CAPE COD COMMISSION

CH2MHILL.

Wastewater Management Planning for Bourne's Downtown

June 20, 2012

Report of the
BOURNE WASTEWATER
ADVISORY COMMITTEE

Presented to the
BOURNE BOARD OF
SEWER COMMISSIONERS

With assistance from
Cape Cod Commission RESET
and
CH2MHill

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TOWN OF BOURNE

Bourne Wastewater Advisory Committee

TOWN HALL

24 PERRY AVE.

BUZZARDS BAY, MA 02532

PHONE: 508-759-0615 ● FAX: 508-759-8026

June 22, 2012

Board of Sewer Commissioners
Town of Bourne
24 Perry Ave.
Buzzards Bay, MA 02532

Re: Wastewater Management Planning for Downtown Bourne

Dear Commissioners:

The Wastewater Advisory Committee to the Board of Sewer Commissioners was authorized by the Board at their meeting on August 24, 2010, and charged with the following:

> *to serve as advisors to the Board of Sewer Commissioners as it reviews options for wastewater management for the Town with a near-term focus on assisting investors and expanding the wastewater management capacity for the Village of Buzzards Bay and its immediate surrounding areas. This near-term focus has a particular urgency in the context of pending investment in Bourne's Downtown and the need to create a Growth Incentive Zone (GIZ) to facilitate new investment.*
>
> *To carry out these objectives, committee members will:*
>
> 1. *Review previous studies of wastewater management needs, recommend solutions, alternative methods of treatment, and private and public funding strategies,*
> 2. *Explore alternative approaches to expanding wastewater treatment capacity, including private and public funding strategies,*
> 3. *Formulate recommendations to the Board of Sewer Commissioners that includes plans, locations, timelines and private and public funding strategies.*

A summary of findings and a recommended action plan, as developed in consultation with the Cape Cod Commission Regional Economic Strategy Execution Team (RESET) and CH2M Hill, are presented herein with a full discussion presented in the attached report.

Summary of Findings and Recommended Action Plan

Wastewater is currently collected in Downtown Bourne and Hideaway Village and sent to the Wareham Wastewater Treatment Plant. The wastewater flows to Wareham are limited by the Inter Municipal Agreement (IMA) to an annual average of 200,000 GPD. Downtown Bourne buildout projections show that wastewater capacity will be exceeded with even modest growth or redevelopment.

To address the issues surrounding the limited wastewater capacity, evaluations of potential wastewater treatment facility sites, treated wastewater disposal sites and financing options were conducted. As a result of the analyses, alternatives were developed for siting a treatment facility and subsurface disposal system within the Downtown area or outside of the Downtown area. The following were identified as key actions necessary as part of a phased approach to developing additional wastewater capacity in Downtown Bourne:

- Continue the services of the Bourne Wastewater Advisory Committee to assist in refining the wastewater option for Downtown Bourne
- Implement a phased approach that will allow for growth utilizing the remaining IMA allocation (Phase 1 of GIZ) while planning for infrastructure needed to develop the additional wastewater capacity needed for Phases 2 and 3 of GIZ
- Engage the public in the wastewater planning process
- Engage the Massachusetts Department of Environmental Protection (DEP) for review and comment on the plan for Downtown Bourne with the goal of DEP plan approval
- Continue discussions with private parties on commercial development plans and private financing options
- Work with the Massachusetts Water Pollution Abatement Trust and DEP to develop public financing options to supplement private investment
- Conduct preliminary hydrogeologic studies at preferred disposal sites

Many of these action items entail little or no cost, but are critical to downtown development and the long term plan of the Town.

In addition to wastewater management, water supply is a limiting factor to Downtown growth. The Town should support the Buzzards Bay Water District in identifying, securing access to, and permitting a new water supply site and investigating an emergency backup connection.

Why act now?

Taking action now will allow the Town of Bourne to control its own destiny and select the options that best meet the needs of the Town and its residents. Given that it can take four or more years to design, permit, and approve wastewater infrastructure, action is required now to avoid delays in Phases 2 and 3 of the GIZ. Delay in action will only increase the costs of implementation and delay economic development.

The BWAC would like to thank the Board of Sewer Commissioners for the opportunity to present these findings and stands ready to assist in moving forward on the path towards a revitalized Downtown Bourne.

Sincerely,

Sallie K. Riggs Chair	William Locke Vice Chair	Michael Brady At Large Member	Mary Andrews At Large Member
Stanley Andrews Board of Health	Elaine Lewis Ryan Commercial User	Don Montour Finance Committee	

Cc: Thomas Guerino, Town Administrator
Coreen Moore, Town Planner
George Tribou, Bourne Plumbing and Gas Inspector
Barry Woods, Buzzards Bay Water District Superintendent

Executive Summary

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The Town of Bourne has focused for many years on the goal of revitalized economic development in Downtown Bourne. Such a re-development would provide the town with business opportunities, increased commercial activity, and augmented tax income. One of the remaining barriers to achieving this goal is limited wastewater treatment capacity in Downtown Bourne. Recognizing this, the Board of Sewer Commissioners established the Bourne Wastewater Advisory Committee (BWAC) on August 24, 2010 to evaluate options and provide direction for an effective and affordable wastewater management plan.

The committee was fortunate in obtaining the assistance of the Cape Cod Commission, specifically their Regional Economic Strategy Execution Team (RESET) initiative. RESET had the expertise and resources necessary to provide the technical services to support the BWAC efforts. These efforts included an assessment of water and wastewater requirements in Downtown Bourne, and the development of feasible options for wastewater services in Downtown Bourne.

Existing Wastewater Services

The Town of Bourne has an existing wastewater collection system built in the early 1990's which serves downtown Bourne, Taylor Point, and Hideaway Village. The system, which is showing signs of age, delivers this wastewater to the Wareham Wastewater Treatment Plant. The flow of wastewater that Bourne can send to Wareham is limited by an Inter-Municipal Agreement to 200,000 gallons per day (GPD).

Water Supply

The Buzzards Bay Water District currently supplies water to the area from four wells, operating at or near their permitted capacity. Options to increase water supply capacity are reviewed in this report and will need to be considered in conjunction with any plans for wastewater expansion. It is recommended that the town support the Buzzards Bay Water District in planning and securing the additional water necessary for economic growth in Downtown Bourne.

Buildout Analysis

The Cape Cod Commission staff prepared a buildout analysis for the study area following assumptions outlined by current zoning and future market analysis. The buildout analysis, done in close cooperation with the Town Planner, helped the BWAC select a practical buildout assumption of future wastewater flows needed over the next 25 years. Downtown growth will occur incrementally so the BWAC chose to evaluate wastewater services for a range of flows, from 25,000 GPD to 335,000 GPD (practical buildout).

Buildout analysis indicates that the development of even a few new restaurants and/or small hotels in the Downtown area will exceed the remaining wastewater flow capacity and the available water supply.

Technologies for Wastewater Management

The committee evaluated a number of treatment technologies including membrane bio reactors, sequencing batch reactors, and package plants. Subsurface disposal of effluents was determined to be the preferred disposal mechanism for whatever system chosen. In addition to odor control, subsurface disposal systems also allow the surface to be used for a variety of recreational activities or open space.

Treatment and Disposal Sites for Wastewater Management

The Commission's RESET team conducted an evaluation of potential wastewater treatment and discharge sites within the town. Based on decision criteria established by the BWAC, forty-five initial parcels were screened for suitability resulting in five wastewater treatment plant sites and preferred subsurface wastewater discharge sites selected for further analysis. Final sites were located both within and outside of the downtown area; and each is capable of handling the 335,000 GPD of wastewater flow projected for the 25 year practical buildout.

As one alternative, the BWAC considered a public-private financing arrangement, wherein the treatment could be located on a portion of a privately owned parcel in the downtown area and the disposal area located on a town-owned parcel also in the downtown. A detailed analysis of site selection and costs are presented in the report.

Costs would vary by site, but the analysis indicates that treatment facility, subsurface disposal, and the related conveyance systems to handle 50,00 GPD and designed to be expandable to 335,000 GPD, including engineering, permitting, construction management, and overall contingency, would cost a developer approximately $10 million.

Financial Options

The town has a number of options when considering financing for potential upgrades to the wastewater infrastructure. The actual means of financing the planning, design, and construction of new facilities will depend upon a number of factors which include possible proposals by commercial developers interested in projects in or near Downtown Bourne. Additionally, a number of state economic grant and loan programs can be considered and have been detailed within this report.

Action Plan

In light of the information collected in this study, the BWAC and the Commission agree that action needs to be taken to allow for the economic development that is essential to revitalization of Downtown Bourne. The following were identified as key actions necessary as part of a phased approach to developing additional wastewater capacity in Downtown Bourne:

- Continue the services of the Bourne Wastewater Advisory Committee to assist in refining the wastewater option for Downtown Bourne
- Implement a phased approach that will allow for growth utilizing the remaining IMA allocation (Phase 1 of GIZ) while planning for infrastructure needed to develop the additional wastewater capacity needed for Phases 2 and 3 of GIZ
- Engage the public in the wastewater planning process
- Engage the Massachusetts Department of Environmental Protection (DEP) for review and comment on the plan for Downtown Bourne with the goal of DEP plan approval
- Continue discussions with private parties on commercial development plans and private financing options
- Work with the Massachusetts Water Pollution Abatement Trust and DEP to develop public financing options to supplement private investment

- Conduct preliminary hydrogeologic studies at preferred disposal sites

Many of the recommended initial action items require little or no cost, but are essential in moving forward towards a successful wastewater management program. The BWAC stands ready to assist.

Acknowledgments

The Bourne Wastewater Advisory Committee would like to thank the Cape Cod Commission RESET staff and CH2M HILL staff for their invaluable assistance on this project.

In addition, we would like to acknowledge the assistance of Town of Bourne employees Tom Guerino, Coreen Moore, George Tribou, and Debbie Judge, and the Buzzards Bay Water District Superintendent Barry Woods.

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Background

The Downtown Bourne area has been the focus of economic development efforts as a means of revitalizing Buzzards Bay Village, and providing business opportunities that will increase the Town's commercial sector to relieve the tax burden on residents. Limited wastewater treatment capacity is a barrier to providing those opportunities. In recognizing the integral role of wastewater infrastructure to provide for economic development and protect the town's coastal waters, the town has established the Bourne Wastewater Advisory Committee (BWAC) to evaluate options and provide direction for consideration. The Cape Cod Commission, through the Regional Economic Strategy Execution Team (RESET) initiative, was requested to provide technical services to support the BWAC effort that will specifically include a review and assessment of water and wastewater planning issues related to Downtown Bourne. The objective of presenting this evaluation in a report is to provide easily understandable information to decision makers and the public on water and wastewater planning issues for Downtown Bourne as it relates to economic development opportunities for the Town of Bourne.

Study Objectives

The purpose of this report is to present the findings of the study performed by the RESET staff relating to water supply and wastewater issues as part of a comprehensive water supply/wastewater assessment of the Downtown Bourne area (including Hideaway Village and the Bourne Development Campus).

The study included the following goals:

- Evaluate water supply and wastewater issues within the study area
- Identify options for water supply and wastewater management
- Assist the Town of Bourne and the Buzzards Bay Water District with water supply and wastewater issues within the area and to provide an action plan for a solution.

The report is organized according to the tasks identified in the Scope of Work endorsed by the Board of Sewer Commissioners at its meeting on June 6, 2011.

STUDY AREA

The study area, as shown in Figure 1, includes Downtown Bourne, Hideaway Village, and the Bourne Development Campus.

Figure 1.
Wastewater Management Planning Study Areas

This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County. The information depicted on these maps is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis. It should not substitute for actual on-site survey, or supersede deed research.

Task 2 - Existing Planning Documentation

Commission staff reviewed prior water and wastewater planning and other related planning documents to provide for a systematic and practical approach to the project. Our review included but was not limited to the following documents:

1. Wastewater Management Study, (Tighe & Bond, 2007)
2. Wastewater Flow Projection & Conceptual Costs for Bourne Development Campus, (Tighe & Bond, June 2008)
3. Wastewater Management Conceptual Alternatives Analysis- South of Canal, (Tighe & Bond, January 2008)
4. Report to Sewer Commissioners, (Tighe & Bond, March 2008
5. Vision Plan for Bourne's Downtown, (Stantec, 2008)
6. Growth Incentive Zone (GIZ) Application (May 2011)
7. Bourne Downtown Site Planning, (Cecil Group Inc,. June 24, 2009)
8. Action Plan for Bourne's Downtown, (November 2008)
9. Downtown Zoning Bylaw (October, 2008)
10. Market Analysis for Main Street Buzzards Bay, (RKG, November 2006)
11. 2000-2011 Monthly Wastewater Flows for Downtown and Hideaway Village
12. Downtown Buzzards Bay Design Guidelines, (Stantec September 2008)
13. Flood Hazard Mitigation Study for Buzzards Bay, (Kennen, December 2007)
14. 2010 Inter Municipal Agreement with Wareham and Bourne for Wastewater
15. Town of Bourne Sewer Use Regulations, 1990
16. Massachusetts Estuaries Project reports for south-side estuaries in Bourne
17. Conservation Law Foundation – status of litigation

A full list of documents that were reviewed in conjunction with the development of this report is shown in *Appendix A: Complete List of Documents Review*. Of the documents reviewed, the three main documents were used to support the wastewater planning efforts, which are discussed below.

Wastewater Management Study, Bourne, MA – Tighe & Bond (October 2007). The purpose of the Bourne Wastewater Management Study was to identify wastewater management solutions that would facilitate the revitalization of Main Street Buzzards Bay and other areas of Bourne north of the Cape Cod Canal and provide a framework for long-term wastewater management needs town-wide.

The analysis and recommendations presented in the Committee's report are not meant to replace the Tighe & Bond study but rather to supplement it and provide a greater level of detail within the study area. The recommendations for wastewater management for Downtown Bourne presented in the Committee's report fit into the larger town-wide wastewater management needs described in the Tighe & Bond report. The town should utilize both documents in concert to address wastewater challenges in Downtown Bourne and town-wide.

Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod - Barnstable County Wastewater Cost Task Force – Wright Pierce (April 2010). Cost estimates for capital and operations and maintenance (O&M) costs for individual, cluster, satellite, and centralized systems sized for Cape Cod.

Community Funding for Wastewater Capital Programs - Robert J. Ciolek (July 20, 2011). The presentation discusses five basic funding choices for Cape Cod towns: contributions from a private developer, funding from existing Town sources for capital and/or operating expenses; funding from betterment assessments for capital expenses; funding from a Proposition 2 ½ override or debt exclusion vote for capital expenses, and funding from a system of rates and charges for operating and/or capital expenses. A copy of this presentation is presented in *Appendix K: Financing Options Presentation*.

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Task 3 - Water Supply and Demands

Commission staff investigated water supply issues related to the Buzzards Bay Water District including supply capacity and demands based on existing studies, maps of well sites, and potential water supply sites. The following subtasks were completed as part of this effort and are detailed in the following sections.

a) Met with Buzzards Bay Water District Superintendent
b) Assessed present status of water supply and demands
c) Project potential future deficits and supply needs
d) Review and refinement of screening for potential lands suitable for water supply

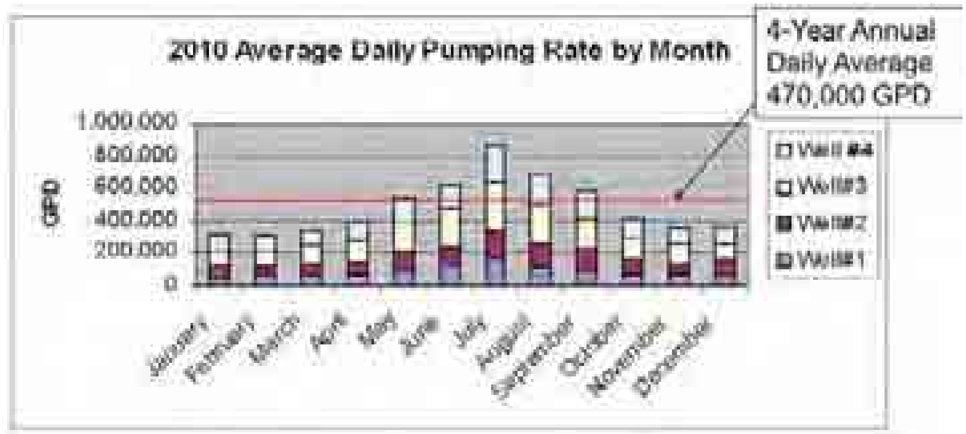
TASK 3A: DISCUSSION WITH BUZZARDS BAY WATER DISTRICT SUPERINTENDENT

Commission staff met with the Buzzards Bay Water District Superintendent Barry Woods on May 18th, 2011. Discussion focused on the current supply, demand, infrastructure, and permits relating to water supply. Copies of the last five (5) years of pumping data were provided and are presented in *Appendix B: Summary of Buzzards Bay Water Pumping Reports*. The Superintendent also provided a copy of the Department of Environmental Protection (DEP) water supply permit that permits the Buzzards Bay Water District to pump an annual average of 530,000 gallons per day (GPD).

TASK 3B: CURRENT WATER SUPPLY AND DEMANDS

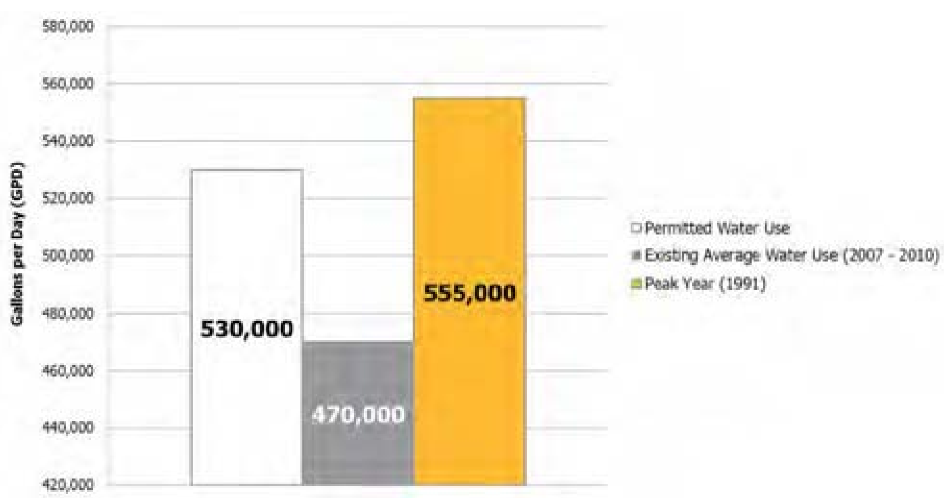
The Buzzards Bay Water District currently operates four water supply wells. Pumping rates vary over the course of the year with the greatest demand experienced in the summer months. The average daily pumping rate at each of the four wells is presented in Figure 2 for each month of 2010.

FIGURE 2. 2010 AVERAGE DAILY WELL PUMPING RATES BY MONTH



The combined four-year annual daily average (2007-2010) pumping rate for all four (4) wells was 470,000 GPD. Historically, this annual daily average pumping rate reached as high as 550,000 GPD in 1991. The current pump configuration has the capacity to handle the current demand. However, as shown in Figure 3, average annual daily pumping rates have exceeded the 530,000 GPDDEP Water Management Act Permit.

FIGURE 3. ANNUAL AVERAGE DAILY WATER USE - PERMITTED, EXISTING, PEAK



TASK 3C: FUTURE SUPPLY NEEDS

A build-out analysis provides an indication of the development growth potential in the downtown area and the need for increased water supply demands. Water use demands for practical and theoretical build-out scenarios (discussed in detail in Task 5), are projected to be 730,000 GPD and 1,770,000 GPD, respectively. For planning purposes, the Committee has chosen 25% of the practical build-out (335,000 GPD) for the present timeline.

Given that the actual pumping rates combined with the projected build-out demand will exceed the current DEP water withdrawal limit, options to increase water supply capacity will need to be considered. One option to explore would be installing a new well to add additional supply. In order to develop a new well, the following steps will need to be completed:

- Open space allowance for water supply purposes
- Test Well Investigation
- DEP New Source Approval
- Water Management Act Permit

Siting a new supply well will be critical and the town should assist the Buzzards Bay Water District in selecting viable sites.

Also worthwhile of consideration going forward would be a connection with other water districts. Currently the District has no connections with other districts and therefore no emergency back-up water supply.

TASK 3D: SCREENING FOR POTENTIAL LANDS SUITABLE FOR WATER SUPPLY

Screening for potential land suitable for water supply is a critical step in developing new water supply sources for the town. A methodology from the Commission's Priority Lands Acquisition Assessment Plan (PLAAP)(1999) was used in this process. The PLAAP uses a map overlay process which looks at priority conservation targets to protect water supply resources. This mapping takes into account both natural and manmade obstacles and designates which areas are most suitable for water supply.

The PLAAP map series is described below and the maps, Figure 4-Figure 8, are presented on the following pages.

The first step of the analysis was to define PLAAP study area. As shown in Figure 4, the study area was identified as the Buzzards Bay Water District and the surrounding area. Next, groundwater flows and water supply sites, water supply protection areas (Zone II's) and buffers, and water supply obstacles were identified within the study area as presented in Figure 5.The District owned land, water table contours, and groundwater flow are shown in Figure 5. Groundwater contours are from the USGS groundwater flow model of the Plymouth-Carver Aquifer. Groundwater flow is perpendicular to the contours showing that groundwater flow is generally southwest through the study area to discharge into Buttermilk Bay and the Cape Cod Canal.

Constraints to developing water supply sites are identified in Figure 6. This shows wetland areas, rivers, ponds, and vernal pools which are water dependent ecosystems are sensitive to water withdrawals. A 100 foot buffer around these areas was added. Constraints to water supply from development are shown in Figure 7. Developed areas include residential and commercial development and roadway areas. The white areas remaining are those that are suitable for water supply exploration.

Using the information presented in the three previous maps, potential water supply areas were identified and are shown in Figure 8. The "best case" areas are shown in blue with "satisfactory" and "potentially constrained" shown in orange and red respectively.

The town should consider the water supply potential of these areas when evaluating proposed competing land uses. In general, the sites with the greatest potential would be up gradient from existing and proposed future development. To the greatest extent possible, the town should take action to protect potential water supply areas. This will allow the town to secure a sufficient water supply for the town as it exists today and allow for future growth.

Figure 4.
Base Map of PLAAP Study Area

This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County. The information depicted on these maps is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis. It should not substitute for actual on-site survey, or supersede deed research.

