and other large open spaces	0
Potential development of Pilgrim Buffer Zone	2	Transfer of development rights	0

John facilitated a discussion of ways to protect assets from identified threats. Through this discussion the group identified two primary recommendations:

1. Development of an areawide open space protection plan for the aquifer.
2. Development of model bylaws as a way to establish consistency between the policies of each town.

Next Meeting
Thursday, April 12, 2008
7:00 p.m.
Carver Town Hall

This meeting will focus on review of the final Plymouth-Carver Aquifer Action Plan and scheduling meetings with the Boards of Selectmen of each Town.

FUSS & O'NEILL

Sign-In
Plymouth-Carver Aquifer Advisory Committee Meeting
April 12, 2007

Name	Email/Phone #	Address
Dean Auder	dauder@fando.com	Fuss & O'Neill
Jim Riordan	jriordan@fando.com	F & O
Brian Wick	bwick@capecodcc.org	CCCGA Wareham
JIM WATSON	OLD COLONY PLANNING COUNCIL JWATSON@OCPCRPA.ORG	70 SCHOOL ST BROCKTON 02301
ALLAN KINGSBURY	ackingsbury@comcast.net	220 TREMONT ST CARVER, MA 02330-1700
Casey Shetterly	cshetterly@tnc.org	TNC
Christine Reardon	824CMR@CapeCod.NET	78 Lakeview Blvd Plymouth, MA 02360
Bobbi Sistrunk	BSISTRUN@CMC.com	182 Standish Ave plymouth
RICHARD WARD	508-866-2829 rjward7@verizon.net	20 WEST ST CARVER, MA. 02330
Sarah Hewins	508.866.3482 sarah.hewins @carverma.org	Conservation 108 main St, Carver, MA 02330

FUSS & O'NEILL

Name	Email/Phone #	Address
Neal Price	508 833-6600 nprice@cfe.com	65 Sawyer St Plymouth
Maureen Thomas	mthomas@kingston mass.org	26 Evergreen St. Kingston, MA 02364
David Gould	dgould@townhall.plymouth ma.us	11 Lincoln St Plymouth, MA 02360
Peter Newton	Peter.Newton@Seacon.com 508.743.7882	404 County St. New Bedford
Robb Johnson	rjohnson@tnc.org	The Nature Conservancy 204 Long Pond Rd. Plymouth, MA ~~02~~ 02360

FUSS & O'NEILL

MEMORANDUM

TO: Plymouth-Carver Aquifer Advisory Committee Meeting

FROM: Jim Riordan, Fuss & O'Neill

DATE: June 2, 2007

RE: Meeting Summary for May 10, 2007 Committee Meeting

Attendees:
(See attached sign-in list)

Opening
Jim Riordan opened the meeting. Attendees were asked to introduce themselves to the group by name and affiliation. He reviewed the agenda and noted that the meeting would focus on reviewing and prioritizing recommendations.

Summary of Progress
Jim Riordan gave a summary of progress on the project.

As of the time of the meeting, progress included:

- Completion of 40 interviews including interviews with representatives of all the major water suppliers and sewer service providers in the Plymouth-Carver Aquifer area as well as all the study area municipalities.
- Entry of all available annual statistical report (ASR) data for the Plymouth-Carver area municipalities and verification of MassGIS data for area water suppliers and sewer service. Some additional data entry will also be provided for small water suppliers (WMAs).
- Continued hosting of Plymouth-Carver Aquifer Advisory Committee website, which is on the Fuss & O'Neill, Inc. Lakeville Office webpage. Although not included in the project scope of work, a webpage was requested by attendees of the December PCAAC meeting.
- Three press releases for each of the first three meetings were prepared per the project scope of work. Meeting announcements have been prepared for each subsequent meeting. Additionally, two on-the-air interviews have been conducted with Christine James of WATD FM.
- The final report has been developed and posted on the web. Technical Memorandum 1 (TM1) was completed and has been distributed to the PCAAC. It has also been posted to the PCAAC website and can be accessed at:

  http://www.fando.com/documents/TM1DRAFT.pdf

Dry-Run of Presentation for Boards of Selectmen

Jim gave a dry-run of the presentation that is planned for each of the PCA Town Boards of Selectmen. Comments were requested and incorporated during the meeting to the extent practicable. In part, comments included:

- Remove directives from the recommendations in the plan (i.e., change "towns should" to "plan recommends that towns").
- Including specific recommendations for each town.
- Making a clear statement of requested next steps for the Boards of Selectmen.
- Changes to some graphics.
- Including an explanation of the scope of the water balance and USGS studies.

Next Meeting
Thursday, June 14, 2008
7:00 p.m.
Carver Town Hall

This meeting will focus on review of the final Plymouth-Carver Aquifer Action Plan and scheduling meetings with the Boards of Selectmen of each Town.

MEMORANDUM

TO: **Plymouth-Carver Aquifer Advisory Committee Meeting**

FROM: Jim Riordan, Fuss & O'Neill

DATE: December 18, 2006

RE: **Meeting Summary**

Attendees:
(See attached sign-in list)

Opening
John Clarkson opened the meeting with a description of the project and introduced Dean Audet and Jim Riordan (Fuss & O'Neill, Inc.) to the commission.

Scope of Services
Dean Audet reviewed Fuss & O'Neill's scope of services with the commission. Dean pointed out the water balance that Fuss & O'Neill had originally planned to do will be completed by the Charles River Watershed Association. This will require that Fuss & O'Neill provides the GIS infrastructure data (e.g., water supply and wastewater) by no later than January 30. As a result, Fuss & O'Neill will focus on collecting GIS data as a priority.

Strategies and Regulatory Parameters for Water Resource Protection

Presentation:
Jim Riordan gave a presentation on strategies and regulatory parameters. The presentation included the following topics:

- Why are we doing an action plan?
- Isn't water a renewable resource?
- How involved do we want to get?
- Who else does aquifer protection?
- What policy tools are available?
- What management techniques are available?
- Q&A: open discussion.

Member Objectives and Introductions:
At the end of the presentation, Robb Johnson suggested that each meeting attendee introduce him/herself and state their primary objective and goals. Below is a summary:

Robb Johnson (The Nature Conservancy)
Primarily interested in seeing development directed to the best location for it.

David Gould (Plymouth)

Brendan Mullaney (Bourne)
Bourne utilizes two water sources. We should engage town planners in the development of this Plymouth-Carver Action Plan (PCAP) Bourne currently implements an overlay district that may be an appropriate model.

Sarah Hewins (Carver)
Carver is almost entirely reliant on septic systems for wastewater disposal and private wells for water supply. She favors use of overlay districts and water conservation. Geolocated storm drains will be very helpful for this project and compliance with Phase II Storm Water. Later, she advocated for consistency in regulations from town to town.

Maureen Thomas (Kington)
Pointed out the importance of watershed protection plans as a source of information for development of the PCAP.

Fred Swenson (Kingstown)
Fred advocated for strong protection of the aquifer and expressed Kingstown's willingness to cooperate.

Bill Napolitano (Southeastern Regional Planning & Economic Development District (SRPEDD))
Bill stated that he was involved in the Sole Source Aquifer designation. He is currently working on development of a cooperative regional entity. Bill also discussed the memorandum of understanding that was recently drafted and an aquifer stewardship brochure, which he described as an aquifer 101.

Tom McLehan (AD Makepeace)
Tom state that Makepeace holds approximately 12,000 acres in the watershed and is the largest cranberry grower.

Neil Price (Horsley & Witten)
Neil stated that he was attending the meeting as a resident of the area and interested observer.

Peter Newton (SEA, New Bedford—representing the Wareham Fire District)

Kevin O'Reilly (Plymouth—interested citizen)

Bobbi Sistrunk (Old Colony, Carver reporter)
Bobbi will cover the commission for the duration of the project.

Open Discussion:
During open discussion the following points were raised by members of the group:

1. Designees have a special level of responsibility and provide two important functions.

    - Make certain that elected officials are well informed regarding commission meetings and commission decisions.
    - Provide a two-way conduit of communication with elected officials.

    Opinions of designees will carry a heavier weight of influence over group decisions.