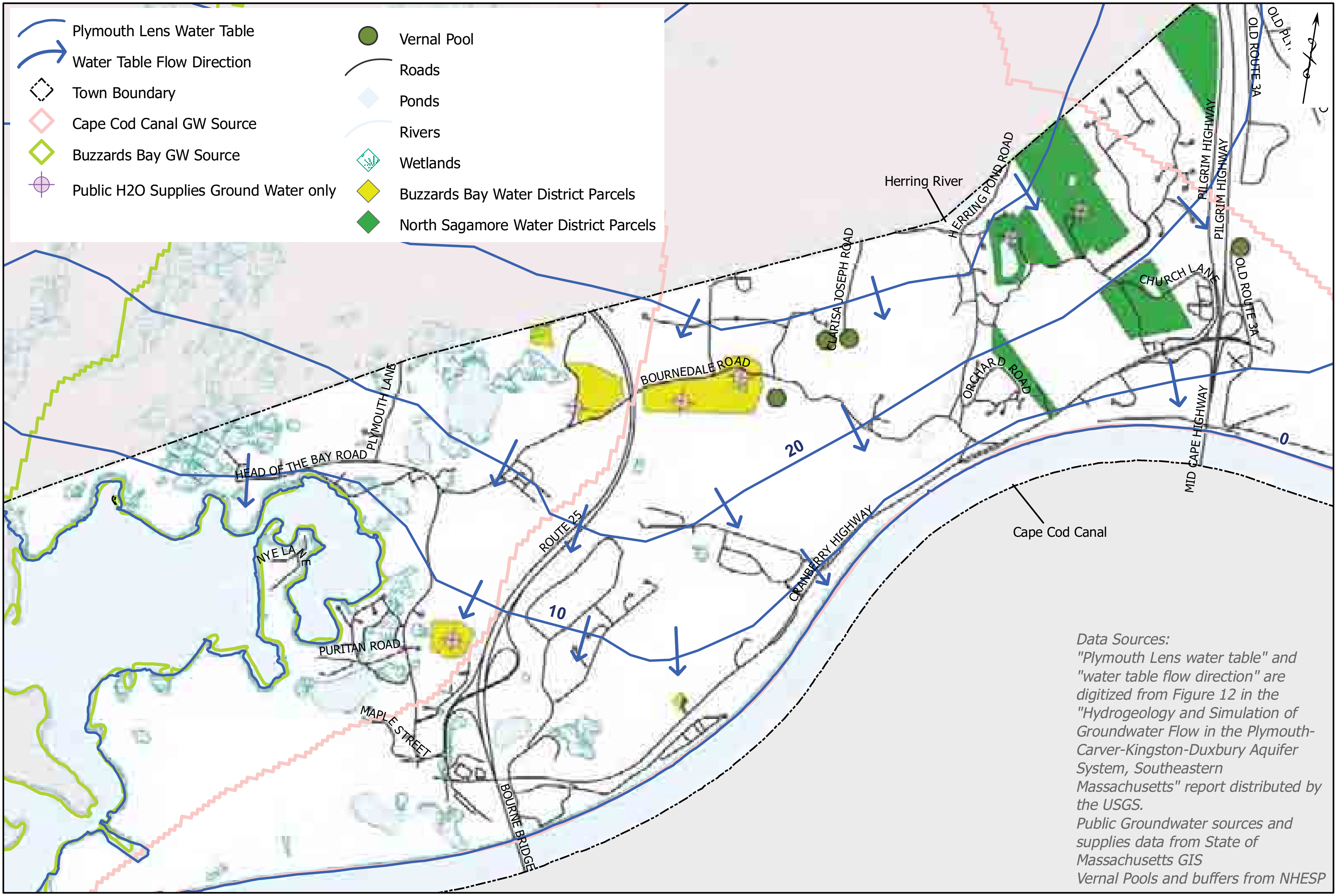


Figure 5.
Groundwater Flow and Water Supply Areas

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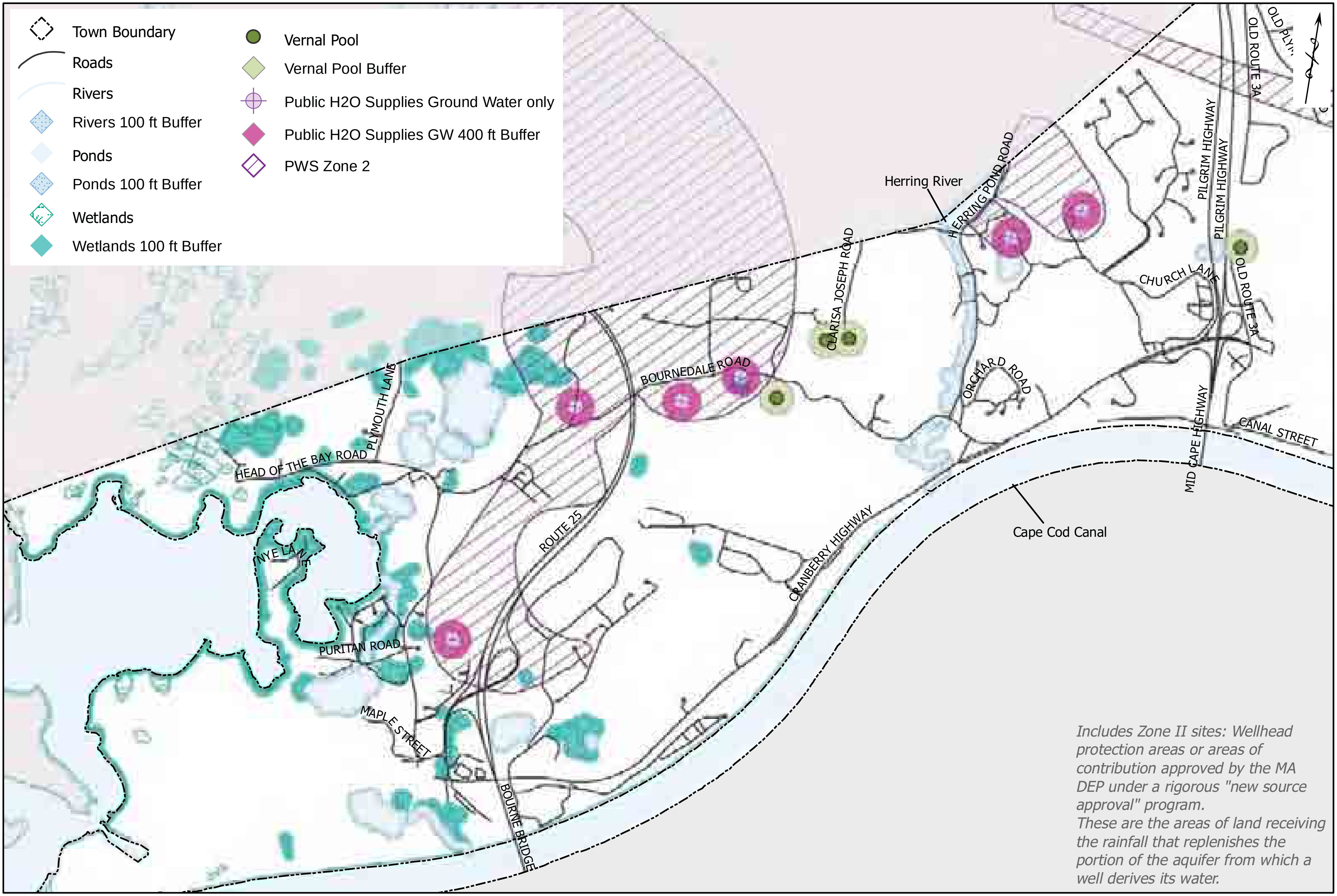

Figure 6.
Water Supply Protection Areas and Buffers

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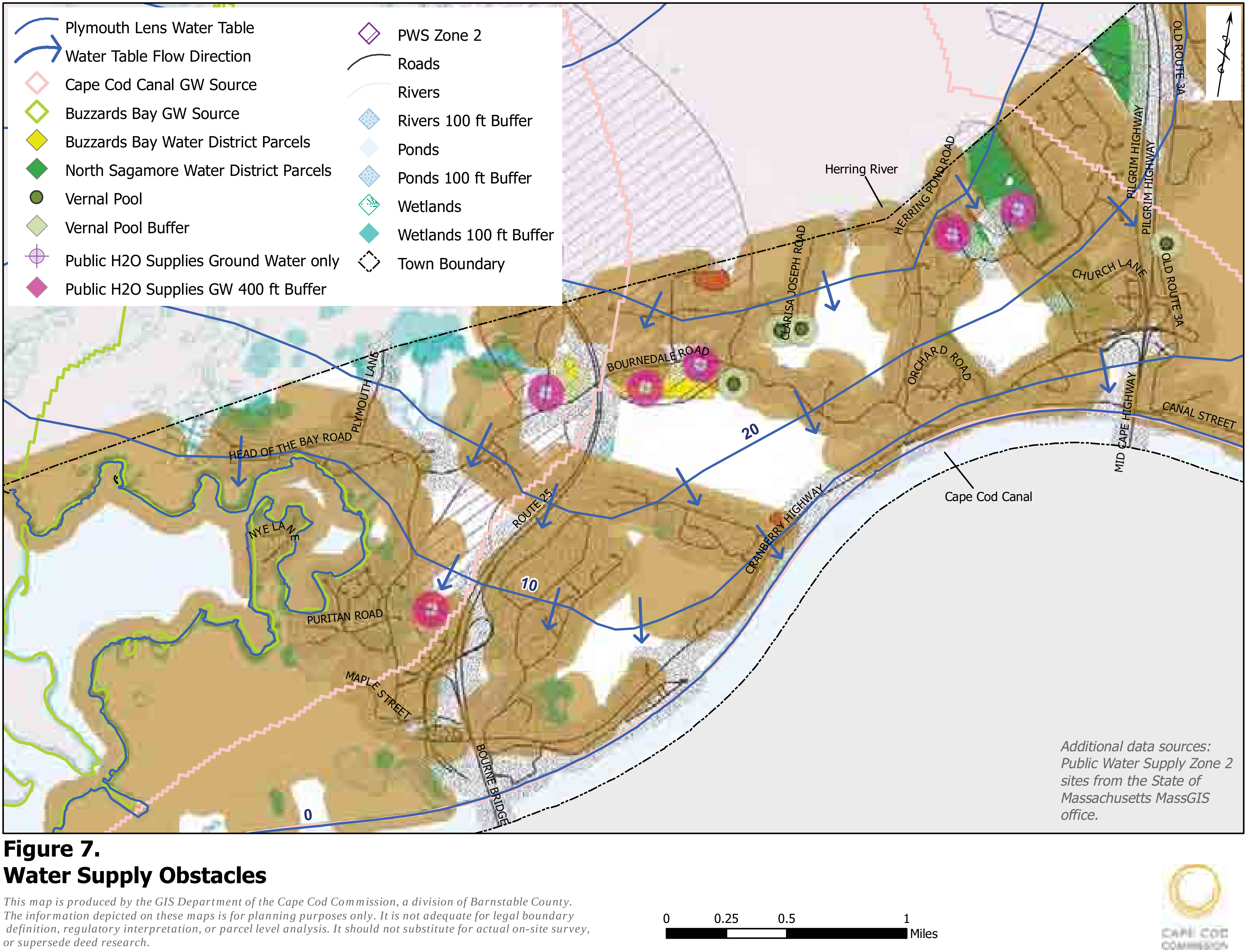

Figure 7.
Water Supply Obstacles

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Figure 8.
Potential Water Supply Areas

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Task 4 - Assessment of Existing Wastewater Infrastructure

As part of this task, the RESET staff reviewed existing documents relating to sewer use patterns, regulations, inter municipal agreements, and potential and future allocation agreements as it effects future expansion planning. The following subtasks were completed as part of this effort and are detailed in the following sections.

a) Review Inter Municipal Agreement (IMA)
b) Summarize allocation issues
c) Develop outline for allocation tracking

TOWN OF BOURNE MUNICIPAL INFRASTRUCTURE

The Town of Bourne has an existing wastewater collection system that was built in the early 1990's and serves Downtown Bourne through eight-inch gravity sewers and Taylor's Point and the eastern section of downtown through a low pressure system. Flows are collected at Hideaway Village/Main Street Pump Station and pumped via a six-inch ductile iron force main along Main Street across Buttermilk Bay to the Wareham Wastewater Treatment Plant (WWTP). According to early design documentation, the capacity of this collection system is estimated to be approximately 140,000 GPD. It is possible that the capacity of the existing infrastructure can accommodate much more than 140,000 GPD, however a rigorous engineering assessment would be required for a determination. Hideaway Village is also served by an existing collection system and the Hideaway Village Pump Station that pumps flow through a six-inch ductile iron force main to the Wareham WWTP.). According to early design documentation, the capacity of this collection system is estimated to be approximately 60,000 GPD.

The existing wastewater collection system is show in Figure 9. All of the wastewater collected in municipal system is pumped to the Wareham wastewater treatment plant per the Inter Municipal Agreement (IMA) detailed in the next section.

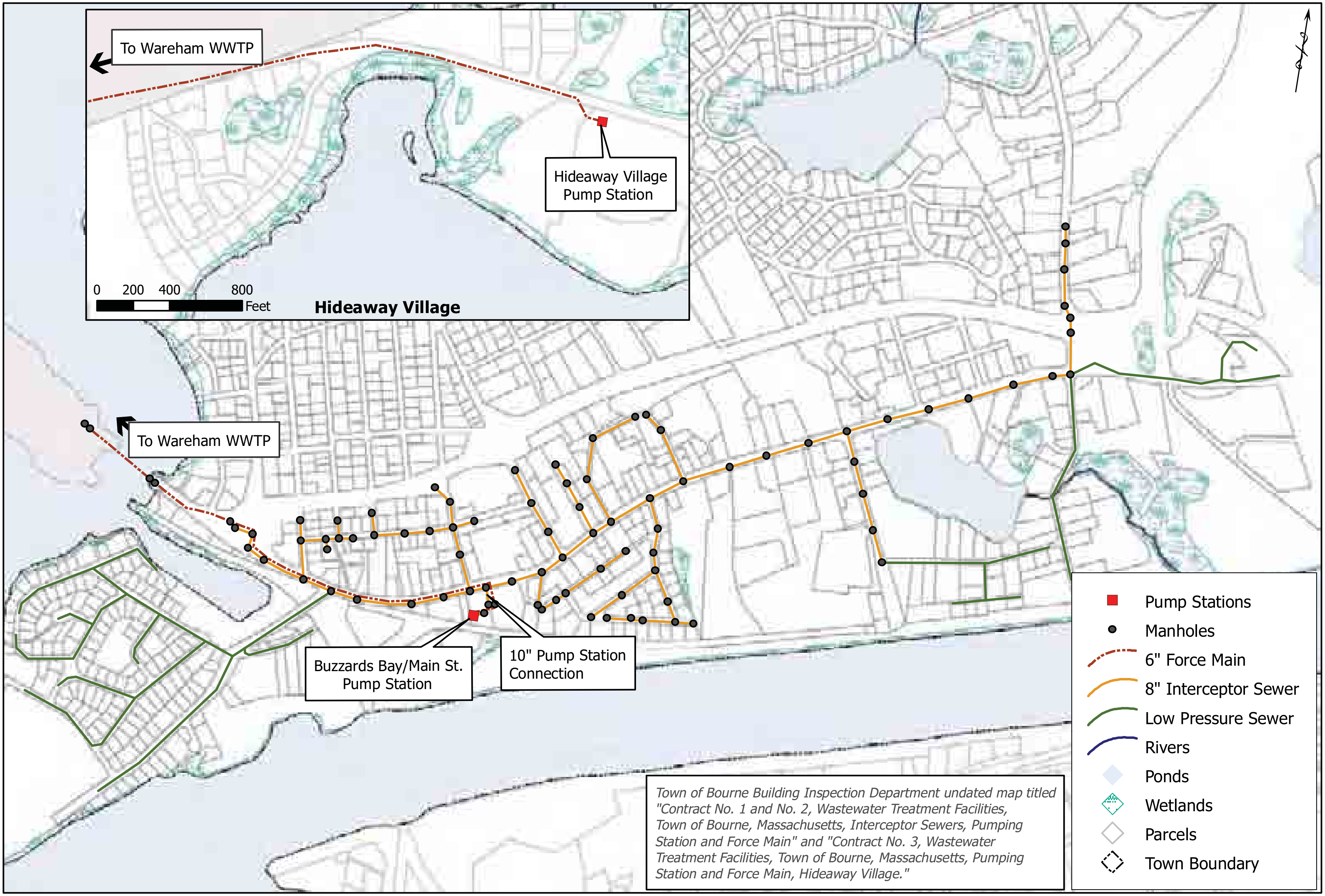


Figure 9.
Existing Sewer Lines

This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County. The information depicted on these maps is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis. It should not substitute for actual on-site survey, or supersede deed research.

Apart from the municipal system, the Massachusetts Maritime Academy, located in the Downtown area, collects and treats all of the wastewater generated on its site. The treatment plant is designed for an average of 77,000 GPD. The treated effluent is disposed of via an outfall pipe into Buzzards Bay, using a NPDES Permit for an average flow of 140,000 GPD.

TASK 4A & 4B: INTER MUNICIPAL AGREEMENT & ALLOCATIONS

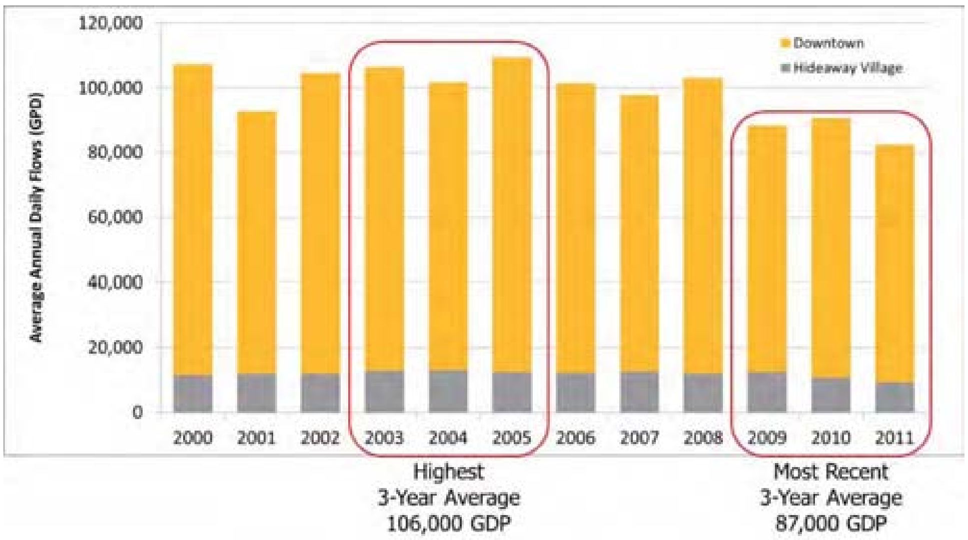
The "Agreement for Wastewater Collection, Treatment and Disposal between Town Of Wareham, Massachusetts and Town Of Bourne, Massachusetts," commonly referred to as the Inter Municipal Agreement (IMA) details the terms by which the Town of Bourne sends wastewater flows to the Wareham Wastewater Treatment Plant (WWTP). The IMA was developed in 1989 and goes through 2009. It was renewed, with only minor changes to language in 2009. The IMA describes the terms of the agreement and payment, for example, Bourne paid Wareham a proportionate share of Wareham's capital investment for common infrastructure, including the WWTP. It states that Wareham will take up to 200,000 GPD (average annual daily) from Bourne, with approximately 140,000 GPD (average annual daily) allocated to the Downtown Bourne area and 60,000 GPD (average annual daily) allocated to the Hideaway Village area.

The IMA also states that, in the event that Bourne's total average daily wastewater flow entering the common sewage works within any two consecutive quarters exceeds 180,000 GPD, then Bourne shall notify Wareham and define measures that will be taken to manage the quarterly flow increase to keep the total within the total flow capacity allocated to Bourne.

EXISTING WASTEWATER FLOWS

To understand how the existing infrastructure is being utilized, wastewater pumping records were requested from the town of Bourne. The records provided measurements of the monthly average number of gallons per days pumped to Wareham from the Downtown (Main Street pumping station) and the Hideaway Village pumping stations. Data from 2000 through 2011 was analyzed and is presented in Figure 10. As highlighted in the figure, the most recent three-year average is 87,000 GPD (2009 – 2011) and the highest three-year average is 160,000 GPD (2003-2005). Detailed data is provided in *Appendix C: Summary of Downtown Bourne Wastewater Pumping Reports*.

FIGURE 10. AVERAGE ANNUAL WASTEWATER FLOW SENT TO WAREHAM (2000   2012)



TASK 4C: ALLOCATION TRACKING OUTLINE

With the IMA limiting the wastewater flows to average annual daily flow of 200,000 GPD, and with a 180,000 GPD action trigger, it is important for the town to track and monitor the flows being sent to Wareham. The tracking is a requirement of the IMA as flow data is collected at the two pumping station feeding the flows into Wareham. Continued monitoring of the actual flows versus the flow limit will be important is inform the town as to the available allocation that is available for development.

It is important to note that this "available allocation" is in constant flux as actual flows will vary year to year. Considering the most recent three-year average flow (2009-2011) and the highest three-year average flow (2003-2005), Table 1 presents Bourne's available allocation to the Wareham WWTP.

TABLE 1. AVAILABLE ALLOCATION TO WAREHAM WWTP

	Highest 3-Year Average (2003-05)	Most Recent 3-Year Average (2009-11)
IMA Wastewater Allocation Trigger (annual average allocation)	180,000 GPD	180,000 GPD
Downtown Bourne (annual average)	-93,000 GPD	-76,000 GPD
Hideaway Village (annual average)	-13,000 GPD	-11,000 GPD
Optimus Senior Living (allocation)	-23,000 GPD	-23,000 GPD
Available Allocation	51,000 GPD	70,000 GPD

OTHER CONCERNS

A discussion on the performance of septic systems, 100 year flood plain, groundwater, soils, water quality issues with estuaries/Massachusetts Estuaries Project, drinking water supply, freshwater ponds, Areas of Critical Environmental Concern, Outstanding Water Resource, leachate, septage, and wastewater constituents biological oxygen demand (BOD), total suspended solids (TSS), total nitrogen (TN), total phosphorus (TP)) are addressed the October 2007 Tighe and Bond report.

REGULATORY REQUIREMENTS

DEP Groundwater Discharge Program – Wastewater treatment facilities that discharge more than 10,000 GPD to ground water are governed by the MA DEP under 314 CMR 5.00. The regulations require a rigorous hydrogeologic assessment to determine the proposed site's suitability and capacity and to characterize and minimize potential impacts on nearby or downgradient resources. The permit requires regular monitoring of performance.

Clean Water Act - the Federal Clean Water Act is implemented by the State DEP. The law requires that the state identify impaired waters and specific plans to restore water quality. These plans require the establishment of a Total Maximum Daily Load (TMDL) as a management goal for regulatory compliance. In the case of coastal waters impaired by nitrogen, the law requires that the TMDL will outline the percent nitrogen removal required and provide guidance to the Towns on the types of controls and measures that might be effective in complying with the TMDL limits.

Massachusetts Estuary Project (MEP) Nitrogen Study - To reach compliance with Massachusetts water quality standards, the Massachusetts Estuaries Project (MEP) in the School for Marine Science and Technology (SMAST) at the University of Massachusetts at Dartmouth completes, under contract to the MADEP, technical studies for water bodies that are impaired under the state 303(d) impaired waters classification. These technical studies are used to develop Total Maximum Daily Loads (TMDLs) for those water bodies. MEP studies have not yet been completed for Cape Cod Canal or Buttermilk Bay.

DEP State Revolving Loan Regulations - The DEP has established requirements that must be met for towns to apply for low interest loans for wastewater infrastructure projects. The SRF regulations specify that Comprehensive Wastewater Management Plans must be developed to recommend and implement programs to attain TMDL limits and water quality standards for the pollutants of concern.

NPDES Permit for Wareham WWTP – The Wareham WWTP has a surface water discharge to the Agawam River and is, therefore, regulated under a discharge permit issued jointly by the EPA and the Massachusetts Department of Environmental Protection (MADEP). The discharge permit includes an industrial pretreatment requirement, which is reflected in the Bourne – Wareham IMA. The total average wastewater flow capacity of the Wareham Plant according to the IMA is 1.5 MGD of which Bourne is allocated 200,000 GPD. Original NPDES permits for outfalls into surrounding coastal waters are extremely difficult to amend for increased capacity.

Massachusetts Maritime Academy – As discussed previously, the MMA has its own treatment facility with a direct ocean discharge into the Cape Cod Canal through an EPA NPDES permit with an average capacity of 140,000GPD. The MMA currently uses an average of 66,000 GPD. Like the Wareham plant that has an existing outfall, the regulatory hurdle for amending a NPDES permit is extremely difficult.

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New Source Approval – DEP regulations for the siting of a new public water supply well requires that a rigorous hydrogeologic assessment of the safe yield and potential impacts of a new water supply well.

Task 5 – Buildout Analysis and Wastewater Flows

Commission staff prepared a buildout analysis for the study area following assumptions outlined by current zoning and future market analysis.

INTRODUCTION TO BUILDOUT

A build-out analysis is an opportunity to create a snap shot of future development potential under current zoning. The methodology requires a series of both fixed and partial constraints. Fixed constraints are determined by both use and dimensional requirements in the zoning code, and partial constraints include more flexible assumptions such as the types of commercial uses (i.e retail, hotel, office, etc.) and the ratio of those commercial uses to residential uses within the zoning district. The result is a maximum development scenario that can be useful as a community visioning tool. However, build-out analyses *do not* predict actual future development, and in this case, it *is not* a parcel level analysis. Rather, fixed and partial constraints are applied to land within the district in the aggregate from which a development scenario emerges.

BUILDOUT METHODOLOGY

The town's 2011 assessor data was used as the basis for calculating the theoretical buildout potential under the town's form based zoning code adopted in 2008. Parcels within the database were aggregated by land area according to the four Downtown District (DTD) zoning districts; Downtown Gateway (DTG), Downtown Core (DTC), Downtown Waterfront (DTW) and Downtown Neighborhood (DTN). These zoning districts are presented in Figure 11.

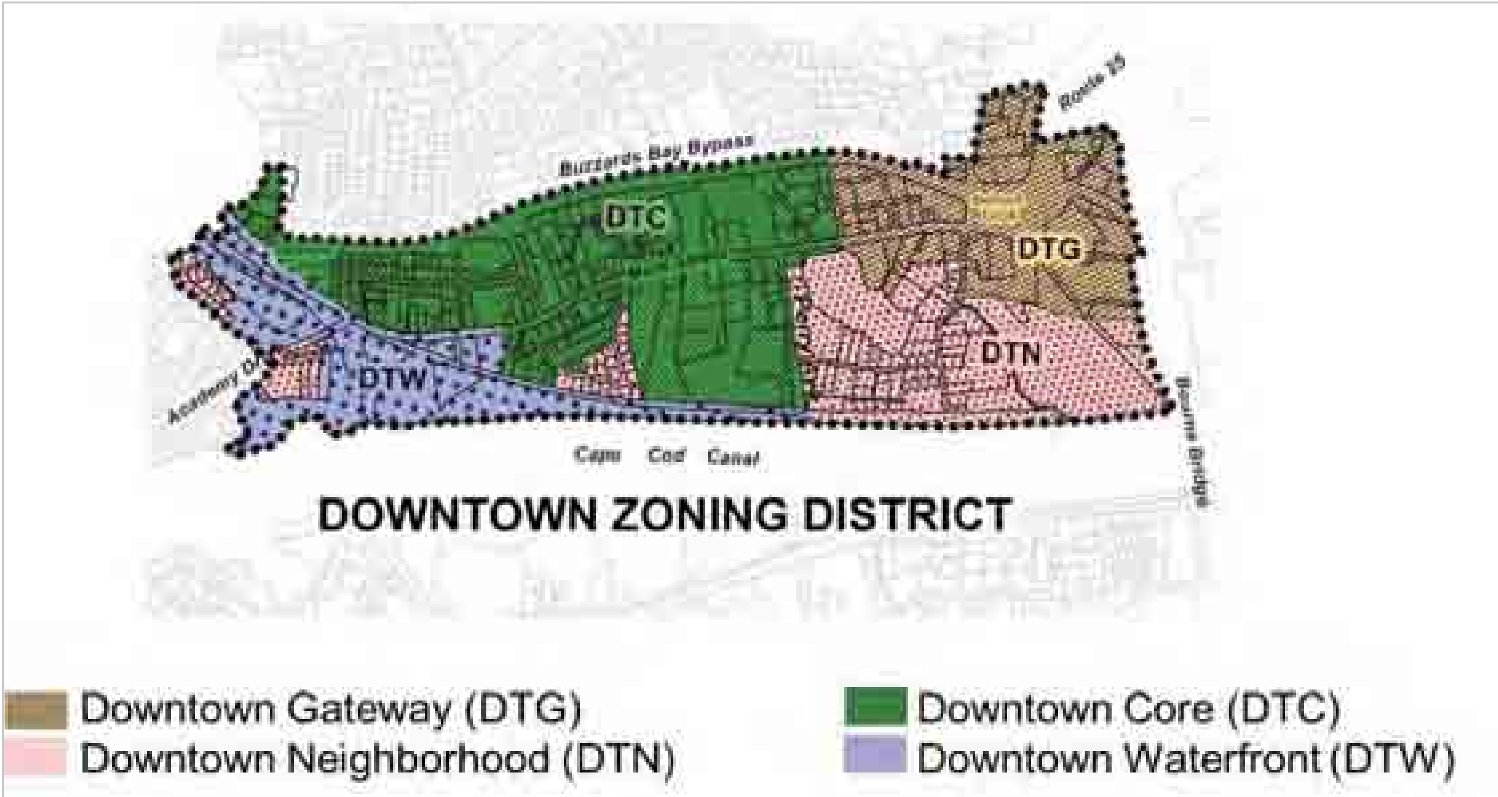

FIGURE 11. DOWNTOWN ZONING DISTRICTS

The DTN parcels retained their R-40 zoning requirements under the new zoning, including a 40,000 sf minimum lot size. Preliminary build-out analysis for the DTN shows the district as nearly built out with only 8 units remaining. Given this limited buildout potential, the DTN parcels were removed from the buildout analysis for the DTD. Remaining parcels in the DTD that met certain characteristics, such as municipally or federally owned land and protected open space, were also removed from the total developable area. Finally, parcels located within the floodplain, as delineated by the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps (FIRMs) were analyzed assuming ground floor parking, whereas parcels located outside the floodplain were not. This analysis was conducted at the direction of the Bourne Wastewater Advisory Committee and resulted in slightly higher densities within the floodplain as surface parking was no longer a limiting factor of development density within the buildout methodology. Table 2 contains the buildout factors used for both fixed and partial constraints.

TABLE 2. BUILDOUT FACTORS

Buildout Factors – Fixed Constraints[a]	
FAR	2
Lot Coverage	80%
Open Space	20%
Building Height	52
Stories	4
Parking (by use):	
# spaces/1000 sf restaurant	10
# spaces/1000 sf office	3
# spaces/1000 sf retail	3
# spaces per residential unit	1.5
# spaces per hotel/motel unit	1
Minimum Lot Size (sf)	3500
Buildout Factors – Partial Constraints[b]	
% site used for ancillary uses	5%
Shared Parking Reduction Credit	30%[c]
Residential Unit (GFA)	1333
Hotel/Motel Unit (GFA)	650[d]
Average Residential Unit Size (sf)	1000
Average sf/parking space	400

[a]Bourne Downtown District Zoning Bylaw (2800)
[b]MassGIS Scope of Services for Buildout Analysis
[c]Assumption of CCC/Town Planner (up to 50% shared credit allowed under zoning)
[d]Town of Yarmouth Buildout Input

MIX OF USES

As previously mentioned in the Introduction to Buildout section of this report, determining the mix of uses (or the ratios between certain types of commercial development and residential development) is an important step in conducting a buildout analysis. Commission staff worked with the Town Planner and the BWAC to determine an appropriate mix of uses for each district. The mix of uses are flexible assumptions intended to align with the Town's vision for certain types of development within the DTD. Table 3 represents the mix of use assumptions for the DTD buildout.

TABLE 3. DTD BUILDOUT MIX OF USE ASSUMPTIONS

Mix of Uses	DTG	DTC	DTW
% Residential	60%	60%	70%
% Commercial	40%	40%	30%
% restaurant	5.0%	5.0%	10.0%
% office	8.0%	5.0%	3.0%
% retail	5.0%	10.0%	5.0%
% hotel	10.0%	10.0%	5.0%
% institutional	10.0%	5.0%	2.0%
% consumer services	2.0%	5.0%	5.0%

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BUILDOUT RESULTS

DOWNTOWN BOURNE

Table 4 summarizes the findings of the theoretical buildout analysis for Downtown Bourne. For the complete buildout analysis, see *Appendix D: Buildout Analysis*.

TABLE 4. DOWNTOWN BOURNE THEORETICAL BUILDOUT PROJECTIONS

	Downtown District (DTD)	Downtown District (DTD) w/ Wastewater Flows
Residential (units)	1,803 Units	396,669 GPD
Commercial (SF)	3,244,928 SF	943,408 GPD
	Total	**1.34 million GPD**

Given the amount of development potential within the district, and associated wastewater flows, the Commission RESET Team worked with the BWAC to identify a practical buildout approach for the Town to move forward with in their wastewater infrastructure planning efforts. Table 5 represents a 25% cut of the theoretical buildout potential for Downtown Bourne. This is a typical planning approach that has been used in other recent Comprehensive Wastewater Management Planning (CWMP) efforts across the Cape. The BWAC recommends this practical buildout scenario as the Town moves forward with water supply and wastewater planning efforts.

TABLE 5. DOWNTOWN BOURNE PRACTICAL BUILDOUT PROJECTIONS

	Downtown District (DTD)	Downtown District (DTD) w/ Wastewater Flows
Residential (units)	541 Units	99,167 GPD
Commercial (SF)	811,232 SF	235,852 GPD
	Total	**335,000 GPD**

HIDEAWAY VILLAGE AND BOURNE DEVELOPMENT CAMPUS

Buildout projections for these two areas were conducted using existing peak wastewater flows for Hideaway Village and a preliminary development scenario for the Bourne Development Campus (BDC). Buildout projects are represented in Table 6.

TABLE 6. HIDEAWAY VILLAGE AND BDC BUILDOUT PROJECTIONS

Bourne Development Campus	**SF**	**GPD**
Commercial	125,000	
Storage	12,500	
Office	50,000	
Industrial	62,500	
Total	250,000	47,500
Hideaway Village	269 units	20,000
Total GPD		**67,500**

Task 6 - Wastewater Facility Siting

A key component to wastewater planning is the identification of one or more feasible sites for a wastewater treatment facility and an associated subsurface disposal system, north of the Cape Cod Canal. The Commission's RESET staff conducted an evaluation of potential wastewater facility and discharge sites.

The overall approach that was used for determining appropriate sites was

1) develop initial criteria to screen potential parcels,
2) identify potential parcels,
3) develop decision criteria on which to score and rank parcels,
4) develop weightings for each decision criteria,
5) rate each decision criteria for each parcel, and
6) calculate an overall score for each parcel and rank.

The highest rated parcels were selected for further analysis. Sites that were deemed appropriate for disposal were evaluated separately from parcels that were appropriate for a treatment plant.

The initial criteria developed for identifying potential wastewater treatment and subsurface disposal sites were:

- Appropriately size to meet disposal and treatment flow requirements
- Adequate soil permeability
- Groundwater depth greater than 6 feet
- Located outside of Zone IIs (drinking water)
- Located outside of Sensitive Habitat, Wetlands, or Water Bodies
- Located outside of the 100 year Flood Plain
- Considered undeveloped or open space

Using these initial criteria and existing Geographic Information System (GIS) information, the areas of Bourne north of the Cape Cod Canal that were not suitable for wastewater treatment or subsurface disposal were identified as shown in Figure 13

Figure 12.
Areas Unsuitable for Wastewater Treatment or Disposal Systems

This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County. The information depicted on these maps is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis. It should not substitute for actual on-site survey, or supersede deed research.

SUBSURFACE DISPOSAL SITES

Based on this analysis, 41 potential subsurface disposal sites (parcels) were identified, as shown in Figure 13. In addition, decision criteria and associated ratings were identified, based on discussions with BWAC, as shown in Table 7. The BWAC identified the appropriate weighting for each decision criteria in order of importance (1 thru 10) – the lower the weight or rating, the higher the importance.

TABLE 7. SUBSURFACE WASTEWATER DISPOSAL SITE DECISION CRITERIA, RATIONG, AND WEIGHTS

Decision Criteria	Rating	Weight
Down Gradient of Wells, Water Bodies, Vernal Pools/Wetlands, or Environmentally Sensitive Habitat	yes (1) - no (5)	1
Proximity to Downtown Buzzards Bay	close (1) - far (5)	2
Cost of Acquisition/Value of Property	low (1), med (3), high (5)	3
Proximity to Historical and Archeological Areas (Not located on)	far (1) - near (5)	4
Area to Expand/Reserve Area/Future Flexibility/Phasing	# acres > 3, many (1) - few (10)	5
Accessibility for Maintenance and Operations	good (1) - poor (10)	6
Compatibility with Adjacent Land Uses	good (1) - poor (10)	7
Number of Abutters	few (1) - many (5)	8
Competing Uses for Land	none (1) - many (1)	9
Wooded Area	minimal (1) - very (5)	10

For each potential parcel, a rating was then assigned for each decision criteria by BWAC, and an overall score was calculated for each parcel, as shown in *Appendix E: Subsurface Disposal Site Selection Matrix*

The four top ranked parcels were selected for further analysis, as shown in Table 8 and Figure 14. Two sites are located within the downtown area, one site is located out of downtown, along the Scenic Highway, and one site is located near Hideaway Village. All sites are owned by the Town, except for the Kramer property. They encompass a range of sizes as shown in Table 8.

TABLE 8. SUBSURFACE WASTEWATER DISPOSAL SITES SELECTED FOR ANALYSIS

Site Number	Ownership	Size (acres)	Location
10	Private	4	Kramer Property (Hideaway Village)
16	Town	124	Scenic Highway (Out of Town)
19	Town	8	Queen Sewell Park (Downtown)
29	Town	4	Community Center (Downtown)

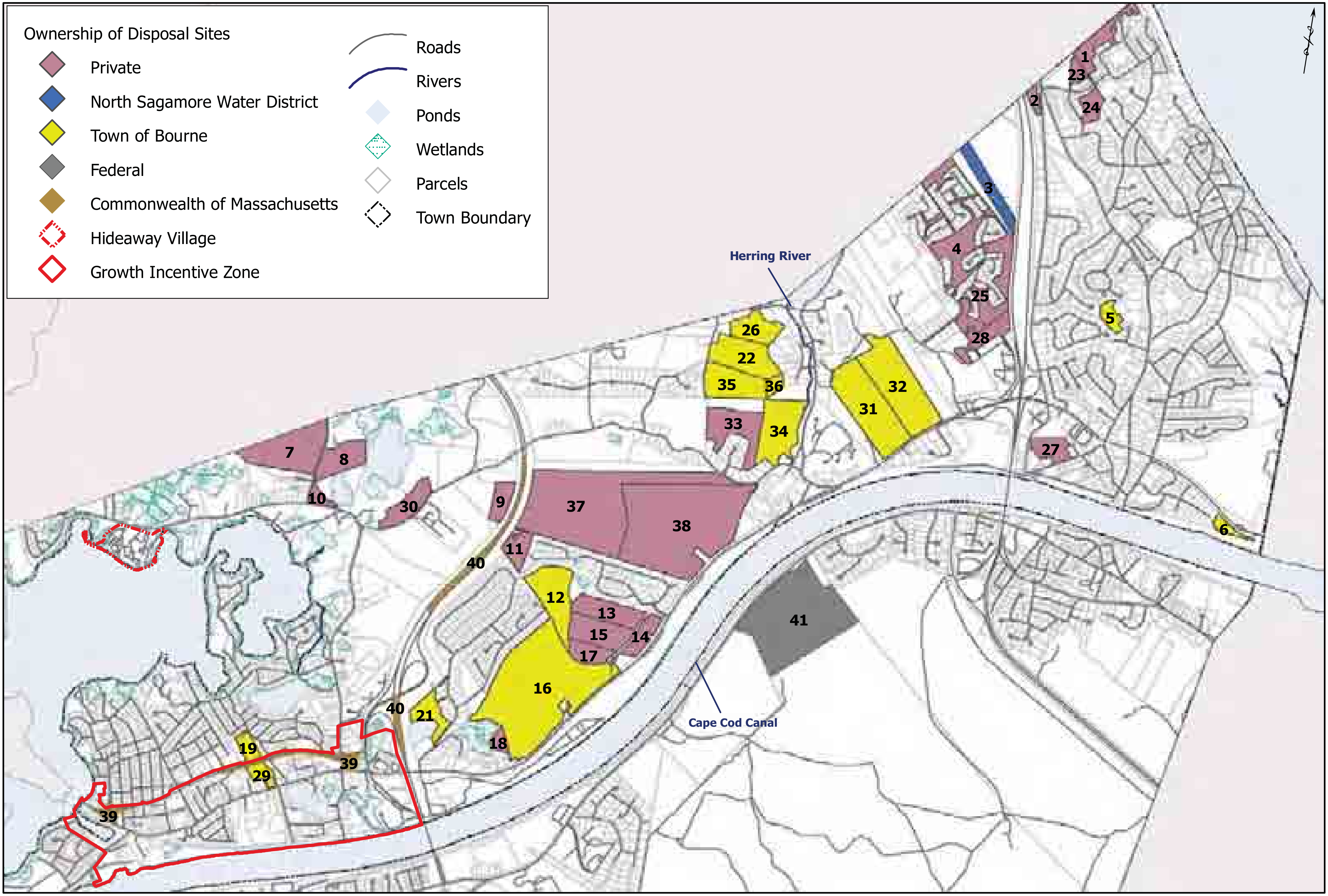

Figure 13.
Potential Wastewater Subsurface Disposal Sites

This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County. The information depicted on these maps is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis. It should not substitute for actual on-site survey, or supersede deed research.

0 0.25 0.5 1 Miles

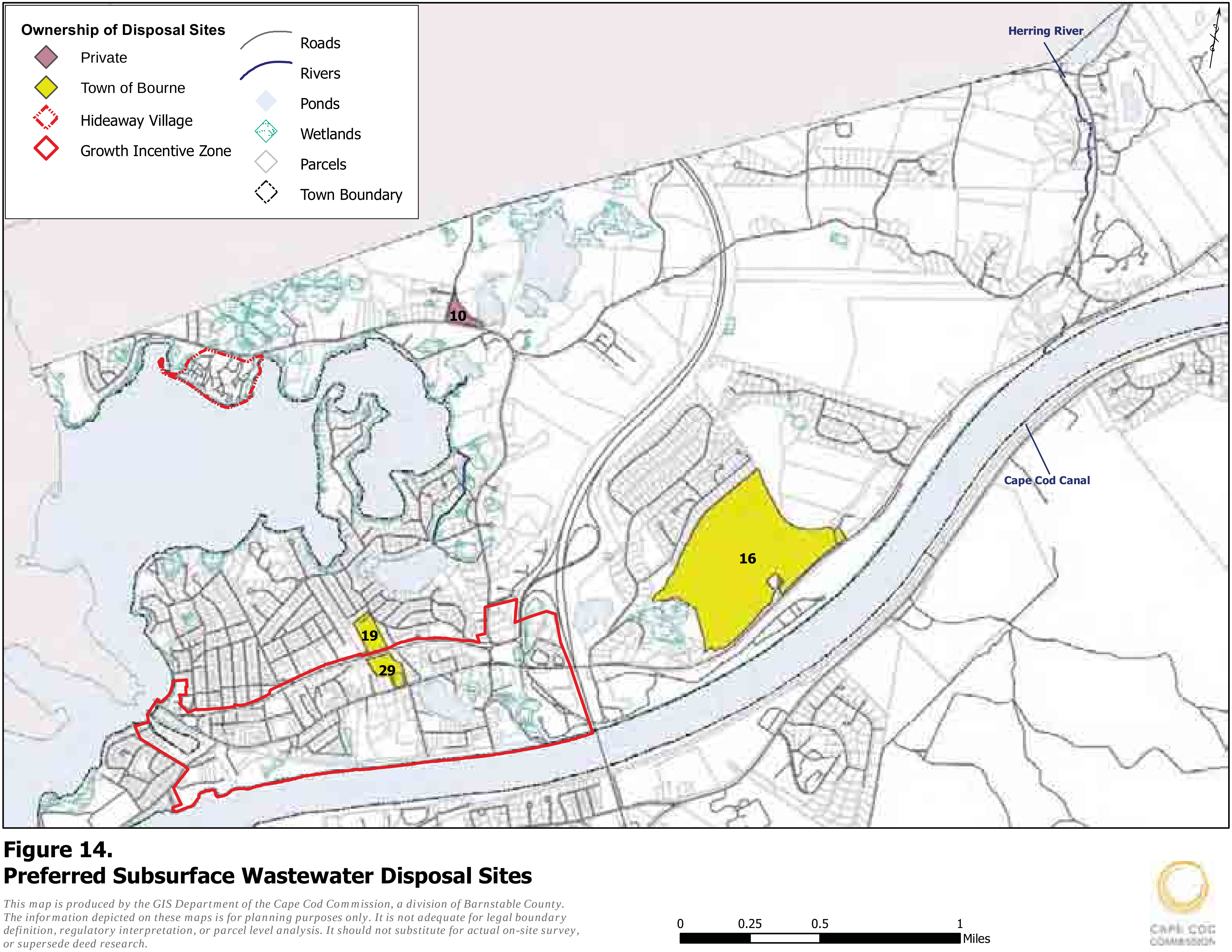

Figure 14.
Preferred Subsurface Wastewater Disposal Sites

This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County. The information depicted on these maps is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis. It should not substitute for actual on-site survey, or supersede deed research.

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TREATMENT SITES

Based on the analysis summarized in Figure 13, 45 potential wastewater sites (parcels) were identified, as shown in Figure 15. Additional downtown sites were identified as potential treatment sites due to the smaller land requirements for a treatment plant versus a subsurface disposal field. In addition, decision criteria and associated ratings were identified, based on discussions with BWAC, as shown in Table 9. The BWAC identified the appropriate weighting for each decision criteria in order of importance (1 thru 9) – the lower the weight or rating, the higher the importance.

TABLE 9. WASTEWATER TREATMENT SITE DECISION CRITERIA, RATINGS, AND WEIGHTS

Decision Criteria	Rating	Weight
Compatibility with Adjacent Land Uses	good (1) - poor (10)	1
Cost of Acquisition/Value of Property	low (1), med (3), high (5)	2
Number of Abutters	few (1) - many (5)	3
Accessibility for Maintenance and Operations	good (1) - poor (10)	4
Area to Expand/Reserve Area/Future Flexibility/Phasing	# acres > 1, many (1) - few (10)	5
Competing Uses for Land	none (1) - many (10)	6
Proximity to Downtown Buzzards Bay	near (1) - far (5)	7
Proximity to Historical and Archeological Areas (Not located on)	near (1) - far (5)	8
Wooded Area	minimal (1) - very (5)	9

For each potential parcel, a rating was assigned for each decision criteria by BWAC, and an overall score was calculated for each parcel, as shown in *Appendix F: Treatment Site Selection Matrix*. The five top ranked parcels were selected for use in further evaluations, as shown in Table 10 and Figure 16. Two sites are located within the downtown area, two sites are located out of downtown, and one site is located near Hideaway Village. The sites are owned by the Town, the State, and private owners and encompass a range of sizes.

TABLE 10. WASTEWATER TREATMENT SITES SELECTED FOR ANALYSIS

Site Number	Ownership	Size (acres)	Location
10	Private	4	Kramer Property (Hideaway Village)
16	Town	124	Scenic Highway (Out of Town)
21	Town	12	Deseret Drive (Out of Town)
39 E	State	2.6	Belmont Circle (Downtown)
C	Private	2[1]	Sandford Property (Downtown)

[1] Assume the Town works with the owner to secure 2 acres of property in a configuration that would work for siting a treatment plant.

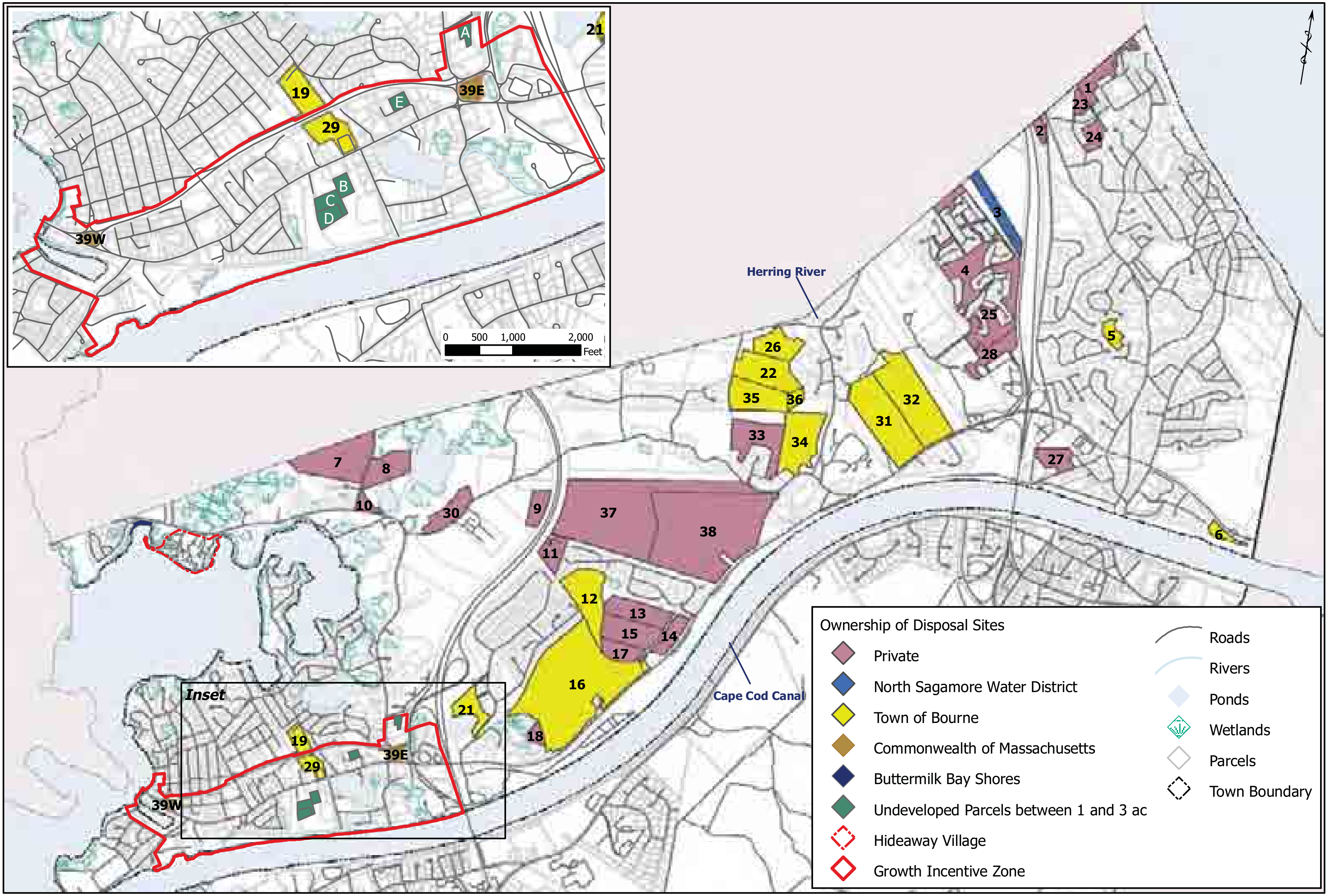

Figure 15.
Potential Wastewater Treatment Sites

This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County. The information depicted on these maps is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis. It should not substitute for actual on-site survey, or supersede deed research.

0 0.25 0.5 1
Miles

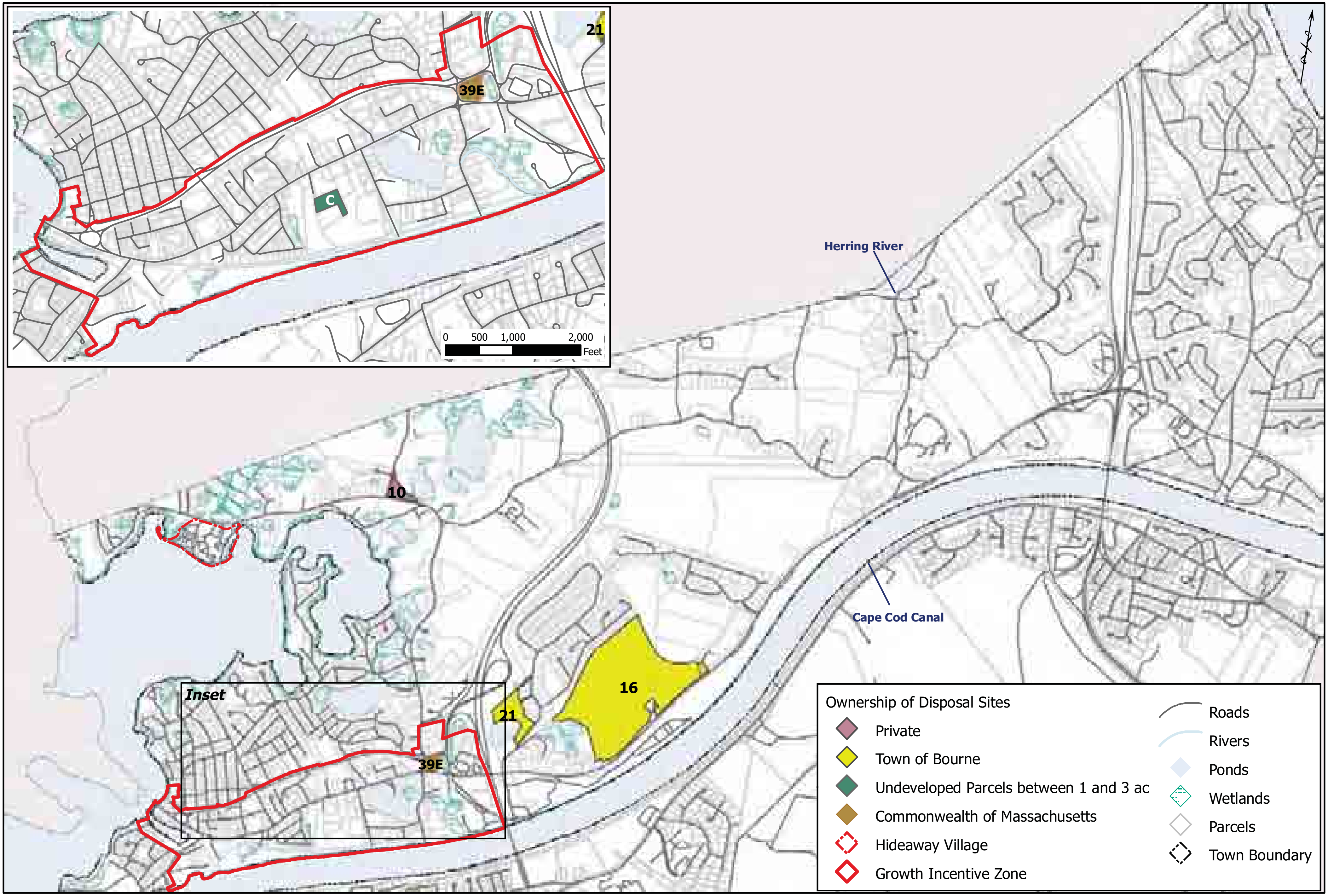

Figure 16.
Wastewater Treatment Sites Selected for Analysis

This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County. The information depicted on these maps is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis. It should not substitute for actual on-site survey, or supersede deed research.