2. How do we define success? What should the plan include?

    - Members of the group asked John about this specifically. John began by deferring to the group and pointing out that the state has no intent of imposing a particular direction, but that he hoped that the end result would a plan that promotes consistency with Massachusetts Water Policy and the communities have a plan that makes them individually and collectively satisfied (i.e., furthers their goals for water quality protection).
    - The plan should include short-term and long-term goals (e.g., like a master plan). It should discuss what communities are doing now and how well they do it. The plan should include a relatively straight-forward executive summary (simpler is better) and an "encyclopedia of ideas" that provide towns with a broad spectrum of implementation approaches. The plan should address Zone 2 protection. The plan should be easy for each community to buy into. The plan should examine long-term risks (e.g. endocrine disruptors as a future pollutant of concern).
    - The commission should establish a method for adjacent towns to cooperate on policy and development issues.
    - Although not currently addressed in state law, the commission should consider methods to prioritize water uses.
    - Plan should address protection of natural resources that are linked (hydrologically) with the water supply.
    - Regionalization is a "hot potato." Pushing regionalization has the potential to derail the success of the commission.
    - Although a memorandum of understanding (MOU) between the towns was proposed unsuccessfully over the summer, participants agreed that an MOU remains feasible. Some members of the group suggested a simplified MOU in which the towns first agree, as a general principle, to collaborate on developing consistent approaches to protect and manage Plymouth-Carver Aquifer. Actual management approaches and options could then be discussed in the PCAP, which the towns would accept subsequent to the MOU. As discussed above, the action plan would provide flexible options for adaptive management (i.e., an encyclopedia of ideas).

3. Education and awareness
    - Education will probably work best if it focuses on children.
    - The potential for loss of water supply is abstract to most people. The problem needs to be made more concrete.

- Since attitude change tends to follow action, the commission should look for easy actions to implement to make stewardship attainable.

4. Marketability
   - Recommended actions should be made to fit with economic and market realities. For example the Plymouth transfer of development rights bylaw makes it possible to develop an area in a profitable way that is also protective of natural resources.
   - Work with the existing Smart-Growth Toolkit

Public Participation Program

Dean Audet asked the group to confirm that it will be appropriate to broadcast commission meetings via cable and radio. The group agreed unanimously. Dean also asked what other news media should be contacted. The following is a list of the group's recommendations:

- New Bedford Standard Times
- WATD 95.9 FM (Jim Stone)
- ComCast (Dan Maoit)

Interviews

Dean Audet reiterated the need to begin interviews as soon as possible. Commission members should send their recommendations to:

Jim Riordan (jriordan@fando.com).

or

Dean Audet (daudet@fando.com).

Next Meeting

Thursday, January 11, 2008
7:00 p.m.
Carver Town Hall

This meeting will focus on the USGS study being conducted on the Plymouth-Carver Aquifer hydrogeology.

APPENDIX D

INTERVIEW FORM

Plymouth-Caver Aquifer Action Plan
Interview Questions for Water Suppliers

Begin interview by describing project and purpose for interview— namely to verify (and supplement) information in MassGIS and ASRs. Explain the manifold issue (i.e., water, which is withdrawn for sale, may be recorded as being withdrawn for use and withdrawn for sale and thus may be double counted). Point out that we have been asked to identify double recording of withdrawals.

1. Review map.
   - Verify extent of water service (and sewer service if applicable to the interviewee).
   - Verify cross-connections (i.e., points where sewer/water crosses town boundaries).
   - Verify locations of withdrawal owned/operated by the entity being interviewed.
   - Review withdrawals not owned/operated by the entity being interviewed. Are there other major (i.e., 100K GPY withdrawals, 50K GPY discharges) that interviewee knows of that the maps don t show? Are there records kept by someone that we could use to verify the non-PWS (WMA) withdrawal points?
   - Are there point locations where you flush the system (e.g., by hydrants) or store water (e.g., tanks) that are not shown on the map? Where are they located (ask for a unique point identification such as an intersection or street address)?

2. Review monthly and annual water use for 2000-2004 for:
   - Walk through each ASR with the interviewee and verify general accuracy.
   - Ask how values on ASRs are developed and whether there are additional records.
   - Does the entity being interviewed purchase water from another water supplier?
   - Does the entity being interviewed supply (sell) water to another water supplier?
   - Are these purchases and sales accurately reflected in the ASRs?