Task 7 - Evaluation of Wastewater Infrastructure Options

INCREMENTAL FLOWS

The planning period buildout wastewater flow for the downtown village of Downtown Bourne and Hideaway Village is 535,000 gallons per day (GPD), including the 200,000 GPD that is allocated at the Wareham WWTP. Downtown growth and the need for wastewater treatment capacity will happen incrementally. Therefore the Committee chose to evaluate wastewater services for a range of additional incremental flows from 25,000 GPD to 335,000 GPD, as shown in Table 11 to provide the flexibility to accommodate initial to full range.

TABLE 11. INCREMENTAL/MODULAR WASTEWATER FLOWS CONSIDERED (GPD)

25,000
50,000
100,000
335,000

WASTEWATER TREATMENT TECHNOLOGIES

As part of the analysis, various wastewater treatment technologies commonly used in Massachusetts for systems up to 500,000 GPD were considered. These technologies were evaluated for a range of criteria, resulting in the recommendation to consider three technologies in development of full wastewater management options. The three treatment technologies being carried forward are membrane bio reactors (MBRs), sequencing batch reactors (SBRs), and package plants as shown in Table 12.

TABLE 12. WASTEWATER TECHNOLOGIES CONSIDERED

Membrane Bio Reactor (MBR)
Sequencing Batch Reactor (SBR)
Package Plant

The ability to remove nutrients, specifically nitrogen, is an important consideration in a treatment technology. *Appendix G: Treatment Technology Information* provides more information on each technology, as well as a summary of the screening process that emphasizes odor control, treatment reliability, and nutrient removal through the weighting of criteria and a summary of the screening process that emphasizes costs through the weighting of criteria.

There are currently more than ten MBRs installed in Massachusetts. MBRs can be scaled to treat a wide range of flows, from 10,000 GPD to over 350,000 GPD. MBRs have a small footprint, a high degree of flexibility to be modified for biological nitrogen removal (BNR) to meet potential future regulations, and low potential for odor issues. They are highly reliable at meeting permit requirements, such as biological oxygen demand (BOD), total suspended solids (TSS), and total nitrogen (TN). MBRs are very capable of handling septage but are complex to operate. Capital and operations and maintenance (O&M) costs are also expensive.

Massachusetts has over twenty SBRs currently installed and operating. They can be scaled to meet a wide range of flows (10,000 to greater than 350,000 GPD). SBRs have a medium sized footprint and a good degree of ability to be able to be modified for BNR. However, they have little ability to handle septage and a high potential for odor issues. SBRs are moderately complicated to operate. They are reliable at meeting permit limits (BOD, TSS, and TN). SBRs are moderately expensive for both capital and O&M costs. The Massachusetts Maritime Academy (MMA) operates a SBR wastewater treatment plant with a capacity of 77,000 GPD.

Package plants have a small footprint and are generally not optimal for onsite flows over 50,000 GPD. Package plants can be used under the right conditions for flows less than 100,000 GPD. Package plants are relatively inexpensive for both capital and O&M costs and have good flexibility to be able to be modified for BNR. They are generally reliable at meeting permit limits (BOD, TSS). Package plants have little ability to handle septage, can have a high potential for odor if not operated properly and can be complex to operate in certain applications.

All of the above technologies must be designed to adequately handle the seasonal variation of flow that will be experienced in Bourne.

WASTEWATER TREATMENT AND SUBSURFACE DISPOSAL SITE AREA REQUIREMENTS

Site area requirements (in acres) were developed for each treatment technology and incremental flow rate. The Committee selected groundwater subsurface disposal (subsurface disposal) as the most appropriate disposal method. Although rapid infiltration beds are less costly and take-up less space, the subsurface disposal method is covered and allows the top to be planted with soil and used for a variety of activities, including recreational. Site area requirements for each flow rate were developed for the subsurface wastewater disposal method. Table 13 shows the amount of acreage required for a parcel for each flow rate for each treatment technology and the selected disposal method.

TABLE 13. WASTEWATER TREATMENT AND SUBSURFACE DISPOSAL SITE AREA REQUIREMENTS

Flow (GPD)	Subsurface Disposal (acres) [1]	MBR (acres)	SBR (acres)	Package Plant (acres)
25,000	0.8	0.5	0.5	0.5
50,000	1.6	0.5	1	0.5
100,000	3	1	1.5	NA
335,000	10	2	3	NA

NA = Not applicable.
[1] = Based on 2.5 GPD/square foot trench surface area(2 ft wide x 2 ft deep x 4 ft above groundwater levels) (including bottom and side of the trench) per Title 5 and DEP 2004 guideline for soil with a minimum percolation rate of 5 min/in. Disposal is subsurface with groundwater separation of 4 ft from the bottom of the trench. 3 ft distance between trenches. Disposal is subsurface. 20% was added for buffer area and 100% redundancy for reserve space.

Because package plants are generally not optimal for flows above 50,000 GPD, site area requirements are shown as Not Applicable (NA). Site area requirements for the selected wastewater treatment technologies were developed using previous experience laying out treatment plants on various sites and best professional judgment. The site area requirement for wastewater disposal was calculated using MADEP requirements and 2.5 GPD/linear foot as the loading rate, 20% for buffer area and 100% redundancy for reserve space. For more information, see *Appendix H: Subsurface Disposal Site Requirements*.

Based on treatment and disposal site requirements, Table 14 presents the appropriateness of the sites selected for analysis for different incremental flow levels. Using the selected wastewater treatment and disposal sites and their sizes (Table 8 and Table 10), selected treatment technologies (Table 12), the range of flows analyzed (Table 11), and the site area (acreage) requirements for the treatment options and the disposal method (Table 13), the selected sites that could accommodate each flow rate for wastewater treatment and subsurface disposal were identified. The flow that could be accommodated at each site, based on the site area requirements for treatment and disposal, are shown in Table 14. Sites that cannot accommodate a flow rate are shown as NA. Technologies that are not appropriate for flow rates are also shown as NA, as discussed previously discussed.

TABLE 14. APPROPRIATE WASTEWATER TREATMENT AND SUBSURFACE DISPOSAL SITES AND TECHNOLOGIES BY FLOW

		Flows			
		25,000 GPD	**50,000 GPD**	**100,000 GPD**	**335,000 GPD**
Treatment Sites*	10	X	X	X	X
	16	X	X	X	X
	39E	X	X	X	X
	C	X	X	X	X
Disposal Sites					
Subsurface Disposal Sites	10	X	X	NA	NA
	16	X	X	X	X
	19	X	X	X	NA
	29	X	X	X	NA
	19 + 29 (combined)	X	X	X	X
Treatment Technologies	Package Plant	X	X	NA	NA
	MBR	X	X	X	X
	SBR	X	X	X	X

X = Applicable
NA = Not applicable
*Site 21 (Deseret Drive) was eliminated from further consideration due to the site's proximately to Nightingale Pond and a residential development

Construction of infrastructure for water transmission from the collection to the treatment site to the subsurface disposal sites constitutes a significant capital cost. Capital transmission costs were tabulated based on the conceptual design presented in Figure 17. The capital transmission costs are presented in greater details for the preferred options presented in the following sections.

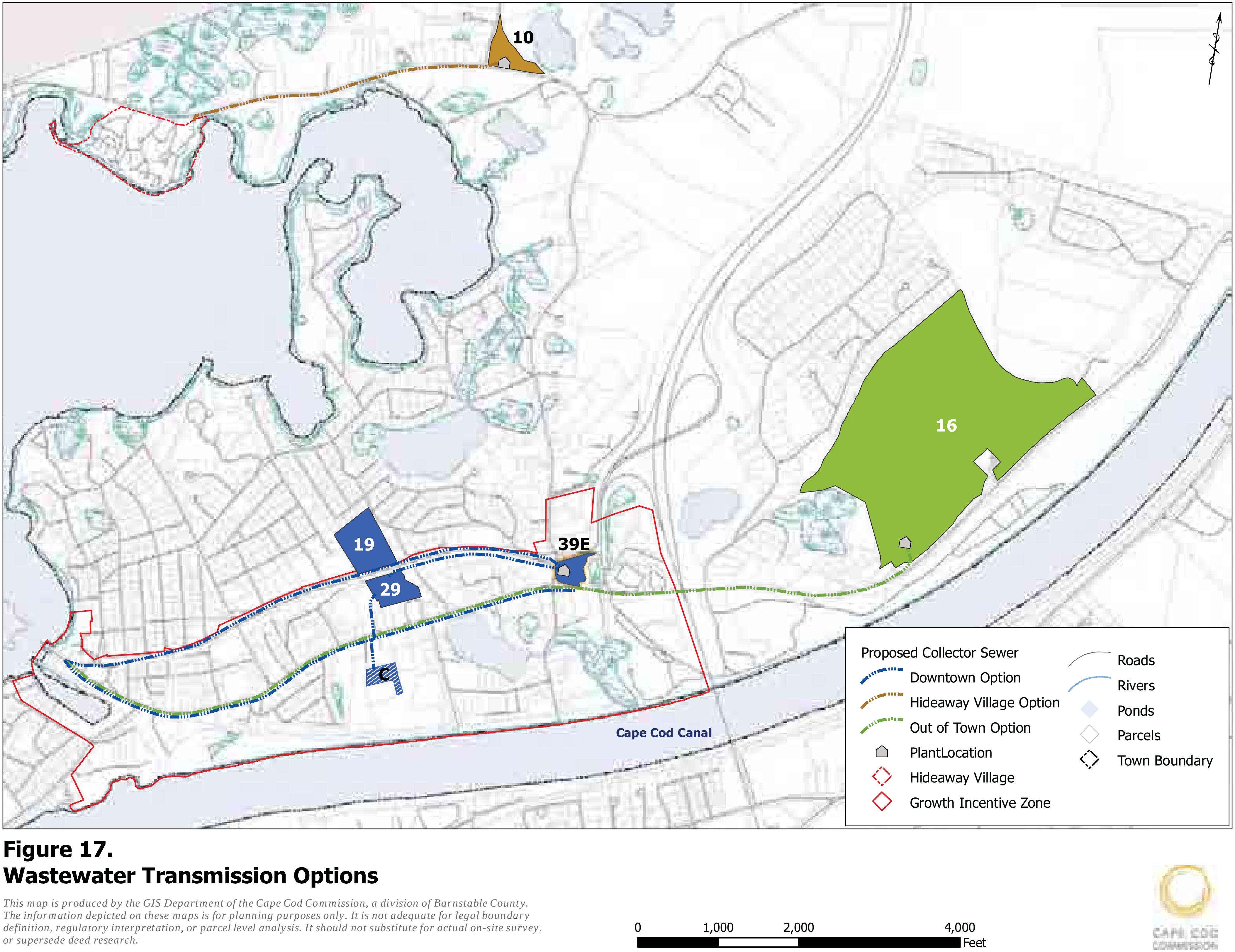

Figure 17.
Wastewater Transmission Options

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PREFERRED ALTERNATIVES FOR DOWNTOWN WASTEWATER FLOWS

Considering the treatment and subsurface disposal site selected for analysis, as shown in Table 8 and Table 10, and their appropriateness for different types of treatment, as presented BWAC developed a menu of preferred options to handle Downtown flows. These preferred sites and the preferred treatment technologies for a downtown and an out of town option are presented in Table 15.

TABLE 15. PREFERRED WASTEWATER TREATMENT AND SUBSURFACE DISPOSAL SITES AND TECHNOLOGIES FOR DOWNTOWN FLOWS

Facility Location	Treatment Technology	Treatment Site ID #	Disposal Site ID #
Downtown	MBR	39E* or Site C**	19 (19+29 for 350,000 GPD)
Out of Downtown	MBR	16	16
*state owned, potential conflict with possible Belmont Circle reconfiguration **privately owned, Town would need to work with owner to secure ownership or rights to part of the site			

Feasible Downtown options for treatment and disposal include construction of an MBR treatment facility on Site 39 E, Belmont Circle (Figure 18) or Site C, the Sandford Property (Figure 19), with subsurface disposal on Site 29, the Community Center, or Site 19, Queen Sewell Park (Figure 20). Both sites can accommodate up to 100,000 GPD of capacity, but if combined can accommodate the 335,000 GPD. It is envisioned that the planned recreation fields would be built over the subsurface disposal field on Site 19, as shown in Figure 21. It should be noted that a downtown wastewater treatment site would not be designed to receive septage due to traffic and public impacts.

Should development plans originate from private entities that own land suitable for required wastewater treatment and/or disposal facilities, such sites can be considered in lieu of those presented herein.

The preferred out of downtown siting option for all flows is to co-locate both wastewater treatment and subsurface disposal on Site 16 (Scenic Highway), as shown in Figure 22 and Figure 23, using an MBR technology. This would require pumping to the Scenic Highway site. The Site 16 wastewater treatment plant would receive flow from the elementary school, the Department of Public Works, and potentially, the Bourne Development Campus to eliminate operation of the on-site systems serving those facilities.

FIGURE 18. PREFERRED DOWNTOWN WASTEWATER TREATMENT OPTION (BELMONT CIRCLE) – 335,000 GPD MBR TREATMENT PLANT

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FIGURE 19. PREFERRED DOWNTOWN WASTEWATER TREATMENT OPTION (SITE "C" - SANDFORD PROPERTY) – 335,000 GPD MBR TREATMENT PLANT

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FIGURE 20. PREFERRED DOWNTOWN DISPOSAL OPTION – 335,000 GPD SUBSURFACE WASTEWATER DISPOSAL

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FIGURE 21. PREFERRED DOWNTOWN WASTEWATER DISPOSAL OPTION - RECREATION FIELDS

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FIGURE 22. PREFERRED OUT OF DOWNTOWN OPTION – 335,000 GPD MBR TREATMENT PLANT AND SUBSURFACE WASTEWATER DISPOSAL

FIGURE 23. CLOSEUP OF PREFERRED OUT OF DOWNTOWN OPTION – 335,000 GPD MBR TREATMENT PLANT AND SUBSURFACE WASTEWATER DISPOSAL

COSTS FOR DOWNTOWN WASTEWATER FLOW ALTERNATIVES

Capital costs, operations and maintenance costs and net present values for alternatives to handle Downtown Wastewater flows are shown in Table 16. The detailed costs are found in *Appendix I: Detailed Cost Analysis*.

All costs were calculated using information from *Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod Barnstable County Wastewater Cost Task Force (April 2010*). Capital costs are presented for wastewater treatment, subsurface disposal and wastewater conveyance (piping and pumping) and include engineering and permitting costs at 10%, constructi0n management at 8%, and contingency at 25%.

The total capital cost of accommodating wastewater treatment and discharge varies slightly by site with a range of $6.3- $7.1 million for 50,000 GPD, $8.5- $9.3 million for 100,000 GPD, and $16.7 - $17.8 million for the full 335,000 GPD.

If the town wishes to build the wastewater infrastructure incrementally, the most cost effective way would be to construct the subsurface disposal field, conveyance system, and permanent treatment structures sized for 335,000 GPD. Most treatment systems within the treatment facility could be constructed to handle only the flow level required with components added later to scale up the facility to 350,000 GPD. This way, the only required construction later on would be to expand the treatment facility within the facility's footprint and make any connections to new users. The total initial capital cost for such an expandable system that could initially handle 50,000 GPD and be later expanded to 335,000 GPD would be approximately $10 million. The additional incremental costs of expanding the treatment facility would then be phased with future development.

TABLE 16. PREFERRED WASTEWATER TREATMENT AND SUBSURFACE DISPOSAL SITES COSTS DOWNTOWN FLOWS

Location of Treatment and Disposal		Downtown – Belmont Circle		Downtown – Sandford Property		Out of Downtown – Scenic Highway	
Treatment/ Disposal Site		Treatment[1]	Disposal[2]	Treatment[1]	Disposal[2]	Treatment	Disposal
25,000 GPD		NA		NA		NA	
50,000 GPD	Site #	39E	19	C	19	16	16
	Capital ($)	$3,735,000	$354,000	$3,735,000	$354,000	$3,735,000	$354,000
	Capital-Transmission($)	$2,402,000		$2,169,000		$3,011,000	
	Total Capital ($)[3]	$6,491,000		$6,258,000		$7,100,000	
	Annual O&M ($)	$444,000		$444,000		$444,000	
100,000 GPD	Site #	39E	19	C	19	16	16
	Capital ($)	$5,722,000	$531,000	$5,722,000	$531,000	$5,722,000	$531,000
	Capital-Transmission($)	$2,446,000		$2,213,000		$3,055,000	
	Total Capital ($)[3]	$8,699,000		$8,466,000		$9,308,000	
	Annual O&M ($)	$673,000		$673,000		$673,000	
335,000 GPD	Site #	39E	19+29	C	19+29	16	16
	Capital ($)	$12,779,000	$1,186,000	$12,779,000	$1,186,000	$12,779,000	$1,186,000
	Capital-Transmission($)	$3,039,000		$2,748,000		$3,800,000	
	Total Capital ($)	$17,004,000		$16,713,000		$17,765,000	
	Annual O&M ($)	$1,173,000		$1,173,000		$1,173,000	

Costs in March 2012 dollars.
Costs from Barnstable County Cost Report, April 2010
Preferred treatment technology for these downtown options is a Membrane Bio Reactor
Package plants are an option for small developer sites located in the Downtown Bourne area.
NA = Not applicable
Capital = capital cost (includes engineering and permitting of 10%, construction management of 8% and overall contingency of 25%)
O&M = operations and maintenance cost
Capital-Transmission = wastewater conveyance and pumping capital cost (includes engineering and permitting of 10%, construction management of 8% and overall contingency of 25%)
[1] = A downtown treatment site cannot take septage.
[2] = A downtown disposal site requires the redesign and construction of the existing park. Estimated construction cost is $62,000.
[3] = Capital costs would be higher if the facility was designed to be expandable to 335,000 GPD

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PREFERRED ALTERNATIVE FOR HIDEAWAY VILLAGE FLOWS

The preferred alternative for handling wastewater flows from Hideaway Village is to continue pumping to the Wareham WWTP. A dedicated treatment and subsurface disposal option, as detailed below, was considered, but deemed financially infeasible given the historical flows.

The option initially considered involved utilizing the privately owned Kramer Site (Site 10) to accommodate treatment and subsurface disposal for up to 50,000 GPD, as shown in Figure 24. For this flow level a package plant or an MBR could be used. The costs associated with this option are presented in Table 17 and detailed in *Appendix I: Detailed Cost Analysis*. The total capital cost for these options is $4.2 million for 25,000 GPD and $5.7 million for 50,000 GPD. Given that actual flows have been in the 10,000 GPD to 13,000 GPD range over the last ten years, such an investment is not financially feasible to handle such low flows.

Given the historic flow patterns from Hideaway Village with the highest year (2004) averaging a daily flow of 13,089 GPD (see *Appendix C: Summary of Downtown Bourne Wastewater Pumping Reports*), the BWAC discussed reevaluating the IMA allocation which appears to be in excess of the likely need of the area. The committee recommends a review of documents and a study of Hideaway Village's potential need for increased wastewater flow.

FIGURE 24. OPTION OF HIDEAWAY VILLAGE WASTEWATER TREATMENT- 50,000 GPD PACKAGE PLANT AND SUBSURFACE DISPOSAL (NOT RECOMMENDED - FINANCIALLY INFEASIBLE)

TABLE 17. WASTEWATER TREATMENT AND SUBSURFACE DISPOSAL SITES AND TECHNOLOGY OPTIONS AND COSTS HIDEAWAY VILLAGE FLOWS

Location of Treatment and Disposal		Hideaway Village – Kramer Property			
Treatment Technology		Package Plant		MBR	
Treatment/ Disposal Site		Treatment	Disposal	Treatment	Disposal
25,000 GPD	Site #	10	10	10	10
	Capital ($)	$2,384,000	$621,000	$2,384,000	$621,000
	Capital-Transmission($)	$1,210,000		$1,210,000	
	Total Capital ($)	$4,215,000		$4,215,000	
	Annual O&M ($)	$323,000		$283,000	
50,000 GPD	Site #	10	10	10	10
	Capital ($)	$3,735,000	$754,000	$3,735,000	$754,000
	Capital-Transmission($)	$1,247,000		$1,247,000	
	Total Capital ($)	$5,736,000		$5,736,000	
	Annual O&M ($)	$444,000		$444,000	

Costs in March 2012 dollars.
Costs from Barnstable County Cost Report, April 2010
Package plants are an option for small developer sites located in the Downtown Bourne area.
NA = Not applicable
Capital = capital cost (includes engineering, legal, administrative, and construction management of 18% and overall contingency of 25%)
O&M = operations and maintenance cost
Capital-Transmission = wastewater conveyance and pumping cost (includes engineering and permitting of 10%, construction management of 8% and overall contingency of 25%)

REGIONAL OPTIONS

Regional wastewater treatment and/or disposal options can potentially reduce the overall costs to the parties involved. A number of regional options were explored as presented in Table 18. None of the regional options explored are feasible options within the Town's desired downtown growth planning horizon.

TABLE 18. REGIONAL WASTEWATER OPTIONS

Convey flow to MMA[1] for treatment and disposal	Infeasible. MMA is constrained on existing capacity and area to expand. *Per discussion with Paul O'Keefe (MMA), Mike Lanahan (MMA), and Elaine Lewis-Ryan (MMA) and Mike Domenica (CH2M HILL) and Priscilla Bloomfield (CH2M HILL) on February 29, 2012.*
Convey flow to Wareham for treatment and disposal	No additional capacity is available at the existing treatment plant. However, Wareham is considering building a new plant, which could be designed to accommodate Bourne flows but is strictly in conceptual stages and outside of Bourne's timeframe. *Per discussion with Guy Campinha (Wareham) and Mike Domenica (CH2M HILL) and Priscilla Bloomfield (CH2M HILL) on March 2, 2012.*
Convey flow to MMR[2] for treatment and/or disposal	Permitted capacity is 300,000 GPD. MMR is currently using about 160,000 GPD. If MMR were to take outside flows, it would be done regionally with Sandwich, Mashpee, Falmouth, and Bourne. Could possibly take a portion of Bourne's flow (50,000 GPD) if wastewater could be piped across the Cape Cod Canal. Cost to install a pipe under the Cape Cod Canal is $6,636,000. *Per discussion with Carter Hunt (Mass Development), Steve Tupper (CCC[3]) and Mike Domenica (CH2M HILL) and Priscilla Bloomfield (CH2M HILL) on March 6, 2012.*
[1] MMA = Massachusetts Maritime Academy [2] MMR = Massachusetts Military Reservation [3] CCC = Cape Cod Commission	

For a complete table of all possible treatment and disposal options for all flow rates, see *Appendix J: All Treatment and Disposal Options*.

Task 8 - Evaluation of Financing Options

The financial plan has four primary components:

1. A plan for financing the implementation of needed projects, including the planning design and construction of required facilities
2. A plan for repayment of debt incurred during the project implementation
3. A plan for funding on-going operations, maintenance and administrative costs associated with the wastewater system.
4. A "model" or approach to managing near-term and long-term financial commitments such that commercial and residential user rates remain affordable and support other non-wastewater Town commitments and responsibilities.

PROJECT IMPLEMENTATION FINANCING PLAN

The actual means of financing the planning, design and construction of new facilities will be dependent on the nature, timing and terms of proposals by commercial developers interested in projects in or near Downtown Bourne. Because the primary goal of the Town is economic development and not, at this time, service to existing residential communities, residential growth or water quality concerns, public – private partnerships for financing the necessary wastewater infrastructure will be the most effective means of leveraging the Town's financial capabilities.

The arrangements for public – private partnerships are generally customized based on specific objectives, schedules and resources of the developer. Recently, there has been increased flexibility in the use of proceeds from state loan programs to serve as the Town's share of the financing plan. In addition, the Massachusetts Executive Office of Housing and Economic Development (EOHED) through its MassWorks programs and other initiatives have targeted its financing assistance packages toward programs that include private partners. The best financing plan for the Town will be based on a combination of the above factors and will likely be composed of a mix of multiple, integrated financing mechanisms.

Table 19 is a summary of state economic assistance grant and loans programs that may be applicable to the Town's wastewater program. Each of the options in Table 19 has advantages and disadvantages. *Appendix K: Financing Options Presentation* presents many of the features and advantages and disadvantages of each program.

It is noted that the conditions, requirements and offerings of the state programs change relatively frequently due to state budget decisions and other factors. For all of the below options, meetings with senior staff managing each program will be the first step to defining program requirements, feasibility and procedures for qualifying and securing the appropriate assistance.