3. PWS system information:

   - Verify usage patterns:

   a. Current Consumption patterns (2004)
      i. Consumption by type (residential, commercial etc.)
      ii. Identification of large commercial users (>10% system use)
   b. Current system/source registration/permit limits
   c. Does the water supplier currently employ conservation measures including;
      i. Residential Water Usage
      ii. Unaccounted-for Water
      iii. Municipal Metering of Public Buildings
      iv. Leak Detection Survey frequency/last completed
      v. Water Audit frequency/last completed
      vi. Municipal Bldgs fitted with Water Saving Devices
      vii. Water Conservation Education Plan
      viii. Written Drought Plan
      ix. Customer Metering
   d. Does the entity being interview have plans for future sources and locations and planned improvements that can be added to GIS database?

APPENDIX E

REVIEW CHECKLIST

PLYMOUTH-CARVER AQUIFER MUNICIPAL POLICY REVIEW

Municipality Bourne

Date of Review 1/22/07

Plans reviewed:

- ☑ **Community comprehensive or Master plan**
- ☑ **Storm water management program**
- ☑ **Zoning bylaws**
- ☐ **Subdivision regulations**
- ☑ **Sand and gravel management policy**

Construction/Land Development	Plan/Page #
☑ **Soil Erosion and Sediment Control**	Zoning Bylaws § 1238 (B)(2)(J)
☑ Enforceable mechanism	§ 3520
☑ Performance standard	§ 3570

Land Use Controls	Plan/Page #
☑ **Environmentally sound subdivision and zoning ordinances.**	
☑ Promote proper stormwater management.	§ 1238 Land Use Section of MP
☑ Direct growth to identified areas.	
☐ Protect sensitive areas such as wetlands and riparian areas.	
☑ Maintain and/or increase open space (including a dedicated source for open space acquisition).	
☐ Provide buffers along sensitive water bodies, minimize impervious surfaces.	
☑ Minimize disturbance of soils and vegetation.	Zoning Bylaws (See Soil Erosion above)
☐ Aquifer protection district Water resource overlay district	
☑ **Encourage in-fill development in higher density urban areas, and areas with existing storm sewer infrastructure.**	Land use sect. of MP

Storm Water Management — Plan/Page #

- ☑ **Stormwater ordinance or other enforceable mechanism (e.g., Stormwater Ordinance, or other regulatory mechanism).** — § 1238 Zoning Bylaw
  - ☑ Proper installation and operation and maintenance of structural BMPs.
  - ☑ Requirements for nonstructural BMPs.

Wastewater Management — Plan/Page #

- ☐ **Onsite Wastewater Management Plan** — P61 Zoning Bylaw
  - ☐ Method to ensure or encourage regular ISDS maintenance in the management area. Acceptable options include, but are not limited to, any of the following:

- ☑ **In sensitive areas and areas of highly permeable soils, adopt more stringent siting requirements for ISDS such as increased set back distances or nitrate controls**
- ☐ **Sewering plans and policy**
  - ☑ Are there plans to expand sewer service

Sand and Gravel — Plan/Page #

- ☑ **Established operational requirements for sand and gravel operations.** — § 4400 Zoning Bylaws
- ☑ **Established site stabilization requirements for sand and gravel operations**

High Risk Land Use	Plan/Page #
☑ **Adopt and implement hazardous materials storage and handling requirements.**	Water resources overlay district
☑ **Adopt and implement siting requirements for automobile junk yards to protect water resources.**	

Land Aquisition	Plan/Page #
☑ **Town program for land acquisition**	P7 LMP
☐ **Partnership efforts for land acquisition**	

Water Supply Planning	Plan/Page #
☐ **Plans for expansion of public water service**	
☑ **Recommendations for protection of the resource**	P15-6 LMP

PLYMOUTH-CARVER AQUIFER MUNICIPAL POLICY REVIEW

Municipality Carver

Date of Review 1/22/07

Plans reviewed:

- ☑ **Community comprehensive or Master plan**
- ☑ **Storm water management program**
- ☑ **Zoning bylaws**
- ☑ **Subdivision regulations**
- ☐ **Sand and gravel management policy**

Construction/Land Development	Plan/Page #
☑ **Soil Erosion and Sediment Control**	
☑ Enforceable mechanism	§ 3620 Zoning Bylaw
☑ Performance standard	

Land Use Controls	Plan/Page #
☑ **Environmentally sound subdivision and zoning ordinances.**	
☑ Promote proper stormwater management.	Regs for stormwater & runoff mangt.
☑ Direct growth to identified areas.	
☑ Protect sensitive areas such as wetlands and riparian areas.	
☑ Maintain and/or increase open space (including a dedicated source for open space acquisition).	
☑ Provide buffers along sensitive water bodies, minimize impervious surfaces.	
☑ Minimize disturbance of soils and vegetation.	§ 3620 Zoning bylaws
☐ Aquifer protection district	
☑ **Encourage in-fill development in higher density urban areas, and areas with existing storm sewer infrastructure.**	§ 1.3 of LMP

Storm Water Management — Plan/Page #

- ☑ **Stormwater ordinance or other enforceable mechanism (e.g., Stormwater Ordinance, or other regulatory mechanism).**
  - ☑ Proper installation and operation and maintenance of structural BMPs.
  - ☑ Requirements for nonstructural BMPs.

Regs for Storm water & Runoff Mangt

Wastewater Management — Plan/Page #

- ☐ **Onsite Wastewater Management Plan**
  - ☐ Method to ensure or encourage regular ISDS maintenance in the management area. Acceptable options include, but are not limited to, any of the following:

- ☐ **In sensitive areas and areas of highly permeable soils, adopt more stringent siting requirements for ISDS such as increased set back distances or nitrate controls**
- ☐ **Sewering plans and policy**
  - ☐ Are there plans to expand sewer service

Sand and Gravel — Plan/Page #

- ☐ **Established operational requirements for sand and gravel operations.**
- ☐ **Established site stabilization requirements for sand and gravel operations**

High Risk Land Use	Plan/Page #
☑ **Adopt and implement hazardous materials storage and handling requirements.**	Water Resources & Wetlands overlay districts
☑ **Adopt and implement siting requirements for automobile junk yards to protect water resources.**	

Land Aquisition	Plan/Page #
☑ **Town program for land acquisition**	§ 1.3 of LMP (P. 1-7)
☑ **Partnership efforts for land acquisition**	

Water Supply Planning	Plan/Page #
☑ **Plans for expansion of public water service**	LMP Water Resource Protect Overlay
☑ **Recommendations for protection of the resource**	

PLYMOUTH-CARVER AQUIFER
MUNICIPAL POLICY REVIEW

Municipality Kingston

Date of Review 1/25/07

Plans reviewed:

- ☐ **Community comprehensive or Master plan**
- ☐ **Storm water management program**
- ☑ **Zoning bylaws**
- ☐ **Subdivision regulations**
- ☐ **Sand and gravel management policy**

Construction/Land Development	Plan/Page #
☑ **Soil Erosion and Sediment Control**	Chapter 12 Earth Removal Zoning Bylaw
☑ Enforceable mechanism	
☑ Performance standard	

Land Use Controls	Plan/Page #
☑ **Environmentally sound subdivision and zoning ordinances.**	
☐ Promote proper stormwater management.	
☐ Direct growth to identified areas.	
☑ Protect sensitive areas such as wetlands and riparian areas.	Conservation Overlay District
☐ Maintain and/or increase open space (including a dedicated source for open space acquisition).	
☐ Provide buffers along sensitive water bodies, minimize impervious surfaces.	
☐ Minimize disturbance of soils and vegetation.	
☐ Aquifer protection district	

☐ **Encourage in-fill development in higher density urban areas, and areas with existing storm sewer infrastructure.**

Storm Water Management — Plan/Page #

- ☐ **Stormwater ordinance or other enforceable mechanism (e.g., Stormwater Ordinance, or other regulatory mechanism).**
  - ☐ Proper installation and operation and maintenance of structural BMPs.
  - ☐ Requirements for nonstructural BMPs.