It is recommended that the Town schedule meetings with senior representatives in each of the loan/grant programs shown in Table 19, beginning with MA DEP and the MA Water Pollution Abatement Trust (WPAT). The EOHED is a "clearinghouse" for a number of the other programs and should also be consulted regarding the details, current funding levels and timeframes for their programs.

TABLE 19. WASTEWATER SYSTEM IMPROVEMENT FINANCING OPTIONS

Agency	Program	Loan/Grant Amount (potential)	Comments
EOHED - Department of Housing & Community Development	CD Action Grants	$1 million per project (Grant)	Private for-profit partner required; $2,500,000 million private investment and $500,000 public investment required. Competitive
EOHED - Department of Housing & Community Development	Economic Development Fund	$1 million (maximum) per business (Loan)	Public financing option in conjunction with DIF; Private investment required under DIF program. Competitive
EOHED - Massachusetts Office of Business Development (MOBD)	MA Opportunity Relocation & Expansion (Jobs capital program)	$100,000 - $10,000,000 (Grant)	Financing for infrastructure improvements for business expansion. Private for-profit partner required; Jobs generation criteria for qualification
EOHED - Massachusetts Office of Business Development (MOBD)	Tax Increment Financing (TIF)	To Be Determined	Financing for commercial redevelopment; Property tax exemption program; Approved by Selectmen vote; TIF Zone designation required with EACC approval; Private for-profit partner beneficial
Massachusetts Office of Business Development MOBD)	District Improvement Financing (DIF)	TBD. Financing terms are negotiable and flexible.	Designated district (up to 25% of town land) and development program required. Private partner beneficial. Public hearings and approvals required. Application must be approved by Economic Assistance Coordination Council.
MassDevelopment Financing Assistance	To Be determined	To Be determined	To Be determined
US Department of Agriculture	Rural Development Grant – Community Facility Grants	75% or project cost (maximum) (Grant)	Population must be below 10,000. Previous Bourne application not renewed. Priorities to communities with less than 5,000. District formation may meet population limits. Highly leveraged with other funding. Used by Chatham recently.
MA State Revolving Fund	Massachusetts Water Pollution Abatement Trust - 0% Loan	100% of project eligible planning and construction costs. Can be used to purchase privately built facility. (Loan)	Zero-net-growth by-law, approved CWMP and nutrient reduction goals required.
MA State Revolving Fund	Massachusetts Water Pollution Abatement Trust - 2% Loan	100% of project eligible costs for planning and construction. Can be used to purchase privately built facility. (Loan)	May be used without CWMP for downtown Bourne.

Task 9: Action Plan

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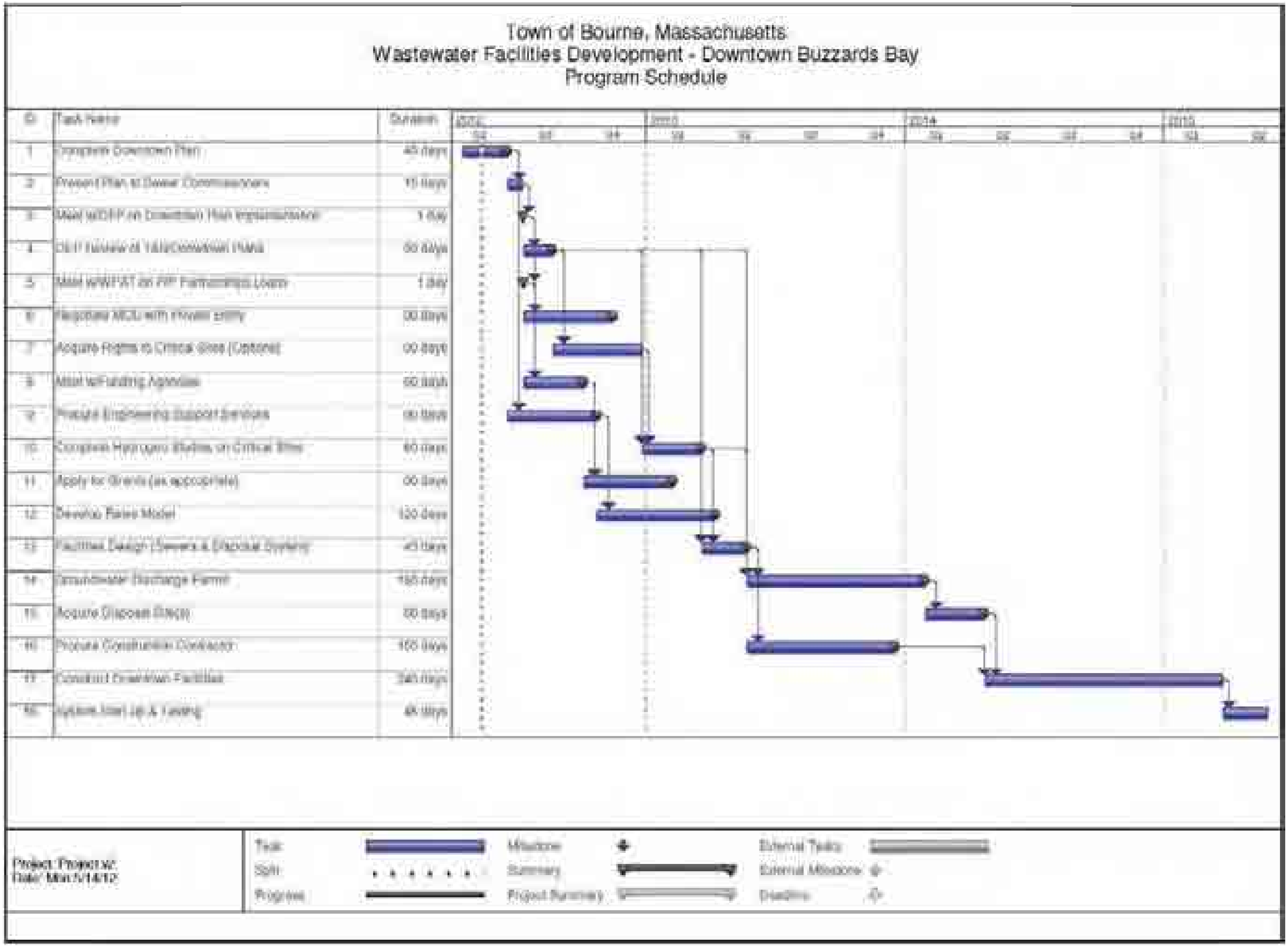
The recommended, phased Wastewater Management Plan to provide critical wastewater services to meet needs of a range of future commercial development in downtown Bourne is summarized as follows:

1. Implement a phased approach
2. Utilize remaining capacity at Wareham WWTF
3. Request DEP Review and Comment on Bourne WWAC Downtown Plan with the ultimate goal of approval to implement
4. Continue discussions with private parties on commercial development plans and private financing options (e.g. Optimus project)
5. Develop and execute Memoranda of Understanding (MOUs) for private partnership
6. Select treatment and disposal sites that fit private development plans
7. Continue to maintain Scenic Highway site pending Downtown plan
8. Procure consulting support to undertake hydraulic studies, define condition and capacity of existing system, and on-going wastewater planning
    - Consider using current SRF planning funds
9. Conduct preliminary hydrogeologic studies of Queen Sewell Park and Community Center
10. Acquire rights to critical treatment and/or disposal sites
11. Obtain SRF funding to supplement private investment
12. Investigate and secure other public financing options
13. Develop public involvement process to support wastewater program

An overall schedule that lays out these timeline, milestones and interrelationship between recommendations is shown in Figure 25.

FIGURE 25. ACTION PLAN SCHEDULE



Glossary of Abbreviations

BDC – Bourne Development Campus

BNR – Biological Nitrogen Removal

BOD – Biological Oxygen Demand

BWAC - Bourne Wastewater Advisory Committee

DEP – Department of Environmental Protection

DIF - District Improvement Financing

GIZ – Growth Incentive Zone

GPD – Gallons per Day

IMA - Inter Municipal Agreement

MBR – Membrane Bioreactor

O&M – Operations and Maintenance

PLAAP - Priority Lands Acquisition Assessment Plan

RESET - Regional Economic Strategy Execution Team

SBR – Sequencing Batch Reactor

TN – Total Nitrogen

TSS – Total Suspended Solids

WWTP - Wastewater Treatment Plant

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List of Appendices

Appendix A: Complete List of Documents Review

Title	Author	Date	Summary
Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod	Barnstable County Wastewater Cost Task Force – Wright Pierce	April 2010	Cost estimates for capital and O&M costs for individual, cluster, satellite, and centralized systems sized for Cape Cod
Community Funding for Wastewater Capital Programs	Robert J. Ciolek	7/20/11	There are four basic funding choices for Cape Cod towns: Funding from existing Town funding sources for capital and/or operating expenses Funding from betterment assessments for capital expenses Funding from a Proposition 2½ override or debt exclusion vote for capital expenses Funding from a system of rates and charges for operating and/or capital expenses
A Vision Plan for Bourne's Downtown	Stantec	March 2008	The Bourne Financial Development Corporation (BFDC) commissioned this study for the purpose of facilitating creative thinking beyond the current status of the Main Street District, including the rebirth of downtown through new zoning, different traffic patterns, greater density, mixed uses, and new infrastructure that will lead to the private commercial and residential development investment sought by the community.
Bourne Wastewater Funding Study for Downtown Area of Buzzards Bay (Modified Alternative 1B) - Potential Cost Allocation/Local Revenue Alternatives	Tighe and Bond	February 2009	Table with potential cost allocation/local revenue alternatives for funding wastewater infrastructure for downtown Bourne.
Bourne Development Campus Concept Master Plan Full Buildout	Tighe and Bond	May 2010	Bourne Development Campus master plan maps
Wastewater Flow Projection and Conceptual Costs for the Bourne Development Campus	Tighe and Bond	June 2008	The conceptual plan for development of the Bourne Development Campus (BDC) is projected to produce an average annual wastewater flow of approximately 48,000 gallons per day (GPD) from commercial and industrial sources. The BDC will require wastewater collection, treatment, and discharge under the Massachusetts Department of Environmental Protection's Groundwater Discharge Permit Program. Four alternatives for treatment and discharge were developed.
Downtown Zoning Bylaw for Town Meeting - Approved Fall TM 2008			The intent of the Downtown District (DTD) is to produce a mixed use zone that fulfills the goals, objectives and action strategies of the Town of Bourne Local Comprehensive Plan 2007.

30-Year Facilities Master Plan	Horsely Witten	April 2005	The Town of Bourne and Horsely Witten Group (HW) collaborated to perform three planning exercises, the results of which constitute a 30-year facilities master plan. The first exercise involved developing a needs assessment for 17 municipal or quasimunicipal agencies in the community over a 30-year planning horizon. The second planning exercise involved using the results of this assessment to develop a conceptual plan of the Canalside property with the assumption that it would be available to meet these municipal facilities needs. The concept was specifically tailored to meet municipal facility needs and considered potential funding sources for acquisition and development from several interested parties. The third exercise involved mapping the implementation of facility expansion across the community in an effort to better visualize the changes that would be required to meet the capacity needs of each department.
Study of Flood Hazard Mitigation and Design for the Main Street Business District	Kennen Landscape Architecture	December 2007	Document and maps provide an inventory of existing flood hazard conditions and applicable regulations for planning purposes.
Wastewater Project for Downtown Area of Buzzards Bay - Funding Flow Chart	Tighe and Bond	February 2009	Funding flow chart.
Bourne Wastewater Funding Study for Downtown Area of Buzzards Bay (Modified Alternative 1B) - Conceptual Funding Scenarios for Modified Alternative 1B	Tighe and Bond	February 2009	Conceptual funding scenarios for modified alternative 1B.
2011 Growth Incentive Zone Application	Bourne Planning Department	May 2011	The Town of Bourne has compiled this document as a application to the Cape Cod Commission requesting the designation of a Growth Incentive Zone (GIZ) in the Village of Buzzards Bay in the area now known as Bourne's Downtown. This designation will allow more local control by raising the Development of Regional Impact (DRI) thresholds in the areas shown in this application.
Wastewater Planning Update Memorandum	Tighe and Bond	February 2009	This update to the Wastewater Planning tasks includes three items - 1. Funding and financing options for the Phase 1 Downtown Bourne portion of the project, 2. Next step scope and budget, 3. NRD Textron Grant through MA Executive Office of Energy and Environmental Affairs
Wastewater Advisory Committee Meeting Minutes	Wastewater Advisory Committee	December 6, 2011	Meeting minutes.
Wastewater Advisory Committee Meeting Minutes	Wastewater Advisory Committee	December 7, 2012	Meeting minutes.

Open Space and Recreation Plan 2008 - 2012	Beals and Thomas Inc	February 2008	The Town of Bourne's 2008 Open Space and Recreation Plan update has been prepared to serve as a guide to the many committees, boards, commissions and volunteer groups in the community. Much like the 1997 plan, this document was designed to encourage programs and policies that will have a lasting and constructive impact on the community in the future. As was mentioned at the Public Forum and within the Focus Groups that were held as a part of the project, the existing open space and recreation amenities and opportunities in Bourne are unique, from the Cape Cod Canal to the small pocket parks that exist in almost every village. Keeping these characteristics and continuing to think about open space, recreation and natural resources in a meaningful manner is an essential piece to quality of life in this seaside community.
Report to Board of Sewer Commissioners	Wastewater Advisory Committee	March 2008	In August 2007, the Wastewater Advisory Committee met with the Bourne Board of Sewer Commissioners to discuss the concept of responding to the urgent economic, infrastructural, and environmental need to expand wastewater treatment capacity for Bourne's Downtown, the Village of Buzzards Bay. The Committee recommended the further study of a central treatment and groundwater discharge facility on Town-owned land in Bournedale (Alternative 1B in Tighe & Bond's Wastewater Management Study forwarded to Sewer Commissioners in December). At that meeting, the Commissioners endorsed the concept as presented in a report from the Wastewater Advisory Committee and encouraged the Committee, along with Tighe & Bond, to continue the study.
Wastewater Management Planning for Bourne's Downtown Scope of Work	Cape Cod Commission	June 2007	The Cape Cod Commission will evaluate water supply and wastewater issues as part of a comprehensive water supply/wastewater assessment of the Downtown Bourne area (including Hideaway Village and the Bourne Development Campus).
Draft Wastewater Management Study	Tighe and Bond	October 2007	The purpose of the Bourne Wastewater Management Study is to identify wastewater management solutions that will facilitate the revitalization of Main Street Buzzards Bay and provide a framework for long-term wastewater management in greater Bourne.
Task 1 Report - Bourne Wastewater Management Study Section 3	Tighe and Bond		Future conditions and flow projection for wastewater study.
Buzzards Bay Water District Pumping Totals		2010	Water district pumping totals for 2008-2010.
DRAFT Market Analysis for the Main Street Business District in the Village of Buzzards Bay, MA	RKG Associates	November 2006	The study assesses the sustainable economic redevelopment options/possibilities for the Main Street business district of the Village of Buzzards Bay, Massachusetts.

Bourne Wastewater Advisory Committee Build Out Analysis Final Write-up	Cape Cod Commission		The purpose of the build out study was to identify future growth potential, primarily in Buzzards Bay, and to project associated wastewater flows necessary to support this potential growth scenario. The build out analysis was conducted in tandem with other preliminary capital infrastructure and wastewater planning efforts the Commission RESET Team has been engaged in with the Town of Bourne.
Bourne Wastewater Management Planning: Task 3: Water Supply and Demands Assessment Presentation	Cape Cod Commission	September 9, 2011	Discussion of task 3.
Bourne Wastewater Management Planning: Task 3: Water Supply and Demands Assessment & Task 4: Assess Existing Wastewater Infrastructure	Cape Cod Commission	September 30, 2011	Discussion of tasks 3 and 4.
Bourne Wastewater Management Planning - An interim progress report to the Bourne Sewer Commissioners	Cape Cod Commission	December 6, 2011	Discussion of tasks 3 and 4 and 5.
Buzzards Bay Area Required for Disposal - 365,000 Title 5 Peak Flow	Cape Cod Commission	December 7, 2012	Area calculations required for disposal - 365,000 Title 5 peak flow and 182,500 average flow.
Bourne Panhandle Site - Combined Resources	MassGIS	October 2008	Map
Bourne Panhandle Site	MassGIS	October 2008	Map
Downtown Zoning Map	Bourne Planning Department	January 2010	Map
Bourne Potential Wastewater Disposal Areas Analysis Mapping	Cape Cod Commission	12/23/11	Map
Ownership of Disposal Sites	Cape Cod Commission	12/23/11	Map
Figure 1 - Wastewater Management Planning Study Areas	Cape Cod Commission	9/27/11	Map
plaap_north_MapSeries1_v5_PP_20111018	Cape Cod Commission	10/18/11	Map - Version 5
plaap_north_MapSeries2_v4_PP_20111018	Cape Cod Commission	10/18/11	Map - Version 4

plaap_north_MapSeries3_v5_PP_20111018	Cape Cod Commission	10/18/11	Map - Version 5
plaap_north_MapSeries4_v3_PP_20110916	Cape Cod Commission	9/16/11	Map - Version 4
plaap_north_MapSeries5_v5_PP_20111018	Cape Cod Commission	10/18/11	Map - Version 5
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plaap_north_MapSeries7_v3_PP_20110929	Cape Cod Commission	9/29/11	Map - Version 3
Bourne Potential Waste Water Disposal Areas	Cape Cod Commission	12/7/11	Map
Bourne Potential Waste Water Disposal Areas	Cape Cod Commission	12/7/11	Map

Appendix B: Summary of Buzzards Bay Water Pumping Reports

Year		STATION 1 #1-cm G	STATION 2 #2-02G	STATION 3 #3-03G	STATION 4 #4-04G	NNW/ Monthly Totals	Maximum Day	Average Day	KOH Total Gallons
2007	January	1,916,100	3,096,200	2,332,010	3,861,750	11,206,060	456,860	361,486	515.4
	February	768,900	2,647,300	3,689,600	3,456,520	10,562,320	503,530	377,226	482.7
	March	1,447,900	2,422,100	4,626,720	3,351,940	11,848,660	527,170	382,215	532.4
	April	2,374,300	2,646,200	3,915,970	2,442,530	11,379,000	484,150	379,300	507
	May	2,343,200	4,505,300	6,146,440	3,846,860	16,841,800	856,170	543,284	767.9
	June	3,327,000	5,485,900	5,885,730	6,323,250	21,021,880	1,132,125	700,729	967.1
	July	3,338,200	6,078,300	7,421,950	7,304,410	24,142,860	1,092,910	778,802	696.5
	August	4,118,500	6,447,700	10,332,010	3,441,820	24,340,030	1,187,870	785,162	1064
	September	3,356,400	5,116,400	7,209,100	3,673,050	19,354,950	1,061,690	645,165	881
	October	2,558,600	3,314,200	4,391,870	3,826,470	14,091,140	727,550	454,553	659.5
	November	1,185,900	2,492,400	3,526,160	3,343,770	10,548,230	509,210	351,608	514.2
	December	1,270,800	1,941,700	4,108,400	2,759,270	10,080,170	466,590	325,167	531
	TOTALS	28,005,800	46,193,700	63,585,960	47,631,640	185,417,100	1,187,870	507,992	8118.7
2008		**STATION 1 #1-cm G**	**STATION 2 #2-02G**	**STATION 3 #3-03G**	**STATION 4 #4-04G**	**NNW/ Monthly Totals**	**Maximum Day**	**Average Day**	**KOH Total Gallons**
	January	662,600	1,912,900	4,588,380	2,519,140	9,683,020	465,400	312,355	463.5
	February	777,800	2,058,100	2,943,520	2,964,070	8,743,490	443,060	312,268	435.5
	March	2,241,800	1,971,000	3,647,600	2,783,350	10,643,750	452,660	343,347	546
	April	2,303,000	2,341,500	3,952,530	3,325,300	11,922,330	537,250	397,411	616.5
	May	2,737,800	2,982,200	4,572,930	3,562,010	13,854,940	723,970	446,934	689.5
	June	4,234,200	3,597,800	7,060,310	5,028,890	19,921,200	949,690	664,040	1002.2
	July	4,830,900	4,658,200	8,462,340	5,573,260	23,524,700	1,078,570	758,861	1182.5
	August	4,406,300	3,257,900	6,870,820	4,717,900	19,252,920	833,010	621,062	970
	September	3,645,600	2,395,900	4,908,670	4,256,460	15,206,630	809,650	506,888	767
	October	2,977,600	2,059,300	4,201,370	3,483,040	12,721,310	555,320	410,365	651
	November	2,425,600	1,762,900	3,303,760	3,079,130	10,571,390	451,350	352,380	551
	December	2,396,900	1,731,800	3,647,440	2,815,930	10,592,070	482,570	341,680	550.7
	TOTALS	33,640,100	30,729,500	58,159,670	44,108,480	166,637,750	1,078,570	456,542	8425.4

2009		STATION 1 #1-cm G	STATION 2 #2-02G	STATION 3 #3-03G	STATION 4 #4-04G	NNW/ Monthly Totals	Maximum Day	Average Day	KOH Total Gallons
	January	2,125,200	2,068,100	3,894,930	3,163,520	11,251,750	681,080	362,960	582.5
	February	1,950,200	713,900	3,718,430	2,880,150	9,262,680	467,530	330,810	486.5
	March	3,111,500	0	3,680,360	4,480,870	11,272,730	479,820	363,636	603.5
	April	3,249,800	1,067,500	3,827,050	3,509,500	11,653,850	585,600	388,462	588.5
	May	2,588,600	3,932,700	3,429,000	4,370,920	14,321,220	717,340	461,975	686
	June	3,366,000	3,526,900	4,984,520	3,319,400	15,196,820	698,070	506,561	688
	July	3,682,500	4,722,500	7,047,980	2,049,590	17,502,570	791,190	564,599	612.5
	August	3,355,900	4,210,100	6,212,990	5,708,480	19,487,470	851,730	628,628	847.5
	September	2,612,200	3,105,300	4,842,000	4,158,430	14,717,930	659,430	490,598	625.5
	October	2,239,000	2,411,100	4,069,590	3,205,100	11,924,790	527,880	384,671	516
	November	1,716,000	2,338,900	3,220,860	3,123,180	10,398,940	469,760	346,631	458
	December	2,147,900	2,635,100	3,245,330	2,923,320	10,951,650	574,300	353,279	479
	TOTALS	**32,144,800**	**30,732,100**	**52,173,040**	**42,892,460**	**157,942,400**	**851,730**	**432,719**	**7173.5**

2010		STATION 1 #1-cm G	STATION 2 #2-02G	STATION 3 #3-03G	STATION 4 #4-04G	NNW/ Monthly Totals	Maximum Day	Average Day	KOH Total Gallons
	January	1,576,200	2,258,100	3,012,650	3,058,790	9,905,740	500,840	319,540	437
	February	1,449,700	1,895,800	2,787,080	2,571,560	8,704,140	464,770	310,862	384
	March	1,863,600	2,211,600	3,582,850	2,987,750	10,645,800	447,360	343,413	479
	April	2,207,700	2,148,700	3,735,980	3,403,400	11,495,780	511,800	383,193	518.5
	May	2,832,600	3,693,800	5,477,280	4,964,470	16,968,150	840,470	547,360	779.5
	June	3,652,900	3,489,900	7,034,690	4,689,140	18,866,630	863,540	628,888	880.5
	July	5,157,000	5,318,700	9,133,540	6,988,910	26,598,150	1,239,950	858,005	899.5
	August	3,678,200	4,389,500	7,275,360	5,635,450	20,978,510	909,640	676,726	998.5
	September	2,882,700	3,836,800	5,431,140	5,066,530	17,217,170	766,520	573,906	830
	October	2,236,600	2,740,300	4,227,230	3,602,110	12,806,240	487,400	413,105	622
	November	2,016,400	2,035,100	3,791,930	2,704,930	10,548,360	471,740	351,612	517.5
	December	1,907,100	2,940,000	3,357,040	3,055,720	11,259,860	582,700	363,221	558
	TOTALS	**31,460,700**	**36,958,300**	**58,846,770**	**48,728,760**	**175,994,530**	**1,239,950**	**482,177**	**7904**

Appendix C: Summary of Downtown Bourne Wastewater Pumping Reports

Downtown Wastewater Pumping Records (Main Street Pumping Station) [GPD]

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
January	90,865	80,942	73,454	95,841	88,760	94,474	87,860	81,511	85,441	83,158	62,990	73,184
February	87,660	80,304	76,145	82,646	84,162	89,762	85,690	74,580	89,705	57,190	67,708	70,195
March	97,203	96,182	82,383	91,035	81,836	94,394	77,461	80,867	91,032	58,265	102,816	68,635
April	104,822	106,759	90,163	98,461	89,160	99,818	81,524	92,025	94,130	76,339	88,341	72,078
May	114,497	78,833	95,145	91,461	88,599	105,389	90,372	90,903	96,037	79,802	75,989	76,332
June	104,210	62,507	107,132	95,785	90,896	103,558	112,820	89,705	90,819	81,274	85,353	77,074
July	106,101	48,835	105,082	100,266	99,048	104,150	99,296	92,206	99,821	87,123	82,245	82,245
August	103,124	64,324	106,175	103,062	95,393	100,244	95,663	89,704	95,690	87,711	77,973	77,973
September	91,600	97,262	99,808	93,149	89,692	96,861	89,451	85,466	90,186	87,998	82,502	82,502
October	84,490	88,359	95,452	87,651	90,542	97,743	82,186	79,182	88,935	70,353	86,229	68,626
November	83,394	84,976	86,170	84,153	83,410	88,295	85,168	75,732	84,721	68,394	74,103	63,487
December	81,214	80,197	92,876	96,447	82,424	87,641	83,487	90,508	87,794	70,672	72,118	64,410
Annual Average	**95,807**	**80,716**	**92,597**	**93,422**	**88,689**	**96,916**	**89,245**	**85,281**	**91,214**	**75,811**	**79,934**	**73,077**