Wastewater Management — Plan/Page #

- ☐ **Onsite Wastewater Management Plan**
  - ☐ Method to ensure or encourage regular ISDS maintenance in the management area. Acceptable options include, but are not limited to, any of the following:

- ☐ **In sensitive areas and areas of highly permeable soils, adopt more stringent siting requirements for ISDS such as increased set back distances or nitrate controls**
- ☐ **Sewering plans and policy**
  - ☐ Are there plans to expand sewer service

Sand and Gravel — Plan/Page #

- ☐ **Established operational requirements for sand and gravel operations.**
- ☐ **Established site stabilization requirements for sand and gravel operations**

Prohibited
Chapter 12
Article 13

High Risk Land Use — Plan/Page #

- ☑ **Adopt and implement hazardous materials storage and handling requirements.** — Conservation Overlay District
- ☑ **Adopt and implement siting requirements for automobile junk yards to protect water resources.** — Conservation Overlay District

Land Aquisition — Plan/Page #

- ☐ **Town program for land acquisition**
- ☐ **Partnership efforts for land acquisition**

Water Supply Planning — Plan/Page #

- ☐ **Plans for expansion of public water service**
- ☑ **Recommendations for protection of the resource** — Article 2 Chapter 8

Water emergency

PLYMOUTH-CARVER AQUIFER
MUNICIPAL POLICY REVIEW

Municipality Middleborough

Date of Review 1/26/07

Plans reviewed:

- ☑ **Community comprehensive or Master plan**
- ☐ **Storm water management program**
- ☐ **Zoning bylaws**
- ☐ **Subdivision regulations**
- ☐ **Sand and gravel management policy**

Construction/Land Development — Plan/Page #

- ☐ **Soil Erosion and Sediment Control**
  - ☐ Enforceable mechanism
  - ☐ Performance standard

Land Use Controls — Plan/Page #

- ☐ **Environmentally sound subdivision and zoning ordinances.**
  - ☐ Promote proper stormwater management.
  - ☐ Direct growth to identified areas. Discussed but unclear p 9 LMP
  - ☑ Protect sensitive areas such as wetlands and riparian areas.
  - ☐ Maintain and/or increase open space (including a dedicated source for open space acquisition).
  - ☑ Provide buffers along sensitive water bodies, minimize impervious surfaces. p16 LMP
  - ☐ Minimize disturbance of soils and vegetation.
  - ☐ Aquifer protection district
- ☐ **Encourage in-fill development in higher density urban areas, and areas with existing storm sewer infrastructure.**

Storm Water Management — Plan/Page #

- ☐ **Stormwater ordinance or other enforceable mechanism (e.g., Stormwater Ordinance, or other regulatory mechanism).**
  - ☐ Proper installation and operation and maintenance of structural BMPs.
  - ☐ Requirements for nonstructural BMPs.

Wastewater Management — Plan/Page #

- ☐ **Onsite Wastewater Management Plan**
  - ☐ Method to ensure or encourage regular ISDS maintenance in the management area. Acceptable options include, but are not limited to, any of the following:

- ☐ **In sensitive areas and areas of highly permeable soils, adopt more stringent siting requirements for ISDS such as increased set back distances or nitrate controls**
- ☐ **Sewering plans and policy**
  - ☐ Are there plans to expand sewer service

Sand and Gravel — Plan/Page #

- ☐ **Established operational requirements for sand and gravel operations.**
- ☐ **Established site stabilization requirements for sand and gravel operations**

High Risk Land Use	Plan/Page #
☑ **Adopt and implement hazardous materials storage and handling requirements.**	P 16 LMP
☑ **Adopt and implement siting requirements for automobile junk yards to protect water resources.**	

Land Aquisition	Plan/Page #
☑ **Town program for land acquisition**	P 67 LMP
☑ **Partnership efforts for land acquisition**	

Water Supply Planning	Plan/Page #
☑ **Plans for expansion of public water service**	P 182 LMP
☐ **Recommendations for protection of the resource**	

PLYMOUTH-CARVER AQUIFER
MUNICIPAL POLICY REVIEW

Municipality Plymouth

Date of Review 1/27/07

Plans reviewed:

- ☑ **Community comprehensive or Master plan** (Strategic Action Plan)
- ☐ **Storm water management program**
- ☑ **Zoning bylaws**
- ☐ **Subdivision regulations**
- ☑ **Sand and gravel management policy** – in bylaws

Construction/Land Development	Plan/Page #
☑ **Soil Erosion and Sediment Control**	§ 205-18(H)
☑ Enforceable mechanism	
☑ Performance standard	

Land Use Controls	Plan/Page #
☑ **Environmentally sound subdivision and zoning ordinances.**	P.6 Strategic Action plan
☑ Promote proper stormwater management.	§ 205-9(C) Zoning Bylaws
☑ Direct growth to identified areas.	
☑ Protect sensitive areas such as wetlands and riparian areas.	
☑ Maintain and/or increase open space (including a dedicated source for open space acquisition).	
☐ Provide buffers along sensitive water bodies, minimize impervious surfaces.	
☐ Minimize disturbance of soils and vegetation.	
☑ Aquifer protection district	§ 205-57 Zoning bylaws
☑ **Encourage in-fill development in higher density urban areas, and areas with existing storm sewer infrastructure.**	

Storm Water Management — Plan/Page #

- ☑ **Stormwater ordinance or other enforceable mechanism (e.g., Stormwater Ordinance, or other regulatory mechanism).** — § 205-9(C)(4)(F)
  - ☑ Proper installation and operation and maintenance of structural BMPs. — § 205-57(D)(6)(b)
  - ☑ Requirements for nonstructural BMPs.

Wastewater Management — Plan/Page #

- ☐ **Onsite Wastewater Management Plan**
  - ☐ Method to ensure or encourage regular ISDS maintenance in the management area. Acceptable options include, but are not limited to, any of the following:

- ☑ **In sensitive areas and areas of highly permeable soils, adopt more stringent siting requirements for ISDS such as increased set back distances or nitrate controls** — § 205-57(D)(6)(a
- ☐ **Sewering plans and policy**
  - ☐ Are there plans to expand sewer service

Sand and Gravel — Plan/Page #

- ☑ **Established operational requirements for sand and gravel operations.** — § 205-18(F) Zoning By laws
- ☑ **Established site stabilization requirements for sand and gravel operations**

High Risk Land Use	Plan/Page #
☑ **Adopt and implement hazardous materials storage and handling requirements.**	Zoning Code Table 5
☑ **Adopt and implement siting requirements for automobile junk yards to protect water resources.**	

Land Aquisition	Plan/Page #
☑ **Town program for land acquisition**	P 12 Strategic Plan
☑ **Partnership efforts for land acquisition**	

Water Supply Planning	Plan/Page #
☐ **Plans for expansion of public water service**	P 21 Strategic Plan
☐ **Recommendations for protection of the resource**	

PLYMOUTH-CARVER AQUIFER
MUNICIPAL POLICY REVIEW

Municipality Plympton

Date of Review 1/27/07

Plans reviewed:

- ☐ **Community comprehensive or Master plan**
- ☐ **Storm water management program**
- ☑ **Zoning bylaws**
- ☑ **Subdivision regulations**
- ☐ **Sand and gravel management policy**

Construction/Land Development	Plan/Page #
☐ **Soil Erosion and Sediment Control**	
☑ Enforceable mechanism	§ 3(D)(3)(b)(2) Zoning Bylaws
☐ Performance standard	

Land Use Controls	Plan/Page #
☐ **Environmentally sound subdivision and zoning ordinances.**	
☐ Promote proper stormwater management.	
☐ Direct growth to identified areas.	
☐ Protect sensitive areas such as wetlands and riparian areas.	
☐ Maintain and/or increase open space (including a dedicated source for open space acquisition).	
☐ Provide buffers along sensitive water bodies, minimize impervious surfaces.	
☐ Minimize disturbance of soils and vegetation.	
☐ Aquifer protection district	
☐ **Encourage in-fill development in higher density urban areas, and areas with existing storm sewer infrastructure.**	

Storm Water Management — Plan/Page #

- ☑ **Stormwater ordinance or other enforceable mechanism (e.g., Stormwater Ordinance, or other regulatory mechanism).** — § 5(B) Subdivision Regs
  - ☑ Proper installation and operation and maintenance of structural BMPs.
  - ☑ Requirements for nonstructural BMPs.