Hideaway Village Pumping Records (Hideaway Village Pumping Station) [GPD]

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
January	7,381	8,400	9,016	10,129	13,048	10,329	8,226	8,710	8,448	9,255	8,997	7,506
February	7,514	7,789	7,771	9,311	9,445	9,632	8,396	9,089	8,462	9,482	8,179	7,296
March	6,765	9,326	8,368	10,977	8,968	10,319	8,155	9,548	8,703	8,945	10,177	6,555
April	8,590	8,790	9,877	10,820	11,203	11,323	9,003	10,513	8,927	15,383	9,283	7,650
May	11,084	11,519	11,039	11,829	12,177	12,935	11,929	15,965	13,542	11,519	10,303	10,206
June	13,783	14,433	14,800	15,963	15,377	14,870	16,663	14,623	13,040	13,220	12,373	9,307
July	20,213	22,152	20,242	19,997	21,300	20,729	22,539	21,032	19,213	20,158	16,294	15,742
August	19,255	19,829	19,545	22,448	19,235	16,990	17,423	17,742	18,868	17,648	14,906	14,729
September	13,810	13,310	12,637	12,820	14,140	14,027	14,613	15,067	11,770	14,100	11,430	10,447
October	10,300	10,239	9,739	10,955	11,729	11,352	11,542	10,958	12,671	11,132	9,781	8,358
November	10,287	8,540	8,977	9,433	10,217	9,780	10,327	9,157	9,997	10,160	8,387	7,257
December	8,826	8,806	10,084	10,290	9,942	8,432	8,258	8,784	9,019	9,629	8,184	7,342
Annual Average	**11,504**	**11,969**	**11,878**	**12,951**	**13,089**	**12,585**	**12,284**	**12,631**	**11,917**	**12,571**	**10,715**	**9,391**

Total Flow to Wareham (Main Street Pumping Station + Hideaway Village Pumping Station) [GPD]

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
January	98,245	89,342	82,470	105,970	101,809	104,803	96,086	90,220	93,889	92,413	71,986	80,690
February	95,173	88,094	83,916	91,957	93,607	99,394	94,086	83,669	98,167	66,672	75,886	77,491
March	103,967	105,507	90,750	102,012	90,804	104,713	85,615	90,415	99,735	67,211	112,993	75,190
April	113,412	115,549	100,040	109,281	100,363	111,141	90,527	102,539	103,057	91,723	97,625	79,728
May	125,581	90,352	106,184	103,290	100,776	118,325	102,301	106,868	109,579	91,321	86,292	86,538
June	117,994	76,941	121,932	111,749	106,273	118,428	129,483	104,328	103,859	94,494	97,727	86,381
July	126,314	70,986	125,324	120,263	120,348	124,879	121,835	113,239	119,034	107,281	98,538	97,987
August	122,379	84,153	125,720	125,510	114,628	117,235	113,086	107,446	114,558	105,359	92,879	92,702
September	105,410	110,572	112,444	105,969	103,832	110,888	104,065	100,533	101,956	102,098	93,932	92,949
October	94,790	98,598	105,190	98,606	102,271	109,095	93,728	90,140	101,606	81,485	96,009	76,984
November	93,681	93,516	95,147	93,586	93,627	98,075	95,495	84,889	94,717	78,554	82,490	70,744
December	90,039	89,004	102,960	106,737	92,365	96,073	91,745	99,292	96,814	80,301	80,302	71,752
Annual Average	**107,311**	**92,685**	**104,474**	**106,374**	**101,777**	**109,501**	**101,528**	**97,911**	**103,132**	**88,382**	**90,649**	**82,468**

Appendix D: Buildout Analysis

Fixed Inputs		Source
FAR	2	Zoning
Lot Coverage	80%	Zoning
Open Space	20%	Zoning
Building Height	52	Zoning
Stories	4	Zoning
Parking (by use):		
# spaces/1000 sf restaurant	10	Zoning
# spaces/1000 sf office	3	Zoning
# spaces/1000 sf retail	3	Zoning
# spaces per residential unit	1.5	Zoning
# spaces per hotel/motel unit	1	Zoning
Minimum Lot Size (sf)	3500	Zoning
Minimum DTN Lot Size (sf)	40000	Zoning

BFDC Development Potential

	Tighe & Bond	Revised (2011)
Commercial	250,000	125,000
Storage	25,000	12,500
Office	100,000	50,000
Industrial	125,000	62,500
Total	**500,000**	**250,000**

Assumptions		Source
% site used for ancilliary uses	5%	Recommended by EOEEA
Shared Parking Reduction Credit	30%	Town planner/CCC
Residential Unit (GFA)	1333	
Average Residential Unit Size	1000	
Average sf/parking space	400	
Mix of Uses:		
DTG:		
% of area commercial		Town Planner/CCC
% of area residential		Town Planner/CCC
% restaurant		Town Planner/CCC
% office		Town Planner/CCC
% retail		Town Planner/CCC
DTC:		
% of area commercial		Town Planner/CCC
% of area residential		Town Planner/CCC
% restaurant		Town Planner/CCC
% office		Town Planner/CCC
% retail		Town Planner/CCC
DTW:		
% of area commercial		Town Planner/CCC
% of area residential		Town Planner/CCC
% restaurant		Town Planner/CCC
% office		Town Planner/CCC
% retail		Town Planner/CCC
DTN:		
% residential		Town Planner/CCC

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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
																		[illegible]		[illegible]							
																		[illegible]		[illegible]							
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
																		[illegible]		[illegible]							
																		[illegible]		[illegible]							

Key

(light blue)	inputs/assumptions that can be varied
(green)	inputs derived from zoning/parking requirements (also can be varied for buildout)
(pink)	estimated building coverages by use
(purple)	estimated FAR by use

[illegible]

Dimensional Limitations	[illegible]		
	DTC	DTG	DTW
FAR [illegible]	300%	300%	300%
Lot Coverage (total bldgs + parking)	80%	60%	80%
OS	20%	20%	20%
Height	32	32	32
Story limit (P=4)	4	4	4

Parking		
Average area needed per space (sf)	400	[illegible]
spaces/1000 sf restaurant	10	[illegible]
spaces/1000 sf office & institutional	3	[illegible]
spaces/1000 sf retail & consumer services	2.5	[illegible]
spaces per residential unit	1.5	[illegible]
spaces per hotel/motel unit	1	[illegible]
Parking Reduction for shared parking	30%	[illegible]

Assumed mix of uses	DTC	DTG	DTW	DTC assumed mix of comm. uses	DTG assumed mix of comm. uses	DTW assumed mix of uses
% of area commercial	40.0%	40.0%	30.0%			
% of area residential	60.0%	60.0%	70.0%			
% restaurant	5.0%	5.0%	10.0%	0.05	0.05	0.1
% office	5.0%	8.0%	3.0%	0.05	0.08	0.03
% retail	10.0%	5.0%	3.0%	0.10	0.05	0.03
% hotel	10.0%	10.0%	5.0%	0.10	0.10	0.05
% institutional	5.0%	10.0%	2.0%	0.05	0.10	0.02
% consumer services	5.0%	2.0%	5.0%	0.05	0.02	0.05
	100.0%	100.0%	100.0%	0.40	0.40	0.3

Site Assumptions		
% site used for ancillary uses	5%	[illegible]

Residential Use Assumptions		
Average unit size (sf)	1000	[illegible]
Gross sf area per residential unit	1335	[illegible]
Gross sf area per hotel/motel unit	650	[illegible]
Minimum Lot Size (for density)	3000	[illegible]
DTW Min. Lot Size (R-40)	40000	

Estimated Coverage and FAR		DTC	DTG	DTW
Illustrative footprint	[illegible]			
Total Floor Area (footprint x stories)		40000	40000	40000
Building parking ratio		DTC	DTG	DTW
Parking spaces (residential)		27.0	27.0	31.8
Parking spaces (restaurant)		20.0	20.0	40.0
Parking spaces (office)		8.0	8.8	3.8
Parking spaces (retail)		10.0	5.0	5.0
Parking spaces (hotel)		8.2	8.2	3.1
Parking spaces (institutional)		8.0	15.0	2.4
Parking spaces (Consumer Services)		5.0	2.0	5.0
Total Spaces		86	82	91
Reduced parking requirement (if applicable)		50	37	63
Space needed for parking		22445.0	22893.0	28383.7
Total impervious area		32445.0	32893.0	38383.7
% parking		69.2%	69.6%	71.7%
% footprint		30.8%	30.4%	28.3%

Effective FAR	DTC	DTG	DTW
open areas	20%	20%	20%
Ancillary areas	5%	5%	5%
% parking	52%	52%	54%
% building coverage	22%	22%	21%
Estimated total FAR	[illegible]	[illegible]	[illegible]
FAR residential	[illegible]	[illegible]	[illegible]
FAR restaurant	7.00%	7.00%	13.00%
FAR office	7.00%	11.00%	4.00%
FAR retail	11.00%	7.00%	4.00%
FAR hotel	13.00%	14.00%	6.00%
FAR institutional	7.00%	14.00%	3.00%
FAR consumer services	7.00%	3.00%	3.00%

Note: Inputs from Method 2 FAR calculation based on ground floor parking

[illegible]	DTC	DTG	DTW	TOTAL	
Lot Area	3,521,851	917,209	196,887	4,635,947	sf

Estimated Buildout - existing zoning	DTC	DTG	DTW	TOTAL	
Restaurant	246,519	64,209	25,606	336,333	sf
Office	246,519	100,900	7,879	355,298	sf
Retail	528,248	64,209	11,819	604,276	sf
Hotel	528,248	128,418	11,819	668,485	sf
Institutional	246,519	128,418	5,910	380,842	sf
Consumer Services	246,519	27,518	11,819	285,855	sf
Residential (sf)	3,099,053	788,852	175,318	4,063,223	sf
Residential units theoretical (1333 sf/unit)	2,325	592	132	3,048	
Residential density per zoning	12	12	12	37	
Residential units per zoning	1,008	262	56	1,325	
Residential (units)	1,008	262	56	1,325	units
Total commercial sf	2,042,558	513,671	74,852	[illegible]	sf

Wastewater Flows by Use (gpd)	Title V	DTC	DTG	DTW	GPD
Restaurant (35/seat)	35	197,212	51,397	20,487	269,096
Office (75/1000sf) , Medical Office 250/Dr. Chair)	75	18,459	7,597	591	26,647
Medical Office 250/Dr Chair	250	0	0	0	0
Retail (50/1000 sf)	50	26,412	3,210	591	30,214
Hotel (110/bedroom)	110	89,396	21,732	2,000	113,128
Institutional (Nursing Home 150/bed)	150	34,688	18,070	832	53,590
Consumer Services (beauty salon 100/chair)	100	246,518	27,518	11,816	285,852
Residential (110/bedroom)	220	221,381	57,657	12,362	291,400
Total		834,874	187,122	48,702	1,069,898

WW Occupancy Factors			
Restaurant (sf/seat)	43.75		
Medical Office (sf/chair)	100		
Hotel	110		
Institutional: Nursing Home ft2/bd	1000		
Consumer Services: Beauty Salon ft2/chair	100		
Calculations	800	gal/1000ft2	
		Restaurant	
	0.8	gal/ft	
	35		
	0.02286	seat/ft2	
	43.75	ft2/seat	6.614378278 ft on a sq side
	175	ft 4 person table	13.22875656 ft on a sq side

Key

(light blue)	inputs/assumptions that can be varied
(green)	inputs derived from zoning/parking requirements (also can be varied for buildout)
(pink)	estimated building coverages by use
(purple)	estimated FAR by use

Assumptions/parameters

Dimensional Limitations	By Right (?) DTC	DTG	DTW
FAR (net?)	200%	200%	200%
Lot Coverage (impervious + parking)	90%	90%	90%
OS	20%	20%	20%
Height	50	50	50
Story limit (P+4)	4	4	4

Parking		
Average area needed per space (sf)	400	[illegible]
spaces/1000 sf restaurant	10	based on 1 space per 100 sf restaurant [illegible]
spaces/1000 sf office & institutional	3	based on 1 space per 333 sf [illegible]
spaces/1000 sf retail & consumer services	2.2	based on 1 space per [illegible]
spaces per residential unit	1.0	[illegible]
spaces per hotel/motel unit	1	[illegible]
Parking Reduction for shared parking	0%	[illegible]

Assumed mix of uses	By Right (?) DTC	DTG	DTW
% of area commercial	40.0%	40.0%	30.0%
% of area residential	60.0%	60.0%	70.0%
% restaurant	5.0%	5.0%	10.0%
% office	5.0%	5.0%	3.0%
% retail	10.0%	5.0%	5.0%
% hotel	10.0%	10.0%	5.0%
% institutional	5.0%	10.0%	2.0%
% consumer services	5.0%	2.0%	5.0%
	100.0%	100.0%	100.0%

DTC assumed mix of comm uses*	DTG assumed mix of comm uses*	DTW assumed mix of uses*
0.00	0.00	0.1
0.05	0.00	0.03
0.10	0.00	0.06
0.10	0.10	0.06
0.05	0.10	0.02
0.05	0.02	0.06
0.40	0.40	0.3

Site Assumptions

% site used for ancillary uses	5%	area of the site [illegible]

Residential Use Assumptions

Average unit size (sf)	1000	[illegible]
Gross sf area per residential unit	1333	[illegible]
Gross sf area per hotel/motel unit	690	[illegible]
Minimum Lot Size (for density)	3500	[illegible]
DTN Min. Lot Size (R-40)	40000	

Estimated Coverage and FAR		By Region (1)		
		DTC	DTG	DTW
Illustrative footprint	10000			
Total Floor Area (footprint x stories)		40000	40000	40000
Building parking ratio		DTC	DTG	DTW
Parking spaces (residential)		27.0	27.0	31.5
Parking spaces (restaurant)		20.0	20.0	40.0
Parking spaces (office)		6.0	8.6	3.6
Parking spaces (retail)		10.0	5.0	6.0
Parking spaces (hotel)		6.2	6.2	4.1
Parking spaces (institutional)		6.0	12.0	2.4
Parking spaces (Consumer Services)		5.0	3.0	5.0
Total Spaces		80	82	91
Reduced parking requirement (if applicable)		56	57	63
Space needed for parking		22445.0	22880.0	25363.7
Total impervious area		32445.0	32880.0	35363.7
% parking		69.2%	69.6%	71.7%
% footprint		30.8%	30.4%	28.3%

Effective FAR	DTC	DTG	DTW
open areas	20%	20%	20%
Ancillary areas	8%	8%	8%
% parking	52%	52%	54%
% building coverage	23%	23%	21%
Estimated total FAR	92.96%	91.20%	84.58%
FAR residential	60.48%	54.72%	52.38%
FAR restaurant	4.62%	1.58%	6.66%
FAR office	4.62%	7.30%	2.54%
FAR retail	9.20%	4.06%	4.24%
FAR hotel	9.25%	9.12%	4.24%
FAR institutional	4.62%	9.12%	1.69%
FAR consumer services	4.62%	1.82%	4.24%

[illegible]	DTC	DTG	DTW	TOTAL	
Lot Area	369,549	1,105,181	0	1,474,730	sf

Estimated Buildout - existing zoning	By Region (1)				
	DTC	DTG	DTW	TOTAL	
Restaurant	26,331	50,399	0	76,730	sf
Office	26,331	80,638	0	106,970	sf
Retail	52,663	50,399	0	103,062	sf
Hotel	52,663	100,798	0	153,461	sf
Institutional	26,331	100,798	0	127,129	sf
Consumer Services	26,331	20,160	0	46,491	sf
Residential (sf)	315,977	604,788	0	920,765	sf
Residential units theoretical (1333 sf/unit)	237	454	0	691	
Residential density per zoning	12	12	12	36	
Residential units per zoning	183	316	0	478	
Residential (units)	183	316	0	478	units
Total commercial sf	210,652	403,192	0	613,843	sf

Wastewater Flows by Use: (gpd)	Title V	DTC	DTC	DTW	GPD
Restaurant (35/seat)	35	21,065	40,319	0	61,384
Office (75/1000sf) , Medical Office 250/Dr. Chair)	75	1,975	6,048	0	8,023
Medical Office 250/Dr Chair	250	?	?	?	0
Retail (50/1000 sf)	50	2,633	2,520	0	5,153
Hotel (110/bedroom)	110	8,912	17,058	0	25,970
Institutional (Nursing Home 150/bed)	150	3,705	14,184	0	17,889
Consumer Services (beauty salon 100/chair)	100	26,331	20,160	0	46,491
Residential (110/bedroom)	220	35,800	69,469	0	105,269
Total		100,422	169,757	0	270,179

WW Occupancy Factors			
Restaurant (sf/seat)	43.75		
Medical Office (sf/chair)	100		
Hotel	110		
Institutional: Nursing Home ft2/bd	1066		
Consumer Services: Beauty Salon: ft2/chair	100		
Calculations	800	gal/1000ft2	
		Restaurant	
	0.8	gal/ft	
	35		
	0.02286	seat/ft2	
	43.75	ft2/seat	6.614378278 ft on a sq side
	175	ft 4 person table	13.22875656 ft on a sq side

Total Buildout

[illegible]		DTC	DTG	DTW	TOTAL
Lot Area					0

		By Right (F)			
Estimated Buildout - existing zoning		DTC	DTG	DTW	TOTAL
Restaurant		272,847	114,608	25,608	413,063
Office		272,847	181,538	7,879	462,264
Retail		580,911	114,608	11,819	707,338
Hotel		580,911	229,216	11,819	821,946
Institutional		272,847	229,216	5,910	507,972
Consumer Services		272,847	47,678	11,819	332,344
Residential (sf)		3,415,031	1,393,638	175,318	4,983,988
Residential units theoretical (1333 sf/unit)		2,562	1,045	132	3,739
Residential density per zoning		12	12	12	37
Residential units per zoning		0	0	0	0
Residential (units)		1,169	578	56	1,803
Total commercial sf		2,253,209	918,882	74,855	3,244,927
Wastewater Flows by Use: (gpd)	Title V	DTC	DTG	DTW	GPD
Restaurant (35/seat)	35	218,278	91,680	20,487	330,451
Office (75/1000sf) Medical Office 250/Dr. Chair)	75	20,464	13,615	591	34,670
Medical Office 250/Dr Chair	250	?	?	?	0
Retail (50/1000 sf)	50	29,046	5,730	591	35,367
Hotel (110/bedroom)	110	98,308	38,790	2,000	139,098
Institutional (Nursing Home 150/bed)	150	38,333	32,264	832	71,478
Consumer Services (beauty salon 100/chair)	100	272,847	47,678	11,819	332,344
Residential (110/bedroom)	110	257,181	127,125	12,382	396,689
Total		934,496	356,879	48,702	1,340,077

WW Occupancy Factors	
Restaurant (sf/seat)	43.75
Medical Office (sf/chair)	100
Hotel	110
Institutional: Nursing Home ft2/bd	1066
Consumer Services: Beauty Salon ft2/chair	100

Calculations

600	gal/1000ft2	
	Restaurant	
0.8	gal/ft	
35		
0.022857143	seat/ft2	
43.75	ft2/seat	6.614378278 ft on a sq side
175	ft 4 person table	13.22875656 ft on a sq side

Appendix E: Subsurface Disposal Site Selection Matrix

Preferred Disposal Sites

Site #	Site Title
Site 29	Town of Bourne - Main St
Site 16	Town of Bourne - Scenic Hwy 2
Site 19	Town of Bourne - Queen Sewel Park
Site 10	Kramer
Full matrix of sites presented on the following page	

Se ected Sites	Criteria	Down Gradient of Wells, Water Bodies, Vernal Pools/ Wetlands, or Environmentally Sensitive Habitat		Proximity to Historical and Archeological Areas		Cost of Acquisition/Value of Property		Competing Uses for Land		Number of Abutters		Compatibility with Adjacent Land Uses		Area to Expand/Reserve Area/Future Flexibility/Phasing			Accessibility for Maintenance and Operations		Wooded Area		Proximity to Downtown Buzzards Bay		
	Weighting	1		4		3		9		8		7		5			6		10		2		
	Rating/ Score	yes (1) - no (5)	Score	1 (far) - 5 (near)	Score	low (1), med (3), high (5)	Score	1 (none) - 10 (many)	Score	1 (few) - 5 (many)	Score	1 (good) - 10 (poor)	Score	# acres > 3	many (1) - few (10)	Score	1 (good) - 10 (poor)	Score	1 (minimal) - 5 (very)	Score	close (1) - far (5)	Score	**TOTAL SCORE**
Site #	**Site Title**																						
Site 29	Town of Bourne - Main St	1	1	1	4	1	3	1	9	2	16	1	7	1.75	8	40	1	6	1	10	1	2	98
Site 16	Town of Bourne - Scenic Hwy 2	1	1	1	4	1	3	2	18	1	8	1	7	121	1	5	1	6	5	50	3	6	108
Site 19	Town of Bourne - Queen Sewel Park	1	1	1	4	1	3	1	9	4	32	5	35	5	3	15	1	6	2	20	1	2	127
Site 10	Kramer	5	5	1	4	3	9	2	18	2	16	2	14	1	9	45	1	6	2	20	3	6	143
Site 38	Cape Aggregates - Scenic Hwy 2	1	1	1	4	5	15	8	72	2	16	2	14	122	1	5	1	6	1	10	3	6	149
Site 40	Route 25 Median	1	1	1	4	1	3	7	63	5	40	2	14	6	2	10	1	6	1	10	1	2	153
Site 13	Cape Aggregates - Ernest Valeri Rd 1	1	1	1	4	5	15	5	45	2	16	1	7	15	1	5	1	6	5	50	3	6	155
Site 15	Cape Aggregates - Ernest Valeri Rd 2	1	1	1	4	5	15	5	45	2	16	1	7	18	1	5	1	6	5	50	3	6	155
Site 17	Cape Aggregates - Ernest Valeri Rd 3	1	1	1	4	5	15	5	45	2	16	1	7	7	1	5	1	6	5	50	3	6	155
Site 14	Cape Aggregates - Scenic Hwy 1	1	1	1	4	5	15	5	45	2	16	1	7	6	2	10	1	6	5	50	3	6	160
Site 39	Buzzards Bay Bypass Rd	1	1	1	4	1	3	7	63	5	40	5	35	7	1	5	1	6	1	10	1	2	169
Site 21	Town of Bourne - Deseret Dr	5	5	1	4	1	3	1	9	3	24	10	70	9	1	5	2	12	4	40	3	6	178
Site 37	Ingersoll - Bournedale Rd 3	1	1	1	4	5	15	5	45	1	8	2	14	112	1	5	8	48	4	40	3	6	186
Site 9	Ingersoll - Bournedale Rd 1	2	2	1	4	5	15	10	90	1	8	1	7	5	3	15	1	6	5	50	4	8	205
Site 3	N Sagamore Water District	1	1	1	4	5	15	10	90	1	8	3	21	10	1	5	5	30	3	30	5	10	214
Site 22	Town of Bourne - Clarissa Jo Rd 1	3	3	1	4	1	3	5	45	2	16	10	70	23	1	5	2	12	5	50	5	10	218
Site 12	Town of Bourne - Scenic Hwy 1	1	1	1	4	1	3	10	90	3	24	5	35	24	1	5	1	6	5	50	3	6	224
Site 11	Sorenti Bros - Scenic Hwy	1	1	1	4	5	15	5	45	3	24	5	35	6	2	10	9	54	3	30	4	8	226
Site 35	Town of Bourne - Clarissa Jo Rd 2	1	1	1	4	1	3	10	90	2	16	8	56	20	1	5	2	12	3	30	5	10	227
Site 2	Sorenti Bros - State Rd	1	1	1	4	5	15	10	90	2	16	1	7	0	10	50	1	6	3	30	5	10	229
Site 31	Town of Bourne - Scenic Hwy 3	1	1	1	4	1	3	10	90	3	24	8	56	45	1	5	1	6	3	30	5	10	229
Site 32	Town of Bourne - Scenic Hwy 4	1	1	1	4	1	3	10	90	3	24	8	56	48	1	5	1	6	3	30	5	10	229
Site 34	Town of Bourne - Bournedale Rd	3	3	1	4	1	3	10	90	3	24	8	56	27	1	5	2	12	3	30	5	10	237
Site 30	Ingersoll - Bournedale Rd 2	2	2	1	4	5	15	10	90	1	8	10	70	11	1	5	2	12	3	30	3	6	242
Site 6	Town of Bourne - Scusset Beach Rd	1	1	1	4	1	3	10	90	2	16	2	14	1	10	50	1	6	5	50	5	10	244
Site 7	Plymouth Bourne Cns Trt	5	5	1	4	5	15	10	90	1	8	10	70	35	1	5	1	6	5	50	3	6	259
Site 8	Ingersoll - Plymouth Lane	5	5	1	4	5	15	10	90	1	8	10	70	14	1	5	1	6	5	50	3	6	259
Site 28	Ladd	1	1	1	4	5	15	10	90	3	24	10	70	10	1	5	2	12	3	30	5	10	261
Site 27	Stolte	1	1	1	4	5	15	10	90	3	24	10	70	7	1	5	3	18	3	30	5	10	267
Site 26	Town of Bourne - Little Sandy Pond Rd	1	1	1	4	1	3	10	90	3	24	10	70	12	1	5	3	18	5	50	5	10	275
Site 4	Weldon Park - Winston Ave 1	1	1	1	4	5	15	10	90	5	40	10	70	20	1	5	2	12	3	30	5	10	277
Site 18	Tassinari	4	4	1	4	4	12	8	72	2	16	5	35	0	10	50	8	48	3	30	3	6	277
Site 1	Cliffside Estates	1	1	1	4	5	15	10	90	5	40	10	70	11	1	5	2	12	5	50	5	10	297
Site 36	Town of Bourne - Herring Pond Rd	1	1	1	4	1	3	10	90	2	16	8	56	0	10	50	8	48	3	30	5	10	308
Site 33	Quinn	1	1	1	4	5	15	10	90	5	40	10	70	22	1	5	8	48	3	30	5	10	313
Site 24	Cape Sagamore - Ridgehill Ln 2	1	1	1	4	5	15	10	90	5	40	10	70	4	4	20	5	30	5	50	5	10	330
Site 5	Town of Bourne - Pinnacle Rd	1	1	1	4	1	3	10	90	3	24	10	70	2	8	40	10	60	3	30	5	10	332
Site 25	Weldon Park - Winston Ave 1	1	1	1	4	5	15	10	90	5	40	10	70	33	1	5	8	48	5	50	5	10	333
Site 23	Cape Sagamore - Ridgehill Ln 1	1	1	1	4	5	15	10	90	5	40	10	70	1	10	50	5	30	5	50	5	10	360

Appendix F: Treatment Site Selection Matrix

Preferred Treatment Sites

Site #	**Site Title**
Site 16	Town of Bourne - Scenic Hwy 2
Site 21	Town of Bourne – Deseret Drive
Site 10	Kramer
Site 39E	Buzzards Bay Bypass (Belmont Circle)
Site C	Sandford Properties – Main St 1
Full matrix of sites presented on the following page	

Selected Sites	No sites on east side, limit 1 3 ac parcels to downtown and hideaway village	**Criteria**	Proximity to Historical and Archeological Areas		Cost of Acquisition/Value of Property		Competing Uses for Land		Number of Abutters		Compatibility with Adjacent Land Uses (including odors, trucks, septage, etc))		Area to Expand/Reserve Area/Future Flexibility/Phasing			Accessibility for Maintenance and Operations		Wooded Area		Proximity to Downtown Buzzards Bay		
	land less than 3 ac = 8 or >	**Weighting**	8		2		6		3		1		5			4		9		7		
under 1 acre	3 10 ac, = 4, < than 10 ac = 1	**Metric/ Score**	1 (far) 5 (near)	Score	low (1), med (3),	Score	1 (none) 10 (many)	Score	1 (few) 5 (many)	Score	1 (good) 10 (poor)	Score	# acres > 1	many (1) few (10)	Score	1 (good) 10 (poor)	Score	1 (minimal) 5 (very)	Score	in (1) out (5)	Score	**TOTAL SCORE**
Site Number	**Site Title**																					
Site 16	Town of Bourne Scenic Hwy 2		1	8	1	2	2	12	1	3	1	1	123	1	5	1	4	5	45	3	21	101
Site 21	Town of Bourne Deseret Dr		1	8	1	2	1	6	3	9	8	8	11	1	5	2	8	4	36	3	21	103
Site 38	Cape Aggregates Scenic Hwy 2		1	8	5	10	8	48	2	6	1	1	124	1	5	1	4	1	9	3	21	112
Site 10	Kramer		1	8	3	6	2	12	2	6	3	3	2.9	8	40	1	4	2	18	3	21	118
Site 29	Town of Bourne Main St (Community Center)		1	8	1	2	10	60	2	6	9	9	3	8	40	1	4	1	9	1	7	145
Site 39 E	Buzzards Bay Bypass Rd (Belmont Circle)		1	8	1	2	7	42	5	15	3	3	1.6	8	40	1	4	1	9	1	7	130
Site 15	Cape Aggregates Ernest Valeri Rd 2		1	8	5	10	5	30	2	6	4	4	20	1	5	1	4	5	45	3	21	133
Site 13	Cape Aggregates Ernest Valeri Rd 1		1	8	5	10	5	30	2	6	6	6	17.1	1	5	1	4	5	45	3	21	135
Site 19	Town of Bourne Queen Sewel Park		1	8	1	2	10	60	4	12	10	10	7	3	15	1	4	2	18	1	7	136
Site 22	Town of Bourne Clarissa Jo Rd 1		1	8	1	2	5	30	2	6	2	2	25.4	1	5	2	8	5	45	5	35	141
Site E	Clark Robert Wagner Way		1	8	5	10	7	42	3	9	2	2	0.1	10	50	1	4	1	9	1	7	141
Site 14	Cape Aggregates Scenic Hwy 1		1	8	5	10	5	30	2	6	3	3	8.1	3	15	1	4	5	45	3	21	142
Site 17	Cape Aggregates Ernest Valeri Rd 3		1	8	5	10	5	30	2	6	3	3	9.8	3	15	1	4	5	45	3	21	142
Site 30	Ingersoll Bournedale Rd 2		1	8	5	10	10	60	1	3	2	2	13.1	1	5	2	8	3	27	3	21	144
Site 39 W	Buzzards Bay Bypass Rd (Memorial Circle)		1	8	1	2	7	42	5	15	8	8	0	10	50	1	4	1	9	1	7	145
Site 37	Ingersoll Bournedale Rd 3		1	8	5	10	5	30	1	3	2	2	114.8	1	5	8	32	4	36	3	21	147
Site 35	Town of Bourne Clarissa Jo Rd 2		1	8	1	2	10	60	2	6	3	3	22.8	1	5	2	8	3	27	5	35	154
Site 7	Plymouth Bourne Cns Trt		1	8	5	10	10	60	1	3	1	1	37.1	1	5	1	4	5	45	3	21	157
Site 8	Ingersoll Plymouth Lane		1	8	5	10	10	60	1	3	1	1	16.5	1	5	1	4	5	45	3	21	157
Site 34	Town of Bourne Bournedale Rd		1	8	1	2	10	60	3	9	5	5	29.9	1	5	2	8	3	27	5	35	159
Site 12	Town of Bourne Scenic Hwy 1		1	8	1	2	10	60	3	9	6	6	26.8	1	5	1	4	5	45	3	21	160
Site 11	Sorenti Bros Scenic Hwy		1	8	5	10	5	30	3	9	8	8	8.3	3	15	9	36	3	27	4	28	171
Site 9	Ingersoll Bournedale Rd 1		1	8	5	10	10	60	1	3	1	1	7.9	3	15	1	4	5	45	4	28	174
Site 26	Town of Bourne Little Sandy Pond Rd		1	8	1	2	10	60	3	9	2	2	14.5	1	5	3	12	5	45	5	35	178
Site 18	Tassinari		1	8	4	8	8	48	2	6	5	5	2.7	8	40	8	32	3	27	3	21	195
Site C	Sanford Properties Main St 1		1	8	5	10	10	60	3	9	6	6	1	8	40	3	12	5	45	1	7	197
Site D	Sanford Properties Main St 2		1	8	5	10	10	60	3	9	6	6	0.9	8	40	3	12	5	45	1	7	197
Site 33	Quinn		1	8	5	10	10	60	5	15	7	7	24.4	1	5	8	32	3	27	5	35	199
Site A	Martin Finch Lane		1	8	5	10	7	42	5	15	10	10	0	10	50	3	12	5	45	1	7	199
Site B	Byron Chris Main St		1	8	5	10	10	60	3	9	6	6	0.5	9	45	3	12	5	45	1	7	202
Site 36	Town of Bourne Herring Pond Rd		1	8	1	2	10	60	2	6	4	4	2.6	8	40	8	32	3	27	5	35	214

Appendix G: Treatment Technology Information

	Wastewater Treatment Technologies	Example Equipment/ Process Names (Manufacturer)	Size	Flexibility to be Modified for BNR[1]	Ability to Handle Septage	Odor Potential	Operational Complexity	Number of Installations in MA	Typical Flow Ranges [GPD[2]]	Treatment Reliability						Relative Cost	
										BOD [mg/l]		TSS		TN		Capital	O&M[3]
										30 mg/L	10 mg/L	30 mg/L	5 mg/L	10 mg/L	5 mg/L		
Suspended Growth	Conventional Activated Sludge	Sequox (Aero-Mod), JET (Jet Aerobic Treatment System), Modulair (Norweco), ADI System (ADI System Inc), AccuLinks System (Brentwood Industries)		→	↗	↓	↑	> 10	10,000 to > 350,000							$$	$$
	Sequencing Batch Reactors (SBR)	Aqua SBR (Aqua Aerobics), Cromaglass (Cromaglass Corporation), Ashbrook SBR (Ashbrook), Fluidyne SBR (Fluidyne Corporation)		↗	→	→	→	> 20	10,000 to > 350,000							$$$	$$$
	Oxidation Ditches	Lakeside (Lakeside), Wes Tech (Wes Tech)		↗	↗	→	→	< 5	> 300,000							$$$	$$
	Membrane Bioreactors (MBR)	Zenon (GE Water), Enviroquip (OVIVO Water), Sanitar (Sanitar), NEOSEP (Kruger)		↑	↑	↑	↓	> 10	10,000 to > 350,000							$$$$	$$$$
F xed F m	Rotating Biological Contactors (RBC)	RBC (Walker/ Ashbrook, US Filter/Davco /Envirex), Rotordisk		→	↗	→	→	> 90	10,000 to > 350,000							$$$$	$$$
	Trickling Filter System	Bioclere (Aquapoint), SeptiTech (SeptiTech), Waterloo BioFilter (Waterloo Biofilter System, Inc), STM Aerotor (Wes Tech)		→	→	↑	→	> 30	10,000 to < 100,000							$$$	$$
	Package System	Amphidrome (F. R. Mahony), Geo-Reactor (Parkson Corp.), AIRR (SPEC Industries, Inc)		↗	↓	↓	→	> 30	10,000 to < 100,000							$$	$$

[1] = BNR Biological Nutrient Removal [2] = GPD gallons per day [3] = O&M operations and maintenance

Treatment Technology Screening Process – Ranked by Odor, Reliability, Nutrient Removal

Criteria	Weight	Conventional Activated Sludge		Sequencing Batch Reactor		Oxidation Channels		Membrane Bioreactor		Rotating Biological Contactor		Package Treatment Plant[1]	
		Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating
Site Area Requirements	2	1	2	6	12	2	4	7	14	3	6	4	8
Flexibility for BNR	6	1	6	6	36	4	24	7	42	3	18	5	30
Capital Cost	4	6	24	5	20	4	16	2	8	1	4	7	28
O&M Costs	5	7	35	5	25	6	30	1	5	2	10	3	15
Septage Handling	1	4	4	6	6	5	5	7	7	3	3	2	2
Odor Control	8	1	8	4	32	3	24	7	56	5	40	2	16
Operational Complexity	3	7	21	1	3	5	15	3	9	6	18	2	6
Treatment Reliability	7	1	7	6	42	2	14	7	49	4	28	5	35
Total Score			**107**		**176**		**132**		**190**		**127**		**140**
Rank			**6th**		**2nd**		**4th**		**1st**		**5th**		**3rd**

[1] = Package treatment plants include trickling filter technology for flows less than 100,000 GPD.
Weight ranges from 8 (most import) to 1 (least important)
Score ranges from 10 (favorable technology for given criteria) to 1 (poor technology for given criteria)
Rating = Weight × Rating
Ranking based on highest Total Score
BRN = biological nutrient removal
O&M = operations and maintenance

Treatment Technology Screening Process – Ranked by Costs

Criteria	Weight	Conventional Activated Sludge		Sequencing Batch Reactor		Oxidation Channels		Membrane Bioreactor		Rotating Biological Contactor		Package Treatment Plant[1]	
		Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating
Site Area Requirements	2	1	2	6	12	2	4	7	14	3	6	4	8
Flexibility for BNR	4	1	4	6	24	4	16	7	28	3	12	5	20
Capital Cost	8	6	48	5	40	4	32	2	16	1	8	7	56
O&M Costs	7	7	49	5	35	6	42	1	7	2	14	3	21
Septage Handling	1	4	4	6	6	5	5	7	7	3	3	2	2
Odor Control	6	1	6	4	24	3	18	7	42	5	30	2	12
Operational Complexity	3	7	21	1	3	5	15	3	9	6	18	2	6
Treatment Reliability	5	1	5	6	30	2	10	7	35	4	20	5	25
Total Score			**139**		**174**		**142**		**158**		**111**		**150**
Rank			**5th**		**1st**		**4th**		**2nd**		**6th**		**3rd**

[1] = Package treatment plants include trickling filter technology for flows less than 100,000 GPD.
Weight ranges from 8 (most import) to 1 (least important)
Score ranges from 10 (favorable technology for given criteria) to 1 (poor technology for given criteria)
Rating = Weight × Rating
Ranking based on highest Total Score
BRN = biological nutrient removal
O&M = operations and maintenance

Appendix H: Subsurface Disposal Site Requirements

Below are notes on the calculation of the area needed for subsurface disposal. Greater detail is provide in the memorandum on the following pages.

Title 5 leaching field:

According to 310 CMR 15.242, Septic Tank Effluent Loading Rate with Pressure Distribution System, the maximum loading rate (for Class I soil (Sand or Loamy Sand, with Perc. Rate < 5 min./inch)) is 0.74 GPD/square foot (sqft). Using a standard design of a 2 ft wide x 2 ft deep trench, the total loading surface area per linear feet of distribution pipe is 6 sqft (two side surfaces (2 sqft/ea) + bottom surface). Each linear foot of distribution piping is equal to 2 sqft of leaching area. Therefore, each square foot of area can take 0.74 GPD/sqft x 6 sqft / 2 sqft = 2.22 GPD/sqft.

WWTF effluent disposal field (Under GWDP reg. 314 CMR 5.00):

Based on the MADEP 2004 guideline, *"Guidelines for Design, Construction, Operation, and Maintenance of Small Wastewater Treatment Facilities with Land Disposal"*, the maximum loading rate (Perc. Rate <= 5 min./inch) is 2.5 GPD/sqft (for hydrogeologic investigation based on percolation tests, which is the most often used technology). However, if infiltration measurement techniques (e.g. double-ring infiltrometer or guelph permeameter) were used for the hydrogeological study to determine the hydraulic conductivity (or infiltration rate), the maximum loading rate (for infiltration rate < 2 min/inch) can be 3.0 GPD/sq. ft. Typically, engineers will use more conservative maximum design rate of 2.5 GPD/sqft and MADEP's hydrogeologist won't have problem with this rate since it is very close to title 5 rate (see discussion above) (for septic water with high BOD and TSS that could clog the adsorption field because of microbio slim generated in the void space of soil particles).

Memorandum

CAPE COD COMMISSION

To: File
From: Steven Tupper, Glenn Cannon
Subject: Calculation of Required Area for Buzzards Bay Wastewater Disposal Site
Date: March 5, 2012

The purpose of this memo is to clarify the methodology used to calculate the area required for a Buzzard Bay wastewater disposal site.

Initial calculations performed by Cape Cod Commission staff were meant to serve as an initial screening tool for potential disposal sites. Different infiltration systems, including various subsurface systems and rapid infiltration beds, were considered. A design loading rate of 3.0 gpd/sf was used for subsurface infiltration and 5.0 gpd/sf for RIB. A reserve area of 25% was assumed along with buffers of 100 ft. and 150 ft. for subsurface and RIB, respectively. The tabulation is presented below for a flow rate of **365,000 gpd**:

365,000 gpd	Subsurface	RIB
Loading Rate (gpd/sq-ft)	3	5
Reserve Area (%)	25	25
Buffer (Ft)	100	150
Gross Area Needed (sq-ft)	240079.06	204372.84
Gross Area Needed (acre)	**5.51**	**4.69**

Subsequent calculations performed by CH2MHill staff were based on a pressure distribution system with infiltration trenches. A design loading rate of 2.5 gpd/sf was used along with an additional area of 20% for pressure distribution and a reserve area of 100%. The trenches were designed with an effective depth of 2 feet, and a width of 2 feet. A spacing of 6 feet between the trenches was used (see note below). The tabulation is presented below for a flow rate of **350,000 gpd**:

350,000 gpd	Pressure Distribution using Infiltration Trenches	
Require soaking area	140,000	sq. ft
Leaching trench soaking area (2ft wide x 2ft tall)	6	sq. ft/linear ft of trench
Total Trench length	23,333	Linear Ft
Typical trench length/pressure distribution lateral	200	ft
# of trench need	118	
Typical trench width	2	ft
Typical space between edge of the trench	3	ft
Leach field width	938	ft
Leaching field area	187,600	sq. ft
Additional area needed for pressure distribution	20%	
Area needed	225,120	sq. ft
	5.2	Acres
Total area with 100% reserved	**10.3**	**Acres**

Note: Title 5 minimum trench separation is 4 feet for a 2 ft by 2 ft trenches. With 6 foot separation, Title 5 would allow the space between the trenches to be counted as reserve area. This option was not used in these calculations.

Calculation of Required Area for Buzzards Bay Wastewater Disposal Site
March 5, 2012

As the calculations by CH2MHill staff are more conservative, this methodology is recommended for use in subsequent analysis. However, if a rapid infiltration system is used or a higher design loading rate is found to be appropriate, the required area for the disposal site will decrease.

Attached is a calculation sheet following the methodology used by CH2MHill for various flow rates under consideration for the project.

CC
Glenn Cannon, Cape Cod Commission
Tom Cambareri, Cape Cod Commission
Tabitha Harkin, Cape Cod Commission
Priscilla Bloomfield, CH2MHill
Mike Dominica, CH2MHill

Calculation of Required Area for Buzzards Bay Wastewater Disposal Site
March 5, 2012

Buzzards Bay Disposal Area Calculation Sheet

Prepared by: Steven Tupper

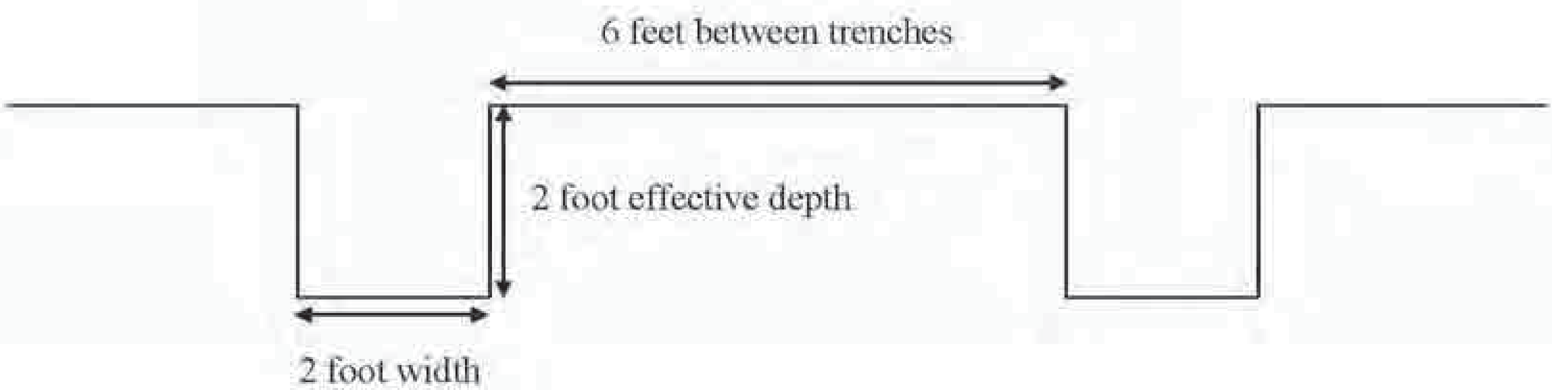
Flow Rates for Analysis:

25,000 gpd
50,000 gpd
100,000 gpd
335,000 gpd
1,300,000 gpd

Assumptions:

Design Loading Rate	2.5 gpd/sf
Leaching Trench Width	2 ft
Leaching Trench Effective Depth	2 ft
Space Between Edge of Trenches	3 ft
Trench Length	200 ft
Additional Area for Pressure Distribution	20%
Reserve Area	100%

Typical Leaching Field Configuration:



Calculation of Required Area for Buzzards Bay Wastewater Disposal Site
March 5, 2012

Sample Calculation:

$$\textbf{\textit{Required soaking area}}$$
$$= \frac{Max\ flow\ rate}{Design\ loding\ rate}$$
$$= \frac{\mathbf{335,000\ gpd}}{2.5\ gpd/ft^2} = 134{,}000\ ft^2$$

$$\textbf{\textit{Trench soaking area per linear ft}}$$
$$= bottoms + sides$$
$$= 2ft + 2ft + 2ft = 6\ ft^2/lin.ft$$

$$\textbf{\textit{Total Trench length required}}$$
$$= \frac{Required\ soaking\ area}{Trench\ soaking\ area\ per\ lin.ft}$$
$$= \frac{134{,}000\ ft^2}{6\ ft^2/lin.ft} = 22{,}333\ ft$$

$$\textbf{\textit{Number of trenches}}$$
$$= \frac{Total\ trench\ length\ required}{Trench\ length}$$
$$= \frac{22{,}333\ ft}{200ft} = 113$$

$$\textbf{\textit{Leaching field width}}$$
$$= Number\ of\ trench \times Trench\ width + (Number\ of\ trench - 1) \times Width\ between\ trenches$$
$$= 113 \times 2\ ft + (113 - 1) \times 6\ ft^2/lin.ft = 898ft$$

$$\textbf{\textit{Leaching filed area}}$$
$$= Leaching\ field\ width \times trench\ length$$
$$= 899ft \times 200ft = 179{,}600ft^2$$

$$\textbf{\textit{Presure distribution area}}$$
$$= Leaching\ field\ area \times 20\%$$
$$= 179{,}600ft^2 \times 20\% = 35{,}920ft^2$$

$$\textbf{\textit{Reserve area}}$$
$$= (Leaching\ filed\ area + Presure\ distribution\ area) \times 100\%$$
$$= (179{,}600ft^2 + 35{,}920ft^2) \times 100\% = 215{,}520ft^2$$

$$\textbf{\textit{Total area with reserve}}$$
$$= Leaching\ filed\ area + Presure\ distribution\ area + Reserve\ area$$
$$= \frac{179{,}600ft^2 + 35{,}920ft^2 + 179{,}600ft^2}{43{,}560\ ft^2/acre} = \mathbf{9.9acres}$$

Calculation of Required Area for Buzzards Bay Wastewater Disposal Site
March 5, 2012

Tabulation of Required Area for Subsurface Disposal at Various Maximum Flow Rates

Max Flow (gpd)	25,000	50,000	100,000	335,000	1,300,000	
Require soaking area	10,000	20,000	40,000	134,000	520,000	sq. ft
Leaching trench soaking area per linear ft	6	6	6	6	6	sq ft/lin.ft
Total trench length required	1,667	3,333	6,667	22,333	86,667	Linear Ft
Number of trenches need	9	18	34	113	434	
Leaching field width	66	138	266	898	3,466	ft
Leaching field area	13,200	27,600	53,200	179,600	693,200	sq. ft
Area for for pressure distriubtion	2,640	5,520	10,640	35,920	138,640	
Area needed	15,840	33,120	63,840	215,520	831,840	sq. ft
	0.4	0.8	1.5	4.9	19.1	Acres
Total area with 100% reserved	**0.7**	**1.5**	**2.9**	**9.9**	**38.2**	**Acres**

Appendix I: Detailed Cost Analysis

Late 2009 ENR from Barnstable County Cost Report	8600
March 2012 ENR	9267
Engineering & Permitting	10%
Engineering Services During Construction	8%
Contingency	25%

MBR			SBR			Package Plant		
Flow (GPD)	**Barnstable County Report Construction Cost 2009 ($/GPD)**	**Barnstable County Report O&M Cost 2009 ($/GPD)**	**Flow (GPD)**	**Barnstable County Report Construction Cost 2009 ($/GPD)**	**Barnstable County Report O&M Cost 2009 ($/GPD)**	**Flow (GPD)**	**Barnstable County Report Construction Cost 2009 ($/GPD)**	**Barnstable County Report O&M Cost 2009 ($/GPD)**
25,000	$60	$12.00	25,000	$90	$10.50	25,000	$60	$10.50
50,000	$47	$8.25	50,000	$80	$8.25	50,000	$47	$8.25
100,000	$36	$6.25	100,000	$ 60	$6.25			
335,000	$24	$3.25	335,000	$24	$3.25			

Disposal Construction	
Flow Rate (GPD)	Disposal Construction Cost 2012 ($/GPD)
25,000	$5
50,000	$4
100,000	$3
335,000	$2

Forcemain Construction	
Flow Rate (GPD)	Forcemain Construction Cost 2012 ($/lf)
25,000	$160
50,000	$160
100,000	$160
335,000	$200

Wastewater Pumping	
Flow Rate (GPD)	Wastewater Pumping Construction Cost 2012 ($/GPD)
25,000	$195,000
50,000	$220,000
100,000	$250,000
335,000	$300,000

Cost per acre of land	$100,000
Site 10 Land Cost (4 acres)	$400,000

	Capital Costs - Wastewater Treatment									
	MBR				**SBR**				**Package Plant**	
Design Flow Rate (GPD)	25,000	50,000	100,000	335,000	25,000	50,000	100,000	335,000	25,000	50,000
Construction 2012 Unit Cost	64.65	$50.65	$38.79	$25.86	$96.98	$86.20	$64.65	$25.86	$64.65	$50.65
Construction	$1,616,337	$2,532,262	$3,879,209	$8,663,567	$2,424,506	$4,310,233	$6,465,349	$8,663,567	$1,616,337	$2,532,262
Engineering & Permitting	$161,634	$253,226	$387,921	$866,357	$242,451	$431,023	$646,535	$866,357	$161,634	$253,226
Services During Construction	$129,307	$202,581	$310,337	$693,085	$193,960	$344,819	$517,228	$693,085	$129,307	$202,581
Subtotal	$1,907,278	$2,988,069	$4,577,467	$10,223,010	$2,860,917	$5,086,074	$7,629,112	$10,223,010	$1,907,278	$2,988,069
Contingency	$476,819	$747,017	$1,144,367	$2,555,752	$715,229	$1,271,519	$1,907,278	$2,555,752	$476,819	$747,017
TOTAL CAPITAL COST	**$2,384,097**	**$3,735,086**	**$5,721,834**	**$12,778,762**	**$3,576,146**	**$6,357,593**	**$9,536,390**	**$12,778,762**	**$2,384,097**	**$3,735,086**