Wastewater Management — Plan/Page #

- ☐ **Onsite Wastewater Management Plan**
  - ☐ Method to ensure or encourage regular ISDS maintenance in the management area. Acceptable options include, but are not limited to, any of the following:

- ☑ **In sensitive areas and areas of highly permeable soils, adopt more stringent siting requirements for ISDS such as increased set back distances or nitrate controls** — Zoning Regs
- ☐ **Sewering plans and policy**
  - ☐ Are there plans to expand sewer service

Sand and Gravel — Plan/Page #

- ☐ **Established operational requirements for sand and gravel operations.**
- ☐ **Established site stabilization requirements for sand and gravel operations**

High Risk Land Use	Plan/Page #
☑ **Adopt and implement hazardous materials storage and handling requirements.**	§ 4.2
☑ **Adopt and implement siting requirements for automobile junk yards to protect water resources.**	§ 8.3.5 Zoning Bylaws

Land Aquisition	Plan/Page #
☑ **Town program for land acquisition**	
☐ **Partnership efforts for land acquisition**	

Water Supply Planning	Plan/Page #
☑ **Plans for expansion of public water service**	interview
☐ **Recommendations for protection of the resource**	

PLYMOUTH-CARVER AQUIFER
MUNICIPAL POLICY REVIEW

Municipality Wareham

Date of Review 1/27/07

Plans reviewed:

- ☑ **Community comprehensive or Master plan**
- ☐ **Storm water management program**
- ☑ **Zoning bylaws**
- ☐ **Subdivision regulations**
- ☐ **Sand and gravel management policy**

Construction/Land Development	Plan/Page #
☑ **Soil Erosion and Sediment Control**	
☐ Enforceable mechanism	
☐ Performance standard	§1541 Zoning Bylaws

Land Use Controls	Plan/Page #

☐ **Environmentally sound subdivision and zoning ordinances.**
- ☐ Promote proper stormwater management.
- ☐ Direct growth to identified areas.
- ☐ Protect sensitive areas such as wetlands and riparian areas.
- ☐ Maintain and/or increase open space (including a dedicated source for open space acquisition).
- ☐ Provide buffers along sensitive water bodies, minimize impervious surfaces.
- ☐ Minimize disturbance of soils and vegetation.
- ☐ Aquifer protection district

☐ **Encourage in-fill development in higher density urban areas, and areas with existing storm sewer infrastructure.**

Storm Water Management — Plan/Page #

- ☐ **Stormwater ordinance or other enforceable mechanism (e.g., Stormwater Ordinance, or other regulatory mechanism).** § 742.7.0
  - ☑ Proper installation and operation and maintenance of structural BMPs.
  - ☐ Requirements for nonstructural BMPs.

Wastewater Management — Plan/Page #

- ☐ **Onsite Wastewater Management Plan**
  - ☐ Method to ensure or encourage regular ISDS maintenance in the management area. Acceptable options include, but are not limited to, any of the following:

- ☐ **In sensitive areas and areas of highly permeable soils, adopt more stringent siting requirements for ISDS such as increased set back distances or nitrate controls**
- ☐ **Sewering plans and policy**
  - ☐ Are there plans to expand sewer service

Sand and Gravel — Plan/Page #

- ☐ **Established operational requirements for sand and gravel operations.**
- ☐ **Established site stabilization requirements for sand and gravel operations**

High Risk Land Use	Plan/Page #
☑ **Adopt and implement hazardous materials storage and handling requirements.**	Water Resources Overlay District
☑ **Adopt and implement siting requirements for automobile junk yards to protect water resources.**	

Land Aquisition	Plan/Page #
☑ **Town program for land acquisition**	P92 Comprehensive Plan
☐ **Partnership efforts for land acquisition**	

Water Supply Planning	Plan/Page #
☑ **Plans for expansion of public water service**	Section H Comprehensive Plan
☐ **Recommendations for protection of the resource**	