	Capital Costs - Treated Wastewater Disposal					
	Site 10		**Site 16, 19 and 29**			
Design Flow Rate (GPD)	25,000	50,000	25,000	50,000	100,000	335,000
2012 Construction Unit Cost	$5.00	$4.00	$5.00	$4.00	$3.00	$2.00
Construction	$125,000	$200,000	$125,000	$200,000	$300,000	$670,000
Engineering & Permitting	$12,500	$20,000	$12,500	$20,000	$30,000	$67,000
Services During Construction	$10,000	$16,000	$10,000	$16,000	$24,000	$53,600
Land Cost	$400,000	$400,000	$ -	$ -	$ -	$ -
Subtotal	$547,500	$636,000	$147,500	$236,000	$354,000	$790,600
Contingency	$36,875	$59,000	$36,875	$59,000	$88,500	$197,650
TOTAL CAPITAL COST	$584,375	$695,000	$184,375	$295,000	$442,500	$988,250
TOTAL	**$621,250**	**$754,000**	**$221,250**	**$354,000**	**$531,000**	**$1,185,900**

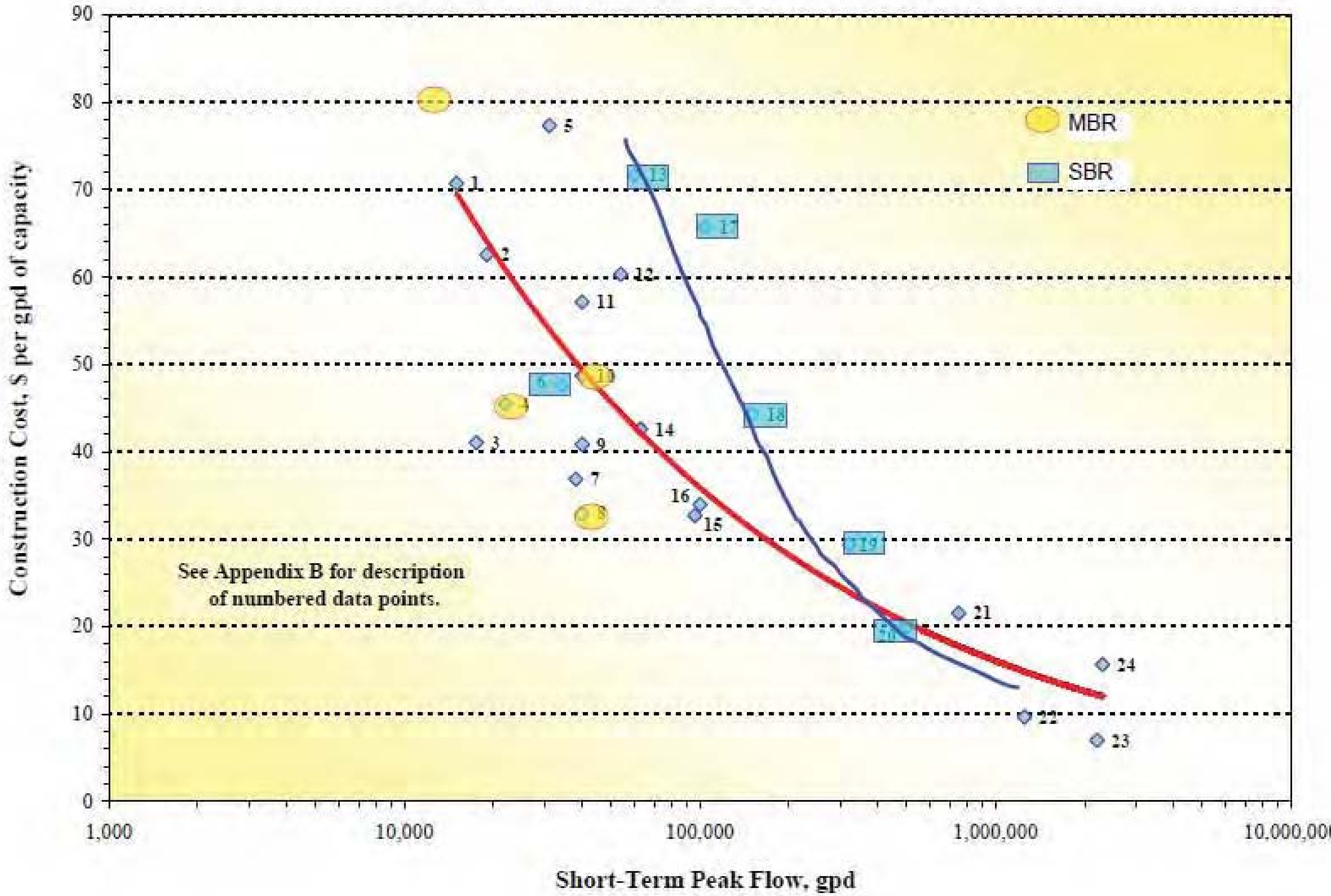
	Capital Costs - Wastewater Conveyance and Pumping							
Flow Rate (GPD)	**25000**				**50000**			
Option	**Hideaway Village**	**Downtown (39E)**	**Downtown (C)**	**Out of Town**	**Hideaway Village**	**Downtown (39E)**	**Downtown (C)**	**Out of Town**
Pipe Length (ft)	3908	8801	7816	11382	3908	8801	7816	11382
Force Main Construction Unit Cost	$160	$160	$160	$160	$160	$160	$ 160	$160
Pump Station Construction	$195,000	$195,000	$195,000	$195,000	$220,000	$220,000	$220,000	$220,000
Construction	$820,280	$1,603,160	$1,445,560	$2,016,120	$845,280	$1,628,160	$1,470,560	$2,041,120
Engineering & Permitting	$82,028	$160,316	$144,556	$201,612	$84,528	$162,816	$147,056	$204,112
Services During Construction	$65,622	$128,253	$115,645	$161,290	$67,622	$130,253	$117,645	$163,290
Subtotal	$967,930	$1,891,729	$1,705,761	$2,379,022	$997,430	$1,921,229	$1,735,261	$2,408,522
Contingency Cost	$241,983	$472,932	$426,440	$594,755	$249,358	$480,307	$433,815	$602,130
TOTAL CAPITAL COST	**$1,209,913**	**$2,364,661**	**$2,132,201**	**$2,973,777**	**$1,246,788**	**$2,401,536**	**$2,169,076**	**$3,010,652**

	Capital Costs - Wastewater Conveyance and Pumping					
Flow Rate (GPD)	**100000**			**335000**		
Option	**Downtown (39E)**	**Downtown (C)**	**Out of Town**	**Downtown (39E)**	**Downtown (C)**	**Out of Town**
Pipe Length (ft)	8801	7816	11382	8801	7816	11382
Force Main Construction Unit Cost	$160	$160	$160	$200	$200	$200
Pump Station Construction	$250,000	$250,000	$250,000	$300,000	$300,000	$300,000
Construction	$1,658,160	$1,500,560	$2,071,120	$2,060,200	$1,863,200	$2,576,400
Engineering & Permitting	$165,816	$150,056	$207,112	$206,020	$186,320	$257,640
Services During Construction	$132,653	$120,045	$165,690	$164,816	$149,056	$206,112
Subtotal	$1,956,629	$1,770,661	$2,443,922	$2,431,036	$2,198,576	$3,040,152
Contingency Cost	$489,157	$442,665	$610,980	$607,759	$549,644	$760,038
TOTAL CAPITAL COST	**$2,445,786**	**$2,213,326**	**$3,054,902**	**$3,038,795**	**$2,748,220**	**$3,800,190**

	Operation & Maintenance Costs									
	MBR				**SBR**				**Package Plant**	
Flow Rate (GPD)	25,000	50,000	100,000	335,000	25,000	50,000	100,000	335,000	25,000	50,000
2012 O&M Cost Rate	$12.93	$8.89	$6.73	$3.50	$11.31	$8.89	$6.73	$3.50	$11.31	$8.89
ANNUAL O&M COST	**$323,267**	**$444,493**	**$673,474**	**$1,173,191**	**$282,859**	**$444,493**	**$673,474**	**$1,173,191**	**$282,859**	**$444,493**

Costs to Send Flow to MMR										
MMR Disposal Option	**Directional Drill Distance (ft.)**	**Directional Drill Unit Cost ($/ft.)**	**Directional Drill Cost**	**Pump Station at WWTP (LS)**	**Forcemain Length from WWTF (ft)**	**Forcemain Unit Cost ($/ft.)**	**Forcemain Cost**	**Price for Disposal Capacity**	**Contingency (%)**	**Estimated Cost**
2012 Estimated Cost	1900	1500	**$2,850,000**	**$300,000**	13,000	$160	**$2,080,000**	$300,000	20	**$6,636,000**

FIGURE 3
RESULTS OF CONSTRUCTION COST SURVEY



Inflation	0%								**NPV Analysis Page 1 of 2**
Discount	1.7%								
Period (years)	20								
					Year0	Year 1	Year 2	Continued out at the same	
						Start of O&M		rate each year to 2035	
	NPV	2012	2013	2014		2015	2016	. . .	2035
MBR O&M Annual Cost									
25,000	$ 5,442,165	$ 323,267	$ 323,267	$ 323,267	$	$ 323,267	$ 323,267	. . .	$ 323,267
50,000	$ 7,482,977	$ 444,493	$ 444,493	$ 444,493	$	$ 444,493	$ 444,493	. . .	$ 444,493
100,000	$ 11,337,844	$ 673,474	$ 673,474	$ 673,474	$	$ 673,474	$ 673,474	. . .	$ 673,474
335,000	$ 19,750,524	$ 1,173,191	$ 1,173,191	$ 1,173,191	$	$ 1,173,191	$ 1,173,191	. . .	$ 1,173,191
SBR O&M Annual Cost									
25,000	$ 4,761,894	$ 282,859	$ 282,859	$ 282,859	$	$ 282,859	$ 282,859	. . .	$ 282,859
50,000	$ 7,482,977	$ 444,493	$ 444,493	$ 444,493	$	$ 444,493	$ 444,493	. . .	$ 444,493
100,000	$ 11,337,844	$ 673,474	$ 673,474	$ 673,474	$	$ 673,474	$ 673,474	. . .	$ 673,474
335,000	$ 19,750,524	$ 1,173,191	$ 1,173,191	$ 1,173,191	$	$ 1,173,191	$ 1,173,191	. . .	$ 1,173,191
Package Plant O&M Annual Cost									
25,000	$ 4,761,894	$ 282,859	$ 282,859	$ 282,859	$	$ 282,859	$ 282,859	. . .	$ 282,859
50,000	$ 7,482,977	$ 444,493	$ 444,493	$ 444,493	$	$ 444,493	$ 444,493	. . .	$ 444,493
	NPV								
MBR Treatment Capital Cost									
25,000	$2,384,097	$ 2,384,097	$ 2,384,097	$ 2,384,097	$ 2,384,097				
50,000	$3,735,086	$ 3,735,086	$ 3,735,086	$ 3,735,086	$ 3,735,086				
100,000	$5,721,834	$ 5,721,834	$ 5,721,834	$ 5,721,834	$ 5,721,834				
335,000	$12,778,762	$ 12,778,762	$12,778,762	$ 12,778,762	$ 12,778,762				
SBR Treatment Capital Cost									
25,000	$3,576,146	$ 3,576,146	$ 3,576,146	$ 3,576,146	$ 3,576,146				
50,000	$6,357,593	$ 6,357,593	$ 6,357,593	$ 6,357,593	$ 6,357,593				
100,000	$9,536,390	$ 9,536,390	$ 9,536,390	$ 9,536,390	$ 9,536,390				
335,000	$12,778,762	$ 12,778,762	$12,778,762	$ 12,778,762	$ 12,778,762				
Package Plant Treatment Capital Cost									
25,000	$2,384,097	$ 2,384,097	$ 2,384,097	$ 2,384,097	$ 2,384,097				
50,000	$3,735,086	$ 3,735,086	$ 3,735,086	$ 3,735,086	$ 3,735,086				

	NPV				
Site 16, 19, and 29 Disposal Capital Cost					
25,000	$221,250	$ 221,250	$ 221,250	$ 221,250	$ 221,250
50,000	$354,000	$ 354,000	$ 354,000	$ 354,000	$ 354,000
100,000	$531,000	$ 531,000	$ 531,000	$ 531,000	$ 531,000
335,000	$1,185,900	$ 1,185,900	$ 1,185,900	$ 1,185,900	$ 1,185,900
Site 10 Disposal Capital Cost					
25,000	$621,250	$ 621,250	$ 621,250	$ 621,250	$ 621,250
50,000	$754,000	$ 754,000	$ 754,000	$ 754,000	$ 754,000

	NPV				
Downtown Conveyance Capital Cost (39E)					
25,000	$2,364,661	2364661	$ 2,364,661	$ 2,364,661	$ 2,364,661
50,000	$2,401,536	2401536	$ 2,401,536	$ 2,401,536	$ 2,401,536
100,000	$2,445,786	2445786	$ 2,445,786	$ 2,445,786	$ 2,445,786
335,000	$3,038,795	3038795	$ 3,038,795	$ 3,038,795	$ 3,038,795
Downtown Conveyance Capital Cost (C)					
25,000	$2,132,201	2132201	$ 2,132,201	$ 2,132,201	$ 2,132,201
50,000	$2,169,076	2169076	$ 2,169,076	$ 2,169,076	$ 2,169,076
100,000	$2,213,326	2213326	$ 2,213,326	$ 2,213,326	$ 2,213,326
335,000	$2,748,220	2748220	$ 2,748,220	$ 2,748,220	$ 2,748,220
Out of Town Conveyance Capital Cost					
25,000	$2,973,777	2973777	$ 2,973,777	$ 2,973,777	$ 2,973,777
50,000	$3,010,652	3010652	$ 3,010,652	$ 3,010,652	$ 3,010,652
100,000	$3,054,902	3054902	$ 3,054,902	$ 3,054,902	$ 3,054,902
335,000	$3,800,190	3800190	$ 3,800,190	$ 3,800,190	$ 3,800,190
Hideaway Village Conveyance Capital Cost					
25,000	$1,209,913	1209913	$ 1,209,913	$ 1,209,913	$ 1,209,913
50,000	$1,246,788	1246788	$ 1,246,788	$ 1,246,788	$ 1,246,788

Appendix J: All Treatment and Disposal Options

Treatment Technology	25,000 GPD	50,000 GPD	100,000 GPD	335,000 GPD	Cost	Comments
Package Plant	10, 16, 21, 39E	10, 16, 21, 39E	NA	NA	$	Medium footprint Odor issues if not operated properly FOG[1] control/ pretreatment required Cannot handle septage
MBR	10, 16, 21, 39E [2]	10, 16, 21, 39E [2]	10, 16, 21, 39E [2]	10, 16, 21, 39E [2]	$$$	30-40% greater capital costs Twice the O&M[3] costs Reliable No odor issues Small footprint Can handle septage Can upgrade
SBR	10, 16, 21, 39E [2]	10, 16, 21, 39E [2]	10, 16, 21, 39E [2]	10, 16, 21	$$	Handling septage can be difficult Larger footprint
Disposal Sites	10, 16, 19, 29	10, 16, 19, 29	16, 19, 29	16, 29 + 19		

Alternative Options	
Send flow to MMA[4] for treatment and disposal	Infeasible. MMA is constrained on existing capacity and area to expand.
Send flow to Wareham for treatment and disposal	No additional capacity is available at the existing treatment plant. However, Wareham is considering building a new plant, which could be designed to accommodate Bourne flows.
Send flow to MMR[5] for treatment and/or disposal	Permitted capacity is 300,000 GPD. MMR is currently using about 160,000 GPD. If MMR were to take outside flows, it would be done regionally with Sandwich, Mashpee, Falmouth, and Bourne. Could possibly take a portion of Bourne's flow (50,000 GPD) if wastewater could be piped across the Cape Cod Canal. Cost to install a pipe under the Cape Cod Canal is $6,636,000.

NA = Not applicable
[1] = FOG – fats, oils, grease
[2] = Downtown plant location cannot take septage.
[3] = O&M – operations and maintenance
[4] = MMA – Massachusetts Maritime Academy
[5] = MMR – Massachusetts Military Reservation

Appendix K: Financing Options Presentation

The following is a copy of the handout given out by Robert J. Ciolek of the Clean Water Protection Planning Group in in July 20th, 2011 presentation to the Bourne Wastewater Advisory Committee.

COMMUNITY FUNDING FOR WASTEWATER CAPITAL PROGRAMS

July 20th, 2011

Presentation to the Town of Bourne Wastewater Advisory Committee

Robert J. Ciolek, Consultant,
Clean Water Protection Planning Group

Cape Cod Wastewater Funding Facts

Wastewater Funding Reality – Cape Cod

Presuming Cape Cod communities execute their present Comprehensive Wastewater Management Plans (CWMP), the total capital cost of building planned wastewater systems will range from $3.2 billion to $5.8 billion.

There are 215,000 people living on Cape Cod. On a *per person* basis, each person would be responsible for between $14,884 to $26,977 in capital costs.

There are 174,000 properties on Cape Cod. On a *per property* basis, each property owner would be responsible for between $18,391 to $33,333 in capital costs.

- Amounts do not include annual operating expenses, ranging from $40 to $68 million per year
- If half of Cape properties become system customers, double per capita and per property estimates
- Several communities have not developed reliable cost estimates
- Does not take into consideration impact from CLF litigation
- Does not take into cost consideration any possible increase in wastewater standards
- Inflation not included

Benefits of Wastewater Capital Program

Benefits of Wastewater Capital Program on Cape Cod

The policy decision involving who should pay and by what funding option or options should be firmly based on an understanding of the tangible and intangible benefits of the program.

Key question: What are the benefits of the wastewater capital program?

- Protection of the Cape's clean drinking water resources
- Protection of public health and sanitation
- Permits responsible growth and targeted economic development
- Renewal and protection of saltwater and freshwater resources
- Achieves compliance with federal and state laws and regulations
- Recognizes that civilized communities do not foul their own nest

If the description of benefits is accurate and generally accepted, two follow-on questions should then be asked and answered:

Who benefits from the wastewater capital program?
Who should pay for the wastewater capital program?

Community Wastewater Funding Choices

Funding Options for Cape Cod Towns

There are two broad categories of expenses for community wastewater projects: *operating expenses* for annual operations and maintenance and *capital expenses* associated with constructing the wastewater system. Some funding options are available for one or the other type of expense; a couple are available for both types of expenses.

There are ***four*** basic funding choices for Cape Cod towns:

- Funding from existing Town funding sources for capital and/or operating expenses
- Funding from betterment assessments for capital expenses
- Funding from a Proposition 2½ override or debt exclusion vote for capital expenses
- Funding from a system of rates and charges for operating and/or capital expenses

There may be some funding support from existing, though *very* limited, federal or state grants for capital expenses. A combination of two or more of the funding options will inevitably be utilized by each town in various permutations and amounts.

Much of the system will be financed by low-interest loans from the Commonwealth or through Town-issued general obligation bonds, with the principal and interest (debt service) repaid by one or more of the four funding alternatives.

Use of Existing Town Revenue

All or most debt service costs paid by property tax ***within*** Proposition 2½ levy limits. A Town may continue to pass through some capital and likely all operating costs to customer base through rates and charges or other funding methodology.

Advantages:

- No immediate financial impact on Town property owners
- Spreads cost over a wider base than other funding choices
- Towns will maintain control over scope, pace and cost of project
- Town government will remain directly accountable for program
- No legislation needed

Disadvantages:

- Most Towns are at Proposition 2½ levy limit
- Major reductions in important Town-funded services will be required
- Available, non-tax revenues are minimal compared to total cost of program
- Town's bonding capacity would be severely stretched and bond rating may decline
- Tax-exempt entities would realize program benefits but do not pay real estate taxes
- Solely using Town funds would make regionalizing services more difficult
- Would create significant pressure to limit scope of wastewater capital program

Betterment Assessments

Towns have the statutory authority to levy involuntarily betterment assessments in order to defray the capital cost of installing sewer infrastructure improvements.

Advantages:

- Town may lien property and may place charges on tax bills, thus reasonably insuring it will be paid by property owners
- Appearance of fairness as assessment is for the receipt of a property benefit
- Relatively low interest rate – 2% over underlying debt interest rate

Disadvantages:

- Narrowest base of funding for wastewater capital program
- Mismatch between benefits of program and those obligated to pay betterments as many beneficiaries will pay nothing
- Sewer betterment assessments bear little relationship to cost of wastewater program – betterments only based on cost of neighborhood sewering projects
- Not tax deductible
- Property owners must pay betterment principal and interest in just twenty years
- If EDU formula used, sewer betterments on Cape Cod could unintentionally become confiscatory

Proposition 2½ Override or Debt Exclusion

Substantial debt service costs paid by property tax *after* successful override campaign(s). Town may continue to pass through some capital and operating costs to customers by system of rates and charges or other funding methodology.

Advantages:

- Minimal impact on existing Town services
- Town will continue to control scope, pace and cost of project
- Spreads cost of program over wider base than other funding options
- Tax deductible for those who itemize
- Town government will remain directly accountable for program
- Creation of "Municipal Stabilization Fund" provides for control over expenditures
- No legislation needed

Disadvantages:

- Override will require capital-related override ballot campaign
- Significant real estate tax impact for town property owners
- Could create conflict between those connected to sewers and those not connected
- Solely using locally generated funds would make regionalizing services more difficult
- Tax-exempt entities would realize program benefits but do not pay real estate taxes

System-wide User Fees, Rates and Charges

Funding could occur by imposing a system of user fees, rates and charges, to be managed by each Town, which could pay for some or all capital costs plus all operating expenses, paid by the users of the service.

Advantages:

- Flexible and efficient funding system
- Wide base for spreading costs (would include tax-exempt and government users)
- Can more easily create a funding system which best matches relationship of treatment costs with contributions of effluent requiring treatment
- System can be designed to permit some subsidy for low-income households and would enable the issuance of monthly billing making household budgeting easier
- Enhances impact of adopting special debt exclusion
- Could encourage regional approach to problem solving

Disadvantages:

- Over time, will grow to become a significant utility bill
- Not tax-deductible
- Zero-sum funding mechanism; absent some new revenue source, reductions for some ratepayers means increases in charges to other ratepayers

Other Financial Options

Limited and usually targeted funding is available from other sources or financing methodologies. Such funding will be constrained in amount or by statutory requirements.

- USDA Rural Development Loan and/or Grant

  Statutorily limited by population size of community/district and amounts available; community income test

- District Improvement Financing/Tax Increment Financing

  Typically for commercial development purposes; likely requires interim financing and a financial backstop; complex approval process; geographically limited

- Community Development Block Grant/Community Development Action Grant

  Limited funds available and must meet strict grant requirements

DIF Efforts in Massachusetts

Very few communities have moved forward with DIF financings, pursuant to MGL Ch.40Q, though examples exist and should be studied:

• Worcester	Completed
• Carver	Completed*
• Gardner	In Process
• Quincy	In Process
• Somerville/MBTA	In Process

Town of Carver DIF effort was directed at creating a water district to enhance planned commercial development:

✓ Town put together planning and financial advisory team

✓ Town created DIF which was approved by Town Meeting and subsequently by the Commonwealth

✓ $5+ million financing done by Unibank, but not through 40Q

Possible Funding Mitigation Options

Legislative Approval of New Revenue Source

Paying for the cost of the capital program can be achieved in part by obtaining direct financial support through the imposition of a new tax, a new fee or reestablishing federal or state grant funding.

Advantages:

- A new tax or array of taxes could pay for part of capital costs
- Depending upon the type of tax, cost of the program might be spread over a larger population base than by either betterments or real estate tax
- Tax revenue or new grant funding might be made available to all Cape Cod communities for similar capital programs
- Could possibly encourage regional approach to problem solving

Disadvantages:

- Would require a major campaign effort and approval by the Legislature and Governor
- Negative financial impact on whomever is obligated to pay any new tax
- Some payers of the tax may not be responsible for or benefit from the Cape's wastewater capital program
- Could result in unforeseen new Town obligations or restrictions imposed by State
- Role of Towns in managing wastewater program may be circumscribed

Use of MGL C59, Section 21(n)

Towns may replace wastewater rate revenue with property tax revenue with only a vote of town Boards of Selectmen or Town Council. Special debt service exclusion and *not* a new funding source, but a legislative grant of authority permitting a shifting of costs from wastewater ratepayers to Town taxpayers.

Advantages:

- Dollar for dollar replacement
- Broadens financial base
- Avoids Proposition 2½ override requirements
- Decreases rate revenue which is paid by system users with property taxes which are paid by both system users and non-users
- Special debt service exclusion will lower rate revenue requirements but cannot be used to reduce betterment assessments

Disadvantages:

- Funding method may pit property owners against wastewater system customer base
- While statutorily permissible, would be controversial as it is non-instinctual
- Avoids Proposition 2½ override requirements

Regionalizing Wastewater System

Could result in a reduction of capital and operating costs, primarily through the development of fewer though somewhat larger wastewater treatment facilities.

Advantages:

- Smaller number of wastewater treatment facilities needed
- Greater flexibility in finding discharge sites outside nitrogen sensitive areas
- Some savings in overhead and operating expenses
- Improved planning coordination of capital program
- Could better integrate alternative and innovative technology solutions
- Improved planning for watershed protection, particularly for shared watersheds
- Could more efficiently and effectively address Cape-wide Title V issues

Disadvantages:

- Would require complex and likely controversial legislation
- Communities would no longer directly control wastewater systems
- Need to insure public accountability

CAPE COD COMMISSION

[illegible] • BARNSTABLE, MASSACHUSETTS [illegible]

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